

Planning Guide: Maximizing Your K-12 Campus Wi-Fi



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The data network infrastructure is rapidly becoming the backbone of the learning environment for K-12 schools. The rapid advancement of education technology and the growth of innovative digital tools and resources for teachers and administrators are transforming the way that teachers teach and students learn.

A recent survey of district officials, principals, and teachers conducted by Education Dive and published in "The State of Education Technology 2015"¹ found that 83.2 percent of respondents use education technology in the classroom (not including laptop or desktop computers) at least once a week. Sixty percent of the survey participants reported using laptop and desktop computers in the classroom every day.

83.2% of respondents use education technology in the classroom at least once a week.

Education Dive

While the use of education technology is revolutionizing the classroom, providing fast, reliable network connectivity to support bandwidth-intensive applications has become one of the main challenges of executing these technology initiatives to their full potential.

Internet Access for Every Student

Two main initiatives, **1:1 computing** and **BYOD**, are designed to maximize students' learning experiences by giving each student access to network resources in the classroom. The 1:1 computing initiatives require school districts to purchase iPads®, Chromebooks™, or other devices for individual student use, whereas BYOD initiatives allow students to use their own devices in the classroom.



The challenges that schools face when implementing BYOD or 1:1 computing go well beyond the simple question of how to put iPads or Chromebooks into the hands of students. The addition of hundreds of devices to the school Wi-Fi network also creates a number of issues that need to be addressed to ensure performance. Issues that a managed wireless local area network (WLAN) can help minimize or even eliminate. These include:

- > **The Need to Scale:** Exponentially increasing the number of mobile devices that can access the school network requires a high-density-capable network, which often means adding multiple wireless access points throughout the campus. Ensuring adequate coverage in all classrooms and common areas can require the deployment of multiple access points into inconvenient, and often hard-to-access locations.

Monitoring and maintaining these individual access points can prove to be cumbersome and time-consuming, as firmware updates and troubleshooting often needs to be conducted separately on each individual device.

Not the case with a managed WLAN, which allows the school's IT administrator to easily add access points, as needed, and to centrally manage and monitor them through a central software dashboard.

¹ The State of Education Technology 2015. Education Dive. Retrieved from <http://app.assetdl.com/landingpage/state-education-technology-2015/>

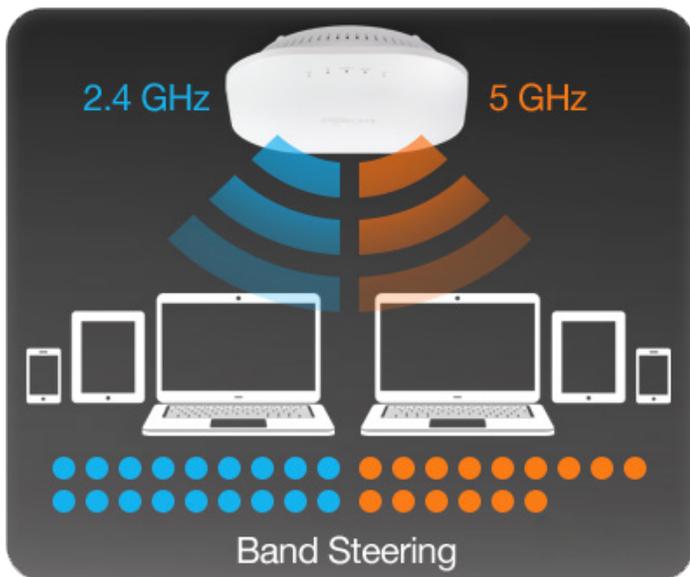
The Need to Scale *continued*

By placing all campus access points into a managed network, IT administrators can conduct maintenance and management tasks such as configuring, provisioning, monitoring and updating firmware in bulk, saving time and providing complete visibility into the status of the network. In addition, managed networks can provide rich analytic capabilities for IT administrators to analyze network performance and maximize usage and experience for all connected devices.

- > **Security Issues:** Providing network connectivity to students and staff via mobile devices, particularly through a wireless network, opens up a host of security concerns that can include network misuse, unauthorized changes to network infrastructures, and even fraudulent use of the network.

A managed WLAN enables the IT administrator to implement and manage blanket security policies from a single dashboard that protects the entire network. Security features that can be implemented across the network include **guest networks**, which ensures that only authorized individuals can access the network, **802.1x RADIUS** for user authentication, **email alerts** to instantly notify the IT administrator of security issues, and **rogue AP detection, and real-time wireless invasion monitoring** to detect unauthorized attempts to enter the wireless network.

