PREPARED STATEMENT OF INTEL CORPORATION

For the

COMMITTEE ON ENERGY AND COMMERCE
OF THE U.S. HOUSE OF REPRESENTATIVES
SUBCOMMITTEE ON COMMERCE, MANUFACTURING, AND TRADE

On

THE DISRUPTER SERIES:
THE FAST-EVOLVING USES AND ECONOMIC IMPACTS OF DRONES

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November 19, 2015

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Chairman Burgess, Ranking Member Schakowsky, and distinguished members of the Subcommittee, thank you for the opportunity to testify on behalf of Intel Corporation. We appreciate the invitation to appear before the Subcommittee to discuss the continuously and rapidly evolving uses of unmanned aerial vehicles (UAVs), or drones, and the vast economic potential of this growing industry. The Subcommittee's interest in the topic demonstrates its strong commitment to ensuring that the United States maintains its competitive edge in this developing market through public policy that fosters the growth of American manufacturing and innovation.

Innovation has been at the heart of Intel's business since we were founded close to half a century ago. To quote our co-founder, Robert Noyce, "innovation is everything." This sentiment has guided Intel for decades and paved the way for our Fortune 50 Company to become a global technology leader. We are proud to have developed the universal serial bus (USB), the world's first microprocessor (sometimes called a CPU), the first commercially dynamic random access memory (DRAM) chips, the first electrically programmable read-only memory (EPROM) chips, and many other products that are essential to today's digital economy.

While we are a recognized global leader with 80% of sales coming from outside the United States, Intel is viewed as a leading American technology company for good

reason. We conduct approximately three-quarters of our advanced manufacturing and R&D in the United States at facilities located across the country, from Oregon to Arizona and New Mexico to Texas. We invest billions of dollars annually in research and development and employ more than 50,000 people nationwide. Our commitment to the US economy is reflected in a strong, consistent history of capital investment and the fact that we consistently rank in the top ten recipients of U.S. patents.

Intel's declared mission statement is to utilize the power of Moore's Law to bring smart and connected devices to every person on Earth. With the help of Moore's Law, we have driven computing innovation to the highest performing servers that speed discoveries in science and medicine, to low power computing sensors that are always on and connected that make devices, homes and cities smarter in future.

It has become increasingly clear to us that UAVs, like cars and watches, are a computing platform of the future. Applications and services enabled by this new connected UAV ecosystem will spur significant economic growth and will be driven by innovations in UAV technology. We are optimistic that Intel has the engineering prowess in computing and sensor technology to help the United States lead the way: delighting consumers and building commercial products that expand the worldwide digital economy.

Because drones represent a significant growth opportunity we at Intel have developed some foundational principles that help us define this new marketplace for computing as part of our innovation strategy. It may also be beneficial for lawmakers, US regulators and policy officials to understand a private sector perspective in how we foster innovation and economic progress through technology. Our goals and outlook are centered as follows:

- *Collision Avoidance Technology Spurs Drone Safety & Innovation*
- *Drones Benefit Consumers and Businesses*
- *Intel Technology Lifts the Drone Economy*
- *Intel's Technology Enhances Individual Privacy*
- *Modernizing Regulations establishes United States as the Leader and Drives Global Innovation in UAV space*

<u>Intel Technology Spurs Drone Safety and Innovation</u>

Technology can improve drone safety. In 1965, our co-founder Gordon Moore observed that computing would dramatically increase in performance, while simultaneously decreasing in relative cost, at an exponential pace, a principle that became a pillar of the electronics industry and a driving force of innovation known as Moore's Law. Today, we are applying Moore's Law to UAV safety and innovation with our computing platforms and RealSense depth sensing camera. We are actively creating the

silicon architecture and computing power that will create onboard drone platform that has outstanding speed, performance and functionality. We anticipate introducing those exciting capabilities in the very near future.

At the same time, Intel has been actively investing in impressive drone companies, such as AirWare, Precision Hawk, Yuneec, and Ascending Technologies, and partnering our computing technology with the ingenuity being created by these early industry leaders.

