Future-Proof Your School's Network With Wi-Fi 6 Technology
Today’s Agenda

What is WiFi 6

Why is it critical to success in Education

Planning and Deploying

Funding Options

The Cambium Difference

Q&A
What is WiFi 6?
Should I care?
**11AX**

**THE PATH TO TRULY BRILLIANT WI-FI**

- **Better in Dense Environments**: Improve average throughput per user by at least four times in dense or congested environments.
- **Faster Throughput**: Deliver up to 40 percent higher peak data rates for a single client device.
- **Increase Network Efficiency**: By more than four times.
- **Extend Battery Life**: Of client devices.

<table>
<thead>
<tr>
<th>Year</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>11b</td>
</tr>
<tr>
<td>2003</td>
<td>11a/g</td>
</tr>
<tr>
<td>2009</td>
<td>11n</td>
</tr>
<tr>
<td>2013</td>
<td>11ac</td>
</tr>
<tr>
<td>2019</td>
<td>11ax</td>
</tr>
</tbody>
</table>
# High capacity deterministic network model

802.11ax focuses on improving the connected client experience by making the network more efficient.

<table>
<thead>
<tr>
<th>802.11ax Keys</th>
<th>Benefit vs 11ac</th>
</tr>
</thead>
<tbody>
<tr>
<td>MU-OFDMA</td>
<td>Small packet efficiency; 37 users</td>
</tr>
<tr>
<td>MU-MIMO</td>
<td>4x capacity, scheduled transmission</td>
</tr>
<tr>
<td>Spatial Reuse</td>
<td>Overlapping networks</td>
</tr>
<tr>
<td>TWT</td>
<td>Longer battery life</td>
</tr>
<tr>
<td>1024QAM</td>
<td>Faster Data Rates</td>
</tr>
<tr>
<td>8x8 AP</td>
<td>High capacity 8SS SU/MU</td>
</tr>
<tr>
<td>Extended Range</td>
<td>3 dB range improvement</td>
</tr>
<tr>
<td>Standard</td>
<td>Modulation</td>
</tr>
<tr>
<td>----------</td>
<td>------------</td>
</tr>
<tr>
<td>802.11n</td>
<td>64QAM, MIMO</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>802.11ac</td>
<td>256QAM, MU-MIMO</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>802.11ax</td>
<td>1024QAM, OFDMA</td>
</tr>
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<td></td>
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</tr>
</tbody>
</table>

11ax is multi-user, expectation ~2.5Gbps of aggregate throughput.
## Downlink Multi-User OFDMA and MIMO

<table>
<thead>
<tr>
<th>OFDMA</th>
<th>MU-MIMO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resource units as small as 2MHz</td>
<td>Up to four concurrent transmissions, 2x2</td>
</tr>
</tbody>
</table>

### OFDMA
- Allocates Resource Units as small as 2MHz (2 | 4 | 8 | 20 | 40 | 80 MHz)
- Benefit: Reduced Latency, efficient use of time and frequency
- Ideal for: VoWLAN, IOT devices, always-connected mobile devices
- Stadiums, Higher Education, Hotels, Enterprise

### MU-MIMO
- Transmit to multiple devices at the same time
- Benefit: high capacity with high bitrate
- Ideal for: Streaming media, high bitrate applications, stationary PCs
- Higher Education, Hotel Conference center, Enterprise
Uplink Multi-User OFDMA and MIMO

**OFDMA**
- Resource units as small as 2MHz
- Increase reverse-path range of multiple low power clients
- Greater combined SNR = improved range

**MU-MIMO**
- Up to four concurrent transmissions, 2x2
- Increase uplink datarate, reduce latency
- Great for gaming, high density social media
- Up to 4.8Gbps PHY rate, combined, bi-directional
## Other 802.11ax key technology

<table>
<thead>
<tr>
<th>Additional 11ax tech</th>
<th>What it will do</th>
</tr>
</thead>
<tbody>
<tr>
<td>1024 QAM</td>
<td>30% topline speed improvement over 11ac. Works with 11ac clients and 11ax</td>
</tr>
<tr>
<td>Spatial Reuse</td>
<td>Allows multiple BSS (AP + its connected clients) to overlap in same frequency</td>
</tr>
<tr>
<td>Preamble Boost and sub-carrier repetition</td>
<td>3dB power boost increases range outdoor, increased GI improves resilience</td>
</tr>
<tr>
<td>Target Wait Time</td>
<td>Sleep time negotiated by AP and Client</td>
</tr>
<tr>
<td></td>
<td>Longer battery life for mobile devices even while streaming media, extended IOT life</td>
</tr>
<tr>
<td>2.4GHz band</td>
<td>AX performance with +30% range, or, AX segmentation for IOT networks</td>
</tr>
<tr>
<td>6GHz band</td>
<td>1200MHz of clean RF spectrum, ideal for AX and expanded network services</td>
</tr>
</tbody>
</table>
Why is it critical to success in Education?
Educational Focus Points

SAFE SCHOOLS
• Many schools (especially in the US) are investing / or upgrading their security infrastructure (IP video surveillance technology, new IP door access control systems, alarms and notification systems)
• These schools will need to invest in a network upgrade to support these enhancements.

