

nsba
Advocacy
**INSTITUTE
ONLINE**

June 8-10, 2021

Student Home Connectivity Study

Keith Krueger
CoSN CEO

www.cosn.org

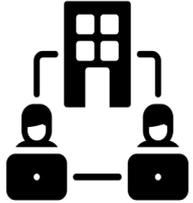


Student Home Connectivity Study

CoSN, under a grant from the Chan Zuckerberg Initiative (CZI), has conducted a study to determine **home internet connectivity requirements to support student learning** in today's education environment. The analysis conducted will be used to:

- **Standards** - Establish recommendations for home internet connectivity standards to support student learning in a virtual, hybrid, or remote environments.
- **Methodology** - Provide a methodology for school districts to use to evaluate the impact of limited home internet connectivity on high need student cohorts such as low income, English Learners, students with disabilities, etc.
- **Recommendations** - Provide recommendations that District Leaders can use to work with ISPs and community leaders to address lack of sufficient bandwidth for the students and families that need it.

Measuring the Student Experience



Using data sources such as network filters logs and online meeting quality of service data, we have discovered effective methods to determine the adequacy of network throughput for each student

The “student experience” varies widely based on the network bandwidth that each student obtains. There are many factors which may impact the student such as:

- Bandwidth provided by the ISP
- Number of users and devices on home network
- Speed and age of computing device used by student
- Quality and type of network signal
- Distance of student from the wireless router.

Network upload and download bitrates significantly impact the student experience in a remote or hybrid learning environment.