Our most important contribution to date involves critical safety technology that will address real concerns expressed by regulators, consumers and others. RealSense is an onboard sensor application that represents a key ingredient for best-in-class collision avoidance. It features several attributes for collision avoidance with real-time on board computing: it is intuitive, self-aware, adaptable and self-guided. It provides real time depth sensing capability for a flying drone and combined with GPS, altitude and other onboard sensors, can also avoid no-fly area and comply with regulatory limits.

This year at CES, our CEO Brian Krzanich introduced RealSense applications for a multitude of sectors and uses to make devices smarter. Intel's RealSense camera module, which weighs as little as 8 grams and is less than 4 mm thick, brings depth perception to drones both indoors and outdoors with minimal impact to payload and

flight times. A live indoor demonstration was shown at CES 2015 on how a drone can sense and avoid objects in its path.

Intel has visited with Administrator Huerta and FAA officials on a number of occasions to explain how Intel RealSense technology can enhance drone safety technology and are pleased to assist in the ongoing effort to reduce the near miss rate of drones down to zero. With an estimated 700,000 UAVs in the hands of consumers currently, and expected holiday sales of a million more drones to the public, the safe integration of drones into the national space is critical. The FAA's list of 764 pilot reports of encounters with and sightings of drones in a ten month timeframe (11/14 to 8/15) is clear evidence that improvement is required. It is important to note that there is a distinction between consumer hobbyists who tend to be novice operators who may not be aware of rules and regulations versus commercial drone operators who are using it for providing a service that has economic value and gives them monetary benefits.

It is possible to both improve safety and promote American innovation involving advances in drone technology. However, a federal government approach that is overly prescriptive regarding the deployment of new hardware and software will deter the private sector's ability to invent and compete in the marketplace. Worse, it will drive us to relocate our business planning and R&D overseas, where we are being welcomed by foreign countries eager for investment in this new technology area.

Along with RealSense, Intel is working with our Intel Capital portfolio companies such as Precision Hawk to create other safety technologies. Earlier this week we learned about the FAA's plan to test related technology in North Carolina, near to where the Wright Brothers originally flew planes for the first time. A *Popular Science* magazine article described the FAA Pathfinder research as follows:

Specifically, the tests focus on first-person-vision flights, where a pilot steers the drone beyond their line of sight using video streamed from the drone itself to either a screen or headset. The FAA's draft drone rules prohibit flights beyond line of sight, which limits drone use to where a pilot can be. The goal is to keep drones from crashing into other objects. The rules also in effect constrain how far drones can fly. So on Monday, the FAA will work with Precision Hawk drones to see if technology that avoids obstacles can allow an alternative solution.

Technology Review writes: Precision Hawk was chosen by the FAA because it is developing such a technology. It can have a drone automatically take action such as landing or turning around if it gets too close to a forbidden area such as an airport, or if a conventional aircraft suddenly appears. The company's system, called LATAS, for low-altitude tracking and avoidance system, can use the Verizon cellular network, satellite links, or standard aircraft location beacons to monitor and communicate with drones.

To test the LATAS system a paraglider pilot will fly at piloted drones, seeing how long it takes for the drone pilot to break contact. After that human baseline, they'll test the software to see if it can move the drones out of a collision course faster. If the tests work, the FAA's Pathfinder program may prove well named indeed, as it clears an avenue for long range commercial drone flights in the future.

Drones Benefit Consumers and Businesses

From infrastructure inspection to delivery of goods, millions of Americans are on the cusp of enjoying the benefits of this continually developing technology. UAVs are being used to inspect bridges safely and efficiently, allowing for real-time repairs. Mobile

carriers aim to keep workers on the ground by using UAVs for cell tower inspection, an application with potential life-saving ramifications; from 2004-2013, there were 95 fatalities associated with cell tower inspections[1].

Utility companies are embracing UAVs as a means of inspecting hard-to-reach assets in a safer, more efficient manner, keeping employees on the ground and out of harm's way and providing for maintenance that reduces service disruptions. In the event of weather-related power outages, UAVs permit utilities to quickly assess and repair damage, allowing them to restore service more quickly and at less cost than traditional inspection and repair methods.

