REPORT TO THE LEGISLATIVE BUDGET COMMITTEE

REPORT ON THE BROADBAND SPEED OF MARYLAND'S PUBLIC SCHOOLS

Maryland State Department of Education

Division of Curriculum, Assessment, and Accountability

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Report on the Broadband Speed of Maryland's Public Schools

Introduction

With the passage and approval of SB 988 - State Department of Education - Assessment Report for Broadband Capabilities in Public Schools, the Maryland State Department of Education (MSDE) is required to submit a report on the Broadband Speed of Maryland's public schools to the Department of Legislative Services.

Specifically, the Legislature has requested information on: 1) Existing broadband speeds and connections in all public schools in the State, including capabilities from the main building to the classrooms; and 2) each local school system's plan to:

a. Reach a broadband speed throughput of 1 gigabit per 1,000 students for each public school by fiscal year 2020 through public and private efforts; and
b. offer support and training programs in the use of education technology tools for classroom teachers

MSDE is committed to analyzing and recording the current and projected broadband speeds of all public schools across the state. In a 21st Century learning environment it is important that all schools have high speed Internet connections, not just to support digital learning, but also to support PARCC next generation assessments, which leverage technology-enhanced test items to a significant degree.

That said, the "per 1000 student" measurement is not meaningful since it really depends on the number of devices connected, not the number of students. If you have 20,000 students where everyone has a device their demand would be far greater than where you have 50,000 students and only a 1:5 student-to-device ratio. Also, it is very difficult to make predictions around broadband access in future years as district funding for information technology changes from year to year. Finally, there are many other costs that need to be factored into the readiness equation. As a district increases bandwidth, the equipment, security and service costs increase exponentially.

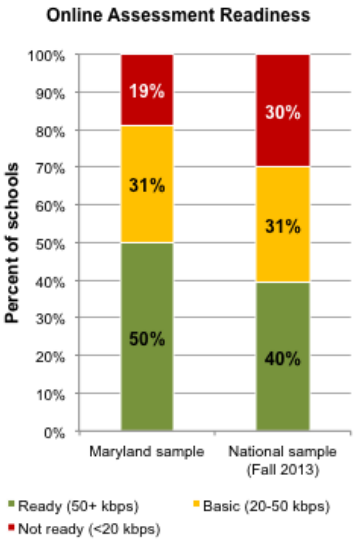
MSDE Partnership with EducationSuperHighway

During the fall of 2014, MSDE partnered with nonprofit EducationSuperHighway to assemble an inventory of school Internet speeds across the state. From October through February, Maryland schools were asked to complete a minimum of 10 SchoolSpeedTests, which are designed to measure the available bandwidth to an end user device in the classroom (as opposed to the maximum speed of the Internet connection to the building). Ultimately, more than 20,000 tests were taken at 1,062 sites across Maryland, representing 73% of all school buildings. Each site took an average of 18 tests, and 87% of those that participated took 6 or more tests, giving us a strong sample to work with. The data collected represents the networks used by 80% of Maryland students.

Maryland SchoolSpeedTest

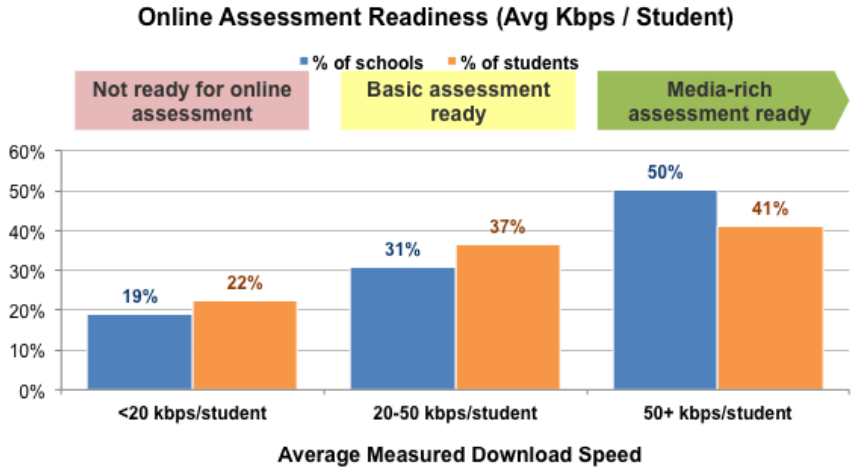
Summary of Findings

The overall findings of the SchoolSpeedTest indicate that in terms of online assessment readiness and overall bandwidth per site, Maryland schools are performing significantly better than the national average. Unfortunately though, this still means that a considerable proportion of students do not have the bandwidth they need for PARCC without caching, and moreover, the vast majority of schools that tested are not at all ready for robust digital learning in the classroom. The graph on the right displays the comparison of Maryland's online assessment readiness against the national sample. In Maryland, fully 50% of schools are ready for PARCC without caching, while nationally, only 40% are ready. In terms of digital learning however, Maryland is actually behind the national average, with only 25% of schools testing at speeds that can support digital learning versus the 37% nationwide average.