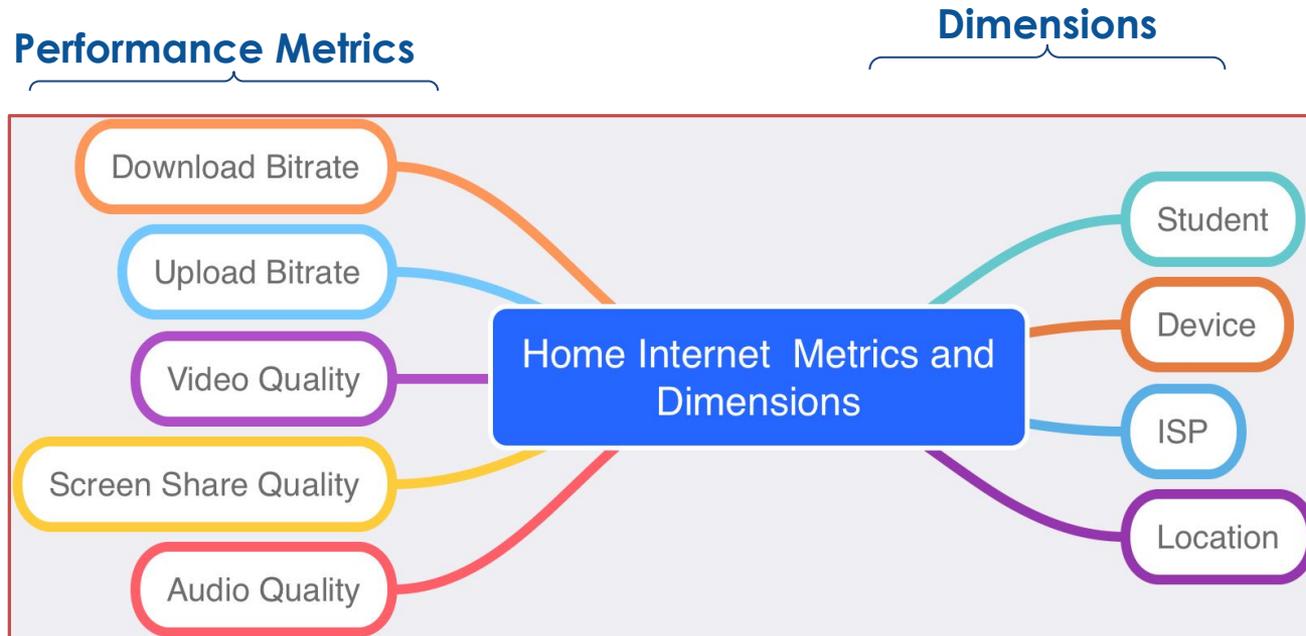
Participating Districts

- Aldine ISD, TX
- Beaverton School District, OR
- Boston Public Schools, MA
- Ector County ISD, TX
- Dallas Independent School District, TX
- Fauquier County Public Schools, VA
- Forest Ridge School District 142, IL
- Hillsborough County Public Schools, FL
- MSD of Wayne Township, IN
- Rock Hill Schools York 3, SC
- Santa Fe Public Schools, NM
- St. Charles CUSD 303, IL
- Wake County Public School System, NC



Study Design

To measure home internet performance, we have selected key metrics shown on the left which can be applied against the four dimensions shown on the right.



Findings and Recommendations Report

Home Internet Connectivity Study

Preliminary findings and recommendations based on the study conducted by CoSN. Made possible by the Chan Zuckerberg Initiative.



CoSN
LEADING EDUCATION INNOVATION

Student Home Bandwidth Recommendations

Students need fast internet connections to participate in remote learning. The current FCC household minimum bandwidth guideline of 25 Mbps download speed and 3 Mbps upload speed is inadequate to support even a single student in a household, let alone multiple students. Based on the findings in the study, CoSN recommends a per-student minimum bandwidth standard of a download speed of 25 Mbps and upload speed of 12 Mbps to support concurrent activity and usage.

To determine this recommendation, actual network traffic was reviewed to identify applications used, how much traffic is going to each application, and how much of the traffic is video. Analysis in the study identified the activities where bandwidth is needed based on actual network traffic patterns, and then researched the recommended bandwidth from application vendors to determine the estimated bandwidth for the activity. Network traffic was also used to analyze activity concurrency; that is, students regularly perform more than one activity at a time. For example, one student may be actively participating in an online meeting while simultaneously performing an internet search via web browser while, in the background, email is automatically refreshing. This scenario and others like it are extremely common in remote learning. For this reason, it is important that a minimum is set at 25 Mbps download and 12 Mbps upload speed.

In addition, it's crucial to highlight the importance of a per-student standard and not a per-household standard like the current FCC recommendation. Standards should be set at the student level and account for the total number of students in the home. For example, network requirements to support a home with six children should be different from network requirements to support a home with one child.

These recommendations are based on the current environment needs. In light of constantly evolving technologies, minimum bandwidth recommendations should be revisited regularly, at least every three years. Support for higher video resolution, such as 1080p high definition (HD) and 4K, will most likely be required in the future. In addition, many new technologies, such as eSports, Augmented Reality (AR), and Virtual Reality (VR) will likely be used to deliver instruction. These kinds of advanced technologies will require at least 25 Mbps download/upload speed for standard definition (SD) and up to 500 Mbps download/upload speed for 4K video.

Student Home Bandwidth Calculator

CoSN Institutional Members receive exclusive access to the Student Home Bandwidth Calculator, which is a tool for determining the recommended amount of available bandwidth for students based on concurrent activity and usage. The calculator provides the estimated bandwidth for each activity and automatically adds up the required bandwidth for a set of students performing selected activities.

