Brocade and Ruckus: Building the Best K-12 Network for Common Core Testing and Beyond

K-12 technology administrators are scrambling to prepare their networks to support Common Core testing, which began in the spring of 2015. The network requirements to support online testing, as laid out by the two predominant Common Core testing consortiums (the Smarter Balanced Assessment Consortium and the Partnership for Assessment of Readiness for College and Careers [PARCC]), should be relatively easy to support. However, the technology requirements for the testing, as laid out by PARCC and Smarter Balanced, do not go far enough to sufficiently address many of the other potential pitfalls that can occur during online testing to a remote third-party service.
# Table of Contents

Background .................................................................................................................................. 3  
Solution Overview ...................................................................................................................... 3  
The Connected Classroom of Today and Tomorrow ................................................... 4  
  Supporting a Broad Range of Devices in the Classroom ................................................. 4  
Network and Software Architecture of the Connected Classroom ............................... 5  
  Classroom Switch .................................................................................................................. 5  
  Classroom Access Point ....................................................................................................... 6  
  Ease of Deployment ................................................................................................................ 7  
  Device Management and Security Policy ........................................................................... 7  
  Enhancing the Learning and Testing Environment ............................................................ 8  
  Cost-Effective Today and Tomorrow ................................................................................ 8  
  Computer Lab/Testing Area Switch ................................................................................. 9  
  Computer Lab/Testing Area Access Point .................................................................... 10  
  Computer Lab/Testing Area ............................................................................................... 10  
Common Areas: Many Devices, Unique Challenges .................................................. 12  
Floor Aggregation Closet and IDF ..................................................................................... 14  
School Site Core and MDF and the Connection to the District Central Office .............................................. 16  
  Connecting to the District-Wide Network ..................................................................... 17  
School District Data Center ................................................................................................. 18  
  Network Management and Policy Enforcement ............................................................. 19  
  Brocade Network Advisor: Wired and Wireless Network Management .................. 20  
  Ruckus/Cloudpath XpressConnect: Secure Automated Onboarding ......................... 20  
E-Rate Modernization and Financial Acquisition Options ............................................. 20  
Summary .................................................................................................................................... 22  
About Brocade ......................................................................................................................... 23  
About Ruckus .......................................................................................................................... 23  
Contact Information ............................................................................................................... 23
Background
Technology requirements that do not sufficiently address potential pitfalls during online testing may cause major disruptions across the school campus. For example, in 2013, Fairfax County Schools in Virginia experienced an Internet Service Provider (ISP) outage during their online testing window that affected thousands of students. This outage caused the school system to reschedule testing for these students to another unplanned day before the end of the academic year, causing major disruptions across the school system and, ultimately, thousands of lost hours of productivity for teachers, students, and administrators. Neither PARCC nor Smarter Balanced provide recommendations to prevent this type of disruption.

In addition, due to a lack of previous E-rate funding, many school district networks have not been upgraded in many years. If a school system simply upgrades its network to support the bare minimum requirements for Common Core testing, it is not prepared to deliver new Common Core curriculum that is delivered via interactive and video-based applications and tools. It also is not prepared to support BYOD or 1:1 learning initiatives that are being implemented now, let alone future digital learning applications.

This paper provides K-12 technology administrators with a blueprint for networking technology that provides a foundation for supporting Common Core testing requirements, including addressing previously unidentified potential pitfalls, as well as supporting BYOD and other future digital learning initiatives.

Solution Overview
The K-12 network architecture blueprint described in this document provides the technology administrator with a background for the challenges that may arise with the implementation of Common Core testing and other digital learning initiatives within the school district. The paper breaks down the network around functional areas within the school and provides suggested network hardware and software solutions to address requirements and potential issues.

E-Rate Impact
With E-rate Modernization and the availability of “Category 2” in-building network infrastructure funding on a once every five years model, simply architecting a network to support minimum Common Core requirements is shortsighted.
The Connected Classroom of Today and Tomorrow

Today’s students are connected to the outside world from birth. Much of their learning to date has occurred through the use of personal devices and television. The connected classroom of today and tomorrow embraces this transformation in learning and utilizes devices to augment classroom curriculum.

Figure 1. The Connected Classroom of Today and Tomorrow.

Supporting a Broad Range of Devices in the Classroom

Most college campus IT departments are reporting that students on average are carrying at least 2.5 connected devices per student with them at all times—including phones, laptops, and tablets or game devices. While the K-12 network environment may not carry that type of burden today, it will become true for the K-12 campus in the near future.

