Lawrence and Debra Esposito
4239 High Rd., Cresco, PA 18326

July 21, 2019
VIA ELECTRONIC FILING

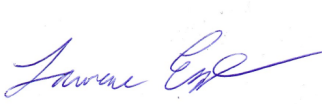
Rosemary Chiavetta, Secretary
Pennsylvania Public Utility Commission
Commonwealth Keystone Building
400 North Street, 2nd Floor North
P.O. Box 3265
Harrisburg, PA 17105-3265

RE: Lawrence And Debra Esposito v. PPL Electric Utilities Corporation
Docket No. C-2019-3007334

Dear Secretary Chiavetta:

Enclosed for filing is the response of Lawrence and Debra Esposito to the Motion of PPL Electric Utilities Corporation to Compel Responses to Discovery Propounded on Lawrence and Debra Esposito – Set I in the above-referenced proceeding. Copies will be provided as indicated on the Certificate of Service.

Respectfully,



Lawrence Esposito

cc: Honorable Elizabeth Barnes
Certificate of Service

CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the foregoing has been served upon the following persons, in the manner indicated, in accordance with the requirements of 52 Pa. Code § 1.54 (relating to service by a participant).

VIA E-MAIL AND FIRST-CLASS MAIL

Devin Ryan
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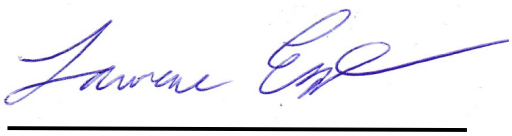

Date: July 22, 2019
Lawrence Esposito

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

Lawrence and Debra Esposito, Complainants, v. PPL Electric Utilities Corporation, Respondent.	Docket No. C-2019-3007334

RESPONSE TO THE MOTION OF PPL ELECTRIC UTILITIES CORPORATION TO COMPEL RESPONSES TO DISCOVERY PROPOUNDED ON LAWRENCE AND DEBRA ESPOSITO – SET I

TO ADMINISTRATIVE LAW JUDGE ELIZABETH H. BARNES:

Pursuant to 52 Pa. Code § 5.342(g) and § 5.349 (d), Lawrence and Debra Esposito request that the Motion to Compel Responses be denied for the following reasons:

FOR REFERENCE: The PPL Motion to Compel quotes the above 52 Pa Code: "a party is entitled to obtain discovery of any matter not privileged that is relevant to the pending proceeding, or any matter that is reasonably calculated to lead to the discovery of admissible evidence."

THE BASES FOR OUR RESPONSES: We endeavored to answer PPL's interrogatory as completely as possible within our rights as U.S. Citizens and Citizens of the Commonwealth of Pennsylvania. We believe that the information requested in "PPL TO COMPLAINANTS SET I, QUESTION 2; SET I, QUESTION 3; AND SET I, QUESTION 4" does not meet the criteria in the above referenced 52 Pa Code. The information PPL requested IS "privileged"; IS mostly "irrelevant", and, for the most part, IS "unreasonable".

REBUTTAL TO SPECIFIC POINTS FOLLOWS

RESPONSE TO MOTION TO COMPEL

PPL I. 3

I. INTRODUCTION

"3.The Complainants never served any objections to PPL to Complainants Set I by June 21, 2019."

RESPONSE TO I. 3. - Had we been aware that it was necessary to object to their interrogatory we would have done so. We believed our carefully thought out answers would be sufficient to comply with PPL's demand.

PPL I. 4

"4. OnJuly8,2019, the Complainants served their responses to PPL to Complainants Set I. However, the Complainants refused to provide or did not provide the information and materials requested in PPL to Complainants Set I, Questions 2,3,and 4."

RESPONSE TO I. 4. - In fact we did not "refuse to provide the "information and materials requested". Sub-part a) below requests information concerning claims we did not make, rendering b) through e) irrelevant. It also includes an interesting request for us to predict the future although one of the issues with "smart meters" and similar technologies is uncertainty about future adverse effects on health.

The entire interrogatory was stated as:

(a) Please state every health condition you claim was caused by a smart meter or will be caused or worsened by the installation of PPL Electric's new smart meter.

(b) Please provide the date that every health condition identified in sub part (a) began.

(c) Please provide copies of all your medical records of every health condition identified in sub part (a).

(d) For each alleged health condition that you do not have medical records for in response to sub part (c), please state whether such condition was diagnosed by a medical professional. If so, please provide the name,

address, and telephone number of the medical professional and the date of the diagnosis.

(e) For each of the alleged health conditions identified in sub part (a), please state whether you have been prescribed any therapy or treatment for the condition by a medical professional. If so, please identify the therapy or treatment, provide the name, address, and telephone number of the prescribing medical professional, and provide the date the therapy or treatment was prescribed.

We also point out that:

1. **The criteria spelled out in 52 Pa Code: "a party is entitled to obtain discovery of any matter <u>not privileged</u> that is <u>relevant</u> to the pending proceeding, or any matter that is <u>reasonably calculated</u> to lead to the discovery of admissible evidence." PPL was seeking information that IS privileged, irrelevant, and unreasonable.**
2. **Demanding such information is a violation of our rights according to the Fourth and Fourteenth Amendments to the United States Constitution, and the Constitution of Pennsylvania, Article I, Section 27.**

PPL II. 17, 18, 22, AND 23

"17. As explained above, Section 5.342(a) 4) requires a party to fully and completely answer an interrogatory. 52Pa. Code § 5.342(a) 4). In addition, a party has a duty to amend its prior responses to discovery requests when the information contained therein is incomplete. Id. §5.332(2).

18. The response served by the Complainants was non-responsive and incomplete because they refused to answer the interrogatory on the grounds that the Company allegedly cannot have access to this information"without a warrant."

22. In addition, PPL Electric's interrogatory does not and cannot violate the Complainants' constitutional rights.

23. For there to be a deprivation of constitution rights, two elements must be met:(1)"the deprivation must be caused by the exercise of some right or privilege created by the state"; and (2) "the party charged with the deprivation must be a person who may fairly said to be a state actor." Commonwealth v. Corley, 491A.2d829,832(Pa.1985) (emphasis added)

RESPONSE TO II. 17, 18, 22, and 23. - In fact we did not "refuse to provide the information and materials requested".

1. **Item II, 17: Again, we chose to answer the interrogatory according to the criteria spelled out in 52 Pa Code: "a party is entitled to obtain discovery of any matter not privileged that is relevant to the pending proceeding, or any matter that is reasonably calculated to lead to the discovery of admissible evidence." Again, PPL was seeking information that IS privileged, irrelevant, and unreasonable. Our answer is "incomplete" only insofar as it does not fulfill PPL's agenda.**
2. **Item II, 18: Since this is not a criminal investigation and no crime was committed by the Complainants it is questionable whether PPL has a right to this information UNDER ANY CIRCUMSTANCES.**
3. **Item II, 22 and 23:**

   -*"(1) the deprivation must be caused by the exercise of some right or privilege created by the state"* **This requirement is met by the following:**

   "Pennsylvania's Act 129 of 2008 requires the state's seven largest electric distribution companies (EDCs) to develop energy efficiency and conservation (EE&C) plans and adopt other methods of reducing electricity used by customers – including the use of smart meters by their customers." (From the Pennsylvania PUC website)

   (2) "the party charged with the deprivation must be a person who may fairly said to be a state actor." **This requirement is met by the following:**

a. “Pennsylvania Act 129. passed into law in 2008, requires electric utilities with more than 100.000 customers to provide those customers with advanced meters that have specific capabilities. PPL Electric Utilities, which serves 1.4 million customers. is subject to this requirement. The specific language, found in Section 3 of the 1aw, says utilities ‘shall furnish’ these meters.” (from October 2018 letter to Lawrence and Debra Esposito from Phil Walnock, Program Manager, Advanced Metering, PPL Electric Utilities)

RESPONSE TO II, 24, 25, and 26.

1. **Item II, 24 AND 25: CONCERNING “Jackson v Metropolitan Edison Co.”** - *“In a 6-3 opinion delivered by Justice William H. Rehnquist, the court affirmed the Third Circuit and held that Metropolitan Edison's termination of Jackson's service did not qualify as state action.” (Supreme Court decision, 1974)*

   This ruling does not apply to this situation. Met Ed was <u>not ordered or required by any government agency</u> to terminate Catherine Jackson’s electric service. They were acting in their own interest and according to their own policies and procedures. As noted above in our response to “Item II, 22 and 23” - “Pennsylvania Act 129. passed into law in 2008, requires electric utilities with more than 100.000 customers to provide those customers with advanced meters that have specific capabilities. PPL Electric Utilities, which serves 1.4 trillion customers. is subject to this requirement. The specific language, found in Section 3 of the 1aw, says utilities ‘shall furnish’ these meters.” (from October 2018 letter to Lawrence and Debra Esposito from Phil Walnock, Program Manager, Advanced Metering, PPL Electric Utilities). **In this present case the Pennsylvania State Legislature passed a law that required the installation of smart meters. Rather than go out into the state and change the meters themselves, they designated and deputized utilities like PPL Electric Corporation to install the new “smart” meters, thus making these utilities, at least temporarily, “agents of the state”, carrying out a mandate legislated by the state. In this circumstance, PPL IS A STATE ACTOR. As such, the PPL interrogatories in question violate our constitutional rights according to the Fourth Amendment and Fourteenth Amendment to the United States Constitution and the Constitution of Pennsylvania, Article I, Section 27. We have answered them as completely as necessary considering those rights.**

2. **Item II, 26:** **"***Moreover, the information requested about Complainants' exposure to other devices that emit radio frequency ("RF") fields is highly relevant to the issues raised in the case."*

   While we are certainly concerned about the health dangers posed by wireless devices, the fact is that devices that emit electro-magnetic frequencies (EMFs) and "dirty electricity" (also harmful to cell-based life) are ubiquitous and unavoidable in the conduct of everyday life in 2019. Our exposure to such devices is thus irrelevant. They are everywhere. Any such devices we own are irrelevant.

SUMMARY

Our answer to PPL's request for information is true and accurate within the scope of what is relevant, necessary and appropriate and also in light of our Human Rights under the previously cited state and federal constitutions:

- **DEVICES WE POSSESS AS PRIVATE PROPERTY: The devices within the sphere of our private property are irrelevant. PPL does not have the right to this information. Our answer to this interrogatory is thus proper and made in good faith. Continued threats and other pressure to force us to provide this information may be considered harassment.**
- **HEALTH RECORDS: We cannot claim, we do not claim, nor could we prove at this time that any health conditions we have are caused or exacerbated by emissions from "smart" technologies. Such deleterious health effects would be difficult to prove or disprove at this time. Our concern is the future impact of such exposure. For every study that makes claims as to the safety of "smart meters" there are other studies that clearly show potential harm. In addition, for any device we may own, we have the ability to take steps to limit exposure to harmful radiation. We do not have this ability to protect ourselves from a "smart meter". Therefore our past health records are irrelevant. PPL does not have the right to this information. Our answer to this interrogatory is thus proper and**

made in good faith. Continued threats and other pressure to force us to provide this information may be considered harassment.

- **OUR RIGHTS AS CITIZENS OF THE UNITED STATES AND THE COMMONWEALTH OF PENNSYLVANIA: We have answered PPL's interrogatories within the scope of our right to be protected from unreasonable invasion of our privacy.**

Finally, concerning the installation of a so-called "smart meter" on our home: WE HAVE THE RIGHT NOT TO BE FORCED TO HAVE ANOTHER SUCH DEVICE INSTALLED ON OUR PRIVATE PROPERTY AGAINST OUR WILL WHEN PERFECTLY CAPABLE ANALOG DEVICES ARE AVAILABLE AND WHICH ARE, IN FACT, A PROVEN SAFE AND RELIABLE TECHNOLOGY.

CONCLUSION:

We stand by our original response to the interrogatory.

Therefore, for the reasons stated above, we respectfully request that Administrative Law Judge Elizabeth H. Barnes allow our original response to the interrogatory to stand.

Respectfully Submitted:

Lawence Esposito
4239 High Rd.
Cresco, PA 18326
917-767-9962
choochcavone@verizon.net

AMENDMENTS

TO THE

CONSTITUTION OF THE UNITED STATES OF AMERICA

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ARTICLES IN ADDITION TO, AND AMENDMENT OF, THE CONSTITUTION OF THE UNITED STATES OF AMERICA, PROPOSED BY CONGRESS, AND RATIFIED BY THE SEVERAL STATES, PURSUANT TO THE FIFTH ARTICLE OF THE ORIGINAL CONSTITUTION [1]

AMENDMENT [I.] [2]

Congress shall make no law respecting an establishment of religion, or prohibiting the free exercise thereof; or abridging the freedom of speech, or of the press; or the right of the people peace-

[1] In *Dillon v. Gloss*, 256 U.S. 368 (1921), the Supreme Court stated that it would take judicial notice of the date on which a State ratified a proposed constitutional amendment. Accordingly the Court consulted the State journals to determine the dates on which each house of the legislature of certain States ratified the Eighteenth Amendment. It, therefore, follows that the date on which the governor approved the ratification, or the date on which the secretary of state of a given State certified the ratification, or the date on which the Secretary of State of the United States received a copy of said certificate, or the date on which he proclaimed that the amendment had been ratified are not controlling. Hence, the ratification date given in the following notes is the date on which the legislature of a given State approved the particular amendment (signature by the speaker or presiding officers of both houses being considered a part of the ratification of the "legislature"). When that date is not available, the date given is that on which it was approved by the governor or certified by the secretary of state of the particular State. In each case such fact has been noted. Except as otherwise indicated information as to ratification is based on data supplied by the Department of State.

[2] Brackets enclosing an amendment number indicate that the number was not specifically assigned in the resolution proposing the amendment. It will be seen, accordingly, that only the Thirteenth, Fourteenth, Fifteenth, and Sixteenth Amendments were thus technically ratified by number. The first ten amendments along with two others that were not ratified were proposed by Congress on September 25, 1789, when they passed the Senate, having previously passed the House on September 24 (1 ANNALS OF CONGRESS 88, 913). They appear officially in 1 Stat. 97. Ratification was completed on December 15, 1791, when the eleventh State (Virginia) approved these amendments, there being then 14 States in the Union.

The several state legislatures ratified the first ten amendments to the Constitution on the following dates: New Jersey, November 20, 1789; Maryland, December 19, 1789; North Carolina, December 22, 1789; South Carolina, January 19, 1790; New Hampshire, January 25, 1790; Delaware, January 28, 1790; New York, February 27, 1790; Pennsylvania, March 10, 1790; Rhode Island, June 7, 1790; Vermont, November 3, 1791; Virginia, December 15, 1791. The two amendments that then failed of ratification prescribed the ratio of representation to population in the House, and specified that no law varying the compensation of members of Congress should be effective until after an intervening election of Representatives. The first was ratified by ten States (one short of the requisite number) and the second, by six States; subsequently, this second proposal was taken up by the States in the period 1980–1992 and was proclaimed as ratified as of May 7, 1992. Connecticut, Georgia, and Massachusetts ratified the first ten amendments in 1939.

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ably to assemble, and to petition the government for a redress of grievances.

AMENDMENT [II.]

A well regulated Militia, being necessary to the security of a free state, the right of the people to keep and bear Arms, shall not be infringed.

AMENDMENT [III.]

No Soldier shall, in time of peace be quartered in any house, without the consent of the Owner, nor in time of war, but in a manner to be prescribed by law.

AMENDMENT [IV.]

The right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated, and no Warrants shall issue, but upon probable cause, supported by Oath or affirmation, and particularly describing the place to be searched, and the persons or things to be seized.

AMENDMENT [V.]

No person shall be held to answer for a capital, or otherwise infamous crime, unless on a presentment or indictment of a Grand Jury, except in cases arising in the land or naval forces, or in the Militia, when in actual service in time of War or public danger; nor shall any person be subject for the same offense to be twice put in jeopardy of life or limb; nor shall be compelled in any criminal case to be a witness against himself, nor be deprived of life, liberty, or property, without due process of law; nor shall private property be taken for public use, without just compensation.

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AMENDMENT [VI.]

In all criminal prosecutions, the accused shall enjoy the right to a speedy and public trial, by an impartial jury of the State and district wherein the crime shall have been committed, which district shall have been previously ascertained by law, and to be informed of the nature and cause of the accusation; to be confronted with the witnesses against him; to have compulsory process for obtaining witnesses in his favor, and to have the Assistance of Counsel for his defense.

AMENDMENT [VII.]

In Suits at common law, where the value in controversy shall exceed twenty dollars, the right of trial by jury shall be preserved, and no fact tried by a jury, shall be otherwise reexamined in any Court of the United States, than according to the rules of the common law.

AMENDMENT [VIII.]

Excessive bail shall not be required, nor excessive fines imposed, nor cruel and unusual punishments inflicted.

AMENDMENT [IX.]

The enumeration in the Constitution, of certain rights, shall not be construed to deny or disparage others retained by the people.

AMENDMENT [X.]

The powers not delegated to the United States by the Constitution, nor prohibited by it to the States, are reserved to the States respectively, or to the people.

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AMENDMENT [XI.] [3]

The Judicial power of the United States shall not be construed to extend to any suit in law or equity, commenced or prosecuted against one on the United States by Citizens of another State, or by Citizens or Subjects of any Foreign State.

AMENDMENT [XII.] [4]

The Electors shall meet in their respective states and vote by ballot for President and Vice-President, one of whom, at least, shall not be an inhabitant of the same state with themselves; they shall name in their ballots the person voted for as Presi-

[3] The Eleventh Amendment was proposed by Congress on March 4, 1794, when it passed the House, 4 ANNALS OF CONGRESS 477, 478, having previously passed the Senate on January 14, Id., 30, 31. It appears officially in 1 Stat. 402. Ratification was completed on February 7, 1795, when the twelfth State (North Carolina) approved the amendment, there being then 15 States in the Union. Official announcement of ratification was not made until January 8, 1798, when President John Adams in a message to Congress stated that the Eleventh Amendment had been adopted by three-fourths of the States and that it "may now be deemed to be a part of the Constitution." In the interim South Carolina had ratified, and Tennessee had been admitted into the Union as the sixteenth State.

The several state legislatures ratified the Eleventh Amendment on the following dates: New York, March 27, 1794; Rhode Island, March 31, 1794; Connecticut, May 8, 1794; New Hampshire, June 16, 1794; Massachusetts, June 26, 1794; Vermont, between October 9 and November 9, 1794; Virginia, November 18, 1794; Georgia, November 29, 1794; Kentucky, December 7, 1794; Maryland, December 26, 1794; Delaware, January 23, 1795; North Carolina, February 7, 1795; South Carolina, December 4, 1797.

[4] The Twelfth Amendment was proposed by Congress on December 9, 1803, when it passed the House, 13 ANNALS OF CONGRESS 775, 776, having previously passed the Senate on December 2. Id., 209. It was not signed by the presiding officers of the House and Senate until December 12. It appears officially in 2 Stat. 306. Ratification was probably completed on June 15, 1804, when the legislature of the thirteenth State (New Hampshire) approved the amendment, there being then 17 States in the Union. The Governor of New Hampshire, however, vetoed this act of the legislature on June 20, and the act failed to pass again by two-thirds vote then required by the state constitution. Inasmuch as Article V of the Federal Constitution specifies that amendments shall become effective "when ratified by legislatures of three-fourths of the several States or by conventions in three-fourths thereof," it has been generally believed that an approval or veto by a governor is without significance. If the ratification by New Hampshire be deemed ineffective, then the amendment became operative by Tennessee's ratification on July 27, 1804. On September 25, 1804, in a circular letter to the Governors of the several States, Secretary of State Madison declared the amendment ratified by three-fourths of the States.

The several state legislatures ratified the Twelfth Amendment on the following dates: North Carolina, December 22, 1803; Maryland, December 24, 1803; Kentucky, December 27, 1803; Ohio, between December 5 and December 30, 1803; Virginia, between December 20, 1803 and February 3, 1804; Pennsylvania, January 5, 1804; Vermont, January 30, 1804; New York, February 10, 1804; New Jersey, February 22, 1804; Rhode Island, between February 27 and March 12, 1804; South Carolina, May 15, 1804; Georgia, May 19, 1804; New Hampshire, June 15, 1804; and Tennessee, July 27, 1804. The amendment was rejected by Delaware on January 18, 1804, and by Connecticut at its session begun May 10, 1804. Massachusetts ratified this amendment in 1961.

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dent, and in distinct ballots the person voted for as Vice-President, and they shall make distinct lists of all persons voted for as President, and of all persons voted for as Vice-President, and of the number of votes for each, which lists they shall sign and certify, and transmit sealed to the seat of the government of the United States, directed to the President of the Senate;—The President of the Senate shall, in the presence of the Senate and House of Representatives, open all the certificates and the votes shall then be counted;—The person having the greatest Number of votes for President, shall be the President, if such number be a majority of the whole number of Electors appointed; and if no person have such majority, then from the persons having the highest numbers not exceeding three on the list of those voted for as President, the House of Representatives shall choose immediately, by ballot, the President. But in choosing the President, the votes shall be taken by states, the representation from each state having one vote; a quorum for this purpose shall consist of a member or members from two-thirds of the states, and a majority of all the states shall be necessary to a choice. And if the House of Representatives shall not choose a President whenever the right of choice shall devolve upon them, before the fourth day of March next following, then the Vice-President shall act as President, as in the case of the death or other constitutional disability of the President—The person having the greatest number of votes as Vice-President, shall be the Vice-President, if such number be a majority of the whole number of Electors appointed, and if no person have a majority, then from the two highest numbers on the list, the Senate shall choose the Vice-President; a quorum for the purpose shall consist of two-

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thirds of the whole number of Senators, and a majority of the whole number shall be necessary to a choice. But no person constitutionally ineligible to the office of President shall be eligible to that of Vice-President of the United States.

AMENDMENT XIII.[5]

SECTION 1. Neither slavery nor involuntary servitude, except as a punishment for crime whereof the party shall have been duly convicted, shall exist within the United States, or any place subject to their jurisdiction.

SECTION 2. Congress shall have power to enforce this article by appropriate legislation.

AMENDMENT XIV.[6]

SECTION 1. All persons born or naturalized in the United States, and subject to the jurisdiction thereof, are citizens of the United

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[5] The Thirteenth Amendment was proposed by Congress on January 31, 1865, when it passed the House, CONG. GLOBE (38th Cong., 2d Sess.) 531, having previously passed the Senate on April 8, 1864. Id., (38th cong., 1st Sess.), 1940. It appears officially in 13 Stat. 567 under the date of February 1, 1865. Ratification was completed on December 6, 1865, when the legislature of the twenty-seventh State (Georgia) approved the amendment, there being then 36 States in the Union. On December 18, 1865, Secretary of State Seward certified that the Thirteenth Amendment had become a part of the Constitution, 13 Stat. 774.

The several state legislatures ratified the Thirteenth Amendment on the following dates: Illinois, February 1, 1865; Rhode Island, February 2, 1865; Michigan, February 2, 1865; Maryland, February 3, 1865; New York, February 3, 1865; West Virginia, February 3, 1865; Missouri, February 6, 1865; Maine, February 7, 1865; Kansas, February 7, 1865; Massachusetts, February 7, 1865; Pennsylvania, February 8, 1865; Virginia, February 9, 1865; Ohio, February 10, 1865; Louisiana, February 15 or 16, 1865; Indiana, February 16, 1865; Nevada, February 16, 1865; Minnesota, February 23, 1865; Wisconsin, February 24, 1865; Vermont, March 9, 1865 (date on which it was "approved" by Governor); Tennessee, April 7, 1865; Arkansas, April 14, 1865; Connecticut, May 4, 1865; New Hampshire, June 30, 1865; South Carolina, November 13, 1865; Alabama, December 2, 1865 (date on which it was "approved" by Provisional Governor); North Carolina, December 4, 1865; Georgia, December 6, 1865; Oregon, December 11, 1865; California, December 15, 1865; Florida, December 28, 1865 (Florida again ratified this amendment on June 9, 1868, upon its adoption of a new constitution); Iowa, January 17, 1866; New Jersey, January 23, 1866 (after having rejected the amendment on March 16, 1865); Texas, February 17, 1870; Delaware, February 12, 1901 (after having rejected the amendment of February 8, 1865). The amendment was rejected by Kentucky on February 24, 1865, and by Mississippi on December 2, 1865.

[6] The Fourteenth Amendment was proposed by Congress on June 13, 1866, when it passed the House, CONG. GLOBE (39th Cong., 1st Sess.) 3148, 3149, having previously passed the Senate on June 8. Id., 3042. It appears officially in 14 Stat. 358 under date of June 16, 1866. Ratification was probably completed on July 9, 1868, when the legislature of the twenty-eighth State

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States and of the State wherein they reside. No State shall make or enforce any law which shall abridge the privileges or immunities of citizens of the United States; nor shall any State deprive any person of life, liberty, or property, without due process of law; nor deny to any person within its jurisdiction the equal protection of the laws.

SECTION 2. Representatives shall be apportioned among the several States according to their respective numbers, counting the whole number of persons in each State, excluding Indians not taxed. But when the right to vote at any election for the choice of electors for President and Vice President of the United States, Representatives in Congress, the Executive and Judicial

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(South Carolina or Louisiana) approved the amendment, there being then 37 States in the Union. However, Ohio and New Jersey had prior to that date "withdrawn" their earlier assent to this amendment. Accordingly, Secretary of State Seward on July 20, 1868, certified that the amendment had become a part of the Constitution if the said withdrawals were ineffective. 15 Stat. 706–707. Congress on July 21, 1868, passed a joint resolution declaring the amendment a part of the Constitution and directing the Secretary to promulgate it as such. On July 28, 1868, Secretary Seward certified without reservation that the amendment was a part of the Constitution. In the interim, two other States, Alabama on July 13 and Georgia on July 21, 1868, had added their ratifications.

The several state legislatures ratified the Fourteenth Amendment on the following dates: Connecticut, June 30, 1866; New Hampshire, July 7, 1866; Tennessee, July 9, 1866; New Jersey, September 11, 1866 (the New Jersey Legislature on February 20, 1868 "withdrew" its consent to the ratification; the Governor vetoed that bill on March 5, 1868; and it was repassed over his veto on March 24, 1868); Oregon, September 19, 1866 (Oregon "withdrew" its consent on October 15, 1868); Vermont, October 30, 1866; New York, January 10, 1867; Ohio, January 11, 1867 (Ohio "withdrew" its consent on January 15, 1868); Illinois, January 15, 1867; West Virginia, January 16, 1867; Michigan, January 16, 1867; Kansas, January 17, 1867; Minnesota, January 17, 1867; Maine, January 19, 1867; Nevada, January 22, 1867; Indiana, January 23, 1867; Missouri, January 26, 1867 (date on which it was certified by the Missouri secretary of state); Rhode Island, February 7, 1867; Pennsylvania, February 12, 1867; Wisconsin, February 13, 1867 (actually passed February 7, but was not signed by legislative officers until February 13); Massachusetts, March 20, 1867; Nebraska, June 15, 1867; Iowa, March 9, 1868; Arkansas, April 6, 1868; Florida, June 9, 1868; North Carolina, July 2, 1868 (after having rejected the amendment on December 13, 1866); Louisiana, July 9, 1868 (after having rejected the amendment on February 6, 1867); South Carolina, July 8, 1868 (after having rejected the amendment on December 20, 1866); Alabama, July 13, 1868 (date on which it was "approved" by the Governor); Georgia, July 21, 1868 (after having rejected the amendment on November 9, 1866—Georgia ratified again on February 2, 1870); Virginia, October 8, 1869 (after having rejected the amendment on January 9, 1867); Mississippi, January 17, 1870; Texas, February 18, 1870 (after having rejected the amendment on October 27, 1866); Delaware, February 12, 1901 (after having rejected the amendment February 7, 1867). The amendment was rejected (and not subsequently ratified) by Kentucky on January 8, 1867. Maryland and California ratified this amendment in 1959.

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officers of a State, or the members of the Legislature thereof, is denied to any of the male inhabitants of such State, being twenty-one years of age, and citizens of the United States, or in any way abridged, except for participation in rebellion, or other crime, the basis of representation therein shall be reduced in the proportion which the number of such male citizens shall bear to the whole number of male citizens twenty-one years of age in such State.

SECTION 3. No person shall be a Senator or Representative in Congress, or elector of President and Vice President, or hold any office, civil or military, under the United States, or under any State, who, having previously taken an oath, as a member of Congress, or as an officer of the United States, or as a member of any State legislature, or as an executive or judicial officer of any State, to support the Constitution of the United States, shall have engaged in insurrection or rebellion against the same, or given aid or comfort to the enemies thereof. But Congress may by a vote of two-thirds of each House, remove such disability.

SECTION 4. The validity of the public debt of the United States, authorized by law, including debts incurred for payment of pensions and bounties for services in suppressing insurrection or rebellion, shall not be questioned. But neither the United States nor any State shall assume or pay any debt or obligation incurred in aid of insurrection or rebellion against the United States, or any claim for the loss or emancipation of any slave; but all such debts, obligations and claims shall be held illegal and void.

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SECTION 5. The Congress shall have power to enforce, by appropriate legislation, the provisions of this article.

AMENDMENT XV.[7]

SECTION 1. The right of citizens of the United States to vote shall not be denied or abridged by the United States or by any State on account of race, color, or previous condition of servitude.

SECTION 2. The Congress shall have power to enforce this article by appropriate legislation.

AMENDMENT XVI.[8]

The Congress shall have power to lay and collect taxes on incomes, from whatever source derived, without apportionment

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[7] The Fifteenth Amendment was proposed by Congress on February 26, 1869, when it passed the Senate, CONG. GLOBE (40th Cong., 3rd Sess.) 1641, having previously passed the House on February 25. Id., 1563, 1564. It appears officially in 15 Stat. 346 under the date of February 27, 1869. Ratification was probably completed on February 3, 1870, when the legislature of the twenty-eighth State (Iowa) approved the amendment, there being then 37 States in the Union. However, New York had prior to that date "withdrawn" its earlier assent to this amendment. Even if this withdrawal were effective, Nebraska's ratification on February 17, 1870, authorized Secretary of State Fish's certification of March 30, 1870, that the Fifteenth Amendment had become a part of the Constitution. 16 Stat. 1131.

The several state legislatures ratified the Fifteenth Amendment on the following dates: Nevada, March 1, 1869; West Virginia, March 3, 1869; North Carolina, March 5, 1869; Louisiana, March 5, 1869 (date on which it was "approved" by the Governor); Illinois, March 5, 1869; Michigan, March 5, 1869; Wisconsin, March 5, 1869; Maine, March 11, 1869; Massachusetts, March 12, 1869; South Carolina, March 15, 1869; Arkansas, March 15, 1869; Pennsylvania, March 25, 1869; New York, April 14, 1869 (New York "withdrew" its consent to the ratification on January 5, 1870); Indiana, March 14, 1869; Connecticut, May 19, 1869; Florida, June 14, 1869; New Hampshire, July 1, 1869; Virginia, October 8, 1869; Vermont, October 20, 1869; Alabama, November 16, 1869; Missouri, January 7, 1870 (Missouri had ratified the first section of the 15th Amendment on March 1, 1869; it failed to include in its ratification the second section of the amendment); Minnesota, January 13, 1870; Mississippi, January 17, 1870; Rhode Island, January 18, 1870; Kansas, January 19, 1870 (Kansas had by a defectively worded resolution previously ratified this amendment on February 27, 1869); Ohio, January 27, 1870 (after having rejected the amendment on May 4, 1869); Georgia, February 2, 1870; Iowa, February 3, 1870; Nebraska, February 17, 1870; Texas, February 18, 1870; New Jersey, February 15, 1871 (after having rejected the amendment on February 7, 1870); Delaware, February 12, 1901 (date on which approved by Governor; Delaware had previously rejected the amendment on March 18, 1869). The amendment was rejected (and was not subsequently ratified) by Kentucky, Maryland, and Tennessee. California ratified this amendment in 1962 and Oregon in 1959.

[8] The Sixteenth Amendment was proposed by Congress on July 12, 1909, when it passed the House, 44 CONG. REC. (61st Cong., 1st Sess.) 4390, 4440, 4441, having previously passed the Senate on July 5. Id., 4121. It appears officially in 36 Stat. 184. Ratification was completed on February 3, 1913, when the legislature of the thirty-sixth State (Delaware, Wyoming, or New

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among the several States, and without regard to any census of enumeration.

AMENDMENT [XVII.] [9]

The Senate of the United States shall be composed of two Senators from each state, elected by the people thereof, for six years; and each Senator shall have one vote. The electors in each State shall have the qualifications requisite for electors of the most numerous branch of the State legislatures.

When vacancies happen in the representation of any State in the Senate, the executive authority of such State shall issue

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Mexico) approved the amendment, there being then 48 States in the Union. On February 25, 1913, Secretary of State Knox certified that this amendment had become a part of the Constitution. 37 Stat. 1785.

The several state legislatures ratified the Sixteenth Amendment on the following dates: Alabama, August 10, 1909; Kentucky, February 8, 1910; South Carolina, February 19, 1910; Illinois, March 1, 1910; Mississippi, March 7, 1910; Oklahoma, March 10, 1910; Maryland, April 8, 1910; Georgia, August 3, 1910; Texas, August 16, 1910; Ohio, January 19, 1911; Idaho, January 20, 1911; Oregon, January 23, 1911; Washington, January 26, 1911; Montana, January 27, 1911; Indiana, January 30, 1911; California, January 31, 1911; Nevada, January 31, 1911; South Dakota, February 1, 1911; Nebraska, February 9, 1911; North Carolina, February 11, 1911; Colorado, February 15, 1911; North Dakota, February 17, 1911; Michigan, February 23, 1911; Iowa, February 24, 1911; Kansas, March 2, 1911; Missouri, March 16, 1911; Maine, March 31, 1911; Tennessee, April 7, 1911; Arkansas, April 22, 1911 (after having rejected the amendment at the session begun January 9, 1911); Wisconsin, May 16, 1911; New York, July 12, 1911; Arizona, April 3, 1912; Minnesota, June 11, 1912; Louisiana, June 28, 1912; West Virginia, January 31, 1913; Delaware, February 3, 1913; Wyoming, February 3, 1913; New Mexico, February 3, 1913; New Jersey, February 4, 1913; Vermont, February 19, 1913; Massachusetts, March 4, 1913; New Hampshire, March 7, 1913 (after having rejected the amendment on March 2, 1911). The amendment was rejected (and not subsequently ratified) by Connecticut, Rhode Island, and Utah.

[9] The Seventeenth Amendment was proposed by Congress on May 13, 1912, when it passed the House, 48 CONG. REC. (62d Cong., 2d Sess.) 6367, having previously passed the Senate on June 12, 1911. 47 CONG. REC. (62d Cong., 1st Sess.) 1925. It appears officially in 37 Stat. 646. Ratification was completed on April 8, 1913, when the thirty-sixth State (Connecticut) approved the amendment, there being then 48 States in the Union. On May 31, 1913, Secretary of State Bryan certified that it had become a part of the Constitution. 38 Stat. 2049.

The several state legislatures ratified the Seventeenth Amendment on the following dates: Massachusetts, May 22, 1912; Arizona, June 3, 1912; Minnesota, June 10, 1912; New York, January 15, 1913; Kansas, January 17, 1913; Oregon, January 23, 1913; North Carolina, January 25, 1913; California, January 28, 1913; Michigan, January 28, 1913; Iowa, January 30, 1913; Montana, January 30, 1913; Idaho, January 31, 1913; West Virginia, February 4, 1913; Colorado, February 5, 1913; Nevada, February 6, 1913; Texas, February 7, 1913; Washington, February 7, 1913; Wyoming, February 8, 1913; Arkansas, February 11, 1913; Illinois, February 13, 1913; North Dakota, February 14, 1913; Wisconsin, February 18, 1913; Indiana, February 19, 1913; New Hampshire, February 19, 1913; Vermont, February 19, 1913; South Dakota, February 19, 1913; Maine, February 20, 1913; Oklahoma, February 24, 1913; Ohio, February 25, 1913; Missouri, March 7, 1913; New Mexico, March 13, 1913; Nebraska, March 14, 193; New Jersey, March 17, 1913; Tennessee, April 1, 193; Pennsylvania, April 2, 1913; Connecticut, April 8, 1913; Louisiana, June 5, 1914. The amendment was rejected by Utah on February 26, 1913.

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writs of election to fill such vacancies: Provided, That the legislature of any State may empower the executive thereof to make temporary appointments until the people fill the vacancies by election as the legislature may direct.

This amendment shall not be so construed as to affect the election or term of any Senator chosen before it becomes valid as part of the Constitution.

AMENDMENT [XVIII.] [10]

SECTION 1. After one year from the ratification of this article the manufacture, sale, or transportation of intoxicating liquors within, the importation thereof into, or the exportation thereof from the United States and all territory subject to the jurisdiction thereof for beverage purposes is hereby prohibited.

SECTION 2. The Congress and the several States shall have concurrent power to enforce this article by appropriate legislation.

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[10] The Eighteenth Amendment was proposed by Congress on December 18, 1917, when it passed the Senate, CONG. REC. (65th Cong. 2d Sess.) 478, having previously passed the House on December 17. Id., 470. It appears officially in 40 Stat. 1059. Ratification was completed on January 16, 1919, when the thirty-sixth State approved the amendment, there being then 48 States in the Union. On January 29, 1919, Acting Secretary of State Polk certified that this amendment had been adopted by the requisite number of States. 40 Stat. 1941. By its terms this amendment did not become effective until 1 year after ratification.

The several state legislatures ratified the Eighteenth Amendment on the following dates: Mississippi, January 8, 1918; Virginia, January 11, 1918; Kentucky, January 14, 1918; North Dakota, January 28, 1918 (date on which approved by Governor); South Carolina, January 29, 1918; Maryland, February 13, 1918; Montana, February 19, 1918; Texas, March 4, 1918; Delaware, March 18, 1918; South Dakota, March 20, 1918; Massachusetts, April 2, 1918; Arizona, May 24, 1918; Georgia, June 26, 1918; Louisiana, August 9, 1918 (date on which approved by Governor); Florida, November 27, 1918; Michigan, January 2, 1919; Ohio, January 7, 1919; Oklahoma, January 7, 1919; Idaho, January 8, 1919; Maine, January 8, 1919; West Virginia, January 9, 1919; California, January 13, 1919; Tennessee, January 13, 1919; Washington, January 13, 1919; Arkansas, January 14, 1919; Kansas, January 14, 1919; Illinois, January 14, 1919; Indiana, January 14, 1919; Alabama, January 15, 1919; Colorado, January 15, 1919; Iowa, January 15, 1919; New Hampshire, January 15, 1919; Oregon, January 15, 1919; Nebraska, January 16, 1919; North Carolina, January 16, 1919; Utah, January 16, 1919; Missouri, January 16, 1919; Wyoming, January 16, 1919; Minnesota, January 17, 1919; Wisconsin, January 17, 1919; New Mexico, January 20, 1919; Nevada, January 21, 1919; Pennsylvania, February 25, 1919; New Jersey, March 9, 1922; New York, January 29, 1919; Vermont, January 29, 1919.

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SECTION 3. This article shall be inoperative unless it shall have been ratified as an amendment to the Constitution by the legislatures of the several States, as provided in the Constitution, within seven years from the date of the submission hereof to the States by the Congress.

AMENDMENT [XIX.] [11]

The right of citizens of the United States to vote shall not be denied or abridged by the United States or by any State on account of sex.

Congress shall have power to enforce this article by appropriate legislation.

AMENDMENT [XX.] [12]

SECTION 1. The terms of the President and Vice President shall end at noon on the 20th day of January, and the terms of

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[11] The Nineteenth Amendment was proposed by Congress on June 4, 1919, when it passed the Senate, CONG. REC. (66th Cong., 1st Sess.) 635, having previously passed the house on May 21. Id., 94. It appears officially in 41 Stat. 362. Ratification was completed on August 18, 1920, when the thirty-sixth State (Tennessee) approved the amendment, there being then 48 States in the Union. On August 26, 1920, Secretary of Colby certified that it had become a part of the Constitution. 41 Stat. 1823.

The several state legislatures ratified the Nineteenth Amendment on the following dates: Illinois, June 10, 1919 (readopted June 17, 1919); Michigan, June 10, 1919; Wisconsin, June 10, 1919; Kansas, June 16, 1919; New York, June 16, 1919; Ohio, June 16, 1919; Pennsylvania, June 24, 1919; Massachusetts, June 25, 1919; Texas, June 28, 1919; Iowa, July 2, 1919 (date on which approved by Governor); Missouri, July 3, 1919; Arkansas, July 28, 1919; Montana, August 2, 1919 (date on which approved by governor); Nebraska, August 2. 1919; Minnesota, September 8, 1919; New Hampshire, September 10, 1919 (date on which approved by Governor); Utah, October 2, 1919; California, November 1, 1919; Maine, November 5, 1919; North Dakota, December 1, 1919; South Dakota, December 4, 1919 (date on which certified); Colorado, December 15, 1919 (date on which approved by Governor); Kentucky, January 6, 1920; Rhode Island, January 6, 1920; Oregon, January 13, 1920; Indiana, January 16, 1920; Wyoming, January 27, 1920; Nevada, February 7, 1920; New Jersey, February 9, 1920; Idaho, February 11, 1920; Arizona, February 12, 1920; New Mexico, February 21, 1920 (date on which approved by govrnor); Oklahoma, February 28, 1920; West Virginia, March 10, 1920 (confirmed September 21, 1920); Washington, March 22, 1920; Tennessee, August 18, 1920; Vermont, February 8, 1921. The amendment was rejected by Georgia on July 24, 1919; by Alabama, on September 22, 1919; by South Carolina on January 29, 1920; by Virginia on February 12, 1920; by Maryland on February 24, 1920; by Mississippi on March 29, 1920; by Louisiana on July 1, 1920. This amendment was subsequently ratified by Virginia in 1952, Alabama in 1953, Florida in 1969, and Georgia and Louisiana in 1970.

[12] The Twentieth Amendment was proposed by Congress on March 2, 1932, when it passed the Senate, CONG. REC. (72d Cong., 1st Sess.) 5086, having previously passed the House on March 1. Id., 5027. It appears officially in 47 Stat. 745. Ratification was completed on January 23,

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Senators and Representatives at noon on the 3d day of January, of the years in which such terms would have ended if this article had not been ratified; and the terms of their successors shall then begin.

SECTION 2. The Congress shall assemble at least once in every year, and such meeting shall begin at noon on the 3d day of January, unless they shall by law appoint a different day.

SECTION 3. If, at the time fixed for the beginning of the term of the President, the President elect shall have died, the Vice President elect shall become President. If a President shall not have been chosen before the time fixed for the beginning of his term, or if the President elect shall have failed to qualify, then the Vice President elect shall act as President until a President shall have qualified; and the Congress may by law provide for the case wherein neither a President elect nor a Vice President elect shall have qualified, declaring who shall then act as President, or the manner in which one who is to act shall be selected, and such person shall act accordingly until a President or Vice President shall have qualified.

1933, when the thirty-sixth State approved the amendment, there being then 48 States in the Union. On February 6, 1933, Secretary of State Stimson certified that it had become a part of the Constitution. 47 Stat. 2569.

The several state legislatures ratified the Twentieth Amendment on the following dates: Virginia, March 4, 1932; New York, March 11, 1932; Mississippi, March 16, 1932; Arkansas March 17, 1932; Kentucky, March 17, 1932; New Jersey, March 21, 1932; South Carolina, March 25, 1932; Michigan, March 31, 1932; Maine, April 1, 1932; Rhode Island, April 14, 1932; Illinois, April 21, 1932; Louisiana, June 22, 1932; West Virginia, July 30, 1932; Pennsylvania, August 11, 1932; Indiana, August 15, 1932; Texas, September 7, 1932; Alabama, September 13, 1932; California, January 3, 1933; North Carolina, January 5, 1933; North Dakota, January 9, 1933; Minnesota, January 12, 1933; Arizona, January 13, 1933; Montana, January 13, 1933; Nebraska, January 13, 1933; Oklahoma, January 13, 1933; Kansas, January 16, 1933; Oregon, January 16, 1933; Delaware, January 19, 1933; Washington, January 19, 1933; Wyoming, January 19, 1933; Iowa, January 20, 1933; South Dakota, January 20, 1933; Tennessee, January 20, 1933; Idaho, January 21, 1933; New Mexico, January 21, 1933; Georgia, January 23, 1933; Missouri, January 23, 1933; Ohio, January 23, 1933; Utah, January 23, 1933; Colorado, January 24, 1933; Massachusetts, January 24, 1933; Wisconsin, January 24, 1933; Nevada, January 26, 1933; Connecticut, January 27, 1933; New Hampshire, January 31, 1933; Vermont, February 2, 1933; Maryland, March 24, 1933; Florida, April 26, 1933.

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SECTION 4. The Congress may by law provide for the case of the death of any of the persons from whom the House of Representatives may choose a President whenever the right of choice shall have devolved upon them, and for the case of the death of any of the persons from whom the Senate may choose a Vice President whenever the right of choice shall have devolved upon them.

SECTION 5. Sections 1 and 2 shall take effect on the 15th day of October following the ratification of this article.

SECTION 6. This article shall be inoperative unless it shall have been ratified as an amendment to the Constitution by the legislatures of three-fourths of the several States within seven years from the date of its submission.

AMENDMENT [XXI.] [13]

SECTION 1. The eighteenth article of amendment to the Constitution of the United State is hereby repealed.

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[13] The Twenty-first Amendment was proposed by Congress on February 20, 1933, when it passed the House, CONG. REC. (72d Cong., 2d Sess.) 4516, having previously passed the Senate on February 16. Id., 4231. It appears officially in 47 Stat. 1625. Ratification was completed on December 5, 1933, when the thirty-sixth State (Utah) approved the amendment, there being then 48 States in the Union. On December 5, 1933, Acting Secretary of State Phillips certified that it had been adopted by the requisite number of States. 48 Stat. 1749.

The several state conventions ratified the Twenty-first Amendment on the following dates: Michigan, April 10, 1933; Wisconsin, April 25, 1933; Rhode Island, May 8, 1933; Wyoming, May 25, 1933; New Jersey, June 1, 1933; Delaware, June 24, 1933; Indiana, June 26, 1933; Massachusetts, June 26, 1933; New York, June 27, 1933; Illinois, July 10, 1933; Iowa, July 10, 1933; Connecticut, July 11, 1933; New Hampshire, July 11, 1933; California, July 24, 1933; West Virginia, July 25, 1933; Arkansas, August 1, 1933; Oregon, August 7, 1933; Alabama, August 8, 1933; Tennessee, August 11, 1933; Missouri, August 29, 1933; Arizona, September 5, 1933; Nevada, September 5, 1933; Vermont, September 23, 1933; Colorado, September 26, 1933; Washington, October 3, 1933; Minnesota, October 10, 1933; Idaho, October 17, 1933; Maryland, October 18, 1933; Virginia, October 25, 1933; New Mexico, November 2, 1933; Florida, November 14, 1933; Texas, November 24, 1933; Kentucky, November 27, 1933; Ohio, December 5, 1933; Pennsylvania, December 5, 1933; Utah, December 5, 1933; Maine, December 6, 1933; Montana, August 6, 1934. The amendment was rejected by a convention in the State of South Carolina, on December 4, 1933. The electorate of the State of North Carolina voted against holding a convention at a general election held on November 7, 1933.

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SECTION 2. The transportation or importation into any State, territory, or possession of the United States for delivery or use therein of intoxicating liquors, in violation of the laws thereof, is hereby prohibited.

SECTION 3. This article shall be inoperative unless it shall have been ratified as an amendment to the Constitution by conventions in the several States, as provided in the Constitution, within seven years from the date of the submission hereof to the States by the Congress.

AMENDMENT [XXII.] [14]

SECTION 1. No person shall be elected to the office of the President more than twice, and no person who has held the office of President, or acted as President, for more than two years of a term to which some other person was elected President shall be elected to the office of the President more than once. But this Article shall not apply to any person holding the office of President, when this Article was proposed by the Congress, and shall not prevent any person who may be holding the office of Presi-

[14] The Twenty-second Amendment was proposed by Congress on March 24, 1947, having passed the House on March 21, 1947, CONG. REC. (80th Cong., 1st Sess.) 2392, and having previously passed the Senate on March 12, 1947. Id., 1978. It appears officially in 61 Stat. 959. Ratification was completed on February 27, 1951, when the thirty-sixth State (Minnesota) approved the amendment, there being then 48 States in the Union. On March 1, 1951, Jess Larson, Administrator of General Services, certified that it had been adopted by the requisite number of States. 16 FED. REG. 2019.

A total of 41 state legislatures ratified the Twenty-second Amendment on the following dates: Maine, March 31, 1947; Michigan, March 31, 1947; Iowa, April 1, 1947; Kansas, April 1, 1947; New Hampshire, April 1, 1947; Delaware, April 2, 1947; Illinois, April 3, 1947; Oregon, April 3, 1947; Colorado, April 12, 1947; California, April 15, 1947; New Jersey, April 15, 1947; Vermont, April 15, 1947; Ohio, April 16, 1947; Wisconsin, April 16, 1947; Pennsylvania, April 29, 1947; Connecticut, May 21, 1947; Missouri, May 22, 1947; Nebraska, May 23, 1947; Virginia, January 28, 1948; Mississippi, February 12, 1948; New York, March 9, 1948; South Dakota, January 21, 1949; North Dakota, February 25, 1949; Louisiana, May 17, 1950; Montana, January 25, 1951; Indiana, January 29, 1951; Idaho, January 30, 1951; New Mexico, February 12, 1951; Wyoming, February 12, 1951; Arkansas, February 15, 1951; Georgia, February 17, 1915; Tennessee, February 20, 1951; Texas, February 22, 1951; Utah, February 26, 1951; Nevada, February 26, 1951; Minnesota, February 27, 1951; North Carolina, February 28, 1951; South Carolina, March 13, 1951; Maryland, March 14, 1951; Florida, April 16, 1951; and Alabama, May 4, 1951.

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dent, or acting as President, during the term within which this Article becomes operative from holding the office of President or acting as President during the remainder of such term.

SECTION 2. This article shall be inoperative unless it shall have been ratified as an amendment to the Constitution by the legislatures of three-fourths of the several States within seven years from the date of its submission to the States by the Congress.

AMENDMENT [XXIII.] [15]

SECTION 1. The District constituting the seat of Government of the United States shall appoint in such manner as the Congress may direct:

A number of electors of President and Vice President equal to the whole number of Senators and Representatives in Congress to which the District would be entitled if it were a State, but in no event more than the least populous State; they shall be in addition to those appointed by the States, but they shall be considered, for the purposes of the election of President and Vice President, to be electors appointed by a State; and they shall

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[15] The Twenty-third Amendment was proposed by Congress on June 16, 1960, when it passed the Senate, CONG. REC. (86th Cong., 2d Sess.) 12858, having previously passed the House on June 14. Id., 12571. It appears officially in 74 Stat. 1057. Ratification was completed on March 29, 1961, when the thirty-eighth State (Ohio) approved the amendment, there being then 50 States in the Union. On April 3, 1961, John L. Moore, Administrator of General Services, certified that it had been adopted by the requisite number of States. 26 FED. REG. 2808.

The several state legislatures ratified the Twenty-third Amendment on the following dates: Hawaii, June 23, 1960; Massachusetts, August 22, 1960; New Jersey, December 19, 1960; New York, January 17, 1961; California, January 19, 1961; Oregon, January 27, 1961; Maryland, January 30, 1961; Idaho, January 31, 1961; Maine, January 31, 1961; Minnesota, January 31, 1961; New Mexico, February 1, 1961; Nevada, February 2, 1961; Montana, February 6, 1961; Colorado, February 8, 1961; Washington, February 9, 1961; West Virginia, February 1961; Alaska, February 10, 1961; Wyoming, February 13, 1961; South Dakota, February 14, 1961; Delaware, February 20, 1961; Utah, February 21, 1961; Wisconsin, February 21, 1961; Pennsylvania, February 28, 1961; Indiana, March 3, 1961; North Dakota, March 3, 1961; Tennessee, March 6, 1961; Michigan, March 8, 1961; Connecticut, March 9, 1961; Arizona, March 10, 1961; Illinois, March 14, 1961; Nebraska, March 15, 1961; Vermont, March 15, 1961; Iowa, March 16, 1961; Missouri, March 20, 1961; Oklahoma, March 21, 1961; Rhode Island, March 22, 1961; Kansas, March 29, 1961; Ohio, March 29, 1961; and New Hampshire, March 30, 1961.

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meet in the District and perform such duties as provided by the twelfth article of amendment.

SECTION 2. The Congress shall have power to enforce this article by appropriate legislation.

AMENDMENT [XXIV.] [16]

SECTION 1. The right of citizens of the United States to vote in any primary or other election for President or Vice President, for electors for President or Vice President, or for Senator or Representative in Congress, shall not be denied or abridged by the United States or any State by reason of failure to pay any poll tax or other tax.

SECTION 2. The Congress shall have power to enforce this article by appropriate legislation.

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[16] The Twenty-fourth Amendment was proposed by Congress on September 14, 1962, having passed the House on August 27, 1962. CONG. REC. (87th Cong., 2d Sess.) 17670 and having previously passed the Senate on March 27, 1962. Id., 5105. It appears officially in 76 Stat. 1259. Ratification was completed on January 23, 1964, when the thirty-eighth State (South Dakota) approved the Amendment, there being then 50 States in the Union. On February 4, 1964, Bernard L. Boutin, Administrator of General Services, certified that it had been adopted by the requisite number of States. 25 FED. REG. 1717. President Lyndon B. Johnson signed this certificate.

Thirty-eight state legislatures ratified the Twenty-fourth Amendment on the following dates: Illinois, November 14, 1962; New Jersey, December 3, 1962; Oregon, January 25, 1963; Montana, January 28, 1963; West Virginia, February 1, 1963; New York, February 4, 1963; Maryland, February 6, 1963; California, February 7, 1963; Alaska, February 11, 1963; Rhode Island, February 14, 1963; Indiana, February 19, 1963; Michigan, February 20, 1963; Utah, February 20, 1963; Colorado, February 21, 1963; Minnesota, February 27, 1963; Ohio, February 27, 1963; New Mexico, March 5, 1963; Hawaii, March 6, 1963; North Dakota, March 7, 1963; Idaho, March 8, 1963; Washington, March 14, 1963; Vermont, March 15, 1963; Nevada, March 19, 1963; Connecticut, March 20, 1963; Tennessee, March 21, 1963; Pennsylvania, March 25, 1963; Wisconsin, March 26, 1963; Kansas, March 28, 1963; Massachusetts, March 28, 1963; Nebraska, April 4, 1963; Florida, April 18, 1963; Iowa, April 24, 1963; Delaware, May 1, 1963; Missouri, May 13, 1963; New Hampshire, June 16, 1963; Kentucky, June 27, 1963; Maine, January 16, 1964; South Dakota, January 23, 1964.

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AMENDMENT [XXV.] [17]

SECTION 1. In case of the removal of the President from office or of his death or resignation, the Vice President shall become President.

SECTION 2. Whenever there is a vacancy in the office of the Vice President, the President shall nominate a Vice President who shall take office upon confirmation by a majority vote of both Houses of Congress.

SECTION 3. Whenever the President transmits to the President *pro tempore* of the Senate and the Speaker of the House of Representatives has written declaration that he is unable to discharge the powers and duties of his office, and until he transmits to them a written declaration to the contrary, such powers and duties shall be discharged by the Vice President as Acting President.

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[17] This Amendment was proposed by the Eighty-ninth Congress by Senate Joint Resolution No. 1, which was approved by the Senate on February 19, 1965, and by the House of Representatives, in amended form, on April 13, 1965. The House of Representatives agreed to a Conference Report on June 30, 1965, and the Senate agreed to the Conference Report on July 6, 1965. It was declared by the Administrator of General Services, on February 23, 1967, to have been ratified.