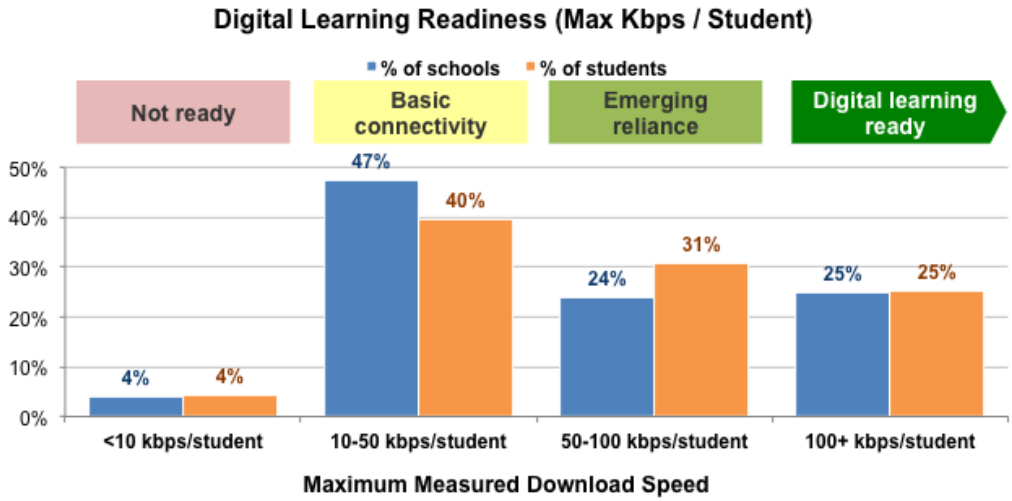


Overall Findings

Maryland's results indicate a high level of readiness for implementing online assessments as compared to other states. According to the PARCC technology requirements, more than 80% of schools are ready for PARCC assessments either using caching or without caching. Unfortunately though, number of schools does not correlate directly to percentage of students, and only 41% of children in Maryland attend schools that have sufficient Internet bandwidth to deliver the PARCC assessments to all of their students without caching.

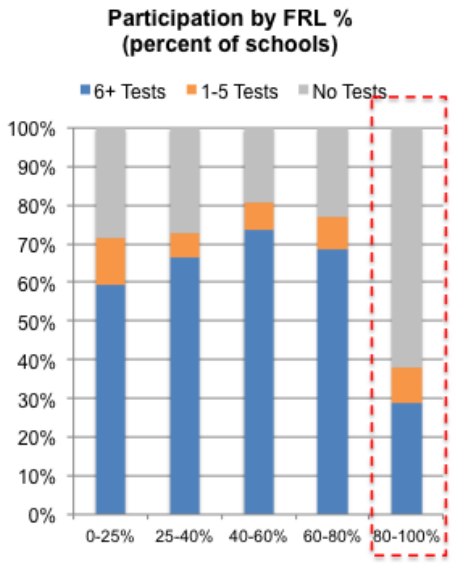


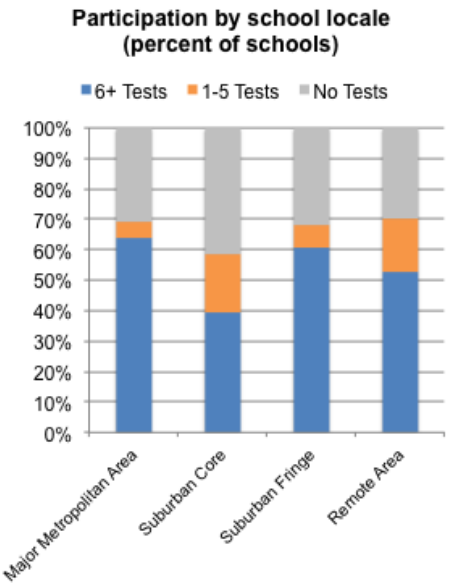
While Maryland is doing well by comparison in terms of online assessment readiness, the digital learning readiness picture is somewhat less encouraging. According to the SETDA standards, schools today need at least 100 kilobits per second per student of bandwidth. As the chart below illustrates, only 25% of schools are presently hitting this mark. Moreover, the largest proportion of sites fall into the 'Basic Connectivity' category, which by definition indicates that their networks are only equipped to support a rotational computer lab with very limited online research and email capabilities.