As most school systems are currently implementing BYOD or 1:1 student-to-device programs, a large amount of time and effort has been put into the workflow to register non-district owned devices (onboarding) with safety and security. However, many districts
have not done a deep analysis on their aging network infrastructure to see if it can handle the burden of all these additional devices both now and in the future. In the connected classroom, not all devices are created equal. A security camera shooting HD-quality video, or an Apple TV device, is more of a strain on the network than a Voice over IP (VoIP) phone. However, the traffic prioritization of the voice call will be higher than the video from the camera or the streaming video device. Districts have been implementing VoIP systems for many years. If they have not done so already, districts will be highly encouraged to implement such systems in the near future, as support for traditional Private Branch Exchange (PBX) systems is phased out with E-rate Modernization.

School districts across the country are implementing video surveillance systems. The need for increased security in the wake of recent tragedies and the need to decrease school liability are the driving factors behind these deployments.

In a BYOD environment, the students’ devices are not created equal, either. For instance, one type of tablet might pull more bandwidth from an Access Point (AP) than another tablet. This presents an interesting challenge during Common Core testing, that of ensuring that each student and device has an equitable amount of bandwidth during the testing window. The next section provides some network and software architecture considerations and recommendations for the connected classroom.

Network and Software Architecture of the Connected Classroom

The connected classroom contains a mix of wired and wireless devices. The wired devices are generally fixed-position and utilize more bandwidth. Examples of these devices are VoIP phones, security cameras, smart boards, or smart televisions. To support this mix of wired and wireless devices, the combined network infrastructure must work in concert. Each element is only as strong as the weakest link of both.

For example, Huntington Beach Union High School District in Southern California began a project to upgrade their wireless infrastructure in support of Common Core testing. They quickly discovered the need to upgrade the wired infrastructure that was supporting the more than 10,000 devices that connected to the network daily.

With the wired and wireless infrastructure working in tandem, the user experience improves, and network operation and maintenance works more smoothly. In the connected classroom, the wireless end-user devices are connected to wireless APs. In turn, the APs are connected to the classroom switch and also receive power from the classroom switch.

Classroom Switch

Within the classroom, certain features of a classroom switch are paramount.

- **The switch has to be quiet.** Teachers do not want to have to talk over fan noise in their classrooms.

- **The switch has to be low cost.** The sheer number of devices deployed in classrooms can overrun a school budget if the device is too expensive.
• **The switch has to provide Power over Ethernet (PoE/PoE+).** Many devices in the classroom are powered off the switch, and running electric circuits to their respective locations is too expensive.

• **The switch has to be remotely manageable.** When issues occur, the IT staff must be able to get a remote view into the network from a central location. Dispatching tech support to classrooms to fix issues proves too costly.

The Brocade® ICX® 6450-C12-PD Switch provides the classroom connectivity needed for today and tomorrow. The unit is fanless and compact, so it is extremely quiet and can be inconspicuously placed on a shelf in the classroom. In fact, the switch itself can be powered through PoE uplink ports, so there is no need for an AC outlet in the location where the switch is placed.

With 12 10/100/1000 Mbps Ethernet ports, four of which can support PoE+ (30-Watt, or 30W) devices, the Brocade ICX 6450-C Compact Switch can power and deliver the bandwidth to the AP in the classroom, as well as to the other fixed devices in the classroom, like video surveillance cameras, smart boards, and VoIP phones.

The uplink ports in the switch provide media flexibility and can uplink to upstream switches via 1 gigabit-per-second (Gbps) connections via copper or fiber Small Form-Factor Pluggable (SFP) modules.

**Classroom Access Point**

Within the classroom, access points that can provide full wall to wall coverage, and most importantly, support high density of users are critical. As more schools introduce flipped classrooms, 1:1 initiatives, and other new interactive teaching approaches, Wi-Fi networks must support a large number of users, who often drive concurrent network traffic. Ruckus’ patented BeamFlex antenna technology utilizes internal antenna elements to optimize the Wi-Fi signal to each connected client in real-time, using up to 2,000 different available antenna patterns.

BYOD and 1:1 trends mean handling an explosion in the number of devices within the classroom. By deploying the Ruckus ZoneFlex APs, school districts are able to keep up with the increase in the number of devices in the years to come. The four-stream Ruckus ZoneFlex R710, the industry’s first 802.11ac Wave 2 access point, utilizes multiuser Multiple Input, Multiple Output (MIMO) technology to deliver over 2.5 Gbps of potential throughput. For more cost-sensitive deployments, the three-stream Ruckus ZoneFlex R600 802.11ac access points deliver up to 1.7 Gbps of total throughput. Both models offer plenty of capacity and range to cover two classrooms with a single AP. This greatly reduces the risk of co-channel interference from adjacent APs. This results in significant deployment cost savings and best-in-class performance that is critical in ensuring flawless support for activities such as Common Core testing.