This Amendment was ratified by the following States:

Nebraska, July 12, 1965; Wisconsin, July 13, 1965; Oklahoma, July 16, 1965; Massachusetts, August 9, 1965; Pennsylvania, August 18, 1965; Kentucky, September 15, 1965; Arizona, September 22, 1965; Michigan, October 5, 1965; Indiana, October 20, 1965; California, October 21, 1965; Arkansas, November 4, 1965; New Jersey, November 29, 1965; Delaware, December 7, 1965; Utah, January 17, 1966; West Virginia, January 20, 1966; Maine, January 24, 1966; Rhode Island, January 28, 1966; Colorado, February 3, 1966; New Mexico, February 3, 1966; Kansas, February 8, 1966; Vermont, February 10, 1966; Alaska, February 18, 1966; Idaho, March 2, 1966; Hawaii, March 3, 1966; Virginia, March 8, 1966; Mississippi, March 10, 1966; New York, March 14, 1966; Maryland, March 23, 1966; Missouri, March 30, 1966; New Hampshire, June 13, 1966; Louisiana, July 5, 1966; Tennessee, January 12, 1967, Wyoming, January 25, 1967; Washington, January 26, 1967; Iowa, January 26, 1967; Oregon, February 2, 1967; Minnesota, February 10, 1967; Nevada, February 10, 1967; Connecticut, February 14, 1967; Montana, February 15, 1967; South Dakota, March 6, 1967; Ohio, March 7, 1967; Alabama, March 14, 1967; North Carolina, March 22, 1967 Illinois, March 22, 1967; Texas, April 25, 1967; Florida, May 25, 1967.

Publication of the certifying statement of the Administrator of General Services that the Amendment had become valid was made on February 25, 1967, F.R. Doc 67–2208, 32 FED. REG. 3287.

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SECTION 4. Whenever the Vice President and a majority of either the principal officers of the executive departments or of such other body as Congress may by law provide, transmit to the President *pro tempore* of the Senate and the Speaker of the House of Representatives their written declaration that the President is unable to discharge the powers and duties of his office, the Vice President shall immediately assume the powers and duties of the office as Acting President.

Thereafter, when the President transmits to the President pro tempore of the Senate and the Speaker of the House of Representatives has written declaration that no inability exists, he shall resume the powers and duties of his office unless the Vice President and a majority of either the principal officers of the executive department or of such other body as Congress may by law provide, transmit within four days to the President *pro tempore* of the Senate and the Speaker of the House of Representatives their written declaration that the President is unable to discharge the powers and duties of his office. Thereupon Congress shall decide the issue, assembling within forty-eight hours for that purpose if not in session. If the Congress, within twenty-one days after receipt of the latter written declaration, or, if Congress is not in session, within twenty-one days after Congress is required to assemble, determines by two-thirds vote of both Houses that the President is unable to discharge the powers and duties of his office, the Vice President shall continue to discharge the same as Acting President; otherwise, the President shall resume the powers and duties of his office.

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AMENDMENT [XXVI.] [18]

SECTION 1. The right of citizens of the United States, who are eighteen years of age or older, to vote shall not be denied or abridged by the United States or any State on account of age.

SECTION 2. The Congress shall have the power to enforce this article by appropriate legislation.

AMENDMENT [XXVII.] [19]

No law varying the compensation for the services of the Senators and Representatives shall take effect, until an election of Representatives shall have intervened.

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[18] The Twenty-sixth Amendment was proposed by Congress on March 23, 1971, upon passage by the House of Representatives, the Senate having previously passed an identical resolution on March 10, 1971. It appears officially in 85 Stat. 825. Ratification was completed on July 1, 1971, when action by the legislature of the 38th State, North Carolina, was concluded, and the Administrator of the General Services Administration officially certified it to have been duly ratified on July 5, 1971. 36 FED. REG. 12725.

As of the publication of this volume, 42 States had ratified this Amendment:

Connecticut, March 23, 1971; Delaware, March 23, 1971; Minnesota, March 23, 1971; Tennessee, March 23, 1971; Washington, March 23, 1971; Hawaii, March 24, 1971; Massachusetts, March 24, 1971; Montana, March 29, 1971; Arkansas, March 30, 1971; Idaho, March 30, 1971; Iowa, March 30, 1971; Nebraska, April 2, 1971; New Jersey, April 3, 1971; Kansas, April 7, 1971; Michigan, April 7, 1971; Alaska, April 8, 1971; Maryland, April 8, 1971; Indiana, April 8, 1971; Maine, April 9, 1971; Vermont, April 16, 1971; Louisiana, April 17, 1971; California, April 19, 1971; Colorado, April 27, 1971; Pennsylvania, April 27, 1971; Texas, April 27, 1971; South Carolina, April 28, 1971; West Virginia, April 28, 1971; New Hampshire, May 13, 1971; Arizona, May 14, 1971; Rhode Island, May 27, 1971; New York, June 2, 1971; Oregon, June 4, 1971; Missouri, June 14, 1971; Wisconsin, June 22, 1971; Illinois, June 29, 1971; Alabama, June 30, 1971; Ohio, June 30, 1971; North Carolina, July 1, 1971; Oklahoma, July 1, 1971; Virginia, July 8, 1971; Wyoming, July 8, 1971; Georgia, October 4, 1971.

[19] This purported amendment was proposed by Congress on September 25, 1789, when it passed the Senate, having previously passed the House on September 24. (1 ANNALS OF CONGRESS 88, 913). It appears officially in 1 Stat. 97. Having received in 1789–1791 only six state ratifications, the proposal then failed of ratification while ten of the 12 sent to the States by Congress were ratified and proclaimed and became the Bill of Rights. The provision was proclaimed as having been ratified and having become the 27th Amendment, when Michigan ratified on May 7, 1992, there being 50 States in the Union. Proclamation was by the Archivist of the United States, pursuant to 1 U.S.C. § 106b, on May 19, 1992. F.R.Doc. 92–11951, 57 FED. REG. 21187. It was also proclaimed by votes of the Senate and House of Representatives. 138 CONG. REC. (DAILY ED) S 6948–49, H 3505–06.

The several state legislatures ratified the proposal on the following dates: Maryland, December 19, 1789; North Carolina, December 22, 1789; South Carolina, January 19, 1790; Delaware, January 28, 1790; Vermont, November 3, 1791; Virginia, December 15, 1791; Ohio, May 6, 1873; Wyoming, March 6, 1978; Maine, April 27, 1983; Colorado, April 22, 1984; South Dakota, February 1985; New Hampshire, March 7, 1985; Arizona, April 3, 1985; Tennessee, May 28, 1985; Oklahoma, July 10, 1985; New Mexico, February 14, 1986; Indiana, February 24, 1986; Utah, February 25, 1986; Arkansas, March 13, 1987; Montana, March 17, 1987; Connecticut, May 13,

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1987; Wisconsin, July 15, 1987; Georgia, February 2, 1988; West Virginia, March 10, 1988; Louisiana, July 7, 1988; Iowa, February 9, 1989; Idaho, March 23, 1989; Nevada, May 25, 1989; Kansas, April 5, 1990; Florida, May 31, 1990; North Dakota, Mary 25, 1991; Alabama, May 5, 1992; Missouri, May 5, 1992; Michigan, May 7, 1992. New Jersey subsequently ratified on May 7, 1992.

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§ 115.27. Confidentiality of medical records.

All records shall be treated as confidential. Only authorized personnel shall have access to the records. The written authorization of the patient shall be presented and then maintained in the original record as authority for release of medical information outside the hospital.

Notes of Decisions

Assertion of Confidentiality Privilege

Since a hospital owes a duty to limit access to the medical records of its patients, it is proper to consider a claim of physician-patient privilege by a hospital when its medical records are subpoenaed, even though such right or privilege is ordinarily properly asserted only by the patient. *In re June 1979 Allegheny County Investigating Grand Jury*, 415 A.2d 73 (Pa. 1980).

Evidence Not Excluded

Blood alcohol test results which were reported to a police officer were not suppressed under the exclusionary rule in that the patient's rights were violated by the nurse who volunteered the information as a private individual, not the police officer. *Commonwealth v. Ellis*, 608 A.2d 1090 (Pa. Super. 1992); appeal denied 620 A.2d 489 (Pa. 1993).

Argument by a defendant, charged with driving under the influence, that medical purposes blood test should have been suppressed by hospital personnel in accordance with confidentiality regulations failed because the regulations governing confidentiality were subject to the exceptions contained in the Motor Vehicle Code which provide that no hospital or medical personnel may refuse to perform or provide the results of a blood alcohol test when requested by a police officer. *Commonwealth v. Hipp*, 551 A.2d 1086 (Pa. Cmwlth. 1988).

Cross References

This section cited in 28 Pa. Code § 115.28 (relating to ownership).

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slightly from the official printed version.

§ 563.9. Confidentiality of medical records.

Records shall be treated as confidential. Only authorized personnel shall have access to the records. The written authorization of the patient shall be presented and then maintained in the original record as authority for release of medical information outside the ASF.

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Syllabus

NOTE: Where it is feasible, a syllabus (headnote) will be released, as is being done in connection with this case, at the time the opinion is issued. The syllabus constitutes no part of the opinion of the Court but has been prepared by the Reporter of Decisions for the convenience of the reader. See *United States* v. *Detroit Timber & Lumber Co.,* 200 U. S. 321, 337.

SUPREME COURT OF THE UNITED STATES

Syllabus

CARPENTER *v.* UNITED STATES

CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE SIXTH CIRCUIT

No. 16–402. Argued November 29, 2017—Decided June 22, 2018

Cell phones perform their wide and growing variety of functions by continuously connecting to a set of radio antennas called "cell sites." Each time a phone connects to a cell site, it generates a time-stamped record known as cell-site location information (CSLI). Wireless carriers collect and store this information for their own business purposes. Here, after the FBI identified the cell phone numbers of several robbery suspects, prosecutors were granted court orders to obtain the suspects' cell phone records under the Stored Communications Act. Wireless carriers produced CSLI for petitioner Timothy Carpenter's phone, and the Government was able to obtain 12,898 location points cataloging Carpenter's movements over 127 days—an average of 101 data points per day. Carpenter moved to suppress the data, arguing that the Government's seizure of the records without obtaining a warrant supported by probable cause violated the Fourth Amendment. The District Court denied the motion, and prosecutors used the records at trial to show that Carpenter's phone was near four of the robbery locations at the time those robberies occurred. Carpenter was convicted. The Sixth Circuit affirmed, holding that Carpenter lacked a reasonable expectation of privacy in the location information collected by the FBI because he had shared that information with his wireless carriers.

Held:

1. The Government's acquisition of Carpenter's cell-site records was a Fourth Amendment search. Pp. 4–18.

(a) The Fourth Amendment protects not only property interests but certain expectations of privacy as well. *Katz* v. *United States,* 389 U. S. 347, 351. Thus, when an individual "seeks to preserve something as private," and his expectation of privacy is "one that society is

prepared to recognize as reasonable," official intrusion into that sphere generally qualifies as a search and requires a warrant supported by probable cause. *Smith* v. *Maryland*, 442 U. S. 735, 740 (internal quotation marks and alterations omitted). The analysis regarding which expectations of privacy are entitled to protection is informed by historical understandings "of what was deemed an unreasonable search and seizure when [the Fourth Amendment] was adopted." *Carroll* v. *United States,* 267 U. S. 132, 149. These Founding-era understandings continue to inform this Court when applying the Fourth Amendment to innovations in surveillance tools. See, *e.g., Kyllo* v. *United States,* 533 U. S. 27. Pp. 4–7.

(b) The digital data at issue—personal location information maintained by a third party—does not fit neatly under existing precedents but lies at the intersection of two lines of cases. One set addresses a person's expectation of privacy in his physical location and movements. See, *e.g., United States* v. *Jones,* 565 U. S. 400 (five Justices concluding that privacy concerns would be raised by GPS tracking). The other addresses a person's expectation of privacy in information voluntarily turned over to third parties. See *United States* v. *Miller,* 425 U. S. 435 (no expectation of privacy in financial records held by a bank), and *Smith,* 442 U. S. 735 (no expectation of privacy in records of dialed telephone numbers conveyed to telephone company). Pp. 7–10.

(c) Tracking a person's past movements through CSLI partakes of many of the qualities of GPS monitoring considered in *Jones*—it is detailed, encyclopedic, and effortlessly compiled. At the same time, however, the fact that the individual continuously reveals his location to his wireless carrier implicates the third-party principle of *Smith* and *Miller*. Given the unique nature of cell-site records, this Court declines to extend *Smith* and *Miller* to cover them. Pp. 10–18.

(1) A majority of the Court has already recognized that individuals have a reasonable expectation of privacy in the whole of their physical movements. Allowing government access to cell-site records—which "hold for many Americans the 'privacies of life,'" *Riley* v. *California*, 573 U. S. ___, ___—contravenes that expectation. In fact, historical cell-site records present even greater privacy concerns than the GPS monitoring considered in *Jones*: They give the Government near perfect surveillance and allow it to travel back in time to retrace a person's whereabouts, subject only to the five-year retention policies of most wireless carriers. The Government contends that CSLI data is less precise than GPS information, but it thought the data accurate enough here to highlight it during closing argument in Carpenter's trial. At any rate, the rule the Court adopts "must take account of more sophisticated systems that are already in use or in

development," *Kyllo*, 533 U. S., at 36, and the accuracy of CSLI is rapidly approaching GPS-level precision. Pp. 12–15.

(2) The Government contends that the third-party doctrine governs this case, because cell-site records, like the records in *Smith* and *Miller*, are "business records," created and maintained by wireless carriers. But there is a world of difference between the limited types of personal information addressed in *Smith* and *Miller* and the exhaustive chronicle of location information casually collected by wireless carriers.

The third-party doctrine partly stems from the notion that an individual has a reduced expectation of privacy in information knowingly shared with another. *Smith* and *Miller*, however, did not rely solely on the act of sharing. They also considered "the nature of the particular documents sought" and limitations on any "legitimate 'expectation of privacy' concerning their contents." *Miller*, 425 U. S., at 442. In mechanically applying the third-party doctrine to this case the Government fails to appreciate the lack of comparable limitations on the revealing nature of CSLI.

Nor does the second rationale for the third-party doctrine—voluntary exposure—hold up when it comes to CSLI. Cell phone location information is not truly "shared" as the term is normally understood. First, cell phones and the services they provide are "such a pervasive and insistent part of daily life" that carrying one is indispensable to participation in modern society. *Riley*, 573 U. S., at ___. Second, a cell phone logs a cell-site record by dint of its operation, without any affirmative act on the user's part beyond powering up. Pp. 15–17.

(d) This decision is narrow. It does not express a view on matters not before the Court; does not disturb the application of *Smith* and *Miller* or call into question conventional surveillance techniques and tools, such as security cameras; does not address other business records that might incidentally reveal location information; and does not consider other collection techniques involving foreign affairs or national security. Pp. 17–18.

2. The Government did not obtain a warrant supported by probable cause before acquiring Carpenter's cell-site records. It acquired those records pursuant to a court order under the Stored Communications Act, which required the Government to show "reasonable grounds" for believing that the records were "relevant and material to an ongoing investigation." 18 U. S. C. §2703(d). That showing falls well short of the probable cause required for a warrant. Consequently, an order issued under §2703(d) is not a permissible mechanism for accessing historical cell-site records. Not all orders compelling the production of documents will require a showing of probable cause. A

Syllabus

warrant is required only in the rare case where the suspect has a legitimate privacy interest in records held by a third party. And even though the Government will generally need a warrant to access CSLI, case-specific exceptions—*e.g.*, exigent circumstances—may support a warrantless search. Pp. 18–22.

819 F. 3d 880, reversed and remanded.

ROBERTS, C. J., delivered the opinion of the Court, in which GINSBURG, BREYER, SOTOMAYOR, and KAGAN, JJ., joined. KENNEDY, J., filed a dissenting opinion, in which THOMAS and ALITO, JJ., joined. THOMAS, J., filed a dissenting opinion. ALITO, J., filed a dissenting opinion, in which THOMAS, J., joined. GORSUCH, J., filed a dissenting opinion.

NOTICE: This opinion is subject to formal revision before publication in the preliminary print of the United States Reports. Readers are requested to notify the Reporter of Decisions, Supreme Court of the United States, Washington, D. C. 20543, of any typographical or other formal errors, in order that corrections may be made before the preliminary print goes to press.

SUPREME COURT OF THE UNITED STATES

No. 16–402

TIMOTHY IVORY CARPENTER, PETITIONER *v.* UNITED STATES

ON WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE SIXTH CIRCUIT

[June 22, 2018]

CHIEF JUSTICE ROBERTS delivered the opinion of the Court.

This case presents the question whether the Government conducts a search under the Fourth Amendment when it accesses historical cell phone records that provide a comprehensive chronicle of the user's past movements.

I

A

There are 396 million cell phone service accounts in the United States—for a Nation of 326 million people. Cell phones perform their wide and growing variety of functions by connecting to a set of radio antennas called "cell sites." Although cell sites are usually mounted on a tower, they can also be found on light posts, flagpoles, church steeples, or the sides of buildings. Cell sites typically have several directional antennas that divide the covered area into sectors.

Cell phones continuously scan their environment looking for the best signal, which generally comes from the closest cell site. Most modern devices, such as smartphones, tap into the wireless network several times

a minute whenever their signal is on, even if the owner is not using one of the phone's features. Each time the phone connects to a cell site, it generates a time-stamped record known as cell-site location information (CSLI). The precision of this information depends on the size of the geographic area covered by the cell site. The greater the concentration of cell sites, the smaller the coverage area. As data usage from cell phones has increased, wireless carriers have installed more cell sites to handle the traffic. That has led to increasingly compact coverage areas, especially in urban areas.

Wireless carriers collect and store CSLI for their own business purposes, including finding weak spots in their network and applying "roaming" charges when another carrier routes data through their cell sites. In addition, wireless carriers often sell aggregated location records to data brokers, without individual identifying information of the sort at issue here. While carriers have long retained CSLI for the start and end of incoming calls, in recent years phone companies have also collected location information from the transmission of text messages and routine data connections. Accordingly, modern cell phones generate increasingly vast amounts of increasingly precise CSLI.

B

In 2011, police officers arrested four men suspected of robbing a series of Radio Shack and (ironically enough) T-Mobile stores in Detroit. One of the men confessed that, over the previous four months, the group (along with a rotating cast of getaway drivers and lookouts) had robbed nine different stores in Michigan and Ohio. The suspect identified 15 accomplices who had participated in the heists and gave the FBI some of their cell phone numbers; the FBI then reviewed his call records to identify additional numbers that he had called around the time of the

robberies.

Based on that information, the prosecutors applied for court orders under the Stored Communications Act to obtain cell phone records for petitioner Timothy Carpenter and several other suspects. That statute, as amended in 1994, permits the Government to compel the disclosure of certain telecommunications records when it "offers specific and articulable facts showing that there are reasonable grounds to believe" that the records sought "are relevant and material to an ongoing criminal investigation." 18 U. S. C. §2703(d). Federal Magistrate Judges issued two orders directing Carpenter's wireless carriers—MetroPCS and Sprint—to disclose "cell/site sector [information] for [Carpenter's] telephone[ ] at call origination and at call termination for incoming and outgoing calls" during the four-month period when the string of robberies occurred. App. to Pet. for Cert. 60a, 72a. The first order sought 152 days of cell-site records from MetroPCS, which produced records spanning 127 days. The second order requested seven days of CSLI from Sprint, which produced two days of records covering the period when Carpenter's phone was "roaming" in northeastern Ohio. Altogether the Government obtained 12,898 location points cataloging Carpenter's movements—an average of 101 data points per day.

Carpenter was charged with six counts of robbery and an additional six counts of carrying a firearm during a federal crime of violence. See 18 U. S. C. §§924(c), 1951(a). Prior to trial, Carpenter moved to suppress the cell-site data provided by the wireless carriers. He argued that the Government's seizure of the records violated the Fourth Amendment because they had been obtained without a warrant supported by probable cause. The District Court denied the motion. App. to Pet. for Cert. 38a–39a.

At trial, seven of Carpenter's confederates pegged him as the leader of the operation. In addition, FBI agent Christopher Hess offered expert testimony about the cell-

site data. Hess explained that each time a cell phone taps into the wireless network, the carrier logs a time-stamped record of the cell site and particular sector that were used. With this information, Hess produced maps that placed Carpenter's phone near four of the charged robberies. In the Government's view, the location records clinched the case: They confirmed that Carpenter was "right where the . . . robbery was at the exact time of the robbery." App. 131 (closing argument). Carpenter was convicted on all but one of the firearm counts and sentenced to more than 100 years in prison.

The Court of Appeals for the Sixth Circuit affirmed. 819 F. 3d 880 (2016). The court held that Carpenter lacked a reasonable expectation of privacy in the location information collected by the FBI because he had shared that information with his wireless carriers. Given that cell phone users voluntarily convey cell-site data to their carriers as "a means of establishing communication," the court concluded that the resulting business records are not entitled to Fourth Amendment protection. *Id.,* at 888 (quoting *Smith* v. *Maryland*, 442 U. S. 735, 741 (1979)).

We granted certiorari. 582 U. S. ___ (2017).

II

A

The Fourth Amendment protects "[t]he right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures." The "basic purpose of this Amendment," our cases have recognized, "is to safeguard the privacy and security of individuals against arbitrary invasions by governmental officials." *Camara* v. *Municipal Court of City and County of San Francisco*, 387 U. S. 523, 528 (1967). The Founding generation crafted the Fourth Amendment as a "response to the reviled 'general warrants' and 'writs of assistance' of the colonial era, which allowed British officers to rum-

mage through homes in an unrestrained search for evidence of criminal activity." *Riley* v. *California*, 573 U. S. ___, ___ (2014) (slip op., at 27). In fact, as John Adams recalled, the patriot James Otis's 1761 speech condemning writs of assistance was "the first act of opposition to the arbitrary claims of Great Britain" and helped spark the Revolution itself. *Id.,* at ___–___ (slip op., at 27–28) (quoting 10 Works of John Adams 248 (C. Adams ed. 1856)).

For much of our history, Fourth Amendment search doctrine was "tied to common-law trespass" and focused on whether the Government "obtains information by physically intruding on a constitutionally protected area." *United States* v. *Jones*, 565 U. S. 400, 405, 406, n. 3 (2012). More recently, the Court has recognized that "property rights are not the sole measure of Fourth Amendment violations." *Soldal* v. *Cook County*, 506 U. S. 56, 64 (1992). In *Katz* v. *United States*, 389 U. S. 347, 351 (1967), we established that "the Fourth Amendment protects people, not places," and expanded our conception of the Amendment to protect certain expectations of privacy as well. When an individual "seeks to preserve something as private," and his expectation of privacy is "one that society is prepared to recognize as reasonable," we have held that official intrusion into that private sphere generally qualifies as a search and requires a warrant supported by probable cause. *Smith*, 442 U. S., at 740 (internal quotation marks and alterations omitted).

Although no single rubric definitively resolves which expectations of privacy are entitled to protection,[1] the

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[1] JUSTICE KENNEDY believes that there is such a rubric—the "property-based concepts" that *Katz* purported to move beyond. *Post,* at 3 (dissenting opinion). But while property rights are often informative, our cases by no means suggest that such an interest is "fundamental" or "dispositive" in determining which expectations of privacy are legitimate. *Post,* at 8–9. JUSTICE THOMAS (and to a large extent JUSTICE GORSUCH) would have us abandon *Katz* and return to an

analysis is informed by historical understandings "of what was deemed an unreasonable search and seizure when [the Fourth Amendment] was adopted." *Carroll* v. *United States*, 267 U. S. 132, 149 (1925). On this score, our cases have recognized some basic guideposts. First, that the Amendment seeks to secure "the privacies of life" against "arbitrary power." *Boyd* v. *United States*, 116 U. S. 616, 630 (1886). Second, and relatedly, that a central aim of the Framers was "to place obstacles in the way of a too permeating police surveillance." *United States* v. *Di Re*, 332 U. S. 581, 595 (1948).

We have kept this attention to Founding-era understandings in mind when applying the Fourth Amendment to innovations in surveillance tools. As technology has enhanced the Government's capacity to encroach upon areas normally guarded from inquisitive eyes, this Court has sought to "assure[ ] preservation of that degree of privacy against government that existed when the Fourth Amendment was adopted." *Kyllo* v. *United States*, 533 U. S. 27, 34 (2001). For that reason, we rejected in *Kyllo* a "mechanical interpretation" of the Fourth Amendment and held that use of a thermal imager to detect heat radiating from the side of the defendant's home was a search. *Id.,* at 35. Because any other conclusion would leave homeowners "at the mercy of advancing technology," we determined that the Government—absent a warrant—could not capitalize on such new sense-enhancing technology to explore

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exclusively property-based approach. *Post,* at 1–2, 17–21 (THOMAS J., dissenting); *post,* at 6–9 (GORSUCH, J., dissenting). *Katz* of course "discredited" the "premise that property interests control," 389 U. S., at 353, and we have repeatedly emphasized that privacy interests do not rise or fall with property rights, see, *e.g., United States* v. *Jones*, 565 U. S. 400, 411 (2012) (refusing to "make trespass the exclusive test"); *Kyllo* v. *United States*, 533 U. S. 27, 32 (2001) ("We have since decoupled violation of a person's Fourth Amendment rights from trespassory violation of his property."). Neither party has asked the Court to reconsider *Katz* in this case.

what was happening within the home. *Ibid.*

Likewise in *Riley*, the Court recognized the "immense storage capacity" of modern cell phones in holding that police officers must generally obtain a warrant before searching the contents of a phone. 573 U. S., at ___ (slip op., at 17). We explained that while the general rule allowing warrantless searches incident to arrest "strikes the appropriate balance in the context of physical objects, neither of its rationales has much force with respect to" the vast store of sensitive information on a cell phone. *Id.*, at ___ (slip op., at 9).

B

The case before us involves the Government's acquisition of wireless carrier cell-site records revealing the location of Carpenter's cell phone whenever it made or received calls. This sort of digital data—personal location information maintained by a third party—does not fit neatly under existing precedents. Instead, requests for cell-site records lie at the intersection of two lines of cases, both of which inform our understanding of the privacy interests at stake.

The first set of cases addresses a person's expectation of privacy in his physical location and movements. In *United States* v. *Knotts*, 460 U. S. 276 (1983), we considered the Government's use of a "beeper" to aid in tracking a vehicle through traffic. Police officers in that case planted a beeper in a container of chloroform before it was purchased by one of Knotts's co-conspirators. The officers (with intermittent aerial assistance) then followed the automobile carrying the container from Minneapolis to Knotts's cabin in Wisconsin, relying on the beeper's signal to help keep the vehicle in view. The Court concluded that the "augment[ed]" visual surveillance did not constitute a search because "[a] person traveling in an automobile on public thoroughfares has no reasonable expectation of

privacy in his movements from one place to another." *Id.,* at 281, 282. Since the movements of the vehicle and its final destination had been "voluntarily conveyed to anyone who wanted to look," Knotts could not assert a privacy interest in the information obtained. *Id.,* at 281.

This Court in *Knotts*, however, was careful to distinguish between the rudimentary tracking facilitated by the beeper and more sweeping modes of surveillance. The Court emphasized the "limited use which the government made of the signals from this particular beeper" during a discrete "automotive journey." *Id.,* at 284, 285. Significantly, the Court reserved the question whether "different constitutional principles may be applicable" if "twenty-four hour surveillance of any citizen of this country [were] possible." *Id.,* at 283–284.

Three decades later, the Court considered more sophisticated surveillance of the sort envisioned in *Knotts* and found that different principles did indeed apply. In *United States* v. *Jones*, FBI agents installed a GPS tracking device on Jones's vehicle and remotely monitored the vehicle's movements for 28 days. The Court decided the case based on the Government's physical trespass of the vehicle. 565 U. S., at 404–405. At the same time, five Justices agreed that related privacy concerns would be raised by, for example, "surreptitiously activating a stolen vehicle detection system" in Jones's car to track Jones himself, or conducting GPS tracking of his cell phone. *Id.*, at 426, 428 (ALITO, J., concurring in judgment); *id.,* at 415 (SOTOMAYOR, J., concurring). Since GPS monitoring of a vehicle tracks "every movement" a person makes in that vehicle, the concurring Justices concluded that "longer term GPS monitoring in investigations of most offenses impinges on expectations of privacy"—regardless whether those movements were disclosed to the public at large. *Id.,* at 430 (opinion of ALITO, J.); *id.,* at 415 (opinion of

SOTOMAYOR, J.).[2]

In a second set of decisions, the Court has drawn a line between what a person keeps to himself and what he shares with others. We have previously held that "a person has no legitimate expectation of privacy in information he voluntarily turns over to third parties." *Smith,* 442 U. S., at 743–744. That remains true "even if the information is revealed on the assumption that it will be used only for a limited purpose." *United States* v. *Miller*, 425 U. S. 435, 443 (1976). As a result, the Government is typically free to obtain such information from the recipient without triggering Fourth Amendment protections.

This third-party doctrine largely traces its roots to *Miller*. While investigating Miller for tax evasion, the Government subpoenaed his banks, seeking several months of canceled checks, deposit slips, and monthly statements. The Court rejected a Fourth Amendment challenge to the records collection. For one, Miller could "assert neither ownership nor possession" of the documents; they were "business records of the banks." *Id.,* at 440. For another, the nature of those records confirmed Miller's limited expectation of privacy, because the checks were "not confidential communications but negotiable instruments to be used in commercial transactions," and the bank statements contained information "exposed to

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[2]JUSTICE KENNEDY argues that this case is in a different category from *Jones* and the dragnet-type practices posited in *Knotts* because the disclosure of the cell-site records was subject to "judicial authorization." *Post*, at 14–16. That line of argument conflates the threshold question whether a "search" has occurred with the separate matter of whether the search was reasonable. The subpoena process set forth in the Stored Communications Act does not determine a target's expectation of privacy. And in any event, neither *Jones* nor *Knotts* purported to resolve the question of what authorization may be required to conduct such electronic surveillance techniques. But see *Jones*, 565 U. S., at 430 (ALITO, J., concurring in judgment) (indicating that longer term GPS tracking may require a warrant).

[bank] employees in the ordinary course of business." *Id.,* at 442. The Court thus concluded that Miller had "take[n] the risk, in revealing his affairs to another, that the information [would] be conveyed by that person to the Government." *Id.,* at 443.

Three years later, *Smith* applied the same principles in the context of information conveyed to a telephone company. The Court ruled that the Government's use of a pen register—a device that recorded the outgoing phone numbers dialed on a landline telephone—was not a search. Noting the pen register's "limited capabilities," the Court "doubt[ed] that people in general entertain any actual expectation of privacy in the numbers they dial." 442 U. S., at 742. Telephone subscribers know, after all, that the numbers are used by the telephone company "for a variety of legitimate business purposes," including routing calls. *Id.,* at 743. And at any rate, the Court explained, such an expectation "is not one that society is prepared to recognize as reasonable." *Ibid.* (internal quotation marks omitted). When Smith placed a call, he "voluntarily conveyed" the dialed numbers to the phone company by "expos[ing] that information to its equipment in the ordinary course of business." *Id.,* at 744 (internal quotation marks omitted). Once again, we held that the defendant "assumed the risk" that the company's records "would be divulged to police." *Id.,* at 745.

III

The question we confront today is how to apply the Fourth Amendment to a new phenomenon: the ability to chronicle a person's past movements through the record of his cell phone signals. Such tracking partakes of many of the qualities of the GPS monitoring we considered in *Jones*. Much like GPS tracking of a vehicle, cell phone location information is detailed, encyclopedic, and effortlessly compiled.

At the same time, the fact that the individual continuously reveals his location to his wireless carrier implicates the third-party principle of *Smith* and *Miller*. But while the third-party doctrine applies to telephone numbers and bank records, it is not clear whether its logic extends to the qualitatively different category of cell-site records. After all, when *Smith* was decided in 1979, few could have imagined a society in which a phone goes wherever its owner goes, conveying to the wireless carrier not just dialed digits, but a detailed and comprehensive record of the person's movements.

We decline to extend *Smith* and *Miller* to cover these novel circumstances. Given the unique nature of cell phone location records, the fact that the information is held by a third party does not by itself overcome the user's claim to Fourth Amendment protection. Whether the Government employs its own surveillance technology as in *Jones* or leverages the technology of a wireless carrier, we hold that an individual maintains a legitimate expectation of privacy in the record of his physical movements as captured through CSLI. The location information obtained from Carpenter's wireless carriers was the product of a search.[3]

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[3]The parties suggest as an alternative to their primary submissions that the acquisition of CSLI becomes a search only if it extends beyond a limited period. See Reply Brief 12 (proposing a 24-hour cutoff); Brief for United States 55–56 (suggesting a seven-day cutoff). As part of its argument, the Government treats the seven days of CSLI requested from Sprint as the pertinent period, even though Sprint produced only two days of records. Brief for United States 56. Contrary to JUSTICE KENNEDY's assertion, *post,* at 19, we need not decide whether there is a limited period for which the Government may obtain an individual's historical CSLI free from Fourth Amendment scrutiny, and if so, how long that period might be. It is sufficient for our purposes today to hold that accessing seven days of CSLI constitutes a Fourth Amendment search.

A

A person does not surrender all Fourth Amendment protection by venturing into the public sphere. To the contrary, "what [one] seeks to preserve as private, even in an area accessible to the public, may be constitutionally protected." *Katz*, 389 U. S., at 351–352. A majority of this Court has already recognized that individuals have a reasonable expectation of privacy in the whole of their physical movements. *Jones*, 565 U. S., at 430 (ALITO, J., concurring in judgment); *id.,* at 415 (SOTOMAYOR, J., concurring). Prior to the digital age, law enforcement might have pursued a suspect for a brief stretch, but doing so "for any extended period of time was difficult and costly and therefore rarely undertaken." *Id.,* at 429 (opinion of ALITO, J.). For that reason, "society's expectation has been that law enforcement agents and others would not—and indeed, in the main, simply could not—secretly monitor and catalogue every single movement of an individual's car for a very long period." *Id.*, at 430.

Allowing government access to cell-site records contravenes that expectation. Although such records are generated for commercial purposes, that distinction does not negate Carpenter's anticipation of privacy in his physical location. Mapping a cell phone's location over the course of 127 days provides an all-encompassing record of the holder's whereabouts. As with GPS information, the time-stamped data provides an intimate window into a person's life, revealing not only his particular movements, but through them his "familial, political, professional, religious, and sexual associations." *Id.,* at 415 (opinion of SOTOMAYOR, J.). These location records "hold for many Americans the 'privacies of life.'" *Riley*, 573 U. S., at ___ (slip op., at 28) (quoting *Boyd*, 116 U. S., at 630). And like GPS monitoring, cell phone tracking is remarkably easy, cheap, and efficient compared to traditional investigative tools. With just the click of a button, the Government can

access each carrier's deep repository of historical location information at practically no expense.

In fact, historical cell-site records present even greater privacy concerns than the GPS monitoring of a vehicle we considered in *Jones*. Unlike the bugged container in *Knotts* or the car in *Jones*, a cell phone—almost a "feature of human anatomy," *Riley*, 573 U. S., at ___ (slip op., at 9)—tracks nearly exactly the movements of its owner. While individuals regularly leave their vehicles, they compulsively carry cell phones with them all the time. A cell phone faithfully follows its owner beyond public thoroughfares and into private residences, doctor's offices, political headquarters, and other potentially revealing locales. See *id.*, at ___ (slip op., at 19) (noting that "nearly three-quarters of smart phone users report being within five feet of their phones most of the time, with 12% admitting that they even use their phones in the shower"); contrast *Cardwell* v. *Lewis*, 417 U. S. 583, 590 (1974) (plurality opinion) ("A car has little capacity for escaping public scrutiny."). Accordingly, when the Government tracks the location of a cell phone it achieves near perfect surveillance, as if it had attached an ankle monitor to the phone's user.

Moreover, the retrospective quality of the data here gives police access to a category of information otherwise unknowable. In the past, attempts to reconstruct a person's movements were limited by a dearth of records and the frailties of recollection. With access to CSLI, the Government can now travel back in time to retrace a person's whereabouts, subject only to the retention polices of the wireless carriers, which currently maintain records for up to five years. Critically, because location information is continually logged for all of the 400 million devices in the United States—not just those belonging to persons who might happen to come under investigation—this newfound tracking capacity runs against everyone.

Unlike with the GPS device in *Jones*, police need not even know in advance whether they want to follow a particular individual, or when.

Whoever the suspect turns out to be, he has effectively been tailed every moment of every day for five years, and the police may—in the Government's view—call upon the results of that surveillance without regard to the constraints of the Fourth Amendment. Only the few without cell phones could escape this tireless and absolute surveillance.

The Government and JUSTICE KENNEDY contend, however, that the collection of CSLI should be permitted because the data is less precise than GPS information. Not to worry, they maintain, because the location records did "not on their own suffice to place [Carpenter] at the crime scene"; they placed him within a wedge-shaped sector ranging from one-eighth to four square miles. Brief for United States 24; see *post,* at 18–19. Yet the Court has already rejected the proposition that "inference insulates a search." *Kyllo*, 533 U. S., at 36. From the 127 days of location data it received, the Government could, in combination with other information, deduce a detailed log of Carpenter's movements, including when he was at the site of the robberies. And the Government thought the CSLI accurate enough to highlight it during the closing argument of his trial. App. 131.

At any rate, the rule the Court adopts "must take account of more sophisticated systems that are already in use or in development." *Kyllo*, 533 U. S., at 36. While the records in this case reflect the state of technology at the start of the decade, the accuracy of CSLI is rapidly approaching GPS-level precision. As the number of cell sites has proliferated, the geographic area covered by each cell sector has shrunk, particularly in urban areas. In addition, with new technology measuring the time and angle of signals hitting their towers, wireless carriers already have

the capability to pinpoint a phone's location within 50 meters. Brief for Electronic Frontier Foundation et al. as *Amici Curiae* 12 (describing triangulation methods that estimate a device's location inside a given cell sector).

Accordingly, when the Government accessed CSLI from the wireless carriers, it invaded Carpenter's reasonable expectation of privacy in the whole of his physical movements.

B

The Government's primary contention to the contrary is that the third-party doctrine governs this case. In its view, cell-site records are fair game because they are "business records" created and maintained by the wireless carriers. The Government (along with JUSTICE KENNEDY) recognizes that this case features new technology, but asserts that the legal question nonetheless turns on a garden-variety request for information from a third-party witness. Brief for United States 32–34; *post,* at 12–14.

The Government's position fails to contend with the seismic shifts in digital technology that made possible the tracking of not only Carpenter's location but also everyone else's, not for a short period but for years and years. Sprint Corporation and its competitors are not your typical witnesses. Unlike the nosy neighbor who keeps an eye on comings and goings, they are ever alert, and their memory is nearly infallible. There is a world of difference between the limited types of personal information addressed in *Smith* and *Miller* and the exhaustive chronicle of location information casually collected by wireless carriers today. The Government thus is not asking for a straightforward application of the third-party doctrine, but instead a significant extension of it to a distinct category of information.

The third-party doctrine partly stems from the notion that an individual has a reduced expectation of privacy in

information knowingly shared with another. But the fact of "diminished privacy interests does not mean that the Fourth Amendment falls out of the picture entirely." *Riley*, 573 U. S., at ___ (slip op., at 16). *Smith* and *Miller*, after all, did not rely solely on the act of sharing. Instead, they considered "the nature of the particular documents sought" to determine whether "there is a legitimate 'expectation of privacy' concerning their contents." *Miller*, 425 U. S., at 442. *Smith* pointed out the limited capabilities of a pen register; as explained in *Riley*, telephone call logs reveal little in the way of "identifying information." *Smith*, 442 U. S., at 742; *Riley*, 573 U. S., at ___ (slip op., at 24). *Miller* likewise noted that checks were "not confidential communications but negotiable instruments to be used in commercial transactions." 425 U. S., at 442. In mechanically applying the third-party doctrine to this case, the Government fails to appreciate that there are no comparable limitations on the revealing nature of CSLI.

The Court has in fact already shown special solicitude for location information in the third-party context. In *Knotts*, the Court relied on *Smith* to hold that an individual has no reasonable expectation of privacy in public movements that he "voluntarily conveyed to anyone who wanted to look." *Knotts*, 460 U. S., at 281; see *id.*, at 283 (discussing *Smith*). But when confronted with more pervasive tracking, five Justices agreed that longer term GPS monitoring of even a vehicle traveling on public streets constitutes a search. *Jones*, 565 U. S., at 430 (ALITO, J., concurring in judgment); *id.*, at 415 (SOTOMAYOR, J., concurring). JUSTICE GORSUCH wonders why "someone's location when using a phone" is sensitive, *post,* at 3, and JUSTICE KENNEDY assumes that a person's discrete movements "are not particularly private," *post,* at 17. Yet this case is not about "using a phone" or a person's movement at a particular time. It is about a detailed chronicle of a person's physical presence compiled every day, every

moment, over several years. Such a chronicle implicates privacy concerns far beyond those considered in *Smith* and *Miller*.

Neither does the second rationale underlying the third-party doctrine—voluntary exposure—hold up when it comes to CSLI. Cell phone location information is not truly "shared" as one normally understands the term. In the first place, cell phones and the services they provide are "such a pervasive and insistent part of daily life" that carrying one is indispensable to participation in modern society. *Riley*, 573 U. S., at ___ (slip op., at 9). Second, a cell phone logs a cell-site record by dint of its operation, without any affirmative act on the part of the user beyond powering up. Virtually any activity on the phone generates CSLI, including incoming calls, texts, or e-mails and countless other data connections that a phone automatically makes when checking for news, weather, or social media updates. Apart from disconnecting the phone from the network, there is no way to avoid leaving behind a trail of location data. As a result, in no meaningful sense does the user voluntarily "assume[] the risk" of turning over a comprehensive dossier of his physical movements. *Smith*, 442 U. S., at 745.

We therefore decline to extend *Smith* and *Miller* to the collection of CSLI. Given the unique nature of cell phone location information, the fact that the Government obtained the information from a third party does not overcome Carpenter's claim to Fourth Amendment protection. The Government's acquisition of the cell-site records was a search within the meaning of the Fourth Amendment.

* * *

Our decision today is a narrow one. We do not express a view on matters not before us: real-time CSLI or "tower dumps" (a download of information on all the devices that connected to a particular cell site during a particular

interval). We do not disturb the application of *Smith* and *Miller* or call into question conventional surveillance techniques and tools, such as security cameras. Nor do we address other business records that might incidentally reveal location information. Further, our opinion does not consider other collection techniques involving foreign affairs or national security. As Justice Frankfurter noted when considering new innovations in airplanes and radios, the Court must tread carefully in such cases, to ensure that we do not "embarrass the future." *Northwest Airlines, Inc.* v. *Minnesota*, 322 U. S. 292, 300 (1944).[4]

IV

Having found that the acquisition of Carpenter's CSLI was a search, we also conclude that the Government must generally obtain a warrant supported by probable cause before acquiring such records. Although the "ultimate measure of the constitutionality of a governmental search is 'reasonableness,'" our cases establish that warrantless searches are typically unreasonable where "a search is undertaken by law enforcement officials to discover evidence of criminal wrongdoing." *Vernonia School Dist. 47J* v. *Acton*, 515 U. S. 646, 652–653 (1995). Thus, "[i]n the absence of a warrant, a search is reasonable only if it falls within a specific exception to the warrant requirement." *Riley*, 573 U. S., at ___ (slip op., at 5).

The Government acquired the cell-site records pursuant to a court order issued under the Stored Communications Act, which required the Government to show "reasonable grounds" for believing that the records were "relevant and

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[4] JUSTICE GORSUCH faults us for not promulgating a complete code addressing the manifold situations that may be presented by this new technology—under a constitutional provision turning on what is "reasonable," no less. *Post,* at 10–12. Like JUSTICE GORSUCH, we "do not begin to claim all the answers today," *post,* at 13, and therefore decide no more than the case before us.

material to an ongoing investigation." 18 U. S. C. §2703(d). That showing falls well short of the probable cause required for a warrant. The Court usually requires "some quantum of individualized suspicion" before a search or seizure may take place. *United States* v. *Martinez-Fuerte*, 428 U. S. 543, 560–561 (1976). Under the standard in the Stored Communications Act, however, law enforcement need only show that the cell-site evidence might be pertinent to an ongoing investigation—a "gigantic" departure from the probable cause rule, as the Government explained below. App. 34. Consequently, an order issued under Section 2703(d) of the Act is not a permissible mechanism for accessing historical cell-site records. Before compelling a wireless carrier to turn over a subscriber's CSLI, the Government's obligation is a familiar one—get a warrant.

JUSTICE ALITO contends that the warrant requirement simply does not apply when the Government acquires records using compulsory process. Unlike an actual search, he says, subpoenas for documents do not involve the direct taking of evidence; they are at most a "constructive search" conducted by the target of the subpoena. *Post,* at 12. Given this lesser intrusion on personal privacy, JUSTICE ALITO argues that the compulsory production of records is not held to the same probable cause standard. In his view, this Court's precedents set forth a categorical rule—separate and distinct from the third-party doctrine—subjecting subpoenas to lenient scrutiny without regard to the suspect's expectation of privacy in the records. *Post,* at 8–19.

But this Court has never held that the Government may subpoena third parties for records in which the suspect has a reasonable expectation of privacy. Almost all of the examples JUSTICE ALITO cites, see *post,* at 14–15, contemplated requests for evidence implicating diminished pri-

vacy interests or for a corporation's own books.[5] The lone exception, of course, is *Miller*, where the Court's analysis of the third-party subpoena merged with the application of the third-party doctrine. 425 U. S., at 444 (concluding that Miller lacked the necessary privacy interest to contest the issuance of a subpoena to his bank).

JUSTICE ALITO overlooks the critical issue. At some point, the dissent should recognize that CSLI is an entirely different species of business record—something that implicates basic Fourth Amendment concerns about arbitrary government power much more directly than corporate tax or payroll ledgers. When confronting new concerns wrought by digital technology, this Court has been careful not to uncritically extend existing precedents. See *Riley*, 573 U. S., at ___ (slip op., at 10) ("A search of the information on a cell phone bears little resemblance to the type of brief physical search considered [in prior precedents].").

If the choice to proceed by subpoena provided a categorical limitation on Fourth Amendment protection, no type of record would ever be protected by the warrant requirement. Under JUSTICE ALITO's view, private letters, digital contents of a cell phone—any personal information reduced to document form, in fact—may be collected by

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[5] See *United States* v. *Dionisio*, 410 U. S. 1, 14 (1973) ("No person can have a reasonable expectation that others will not know the sound of his voice"); *Donovan* v. *Lone Steer, Inc.*, 464 U. S. 408, 411, 415 (1984) (payroll and sales records); *California Bankers Assn.* v. *Shultz*, 416 U. S. 21, 67 (1974) (Bank Secrecy Act reporting requirements); *See* v. *Seattle*, 387 U. S. 541, 544 (1967) (financial books and records); *United States* v. *Powell*, 379 U. S. 48, 49, 57 (1964) (corporate tax records); *McPhaul* v. *United States*, 364 U. S. 372, 374, 382 (1960) (books and records of an organization); *United States* v. *Morton Salt Co.*, 338 U. S. 632, 634, 651–653 (1950) (Federal Trade Commission reporting requirement); *Oklahoma Press Publishing Co.* v. *Walling*, 327 U. S. 186, 189, 204–208 (1946) (payroll records); *Hale* v. *Henkel*, 201 U. S. 43, 45, 75 (1906) (corporate books and papers).

subpoena for no reason other than "official curiosity." *United States* v. *Morton Salt Co.*, 338 U. S. 632, 652 (1950). JUSTICE KENNEDY declines to adopt the radical implications of this theory, leaving open the question whether the warrant requirement applies "when the Government obtains the modern-day equivalents of an individual's own 'papers' or 'effects,' even when those papers or effects are held by a third party." *Post,* at 13 (citing *United States* v. *Warshak*, 631 F. 3d 266, 283–288 (CA6 2010)). That would be a sensible exception, because it would prevent the subpoena doctrine from overcoming any reasonable expectation of privacy. If the third-party doctrine does not apply to the "modern-day equivalents of an individual's own 'papers' or 'effects,'" then the clear implication is that the documents should receive full Fourth Amendment protection. We simply think that such protection should extend as well to a detailed log of a person's movements over several years.

This is certainly not to say that all orders compelling the production of documents will require a showing of probable cause. The Government will be able to use subpoenas to acquire records in the overwhelming majority of investigations. We hold only that a warrant is required in the rare case where the suspect has a legitimate privacy interest in records held by a third party.

Further, even though the Government will generally need a warrant to access CSLI, case-specific exceptions may support a warrantless search of an individual's cell-site records under certain circumstances. "One well-recognized exception applies when '"the exigencies of the situation" make the needs of law enforcement so compelling that [a] warrantless search is objectively reasonable under the Fourth Amendment.'" *Kentucky* v. *King*, 563 U. S. 452, 460 (2011) (quoting *Mincey* v. *Arizona*, 437 U. S. 385, 394 (1978)). Such exigencies include the need to pursue a fleeing suspect, protect individuals who are

threatened with imminent harm, or prevent the imminent destruction of evidence. 563 U. S., at 460, and n. 3.

As a result, if law enforcement is confronted with an urgent situation, such fact-specific threats will likely justify the warrantless collection of CSLI. Lower courts, for instance, have approved warrantless searches related to bomb threats, active shootings, and child abductions. Our decision today does not call into doubt warrantless access to CSLI in such circumstances. While police must get a warrant when collecting CSLI to assist in the mine-run criminal investigation, the rule we set forth does not limit their ability to respond to an ongoing emergency.

* * *

As Justice Brandeis explained in his famous dissent, the Court is obligated—as "[s]ubtler and more far-reaching means of invading privacy have become available to the Government"—to ensure that the "progress of science" does not erode Fourth Amendment protections. *Olmstead* v. *United States*, 277 U. S. 438, 473–474 (1928). Here the progress of science has afforded law enforcement a powerful new tool to carry out its important responsibilities. At the same time, this tool risks Government encroachment of the sort the Framers, "after consulting the lessons of history," drafted the Fourth Amendment to prevent. *Di Re*, 332 U. S., at 595.

We decline to grant the state unrestricted access to a wireless carrier's database of physical location information. In light of the deeply revealing nature of CSLI, its depth, breadth, and comprehensive reach, and the inescapable and automatic nature of its collection, the fact that such information is gathered by a third party does not make it any less deserving of Fourth Amendment protection. The Government's acquisition of the cell-site records here was a search under that Amendment.

The judgment of the Court of Appeals is reversed, and

the case is remanded for further proceedings consistent with this opinion.

It is so ordered.

SUPREME COURT OF THE UNITED STATES

No. 16–402

TIMOTHY IVORY CARPENTER, PETITIONER *v.* UNITED STATES

ON WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE SIXTH CIRCUIT

[June 22, 2018]

JUSTICE KENNEDY, with whom JUSTICE THOMAS and JUSTICE ALITO join, dissenting.

This case involves new technology, but the Court's stark departure from relevant Fourth Amendment precedents and principles is, in my submission, unnecessary and incorrect, requiring this respectful dissent.

The new rule the Court seems to formulate puts needed, reasonable, accepted, lawful, and congressionally authorized criminal investigations at serious risk in serious cases, often when law enforcement seeks to prevent the threat of violent crimes. And it places undue restrictions on the lawful and necessary enforcement powers exercised not only by the Federal Government, but also by law enforcement in every State and locality throughout the Nation. Adherence to this Court's longstanding precedents and analytic framework would have been the proper and prudent way to resolve this case.

The Court has twice held that individuals have no Fourth Amendment interests in business records which are possessed, owned, and controlled by a third party. *United States* v. *Miller*, 425 U. S. 435 (1976); *Smith* v. *Maryland*, 442 U. S. 735 (1979). This is true even when the records contain personal and sensitive information. So when the Government uses a subpoena to obtain, for example, bank records, telephone records, and credit card

statements from the businesses that create and keep these records, the Government does not engage in a search of the business's customers within the meaning of the Fourth Amendment.

In this case petitioner challenges the Government's right to use compulsory process to obtain a now-common kind of business record: cell-site records held by cell phone service providers. The Government acquired the records through an investigative process enacted by Congress. Upon approval by a neutral magistrate, and based on the Government's duty to show reasonable necessity, it authorizes the disclosure of records and information that are under the control and ownership of the cell phone service provider, not its customer. Petitioner acknowledges that the Government may obtain a wide variety of business records using compulsory process, and he does not ask the Court to revisit its precedents. Yet he argues that, under those same precedents, the Government searched his records when it used court-approved compulsory process to obtain the cell-site information at issue here.

Cell-site records, however, are no different from the many other kinds of business records the Government has a lawful right to obtain by compulsory process. Customers like petitioner do not own, possess, control, or use the records, and for that reason have no reasonable expectation that they cannot be disclosed pursuant to lawful compulsory process.

The Court today disagrees. It holds for the first time that by using compulsory process to obtain records of a business entity, the Government has not just engaged in an impermissible action, but has conducted a search of the business's customer. The Court further concludes that the search in this case was unreasonable and the Government needed to get a warrant to obtain more than six days of cell-site records.

In concluding that the Government engaged in a search,

the Court unhinges Fourth Amendment doctrine from the property-based concepts that have long grounded the analytic framework that pertains in these cases. In doing so it draws an unprincipled and unworkable line between cell-site records on the one hand and financial and telephonic records on the other. According to today's majority opinion, the Government can acquire a record of every credit card purchase and phone call a person makes over months or years without upsetting a legitimate expectation of privacy. But, in the Court's view, the Government crosses a constitutional line when it obtains a court's approval to issue a subpoena for more than six days of cell-site records in order to determine whether a person was within several hundred city blocks of a crime scene. That distinction is illogical and will frustrate principled application of the Fourth Amendment in many routine yet vital law enforcement operations.

It is true that the Cyber Age has vast potential both to expand and restrict individual freedoms in dimensions not contemplated in earlier times. See *Packingham* v. *North Carolina*, 582 U. S. ___, ___–___ (2017) (slip op., at 4–6). For the reasons that follow, however, there is simply no basis here for concluding that the Government interfered with information that the cell phone customer, either from a legal or commonsense standpoint, should have thought the law would deem owned or controlled by him.

I

Before evaluating the question presented it is helpful to understand the nature of cell-site records, how they are commonly used by cell phone service providers, and their proper use by law enforcement.

When a cell phone user makes a call, sends a text message or e-mail, or gains access to the Internet, the cell phone establishes a radio connection to an antenna at a nearby cell site. The typical cell site covers a more-or-less

circular geographic area around the site. It has three (or sometimes six) separate antennas pointing in different directions. Each provides cell service for a different 120-degree (or 60-degree) sector of the cell site's circular coverage area. So a cell phone activated on the north side of a cell site will connect to a different antenna than a cell phone on the south side.

Cell phone service providers create records each time a cell phone connects to an antenna at a cell site. For a phone call, for example, the provider records the date, time, and duration of the call; the phone numbers making and receiving the call; and, most relevant here, the cell site used to make the call, as well as the specific antenna that made the connection. The cell-site and antenna data points, together with the date and time of connection, are known as cell-site location information, or cell-site records. By linking an individual's cell phone to a particular 120- or 60-degree sector of a cell site's coverage area at a particular time, cell-site records reveal the general location of the cell phone user.

The location information revealed by cell-site records is imprecise, because an individual cell-site sector usually covers a large geographic area. The FBI agent who offered expert testimony about the cell-site records at issue here testified that a cell site in a city reaches between a half mile and two miles in all directions. That means a 60-degree sector covers between approximately one-eighth and two square miles (and a 120-degree sector twice that area). To put that in perspective, in urban areas cell-site records often would reveal the location of a cell phone user within an area covering between around a dozen and several hundred city blocks. In rural areas cell-site records can be up to 40 times more imprecise. By contrast, a Global Positioning System (GPS) can reveal an individual's location within around 15 feet.

