Mesa Public Schools Untethers Teachers

Best Practices for District-Wide Wireless Display Deployment

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— David Sanders
Director of Information Systems
Mesa Public Schools

Introduction: Mesa's Ambitious Technology Initiative

Mesa Public Schools is the unified district for the city of Mesa, Arizona. With approximately 64,000 students, it has the largest student enrollment of any unified school district in Arizona. In the fall of 2014, the school district faced several challenges with their existing hardware deployment: teachers were using old desktop computers; slow network connections were prevalent throughout the district; and classrooms had outdated display technology. As a leading educational institution in the state, Mesa Public Schools knew they needed to modernize their school district. Following a voter-approved $230M bond in 2012, Mesa had the opportunity to reengineer its classroom technology from the ground up.

Mesa decided that the future of classroom technology was wireless. The flexibility of a wireless infrastructure creates an open framework for tomorrow's classroom, giving teachers the freedom to design their classrooms and curriculum in a way that would best serve students and their learning experience.

But the technical intricacies and project scale posed many challenges. The sheer complexity of deploying multiple wireless networks in the dense operating environment of a traditional school, for example, cut down Mesa's margin for error and compelled it to select the right solutions from the start.

Over the course of a year, the district deployed 802.11n Wi-Fi throughout the schools and grounds; gave each teacher a Lenovo Ultrabook; and introduced wireless display into each classroom with the Actiontec ScreenBeam™ wireless display adapter along with new short-throw projectors.

The result is an exciting new learning experience that renews the connection between teachers and students, allowing curriculum, lectures, and in-class participation to align more closely with the pace of an increasingly digital world.

"A driving factor behind this initiative is that we knew we'd be doing a disservice to our students by not exposing them to technology in the classroom. This generation picks up technology quickly, but we still need to make sure that all our students, whether they have a computer and broadband at home or not, have access to technology

Deployment Summary

- 3,600 Actiontec ScreenBeam wireless display adapters
- 3,600 projectors
- 6,500 Cisco 2602 AP access points
- 3,600 classrooms
- 25-30 devices connect per access point in the classroom; 100-150 devices during peak times in common areas
- BYOD is allowed, but the district is working toward a one-to-one student initiative
- District: 57 elementary schools, 11 junior high schools, six comprehensive high schools, and several alternative schools
- Serves approximately 64,000 students district-wide

and are prepared for today's digital world," said David Sanders, Director of Information Systems at Mesa.

Much can be learned from Mesa's ambitious deployment, including how and why they chose wireless technology and wireless display; the benefits of a wireless school and classroom; and how their planning made for a successful deployment, even in a complex environment under a constricted timeframe. This whitepaper will chart the first phase of Mesa's journey—from evaluation and deployment to teacher training.

While Mesa's deployment of wireless display was part of a larger technology initiative to serve a large student population, many of the lessons learned, technical details, and opportunities described here are equally relevant to smaller districts and budgets.

Untethering Teachers: Wireless Display in the Classroom

In the process of redesigning the classroom experience, Mesa decided early on to make the classroom completely wireless. Cost was a key factor in this decision. Installing a traditional wired projector is costly and labor-intensive; they estimated that running a cable in the wall would cost $600-1,000 per classroom, depending on the construction of the building.

Wireless technology eliminates the need to break into the drywall and route cables. According to Sanders, installing wireless displays in the classroom was one-third the cost of hard-wiring a projector and could be done twice as fast.

Furthermore, a wired projector limits the teacher's mobility and classroom dynamics. "It's important that our teachers have the flexibility to move around the classroom, interact with students, and even let students interact with material, without being stuck in the corner of the room," explained Sanders.

Freely move around the classroom and simultaneously share content to the classroom projector

Wireless display technology brings a new level of interactivity to today's classrooms. It works by creating a direct wireless connection between a mobile device (tablet, laptop, or smartphone) and a display (television or projector). Once the connection is made, everything (from apps to videos to websites) is duplicated on the big screen.

With wireless display, teachers are free to move around the classroom and interact with their students, while simultaneously sharing content to the classroom projector with the swipe of a finger. This interactive learning environment increases classroom participation, enabling teachers to work more closely with students.