The APs can be managed by either an onsite or a centralized controller that can scale to manage from one to 30,000 APs via a single cluster. Using a virtualized, central controller, school districts can significantly reduce their CAPEX costs and enable the limited district IT staff to manage Wi-Fi across all their schools. The controller enables school or zone level AP management and can push new or updated configurations for
firmware to all appropriate APs on the network. The process is simple to replace an AP or acquire additional APs to meet new demands. Anyone, including the field staff, can simply plug in a new AP, and it contacts the controller to download the appropriate configuration.

Ease of Deployment
Most school districts have a limited IT staff that is stretched to serve a large geographic area and thousands of end users. Even more limited within the school district is the number of networking “experts” on the IT staff. The Brocade ICX Switch and the Ruckus Smart Wi-Fi both reduce the stress of network deployment. Ruckus ZoneFlex APs deliver superior coverage and high-density performance with fewer APs, and they include two mounting options: an adjustable acoustic drop ceiling bracket for attaching to the drop-tile ceiling or slotted tabs for screw mounting to a wall, ceiling, or other flat surface. Brocade ICX Compact Switches are compact, less than 11 inches wide and 9 inches deep. They are extremely quiet, since they are fanless and weigh less than five pounds. They are designed to be placed in various inconspicuous places in the classroom.

Brocade ICX Switches also support Zero Touch Provisioning (ZTP) and autoconfiguration. When the switches are powered up, they automatically receive an IP address and configuration from Dynamic Host Configuration Protocol (DHCP) and Trivial File Transport Protocol (TFTP) servers. At this time, the switches can also automatically receive a software update to be at the same code revision as currently installed switches. This ZTP option alleviates the need for highly trained network engineers to be on site for the deployment of the network or replacement of a device, enabling the IT staff to focus on more mission-critical tasks.

Device Management and Security Policy
One of the more difficult aspects of a K-12 school district is onboarding student and faculty devices while keeping the students safe, keeping the network secure, and adhering to school district device use policies. Seamless network connectivity and simplified policy-based access to learning resources are critical for successful digital classrooms. Spending precious classroom time waiting to connect or for troubleshooting can be very frustrating to teachers and often leads them to abandon technology tools.

Ruckus has fully integrated features to handle BYOD stress points for both administrators and users. The Wi-Fi controller leverages existing district resources by integrating with current network segmentation and security architectures, authentication protocols, and directory services to simplify and streamline wired and wireless access management implementation. In addition, Ruckus has built easy and intuitive device provisioning and onboarding processes that are foolproof for users and simple to implement by IT. Device fingerprinting and access control enable differentiated policies for specific device types and user roles, as well as enhanced monitoring and visibility to improve network operations, troubleshooting, and policy changes over time.

End users with new devices simply log in via a captive portal the first time they connect to the network. They then are automatically connected to the appropriate secured network. Robust wireless performance enables users to connect and stay connected, making BYOD initiatives work for the schools.
**Enhancing the Learning and Testing Environment**

As digital learning is embraced in more school districts, new devices are being used to assist the learning experience. Some of these new devices can negatively impact overall network performance. Devices such as Apple TV, Apple Print, Google Chromecast, or a myriad of devices from the Digital Living Network Alliance (DLNA) use broadcast protocols that can have adverse effects on the entire network when in use. To combat this issue while still enabling the digital learning experience, Ruckus SmartWay is a new Wi-Fi software technology that not only simplifies the administration and optimization of service discovery traffic such as Apple Bonjour and Universal Plug and Play (UPnP) protocols over smart Wi-Fi networks, it also supports advanced facilities to restrict or “fence” these services to a given AP, a group of APs, or a particular geographic area.

Ideally suited for K-12 and higher education environments, Ruckus SmartWay helps organizations enable users with Apple devices to exploit other resources on their networks. For example, Ruckus SmartWay makes Apple Bonjour services such as AirPrint, AirPlay, and the Apple Filing Protocol (AFP), which are used in wireless printers and multimedia devices, usable and controllable across subnets.

Alternative approaches simply bridge all multicast traffic between two virtual LANs (VLANs) or bridge the traffic from a single VLAN to all VLANs on a service-by-service basis. This means that a given service, such as Apple TV, becomes available everywhere, creating security concerns as resources are visible in undesired locations. For example, without Ruckus SmartWay, a teacher can use AirPlay to transmit traffic from an iPad to the Apple TV in the classroom only if both devices are on the same subnet. With Ruckus SmartWay support for Bonjour, the teacher can access any Apple TV as well as enable any student to transmit traffic from their iPad on the student Wi-Fi network to the Apple TV on a different Wi-Fi network.