Major cell phone service providers keep cell-site records

for long periods of time. There is no law requiring them to do so. Instead, providers contract with their customers to collect and keep these records because they are valuable to the providers. Among other things, providers aggregate the records and sell them to third parties along with other information gleaned from cell phone usage. This data can be used, for example, to help a department store determine which of various prospective store locations is likely to get more foot traffic from middle-aged women who live in affluent zip codes. The market for cell phone data is now estimated to be in the billions of dollars. See Brief for Technology Experts as *Amici Curiae* 23.

Cell-site records also can serve an important investigative function, as the facts of this case demonstrate. Petitioner, Timothy Carpenter, along with a rotating group of accomplices, robbed at least six RadioShack and T-Mobile stores at gunpoint over a 2-year period. Five of those robberies occurred in the Detroit area, each crime at least four miles from the last. The sixth took place in Warren, Ohio, over 200 miles from Detroit.

The Government, of course, did not know all of these details in 2011 when it began investigating Carpenter. In April of that year police arrested four of Carpenter's co-conspirators. One of them confessed to committing nine robberies in Michigan and Ohio between December 2010 and March 2011. He identified 15 accomplices who had participated in at least one of those robberies; named Carpenter as one of the accomplices; and provided Carpenter's cell phone number to the authorities. The suspect also warned that the other members of the conspiracy planned to commit more armed robberies in the immediate future.

The Government at this point faced a daunting task. Even if it could identify and apprehend the suspects, still it had to link each suspect in this changing criminal gang to specific robberies in order to bring charges and convict.

And, of course, it was urgent that the Government take all necessary steps to stop the ongoing and dangerous crime spree.

Cell-site records were uniquely suited to this task. The geographic dispersion of the robberies meant that, if Carpenter's cell phone were within even a dozen to several hundred city blocks of one or more of the stores when the different robberies occurred, there would be powerful circumstantial evidence of his participation; and this would be especially so if his cell phone usually was not located in the sectors near the stores except during the robbery times.

To obtain these records, the Government applied to federal magistrate judges for disclosure orders pursuant to §2703(d) of the Stored Communications Act. That Act authorizes a magistrate judge to issue an order requiring disclosure of cell-site records if the Government demonstrates "specific and articulable facts showing that there are reasonable grounds to believe" the records "are relevant and material to an ongoing criminal investigation." 18 U. S. C. §§2703(d), 2711(3). The full statutory provision is set out in the Appendix, *infra*.

From Carpenter's primary service provider, MetroPCS, the Government obtained records from between December 2010 and April 2011, based on its understanding that nine robberies had occurred in that timeframe. The Government also requested seven days of cell-site records from Sprint, spanning the time around the robbery in Warren, Ohio. It obtained two days of records.

These records confirmed that Carpenter's cell phone was in the general vicinity of four of the nine robberies, including the one in Ohio, at the times those robberies occurred.

II

The first Clause of the Fourth Amendment provides that "the right of the people to be secure in their persons, houses,

papers, and effects, against unreasonable searches and seizures, shall not be violated." The customary beginning point in any Fourth Amendment search case is whether the Government's actions constitute a "search" of the defendant's person, house, papers, or effects, within the meaning of the constitutional provision. If so, the next question is whether that search was reasonable.

Here the only question necessary to decide is whether the Government searched anything of Carpenter's when it used compulsory process to obtain cell-site records from Carpenter's cell phone service providers. This Court's decisions in *Miller* and *Smith* dictate that the answer is no, as every Court of Appeals to have considered the question has recognized. See *United States* v. *Thompson*, 866 F. 3d 1149 (CA10 2017); *United States* v. *Graham*, 824 F. 3d 421 (CA4 2016) (en banc); *Carpenter* v. *United States*, 819 F. 3d 880 (CA6 2016); *United States* v. *Davis*, 785 F. 3d 498 (CA11 2015) (en banc); *In re Application of U. S. for Historical Cell Site Data*, 724 F. 3d 600 (CA5 2013).

A

Miller and *Smith* hold that individuals lack any protected Fourth Amendment interests in records that are possessed, owned, and controlled only by a third party. In *Miller* federal law enforcement officers obtained four months of the defendant's banking records. 425 U. S., at 437–438. And in *Smith* state police obtained records of the phone numbers dialed from the defendant's home phone. 442 U. S., at 737. The Court held in both cases that the officers did not search anything belonging to the defendants within the meaning of the Fourth Amendment. The defendants could "assert neither ownership nor possession" of the records because the records were created, owned, and controlled by the companies. *Miller*, *supra*, at 440; see *Smith*, *supra*, at 741. And the defendants had no

reasonable expectation of privacy in information they "voluntarily conveyed to the [companies] and exposed to their employees in the ordinary course of business." *Miller*, *supra*, at 442; see *Smith*, 442 U. S., at 744. Rather, the defendants "assumed the risk that the information would be divulged to police." *Id.*, at 745.

Miller and *Smith* have been criticized as being based on too narrow a view of reasonable expectations of privacy. See, *e.g.,* Ashdown, The Fourth Amendment and the "Legitimate Expectation of Privacy," 34 Vand. L. Rev. 1289, 1313–1316 (1981). Those criticisms, however, are unwarranted. The principle established in *Miller* and *Smith* is correct for two reasons, the first relating to a defendant's attenuated interest in property owned by another, and the second relating to the safeguards inherent in the use of compulsory process.

First, *Miller* and *Smith* placed necessary limits on the ability of individuals to assert Fourth Amendment interests in property to which they lack a "requisite connection." *Minnesota* v. *Carter*, 525 U. S. 83, 99 (1998) (KENNEDY, J., concurring). Fourth Amendment rights, after all, are personal. The Amendment protects "[t]he right of the people to be secure in *their* . . . persons, houses, papers, and effects"—not the persons, houses, papers, and effects of others. (Emphasis added.)

The concept of reasonable expectations of privacy, first announced in *Katz* v. *United States*, 389 U. S. 347 (1967), sought to look beyond the "arcane distinctions developed in property and tort law" in evaluating whether a person has a sufficient connection to the thing or place searched to assert Fourth Amendment interests in it. *Rakas* v. *Illinois*, 439 U. S. 128, 143 (1978). Yet "property concepts" are, nonetheless, fundamental "in determining the presence or absence of the privacy interests protected by that Amendment." *Id.,* at 143–144, n. 12. This is so for at least two reasons. First, as a matter of settled expectations

from the law of property, individuals often have greater expectations of privacy in things and places that belong to them, not to others. And second, the Fourth Amendment's protections must remain tethered to the text of that Amendment, which, again, protects only a person's own "persons, houses, papers, and effects."

Katz did not abandon reliance on property-based concepts. The Court in *Katz* analogized the phone booth used in that case to a friend's apartment, a taxicab, and a hotel room. 389 U. S., at 352, 359. So when the defendant "shu[t] the door behind him" and "pa[id] the toll," *id.,* at 352, he had a temporary interest in the space and a legitimate expectation that others would not intrude, much like the interest a hotel guest has in a hotel room, *Stoner* v. *California*, 376 U. S. 483 (1964), or an overnight guest has in a host's home, *Minnesota* v. *Olson*, 495 U. S. 91 (1990). The Government intruded on that space when it attached a listening device to the phone booth. *Katz*, 389 U. S., at 348. (And even so, the Court made it clear that the Government's search could have been reasonable had there been judicial approval on a case-specific basis, which, of course, did occur here. *Id*., at 357–359.)

Miller and *Smith* set forth an important and necessary limitation on the *Katz* framework. They rest upon the commonsense principle that the absence of property law analogues can be dispositive of privacy expectations. The defendants in those cases could expect that the third-party businesses could use the records the companies collected, stored, and classified as their own for any number of business and commercial purposes. The businesses were not bailees or custodians of the records, with a duty to hold the records for the defendants' use. The defendants could make no argument that the records were their own papers or effects. See *Miller*, *supra*, at 440 ("the documents subpoenaed here are not respondent's 'private papers'"); *Smith*, *supra*, at 741 ("petitioner obviously

cannot claim that his 'property' was invaded"). The records were the business entities' records, plain and simple. The defendants had no reason to believe the records were owned or controlled by them and so could not assert a reasonable expectation of privacy in the records.

The second principle supporting *Miller* and *Smith* is the longstanding rule that the Government may use compulsory process to compel persons to disclose documents and other evidence within their possession and control. See *United States* v. *Nixon*, 418 U. S. 683, 709 (1974) (it is an "ancient proposition of law" that "the public has a right to every man's evidence" (internal quotation marks and alterations omitted)). A subpoena is different from a warrant in its force and intrusive power. While a warrant allows the Government to enter and seize and make the examination itself, a subpoena simply requires the person to whom it is directed to make the disclosure. A subpoena, moreover, provides the recipient the "opportunity to present objections" before complying, which further mitigates the intrusion. *Oklahoma Press Publishing Co.* v. *Walling*, 327 U. S. 186, 195 (1946).

For those reasons this Court has held that a subpoena for records, although a "constructive" search subject to Fourth Amendment constraints, need not comply with the procedures applicable to warrants—even when challenged by the person to whom the records belong. *Id.,* at 202, 208. Rather, a subpoena complies with the Fourth Amendment's reasonableness requirement so long as it is "'sufficiently limited in scope, relevant in purpose, and specific in directive so that compliance will not be unreasonably burdensome.'" *Donovan* v. *Lone Steer, Inc.*, 464 U. S. 408, 415 (1984). Persons with no meaningful interests in the records sought by a subpoena, like the defendants in *Miller* and *Smith*, have no rights to object to the records' disclosure—much less to assert that the Government must obtain a warrant to compel disclosure of the

records. See *Miller*, 425 U. S., at 444–446; *SEC* v. *Jerry T. O'Brien, Inc.*, 467 U. S. 735, 742–743 (1984).

Based on *Miller* and *Smith* and the principles underlying those cases, it is well established that subpoenas may be used to obtain a wide variety of records held by businesses, even when the records contain private information. See 2 W. LaFave, Search and Seizure §4.13 (5th ed. 2012). Credit cards are a prime example. State and federal law enforcement, for instance, often subpoena credit card statements to develop probable cause to prosecute crimes ranging from drug trafficking and distribution to healthcare fraud to tax evasion. See *United States* v. *Phibbs*, 999 F. 2d 1053 (CA6 1993) (drug distribution); *McCune* v. *DOJ*, 592 Fed. Appx. 287 (CA5 2014) (healthcare fraud); *United States* v. *Green*, 305 F. 3d 422 (CA6 2002) (drug trafficking and tax evasion); see also 12 U. S. C. §§3402(4), 3407 (allowing the Government to subpoena financial records if "there is reason to believe that the records sought are relevant to a legitimate law enforcement inquiry"). Subpoenas also may be used to obtain vehicle registration records, hotel records, employment records, and records of utility usage, to name just a few other examples. See 1 LaFave, *supra*, §2.7(c).

And law enforcement officers are not alone in their reliance on subpoenas to obtain business records for legitimate investigations. Subpoenas also are used for investigatory purposes by state and federal grand juries, see *United States* v. *Dionisio*, 410 U. S. 1 (1973), state and federal administrative agencies, see *Oklahoma Press*, *supra*, and state and federal legislative bodies, see *McPhaul* v. *United States*, 364 U. S. 372 (1960).

B

Carpenter does not question these traditional investigative practices. And he does not ask the Court to reconsider *Miller* and *Smith*. Carpenter argues only that, under

Miller and *Smith*, the Government may not use compulsory process to acquire cell-site records from cell phone service providers.

There is no merit in this argument. Cell-site records, like all the examples just discussed, are created, kept, classified, owned, and controlled by cell phone service providers, which aggregate and sell this information to third parties. As in *Miller*, Carpenter can "assert neither ownership nor possession" of the records and has no control over them. 425 U. S., at 440.

Carpenter argues that he has Fourth Amendment interests in the cell-site records because they are in essence his personal papers by operation of 47 U. S. C. §222. That statute imposes certain restrictions on how providers may use "customer proprietary network information"—a term that encompasses cell-site records. §§222(c), (h)(1)(A). The statute in general prohibits providers from disclosing personally identifiable cell-site records to private third parties. §222(c)(1). And it allows customers to request cell-site records from the provider. §222(c)(2).

Carpenter's argument is unpersuasive, however, for §222 does not grant cell phone customers any meaningful interest in cell-site records. The statute's confidentiality protections may be overridden by the interests of the providers or the Government. The providers may disclose the records "to protect the[ir] rights or property" or to "initiate, render, bill, and collect for telecommunications services." §§222(d)(1), (2). They also may disclose the records "as required by law"—which, of course, is how they were disclosed in this case. §222(c)(1). Nor does the statute provide customers any practical control over the records. Customers do not create the records; they have no say in whether or for how long the records are stored; and they cannot require the records to be modified or destroyed. Even their right to request access to the records is limited, for the statute "does not preclude a carrier from

being reimbursed by the customers . . . for the costs associated with making such disclosures." H. R. Rep. No. 104–204, pt. 1, p. 90 (1995). So in every legal and practical sense the "network information" regulated by §222 is, under that statute, "proprietary" to the service providers, not Carpenter. The Court does not argue otherwise.

Because Carpenter lacks a requisite connection to the cell-site records, he also may not claim a reasonable expectation of privacy in them. He could expect that a third party—the cell phone service provider—could use the information it collected, stored, and classified as its own for a variety of business and commercial purposes.

All this is not to say that *Miller* and *Smith* are without limits. *Miller* and *Smith* may not apply when the Government obtains the modern-day equivalents of an individual's own "papers" or "effects," even when those papers or effects are held by a third party. See *Ex parte Jackson*, 96 U. S. 727, 733 (1878) (letters held by mail carrier); *United States* v. *Warshak*, 631 F. 3d 266, 283–288 (CA6 2010) (e-mails held by Internet service provider). As already discussed, however, this case does not involve property or a bailment of that sort. Here the Government's acquisition of cell-site records falls within the heartland of *Miller* and *Smith*.

In fact, Carpenter's Fourth Amendment objection is even weaker than those of the defendants in *Miller* and *Smith*. Here the Government did not use a mere subpoena to obtain the cell-site records. It acquired the records only after it proved to a Magistrate Judge reasonable grounds to believe that the records were relevant and material to an ongoing criminal investigation. See 18 U. S. C. §2703(d). So even if §222 gave Carpenter some attenuated interest in the records, the Government's conduct here would be reasonable under the standards governing subpoenas. See *Donovan*, 464 U. S., at 415.

Under *Miller* and *Smith*, then, a search of the sort that

requires a warrant simply did not occur when the Government used court-approved compulsory process, based on a finding of reasonable necessity, to compel a cell phone service provider, as owner, to disclose cell-site records.

III

The Court rejects a straightforward application of *Miller* and *Smith*. It concludes instead that applying those cases to cell-site records would work a "significant extension" of the principles underlying them, *ante,* at 15, and holds that the acquisition of more than six days of cell-site records constitutes a search, *ante,* at 11, n. 3.

In my respectful view the majority opinion misreads this Court's precedents, old and recent, and transforms *Miller* and *Smith* into an unprincipled and unworkable doctrine. The Court's newly conceived constitutional standard will cause confusion; will undermine traditional and important law enforcement practices; and will allow the cell phone to become a protected medium that dangerous persons will use to commit serious crimes.

A

The Court errs at the outset by attempting to sidestep *Miller* and *Smith*. The Court frames this case as following instead from *United States* v. *Knotts*, 460 U. S. 276 (1983), and *United States* v. *Jones*, 565 U. S. 400 (2012). Those cases, the Court suggests, establish that "individuals have a reasonable expectation of privacy in the whole of their physical movements." *Ante*, at 7–9, 12.

Knotts held just the opposite: "A person traveling in an automobile on public thoroughfares has no reasonable expectation of privacy in his movements from one place to another." 460 U. S., at 281. True, the Court in *Knotts* also suggested that "different constitutional principles may be applicable" to "dragnet-type law enforcement practices." *Id.,* at 284. But by dragnet practices the Court was refer-

ring to "'twenty-four hour surveillance of any citizen of this country . . . without judicial knowledge or supervision.'" *Id.*, at 283.

Those "different constitutional principles" mentioned in *Knotts*, whatever they may be, do not apply in this case. Here the Stored Communications Act requires a neutral judicial officer to confirm in each case that the Government has "reasonable grounds to believe" the cell-site records "are relevant and material to an ongoing criminal investigation." 18 U. S. C. §2703(d). This judicial check mitigates the Court's concerns about "'a too permeating police surveillance.'" *Ante*, at 6 (quoting *United States* v. *Di Re*, 332 U. S. 581, 595 (1948)). Here, even more so than in *Knotts*, "reality hardly suggests abuse." 460 U. S., at 284.

The Court's reliance on *Jones* fares no better. In *Jones* the Government installed a GPS tracking device on the defendant's automobile. The Court held the Government searched the automobile because it "physically occupied private property [of the defendant] for the purpose of obtaining information." 565 U. S., at 404. So in *Jones* it was "not necessary to inquire about the target's expectation of privacy in his vehicle's movements." *Grady* v. *North Carolina*, 575 U. S. ___, ___ (2015) (*per curiam*) (slip op., at 3).

Despite that clear delineation of the Court's holding in *Jones*, the Court today declares that *Jones* applied the "'different constitutional principles'" alluded to in *Knotts* to establish that an individual has an expectation of privacy in the sum of his whereabouts. *Ante*, at 8, 12. For that proposition the majority relies on the two concurring opinions in *Jones*, one of which stated that "longer term GPS monitoring in investigations of most offenses impinges on expectations of privacy." 565 U. S., at 430 (ALITO, J., concurring). But *Jones* involved direct governmental surveillance of a defendant's automobile without judicial

authorization—specifically, GPS surveillance accurate within 50 to 100 feet. *Id.*, at 402–403. Even assuming that the different constitutional principles mentioned in *Knotts* would apply in a case like *Jones*—a proposition the Court was careful not to announce in *Jones*, *supra*, at 412–413—those principles are inapplicable here. Cases like this one, where the Government uses court-approved compulsory process to obtain records owned and controlled by a third party, are governed by the two majority opinions in *Miller* and *Smith*.

B

The Court continues its analysis by misinterpreting *Miller* and *Smith*, and then it reaches the wrong outcome on these facts even under its flawed standard.

The Court appears, in my respectful view, to read *Miller* and *Smith* to establish a balancing test. For each "qualitatively different category" of information, the Court suggests, the privacy interests at stake must be weighed against the fact that the information has been disclosed to a third party. See *ante*, at 11, 15–17. When the privacy interests are weighty enough to "overcome" the third-party disclosure, the Fourth Amendment's protections apply. See *ante*, at 17.

That is an untenable reading of *Miller* and *Smith*. As already discussed, the fact that information was relinquished to a third party was the entire basis for concluding that the defendants in those cases lacked a reasonable expectation of privacy. *Miller* and *Smith* do not establish the kind of category-by-category balancing the Court today prescribes.

But suppose the Court were correct to say that *Miller* and *Smith* rest on so imprecise a foundation. Still the Court errs, in my submission, when it concludes that cell-site records implicate greater privacy interests—and thus deserve greater Fourth Amendment protection—than

financial records and telephone records.

Indeed, the opposite is true. A person's movements are not particularly private. As the Court recognized in *Knotts*, when the defendant there "traveled over the public streets he voluntarily conveyed to anyone who wanted to look the fact that he was traveling over particular roads in a particular direction, the fact of whatever stops he made, and the fact of his final destination." 460 U. S., at 281–282. Today expectations of privacy in one's location are, if anything, even less reasonable than when the Court decided *Knotts* over 30 years ago. Millions of Americans choose to share their location on a daily basis, whether by using a variety of location-based services on their phones, or by sharing their location with friends and the public at large via social media.

And cell-site records, as already discussed, disclose a person's location only in a general area. The records at issue here, for example, revealed Carpenter's location within an area covering between around a dozen and several hundred city blocks. "Areas of this scale might encompass bridal stores and Bass Pro Shops, gay bars and straight ones, a Methodist church and the local mosque." 819 F. 3d 880, 889 (CA6 2016). These records could not reveal where Carpenter lives and works, much less his "'familial, political, professional, religious, and sexual associations.'" *Ante*, at 12 (quoting *Jones*, *supra*, at 415 (SOTOMAYOR, J., concurring)).

By contrast, financial records and telephone records do "'revea[l] . . . personal affairs, opinions, habits and associations.'" *Miller*, 425 U. S., at 451 (Brennan, J., dissenting); see *Smith*, 442 U. S., at 751 (Marshall, J., dissenting). What persons purchase and to whom they talk might disclose how much money they make; the political and religious organizations to which they donate; whether they have visited a psychiatrist, plastic surgeon, abortion clinic, or AIDS treatment center; whether they go to gay bars or

straight ones; and who are their closest friends and family members. The troves of intimate information the Government can and does obtain using financial records and telephone records dwarfs what can be gathered from cell-site records.

Still, the Court maintains, cell-site records are "unique" because they are "comprehensive" in their reach; allow for retrospective collection; are "easy, cheap, and efficient compared to traditional investigative tools"; and are not exposed to cell phone service providers in a meaningfully voluntary manner. *Ante*, at 11–13, 17, 22. But many other kinds of business records can be so described. Financial records are of vast scope. Banks and credit card companies keep a comprehensive account of almost every transaction an individual makes on a daily basis. "With just the click of a button, the Government can access each [company's] deep repository of historical [financial] information at practically no expense." *Ante*, at 12–13. And the decision whether to transact with banks and credit card companies is no more or less voluntary than the decision whether to use a cell phone. Today, just as when *Miller* was decided, "'it is impossible to participate in the economic life of contemporary society without maintaining a bank account.'" 425 U. S., at 451 (Brennan, J., dissenting). But this Court, nevertheless, has held that individuals do not have a reasonable expectation of privacy in financial records.

Perhaps recognizing the difficulty of drawing the constitutional line between cell-site records and financial and telephonic records, the Court posits that the accuracy of cell-site records "is rapidly approaching GPS-level precision." *Ante*, at 14. That is certainly plausible in the era of cyber technology, yet the privacy interests associated with location information, which is often disclosed to the public at large, still would not outweigh the privacy interests implicated by financial and telephonic records.

Perhaps more important, those future developments are no basis upon which to resolve this case. In general, the Court "risks error by elaborating too fully on the Fourth Amendment implications of emerging technology before its role in society has become clear." *Ontario* v. *Quon*, 560 U. S. 746, 759 (2010). That judicial caution, prudent in most cases, is imperative in this one.

Technological changes involving cell phones have complex effects on crime and law enforcement. Cell phones make crimes easier to coordinate and conceal, while also providing the Government with new investigative tools that may have the potential to upset traditional privacy expectations. See Kerr, An Equilibrium-Adjustment Theory of the Fourth Amendment, 125 Harv. L. Rev 476, 512–517 (2011). How those competing effects balance against each other, and how property norms and expectations of privacy form around new technology, often will be difficult to determine during periods of rapid technological change. In those instances, and where the governing legal standard is one of reasonableness, it is wise to defer to legislative judgments like the one embodied in §2703(d) of the Stored Communications Act. See *Jones*, 565 U. S., at 430 (ALITO, J., concurring). In §2703(d) Congress weighed the privacy interests at stake and imposed a judicial check to prevent executive overreach. The Court should be wary of upsetting that legislative balance and erecting constitutional barriers that foreclose further legislative instructions. See *Quon*, *supra*, at 759. The last thing the Court should do is incorporate an arbitrary and outside limit—in this case six days' worth of cell-site records—and use it as the foundation for a new constitutional framework. The Court's decision runs roughshod over the mechanism Congress put in place to govern the acquisition of cell-site records and closes off further legislative debate on these issues.

C

The Court says its decision is a "narrow one." *Ante,* at 17. But its reinterpretation of *Miller* and *Smith* will have dramatic consequences for law enforcement, courts, and society as a whole.

Most immediately, the Court's holding that the Government must get a warrant to obtain more than six days of cell-site records limits the effectiveness of an important investigative tool for solving serious crimes. As this case demonstrates, cell-site records are uniquely suited to help the Government develop probable cause to apprehend some of the Nation's most dangerous criminals: serial killers, rapists, arsonists, robbers, and so forth. See also, *e.g.*, *Davis*, 785 F. 3d, at 500–501 (armed robbers); Brief for Alabama et al. as *Amici Curiae* 21–22 (serial killer). These records often are indispensable at the initial stages of investigations when the Government lacks the evidence necessary to obtain a warrant. See *United States* v. *Pembrook*, 876 F. 3d 812, 816–819 (CA6 2017). And the long-term nature of many serious crimes, including serial crimes and terrorism offenses, can necessitate the use of significantly more than six days of cell-site records. The Court's arbitrary 6-day cutoff has the perverse effect of nullifying Congress' reasonable framework for obtaining cell-site records in some of the most serious criminal investigations.

The Court's decision also will have ramifications that extend beyond cell-site records to other kinds of information held by third parties, yet the Court fails "to provide clear guidance to law enforcement" and courts on key issues raised by its reinterpretation of *Miller* and *Smith*. *Riley* v. *California*, 573 U. S. ___, ___ (2014) (slip op., at 22).

First, the Court's holding is premised on cell-site records being a "distinct category of information" from other busi-

ness records. *Ante*, at 15. But the Court does not explain what makes something a distinct category of information. Whether credit card records are distinct from bank records; whether payment records from digital wallet applications are distinct from either; whether the electronic bank records available today are distinct from the paper and microfilm records at issue in *Miller*; or whether cell-phone call records are distinct from the home-phone call records at issue in *Smith*, are just a few of the difficult questions that require answers under the Court's novel conception of *Miller* and *Smith*.

Second, the majority opinion gives courts and law enforcement officers no indication how to determine whether any particular category of information falls on the financial-records side or the cell-site-records side of its newly conceived constitutional line. The Court's multifactor analysis—considering intimacy, comprehensiveness, expense, retrospectivity, and voluntariness—puts the law on a new and unstable foundation.

Third, even if a distinct category of information is deemed to be more like cell-site records than financial records, courts and law enforcement officers will have to guess how much of that information can be requested before a warrant is required. The Court suggests that less than seven days of location information may not require a warrant. See *ante,* at 11, n. 3; see also *ante,* at 17–18 (expressing no opinion on "real-time CSLI," tower dumps, and security-camera footage). But the Court does not explain why that is so, and nothing in its opinion even alludes to the considerations that should determine whether greater or lesser thresholds should apply to information like IP addresses or website browsing history.

Fourth, by invalidating the Government's use of court-approved compulsory process in this case, the Court calls into question the subpoena practices of federal and state grand juries, legislatures, and other investigative bodies,

as JUSTICE ALITO's opinion explains. See *post,* at 2–19 (dissenting opinion). Yet the Court fails even to mention the serious consequences this will have for the proper administration of justice.

In short, the Court's new and uncharted course will inhibit law enforcement and "keep defendants and judges guessing for years to come." *Riley*, 573 U. S., at ___ (slip op., at 25) (internal quotation marks omitted).

* * *

This case should be resolved by interpreting accepted property principles as the baseline for reasonable expectations of privacy. Here the Government did not search anything over which Carpenter could assert ownership or control. Instead, it issued a court-authorized subpoena to a third party to disclose information it alone owned and controlled. That should suffice to resolve this case.

Having concluded, however, that the Government searched Carpenter when it obtained cell-site records from his cell phone service providers, the proper resolution of this case should have been to remand for the Court of Appeals to determine in the first instance whether the search was reasonable. Most courts of appeals, believing themselves bound by *Miller* and *Smith*, have not grappled with this question. And the Court's reflexive imposition of the warrant requirement obscures important and difficult issues, such as the scope of Congress' power to authorize the Government to collect new forms of information using processes that deviate from traditional warrant procedures, and how the Fourth Amendment's reasonableness requirement should apply when the Government uses compulsory process instead of engaging in an actual, physical search.

These reasons all lead to this respectful dissent.

APPENDIX

"**§2703. Required disclosure of customer communications or records**

"(d) REQUIREMENTS FOR COURT ORDER.—A court order for disclosure under subsection (b) or (c) may be issued by any court that is a court of competent jurisdiction and shall issue only if the governmental entity offers specific and articulable facts showing that there are reasonable grounds to believe that the contents of a wire or electronic communication, or the records or other information sought, are relevant and material to an ongoing criminal investigation. In the case of a State governmental authority, such a court order shall not issue if prohibited by the law of such State. A court issuing an order pursuant to this section, on a motion made promptly by the service provider, may quash or modify such order, if the information or records requested are unusually voluminous in nature or compliance with such order otherwise would cause an undue burden on such provider."

SUPREME COURT OF THE UNITED STATES

No. 16–402

TIMOTHY IVORY CARPENTER, PETITIONER *v.* UNITED STATES

ON WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE SIXTH CIRCUIT

[June 22, 2018]

JUSTICE THOMAS, dissenting.

This case should not turn on "whether" a search occurred. *Ante,* at 1. It should turn, instead, on *whose* property was searched. The Fourth Amendment guarantees individuals the right to be secure from unreasonable searches of "*their* persons, houses, papers, and effects." (Emphasis added.) In other words, "*each* person has the right to be secure against unreasonable searches . . . in *his own* person, house, papers, and effects." *Minnesota* v. *Carter*, 525 U. S. 83, 92 (1998) (Scalia, J., concurring). By obtaining the cell-site records of MetroPCS and Sprint, the Government did not search Carpenter's property. He did not create the records, he does not maintain them, he cannot control them, and he cannot destroy them. Neither the terms of his contracts nor any provision of law makes the records his. The records belong to MetroPCS and Sprint.

The Court concludes that, although the records are not Carpenter's, the Government must get a warrant because Carpenter had a reasonable "expectation of privacy" in the location information that they reveal. *Ante,* at 11. I agree with JUSTICE KENNEDY, JUSTICE ALITO, JUSTICE GORSUCH, and every Court of Appeals to consider the question that this is not the best reading of our precedents.

The more fundamental problem with the Court's opinion, however, is its use of the "reasonable expectation of privacy" test, which was first articulated by Justice Harlan in *Katz* v. *United States*, 389 U. S. 347, 360–361 (1967) (concurring opinion). The *Katz* test has no basis in the text or history of the Fourth Amendment. And, it invites courts to make judgments about policy, not law. Until we confront the problems with this test, *Katz* will continue to distort Fourth Amendment jurisprudence. I respectfully dissent.

I

Katz was the culmination of a series of decisions applying the Fourth Amendment to electronic eavesdropping. The first such decision was *Olmstead* v. *United States*, 277 U. S. 438 (1928), where federal officers had intercepted the defendants' conversations by tapping telephone lines near their homes. *Id.,* at 456–457. In an opinion by Chief Justice Taft, the Court concluded that this wiretap did not violate the Fourth Amendment. No "search" occurred, according to the Court, because the officers did not physically enter the defendants' homes. *Id.,* at 464–466. And neither the telephone lines nor the defendants' intangible conversations qualified as "persons, houses, papers, [or] effects" within the meaning of the Fourth Amendment. *Ibid.*[1] In the ensuing decades, this Court adhered to

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[1]Justice Brandeis authored the principal dissent in *Olmstead*. He consulted the "underlying purpose," rather than "the words of the [Fourth] Amendment," to conclude that the wiretap was a search. 277 U. S., at 476. In Justice Brandeis' view, the Framers "recognized the significance of man's spiritual nature, of his feelings and of his intellect" and "sought to protect Americans in their beliefs, their thoughts, their emotions and their sensations." *Id.,* at 478. Thus, "every unjustifiable intrusion by the Government upon the privacy of the individual, whatever the means employed," should constitute an unreasonable search under the Fourth Amendment. *Ibid.*

Olmstead and rejected Fourth Amendment challenges to various methods of electronic surveillance. See *On Lee* v. *United States*, 343 U. S. 747, 749–753 (1952) (use of microphone to overhear conversations with confidential informant); *Goldman* v. *United States*, 316 U. S. 129, 131–132, 135–136 (1942) (use of detectaphone to hear conversations in office next door).

In the 1960s, however, the Court began to retreat from *Olmstead*. In *Silverman* v. *United States*, 365 U. S. 505 (1961), for example, federal officers had eavesdropped on the defendants by driving a "spike mike" several inches into the house they were occupying. *Id.,* at 506–507. This was a "search," the Court held, because the "unauthorized physical penetration into the premises" was an "actual intrusion into a constitutionally protected area." *Id.,* at 509, 512. The Court did not mention *Olmstead*'s other holding that intangible conversations are not "persons, houses, papers, [or] effects." That omission was significant. The Court confirmed two years later that "[i]t follows from [*Silverman*] that the Fourth Amendment may protect against the overhearing of verbal statements as well as against the more traditional seizure of 'papers and effects.'" *Wong Sun* v. *United States*, 371 U. S. 471, 485 (1963); accord, *Berger* v. *New York*, 388 U. S. 41, 51 (1967).

In *Katz*, the Court rejected *Olmstead*'s remaining holding—that eavesdropping is not a search absent a physical intrusion into a constitutionally protected area. The federal officers in *Katz* had intercepted the defendant's conversations by attaching an electronic device to the outside of a public telephone booth. 389 U. S., at 348. The Court concluded that this was a "search" because the officers "violated the privacy upon which [the defendant] justifiably relied while using the telephone booth." *Id.,* at 353. Although the device did not physically penetrate the booth, the Court overruled *Olmstead* and held that "the reach of [the Fourth] Amendment cannot turn upon the

presence or absence of a physical intrusion." 389 U. S., at 353. The Court did not explain what should replace *Olmstead*'s physical-intrusion requirement. It simply asserted that "the Fourth Amendment protects people, not places" and "what [a person] seeks to preserve as private . . . may be constitutionally protected." 389 U. S., at 351.

Justice Harlan's concurrence in *Katz* attempted to articulate the standard that was missing from the majority opinion. While Justice Harlan agreed that "'the Fourth Amendment protects people, not places,'" he stressed that "[t]he question . . . is what protection it affords to those people," and "the answer . . . requires reference to a 'place.'" *Id.,* at 361. Justice Harlan identified a "twofold requirement" to determine when the protections of the Fourth Amendment apply: "first that a person have exhibited an actual (subjective) expectation of privacy and, second, that the expectation be one that society is prepared to recognize as 'reasonable.'" *Ibid.*

Justice Harlan did not cite anything for this "expectation of privacy" test, and the parties did not discuss it in their briefs. The test appears to have been presented for the first time at oral argument by one of the defendant's lawyers. See Winn, *Katz* and the Origins of the "Reasonable Expectation of Privacy" Test, 40 McGeorge L. Rev. 1, 9–10 (2009). The lawyer, a recent law-school graduate, apparently had an "[e]piphany" while preparing for oral argument. Schneider, *Katz v. United States*: The Untold Story, 40 McGeorge L. Rev. 13, 18 (2009). He conjectured that, like the "reasonable person" test from his Torts class, the Fourth Amendment should turn on "whether a reasonable person . . . could have expected his communication to be private." *Id.,* at 19. The lawyer presented his new theory to the Court at oral argument. See, *e.g.,* Tr. of Oral Arg. in *Katz* v. *United States*, O. T. 1967, No. 35, p. 5 (proposing a test of "whether or not, objectively speaking, the communication was intended to be private"); *id.,* at 11

("We propose a test using a way that's not too dissimilar from the tort 'reasonable man' test"). After some questioning from the Justices, the lawyer conceded that his test should also require individuals to subjectively expect privacy. See *id.,* at 12. With that modification, Justice Harlan seemed to accept the lawyer's test almost verbatim in his concurrence.

Although the majority opinion in *Katz* had little practical significance after Congress enacted the Omnibus Crime Control and Safe Streets Act of 1968, Justice Harlan's concurrence profoundly changed our Fourth Amendment jurisprudence. It took only one year for the full Court to adopt his two-pronged test. See *Terry* v. *Ohio*, 392 U. S. 1, 10 (1968). And by 1979, the Court was describing Justice Harlan's test as the "lodestar" for determining whether a "search" had occurred. *Smith* v. *Maryland*, 442 U. S. 735, 739 (1979). Over time, the Court minimized the subjective prong of Justice Harlan's test. See Kerr, *Katz* Has Only One Step: The Irrelevance of Subjective Expectations, 82 U. Chi. L. Rev. 113 (2015). That left the objective prong—the "reasonable expectation of privacy" test that the Court still applies today. See *ante,* at 5; *United States* v. *Jones*, 565 U. S. 400, 406 (2012).

II

Under the *Katz* test, a "search" occurs whenever "government officers violate a person's 'reasonable expectation of privacy.'" *Jones*, *supra,* at 406. The most glaring problem with this test is that it has "no plausible foundation in the text of the Fourth Amendment." *Carter*, 525 U. S., at 97 (opinion of Scalia, J.). The Fourth Amendment, as relevant here, protects "[t]he right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches." By defining "search" to mean "any violation of a reasonable expectation of pri-

vacy," the *Katz* test misconstrues virtually every one of these words.

A

The *Katz* test distorts the original meaning of "searc[h]"—the word in the Fourth Amendment that it purports to define, see *ante*, at 5; *Smith*, *supra*. Under the *Katz* test, the government conducts a search anytime it violates someone's "reasonable expectation of privacy." That is not a normal definition of the word "search."

At the founding, "search" did not mean a violation of someone's reasonable expectation of privacy. The word was probably not a term of art, as it does not appear in legal dictionaries from the era. And its ordinary meaning was the same as it is today: "'[t]o look over or through for the purpose of finding something; to explore; to examine by inspection; as, to *search* the house for a book; to *search* the wood for a thief.'" *Kyllo* v. *United States*, 533 U. S. 27, 32, n. 1 (2001) (quoting N. Webster, An American Dictionary of the English Language 66 (1828) (reprint 6th ed. 1989)); accord, 2 S. Johnson, A Dictionary of the English Language (5th ed. 1773) ("Inquiry by looking into every suspected place"); N. Bailey, An Universal Etymological English Dictionary (22d ed. 1770) ("a seeking after, a looking for, &c."); 2 J. Ash, The New and Complete Dictionary of the English Language (2d ed. 1795) ("An enquiry, an examination, the act of seeking, an enquiry by looking into every suspected place; a quest; a pursuit"); T. Sheridan, A Complete Dictionary of the English Language (6th ed. 1796) (similar). The word "search" was not associated with "reasonable expectation of privacy" until Justice Harlan coined that phrase in 1967. The phrase "expectation(s) of privacy" does not appear in the pre-*Katz* federal or state case reporters, the papers of prominent

Founders,[2] early congressional documents and debates,[3] collections of early American English texts,[4] or early American newspapers.[5]

B

The *Katz* test strays even further from the text by focusing on the concept of "privacy." The word "privacy" does not appear in the Fourth Amendment (or anywhere else in the Constitution for that matter). Instead, the Fourth Amendment references "[t]he right of the people to be secure." It then qualifies that right by limiting it to "persons" and three specific types of property: "houses, papers, and effects." By connecting the right to be secure to these four specific objects, "[t]he text of the Fourth Amendment reflects its close connection to property." *Jones*, *supra*, at 405. "[P]rivacy," by contrast, "was not part of the political vocabulary of the [founding]. Instead, liberty and privacy rights were understood largely in terms of property rights." Cloud, Property Is Privacy: Locke and Brandeis in the Twenty-First Century, 55 Am. Crim. L. Rev. 37, 42 (2018).

Those who ratified the Fourth Amendment were quite familiar with the notion of security in property. Security in property was a prominent concept in English law. See, *e.g.,* 3 W. Blackstone, Commentaries on the Laws of Eng-

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[2] National Archives, Library of Congress, Founders Online, https://founders.archives.gov (all Internet materials as last visited June 18, 2018).

[3] A Century of Lawmaking For A New Nation, U. S. Congressional Documents and Debates, 1774–1875 (May 1, 2003), https://memory.loc.gov/ammem/amlaw/lawhome.html.

[4] Corpus of Historical American English, https://corpus.byu.edu/coha; Google Books (American), https://googlebooks.byu.edu/x.asp; Corpus of Founding Era American English, https://lawncl.byu.edu/cofea.

[5] Readex, America's Historical Newspapers (2018), https://www.readex.com/content/americas-historical-newspapers.

land 288 (1768) ("[E]very man's house is looked upon by the law to be his castle"); 3 E. Coke, Institutes of Laws of England 162 (6th ed. 1680) ("[F]or a man[']s house is his Castle, & domus sua cuique est tutissimum refugium [each man's home is his safest refuge]"). The political philosophy of John Locke, moreover, "permeated the 18th-century political scene in America." *Obergefell* v. *Hodges*, 576 U. S. ___, ___ (2015) (THOMAS, J., dissenting) (slip op., at 8). For Locke, every individual had a property right "in his own person" and in anything he "removed from the common state [of] Nature" and "mixed his labour with." Second Treatise of Civil Government §27 (1690). Because property is "very unsecure" in the state of nature, §123, individuals form governments to obtain "a secure enjoyment of their properties." §95. Once a government is formed, however, it cannot be given "a power to destroy that which every one designs to secure"; it cannot legitimately "endeavour to take away, and destroy the property of the people," or exercise "an absolute power over [their] lives, liberties, and estates." §222.

The concept of security in property recognized by Locke and the English legal tradition appeared throughout the materials that inspired the Fourth Amendment. In *Entick* v. *Carrington*, 19 How. St. Tr. 1029 (C. P. 1765)—a heralded decision that the founding generation considered "the true and ultimate expression of constitutional law," *Boyd* v. *United States*, 116 U. S. 616, 626 (1886)—Lord Camden explained that "[t]he great end, for which men entered into society, was to secure their property." 19 How. St. Tr., at 1066. The American colonists echoed this reasoning in their "widespread hostility" to the Crown's writs of assistance[6]—a practice that inspired the Revolu-

[6] Writs of assistance were "general warrants" that gave "customs officials blanket authority to search where they pleased for goods

tion and became "[t]he driving force behind the adoption of the [Fourth] Amendment." *United States* v. *Verdugo-Urquidez*, 494 U. S. 259, 266 (1990). Prominent colonists decried the writs as destroying "'domestic security'" by permitting broad searches of homes. M. Smith, The Writs of Assistance Case 475 (1978) (quoting a 1772 Boston town meeting); see also *id.,* at 562 (complaining that "'every householder in this province, will necessarily become *less secure* than he was before this writ'" (quoting a 1762 article in the Boston Gazette)); *id.,* at 493 (complaining that the writs were "'expressly contrary to the common law, which ever regarded a man's *house* as his castle, or a place of perfect security'" (quoting a 1768 letter from John Dickinson)). James Otis, who argued the famous Writs of Assistance case, contended that the writs violated "'the fundamental Principl[e] of Law'" that "'[a] Man who is quiet, is as secure in his House, as a Prince in his Castle.'" *Id.,* at 339 (quoting John Adam's notes). John Adams attended Otis' argument and later drafted Article XIV of the Massachusetts Constitution,[7] which served as a model for the Fourth Amendment. See Clancy, The Framers' Intent: John Adams, His Era, and the Fourth Amendment, 86 Ind. L. J. 979, 982 (2011); Donohue, The Original Fourth Amendment, 83 U. Chi. L. Rev. 1181, 1269 (2016)

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imported in violation of the British tax laws." *Stanford* v. *Texas*, 379 U. S. 476, 481 (1965).

[7] "Every subject has a right to be secure from all unreasonable searches and seizures of his person, his house, his papers, and all his possessions. All warrants, therefore, are contrary to right, if the cause or foundation of them be not previously supported by oath or affirmation, and if the order in the warrant to a civil officer, to make search in suspected places, or to arrest one or more suspected persons, or to seize their property, be not accompanied with a special designation of the person or objects of search, arrest, or seizure; and no warrant ought to be issued but in cases, and with the formalities prescribed by the laws." Mass. Const., pt. I, Art. XIV (1780).

(Donohue). Adams agreed that "[p]roperty must be secured, or liberty cannot exist." Discourse on Davila, in 6 The Works of John Adams 280 (C. Adams ed. 1851).

Of course, the founding generation understood that, by securing their property, the Fourth Amendment would often protect their privacy as well. See, *e.g., Boyd*, *supra*, at 630 (explaining that searches of houses invade "the privacies of life"); *Wilkes* v. *Wood*, 19 How. St. Tr. 1153, 1154 (C. P. 1763) (argument of counsel contending that seizures of papers implicate "our most private concerns"). But the Fourth Amendment's attendant protection of privacy does not justify *Katz*'s elevation of privacy as the *sine qua non* of the Amendment. See T. Clancy, The Fourth Amendment: Its History and Interpretation §3.4.4, p. 78 (2008) ("[The *Katz* test] confuse[s] the reasons for exercising the protected right with the right itself. A purpose of exercising one's Fourth Amendment rights might be the desire for privacy, but the individual's motivation is not the right protected"); cf. *United States* v. *Gonzalez-Lopez*, 548 U. S. 140, 145 (2006) (rejecting "a line of reasoning that 'abstracts from the right to its purposes, and then eliminates the right'"). As the majority opinion in *Katz* recognized, the Fourth Amendment "cannot be translated into a general constitutional 'right to privacy,'" as its protections "often have nothing to do with privacy at all." 389 U. S., at 350. Justice Harlan's focus on privacy in his concurrence—an opinion that was issued between *Griswold* v. *Connecticut*, 381 U. S. 479 (1965), and *Roe* v. *Wade*, 410 U. S. 113 (1973)—reflects privacy's status as the organizing constitutional idea of the 1960s and 1970s. The organizing constitutional idea of the founding era, by contrast, was property.

C

In shifting the focus of the Fourth Amendment from property to privacy, the *Katz* test also reads the words

"persons, houses, papers, and effects" out of the text. At its broadest formulation, the *Katz* test would find a search "*wherever* an individual may harbor a reasonable 'expectation of privacy.'" *Terry*, 392 U. S., at 9 (emphasis added). The Court today, for example, does not ask whether cell-site location records are "persons, houses, papers, [or] effects" within the meaning of the Fourth Amendment.[8] Yet "persons, houses, papers, and effects" cannot mean "anywhere" or "anything." *Katz*'s catchphrase that "the Fourth Amendment protects people, not places," is not a serious attempt to reconcile the constitutional text. See *Carter*, 525 U. S., at 98, n. 3 (opinion of Scalia, J.). The Fourth Amendment obviously protects people; "[t]he question . . . is what protection it affords to those people." *Katz*, 389 U. S., at 361 (Harlan, J., concurring). The Founders decided to protect the people from unreasonable searches and seizures of four specific things—persons, houses, papers, and effects. They identified those four categories as "the objects of privacy protection to which the *Constitution* would extend, leaving further expansion to the good judgment . . . of the people through their representatives in the legislature." *Carter*, *supra*, at 97–98 (opinion of Scalia, J.).

This limiting language was important to the founders. Madison's first draft of the Fourth Amendment used a different phrase: "their persons, their houses, their papers, and their *other property*." 1 Annals of Cong. 452 (1789)

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[8] The answer to that question is not obvious. Cell-site location records are business records that mechanically collect the interactions between a person's cell phone and the company's towers; they are not private papers and do not reveal the contents of any communications. Cf. Schnapper, Unreasonable Searches and Seizures of Papers, 71 Va. L. Rev. 869, 923–924 (1985) (explaining that business records that do not reveal "personal or speech-related confidences" might not satisfy the original meaning of "papers").

(emphasis added). In one of the few changes made to Madison's draft, the House Committee of Eleven changed "other property" to "effects." See House Committee of Eleven Report (July 28, 1789), in N. Cogan, The Complete Bill of Rights 334 (2d ed. 2015). This change might have narrowed the Fourth Amendment by clarifying that it does not protect real property (other than houses). See *Oliver* v. *United States*, 466 U. S. 170, 177, and n. 7 (1984); Davies, Recovering the Original Fourth Amendment, 98 Mich. L. Rev. 547, 709–714 (1999) (Davies). Or the change might have broadened the Fourth Amendment by clarifying that it protects commercial goods, not just personal possessions. See Donohue 1301. Or it might have done both. Whatever its ultimate effect, the change reveals that the Founders understood the phrase "persons, houses, papers, and effects" to be an important measure of the Fourth Amendment's overall scope. See Davies 710. The *Katz* test, however, displaces and renders that phrase entirely "superfluous." *Jones*, 565 U. S., at 405.

D

"[P]ersons, houses, papers, and effects" are not the only words that the *Katz* test reads out of the Fourth Amendment. The Fourth Amendment specifies that the people have a right to be secure from unreasonable searches of "their" persons, houses, papers, and effects. Although phrased in the plural, "[t]he obvious meaning of ['their'] is that *each* person has the right to be secure against unreasonable searches and seizures in *his own* person, house, papers, and effects." *Carter*, *supra*, at 92 (opinion of Scalia, J.); see also *District of Columbia* v. *Heller*, 554 U. S. 570, 579 (2008) (explaining that the Constitution uses the plural phrase "the people" to "refer to individual rights, not 'collective' rights"). Stated differently, the word "their" means, at the very least, that individuals do not have Fourth Amendment rights in *someone else's* property. See

Carter, *supra*, at 92–94 (opinion of Scalia, J.). Yet, under the *Katz* test, individuals can have a reasonable expectation of privacy in another person's property. See, *e.g., Carter*, 525 U. S., at 89 (majority opinion) ("[A] person may have a legitimate expectation of privacy in the house of someone else"). Until today, our precedents have not acknowledged that individuals can claim a reasonable expectation of privacy in someone else's business records. See *ante,* at 2 (KENNEDY, J., dissenting). But the Court erases that line in this case, at least for cell-site location records. In doing so, it confirms that the *Katz* test does not necessarily require an individual to prove that the government searched *his* person, house, paper, or effect.

Carpenter attempts to argue that the cell-site records are, in fact, his "papers," see Brief for Petitioner 32–35; Reply Brief 14–15, but his arguments are unpersuasive, see *ante,* at 12–13 (opinion of KENNEDY, J.); *post,* at 20–23 (ALITO, J., dissenting). Carpenter stipulated below that the cell-site records are the business records of Sprint and MetroPCS. See App. 51. He cites no property law in his briefs to this Court, and he does not explain how he has a property right in the companies' records under the law of any jurisdiction at any point in American history. If someone stole these records from Sprint or MetroPCS, Carpenter does not argue that he could recover in a traditional tort action. Nor do his contracts with Sprint and MetroPCS make the records his, even though such provisions could exist in the marketplace. Cf., *e.g.,* Google Terms of Service, https://policies.google.com/terms ("Some of our Services allow you to upload, submit, store, send or receive content. You retain ownership of any intellectual property rights that you hold in that content. In short, what belongs to you stays yours").

Instead of property, tort, or contract law, Carpenter relies on the federal Telecommunications Act of 1996 to demonstrate that the cell site records are his papers. The

Telecommunications Act generally bars cell-phone companies from disclosing customers' cell site location information to the public. See 47 U. S. C. §222(c). This is sufficient to make the records his, Carpenter argues, because the Fourth Amendment merely requires him to identify a source of "positive law" that "protects against access by the public without consent." Brief for Petitioner 32–33 (citing Baude & Stern, The Positive Law Model of the Fourth Amendment, 129 Harv. L. Rev. 1821, 1825–1826 (2016); emphasis deleted).

Carpenter is mistaken. To come within the text of the Fourth Amendment, Carpenter must prove that the cell-site records are *his*; positive law is potentially relevant only insofar as it answers that question. The text of the Fourth Amendment cannot plausibly be read to mean "any violation of positive law" any more than it can plausibly be read to mean "any violation of a reasonable expectation of privacy."

Thus, the Telecommunications Act is insufficient because it does not give Carpenter a property right in the cell-site records. Section 222, titled "Privacy of customer information," protects customers' privacy by preventing cell-phone companies from disclosing sensitive information about them. The statute creates a "duty to protect the confidentiality" of information relating to customers, §222(a), and creates "[p]rivacy requirements" that limit the disclosure of that information, §222(c)(1). Nothing in the text pre-empts state property law or gives customers a property interest in the companies' business records (assuming Congress even has that authority).[9] Although

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[9] Carpenter relies on an order from the Federal Communications Commission (FCC), which weakly states that "'*[t]o the extent* [a customer's location information] is property, . . . it is better understood as belonging to the customer, not the carrier.'" Brief for Petitioner 34, and n. 23 (quoting 13 FCC Rcd. 8061, 8093 ¶43 (1998); emphasis added).

§222 "protects the interests of individuals against wrongful uses or disclosures of personal data, the rationale for these legal protections has not historically been grounded on a perception that people have property rights in personal data as such." Samuelson, Privacy as Intellectual Property? 52 Stan. L. Rev. 1125, 1130–1131 (2000) (footnote omitted). Any property rights remain with the companies.

E

The *Katz* test comes closer to the text of the Fourth Amendment when it asks whether an expectation of privacy is "reasonable," but it ultimately distorts that term as well. The Fourth Amendment forbids "unreasonable searches." In other words, reasonableness determines the legality of a search, not "whether a search . . . within the meaning of the Constitution has *occurred*." *Carter*, 525 U. S., at 97 (opinion of Scalia, J.) (internal quotation marks omitted).

Moreover, the *Katz* test invokes the concept of reasonableness in a way that would be foreign to the ratifiers of the Fourth Amendment. Originally, the word "unreasonable" in the Fourth Amendment likely meant "against reason"—as in "against the reason of the common law." See Donohue 1270–1275; Davies 686–693; *California* v. *Acevedo*, 500 U. S. 565, 583 (1991) (Scalia, J., concurring in judgment). At the founding, searches and seizures were

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But this order was vacated by the Court of Appeals for the Tenth Circuit. *U. S. West, Inc.* v. *FCC*, 182 F. 3d 1224, 1240 (1999). Notably, the carrier in that case argued that the FCC's regulation of customer information was a taking of *its* property. See *id.,* at 1230. Although the panel majority had no occasion to address this argument, see *id.,* at 1239, n. 14, the dissent concluded that the carrier had failed to prove the information was "property" at all, see *id.,* at 1247–1248 (opinion of Briscoe, J.).

regulated by a robust body of common-law rules. See generally W. Cuddihy, The Fourth Amendment: Origins and Original Meaning 602–1791 (2009); *e.g., Wilson* v. *Arkansas*, 514 U. S. 927, 931–936 (1995) (discussing the common-law knock-and-announce rule). The search-and-seizure practices that the Founders feared most—such as general warrants—were already illegal under the common law, and jurists such as Lord Coke described violations of the common law as "against reason." See Donohue 1270–1271, and n. 513. Locke, Blackstone, Adams, and other influential figures shortened the phrase "against reason" to "unreasonable." See *id.,* at 1270–1275. Thus, by prohibiting "unreasonable" searches and seizures in the Fourth Amendment, the Founders ensured that the newly created Congress could not use legislation to abolish the established common-law rules of search and seizure. See T. Cooley, Constitutional Limitations *303 (2d ed. 1871); 3 J. Story, Commentaries on the Constitution of the United States §1895, p. 748 (1833).

Although the Court today maintains that its decision is based on "Founding-era understandings," *ante,* at 6, the Founders would be puzzled by the Court's conclusion as well as its reasoning. The Court holds that the Government unreasonably searched Carpenter by subpoenaing the cell-site records of Sprint and MetroPCS without a warrant. But the Founders would not recognize the Court's "warrant requirement." *Ante,* at 21. The common law required warrants for some types of searches and seizures, but not for many others. The relevant rule depended on context. See *Acevedo*, *supra*, at 583–584 (opinion of Scalia, J.); Amar, Fourth Amendment First Principles, 107 Harv. L. Rev. 757, 763–770 (1994); Davies 738–739. In cases like this one, a subpoena for third-party documents was not a "search" to begin with, and the common law did not limit the government's authority to subpoena third parties. See *post,* at 2–12 (ALITO, J., dissent-

ing). Suffice it to say, the Founders would be confused by this Court's transformation of their common-law protection of property into a "warrant requirement" and a vague inquiry into "reasonable expectations of privacy."

