Hearing on

Technologies Transforming Transportation: Is the Government Keeping Up?

Before the

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Committee on Commerce, Science, and Transportation
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Testimony of

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Thank you, Chairwoman Fischer and Ranking Member Booker. My name is Paul Misener, and I am Amazon's Vice President for Global Public Policy. Transformative innovations in commercial transportation technology are dramatically improving the way American consumers buy and receive goods, but the private sector cannot make all of the necessary improvements; government needs to keep up. Thank you for your attention to this important topic; for calling this hearing; and for inviting me to testify.

As familiar as the Amazon.com website may be, the physical infrastructure and transportation operations that support the delivery of physical products ordered through it are less well known. Some of that infrastructure and operations – such as within our warehouses – is completely controlled by Amazon; some of it is shared with third parties, such as parcel carriers, with which we work closely; and some of it is beyond our control, such as the construction and maintenance of public highways and bridges. All of it is necessary, however, to support how American consumers shop online.

Amazon first began selling online 20 years ago this month, in July 1995. By that time, other companies already had perfected large-scale warehousing designed to support networks of physical retail stores. In their model, warehouses are designed to receive, from suppliers, truckloads of goods, usually stacked on pallets easily moved by forklifts. Inside the warehouses, the pallet loads – for example, one pallet of light bulbs, another of staplers, and another of printer paper – would be disassembled, and the goods stored on shelves, awaiting distribution to physical stores in the region. Periodically, perhaps daily or weekly, and based on the inventory needs of individual stores, a new truckload of pallets would be assembled for delivery, perhaps with one of the pallets carrying, among many other things, two dozen lightbulbs, three staplers, and two boxes of printer paper. In sum: pallet in and pallet out.

Our challenge at Amazon was to create at scale a new form of warehousing, where truckloads of pallets of goods would be received and stored, but instead of newly assembled big pallets being periodically trucked out to retail stores, we would ship out little brown boxes via carriers directly to customers. To meet this challenge efficiently, we needed to create a new kind of warehouse infrastructure that was highly reliant on computer technology and automation. For large items, such as a washing machine, we still needed to handle them individually, but for relatively small items – which comprise the vast majority of the items we sell – we developed elaborate conveyor systems which can whisk items quickly through a warehouse from where they are stored to other locations where they can be boxed and loaded into a carrier's truck. Thus we developed at scale, pallet in, *box* out.

At first, the sales through our website were only retail, meaning that we had bought the goods ourselves and then sold them to our buyer customers, *i.e.*, consumers. But in order to increase the selection of products for our buyer customers, we invited a new class of customers to *sell* through our website. These seller customers, through what became known as the Amazon Marketplace, have become a very important part of our customer experience, and currently are responsible for 40% of all

the units sold through Amazon. Many of these seller customers now also use our services to warehouse and fulfill orders of their goods. Through this service, known as Fulfillment by Amazon, we now receive not just pallets of goods, we often also receive little brown boxes, to be stored, waiting for a customer to place an order for the goods. In sum, our warehouses – which we call "fulfillment centers" – now support box in, box out.

There are three particularly transformative aspects of our fulfillment center technology. The first is random placement of items. Take, for example, a teddy bear. A teddy bear is not stored on a shelf labeled "Teddy Bears" or "Stuffed Animals" or even "Toys." It is placed among other completely unrelated items, such as a Cuisinart product. This process, by which products are stored anywhere within our fulfillment centers is called, appropriately, "random stow." But although it might seem haphazard as well as random, it is not. This process, carefully monitored by our computer systems, allows us, following a customer order, to find the most efficient path for that item to travel from where it is stored to the place where it is boxed for shipment.

The second aspect to note is the extensive conveyor system, which I mentioned before. Much of this automation was designed specifically for our kind of operations, at large scale. Our fulfillment centers are indeed very large: many exceed one million square feet and, with mezzanine floor space included, some contain 59 football fields of floor area under one roof. At these sizes, it is essential for efficiency and customer delivery speed that items can move within the building at high speed, hence the extensive use of conveyor technology.

Lastly, there are squat mobile robots from Amazon Robotics that carry shelves around the fulfillment center floor. A natural extension of our conveyor automation, these robots greatly increase the speed of order fulfillment for our customers. They each weigh 320 pounds and can lift 750 pounds – something like an NFL lineman – and we now have more than 15,000 operating in 10 fulfilment centers across the United States. Another kind of robot we use is called "Robo-Stow" which, at over five tons,

the size of a male elephant, is Earth's largest robot arm. This machine allows us to move items quickly between floors in our buildings.