Wi-Fi deployments supporting multicast traffic such as Bonjour and UPnP can quickly get out of control if not scaled properly. Rather than flooding the network with traffic from all devices and subnets, Ruckus SmartWay selectively bridges this traffic to the subnets of choice. Ruckus has natively integrated SmartWay support for bridging Bonjour and other multicast traffic directly into its ZoneFlex software system. This allows service discovery traffic to be selectively bridged across subnets to enable large-scale deployments without overloading the network.

**Cost-Effective Today and Tomorrow**

Even with increased E-rate support, school districts are continually challenged to keep the cost of network deployments and maintenance under control. The Brocade ICX 6450-C Compact Switch and Ruckus Smart Wi-Fi allow school districts to stretch their E-rate dollars further. With E-rate 2.0, many school districts will have access to some level of E-rate funding for the first time in years. While the total funds have been increased to up to $3.9 billion (including rollover from the previous year), schools still need to look at maximizing the dollars they get out of the budget, because E-rate budget for a school is capped over five years.
Both Brocade ICX Series Switches and the Ruckus Wi-Fi are priced very competitively and have the capability to support the connected classroom for years to come. But the huge advantage these products bring to the school district is a Limited Lifetime hardware and software warranty.

The Brocade ICX 6450-C Compact Switch is covered by the Brocade Assurance® Limited Lifetime Warranty. This warranty provides advanced replacement of faulty hardware for the lifetime of the equipment, as well as software upgrades through the end of the product support date. Ruckus indoor APs are covered by Ruckus’ Limited Lifetime Warranty and access to the latest-shipping software images.

Computer Lab/Testing Area
Many school districts have not yet implemented a BYOD or 1:1 plan, and these districts use testing rooms or computer labs to perform online Common Core testing. The requirements for these rooms vary slightly from the classroom, as labs generally implement a higher density of wired connected devices with a wireless overlay.

Figure 2. Computer Lab/Testing area.
Computer Lab/Testing Area Switch
For areas with a higher density of fixed workstations, such as computer labs and testing areas, the rooms require a higher density switch than classrooms that are dominated by wireless devices. The Brocade ICX 7250-48P Switch provides 48 1-GbE ports for connectivity to workstations. With up to 740W of PoE+ power support, the Brocade ICX 7250-48P can power a large number of devices (for example, APs, VoIP phones, security cameras, and so on). In fact, all ports on the switch can provide PoE+ (30W) when paired with an external power supply. A non-blocking switch architecture and high throughput uplinks to the school core ensure that bandwidth-intensive workstations in the lab perform without network bandwidth hindrance.

To encourage uninterrupted testing, the Brocade ICX 7250 Series has an optional external redundant power supply option (the Brocade ICX-EPS 4000). This low-profile unit provides additional redundancy and availability in case of power supply failure on the switch. The unit can provide power backup to up to sixteen Brocade ICX switches. It can also be used to provide system power redundancy and additional PoE/PoE+ power budget for up to eight switches.

The Brocade ICX 7250 Family supports eight priority queues. By enabling traffic prioritization, testing applications can be given a higher priority, to ensure that students have the best testing experience possible.

ZTP is also supported on the Brocade ICX 7250, to reduce specially trained network installation resources and speed deployments.

Computer Lab/Testing Area Access Point
The same AP used in the classroom environment, the Ruckus ZoneFlex R710 and R600, can be used in the computer lab as well. All Ruckus ZoneFlex APs include select features that are key to enabling a stress-free Common Core testing experience for the wirelessly connected student in the computer lab. These SmartLink features are described in the table on the next page.

Client Load Balancing and Band Balancing work together to maintain an even RF load across network assets to deliver the best service to the most end users. Band Balancing is triggered when the number of connected clients on a specific radio exceeds the predefined threshold. When active, Band Balancing temporarily withholds probe responses to maintain the percentage of client load across radios during association. The default is 25 percent of clients on 2.4 GHz and 75 percent on 5 GHz. Similarly, Client Load Balancing uniformly distributes clients across APs to maintain an even RF load across neighboring access points.

Effectively balancing client across APs and radios can boost overall WLAN performance and help ensure consistent, predictable performance to every user and client while eliminating the “sticky client” problem for good. For example, when a student with a wirelessly connected tablet goes from the classroom to the computer test lab, Band Balancing will switch the student’s connection from the classroom to the better performing AP in the lab.
As we have seen from the documents posted by PARCC and Smarter Balanced, the amount of bandwidth required per user for Common Core testing is not estimated to be great, but it is important ensure that a student with an 802.11ac enabled tablet is not starving the wireless connection from another student with an 802.11g enabled tablet. For example, if one client is further away, or is on an older 802.11a/b/g device, it will take a lot more time to transmit than a client nearby, or one that uses the newer 802.11ac standard. In a mixed environment, even though most users may be on 802.11ac, all users will see slower speeds since they will be waiting for the slower transmissions from the older, slower devices. Ruckus Airtime Fairness addresses this issue via smart scheduling that ensures that all devices get an equal amount of time, so that the slower devices are not reducing the speeds of faster devices.

