
# Wi-Fi 6 – How MU-MIMO Enhances Connectivity for Public Safety, Transit and Industry

Wi-Fi has transformed our homes and workplaces. Home networks connect our phones and laptops in addition to Smart TVs, surveillance cameras, doorbells and even refrigerators. In our workplaces we regularly network with printers, servers, the cloud and IoT devices.

In public safety and transit, Wi-Fi provides vehicle area networks (VANs) connecting people as well as mission-critical systems. Industrial organizations use Wi-Fi to connect with IoT devices and manufacturers use Wi-Fi to monitor processes and control machines. Wi-Fi also works in conjunction with 5G wireless to provide fixed wireless access (FWA) for new home and business expansion.


## Wi-Fi 6 – MU-MIMO Technology Delivers Lightening Fast End-To-End Throughput

When new 5G cellular routers were developed, they needed enhanced Wi-Fi technologies to provide high-speed, low-latency end-to-end connectivity. As a result, Wi-Fi 6 (also known as 802.11 ax) was launched in 2019 as a replacement for Wi-Fi 5 (802.11 ac). While Wi-Fi 6 delivers a 25 percent increase in basic data transmission, the real communications gain is enabled through multi-user, multiple input, multiple output functionality, also known as MU-MIMO.

MU-MIMO allows a single router to communicate with multiple devices at the same time. Most older routers featured single-user MIMO (SU-MIMO) that used multiple data streams to communicate with only one device at a time. SU-MIMO devices streaming high-bandwidth content would drastically slow down a network in a crowded environment. Using MU-MIMO significantly increases throughput and reduces latency as devices have much shorter wait times to transmit and receive data.

MU-MIMO routers come in different configurations including 2X2, 3X3 and 4X4. These configurations indicate the number of different streams created. As an example, a 4X4 MU-MIMO has 4 antennas for four data streams. Wi-Fi 6 supports transmissions on both 2.4 GHz and 5 GHz.

## Wi-Fi 6 Complements 5G

It's important to note that Wi-Fi 6 and 5G (cellular) are different technologies that complement each other. Improvements in Wi-Fi 6 in conjunction with 5G Stand Alone (SA) networks can now provide ultra-low latency, end-to-end communications. This is important for real-time, mission and business-critical applications in addition to communications in high-density environments such as stadiums and conference halls.

Here is an example of how 5G and Wi-Fi 6 work together. In the figure below, 5G cellular connects a law enforcement depot/dispatch center with a 5G router in a police vehicle when it is on patrol. The router also provides a Wi-Fi 6 vehicle access point or vehicle area network (VAN) to connect various law enforcement tools including dash cameras, body cameras, laptops and automated license plate readers (ALPRs). When the police vehicle is back in the depot, the vehicle Wi-Fi connects directly to the depot Wi-Fi for video archive uploads.

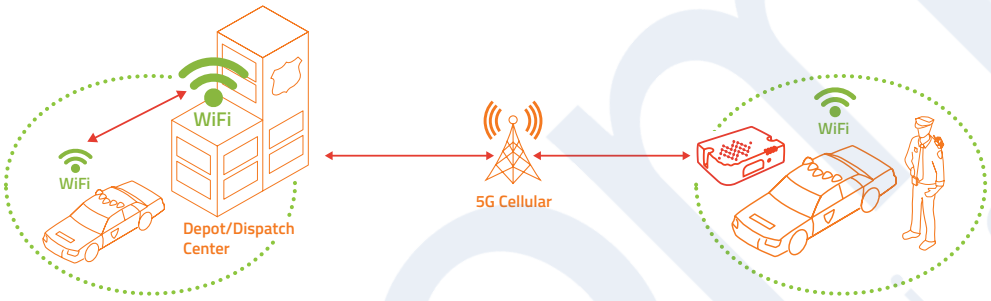



*Figure 1 – Law Enforcement Vehicle Using 5G and Wi-Fi 6*

## Wi-Fi 6 Use Cases

### HIGH-SPEED VIDEO UPLOADING AT LAW ENFORCEMENT DEPOTS

At the end of every shift, law enforcement vehicles return to their depot where all video data stored in each vehicle is uploaded to the depot servers. With traditional single user MIMO routers, uploading this video data was extremely time consuming. A station using multiple 4X4 MU-MIMO access points enables multiple law enforcement vehicles to quickly upload their videos at the same time.


