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# Driving Innovation: Harnessing the Power of 5G In-Vehicle Connectivity

Guidelines and lessons  
learned from real-world  
examples in Public Safety,  
Utility and Transit fleets





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## Introduction

Cellular communication is the logical choice for connecting field teams given its widespread coverage and adoption. With the simple addition of a 5G or 4G LTE cellular modem, a field service vehicle or bus is transformed into a vehicle area network (VAN) which connects hand-held equipment including tablets, laptops and phones as well as installed components such as real-time dash cameras, automated license plate readers, electrocardiogram (EKG) monitors and fare collection systems. VANs can also connect Land Mobile Radios (LMRs) in addition to vehicle navigation and diagnostic systems giving dispatch teams improved situational awareness and faster response times.

Numerous Utility, Public Safety, and Transit organizations have begun deploying 5G in their vehicles, experiencing firsthand its ability to provide faster, more reliable data transfer and process large volumes of information rapidly. However, the key to fully leveraging the potential of 5G in-vehicle connectivity lies in choosing the right router solution. The correct router can significantly enhance the overall data speed, stability, and reliability of the VAN.

This eBook will delve into these considerations, offering a comprehensive guide to selecting the optimal in-vehicle 5G solution. It will also explore real-life examples of successful 5G deployments in Public Safety, Utility, and Transit vehicles.





## Key Considerations to Harness and Expand the Power of 5G In-Vehicle Connectivity

With the promise of high-speed, low latency communication on the go, 5G holds immense potential to revolutionize the way utility, public safety, and transit companies operate.

However, as we step into this exciting frontier, it's important to understand that the successful implementation of 5G in-vehicle connectivity comes with its own set of challenges. Security and reliability are at the forefront of these concerns, necessitating stringent compliance with specific design and management criteria. Moreover, the power of 5G in-vehicle connectivity can be further amplified by leveraging adjacent technologies and interoperability features. This multifaceted approach not only maximizes the benefits of 5G but also paves the way for future innovations.

While selecting the right in-vehicle router for your application there are a few things to consider that will help you harness and expand the power of 5G in-vehicle connectivity.



### 5G AND/OR LTE

While 4G LTE will handle many of today's connectivity requirements, 5G is designed to support high bandwidth and low latency applications such as live video streaming and virtual reality/augmented reality (AR/VR).

A 5G router solution also future-proofs the design, making it an ideal choice for router deployments expected to have a long lifespan. A 5G solution can take advantage of new/future technologies including MEC (multi-access edge computing), network slicing, SD-WAN (software-defined wide area networking) and 5G stand-alone (SA) which will deliver increased bandwidths and lower latencies. But to realistically accomplish 5G speeds and low latency, it takes more than just a fast 5G radio. All the components within the router including CPU, memory, Wi-Fi and operating system need to be 5G fast..

If your fleet doesn't require the enhanced performance of 5G, an LTE router remains a viable option, as 4G networks will coexist with 5G networks for many years. To future-proof your deployment, look for a router with an expandable design that provides a path to 5G.



### SINGLE OR DUAL CELLULAR RADIOS

Dual cellular radio routers can connect to two carriers at the same time delivering cellular-to-cellular failover and always-on connectivity. This is especially important for first responders who need to maintain connectivity when driving in and out of their primary coverage areas.

For less critical applications, a single cellular radio with dual SIM cards can deliver increased connectivity. A use case example would be a utility truck connecting to both a primary carrier and FirstNet®.



### WI-FI 5 VS. WI-FI 6

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 was launched in 2019 as a replacement to Wi-Fi 5 and delivers a 25 percent increase in basic transmission. Additional gains are achieved through enhanced MU-MIMO (multiple user, multiple input, multiple output) technology in addition to beamforming and other advancements. 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 high bandwidth applications such as high-speed video uploading at law enforcement depots, or applications involving multiple Wi-Fi users such as Passenger Wi-Fi in Transit Vehicles.

Learn more: [Wi-Fi 6 – How MU-MIMO Enhances Connectivity for Public Safety, Transit and Industry](#)



### IS THE ROUTER RUGGED ENOUGH FOR A VEHICLE ENVIRONMENT

Most field service vehicles see a lot of hard use. Routers which are typically installed in a vehicle trunk will see extreme temperature variations and high levels of shock and vibration. Plus, units running from vehicle power systems are subjected to start-up transients and low voltage extremes. It's important to ensure that you select a 5G router that can handle these conditions.