STUDENT SUCCESS
• Individual Education Based on Student Data & Classroom Needs
• Analyze Student Attitude, Learning
• Move Tools to the Cloud for 24 x 7 Learning
• Daily Per-User Information
• Online Testing & High Stakes Performance Testing

FLEXIBLE LEARNING
• Distance learning, video & audio based lectures are all now mainstream.
• On-line test applications mandated by most states.
• Requirement for reliable, stable network (both wired and wireless)
• BYOD and high speed wireless needs to both indoor and outdoor environments.
Here is the dilemma

How users see applications:

Port 80
Port 443
Application Intelligence: Policy Enforcement at the Edge
Simplicity: Cloud-based Control from a Single Console

- EasyPass™ Access Control
- CommandCenter™ Multi-tenant Control
- Zero-touch Provisioning
- Policy Enforcement L1-L7 Control
- XPS Location Integrated Service
- Analytics Who, What, Where

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Easy Pass Free for Education

**Employees/Students/IoT**
- **Onboarding**
  Users gain secure access using a unique PSK.
- **Microsoft Azure**
  Users gain secure access using Microsoft Azure authentication.
- **Google Login**
  Users gain secure access using Google authentication.

**Guests**
- **Self-Registration**
  Guests sign up to gain access using an online form.
- **Guest Ambassador**
  A guest ambassador must register the guest.
- **Personal Wi-Fi**
  Users create their own secure personal network.

**Customers**
- **Voucher**
  Users gain access using a pre-assigned access code.
- **One-Click Access**
  Guests gain access after agreeing to terms of use.

**Simplify and secure user connections**
Automated Testing Facilities
Thousand Oaks, CA

Ensure Real World EDU Success
Wi-Fi 6 Improves Wireless Performance

Wi-Fi 6 Advantage:
Up to 40% Higher Performance vs. Wi-Fi 5

What is happening?

- 8x8 antennas provide better receive sensitivity and signal integrity
- Improved radio driver and offload
- 1024QAM is 25% more bits/Hz

Test Details
AP located outside of Room 1
Increasing distance from AP to Rooms on the right of graph
Throughput measured to single Macbook 3x3 11ac client
Wi-Fi 6 Improves Wireless Performance

RSSI over range (dBm)

Samsung S10, 2x2, Wi-Fi 6

Google Pixel, 2x2, Wi-Fi 5

Wi-Fi 6 Advantage:
Average 135% Improvement vs. Wi-Fi 5

What is happening?

• 1024QAM is 25% more bits/Hz
• More efficient signaling protocols
• Client-side CPU speed increase

Test Details
iperf3 client on Windows 10 PC
iperf3 server on smart phone
iperf3 -c <ip> -i 10 -t 10 -P 6
40Mhz channel, 44/48, short guard
Planning and Deploying
Wi-Fi Designer, it is a free, cloud-based app for designing and planning Wi-Fi networks.

It is available on the Cambium web site at https://www.cambiumnetworks.com/products/software/wifi-designer-and-wifi-inspector/ and can be used by customer, partners, or anyone.

Features include:
- Import or draw floor plans
- Visualize Wi-Fi coverage by AP model
- Tune AP parameters – rotation, 5GHz/2.4GHz, power
- Develop a bill of materials
- Create/email PDF reports

It can be used in a guest mode, or users can register to save their designs and get a PDF report.
Deployment Considerations

Density Concerns
Locations needs
End User Devices
Adoption of Wi-Fi 6 client devices for 1-1 deployments
Switching and Cabling Upgrade
Cloud Deployment and Management
Network As A Service
Funding Options
Considerations

E-Rate

All Schools have refreshed 5 Year Budgets

Cares Act

Focused on COVID-19 support and NTI environments

Leasing vs NAAS

Payment Planning vs Outsourcing Day to Day deployments and support.

What is real cost of Wireless Refresh?