*Figure 2 – Law Enforcement Video Uploads using MU-MIMO*

## PUBLIC TRANSIT

For public transit operations, a dual 4X4 MU-MIMO Wi-Fi solution enables buses to have two independent Wi-Fi systems greatly enhancing performance and security. One Wi-Fi 6 radio is dedicated to bus operations as well as passenger Wi-Fi which enables riders to check emails and messages and stream videos. The passenger Wi-Fi traffic may be steered to a dedicated cellular link and APN delivering enhanced security by completely isolating that traffic from internal operations traffic. The Wi-Fi 6 radio supports up to 256 concurrent users.

The second Wi-Fi radio is used to connect the onboard systems on the bus to servers for video offload and other data exchanges once the bus pulls into a station/depot. The speed of offload/upload of the dual 4X4 MU-MIMO configuration is 4 times faster than a 2X2 Wi-Fi solution.

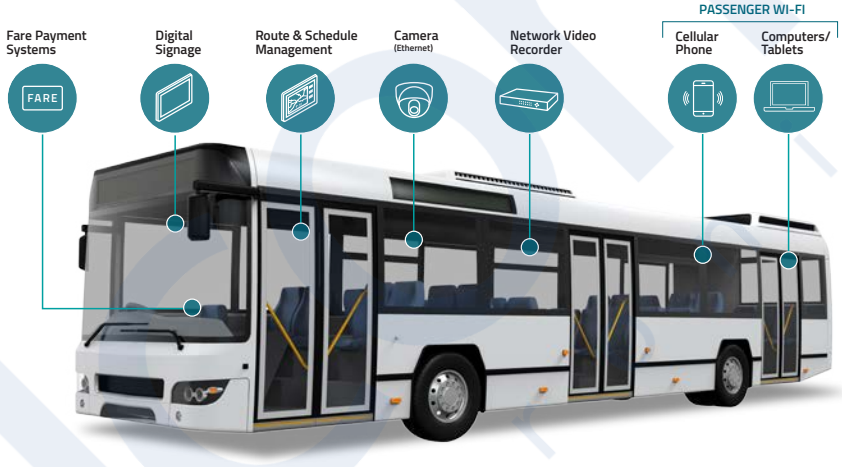



*Figure 3 – Transit Wi-Fi 6 Application*

## PUBLIC SAFETY – FIRE AND EMERGENCY MEDICAL SERVICES

Wi-Fi 6 enables multiple users to access Wi-Fi mission-critical applications for fire services, emergency medical services and emergency utility services. The speed of Wi-Fi 6 and the ability to filter out other networks helps ensure reliable communications between vehicles, dispatch/depots and hospitals. The Wi-Fi 6 router creates a vehicle area network (VAN) that enables connectivity between all connected devices in an emergency vehicle.