Intel works across the information and communications technology ecosystem to make technology impactful for consumers. There are few developing areas of business and technology with more potential benefits for consumers than the UAV industry. The upside potential is extraordinary and the federal government has assessed potentially hundreds of future applications for drones over time.

Another up and coming usage will be in having multiple drones flying in a swarm formation - simultaneous, aware of each other and being able to work in conjunction with one another. They can be used for surveillance, safety, agriculture and even

[1] Martyn Williams, *FAA Seen Ready to Open Skies to Commercial Drones*, (Feb. 14, 2015), http://www.pcworld.com/article/2884672/faa-seen-ready-to-open-skies-to-commercial-drones.html.

entertainment. Computing technology is what will help drive and manage this capability with more precision, safety and accuracy than manual control.

Society, consumers, business and the overall worldwide economy stand to benefit in profound ways if the nascent drone ecosystem can develop safely, quickly, and in a manner where governments and the private sector work cooperatively and expeditiously across a range of statutory, regulatory and policy matters.

oMre importantly, UAVs have immense humanitarian applications. UAVs can deliver medicine and diagnostics to remote or rural areas faster and more efficiently than any other means. They may be able to access individuals in remote locations who are lost, stranded or trapped in buildings.

Across the world, UAVs are being used to map areas affected by natural disasters, allowing first responders to quickly and safely locate survivors, inspect damaged structures, track fires, and survey damage. UAVs also protect innocent people from landmines and endangered wildlife from the threat of poachers. The myriad uses of drones – to help people first and foremost – is heartening and exciting.

Intel Technology Lifts the Drone Economy

The essential attributes of Intel technology inside drones are its utility, ubiquity, ease of operation, and cost-effectiveness. Drones are becoming the computing platforms

for the near future, and Intel is poised to play a leading role in developing this computing technology.

Intel hardware powers the present and future cloud, where unmanned air traffic management systems being designed by NASA in partnership with several leading UAV companies are likely to be sited. Intel also brings its data analytics, communications platforms, vision and depth based computing technology to UAV software and to the data that such software will create. Drones in the future will have sense and avoid with auto landing and re-charge capability and provide real time communication and data links to ground stations and cloud infrastructures securely.

To properly take advantage of the advanced technology that will be available on the UAV platform, there will be an increased need for computing power Intel is known for bringing to the home, office, the datacenter and the internet of things. UAVs with Intel Inside are part of the future of computing that we are inventing. Intel powered UAVs will be known as the most reliable, safest and highest performing computing platforms available.

Along with the technology we develop for Intel Inside UAVs will come investment in the software and services ecosystem to take advantage of this computing power. For over forty years, Intel has invested to help other companies bring new business ideas to the market to build on top of our hardware and software. We expect

this will also be true in UAVs and this investment will compound the positive economic impact on the broader US economy.

Intel's Technology Enhances Individual Privacy

Respecting individual privacy is of paramount importance for the public's acceptance and understanding of widespread UAV operations in all environments. Protection of privacy has always been built into the fabric of Intel. Intel has embraced Fair Information Privacy Principles (FIPPs) as the global foundation for privacy protection to foster technological innovation.

Intel is committed to consumer privacy as it continues to innovate and as lower cost/higher yield technological solutions become ubiquitous across every sector of the economy. Privacy is part of what Intel does every day and it is an integral part of our product development life cycle.

Intel has long supported comprehensive technology neutral privacy legislation based on the FIPPs. With respect to drones, the FIPPs can be applied to the drone platform and the collection, usage, and distribution of data. Intel's technology can enable UAV operators to meet their privacy commitments to consumers and the general public. One example of this application of the FIPPs is Intel's decision to only have the RealSense sensor collect the minimum data necessary for collision avoidance collected

by RealSense sensors, instead of using the sensors for other purposes. Over time, there may be other uses for these sensors, and the FIPPs will guide how to implement those uses and to make their data collection practices transparent to consumers, regulators and the general public.