Student Activities During Online Instruction and Estimated Bandwidth

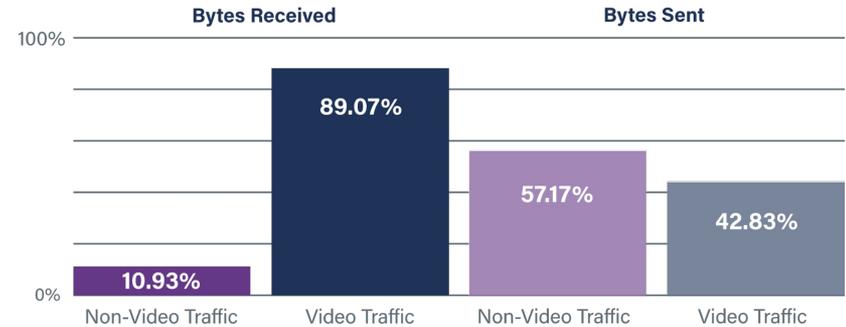
Student Bandwidth Usage	Resolution	Download (Mbps)	Upload (Mbps)
Email -- Is used to communicate to students by teachers, administrators, and other students.	n/a	1	1
Web Browsing -- Students access the internet frequently to research topics using a web browser and search engine such as Google or to read blog articles. Ad services related to various websites also consume a significant amount of bandwidth.	n/a	1	0.5
Learning Management System -- Students use a learning management system such as Canvas, Google Classroom, Schoology, PowerSchool, or D2L to access and submit assignments and communicate with their teacher and other students.	n/a	1	1
Video Instructional Content -- Students access video instructional content from sources such as PBS Kids, Khan Academy, Newsela, McGraw Hill, Discovery, National Geographic, YouTube, etc.	SD	3	0.5
Online Assessments -- Assessments for essential skills and content knowledge are provided online and taken at home. Assessment software can be divided into two broad categories: formative and benchmark. Examples of formative assessment software include Edupuzzle and Edulastic. Examples of benchmark assessment software include Ready and Renaissance.	n/a	1.5	0.5
Cloud Storage -- Students download and upload homework assignments using cloud storage such as Google Drive or Office 365.	n/a	5	2
Online Meetings -- Students participate in daily online meetings with teachers using an online video tool such as Google Meet, Zoom, Cisco Webex, or Microsoft Teams. In addition, online meetings are used for counseling and providing services for English Learners and students with disabilities. Students frequently participate in small group instruction sessions and use video to communicate with teachers and other students.	SD	3.2	3.2
Feedback -- Asynchronous video is frequently used by teachers and students to communicate and provide feedback to each other. Teachers and students often record videos using software from companies such as Loom and Screencastify to communicate. Other feedback tools are provided by companies such as Class Dojo and Edmodo.	SD	2	2
Instructional Support -- Interventions and instructional support are provided through online resources. Many companies such as Edmentum, Renaissance and Illuminate provide solutions in this category.	n/a	3	1
Multiple Devices -- Students frequently use two or more devices to access the internet (e.g. Computer, Tablet, Smart phone, etc.)	n/a	1	1
Educational Gaming Technology -- Instruction is often provided through software such as Kahoots, BrainiQ, FunSchool, Socrates, ZooWhiz that utilize gaming technologies.	HD	5	1

www.cosn.org/digitalequity

Free, but must set up complimentary account

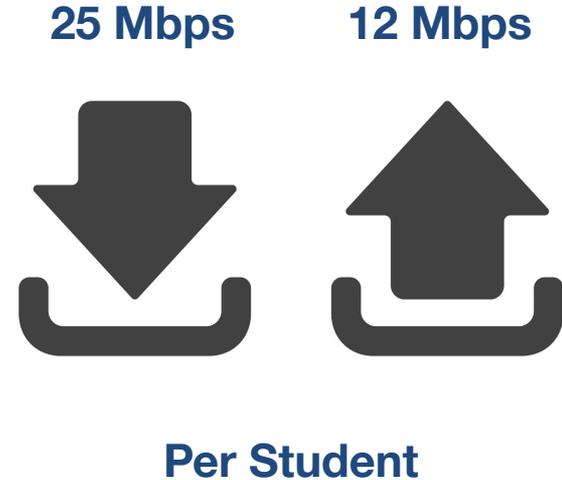
Finding #1: Learning with Video is Essential for Education

- A. Over 85% of network traffic in remote learning is used for **video** (both synchronous and asynchronous).
- B. A sufficient **upload speed** critical.
- C. A sufficient **download speed** is critical for uninterrupted viewing of synchronous or asynchronous video.
- D. Video-intensive content and apps are increasing and will continue to require **more bandwidth**.