Establishing a secure **virtual network** for student access ensures that they can get connected to the resources they need, while blocking main school computers and network resources from unauthorized access.



Impact to Network Performance and Reliability

The survey from Education Dive found that 38.2 percent of respondents reported that inadequate network infrastructure is one of the greatest challenges to providing access to education technology for students in their districts.

Technology initiatives are largely focused on giving students and teachers access to the vast educational digital resources available on the network and from the Internet. Whether streaming video content from a school's network storage device or directly from the Internet, the network must deliver fast, reliable connectivity to support these high bandwidth applications. Technical issues like buffering videos or the inability to retrieve online content such as electronic books and tests can significantly reduce the impact of a classroom lesson.

- > **Diminished Network Performance:** As an increasing number of devices connect to the limited amount of available bandwidth, the network's performance suffers, negatively impacting the operation of critical classroom applications such as live or on-demand video streaming, cloud-based applications and interactive classroom tools.

While inadequate bandwidth coming into the school is the primary reason for network performance issues, a managed WLAN can help to greatly minimize issues caused by a large numbers of devices on the network.

Dual-band mobile devices support both new and legacy wireless technology and utilize **band steering**, which automatically places dual-band-capable devices on the less-congested 5 GHz band to reduce network traffic on the 2.4 GHz band. **Band balancing** manages the number of devices served by each dual-band access point to balance the client load and improve network performance for all connected devices. **Transmit power** and **channel allocation** controls ensure optimized RF coverage and wireless efficiency across the network.

- > **Network Prioritization:** Not all access requirements are created equal. The ability for a teacher to stream a video or conduct a video conference during a classroom session should take precedence over the desire for students to send email or surf the web from their devices. With each device that connects to the school network, bandwidth allocations shift, potentially taking valuable bandwidth away from teachers and impacting the delivery of their lessons.

Managed WLANs not only allow IT administrators to implement **traffic prioritization** across the network, but they can allow the allocation of specific amounts of bandwidth for different users (i.e. staff, teachers and students) and different network segments (i.e. computer labs and libraries). This can ensure that adequate bandwidth is reserved for teacher's use in the classroom, and for those segments requiring more, while providing the maximum performance of education technology resources and applications.

38.2% Say inadequate Network Infrastructure is one of the greatest challenges to providing access to education technology for their students.

Education Dive

Connectivity Everywhere

No school is built the same. Floor plans, construction materials, and campus layouts are just a few of the elements that make the wireless network connectivity challenges unique to each school. In addition to providing connections within school buildings, some districts have even begun to deploy wireless beyond classrooms and hallways to support students with Internet access during breaks and even after school hours.

According to the 2013 “Speak Up”² survey conducted by Project Tomorrow, Digital Equity is a growing concern for K-12 educators and technology professionals, and many are considering efforts to extend Internet access beyond the classroom.

- > **Providing Network Access Everywhere:** Along with the 1:1 computing and BYOD initiatives, students are beginning to expect network access for completing classwork and homework wherever they are on campus. These locations can include common and outdoor areas, portable classrooms and athletic fields. The challenges of providing this level of access may mean supporting Wi-Fi in harsh outdoor environments or in buildings that are built of materials such as cinder block, through which RF signals cannot penetrate.

While there are specialized wireless access points designed to provide connectivity in these environments, simply connecting them to the network does not guarantee performance and reliability.

Managed WLANs can tie these “specialized” access points from around the campus into a single managed network through which all access, bandwidth and security policies can be enforced. Deploying a managed wireless network infrastructure ensures that students and faculty experience the same network quality throughout the campus regardless of where they are using their mobile devices.

“We’ve provided resources outside the school in a place where students can meet - tables and lounge areas where they’ll have Internet access through the school’s Wi-Fi and be able to complete their school work.”

