

Bandwidth



How much bandwidth will standardized or CCR assessments require?

There are several online calculators that provide bandwidth guidelines. Some are affiliated with the Partnership for Assessment of Readiness for College and Careers (PARCC), Smarter Balanced Assessment Consortium (Smarter Balanced), or state-based assessments, while others may be unaffiliated. Be aware that if you choose a tool and provide the input and then run several other tools using identical input data, you will likely get very different results.

Much of the reason for this difference in results is based on the assumptions. We suggest that you begin with a discovery baseline using a relatively simple calculation, and use this baseline throughout the rest of your network-readiness planning.

Action:

Calculate a discovery baseline for bandwidth:

$$\begin{aligned}
 &(\text{Number of classrooms taking tests simultaneously}) \times \\
 &(\text{Number of testing devices per classroom}) \times (30 \text{ to } 100 \\
 &\text{Kbps per device}) = \text{Discovery Baseline Estimated Total} \\
 &\text{Bandwidth in Kbps}
 \end{aligned}$$

This is a discovery baseline during an assessment test window, in Kbps, so you may need to convert to Mbps or Gbps.

We are assuming a range of 30 to 100 Kbps per device, based on estimates from PARCC and Smarter Balanced. We recommend using the higher end of the range, so that your school is prepared for any spikes in usage that may occur. However, if you have information from your assessment organization that indicates a higher range, use that range.

You can also apply this formula to any location within your school district. For example, you can apply a baseline to a particular building getting to an aggregated district core or to all buildings aggregating to the Internet connection going toward the assessment service.

Once you have a discovery baseline, think about the network path from the student's device to the testing service in the cloud. Work through the entire path, including your Internet service provider connection, to come up with the maximum bandwidth for each. Compare the baseline with the lowest bandwidth in the path from the device itself (wired or wireless) to the assessment test center. This will give you an initial answer as follows: the bandwidth CCR online assessments will require (discovery baseline), and we have maximum (lowest bandwidth) available today for the assessments.



How do you measure what else may be happening on the network during assessment days to ensure that enough bandwidth is available for the assessments?

While preparations can be made ahead of time to understand background traffic, network applications and traffic are dynamic and can change quickly. Network traffic may change on assessment day without the knowledge of technical staff and may cause assessments to be affected. This scenario may require immediate action to assess and remediate impacted background traffic.

Make sure you have network visibility tools ready beforehand to identify and remediate background traffic if necessary.



How do you ensure that enough bandwidth is available for the assessment on test days, regardless of what else may be happening on the network?

To ensure that enough bandwidth is available, enable quality of service (QoS) in your network and prioritize student test traffic to "mission critical" status. This can be done by building a list of standardized or CCR assessment hosts and URLs, and then marking this traffic as critical on the inbound sides of the traffic flows, including from the Internet and ports from student systems.

Use a network management tool to apply your policy to the network. The policy tells the network switches and routers to reserve network bandwidth for assessment traffic, making sure that at least the amount (for example, the percentage) that you specify is always available for outbound traffic. Other traffic will be delayed slightly or shaped to fit within the remaining bandwidth available. This allows student assessments to always get through, no matter what other traffic is using the network at that time.

Action:

Once you have a discovery baseline for assessment bandwidth, ensure that this bandwidth is always available by implementing QoS and using traffic marking and prioritization. Deploy network management tools that show what is happening on the network in real time, streamline configuration across multiple switches and routers, and monitor the prioritized traffic flows.



Do you classify applications running on your network today? Do you receive detailed reports about usage?

To understand how assessment load will affect your network, it is critical to understand what applications currently use your network.

Action:

As mentioned above, look into network equipment features that can monitor and report all applications that are in use and provide a time-based history of usage. This is critical to develop an understanding of existing applications and how they may impact assessments.



Are the applications currently running on your network prioritized to handle the most critical functions first?

