



SEMTECH®

The Convergence: Satellite and 5G for Mission- Critical Success



Hybrid Network
Communications Architecture
Delivers Global Connectivity



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5G

Introduction

5G is a success story. It delivers broadband-quality connectivity well beyond the confines of a business or residence at reasonable costs. 5G enables mission and business-critical organizations to stream real-time video, data and voice communications with teams further out in the field. First responder organizations now have increased efficiency, enhanced safety and increased transparency. 5G has also helped enhance business processes and personnel safety for utilities and industrial operations.

While the 5G coverage map continues to expand, some rural and remote areas do not have adequate or any cellular coverage leaving these areas with little or no connectivity. Traditional satellite connectivity offered a means to bridge this gap, although data rates were often slow, and hardware and connectivity plans were expensive.





The Growth and Benefits of Low Earth Orbit (LEO) Satellite Communications

Satellite communication experienced rapid growth over the past few years with the launch of new low earth orbit (LEO) satellite constellations. Unlike geostationary or geosynchronous orbit (GEO) satellites, the LEO constellations deliver worldwide coverage with lower latencies through a large number of small fast-moving satellites. Reduced launch costs, lower costs for user satellite receivers and antennas, and lower-cost data plans have fueled rapid market expansion. According to Allied Market Research, the global satellite communications market is expected to go from \$25.5 Billion in 2021 to \$65.1 Billion by 2031 growing at a compound annual growth rate (CAGR) of 9.5% from 2022 to 2031.¹



Low-cost satellite connectivity is beneficial to many market segments. First responders including police, fire and EMS can perform their duties in remote areas and in times when natural disasters have cut off cellular service. Utility crews can now be in communication when maintaining remote sites and remote mining and oil and gas operations can leverage real time data communications. Governments can also effectively manage and communicate with their teams no matter where they are.





Satellite Communications Complements 5G Technology

While LEO satellite communication has great benefits, it also has several drawbacks, particularly with mobile applications. In addition to needing a line of sight to the sky, satellite communication typically delivers lower bandwidths and higher latencies as compared to 5G. Satellite communications can also slow down as more users are added to the network, and satellite connectivity costs are typically higher than 5G.

5G CELLULAR VS LOW EARTH ORBIT (LEO) SATELLITE COMMUNICATIONS

	5G Cellular	LEO Satellite
Data Rates	5G can deliver average download speeds between 50 Mbps and 2 Gbps, depending on available spectrum layers. Latency with 5G is lower.	Slower than 5G. As an example, in optimal conditions, Starlink download speeds range between 50 and 220 Mbps. ²
Remote Connectivity	Must be in proximity to cell towers.	Connects in remote and underserved areas.
Affected by Weather?	Only in cases of extreme weather due to cell tower damage.	Needs a clear view of the sky. Tall nearby objects may affect the signal.
Subscriber Capacity	Huge network capacity.	May get bogged down as subscriptions increase.
Mobile Applications	Works well.	Has limitations.

Maximize Coverage and Performance with 5G plus Satellite Connectivity

Mission and business-critical teams rely on real-time, high-bandwidth communications including voice, data and video to get their jobs done. In remote or rural areas where cellular service is marginal or non-existent, satellite communications can become a failover to 5G/4G cellular, and in fixed applications, an alternative to microwave communications or cable/fiber which can be very expensive to install.

Satellite communications failover ability is a useful asset in times of natural disaster when cell towers may be disabled. As an example, when Hurricane Harvey hit the Gulf Coast in August 2017, it brought massive winds, torrential rains, and a high-powered storm surge that quickly devastated the area's infrastructure. Reports from the Houston area said the storm knocked out 70% of cell towers, impacting more than 200,000 homes and nearly 17,000 call centers—including 911 dispatch centers and other critical parts of the emergency response network.³





Wireless Routers Connect All the Pieces

Modern wireless routers bring together different communication wide area networks (WANs) and optimize quality of service (QoS) delivery to the end user. *Figure 1* shows many of the different communications channels that can connect to a wireless router including satellite, cellular, microwave and broadband/fiber. Cellular antennas interface directly to the router and the other communication channels typically connect via Ethernet ports.

Wireless routers deliver connectivity to personnel, vehicles and fixed structures. (See *Figure 1*) Ruggedized routers are typically installed in a vehicle and provide connectivity to the vehicle itself through Ethernet, GPIO (general purpose I/O) and the vehicle's CAN Bus which can monitor vehicle and driver performance. The in-vehicle router also provides high-speed Wi-Fi which connects personnel gear including cell phones, hand-held radios and body cameras.

