November 8, 2021

Matthew S. Borman
Deputy Assistant Secretary for Export Administration
Bureau of Industry and Security, U.S. Department of Commerce
1401 Constitution Ave. NW
Washington, DC 20230

Re: Docket Number BIS-2021-0036

Dear Deputy Assistant Secretary Borman:

Thank you for providing HP Inc. ("HP") the opportunity to provide additional comments on the risks in the semiconductor supply chain. HP deeply appreciates the efforts the Administration has taken to date with the 100-day review on semiconductors (see previous HP comments) and the broader year-long review of the ICT ecosystem, to which HP has also submitted comments (Docket 2021-0021).

We commend the Secretary's visible engagement and the Department's efforts to develop longer-term U.S. semiconductor capacity and focus on collaboration with other semiconductor producing regions (EU, Taiwan, Japan, and South Korea) to address the shortages. HP continues to strongly encourage Congress to provide funding for the CHIPS Act to expand semiconductor design and production in the United States.

As the pandemic shifted millions of workers, students, and consumers online, PCs and printers have never been more vital to productivity, educational equity, remote healthcare delivery, and small business survival. According to Gartner, PC sales in 2020 grew to 275M worldwide, achieving the highest growth rate seen since 2010.[1] Global PC sales in Q1 2021 continued to break records, with 36% year on year growth, while Q2 and Q3 sales growth slowed largely due to supply constraints in semiconductors.[2]

Semiconductors are the key enabling components for our computing and printing products. For example, a single PC can contain roughly 1,200 distinct semiconductors from up to 500 different suppliers. In addition to our direct procurement of semiconductors, the subassemblies we procure also contain chips (graphic cards, solid state devices, memory modules, motherboards, etc.). During the ongoing shortage, HP has witnessed nearly every semiconductor type falling short of current demand, with a back and forth between which types are most challenged in supply. The most extreme shortages are found in part types that are

---

[1] Gartner Says Worldwide PC Shipments Grew 10.7% in Fourth Quarter of 2020 and 4.8% for the Year
[2] Gartner Says Worldwide PC Shipments Grew 4.6% in Second Quarter of 2021

common across all electronics industries, especially those with more fixed capacity and less variable capacity (due to older process nodes and processes with custom or inflexible tool sets).

Given the complexity of our semiconductor purchasing and the burden it would place on our employees who are the same ones actively managing the shortage with the holiday season looming, HP is unable to provide a response at the level of detail sought in the questionnaire. Further, we urge caution in interpreting the responses, as semiconductor supply chain information is complex and dynamic, with bottlenecks changing on a weekly basis. In our experience, the chip shortage is primarily an issue of capacity in light of unprecedented demand, not an issue of lack of transparency.

Background on HP

HP's vision is a world where innovation drives extraordinary contributions to humanity. Our mission is to create technology that inspires ambitious and meaningful progress. For more than 80 years, HP has been a worldwide leader in developing technology products and solutions for consumers and businesses. HP is recognized throughout the industry for its product leadership in both the PC and print markets.

Headquartered in Palo Alto, California with major sites in Colorado, Georgia, Idaho, New Mexico, Oregon, Texas, and Washington, HP is a global leader in information technology. We are proud of our involvement in American innovation – from our founders' role in the creation of Silicon Valley to our leading position in personal computers, printers, and related supplies – and we continue this tradition with our latest innovations in areas like 3D printing/additive manufacturing and microfluidics precision bioprinting for healthcare.

Comments on Risks in the Semiconductor Supply Chain

HP's supply chain for semiconductors is complex and dynamic. HP employs sophisticated modelling to plan capacity and sourcing. To create transparency and enhance information sharing in the supply chain, we provide forecasts to our original design manufacturer partners ("ODMs") and key component suppliers. Our multi-year forecasts are used to provide supplier decisions to invest in capacity which can take multiple years to implement. Typically, semiconductor fabrication capacity must be contracted an average of 12-18 months in advance, and the shortage is now creating lead times of 24+ months, with some foundry providers already at capacity through the end of 2023.[3]

Since our prior comments last April, shortages have been better managed, and are still severe but slightly less so. However, lead times have become even longer. HP's agility and strategy has mitigated some of the most acute effects, but lead times continue to increase even now for many components.