Using hardware priority queues and management, critical applications, such as student assessments, can be given the highest priority to ensure that they are not affected by other traffic loads.

Action:

Develop a QoS implementation plan that guarantees assessment traffic will not be impacted by other application bursts from elsewhere on the network.



What is the utilization of your main Internet connection today (in a percentage)?

If you are running a very high utilization (above 80 percent) without prioritization, any added load may cause assessments to time out or have severe delays.

Action:

Look into network management tools that monitor all network interfaces, including the inbound/outbound Internet usage.



How much total bandwidth do you have available for the Internet today?

While your Internet service provider probably offers peak bandwidth times, you should conduct network performance tests at various times throughout the school day to assess actual bandwidth availability.

Action:

Develop a daily, automated, and measurable routine to test Internet bandwidth availability.



How much total bandwidth do you currently have available between school buildings?

The bandwidth and network utilization between school buildings will be different than Internet bandwidth, but they are just as critical.

Action:

Create a network map of all school buildings, how they interconnect, and what bandwidth they have available. Look into network management tools that monitor how bandwidth is utilized throughout the day.



Do you plan to use network caching (or PARCC/ Pearson Proctor Caching) to reduce Internet bandwidth requirements?

Make sure that your network caching solution works properly with your assessment services and that they do not interfere with each other.

Action:

Evaluate your current network caching deployment and ensure that it actually reduces assessment Internet bandwidth. Understand load limits and test caching configuration thoroughly before the actual student test loads.

Wireless



Will students be using wireless devices for assessments?

Understand how many wireless devices can be active at one time for wireless network load. Is there more or less load on a test day? Look into the wireless standards, performance, and capabilities of the devices.

Action:

Perform a wireless survey to make sure the existing wireless infrastructure can handle assessment loads. Test heavy wireless density ahead of time. Take remedial action if necessary. Understand what Wi-Fi protocols and standards that you have in place today, from 802.11b/g to Wi-Fi 6.



If students will be using wireless, how many student assessment devices will be using one access point?

Determine whether the wireless infrastructure is designed to handle the activity of 20 or more students per classroom simultaneously. Additional access points may be needed, depending on the student-to-access-point ratio.

Action:

Consider replacing older access points with ones that are more capable of handling additional traffic and devices simultaneously, such as Wi-Fi 6. Enable load balancing across multiple access points so single units are not overloaded.



If students are using wireless devices, what wireless speed and performance standard devices do you use (802.11b, 802.11b/g, 802.11b/g/a, 802.11n, 802.11ac Wave 1 or Wave 2 Wi-Fi 6 (802.11ax)? Dual-radio or multiple-radio?

Older 802.11b can only provide 11 Mbps per access point (about 5.5 Mbps actual throughput), while newer 802.11ac Wave 1 can provide up to 1.5 Gbps per access point (about 750 Mbps actual throughput; this also may be limited by 1 Gbps wired uplink). 802.11ac Wave 2 can provide up to 3.5 Gbps in wireless bandwidth, and Wi-Fi 6 can give higher performance across multiple wireless bands. Wi-Fi 6 can handle many more simultaneous wireless devices per access point, helping greatly with high-density environments such as auditoriums, cafeterias, and gymnasiums.

Also, WPA2 Personal (WPA-PSK) and WPA2 Enterprise (WPA-802.1x) must use Advanced Encryption Standard (AES) to achieve full 802.11n performance. Bandwidth is limited when using Temporal Key Integrity Protocol (TKIP).

Action:

Consider replacing older access points with ones that are more capable of handling additional traffic and devices simultaneously.





Based on your earlier response, is the local network (routers, switches, and wireless controller) capable of handling all the aggregate traffic from the access points?

Installing 802.11ac or Wi-Fi 6 access points to provide extra bandwidth to students requires the infrastructure to handle larger loads of traffic.