Routers also enable Wi-Fi connectivity in temporary and fixed structures. Routers can connect to temporary field hospitals and construction trailers. They can also connect remote schools, medical centers and remote industrial sites without the expense of running broadband or fiber.

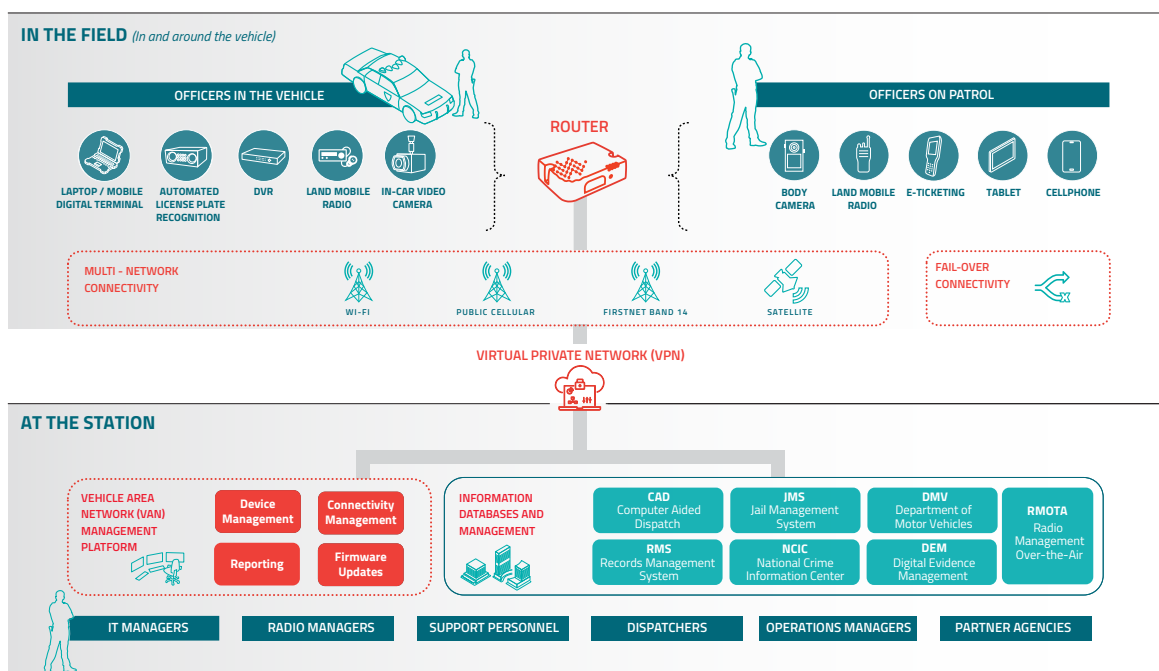


Figure 1 – Wireless Routers Connections

Selecting the Best Communications Channel

Maximizing connectivity in a multi-network environment requires a solution that can pick the best WAN link as conditions change. Modern wireless routers are designed to identify and intelligently steer communications traffic based on signal strength and quality of service (QoS). Traffic switching can be near instantaneous between different cell towers, Wi-Fi networks and satellite services. Routing can also be set by the cost of data transmission, so low-priority data can be sent on low-cost channels, and high-speed, high-priority data can be sent on more expensive, faster channels as needed.

With the addition of satellite data, a router now has an additional data source to choose from. Smart routers can automatically find the best QoS WAN link, or choose a WAN based on customer-specified failover criteria. Failover rules can be set depending on the type of application (video vs. low data rate telemetry) and the cost of each channel.

For mission-critical applications such as first responders, switching between data streams needs to be instantaneous and invisible to the user. This is accomplished by having the router continuously monitor multiple data streams and quickly make the switch. Many routers utilize dual live cellular radios to help ensure uninterrupted communications. A good router will preemptively switch channels before connectivity is lost.





Satellite Connectivity Use Cases

First Responders/Public Safety – Police, Fire and EMS

In-vehicle routers are used to create a vehicle area network (VAN) or a vehicle as a node (VaaN) ensuring secure and reliable communication between officers, their equipment and their command centers. This helps organizations increase safety, accelerate collaboration and ensure accountability.

When traveling into rural or remote areas, satellite communications become the primary or failover channel for the officers. When back in cellular range, the router automatically switches back to full-time high-speed, low-latency 5G communications. Video recordings stored in vehicles can be uploaded over 5G when in range or over Wi-Fi when close to the depot. This solution scenario also applies to fire, EMS, transit and utility vehicles.