The ongoing chip shortage means ICT products are gated primarily due to the single worst shortage out of hundreds of possible parts, not due to the overall supply landscape. These

[3] GlobalFoundries CEO: We're sold out of semiconductor chip capacity through 2023 (msn.com)

bottlenecks can change on a weekly basis, creating a “whack-a-mole” effect—where the worst immediate shortage is solved, only for another to crop up. ICT providers are constantly working the worst shortages, and often resolve them, only to then move to the next items on the list, which then become the item limiting components restricting production. If we solve the ten worst shortages, we improve supply but still not enough to fully meet demand, we just improve a bit and then move to the next-worst ten shortages.

Power electronics, certain sensor types, and discrete components are likely to use the oldest technology and manufacturing facilities, with a limited and non-expanding supply base. Other types span a range in between, depending on volume of production, complexity of design, and importance of size/cost to the final products.

Migrating from an older technology to a newer technology where capacity is expanding is generally a matter of significant design investment both at the chip and product level, and the design cycle can be many months, plus an additional 3-6 months to reach volume production.

Further, not all fab capacity is the same. While multiple fabs will have capacity at any node, the manufacturing processes used by each will have subtle differences making it difficult to move parts from one supplier to another.

For low-value simple parts (100s of parts per USD) it is difficult to justify the investment to move even if they are production-limiting. Companies would rather gamble that the supply will be less constrained before the several months of time and hundreds of thousands of dollars investment is completed to move the part. Some items like power transistors cannot be migrated as the physical size is a necessary characteristic.

While some semiconductor producers are not meeting demand, these products are not the immediate gating components, only because there are more severe shortages of other critical components. Processors (CPU and GPU) and Memory are most likely to use newest process nodes and latest technology. Our industry has seen shortages of things like memory modules (DIMMS), SSD, and displays not because of the DRAM chips, Flash chips, or display panels themselves, but because of shortages of power management ICs, driver ICs or controller ICs for the memory modules and complete displays.

Conclusion

HP applauds the Department’s ongoing efforts to engage both semiconductor producers and consumers and to address the challenges plaguing the semiconductor industry. We appreciate the Department’s continued commitment to holistically address the shortage for all affected sectors, rather than intervening on behalf of one industry, which would create unintended consequences and exacerbate shortages for other sectors vital to the U.S. economy. We encourage the Department to concentrate its efforts on the longer-term solution of building capacity rather than on attempting to diagnose specific point shortages by type or company which are dynamic and ephemeral that the private sector manages daily.

To this end, we look forward to the Department standing up a dedicated semiconductor program following Congressional funding of the CHIPS Act. HP also encourages the Department to continue its close collaboration with international supply chain partners to address both semiconductors and the broader ICT supply chains through bilateral and multilateral engagements. HP stands ready to assist the Department to provide our expertise as a major global end-user of semiconductors.

ANNEX

Semiconductor types used in ICT products and systems – note that almost all types are currently also in use in, and competing for supply with, automotive, consumer electronics, home appliances, etc.

CPU / Microprocessor
GPU / Graphics Accelerator
Memory
DRAM
SRAM
FLASH
Other (NVM, Phase change, STT, etc.)
Custom silicon devices
ASIC – Application Specific IC
ASSP – Application Specific Standard Part
AI/neural net chips (most are ASIC or advanced FPGA)
TPM (security)
Display-specific semiconductor components
Driver IC
Display Power management IC (PMIC)
Timing controller IC (T-Con)
Scalar IC
SOC (system on chip)
Sensors and actuators
Fingerprint
Camera
Touch
MEMS speaker
MEMS microphone
Infrared
TOF (time-of-flight)
Radar
Print head ICs (printers)
Linear sensors (scanners)
Other MEMS sensors and actuators (piezo-electric sensors, pumps, accelerometers, etc.)
I/O and Communication
USB IC
USB-C IC
PCI-E IC
Bluetooth
Wireless / WLAN
Programmable devices
FPGA (field programmable gate array)
PLA (programmable logic array)
MCU (microcontroller) (almost every subsystem or electronic device, many physical systems such as motors, pumps, fuel systems, etc.)
IMU (inertial microprocessor unit)
Service processors
Inference engines
Driver ICs (peripherals, drives, any connected module or device)
Scalar ICs (single-instruction low-performance processors)
Timing controllers
Radio ICs
Bluetooth
Wireless / WLAN
Audio CODEC IC
Power and Power Management
Power Management IC (PMIC) generally a different, specific, non-interchangeable design for each application, module, or subsystem
Voltage regulator IC
Power MOSFET
Discrete silicon-based electronic components
Discrete transistor
Passive components: Silicon resistor blocks, inductors, etc.