### LMR COMPATIBILITY

If your team uses Land Mobile Radios (LMR) equipment, It's critical to ensure that the cellular router can also support LMRs via cellular as a backhaul when you are out of radio range, but still within cell coverage. This interface enables a LMR device to establish radio connections beyond the basic radio range. This interoperability ensures your team stays connected, even when they stray beyond the reach of the radio network. It also enables users to update LMR devices faster by using a cellular/Wi-Fi data channel versus a slow radio channel.



### REMOTE MANAGEMENT & SUPPORT

Since it's crucial that your solution remains consistently secure and high-performing, there are many applications where remote management and support make sense. 5G routers must include both technical support as well as a remote device management solution which actively monitors the health of each device. The management solution must also securely deliver firmware and security updates at scale and in a timely fashion.



### CAN BUS INTERFACE AND REPORTING TOOLS

Many public safety, utility, and transit agencies need to access remote vehicle data to enhance operational efficiency and gain crucial insights into vehicle performance. To collect this data, your router must feature a controller area network (CAN) bus interface. Data gathered can include driver behavior, engine faults, odometer readings, and seat belt usage. However, to effectively and intelligently leverage this data, you also need purpose-built software tools that can offer real-time reports. These reports can include details on vehicle/engine status, driver behavior, coverage maps and trails, vehicle utilization, and travel zone summaries.

For example, a utility company can use these reports to anticipate potential mechanical issues, thus reducing the risk of breakdowns during critical operations. For transit agencies, a CAN-Bus interface can provide invaluable insights into driving patterns, fuel efficiency, and overall vehicle health. Data on harsh braking or excessive speed, for instance, can be used to address driver behavior, leading to safer and smoother rides for passengers.



### ENHANCED SECURITY

Whether you are deploying your 5G router in a bus, in a bucket truck, or in a police car, it's critical to have end-to-end security from device to the cloud. Routers must have VPNs, device authentication, port level segmentation, firewalling and MAC address filtering. You should also assess the vendor's overall security posture. The router company must have a formalized security process and demonstrated capability to detect, contain and respond to vulnerabilities and other security incidents.

# Lessons Learned from Successful 5G In-Vehicle Implementations

These three Sierra Wireless customer case studies demonstrate how a 5G cellular router can increase the performance of business and mission-critical organizations. All three organizations chose Sierra Wireless *AirLink® XR Series cellular routers* with *AirLink® Complete* and *AirLink® Management Service (ALMS)* for their connectivity solution.

## Major Police, Fire and Rescue Agency

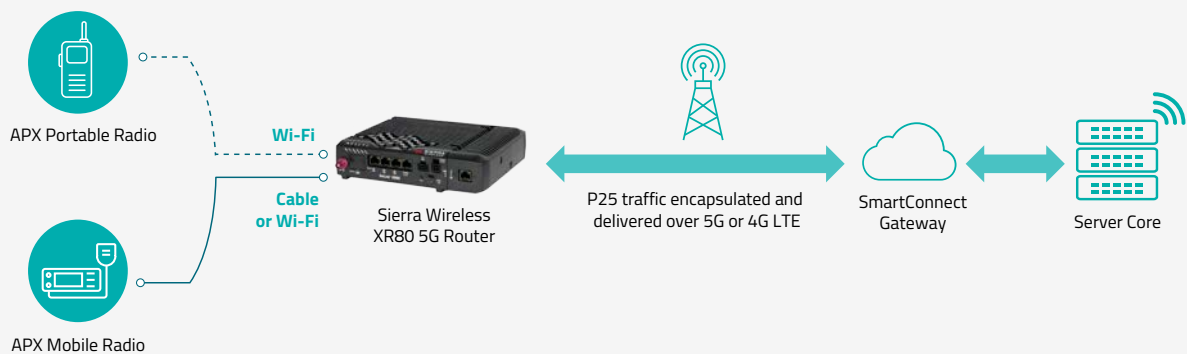
One of the largest police, fire and rescue agencies in the US wanted to provide interoperability capabilities to their voice radio systems enabling operations across regions and providing mutual aid in times of crisis. Their solution included *AirLink XR80 5G routers*, antennas and multi-year Airlink Complete packages.