Participation

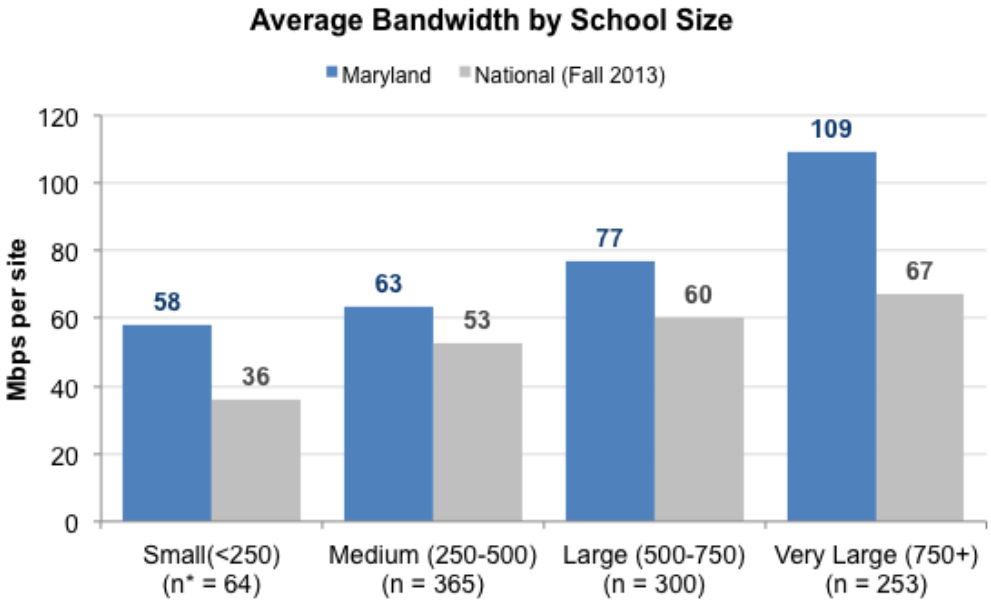
Participation in the SchoolSpeedTest was essentially even across all locales in the state, with just slightly less robust participation among schools located in the suburban core. Participation was similarly even across all wealth categories except for the most disadvantaged schools which showed drastically lower participation. Using the percentage of students who qualify for free or reduced price lunch as an indicator of financial resources, those schools with 80-100% of students eligible for subsidized meal programs took markedly fewer tests than their higher-income counterparts across the state.



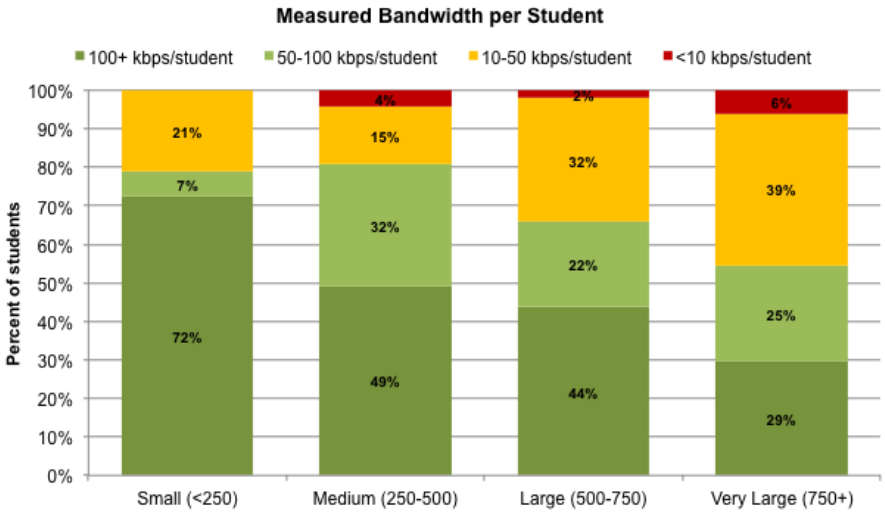


Bandwidth by School Size

As compared to the national average, Maryland schools exhibited substantially higher per site bandwidth across all school sizes. Additionally, per site bandwidth increased proportionally with the increase in school size. This is a credit to Maryland LEAs' networks since in many cases, as is true for the national average shown below in grey, the correlation between school size and bandwidth tapers off as the schools increase in size.

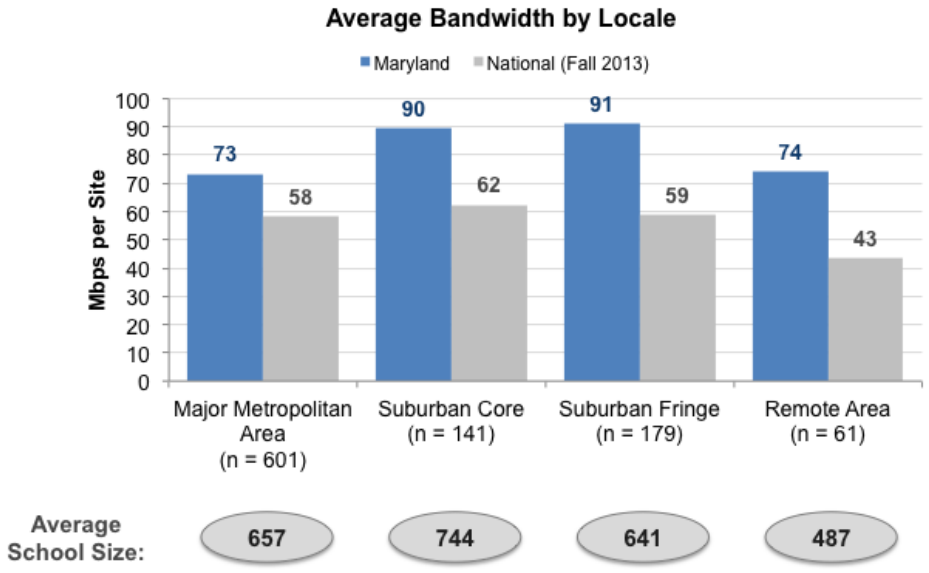


As much as schools in the very large category seem to be doing well in the context of average bandwidth per site, the reality is that they are still not able to keep up with demand given the size of their student populations. As illustrated below, very large schools have the largest proportion of students with fewer than 10kbps each, and the smallest percentage of students with digital learning-ready networks. Across all but the smallest schools there are a handful of sites with networks that cannot even provide basic connectivity, which may be an interesting starting point when looking towards infrastructure upgrades.