Recommendations for Learning with Video

1. **Increase the Minimum Standard for Student Home Internet Bandwidth** - current FCC household broadband definition of 25 Mbps download speed / 3 Mbps upload speed is inadequate. CoSN recommends a new broadband definition: **25 Mbps for download / 12 Mbps for upload speeds per student.**
2. **Remove Data Caps for Classwork and Learning Activities**

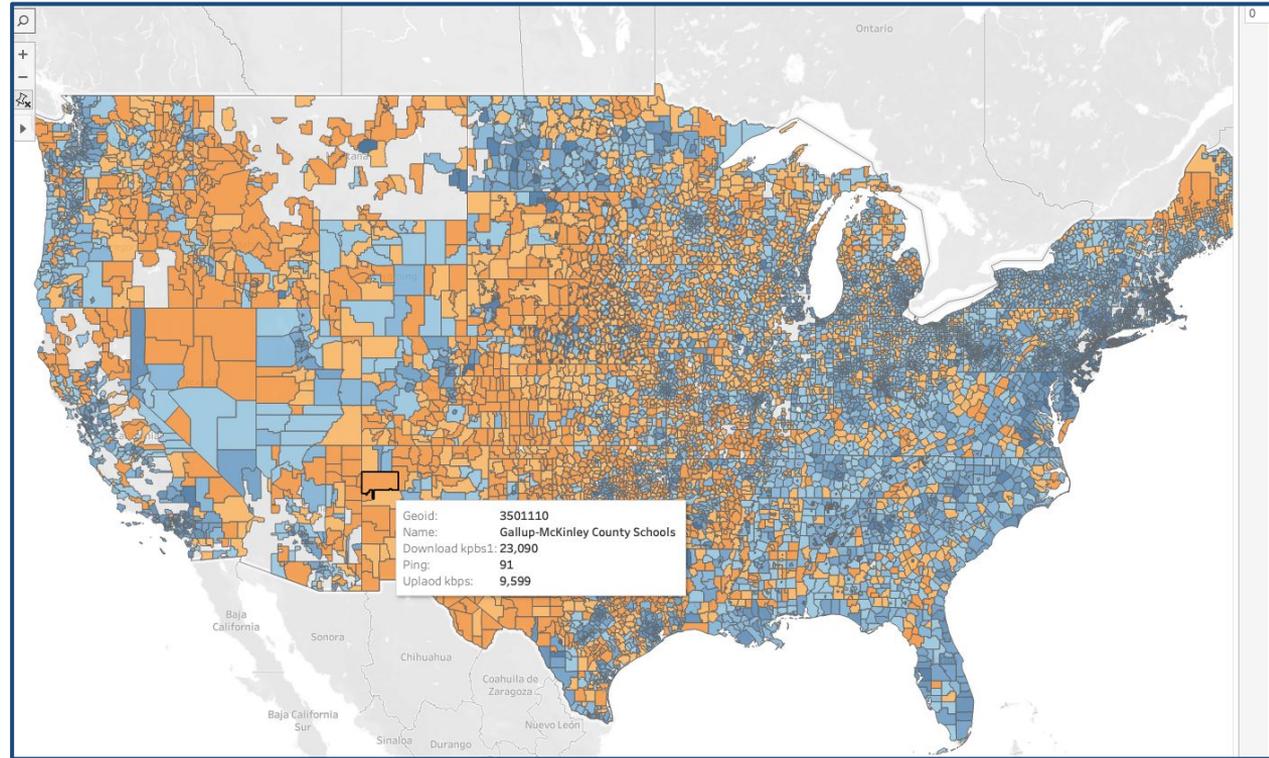


Internet Speeds by District

Using data provided by Ookla, we constructed a national map that shows upload, download, and latency for all Ookla Speedtests conducted within each District Boundary.