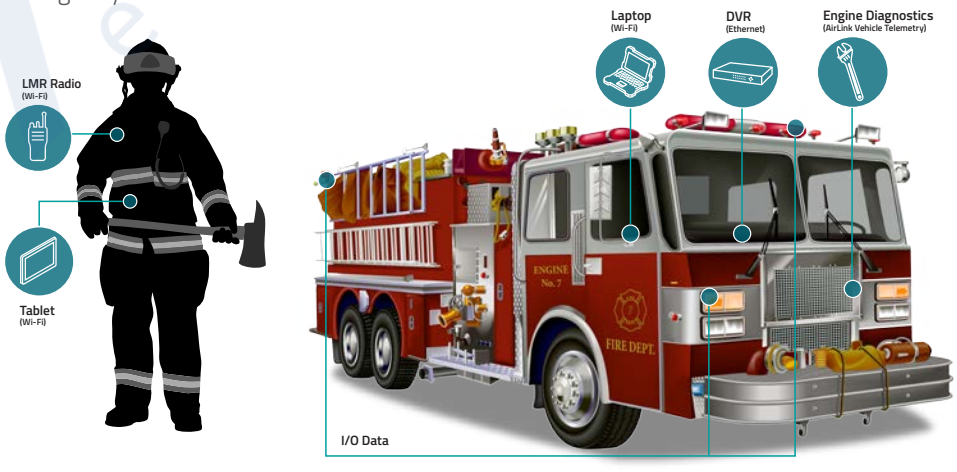



*Figure 4 – Fire Services Using 5G and Wi-Fi 6*

### LAST MILE CONNECTIVITY WITH FIXED WIRELESS ACCESS (FWA)

5G cellular speeds are now fast enough to be used as a substitute for cable-based broadband in homes, branch offices and venues. The use of Wi-Fi 6 in conjunction with 5G helps ensure that multiple users in dense environments have access to the high speeds and low latencies they need. As an example, a retail branch environment must support point-of-sale (POS) devices in addition to employee and customer laptops, tablets and cell phones.

## Additional Wi-Fi 6 Enhancements

In addition to MU-MIMO, there are several technology updates that benefit Wi-Fi 6 users. These technologies deliver improved speeds and traffic throughput, particularly in dense environments. These dense environments include crowded stadiums, auditoriums, concert halls, and even residential neighborhoods and commercial centers with numerous competing networks. Wi-Fi 6 also helps enterprises who use large amounts of AI, big data, AR/VR and machine learning (ML), and need to have improved reliability and manageability of their Wi-Fi networks.

### OFDMA

Orthogonal Frequency Division Multiple Access (OFDMA) enables a router to send a single transmission that communicates with multiple devices/clients delivering increased throughput and reduced system latency. OFDMA also adjusts the amount of data sent to each client depending on the application. A simple IoT device would use significantly less resources versus a 4K video stream.

### 1024 QAM

Quadrature amplitude modulation (QAM) is the scheme used to convert data into radio signals. The 1024 QAM (10 bits) in Wi-Fi 6 delivers a 25 percent increase in data transmission versus Wi-Fi 5 which uses 256 QAM (8 bits).

### IMPROVED BEAMFORMING

With beamforming, a router can detect where a data request is coming from, and then transmit a localized stream in that direction. This offers more direct targeting of specific devices, resulting in faster connection speeds.

### BSS COLORING

Basic Services Set Coloring (BSS Coloring) improves reliability in very dense environments by helping to filter out transmissions on competing or overlapping networks.

*AirLink XR90 5G with Dual 5G radios and Dual Wi-Fi 6 Radios*

*AirLink XR80 5G with Dual 5G radios and Single Wi-Fi 6 Radio*

## Sierra Wireless 5G and Wi-Fi 6 Router Solutions

The Sierra Wireless AirLink® XR90 5G and AirLink XR80 5G both offer Wi-Fi 6 connectivity. The AirLink XR90 5G features dual independent 5GHz Wi-Fi radios plus a single 4x4 MU-MIMO 2.4GHz Wi-Fi radio for a total of twelve data streams.

The AirLink XR90 5G is designed for use in transit, rail and first responder fleets. These users rely heavily on high-speed communications to both clients and infrastructure networks at the same time.

The AirLink XR80 5G is available with dual 5G radios and a single 4X5 MU-MIMO Wi-Fi 6 radio. The AirLink XR80 5G delivers eight data streams which is the highest performance for a single antenna solution. The extra MIMO channel (4X5 MIMO) operates as receive only and is dedicated to depot discovery. The AirLink XR80 5G is designed for public safety, field service fleets and mission-critical fixed applications.