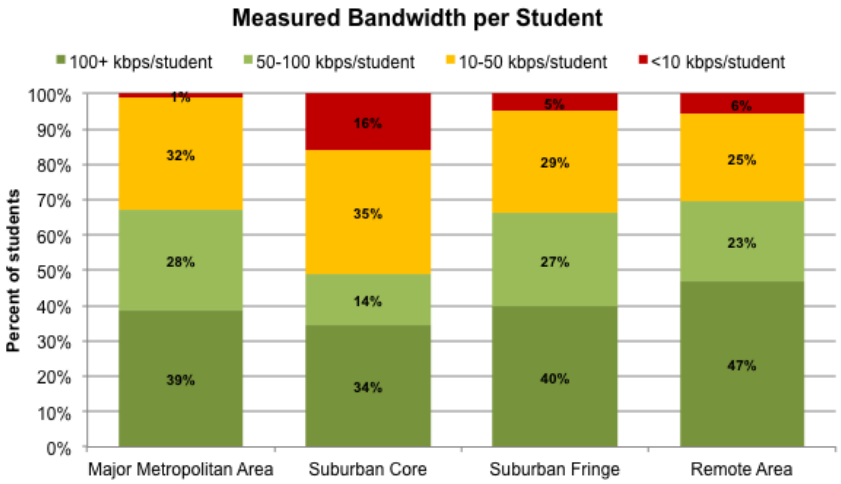


Bandwidth by Locale

When looking at locale (major metropolitan area, suburban core, suburban fringe, and remote area), we also see that Maryland tested far above the national averages across all categories. In keeping with the typically observed trend, schools in suburban areas tended to have the highest average bandwidth per site, although schools considered to be remote in Maryland showed higher speeds than would normally be expected in comparison to the other categories.

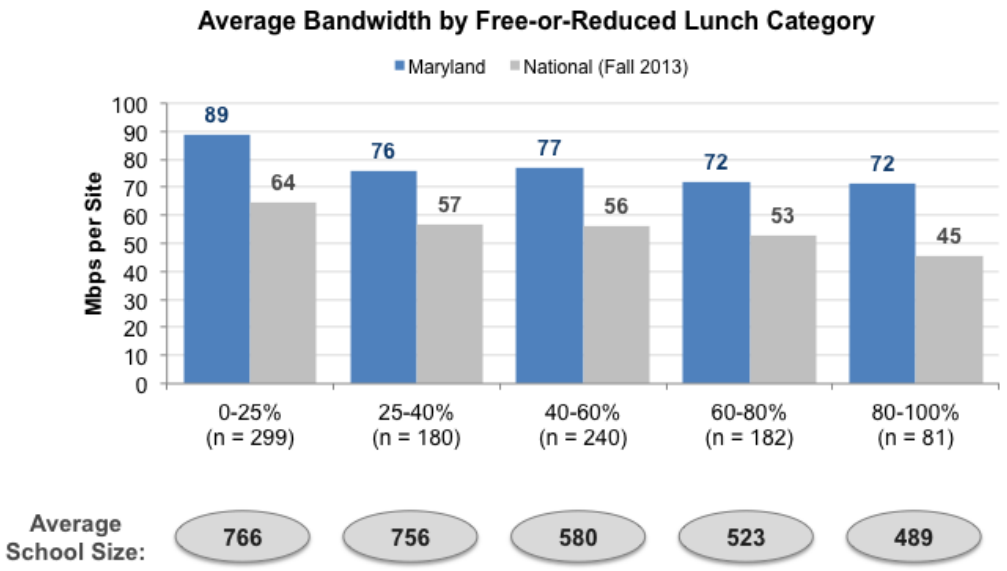


While suburban schools exhibited the highest bandwidth per site out of all locales, suburban core schools are actually doing substantially worse in terms of digital learning readiness than any other locale. As shown below, 16% of suburban core schools have fewer than 10 kilobits per second per student, and only 34% have digital learning-ready networks with 100 kilobits per second per student or more. While there are likely a variety of factors at play here, one significant element contributing to this result is school size, whereby the large population of many suburban core schools is making it extraordinarily difficult for LEAs to provide sufficient bandwidth for all of their students at sustainable prices.