**Joe Carnation, Superintendent
Geyserville Unified School District
Geyserville, CA**



² Speak Up 2013 National Findings K-12 Student. April 2014. Project Tomorrow. Retrieved from http://www.tomorrow.org/speakup/SU13DigitalLearningPlaybook_StudentReport.html



5 Key Best Practices to Consider when Planning Your Campus Wi-Fi Network Upgrades

1 Number of Access Points³ (Indoors & Outdoors):

- > **Balance Coverage & Capacity:** Due to the high mobile device density found in schools, often a 1:3 ratio, i.e. student mobile phone, student tablet and school Chromebook, having the right balance of coverage and capacity is critical. Access points must be powerful enough to provide complete Wi-Fi coverage, and offer enough bandwidth to handle multiple devices without compromising quality.
- > **Install Only What You Need:** Some wireless integrators suggest installing one (1) access point per classroom; however, your real world needs can vary, so it's important not to install more access points than you'll really need. How will you really know what you need?
- > **Do A Site Survey:** A professionally detailed site survey will allow you to assess the unique needs of your specific campus to determine the right number of access points needed.
- > **Know Your School's Building Materials & Structure:** Having an understanding of your school's structure and wall materials will help ensure proper signal transmission. Structural components to be aware of include:
 - Exterior Wall Materials: Brick, Concrete, Metal Siding or other?
 - Interior Wall Materials: Plaster, Concrete, Glass or other?
 - Roof Type: Flat or Sloped
 - Ceiling Type: Hard or Drop
 - Number of Floors
 - Number of Buildings

2 802.11 AC⁴ (Wave 1 & 2)

- > **Use Leading Wireless Technology:** 802.11ac access points offer faster wireless speeds and greater device capacity than previous wireless standards such as 802.11n. Introduced in 2013, 11ac access points operating at their maximum data rates can reach theoretical speeds that are more than double that of existing 802.11n access points. In addition to the increase in speeds, the biggest benefit of using 11ac technology is its ability to handle the high density requirements driven by the growing number of mobile devices in schools.
- > **Wave 1 & Wave 2:** Wave 1 access points make up the majority of available 802.11ac access points currently on the market and provide a marked increase in speed and capacity handling than previous technology. Wave 1 APs generally won't require IT administrators to make widespread network infrastructure changes, making network planning fairly straight forward. Yet, due to Wave 2's additional features, network design adjustments may be needed.⁵ The theoretical speeds of Wave 2 will reach up to 7 Gbps, though with the limited number of Wave 2 access points available, pricing will remain at a premium for some time.
- > **Future-Proofing for the Next 5 Years:** Upgrading school Wi-Fi networks from older, slower technology to 11ac provides a level of future-proofing that won't need to be upgraded again for another 5 years, maximizing your E-Rate budget allocation.

³ Jason D. Hinterstein, Certified Wireless Network Expert (CWNE #171)

⁴ Zeus Kerravala (2014) Considerations for Wi-Fi deployments in K-12 education settings. NetworkWorld. Retrieved from <http://www.networkworld.com/article/2458948/cisco-subnet/considerations-for-wi-fi-deployments-in-k-12-education-settings.html>

⁵ Antone Gonsalves, 802.11ac speed gains may drive WLAN architecture changes in Wave 2. Search Networking. TechTarget. Retrieved from <http://searchnetworking.techtarget.com/feature/80211ac-speed-gains-may-drive-WLAN-architecture-changes-in-Wave-2>

3 Managed WLAN is a Requirement (onsite or cloud-based)

- > **A Managed WLAN Provides Visibility & Awareness of the Network:** Using networking hardware that supports management capabilities is essential. Access points, switches and controllers that are manageable provide network visibility and awareness that's invaluable when it comes to monitoring network traffic, applying security and access policies network wide, and troubleshooting and firmware updates.
- > **Look for WLAN Management that Can Scale:** The scalability of a WLAN management system also provides a future-proof way to manage and expand your network as you choose. Look for a system that allows you to manage the network onsite and/or remotely, either through a cloud-based service or through remote access. This gives you the flexibility to decide who will handle this important task and whether they must be on campus to do it or if it can be done from a central location, such as from the district office or via a managed service provider.
- > **Make Sure It's Easy to Deploy & Configure:** With the abundance of wireless and network management tools available, it's important to select a vendor application that's easy to deploy and configure. Network management can be complex, so choose a solution that's intuitive with a relatively low learning curve, yet one that's robust enough to meet the varying needs and complexities of a growing distributed network.