<table>
<thead>
<tr>
<th>SmartLink Features</th>
<th>What It Is</th>
<th>How It Works</th>
</tr>
</thead>
<tbody>
<tr>
<td>Client Load Balancing</td>
<td>Uniformly distributes clients across APs on the same radio frequency to maintain an even RF load across neighboring access points. Interoperates with Band Steering and Band Balancing, which activate when the client attempts to join a specific AP.</td>
<td>Requires background scanning to be enabled. Neighboring APs share their connected client state, and ZD/SZ will provide a desired client count based on the current client load of the AP neighbors. This is dynamically recalculated as client count increases. When enabled, APs make their own decision to suppress client probe responses when the desired AP count limit is reached. (The same mechanism is used for Band Steering.) This takes effect only during client association and does not disassociate any client. Safeguards are built in to prevent client stranding and edge network connectivity.</td>
</tr>
<tr>
<td>Band Steering</td>
<td>Steers dual radio clients to connect with 5 GHz.</td>
<td>Temporarily-withholds probe response to a 2.4 GHz client request Band Balancing is triggered when the number of connected clients exceeds the pre-defined threshold (def=20).</td>
</tr>
<tr>
<td>Band Balancing</td>
<td>Steers clients towards the less utilized radio band to achieve optimized throughput.</td>
<td>When active, Band Balancing temporarily-withholds probe responses to maintain percentage of client load across radios during association. Default is 25% of clients on 2.4 and 75% on 5 GHz. This feature interoperates with load balancing between access points.</td>
</tr>
<tr>
<td>Capacity-Based Client</td>
<td>Helps to ensure existing clients’ Wi-Fi quality experience by preventing new client connects when the maximum acceptable load has been reached.</td>
<td>Client admission control starts when the client count reaches the minimum client count specified in the GUI. (The default is 10 clients for 2.4 GHz and 20 clients for 5 GHz.) New client requests will be rejected if the radio load reaches the max radio load setting (default is 75%) and the estimated average client throughput falls below the specified minimum throughput.</td>
</tr>
<tr>
<td>Admission Control</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Common Areas: Many Devices, Unique Challenges

Some of the most difficult areas to support with optimal network coverage are large common areas, such as auditoriums, cafeterias, gyms, and even outdoor stadiums. The importance of providing excellent network access in these areas continues to increase. In fact, some K-12 school districts are using gyms as their Common Core testing area.

![Image of Ruckus Zoneflex R710 Access Points and Brocade Icx 7250-48P](image)

**Figure 3.** Common Areas: Many Devices, Unique Challenges.
Ruckus has a vast amount of experience in this area, including recent deployments at the World Cup stadiums and several Major League ballparks in the United States, where tens of thousands of concurrent connections are supported on any given game day.

For the K-12 network, more and more students and faculty are bringing devices on campus, and they expect those devices to have connectivity anywhere on campus. In a large common area, device congestion can cause poor performance and a poor user experience. Ruckus is uniquely able to support a dense number of devices in an open area based on a range of technologies. BeamFlex helps to get users on and off the network faster via improved connectivity, and Client Load Balancing and Band Balancing steer clients to the best performing APs and balance the load between 2.4 and 5 GHz bands. ChannelFly moves clients to the optimal channel based on actual throughput measurements.

The backend wired infrastructure is supported through the Brocade ICX 7250-48P. The Brocade ICX 7250 provides the bandwidth and PoE+ power to support the avalanche of devices needed in a large K-12 meeting area. With up to 740W of PoE+ power support, the Brocade ICX 7250-48P can power a large number of ZoneFlex R710/600 APs on a single switch. The Brocade ICX 7250 also has multiple Gigabit Uplinks to provide sufficient bandwidth between the common area and the school core network and that the northbound connection to the upstream switch will not be a gating factor in slowing down the client’s connection.
Floor Aggregation Closet and IDF
Most schools have an Intermediate Distribution Frame (IDF) on each floor. Also known as the electrical closet or the Telco closet, this is an aggregation point for the network switches and devices on a single floor.

Figure 4. Floor Aggregation Closet and IDF.
The IDF switch aggregates (and potentially powers) the Brocade ICX 6450-C12-PD switches in the classrooms on their respective floors, along with any Brocade ICX 7250-48s deployed for the computer labs/testing areas and the common areas. These switches also provide wired connectivity to physical security devices on a floor, such as badge readers and video surveillance cameras in the hallways. Due to the larger number of end devices supported off of the IDF switch, such as new application types with rich media and high bandwidth needs, the availability requirements of these switches are greater.