III

That the *Katz* test departs so far from the text of the Fourth Amendment is reason enough to reject it. But the *Katz* test also has proved unworkable in practice. Jurists and commentators tasked with deciphering our jurisprudence have described the *Katz* regime as "an unpredictable jumble," "a mass of contradictions and obscurities," "all over the map," "riddled with inconsistency and incoherence," "a series of inconsistent and bizarre results that [the Court] has left entirely undefended," "unstable," "chameleon-like," "'notoriously unhelpful,'" "a conclusion rather than a starting point for analysis," "distressingly unmanageable," "a dismal failure," "flawed to the core," "unadorned fiat," and "inspired by the kind of logic that produced Rube Goldberg's bizarre contraptions."[10] Even

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[10] Kugler & Strahilevitz, Actual Expectations of Privacy, Fourth Amendment Doctrine, and the Mosaic Theory, 2015 S. Ct. Rev. 205, 261; Bradley, Two Models of the Fourth Amendment, 83 Mich. L. Rev. 1468 (1985); Kerr, Four Models of Fourth Amendment Protection, 60 Stan. L. Rev. 503, 505 (2007); Solove, Fourth Amendment Pragmatism, 51 Boston College L. Rev. 1511 (2010); Wasserstom & Seidman, The Fourth Amendment as Constitutional Theory, 77 Geo. L. J. 19, 29 (1988); Colb, What Is a Search? Two Conceptual Flaws in Fourth Amendment Doctrine and Some Hints of a Remedy, 55 Stan. L. Rev. 119, 122 (2002); Clancy, The Fourth Amendment: Its History and Interpretation §3.3.4, p. 65 (2008); *Minnesota* v. *Carter*, 525 U. S. 83, 97 (1998) (Scalia, J., dissenting); *State* v. *Campbell*, 306 Ore. 157, 164, 759 P. 2d 1040, 1044 (1988); Wilkins, Defining the "Reasonable Expectation of Privacy": an Emerging Tripartite Analysis, 40 Vand. L. Rev. 1077, 1107 (1987); Yeager, Search, Seizure and the Positive Law: Expectations of Privacy Outside the Fourth Amendment, 84 J. Crim. L. & C. 249, 251 (1993); Thomas, Time Travel, Hovercrafts, and the Framers:

Justice Harlan, four years after penning his concurrence in *Katz*, confessed that the test encouraged "the substitution of words for analysis." *United States* v. *White*, 401 U. S. 745, 786 (1971) (dissenting opinion).

After 50 years, it is still unclear what question the *Katz* test is even asking. This Court has steadfastly declined to elaborate the relevant considerations or identify any meaningful constraints. See, *e.g., ante,* at 5 ("[N]o single rubric definitively resolves which expectations of privacy are entitled to protection"); *O'Connor* v. *Ortega*, 480 U. S. 709, 715 (1987) (plurality opinion) ("We have no talisman that determines in all cases those privacy expectations that society is prepared to accept as reasonable"); *Oliver*, 466 U. S., at 177 ("No single factor determines whether an individual legitimately may claim under the Fourth Amendment that a place should be free of government intrusion").

Justice Harlan's original formulation of the *Katz* test appears to ask a descriptive question: Whether a given expectation of privacy is "one that society is prepared to recognize as 'reasonable.'" 389 U. S., at 361. As written, the *Katz* test turns on society's actual, current views about the reasonableness of various expectations of privacy.

But this descriptive understanding presents several problems. For starters, it is easily circumvented. If, for example, "the Government were suddenly to announce on nationwide television that all homes henceforth would be subject to warrantless entry," individuals could not realistically expect privacy in their homes. *Smith*, 442 U. S., at 740, n. 5; see also Chemerinsky, Rediscovering Brandeis's

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James Madison Sees the Future and Rewrites the Fourth Amendment, 80 Notre Dame L. Rev. 1451, 1500 (2005); *Rakas* v. *Illinois*, 439 U. S. 128, 165 (1978) (White, J., dissenting); Cloud, Rube Goldberg Meets the Constitution: The Supreme Court, Technology, and the Fourth Amendment, 72 Miss. L. J. 5, 7 (2002).

Right to Privacy, 45 Brandeis L. J. 643, 650 (2007) ("[Under *Katz,* t]he government seemingly can deny privacy just by letting people know in advance not to expect any"). A purely descriptive understanding of the *Katz* test also risks "circular[ity]." *Kyllo*, 533 U. S., at 34. While this Court is supposed to base its decisions on society's expectations of privacy, society's expectations of privacy are, in turn, shaped by this Court's decisions. See Posner, The Uncertain Protection of Privacy by the Supreme Court, 1979 S. Ct. Rev. 173, 188 ("[W]hether [a person] will or will not have [a reasonable] expectation [of privacy] will depend on what the legal rule is").

To address this circularity problem, the Court has insisted that expectations of privacy must come from outside its Fourth Amendment precedents, "either by reference to concepts of real or personal property law or to understandings that are recognized and permitted by society." *Rakas* v. *Illinois*, 439 U. S. 128, 144, n. 12 (1978). But the Court's supposed reliance on "real or personal property law" rings hollow. The whole point of *Katz* was to "'discredi[t]'" the relationship between the Fourth Amendment and property law, 389 U. S., at 353, and this Court has repeatedly downplayed the importance of property law under the *Katz* test, see, *e.g., United States* v. *Salvucci*, 448 U. S. 83, 91 (1980) ("[P]roperty rights are neither the beginning nor the end of this Court's inquiry [under *Katz*]"); *Rawlings* v. *Kentucky*, 448 U. S. 98, 105 (1980) ("[This Court has] emphatically rejected the notion that 'arcane' concepts of property law ought to control the ability to claim the protections of the Fourth Amendment"). Today, for example, the Court makes no mention of property law, except to reject its relevance. See *ante,* at 5, and n. 1.

As for "understandings that are recognized or permitted in society," this Court has never answered even the most basic questions about what this means. See Kerr, Four

Models of Fourth Amendment Protection, 60 Stan. L. Rev. 503, 504–505 (2007). For example, our precedents do not explain who is included in "society," how we know what they "recogniz[e] or permi[t]," and how much of society must agree before something constitutes an "understanding."

Here, for example, society might prefer a balanced regime that prohibits the Government from obtaining cell-site location information unless it can persuade a neutral magistrate that the information bears on an ongoing criminal investigation. That is precisely the regime Congress created under the Stored Communications Act and Telecommunications Act. See 47 U. S. C. §222(c)(1); 18 U. S. C. §§2703(c)(1)(B), (d). With no sense of irony, the Court invalidates this regime today—the one that society actually created "in the form of its elected representatives in Congress." 819 F. 3d 880, 890 (2016).

Truth be told, this Court does not treat the *Katz* test as a descriptive inquiry. Although the *Katz* test is phrased in descriptive terms about society's views, this Court treats it like a normative question—whether a particular practice *should* be considered a search under the Fourth Amendment. Justice Harlan thought this was the best way to understand his test. See *White*, 401 U. S., at 786 (dissenting opinion) (explaining that courts must assess the "desirability" of privacy expectations and ask whether courts "should" recognize them by "balanc[ing]" the "impact on the individual's sense of security . . . against the utility of the conduct as a technique of law enforcement"). And a normative understanding is the only way to make sense of this Court's precedents, which bear the hallmarks of subjective policymaking instead of neutral legal decisionmaking. "[T]he only thing the past three decades have established about the *Katz* test" is that society's expectations of privacy "bear an uncanny resemblance to those expectations of privacy that this Court considers reasonable."

Carter, 525 U. S., at 97 (opinion of Scalia, J.). Yet, "[t]hough we know ourselves to be eminently reasonable, self-awareness of eminent reasonableness is not really a substitute for democratic election." *Sosa* v. *Alvarez-Machain*, 542 U. S. 692, 750 (2004) (Scalia, J., concurring in part and concurring in judgment).

* * *

In several recent decisions, this Court has declined to apply the *Katz* test because it threatened to narrow the original scope of the Fourth Amendment. See *Grady* v. *North Carolina*, 575 U. S. ___, ___ (2015) (*per curiam*) (slip op., at 3); *Florida* v. *Jardines*, 569 U. S. 1, 5 (2013); *Jones*, 565 U. S., at 406–407. But as today's decision demonstrates, *Katz* can also be invoked to expand the Fourth Amendment beyond its original scope. This Court should not tolerate errors in either direction. "The People, through ratification, have already weighed the policy tradeoffs that constitutional rights entail." *Luis* v. *United States*, 578 U. S. ___, ___ (2016) (THOMAS, J., concurring in judgment) (slip op., at 10). Whether the rights they ratified are too broad or too narrow by modern lights, this Court has no authority to unilaterally alter the document they approved.

Because the *Katz* test is a failed experiment, this Court is dutybound to reconsider it. Until it does, I agree with my dissenting colleagues' reading of our precedents. Accordingly, I respectfully dissent.

SUPREME COURT OF THE UNITED STATES

No. 16–402

TIMOTHY IVORY CARPENTER, PETITIONER *v.* UNITED STATES

ON WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE SIXTH CIRCUIT

[June 22, 2018]

JUSTICE ALITO, with whom JUSTICE THOMAS joins, dissenting.

I share the Court's concern about the effect of new technology on personal privacy, but I fear that today's decision will do far more harm than good. The Court's reasoning fractures two fundamental pillars of Fourth Amendment law, and in doing so, it guarantees a blizzard of litigation while threatening many legitimate and valuable investigative practices upon which law enforcement has rightfully come to rely.

First, the Court ignores the basic distinction between an actual search (dispatching law enforcement officers to enter private premises and root through private papers and effects) and an order merely requiring a party to look through its own records and produce specified documents. The former, which intrudes on personal privacy far more deeply, requires probable cause; the latter does not. Treating an order to produce like an actual search, as today's decision does, is revolutionary. It violates both the original understanding of the Fourth Amendment and more than a century of Supreme Court precedent. Unless it is somehow restricted to the particular situation in the present case, the Court's move will cause upheaval. Must every grand jury subpoena *duces tecum* be supported by probable cause? If so, investigations of terrorism, political

corruption, white-collar crime, and many other offenses will be stymied. And what about subpoenas and other document-production orders issued by administrative agencies? See, *e.g.*, 15 U. S. C. §57b–1(c) (Federal Trade Commission); §§77s(c), 78u(a)–(b) (Securities and Exchange Commission); 29 U. S. C. §657(b) (Occupational Safety and Health Administration); 29 CFR §1601.16(a)(2) (2017) (Equal Employment Opportunity Commission).

Second, the Court allows a defendant to object to the search of a third party's property. This also is revolutionary. The Fourth Amendment protects "[t]he right of the people to be secure in *their* persons, houses, papers, and effects" (emphasis added), not the persons, houses, papers, and effects of others. Until today, we have been careful to heed this fundamental feature of the Amendment's text. This was true when the Fourth Amendment was tied to property law, and it remained true after *Katz* v. *United States*, 389 U. S. 347 (1967), broadened the Amendment's reach.

By departing dramatically from these fundamental principles, the Court destabilizes long-established Fourth Amendment doctrine. We will be making repairs—or picking up the pieces—for a long time to come.

I

Today the majority holds that a court order requiring the production of cell-site records may be issued only after the Government demonstrates probable cause. See *ante*, at 18. That is a serious and consequential mistake. The Court's holding is based on the premise that the order issued in this case was an actual "search" within the meaning of the Fourth Amendment, but that premise is inconsistent with the original meaning of the Fourth Amendment and with more than a century of precedent.

A

The order in this case was the functional equivalent of a subpoena for documents, and there is no evidence that these writs were regarded as "searches" at the time of the founding. Subpoenas *duces tecum* and other forms of compulsory document production were well known to the founding generation. Blackstone dated the first writ of subpoena to the reign of King Richard II in the late 14th century, and by the end of the 15th century, the use of such writs had "become the daily practice of the [Chancery] court." 3 W. Blackstone, Commentaries on the Laws of England 53 (G. Tucker ed. 1803) (Blackstone). Over the next 200 years, subpoenas would grow in prominence and power in tandem with the Court of Chancery, and by the end of Charles II's reign in 1685, two important innovations had occurred.

First, the Court of Chancery developed a new species of subpoena. Until this point, subpoenas had been used largely to compel attendance and oral testimony from witnesses; these subpoenas correspond to today's subpoenas *ad testificandum*. But the Court of Chancery also improvised a new version of the writ that tacked onto a regular subpoena an order compelling the witness to bring certain items with him. By issuing these so-called subpoenas *duces tecum*, the Court of Chancery could compel the production of papers, books, and other forms of physical evidence, whether from the parties to the case or from third parties. Such subpoenas were sufficiently commonplace by 1623 that a leading treatise on the practice of law could refer in passing to the fee for a "*Sub pœna* of *Ducas tecum*" (seven shillings and two pence) without needing to elaborate further. T. Powell, The Attourneys Academy 79 (1623). Subpoenas *duces tecum* would swell in use over the next century as the rules for their application became ever more developed and definite. See, *e.g.*, 1 G. Jacob, The Compleat Chancery-Practiser 290 (1730) ("The *Sub-*

poena duces tecum is awarded when the Defendant has confessed by his Answer that he hath such Writings in his Hands as are prayed by the Bill to be discovered or brought into Court").

Second, although this new species of subpoena had its origins in the Court of Chancery, it soon made an appearance in the work of the common-law courts as well. One court later reported that "[t]he Courts of Common law . . . employed the same or similar means . . . from the time of Charles the Second at least." *Amey* v. *Long*, 9 East. 473, 484, 103 Eng. Rep. 653, 658 (K. B. 1808).

By the time Blackstone published his Commentaries on the Laws of England in the 1760's, the use of subpoenas *duces tecum* had bled over substantially from the courts of equity to the common-law courts. Admittedly, the transition was still incomplete: In the context of jury trials, for example, Blackstone complained about "the want of a compulsive power for the production of books and papers belonging to the parties." Blackstone 381; see also, *e.g.*, *Entick* v. *Carrington*, 19 State Trials 1029, 1073 (K. B. 1765) ("I wish some cases had been shewn, where the law forceth evidence out of the owner's custody by process. [But] where the adversary has by force or fraud got possession of your own proper evidence, there is no way to get it back but by action"). But Blackstone found some comfort in the fact that at least those documents "[i]n the hands of third persons . . . can generally be obtained by rule of court, or by adding a clause of requisition to the writ of *subpoena*, which is then called a *subpoena duces tecum*." Blackstone 381; see also, *e.g.*, *Leeds* v. *Cook*, 4 Esp. 256, 257, 170 Eng. Rep. 711 (N. P. 1803) (third-party subpoena *duces tecum*); *Rex* v. *Babb*, 3 T. R. 579, 580, 100 Eng. Rep. 743, 744 (K. B. 1790) (third-party document production). One of the primary questions outstanding, then, was whether common-law courts would remedy the "defect[s]" identified by the Commentaries, and allow

parties to use subpoenas *duces tecum* not only with respect to third parties but also with respect to each other. Blackstone 381.

That question soon found an affirmative answer on both sides of the Atlantic. In the United States, the First Congress established the federal court system in the Judiciary Act of 1789. As part of that Act, Congress authorized "all the said courts of the United States . . . in the trial of actions at law, on motion and due notice thereof being given, to require the parties to produce books or writings in their possession or power, which contain evidence pertinent to the issue, in cases and under circumstances where they might be compelled to produce the same by the ordinary rules of proceeding in chancery." §15, 1 Stat. 82. From that point forward, federal courts in the United States could compel the production of documents regardless of whether those documents were held by parties to the case or by third parties.

In Great Britain, too, it was soon definitively established that common-law courts, like their counterparts in equity, could subpoena documents held either by parties to the case or by third parties. After proceeding in fits and starts, the King's Bench eventually held in *Amey* v. *Long* that the "writ of subpœna duces tecum [is] a writ of compulsory obligation and effect in the law." 9 East., at 486, 103 Eng. Rep., at 658. Writing for a unanimous court, Lord Chief Justice Ellenborough explained that "[t]he right to resort to means competent to compel the production of written, as well as oral, testimony seems essential to the very existence and constitution of a Court of Common Law." *Id.,* at 484, 103 Eng. Rep., at 658. Without the power to issue subpoenas *duces tecum*, the Lord Chief Justice observed, common-law courts "could not possibly proceed with due effect." *Ibid.*

The prevalence of subpoenas *duces tecum* at the time of the founding was not limited to the civil context. In crim-

inal cases, courts and prosecutors were also using the writ to compel the production of necessary documents. In *Rex* v. *Dixon*, 3 Burr. 1687, 97 Eng. Rep. 1047 (K. B. 1765), for example, the King's Bench considered the propriety of a subpoena *duces tecum* served on an attorney named Samuel Dixon. Dixon had been called "to give evidence before the grand jury of the county of Northampton" and specifically "to produce three vouchers . . . in order to found a prosecution by way of indictment against [his client] Peach . . . for forgery." *Id.,* at 1687, 97 Eng. Rep., at 1047–1048. Although the court ultimately held that Dixon had not needed to produce the vouchers on account of attorney-client privilege, none of the justices expressed the slightest doubt about the general propriety of subpoenas *duces tecum* in the criminal context. See *id.,* at 1688, 97 Eng. Rep., at 1048. As Lord Chief Justice Ellenborough later explained, "[i]n that case no objection was taken to the writ, but to the special circumstances under which the party possessed the papers; so that the Court may be considered as recognizing the general obligation to obey writs of that description in other cases." *Amey*, *supra*, at 485, 103 Eng. Rep., at 658; see also 4 J. Chitty, Practical Treatise on the Criminal Law 185 (1816) (template for criminal subpoena *duces tecum*).

As *Dixon* shows, subpoenas *duces tecum* were routine in part because of their close association with grand juries. Early American colonists imported the grand jury, like so many other common-law traditions, and they quickly flourished. See *United States* v. *Calandra*, 414 U. S. 338, 342–343 (1974). Grand juries were empaneled by the federal courts almost as soon as the latter were established, and both they and their state counterparts actively exercised their wide-ranging common-law authority. See R. Younger, The People's Panel 47–55 (1963). Indeed, "the Founders thought the grand jury so essential . . . that they provided in the Fifth Amendment that federal prosecution

for serious crimes can only be instituted by 'a presentment or indictment of a Grand Jury.'" *Calandra*, *supra*, at 343.

Given the popularity and prevalence of grand juries at the time, the Founders must have been intimately familiar with the tools they used—including compulsory process—to accomplish their work. As a matter of tradition, grand juries were "accorded wide latitude to inquire into violations of criminal law," including the power to "compel the production of evidence or the testimony of witnesses as [they] conside[r] appropriate." *Ibid.* Long before national independence was achieved, grand juries were already using their broad inquisitorial powers not only to present and indict criminal suspects but also to inspect public buildings, to levy taxes, to supervise the administration of the laws, to advance municipal reforms such as street repair and bridge maintenance, and in some cases even to propose legislation. Younger, *supra*, at 5–26. Of course, such work depended entirely on grand juries' ability to access any relevant documents.

Grand juries continued to exercise these broad inquisitorial powers up through the time of the founding. See *Blair* v. *United States*, 250 U. S. 273, 280 (1919) ("At the foundation of our Federal Government the inquisitorial function of the grand jury and the compulsion of witnesses were recognized as incidents of the judicial power"). In a series of lectures delivered in the early 1790's, Justice James Wilson crowed that grand juries were "the peculiar boast of the common law" thanks in part to their wide-ranging authority: "All the operations of government, and of its ministers and officers, are within the compass of their view and research." 2 J. Wilson, The Works of James Wilson 534, 537 (R. McCloskey ed. 1967). That reflected the broader insight that "[t]he grand jury's investigative power must be broad if its public responsibility is adequately to be discharged." *Calandra*, *supra*, at 344.

Compulsory process was also familiar to the founding

generation in part because it reflected "the ancient proposition of law" that "'"the public . . . has a right to every man's evidence."'" *United States* v. *Nixon*, 418 U. S. 683, 709 (1974); see also *ante*, at 10 (KENNEDY, J., dissenting). As early as 1612, "Lord Bacon is reported to have declared that 'all subjects, without distinction of degrees, owe to the King tribute and service, not only of their deed and hand, but of their knowledge and discovery.'" *Blair*, *supra*, at 279–280. That duty could be "onerous at times," yet the Founders considered it "necessary to the administration of justice according to the forms and modes established in our system of government." *Id.,* at 281; see also *Calandra*, *supra*, at 345.

B

Talk of kings and common-law writs may seem out of place in a case about cell-site records and the protections afforded by the Fourth Amendment in the modern age. But this history matters, not least because it tells us what was on the minds of those who ratified the Fourth Amendment and how they understood its scope. That history makes it abundantly clear that the Fourth Amendment, as originally understood, did not apply to the compulsory production of documents at all.

The Fourth Amendment does not regulate all methods by which the Government obtains documents. Rather, it prohibits only those "searches and seizures" of "persons, houses, papers, and effects" that are "unreasonable." Consistent with that language, "at least until the latter half of the 20th century" "our Fourth Amendment jurisprudence was tied to common-law trespass." *United States* v. *Jones*, 565 U. S. 400, 405 (2012). So by its terms, the Fourth Amendment does not apply to the compulsory production of documents, a practice that involves neither any physical intrusion into private space nor any taking of property by agents of the state. Even Justice Brandeis—a

stalwart proponent of construing the Fourth Amendment liberally—acknowledged that "under any ordinary construction of language," "there is no 'search' or 'seizure' when a defendant is required to produce a document in the orderly process of a court's procedure." *Olmstead* v. *United States*, 277 U. S. 438, 476 (1928) (dissenting opinion).[1]

Nor is there any reason to believe that the Founders intended the Fourth Amendment to regulate courts' use of compulsory process. American colonists rebelled against the Crown's physical invasions of their persons and their property, not against its acquisition of information by any and all means. As Justice Black once put it, "[t]he Fourth Amendment was aimed directly at the abhorred practice of breaking in, ransacking and searching homes and other buildings and seizing people's personal belongings without warrants issued by magistrates." *Katz*, 389 U. S., at 367 (dissenting opinion). More recently, we have acknowledged that "the Fourth Amendment was the founding generation's response to the reviled 'general warrants' and 'writs of assistance' of the colonial era, which allowed

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[1]Any other interpretation of the Fourth Amendment's text would run into insuperable problems because it would apply not only to subpoenas *duces tecum* but to all other forms of compulsory process as well. If the Fourth Amendment applies to the compelled production of documents, then it must also apply to the compelled production of testimony—an outcome that we have repeatedly rejected and which, if accepted, would send much of the field of criminal procedure into a tailspin. See, *e.g.*, *United States* v. *Dionisio*, 410 U. S. 1, 9 (1973) ("It is clear that a subpoena to appear before a grand jury is not a 'seizure' in the Fourth Amendment sense, even though that summons may be inconvenient or burdensome"); *United States* v. *Calandra*, 414 U. S. 338, 354 (1974) ("Grand jury questions . . . involve no independent governmental invasion of one's person, house, papers, or effects"). As a matter of original understanding, a subpoena *duces tecum* no more effects a "search" or "seizure" of papers within the meaning of the Fourth Amendment than a subpoena *ad testificandum* effects a "search" or "seizure" of a person.

British officers to rummage through homes in an unrestrained search for evidence of criminal activity." *Riley* v. *California*, 573 U. S. ___, ___ (2014) (slip op., at 27).

General warrants and writs of assistance were noxious not because they allowed the Government to acquire evidence in criminal investigations, but because of the *means* by which they permitted the Government to acquire that evidence. Then, as today, searches could be quite invasive. Searches generally begin with officers "mak[ing] nonconsensual entries into areas not open to the public." *Donovan* v. *Lone Steer, Inc.*, 464 U. S. 408, 414 (1984). Once there, officers are necessarily in a position to observe private spaces generally shielded from the public and discernible only with the owner's consent. Private area after private area becomes exposed to the officers' eyes as they rummage through the owner's property in their hunt for the object or objects of the search. If they are searching for documents, officers may additionally have to rifle through many other papers—potentially filled with the most intimate details of a person's thoughts and life—before they find the specific information they are seeking. See *Andresen* v. *Maryland*, 427 U. S. 463, 482, n. 11 (1976). If anything sufficiently incriminating comes into view, officers seize it. *Horton* v. *California*, 496 U. S. 128, 136–137 (1990). Physical destruction always lurks as an underlying possibility; "officers executing search warrants on occasion must damage property in order to perform their duty." *Dalia* v. *United States*, 441 U. S. 238, 258 (1979); see, *e.g.*, *United States* v. *Ramirez*, 523 U. S. 65, 71–72 (1998) (breaking garage window); *United States* v. *Ross*, 456 U. S. 798, 817–818 (1982) (ripping open car upholstery); *Brown* v. *Battle Creek Police Dept.*, 844 F. 3d 556, 572 (CA6 2016) (shooting and killing two pet dogs); *Lawmaster* v. *Ward*, 125 F. 3d 1341, 1350, n. 3 (CA10 1997) (breaking locks).

Compliance with a subpoena *duces tecum* requires none

of that. A subpoena *duces tecum* permits a subpoenaed individual to conduct the search for the relevant documents himself, without law enforcement officers entering his home or rooting through his papers and effects. As a result, subpoenas avoid the many incidental invasions of privacy that necessarily accompany any actual search. And it was *those* invasions of privacy—which, although incidental, could often be extremely intrusive and damaging—that led to the adoption of the Fourth Amendment.

Neither this Court nor any of the parties have offered the slightest bit of historical evidence to support the idea that the Fourth Amendment originally applied to subpoenas *duces tecum* and other forms of compulsory process. That is telling, for as I have explained, these forms of compulsory process were a feature of criminal (and civil) procedure well known to the Founders. The Founders would thus have understood that holding the compulsory production of documents to the same standard as actual searches and seizures would cripple the work of courts in civil and criminal cases alike. It would be remarkable to think that, despite that knowledge, the Founders would have gone ahead and sought to impose such a requirement. It would be even more incredible to believe that the Founders would have imposed that requirement through the inapt vehicle of an amendment directed at different concerns. But it would blink reality entirely to argue that this entire process happened without anyone saying *the least thing about it*—not during the drafting of the Bill of Rights, not during any of the subsequent ratification debates, and not for most of the century that followed. If the Founders thought the Fourth Amendment applied to the compulsory production of documents, one would imagine that there would be *some* founding-era evidence of the Fourth Amendment being applied to the compulsory production of documents. Cf. *Free Enterprise Fund* v. *Public Company Accounting Oversight Bd.*, 561 U. S. 477, 505

(2010); *Printz* v. *United States*, 521 U. S. 898, 905 (1997). Yet none has been brought to our attention.

C

Of course, our jurisprudence has not stood still since 1791. We now evaluate subpoenas *duces tecum* and other forms of compulsory document production under the Fourth Amendment, although we employ a reasonableness standard that is less demanding than the requirements for a warrant. But the road to that doctrinal destination was anything but smooth, and our initial missteps—and the subsequent struggle to extricate ourselves from their consequences—should provide an object lesson for today's majority about the dangers of holding compulsory process to the same standard as actual searches and seizures.

For almost a century after the Fourth Amendment was enacted, this Court said and did nothing to indicate that it might regulate the compulsory production of documents. But that changed temporarily when the Court decided *Boyd* v. *United States*, 116 U. S. 616 (1886), the first—and, until today, the only—case in which this Court has ever held the compulsory production of documents to the same standard as actual searches and seizures.

The *Boyd* Court held that a court order compelling a company to produce potentially incriminating business records violated both the Fourth and the Fifth Amendments. The Court acknowledged that "certain aggravating incidents of actual search and seizure, such as forcible entry into a man's house and searching amongst his papers, are wanting" when the Government relies on compulsory process. *Id.*, at 622. But it nevertheless asserted that the Fourth Amendment ought to "be liberally construed," *id.*, at 635, and further reasoned that compulsory process "effects the sole object and purpose of search and seizure" by "forcing from a party evidence against himself," *id.*, at 622. "In this regard," the Court concluded,

"the Fourth and Fifth Amendments run almost into each other." *Id.*, at 630. Having equated compulsory process with actual searches and seizures and having melded the Fourth Amendment with the Fifth, the Court then found the order at issue unconstitutional because it compelled the production of property to which the Government did not have superior title. See *id.*, at 622–630.

In a concurrence joined by Chief Justice Waite, Justice Miller agreed that the order violated the Fifth Amendment, *id.*, at 639, but he strongly protested the majority's invocation of the Fourth Amendment. He explained: "[T]here is no reason why this court should assume that the action of the court below, in requiring a party to produce certain papers . . . , authorizes an unreasonable search or seizure of the house, papers, or effects of that party. There is in fact no search and no seizure." *Ibid.* "If the mere service of a notice to produce a paper . . . is a search," Justice Miller concluded, "then a change has taken place in the meaning of words, which has not come within my reading, and which I think was unknown at the time the Constitution was made." *Id.,* at 641.

Although *Boyd* was replete with stirring rhetoric, its reasoning was confused from start to finish in a way that ultimately made the decision unworkable. See 3 W. LaFave, J. Israel, N. King, & O. Kerr, Criminal Procedure §8.7(a) (4th ed. 2015). Over the next 50 years, the Court would gradually roll back *Boyd*'s erroneous conflation of compulsory process with actual searches and seizures.

That effort took its first significant stride in *Hale* v. *Henkel*, 201 U. S. 43 (1906), where the Court found it "quite clear" and "conclusive" that "the search and seizure clause of the Fourth Amendment was not intended to interfere with the power of courts to compel, through a *subpœna duces tecum*, the production, upon a trial in court, of documentary evidence." *Id.,* at 73. Without that writ, the Court recognized, "it would be 'utterly impossible

to carry on the administration of justice.'" *Ibid.*

Hale, however, did not entirely liberate subpoenas *duces tecum* from Fourth Amendment constraints. While refusing to treat such subpoenas as the equivalent of actual searches, *Hale* concluded that they must not be unreasonable. And it held that the subpoena *duces tecum* at issue was "far too sweeping in its terms to be regarded as reasonable." *Id.,* at 76. The *Hale* Court thus left two critical questions unanswered: Under the Fourth Amendment, what makes the compulsory production of documents "reasonable," and how does that standard differ from the one that governs actual searches and seizures?

The Court answered both of those questions definitively in *Oklahoma Press Publishing Co.* v. *Walling*, 327 U. S. 186 (1946), where we held that the Fourth Amendment regulates the compelled production of documents, but less stringently than it does full-blown searches and seizures. *Oklahoma Press* began by admitting that the Court's opinions on the subject had "perhaps too often . . . been generative of heat rather than light," "mov[ing] with variant direction" and sometimes having "highly contrasting" "emphasis and tone." *Id.,* at 202. "The primary source of misconception concerning the Fourth Amendment's function" in this context, the Court explained, "lies perhaps in the identification of cases involving so-called 'figurative' or 'constructive' search with cases of actual search and seizure." *Ibid.* But the Court held that "the basic distinction" between the compulsory production of documents on the one hand, and actual searches and seizures on the other, meant that two different standards had to be applied. *Id.,* at 204.

Having reversed *Boyd*'s conflation of the compelled production of documents with actual searches and seizures, the Court then set forth the relevant Fourth Amendment standard for the former. When it comes to "the production of corporate or other business records," the

Court held that the Fourth Amendment "at the most guards against abuse only by way of too much indefiniteness or breadth in the things required to be 'particularly described,' if also the inquiry is one the demanding agency is authorized by law to make and the materials specified are relevant." *Oklahoma Press*, *supra*, at 208. Notably, the Court held that a showing of probable cause was not necessary so long as "the investigation is authorized by Congress, is for a purpose Congress can order, and the documents sought are relevant to the inquiry." *Id.,* at 209.

Since *Oklahoma Press*, we have consistently hewed to that standard. See, *e.g.*, *Lone Steer, Inc.*, 464 U. S., at 414–415; *United States* v. *Miller*, 425 U. S. 435, 445–446 (1976); *California Bankers Assn.* v. *Shultz*, 416 U. S. 21, 67 (1974); *United States* v. *Dionisio*, 410 U. S. 1, 11–12 (1973); *See* v. *Seattle*, 387 U. S. 541, 544 (1967); *United States* v. *Powell*, 379 U. S. 48, 57–58 (1964); *McPhaul* v. *United States*, 364 U. S. 372, 382–383 (1960); *United States* v. *Morton Salt Co.*, 338 U. S. 632, 652–653 (1950); cf. *McLane Co.* v. *EEOC*, 581 U. S. ___, ___ (2017) (slip op., at 11). By applying *Oklahoma Press* and thereby respecting "the traditional distinction between a search warrant and a subpoena," *Miller*, *supra*, at 446, this Court has reinforced "the basic compromise" between "the public interest" in every man's evidence and the private interest "of men to be free from officious meddling." *Oklahoma Press*, *supra*, at 213.

D

Today, however, the majority inexplicably ignores the settled rule of *Oklahoma Press* in favor of a resurrected version of *Boyd*. That is mystifying. This should have been an easy case regardless of whether the Court looked to the original understanding of the Fourth Amendment or to our modern doctrine.

As a matter of original understanding, the Fourth

Amendment does not regulate the compelled production of documents at all. Here the Government received the relevant cell-site records pursuant to a court order compelling Carpenter's cell service provider to turn them over. That process is thus immune from challenge under the original understanding of the Fourth Amendment.

As a matter of modern doctrine, this case is equally straightforward. As JUSTICE KENNEDY explains, no search or seizure of Carpenter or his property occurred in this case. *Ante*, at 6–22; see also Part II, *infra*. But even if the majority were right that the Government "searched" Carpenter, it would at most be a "figurative or constructive search" governed by the *Oklahoma Press* standard, not an "actual search" controlled by the Fourth Amendment's warrant requirement.

And there is no doubt that the Government met the *Oklahoma Press* standard here. Under *Oklahoma Press*, a court order must "'be sufficiently limited in scope, relevant in purpose, and specific in directive so that compliance will not be unreasonably burdensome.'" *Lone Steer, Inc.*, *supra*, at 415. Here, the type of order obtained by the Government almost necessarily satisfies that standard. The Stored Communications Act allows a court to issue the relevant type of order "only if the governmental entity offers specific and articulable facts showing that there are reasonable grounds to believe that . . . the records . . . sough[t] are relevant and material to an ongoing criminal investigation." 18 U. S. C. §2703(d). And the court "may quash or modify such order" if the provider objects that the "records requested are unusually voluminous in nature or compliance with such order otherwise would cause an undue burden on such provider." *Ibid.* No such objection was made in this case, and Carpenter does not suggest that the orders contravened the *Oklahoma Press* standard in any other way.

That is what makes the majority's opinion so puzzling.

It decides that a "search" of Carpenter occurred within the meaning of the Fourth Amendment, but then it leaps straight to imposing requirements that—until this point—have governed only *actual* searches and seizures. See *ante*, at 18–19. Lost in its race to the finish is any real recognition of the century's worth of precedent it jeopardizes. For the majority, this case is apparently no different from one in which Government agents raided Carpenter's home and removed records associated with his cell phone.

Against centuries of precedent and practice, all that the Court can muster is the observation that "this Court has never held that the Government may subpoena third parties for records in which the suspect has a reasonable expectation of privacy." *Ante*, at 19. Frankly, I cannot imagine a concession more damning to the Court's argument than that. As the Court well knows, the reason that we have never seen such a case is because—until today—defendants categorically had no "reasonable expectation of privacy" and no property interest in records belonging to third parties. See Part II, *infra*. By implying otherwise, the Court tries the nice trick of seeking shelter under the cover of precedents that it simultaneously perforates.

Not only that, but even if the Fourth Amendment permitted someone to object to the subpoena of a third party's records, the Court cannot explain why that individual should be entitled to *greater* Fourth Amendment protection than the party actually being subpoenaed. When parties are subpoenaed to turn over their records, after all, they will at most receive the protection afforded by *Oklahoma Press* even though they will own and have a reasonable expectation of privacy in the records at issue. Under the Court's decision, however, the Fourth Amendment will extend greater protections to someone else who is not being subpoenaed and does not own the records. That outcome makes no sense, and the Court does not even attempt to defend it.

We have set forth the relevant Fourth Amendment standard for subpoenaing business records many times over. Out of those dozens of cases, the majority cannot find even one that so much as suggests an exception to the *Oklahoma Press* standard for sufficiently personal information. Instead, we have always "described the constitutional requirements" for compulsory process as being "'settled'" and as applying categorically to all "'subpoenas [of] corporate books or records.'" *Lone Steer, Inc.*, 464 U. S., at 415 (internal quotation marks omitted). That standard, we have held, is "*the most*" protection the Fourth Amendment gives "to the production of corporate records and papers." *Oklahoma Press*, 327 U. S., at 208 (emphasis added).[2]

Although the majority announces its holding in the context of the Stored Communications Act, nothing stops its logic from sweeping much further. The Court has offered no meaningful limiting principle, and none is apparent. Cf. Tr. of Oral Arg. 31 (Carpenter's counsel admitting that "a grand jury subpoena . . . would be held to the same standard as any other subpoena or subpoena-like request for [cell-site] records").

Holding that subpoenas must meet the same standard as conventional searches will seriously damage, if not destroy, their utility. Even more so than at the founding, today the Government regularly uses subpoenas *duces tecum* and other forms of compulsory process to carry out its essential functions. See, *e.g.*, *Dionisio*, 410 U. S., at 11–12 (grand jury subpoenas); *McPhaul*, 364 U. S., at 382–383 (legislative subpoenas); *Oklahoma Press*, *supra*, at 208–209 (administrative subpoenas). Grand juries, for

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[2] All that the Court can say in response is that we have "been careful not to uncritically extend existing precedents" when confronting new technologies. *Ante*, at 20. But applying a categorical rule categorically does not "extend" precedent, so the Court's statement ends up sounding a lot like a tacit admission that it is overruling our precedents.

example, have long "compel[led] the production of evidence" in order to determine "*whether* there is probable cause to believe a crime has been committed." *Calandra*, 414 U. S., at 343 (emphasis added). Almost by definition, then, grand juries will be unable at first to demonstrate "the probable cause required for a warrant." *Ante*, at 19 (majority opinion); see also *Oklahoma Press*, *supra*, at 213. If they are required to do so, the effects are as predictable as they are alarming: Many investigations will sputter out at the start, and a host of criminals will be able to evade law enforcement's reach.

"To ensure that justice is done, it is imperative to the function of courts that compulsory process be available for the production of evidence." *Nixon*, 418 U. S., at 709. For over a hundred years, we have understood that holding subpoenas to the same standard as actual searches and seizures "would stop much if not all of investigation in the public interest at the threshold of inquiry." *Oklahoma Press*, *supra*, at 213. Today a skeptical majority decides to put that understanding to the test.

II

Compounding its initial error, the Court also holds that a defendant has the right under the Fourth Amendment to object to the search of a third party's property. This holding flouts the clear text of the Fourth Amendment, and it cannot be defended under either a property-based interpretation of that Amendment or our decisions applying the reasonable-expectations-of-privacy test adopted in *Katz*, 389 U. S. 347. By allowing Carpenter to object to the search of a third party's property, the Court threatens to revolutionize a second and independent line of Fourth Amendment doctrine.

A

It bears repeating that the Fourth Amendment guaran-

tees "[t]he right of the people to be secure in *their* persons, houses, papers, and effects." (Emphasis added.) The Fourth Amendment does not confer rights with respect to the persons, houses, papers, and effects of others. Its language makes clear that "Fourth Amendment rights are personal," *Rakas* v. *Illinois*, 439 U. S. 128, 140 (1978), and as a result, this Court has long insisted that they "may not be asserted vicariously," *id.*, at 133. It follows that a "person who is aggrieved . . . only through the introduction of damaging evidence secured by a search of a third person's premises or property has not had any of his Fourth Amendment rights infringed." *Id.*, at 134.

In this case, as JUSTICE KENNEDY cogently explains, the cell-site records obtained by the Government belong to Carpenter's cell service providers, not to Carpenter. See *ante*, at 12–13. Carpenter did not create the cell-site records. Nor did he have possession of them; at all relevant times, they were kept by the providers. Once Carpenter subscribed to his provider's service, he had no right to prevent the company from creating or keeping the information in its records. Carpenter also had no right to demand that the providers destroy the records, no right to prevent the providers from destroying the records, and, indeed, no right to modify the records in any way whatsoever (or to prevent the providers from modifying the records). Carpenter, in short, has no meaningful control over the cell-site records, which are created, maintained, altered, used, and eventually destroyed by his cell service providers.

Carpenter responds by pointing to a provision of the Telecommunications Act that requires a provider to disclose cell-site records when a customer so requests. See 47 U. S. C. §222(c)(2). But a statutory disclosure requirement is hardly sufficient to give someone an ownership interest in the documents that must be copied and disclosed. Many statutes confer a right to obtain copies of documents

without creating any property right.[3]

Carpenter's argument is particularly hard to swallow because nothing in the Telecommunications Act precludes cell service providers from charging customers a fee for accessing cell-site records. See *ante*, at 12–13 (KENNEDY, J., dissenting). It would be very strange if the owner of records were required to pay in order to inspect his own

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[3] See, *e.g.*, Freedom of Information Act, 5 U. S. C. §552(a) ("Each agency shall make available to the public information as follows . . ."); Privacy Act, 5 U. S. C. §552a(d)(1) ("Each agency that maintains a system of records shall . . . upon request by any individual to gain access to his record or to any information pertaining to him which is contained in the system, permit him and upon his request, a person of his own choosing to accompany him, to review the record and have a copy made of all or any portion thereof . . ."); Fair Credit Reporting Act, 15 U. S. C. §1681j(a)(1)(A) ("All consumer reporting agencies . . . shall make all disclosures pursuant to section 1681g of this title once during any 12-month period upon request of the consumer and without charge to the consumer"); Right to Financial Privacy Act of 1978, 12 U. S. C. §3404(c) ("The customer has the right . . . to obtain a copy of the record which the financial institution shall keep of all instances in which the customer's record is disclosed to a Government authority pursuant to this section, including the identity of the Government authority to which such disclosure is made"); Government in the Sunshine Act, 5 U. S. C. §552b(f)(2) ("Copies of such transcript, or minutes, or a transcription of such recording disclosing the identity of each speaker, shall be furnished to any person at the actual cost of duplication or transcription"); Cable Act, 47 U. S. C. §551(d) ("A cable subscriber shall be provided access to all personally identifiable information regarding that subscriber which is collected and maintained by a cable operator"); Family Educational Rights and Privacy Act of 1974, 20 U. S. C. §1232g(a)(1)(A) ("No funds shall be made available under any applicable program to any educational agency or institution which has a policy of denying, or which effectively prevents, the parents of students who are or have been in attendance at a school of such agency or at such institution, as the case may be, the right to inspect and review the education records of their children. . . . Each educational agency or institution shall establish appropriate procedures for the granting of a request by parents for access to the education records of their children within a reasonable period of time, but in no case more than forty-five days after the request has been made").

property.

Nor does the Telecommunications Act give Carpenter a property right in the cell-site records simply because they are subject to confidentiality restrictions. See 47 U. S. C. §222(c)(1) (without a customer's permission, a cell service provider may generally "use, disclose, or permit access to individually identifiable [cell-site records]" only with respect to "its provision" of telecommunications services). Many federal statutes impose similar restrictions on private entities' use or dissemination of information in their own records without conferring a property right on third parties.[4]

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[4] See, *e.g.*, Family Educational Rights and Privacy Act, 20 U. S. C. §1232g(b)(1) ("No funds shall be made available under any applicable program to any educational agency or institution which has a policy or practice of permitting the release of education records (or personally identifiable information contained therein other than directory information . . .) of students without the written consent of their parents to any individual, agency, or organization . . ."); Video Privacy Protection Act, 18 U. S. C. §2710(b)(1) ("A video tape service provider who knowingly discloses, to any person, personally identifiable information concerning any consumer of such provider shall be liable to the aggrieved person for the relief provided in subsection (d)"); Driver Privacy Protection Act, 18 U. S. C. §2721(a)(1) ("A State department of motor vehicles, and any officer, employee, or contractor thereof, shall not knowingly disclose or otherwise make available to any person or entity . . . personal information . . ."); Fair Credit Reporting Act, 15 U. S. C. §1681b(a) ("[A]ny consumer reporting agency may furnish a consumer report under the following circumstances and no other . . ."); Right to Financial Privacy Act, 12 U. S. C. §3403(a) ("No financial institution, or officer, employees, or agent of a financial institution, may provide to any Government authority access to or copies of, or the information contained in, the financial records of any customer except in accordance with the provisions of this chapter"); Patient Safety and Quality Improvement Act, 42 U. S. C. §299b–22(b) ("Notwithstanding any other provision of Federal, State, or local law, and subject to subsection (c) of this section, patient safety work product shall be confidential and shall not be disclosed"); Cable Act, 47 U. S. C. §551(c)(1) ("[A] cable operator shall not disclose personally identifiable information concerning any subscriber without the prior written or electronic consent of the sub-

It would be especially strange to hold that the Telecommunication Act's confidentiality provision confers a property right when the Act creates an express exception for any disclosure of records that is "required by law." 47 U. S. C. §222(c)(1). So not only does Carpenter lack "'the most essential and beneficial'" of the "'constituent elements'" of property, *Dickman* v. *Commissioner*, 465 U. S. 330, 336 (1984)—*i.e.*, the right to use the property to the exclusion of others—but he cannot even exclude the party he would most like to keep out, namely, the Government.[5]

For all these reasons, there is no plausible ground for maintaining that the information at issue here represents Carpenter's "papers" or "effects."[6]

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scriber concerned and shall take such actions as are necessary to prevent unauthorized access to such information by a person other than the subscriber or cable operator").

[5] Carpenter also cannot argue that he owns the cell-site records merely because they fall into the category of records referred to as "customer proprietary network information." 47 U. S. C. §222(c). Even assuming labels alone can confer property rights, nothing in this particular label indicates whether the "information" is "proprietary" to the "customer" or to the provider of the "network." At best, the phrase "customer proprietary network information" is ambiguous, and context makes clear that it refers to the *provider*'s information. The Telecommunications Act defines the term to include all "information that relates to the quantity, technical configuration, type, destination, location, and amount of use of a telecommunications service subscribed to by any customer of a telecommunications carrier, and that is made available to the carrier by the customer solely by virtue of the carrier-customer relationship." 47 U. S. C. §222(h)(1)(A). For Carpenter to be right, he must own not only the cell-site records in this case, but also records relating to, for example, the "technical configuration" of his subscribed service—records that presumably include such intensely personal and private information as transmission wavelengths, transport protocols, and link layer system configurations.

[6] Thus, this is not a case in which someone has entrusted papers that he or she owns to the safekeeping of another, and it does not involve a bailment. Cf. *post*, at 14 (GORSUCH, J., dissenting).

B

In the days when this Court followed an exclusively property-based approach to the Fourth Amendment, the distinction between an individual's Fourth Amendment rights and those of a third party was clear cut. We first asked whether the object of the search—say, a house, papers, or effects—belonged to the defendant, and, if it did, whether the Government had committed a "trespass" in acquiring the evidence at issue. *Jones*, 565 U. S., at 411, n. 8.

When the Court held in *Katz* that "property rights are not the sole measure of Fourth Amendment violations," *Soldal* v. *Cook County*, 506 U. S. 56, 64 (1992), the sharp boundary between personal and third-party rights was tested. Under *Katz*, a party may invoke the Fourth Amendment whenever law enforcement officers violate the party's "justifiable" or "reasonable" expectation of privacy. See 389 U. S., at 353; see also *id.*, at 361 (Harlan, J., concurring) (applying the Fourth Amendment where "a person [has] exhibited an actual (subjective) expectation of privacy" and where that "expectation [is] one that society is prepared to recognize as 'reasonable'"). Thus freed from the limitations imposed by property law, parties began to argue that they had a reasonable expectation of privacy in items owned by others. After all, if a trusted third party took care not to disclose information about the person in question, that person might well have a reasonable expectation that the information would not be revealed.

Efforts to claim Fourth Amendment protection against searches of the papers and effects of others came to a head in *Miller*, 425 U. S. 435, where the defendant sought the suppression of two banks' microfilm copies of his checks, deposit slips, and other records. The defendant did not claim that he owned these documents, but he nonetheless argued that "analysis of ownership, property rights and possessory interests in the determination of Fourth

Amendment rights ha[d] been severely impeached" by *Katz* and other recent cases. See Brief for Respondent in *United States* v. *Miller*, O. T. 1975, No. 74–1179, p. 6. Turning to *Katz*, he then argued that he had a reasonable expectation of privacy in the banks' records regarding his accounts. Brief for Respondent in No. 74–1179, at 6; see also *Miller*, *supra*, at 442–443.

Acceptance of this argument would have flown in the face of the Fourth Amendment's text, and the Court rejected that development. Because Miller gave up "dominion and control" of the relevant information to his bank, *Rakas,* 439 U. S., at 149, the Court ruled that he lost any protected Fourth Amendment interest in that information. See *Miller*, *supra*, at 442–443. Later, in *Smith* v. *Maryland*, 442 U. S. 735, 745 (1979), the Court reached a similar conclusion regarding a telephone company's records of a customer's calls. As JUSTICE KENNEDY concludes, *Miller* and *Smith* are thus best understood as placing "necessary limits on the ability of individuals to assert Fourth Amendment interests in property to which they lack a 'requisite connection.'" *Ante*, at 8.

The same is true here, where Carpenter indisputably lacks any meaningful property-based connection to the cell-site records owned by his provider. Because the records are not Carpenter's in any sense, Carpenter may not seek to use the Fourth Amendment to exclude them.

By holding otherwise, the Court effectively allows Carpenter to object to the "search" of a third party's property, not recognizing the revolutionary nature of this change. The Court seems to think that *Miller* and *Smith* invented a new "doctrine"—"the third-party doctrine"—and the Court refuses to "extend" this product of the 1970's to a new age of digital communications. *Ante*, at 11, 17. But the Court fundamentally misunderstands the role of *Miller* and *Smith*. Those decisions did not forge a new doctrine; instead, they rejected an argument that would have

disregarded the clear text of the Fourth Amendment and a formidable body of precedent.

In the end, the Court never explains how its decision can be squared with the fact that the Fourth Amendment protects only "[t]he right of the people to be secure in *their* persons, houses, papers, and effects." (Emphasis added.)

* * *

Although the majority professes a desire not to "'embarrass the future,'" *ante*, at 18, we can guess where today's decision will lead.

One possibility is that the broad principles that the Court seems to embrace will be applied across the board. All subpoenas *duces tecum* and all other orders compelling the production of documents will require a demonstration of probable cause, and individuals will be able to claim a protected Fourth Amendment interest in any sensitive personal information about them that is collected and owned by third parties. Those would be revolutionary developments indeed.

The other possibility is that this Court will face the embarrassment of explaining in case after case that the principles on which today's decision rests are subject to all sorts of qualifications and limitations that have not yet been discovered. If we take this latter course, we will inevitably end up "mak[ing] a crazy quilt of the Fourth Amendment." *Smith*, *supra*, at 745.

All of this is unnecessary. In the Stored Communications Act, Congress addressed the specific problem at issue in this case. The Act restricts the misuse of cell-site records by cell service providers, something that the Fourth Amendment cannot do. The Act also goes beyond current Fourth Amendment case law in restricting access by law enforcement. It permits law enforcement officers to acquire cell-site records only if they meet a heightened standard and obtain a court order. If the American people

now think that the Act is inadequate or needs updating, they can turn to their elected representatives to adopt more protective provisions. Because the collection and storage of cell-site records affects nearly every American, it is unlikely that the question whether the current law requires strengthening will escape Congress's notice.

Legislation is much preferable to the development of an entirely new body of Fourth Amendment caselaw for many reasons, including the enormous complexity of the subject, the need to respond to rapidly changing technology, and the Fourth Amendment's limited scope. The Fourth Amendment restricts the conduct of the Federal Government and the States; it does not apply to private actors. But today, some of the greatest threats to individual privacy may come from powerful private companies that collect and sometimes misuse vast quantities of data about the lives of ordinary Americans. If today's decision encourages the public to think that this Court can protect them from this looming threat to their privacy, the decision will mislead as well as disrupt. And if holding a provision of the Stored Communications Act to be unconstitutional dissuades Congress from further legislation in this field, the goal of protecting privacy will be greatly disserved.

The desire to make a statement about privacy in the digital age does not justify the consequences that today's decision is likely to produce.

SUPREME COURT OF THE UNITED STATES

No. 16–402

TIMOTHY IVORY CARPENTER, PETITIONER *v.* UNITED STATES

ON WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE SIXTH CIRCUIT

[June 22, 2018]

JUSTICE GORSUCH, dissenting.

In the late 1960s this Court suggested for the first time that a search triggering the Fourth Amendment occurs when the government violates an "expectation of privacy" that "society is prepared to recognize as 'reasonable.'" *Katz* v. *United States*, 389 U. S. 347, 361 (1967) (Harlan, J., concurring). Then, in a pair of decisions in the 1970s applying the *Katz* test, the Court held that a "reasonable expectation of privacy" *doesn't* attach to information shared with "third parties." See *Smith* v. *Maryland*, 442 U. S. 735, 743–744 (1979); *United States* v. *Miller*, 425 U. S. 435, 443 (1976). By these steps, the Court came to conclude, the Constitution does nothing to limit investigators from searching records you've entrusted to your bank, accountant, and maybe even your doctor.

What's left of the Fourth Amendment? Today we use the Internet to do most everything. Smartphones make it easy to keep a calendar, correspond with friends, make calls, conduct banking, and even watch the game. Countless Internet companies maintain records about us and, increasingly, *for* us. Even our most private documents—those that, in other eras, we would have locked safely in a desk drawer or destroyed—now reside on third party servers. *Smith* and *Miller* teach that the police can review all of this material, on the theory that no one reasonably

expects any of it will be kept private. But no one believes that, if they ever did.

What to do? It seems to me we could respond in at least three ways. The first is to ignore the problem, maintain *Smith* and *Miller*, and live with the consequences. If the confluence of these decisions and modern technology means our Fourth Amendment rights are reduced to nearly nothing, so be it. The second choice is to set *Smith* and *Miller* aside and try again using the *Katz* "reasonable expectation of privacy" jurisprudence that produced them. The third is to look for answers elsewhere.

*

Start with the first option. *Smith* held that the government's use of a pen register to record the numbers people dial on their phones doesn't infringe a reasonable expectation of privacy because that information is freely disclosed to the third party phone company. 442 U. S., at 743–744. *Miller* held that a bank account holder enjoys no reasonable expectation of privacy in the bank's records of his account activity. That's true, the Court reasoned, "even if the information is revealed on the assumption that it will be used only for a limited purpose and the confidence placed in the third party will not be betrayed." 425 U. S., at 443. Today the Court suggests that *Smith* and *Miller* distinguish between *kinds* of information disclosed to third parties and require courts to decide whether to "extend" those decisions to particular classes of information, depending on their sensitivity. See *ante,* at 10–18. But as the Sixth Circuit recognized and JUSTICE KENNEDY explains, no balancing test of this kind can be found in *Smith* and *Miller*. See *ante*, at 16 (dissenting opinion). Those cases announced a categorical rule: Once you disclose information to third parties, you forfeit any reasonable expectation of privacy you might have had in it. And even if *Smith* and *Miller* did permit courts to conduct a

balancing contest of the kind the Court now suggests, it's still hard to see how that would help the petitioner in this case. Why is someone's location when using a phone so much more sensitive than who he was talking to (*Smith*) or what financial transactions he engaged in (*Miller*)? I do not know and the Court does not say.