4 Security Measures

- > **Secure & Control Network Access:** Protect and block school assets and sensitive student information located on the network from unauthorized access, while allowing students and teachers to get connected with the resources they need.
- > **Utilize Networking Industry Standards & Protocols:** Use hardware and management software that adheres to industry security standards and accepted network security protocols such as Wi-Fi Protected Access Encryption (WPA Personal & WPA2-Enterprise) and 802.1X with RADIUS for user authentication. Wireless standards and protocols protect and encrypt data as it moves across the network.
- > **Segment Network Access:** Establish a secure network segment that blocks access to administrative computers and servers while allowing teachers and administrators to collaborate and students to access study resources. Create and utilize separate, secure virtual network segments and assign them to single or multiple access points while regulating network bandwidth based on the needs of specific virtual network segments; and isolate student devices to keep them secure from other students' devices on the network.

5 Consult with Experts

- > **Expert Site Survey:** School Wi-Fi network design by nature is complicated due to its high-density needs, varying building structures and outdoor considerations. Be sure to work with wireless experts to perform a school site survey. A qualified expert will ask a series of questions designed to gain a deeper understanding of your existing network and any issues you have, any future technology and building expansion plans, student capacities and projected enrollment information, as well as areas for coverage expansion.

Consult with Experts continued

- > **Network Design:** Once your survey is complete, a network design and deployment plan will spell out the hardware and deployment locations for access points and other needed hardware in order to achieve the best wireless coverage and network connectivity.

Getting Help Paying for Campus Wi-Fi Upgrades

There are up to \$5.8 billion in total 2016 Federal E-Rate funds available⁶ exclusively for infrastructure and Wi-Fi improvements, upgrades and expansions. There's NEVER been a better time to get Federal E-Rate dollars AND EnGenius working for you.

E-Rate Resources

Application Timeframe: January 2016 – March/April 2016

New for 2016:

- Form 470 & 471
- New E-Rate Productivity Portal (EPC)
- BEAR Payment Goes Directly to Your School Account, Not Your Vendor
- May Take Up to 12 Months for Approval, So Start Early

Resources:

E-Rate, USAC Schools & Libraries

- All the Information You Need to Know about E-Rate
- Glossary of Terms, FAQs, Resources & Tools
- Applicant & Service Provider User Guides
- Videos, Webinars, Samples, Checklists, etc.
<http://www.usac.org/sl/>