For example, if you install 10 new 802.11ac access points, each with a 1 Gbps wired uplink, the maximum performance per access point is 1 Gbps. If the core wireless switching architecture cannot handle 10 Gbps of traffic from these access points alone, then they will not be able to deliver 1 Gbps per access point. Wi-Fi 6 access points are capable of multiple-gigabit uplinks and bandwidth to the distribution switch.

Action:

If an older, lower-performing switching infrastructure is in place today and the wireless access points are capable of faster performance, consider replacing the current switching infrastructure with one that can handle an aggregated wireless load to avoid lower end-user performance.



How do student wireless devices authenticate into the network?

If you do not have per-student authentication into the network today, is it required for access into assessments? Is it critical that only students who are testing use the network during tests and that guest access is not allowed?

If you do have wireless authentication using WebAuth, there may be time-out settings that require users to reauthenticate periodically, and this may occur during an assessment. Some assessments require that no other applications can be accessed during the test; therefore, the wireless re-authentication pop-up will not appear, and it cannot be switched to during the test. The test will lose the connection to the server.

Consider using 802.1x authentication, which will not prompt a re-authentication pop-up notice.

Action:

Enable an authentication system that tells you exactly who is logged into the network and from what location to reduce fraudulent testing. Ensure that the wireless authentication mechanism, such as WebAuth, will not time out during a test as it will result in a lost connection and will require students to re-authenticate.



Is wireless network traffic encrypted between devices and access points?

Smarter Balanced assessments use dedicated, secure browsers on each student device. PARCC uses specific versions of existing browsers with SSL enabled. State-sponsored assessment organizations may use something similar or different. However, it is a best network practice to encrypt all wireless traffic between endpoints and access points. Considerable traffic, sometimes including login names and passwords, is unencrypted by applications today, and can be easily captured by any device within wireless range.

Action:

Enable encrypted transport by requiring WPA2 or AES encryption for all wireless devices. WEP is considered non-secure and should be avoided.



Do you have complaints from students or faculty that their devices sometimes “drop off” the network randomly, leaving them unable to get back on?

This may indicate that your wireless network has become unstable or overloaded, or that it needs maintenance work.

Action:

Look into wireless network management tools that track wireless coverage, find weak spots, eliminate rogue access points, and boost signal where it is needed.



If you are using wireless, how do you currently monitor the wireless network for outages?

Do you have a wireless network control panel that shows active connections and sets off trouble alarms when wireless problems occur?

Action:

Look into network monitoring tools that alert staff about outages so they are able to take action quickly to resolve issues.



Will students be using only wired desktop (lab) computers for assessments?

Make sure student authentication onto the shared lab computers does not interfere with assessment authentication.

Firewalls, Content Filtering, and Proxy Servers



Does your school have a firewall between your network and the Internet?

Firewalls are critical security devices; however, firewall configurations can interfere with assessment activity between student devices and the assessment center. Session timers, which are configured in firewall appliances, may need to be increased for testing. If these timers are set to expire before the end of a testing session occurs, then the student's assessment may be disconnected before he or she is finished, requiring the student to log in again.

Action:

Look into how your firewall is currently configured. Make sure that it can be configured per specifications from assessment centers. Check session timers to ensure that they are sufficient for the length of the assessments.



Do you currently use web proxy servers?

Web proxies can interfere with assessment activity between student devices and the assessment center.

Action:

Make sure web proxies do not time out after test-taking connections that may last more than one hour.



Do you currently implement content filtering for inappropriate content?

Make sure that content filtering solutions do not impact the high levels of performance needed to interact with assessment centers. If the assessment software uses interactive mechanisms such as keyword searches, for example, the keyword may trigger a content alert. Consider how content alerts appear on the device during a test and how they might affect the student's test activity.

Action:

Check the response to content alerts during practice tests and document the results. Determine whether the content filtering mechanism needs to be adjusted and whether it can be adjusted specifically for assessments.



Other Topics



Do you plan to use thin clients (virtual desktop or VDI) for student assessments?