The problem isn't with the Sixth Circuit's application of *Smith* and *Miller* but with the cases themselves. Can the government demand a copy of all your e-mails from Google or Microsoft without implicating your Fourth Amendment rights? Can it secure your DNA from 23andMe without a warrant or probable cause? *Smith* and *Miller* say yes it can—at least without running afoul of *Katz*. But that result strikes most lawyers and judges today—me included—as pretty unlikely. In the years since its adoption, countless scholars, too, have come to conclude that the "third-party doctrine is not only wrong, but horribly wrong." Kerr, The Case for the Third-Party Doctrine, 107 Mich. L. Rev. 561, 563, n. 5, 564 (2009) (collecting criticisms but defending the doctrine (footnotes omitted)). The reasons are obvious. "As an empirical statement about subjective expectations of privacy," the doctrine is "quite dubious." Baude & Stern, The Positive Law Model of the Fourth Amendment, 129 Harv. L. Rev. 1821, 1872 (2016). People often *do* reasonably expect that information they entrust to third parties, especially information subject to confidentiality agreements, will be kept private. Meanwhile, if the third party doctrine is supposed to represent a normative assessment of when a person should expect privacy, the notion that the answer might be "never" seems a pretty unattractive societal prescription. *Ibid.*

What, then, is the explanation for our third party doctrine? The truth is, the Court has never offered a persuasive justification. The Court has said that by conveying information to a third party you "'assum[e] the risk'" it will be revealed to the police and therefore lack a reason-

able expectation of privacy in it. *Smith*, *supra,* at 744. But assumption of risk doctrine developed in tort law. It generally applies when "by contract or otherwise [one] expressly agrees to accept a risk of harm" or impliedly does so by "manifest[ing] his willingness to accept" that risk and thereby "take[s] his chances as to harm which may result from it." Restatement (Second) of Torts §§496B, 496C(1), and Comment *b* (1965); see also 1 D. Dobbs, P. Hayden, & E. Bublick, Law of Torts §§235–236, pp. 841–850 (2d ed. 2017). That rationale has little play in this context. Suppose I entrust a friend with a letter and he promises to keep it secret until he delivers it to an intended recipient. In what sense have I agreed to bear the risk that he will turn around, break his promise, and spill its contents to someone else? More confusing still, what have I done to "manifest my willingness to accept" the risk that the government will pry the document from my friend and read it *without* his consent?

One possible answer concerns knowledge. I know that my friend *might* break his promise, or that the government *might* have some reason to search the papers in his possession. But knowing about a risk doesn't mean you assume responsibility for it. Whenever you walk down the sidewalk you know a car may negligently or recklessly veer off and hit you, but that hardly means you accept the consequences and absolve the driver of any damage he may do to you. Epstein, Privacy and the Third Hand: Lessons From the Common Law of Reasonable Expectations, 24 Berkeley Tech. L. J. 1199, 1204 (2009); see W. Keeton, D. Dobbs, R. Keeton, & D. Owen, Prosser & Keeton on Law of Torts 490 (5th ed. 1984).

Some have suggested the third party doctrine is better understood to rest on consent than assumption of risk. "So long as a person knows that they are disclosing information to a third party," the argument goes, "their choice to do so is voluntary and the consent valid." Kerr, *supra,*

at 588. I confess I still don't see it. Consenting to give a third party access to private papers that remain my property is not the same thing as consenting to a *search of those papers by the government.* Perhaps there are exceptions, like when the third party is an undercover government agent. See Murphy, The Case Against the Case Against the Third-Party Doctrine: A Response to Epstein and Kerr, 24 Berkeley Tech. L. J. 1239, 1252 (2009); cf. *Hoffa* v. *United States*, 385 U. S. 293 (1966). But otherwise this conception of consent appears to be just assumption of risk relabeled—you've "consented" to whatever risks are foreseeable.

Another justification sometimes offered for third party doctrine is clarity. You (and the police) know exactly how much protection you have in information confided to others: none. As rules go, "the king always wins" is admirably clear. But the opposite rule would be clear too: Third party disclosures *never* diminish Fourth Amendment protection (call it "the king always loses"). So clarity alone cannot justify the third party doctrine.

In the end, what do *Smith* and *Miller* add up to? A doubtful application of *Katz* that lets the government search almost whatever it wants whenever it wants. The Sixth Circuit had to follow that rule and faithfully did just that, but it's not clear why we should.

*

There's a second option. What if we dropped *Smith* and *Miller*'s third party doctrine and retreated to the root *Katz* question whether there is a "reasonable expectation of privacy" in data held by third parties? Rather than solve the problem with the third party doctrine, I worry this option only risks returning us to its source: After all, it was *Katz* that produced *Smith* and *Miller* in the first place.

Katz's problems start with the text and original under-

standing of the Fourth Amendment, as JUSTICE THOMAS thoughtfully explains today. *Ante,* at 5–17 (dissenting opinion). The Amendment's protections do not depend on the breach of some abstract "expectation of privacy" whose contours are left to the judicial imagination. Much more concretely, it protects your "person," and your "houses, papers, and effects." Nor does your right to bring a Fourth Amendment claim depend on whether a judge happens to agree that your subjective expectation to privacy is a "reasonable" one. Under its plain terms, the Amendment grants you the right to invoke its guarantees whenever one of your protected things (your person, your house, your papers, or your effects) is unreasonably searched or seized. Period.

History too holds problems for *Katz*. Little like it can be found in the law that led to the adoption of the Fourth Amendment or in this Court's jurisprudence until the late 1960s. The Fourth Amendment came about in response to a trio of 18th century cases "well known to the men who wrote and ratified the Bill of Rights, [and] famous throughout the colonial population." Stuntz, The Substantive Origins of Criminal Procedure, 105 Yale L. J. 393, 397 (1995). The first two were English cases invalidating the Crown's use of general warrants to enter homes and search papers. *Entick* v. *Carrington*, 19 How. St. Tr. 1029 (K. B. 1765); *Wilkes* v. *Wood*, 19 How. St. Tr. 1153 (K. B. 1763); see W. Cuddihy, The Fourth Amendment: Origins and Original Meaning 439–487 (2009); *Boyd* v. *United States*, 116 U. S. 616, 625–630 (1886). The third was American: the Boston Writs of Assistance Case, which sparked colonial outrage at the use of writs permitting government agents to enter houses and business, breaking open doors and chests along the way, to conduct searches and seizures—and to force third parties to help them. Stuntz, *supra,* at 404–409; M. Smith, The Writs of Assistance Case (1978). No doubt the colonial outrage engen-

dered by these cases rested in part on the government's intrusion upon privacy. But the framers chose not to protect privacy in some ethereal way dependent on judicial intuitions. They chose instead to protect privacy in particular places and things—"persons, houses, papers, and effects"—and against particular threats—"unreasonable" governmental "searches and seizures." See *Entick*, *supra,* at 1066 ("Papers are the owner's goods and chattels; they are his dearest property; and so far from enduring a seizure, that they will hardly bear an inspection"); see also *ante,* at 1–21 (THOMAS, J., dissenting).

Even taken on its own terms, *Katz* has never been sufficiently justified. In fact, we still don't even know what its "reasonable expectation of privacy" test *is*. Is it supposed to pose an empirical question (what privacy expectations do people *actually* have) or a normative one (what expectations *should* they have)? Either way brings problems. If the test is supposed to be an empirical one, it's unclear why judges rather than legislators should conduct it. Legislators are responsive to their constituents and have institutional resources designed to help them discern and enact majoritarian preferences. Politically insulated judges come armed with only the attorneys' briefs, a few law clerks, and their own idiosyncratic experiences. They are hardly the representative group you'd expect (or want) to be making empirical judgments for hundreds of millions of people. Unsurprisingly, too, judicial judgments often fail to reflect public views. See Slobogin & Schumacher, Reasonable Expectations of Privacy and Autonomy in Fourth Amendment Cases: An Empirical Look at "Understandings Recognized and Permitted by Society," 42 Duke L. J. 727, 732, 740–742 (1993). Consider just one example. Our cases insist that the seriousness of the offense being investigated does *not* reduce Fourth Amendment protection. *Mincey* v. *Arizona*, 437 U. S. 385, 393–394 (1978). Yet scholars suggest that most people *are* more tolerant of

police intrusions when they investigate more serious crimes. See Blumenthal, Adya, & Mogle, The Multiple Dimensions of Privacy: Testing Lay "Expectations of Privacy," 11 U. Pa. J. Const. L. 331, 352–353 (2009). And I very much doubt that this Court would be willing to adjust its *Katz* cases to reflect these findings even if it believed them.

Maybe, then, the *Katz* test should be conceived as a normative question. But if that's the case, why (again) do judges, rather than legislators, get to determine whether society *should be* prepared to recognize an expectation of privacy as legitimate? Deciding what privacy interests *should be* recognized often calls for a pure policy choice, many times between incommensurable goods—between the value of privacy in a particular setting and society's interest in combating crime. Answering questions like that calls for the exercise of raw political will belonging to legislatures, not the legal judgment proper to courts. See The Federalist No. 78, p. 465 (C. Rossiter ed. 1961) (A. Hamilton). When judges abandon legal judgment for political will we not only risk decisions where "reasonable expectations of privacy" come to bear "an uncanny resemblance to those expectations of privacy" shared by Members of this Court. *Minnesota* v. *Carter*, 525 U. S. 83, 97 (1998) (Scalia, J., concurring). We also risk undermining public confidence in the courts themselves.

My concerns about *Katz* come with a caveat. *Sometimes*, I accept, judges may be able to discern and describe existing societal norms. See, *e.g., Florida* v. *Jardines*, 569 U. S. 1, 8 (2013) (inferring a license to enter on private property from the "'habits of the country'" (quoting *McKee* v. *Gratz*, 260 U. S. 127, 136 (1922))); Sachs, Finding Law, 107 Cal. L. Rev. (forthcoming 2019), online at https://ssrn.com/abstract=3064443 (as last visited June 19, 2018). That is particularly true when the judge looks to positive law rather than intuition for guidance on social norms. See

Byrd v. *United States,* 584 U. S. ___, ___–___ (2018) (slip op., at 7–9) ("general property-based concept[s] guid[e] the resolution of this case"). So there may be *some* occasions where *Katz* is capable of principled application—though it may simply wind up approximating the more traditional option I will discuss in a moment. Sometimes it may also be possible to apply *Katz* by analogizing from precedent when the line between an existing case and a new fact pattern is short and direct. But so far this Court has declined to tie itself to any significant restraints like these. See *ante,* at 5, n. 1 ("[W]hile property rights are often informative, our cases by no means suggest that such an interest is 'fundamental' or 'dispositive' in determining which expectations of privacy are legitimate").

As a result, *Katz* has yielded an often unpredictable—and sometimes unbelievable—jurisprudence. *Smith* and *Miller* are only two examples; there are many others. Take *Florida* v. *Riley*, 488 U. S. 445 (1989), which says that a police helicopter hovering 400 feet above a person's property invades no reasonable expectation of privacy. Try that one out on your neighbors. Or *California* v. *Greenwood*, 486 U. S. 35 (1988), which holds that a person has no reasonable expectation of privacy in the garbage he puts out for collection. In that case, the Court said that the homeowners forfeited their privacy interests because "[i]t is common knowledge that plastic garbage bags left on or at the side of a public street are readily accessible to animals, children, scavengers, snoops, and other members of the public." *Id.*, at 40 (footnotes omitted). But the habits of raccoons don't prove much about the habits of the country. I doubt, too, that most people spotting a neighbor rummaging through their garbage would think they lacked reasonable grounds to confront the rummager. Making the decision all the stranger, California state law expressly *protected* a homeowner's property rights in discarded trash. *Id.*, at 43. Yet rather than defer to that

as evidence of the people's habits and reasonable expectations of privacy, the Court substituted its own curious judgment.

Resorting to *Katz* in data privacy cases threatens more of the same. Just consider. The Court today says that judges should use *Katz*'s reasonable expectation of privacy test to decide what Fourth Amendment rights people have in cell-site location information, explaining that "no single rubric definitively resolves which expectations of privacy are entitled to protection." *Ante,* at 5. But then it offers a twist. Lower courts should be sure to add two special principles to their *Katz* calculus: the need to avoid "arbitrary power" and the importance of "plac[ing] obstacles in the way of a too permeating police surveillance." *Ante,* at 6 (internal quotation marks omitted). While surely laudable, these principles don't offer lower courts much guidance. The Court does not tell us, for example, how far to carry either principle or how to weigh them against the legitimate needs of law enforcement. At what point does access to electronic data amount to "arbitrary" authority? When does police surveillance become "too permeating"? And what sort of "obstacles" should judges "place" in law enforcement's path when it does? We simply do not know.

The Court's application of these principles supplies little more direction. The Court declines to say whether there is any sufficiently limited period of time "for which the Government may obtain an individual's historical [location information] free from Fourth Amendment scrutiny." *Ante,* at 11, n. 3; see *ante,* at 11–15. But then it tells us that access to seven days' worth of information *does* trigger Fourth Amendment scrutiny—even though here the carrier "produced only two days of records." *Ante,* at 11, n. 3. Why is the relevant fact the seven days of information the government *asked for* instead of the two days of information the government *actually saw*? Why seven days instead of ten or three or one? And in what possible sense

did the government "search" five days' worth of location information it was never even sent? We do not know.

Later still, the Court adds that it can't say whether the Fourth Amendment is triggered when the government collects "real-time CSLI or 'tower dumps' (a download of information on all the devices that connected to a particular cell site during a particular interval)." *Ante,* at 17–18. But what distinguishes historical data from real-time data, or seven days of a single person's data from a download of *everyone*'s data over some indefinite period of time? Why isn't a tower dump the *paradigmatic* example of "too permeating police surveillance" and a dangerous tool of "arbitrary" authority—the touchstones of the majority's modified *Katz* analysis? On what possible basis could such mass data collection survive the Court's test while collecting a single person's data does not? Here again we are left to guess. At the same time, though, the Court offers some firm assurances. It tells us its decision does *not* "call into question conventional surveillance techniques and tools, such as security cameras." *Ibid.* That, however, just raises more questions for lower courts to sort out about what techniques qualify as "conventional" and why those techniques would be okay *even if* they lead to "permeating police surveillance" or "arbitrary police power."

Nor is this the end of it. After finding a reasonable expectation of privacy, the Court says there's still more work to do. Courts must determine whether to "extend" *Smith* and *Miller* to the circumstances before them. *Ante,* at 11, 15–17. So apparently *Smith* and *Miller* aren't quite left for dead; they just no longer have the clear reach they once did. How do we measure their new reach? The Court says courts now must conduct a *second Katz*-like balancing inquiry, asking whether the fact of disclosure to a third party outweighs privacy interests in the "category of information" so disclosed. *Ante,* at 13, 15–16. But how are lower courts supposed to weigh these radically different

interests? Or assign values to different categories of information? All we know is that historical cell-site location information (for seven days, anyway) escapes *Smith* and *Miller*'s shorn grasp, while a lifetime of bank or phone records does not. As to any other kind of information, lower courts will have to stay tuned.

In the end, our lower court colleagues are left with two amorphous balancing tests, a series of weighty and incommensurable principles to consider in them, and a few illustrative examples that seem little more than the product of judicial intuition. In the Court's defense, though, we have arrived at this strange place not because the Court has misunderstood *Katz*. Far from it. We have arrived here because this is where *Katz* inevitably leads.

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There is another way. From the founding until the 1960s, the right to assert a Fourth Amendment claim didn't depend on your ability to appeal to a judge's personal sensibilities about the "reasonableness" of your expectations or privacy. It was tied to the law. *Jardines*, 569 U. S., at 11; *United States* v. *Jones*, 565 U. S. 400, 405 (2012). The Fourth Amendment protects "the right of the people to be secure in their persons, houses, papers and effects, against unreasonable searches and seizures." True to those words and their original understanding, the traditional approach asked if a house, paper or effect was *yours* under law. No more was needed to trigger the Fourth Amendment. Though now often lost in *Katz*'s shadow, this traditional understanding persists. *Katz* only "supplements, rather than displaces the traditional property-based understanding of the Fourth Amendment." *Byrd*, 584 U. S., at ___ (slip op., at 7) (internal quotation marks omitted); *Jardines*, *supra,* at 11 (same); *Soldal* v. *Cook County*, 506 U. S. 56, 64 (1992) (*Katz* did not "snuf[f] out the previously recognized protection for property under

the Fourth Amendment").

Beyond its provenance in the text and original understanding of the Amendment, this traditional approach comes with other advantages. Judges are supposed to decide cases based on "democratically legitimate sources of law"—like positive law or analogies to items protected by the enacted Constitution—rather than "their own biases or personal policy preferences." Pettys, Judicial Discretion in Constitutional Cases, 26 J. L. & Pol. 123, 127 (2011). A Fourth Amendment model based on positive legal rights "carves out significant room for legislative participation in the Fourth Amendment context," too, by asking judges to consult what the people's representatives have to say about their rights. Baude & Stern, 129 Harv. L. Rev., at 1852. Nor is this approach hobbled by *Smith* and *Miller*, for those cases are just *limitations* on *Katz*, addressing only the question whether individuals have a reasonable expectation of privacy in materials they share with third parties. Under this more traditional approach, Fourth Amendment protections for your papers and effects do not automatically disappear just because you share them with third parties.

Given the prominence *Katz* has claimed in our doctrine, American courts are pretty rusty at applying the traditional approach to the Fourth Amendment. We know that if a house, paper, or effect is yours, you have a Fourth Amendment interest in its protection. But what kind of legal interest is sufficient to make something *yours*? And what source of law determines that? Current positive law? The common law at 1791, extended by analogy to modern times? Both? See *Byrd*, *supra*, at ___–___ (slip op., at 1–2) (THOMAS, J., concurring); cf. Re, The Positive Law Floor, 129 Harv. L. Rev. Forum 313 (2016). Much work is needed to revitalize this area and answer these questions. I do not begin to claim all the answers today, but (unlike with *Katz*) at least I have a pretty good idea

what the questions *are*. And it seems to me a few things can be said.

First, the fact that a third party has access to or possession of your papers and effects does not necessarily eliminate your interest in them. Ever hand a private document to a friend to be returned? Toss your keys to a valet at a restaurant? Ask your neighbor to look after your dog while you travel? You would not expect the friend to share the document with others; the valet to lend your car to his buddy; or the neighbor to put Fido up for adoption. Entrusting your stuff to others is a *bailment*. A bailment is the "delivery of personal property by one person (the *bailor*) to another (the *bailee*) who holds the property for a certain purpose." Black's Law Dictionary 169 (10th ed. 2014); J. Story, Commentaries on the Law of Bailments §2, p. 2 (1832) ("a bailment is a delivery of a thing in trust for some special object or purpose, and upon a contract, expressed or implied, to conform to the object or purpose of the trust"). A bailee normally owes a legal duty to keep the item safe, according to the terms of the parties' contract if they have one, and according to the "implication[s] from their conduct" if they don't. 8 C. J. S., Bailments §36, pp. 468–469 (2017). A bailee who uses the item in a different way than he's supposed to, or against the bailor's instructions, is liable for conversion. *Id.*, §43, at 481; see *Goad* v. *Harris*, 207 Ala. 357, 92 So. 546, (1922); *Knight* v. *Seney*, 290 Ill. 11, 17, 124 N. E. 813, 815–816 (1919); *Baxter* v. *Woodward*, 191 Mich. 379, 385, 158 N. W. 137, 139 (1916). This approach is quite different from *Smith* and *Miller*'s (counter)-intuitive approach to reasonable expectations of privacy; where those cases extinguish Fourth Amendment interests once records are given to a third party, property law may preserve them.

Our Fourth Amendment jurisprudence already reflects this truth. In *Ex parte Jackson*, 96 U. S. 727 (1878), this Court held that sealed letters placed in the mail are "as

fully guarded from examination and inspection, except as to their outward form and weight, as if they were retained by the parties forwarding them in their own domiciles." *Id.,* at 733. The reason, drawn from the Fourth Amendment's text, was that "[t]he constitutional guaranty of the right of the people to be secure in their papers against unreasonable searches and seizures extends to *their papers*, thus closed against inspection, *wherever they may be*." *Ibid.* (emphasis added). It did not matter that letters were bailed to a third party (the government, no less). The sender enjoyed the same Fourth Amendment protection as he does "when papers are subjected to search in one's own household." *Ibid.*

These ancient principles may help us address modern data cases too. Just because you entrust your data—in some cases, your modern-day papers and effects—to a third party may not mean you lose any Fourth Amendment interest in its contents. Whatever may be left of *Smith* and *Miller*, few doubt that e-mail should be treated much like the traditional mail it has largely supplanted—as a bailment in which the owner retains a vital and protected legal interest. See *ante,* at 13 (KENNEDY, J., dissenting) (noting that enhanced Fourth Amendment protection may apply when the "modern-day equivalents of an individual's own 'papers' or 'effects' . . . are held by a third party" through "bailment"); *ante,* at 23, n. 6 (ALITO, J., dissenting) (reserving the question whether Fourth Amendment protection may apply in the case of "bailment" or when "someone has entrusted papers he or she owns . . . to the safekeeping of another"); *United States* v. *Warshak*, 631 F. 3d 266, 285–286 (CA6 2010) (relying on an analogy to *Jackson* to extend Fourth Amendment protection to e-mail held by a third party service provider).

Second, I doubt that complete ownership or exclusive control of property is always a necessary condition to the assertion of a Fourth Amendment right. Where houses

are concerned, for example, individuals can enjoy Fourth Amendment protection without fee simple title. Both the text of the Amendment and the common law rule support that conclusion. "People call a house 'their' home when legal title is in the bank, when they rent it, and even when they merely occupy it rent free." *Carter*, 525 U. S., at 95–96 (Scalia, J., concurring). That rule derives from the common law. *Oystead* v. *Shed*, 13 Mass. 520, 523 (1816) (explaining, citing "[t]he very learned judges, *Foster*, *Hale*, and *Coke*," that the law "would be as much disturbed by a forcible entry to arrest a boarder or a servant, who had acquired, by contract, express or implied, a right to enter the house at all times, and to remain in it as long as they please, as if the object were to arrest the master of the house or his children"). That is why tenants and resident family members—though they have no legal title—have standing to complain about searches of the houses in which they live. *Chapman* v. *United States*, 365 U. S. 610, 616–617 (1961), *Bumper* v. *North Carolina*, 391 U. S. 543, 548, n. 11 (1968).

Another point seems equally true: just because you *have* to entrust a third party with your data doesn't necessarily mean you should lose all Fourth Amendment protections in it. Not infrequently one person comes into possession of someone else's property without the owner's consent. Think of the finder of lost goods or the policeman who impounds a car. The law recognizes that the goods and the car still belong to their true owners, for "where a person comes into lawful possession of the personal property of another, even though there is no formal agreement between the property's owner and its possessor, the possessor will become a constructive bailee when justice so requires." *Christensen* v. *Hoover*, 643 P. 2d 525, 529 (Colo. 1982) (en banc); Laidlaw, Principles of Bailment, 16 Cornell L. Q. 286 (1931). At least some of this Court's decisions have already suggested that use of technology is

functionally compelled by the demands of modern life, and in that way the fact that we store data with third parties may amount to a sort of involuntary bailment too. See *ante,* at 12–13 (majority opinion); *Riley* v. *California*, 573 U. S. ___, ___ (2014) (slip op., at 9).

Third, positive law may help provide detailed guidance on evolving technologies without resort to judicial intuition. State (or sometimes federal) law often creates rights in both tangible and intangible things. See *Ruckelshaus* v. *Monsanto Co.*, 467 U. S. 986, 1001 (1984). In the context of the Takings Clause we often ask whether those state-created rights are sufficient to make something someone's property for constitutional purposes. See *id.,* at 1001–1003; *Louisville Joint Stock Land Bank* v. *Radford*, 295 U. S. 555, 590–595 (1935). A similar inquiry may be appropriate for the Fourth Amendment. Both the States and federal government are actively legislating in the area of third party data storage and the rights users enjoy. See, *e.g.,* Stored Communications Act, 18 U. S. C. §2701 *et seq.*; Tex. Prop. Code Ann. §111.004(12) (West 2017) (defining "[p]roperty" to include "property held in any digital or electronic medium"). State courts are busy expounding common law property principles in this area as well. *E.g., Ajemian* v. *Yahoo!, Inc.*, 478 Mass. 169, 170, 84 N. E. 3d 766, 768 (2017) (e-mail account is a "form of property often referred to as a 'digital asset'"); *Eysoldt* v. *ProScan Imaging*, 194 Ohio App. 3d 630, 638, 2011–Ohio–2359, 957 N. E. 2d 780, 786 (2011) (permitting action for conversion of web account as intangible property). If state legislators or state courts say that a digital record has the attributes that normally make something property, that may supply a sounder basis for judicial decisionmaking than judicial guesswork about societal expectations.

Fourth, while positive law may help establish a person's Fourth Amendment interest there may be some circumstances where positive law cannot be used to defeat it.

Ex parte Jackson reflects that understanding. There this Court said that "[n]o law of Congress" could authorize letter carriers "to invade the secrecy of letters." 96 U. S., at 733. So the post office couldn't impose a regulation dictating that those mailing letters surrender all legal interests in them once they're deposited in a mailbox. If that is right, *Jackson* suggests the existence of a constitutional floor below which Fourth Amendment rights may not descend. Legislatures cannot pass laws declaring your house or papers to be your property except to the extent the police wish to search them without cause. As the Court has previously explained, "we must 'assur[e] preservation of that degree of privacy against government that existed when the Fourth Amendment was adopted.'" *Jones*, 565 U. S., at 406 (quoting *Kyllo* v. *United States*, 533 U. S. 27, 34 (2001)). Nor does this mean protecting only the specific rights known at the founding; it means protecting their modern analogues too. So, for example, while thermal imaging was unknown in 1791, this Court has recognized that using that technology to look inside a home constitutes a Fourth Amendment "search" of that "home" no less than a physical inspection might. *Id.,* at 40.

Fifth, this constitutional floor may, in some instances, bar efforts to circumvent the Fourth Amendment's protection through the use of subpoenas. No one thinks the government can evade *Jackson*'s prohibition on opening sealed letters without a warrant simply by issuing a subpoena to a postmaster for "all letters sent by John Smith" or, worse, "all letters sent by John Smith concerning a particular transaction." So the question courts will confront will be this: What other kinds of records are sufficiently similar to letters in the mail that the same rule should apply?

It may be that, as an original matter, a subpoena requiring the recipient to produce records wasn't thought of as a

"search or seizure" by the government implicating the Fourth Amendment, see *ante,* at 2–12 (opinion of ALITO, J.), but instead as an act of compelled self-incrimination implicating the Fifth Amendment, see *United States* v. *Hubbell*, 530 U. S. 27, 49–55 (2000) (THOMAS, J., dissenting); Nagareda, Compulsion "To Be a Witness" and the Resurrection of Boyd, 74 N. Y. U. L. Rev. 1575, 1619, and n. 172 (1999). But the common law of searches and seizures does not appear to have confronted a case where private documents equivalent to a mailed letter were entrusted to a bailee and then subpoenaed. As a result, "[t]he common-law rule regarding subpoenas for documents held by third parties entrusted with information from the target is . . . unknown and perhaps unknowable." Dripps, Perspectives on The Fourth Amendment Forty Years Later: Toward the Realization of an Inclusive Regulatory Model, 100 Minn. L. Rev. 1885, 1922 (2016). Given that (perhaps insoluble) uncertainty, I am content to adhere to *Jackson* and its implications for now.

To be sure, we must be wary of returning to the doctrine of *Boyd* v. *United States*, 116 U. S. 616. *Boyd* invoked the Fourth Amendment to restrict the use of subpoenas even for ordinary business records and, as JUSTICE ALITO notes, eventually proved unworkable. See *ante,* at 13 (dissenting opinion); 3 W. LaFave, J. Israel, N. King, & O. Kerr, Criminal Procedure §8.7(a), pp. 185–187 (4th ed. 2015). But if we were to overthrow *Jackson* too and deny Fourth Amendment protection to *any* subpoenaed materials, we would do well to reconsider the scope of the Fifth Amendment while we're at it. Our precedents treat the right against self-incrimination as applicable only to testimony, not the production of incriminating evidence. See *Fisher* v. *United States*, 425 U. S. 391, 401 (1976). But there is substantial evidence that the privilege against self-incrimination was also originally understood to protect a person from being forced to turn over potentially incrimi-

nating evidence. Nagareda, *supra,* at 1605–1623; *Rex* v. *Purnell*, 96 Eng. Rep. 20 (K. B. 1748); Slobogin, Privacy at Risk 145 (2007).

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What does all this mean for the case before us? To start, I cannot fault the Sixth Circuit for holding that *Smith* and *Miller* extinguish any *Katz*-based Fourth Amendment interest in third party cell-site data. That is the plain effect of their categorical holdings. Nor can I fault the Court today for its implicit but unmistakable conclusion that the rationale of *Smith* and *Miller* is wrong; indeed, I agree with that. The Sixth Circuit was powerless to say so, but this Court can and should. At the same time, I do not agree with the Court's decision today to keep *Smith* and *Miller* on life support and supplement them with a new and multilayered inquiry that seems to be only *Katz*-squared. Returning there, I worry, promises more trouble than help. Instead, I would look to a more traditional Fourth Amendment approach. Even if *Katz* may still supply one way to prove a Fourth Amendment interest, it has never been the only way. Neglecting more traditional approaches may mean failing to vindicate the full protections of the Fourth Amendment.

Our case offers a cautionary example. It seems to me entirely possible a person's cell-site data could qualify as *his* papers or effects under existing law. Yes, the telephone carrier holds the information. But 47 U. S. C. §222 designates a customer's cell-site location information as "customer proprietary network information" (CPNI), §222(h)(1)(A), and gives customers certain rights to control use of and access to CPNI about themselves. The statute generally forbids a carrier to "use, disclose, or permit access to individually identifiable" CPNI without the customer's consent, except as needed to provide the customer's telecommunications services. §222(c)(1). It also

requires the carrier to disclose CPNI "upon affirmative written request by the customer, to any person designated by the customer." §222(c)(2). Congress even afforded customers a private cause of action for damages against carriers who violate the Act's terms. §207. Plainly, customers have substantial legal interests in this information, including at least some right to include, exclude, and control its use. Those interests might even rise to the level of a property right.

The problem is that we do not know anything more. Before the district court and court of appeals, Mr. Carpenter pursued only a *Katz* "reasonable expectations" argument. He did not invoke the law of property or any analogies to the common law, either there or in his petition for certiorari. Even in his merits brief before this Court, Mr. Carpenter's discussion of his positive law rights in cell-site data was cursory. He offered no analysis, for example, of what rights state law might provide him in addition to those supplied by §222. In these circumstances, I cannot help but conclude—reluctantly—that Mr. Carpenter forfeited perhaps his most promising line of argument.

Unfortunately, too, this case marks the second time this Term that individuals have forfeited Fourth Amendment arguments based on positive law by failing to preserve them. See *Byrd*, 584 U. S., at ___ (slip op., at 7). Litigants have had fair notice since at least *United States* v. *Jones* (2012) and *Florida* v. *Jardines* (2013) that arguments like these may vindicate Fourth Amendment interests even where *Katz* arguments do not. Yet the arguments have gone unmade, leaving courts to the usual *Katz* handwaving. These omissions do not serve the development of a sound or fully protective Fourth Amendment jurisprudence.

CONSTITUTION
of the
COMMONWEALTH OF PENNSYLVANIA

Article

Constitution of 1874. The Constitution of 1874 was adopted November 3, 1873, by a Constitutional Convention which was called pursuant to the act of April 11, 1872 (P.L.53, No.42). The Constitution was ratified at a special election held December 16, 1873, and went into effect January 1, 1874. This Constitution was amended in 1901, 1909, 1911, 1913, 1915, 1918, 1920, 1922, 1923, 1928, 1933, 1937, 1943, 1945, 1949, 1951, 1953, 1955, 1956, 1957, 1958, 1959, 1961, 1963 and 1965. By statute, 1 Pa.C.S. § 906, the Constitution, as adopted by referendum of December 16, 1873, shall be known and may be cited as the Constitution of 1874.

Constitution of 1968. The Constitution of 1874 was modified and renumbered by extensive amendments on May 17, 1966, November 8, 1966, and May 16, 1967; and by proclamation of the Governor of July 7, 1967, P.L.1063, pursuant to the act of August 17, 1965 (P.L.345, No.180). Proposals 1 through 7 to amend the Constitution were recommended by a Constitutional Convention which was called pursuant to the act of March 15, 1967 (P.L.2, No.2). The proposals were approved by the electorate on April 23, 1968. By statute, 1 Pa.C.S. § 906, the Constitution, as amended by referenda of May 17, 1966, November 8, 1966, May 16, 1967, and April 23, 1968, and as numbered by proclamation of the Governor of July 7, 1967, shall be known and may be cited as the Constitution of 1968.

Section Headings. Section headings were not contained in the Constitution as adopted by referendum of December 16, 1873, but were either added by various constitutional amendments or promulgated on June 11, 1974, P.L.1573, by the Director of the Legislative Reference Bureau with the approval of the Attorney General under statutory authority contained in 1 Pa.C.S. § 905.

Explanation of Amendment Notes. Unless otherwise noted, amendments are referred to by date of adoption by the electorate together with a reference to the applicable joint resolution (J.R.) or, in rare cases, concurrent resolution (C.R.) adopted by the General Assembly and the page in the Laws of Pennsylvania (P.L.) in which the joint resolution or concurrent resolution was published.

PREAMBLE

WE, the people of the Commonwealth of Pennsylvania, grateful to Almighty God for the blessings of civil and religious liberty, and humbly invoking His guidance, do ordain and establish this Constitution.

ARTICLE I
DECLARATION OF RIGHTS

Sec.

Adoption. Unless otherwise noted, the provisions of Article I were adopted December 16, 1873, 1874 P.L.3, effective January 1, 1874.

That the general, great and essential principles of liberty and free government may be recognized and unalterably established, WE DECLARE THAT--

§ 1. Inherent rights of mankind.

All men are born equally free and independent, and have certain inherent and indefeasible rights, among which are those of enjoying and defending life and liberty, of acquiring, possessing and protecting property and reputation, and of pursuing their own happiness.

§ 2. Political powers.

All power is inherent in the people, and all free governments are founded on their authority and instituted for their peace, safety and happiness. For the advancement of these ends they have at all times an inalienable and indefeasible right to alter, reform or abolish their government in such manner as they may think proper.

§ 3. Religious freedom.

All men have a natural and indefeasible right to worship Almighty God according to the dictates of their own consciences; no man can of right be compelled to attend, erect or support any place of worship, or to maintain any ministry against his consent; no human authority can, in any case whatever, control or interfere with the rights of conscience, and no preference shall ever be given by law to any religious establishments or modes of worship.

§ 4. Religion.

No person who acknowledges the being of a God and a future state of rewards and punishments shall, on account of his religious sentiments, be disqualified to hold any office or place of trust or profit under this Commonwealth.

§ 5. Elections.

Elections shall be free and equal; and no power, civil or military, shall at any time interfere to prevent the free exercise of the right of suffrage.

§ 6. Trial by jury.

Trial by jury shall be as heretofore, and the right thereof remain inviolate. The General Assembly may provide, however, by law, that a verdict may be rendered by not less than five-sixths of the jury in any civil case. Furthermore, in criminal cases the Commonwealth shall have the same right to trial by jury as does the accused.

(May 18, 1971, P.L.765, J.R.1; Nov. 3, 1998, P.L.1328, J.R.2)

§ 7. Freedom of press and speech; libels.

The printing press shall be free to every person who may undertake to examine the proceedings of the Legislature or any branch of government, and no law shall ever be made to restrain the right thereof. The free communication of thoughts and opinions is one of the invaluable rights of man, and every citizen may freely speak, write and print on any subject, being responsible for the abuse of that liberty. No conviction shall be had in any prosecution for the publication of papers relating to the official conduct of officers or men in public capacity, or to any other matter proper for public investigation or information, where the fact that such publication was not maliciously or negligently made shall be established to the satisfaction of the jury; and in all indictments for libels the jury shall have the right to determine the law and the facts, under the direction of the court, as in other cases.

Constitutionality. The provisions of section 7 relating to criminal libel were declared unconstitutional by the Supreme Court of Pennsylvania in Commonwealth v. Armao, 446 Pa. 325, 286 A.2d 626 (1972).

§ 8. Security from searches and seizures.

The people shall be secure in their persons, houses, papers and possessions from unreasonable searches and seizures, and no warrant to search any place or to seize any person or things shall issue without describing them as nearly as may be, nor without probable cause, supported by oath or affirmation subscribed to by the affiant.

§ 9. Rights of accused in criminal prosecutions.

In all criminal prosecutions the accused hath a right to be heard by himself and his counsel, to demand the nature and cause of the accusation against him, to be confronted with the witnesses against him, to have compulsory process for obtaining witnesses in his favor, and, in prosecutions by indictment or information, a

speedy public trial by an impartial jury of the vicinage; he cannot be compelled to give evidence against himself, nor can he be deprived of his life, liberty or property, unless by the judgment of his peers or the law of the land. The use of a suppressed voluntary admission or voluntary confession to impeach the credibility of a person may be permitted and shall not be construed as compelling a person to give evidence against himself. (Nov. 6, 1984, P.L.1306, J.R.2; Nov. 7, 1995, 1st Sp.Sess., P.L.1151, J.R.1; Nov. 4, 2003, P.L.459, J.R.1)

1995 Amendment. Joint Resolution No. 1 amended section 9. The passage of Joint Resolution No.1 was declared unconstitutional by Bergdoll v. Kane 731 A.2d 1261 (1999) and the language was reverted.

§ 10. Initiation of criminal proceedings; twice in jeopardy; eminent domain.

Except as hereinafter provided no person shall, for any indictable offense, be proceeded against criminally by information, except in cases arising in the land or naval forces, or in the militia, when in actual service, in time of war or public danger, or by leave of the court for oppression or misdemeanor in office. Each of the several courts of common pleas may, with the approval of the Supreme Court, provide for the initiation of criminal proceedings therein by information filed in the manner provided by law. No person shall, for the same offense, be twice put in jeopardy of life or limb; nor shall private property be taken or applied to public use, without authority of law and without just compensation being first made or secured. (Nov. 6, 1973, P.L.452, J.R.2)

§ 11. Courts to be open; suits against the Commonwealth.

All courts shall be open; and every man for an injury done him in his lands, goods, person or reputation shall have remedy by due course of law, and right and justice administered without sale, denial or delay. Suits may be brought against the Commonwealth in such manner, in such courts and in such cases as the Legislature may by law direct.

§ 12. Power of suspending laws.

No power of suspending laws shall be exercised unless by the Legislature or by its authority.

§ 13. Bail, fines and punishments.

Excessive bail shall not be required, nor excessive fines imposed, nor cruel punishments inflicted.

§ 14. Prisoners to be bailable; habeas corpus.

All prisoners shall be bailable by sufficient sureties, unless for capital offenses or for offenses for which the maximum sentence is life imprisonment or unless no condition or

combination of conditions other than imprisonment will reasonably assure the safety of any person and the community when the proof is evident or presumption great; and the privilege of the writ of habeas corpus shall not be suspended, unless when in case of rebellion or invasion the public safety may require it.
(Nov. 3, 1998, P.L.1327, J.R.1)

§ 15. Special criminal tribunals.

No commission shall issue creating special temporary criminal tribunals to try particular individuals or particular classes of cases.
(May 16, 1967, P.L.1035, J.R.1)

§ 16. Insolvent debtors.

The person of a debtor, where there is not strong presumption of fraud, shall not be continued in prison after delivering up his estate for the benefit of his creditors in such manner as shall be prescribed by law.

§ 17. Ex post facto laws; impairment of contracts.

No ex post facto law, nor any law impairing the obligation of contracts, or making irrevocable any grant of special privileges or immunities, shall be passed.

§ 18. Attainder.

No person shall be attainted of treason or felony by the Legislature.

§ 19. Attainder limited.

No attainder shall work corruption of blood, nor, except during the life of the offender, forfeiture of estate to the Commonwealth.
(May 16, 1967, P.L.1035, J.R.1)

§ 20. Right of petition.

The citizens have a right in a peaceable manner to assemble together for their common good, and to apply to those invested with the powers of government for redress of grievances or other proper purposes, by petition, address or remonstrance.

§ 21. Right to bear arms.

The right of the citizens to bear arms in defense of themselves and the State shall not be questioned.

§ 22. Standing army; military subordinate to civil power.

No standing army shall, in time of peace, be kept up without the consent of the Legislature, and the military shall in all cases and at all times be in strict subordination to the civil power.

§ 23. Quartering of troops.

No soldier shall in time of peace be quartered in any house without the consent of the owner, nor in time of war but in a manner to be prescribed by law.

§ 24. Titles and offices.

The Legislature shall not grant any title of nobility or hereditary distinction, nor create any office the appointment to which shall be for a longer term than during good behavior.

§ 25. Reservation of powers in people.

To guard against transgressions of the high powers which we have delegated, we declare that everything in this article is excepted out of the general powers of government and shall forever remain inviolate.

(May 16, 1967, P.L.1035, J.R.1)

1967 Amendment. Joint Resolution No.1 repealed former section 25 and renumbered former section 26 to present section 25.

§ 26. No discrimination by Commonwealth and its political subdivisions.

Neither the Commonwealth nor any political subdivision thereof shall deny to any person the enjoyment of any civil right, nor discriminate against any person in the exercise of any civil right.

(May 16, 1967, P.L.1035, J.R.1)

1967 Amendment. Joint Resolution No.1 added present section 26 and renumbered former section 26 to present section 25.

§ 27. Natural resources and the public estate.

The people have a right to clean air, pure water, and to the preservation of the natural, scenic, historic and esthetic values of the environment. Pennsylvania's public natural resources are the common property of all the people, including generations yet to come. As trustee of these resources, the Commonwealth shall conserve and maintain them for the benefit of all the people.

(May 18, 1971, P.L.769, J.R.3)

1971 Amendment. Joint Resolution No.3 added section 27.

§ 28. Prohibition against denial or abridgment of equality of rights because of sex.

Equality of rights under the law shall not be denied or abridged in the Commonwealth of Pennsylvania because of the sex of the individual.

(May 18, 1971, P.L.767, J.R.2)

1971 Amendment. Joint Resolution No.2 added section 28.

SECTION 1

Summary for the Public

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Prepared for the BioInitiative Working Group

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I. SUMMARY FOR THE PUBLIC

A. Introduction

You cannot see it, taste it or smell it, but it is one of the most pervasive environmental exposures in industrialized countries today. Electromagnetic radiation (EMR) or electromagnetic fields (EMFs) are the terms that broadly describe exposures created by the vast array of wired and wireless technologies that have altered the landscape of our lives in countless beneficial ways. However, these technologies were designed to maximize energy efficiency and convenience; not with biological effects on people in mind. Based on new studies, there is growing evidence among scientists and the public about possible health risks associated with these technologies.

Human beings are bioelectrical systems. Our hearts and brains are regulated by internal bioelectrical signals. Environmental exposures to artificial EMFs can interact with fundamental biological processes in the human body. In some cases, this can cause discomfort and disease. Since World War II, the background level of EMF from electrical sources has risen exponentially, most recently by the soaring popularity of wireless technologies such as cell phones (two billion and counting in 2006), cordless phones, WI-FI and WI-MAX networks. Several decades of international scientific research confirm that EMFs are biologically active in animals and in humans, which could have major public health consequences.

In today's world, everyone is exposed to two types of EMFs: (1) extremely low frequency electromagnetic fields (ELF) from electrical and electronic appliances and power lines and (2) radiofrequency radiation (RF) from wireless devices such as cell phones and cordless phones, cellular antennas and towers, and broadcast transmission towers. In this report we will use the term EMFs when referring to all electromagnetic fields in general; and the terms ELF and RF when referring to the specific type of exposure. They are both types of non-ionizing radiation, which means that they do not have sufficient energy to break off electrons from their orbits around atoms and ionize (charge) the atoms, as do x-rays, CT scans, and other forms of ionizing radiation. A glossary and definitions are provided in Section 18 to assist you. Some handy definitions you will probably need when reading about ELF and RF in this summary section (the language for measuring it) are shown with the references for this section.

B. Purpose of the Report

This report has been written by 14 (fourteen) scientists, public health and public policy experts to document the scientific evidence on electromagnetic fields. Another dozen outside reviewers have looked at and refined the Report.

The purpose of this report is to assess scientific evidence on health impacts from electromagnetic radiation below current public exposure limits and evaluate what changes in these limits are warranted now to reduce possible public health risks in the future.

Not everything is known yet about this subject; but what is clear is that the existing public safety standards limiting these radiation levels in nearly every country of the world look to be thousands of times too lenient. Changes are needed.

New approaches are needed to educate decision-makers and the public about sources of exposure and to find alternatives that do not pose the same level of possible health risks, while there is still time to make changes.

A working group composed of scientists, researchers and public health policy professionals (The BioInitiative Working Group) has joined together to document the information that must be considered in the international debate about the adequacy (or inadequacy) of existing public exposure standards.

This Report is the product of an international research and public policy initiative to give an overview of what is known of biological effects that occur at low-intensity EMFs exposures (for both radiofrequency radiation RF and power-frequency ELF, and various forms of combined exposures that are now known to be bioactive). The Report examines the research and current standards and finds that these standards are far from adequate to protect public health.

Recognizing that other bodies in the United States, United Kingdom, Australia, many European Union and eastern European countries as well as the World Health Organization are actively debating this topic, the BioInitiative Working Group has conducted a independent science and public health policy review process. The report presents solid science on this issue, and makes recommendations to decision-makers and the public. Conclusions of the individual authors, and overall conclusions are given in Table 2-1 (BioInitiative Overall Summary Chart).

Eleven (11) chapters that document key scientific studies and reviews identifying low-intensity effects of electromagnetic fields have been written by members of the BioInitiative Working Group. Section 16 and 17 have been prepared by public health and policy experts. These sections discusses the standard of evidence which should be applied in public health planning, how the scientific information should be evaluated in the context of prudent public health policy, and identifies the basis for taking precautionary and preventative actions that are proportionate to the knowledge at hand. They also evaluate the evidence for ELF that leads to a recommendation for new public safety limits (not precautionary or preventative actions, as need is demonstrated).

Other scientific review bodies and agencies have reached different conclusions than we have by adopting standards of evidence so unreasonably high as to exclude any conclusions likely to lead to new public safety limits. Some groups are actually recommending a relaxation of the existing (and inadequate) standards. Why is this happening? One reason is that exposure limits for ELF and RF are developed by bodies of scientists and engineers that belong to professional societies who have traditionally developed recommendations; and then government agencies have adopted those recommendations. The standard-setting processes have little, if any, input from other stakeholders outside professional engineering and closely-related commercial interests. Often, the industry view of allowable risk and proof of harm is most influential, rather than what public health experts would determine is acceptable.

Main Reasons for Disagreement among Experts

1) Scientists and public health policy experts use very different definitions of the standard of evidence used to judge the science, so they come to different conclusions about what to do. Scientists do have a role, but it is not exclusive and other opinions matter.
2) We are all talking about essentially the same scientific studies, but use a different way of measuring when "enough is enough" or "proof exists".
3) Some experts keep saying that all studies have to be consistent (turn out the same way every time) before they are comfortable saying an effect exists.
4) Some experts think that it is enough to look only at short-term, acute effects.
5) Other experts say that it is imperative we have studies over longer time (showing the effects of chronic exposures) since that is what kind of world we live in.
6) Some experts say that everyone, including the very young, the elderly, pregnant women, and people with illnesses have to be considered – others say only the average person (or in the case of RF, a six-foot tall man) matter.
7) There is no unexposed population, making it harder to see increased risk of diseases.
8) The lack of consensus about a single biological mechanism of action.
9) The strength of human epidemiological studies reporting risks from ELF and RF exposures, but animal studies don't show a strong toxic effect.
10) Vested interests have a substantial influence on the health debate.

Public Policy Decisions

Safety limits for public exposure to EMFs need to be developed on the basis of interaction among not only scientists, but also public health experts, public policy makers and the general public.

"In principle, the assessment of the evidence should combine with judgment based on other societal values, for example, costs and benefits, acceptability of risks, cultural preferences, etc. and result in sound and effective decision-making. Decisions on these matters are eventually taken as a function of the views, values and interests of the stakeholders participating in the process, whose opinions are then weighed depending on several factors. Scientific evidence perhaps carries, or should carry, relatively heavy weight, but grants no exclusive status; decisions will be evidence-based but will also be based on other factors." (1)

The clear consensus of the BioInitiative Working Group members is that the existing public safety limits are inadequate for both ELF and RF.

These proposals reflect the evidence that a positive assertion of safety with respect to chronic exposure to low-intensity levels of ELF and RF cannot be made. As with many other standards for environmental exposures, these proposed limits may not be totally protective, but more stringent standards are not realistic at the present time. Even a small increased risk for cancer and neurodegenerative diseases translates into an enormous public health consequence. Regulatory action for ELF and preventative actions for RF are warranted at this time to reduce exposures and inform the public of the potential for increased risk; at what levels of chronic exposure these risks may be present; and what measures may be taken to reduce risks.

C. Problems with Existing Public Health Standards (Safety Limits)

Today's public exposure limits for telecommunications are based on the presumption that heating of tissue (for RF) or induced electric currents in the body (for ELF) are the only concerns when living organisms are exposed to RF. These exposures can create tissue heating that is well known to be harmful in even very short-term doses. As such, thermal limits do serve a purpose. For example, for people whose occupations require them to work around radar facilities or RF heat-sealers, or for people who install and service wireless antenna tower, thermally-based limits are necessary to prevent damage from heating (or, in the case of power-frequency ELF from induced current flow in tissues). In the past, scientists and engineers developed exposure standards for electromagnetic radiation based what we now believe are faulty assumptions that the right way to measure how much non-ionizing energy humans can tolerate (how much exposure) without harm is to measure only the heating of tissue (RF) or induced currents in the body (ELF).

In the last few decades, it has been established beyond any reasonable doubt that bioeffects and some adverse health effects occur at far lower levels of RF and ELF exposure where no heating (or induced currents) occurs at all; some effects are shown to occur at several hundred thousand times below the existing public safety limits where heating is an impossibility.

It appears it is the INFORMATION conveyed by electromagnetic radiation (rather than heat) that causes biological changes - some of these biological changes may lead to loss of wellbeing, disease and even death.

Effects occur at non-thermal or low-intensity exposure levels thousands of times below the levels that federal agencies say should keep the public safe. For many new devices operating with wireless technologies, the devices are exempt from any regulatory standards. The existing standards have been proven to be inadequate to control against harm from low-intensity, chronic exposures, based on any reasonable, independent assessment of the scientific literature. It means that an entirely new basis (a biological basis) for new exposure standards is needed. New standards need to take into account what we have learned about the effects of ELF and RF (all non-ionizing electromagnetic radiation and to design new limits based on biologically-

demonstrated effects that are important to proper biological function in living organisms. It is vital to do so because the explosion of new sources has created unprecedented levels of artificial electromagnetic fields that now cover all but remote areas of the habitable space on earth. Mid-course corrections are needed in the way we accept, test and deploy new technologies that expose us to ELF and RF in order to avert public health problems of a global nature.

Recent opinions by experts have documented deficiencies in current exposure standards. There is widespread discussion that thermal limits are outdated, and that biologically-based exposure standards are needed. Section 4 describes concerns expressed by WHO, 2007 in its ELF Health Criteria Monograph; the SCENIHR Report, 2006 prepared for the European Commission; the UK SAGE Report, 2007; the Health Protection Agency, United Kingdom in 2005; the NATO Advanced Research Workshop in 2005; the US Radiofrequency Interagency Working Group in 1999; the US Food and Drug Administration in 2000 and 2007; the World Health Organization in 2002; the International Agency for Cancer Research (IARC, 2001), the United Kingdom Parliament Independent Expert Group Report on Mobile Phones – Stewart Report, 2000) and others.

A pioneer researcher, the late Dr. Ross Adey, in his last publication in Bioelectromagnetic Medicine (P. Roche and M. Markov, eds. 2004) concluded:

> "*There are major unanswered questions about possible health risks that may arise from exposures to various man-made electromagnetic fields where these human exposures are intermittent, recurrent, and may extend over a significant portion of the lifetime of the individual."*
>
> *"Epidemiological studies have evaluated ELF and radiofrequency fields as possible risk factors for human health, with historical evidence relating rising risks of such factors as progressive rural electrification, and more recently, to methods of electrical power distribution and utilization in commercial buildings. Appropriate models describing these bioeffects are based in non-equilibrium thermodynamics, with nonlinear electrodynamics as an integral feature. Heating models, based in equilibrium thermodynamics, fail to explain an impressive new frontier of much greater significance. ..... Though incompletely understood, tissue free radical interactions with magnetic fields may extend to zero field levels." (2)*

There may be no lower limit at which exposures do not affect us. Until we know if there is a lower limit below which bioeffects and adverse health impacts do not occur, it is unwise from a public health perspective to continue "business-as-usual" deploying new technologies that increase ELF and RF exposures, particularly involuntary exposures.

II. SUMMARY OF THE SCIENCE

A. Evidence for Cancer

1. Childhood Leukemia

The evidence that power lines and other sources of ELF are consistently associated with higher rates of childhood leukemia has resulted in the International Agency for Cancer Research (an arm of the World Health Organization) to classify ELF as a Possible Human Carcinogen (in the Group 2B carcinogen list). Leukemia is the most common type of cancer in children.

There is little doubt that exposure to ELF causes childhood leukemia.

The exposure levels for increased risk are quite low – just above background or ambient levels and much lower than current exposure limits. The existing ICNIRP limit is 1000 mG (904 mG in the US) for ELF. Increased risk for childhood leukemia starts at levels almost one thousand times below the safety standard. Leukemia risks for young boys are reported in one study to double at only 1.4 mG and above (7) Most other studies combine older children with younger children (0 to 16 years) so that risk levels do not reach statistical significance until exposure levels reach 2 mG or 3 mG. Although some reviews have combined studies of childhood leukemia in ways that indicate the risk level starts at 4 mG and above; this does not reflect many of the studies reporting elevated risks at the lower exposure levels of 2 mG and 3 mG.

2. Other Childhood Cancers

Other childhood cancers have been studied, including brain tumors, but not enough work has been done to know if there are risks, how high these risks might be or what exposure levels might be associated with increased risks. The lack of certainty about other childhood cancers should not be taken to signal the "all clear"; rather it is a lack of study.

The World Health Organization ELF Health Criteria Monograph No 322 (2007) says that other childhood cancers "cannot be ruled out". (8)

There is some evidence that other childhood cancers may be related to ELF exposure but not enough studies have been done.

Several recent studies provide even stronger evidence that ELF is a risk factor for childhood leukemia and cancers later in life. In the first study (9), children who were recovering in high-ELF environments had poorer survival rates (a 450% increased risk of dying if the ELF fields were 3 mG and above). In the second study, children who were recovering in 2 mG and above ELF environments were 300% more likely to die than children exposed to 1 mG and below. In

this second study, children recovering in ELF environments between 1 and 2 mG also had poorer survival rates, where the increased risk of dying was 280%. (10) These two studies give powerful new information that ELF exposures in children can be harmful at levels above even 1 mG. The third study looked what risks for cancer a child would have later in life, if that child was raised in a home within 300 meters of a high-voltage electric power line. (11) For children who were raised for their first five years of life within 300 meters, they have a life-time risk that is 500% higher for developing some kinds of cancers.

Children who have leukemia and are in recovery have poorer survival rates if their ELF exposure at home (or where they are recovering) is between 1mG and 2 mG in one study; over 3 mG in another study.

Given the extensive study of childhood leukemia risks associated with ELF, and the relatively consistent findings that exposures in the 2 mG to 4 mG range are associated with increased risk to children, a 1 mG limit for habitable space is recommended for new construction. While it is difficult and expensive to retrofit existing habitable space to a 1 mG level, and is also recommended as a desirable target for existing residences and places where children and pregnant women may spend prolonged periods of time.

New ELF public exposure limits are warranted at this time, given the existing scientific evidence and need for public health policy intervention and prevention.

3. Brain Tumors and Acoustic Neuromas

Radiofrequency radiation from cell phone and cordless phone exposure has been linked in more than one dozen studies to increased risk for brain tumors and/or acoustic neuromas (a tumor in the brain on a nerve related to our hearing).

People who have used a cell phone for ten years or more have higher rates of malignant brain tumor and acoustic neuromas. It is worse if the cell phone has been used primarily on one side of the head.