### KEY AGENCY REQUIREMENT

#### Interoperability with Land Mobile Radios (LMRs) to achieve ultimate radio coverage

The agency relies extensively on Motorola P25 LMR handhelds and vehicle-mounted radio systems. The AirLink XR80/ XR90 router solution has been chosen due to its collaborative integration with Motorola LMR devices via *Motorola SmartConnect*. This feature allows the AirLink XR80/XR90 routers to automatically toggle voice communications to the available 5G or LTE network if the radio loses LMR coverage, and then revert back as soon as LMR coverage is restored. This transition occurs seamlessly without affecting authentication or encryption parameters. Consequently, field teams can now maintain secure connections through their LMR devices under certain circumstances.

The AirLink XR80/XR90 series also enables the agency to leverage Motorola's Mobile Data Tethering capabilities. This delivers firmware and other LMR device updates over the cellular network, rather than using an open radio channel or bringing the radios back to the radio shop for updating. This capability allows updates to take place on the fly in one-tenth the time required when using a radio channel and keeps the LMRs available for mission-critical communications.



SmartConnect Illustration - Motorola P25 Traffic Over Cellular Network



## Large US Public Water Utility

One of the largest public water utilities in the US wanted to improve connectivity with their field worker tablets. Despite using rugged tablets and computers with integral cellular connectivity, they faced numerous connectivity interruptions due to both the failure rates of the rugged devices and inconsistent cellular coverage in certain rural locations. To achieve ultimate coverage, they updated their fleet of 3000 vehicles with AirLink XR80 routers to create a reliable Vehicle Area Network (VAN) in and around the vehicle, and High-Power User Equipment (HPUE) antennas/devices. Leveraging AirLink Management Service (ALMS) was critical for the utility enabling them to continuously monitor their vehicle fleet.

### KEY SOLUTION COMPONENT

#### Rugged Design and Ultimate Coverage with seamless HPUE integration

In the US, the FCC allows an 8 dBm increase in signal transmit power (from 23 dBm to 31 dBm) in Band 14 which is reserved for first responders and utilities. HPUE devices are designed to transmit at these increased power levels which helps boost both coverage and uplink data throughput. The AirLink XR80 seamlessly connects with HPUE devices, and the overall solution – XR80 router but also HPUE device – can be remotely monitored at scale and from a unified interface through the AirLink Management Service platform.

The combination of the rugged AirLink XR80 router, HPUE devices and Sierra Wireless ALMS for ongoing fleet monitoring enabled the water utility to gain enhanced cellular coverage and improved field team performance.



## Public Transportation Enterprise in Italy

A large transportation enterprise in Italy needed to improve remote management of IT components in one thousand city and inter-regional buses. They especially wanted to integrate and remotely manage their vehicle fare systems, emergency call systems (VoIP) and media systems while gaining critical information from vehicle engines. The solution included AirLink XR80 5G routers and ALMS enabling the enterprise to remotely determine bus location and on-board vehicle status.

### KEY SOLUTION COMPONENT

#### Monitoring Vehicle CAN Bus to improve route scheduling

The AirLink XR80 connects directly to a vehicle's Controller Area Network (CAN) bus diagnostic data port to extract critical vehicle data and notably speed, hard accelerations and decelerations, engine faults, odometers and seat belt utilization. The transit agency not only utilizes this data to inform their route scheduling system, but also employs Sierra Wireless [Advanced Mobility Reporting \(AMR\)](#) to transform this data into easily digestible reports. Reports on vehicle utilization and engine fault summaries aid in anticipating when specific components of the vehicle might require maintenance or replacement, thereby helping to prevent breakdowns and enhance fleet efficiency. Furthermore, driver behavior reports serve as a valuable resource for training and verifying adherence to safety standards by drivers.





## Sierra Wireless In-Vehicle Router Solutions

As every vehicle fleet is different Sierra Wireless offers a complete suite of 5G and LTE in-vehicle router solutions that meet the different, needs of Public Safety, Transit, and Utility organizations.

These routers are purpose-built for in-vehicle use, featuring ruggedized die-cast aluminum housings that have been meticulously designed and tested to withstand the harsh conditions of vehicle deployment. All our router solutions are also designed to maximize always-on connectivity and are managed and remotely updated via AirLink Management Service (ALMS), allowing you to maintain control over your fleet, no matter where they are, and easily deliver over-the-air (OTA) updates with the latest security patches as new threats emerge.