Make sure the assessment application requirements are met by the VDI environment. Understand the network path performance between the VDI terminals, the VDI data center, and the assessment center.



Is network printing required in the student assessment process?

Smarter Balanced allows test administrators to print out session information and can approve student requests to print stimuli or test items. This requires administrators to preserve test security involving paper printing and distribution. The student devices must also be able to print to the designated printer(s) and have the appropriate printer drivers installed. This can be challenging from mobile devices using tablet operating systems.

Also understand where physical printing will occur, who has or does not have physical access to the printer, the queuing capacity of the printer as potentially hundreds of students may print at nearly the same time, and the ability to re-stock paper.



Are you planning to use student-provided tablets for assessments? If so, does your current network environment limit network access for these devices?

Some schools differentiate between student-provided devices and devices owned by the district. For example, instructor iPads may have more access to the wireless network than student tablets or smartphones, so instructors have access to more content and student devices do not interfere with instructor use.

If these student BYOD tablets are to be used for assessments, it's possible that limits placed on these devices will interfere with the assessment. For example, assessment sites may be inadvertently blocked. Or bandwidth limitations on BYOD tablets could be restrictive, creating issues with the way the assessment operates.

Also consider security aspects of BYOD devices in terms of how to deploy and manage applications on these devices. They must be secure and configured to prevent tampering. Remember that Smarter Balanced, among possibly other assessments, requires that special browser software be installed and configured manually on each testing device.

Action:

If your student assessment devices are BYOD or multipurpose, make sure the network is configured for the best assessment experience, both on practice day and test day. Develop a plan around BYOD for testing and a methodology for installing and securing test software on these devices.





Are practice exams being conducted on the same technology and at the same physical location as the summative exam?

Schools have found that students can become distracted or have difficulty if there are differences between practice exam and actual summative exam environments. This includes the technology used in the exams – some practice exams may be conducted using one part of the network on one set of equipment, while the summative exams may be on a different part of the network, with different student technology.

Action:

Try to ensure that the practice tests are using the same room, network topology, and location as the actual summative exams. As practice tests occur, look to your network performance monitoring tools to gather feedback and watch network statistics. The goals are to ensure that students are familiar with the environment, limit distractions, and provide a consistent network infrastructure experience.



How quickly do DNS lookups occur on the school network?

Domain Name Service (DNS) is used to translate the names of Internet devices into their actual IP addresses. When you type in a name, the network should respond with the correct IP address within a few seconds. If this takes more than a few seconds (some sites may have 30- to 40-second lookups), it can seriously impact the time that students are waiting for the test to respond. You may hear complaints regarding how long it's taking to load, yet know that there is plenty of bandwidth available. Long DNS resolution times are usually the result of poor or incorrect DNS server lookup configuration in the network equipment.

Action:

Test your DNS response times in advance using a DNS lookup tool. Enter several different domains in succession. If response time is poor (more than a few seconds), look into changing the DNS server settings for the network.



Do you use antivirus scanning tools on the computers or tablets that will be used for assessments?

Antivirus scanning tools can be configured to regularly scan the entire hard drive, sometimes at any time of day. When this occurs, usually a pop-up message will appear on the screen, indicating that the scan is starting, the progress of the scan, and possibly the option to postpone. Depending on the software load and the performance of the computer, the computer interactive speed may be dragged down until the scan finishes. Other pop-ups may occur, such as when antivirus databases are updated.

If this happens during an assessment, what is the result? Will the student see the pop-up and need to know how to disable it? Will the student be unable to clear or move the pop-up because it is blocked by the assessment software as an inappropriate application? Can the scans be reliably scheduled for an after-school time?

Action:

Determine whether automatic scanning software is installed on student assessment computers during practice and non-practice assessments. If these are disruptive to tests, consider manually disabling the software during all assessments.





With wireless tablets, what type of keyboard will students use?