For brain tumors, people who have used a cell phone for 10 years or longer have a 20% increase in risk (when the cell phone is used on both sides of the head). For people who have used a cell phone for 10 years or longer predominantly on one side of the head, there is a 200% increased risk of a brain tumor. This information relies on the combined results of many brain tumor/cell phone studies taken together (a meta-analysis of studies).

People who have used a cordless phone for ten years or more have higher rates of malignant brain tumor and acoustic neuromas. It is worse if the cordless phone has been used primarily on one side of the head.

The risk of brain tumor (high-grade malignant glioma) from cordless phone use is 220% higher (both sides of the head). The risk from use of a cordless phone is 470% higher when used mostly on only one side of the head.

For acoustic neuromas, there is a 30% increased risk with cell phone use at ten years and longer; and a 240% increased risk of acoustic neuroma when the cell phone is used mainly on one side of the head. These risks are based on the combined results of several studies (a meta-analysis of studies).

For use of cordless phones, the increased risk of acoustic neuroma is three-fold higher (310%) when the phone is mainly used on one side of the head.

The current standard for exposure to the emissions of cell phones and cordless phones is not safe considering studies reporting long-term brain tumor and acoustic neuroma risks.

Other indications that radiofrequency radiation can cause brain tumors comes from exposures to low-level RF other than from cell phone or cordless phone use. Studies of people who are exposed in their work (occupational exposure) show higher brain tumor rates as well. Kheifets (1995) reported a 10% to 20% increased risk of brain cancer for those employed in electrical occupations. This meta-analysis surveyed 29 published studies of brain cancer in relation to occupational EMFs exposure or work in electrical occupations. (6). The evidence for a link between other sources of RF exposure like working at a job with EMFs exposure is consistent with a moderately elevated risk of developing brain tumors.

4. *Other Adult Cancers*

There are multiple studies that show statistically significant relationships between occupational exposure and leukemia in adults (see Chapter 11), in spite of major limitations in the exposure assessment. A very recent study by Lowenthal et al. (2007) investigated leukemia in adults in relation to residence near to high-voltage power lines. While they found elevated risk in all adults living near to the high voltage power lines, they found an OR of 3.23 (95% CI = 1.26-8.29) for individuals who spent the first 15 years of life within 300 m of the power line. This study provides support for two important conclusions: adult leukemia is also associated with EMF exposure, and exposure during childhood increases risk of adult disease.

A significant excess risk for adult brain tumors in electrical workers and those adults with occupational EMF exposure was reported in a meta-analysis (review of many individual studies) by Kheifets et al., (1995). This is about the same size risk for lung cancer and secondhand smoke (US DHHS, 2006). A total of 29 studies with populations from 12 countries were included in this meta-analysis. The relative risk was reported as 1.16 (CI = 1.08 – 1.24) or a 16% increased risk

for all brain tumors. For gliomas, the risk estimate was reported to be 1.39 (1.07 – 1.82) or a 39% increased risk for those in electrical occupations. A second meta-analysis published by Kheifets et al., ((2001) added results of 9 new studies published after 1995. It reported a new pooled estimate (OR = 1.16, 1.08 – 1.01) that showed little change in the risk estimate overall from 1995.

The evidence for a relationship between exposure and breast cancer is relatively strong in men (Erren, 2001), and some (by no means all) studies show female breast cancer also to be elevated with increased exposure (see Chapter 12). Brain tumors and acoustic neuromas are more common in exposed persons (see Chapter 10). There is less published evidence on other cancers, but Charles et al. (2003) report that workers in the highest 10% category for EMF exposure were twice as likely to die of prostate cancer as those exposed at lower levels (OR 2.02, 95% CI = 1.34-3.04). Villeneuve et al. (2000) report statistically significant elevations of non-Hodgkin's lymphoma in electric utility workers in relation to EMF exposure, while Tynes et al. (2003) report elevated rates of malignant melanoma in persons living near to high voltage power lines. While these observations need replication, they suggest a relationship between exposure and cancer in adults beyond leukemia.

In total the scientific evidence for adult disease associated with EMF exposure is sufficiently strong for adult cancers that preventive steps are appropriate, even if not all reports have shown exactly the same positive relationship. This is especially true since many factors reduce our ability to see disease patterns that might be related to EMF exposure: there is no unexposed population for comparison, for example, and other difficulties in exposure assessment, The evidence for a relationship between EMF exposure and adult cancers and neurodegenerative diseases is sufficiently strong at present to merit preventive actions to reduce EMF exposure.

5. *Breast Cancer*

There is rather strong evidence from multiple areas of scientific investigation that ELF is related to breast cancer. Over the last two decades there have been numerous epidemiological studies (studies of human illness) on breast cancer in both men and women, although this relationship remains controversial among scientists. Many of these studies report that ELF exposures are related to increased risk of breast cancer (not all studies report such effects, but then, we do not expect 100% or even 50% consistency in results in science, and do not require it to take reasonable preventative action).

The evidence from studies on women in the workplace rather strongly suggests that ELF is a risk factor for breast cancer for women with long-term exposures of 10 mG and higher.

Breast cancer studies of people who work in relatively high ELF exposures (10 mG and above) show higher rates of this disease. Most studies of workers who are exposed to ELF have defined high exposure levels to be somewhere between 2 mG and 10 mG; however this kind of mixing of relatively low to relatively high ELF exposure just acts to dilute out real risk levels. Many of the occupational studies group exposures so that the highest group is exposed to 4 mG and above. What this means is that a) few people are exposed to much higher levels and b) illness patterns show up at relatively low ELF levels of 4 mG and above. This is another way of demonstrating

that existing ELF limits that are set at 933-1000 mG are irrelevant to the exposure levels reporting increased risks.

Laboratory studies that examine human breast cancer cells have shown that ELF exposure between 6 mG and 12 mG can interfere with protective effects of melatonin that fights the growth of these breast cancer cells. For a decade, there has been evidence that human breast cancer cells grow faster if exposed to ELF at low environmental levels. This is thought to be because ELF exposure can reduce melatonin levels in the body. The presence of melatonin in breast cancer cell cultures is known to reduce the growth of cancer cells. The absence of melatonin (because of ELF exposure or other reasons) is known to result in more cancer cell growth.

Laboratory studies of animals that have breast cancer tumors have been shown to have more tumors and larger tumors when exposed to ELF and a chemical tumor promoter at the same time. These studies taken together indicate that ELF is a likely risk factor for breast cancer, and that ELF levels of importance are no higher than many people are exposed to at home and at work. A reasonable suspicion of risk exists and is sufficient evidence on which to recommend new ELF limits; and to warrant preventative action.

Given the very high lifetime risks for developing breast cancer, and the critical importance of prevention; ELF exposures should be reduced for all people who are in high ELF environments for prolonged periods of time.

Reducing ELF exposure is particularly important for people who have breast cancer. The recovery environment should have low ELF levels given the evidence for poorer survival rates for childhood leukemia patients in ELF fields over 2 mG or 3 mG. Preventative action for those who may be at higher risk for breast cancer is also warranted (particularly for those taking tamoxifen as a way to reduce the risk of getting breast cancer, since in addition to reducing the effectiveness of melatonin, ELF exposure may also reduce the effectiveness of tamoxifen at these same low exposure levels). There is no excuse for ignoring the substantial body of evidence we already have that supports an association between breast cancer and ELF exposure; waiting for conclusive evidence is untenable given the enormous costs and societal and personal burdens caused by this disease.

Studies of human breast cancer cells and some animal studies show that ELF is likely to be a risk factor for breast cancer. There is supporting evidence for a link between breast cancer and exposure to ELF that comes from cell and animal studies, as well as studies of human breast cancers.

These are just some of the cancer issues to discuss. It may be reasonable now to make the assumption that all cancers, and other disease endpoints might be related to, or worsened by exposures to EMFs (both ELF and RF).

If one or more cancers are related, why would not all cancer risks be at issue? It can no longer be said that the current state of knowledge rules out or precludes risks to human health. The

enormous societal costs and impacts on human suffering by not dealing proactively with this issue require substantive public health policy actions; and actions of governmental agencies charged with the protection of public health to act on the basis of the evidence at hand.

B. Changes in the Nervous System and Brain Function

Exposure to electromagnetic fields has been studies in connection with Alzheimer's disease, motor neuron disease and Parkinson's disease. (4) These diseases all involve the death of specific neurons and may be classified as neurodegenerative diseases. There is evidence that high levels of amyloid beta are a risk factor for Alzheimer's disease, and exposure to ELF can increase this substance in the brain. There is considerable evidence that melatonin can protect the brain against damage leading to Alzheimer's disease, and also strong evidence that exposure to ELF can reduce melatonin levels. Thus it is hypothesized that one of the body's main protections against developing Alzheimer's disease (melatonin) is less available to the body when people are exposed to ELF. Prolonged exposure to ELF fields could alter calcium (Ca2+) levels in neurons and induce oxidative stress (4). It is also possible that prolonged exposure to ELF fields may stimulate neurons (particularly large motor neurons) into synchronous firing, leading to damage by the buildup of toxins.

Evidence for a relationship between exposure and the neurodegenerative diseases, Alzheimer's and amyotrophic lateral sclerosis (ALS), is strong and relatively consistent (see Chapter 12). While not every publication shows a statistically significant relationship between exposure and disease, ORs of 2.3 (95% CI = 1.0-5.1 in Qio et al., 2004), of 2.3 (95% CI = 1.6-3.3 in Feychting et al., 2003) and of 4.0 (95% CI = 1.4-11.7 in Hakansson et al., 2003) for Alzheimer's Disease, and of 3.1 (95% CI = 1.0-9.8 in Savitz et al., 1998) and 2.2 (95% CI = 1.0-4.7 in Hakansson et al., 2003) for ALS cannot be simply ignored.

Alzheimer's disease is a disease of the nervous system. There is strong evidence that long-term exposure to ELF is a risk factor for Alzheimer's disease.

Concern has also been raised that humans with epileptic disorders could be more susceptible to RF exposure. Low-level RF exposure may be a stressor based on similarities of neurological effects to other known stressors; low-level RF activates both endogenous opioids and other substances in the brain that function in a similar manner to psychoactive drug actions. Such effects in laboratory animals mimic the effects of drugs on the part of the brain that is involved in addiction.

Laboratory studies show that the nervous system of both humans and animals is sensitive to ELF and RF. Measurable changes in brain function and behavior occur at levels associated with new technologies including cell phone use. Exposing humans to cell phone radiation can change brainwave activity at levels as low as 0.1 watt per kilogram SAR (W/Kg)*** in comparison to the US allowable level of 1.6 W/Kg and the International Commission for Non-ionizing Radiation Protection (ICNIRP) allowable level of 2.0 W/Kg. It can affect memory and learning. It can affect normal brainwave activity. ELF and RF exposures at low levels are able to change behavior in animals.

There is little doubt that electromagnetic fields emitted by cell phones and cell phone use affect electrical activity of the brain.

Effects on brain function seem to depend in some cases on the mental load of the subject during exposure (the brain is less able to do two jobs well simultaneously when the same part of the brain is involved in both tasks). Some studies show that cell phone exposure speeds up the brain's activity level; but also that the efficiency and judgment of the brain are diminished at the same time. One study reported that teenage drivers had slowed responses when driving and exposed to cell phone radiation, comparable to response times of elderly people. Faster thinking does not necessarily mean better quality thinking.

Changes in the way in which the brain and nervous system react depend very much on the specific exposures. Most studies only look at short-term effects, so the long-term consequences of exposures are not known.

Factors that determine effects can depend on head shape and size, the location, size and shape of internal brain structures, thinness of the head and face, hydration of tissues, thickness of various tissues, dialectric constant of the tissues and so on. Age of the individual and state of health also appear to be important variables. Exposure conditions also greatly influence the outcome of studies, and can have opposite results depending on the conditions of exposure including frequency, waveform, orientation of exposure, duration of exposure, number of exposures, any pulse modulation of the signal, and when effects are measured (some responses to RF are delayed). There is large variability in the results of ELF and RF testing, which would be expected based on the large variability of factors that can influence test results. However, it is clearly demonstrated that under some conditions of exposure, the brain and nervous system functions of humans are altered. The consequence of long-term or prolonged exposures have not been thoroughly studied in either adults or in children.

The consequence of prolonged exposures to children, whose nervous systems continue to develop until late adolescence, is unknown at this time. This could have serious implications to adult health and functioning in society if years of exposure of the young to both ELF and RF result in diminished capacity for thinking, judgment, memory, learning, and control over behavior.

People who are chronically exposed to low-level wireless antenna emissions report symptoms such as problems in sleeping (insomnia), fatigue, headache, dizziness, grogginess, lack of concentration, memory problems, ringing in the ears (tinnitus), problems with balance and orientation, and difficulty in multi-tasking. In children, exposures to cell phone radiation have resulted in changes in brain oscillatory activity during some memory tasks. Although scientific studies as yet have not been able to confirm a cause-and-effect relationship; these complaints are

widespread and the cause of significant public concern in some countries where wireless technologies are fairly mature and widely distributed (Sweden, Denmark, France, Germany, Italy, Switzerland, Austria, Greece, Israel). For example, the roll-out of the new 3rd Generation wireless phones (and related community-wide antenna RF emissions in the Netherlands) caused almost immediate public complaints of illness.(5)

Conflicting results from those few studies that have been conducted may be based on the difficulty in providing non-exposed environments for testing to compare to environments that are intentionally exposed. People traveling to laboratories for testing are pre-exposed to a multitude of RF and ELF exposures, so they may already be symptomatic prior to actual testing. Also complicating this is good evidence that RF exposures testing behavioral changes show delayed results; effects are observed after termination of RF exposure. This suggests a persistent change in the nervous system that may be evident only after time has passed, so is not observed during a short testing period.

The effects of long-term exposure to wireless technologies including emissions from cell phones and other personal devices, and from whole-body exposure to RF transmissions from cell towers and antennas is simply not known yet with certainty. However, the body of evidence at hand suggests that bioeffects and health impacts can and do occur at exquisitely low exposure levels: levels that can be thousands of times below public safety limits.

The evidence reasonably points to the potential for serious public health consequences (and economic costs), which will be of global concern with the widespread public use of, and exposure to such emissions. Even a small increase in disease incidence or functional loss of cognition related to new wireless exposures would have a large public health, societal and economic consequences. Epidemiological studies can report harm to health only after decades of exposure, and where large effects can be seen across "average" populations; so these early warnings of possible harm should be taken seriously now by decision-makers.

C. Effects on Genes (DNA)

Cancer risk is related to DNA damage, which alters the genetic blueprint for growth and development. If DNA is damaged (the genes are damaged) there is a risk that these damaged cells will not die. Instead they will continue to reproduce themselves with damaged DNA, and this is one necessary pre-condition for cancer. Reduced DNA repair may also be an important part of this story. When the rate of damage to DNA exceeds the rate at which DNA can be repaired, there is the possibility of retaining mutations and initiating cancer. Studies on how ELF and RF may affect genes and DNA is important, because of the possible link to cancer.
Even ten years ago, most people believed that very weak ELF and RF fields could not possibly have any effect at all on DNA and how cells work (or are damaged and cannot do their work properly). The argument was that these weak fields are do not possess enough energy (are not physically strong enough) to cause damage. However, there are multiple ways we already know about where energy is not the key factor in causing damage. For example, exposure to toxic chemicals can cause damage. Changing the balance of delicate biological processes, including

hormone balances in the body, can damage or destroy cells, and cause illness. In fact, many chronic diseases are directly related to this kind of damage that does not require any heating at all. Interference with cell communication (how cells interact) may either cause cancer directly or promote existing cancers to grow faster.

Using modern gene-testing techniques will probably give very useful information in the future about how EMFs targets and affects molecules in the body. At the gene level, there is some evidence now that EMFs (both ELF and RF) can cause changes in how DNA works. Laboratory studies have been conducted to see whether (and how) weak EMFs fields can affect how genes and proteins function. Such changes have been seen in some, but not all studies.

Small changes in protein or gene expression might be able to alter cell physiology, and might be able to cause later effects on health and well-being. The study of genes, proteins and EMFs is still in its infancy, however, by having some confirmation at the gene level and protein level that weak EMFs exposures do register changes may be an important step in establishing what risks to health can occur.

What is remarkable about studies on DNA, genes and proteins and EMFs is that there should be no effect at all if it were true that EMFs is too weak to cause damage. Scientists who believe that the energy of EMFs is insignificant and unlikely to cause harm have a hard time explaining these changes, so are inclined to just ignore them. The trouble with this view is that the effects are occurring. Not being able to explain these effects is not a good reason to consider them imaginary or unimportant.

The European research program (REFLEX) documented many changes in normal biological functioning in tests on DNA (3). The significance of these results is that such effects are directly related to the question of whether human health risks might occur, when these changes in genes and DNA happen. This large research effort produced information on EMFs effects from more than a dozen different researchers. Some of the key findings included:

> *"Gene mutations, cell proliferation and apoptosis are caused by or result in altered gene and protein expression profiles. The convergence of these events is required for the development of all chronic diseases."* (3)
>
> *"Genotoxic effects and a modified expression of numerous genes and proteins after EMF exposure could be demonstrated with great certainty.*" (3)
>
> *"RF-EMF produced genotoxic effects in fibroblasts, HL-60 cells, granulosa cells of rats and neural progenitor cells derived from mouse embryonic stem cells."* (Participants 2, 3 and 4). (3)
>
> *"Cells responded to RF exposure between SAR levels of 0.3 and 2 W/Kg with a significant increase in single- and double-strand DNA breaks and in micronuclei frequency."* (Participants 2, 3 and 4). (3)
>
> *"In HL-60 cells an increase in intracellular generation of free radicals accompanying RF-EMF exposure could clearly be demonstrated."* (Participant 2). (3)
>
> *"The induced DNA damage was not based on thermal effects and arouses consideration about the environmental safety limits for ELF-EMF exposure." (3)*

"The effects were clearly more pronounced in cells from older donors, which could point to an age-related decrease of DNA repair efficiency of ELF-EMF induced DNA strand breaks." (3)

Both ELF and RF exposures can be considered genotoxic (will damage DNA) under certain conditions of exposure, including exposure levels that are lower than existing safety limits.

D. Effects on Stress Proteins (Heat Shock Proteins)

In nearly every living organism, there is a special protection launched by cells when they are under attack from environmental toxins or adverse environmental conditions. This is called a stress response, and what are produced are stress proteins (also known as heat shock proteins). Plants, animals and bacteria all produce stress proteins to survive environmental stressors like high temperatures, lack of oxygen, heavy metal poisoning, and oxidative stress (a cause of premature aging). We can now add ELF and RF exposures to this list of environmental stressors that cause a physiological stress response.

Very low-level ELF and RF exposures can cause cells to produce stress proteins, meaning that the cell recognizes ELF and RF exposures as harmful. This is another important way in which scientists have documented that ELF and RF exposures can be harmful, and it happens at levels far below the existing public safety standards.

An additional concern is that if the stress goes on too long, the protective effect is diminished. There is a reduced response if the stress goes on too long, and the protective effect is reduced. This means the cell is less protected against damage, and it is why prolonged or chronic exposures may be quite harmful, even at very low intensities.

The biochemical pathway that is activated is the same for ELF and for RF exposures, and it is non-thermal (does not require heating or induced electrical currents, and thus the safety standards based on protection from heating are irrelevant and not protective). ELF exposure levels of only 5 to 10 mG have been shown to activate the stress response genes (Table 2, Section 6). The specific absorption rate or SAR is not the appropriate measure of biological threshold or dose, and should not be used as the basis for a safety standard, since SAR only regulates against thermal damage.

E. Effects on the Immune System

The immune system is another defense we have against invading organisms (viruses, bacteria, and other foreign molecules). It protects us against illness, infectious diseases, and tumor cells.

There are many different kinds of immune cells; each type of cell has a particular purpose, and is launched to defend the body against different kinds of exposures that the body determines might be harmful.

There is substantial evidence that ELF and RF can cause inflammatory reactions, allergy reactions and change normal immune function at levels allowed by current public safety standards.

The body's immune defense system senses danger from ELF and RF exposures, and targets an immune defense against these fields, much like the body's reaction in producing stress proteins. These are additional indicators that very low intensity ELF and RF exposures are a) recognized by cells and b) can cause reactions as if the exposure is harmful. Chronic exposure to factors that increase allergic and inflammatory responses on a continuing basis are likely to be harmful to health. Chronic inflammatory responses can lead to cellular, tissue and organ damage over time. Many chronic diseases are thought to be related to chronic problems with immune system function.

The release of inflammatory substances, such as histamine, are well-known to cause skin reactions, swelling, allergic hypersensitivity and other conditions that are normally associated with some kind of defense mechanism. The human immune system is part of a general defense barrier that protects against harmful exposures from the surrounding environment. When the immune system is aggravated by some kind of attack, there are many kinds of immune cells that can respond. Anything that triggers an immune response should be carefully evaluated, since chronic stimulation of the immune system may over time impair the system's ability to respond in the normal fashion.

Measurable physiological changes (mast cell increases in the skin, for example that are markers of allergic response and inflammatory cell response) are triggered by ELF and RF at very low intensities. Mast cells, when activated by ELF or RF, will break (degranulate) and release irritating chemicals that cause the symptoms of allergic skin reactions.

There is very clear evidence that exposures to ELF and RF at levels associated with cell phone use, computers, video display terminals, televisions, and other sources can cause these skin reactions. Changes in skin sensitivity have been measured by skin biopsy, and the findings are remarkable. Some of these reactions happen at levels equivalent to those of wireless technologies in daily life. Mast cells are also found in the brain and heart, perhaps targets of immune response by cells responding to ELF and RF exposures, and this might account for some of the other symptoms commonly reported (headache, sensitivity to light, heart arrhythmias and other cardiac symptoms). Chronic provocation by exposure to ELF and RF can lead to immune dysfunction, chronic allergic responses, inflammatory diseases and ill health if they occur on a continuing basis over time.

These clinical findings may account for reports of persons with electrical hypersensitivity, which is a condition where there is intolerance for any level of exposure to ELF and/or RF. Although there is not yet a substantial scientific assessment (under controlled conditions, if that is even possible); anecdotal reports from many countries show that estimates range from 3% to perhaps 5% of populations, and it is a growing problem. Electrical hypersensitivity, like multiple

chemical sensitivity, can be disabling and require the affected person to make drastic changes in work and living circumstances, and suffer large economic losses and loss of personal freedom. In Sweden, electrohypersensitivity (EHS) is officially recognized as fully functional impairment (i.e., it is not regarded as a disease – see Section 6, Appendix A).

F. Plausible Biological Mechanisms

Plausible biological mechanisms are already identified that can reasonably account for most biological effects reported for exposure to RF and ELF at low-intensity levels (oxidative stress and DNA damage from free radicals leading to genotoxicity; molecular mechanisms at very low energies are plausible links to disease, e.g., effect on electron transfer rates linked to oxidative damage, DNA activation linked to abnormal biosynthesis and mutation). It is also important to remember that traditional public health and epidemiological determinations do not require a proven mechanism before inferring a causal link between EMFs exposure and disease (12). Many times, proof of mechanism is not known before wise public health responses are implemented.

"Obviously, melatonin's ability to protect DNA from oxidative damage has implications for many types of cancer, including leukemia, considering that DNA damage due to free radicals is believed to be the initial oncostatic event in a majority of human cancers [Cerutti et al., 1994]. In addition to cancer, free radical damage to the central nervous system is a significant component of a variety of neurodegenerative diseases of the aged including Alzheimer's disease and Parkinsonism. In experimental animal models of both of these conditions, melatonin has proven highly effective in forestalling their onset, and reducing their severity [Reiter et al., 2001]." (13)

Oxidative stress through the action of free radical damage to DNA is a plausible biological mechanism for cancer and diseases that involve damage from ELF to the central nervous system.

G. Another Way of Looking at EMFs: Therapeutic Uses

Many people are surprised to learn that certain kinds of EMFs treatments actually can heal. These are medical treatments that use EMFs in specific ways to help in healing bone fractures, to heal wounds to the skin and underlying tissues, to reduce pain and swelling, and for other post-surgical needs. Some forms of EMFs exposure are used to treat depression.

EMFs have been shown to be effective in treating conditions of disease at energy levels far below current public exposure standards. This leads to the obvious question. How can scientists dispute the harmful effects of EMF exposures while at the same time using forms of EMF treatment that are proven to heal the body?

Medical conditions are successfully treated using EMFs at levels below current public safety standards, proving another way that the body recognizes and responds to low-intensity EMF signals. Otherwise, these medical treatments could not work. The FDA has approved EMFs medical treatment devices, so is clearly aware of this paradox.

Random exposures to EMFs, as opposed to EMFs exposures done with clinical oversight, could lead to harm just like the unsupervised use of pharmaceutical drugs. This evidence forms a strong warning that indiscriminate EMF exposure is probably a bad idea.

No one would recommend that drugs used in medical treatments and prevention of disease be randomly given to the public, especially to children. Yet, random and involuntary exposures to EMFs occur all the time in daily life.

The consequence of multiple sources of EMFs exposures in daily life, with no regard to cumulative exposures or to potentially harmful combinations of EMFs exposures means several things. First, it makes it very difficult to do clinical studies because it is almost impossible to find anyone who is not already exposed. Second, people with and without diseases have multiple and overlapping exposures – this will vary from person to person.

Just as ionizing radiation can be used to effectively diagnose disease and treat cancer, it is also a cause of cancer under different exposure conditions. Since EMFs are both a cause of disease, and also used for treatment of disease, it is vitally important that public exposure standards reflect our current understanding of the biological potency of EMF exposures, and develop both new public safety limits and measures to prevent future exposures.

III. EMF EXPOSURE AND PRUDENT PUBLIC HEALTH PLANNING

- **The scientific evidence is sufficient to warrant regulatory action for ELF; and it is substantial enough to warrant preventative actions for RF.**
- **The standard of evidence for judging the emerging scientific evidence necessary to take action should be proportionate to the impacts on health and well-being**
- **The exposures are widespread.**
- **Widely accepted standards for judging the science are used in this assessment.**

Public exposure to electromagnetic radiation (power-line frequencies, radiofrequency and microwave) is growing exponentially worldwide. There is a rapid increase in electrification in developing countries, even in rural areas. Most members of society now have and use cordless phones, cellular phones, and pagers. In addition, most populations are also exposed to antennas in communities designed to transmit wireless RF signals. Some developing countries have even given up running land lines because of expense and the easy access to cell phones. Long-term and cumulative exposure to such massively increased RF has no precedent in human history. Furthermore, the most pronounced change is for children, who now routinely spend hours each day on the cell phone. Everyone is exposed to a greater or lesser extent. No one can avoid exposure, since even if they live on a mountain-top without electricity there will likely be exposure to communication-frequency RF exposure. Vulnerable populations (pregnant women, very young children, elderly persons, the poor) are exposed to the same degree as the general population. Therefore it is imperative to consider ways in which to evaluate risk and reduce exposure. Good public health policy requires preventative action proportionate to the potential risk of harm and the public health consequence of taking no action.

IV. RECOMMENDED ACTIONS

A. Defining new exposure standards for ELF

This chapter concludes that new ELF limits are warranted based on a public health analysis of the overall existing scientific evidence. The public health view is that new ELF limits are needed now. They should reflect environmental levels of ELF that have been demonstrated to increase risk for childhood leukemia, and possibly other cancers and neurological diseases. ELF limits should be set below those exposure levels that have been linked in childhood leukemia studies to increased risk of disease, plus an additional safety factor. It is no longer acceptable to build new power lines and electrical facilities that place people in ELF environments that have been determined to be risky. These levels are in the 2 to 4 milligauss* (mG) range, not in the 10s of mG or 100s of mG. The existing ICNIRP limit is 1000 mG (904 mG in the US) for ELF is outdated and based on faulty assumptions. These limits are can no longer be said to be protective of public health and they should be replaced. A safety buffer or safety factor should also be applied to a new, biologically-based ELF limit, and the conventional approach is to add a safety factor lower than the risk level.

While new ELF limits are being developed and implemented, a reasonable approach would be a 1 mG planning limit for habitable space adjacent to all new or upgraded power lines and a 2 mG limit for all other new construction. It is also recommended for that a 1 mG limit be established for existing habitable space for children and/or women who are pregnant (because of the possible link between childhood leukemia and *in utero* exposure to ELF). This recommendation is based on the assumption that a higher burden of protection is required for children who cannot protect themselves, and who are at risk for childhood leukemia at rates that are traditionally high enough to trigger regulatory action. This situation in particular warrants extending the 1 mG limit to existing occupied space. "Establish" in this case probably means formal public advisories from relevant health agencies. While it is not realistic to reconstruct all existing electrical distribution
systems, in the short term; steps to reduce exposure from these existing systems need to be initiated, especially in places where children spend time, and should be encouraged. These limits should reflect the exposures that are commonly associated with increased risk of child hood leukemia (in the 2 to 5 mG range for all children, and over 1.4 mG for children age 6 and younger). Nearly all of the occupational studies for adult cancers and neurological diseases

report their highest exposure category is 4 mG and above, so that new ELF limits should target the exposure ranges of interest, and not necessarily higher ranges.

Avoiding chronic ELF exposure in schools, homes and the workplace above levels associated with increased risk of disease will also avoid most of the possible bioactive parameters of ELF discussed in the relevant literature.

B. Defining preventative actions for reduction in RF exposures

Given the scientific evidence at hand (Chapter 17), the rapid deployment of new wireless technologies that chronically expose people to pulsed RF at levels reported to cause bioeffects, which in turn, could reasonably be presumed to lead to serious health impacts, is of public health concern. Section 17 summarizes evidence that has resulted in a public health recommendation that preventative action is warranted to reduce or minimize RF exposures to the public. There is suggestive to strongly suggestive evidence that RF exposures may cause changes in cell membrane function, cell communication, cell metabolism, activation of proto-oncogenes and can trigger the production of stress proteins at exposure levels below current regulatory limits. Resulting effects can include DNA breaks and chromosome aberrations, cell death including death of brain neurons, increased free radical production, activation of the endogenous opioid system, cell stress and premature aging, changes in brain function including memory loss, retarded learning, slower motor function and other performance impairment in children, headaches and fatigue, sleep disorders, neurodegenerative conditions, reduction in melatonin secretion and cancers (Chapters 5, 6, 7, 8, 9, 10, and 12).

As early as 2000, some experts in bioelectromagnetics promoted a 0.1 µW/cm2 limit (which is 0.614 Volts per meter) for ambient outdoor exposure to pulsed RF, so generally in cities, the public would have adequate protection against involuntary exposure to pulsed radiofrequency (e.g., from cell towers, and other wireless technologies). The Salzburg Resolution of 2000 set a target of 0.1 µW/cm2 (or 0.614 V/m) for public exposure to pulsed radiofrequency. Since then, there are many credible anecdotal reports of unwellness and illness in the vicinity of wireless transmitters (wireless voice and data communication antennas) at lower levels. Effects include sleep disruption, impairment of memory and concentration, fatigue, headache, skin disorders,

visual symptoms (floaters), nausea, loss of appetite, tinnitus, and cardiac problems (racing heartbeat), There are some credible articles from researchers reporting that cell tower -level RF exposures (estimated to be between 0.01 and 0.5 μW/cm2) produce ill-effects in populations living up to several hundred meters from wireless antenna sites.

This information now argues for thresholds or guidelines that are substantially below current FCC and ICNIPR standards for whole body exposure. Uncertainty about how low such standards might have to go to be prudent from a public health standpoint should not prevent reasonable efforts to respond to the information at hand. No lower limit for bioeffects and adverse health effects from RF has been established, so the possible health risks of wireless WLAN and WI-FI systems, for example, will require further research and no assertion of safety at any level of wireless exposure (chronic exposure) can be made at this time. The lower limit for reported human health effects has dropped 100-fold below the safety standard (for mobile phones and PDAs); 1000- to 10,000-fold for other wireless (cell towers at distance; WI-FI and WLAN devices). The entire basis for safety standards is called into question, and it is not unreasonable to question the safety of RF at any level.

A cautionary target level for pulsed RF exposures for ambient wireless that could be applied to RF sources from cell tower antennas, WI-FI, WI-MAX and other similar sources is proposed. The recommended cautionary target level is 0.1 microwatts per centimeter squared (μW/cm2)** (or 0.614 Volts per meter or V/m)** for pulsed RF where these exposures affect the general public; this advisory is proportionate to the evidence and in accord with prudent public health policy. A precautionary limit of 0.1 μW/cm2 should be adopted for outdoor, cumulative RF exposure. This reflects the current RF science and prudent public health response that would reasonably be set for pulsed RF (ambient) exposures where people live, work and go to school. This level of RF is experienced as whole-body exposure, and can be a chronic exposure where there is wireless coverage present for voice and data transmission for cell phones, pagers and PDAs and other sources of radiofrequency radiation. An outdoor precautionary limit of 0.1 μW/cm2 would mean an even lower exposure level inside buildings, perhaps as low as 0.01 μW/cm2. Some studies and many anecdotal reports on ill health have been reported at lower levels than this; however, for the present time, it could prevent some of the most disproportionate burdens placed on the public nearest to such installations. Although this RF target level does not preclude further rollout of WI-FI technologies, we also recommend that wired alternatives to WI-FI be implemented, particularly in schools and libraries so that children are not subjected to

elevated RF levels until more is understood about possible health impacts. This recommendation should be seen as an interim precautionary limit that is intended to guide preventative actions; and more conservative limits may be needed in the future.

Broadcast facilities that chronically expose nearby residents to elevated RF levels from AM, FM and television antenna transmission are also of public health concern given the potential for very high RF exposures near these facilities (antenna farms). RF levels can be in the 10s to several 100's of μW/cm2 in residential areas within half a mile of some broadcast sites (for example, Lookout Mountain, Colorado and Awbrey Butte, Bend, Oregon). Such facilities that are located in, or expose residential populations and schools to elevated levels of RF will very likely need to be re-evaluated for safety.

For emissions from wireless devices (cell phones, personal digital assistant or PDA devices, etc) there is enough evidence for increased risk of brain tumors and acoustic neuromas now to warrant intervention with respect to their use. Redesign of cell phones and PDAs could prevent direct head and eye exposure, for example, by designing new units so that they work only with a wired headset or on speakerphone mode.

These effects can reasonably be presumed to result in adverse health effects and disease with chronic and uncontrolled exposures, and children may be particularly vulnerable. The young are also largely unable to remove themselves from such environments. Second-hand radiation, like second-hand smoke is an issue of public health concern based on the evidence at hand.

V. CONCLUSIONS

• We cannot afford 'business as usual" any longer. It is time that planning for new power lines and for new homes, schools and other habitable spaces around them is done with routine provision for low-ELF environments. The business-as-usual deployment of new wireless technologies is likely to be risky and harder to change if society does not make some educated decisions about limits soon. Research must continue to define what levels of RF related to new wireless technologies are acceptable; but more research should not prevent or delay substantive changes today that might save money, lives and societal disruption tomorrow.

• New regulatory limits for ELF are warranted. ELF limits should be set below those exposure levels that have been linked in childhood leukemia studies to increased risk of disease, plus an additional safety factor. It is no longer acceptable to build new power lines and electrical facilities that place people in ELF environments that have been determined to be risky (at levels generally at 2 mG and above).

• While new ELF limits are being developed and implemented, a reasonable approach would be a 1 mG planning limit for habitable space adjacent to all new or upgraded power lines and a 2 mG limit for all other new construction, It is also recommended for that a 1 mG limit be established for existing habitable space for children and/or women who are pregnant . This recommendation is based on the assumption that a higher burden of protection is required for children who cannot protect themselves, and who are at risk for childhood leukemia at rates that are traditionally high enough to trigger regulatory action. This situation in particular warrants extending the 1 mG limit to existing occupied space. "Establish" in this case probably means formal public advisories from relevant health agencies.

• While it is not realistic to reconstruct all existing electrical distributions systems, in the short term; steps to reduce exposure from these existing systems need to be initiated, especially in places where children spend time, and should be encouraged.

• A precautionary limit of 0.1 (μW/cm2 (which is also 0.614 Volts per meter) should be adopted for outdoor, cumulative RF exposure. This reflects the current RF science and prudent public health response that would reasonably be set for pulsed RF (ambient) exposures where people

live, work and go to school. This level of RF is experienced as whole-body exposure, and can be a chronic exposure where there is wireless coverage present for voice and data transmission for cell phones, pagers and PDAs and other sources of radiofrequency radiation. Some studies and many anecdotal reports on ill health have been reported at lower levels than this; however, for the present time, it could prevent some of the most disproportionate burdens placed on the public nearest to such installations. Although this RF target level does not preclude further rollout of WI-FI technologies, we also recommend that wired alternatives to WI-FI be implemented, particularly in schools and libraries so that children are not subjected to elevated RF levels until more is understood about possible health impacts. This recommendation should be seen as an interim precautionary limit that is intended to guide preventative actions; and more conservative limits may be needed in the future.

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Some Quick Definitions for Units of Measurement of ELF and RF

***Milligauss (mG)**

A milligauss is a measure of ELF intensity and is abbreviated mG. This is used to describe electromagnetic fields from appliances, power lines, interior electrical wiring.

****Microwatts per centimeter squared (µW/cm2)**

Radiofrequency radiation in terms of power density is measured in microwatts per centimeter squared and abbreviated (µW/cm2). It is used when talking about emissions from wireless facilities, and when describing ambient RF in the environment. The amount of allowable RF near a cell tower is 1000 µW/cm2 for some cell phone frequencies, for example.

*****Specific Absorption Rate (SAR is measured in watts per kilogram or W/Kg)**

SAR stands for specific absorption rate. It is a calculation of how much RF energy is absorbed into the body, for example when a cell phone or cordless phone is pressed to the head. SAR is expressed in watts per kilogram of tissue (W/Kg). The amount of allowable energy into 1 gram of brain tissue from a cell phone is 1.6 W/Kg in the US. For whole body exposure, the exposure is 0.8 W/Kg averaged over 30 minutes for the general public. International standards in most countries are similar, but not exactly the same.

Table 1-1 BioInitiative Report Overall Conclusions

OVERALL SUMMARY OF CONCLUSIONS

- The existing ICNIRP and FCC limits for public and occupational exposure to ELF and RF are insufficiently protective of public health.

- Biologically-based public and occupational exposure standards for extra-low frequency and radiofrequency radiation are recommended to address bioeffects and potential adverse health effects of chronic exposure to ELF and RF. These effects are now widely reported to occur at exposure levels significantly below most current national and international limits.

- A biologically-based exposure limit is one that is protective against ELF and RF intensity and modulation factors which, with chronic exposure, can reasonably be presumed to result in significant impacts to health and well-being.

- Research is needed (but should not delay) regulatory action for ELF and substantive *preventative action* for RF proportionate to potential health and wellbeing risks from chronic exposure.

- A biologically-based exposure limit should reflect current scientific knowledge of bioeffects and health effects, and impose new limits based on preventative action as defined by the Precautionary Principle (EEA, 2001).

- Biologically-based exposure standards shall be protective against exposures levels of ELF and RF that affect or change normal biological functioning of organisms (humans). They shall not be based solely on energy absorption or thermal levels of energy input, or resulting tissue heating. They shall be protective against chronic exposure responses.

- The existing standards are based on thermal (heating) limits, and do not address non-thermal (or low-intensity) exposures which are widely reported to cause bioeffects, some likely leading to adverse health effects with chronic exposure.

- Biological effects may include both potential adverse health effects and loss of homeostasis and well-being.

- Biologically-based exposure standards are needed to prevent disruption of normal body processes. Effects are reported for DNS damage (genotoxicity that is directly linked to integrity of the human genome), cellular communication, cellular metabolism and repair, cancer surveillance within the body; and for protection against cancer and neurological diseases. Also reported are neurological effects including impairment of sleep and sleep architecture, cognitive function and memory; depression; cardiac effects; pathological leakage of the blood-brain barrier; and impairment of normal immune function, fertility and reproduction.

- Frequency, intensity, exposure duration, and the number of exposure episodes can affect the response, and these factors can interact with each other to produce different effects. In addition, in order to understand the biological consequences of EMF exposure, one must know whether the effect is cumulative, whether compensatory responses result, and when homeostasis will break down.

- Plausible biological mechanisms that can account for genotoxicity (DNA damage) are already well known (oxidative damage via free-radical actions) although it should also be said that there is not yet proof. *However, proof of mechanism is not required to set prudent public health policy, nor is it mandatory to set new guidelines or limits if adverse health effects occur at lower-than-existing IEEE and ICNIRP standards.*

Table 1-1 BioInitiative Report Overall Conclusions

OVERALL SUMMARY OF CONCLUSIONS (continued

• The SCENIHR report (2007) states that "for breast cancer and cardiovascular disease, recent research has indicated that an association with EMF is unlikely." The WHO ELF Health Criteria Monograph (2007) states "The evidence does not support an association between ELF exposure and cardiovascular disease" and "(T)he evidence for breast cancer was also considered to be effectively negative, while for other diseases it was judged to be inadequate." Neither conclusion is supported by any finding by IARC that would classify EMF as Class 4 (Not A Carcinogen), so it is premature for either group to dismiss the evidence for EMF as a potential risk factor for either breast cancer or for cardiovascular disease.

• The standard for taking action should be precautionary; action should not be deferred while waiting for final proof or causal evidence to be established that EMF is harmful to health and well-being.

• There is great public concern over increasing levels of involuntary exposure to radiofrequency and ELF-modulated radiofrequency exposures from new wireless technologies; there is widespread public resistance to radiofrequency and extra-low frequency radiation exposures which are allowable under current, thermally-based exposure standards.

• There is inadequate warning and notice to the public about possible risks from wireless technologies in the marketplace, which is resulting in adoption and use of technologies that may have adverse health consequences which are still unknown to the public. There is no "informed consent".

• No positive assertion of safety can be made by governments that continue to support and enforce exposure limits for RF and ELF based on ICNIRP or IEEE criteria (or the equivalent). Governments that are considering proposals to relax existing RF and ELF standards should reject these proposals given the weight of scientific evidence that is available; and the clear disconnect between existing public safety limits and their responsibility to provide safe and healthful living environments for all segments of affected populations.

Section 5 Genotoxicity Based on Proteomics

• EMF exposure can change gene and/or protein expression in certain types of cells, even at intensities lower than ICNIRP recommended values.

• The biological consequences of most of the changed genes/proteins are still unclear, and need to be further explored.

• The EMF research community should pay equal attention to the negative reports as to the positive ones. Not only the positive findings need to be replicated, all the negative ones are also needed to be validated.

• The IEEE and WHO data bases do not include the majority of ELF studies (only 6 of 14 in the WHO; 0 of 16 in IEEE); they do include the majority of the RF studies (14 of 16).

Table 1-1 BioInitiative Report Overall Conclusions

Section 6 Genotoxicity (DNA Damage from RF and ELF)

• Toxicity to the genome can lead to a change in cellular functions, cancer, and cell death. One can conclude that under certain conditions of exposure RF is genotoxic. Data available are mainly applicable only to cell phone radiation exposure. One study reports that RF at levels equivalent to the vicinity of base stations and RF- transmission towers is genotoxic and could cause DNA damage (Phillips et al., 1998).

• RF may be considered genotoxic (cause DNA damage). Of 28 total studies on radiofrequency radiation (RF) and DNA damage, 14 studies reported effects (50%) and 14 reported no significant effect (50%). Of 29 total studies on radiofrequency radiation and micronucleation, 16 studies reported effects (55%) and 13 reported no significant effect (45%). Of 21 total studies on chromosome and genome damage from radiofrequency radiation, 13 studies (62%) reported effects and 8 studies (38%) reported no significant effects.

• During cell phone use, a relatively constant mass of tissue in the brain is exposed to radiation at relatively high intensity (peak SAR of 4 - 8 W/kg). Several studies have reported DNA damage at lower than 4 W/kg.

• Since critical genetic mutations in one single cell are sufficient to lead to cancer and there are millions of cells in a gram of tissue, *it is* ***inconceivable*** that the base of the IEEE SAR standard was changed from averaged over 1 gram of tissue to 10 grams.

• Frequency, intensity, exposure duration, and the number of exposure episodes can affect the response, and these factors can interact with each other to produce different consequences. In order to understand the biological consequence of exposure, one must understand whether the effect is cumulative, whether compensatory responses result and when homeostasis will break down. The choice of cell type or organism studied can also influence the outcome.

• Extremely-low frequency (ELF) has also been shown to be genotoxic and cause DNA damage. Of 41 relevant studies of genotoxicity and ELF exposure, 27 studies (66%) report DNA damage and 14 studies (44%) report no significant effect.

Table 1-1 BioInitiative Report Overall Conclusions

Section 7: Stress Response

- Scientific research on stress proteins has shown that the public is not being protected from potential damage that can be caused by exposure to EMF, both power frequency (ELF) and radio frequency (RF).
- Cells react to an EMF as potentially harmful by producing stress proteins (heat shock proteins or hsp).
- Direct interaction of ELF and RF with DNA has been documented and both activate the synthesis of stress proteins.
- The biochemical pathway that is activated is the same pathway in both ELF and RF and it is non-thermal.
- Many biological systems are affected by EMFs (meaning both ELF and RF trigger stress proteins).
- Many frequencies are active. Field strength and exposure duration thresholds are very low.
- Molecular mechanisms at very low energies are plausible links to disease (e.g., effect on electron transfer rates linked to oxidative damage, DNA activation linked to abnormal biosynthesis and mutation). Cells react to an EMF as potentially harmful.
- Many lines of research now point to changes in DNA electron transfer as a plausible mechanism of action as a result of non-thermal ELF and RF.
- The same biological reaction (production of stress proteins) to an EMF can be activated in more than one division of the EM spectrum.
- Direct interaction of ELF and RF with DNA has been documented and both activate the synthesis of stress proteins.
- Thresholds triggering stress on biological systems occur at environment levels on the order of 0.5 to 1.0 μT for ELF.
- DNA damage (e.g., strand breaks), a cause of cancer, occurs at levels of ELF and RF that are below the safety limits. Also, there is no protection against cumulative effects stimulated by different parts of the EM spectrum.
- The scientific basis for EMF safety limits is flawed when the same biological mechanisms are activated in ELF and RF ranges at vastly different levels of the Specific Absorption Rate (SAR). Activation of DNA to synthesize stress proteins (the stress response) is stimulated in the ELF at a non-thermal SAR level that is over a billion times lower than the same process activated by RF at the thermal level.
- There is a need for a biological standard to replace the thermal standard and to also protect against cumulative effects across the EM spectrum.
- Based on studies of stress proteins, the specific absorption rate (SAR) is not the appropriate measure of biological threshold or dose, and should not be used as a basis for a safety standard since it regulates against thermal effects only.

Table 1-1 BioInitiative Report Overall Conclusions

Section 8 Effects on Immune Function

• Both human and animal studies report large immunological changes with exposure to environmental levels of electromagnetic fields (EMFs). Some of these exposure levels are equivalent to those of e.g. wireless technologies in daily life.

• Measurable physiological changes (mast cells increases, for example) that are bedrock indicators of allergic response and inflammatory conditions are stimulated by EMF exposures.

• Chronic exposure to such factors that increase allergic and inflammatory responses on a continuing basis may be harmful to health.

• It is possible that chronic provocation by exposure to EMF can lead to immune dysfunction, chronic allergic responses, inflammatory responses and ill health if they occur on a continuing basis over time. This is an important area for future research.

• Specific findings from studies on exposures to various types of modern equipment and/or EMFs report over-reaction of the immune system; morphological alterations of immune cells; profound increases in mast cells in the upper skin layers, increased degranulation of mast cells and larger size of mast cells in electrohypersensitive individuals; presence of biological markers for inflammation that are sensitive to EMF exposure at non-thermal levels; changes in lymphocyte viability; decreased count of NK cells; decreased count of T lymphocytes; negative effects on pregnancy (uteroplacental circulatory disturbances and placental dysfunction with possible risks to pregnancy); suppressed or impaired immune function; and inflammatory responses which can ultimately result in cellular, tissue and organ damage.

• Electrical hypersensitivity is reported by individuals in the United States, Sweden, Switzerland, Germany. Denmark and many other countries of the world. Estimates range from 3% to perhaps 10% of populations, and appears to be a growing condition of ill-health leading to lost work and productivity.

• The WHO and IEEE literature surveys do not include all of the relevant papers cited here, leading to the conclusion that evidence has been ignored in the current WHO ELF Health Criteria Monograph; and the proposed new IEEE C95.1 RF public exposure limits (April 2006).

• The current international public safety limits for EMFs do not appear to be sufficiently protective of public health at all, based on the studies of immune function. New, biologically-based public standards are warranted that take into account low-intensity effects on immune function and health that are reported in the scientific literature.

Table 1-1 BioInitiative Report Overall Conclusions

Section 9 Neurology and Behavioral Effects

• Effects on neurophysiological and cognitive functions are quite well established.

• Studies on EEG and brain evoked-potentials in humans exposed to cellular phone radiation predominantly showed positive effects (i.e., positive means the exposure has the ability to change brainwave activity even at exposure levels where no effect would be expected, based on traditional understanding and safety limits).

• There is little doubt that electromagnetic fields emitted by cell phones and cell phone use affect electrical activity in the brain.

• The behavioral consequences of these neuroelectrophysiological changes are not always predictable and research on electrophysiology also indicates that effects are dependent on the mental load of the subjects during exposure, e.g., on the complexity of the task that a subject is carrying out.

• Most of the studies carried out so far are short-term exposure experiments, whereas cell phone use causes long-term repeated exposure of the brain.

• In most of the behavioral experiments, effects were observed after the termination of RF exposure. In some experiments, tests were made days after exposure. This suggests a persistent change in the nervous system after exposure to RF.

• In many instances, neurological and behavioral effects were observed at a SAR less than 4 W/kg. This directly contradicts the basic assumption of the IEEE guideline criterion.

• Caution should be taken in concluding that a neurological effect resulted solely from the action of RF on the central nervous system because it is well known that the functions of the central nervous system can be affected by activity in the peripheral nervous system.

Table 1-1 BioInitiative Report Overall Conclusions

Section 10 Brain Tumors and Acoustic Neuromas

• Studies on brain tumors and use of mobile phones for ≥ 10 years gave a consistent pattern of an increased risk for acoustic neuroma and glioma.

• Cell phone use > 10 years give a consistent pattern of an increased risk for acoustic neuroma and glioma, most pronounced for high-grade glioma. The risk is highest for ipsilateral exposure.

Section 10 Brain Tumors and RF - Epidemiology

- Only a few studies of long-term exposure to low levels of RF fields and brain tumors exist, all of which have methodological shortcomings including lack of quantitative exposure assessment. Given the crude exposure categories and the likelihood of a bias towards the null hypothesis of no association*, the body of evidence is consistent with a moderately elevated risk.*

- Occupational studies indicate that long-term exposure at workplaces may be associated with an elevated brain tumor risk.

- Although the population attributable risk is low (likely below 4%), still more than 1,000 cases per year in the US can be attributed to RF exposure at workplaces alone. Due to the lack of conclusive studies of environmental RF exposure and brain tumors the potential of these exposures to increase the risk cannot be estimated.

- Overall, the evidence suggests that long-term exposure to levels generally below current guideline levels still carry the risk of increasing the incidence of brain tumors.

• Epidemiological studies as reviewed in the IEEE C95.1 revision (2006) are deficient to the extent that the entire analysis is professionally unsupportable. IEEEs dismissal of epidemiological studies that link RF exposure to cancer endpoints should be disregarded, as well as any IEEE conclusions drawn from this flawed analysis of epidemiological studies.

Table 1-1 BioInitiative Report Overall Conclusions

Brain Tumors and Acoustic Neuromas

Additional Data from Section 10

• Mobile phone use increases the risk of acoustic neuroma for persons using a mobile phone 10 years or longer by 30% (when used on both sides of head) to 240% (habitually used on one side of head). This information relies on a meta-analysis of several major studies. For acoustic neuroma studies by Lönn et al., (2004), Christensen et al., (2004) Schoemaker et al., (2005) and Hardell et al., (2006a) all giving results for at least 10 years latency period or more. Overall OR = 1.3, 95 % CI = 0.6-2.8 was obtained increasing to OR = 2.4, 95 % CI = 1.1-5.3 for ipsilateral mobile phone use (Lönn et al., 2004, Schoemaker et al., 2005, Hardell et al., 2006).

• There is observational support for the association between acoustic neuroma and the use of mobile phones since some studies report that the tumor is often located in an anatomical area with high exposure during calls with cellular or cordless phones (Hardell et al., 2003).

• Mobile phone use increases the risk of brain tumors (glioma) for persons using a mobile phone 10 years or longer by 20% (when used on both sides of head) to 200% (habitually used on one side of head). This information relies on a meta-analysis of several major studies. For glioma OR = 1.2, [95 % CI = 0.8-1.9] was calculated (Lönn et al., 2005, Christensen et al., 2005, Hepworth et al., 2006, Schüz et al., 2006, Hardell et al., 2006b, Lahkola et al., 2007). Ipsilateral use yielded OR = 2.0, [95 % CI = 1.2-3.4](Lönn et al., 2005, Hepworth et al., 2006, Hardell et al., 2006b, Lahkola et al., 2007).

• Cordless phone use is also associated with an increased risk for acoustic neuromas and brain tumors (both low-and high-grade gliomas (Hardell et al., 2006 a,b).

• The increased risk of acoustic neuroma from use of a cordless phone for ten years or more was reported to be 310% higher risk (when the cordless phone habitually used on the same-side of the head) in Hardell et al., 2006a.

• The increased risk of high-grade glioma from use of a cordless phone for ten years or more was reported to be 220% higher risk (when cordless used on both sides of head) to 470% higher risk (when cordless used habitually on same side of head) in Hardell et al., 2006b.

• The increased risk of low-grade glioma from use of a cordless phone for ten years or more was reported to be 60% higher risk (when cordless used on both sides of head) to 320% higher risk (when cordless used habitually on same side of head) in Hardell et al., 2006b.

• The current standard for exposure to microwaves during mobile phone use and for cordless phone use is not safe considering studies reporting long-term brain tumor risk.

Table 1-1 BioInitiative Report Overall Conclusions

Section 11 Leukemia

- The balance of evidence suggests that childhood leukemia is associated with exposure to power frequency EMFs either during early life or pregnancy.

- Considering only average ELF (MF flux densities) the population attributable risk is low to moderate. However there is a possibility that other exposure metrics are much more strongly related to childhood leukemia and may account for a substantial proportion of cases. The population attributable fraction ranges between 1-4% (Kheifets et al., 2007); 2-4% (Greenland & Kheifets 2006); and 3.3% (Greenland, 2001) assuming only exposures above 3 to 4 mG (0.3 – 0.4 μT) are relevant. However, if it is not average ELF (average MF flux density) that is the metric causally related to childhood leukemia the attributable fraction can be much higher. Up to 80% of childhood leukemia may be caused by exposure to ELF.

- Other childhood cancers except leukemia have not been studied in sufficient detail to allow conclusions about the existence and magnitude of the risk.

- IEEE guideline levels are designed to protect from short-term immediate effects, long-term effects, such as cancer are evoked by levels several orders of magnitudes below current guideline levels.

- Measures should be implemented to guarantee that exposure due to transmission and distribution lines is below an average of about 1 mG (0.1 μT) and precautionary measures are warranted that can reduce all aspects of exposure.

Table 1-1 BioInitiative Report Overall Conclusions

Section 12 Melatonin, Alzheimers Disease and Breast Cancer

- There is strong epidemiologic evidence that long-term exposure to ELF magnetic field (MF) is a risk factor for Alzheimers disease.

- There is now evidence that 1) high levels of peripheral amyloid beta are a risk factor for AD and 2) medium to high MF exposure can increase peripheral amyloid beta. High brain levels of amyloid beta are also a risk factor for AD and medium to high MF exposure to brain cells likely also increases these cells' production of amyloid beta.

- There is considerable *in vitro* and animal evidence that melatonin protects against Alzheimer's disease. Therefore it is certainly possible that low levels of melatonin production are associated with an increase in the risk of AD.

