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ROY BLUNT, MISSOURI
TED CRUZ, TEXAS
DEB FISCHER, NEBRASKA
JERRY MORAN, KANSAS
DAN SULLIVAN, ALASKA
DEAN HELLER, NEVADA
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JON TESTER, MONTANA

United States Senate

COMMITTEE ON COMMERCE, SCIENCE,
AND TRANSPORTATION

WASHINGTON, DC 20510-6125

WEBSITE: <http://commerce.senate.gov>

NICK ROSSL, STAFF DIRECTOR
KIM LIPSKY, DEMOCRATIC STAFF DIRECTOR

February 15, 2018

Mr. Jeffrey P. Bezos
President, Chief Executive Officer,
and Chairman of the Board
Amazon.com, Inc.
410 Terry Avenue North
Seattle, WA 98109

Dear Mr. Bezos:

Academic and independent security researchers,¹ some of whom were federally-funded,² recently discovered three vulnerabilities in modern computer processors that have existed for more than two decades.³ These side-channel vulnerabilities,⁴ which researchers have named “Meltdown” and “Spectre,” could allow sophisticated hackers access to stored passwords, encryption keys, and other highly sensitive information.⁵

According to one of the researchers, the Meltdown vulnerability is “probably one of the worst CPU [central processing unit] bugs ever found,”⁶ while Spectre, although arguably more difficult to exploit, presents more significant challenges to mitigate or patch. For years, the National Institute of Standards and Technology (NIST) within the U.S. Department of Commerce has been concerned with such side-channel attacks and their impact on cryptography. In 2011, NIST held a testing workshop and coauthored standards in cooperation and accordance with the

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Sincerely,



JOHN THUNE
Chairman



BILL NELSON
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February 15, 2018

Mr. Tim Cook
Chief Executive Officer
Apple Inc.
1 Infinite Loop
Cupertino, CA 95014

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Sincerely,



JOHN THUNE
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NICK ROSSI, STAFF DIRECTOR
KIM LIPSKY, DEMOCRATIC STAFF DIRECTOR

February 15, 2018

Mr. Jensen Huang
President and Chief Executive Officer
NVIDIA Corporation
2788 San Tomas Expressway
Santa Clara, CA 95051

Dear Mr. Huang:

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February 15, 2018

Mr. Brian M. Krzanich
Chief Executive Officer
Intel Corporation
2200 Mission College Boulevard
Santa Clara, CA 95054

Dear Mr. Krzanich:

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Sincerely,



JOHN THUNE
Chairman



BILL NELSON
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United States Senate

COMMITTEE ON COMMERCE, SCIENCE,
AND TRANSPORTATION

WASHINGTON, DC 20510-6125

WEBSITE: <http://commerce.senate.gov>

NICK ROSSI, STAFF DIRECTOR
KIM LIPSKY, DEMOCRATIC STAFF DIRECTOR

February 15, 2018

Mr. Satya Nadella
Chief Executive Officer
Microsoft Corporation
One Microsoft Way
Redmond, WA 98052

Dear Mr. Nadella:

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Sincerely,



JOHN THUNE
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BILL NELSON
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WEBSITE: <http://commerce.senate.gov>

NICK ROSSI, STAFF DIRECTOR
KIM LIPSKY, DEMOCRATIC STAFF DIRECTOR

February 15, 2018

Mr. Sundar Pichai
Chief Executive Officer
Google LLC
1600 Amphitheatre Parkway
Mountain View, CA 94043

Dear Mr. Pichai:

Academic and independent security researchers,¹ some of whom were federally-funded,² recently discovered three vulnerabilities in modern computer processors that have existed for more than two decades.³ These side-channel vulnerabilities,⁴ which researchers have named “Meltdown” and “Spectre,” could allow sophisticated hackers access to stored passwords, encryption keys, and other highly sensitive information.⁵

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While we recognize industry's coordinated response to this ubiquitous, complex problem, some security experts have been critical of the process to disclose and mitigate these vulnerabilities.⁹ Although security researchers initially informed certain companies of the vulnerabilities in June of 2017, the vulnerabilities were not widely disclosed until January of 2018. In addition, a handful of Chinese customers, but not the United States government, were initially informed as part of the coordinated response, raising questions as to whether a foreign government or malicious actors could have exploited the vulnerabilities.¹⁰ As such, the full picture of the impact of these vulnerabilities, including who is affected, when they knew, with whom they communicated, and what steps they have taken in response, is far from clear.