On-screen, virtual keyboards are supported by Smarter Balanced. However, they occupy valuable screen real estate. Do virtual keyboards interfere with the test?

PARCC requires physical keyboards for all devices, wired or wireless, due to limited tablet display real estate. While popular, most wireless keyboards use Bluetooth protocol. Bluetooth uses the same 2.4 Ghz frequency spectrum as other wireless technology, such as 802.11, and can experience interference from other electronics. In addition, pairing of the correct keyboard with the correct wireless device can be difficult and problematic when you have 30 or more Bluetooth devices in the same room and another 30 or more devices in a neighboring room that are active. Also, during or between assessments, Bluetooth pairing may be lost, which requires manual intervention by an administrator.

Directly attached keyboards are offered by most tablet vendors, or third parties.

Action:

Deploy wired keyboards for wireless tablets to avoid potential wireless interference and Bluetooth pairing issues before and during assessments.



If sound is used for listening during assessments, what types of headphones will students use?

Wireless headphones are popular and typically use Bluetooth technology. Since these also have the same issues as wireless keyboards, wired headphones eliminate these concerns.

Action:

If sound is used during assessments, deploy wired headphones to avoid potential wireless interference and Bluetooth pairing issues before and during tests.

Checklist: Questions for determining network readiness

Bandwidth

- ✓ How much bandwidth will standardized or CCR assessments require?
- ✓ How do you measure what else may be happening on the network during assessment days to ensure that enough bandwidth is available for the assessments?
- ✓ How do you ensure that enough bandwidth is available for the assessment on test days, regardless of what else may be happening on the network?
- ✓ Do you classify applications running on your network today? Do you receive detailed reports about usage?
- ✓ Are the applications currently running on your network prioritized to handle the most critical functions first?
- ✓ What is the utilization of your main Internet connection today (in a percentage)?
- ✓ How much total bandwidth do you have available to the Internet today?
- ✓ How much total bandwidth do you currently have available between school buildings?
- ✓ Do you plan to use network caching (or PARCC/ Pearson Proctor Caching) to reduce Internet bandwidth requirements?

Wireless

- ✓ Will students be using wireless devices for assessments?
- ✓ If students will be using wireless, how many student assessment devices will be using one access point?
- ✓ If students are using wireless devices, what wireless speed and performance standard devices do you use (802.11b, 802.11b/g, 802.11b/g/a, 802.11n, 802.11ac Wave 1 or Wave 2, Wi-Fi 6 (802.11ax))? Dual-radio or multiple-radio?
- ✓ Based on your earlier response, is the local network (routers, switches, and wireless controller) capable of handling all the aggregate traffic from the access points?
- ✓ How do student wireless devices authenticate into the network?
- ✓ Is wireless network traffic encrypted between devices and access points?
- ✓ Do you have complaints from students or faculty that their devices sometimes “drop off” the network randomly, leaving them unable to get back on?
- ✓ If you are using wireless, how do you currently monitor the wireless network for outages?
- ✓ Will students be using only wired desktop (lab) computers for assessments?

Firewall, Content Filtering, and Proxy Servers

- ✓ Does your school have a firewall between your network and the Internet?
- ✓ Do you currently use web proxy servers?
- ✓ Do you currently implement content filtering for inappropriate content?

Other Topics

- ✓ Do you plan to use thin clients (virtual desktop or VDI) for student assessments?
- ✓ Is network printing required in the student assessment process?
- ✓ Are you planning to use student-provided tablets for assessments? If so, does your current network environment limit network access for these devices?
- ✓ Are practice exams being conducted on the same technology and at the same physical location as the summative exam?
- ✓ How quickly do DNS lookups occur on the school network?
- ✓ Do you use antivirus scanning tools on the computers or tablets that will be used for assessments?
- ✓ With wireless tablets, what type of keyboard will students use?
- ✓ If audible sound is used for listening during assessments, what types of headphones will students use?

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