But wireless display does more than just mirror the content; it also lets users wirelessly interact with the content from their tablet or other mobile device. This means that when students are equipped with laptops or tablets, they can share their work and answer problems directly from their device, without having to get up and walk to the front of the class.

"No one uses desktop computers anymore. Moving forward, everything will become more mobile and flexible. In this technology initiative, we didn't want to invest in old technology. Wireless, including wireless display, will be an important part of tomorrow's classroom," said Sanders.

Moreover, wireless display is now an important factor driving the selection of Mesa's student 1:1 devices. As the district began to evaluate devices for this program, they reached out to their teachers to help determine the requirements for these devices. Teachers across the district emphasized the need for wireless display, as it would allow students to interact with content in new ways, show their work, and collaborate with the rest of the class right from their desk.

While some student devices typically sold into school districts do not support wireless display, Mesa concluded it was a required criterion. They ultimately selected the latest Windows 8.1 devices in part for their ability to deliver this important classroom experience. "The teachers' feedback helped us decide to deploy Windows devices because they wanted students to have that wireless display experience," said Sanders.

The Evaluation Process

Led by Mesa's Educational Technology and Information Systems teams, the district launched a comprehensive evaluation for their Teacher Device Initiative, the first phase of their deployment. This provided every teacher across the district with a modern computing device and equipped every classroom with wireless display.

Selecting the Teacher Device

The school district wanted their teachers to determine which device would best serve their needs in the classroom. The Information Systems team narrowed down the options to four popular touch interface/convertible devices. They set up four mock classrooms, each equipped with a docking station, one of the devices, a monitor and keyboard to give teachers a feel for how it would look in their classroom. An EdTech trainer was assigned to each mock classroom to help train and answer questions.

The Future is Wireless

For Mesa Public Schools, wireless display lays the foundation for its future classrooms. Rather than dictating how teachers should arrange their classroom or change their teaching style, wireless display gives each teacher the flexibility to bring digital content into their teaching without any barriers.

Over the course of two weeks, nearly 500 teachers, staff, and administrators from across the district cycled through the four classrooms, evaluating each device. After trying out the four devices, each participant was asked to submit their preference in an online poll. The scores were calculated and the teachers selected the Lenovo ThinkPad Helix Ultrabook.

Selecting the Wireless Display Adapter

The teachers' Lenovo Ultrabooks run the latest Windows 8.1 operating system with built-in wireless display capabilities. The next piece of the puzzle was selecting a wireless display adapter to add wireless display to the classroom projector.

Both the Information Systems and EdTech teams researched and evaluated the available wireless display options and selected Actiontec's ScreenBeam Wireless Display Adapter for several key reasons:

- **Remote Manageability:** With 22 techs to support 3,600 classrooms and more than 4,000 teachers and staff, Mesa's wireless deployment wouldn't work if someone needed to physically update and manage the wireless display adapters one by one. Information Systems required remote provisioning and troubleshooting capabilities—for example, to be able to centrally update the firmware on all devices across a school or district or to be able to remotely troubleshoot a device (see if the adapter is connected and powered on) when a teacher reported problems from the classroom.

  With its Central Management System (CMS) console, Actiontec was the only wireless display solution to provide the ability to remotely manage and troubleshoot all devices from a central location. This has a tremendous impact on both real costs and opportunity costs. It is significantly more efficient and cost effective for one tech to manage receivers from a single location instead of sending people to each classroom to manage devices individually. Furthermore, once a tech is sent to a location, that person no longer has the opportunity or availability to support other teachers or issues should they arise. CMS also gives Mesa more than just the ability to manage firmware updates and remote troubleshooting; it allows the IT team to set device policies, process receivers in groups, set custom background images, and more—all from a central location—ultimately saving both time and money.

- **Stability:** During the EdTech team's evaluation, they found that Actiontec offered the most robust performance in their high density wireless environment, while other solutions were more likely to drop a connection from time to time.