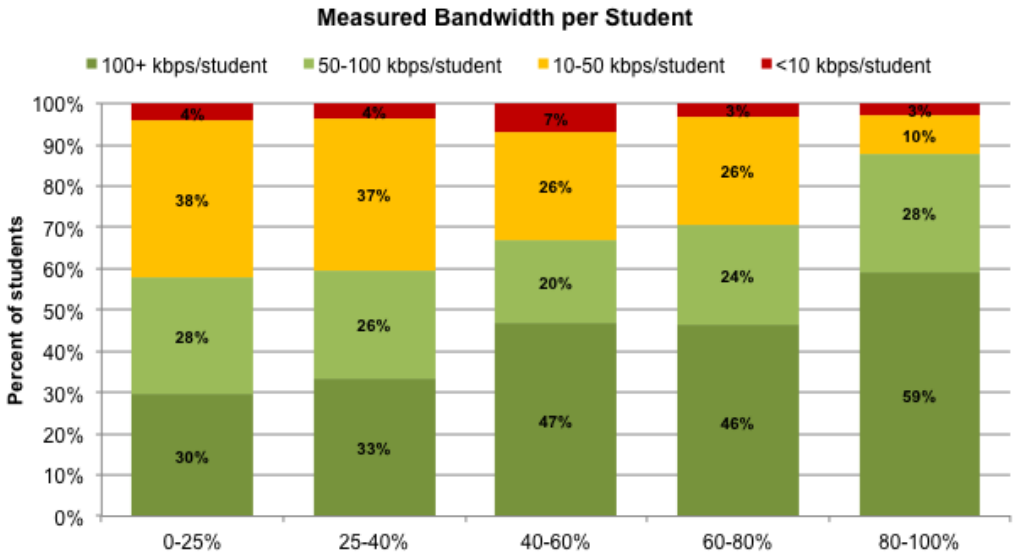


Bandwidth by Free/Reduced Price Lunch Percentage

The correlation between free and reduced price lunch category and average bandwidth per site followed the typical trend line in Maryland with the exception that the highest and lowest groups both had higher results than would be expected. The schools in the 0-25% category, as well as those in the 80-100% category tested at surprisingly high speeds. Additionally, as was the case across the board, schools in every FRL category in Maryland showed substantially higher speeds than the national average.



When it comes to per student bandwidth by free and reduced price lunch population, there is actually a reverse trend in Maryland in terms of digital learning readiness. Typically schools with more financial resources tend to have higher proportions of students in schools with digital learning-ready networks. In Maryland however, as illustrated below, the schools in the 0-25% category actually had the smallest percentage of students with 100kbps or more, while the 80-100% schools had the largest percentage with 59% of students having robust, digital learning-ready networks in the classroom.



Conclusion

In summary, the Maryland SchoolSpeedTest found that while the state is doing well in terms of national performance, there is still a long way to go before every student has reliable access to bandwidth-

intensive digital learning tools in the classroom. The results indicate that nearly all schools will be ready for PARCC assessments either with or without caching. However, schools and LEAs will need a great deal of assistance to get over the hurdle of transforming their passable networks today into networks that are able to support the technology-rich classrooms of tomorrow. Some possible areas of focus for future Internet infrastructure upgrades are very large schools, suburban core schools, and those schools that receive smaller E-Rate subsidies (0-25% FRL schools). Armed with this information, MSDE can now make data-driven decisions in the effort to ensure that every school has the bandwidth they need at prices they can afford.

MSDE's partnership with SETDA

MSDE has partnered with the State Education Technology Director's Association (SETDA) for many years. As stated on their website, "The State Educational Technology Directors Association (SETDA) is a 501(c)3 not-for-profit membership association launched by state education agency leaders in 2001 to serve, support and represent their emerging interests and needs with respect to the use of technology for teaching, learning, and school operations. Our current work is guided by a strategic plan, Leading, Inspiring and Empowering: The 2013-16 SETDA Strategic Plan, adopted by the SETDA Board of Directors in October 2012 after extensive consultation with the membership."

The SETDA mission is to build and increase the capacity of state and national leaders to improve education through technology policy and practice. In carrying out this mission, we are committed to:

- Serving every U.S. state and territorial education agency
- Maintaining a future-focused, holistic view on how to leverage technology for education
- Fostering collaboration among our members, strategic partners and other education leaders and policymakers
- Taking action on important issues facing public education

In SETDA's report, "The Broadband Imperative: Recommendations to Address K-12 Education Infrastructure Needs,"[1] SETDA lists three recommendations to address K-12 education infrastructure needs (see link below for full report). Their number one recommendation is to "Move to address broadband infrastructure needs."

Their stated objective "To reach the goal of sufficient broadband access for enhanced K-12 teaching and learning and improved school operations as outlined in this report, SETDA recommends that schools and districts meet the following minimum bandwidth targets between now and the 2017-18 school year:

[1] The Broadband Imperative: http://www.setda.org/wp-content/uploads/2013/09/Broadband_Trifold.pdf

Broadband Access for Teaching, Learning, and School Operations	2014-15 School Year Target	2017-18 School Year Target
An external Internet connection to the Internet service provider (ISP)	At least 100 Mbps per 1,000 students/ staff	At least 1 Gbps per 1,000 students/staff
Internal wide area network (WAN) connections from the district to each school and among schools within the district	At least 1 Gbps per 1,000 students/staff	At least 10 Gbps per 1,000 students/staff

Using SETDA's broadband recommendations for the 2014-2015 school year, MSDE surveyed each of the 24 Chief Information Officers and asked them to respond to the following questions:

1. What is your schools' average external Internet connection to the ISP? Please supply an estimate for Mbps per 1000 students/staff.
2. What is your district's internal WAN connection from the district to the schools and among schools in the district? If possible please supply an estimate for Gbps per 1,000 students/staff.