The **Brocade ICX 7450-24P-E** Switch is the ideal IDF switch. This cost-effective device has 24 ports of 1 gigabit Ethernet (GbE) via RJ-45 ports, supports 2 internal redundant power supplies and 2 fan trays that can be swapped out in the field without downtime. This extra level of redundancy is a necessity during Common Core testing time to prevent a power supply failure from causing a major outage.

The Brocade ICX 7450 line has a modular uplink option that is flexible and scalable. Four different optional port modules are offered for the Brocade ICX 7450 with a choice of 1 GbE SFP, 10 GbE SFP/SFP+, 10 GBASE-T, and 40 GbE Quad SFP+ (QSFP+) options. These options are great for school sites with varied cabling installations (for example, when no fiber optic cabling is available between floors). They allow a school to scale their infrastructure from a 1 Gbps backbone all the way to a 40 Gbps backbone, as bandwidth demands necessitate.

In addition to supporting the PoE/PoE+ standards, the Brocade ICX 7450 also supports Power over HDBaseT (PoH). This new, high-power standard delivers up to 95W per port through a standard Ethernet cable, simplifying the wiring of next-generation Ethernet-connected devices such as large HD displays, video surveillance equipment, and Virtual Desktop Infrastructure (VDI) thin terminals. PoH enables data and power to be carried by a single Ethernet wire. The PoE/PoE+ and PoH capabilities reduce the number of required power receptacles and power adapters, while increasing reliability and wiring flexibility.

The Brocade ICX 7450 is covered by the Brocade Assurance Limited Lifetime Warranty. This warranty provides advanced replacement of faulty hardware for the lifetime of the equipment, as well as software upgrades through the end-of-product support date. This allows K-12 school districts to stretch their E-rate basic maintenance and operating expense budget dollars further, without having to spend resources on network infrastructure.
School Site Core and MDF and the Connection to the District Central Office

The Main Distribution Frame (MDF) or the core of a school site network is the aggregation point of each of the IDF locations (or floor aggregation switches). The MDF provides connections to any centralized servers or resources for the school, as well as to the connection point to the school district Wide Area Network (WAN). As with the IDF, the MDF location requires a high level of redundancy and availability, as it is the main aggregation point to the outside world for the school.

Figure 5. School Site Core and MDF and the Connection to the District Central Office.
The Brocade ICX 7750 Switch delivers industry-leading 10/40 GbE port density, advanced high-availability capabilities, and flexible stacking architecture, making it the most robust Brocade aggregation and core distributed chassis switch offering for enterprise LANs. In addition to rich Layer 3 features, the Brocade ICX 7750 supports up to a 12-unit distributed chassis stacking or Multi-Chassis Trunking (MCT) and forms an integral part of campus LANs. The MCT capability of the Brocade ICX 7750s provides redundancy and more efficient utilization of switch connectivity links by making both links active. MCT also alleviates the need for Spanning Tree Protocol (STP), which is susceptible to large reconvergence times in the event of switch or port failure. From a K-12 school network architecture, this technology could be used by the school to provide redundant links from each of the IDF or floor switches to each of the core switches in the MDF. This architecture provides redundancy and capacity from each of the floors to the core network.

The Brocade ICX 7750 distributed chassis technology in the Brocade ICX line allows for extra reliability without the added cost. Administrators have the ability to stack through regular ports and the ability to remove failed components of the stack or insert new members to the stack without interruption to the rest of the stack. Administrators can apply all configuration changes, firmware updates, and policy settings to every member of the switch stack from a single point of management. This significantly reduces the time and cost associated with these frequent tasks and reduces the time required to deploy new applications.

Connecting to the District-Wide Network

President Obama’s ConnectED initiative advocates for 99 percent of all schools to be connected via a minimum of 100 Mbps. This initiative means that the vast majority of school districts either have moved to, or will be moving to, Carrier Ethernet WAN and Metropolitan Area Network (MAN) connections to support the increased bandwidth targets. The Brocade ICX 7750 supports the Carrier Ethernet features and services needed to meet this initiative, whether the network is provided by a local service provider or whether the district owns its own physical plant (connected over dark fiber).

The Brocade ICX 7750 is covered by the Brocade Assurance Limited Lifetime Warranty. This warranty provides advanced replacement of faulty hardware for the lifetime of the equipment, as well as software upgrades through the end-of-product support date. This type of warranty on a core switch device is unheard of in the networking industry, and it allows K-12 school districts to stretch their E-rate basic maintenance and operating expense budget dollars further, without having to use resources on network infrastructure.
School District Data Center

A school district’s central office is usually the hub of the district’s metro or regional network. The Carrier Ethernet connections to all the school sites aggregate here and provide upstream connectivity to the district’s chosen ISPs. Generally, the district office is also where the vast majority of IT personnel are situated. It is the central site for district-wide shared resources and network management and administration.