The use of satellites for public safety communications is rapidly growing. According to Allied Market Research, satellite communications market growth in public safety is projected to reach \$10.76 billion by 2030 with a CAGR of 23.1% from 2021 to 2030.⁴

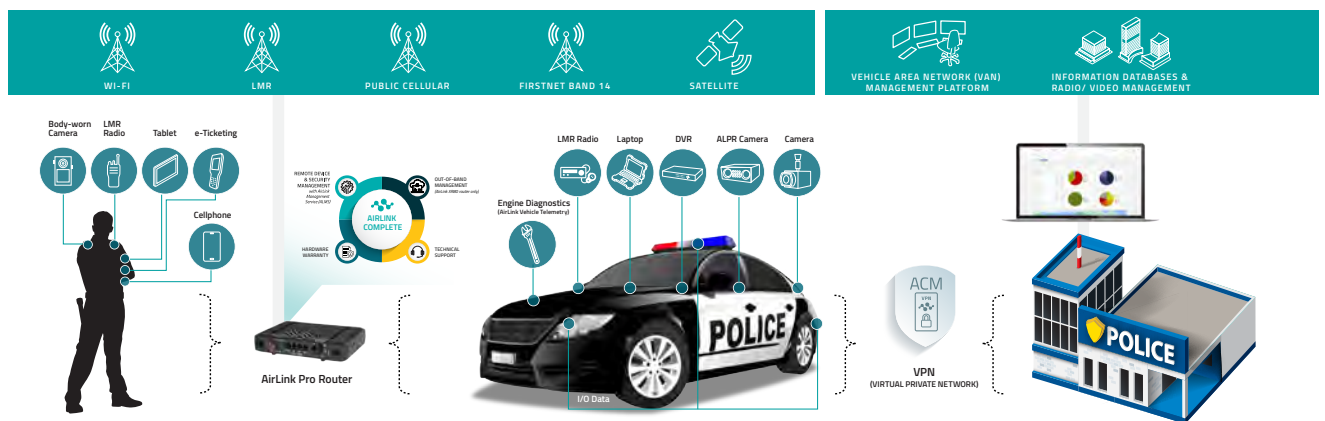


Figure 3 – First Responder Communication Ecosystem

Government and Military

With satellite communications, government and military vehicles and remote command posts can move in and out of remote areas without losing mission-critical connectivity. Satellites are used as the primary communications channel in truly remote areas or as a failover when cellular communication is available.

Wireless routers create a vehicle area network (VAN) or fixed access network using Wi-Fi 6 to connect local devices. The router automatically connects to the best connectivity (cellular, satellite, microwave or broadband) to connect to a command-and-control center and gain secure internet access.

Militaries are also leveraging satellite communications for the secure transmission of data and images. This includes data from remote or hostile locations that need to be transmitted in real-time. High-bandwidth low latency communications also enable voice communications and live video transmission.



Figure 4 – Government Field Communications Ecosystem

Remote Mining Operations

Remote mining operations can utilize wireless routers to connect operations centers in addition to manned or autonomous vehicles on site. When within the range of a private network, routers use cellular signals for connectivity. When outside of the private network, the routers automatically switch over to satellite communications.

Mining operations use in-vehicle routers to create vehicle area networks (VANS) that connect equipment and personnel via Wi-Fi and Ethernet connections. Autonomous mining vehicles can connect with automated navigation systems, collision avoidance systems, payload weighing systems and video cameras. GNSS navigation systems in these routers offer unsurpassed position reporting and feed information to vehicle tracking systems. Manned vehicles also offer Wi-fi connectivity for laptops, cell phones and land mobile radios.



Figure 5 – Mining Operations Communications Infrastructure

Forest Service Firefighting

Firefighting teams are often dropped into remote areas with no cellular or radio communications available. The relatively small size of LEO satellite communications equipment can be combined with battery-operated routers to create a node-in-a-box communications system that can be set up in minutes.



Figure 6 – Firefighting Communications Kit

Industrial and Agriculture

Industrial sectors including oil and gas, mining and power generation are using satellite communications to implement control systems, remote monitoring and predictive maintenance to increase productivity and safety. Farmers in remote regions can now have real-time connectivity to implement precision agriculture which is especially important as climate change continues to affect farms in remote areas.

