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Via ECFS

Marlene H. Dortch, Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Re: Notice of *Ex Parte* Presentation, WC Docket No. 13-184

Dear Ms. Dortch:

Microsoft commends the Commission for taking steps to reform the E-rate program. It is widely understood that educating today's students for tomorrow's world requires more than a mere Internet connection; it requires high-speed connectivity to and within schools and libraries as well as local area networks (LANs) and Wi-Fi networks that are capable of supporting anytime, anywhere learning. Although internal networks are critical to useful and effective broadband connectivity, they long have been underfunded by the E-rate program. The Commission must take steps to correct this, whether by modifying the priority system or through other measures, so that schools and libraries can maximize the educational tools that rely on connectivity.

Evaluating the connectivity needs of schools and libraries can be challenging. This is because schools and libraries are not all the same; they vary by geography, physical plant, student body size, and other factors. Microsoft is deeply familiar with these challenges, as it must evaluate similar factors when determining where to focus its resources in the education market, and also when developing and upgrading its own corporate network, whether on Microsoft's main campus in Redmond, Washington, or in various Microsoft offices and research centers around the world.

Evaluating the Education Market

Microsoft makes its products and services available to each of the roughly 14,000 school districts in the U.S., though Microsoft focuses its sales and marketing efforts primarily on a subset of those districts. Naturally, higher-bandwidth districts are considered more optimal candidates for cloud-based offerings, though all districts remain eligible to be potential Microsoft customers. Some districts opt to purchase Microsoft services via consortia, which increase their economic purchasing power and simplify their transaction processes.

Schools with a broadband connection of 1 Gbps or faster and sufficient internal connections are best able to maximize the usability of bandwidth and optimize cloud-based services. In Microsoft's experience, school districts in urban areas or near major universities frequently have 1 Gbps connectivity. But more than half of the students in the U.S. are in rural, not urban, school districts; and reaching the 1 Gbps threshold in rural areas can be more challenging. Microsoft believes that employing alternative technologies like TV white spaces should increase the likelihood and reduce the expense of reaching that broadband threshold in rural areas. To ensure that schools and libraries can avail themselves of these alternative technologies, particularly where more traditional forms of broadband service (*e.g.,* wireline) are not commonly available, the Commission should clarify in its upcoming Report and Order that equipment capable of using alternative technologies that are understood to be capable of providing reliable broadband service to schools and libraries, such as TV white spaces technologies, qualify for E-rate funding, even if provisioned by schools and libraries and not by a broadband service provider.[1]

Ideally, connectivity should be omnipresent throughout the school to facilitate connections for people, not merely spaces or places. This is because connected devices – including tablets, laptops, smartphones, and wearable devices – increasingly accompany people (such as students and educators) wherever they go, making the omnipresence of broadband connectivity more important.

To date, the E-rate program has been premised implicitly on the notion that there is not a device for every student. Microsoft, however, assumes a 1:1 device-to-student ratio in its own assessment of the market. In evaluating the future needs of schools, the Commission also should assume *at least* one device for every student. Schools increasingly are moving to a 1:1 device-to-student ratio, and Microsoft expects every student to possess more than one device by 2017, as students increasingly are carrying not just a single laptop or tablet, but also Wi-Fi-enabled smart phones that include ever-increasing computing capability.

In addition to connectivity to and within schools, connectivity *between* schools is important due to the increasing amount of content that lives within the school district rather than in a single school and because of the increase in collaborative learning. Microsoft believes that, ideally, connectivity between schools also should be at 1 Gbps or faster.

As noted above, some school districts will more effectively negotiate for and purchase cloud-based services through consortia. Microsoft encourages the Commission to support and incentivize school districts' use of purchasing consortia for broadband and cloud-based services. Implementing mechanisms to incentivize and support consortium-based purchasing for broadband and cloud-based services should

[1] There are a handful of spectrum bands that can be or have the potential to be used for Wi-Fi or Wi-Fi-like service. These include the 2.4 GHz band, 5.0 GHz band, the TV White Spaces (600 MHz band), and potentially the 3.5 GHz band. Microsoft suggests that for purposes of the E-rate rules, the Commission define Wi-Fi to encompass the range of unlicensed spectrum that can be used to provide such wireless connectivity and make eligible for funding equipment capable of using these various spectrum bands.

reduce administrative complexity for the Commission, increase the purchasing power and sophistication of contracting capabilities of smaller schools, and make it easier for vendors such as Microsoft and its partners to support more of these schools to the extent they are able better able to join consortia.