We have this data for both fixed broadband and mobile.

The interactive map and the data will be part of the public data set that will be provided as part of the grant.



Finding #2: Students are Mobile & Rely on Wi-Fi

- A. Students participate in online learning from peers' homes, and even attending classes from other cities, states, and countries.
- B. **92% of students use WiFi** instead of a wired connection, therefore critical to address home WiFi issues.
- C. Alongside district-provided devices, students often concurrently use mobile devices, such as **personal phone or tablet**, which contributes to increased home bandwidth needs.



Many Factors Can Impact Student Home Internet Experience



Computing Device

- Type of device
- Age of device
- Quality of antenna
- Type of network connectivity
- CPU Utilization
- No of applications running
- District filtering and monitoring agents



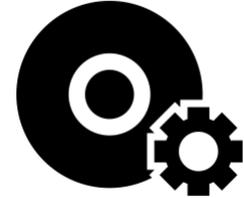
Home Network

- Router
- No of Devices
- People in household
- Distance from router
- Router rebooting
- Signal interference
- Wired or Wireless



ISPs

- Download Speed
- Upload Speed
- Latency
- Video Throttling



SaaS Provider

- Capacity Constraints
- Network traffic
- Device resource utilization

Recommendations for Home WiFi

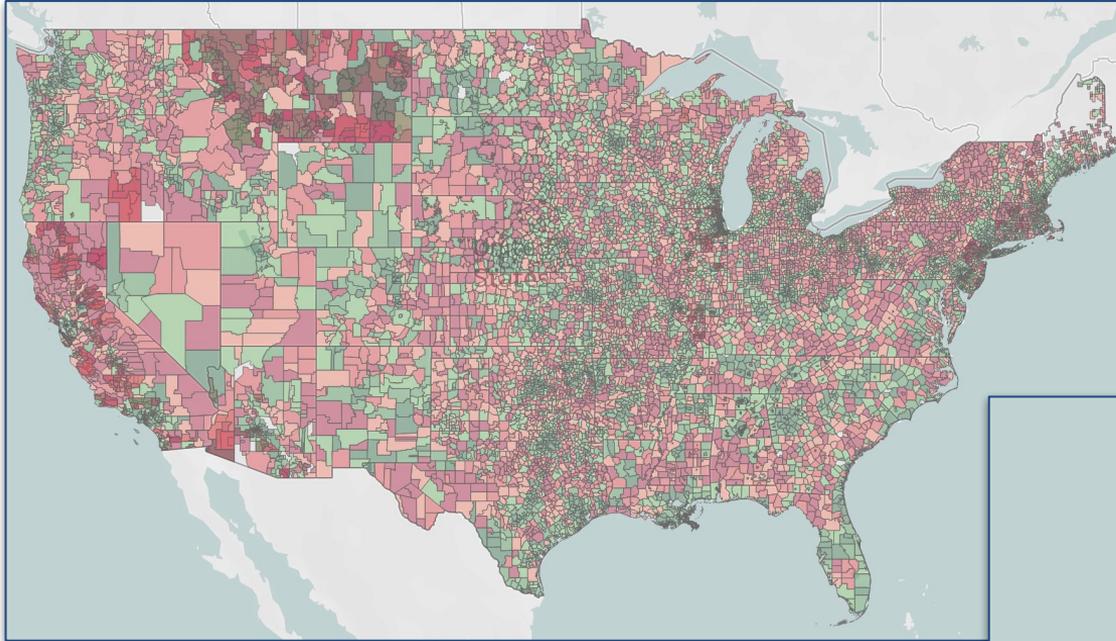
1. Help families acquire **new routers** if their router has not been upgraded in a few years
2. Work with ISPs to replace outdated routers
3. Provide **network extenders** in areas with poor signals
4. **Educate families** on router placement and maintenance



Finding #3: Certain Communities, Especially Remote and Rural Areas, Require More Support and Resources

- A. Students in more **remote or rural areas** most often have limited internet access.
- B. Students working in areas with a **large concentration of students** may experience poor connectivity.
- C. Even students from higher socioeconomic families have frequent problems in remote learning/online meeting experience.