County	Response
Carroll	We have a 500Mb ISP soon to upgrade to 1Gb. We are 1Gb to the core for all locations except two Elementary Schools that are 100Mb.
Calvert	We do not meet any of the external connections as outlined. Currently, we meet internal connections building to building but have no plans to upgrade to 10Gbs building to building. We have 1 GB links to all of our buildings. We have a 900Mb internet connection for the district through network Maryland. This connection is used by 16k students and 2.5k staff.
Cecil	1. 160Mbps/1,000 staff & students at the ISP level. For grins, in the last year of the Sailor years (FY14) we were running 8Mbps/1,000 S&S in Sailor schools and 42Mbps/1,000 S&S in Cable schools. 2. Since we decided to implement a managed, lit fiber service at each OMBN site (rather than point-to-point dark fiber), our WAN data rate is functionally the same average number, 160Mbps/1,000 staff & students at the WAN level.

	Because it's a managed, lit service, that means these data rates will not improve until the backbone fiber capacity is expanded (at DoIT's and our agreement later on in the contract) and hardware capabilities are improved within the county carrier backbone (again, later in the agreement). 10Gbps in the WAN can't functionally happen for us.
Somerset	1. Our average is 100 Mps per 1000 students/staff. 2. This one is harder for us to say since we no longer have a hub and spoke WAN design. I'd say our average is probably close to 1 Gbps per 1000 students/staff. But we do have two very small rural schools that are still on copper T1 services.
Anne Arundel	1. What is your schools' average external Internet connection to the ISP? Please supply an estimate for Mbps per 1000 students/staff. ~ 23.5 mbps/1000. 2. What is your district's internal WAN connection from the district to the schools and among schools in the district? If possible please supply an estimate for Gbps per 1,000 students/staff. One half of the schools ~ 0.41 gbps/1000, the other half ~0.091 gbps/1000. We have high schools with populations of close to 3,000 students and staff. For FY18 I need a 30gbps WAN connection for each of those? That's not likely to happen.
Harford	1. What is your schools' average external Internet connection to the ISP? Please supply an estimate for Mbps per 1000 students/staff. 13.2Mbps / 1000 students 2. What is your district's internal WAN connection from the district to the schools and among schools in the district? If possible please supply an estimate for Gbps per 1,000 students/staff .01Gbps/1000
Prince George's	1. What is your schools district's average external Internet connection to the ISP? 10Gbps for the district. Please supply an estimate for Mbps per 1000 students/staff. 80Mbps per 1,000 students 2. What is your district's internal WAN connection from the district to the schools and among schools in the district? Elementary Schools – 100Mbps Secondary Schools – 1GBps If possible please supply an estimate for Mbps per 1,000 students/staff.