- There are insufficient studies to formulate an opinion as to whether radiofrequency MF exposure is a risk factor for AD.

- Some studies on EMF show reduced melatonin levels, There is sufficient evidence from *in vitro* and animal studies, from human biomarker studies, from occupational and light-at-night studies, and a single longitudinal study with appropriate collection of urine samples to conclude that high MF exposure may be a risk factor for breast cancer.

- There is rather strong evidence from case-control studies that longterm, high occupational exposure ($\geq$ 10 mG or 1.0 μT)) to ELF magnetic fields is a risk factor for breast cancer.

- Seamstresses are, in fact, one of the most highly MF exposed occupations, with exposure levels generally above 10 mG (1.0 μT) over a significant proportion of the workday. They have also been consistently found to be at higher risk of Alzheimer's disease and (female) breast cancer. This occupation deserves attention in future studies.

- There are no studies of RF magnetic fields on breast cancer that do not exclude ELF magnetic field, so that predictions of RF magnetic field alone on breast cancer cannot be assessed at this time.

Table 1-1 BioInitiative Report Overall Conclusions

Section 13 Melatonin – Cell and Animal Studies

• An association between power-frequency electromagnetic fields (ELF) and breast cancer is strongly supported in the scientific literature by a constellation of relevant scientific papers providing mutually-reinforcing evidence from cell and animal studies.

• ELF at environmental levels negatively affects the oncostatic effects of both melatonin and tamoxifen on human breast cancer cells at common environmental levels of ELF exposure at 6 to 12 mG (0.6 to 1.2 μT). Epidemiological studies over the last two decades have reported increased risk of male and female breast cancer with exposures to residential and occupational levels of ELF. Animal studies have reported increased mammary tumor size and incidence in association with ELF exposure.

• ELF limits for public exposure should be revised to reflect increased risk of breast cancer at environmental levels possibly as low as 2 mG or 3 mG (o.2 to 0.3 μT); certainly as low as 4 mG (0.4 μT).

Section 14 Effects of Modulation of Signal

• There is substantial scientific evidence that some modulated fields (pulsed or repeated signals) are bioactive, which increases the likelihood that they could have health impacts with chronic exposure even at very low exposure levels.

• Modulation signals may interfere with normal, non-linear biological processes.

• Modulation is a fundamental factor that should be taken into account in new public safety standards; at present it is not even a contributing factor.

• To properly evaluate the biological and health impacts of exposure to modulated RF (carrier waves), it is also essential to study the impact of the modulating signal (lower frequency fields or ELF-modulated RF).

.• Current standards have ignored modulation as a factor in human health impacts, and thus are inadequate in the protection of the public in terms of chronic exposure to some forms of ELF-modulated RF signals.

• The current IEEE and ICNIRP standards are not sufficiently protective of public health with respect to chronic exposure to modulated fields (particularly new technologies that are pulse-modulated and heavily used in cellular telephony).

Table 1-1 BioInitiative Report Overall Conclusions

Section 14 **Effects of Modulation of Signal** (continued)

• The collective papers on modulation appear to be omitted from consideration in the recent WHO and IEEE science reviews. This body of research has been ignored by current standard setting bodies that rely only on traditional energy-based (thermal) concepts.

• More research is needed to determine which modulation factors, and combinations are bioactive and deleterious at low intensities, and are likely to result in disease-related processes and/or health risks; however this should not delay preventative actions supporting public health and wellness.

• If signals need to be modulated in the development of new wireless technologies, for example, it makes sense to use what existing scientific information is available to avoid the most obviously deleterious exposure parameters and select others that may be less likely to interfere with normal biological processes in life.

• The current membership on Risk Assessment committees needs to be made more inclusive, by adding scientists experienced with the research reporting non-thermal biological effects.

• The current practice of segregating scientific investigations (and resulting public health limits) by artificial divisions of frequency needs to be changed because this approach dramatically dilutes the impact of the basic science results and eliminates consideration of modulation signals, thereby reducing and distorting the weight of evidence in any evaluation process.

Section 15 **Therapeutic Uses of EMF at Low-Intensity Levels**

• EMFs are both a cause of disease, and also used for treatment of disease (at levels far below existing public exposure standards).

• Electromagnetic fields are widely used in therapeutic medical applications.

• Proof of effectiveness has been demonstrated in numerous clinical applications of low-intensity ELF and RF.

• EMFs have been shown to be effective in treating conditions of disease at energy levels far below current public exposure standards.

• Indiscriminate EMF exposure is ill advised at even at common environmental levels.

• Multiple sources of EMF exposure in daily life, and cumulative exposures to potentially harmful combinations of EMF are ignored – we don't even study it properly yet.

Table 1-1 BioInitiative Report Overall Conclusions

Section 16 The Precautionary Principle

• The Precautionary Principle has been developed to help justify public policy action on the protection of health where there are plausible, serious and irreversible hazards from current and future exposures and where there are many uncertainties and much scientific ignorance. EMF is characterized by such circumstances.

• The lessons from the histories of most well known hazards show that precautionary- based yet proportionate measures taken in response to robust early warnings can avoid the kinds of costs incurred by asbestos, smoking, PCBs ,X rays etc. Such lessons are relevant to the EMF issue.

• Policymakers need to be aware of the systematic biases within the environmental health science against finding a true hazard, in order to not compromise scientific integrity. However, this bias can lead to the health of people or environments being compromised.

• The Precautionary Principle introduces the use of different levels of proof (or strengths of evidence) to justify actions to reduce exposure, where the level of proof chosen depends upon the nature and distribution of the costs of being wrong in acting, or not acting; the benefits of the agent or substance in question; the availability of alternatives, etc. Waiting for high levels of scientific proof of causality, or for knowledge about mechanisms of action, can be very expensive in terms of compensation, health care, job losses, reductions in public trust of scientists etc.

• The level of proof chosen to justify action does not determine any particular policy measure, or type of action. This is dependent on factors such as the costs of different measures, equity, the origins of the risk, ie voluntary or imposed, etc.

• There is a need to involve stakeholders in helping to frame problems for risk assessments and to choose appropriate levels of proof and types of actions to reduce exposure.

Table 1-1 BioInitiative Report Overall Conclusions

Section 17: Key Scientific Evidence and Public Health Policy Recommendations

• We cannot afford 'business as usual" any longer. It is time that planning for new power lines and for new homes, schools and other habitable spaces around them is done with provision for low-ELF environments. The business-as-usual deployment of new wireless technologies is likely to be risky and harder to change if society does not make some educated decisions about limits soon. Research must continue to define what levels of RF related to new wireless technologies are acceptable; but more research should not prevent or delay substantive changes today that might save money, lives and societal disruption tomorrow.

• New regulatory limits for ELF are warranted. ELF limits should be set below those exposure levels that have been linked in childhood leukemia studies to increased risk of disease, plus an additional safety factor. It is no longer acceptable to build new power lines and electrical facilities that place people in ELF environments that have been determined to be risky (at levels generally at 2 mG (0.2 μT) and above).

• While new ELF limits are being developed and implemented, a reasonable approach would be a 1 mG (0.1 μT) planning limit for habitable space adjacent to all new or upgraded power lines and a 2 mG (0.2 μT) limit for all other new construction, It is also recommended for that a 1 mG (0,1 μT) limit be established for existing habitable space for children and/or women who are pregnant . This recommendation is based on the assumption that a higher burden of protection is required for children who cannot protect themselves, and who are at risk for childhood leukemia at rates that are traditionally high enough to trigger regulatory action. This situation in particular warrants extending the 1 mG (0.1 μT) limit to existing occupied space. "Establish" in this case probably means formal public advisories from relevant health agencies.

• While it is not realistic to reconstruct all existing electrical distributions systems, in the short term; steps to reduce exposure from these existing systems need to be initiated, especially in places where children spend time, and should be encouraged.

• A precautionary limit of 0.1 μW/cm2 (which is also 0.614 Volts per meter) should be adopted for outdoor, cumulative RF exposure. This reflects the current RF science and prudent public health response that would reasonably be set for pulsed RF (ambient) exposures where people live, work and go to school. This level of RF is experienced as whole-body exposure, and can be a chronic exposure where there is wireless coverage present for voice and data transmission for cell phones, pagers and PDAs and other sources of radiofrequency radiation. Some studies and many anecdotal reports on ill health have been reported at lower levels than this; however, for the present time, it could prevent some of the most disproportionate burdens placed on the public nearest to such installations. Although this RF target level does not preclude further rollout of WI-FI technologies, we also recommend that wired alternatives to WI-FI be implemented, particularly in schools and libraries so that children are not subjected to elevated RF levels until more is understood about possible health impacts. This recommendation should be seen as an interim precautionary limit that is intended to guide preventative actions; and more conservative limits may be needed in the future.

Table 1-1 BioInitiative Report Overall Conclusions

Section 17: Key Scientific Evidence and Public Health Policy Recommendations (continued)

• New public safety limits should be developed and implemented for ELF (50 Hz and 60 Hz electrical power frequencies). ELF limits should be set below those exposure levels that have been linked in childhood leukemia studies to increased risk of disease, plus an additional safety factor.

• Guidance should be provided to electric utilities on the need to reduce ELF exposures in siting and construction of new power lines and substations. Mitigation of existing sources of ELF over 1 mG (0.1 μT) should be encouraged, particularly where children and women who are pregnant, or who may be come pregnant spend significant portions of their time.

• Requests for measurement and monitoring of ELF and RF should be provided by utilities (for power line and household ELF) and by employers (for workplace ELF and RF) ,and those who request information should receive full results of such surveys on request.

• International health organizations and agencies should issue public health advisories for those exposed to levels of ELF and RF implicated with increased risks from cancer/neurodegenerative diseases and memory/learning/immune/stress responses. These advisories should address both residential and occupational exposures.

• Reliable, unbiased information should be developed and distributed through a clearinghouse that is available to the public. Scientific, public health and policy option information should be provided for independent review at an affordable cost to the public. Research articles and prudent avoidance strategies should be made available in many languages.

• Cell phones and other wireless devices should be redesigned to operate only on speaker-phone mode or text message mode.

• Restrictions should be placed on the sale and advertising of cell phones and other wireless devices to children age 0 to 18 years.

• All countries should continue to provide wired phone service; and should be strongly discouraged from phasing it out; including pay telephones in public places.

• Manufacturers of devices that operate with wireless features should be required to carry SAR level information and warning labels on the outside packaging (not hidden inside). Wireless devices that create elevated RF levels for the user should be required to warn the user of possible adverse effects on memory and learning, cognitive function, sleep disruption and insomnia, mood disorders, balance, headache, fatigue, ringing in the ears (tinnitus), immune function, and other adverse symptoms of use.

• Warning labels on cell phones and PDAs (personal digital assistant devices) and other wireless devices are needed to alert users to excessively high ELF emissions from the switching battery pack, and require labels to list mitigation measures to reduce exposure (do not wear on or near body in “ON-Receive” position; use only with earpiece or on speaker mode, etc).

• Disclosure should be provided to the public on the location and operating characteristics of all wireless antenna sites in a fashion easily accessible to the public so informed choices can be made about where to live, shop, work and go to school. Such information should mandatorily include cumulative RF/MW exposures based on calculations from FCC OET Bulletin 65 (or equivalent) at ground level and second story level in increments of 50 feet outward from the facility to a power density of 0.1 μW/cm2 or 0.614 V/m. Signage for the public should be a mandatory condition of approval for all sites, and should be kept current. Public agencies that approve and monitor wireless sites should require the applicant to identify locations of wireless facilities.

Table 1-1 BioInitiative Report Overall Conclusions

Section 17: Key Scientific Evidence and Public Health Policy Recommendations (continued)

• Mobile phone - free and WI-FI-free public areas should be established in areas where the public congregates and can have a reasonable expectation of safety; including airports, public shopping, hospitals, libraries, medical clinics, convalescent homes and assisted living facilities, theatres, restaurants, parks, etc.

• Health agencies and school districts should strongly discourage or prohibit cell towers on or near (within 1000' of) school properties, should delay any new WLAN installations in school classrooms, pre-schools and day-care facilities; and should either remove or disable existing wireless facilities, or be required to offer classrooms with no RF exposure to those families who choose not to have their children involuntarily exposed.

SECTION 1

Summary for the Public (2014 Supplement)

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I. SUMMARY FOR THE PUBLIC

A. Introduction

The BioInitiative Working Group concluded in 2007 that existing public safety limits were inadequate to protect public health, and agreed that new, biologically-based public safety limits were needed five years ago. The BioInitiative Report was prepared by more than a dozen world-recognized experts in science and public health policy; and outside reviewers also contributed valuable content and perspective.

From a public health standpoint, experts reasoned that it was not in the public interest to wait. In 2007, the evidence at hand coupled with the enormous populations placed at possible risk was argued as sufficient to warrant strong precautionary measures for RFR, and lowered safety limits for ELF-EMF. The ELF recommendations were biologically-based and reflected the ELF levels consistently associated with increased risk of childhood cancer, and further incorporated a safety factor that is proportionate to others used in similar circumstances. The public health cost of doing nothing was judged to be unacceptable in 2007.

What has changed in 2012? In twenty-four technical chapters, the contributing authors discuss the content and implications of about 1800 new studies. Overall, these new studies report abnormal gene transcription (Section 5); genotoxicity and single- and double-strand DNA damage (Section 6); stress proteins because of the fractal RF-antenna like nature of DNA (Section 7); chromatin condensation and loss of DNA repair capacity in human stem cells (Sections 6 and 15); reduction in free-radical scavengers, particularly melatonin (Sections 5, 9, 13, 14, 15, 16 and 17); neurotoxicity in humans and animals (Section 9); carcinogenicity in humans (Sections 11, 12, 13, 14, 15, 16 and 17); serious impacts on human and animal sperm morphology and function (Section 18); effects on the fetus, neonate and offspring (Section 18 and 19); effects on brain and cranial bone development in the offspring of animals that are exposed to cell phone radiation during pregnancy (Sections 5 and 18); and findings in autism spectrum disorders consistent with EMF/RFR exposure. This is only a snapshot of the evidence presented in the BioInitiative 2012 updated report.

There is reinforced scientific evidence of risk from chronic exposure to low-intensity electromagnetic fields and to wireless technologies (radiofrequency radiation including microwave radiation). The levels at which effects are reported to occur is lower by hundreds of times in comparison to 2007. The range of possible health effects that are adverse with chronic exposures has broadened. There has been a big increase in the number of studies looking at the effects of cell phones (on the belt, or in the pocket of men radiating only on standby mode) and from wireless laptops on impacts to sperm quality and motility; and sperm death (fertility and reproduction). In other new studies of the fetus, infant and young child, and child-in-school – there are a dozen or more new studies of importance. There is more evidence that such exposures damage DNA, interfere with DNA repair, evidence of toxicity to the human genome (genes), more worrisome effects on the nervous system (neurology) and more and better studies on the effects of mobile phone base stations (wireless antenna facilities or cell towers) that report lower RFR levels over time can result in adverse health impacts.

Importantly, some very large studies were completed on brain tumor risk from cell phone use. The 13-country World Health Organization Interphone Final study (2010) produced evidence (although highly debated

among fractious members of the research committee) that cell phone use at 10 years or longer, with approximately 1,640 hours of cumulative use of a cell and/or cordless phone approximately doubles glioma risk in adults. Gliomas are aggressive, malignant tumors where the average life-span following diagnosis is about 400 days. That brain tumors should be revealed in epidemiological studies at ONLY 10 or more years is significant; x-ray and other ionizing radiation exposures that can also cause brain tumors take nearly 15-20 years to appear making radiofrequency/microwave radiation from cell phones a very effective cancer-causing agent. Studies by Lennart Hardell and his research team at Orebro University in Sweden later showed that children who start using a mobile phone in early years have more than a 5-fold (more than a 500%) risk for developing a glioma by the time they are in the 20-29 year age group. This has significant ramifications for public health intervention.

In short order, in 2011 the World Health Organization International Agency on Cancer Research (IARC) classified radiofrequency radiation as a Group 2B Possible Human Carcinogen, joining the IARC classification of ELF-EMF that occurred in 2001. The evidence for carcinogenicity for RFR was primarily from cell phone/brain tumor studies but by IARC rules, applies to all RFR exposures (it applies to the exposure, not just to devices like cell phones or cordless phones that emit RFR).

B. Why We Care?

The stakes are very high. Exposure to electromagnetic fields (both extremely low-frequency ELF-EMF from power frequency sources like power lines and appliances; and radiofrequency radiation or RFR) has been linked to a variety of adverse health outcomes that may have significant public health consequences. The most serious health endpoints that have been reported to be associated with extremely low frequency (ELF) and/or radiofrequency radiation (RFR) include childhood and adult leukemia, childhood and adult brain tumors, and increased risk of the neurodegenerative diseases, Alzheimer's and amyotrophic lateral sclerosis (ALS). In addition, there are reports of increased risk of breast cancer in both men and women, genotoxic effects (DNA damage, chromatin condensation, micronucleation, impaired repair of DNA damage in human stem cells), pathological leakage of the blood–brain barrier, altered immune function including increased allergic and inflammatory responses, miscarriage and some cardiovascular effects. Insomnia (sleep disruption) is reported in studies of people living in very low-intensity RF environments with WI-FI and cell tower-level exposures. Short-term effects on cognition, memory and learning, behavior, reaction time, attention and concentration, and altered brainwave activity (altered EEG) are also reported in the scientific literature. Biophysical mechanisms that may account for such effects can be found in various articles and reviews (Sage, 2012).

Traditional scientific consensus and scientific method is but one contributor to deciding when to take public health action; rather, it is one of several voices that are important in determining when new actions are warranted to protect public health. Certainly it is important, but not the exclusive purview of scientists alone to determine for all of society when changes are in the public health interest and welfare of children.

C. Do We Know Enough to Take Action

Human beings are bioelectrical systems. Our hearts and brains are regulated by internal bioelectrical signals. Environmental exposures to artificial EMFs can interact with fundamental biological processes in the human body. In some cases, this may cause discomfort, or sleep disruption, or loss of well-being (impaired mental functioning and impaired metabolism) or sometimes, maybe it is a dread disease like cancer or Alzheimer's disease. It may be interfering with one's ability to become pregnant, or to carry a child to full term, or result in brain development changes that are bad for the child. It may be these exposures play a role in causing long-term impairments to normal growth and development of children, tipping the scales away from becoming productive adults. The use of common wireless devices like wireless laptops and mobile phones requires urgent action simply because the exposures are everywhere in daily life; we need to define whether and when these exposures can damage health, or the children of the future who will be born to parents now immersed in wireless exposures.

Since World War II, the background level of EMF from electrical sources has risen exponentially, most recently by the soaring popularity of wireless technologies such as cell phones (six billion in 2011-12, up from two billion in 2006), cordless phones, WI-FI ,WiMAX and LTE networks. Some countries are moving from telephone landlines (wired) to wireless phones exclusively, forcing wireless exposures on uninformed populations around the world. These wireless exposures at the same time are now classified by the world's highest authority on cancer assessment, the World Health Organization International Agency for Research on Cancer to be a possible risk to health. Several decades of international scientific research confirm that EMFs are biologically active in animals and in humans. Now, the balance has clearly shifted to one of 'presumption of possible adverse effects' from chronic exposure. It is difficult to conclude otherwise, when the bioeffects that are clearly now occurring lead to such conditions as pathological leakage of the blood-brain barrier (allowing toxins into the brain tissues); oxidative damage to DNA and the human genome, preventing normal DNA repair in human stem cells; interfering with healthy sperm production; producing poor quality sperm or low numbers of healthy sperm, altering fetal brain development that may be fundamentally tied to epidemic rates of autism and problems in school children with memory, attention, concentration, and behavior; and leading to sleep disruptions that undercut health and healing in numerous ways.

In today's world, everyone is exposed to two types of EMFs: (1) extremely low frequency electromagnetic fields (ELF) from electrical and electronic appliances and power lines and (2) radiofrequency radiation (RFR) from wireless devices such as cell phones and cordless phones, cellular antennas and towers, and broadcast transmission towers. In this report we will use the term EMFs when referring to all electromagnetic fields in general; and the terms ELF or RFR when referring to the specific type of exposure. They are both types of non-ionizing radiation, which means that they do not have sufficient energy to break off electrons from their orbits around atoms and ionize (charge) the atoms, as do x-rays, CT scans, and other forms of ionizing radiation. A glossary and definitions are provided in this report to assist you. Some handy definitions you will probably need when reading about ELF and RF in this summary section (the language for measuring it) are shown in Section 26 – Glossary.

II. SUMMARY OF THE SCIENCE

A. Evidence for Damage to Sperm and Reproduction

Several international laboratories have replicated studies showing adverse effects on sperm quality, motility and pathology in men who use and particularly those who wear a cell phone, PDA or pager on their belt or in a pocket (See Section 18 for references including Agarwal et al, 2008; Agarwal et al, 2009; Wdowiak et al, 2007; De Iuliis et al, 2009; Fejes et al, 2005; Aitken et al, 2005; Kumar, 2012). Other studies conclude that usage of cell phones, exposure to cell phone radiation, or storage of a mobile phone close to the testes of human males affect sperm counts, motility, viability and structure (Aitken et al, 2004; Agarwal et al, 2007; Erogul et al, 2006). Animal studies have demonstrated oxidative and DNA damage, pathological changes in the testes of animals, decreased sperm mobility and viability, and other measures of deleterious damage to the male germ line (Dasdag et al, 1999; Yan et al, 2007; Otitoloju et al, 2010; Salama et al, 2008; Behari et al, 2006; Kumar et al, 2012). There are fewer animal studies that have studied effects of cell phone radiation on female fertility parameters. Panagopoulous et al (2012) report decreased ovarian development and size of ovaries, and premature cell death of ovarian follicles and nurse cells in *Drosophila melanogaster.* Gul et al (2009) reported rats exposed to stand-by level RFR (phones on but not transmitting calls) had a decrease in the number of ovarian follicles in pups born to these exposed dams. Magras and Xenos (1997) reported irreversible infertility in mice after five (5) generations of exposure to RFR at cell phone tower exposure levels of less than one microwatt per centimeter squared (μW/cm2). See Section 18 for references.

HUMAN SPERM AND THEIR DNA ARE DAMAGED
Human sperm are damaged by cell phone radiation at very low intensities (0.00034 – 0.07 μW/cm2). There is a veritable flood of new studies reporting sperm damage in humans and animals, leading to substantial concerns for fertility, reproduction and health of the offspring (unrepaired de novo mutations in sperm). Exposure levels are similar to those resulting from wearing a cell phone on the belt, or in the pants pocket, or using a wireless laptop computer on the lap. Sperm lack the ability to repair DNA damage. (Behari and Rajamani, Section 18) young child are more vulnerable than older persons are to chemicals and ionizing radiation. The US Environmental Protection Agency (EPA) proposes a 10-fold risk adjustment for the first 2 years of life exposure to carcinogens, and a 3-fold adjustment for years 3 to 5. These adjustments do not deal with fetal risk, and the possibility of extending this protection to the fetus should be examined, because of fetus' rapid organ development.

The Presidential Cancer Panel (2010) found that children "are at special risk due to their smaller body mass and rapid physical development, both of which magnify their vulnerability to known carcinogens, including radiation." The American Academy of Pediatrics, in a letter to Congressman Dennis Kucinich dated 12 December 2012 states: "Children are disproportionately affected by environmental exposures, including cell phone radiation. The differences in bone density and the amount of fluid in a child's brain compared to an adult's brain could allow children to absorb greater quantities of RF energy deeper into their brains than adults. It is essential that any new standards for cell phones or other wireless devices be based on protecting the youngest and most vulnerable populations to ensure they are safeguarded through their lifetimes."

The issue around exposure of children to RFR is of critical importance. There is overwhelming evidence that children are more vulnerable than adults to many different exposures (Sly and Carpenter, 2012), including RFR, and that the diseases of greatest concern are cancer and effects on neurodevelopment. Yet parents place RFR-emitting baby monitors in cribs, provide very young children with wireless toys, and give cell phones to young children, usually without any knowledge of the potential dangers. A growing concern is the movement to make all student computer laboratories in schools wireless. A wired computer laboratory will not increase RFR exposure, and will provide safe access to the Internet (Section, Sage and Carpenter, BioInitiative 2012 Report).

C. Evidence for Fetal and Neonatal Effects

Effects on the developing fetus from in-utero exposure to cell phone radiation have been observed in both human and animal studies since 2006. Sources of fetal and neonatal exposures of concern include cell phone radiation (both paternal use of wireless devices worn on the body and maternal use of wireless phones during pregnancy). Sources include exposure to whole-body RFR from base stations and Wi-Fi, use of wireless laptops, use of incubators for newborns with excessively high ELF-EMF levels resulting in altered heart rate variability and reduced melatonin levels in newborns, fetal exposures to MRI of the pregnant mother, and greater susceptibility to leukemia and asthma in the child where there have been maternal exposures to ELF-EMF. Divan et al (2008) found that children born to mothers who used cell phones during pregnancy develop more behavioral problems by the time they have reached school age than children whose mothers did not use cell phones during pregnancy. Children whose mothers used cell phones during pregnancy had 25% more emotional problems, 35% more hyperactivity, 49% more conduct problems and 34% more peer problems (Divan et al, 2008). Aldad et al (2012) showed that cell phone radiation significantly altered fetal brain development and produced ADHD-like behavior in the offspring of pregnant mice. Exposed mice had a dose-dependent impaired glutamatergic synaptic transmission onto Layer V pyramidal neurons of the prefrontal cortex. The authors conclude the behavioral changes were the result of altered neuronal developmental programming in utero. Offspring mice were hyperactive and had impaired memory function and behavior problems, much like the human children in Divan et al (2008). See Sections 19 and 20 for references. Fragopoulou et al (2012) reports that brain astrocyte development followed by proteomic studies is adversely affected by DECT (cordless phone radiation) and mobile phone radiation.

Fetal (in-utero) and early childhood exposures to cell phone radiation and wireless technologies in general may be a risk factor for hyperactivity, learning disorders and behavioral problems in school. Common sense measures to limit both ELF-EMF and RF EMF in these populations is needed, especially with respect to avoidable exposures like incubators that can be modified; and where education of the pregnant mother with respect to laptop computers, mobile phones and other sources of ELF-EMF and RF EMF are easily instituted.

A precautionary approach may provide the frame for decision-making where remediation actions have to be realized to prevent high exposures of children and pregnant woman.

(Bellieni and Pinto, 2012 – Section 19)

D. Evidence for Effects on Autism (Autism Spectrum Conditions)

Physicians and health care practitioners should raise the visibility of EMF/RFR as a plausible environmental factor in ASC clinical evaluations and treatment protocols. Reducing or removing EMF and wireless RFR stressors from the environment is a reasonable precautionary action given the overall weight of evidence for a link to ASCs.

Several thousand scientific studies over four decades point to serious biological effects and health harm from EMF and RFR. These studies report genotoxicity, single-and double-strand DNA damage, chromatin condensation, loss of DNA repair capacity in human stem cells, reduction in free-radical scavengers (particularly melatonin), abnormal gene transcription, neurotoxicity, carcinogenicity, damage to sperm morphology and function, effects on behavior, and effects on brain development in the fetus of human mothers that use cell phones during pregnancy. Cell phone exposure has been linked to altered fetal brain development and ADHD-like behavior in the offspring of pregnant mice.

Many disrupted physiological processes and impaired behaviors in people with ASCs closely resemble those related to biological and health effects of EMF/RFR exposure. Biomarkers and indicators of disease and their clinical symptoms have striking similarities. At the cellular and molecular level many studies of people with ASCs have identified oxidative stress and evidence of free-radical damage, as well as deficiencies of antioxidants such as glutathione. Elevated intracellular calcium in ASCs can be associated with genetic mutations but more often may be downstream of inflammation or chemical exposures. Lipid peroxidation of cell membranes, disruption of calcium metabolism, altered brain wave activity and consequent sleep, behavior and immune dysfunction, pathological leakage of critical barriers between gut and blood or blood and brain may also occur. Mitochondria may function poorly, and immune system disturbances of various kinds are common. Changes in brain and autonomic nervous system electrophysiology can be measured and seizures are far more common than in the population at large. Sleep disruption and high levels of stress are close to universal. All of these phenomena have also been documented to result from or be modulated by EMF/RFR exposure.

- • Children with existing neurological problems that include cognitive, learning, attention, memory, or behavioral problems should as much as possible be provided with wired (not wireless) learning, living and sleeping environments.
- • Special education classrooms should observe 'no wireless' conditions to reduce avoidable stressors that may impede social, academic and behavioral progress.
- • All children should reasonably be protected from the physiological stressor of significantly elevated EMF/RFR (wireless in classrooms, or home environments).
- • School districts that are now considering all-wireless learning environments should be strongly cautioned that wired environments are likely to provide better learning and teaching environments, and prevent possible adverse health consequences for both students and faculty in the long-term.
- • Monitoring of the impacts of wireless technology in learning and care environments should be performed with sophisticated measurement and data analysis techniques that are cognizant of the non-linear impacts of EMF/RFR and of data techniques most appropriate for discerning these impacts.
- • There is sufficient scientific evidence to warrant the selection of wired Internet, wired classrooms and wired learning devices, rather than making an expensive and potentially health-harming commitment to wireless devices that may have to be substituted out later.
- • Wired classrooms should reasonably be provided to all students who opt-out of wireless environments.

(Herbert and Sage, 2012 – Section 20)

The public needs to know that these risks exist, that transition to wireless should not be presumed safe, and that it is very much worth the effort to minimize exposures that still provide the benefits of technology in learning, but without the threat of health risk and development impairments to learning and behavior in the classroom.

Broader recommendations also apply, related to reducing the physiological vulnerability to exposures, reduce allostatic load and build physiological resiliency through high quality nutrition, reducing exposure to toxicants and infectious agents, and reducing stress, all of which can be implemented safely based upon presently available knowledge.

E. Evidence for Electrohypersensitivity

The contentious question of whether electrohypersensitivity exists as a medical condition and what kinds of testing might reveal biomarkers for diagnosis and treatment has been furthered by several new studies presented in Section 24 – Key Scientific Evidence and Public Health Policy Recommendations. What is evident is that a growing number of people world-wide have serious and debilitating symptoms that key to various types of EMF and RFR exposure. Of this there is little doubt. The continued massive rollout of wireless technologies, in particular the wireless 'smart' utility meter, has triggered thousands of complaints of ill-health and disabling symptoms when the installation of these meters is in close proximity to family home living spaces.

McCarty et al (2011) studied electrohypersensitivity in a patient (a female physician). The patient was unable to detect the presence or absence of EMF exposure, largely ruling out the possibility of bias. In multiple trials with the fields either on or not on, the subject experienced and reported temporal pain, feeling of unease, skipped heartbeats, muscle twitches and/or strong headache when the pulsed field (100 ms, duration at 10 Hz) was on, but no or mild symptoms when it was off. Symptoms from continuous fields were less severe than with pulsed fields. The differences between field on and sham exposure were significant at the $p < 0.05$ level. The authors conclude that electromagnetic hypersensitivity is a neurological syndrome, and statistically reliable somatic reactions can be provoked in this patient by exposure to 60-Hz electric fields at 300 volts per meter (V/m). Marino et al (2012) responded to comments on his study with McCarty saying:

> *"EMF hypersensitivity can occur as a bona fide environmentally inducible neurological syndrome. We followed an empirical approach and demonstrated a cause-and-effect relationship ($p < 0.05$) under conditions that permitted us to infer the existence of electromagnetic hypersensitivity (EHS), a novel neurological syndrome."*

The team of Sandstrom, Hansson Mild and Lyskov produced numerous papers between 1994 and 2003 involving people who are electrosensitive (See Section 24 - Lyskov et al, 1995; Lyskov et al, 1998; Sandstrom et al, 1994; Sandstrom et al, 1995;

Sandstrom et al, 1997; Sandstrom et al, 2003). Sandstrom et al (2003) presented evidence that heart rate variability is impaired in people with electrical hypersensitivity and showed disruption of the autonomic nervous system.

"EHS patients had a disturbed pattern of circadian rhythms of HRF and showed a relatively 'flat' representation of hourly-recorded spectral power of the HF component of HRV". This research team also found that "EHS patients have a dysbalance of the autonomic nervous system (ANS) regulation with a trend to hyper-sympathotonia, as measured by heart rate (HR) and electrodermal activity, and a hyperreactivity to different external physical factors, as measured by brain evoked potentials and sympathetic skin responses to visual and audio stimulation." (Lyskov et al, 2001 a,b; Sandstrom et al, 1997).

The reports referenced above provide evidence that persons who report being electrosensitive differ from others in having some abnormalities in the autonomic nervous system, reflected in measures such as heart rate variability.

F. Evidence for Effects from Cell Tower-Level RFR Exposures

Very low exposure RFR levels are associated with bioeffects and adverse health effects. At least five new cell tower studies are reporting bioeffects in the range of 0.001 to 0.05 μW/cm2 at lower levels than reported in 2007 (0.05 to 0.1 uW/cm2 was the range below which, in 2007, effects were not observed). Researchers report headaches, concentration difficulties and behavioral problems in children and adolescents; and sleep disturbances, headaches and concentration problems in adults. Public safety standards are 1,000 – 10,000 or more times higher than levels now commonly reported in mobile phone base station studies to cause bioeffects.

Since 2007, five new studies of base station level RFR at intensitites ranging from lessthan 0.001 uW/cm2 to 0.05 uW/cm2 report headaches, concentrationdifficulties and behavioral problems in children and adolescents; and sleep disturbances, headaches and concentration problems in adults.

G. Evidence for Effects on the Blood-brain Barrier (BBB)

The Lund University (Sweden) team of Leif Salford, Bertil Persson and Henrietta Nittby has done pioneering work on effects of very low level RFR on the human brain's protective lining – the barrier that protects the brain from large molecules and toxins that are in the blood.

THE BLOOD-BRAIN BARRIER IS AT RISK

The BBB is a protective barrier that prevents the flow of toxins into sensitive brain tissue. Increased permeability of the BBB caused by cell phone RFR may result in neuronal damage. Many research studies show that very low intensity exposures to RFR can affect the blood-brain barrier (BBB) (mostly animal studies). Summing up the research, it is more probable than unlikely that non-thermal EMF from cell phones and base stations do have effects upon biology. A single 2-hr exposure to cell phone radiation can result in increased leakage of the BBB, and 50 days after exposure, neuronal damage can be seen, and at the later time point also albumin leakage is demonstrated. The levels of RFR needed to affect the BBB have been shown to be as low as 0.001 W/kg, or less than holding a mobile phone at arm's length. The US FCC standard is 1.6 W/kg; the ICNIRP standard is 2 W/kg of energy (SAR) into brain tissue from cell/cordless phone use. Thus, BBB effects occur at about 1000 times lower RFR exposure levels than the US and ICNIRP limits allow.

(Salford et al, 2012 - Section 10)

H. Evidence for Effects on Brain Tumors

The Orebro University (Sweden) team led by Lennart Hardell, MD, an oncologist and medical researcher, has produced an extraordinary body of work on environmental toxins of several kinds, including the effects of radiofrequency/microwave radiation and cancer. Their 2012 work concludes:

> "Based on epidemiological studies there is a consistent pattern of increased risk for glioma and acoustic neuroma associated with use of mobile phones and cordless phones. The evidence comes mainly from two study centres, the Hardell group in Sweden and the Interphone Study Group. No consistent pattern of an increased risk is seen for meningioma. A systematic bias in the studies that explains the results would also have been the case for meningioma. The different risk pattern for tumor type strengthens the findings regarding glioma and acoustic neuroma. Meta-analyses of the Hardell group and Interphone studies show an increased risk for glioma and acoustic neuroma. Supportive evidence comes also from anatomical localisation of the tumor to the most exposed area of the brain, cumulative exposure in hours and latency time that all add to the biological relevance of an increased risk. In addition risk calculations based on estimated absorbed dose give strength to the findings. (Hardell et al, 2012 – Section 11)

> "There is reasonable basis to conclude that RF-EMFs are bioactive and have a potential to cause health impacts. There is a consistent pattern of increased risk for glioma and acoustic neuroma associated with use of wireless phones (mobile phones and cordless phones) mainly based on results from case-control studies from the Hardell group and Interphone Final Study results. Epidemiological evidence gives that RF-EMF should be classified as a human carcinogen. Based on our own research and review of other evidence the existing FCC/IEE and ICNIRP public safety limits and reference levels are not adequate to protect public health. New public health standards and limits are needed. (Hardell et al, 2012 – Section 11)

I. Evidence for Genotoxic Effects (Genotoxicity)

Genetic Damage (Genotoxicity Studies): There are at least several hundred published papers that report EMF (ELF/RFR) can affect cellular oxidative processes (oxidative damage). Increased free radical activity and changes in enzymes involved in cellular oxidative processes are the most consistent effects observed in cells and animals after EMF exposure. Aging may make an individual more susceptible to the detrimental effects of ELF EMF from oxidative damage, since anti-oxidants may decline with age. Clearly, the preponderance of genetic studies report DNA damage and failure to repair DNA damage.

> One hundred fourteen (114) new papers on genotoxic effects of RFR published between 2007 and early 2014 are profiled. Of these, 74 (65%) showed effects and 40 (35%) showed no effects. (Lai, 2014 – Section 6)
>
> Fifty nine (59) new ELF-EMF papers and two static magnetic field papers that report on genotoxic effects of ELF-EMF published between 2007 and early 2014 are profiled. Of these, 49 (83%) show effects and 10 (17%) show no effect. (Lai, 2014 – Section 6)

Factors that act directly or indirectly on the nervous system can cause morphological, chemical, or electrical changes in the nervous system that can lead to neurological effects. Both RF and ELF EMF affect neurological functions and behavior in animals and humans.

Two hundred eleven (211) new papers that report on neurological effects of RFR published between 2007 and early 2014 are profiled. Of these, 144 (68%) showed effects and 67 (32%) showed no effects.

One hundred five (105) new ELF-EMF papers (including two static field papers) that report on neurological effects of ELF-EMF published between 2007 and early 2014 are profiled. Of these, 95 (90%) show effects and 10 (10%) show no effect. (Lai, 2014 – Section 9)

K. Evidence for Cancer (Childhood Leukemia)

With overall 42 epidemiological studies published to datel power frequency ELF-EMF is among the most comprehensively studied environmental factors. Except ionizing radiation no other environmental factor has been as firmly established to increase the risk of childhood leukemia.

Sufficient evidence exists from epidemiological studies of an increased risk from exposure to EMF (power frequency ELF-EMF magnetic fields) and cannot be attributed to chance, bias or confounding. Therefore, according to the rules of IARC such exposures can be classified as a **Group 1 carcinogen (Known Carcinogen).**

There is no other risk factor identified so far for which such unlikely conditions have been put forward to postpone or deny the necessity to take steps towards exposure reduction. As one step in the direction of precaution, measures should be implemented to guarantee that exposure due to transmission and distribution lines is below an average of about 1 mG. This value is arbitrary at present and only supported by the fact that in many studies this level has been chosen as a reference. (Kundi, 2012 – Section 12)

L. Melatonin, Breast Cancer and Alzheimer's Disease

MELATONIN AND BREAST CANCER: Eleven (11) of the 13 published epidemiologic residential and occupational studies are considered to provide (positive) evidence that high ELF magnetic fields (MF) exposure can result in decreased melatonin production. The two negative studies had important deficiencies that may certainly have biased the results. There is sufficient evidence to conclude that long-term relatively high ELF MF exposure can result in a decrease in melatonin production. It has not been determined to what extent personal characteristics, e.g., medications, interact with ELF MF exposure in decreasing melatonin production.

There is sufficient evidence to conclude that long-term relatively high ELF MF exposure can result in a decrease in melatonin production, which may increase risk for breast cancer. It has not been determined to what extent personal characteristics, e.g., medications, interact with ELF MF exposure in decreasing melatonin production. New research indicates that ELF MF exposure, in vitro, can significantly decrease melatonin activity through effects on MT1, an important melatonin receptor. Five longitudinal studies have now been conducted of low melatonin production as a risk factor for breast cancer. There is increasingly strong longitudinal evidence that low melatonin production is a risk factor for at least post-menopausal breast cancer.

(Davanipour and Sobel, 2012 – Section 13)

ALZHEIMER'S DISEASE: There is now evidence that a) high levels of peripheral amyloid beta are a risk factor for AD, and b) medium to high ELF MF exposure can increase peripheral amyloid beta. High brain levels of amyloid beta are also a risk factor for AD and medium to high ELF MF exposure to brain cells likely also increases these cells' production of amyloid beta. There is considerable in vitro and animal evidence that melatonin protects against AD. Therefore it is certainly possible that low levels of melatonin production are associated with an increase in the risk of AD.

There is strong epidemiologic evidence that exposure to ELF MF is a risk factor for AD. There are now twelve (12) studies of ELF MF exposure and AD or dementia. Nine (9) of these studies are considered positive and three (3) are considered negative. The three negative studies have serious deficiencies in ELF MF exposure classification that results in subjects with rather low exposure being considered as having significant exposure. There are insufficient studies to formulate an opinion as to whether radiofrequency MF exposure is a risk or protective factor for AD.

There is now evidence that (i) high levels of peripheral amyloid beta are a risk factor for AD and (ii) medium to high ELF MF exposure can increase peripheral amyloid beta. High brain levels of amyloid beta are also a risk factor for AD and medium to high ELF MF exposure to brain cells likely also increases these cells' production of amyloid beta.

There is considerable in vitro and animal evidence that melatonin protects against AD. Therefore it is certainly possible that low levels of melatonin production are associated with an increase in the risk of AD.

(Davanipour and Sobel, 2012 – Section 13)

M. Stress, Stress Proteins and DNA as a Fractal Antenna

Any agent (EMF, ionizing radiation, chemicals, heavy metals, heat and other factors) that continuously generates stress proteins is not adaptive, and is harmful, if it is a constant provocation. The work of Martin Blank and Reba Goodman of Columbia University has established that stress proteins are produced by ELF-EMF and RFR at levels far below what current safety standards allow. Further, they think DNA is actually a very good fractal RF-antenna which is very sensitive to low doses of EMF, and may induce the cellular processes that result in chronic 'unrelenting' stress. That daily environmental levels of ELF-EMF and RFR can and do throw the human body into stress protein response mode (out of homeostasis) is a fundamental and continuous insult. Chronic exposures can then result in chronic ill-health**.**

> *"It appears that the DNA molecule is particularly vulnerable to damage by EMF because of the coiled-coil configuration of the compacted molecule in the nucleus. The unusual structure endows it with the self similarity of a fractal antenna and the resulting sensitivity to a wide range of frequencies. The greater reactivity of DNA with EMF, along with a vulnerability to damage,*

underscores the urgent need to revise EMF exposure standards in order to protect the public. Recent studies have also exploited the properties of stress proteins to devise therapies for limiting oxidative damage and reducing loss of muscle strength associated with aging." (Blank, 2012- Section 7)

- DNA acts as a 'fractal antenna' for EMF and RFR. The coiled-coil structure of DNA in the nucleus makes the molecule react like a fractal antenna to a wide range of frequencies.
- The structure makes DNA particularly vulnerable to EMF damage.
- The mechanism involves direct interaction of EMF with the DNA molecule (claims that there are no known mechanisms of interaction are patently false).
- Many EMF frequencies in the environment can and do cause DNA changes.
- The EMF-activated cellular stress response is an effective protective mechanism for cells exposed to a wide range of EMF frequencies.
- EMF stimulates stress proteins (indicating an assault on the cell).
- EMF efficiently harms cells at billions of times lower levels than conventional heating.
- Safety standards based on heating are irrelevant to protect against EMF-levels of exposure. There is an urgent need to revise EMF exposure standards. Research has shown thresholds are very low (safety standards must be reduced to limit biological responses). Biologically-based safety standards could be developed from the research on the stress response. (Blank, 2012 – Section 7).

N. Effects of Weak-Field Interactions on Non-Linear Biological Oscillators and Synchronized Neural Activity:

A unifying hypothesis for a plausible biological mechanism to account for very weak field EMF bioeffects other than cancer may lie with weak field interactions of pulsed RFR and ELF-modulated RFR as disrupters of synchronized neural activity. Electrical rhythms in our brains can be influenced by external signals. This is consistent with established weak field effects on coupled biological oscillators in living tissues. Biological systems of the heart, brain and gut are dependent on the cooperative actions of cells that function according to principles of non-linear, coupled biological oscillations for their synchrony, and are dependent on exquisitely timed cues from the environment at vanishingly small levels (Buzsaki, 2006; Strogatz, 2003). The key to synchronization is the joint actions of cells that co-operate electrically and link populations of biological oscillators that couple together in large arrays and synchronize spontaneously. Synchronous biological oscillations in cells (pacemaker cells) can be disrupted by artificial, exogenous environmental signals, resulting in desynchronization of neural activity that regulates critical functions (including metabolism) in the brain, gut and heart and circadian rhythms governing sleep and hormone cycles (Strogatz, 1987). The brain contains a population of oscillators with distributed natural frequencies, which pull one another into synchrony (the circadian pacemaker cells). Strogatz has addressed the unifying mathematics of biological cycles and external factors disrupt these cycles (Strogatz, 2001, 2003)

"Rhythms can be altered by a wide variety of agents and that these perturbations must seriously alter brain performance." (Busaki, 2006)

III. EMF EXPOSURE AND PRUDENT PUBLIC HEALTH PLANNING

Chronic exposure to low-intensity RFR and to ELF-modulated RFR at today's environmental levels in many cities will exceed thresholds for increased risk of many diseases and causes of death (Sage and Huttunen, 2012). RFR exposures in daily life alter homeostasis in human beings. These exposures can alter and damage genes, trigger epigenetic changes to gene expression and cause de novo mutations that prevent genetic recovery and healing mechanisms. These exposures may interfere with normal cardiac and brain function; alter circadian rhythms that regulate sleep, healing, and hormone balance; impair short-term memory, concentration, learning and behavior; provoke aberrant immune, allergic and inflammatory responses in tissues; alter brain metabolism; increase risks for reproductive failure (damage sperm and increase miscarriage risk); and cause cells to produce stress proteins. Exposures now common in home and school environments are likely to be physiologically addictive and the effects are particularly serious in the young (Sage and Huttunen, 2012).

RECOMMENDED ACTIONS

A. Defining Preventative Actions for Reduction in RFR Exposures

ELF-EMF and RFR are Classified as Possible Cancer-causing Agents – Why Are Governments Not Acting?

The World Health Organization International Agency for Research on Cancer has classified wireless radiofrequency as a Possible Human Carcinogen (May, 2011)*. The designation applies to low-intensity RFR in general, covering all RFR-emitting devices and exposure sources (cell and cordless phones, Wi-Fi, wireless laptops, wireless hotspots, electronic baby monitors, wireless classroom access points, wireless antenna facilities). The IARC Panel could have chosen to classify RFR as a Group 4 – Not A Carcinogen if the evidence was clear that RFR is not a cancer-causing agent. It could also have found a Group 3 designation was a good interim choice (Insufficient Evidence). IARC did neither.

New Safety Limits Must Be Established – Health Agencies Should Act Now

Existing public safety limits (FCC and ICNIRP public safety limits) do not sufficiently protect public health against chronic exposure from very low-intensity exposures. If no mid-course corrections are made to existing and outdated safety limits, such delay will magnify the public health impacts with even more applications of wireless-enabled technologies exposing even greater populations around the world in daily life.

Scientific Benchmarks for Harm Plus Safety Margins = New Safety Limits that are Valid

Health agencies and regulatory agencies that set public safety standards for ELF-EMF and RFR should act now to adopt new, biologically-relevant safety limits that key to the lowest scientific benchmarks for harm coming from the recent studies, plus a lower safety margin. Existing public safety limits are too high by several orders of magnitude, if prevention of bioeffects and resulting adverse health effects are to be minimized or

eliminated. Most safety standards are a thousand times or more too high to protect healthy populations, and even less effective in protecting sensitive subpopulations.

Sensitive Populations Must Be Protected

Safety standards for sensitive populations will more likely need to be set at lower levels than for healthy adult populations. Sensitive populations include the developing fetus, the infant, children, the elderly, those with pre-existing chronic diseases, and those with developed electrical sensitivity (EHS).

Protecting New Life – Infants and Children

Strong precautionary action and clear public health warnings are warranted immediately to help prevent a global epidemic of brain tumors resulting from the use of wireless devices (mobile phones and cordless phones). Commonsense measures to limit both ELF-EMF and RFR in the fetus and newborn infant (sensitive populations) are needed, especially with respect to avoidable exposures like baby monitors in the crib and baby isolettes (incubators) in hospitals that can be modified; and where education of the pregnant mother with respect to laptop computers, mobile phones and other sources of ELF-EMF and RFR are easily instituted.

Wireless laptops and other wireless devices should be strongly discouraged in schools for children of all ages.

Standard of Evidence for Judging the Science

The standard of evidence for judging the scientific evidence should be based on good public health principles rather than demanding scientific certainty before actions are taken.

Wireless Warnings for All

The continued rollout of wireless technologies and devices puts global public health at risk from unrestricted wireless commerce unless new, and far lower exposure limits and strong precautionary warnings for their use are implemented.

EMF and RFR are Preventable Toxic Exposures

We have the knowledge and means to save global populations from multi-generational adverse health consequences by reducing both ELF and RFR exposures. Proactive and immediate measures to reduce unnecessary EMF exposures will lower disease burden and rates of premature death.

B. Defining New 'Effect Level' for RFR

Section 24 concludes that RFR 'effect levels' for bioeffects and adverse health effects justify new and lower precautionary target levels for RFR exposure. New epidemiological and laboratory studies are finding effects on humans at lower exposure levels where studies are of longer duration (chronic exposure studies). Real-world experience is revealing worrisome evidence that sperm may be damaged by cell phones even on

stand-by mode; and people can be adversely affected by placing new wireless pulsed RFR transmitters (utility meters on the sides or interiors of homes), even when the time-weighted average for RFR is miniscule in both cases.

There is increasing reason to believe that the critical factor for biologic significance is the intermittent pulse of RF, not the time-averaged SAR. For example, Hansson Mild et al, (2012) concluded there could be no effect on sleep and testicular function from a GSM mobile phone because the "*exposure in stand-by mode can be considered negligible".* It may be that we, as a species, are more susceptible than we thought to intermittent, very low-intensity pulsed RFR signals that can interact with critical activities in living tissues. It is a mistake to conclude that the effect does not exist because we cannot explain HOW it is happening or it upsets our mental construct of how things should work.

This highlights the serious limitation of not taking the nature of the pulsed RFR signal (high intensity but intermittent, microsecond pulses of RFR) into account in the safety standards. This kind of signal is biologically active. Even if it is essentially mathematically invisible when the individual RFR pulses are time-averaged, it is apparently NOT invisible to the human body and its proper biological functioning.

For these reasons, and in light of parallel scientific work on non-linear biological oscillators including the accepted mathematics in this branch of science regarding coupled oscillators (Bezsaki, 2006; Strogatz, 2001, 2003), it is essential to think forward about the ramifications of shifting national energy strategies toward ubiquitous wireless systems. And, it is essential to re-think safety standards to take into account the exquisite sensitivity of biological systems and tissue interactions where the exposures are pulsed and cumulatively insignificant over time-scale averaging, but highly relevant to body processes and functioning. If it is true that weak-field effects have control elements over synchronous activity of neurons in the brain, and other pacemaker cells and tissues in the heart and gut that drive essential metabolic pathways as a result, then this will go far in explaining why living tissues are apparently so reactive to very small inputs of pulsed RFR, and lead to better understanding of what is required for new, biologically-based public exposure standards.

A reduction from the BioInitiative 2007 recommendation of 0.1 uW/cm2 (or one-tenth of a microwatt per square centimeter) for cumulative outdoor RFR down to something three orders of magnitude lower (in the low nanowatt per square centimeter range) is justified on a public health basis. We use the new scientific evidence documented in this Report to identify 'effect levels' and then apply one or more reduction factors to provide a safety margin. A cautionary target level for cumulative, outdoor pulsed RFR exposures for ambient wireless that could be applied to RFR sources from cell tower antennas, Wi-Fi, WiMAX and other similar sources is proposed. Research is needed to determine what is biologically damaging about intermittent pulses of RFR, and how to provide for protection in safety limits against it. With this knowledge it might be feasible to recommend a higher time-averaged number.

A scientific benchmark of 0.003 uW/cm2 or three nanowatts per centimeter squared for 'lowest observed effect level' for RFR is based on mobile phone base station-level studies. Applying a ten-fold reduction to compensate for the lack of long-term exposure (to provide a safety buffer for chronic exposure, if needed) or for children as a sensitive subpopulation (if studies are on adults, not children) yields a 300 to 600 picowatts per

square centimeter precautionary action level. This equates to a 0.3 nanowatts to 0.6 nanowatts per square centimeter as a reasonable, precautionary action level for chronic exposure to pulsed RFR. Even so, these levels may need to change in the future, as new and better studies are completed. This is what the authors said in 2007 (Carpenter and Sage, 2007, BioInitiative Report) and it remains true today in 2012.

We leave room for future studies that may lower or raise today's observed 'effects levels' and should be prepared to accept new information as a guide for new precautionary action.

BIOINITIATIVE 2012 - CONCLUSIONS Table 1-1

(Genetics and Neurological Effects Updated March 2014)

Overall, more than 1800 or so new studies report abnormal gene transcription (Section 5); genotoxicity and single-and double-strand DNA damage (Section 6); stress proteins because of the fractal RF-antenna like nature of DNA (Section 7); chromatin condensation and loss of DNA repair capacity in human stem cells (Sections 6 and 15); reduction in free-radical scavengers - particularly melatonin (Sections 5, 9, 13, 14, 15, 16 and 17); neurotoxicity in humans and animals (Section 9), carcinogenicity in humans (Sections 11, 12, 13, 14, 15, 16 and 17); serious impacts on human and animal sperm morphology and function (Section 18); effects on offspring behavior (Section 18, 19 and 20); and effects on brain and cranial bone development in the offspring of animals that are exposed to cell phone radiation during pregnancy (Sections 5 and 18). This is only a snapshot of the evidence presented in the BioInitiative 2012 updated report.

BIOEFFECTS ARE CLEARLY ESTABLISHED

Bioeffects are clearly established and occur at very low levels of exposure to electromagnetic fields and radiofrequency radiation. Bioeffects can occur in the first few minutes at levels associated with cell and cordless phone use. Bioeffects can also occur from just minutes of exposure to mobile phone masts (cell towers), WI-FI, and wireless utility 'smart' meters that produce whole-body exposure. Chronic base station level exposures can result in illness.

BIOEFFECTS WITH CHRONIC EXPOSURES CAN REASONABLY BE PRESUMED TO RESULT IN ADVERSE HEALTH EFFECTS

Many of these bioeffects can reasonably be presumed to result in adverse health effects if the exposures are prolonged or chronic. This is because they interfere with normal body processes (disrupt homeostasis), prevent the body from healing damaged DNA, produce immune system imbalances, metabolic disruption and lower resilience to disease across multiple pathways. Essential body processes can eventually be disabled by incessant external stresses (from system-wide electrophysiological interference) and lead to pervasive impairment of metabolic and reproductive functions.

LOW EXPOSURE LEVELS ARE ASSOCIATED WITH BIOEFFECTS AND ADVERSE HEALTH EFFECTS AT CELL TOWER RFR EXPOSURE LEVELS

At least five new cell tower studies are reporting bioeffects in the range of 0.003 to 0.05 μW/cm2 at lower levels than reported in 2007 (0.05 to 0.1 uW/cm2 was the range below which, in 2007, effects were not observed). Researchers report headaches, concentration difficulties and behavioral problems in children and adolescents; and sleep disturbances, headaches and concentration problems in adults. Public safety standards are 1,000 – 10,000 or more times higher than levels now commonly reported in mobile phone base station studies to cause bioeffects.