Both the AirLink XR90 and AirLink XR80 feature 5 Gbps ethernet ports.

## AirLink Router Superior Performance

With 4X4 MU-MIMO, the AirLink XR90 and AirLink XR80 deliver ultimate Wi-Fi connectivity as compared to 2X2 MU-MIMO. The network speeds shown below are the best theoretical speeds possible. Actual speeds are dependent on many factors including antenna and cable losses, contention from other wireless networks and RF sources, channel and bandwidth selection, the number of clients and amounts of data being sent, and the location and distance to infrastructure (depot) access points.

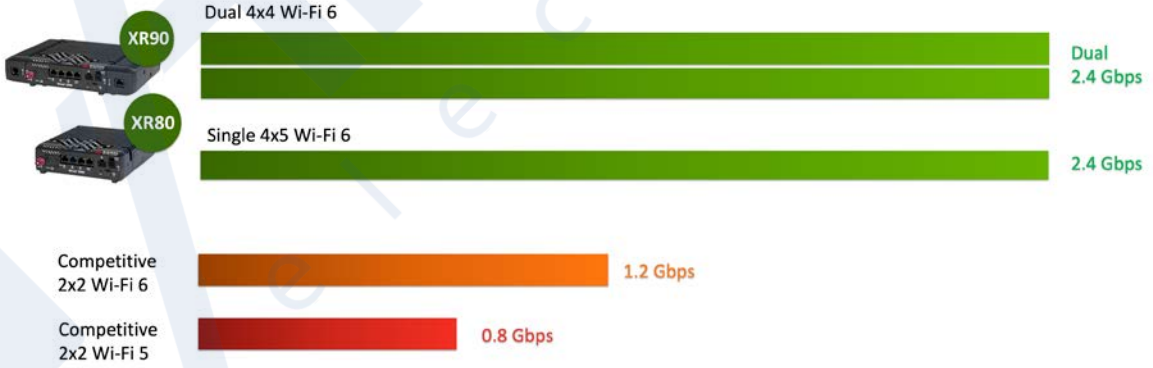
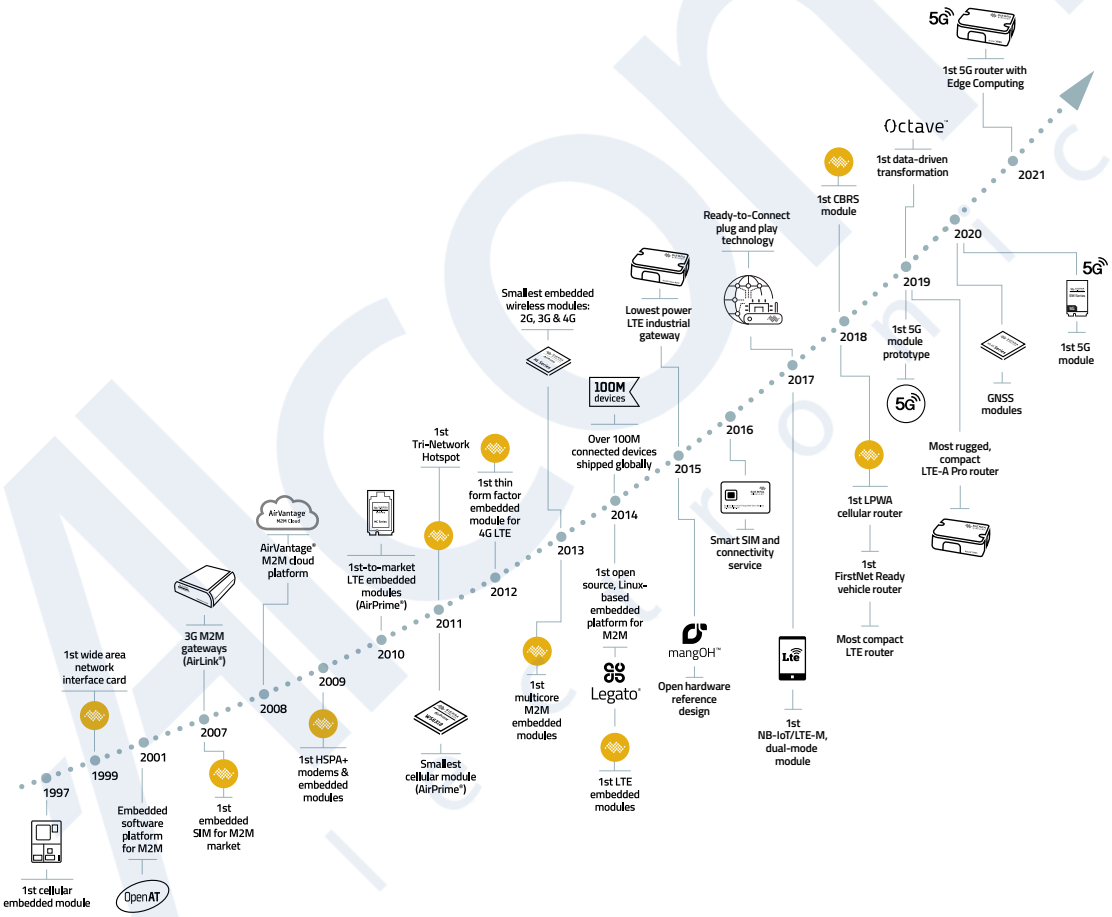