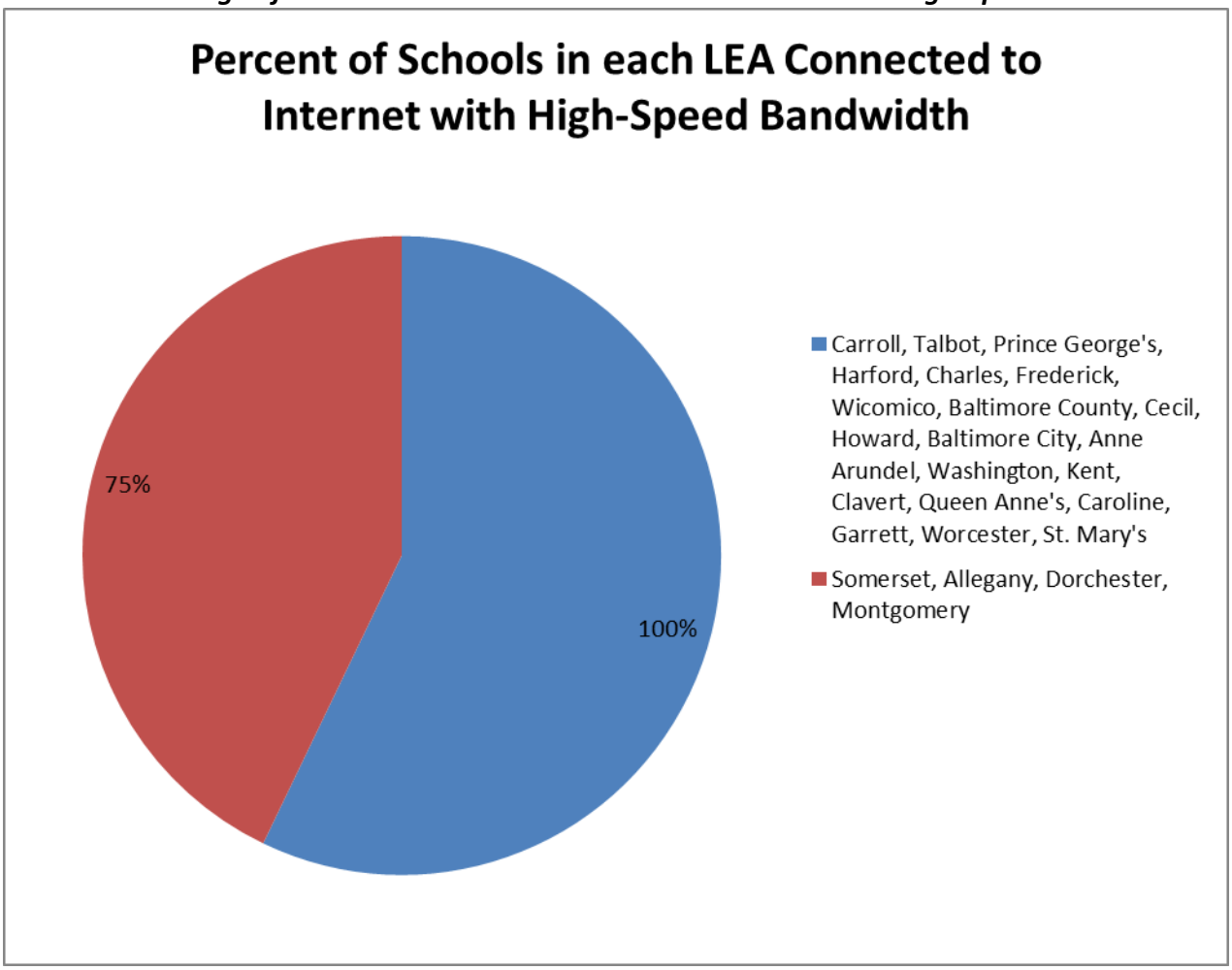
	Average Elementary School – 600 students - 100Mbps per 1,000 students Middle School – 800 students – 1Gbps per 1,000 students High School – 1,500 students – 650Mbps per 1,000 students
Queen Anne's	1. What is your schools' average external Internet connection to the ISP? Please supply an estimate for Mbps per 1000 students/staff. ISP service is 300 Mbps shared with the county government. Maximum is 38 Kbps per 1000 students 2. What is your district's internal WAN connection from the district to the schools and among schools in the district? If possible please supply an estimate for Gbps per 1,000 students/staff. All schools have a 1Gbps internal WAN connection Elementary Schools - 2.2 Mbps per 1000 students Middle Schools - 2.2 Mbps per 1000 students High Schools - 833 Kbps per 1000 students
Allegany	1. What is your schools' average external Internet connection to the ISP? Please supply an estimate for Mbps per 1000 students/staff. Fiber ring is 10G, schools are set to 1G based on the firewall at each school. Packet shaping to the desktop is at 3Mbps. 2. What is your district's internal WAN connection from the district to the schools and among schools in the district? If possible please supply an estimate for Gbps per 1,000 students/staff. We are still at 1G between any two schools based on the firewall.
Howard	2014-15 Target External Internet Connection: 322.91 MBPS per student/staff. Internal WAN Connection to Schools and Offices: 1.308 GBPS per student/staff. 2017-18 Target: At least 500 MBPS per student/staff and At least 2.696 GBPS per student/staff
Baltimore City	No response
Baltimore County	No response

Garrett	No response
Washington	No response
Frederick	No response
Montgomery	No response
Charles	No response
St. Mary's	No response
Kent	No response
Talbot	No response
Caroline	No response
Dorchester	No response
Wicomico	No response
Worcester	No response

Generally speaking, school Internet connections can support next generation, online assessments. This readiness is due to the fact that Maryland's model for assessing children online includes proctor caching. Proctor caching enables digital test content to be downloaded from the vendor's server and stored locally on a server in a school, significantly reducing the bandwidth a school needs to test online. In order for schools to support digital learning and the proliferation of computers and tablets brought about with 1-to-1 and BYOD greater investments in bandwidth at the classroom level are needed.

The following chart shows the percentage of schools in each LEA with high-speed Internet connections:

Chart 1 Percentage of Schools in each LEA Connected to Internet with High-Speed Bandwidth