Figure 6. School District Data Center.
Whether the district network is configured in a star topology (with individual direct connections to the school sites from the central site) or, more often, configured in a ring topology (with one direct connection to the next school site to the "east" and one direct connection to the "west"), a pair of Brocade MLXe-4 Core Routers provide the services to the district network and upstream service provider in a highly available and redundant fashion. The core MLXe-4s have a connection between themselves to announce the current state with each other. If one system fails, the other continues to provide core network services to school sites and to the upstream ISPs. The Brocade MLXe® Series Routers scale to meet the district’s needs for many years to come. The platform provides high-density 1 GbE, 10 GbE, 40 GbE, and 100 GbE module options. As a district’s bandwidth demands increase, the platform scales to meet those needs. With a very advanced feature set that includes Multi-Protocol Label Switching (MPLS), IPv6, and OpenFlow v1.3, this platform allows for the deployment of new applications with unique requirements for years to come.

As depicted in the diagram above, a school district should have at minimum a primary and a backup service provider, especially during testing time. The Brocade Virtual Application Delivery Switch (vADX™) contains a feature called Link Load Balancing. Link Load Balancing is used to provide continuous health checks to the primary upstream provider, ensuring that no outages occur. If the health check fails, traffic can be shifted to the backup provider without service interruption for the user. For instance, in the Fairfax County example provided in the Introduction to this document, having a backup service provider and implementing Link Load Balancing could have alleviated the testing issues experienced. The Brocade vADX can be installed on a generic server or a virtual machine, and that server can be directly connected to the Brocade MLXe-4.

If a school district is a participating member of the PARCC consortium, the use of Proctor Caching Servers is recommended for districts with low bandwidth connections to upstream providers. (Caching servers are not recommended for members of the Smarter Balanced Assessment Consortium.) For added redundancy and performance, a good policy is to implement caching on multiple servers, because a district would not want to rely on a single server to support all the students who are testing at one time. The Brocade vADX can be used to distribute load between the servers and ensure the health of the servers and the application. The Proctor Caching Servers are directly connected to the Brocade MLXe via a 1 GbE connection.

The district office is typically the where the central IT department resides and performs day-to-day network management and administration. A number of options exist for administrative applications. The decisions about which applications to use are often dependent upon the size of the school district and the execution of school district security and access policies.

**Network Management and Policy Enforcement**

A number of tools are available to K-12 school districts when implementing a Brocade/Ruckus Network. These companies together have made strategic efforts to ensure a single pane of glass for management.

---

**E-Rate Impact**

Proctor Caching Servers are Category 2 Eligible Services, as of FY2015.
Brocade Network Advisor: Wired and Wireless Network Management

Brocade Network Advisor is an excellent on-premises option for wired and wireless network management for school districts with a smaller wireless deployment that want a “single pane of glass” for managing the network.

Brocade Network Advisor helps proactively manage end-to-end network health and performance and helps with troubleshooting. Administrators can quickly identify network issues with customizable dashboards and can drill down to isolate and fix problems. Brocade Network Advisor supports the entire Brocade IP and Ruckus portfolio of products, for unified network visibility.

• Improve agility and responsiveness: Anticipate network issues with continuous monitoring of network health and performance indicators. Administrators can quickly drill down to troubleshoot issues, identify changes, and adapt configurations to avoid downtime and scale capacity.

• Share network insights: Visualize network insights using out-of-the-box, customizable dashboard and topology views. Share that critical data with peers through a browser-accessible interface, or use REST APIs to represent network data in other tools.

• Optimize resources: Dramatically reduce administration time by standardizing and automating critical network management tasks. Simplify this process transition using built-in best-practice content, an easy-to-use interface, and group management of devices and fabrics.

• Simplify integrations: Manage the entire network from a single tool, from edge to core, incorporating data from Ruckus wireless devices.

Ruckus/Cloudpath XpressConnect: Secure Automated Onboarding

To improve the end-user experience, Ruckus/Cloudpath XpressConnect delivers a wide range of network security capabilities through a single portal-of-entry for all users and devices. Users can securely onboard their own devices through a one-time posture check to make sure that all devices are up-to-date before they are allowed on the secure network. Once authenticated, Cloudpath ensures that each device entering the network is authorized, registered, and provisioned with the appropriate network access and policies. Cloudpath not only applies appropriate policies for every device, it also provides visibility into the user, device, and policy information.

E-Rate Modernization and Financial Acquisition Options

In July 2014, the FCC approved E-rate Modernization measures aimed at improving the internal connections and broadband capabilities to end-user students within the schools. In a major new ruling later that year, and in two subsequent rulings, the FCC released the 7th Report and Order (E-rate 2.0). Included in these measures was a focus on funding in two categories: Category 1 for broadband and Internet access and Category 2 for wired and wireless infrastructure. A subsequent adoption of another E-Rate Modernization Order called E-Rate 2.1 increased the program budget by $1.5 billion, raising the funding cap to $3.9 billion.