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Sincerely,



JOHN THUNE
Chairman



BILL NELSON
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COMMITTEE ON COMMERCE, SCIENCE,
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WASHINGTON, DC 20510-6125

WEBSITE: <http://commerce.senate.gov>

February 15, 2018

Mr. Chuck Robbins
Chairman and Chief Executive Officer
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134

Dear Mr. Robbins:

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Sincerely,



JOHN THUNE
Chairman



BILL NELSON
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United States Senate

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WASHINGTON, DC 20510-6125

WEBSITE: <http://commerce.senate.gov>

February 15, 2018

Ms. Virginia M. Rometty
Chairman, President, and
Chief Executive Officer
International Business Machines Corporation
1 New Orchard Road
Armonk, NY 10504

Dear Ms. Rometty:

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JOHN THUNE
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United States Senate

COMMITTEE ON COMMERCE, SCIENCE,
AND TRANSPORTATION

WASHINGTON, DC 20510-6125

WEBSITE: <http://commerce.senate.gov>

February 15, 2018

Mr. Simon Segars
Chief Executive Officer
ARM Holdings PLC
150 Rose Orchard Way
San Jose, CA 95134

Dear Mr. Segars:

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We look forward to receiving your written response as soon as possible, but by no later than March 1, 2018. Thank you for your consideration of this request.

Sincerely,



JOHN THUNE
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NICK ROSSI, STAFF DIRECTOR
KIM LIPSKY, DEMOCRATIC STAFF DIRECTOR

February 15, 2018

Dr. Lisa Su
President and Chief Executive Officer
Advanced Micro Devices, Inc.
2485 Augustine Drive
Santa Clara, CA 95054

Dear Dr. Su:

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NICK ROSSL, STAFF DIRECTOR
KIM LIPSKY, DEMOCRATIC STAFF DIRECTOR

February 15, 2018

Mr. Yang Yuanqing
Chairman and Chief Executive Officer
Lenovo Group Limited
1009 Think Place
Morrisville, NC 27560

Dear Mr. Yuanqing:

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10. Do you have recommendations for further or future steps to be taken to reduce cybersecurity risks stemming from hardware vulnerabilities? What role, if any, do you think the U.S. Government should take in addressing hardware vulnerabilities or in response to their discovery?

We look forward to receiving your written response as soon as possible, but by no later than March 1, 2018. Thank you for your consideration of this request.

Sincerely,



JOHN THUNE
Chairman



BILL NELSON
Ranking Member

ROGER WICKER, MISSISSIPPI
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NICK ROSSL, STAFF DIRECTOR
KIM LIPSKY, DEMOCRATIC STAFF DIRECTOR

United States Senate

COMMITTEE ON COMMERCE, SCIENCE,
AND TRANSPORTATION

WASHINGTON, DC 20510-6125

WEBSITE: <http://commerce.senate.gov>

February 15, 2018

Mr. Ren Zhengfei
Deputy Chairman of the Board
and Chief Executive Officer
Huawei Technologies, Co., Ltd.
c/o Huawei Technologies USA
5700 Tennyson Parkway Suite 500
Plano, TX 75024

Dear Mr. Zhengfei:

Academic and independent security researchers,¹ some of whom were federally-funded,² recently discovered three vulnerabilities in modern computer processors that have existed for more than two decades.³ These side-channel vulnerabilities,⁴ which researchers have named “Meltdown” and “Spectre,” could allow sophisticated hackers access to stored passwords, encryption keys, and other highly sensitive information.⁵

According to one of the researchers, the Meltdown vulnerability is “probably one of the worst CPU [central processing unit] bugs ever found,”⁶ while Spectre, although arguably more difficult to exploit, presents more significant challenges to mitigate or patch. For years, the National Institute of Standards and Technology (NIST) within the U.S. Department of Commerce has been concerned with such side-channel attacks and their impact on cryptography. In 2011, NIST held a testing workshop and coauthored standards in cooperation and accordance with the

¹ Affiliated with Google’s Project Zero, Graz University of Technology, University of Pennsylvania, University of Maryland, University of Adelaide, Cyberus, and Rambus.

² Nat’l Instl of Standards and Tech., “70NANB15H328, Provable Security for Next-Generation Cryptography;” Nat’l Sci. Found., “Award 1514261, TWC: Medium: Apollo: An Architecture for Scalable Verifiable Computing;” and Nat’l Sci. Found., “Award 1652259, CAREER: Towards Practical Systems for Trustworthy Cloud Computing.”