- **Out-of-the-Box Experience:** The EdTech team concluded that Actiontec ScreenBeam was the easiest to get up and running right out of the box. With some of the other devices, the team found they needed to install software, but since Actiontec uses the Miracast wireless display standard (also used in Windows 8.1), "it just worked."

ScreenBeam Central Management System (CMS)

ScreenBeam Education Edition 2 Receiver

Deployment

The district started rolling out wireless display capability during summer 2014. Each classroom deployment included four components:

- New teacher device (Lenovo ThinkPad Helix Ultrabook, a hybrid laptop-tablet)

- Projector Hitachi CP-AW3003

- Actiontec ScreenBeam wireless display adapter

- Docking station, with a keyboard and display. This mimicked a traditional desktop experience to help ease the transition for teachers who were accustomed to working on a desktop in their classroom.

In all, more than 3,600 ScreenBeam wireless display adapters were deployed, including one in each classroom as well as in conference rooms. Administrators were also given wireless display adapters to facilitate their presentations and meetings.

The Technical Wireless Environment

Wireless display was part of a larger technology initiative that included 802.11n Wi-Fi throughout the schools. Mesa was creating a high-density environment and wanted to cover all the classrooms and hallways as well as interior office spaces. The district also requested that they cover all outdoor spaces, including out to the parking lots and in between buildings with Wi-Fi as well.

"We weren't necessarily thinking about wireless display when we installed the 802.11n wireless network at this point, but our philosophy was that if we built the network right, it wouldn't matter what apps and devices end up being used," said Saro Hayan, founder of Hye Tech Network & Security Solutions, the engineering company responsible for installing the district's Wi-Fi network. However, as previously discovered, Actiontec receivers offered the best stability and performance in Mesa's environment.
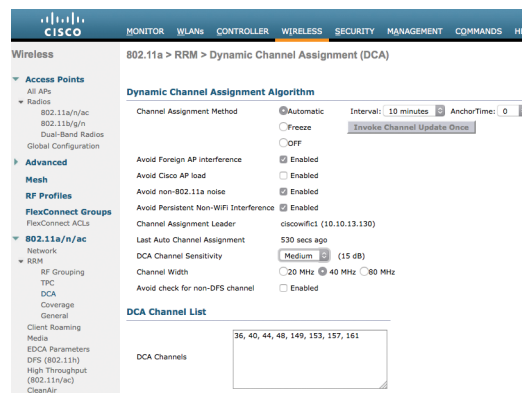
Using building floor plans, Hayan and Hye Tech did a predictive survey, followed by a site survey to verify the accuracy of the predictive results. This was particularly important since there's no guarantee that all building maps and floor plans were 100% accurate.

During the EdTech team's evaluation, they found that Actiontec offered the most robust performance in their high density wireless environment, while other solutions were more likely to drop a connection from time to time.

Mesa's design approach was to use enough access points (APs) to ensure sufficient coverage and throughput. They ended up deploying one access point per classroom, with multiple APs in common areas like cafeterias.
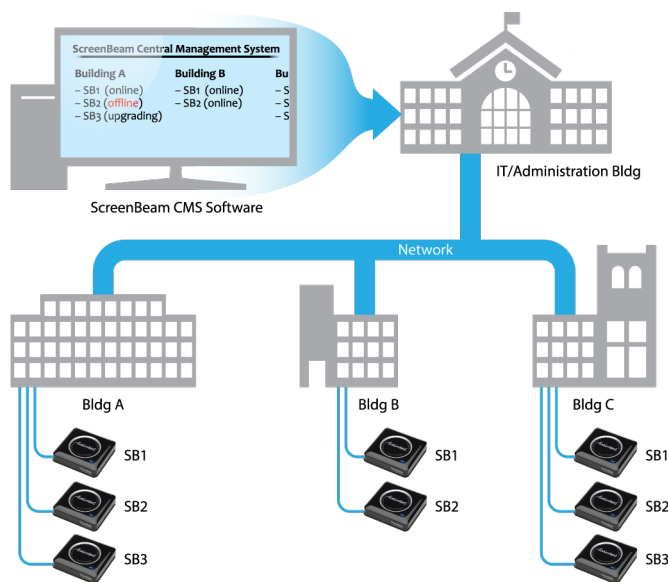
"We didn't want an access point in Classroom A to try to cover kids in Classroom B. Considering the district was headed toward one-to-one computing, we knew that sharing access points wouldn't work," said Hayan.