EVIDENCE FOR FERTILITY AND REPRODUCTION EFFECTS: HUMAN SPERM AND THEIR DNA ARE DAMAGED

Human sperm are damaged by cell phone radiation at very low intensities in the low microwatt and nanowatt/cm2 range (0.00034 – 0.07 uW/cm2). There is a veritable flood of new studies reporting sperm damage in humans and animals, leading to substantial concerns for fertility, reproduction and health of the offspring (unrepaired de novo mutations in sperm). Exposure levels are similar to those resulting from wearing a cell phone on the belt, or in the pants pocket, or using a wireless laptop computer on the lap. Sperm lack the ability to repair DNA damage.

Studies of human sperm show genetic (DNA) damage from cell phones on standby mode and wireless laptop use. Impaired sperm quality, motility and viability occur at exposures of 0.00034 uW/cm2 to 0.07 uW/cm2 with a resultant reduction in human male fertility. Sperm cannot repair DNA damage.

Several international laboratories have replicated studies showing adverse effects on sperm quality, motility and pathology in men who use and particularly those who wear a cell phone, PDA or pager on their belt or in a pocket (Agarwal et al, 2008; Agarwal et al, 2009; Wdowiak et al, 2007; De Iuliis et al, 2009; Fejes et al, 2005; Aitken et al, 2005; Kumar, 2012). Other studies conclude that usage of cell phones, exposure to cell phone radiation, or storage of a mobile phone close to the testes of human males affect sperm counts, motility, viability and structure (Aitken et al, 2004; Agarwal et al, 2007; Erogul et al., 2006). Animal studies have demonstrated oxidative and DNA damage, pathological changes in the testes of animals, decreased sperm mobility and viability, and other measures of deleterious damage to the male germ line (Dasdag et al, 1999; Yan et al, 2007; Otitoloju et al, 2010; Salama et al, 2008; Behari et al, 2006; Kumar et al, 2012). There are fewer animal studies that have studied effects of cell phone radiation on female fertility parameters. Panagopoulous et al. 2012 report decreased ovarian development and size of ovaries, and premature cell death of ovarian follicles and nurse cells in *Drosophila melanogaster.* Gul et al (2009) report rats exposed to stand-by level RFR (phones on but not transmitting calls) caused decrease in the number of ovarian follicles in pups born to these exposed dams. Magras and Xenos (1997) reported irreversible infertility in mice after five (5) generations of exposure to RFR at cell phone tower exposure levels of less than one microwatt per centimeter squared (μW/cm2).

EVIDENCE THAT CHILDREN ARE MORE VULNERABLE

There is good evidence to suggest that many toxic exposures to the fetus and very young child have especially detrimental consequences depending on when they occur during critical phases of growth and development (time windows of critical development), where such exposures may lay the seeds of health harm that develops even decades later. Existing FCC and ICNIRP public safety limits seem to be not sufficiently protective of public health, in particular for the young (embryo, fetus, neonate, very young child).

The Presidential Cancer Panel (2010) found that children '*are at special risk due to their smaller body mass and rapid physical development, both of which magnify their vulnerability to known carcinogens, including radiation.*'

The American Academy of Pediatrics, in a letter to Congressman Dennis Kucinich dated 12 December 2012 states "*Children are disproportionately affected by environmental exposures, including cell phone radiation. The differences in bone density and the amount of fluid in a child's brain compared to an adult's brain could allow children to absorb greater quantities of RF energy deeper into their brains than adults. It is essential that any new standards for cell phones or other wireless devices be based on protecting the youngest and most vulnerable populations to ensure thay are safeguarded through their lifetimes."*

FETAL AND NEONATAL EFFECTS OF EMF

Fetal (*in-utero*) and early childhood exposures to cell phone radiation and wireless technologies in general may be a risk factor for hyperactivity, learning disorders and behavioral problems in school.

Fetal Development Studies: Effects on the developing fetus from *in-utero* exposure to cell phone radiation have been observed in both human and animal studies since 2006. Divan et al (2008) found that children born of mothers who used cell phones during pregnancy develop more behavioral problems by the time they have reached school age than children whose mothers did not use cell phones during pregnancy. Children whose mothers used cell phones during pregnancy had 25% more emotional problems, 35% more hyperactivity, 49% more conduct problems and 34% more peer problems

(Divan et al., 2008).

Common sense measures to limit both ELF-EMF and RF EMF in these populations is needed, especially with respect to avoidable exposures like incubators that can be modified; and where education of the pregnant mother with respect to laptop computers, mobile phones and other sources of ELF-EMF and RF EMF are easily instituted.

Sources of fetal and neonatal exposures of concern include cell phone radiation (both paternal use of wireless devices worn on the body and maternal use of wireless phones during pregnancy). Exposure to whole-body RFR from base stations and WI-FI, use of wireless laptops, use of incubators for newborns with excessively high ELF-EMF levels resulting in altered heart rate variability and reduced melatonin levels in newborns, fetal exposures to MRI of the pregnant mother, and greater susceptibility to leukemia and asthma in the child where there have been maternal exposures to ELF-EMF.

A precautionary approach may provide the frame for decision-making where remediation actions have to be realized to prevent high exposures of children and pregnant woman.

(Bellieni and Pinto, 2012 – Section 19)

EMF/RFR AS A PLAUSIBLE BIOLGICAL MECHANISM FOR AUTISM (ASD)

- Children with existing neurological problems that include cognitive, learning, attention, memory, or behavioral problems should as much as possible be provided with wired (not wireless) learning, living and sleeping environments,
- Special education classrooms should observe 'no wireless' conditions to reduce avoidable stressors that may impede social, academic and behavioral progress.
- All children should reasonably be protected from the physiological stressor of significantly elevated EMF/RFR (wireless in classrooms, or home environments).
- School districts that are now considering all-wireless learning environments should be strongly cautioned that wired environments are likely to provide better learning and teaching environments, and prevent possible adverse health consequences for both students and faculty in the long-term.
- Monitoring of the impacts of wireless technology in learning and care environments should be performed with sophisticated measurement and data analysis techniques that are cognizant of the non-linear impacts of EMF/RFR and of data techniques most appropriate for discerning these impacts.
- There is sufficient scientific evidence to warrant the selection of wired internet, wired classrooms and wired learning devices, rather than making an expensive and potentially health-harming commitment to wireless devices that may have to be substituted out later, and
- Wired classrooms should reasonably be provided to all students who opt-out of wireless environments. (Herbert and Sage, 2012 – Section 20)

Many disrupted physiological processes and impaired behaviors in people with ASDs closely resemble those related to biological and health effects of EMF/RFR exposure. Biomarkers and indicators of disease and their clinical symptoms have striking similarities. Broadly speaking, these types of phenomena can fall into one or more of several classes: a) alteration of genes or gene expression, b) induction of change in brain or organismic development, c) alteration of phenomena modulating systemic and brain function on an ongoing basis throughout the life course (which can include systemic pathophysiology as well as brain-based changes), and d) evidence of functional alteration in domains such as behavior, social interaction and attention known to be challenged in ASD.

Several thousand scientific studies over four decades point to serious biological effects and health harm from EMF and RFR. These studies report genotoxicity, single-and double-strand DNA damage, chromatin condensation, loss of DNA repair capacity in human stem cells, reduction in free-radical scavengers (particularly melatonin), abnormal gene transcription, neurotoxicity, carcinogenicity, damage to sperm morphology and function, effects on behavior, and effects on brain development in the fetus of human mothers that use cell phones during pregnancy. Cell phone exposure has been linked to altered fetal brain development and ADHD-like behavior in the offspring of pregnant mice.

Reducing life-long health risks begins in the earliest stages of embryonic and fetal development, is accelerated for the infant and very young child compared to adults, and is not complete in young people (as far as brain and nervous system maturation) until the early 20's. Windows of critical development mean that risk factors once laid down in the cells, or in epigenetic changes in the genome may have grave and life-long consequences for health or illness for every individual.

All relevant environmental conditions, including EMF and RFR, which can degrade the human genome, and impair normal health and development of species including homo sapiens, should be given weight in defining and implementing prudent, precautionary actions to protect public health.

Allostatic load in autism and autistic decompensation - we may be at a tipping point that can be pushed back by removing unnecessary stressors like EMF/RFR and building resilience.

The consequence of ignoring clear evidence of large-scale health risks to global populations, when the risk factors are largely avoidable or preventable is too high a risk to take. With the epidemic of autism (ASD) putting the welfare of children, and their families in peril at a rate of one family in 88, the rate still increasing annually, we cannot afford to ignore this body of evidence. The public needs to know that these risks exist, that transition to wireless should not be presumed safe, and that it is very much worth the effort to minimize exposures that still provide the benefits of technology in learning, but without the threat of health risk and development impairments to learning and behavior in the classroom.

(Herbert and Sage, 2012 – Section 20)

THE BLOOD-BRAIN BARRIER IS AT RISK

The BBB is a protective barrier that prevents the flow of toxins into sensitive brain tissue. Increased permeability of the BBB caused by cell phone RFR may result in neuronal damage. Many research studies show that very low intensity exposures to RFR can affect the blood-brain barrier (BBB) (mostly animal studies). Summing up the research, it is more probable than unlikely that non-thermal EMF from cell phones and base stations do have effects upon biology. A single 2-hr exposure to cell phone radiation can result in increased leakage of the BBB, and 50 days after exposure, neuronal damage can be seen, and at the later time point also albumin leakage is demonstrated*. The levels of RFR needed to affect the BBB have been shown to be as low as 0.001 W/kg, or less than holding a mobile phone at arm's length. The US FCC standard is 1.6 W/kg; the ICNIRP standard is 2 W/kg of energy (SAR) into brain tissue from cell/cordless phone use. Thus, BBB effects occur at about 1000 times lower RFR exposure levels than the US and ICNIRP limits allow.* (Salford et al, 2012 - Section 10)

If the blood-brain barrier is vulnerable to serious and on-going damage from wireless exposures, then we should perhaps also be looking at the blood-ocular barrier (that protects the eyes), the blood-placenta barrier (that protects the developing fetus) and the blood-gut barrier (that protects proper digestion and nutrition), and the blood-testes barrier (that protects developing sperm) to see if they too can be damaged by RFR.

EPIDEMIOLOGICAL STUDIES CONSISTENTLY SHOW ELEVATIONS IN RISK OF BRAIN CANCERS

Brain Tumors: There is a consistent pattern of increased risk of glioma and acoustic neuroma associated with use of mobile phones and cordless phones.

"Based on epidemiological studies there is a consistent pattern of increased risk for glioma and acoustic neuroma associated with use of mobile phones and cordless phones. The evidence comes mainly from two study centres, the Hardell group in Sweden and the Interphone Study Group. No consistent pattern of an increased risk is seen for meningioma. A systematic bias in the studies that explains the results would also have been the case for meningioma. The different risk pattern for tumor type strengthens the findings regarding glioma and acoustic neuroma. Meta-analyses of the Hardell group and Interphone studies show an increased risk for glioma and acoustic neuroma. Supportive evidence comes also from anatomical localisation of the tumor to the most exposed area of the brain, cumulative exposure in hours and latency time that all add to the biological relevance of an increased risk. In addition risk calculations based on estimated absorbed dose give strength to the findings.

"There is reasonable basis to conclude that RF-EMFs are bioactive and have a potential to cause health impacts. There is a consistent pattern of increased risk for glioma and acoustic neuroma associated with use of wireless phones (mobile phones and cordless phones) mainly based on results from case-control studies from the Hardell group and Interphone Final Study results. Epidemiological evidence gives that RF-EMF should be classified as a human carcinogen.

Based on our own research and review of other evidence the existing FCC/IEE and ICNIRP public safety limits and reference levels are not adequate to protect public health. New public health standards and limits are needed.

(Hardell et al, 2012 –Section 11)

EVIDENCE FOR GENETIC EFFECTS (Updated March 2014)

One hundred fourteen (114) new papers on genotoxic effects of RFR published between 2007 and early 2014 are profiled. Of these, 74 (65%) showed effects and 40 (35%) showed no effects.

Fifty nine (59) new ELF-EMF papers and two static magnetic field papers that report on genotoxic effects of ELF-EMF between 2007 and early 2014 are profiled. Of these, 49 (83%) show effects and 10 (17%) show no effect. (Lai, 2014 – Section 6)

EVIDENCE FOR NEUROLOGICAL EFFECTS (Updated March 2014)

Two hundred eleven (211) new papers that report on neurological effects of RFR published between 2007 and early 2014 are profiled. Of these, 144 (68%) showed effects and 67 (32%) showed no effects.

One hundred five (105) new ELF-EMF papers (including two static field papers) that report on neurological-effects of ELF-EMF published between 2007 and early 2014 are profiled. Of these, 95 (90%) show effects and 10 (10%) show no effect. (Lai, 2014 – Section 9)

EVIDENCE FOR CHILDHOOD CANCERS (LEUKEMIA)

With overall 42 epidemiological studies published to date power frequency EMFs are among the most comprehensively studied environmental factors. Except ionizing radiation no other environmental factor has been as firmly established to increase the risk of childhood leukemia. Sufficient evidence from epidemiological studies of an increased risk from exposure to EMF (power frequency magnetic fields) that cannot be attributed to chance, bias or confounding. Therefore, according to the rules of IARC such exposures can be classified as a **Group 1 carcinogen (Known Carcinogen).**

There is no other risk factor identified so far for which such unlikely conditions have been put forward to postpone or deny the necessity to take steps towards exposure reduction. As one step in the direction of precaution, measures should be implemented to guarantee that exposure due to transmission and distribution lines is below an average of about 1 mG. This value is arbitrary at present and only supported by the fact that in many studies this level has been chosen as a reference.

Base-station level RFR at levels ranging from less than 0.001 uW/cm2 to 0.05 uW/cm2. In 5 new studies since 2007, researchers report headaches, concentration difficulties and behavioral problems in children and adolescents; and sleep disturbances, headaches and concentration problems in adults.

MELATONIN, BREAST CANCER AND ALZHEIMER'S DISEASE

MELATONIN AND BREAST CANCER

Conclusion: Eleven (11) of the 13 published epidemiologic residential and occupational studies are considered to provide (positive) evidence that high ELF MF exposure can result in decreased melatonin production. The two negative studies had important deficiencies that may certainly have biased the results. There is sufficient evidence to conclude that long-term relatively high ELF MF exposure can result in a decrease in melatonin production. It has not been determined to what extent personal characteristics, e.g., medications, interact with ELF MF exposure in decreasing melatonin production

Conclusion: New research indicates that ELF MF exposure, in vitro, can significantly decrease melatonin activity through effects on MT1, an important melatonin receptor.

(Davanipour and Sobel, 2012 – Section 13)

ALZHEIMER'S DISEASE

There is strong epidemiologic evidence that exposure to ELF MF is a risk factor for AD. There are now twelve (12) studies of ELF MF exposure and AD or dementia which . Nine (9) of these studies are considered positive and three (3) are considered negative. The three negative studies have serious deficiencies in ELF MF exposure classification that results in subjects with rather low exposure being considered as having significant exposure. There are insufficient studies to formulate an opinion as to whether radiofrequency MF exposure is a risk or protective factor for AD.

There is now evidence that (i) high levels of peripheral amyloid beta are a risk factor for AD and (ii) medium to high ELF MF exposure can increase peripheral amyloid beta. High brain levels of amyloid beta are also a risk factor for AD and medium to high ELF MF exposure to brain cells likely also increases these cells' production of amyloid beta.

There is considerable in vitro and animal evidence that melatonin protects against AD. Therefore it is certainly possible that low levels of melatonin production are associated with an increase in the risk of AD.

(Davanipour and Sobel, 2012 – Section 13)

STRESS PROTEINS AND DNA AS A FRACTAL ANTENNA FOR RFR

DNA acts as a 'fractal antenna' for EMF and RFR.

The coiled-coil structure of DNA in the nucleus makes the molecule react like a fractal antenna to a wide range of frequencies.

The structure makes DNA particularly vulnerable to EMF damage.

The mechanism involves direct interaction of EMF with the DNA molecule (claims that there are no known mechanisms of interaction are patently false)

Many EMF frequencies in the environment can and do cause DNA changes.

The EMF-activated cellular stress response is an effective protective mechanism for cells exposed to a wide range of EMF frequencies.

EMF stimulates stress proteins (indicating an assault on the cell).

EMF efficiently harms cells at a billion times lower levels than conventional heating. Blank, 2012 – Section 7)

Safety standards based on heating are irrelevant to protect against EMF-levels of exposure. There is an urgent need to revise EMF exposure standards. Research has shown thresholds are very low (safety standards must be reduced to limit biological responses). Biologically-based EMF safety standards could be developed from the research on the stress response. (Blank, 2012 – Section 7)

EVIDENCE FOR DISRUPTION OF THE MODULATING SIGNAL
HUMAN STEM CELL DNA DOES NOT ADAPT OR REPAIR

Human stem cells do not adapt to chronic exposures to non-thermal microwave (cannot repair damaged DNA), and damage to DNA in genes in other cells generally do not repair as efficiently. (Belyaev, 2012 – Section 15)

Non-thermal effects of microwaves depend on variety of biological and physical parameters that should be taken into account in setting the safety standards. Emerging evidence suggests that the SAR concept, which has been widely adopted for safety standards, is not useful alone for the evaluation of health risks from non-thermal microwave of mobile communication. Other parameters of exposure, such as frequency, modulation, duration, and dose should be taken into account.

Lower intensities are not always less harmful; they may be more harmful.

Intensity windows exist, where bioeffects are much more powerful.

A linear, dose-response relationship test is probably invalid for testing of RFR and EMF (as is done in chemicals testing for toxicity).

Resonant frequencies may result in biological effects at very low intensities comparable to base station (cell tower) and other microwave sources used in mobile communications. These exposures can cause health risk. The current safety standards are insufficient to protect from non-thermal microwave effects.

The data about the effects of microwave at super-low intensities and significant role of duration of exposure in these effects along with the data showing that adverse effects of non-thermal microwave from GSM/UMTS mobile phones depend on carrier frequency and type of the microwave signal suggest that microwave from base-stations/masts, wireless routers, WI-FI and other wireless devices and exposures in common use today can also produce adverse effects at prolonged durations of exposure.

Most of the real signals that are in use in mobile communication have not been tested so far. Very little research has been done with real signals and for durations and intermittences of exposure that are relevant to chronic exposures from mobile communication. In some studies, so-called "mobile communication-like" signals were investigated that in fact were different from the real exposures in such important aspects as intensity, carrier frequency, modulation, polarization, duration and intermittence.

New standards should be developed based on knowledge of mechanisms of non-thermal effects. Importantly, because the signals of mobile communication are completely replaced by other signals faster then once per 10 years, duration comparable with latent period, epidemiologic studies cannot provide basement for cancer risk assessment from upcoming new signals.

In many cases, because of ELF modulation and additional ELF fields created by the microwave sources, for example by mobile phones, it is difficult to distinguish the effects of exposures to ELF and microwave. Therefore, these combined exposures and their possible cancer risks should be considered in combination.

As far as different types of microwave signals (carrier frequency, modulation, polarization, far and near field, intermittence, coherence, *etc.*) may produce different effects, cancer risks should ideally be estimated for each microwave signal separately.

The Precautionary Principle should be implemented while new standards are in progress.

It should be anticipated that some part of the human population, such as children, pregnant women and groups of hypersensitive persons could be especially sensitive to the non-thermal microwave exposures.
(Belyaev, 2012 – Section 15)

N. EFFECTS OF WEAK-FIELD INTERACTIONS ON NON-LINEAR BIOLOGICAL OSCILLATORS AND SYNCHRONIZED NEURAL ACTIVITY

A unifying hypothesis for a plausible biological mechanism to account for very weak field EMF bioeffects other than cancer may lie with weak field interactions of pulsed RFR and ELF-modulated RFR as disrupters of synchronized neural activity. Electrical rhythms in our brains can be influenced by external signals. This is consistent with established weak field effects on coupled biological oscillators in living tissues. Biological systems of the heart, brain and gut are dependent on the cooperative actions of cells that function according to principles of non-linear, coupled biological oscillations for their synchrony, and are dependent on exquisitely timed cues from the environment at vanishingly small levels (Buzsaki, 2006; Strogatz, 2003). The key to synchronization is the joint actions of cells that co-operate electrically - linking populations of biological oscillators that couple together in large arrays and synchronize spontaneously. Synchronous biological oscillations in cells (pacemaker cells) can be disrupted by artificial, exogenous environmental signals, resulting in desynchronization of neural activity that regulates critical functions (including metabolism) in the brain, gut and heart and circadian rhythms governing sleep and hormone cycles (Strogatz, 1987). The brain contains a population of oscillators with distributed natural frequencies, which pull one another into synchrony (the circadian pacemaker cells). Strogatz has addressed the unifying mathematics of biological cycles and external factors disrupt these cycles (Strogatz, 2001, 2003). "*Rhythms can be altered by a wide variety of agents and that these perturbations must seriously alter brain performance"* (Buzsaki, 2006).

"Organisms are biochemically dynamic. They are continuously subjected to time-varying conditions in the form of both extrinsic driving from the environment and intrinsic rhythms generated by specialized cellular clocks within the organism itself. Relevant examples of the latter are the cardiac pacemaker located at the sinoatrial node in mammalian hearts (1) and the circadian clock residing at the suprachiasmatic nuclei in mammalian brains (2). These rhythm generators are composed of thousands of clock cells that are intrinsically diverse but nevertheless manage to function in a coherent oscillatory state. This is the case, for instance, of the circadian oscillations exhibited by the suprachiasmatic nuclei, the period of which is known to be determined by the mean period of the individual neurons making up the circadian clock (3–7). The mechanisms by which this collective behavior arises remain to be understood." (Strogatz, 2001; Strogatz, 2003)

Synchronous biological oscillations in cells (pacemaker cells) can be disrupted by artificial, exogenous environmental signals, resulting in desynchronization of neural activity that regulates critical functions (including metabolism) in the brain, gut and heart and circadian rhythms governing sleep and hormone cycles. The brain contains a population of oscillators with distributed natural frequencies, which pull one another into synchrony (the circadian pacemaker cells). Strogatz has addressed the unifying mathematics of biological cycles and external factors disrupt these cycles.

EMF AND RFR MAKE CHEMICAL TOXINS MORE HARMFUL

EMF acts on the body like other environmental toxicants do (heavy metals, organic chemicals and pesticides). Both toxic chemicals and EMF may generate free radicals, produce stress proteins and cause indirect damage to DNA. Where there is combined exposure the damages may add or even synergistically interact, and result in worse damage to genes.
(Sage and Carpenter, 2012 – Section 24)

EMF IS SUCCESSFULLY USED IN HEALING AND DISEASE TREATMENTS

"The potential application of the up-regulation of the HSP70 gene by both ELF-EMF and nanosecond PEMF in clinical practice would include trauma, surgery, peripheral nerve damage, orthopedic fracture, and vascular graft support, among others. Regardless of pulse design, EMF technology has been shown to be effective in bone healing [5], wound repair [11] and neural regeneration [31,36,48,49,51,63,64,65,66]. In terms of clinical applica- tion, EMF-induction of elevated levels of hsp70 protein also confers protection against hypoxia [61] and aid myocardial function and survival [20,22]. Given these results, we are particularly interested in the translational significance of effect vs. efficacy which is not usually reported by designers or investigators of EMF devices. More precise description of EM pulse and sine wave parameters, including the specific EM output sector, will provide consistency and "scientific basis" in reporting findings."

"The degree of electromagnetic field-effects on biological systems is known to be dependent on a number of criteria in the waveform pattern of the exposure system used; these include frequency, duration, wave shape, and relative orientation of the fields [6,29,32,33,39,40]. In some cases pulsed fields have demonstrated increased efficacy over static designs [19,21] in both medical and experimental settings." (Madkan et al, 2009)

(Sage and Carpenter, 2012 – Section 24)

ELF-EMF AND RFR ARE CLASSIFIED AS POSSIBLE CANCER-CAUSING AGENTS – WHY ARE GOVERNMENTS NOT ACTING?

The World Health Organization International Agency for Research on Cancer has classified wireless radiofrequency as a Possible Human Carcinogen (May, 2011)*. The designation applies to low-intensity RFR in general, covering all RFR-emitting devices and exposure sources (cell and cordless phones, WI-FI, wireless laptops, wireless hotspots, electronic baby monitors, wireless classroom access points, wireless antenna facilities, etc). The IARC Panel could have chosen to classify RFR as a Group 4 – Not A Carcinogen if the evidence was clear that RFR is not a cancer-causing agent. It could also have found a Group 3 designation was a good interim choice (Insufficient Evidence). IARC did neither.

(Sage and Carpenter, 2012 – Section 24)

NEW SAFETY LIMITS MUST BE ESTABLISHED - HEALTH AGENCIES SHOULD ACT NOW

Existing public safety limits (FCC and ICNIRP public safety limits) do not sufficiently protect public health against chronic exposure from very low-intensity exposures. If no mid-course corrections are made to existing and outdated safety limits, such delay will magnify the public health impacts with even more applications of wireless-enabled technologies exposing even greater populations around the world in daily life. (Sage and Carpenter, 2012 – Section 24)

SCIENTIFIC BENCHMARKS FOR HARM PLUS SAFETY MARGIN = NEW SAFETY LIMITS THAT ARE VALID

Health agencies and regulatory agencies that set public safety standards for ELF-EMF and RFR should act now to adopt new, biologically-relevant safety limits that key to the lowest scientific benchmarks for harm coming from the recent studies, plus a lower safety margin. Existing public safety limits are too high by several orders of magnitude, if prevention of bioeffects and minimization or elimination of resulting adverse human health effects. Most safety standards are a thousand times or more too high to protect healthy populations, and even less effective in protecting sensitive subpopulations.

(Sage and Carpenter, 2012 – Section 24)

SENSITIVE POPULATIONS MUST BE PROTECTED

Safety standards for sensitive populations will more likely need to be set at lower levels than for healthy adult populations. Sensitive populations include the developing fetus, the infant, children, the elderly, those with pre-existing chronic diseases, and those with developed electrical sensitivity (EHS). (Sage and Carpenter, 2012 – Section 24)

PROTECTING NEW LIFE - INFANTS AND CHILDREN

Strong precautionary action and clear public health warnings are warranted immediately to help prevent a global epidemic of brain tumors resulting from the use of wireless devices (mobile phones and cordless phones). Common sense measures to limit both ELF-EMF and RFR in the fetus and newborn infant (sensitive populations) are needed, especially with respect to avoidable exposures like baby monitors in the crib and baby isolettes (incubators) in hospitals that can be modified; and where education of the pregnant mother with respect to laptop computers, mobile phones and other sources of ELF-EMF and RFR are easily instituted.

(Sage and Carpenter, 2012 – Section 24)

Wireless laptops and other wireless devices should be strongly discouraged in schools for children of all ages. (Sage and Carpenter, 2012 – Section 24)

STANDARD OF EVIDENCE FOR JUDGING THE SCIENCE

The standard of evidence for judging the scientific evidence should be based on good public health principles rather than demanding scientific certainty before actions are taken. (Sage and Carpenter, 2012 – Section 24)

WIRELESS WARNINGS FOR ALL

The continued rollout of wireless technologies and devices puts global public health at risk from unrestricted wireless commerce unless new, and far lower exposure limits and strong precautionary warnings for their use are implemented.
(Sage and Carpenter, 2012 – Section 24)

EMF AND RFR ARE PREVENTABLE TOXIC EXPOSURES

We have the knowledge and means to save global populations from multi-generational adverse health consequences by reducing both ELF and RFR exposures. Proactive and immediate measures to reduce unnecessary EMF exposures will lower disease burden and rates of premature death.
(Sage and Carpenter, 2012 – Section 24)

DEFINING A NEW 'EFFECT LEVEL' FOR RFR

On a precautionary public health basis, a reduction from the BioInitiative 2007 recommendation of 0.1 uW/cm2 (or one-tenth of a microwatt per square centimeter) for cumulative outdoor RFR down to something three orders of magnitude lower (in the low nanowatt per square centimeter range) is justified.

A scientific benchmark of 0.003 uW/cm2 or three nanowatts per centimeter squared for 'lowest observed effect level' for RFR is based on mobile phone base station-level studies. Applying a ten-fold reduction to compensate for the lack of long-term exposure (to provide a safety buffer for chronic exposure, if needed) or for children as a sensitive subpopulation yields a 300 to 600 picowatts per square centimeter precautionary action level. This equates to a 0.3 nanowatts to 0.6 nanowatts per square centimeter as a reasonable, precautionary action level for chronic exposure to pulsed RFR.

These levels may need to change in the future, as new and better studies are completed. We leave room for future studies that may lower or raise today's observed 'effects levels' and should be prepared to accept new information as a guide for new precautionary actions.

(Sage and Carpenter, 2012 – Section 24)

Reported Biological Effects from Radiofrequency Radiation at Low-Intensity Exposure
(Cell Tower, Wi-Fi, Wireless Laptop and 'Smart' Meter RF Intensities)

Power Density (Microwatts/centimeter2 - uW/cm2)		**Reference**
As low as (10^{-13}) or 100 femtowatts/cm2	Super-low intensity RFR effects at MW reasonant frequencies resulted in changes in genes; problems with chromatin conformation (DNA)	Belyaev, 1997
5 picowatts/cm2 (10^{-12})	Changed growth rates in yeast cells	Grundler, 1992
0.1 nanowatt/cm2 (10^{-10}) or 100 picowatts/cm2	Super-low intensity RFR effects at MW reasonant frequencies resulted in changes in genes; problems with chromatin condensation (DNA) intensities comparable to base stations	Belyaev, 1997
0.00034 uW/cm2	Chronic exposure to mobile phone pulsed RF significantly reduced sperm count,	Behari, 2006
0.0005 uW/cm2	RFR decreased cell proliferation at 960 MHz GSM 217 Hz for 30-min exposure	Velizarov, 1999
0.0006 - 0.0128 uW/cm2	Fatigue, depressive tendency, sleeping disorders, concentration difficulties, cardio- vascular problems reported with exposure to GSM 900/1800 MHz cell phone signal at base station level exposures.	Oberfeld, 2004
0.003 - 0.02 uW/cm2	In children and adolescents (8-17 yrs) short-term exposure caused headache, irritation, concentration difficulties in school.	Heinrich, 2010
0.003 to 0.05 uW/cm2	In children and adolescents (8-17 yrs) short-term exposure caused conduct problems in school (behavioral problems)	Thomas, 2010
0.005 uW/cm2	In adults (30-60 yrs) chronic exposure caused sleep disturbances, (but not significantly increased across the entire population)	Mohler, 2010
0.005 - 0.04 uW/cm2	Adults exposed to short-term cell phone radiation reported headaches, concentration difficulties (differences not significant, but elevated)	Thomas, 2008
0.006 - 0.01 uW/cm2	Chronic exposure to base station RF (whole-body) in humans showed increased stress hormones; dopamine levels substantially decreased; higher levels of adrenaline and nor-adrenaline; dose-response seen; produced chronic physiological stress in cells even after 1.5 years.	Buchner, 2012
0.01 - 0.11 uW/cm2	RFR from cell towers caused fatigue, headaches, sleeping problems	Navarro, 2003

Stress proteins, HSP, disrupted immune function	Brain tumors and blood-brain barrier
Reproduction/fertility effects	Sleep, neuron firing rate, EEG, memory, learning, behavior
Oxidative damage/ROS/DNA damage/DNA repair failure	Cancer (other than brain), cell proliferation
Disrupted calcium metabolism	Cardiac, heart muscle, blood-pressure, vascular effects

Reported Biological Effects from Radiofrequency Radiation at Low-Intensity Exposure
(Cell Tower, Wi-Fi, Wireless Laptop and 'Smart' Meter RF Intensities)

Power Density (Microwatts/centimeter2 - uW/cm2)		Reference
0.01 - 0.05 uW/cm2	Adults (18-91 yrs) with short-term exposure to GSM cell phone radiation reported headache, neurological problems, sleep and concentration problems.	Hutter, 2006
0.005 - 0.04 uW/cm2	Adults exposed to short-term cell phone radiation reported headaches, concentration difficulties (differences not significant, but elevated)	Thomas, 2008
0.015 - 0.21 uW/cm2	Adults exposed to short-term GSM 900 radiation reported changes in mental state (e.g., calmness) but limitations of study on language descriptors prevented refined word choices (stupified, zoned-out)	Augner, 2009
0.05 - 0.1 uW/cm2	RFR linked to adverse neurological, cardio symptoms and cancer risk	Khurana, 2010
0.05 - 0.1 uW/cm2	RFR related to headache, concentration and sleeping problems, fatigue	Kundi, 2009
0.07 - 0.1 uW/cm2	Sperm head abnormalities in mice exposed for 6-months to base station level RF/MW. Sperm head abnormalities occurred in 39% to 46% exposed mice (only 2% in controls) abnormalities was also found to be dose dependent. The implications of the pin-head and banana-shaped sperm head. The occurrence of sperm head observed increase occurrence of sperm head abnormalities on the reproductive health of humans living in close proximity to GSM base stations were discussed."	Otitoloju, 2010
0.38 uW/cm2	RFR affected calcium metabolism in heart cells	Schwartz, 1990
0.8 - 10 uW/cm2	RFR caused emotional behavior changes, free-radical damage by super-weak MWs	Akoev, 2002
0.13 uW/cm2	RFR from 3G cell towers decreased cognition, well-being	Zwamborn, 2003
0.16 uW/cm2	Motor function, memory and attention of school children affected (Latvia)	Kolodynski, 1996
0.168 - 1.053 uW/cm2	Irreversible infertility in mice after 5 generations of exposure to RFR from an 'antenna park'	Magras & Zenos, 1997
0.2 - 8 uW/cm2	RFR caused a two-fold increase in leukemia in children	Hocking, 1996
0.2 - 8 uW/cm2	RFR decreased survival in children with leukemia	Hocking, 2000
0.21 - 1.28 uW/cm2	Adolescents and adults exposed only 45 min to UMTS cell phone radiation reported increases In headaches.	Riddervold, 2008

Stress proteins, HSP, disrupted immune function	Brain tumors and blood-brain barrier
Reproduction/fertility effects	Sleep, neuron firing rate, EEG, memory, learning, behavior
Oxidative damage/ROS/DNA damage/DNA repair failure	Cancer (other than brain), cell proliferation
Disrupted calcium metabolism	Cardiac, heart muscle, blood-pressure, vascular effects

Reported Biological Effects from Radiofrequency Radiation at Low-Intensity Exposure
(Cell Tower, Wi-Fi, Wireless Laptop and 'Smart' Meter RF Intensities)

Power Density (Microwatts/centimeter2 - uW/cm2)		Reference
0.5 uW/cm2	Significant degeneration of seminiferous epithelium in mice at 2.45 GHz, 30-40 min.	Saunders, 1981
0.5 - 1.0 uW/cm2	Wi-FI level laptop exposure for 4-hr resulted in decrease in sperm viability, DNA fragmentation with sperm samples placed in petri dishes under a laptop connected via WI-FI to the internet.	Avendano, 2012
1.0 uW/cm2	RFR induced pathological leakage of the blood-brain barrier	Persson, 1997
1.0 uW/cm2	RFR caused significant effect on immune function in mice	Fesenko, 1999
1.0 uW/cm2	RFR affected function of the immune system	Novoselova, 1999
1.0 uW/cm2	Short-term (50 min) exposure in electrosensitive patients, caused loss of well-being after GSM and especially UMTS cell phone radiation exposure	Eltiti, 2007
1.3 - 5.7 uW/cm2	RFR associated with a doubling of leukemia in adults	Dolk, 1997
1.25 uW/cm2	RFR exposure affected kidney development in rats (in-utero exposure)	Pyrpasopoulou, 2004
1.5 uW/cm2	RFR reduced memory function in rats	Nittby, 2007
2 uW/cm2	RFR induced double-strand DNA damage in rat brain cells	Kesari, 2008
2.5 uW/cm2	RFR affected calcium concentrations in heart muscle cells	Wolke, 1996
2 - 4 uW/cm2	Altered cell membranes; acetycholine-induced ion channel disruption	D'Inzeo, 1988
4 uW/cm2	RFR caused changes in hippocampus (brain memory and learning)	Tattersall, 2001
4 - 15 uW/cm2	Memory impairment, slowed motor skills and retarded learning in children	Chiang, 1989
5 uW/cm2	RFR caused drop in NK lymphocytes (immune function decreased)	Boscolo, 2001
5.25 uW/cm2	20 minutes of RFR at cell tower frequencies induced cell stress response	Kwee, 2001
5 - 10 uW/cm2	RFR caused impaired nervous system activity	Dumansky, 1974
6 uW/cm2	RFR induced DNA damage in cells	Phillips, 1998

Stress proteins, HSP, disrupted immune function	Brain tumors and blood-brain barrier
Reproduction/fertility effects	Sleep, neuron firing rate, EEG, memory, learning, behavior
Oxidative damage/ROS/DNA damage/DNA repair failure	Cancer (other than brain), cell proliferation
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Reported Biological Effects from Radiofrequency Radiation at Low-Intensity Exposure
(Cell Tower, Wi-Fi, Wireless Laptop and 'Smart' Meter RF Intensities)

Power Density (Microwatts/centimeter2 - uW/cm2)		Reference
8.75 uW/cm2	RFR at 900 MHz for 2-12 hours caused DNA breaks in leukemia cells	Marinelli, 2004
10 uW/cm2	Changes in behavior (avoidance) after 0.5 hour exposure to pulsed RFR	Navakatikian, 1994
10 - 100 uW/cm2	Increased risk in radar operators of cancer; very short latency period; dose response to exposure level of RFR reported.	Richter, 2000
12.5 uW/cm2	RFR caused calcium efflux in cells - can affect many critical cell functions	Dutta, 1989
13.5 uW/cm2	RFR affected human lymphocytes - induced stress response in cells	Sarimov, 2004
20 uW/cm2	Increase in serum cortisol (a stress hormone)	Mann, 1998
28.2 uW/cm2	RFR increased free radical production in rat cells	Yurekli, 2006
37.5 uW/cm2	Immune system effects - elevation of PFC count (antibody producing cells	Veyret, 1991
45 uW/cm2	Pulsed RFR affected serum testosterone levels in mice	Forgacs, 2006
50 uW/cm2	Cell phone RFR caused a pathological leakage of the blood-brain barrier in 1 hour	Salford, 2003
50 uW/cm2	An 18% reduction in REM sleep (important to memory and learning functions)	Mann, 1996
60 uW/cm2	RFR caused structural changes in cells of mouse embryos	Somozy, 1991
60 uW/cm2	Pulsed RFR affected immune function in white blood cells	Stankiewicz, 2006
60 uW/cm2	Cortex of the brain was activated by 15 minutes of 902 MHz cell phone	Lebedeva, 2000
65 uW/cm2	RFR affected genes related to cancer	Ivaschuk, 1999
92.5 uW/cm2	RFR caused genetic changes in human white blood cells	Belyaev, 2005
100 uW/cm2	Changes in immune function	Elekes, 1996
100 uW/cm2	A 24.3% drop in testosterone after 6 hours of CW RFR exposure	Navakatikian, 1994
120 uW/cm2	A pathological leakage in the blood-brain barrier with 915 MHz cell RF	Salford, 1994

Stress proteins, HSP, disrupted immune function	Brain tumors and blood-brain barrier
Reproduction/fertility effects	Sleep, neuron firing rate, EEG, memory, learning, behavior
Oxidative damage/ROS/DNA damage/DNA repair failure	Cancer (other than brain), cell proliferation
Disrupted calcium metabolism	Cardiac, heart muscle, blood-pressure, vascular effects

Reported Biological Effects from Radiofrequency Radiation at Low-Intensity Exposure
(Cell Tower, Wi-Fi, Wireless Laptop and 'Smart' Meter RF Intensities)

Power Density (Microwatts/centimeter2 - uW/cm2)		Reference
500 uW/cm2	Intestinal epithelial cells exposed to 2.45 GHz pulsed at 16 Hz showed changes in intercellular calcium.	Somozy, 1993
500 uW/cm2	A 24.6% drop in testosterone and 23.2% drop in insulin after 12 hrs of pulsed RFR exposure.	Navakatikian, 1994

STANDARDS		
530 - 600 uW/cm2	Limit for uncontrolled public exposure to 800-900 MHz	ANSI/IEEE and FCC
1000 uW/cm2	PCS STANDARD for public exposure (as of September 1,1997)	FCC, 1996
5000 uW/cm2	PCS STANDARD for occupational exposure (as of September 1, 1997)	FCC, 1996
BACKGROUND LEVELS		
0.003 uW/cm2	Background RF levels in US cities and suburbs in the 1990s	Mantiply, 1997
0.05 uW/cm2	Median ambient power density in cities in Sweden (30-2000 MHz)	Hamnierius, 2000
0.1 - 10 uW/cm2	Ambient power density within 100-200' of cell site in US (data from 2000)	Sage, 2000

Stress proteins, HSP, disrupted immune function	Brain tumors and blood-brain barrier
Reproduction/fertility effects	Sleep, neuron firing rate, EEG, memory, learning, behavior
Oxidative damage/ROS/DNA damage/DNA repair failure	Cancer (other than brain), cell proliferation
Disrupted calcium metabolism	Cardiac, heart muscle, blood-pressure, vascular effects

Reported Biological Effects from Radiofrequency Radiation at Low-Intensity Exposure
(Cell Tower, Wi-Fi, Wireless Laptop and 'Smart' Meter RF Intensities)

SAR (Watts/Kilogram)		Reference
0.000064 - 0.000078 W/Kg	Well-being and cognitive function affected in humans exposed to GSM-UMTS cell phone frequencies; RF levels similar near cell sites	TNO Physics and
0.00015 - 0.003 W/Kg	Calcium ion movement in isolated frog heart tissue is increased 18% (P<.01) and by 21% (P<.05) by weak RF field modulated at 16 Hz	Schwartz, 1990
0.000021 - 0.0021 W/Kg	Changes in cell cycle; cell proliferation (960 MHz GSM mobile phone)	Kwee, 1997
0.0003 - 0.06 W/Kg	Neurobehavioral disorders in offspring of pregnant mice exposed in utero to cell phones - dose-response impaired glutamatergic synaptic transmission onto layer V pyramidal neurons of the prefrontal cortex. Hyperactivity and impaired memory function in offspring. Altered brain development.	Aldad, 2012
0.0016 - 0.0044 W/Kg	Very low power 700 MHz CW affects excitability of hippocampus tissue, consistent with reported behavioral changes.	Tattersall, 2001
0.0021 W/Kg	Heat shock protein HSP 70 is activated by very low intensity microwave exposure in human epithelial amnion cells	Kwee, 2001
0.0024 - 0.024 W/Kg	Digital cell phone RFR at very low intensities causes DNA damage in human cells; both DNA damage and impairment of DNA is reported	Phillips, 1998
0.0027 W/Kg	Changes in active avoidance conditioned behavioral effect is seen after one-half hour of pulsed radiofrequency radiation	Navakatikian, 1994
0.0035 W/Kg	900 MHz cell phone signal induces DNA breaks and early activation of p53 gene; short exposure of 2-12 hours leads cells to acquire greater survival chance - linked to tumor agressiveness.	Marinelli, 2004
0.0095 W/Kg	MW modulated at 7 Hz produces more errors in short-term memory functioin on complex tasks (can affect cognitive processes such as attention and memory)	Lass, 2002
0.001 W/Kg	750 MHz continuous wave (CW) RFR exposure caused increase in heat shock protein (stress proteins). Equivalent to what would be induced by 3 degree C. heating of tissue (but no heating occurred)	De Pomerai, 2000
0.001 W/Kg	Statistically significant change in intracellular calcium concentration in heart muscle cells exposed to RFR (900 MHz/50 Hz modulation)	Wolke, 1996

Stress proteins, HSP, disrupted immune function	Brain tumors and blood-brain barrier
Reproduction/fertility effects	Sleep, neuron firing rate, EEG, memory, learning, behavior
Oxidative damage/ROS/DNA damage/DNA repair failure	Cancer (other than brain), cell proliferation
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SAR (Watts/Kilogram)		Reference
0.0021 W/Kg	A significant change in cell proliferation not attributable to thermal heating. RFR induces non-thermal stress proteins (960 MHz GSM)	Velizarov, 1999
0.004 - 0.008 W/Kg	915 MHz cell phone RFR caused pathological leakage of blood-brain barrier. Worst at lower SAR levels and worse with CW compared to Frequency of pathological changes was 35% in rats exposed to pulsed radiation at 50% to continuous wave RFR. Effects observed at a specific absorption (SA) of > 1.5 joules/Kg in human tissues	Persson, 1997
0.0059 W/Kg	Cell phone RFR induces glioma (brain cancer) cells to significantly increase thymidine uptake, which may be indication of more cell division	Stagg, 1997
0.014 W/Kg	Sperm damage from oxidative stress and lowered melatonin levels resulted from 2-hr per day/45 days exposure to 10 GHz.	Kumar, 2012
0.015 W/Kg	Immune system effects - elevation of PFC count (antibody-producing cells)	Veyret, 1991
0.02 W/Kg	A single, 2-hr exposure to GSM cell phone radiation results in serious neuron damage (brain cell damage) and death in cortex, hippocampus, and basal ganglia of brain- even 50+ days later blood-brain barrier is still leaking albumin (P<.002) following only one cell phone exposure	Salford, 2003
0.026 W/Kg	Activity of c-jun (oncogene or cancer gene) was altered in cells after 20 minutes exposure to cell phone digital TDMA signal	Ivaschuk, 1997
0.0317 W/Kg	Decrease in eating and drinking behavior	Ray, 1990
0.037 W/Kg	Hyperactivity caused by nitric oxide synthase inhibitor is countered by exposure to ultra-wide band pulses (600/sec) for 30 min	Seaman, 1999
0.037 - 0.040 W/Kg	A 1-hr cell phone exposure causes chromatin condensation; impaired DNA repair mechanisms; last 3 days (longer than stress response) the effect reaches saturation in only one hour of exposure; electro- sensitive (ES) people have different response in formation of DNA repair foci, compared to healthy individuals; effects depend on carrier frequency (915 MHz = 0.037 W/Kg but 1947 MHz = 0.040 W/Kg)	Belyaev, 2008
0.05 W/Kg	Significant increase in firing rate of neurons (350%) with pulsed 900 MHz cell phone radiation exposure (but not with CW) in avian brain cells	Beason, 2002

Stress proteins, HSP, disrupted immune function	Brain tumors and blood-brain barrier
Reproduction/fertility effects	Sleep, neuron firing rate, EEG, memory, learning, behavior
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SAR (Watts/Kilogram)		Reference
0.09 W/Kg	900 MHz study of mice for 7 days, 12-hr per day (whole-body) resulted in significant effect on mitochondria and genome stability	Aitken, 2005
0.091 W/Kg	Wireless internet 2400 MHz, 24-hrs per day/20 weeks increased DNA damage and reduced DNA repair; levels below 802.11 g Authors say "findings raise questions about safety of radiofrequency exposure from Wi-Fi internet access devices for growing organisms of reproductive age, with a potential effect on fertility and integrity of germ cells" (male germ cells are the reproductive cells=sperm)	Atasoy, 2012
0.11 W/Kg	Increased cell death (apoptosis) and DNA fragmentation at 2.45 GHz for 35 days exposure (chronic exposure study)	Kesari, 2010
0.121 W/Kg	Cardiovascular system shows significant decrease in arterial blood pressure (hypotension) after exposure to ultra-wide band pulses	Lu, 1999
0.13 - 1.4 W/Kg	Lymphoma cancer rate doubled with two 1/2-hr exposures per day of cell phone radiation for 18 months (pulsed 900 MHz cell signal)	Repacholi, 1997
0.14 W/Kg	Elevation of immune response to RFR exposure	Elekes, 1996
0.141 W/Kg	Structural changes in testes - smaller diameter of seminiferous	Dasdag, 1999
0.15 - 0.4 W/Kg	Statistically significant increase in malignant tumors in rats chronically exposed to RFR	Chou, 1992
0.26 W/Kg	Harmful effects to the eye/certain drugs sensitize the eye to RFR	Kues, 1992
0.28 - 1.33 W/Kg	Significant increase in reported headaches with increasing use of hand-held cell phone use (maximum tested was 60 min per day)	Chia, 2000
0.3 - 0.44 W/Kg	Cell phone use results in changes in cognitive thinking/mental tasks related to memory retrieval	Krause, 2000
0.3 - 0.44 W/Kg	Attention function of brain and brain responses are speeded up	Preece, 1999
0.3 - 0.46 W/Kg	Cell phone RFR doubles pathological leakage of blood-brain barrier permeability at two days (P=.002) and triples permeability at four days (P=.001) at 1800 MHz GSM cell phone radiation	Schirmacher, 2000
0.43 W/Kg	Significant decrease in sperm mobility; drop in sperm concentration; and decrease in seminiferous tubules at 800 MHz, 8-hr/day, 12 weeks, with mobile phone radiation level on STANDBY ONLY (in rabbits)	Salama, 2008

Stress proteins, HSP, disrupted immune function	Brain tumors and blood-brain barrier
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SAR (Watts/Kilogram)		Reference
0.5 W/Kg	900 MHz pulsed RF affects firing rate of neurons (Lymnea stagnalis) but continuous wave had no effect	Bolshakov, 1992
0.58 - 0.75 W/Kg	Decrease in brain tumors after chronic exposure to RFR at 836 MHz	Adey, 1999
0.6 - 0.9 W/Kg	Mouse embryos develop fragile cranial bones from in utero 900 MHz The authors say "(O)ur results clearly show that even modest exposure (e.g., 6 min daily for 21 days" is sufficient to interfere with the normal mouse developmental process"	Fragopoulou, 2009
0.6 and 1.2 W/Kg	Increase in DNA single and double-strand DNA breaks in rat brain cells with exposure to 2450 MHz RFR	Lai & Singh, 1996
0.795 W/Kg	GSM 900 MHz, 217 Hz significantly decreases ovarian development and size of ovaries, due to DNA damage and premature cell death of nurse cells and follicles in ovaries (that nourish egg cells)	Panagopoulous, 2012
0.87 W/Kg	Altered human mental performance after exposure to GSM cell phone radiation (900 MHz TDMA digital cell phone signal)	Hamblin, 2004
0.87 W/Kg	Change in human brainwaves; decrease in EEG potential and statistically significant change in alpha (8-13 Hz) and beta (13-22 Hz) brainwave activity in humans at 900 MHz; exposures 6/min per day for 21 days (chronic exposure)	D'Costa, 2003
0.9 W/Kg	Decreased sperm count and more sperm cell death (apoptosis) after 35 days exposure, 2-hr per day	Kesari, 2012
< 1.0 W/Kg	Rats exposed to mobile phone radiation on STANDBY ONLY for 11-hr 45-min plus 15-min TRANSMIT mode; 2 times per day for 21 days showed decreased number of ovarian follicles in pups born to these pregnant rats. The authors conclude "the decreased number of follicles in pups exposed to mobile phone microwaves suggest that intrauterine exposure has toxic effects on ovaries."	Gul, 2009
0.4 - 1.0 W/Kg	One 6-hr exposure to 1800 MHz cell phone radiation in human sperm cells caused a significant dose response and reduced sperm motility and viability; reactive oxygen species levels were significantly increased after exposure to 1.0 W/Kg; study confirms detrimental effects of RF/MW to human sperm. The authors conclude "(T)hese findings have clear implicatiions for the safety of extensive mobile phone use by males of reproductive age, potentially affecting both their fertility and the health and wellbeing of their offspring."	De Iuliis, 2009
1.0 W/Kg	Human semen degraded by exposure to cell phone frequency RF increased free-radical damage.	De Iuliis, 2009

Stress proteins, HSP, disrupted immune function	Brain tumors and blood-brain barrier
Reproduction/fertility effects	Sleep, neuron firing rate, EEG, memory, learning, behavior
Oxidative damage/ROS/DNA damage/DNA repair failure	Cancer (other than brain), cell proliferation
Disrupted calcium metabolism	Cardiac, heart muscle, blood-pressure, vascular effects

Reported Biological Effects from Radiofrequency Radiation at Low-Intensity Exposure
(Cell Tower, Wi-Fi, Wireless Laptop and 'Smart' Meter RF Intensities)

SAR (Watts/Kilogram)		Reference
1.0 W/Kg	Motility, sperm count, sperm morphology, and viability reduced in active cell phone users (human males) in dose-dependent manner.	Agarwal, 2008
1.0 W/Kg	GSM cell phone use modulates brain wave oscillations and sleep EEG	Huber, 2002
1.0 W/Kg	Cell phone RFR during waking hours affects brain wave activity. (EEG patterns) during subsequent sleep	Achermann, 2000
1.0 W/Kg	Cell phone use causes nitric oxide (NO) nasal vasodilation (swelling inside nasal passage) on side of head phone use	Paredi, 2001
1.0 W/Kg	Increase in headache, fatigue and heating behind ear in cell phone users	Sandstrom, 2001
1.0 W/Kg	Significant increase in concentration difficulties using 1800 MHz cell phone compared to 900 MHz cell phone	Santini, 2001
1.0 W/Kg	Sleep patterns and brain wave activity are changed with 900 MHz cell phone radiation exposure during sleep	Borbely, 1999
1.4 W/Kg	GSM cell phone exposure induced heat shock protein HSP 70 by 360% (stress response) and phosphorylation of ELK-1 by 390%	Weisbrot, 2003
1.46 W/Kg	850 MHz cell phone radiation decreases sperm motility, viability is significantly decreased; increased oxidative damage (free-radicals) significantly decreased; increased oxidative damage (free-radicals)	Agarwal, 2009
1.48 W/Kg	A significant decrease in protein kinase C activity at 112 MHz with 2-hr per day for 35 days; hippocampus is site, consistent with reports that RFR negatively affects learning and memory functions	Paulraj, 2004
1.0 - 2.0 W/Kg	Significant elevation in micronuclei in peripheral blood cells at 2450 MHz (8 treatments of 2-hr each)	Trosic, 2002
1.5 W/Kg	GSM cell phone exposure affected gene expression levels in tumor suppressor p53-deficient embryonic stem cells; and significantly increased HSP 70 heat shock protein production	Czyz, 2004
1.8 W/Kg	Whole-body exposure to RF cell phone radiation of 900-1800 MHz 1 cm from head of rats caused high incidence of sperm cell death; deformation of sperm cells; prominent clumping together of sperm cells into "grass bundle shapes" that are unable to separate/swim. Sperm cells unable to swim and fertilize in normal manner.	Yan, 2007

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SAR (Watts/Kilogram)		Reference
2.0 W/Kg	GSM cell phone exposure of 1-hr activated heat shock protein HSP 27 (stress response) and P38 MAPK (mutagen-activated protein kinase) that authors say facilitates brain cancer and increased blood-brain barrier permeability, allowing toxins to cross BBB into brain	Leszczynski, 2002
2 W/Kg	900 MHz cell phone exposure caused brain cell oxidative damage by increasing levels of NO, MDA, XO and ADA in brain cells; caused statistically significant increase in 'dark neurons' or damaged brain cells in cortex, hippocampus and basal ganglia with a 1-hr exposure for 7 consecutive days	Ilhan, 2004
2.6 W/Kg	900 MHz cell phone exposure for 1-hr significantly altered protein expression levels in 38 proteins following irradiation; activates P38 MAP kinase stress signalling pathway and leads to changes in cell sie and shape (shrinking and rounding up) and to activation of HSP 27, a stress protein (heat shock protein)	Leszczynski, 2004
2.0 - 3.0 W/Kg	RFR accelerated development of both skin and breast tumors	Szmigielski, 1982
2 W/Kg	Pulse-modulated RFR and MF affect brain physiology (sleep study)	Schmidt, 2012

STANDARDS		
0.08 W/Kg	IEEE Standard uncontrolled public environment (whole body)	IEEE
0.4 W/Kg	IEEE Standard controlled occupational environment (whole body)	IEEE
1.6 W/Kg	FCC (IEEE) SAR limit for 1 gram of tissue in a partial body exposure	FCC, 1996
2 W/Kg	ICNIRP SAR limit for 10 grams of tissue	ICNIRP, 1996

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