Microsoft's Own Corporate Networks

Microsoft also evaluates connectivity needs when developing and updating its own corporate network, both on its main campus and in offices and learning centers around the world. While Microsoft's campuses may have different needs than school and library campuses, Microsoft's approach to evaluating those needs may be informative in determining how to evaluate schools' and libraries' connectivity needs relative to the E-rate program. Microsoft hopes the Commission can use these insights in considering the type of equipment and connections that should be supported, as well as the frequency with which schools and libraries should be eligible for upgrading their equipment.

Microsoft begins by collecting information on bandwidth usage in a particular location, and builds in room for future growth. In evaluating this usage, Microsoft looks at the network on an end-to-end basis to identify potential congestion points. For example, on a LAN network, there are two areas where congestion may be common. First, on a wired network, Microsoft looks for dropped frames/packets on switched, or routed interfaces. Second, on a wireless network, Microsoft looks for congestion in the controller datapath, and dropped frames between the controller or access points (APs). These issues may result in slow application performance, the wireless network disconnecting, Media Access Control (MAC) errors, or Frame Check Sequence (FCS) errors. In the context of schools and libraries, this issue can be especially relevant when the network is being used to administer real-time standardized testing and a large portion of the student body is relying on the network at the same time.

Traffic measurements also can be affected by the *type* of traffic being transmitted. For instance, it is important to determine whether a particular network will be used for real-time traffic (such as video or voice teleconferencing) or asynchronous traffic (such as e-mail and web browsing), and if the network will be used for both to understand the anticipated respective ratios of traffic types. Real-time traffic requires more bandwidth than asynchronous traffic to function properly.

Microsoft also identifies the desired geographic scope of the LAN and uses of the network, which determines the number of APs and wired infrastructure needed. The campus must determine how much coverage is desired, such as if coverage is needed only indoors or both indoors and outdoors. Peak usage is affected by the number and types of connected devices and the applications they use. For example, campuses that anticipate higher voice and video usage will require higher signal strength. It is important to measure this usage over time, to determine the minimum, maximum, and average usage. Indeed, adding too many access points can actually reduce overall bandwidth usability because of co-channel interference within the radiofrequency spectrum band. Currently Microsoft recommends 30 foot cells (60x60 square feet) in office areas and conference rooms, and 50 foot cells (100x100 square feet) in open cubical areas or open areas that do not have walls to attenuate the wireless signals. Microsoft also looks at the number of users per radio per AP, and the company's current standards recommend 40 total devices, with 20 per radio. However, the most important metric is the total average bandwidth/users per

radio (both the physical radio and their corresponding antennas), particularly if the campus anticipates the LAN network will be used to run bandwidth-intensive applications.

The level of security required can affect this evaluation. For content or services that are not encrypted and that deliver duplicates to each device (*e.g.,* videos, lectures, lessons), the campus can cache content on designated caching servers to optimize bandwidth. However, this will not provide efficiencies for SSL encrypted services or for individual feeds that are not duplicated on each device. The campus also should ensure that firewalls are included to separate Internet-facing communications from confidential or sensitive data.

Connectivity evaluations also must take into account new technologies, which are likely to make more efficient use of radiofrequency spectrum. For example, enterprise-grade LAN systems permit better coordination of Wi-Fi frequency space because they prevent or reduce co-channel interference between APs. These systems have the ability to dynamically adjust the AP transmit power and channel assignments for each device in the LAN. These features in enterprise-grade wireless LAN systems provide better channel reuse. In contrast, consumer grade APs and wireless LAN routers typically require manual channel and power settings, and they often do not have the ability to change channels or transmit power dynamically if another AP is within the same coverage area or on the same or an adjacent channel. That can cause a jamming effect on the channel. In Microsoft's experience, an upgrade cycle of three to five years would be ideal as it would allow for newer wireless LAN network equipment to support newer technology functions.

Please direct any questions concerning this submission to the undersigned.

Respectfully submitted,

/s/

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