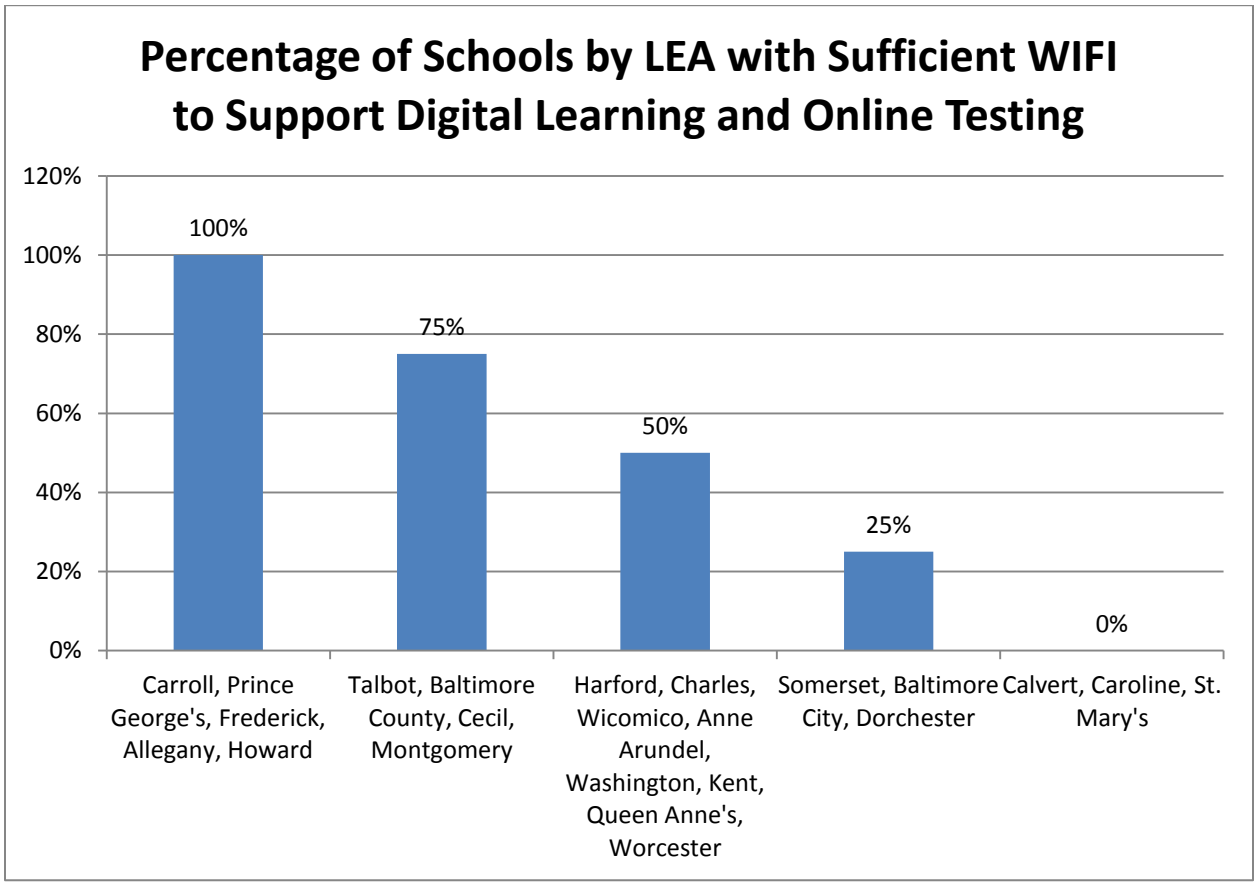


While a vast majority of the schools in Maryland have high-speed Internet connections, many LEAs are still in the process of building out their WIFI infrastructure which means that most classrooms in Maryland do not have Internet connectivity at the classroom level yet.

With the increase in digital learning on mobile devices, and limited space in schools in which to create computer labs, schools are interested in administering online assessments in classrooms on the same devices used for instruction. Since the PARCC next generation online assessments are platform independent, they can be administered on almost any device used for instruction (PCs, Macs, tablets, and Chromebooks).

The following chart shows the percentage of schools in each LEA with sufficient WiFi to support digital learning and online testing. With regard to WiFi in the classroom, there is great variation among counties. Having a high-speed Internet connection in every school is one thing, but making high-speed connections available in every classroom is still a work in progress.

Chart 2 Percentage of Schools by LEA with Sufficient WIFI to Support Digital Learning and Online Testing



In conclusion, while most LEAs are unable to support SETDA's recommendations across the entire district for the 2014-2015 school year, of at least 1 Gbps per 1,000 students/staff, it should be noted that SETDA's recommendations are very aggressive. Also, as stated earlier, the goal to support 1 Gb/1,000 students by 2020 should be revised to reflect the number of devices, not students. While a majority of the schools in Maryland have high-speed Internet connections many LEAs are still in the process of building out their WIFI infrastructure down to the classroom level. Whether or not schools will be able to support 1Gb/1,000 students (or devices) down to the classroom by 2020 is unclear since information technology budgets vary from year to year.

Support and training programs to support educational technology tools for educators

The Maryland State Department of Education is supporting all educators, students, parents, and local communities with a learning management system, MSDE Blackboard Learn. Hundreds of lessons and lesson seeds in all content areas, including STEM and Digital Literacy, are available to the public. These lessons and lesson seeds provide a "springboard" for teachers as they implement curriculum aligned with the Maryland College and Career-Ready Standards. During ongoing school support visits, MSDE staff members provide content and navigational overview of digital resources on MSDE's learning management system, MSDE Blackboard Learn. In addition, a volume of the Maryland Classroom newsletter and Learning Management System flyers have been distributed to all Local Education Agencies and educators highlighting site resources and providing navigational support. Overviews and hands on explorations have also been provided during various levels of curriculum MSDE and Local Education Agency meetings related to the MSDE digital resources as well as other quality open educational resources.

Two hundred and forty-two student intervention/enrichment modules, eight student STEM modules, twelve Adolescent Literacy modules, and six student Algebra II modules include digital teacher resources that provide educators with strategies on how to effectively use the online modules in and/or out of the classroom. These student modules are available to all Maryland stakeholders. MSDE has presented multiple sessions at local, state, national, and international conferences related to the availability and use of MSDE's digital resources in a blended environment to provide personalized teaching and learning.

Nine online professional learning courses aligned with new standards were piloted during the spring and fall of 2014. Over two hundred and fifty educators participated and completed the piloted courses. These courses are now in production. In development are nine additional online professional learning courses that will be piloted during the spring and fall of 2015. Educators are finding these courses to be challenging, interactive, and beneficial.

The Office of Instructional Technology is currently working with stakeholders to develop a menu of online blended learning professional learning options for educators to pursue. This program will be implemented during the school year 2015-2016.