AirLink in-vehicle solutions offer a spectrum of cellular and Wi-Fi performance options, as well as varying numbers of interfaces and features.

To determine the solution best suited to your needs, we recommend using our in-vehicle router selection criteria list to identify the essential features for achieving your organizational objectives.

You can then refer to the table below to select the most fitting AirLink solution.

## AirLink In-Vehicle Solution Comparison

	AirLink XR90	AirLink XR80 5G	AirLink XR80 LTE	AirLink MP70	AirLink RX55
	Highest performing 5G and Wi-Fi 6 solution.	Multi-network 5G/Wi-Fi 6 solution	4G variant with easy expansion to 5G through a 5G cartridge	Multi-ethernet 4G solution	Ultra-compact 4G solution
<b>Recommended for</b>	Transit and Public Safety fleets		Public Safety and Utility fleets.		
<b>HARDWARE</b>					
Technology	5G/4G	5G/4G	4G optional 5G expansion	4G LTE-A Pro	4G LTE-A
Dual Cellular Radio Option	Yes (Dual 5G)	Yes (Dual 5G)	Yes (4G/5G)	No	No
Max Cellular Speeds (DL/UL)	5G: Up to 4.14 Gbps DL/660 Mbps UL  4G LTE CAT 20: Up to 2 Gbps DL/210 Mbps UL	5G: Up to 4.14 Gbps DL/660 Mbps UL  4G LTE CAT 20: Up to 2 Gbps DL/210 Mbps UL	4G LTE CAT 20: Up to 2 Gbps DL/210 Mbps UL	LTE-A Pro: 600/150  LTE-A: 300/50	LTE-A: 300/150
<b>Environmental Design</b>	Rugged die-cast aluminum housing rated to IP64 with built in protection against voltage transients and low vehicle voltages.				
Wi-Fi Options	Dual 4X4 MIMO Wi-Fi 6  Can connect up to 256 clients	Single 5X4 MIMO Wi-Fi 6  Can connect up to 256 clients	Single 5X4 MIMO Wi-Fi 6  Can connect up to 256 clients	Dual 1X1 MIMO Wi-Fi 5  Can connect up to 128 clients	Single 3x3 MIMO Wi-Fi 5  Can connect up to 10 clients
CAN Bus Interface	Yes	Yes	Yes	Yes	Yes (with optional cable)
Ethernet ports	Up to 5	Up to 4	Up to 4	4	1
<b>SERVICES</b>					
Service and Support	AirLink Premium	AirLink Complete			
Over the air Firmware & Security Update	Yes*				
Advanced Mobility Reporting	Included*	Optional*			
LMR Interoperability	Yes				

\*With valid subscription



## Conclusion

### Confidently Embrace 5G's Full Potential with Sierra Wireless

5G has the capacity to revolutionize the way field personnel operate, empowering them with unparalleled efficiency, effectiveness, and safety. With 5G's lightning-fast, high-bandwidth, and low-latency communications, tasks are accomplished with unrivaled speed and precision, unlocking new realms of productivity. Not only that - embracing the cutting-edge power of 5G future-proofs your designs, ensuring your vehicles stay ahead of the curve with access to upcoming 5G feature releases.

### Why Choose AirLink

Sierra Wireless AirLink cellular router solutions stand at the forefront of this technological advancement, purpose-built and rigorously tested to provide the most reliable and secure connectivity in both business and mission-critical vehicle applications.

For more than 25 years, Sierra Wireless has been delivering secure, manageable, high-performance cellular networking for mission-critical applications. From fleet management to public safety operations, our innovative solutions guarantee seamless, uninterrupted connectivity, enabling real-time data exchange, remote monitoring, and enhanced situational awareness.

We'll let the numbers speak for themselves:

- 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 Sierra Wireless routers for smart grid deployments and vehicle fleets.
- All of the Top 10 Oil & Gas producers rely on Sierra Wireless to keep their infrastructure running smoothly.
- More than 25% of the Top 50 US Transit Agencies depend on Sierra Wireless to improve passenger services and operations.

### More Information:

To learn more about our vehicle networking solutions visit [Sierrawireless.com/router-solutions/vehicle-networking](https://www.sierrawireless.com/router-solutions/vehicle-networking)

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### **About Sierra Wireless**

Sierra Wireless (a subsidiary of Semtech Corporation) 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](http://www.sierrawireless.com).

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