The products from Brocade and Ruckus detailed in this document are included in the 2015 and 2016 Approved Eligible Services List for the E-rate program as Category 2 funds. While the additional $2 billion of funds in funding year 2015 and funding year 2016
are certainly welcome by the K-12 community, it is expected that the pent-up demand for in-building network upgrades will outstrip the supply of available funds. Additionally, depending on the upgrade requirements of particular school districts, it is very likely that the funding caps implemented for these funds will not fully cover the cost of needed upgrades.

The funding caps for Category 2 Eligible Services (equipment and basic maintenance for equipment) are $150 per student over 5 years on a pre-discount basis. Discounts are calculated the same as before (that is, based off the percentage of students eligible for the National School Lunch Program), with two major changes. First, the maximum discount for a district is 85 percent (down from 90 percent). Second, the percentage is calculated on a district-wide basis instead of a school site by school site basis. Both of these measures were put in place to stretch the pool of funds to cover more districts and more students.

To assist school districts that will not receive Category 2 funding because of funding pool exhaustion, or for those school districts that find their funding eligibility to be short of what is needed, Brocade has developed a unique network acquisition model. The program is called Brocade Network Subscription. Brocade Network Subscription is an Infrastructure as a Service (IaaS) model, where the end user pays a monthly fee based on the infrastructure that is currently required by the school district. The program differs from a lease, because there is no calendar term, so end users can return equipment without penalty if they no longer need it—or they can upgrade their infrastructure as their needs change, again without penalty. Another great benefit of Brocade Network Subscription is that it can include Ruckus equipment as part of the subscription, so school districts that are unable to get full coverage of their network upgrades via E-rate or capital improvement bonds have a viable financial vehicle through which to upgrade their networks to support Common Core testing.

As an example of the financial power Brocade Network Subscription can bring to a school district, look at the results of Brocade Network Subscription utilization at an Illinois school district. Like many IT organizations, this district’s Information Services department’s annual maintenance contract from their incumbent networking vendor placed a huge burden on the operations expense budget. After a review of the district’s network requirements to support Common Core testing and other digital learning initiatives for the future, the district chose to implement a Brocade network. They also chose to acquire the network through the Brocade Network Subscription program.

What were the results?

• A brand-new network that prepared the district for Common Core testing and future digital learning initiatives

• No capital expense

• Significant cost savings in annual operating expenses through Brocade Network Subscription

• Flexibility to expand or contract the network capability as required in the future, without penalty
Summary

Common Core testing presents a number of new challenges to school district IT administrators. The baseline networking requirements that the Common Core consortia (PARCC and Smarter Balanced) offer to their constituents do not go far enough in outlining the architecture of a highly available network during testing periods. As discussed, a number of outside factors can inhibit the performance of the network during this crucial time. By implementing the network architecture referenced in this paper, school districts can be prepared for Common Core testing.

The impetus to prepare for Common Core testing, combined with the additional funding possibilities available through E-rate reform, presents an opportunity for school districts to perform long-needed network upgrades. For those districts in which available E-rate funds fall short of their requirements, the reduction in current annual maintenance contracts by means of implementing a Brocade/Ruckus network with inherent Lifetime Warranties makes a network refresh possible. If capital expense dollars within the district are still restricted, Brocade Network Subscription can assist those districts in making that new network a reality.

The vast majority of K-12 school district networks have been neglected for far too long. Use the Common Core Initiative and the E-rate Modernization opportunity to prepare your network for digital learning initiatives for years to come.
About Brocade
Brocade networking solutions help organizations achieve their critical business initiatives as they transition to a world where applications and information reside anywhere. Today, Brocade is extending its proven data center expertise across the entire network with open, virtual, and efficient solutions built for consolidation, virtualization, and cloud computing. Learn more at www.brocade.com.

About Ruckus Wireless
Ruckus Wireless delivers simply better wireless for more than 61,000 enterprise, service provider, government and small business customers worldwide. The company is focused on technology innovation, partner ecosystems and customer service—yielding the best possible wireless experience for the most challenging indoor and outdoor environments. Its Smart Wi-Fi™ platform delivers scalable, high-performance Wi-Fi with simplified control and management for on-premise and cloud-based Wi-Fi deployments, along with new services for secure on-boarding, policy management, location services and analytics that enable new business opportunities. Learn more at www.ruckuswireless.com.

Contact Information
For further information on how to prepare your school district for Common Core Testing and beyond, please contact your Brocade Authorized Partner.