The Digital Divide: Rural/Remote Vs. Urban/Suburban Areas



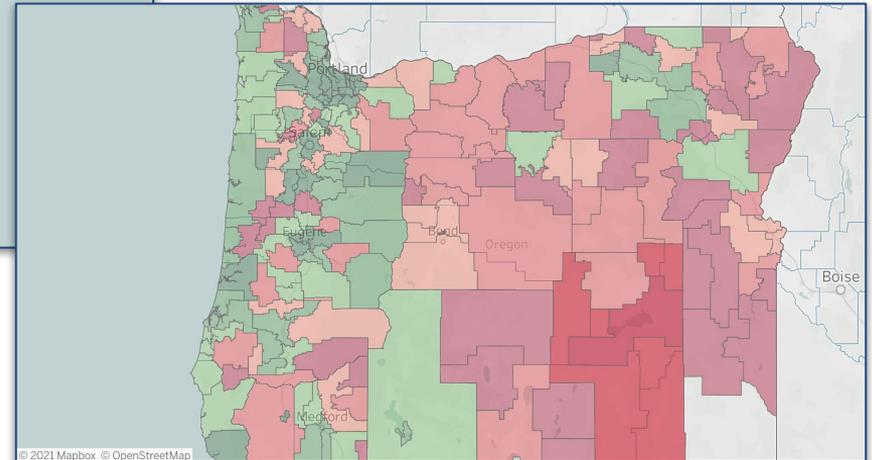
This map (left), created by Innive K12 360°, shows an example of the difference in available bandwidth between rural/remote school districts and urban school districts.

Available Bandwidth

Strong

Poor

In Oregon (right), one can clearly see that the dark red remote school districts in the southeast corner of the state have poorer connectivity than urban and suburban school districts in green along the west coast.



No One Solution Meets All Students Connectivity Needs

1. **Need local flexibility** to truly address ALL students.
2. The new Emergency Connectivity Fund (+\$7bil) provides unconnected students with hotspots and internet enabled devices, as well as routers. Also WiFi on buses.
3. **Work with ISPs** and community leaders to ensure that ISPs offer suitable plans for the community.
4. **Leverage other federal and state funding** to leverage a variety of internet access pathways, such as:
 - District-Provided Mobile Wi-Fi
 - CBRS
 - LTE Broadband
 - Satellite

Finding #4: The Remote Learning Experience is Significantly Impacted by Device Used

- A. Quality of student experience can be impacted by age, type, and quality of **device**, as well as device configuration (i.e., user authentication and network filtering tools).
- B. Student experience can be improved by routinely collecting **datasets** that provide insight into the student use of district-provided devices.

Computing Devices



The network bandwidth varies significantly depending on the type of computing device used. For example, for one school district we notice significant speed differences between iPads and Chromebooks. The difference in speed could be a result of many things such as:

- ▶ CPU speed
- ▶ RAM
- ▶ CPU utilization from other apps running in background
- ▶ Network connection (2.4 Ghz or 5 Ghz)
- ▶ Quality of antenna or wifi card in the device
- ▶ Type of filtering software used

Districts must consider the impact of various types of computing devices when determining student network throughput requirements.

Recommendations for District-Provided Devices

1. Students need a **high-quality device(s)** to participate in online remote learning. Factors to be considered:
 - a. CPU type, speed, and number of cores
 - b. Amount of memory
 - c. WiFi connection
 - d. Integrated webcam
 - e. Integrated microphone
 - f. Headphone port
2. Refer to device **requirements for online meeting software**.
3. Using funding to improve data capture and analysis will help districts make more informed decisions around student devices and home internet supports.

Report Available

www.cosn.org/digitalequity

Free...need to set up a complimentary user account

keith@cosn.org