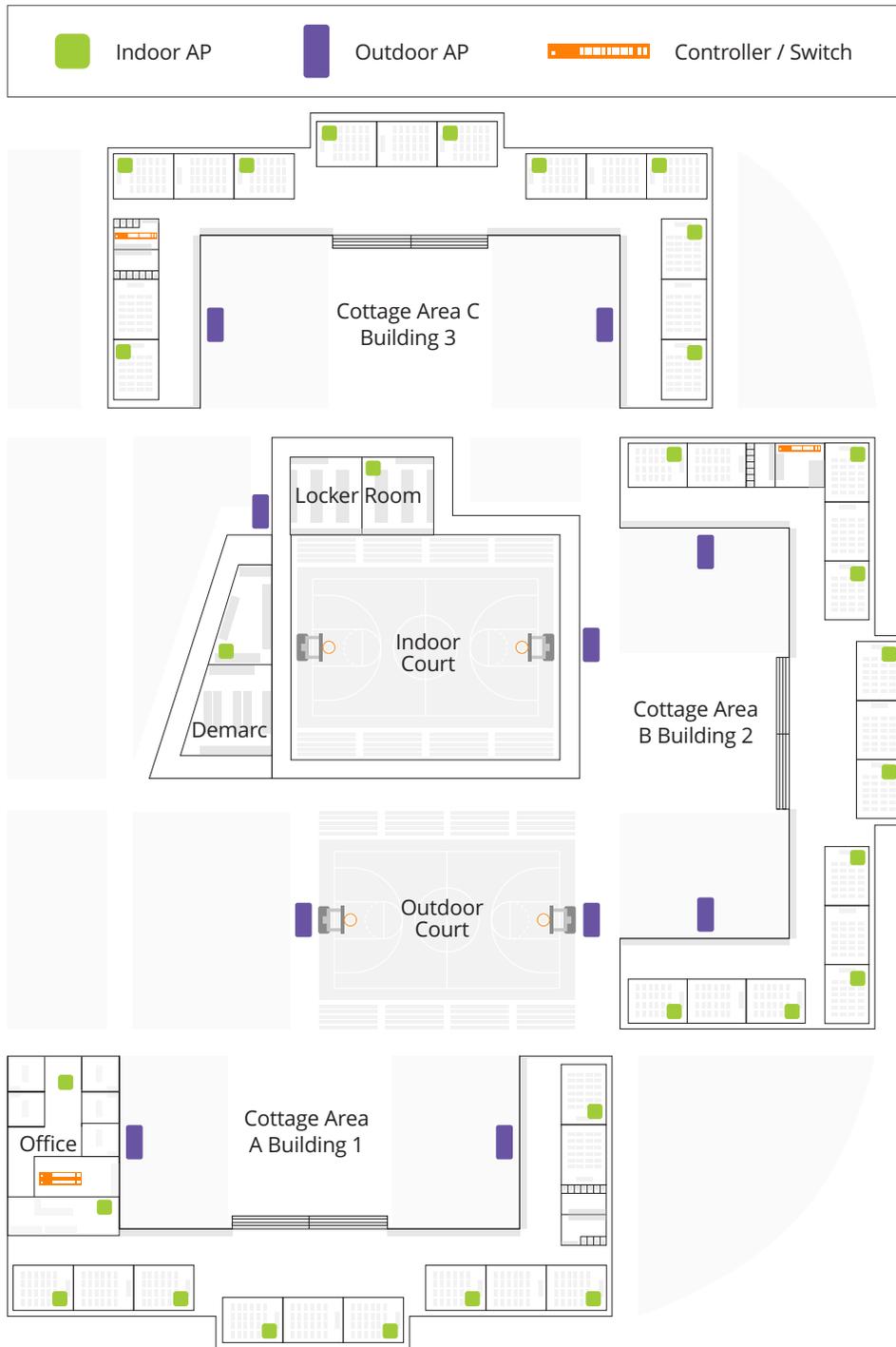
EnGenius Education Benefits

EnGenius supports education with special benefits that provide additional savings:

- Free Campus Wi-Fi Design Services: Expert Consultation & Wi-Fi Design
<http://www.engeniustech.com/design-services>
- Deal Registration Discounts: Ask Your Reseller to Register Your Equipment Needs Before Purchase
<http://www.engeniustech.com/k12-deal-registration>
- Trade-In Program (coming soon!): Receive Tax Credits on Existing Hardware
- No Recurring Licensing Fees: One-Time Hardware Purchase & Free Software
- Need Help Finding A Reseller? EnGenius Can Help. Email Us at partners@engeniustech.com

⁶ FY 2016 E-Rate Funding, December 28, 2015. E-Rate Central. Retrieved from <http://e-ratecentral.com/archive/News/News2015/weekly-news-2015-1228.asp>

Sample Single Campus Deployment Design



Sample Bill of Materials

The table shows the recommended Bill of Materials (BoM) for this design. Please verify actual pricing with your distributor/reseller, as there are often applicable discounts, promotional offers, and/or bundled kits available when purchasing quantities.

EnGenius PN	Description	Quantity
EWS360AP	Neutron Series Dual-Band 11ac 3x3:3 Ceiling-Mount Wireless Managed Indoor Access Point	29
EWS660AP	Neutron Series Dual-Band 11ac 3x3:3 Wireless Managed Outdoor Access Point	10
EWS7928FP	Neutron Series 24-Port GigE 370W PoE+ WLAN Management Controller/Switch	4