The highly-automated kind of fulfillment center is known as "sortable," because it is designed to quickly sort items and, if there are multiple items in a customer order, to combine them into a single box. Another kind of fulfillment center – designed to handle larger items – is called "non-sort." In total, we have over 50 fulfillment centers throughout the United States, and each generation of fulfillment center is more technically sophisticated than the prior. Ten of our eighth generation fulfillment centers are operating already, and the first of our ninth generation is under construction in Kent, Washington.

We are continuing to improve the efficiency of our operations within our facilities but, of course, the speed of customer order delivery also depends on how quickly ordered goods move from our fulfillment centers to our customers, so we also are working to improve efficiencies outside these buildings. One way, as I recently described to the Committee, is package delivery by drone, in the future Prime Air service. Drone deliveries not only require innovative aviation technologies and government approvals, but also meeting logistical challenges within our fulfillment centers.

We also have developed a more efficient way to hand off boxes to the U.S. Postal Service. Rather than give the USPS an unsorted stack of boxes, some bound for Nebraska and others destined for New Jersey, we now are sorting boxes and consolidating them into sets of boxes heading for customers in the same particular area of the country. To help do this, we have begun operating over 15 so-called "sortation centers" that provide the USPS *groups* of boxes, all going to roughly the same location. So, in addition to "pallet in, *box* out," and "*box* in, box out," we now are providing what amounts to pallet or box in, and box or pallet out.

Amazon has invested heavily in building these sortation centers at locations optimized for injecting packages deep into the USPS network. For deliveries coming from Amazon sortation centers, the USPS provides only final mile delivery services: Amazon arranges for transportation from our

fulfillment centers; for sortation at sortation centers; and for delivery of sorted boxes to USPS facilities. Individual USPS facilities receive these packages in the early morning, so that postal carriers can deliver them the same day. In a single day, a typical Amazon sortation center will sort tens of thousands of packages, speeding up delivery times as well as providing later daily cutoff times for customer orders.

USPS and Amazon have worked together to create innovative technology and develop efficient processes, including improvements in labelling, to help the Postal Service reduce the costs of providing final mile services. This arrangement and Amazon's package volume benefit the USPS by letting it make better use of its facilities, equipment, and personnel throughout the week and provide final mile delivery without incurring the costs of building additional capacity in its upstream logistics network. As on other days, Sunday shipments arrive at USPS post offices pre-sorted and ready for delivery and, because Amazon provides destination address information in advance, the USPS has improved efficiency on Sundays by operating only from select hub locations and tailoring routes to actual requirements.

Upstream of our fulfillment centers, we are working to ensure that goods can easily flow into our warehouse network, including via US ports on both the Pacific and Atlantic coasts, and via rail across the country. Our work and partnerships with private commercial infrastructure and transportation providers of multiple modes will only increase in the coming years.

But, of course, our partners, we, and ultimately our customers, need government help to maintain adequate public infrastructure and provide appropriate regulation. For example, the productivity of US ports is a significant concern. Ocean carriers have built larger ships, but the U.S. west coast ports have not improved their throughput and thus have fallen behind the larger ports in the world, and will continue to do so, especially as US exports continue to grow.

There are three examples of government help that deserve brief mention here. The first is the biggest and perhaps hardest: America's public transportation infrastructure simply needs investment. Thank you, Chairwoman Fischer, for your personal attention to transportation infrastructure funding. As

you have pointed out, our highways and bridges are in dire need of investment. Like other American businesses, Amazon and our customers depend on an efficient and reliable transportation system, and we agree with your belief in the importance of long-term transportation policy and long-term reauthorization. Second, we need innovative policies for developing the future transportation infrastructure. A bill sponsored by the Ranking Member, Senator Booker, as well as Senators Murray and Cantwell from Amazon's home state, is one such innovative proposal, for multimodal freight policy. Lastly, as several of the carriers we work with have pointed out, permitting the use of slightly longer twin highway trailers would dramatically decrease the number of truck trips and miles driven. Amazon believes that such efficiency improvements should be embraced. Moreover, as the carriers note, research indicates that, if weight limits are maintained, the longer trailers actually would improve their handing properties; a finding supported by experience in Florida and North Dakota.

In conclusion, commercial entities are deploying technologies to transform and improve the transportation infrastructure of the United States, and recent innovations already are providing impressive efficiency gains, improving the way American consumers buy and receive goods. But, to keep up with these advances, government needs to provide adequate funding, innovative policies, and balanced regulation.

Thank you again for inviting me to testify; I look forward to your questions.

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