We support the Department of Commerce's efforts, through the National Telecommunications Infrastructure Agency, to recommend best practices for the protection of privacy while operating UAVs. We have been participating in the working group discussions on this topic, with another one occurring tomorrow. These best practices can be consistent with existing Federal Trade Commission and State Attorney General Enforcement of existing privacy laws. Intel has recently issued a white paper on how to apply the FIPPs to new technology such as UAVs. We will be active within the industry and with the NTIA to ensure we help lead privacy solutions as well as innovating at pace with demand.

Modernizing the US Regulatory Framework Helps Lead and Drive Global Innovation

Intel believes that it is critical for the United States to develop a regulatory framework for UAVs that role models innovation for the rest of the world. This framework should allow US companies not only to compete in the global market, but also lead and drive global UAV innovation. As a respected US technology leader and manufacturer, Intel stands ready to provide private sector leadership for innovation that

can enhance regulations and serve as a trusted US resource as foreign firms strive for market growth.

Intel supports a regulatory framework that is risk-based and flexible enough to change as technology evolves so that it does not hinder innovation and economic growth. This flexibility can be achieved through adopting a streamlined certification and approval process, and through exemptions and waivers under existing FAA authority.

Simultaneously, regulations should encourage the use of computing to meet the key challenges to safe integration of UAVs in the National Airspace System: sense and avoid, collision avoidance, secure geo fencing and command and control technology. Adoption of such a flexible regulatory system for UAVs will sustain US industry leadership.

This flexible regulatory framework should recognize that there are a wide variety of devices that fall under the definition of UAVs. A hobbyist's small quad copter should not necessarily be governed by the same regulations as plane size platforms. One of the benefits of Moore's Law is that technology gets smaller and more powerful.

As Intel and others innovate and then integrate those innovations onto UAV platforms, it will be critical to have a seamless and effective regulatory structure in places that supports such innovation. For example, there ought to be multiple categories of

UAV categories considered by the FAA based on their size and functionality. Commercial micro UAVs that you can hold in the palm of your hand certainly should receive a different level of regulatory scrutiny compared to larger devices.

Bottom line, governments should strive to substantially decrease administrative burdens on innovators. Approval processes that can stretch close to a year should be dramatically streamlined. Many commercial uses of small UAVs should be allowed without filing requirements, just as hobbyist use is permitted today.

Regulations that prohibits our company from demonstrating a small quad copter at less than 50 fifty feet of altitude, without an effective exemption process, simply impedes American innovation and compels companies like Intel to test their ideas abroad. Given lack of FAA permissions, we have been actively flying cutting edge drones overseas. Our preference is to do so in the United States, to help spur American ingenuity. But the FAA's current 333 exemption process has been exceedingly slow and difficult for us to navigate. The FAA has issued over 2000 exemptions to date and that represents an improvement. But many of the approvals do not present unique or new ideas. Our efforts to break the mold through the exemption process has been painstaking. Meanwhile, Intel's development drone work will continue abroad at a rapid pace.

Regulators know that extensive delays in rolling out a new regulatory structure for UAVs, as called for by Congress, risks US economic opportunity. The economic

implications for commercial drone use are undeniable. A recent study estimates over the 10 year span from 2015 to 2025 UAV integration with the national airspace will account for $82.1 billion in job creation and growth.

On a macroeconomic scale, integration of UAVs is expected to create over 100,000 jobs. Over a ten year span, job creation from commercial drone use will consist primarily of manufacturing jobs. Likewise, states will benefit from increased economic activity.

The government can also promote the development of the UAV industry by continuing to invest in research and development. We support the efforts now underway at the six test sites, the newly created Center for Excellence, the FAA's Technical Center and, as mentioned, NASA's UTM work. We urge Congress to provide sufficient funding and direction to these R&D projects.

Conclusion

Thank you for conducting this hearing and for giving Intel the opportunity to testify on the continuously developing uses of UAVs and the great economic potential of the industry as a whole. At Intel we like to say "Look Inside" – because, in fact, it is what's inside that counts. This could not be more true than in the exciting field of drone technology which – with modernized regulations in place – will transform our society in

a safe and responsible fashion. Take a look: Intel will be at the center of this fast-changing market and we appreciate the Subcommittee's commitment to fostering and protecting American innovation.