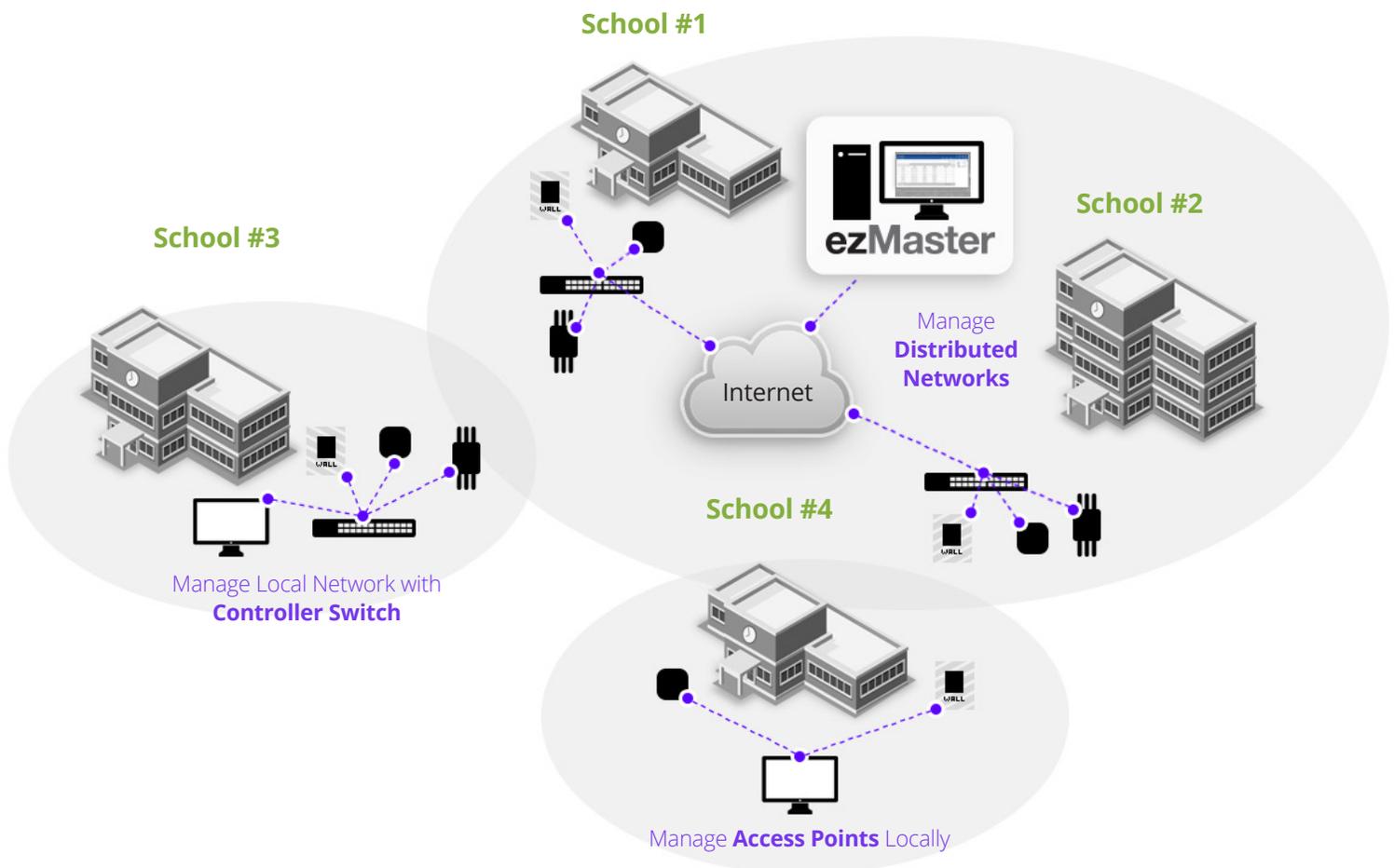
Sample Deployment Notes

- > Designed for a school application, this proposal assumes a design for capacity. Access points are placed at roughly one AP per two classrooms in order to ensure capacity for current and future applications over the life of the network.
- > The network should be configured with three SSIDs and three VLANs as follows:
 - **Staff:** This VLAN is for use by teachers, office administrators and other staff. Access to this network should be regulated by WPA2-AES Enterprise security using a RADIUS server. At a minimum, WPA2-AES Personal security using a passphrase should be used.
 - **Security:** This VLAN is for use by campus surveillance cameras, access control (i.e. door locks), and other security system devices. It is recommended that all video surveillance equipment be wired into the network on this VLAN. Wireless access should be regulated by WPA2-AES Personal security using a dedicated passphrase.
 - **Student:** This VLAN is for use by students and other visitors to the school campus.

Sample District-Wide Deployment

When distributed campuses within one district all need WLAN support, having a centralized management solution like ezMaster™ is critical to ensure:

- Scalability
- Security
- Manageability
- Budget Friendly – No Recurring Licensing Fee



About Engenius Technologies

Established in 1999, Engenius Technologies, Inc. headquartered in Costa Mesa, California, is an industry expert in wireless communications and RF technology. The company delivers feature-rich, long-range, business-class wireless communications technology for voice and data. The versatility and performance of the company's solutions lower total cost of ownership, increase productivity and maximize return on investment.

Why EnGenius?

- > Award-Winning Industry Expert
- > Ranked Among Top 3 Providers of Wireless Access Points in North America⁷
- > Comprehensive Line of Business-Class Solutions
- > Reliable, High Quality Hardware & Free Utility Software
- > Best Price/Performance Value in the Industry
- > Lower Total Cost of Ownership & Maximum Return on Investment
- > No Annual License or Subscription Fees
- > Free System Design Services & Technical Support

Neutron Series Distributed Network Management Solution

EnGenius' Neutron Series offers fully integrated, simplified network configuration and management for both large and small campus networks. The Neutron Series is flexible and scales to meet the needs of a single campus network or that of distributed networks across the school district.