All APs are NOT made the same. Number of Radios, Shared Services, Annual Software Subscriptions, Add-Ons, Support & Integration
About Cambium

Cambium Networks™
Cambium Networks at a Glance

- **Spun out of Motorola Solutions** in October 2011
- Pioneer in Point-to-Multipoint & Point-to-Point **IP Wireless Broadband Solutions**
- Focused on wireless connectivity; **2 meters to 200 km** – people, places & things
- HQ outside of **Chicago, IL**
- **700+ employees** across 6 continents
- More than **8 million nodes** shipped totaling over **$1.5B**
- Emerging leader in **IIoT and 5G like solutions**
Enterprise Wi-Fi from SMBs to Large Businesses

Broad Range of Dual Radio, Software-Defined, and High-Density APs
Small Form Factor to High Density Wi-Fi Solutions from Wi-Fi 5 (11ac) and Wi-Fi 6 (11ax)
Segmented IOT, BYOD, WIFI, App Ctrl, Security services

- cnMaestro
  - Single Cloud Dashboard for Broadband/Eth/Wi-Fi

- XMS
  - Simple Management
  - App Control, Security

Intelligent PoE Switches

- EasyPass™
  - Access Control
- CommandCenter™
  - Multi-tenant Control
- Zero-touch
  - Provisioning
- Policy Enforcement
  - L1-L7 Control
- XPS Location
  - Integrated Service
- Analytics
  - Who, What, Where

Converged Wi-Fi 6 AP’s
## XV3-8 Wi-Fi 6 Access Point

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unique Value</td>
<td>Tri-Radio 11ax with Software Defined Radio and Dedicated Sensor</td>
</tr>
<tr>
<td>802.11 Radios</td>
<td>2 or 3 (software defined radio)</td>
</tr>
<tr>
<td>Streams</td>
<td>4x4 in 2.4G; 8x8 in 5GHz; or dual 4x4 5GHz</td>
</tr>
<tr>
<td>Antennas</td>
<td>Internal</td>
</tr>
<tr>
<td>BT / BLE</td>
<td>Yes, BLE 4.0</td>
</tr>
<tr>
<td>Sensor</td>
<td>Dedicated dual-band sensor radio. 2x2:2 for WIPs / Location services / RF scan / Network scan</td>
</tr>
<tr>
<td>Technology</td>
<td>Wi-Fi 6 11AX Software defined + BLE + Sensor</td>
</tr>
<tr>
<td>Wired</td>
<td>1 x GigE + 1 x 5GigE</td>
</tr>
<tr>
<td>Power</td>
<td>802.3at</td>
</tr>
<tr>
<td>USB</td>
<td>Yes</td>
</tr>
<tr>
<td>Management</td>
<td>XMS-Cloud or cnMaestro</td>
</tr>
</tbody>
</table>

**Tri-Radio with SDR**
- Cloud or on-premises managed
- 5GHz 8x8/4x4 11a/n/ac/ax
- 2.4GHz 4x4 11b/g/n/ax
- WPA3 secure public access
- Application Control
- 802.3bz uplink (5Gbps)

**Technology**
- Education
- Public Venues
- Enterprise
- Retail

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## Cost Effective Wi-Fi 6

### XV2-2 Wi-Fi 6 Access Point

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unique Value</td>
<td>Cost effective 11ax, standards-compliant, high performance 2x2</td>
</tr>
<tr>
<td>802.11 Radios</td>
<td>2</td>
</tr>
<tr>
<td>Streams</td>
<td>2x2 in 2.4G; 2x2 in 5GHz</td>
</tr>
<tr>
<td>Antennas</td>
<td>Internal</td>
</tr>
<tr>
<td>BT / BLE</td>
<td>No</td>
</tr>
<tr>
<td>Sensor</td>
<td>Shared sensor with data radios. Control duration, periodicity. WIPs / Location services / RF scan / Network scan</td>
</tr>
<tr>
<td>Technology</td>
<td>Wi-Fi 6 11ax</td>
</tr>
<tr>
<td>Wired</td>
<td>1 x 2.5GigE</td>
</tr>
<tr>
<td>Power</td>
<td>802.3at</td>
</tr>
<tr>
<td>USB</td>
<td>Yes – USB 2.0 port</td>
</tr>
<tr>
<td>Management</td>
<td>XMS-Cloud or cnMaestro</td>
</tr>
</tbody>
</table>

- **Cost Effective 11ax**
  - Cloud or on-premises managed
  - 5GHz 2x2 11a/n/ac/ax
  - 2.4GHz 2x2 11b/g/n/ax
  - WPA3 secure public access
  - Application Control
  - 802.3bz uplink (2.5Gbps)

- Education
- Hospitality
- S/M Enterprise
- Retail
Questions

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