*Figure 7 – MU-MIMO Maximum Performance Comparisons*

# Why Sierra Wireless

Sierra Wireless has more than 25 years of cellular-first experience helping public safety and infrastructure organizations deploy reliable and cost-effective wireless solutions. As a part of the global cellular technology ecosystem, our partnership with all major cellular carriers ensures you have the performance and connectivity required for your mission-critical and business-critical applications.




Sierra Wireless has delivered innovation and leadership throughout every cellular evolution.

- 150 million devices shipped worldwide
- 80+ networks supported globally
- 400+ patents in wireless technology
- 130+ countries
- $75M+ invested annually in cellular technology R&D

In addition, Sierra Wireless provides mission-critical and business-critical solutions where they are needed most.

- More than 25% of the Top 50 US Transit Agencies depend on Sierra Wireless to improve passenger services and operations.
- More than 75% of high-performance EMS Systems trust Sierra Wireless routers to support paramedics in the field.
- 70% of the Top 10 State Police Agencies use Sierra Wireless purpose-built routers in their vehicles.
- More than 50% of the Top 100 Police Departments rely on Sierra Wireless routers in cruisers and incident response vehicles.
- More than 80% of the Top 20 US Utilities use AirLink routers for smart grid deployments and vehicle fleets.

## TO LEARN MORE

To learn more about 5G solutions from Sierra Wireless call us at 1-877-687-7795 or email sales@sierrawireless.com.

**About Sierra Wireless**

Sierra Wireless (NASDAQ: SWIR) (TSX: SW) is a world leading IoT solutions provider that combines devices, network services, and software to unlock value in the connected economy. Companies globally are adopting 4G, 5G, and LPWA solutions to improve operational efficiency, create better customer experiences, improve their business models, and create new revenue streams. Sierra Wireless works with its customers to develop the right industry-specific solution for their IoT deployments, whether this is an integrated solution to help connect edge devices to the cloud, a software/API service to manage processes with billions of connected assets, or a platform to extract real-time data to improve business decisions. With more than 25 years of cellular IoT experience, Sierra Wireless is the global partner customers trust to deliver them their next IoT solution.

For more information, visit www.sierrawireless.com.

Connect with Sierra Wireless on the IoT Blog at www.sierrawireless.com/iot-blog, on Twitter at @SierraWireless, on LinkedIn at www.linkedin.com/company/sierra-wireless and on YouTube at www.youtube.com/SierraWireless