Overview of the Mesa Wireless Infrastructure

- Controller-based infrastructure

- Access points: Cisco 2602 (4x3, 802.11n)

- One access point per classroom

- Access points support beamforming, Cisco CleanAir and RRM (Radio Resource Management). In a few select cases, they enabled Band Select.

- 5 GHz with 40 MHz channels

- WLAN controller automatically sets access point channel and transmit power

- WPA2 Enterprise with server-side certificate (PEAP)

- Wireless profiles are pushed via group policy from the domain

- Wireless WMM QoS, prioritizing the main network (MPS SSID) over the guest network

- Day to day management: Cisco Prime, handheld Fluke Aircheck device, and AirMagnet for assessments

ScreenBeam Central Management System

Building A	Building B	Bu
– SB1 (online)	– SB1 (online)	– S
– SB2 (offline)	– SB2 (online)	– S
– SB3 (upgrading)		– S

ScreenBeam CMS Software

Network

IT/Administration Bldg

Bldg A — SB1, SB2, SB3
Bldg B — SB1, SB2
Bldg C — SB1, SB2, SB3

SSID Configuration and Authentication

In high-density designs like Mesa, the number of SSIDs can impact overall performance. More SSIDs result in more management traffic and more beacons being broadcast, which can negatively impact performance. Throughout the district, Mesa just uses two SSIDs: guest (for visitors) and MPS (for teachers and students). The district differentiates between teachers and students at the backend via PEAP 802.1x authentication.

"We can accomplish everything we need with just two SSIDs. There's no point in introducing complexity by adding more," said Hayan. To help minimize SSID management, Mesa requested the ability to turn off the local management capability of the wireless display receivers. This was another important feature unique from Actiontec that helped improve performance and reliability in Mesa's high-density deployment.

2.4 GHz and 5 GHz

Mesa's deployment features a mixed 2.4 GHz and 5 GHz environment with both bands available to all client devices. Since there's still a large percentage of legacy or lower-cost devices that only support 2.4 GHz in the population, the Information Systems team wanted to make sure that all devices could connect to the network. "We didn't want to incur extra support calls because

someone brought in a device that doesn't have 5 GHz," said Hayan. With 40 MHz channels, Mesa still has plenty of bandwidth within 5 GHz.

VLANs

Mesa uses a centrally managed WLAN controller, but VLANs are local to each school in the district. Today both teachers and students are dropped onto one VLAN, but they anticipate separating teachers and students on different VLANs in order to assign different policies to each group. This is one key difference between Actiontec's ScreenBeam and other solutions like Apple TV. ScreenBeam is device agnostic and can support traffic from two VLANs in the same classroom, while other solutions require everyone to be on the same VLAN to have access.

Lessons Learned

Throughout the process, the district discovered several best practices and learned valuable lessons:

Technology

1. Naming Conventions: The team discovered that the best strategy was to name the receiver after its classroom name. That way support techs easily know the location of each device, without having to walk from classroom to classroom.

2. Standby Mode: Most projectors are configured to go to sleep after a period of inactivity in order to maximize bulb life. At the beginning, the Mesa Information Systems team wasn't sure how ScreenBeam could connect to a projector in sleep mode. However, they soon found an easy solution: simply swiping to connect will wake up the projector.

3. Access Point Density and Traffic: Mesa knew from the start that they wanted one access point per classroom, rather than trying to share amongst two classrooms. Typically, they'll see 25-30 devices connected in each classroom. While there's sufficient bandwidth, the Information System still needs to educate teachers about usage constraints. For example, if a teacher

streams video from a website to the projector display, there's no reason that all 30 students also need to individually stream the same video on their own devices.

4. Attaching ScreenBeam: The Mesa team determined that the best solution was to mount the ScreenBeam receiver to the projector with industrial-strength Velcro.