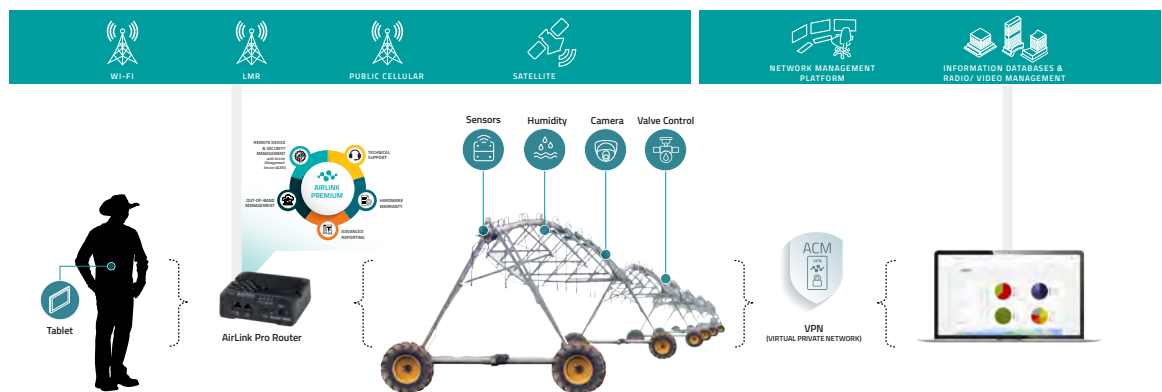


Figure7 – Agriculture Communications

AirLink Pro Routers – Central Node for Mission Critical Networks



AirLink XR90

Highest performance multi-network 5G / Wi-Fi 6 rugged router



AirLink XR80

High performance multi-network 5G / Wi-Fi 6 rugged router



AirLink XR60

Ultra-compact 5G / Wi-Fi 6 rugged router



AirLink RX55

Ultra-compact, ultra-low power 4G / Wi-Fi 5 rugged router

AirLink Pro ruggedized wireless router solutions are purpose-built to deliver high-reliability communications for mission and business-critical applications. These routers directly interface with cellular, satellite, broadband and microwave communication sources to deliver a comprehensive, future-proof connectivity solution.

AirLink Pro routers are designed to operate on both public and private cellular networks. Private networks offer better coverage, stronger security, higher device capacity, faster upstream data speeds, lower latency, easier management and the ability to failover to public networks.

Our extensive portfolio features the Pro Series rugged 5G and LTE routers that are tested to stringent military-grade and industry standards. These routers are designed to work in harsh environments and deliver the high security, extreme reliability and high performance needed by mission-critical applications. AirLink Management Service enables remote management and security update delivery to all connected routers to keep your critical infrastructure secure.

[See all AirLink router models.](#)

AirLink Cognitive Wireless Helps Ensure Always-On Connectivity

AirLink Cognitive Wireless leverages patented WAN routing capabilities to intelligently steer traffic (or split traffic) across multiple WAN links including cellular, satellite, Wi-Fi with sub-second switching for always-on connectivity and cost/bandwidth optimization. Selectable WAN optimization factors include types of traffic, network priority, signal strength and vehicle speed, time and location.



AirLink Connection Manager VPN

AirLink Connection Manager (ACM) is a mobile-optimized VPN server that consolidates security onto a single platform for all connected devices and sources including satellite communications. ACM delivers always-on VPN tunnels helping to eliminate downtime or loss of communications when roaming between different networks of types of networks. It securely connects all in-field applications and mobile assets to the enterprise with FIPS 140-2 or AES 256 encryption.

[See our AirLink Connection Manager \(ACM\) page for more details](#)



AirLink Services

AirLink Services deliver real-time visibility, robust security and proactive management of large-scale networks from multiple locations. Our single pane of glass router management solution enables full network control for device monitoring and delivery of critical network and security updates. Our Hybrid Cloud optional feature merges the benefits of cloud technology with on-premises security controls for the management of your AirLink XR and RX routers, offering ultimate security and control.

[See our AirLink Services page for more details](#)



Semtech - Supporting Your Success

With more than 30 years of experience, Semtech is a trusted provider of Public Safety and industrial solutions and currently serves hundreds of organizations globally. Our solutions come with comprehensive services to help ensure your devices operate securely and at peak performance. We support our customers with professional technical support, always-on remote management, unrestricted access to firmware and security updates and hardware warranty with AirLink service subscriptions.

As a part of the global cellular and IoT ecosystem, we contribute to the definition and evolution of technology standards. Our partnership with all major U.S. cellular carriers ensures you have the performance and connectivity required for your mission-critical and business-critical applications. This has enabled Semtech to deliver innovation and leadership throughout every cellular evolution.





To Learn More

To learn more about cellular and satellite communication solutions from Semtech, call us at **1-877-687-7795** or email **sales@semtech.com**

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