Neutron's hardware and management software offers network features found in more costly solutions providing schools with a reliable, high-performing network at a fraction of the cost without compromising quality.

Neutron Series Offers:

Unlimited Flexibility

- Operate Neutron APs Alone or
- Manage up to 50 APs per Controller/Switch
- Centrally Manage Unlimited APs & Switches with ezMaster
- Deploy ezMaster Software on a Local or Remote Server, or via the Cloud*

Complete Scalability

- Manage 1,000+ APs & Controller/Switches
- 10,000+ Users
- Unlimited Number of Distributed Networks
- Managed across Cities or Regions, Regardless of Size

Unmatched Affordability

- No AP Licensing, Annual Subscriptions or Technical Support Fees
- Affordable Hardware & Free ezMaster Management Software
- Saves Time & Resources, Lowers TCO per Deployment
- Best Price/Performance Ratio in the Industry

Neutron Series Includes:

- Full-Featured, Power-over-Ethernet Controller/Switches
- Dual-Band, 11ac Indoor/Outdoor & Classroom Wall-Mount* Access Points
- ezMaster Network Management Software

*Cloud feature available Q1 2016

*11ac wall-mount AP available Q2 2016

"We decided to go with the EnGenius Neutron EWS Series, we found that it's a cost-effective, robust system that's on one platform. One of the biggest things for us is that there isn't any ongoing licensing and subscription fees. So it really is a one-time purchase for our clients."

**Martin Wolfe, Owner
Wolf Communications
Santa Rosa, CA**

"It was easy to install, easy to configure, easy to teach the techs at the school how to use it."

**Lockie Gillies, Owner
Wine Country Computers
Napa, CA**

"We couldn't be happier with how well the EnGenius wireless network performs in our school."

**Cameron Shaw, IT Director
Dawson Independent School District
Dawson, TX**

ezMaster™
Best of
INTEROP®
2015 Finalist

⁷ 2014 Stand-Alone Access Point Shipments as Reported by The NPD Group.

The Price Paid Over 5 Years for 25 Access Points

The table below compares the initial hardware cost and subsequent recurring operating expenses associated with Access Point deployments over the course of a 5-year period. E-Rate funding discounts for eligible hardware and subsequent fees range from 20 to 90 percent with higher discounts for higher poverty and more rural schools and libraries. Schools and libraries will be responsible for paying at least some part of the cost of services.⁸ Lowering overall Wi-Fi capital and operational expenses will help schools stretch technology budgets, enabling funds to be utilized on other important educational technology initiatives.

Compare	EnGenius Hybrid Solution	Controller-based Vendor	Cloud-based Vendor
Access Points	11ac 3x3 : 3 Streams EWS360AP \$599	11ac 3x3 : 3 Streams \$795	11ac 3x3 : 3 Streams \$1,399
HW Controller	0	1	0
Annual Subscription	0	0	\$3,750 per year
Annual License	0	\$4,000 per year	0
Annual Firmware Upgrade	0	\$3,600 per year	0
Total Cost (USD)	\$14,975	\$38,000	\$53,725

MSRP October 2015 - Not including cost of power sources and Ethernet Switches

Ready for a Campus Site Design?

EnGenius' Free Design Services Include:

- Wireless Expert Consultation
- Field Applications Engineer Consultation
- Free Site Design
 - Design Layout
 - Recommended Bill of Materials
 - Device Configuration Recommendations
 - Predictive Modeling

Click the button to get started

Want to Learn More about the EnGenius Neutron Series?

Visit the Neutron Distributed Network Management site

Try the Neutron Series Risk-Free for 30 Days

Purchase the product at any time during the 30-day trial at 50% off MSRP

Have Questions? Need More Info?

We're Here to Help. Call: 888-735-7888. Email: partners@engeniustech.com

Visit: www.engeniustech.com

⁸ Universal Service Program for Schools and Libraries (E-Rate). Consumer Guide (11/3/15). Federal Communications Commission, Consumer and Government Affairs Bureau. Retrieved from https://transition.fcc.gov/cgb/consumerfacts/usp_Schools.pdf