Adapting to Change

As with any large-scale technology deployment, there's an important human element involved. Getting teacher buy-in is critical for success. As Sanders summarized, "The technology is the easy part. Changing the mindset and changing the culture is the hard part."

In Mesa's case, teachers, administrators, and staff were asked to adapt to multiple changes in a short period of time. In the course of a year, the school district added Wi-Fi connectivity, gave the

teachers Lenovo Ultrabooks instead of desktop computers, and migrated from Windows XP to Windows 8. To help smooth the transition, Sanders suggests the following:

- **Communicate the Big Picture:** Sanders emphasized the importance of making sure teachers and administrators understand the big picture and ultimate end goal of what you're trying to do. Especially as technology pieces are added in stages, it's important that everyone understands how each new technology component or upgrade contributes to the bigger goals of the school. "You need to tell the story over and over again, way more often than you think you need to," said Sanders.

- **Emphasize Training and Internal Support:** The Educational Technology team tries to get out and teach the teachers, but with 22 trainers to support more than 4,000 teachers and staff, only so much hands-on training is possible. Instead they rely heavily on webinars, training videos, and support documentation. Throughout the first year of deployment, a support person visited each high school each morning to check if anyone needed help with the technology. In the elementary school, teachers didn't receive devices until they were trained on it.

- **Show Teachers an Example:** Often times, you can set up numerous webinars and training sessions, but teachers won't necessarily grasp the potential of the technology until they see it in action. "Once a teacher sees a colleague using wireless display, that's when the light goes off and they're eager to start using it in their own classroom," said Sanders.

- **Be Patient:** Mainstream user adoption won't happen overnight, and there's always a wide range of comfort and experience with technology. "Teachers and schools work at their own pace. Some teachers dove right into wireless display and were instantly moving around the classroom, interacting with content. Others still wanted a cable and a desktop on a cart," said Sanders.

Sanders explained that his goal for the first year was to just allow teachers to use wireless display at their own pace. In the second year they expect adoption to pick up and by the third year, wireless display will be an expected part of the classroom experience. "It takes time. But one teacher will follow another teacher, and so on. Soon, no one will remember what it was like to use cables," he said.

The Results

While it's still early in the adoption cycle, the Information Systems team has already seen several positive indications about wireless display's impact across the district.

For example, as school administrators were preparing to attend an offsite retreat, they asked that wireless display be installed. Now, every administrator has a ScreenBeam adapter to facilitate meetings and presentations.

As described above, Mesa teachers are embracing wireless display at their own pace. But Sanders noted how quickly teachers adopt the technology once they are familiar with it. "There was one teacher who was particularly negative about the whole teacher device initiative and questioned why the district was spending money on this. Now when we check the CMS Control Panel, we notice that this same teacher is using wireless display all the time."

Actiontec: A Partner in Wireless Display

Actiontec is the leading provider of wireless display adapters, and is a preferred vendor and wireless display technology partner of both Intel and Microsoft. Actiontec is committed to working closely with school districts to ensure the success of their deployment and that teachers and students get maximum value from the wireless display experience.

"Actiontec listened to us throughout the whole process. They acted on our 'wish list' items, making small changes that had a big impact on the ease and success of our deployment. We were able to access their engineers when we needed support. From the start, Actiontec has been invested in our success," said Sanders.

About Actiontec Electronics

Actiontec Electronics develops broadband-powered solutions that connect people to the Internet, applications, and content they care about. Our products—including Gigabit Ethernet fiber routers, high speed VDSL gateways, industry-leading WiFi technology, wireless display solutions, and home networking products—set the bar for home broadband performance and are installed in more than 40 million homes. Our innovation has been recognized throughout the industry, with numerous awards. As a minority-owned company, we're committed to the world we live in by promoting diversity among our employees and partners, and actively pushing a variety of green programs designed to reduce the carbon footprint of our company, and customers. Founded in 1993, Actiontec is headquartered in Sunnyvale, CA, and maintains branch offices in Colorado Springs, CO; Shanghai, China; and Taipei, Taiwan.

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