³ Horn, Jann, “Reading Privileged Memory with a Side-Channel,” January 3, 2018; Kocher, Paul, Daniel Genkin, Daniel Gruss, Werner Haas, Mike Hamburg, Moritz Lipp, Stefan Mangard, Thomas Prescher, Michael Schwarz, and Yuval Yarom, “Spectre Attacks: Exploiting Speculative Execution,” January 03, 2018; Lipp, Moritz, Michael Schwarz, Daniel Gruss, Thomas Prescher, Werner Haas, Stefan Mangard, Paul Kocher, Daniel Genkin, Yuval Yarom, and Mike Hamburg, “Meltdown,” January 03, 2018; Galowicz, Jacek, Cyberus Technology, “Meltdown,” January 3, 2018.

⁴ Nat’l Inst. of Standards and Tech., Nat’l Vulnerability Database, “CVE-2017-5754 Detail,” “CVE-2017-5733 Detail,” and “CVE-2017-5715 Detail,” January 4, 2018.

⁵ “Alert (TA 1804A): Meltdown and Spectre Side-Channel Vulnerability Guidance,” January 4, 2018, <https://www.us-cert.gov/ncas/alerts/TA18-004A>.

⁶ Busvine, Douglas, and Stephen Nellis, “Security Flaws Put Virtually All Phones, Computers at Risk,” January 04, 2018, Accessed January 31, 2018, <https://www.reuters.com/article/us-cyber-intel/security-flaws-put-virtually-all-phones-computers-at-risk-idUSKBN1ES1BO>.

International Organization for Standardization (ISO).⁷ These types of novel hardware vulnerabilities may represent the future of the potential cybersecurity risks we face.⁸ They have few countermeasures, and the scope of these vulnerabilities is unprecedented given the number of organizations and products affected.

While we recognize industry's coordinated response to this ubiquitous, complex problem, some security experts have been critical of the process to disclose and mitigate these vulnerabilities.⁹ Although security researchers initially informed certain companies of the vulnerabilities in June of 2017, the vulnerabilities were not widely disclosed until January of 2018. In addition, a handful of Chinese customers, but not the United States government, were initially informed as part of the coordinated response, raising questions as to whether a foreign government or malicious actors could have exploited the vulnerabilities.¹⁰ As such, the full picture of the impact of these vulnerabilities, including who is affected, when they knew, with whom they communicated, and what steps they have taken in response, is far from clear.

The Senate Commerce Committee has previously sought to reduce cybersecurity risks through the encouragement of public-private partnerships to share cyber threat information and best practices and the promotion of cybersecurity research and standards development. Cybersecurity remains a priority for the Committee, and we request written responses to the following questions as the Committee looks for lessons and recommendations to be better prepared to address cybersecurity risks associated with these vulnerabilities in the future:

1. When and how did you first become aware of these vulnerabilities?
2. Which of your products are affected by these vulnerabilities and how are they affected?
3. Did you communicate with any entity outside your company, including any U.S. or foreign government agencies, regarding these vulnerabilities prior to the date the vulnerabilities were publicly disclosed? If so, please identify each such entity and when you communicated with them.

⁷ Nat'l Inst. of Standards and Tech., Computer Security Resource Center, "Non-Invasive Attack Testing Workshop," Updated August 17, 2011, available at: <https://csrc.nist.gov/Events/2011/Non-Invasive-Attack-Testing-Workshop>; International Organization for Standardization, "ISO/IEC 17825:2016: Information Technology – Security Techniques – Testing Methods for the Mitigation of Non-Invasive Attack Classes against Cryptographic Modules," January 2016, <https://www.iso.org/standard/52906.html>; International Organization for Standardization, "ISO/IEC 17825:2016: Information Technology – Security Techniques – Testing Methods for the Mitigation of Non-Invasive Attack Classes against Cryptographic Modules," January 2016, <https://www.iso.org/standard/60612.html>

⁸ Schneier, Bruce, "The New Way Your Computer Can Be Attacked," *The Atlantic*, January 22, 2018, accessed February 01, 2018, <https://www.theatlantic.com/technology/archive/2018/01/spectre-meltdown-cybersecurity/551147/>.

⁹ Newman, Lily Hay, "Meltdown and Spectre Patching has been a Total Train Wreck," *Wired*, January 23, 2018, accessed February 1, 2018, <https://www.wired.com/story/meltdown-spectre-patching-total-train-wreck/>

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