



5G WIRELESS SD-WAN

PREPARE FOR THE 5G FUTURE WITH PEPLINK | PEPWAVE

Whitepaper | Version 1.0 - April 2019

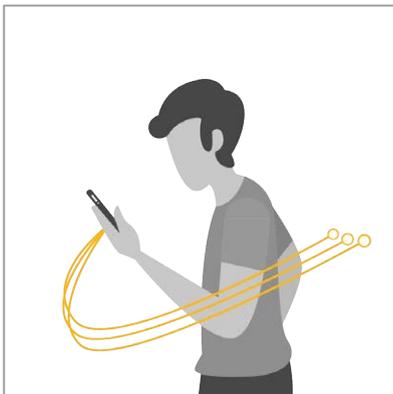
Getting Ready for 5G

Current Status of 5G

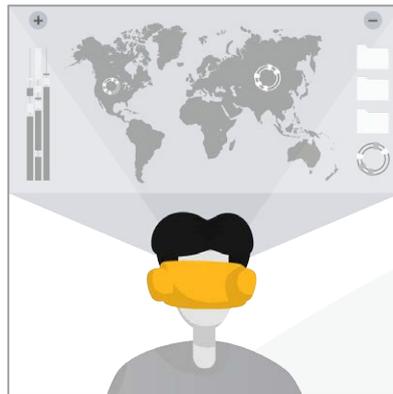
The adoption of 5G is happening much faster than previous transitions. In the early years of 4G (2010-2011), only 4 carriers and 4 devices supported the standard. Right now, 5G is at its nascent phase. Yet, over 30 5G-smartphones have already been scheduled for release in 2019, and over 20 carriers worldwide have announced support for this standard.

This time around, the upgrade from 4G to 5G does not only promise faster speed. The 5G standard is meant to enable the next killer app, be it AR/VR, Internet of Things, autonomous driving or something entirely new. These new applications will change the way enterprises and organisations connect with the outside world. This paper aims to help Peplink customers get ready for the 5G network.

5G Use cases:



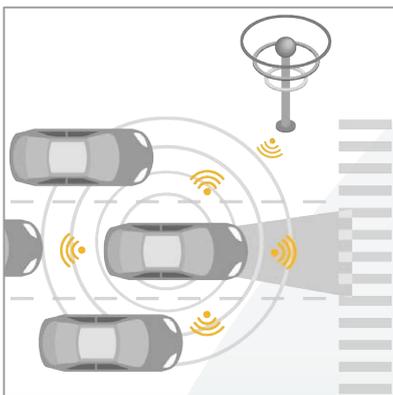
Broadband access everywhere



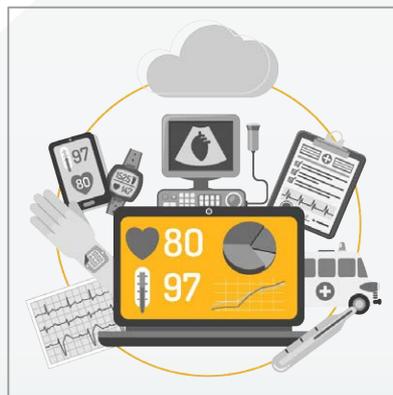
Augmented / Virtual reality (AR/VR)



Internet of Thing (IoT)



Automotive



Health

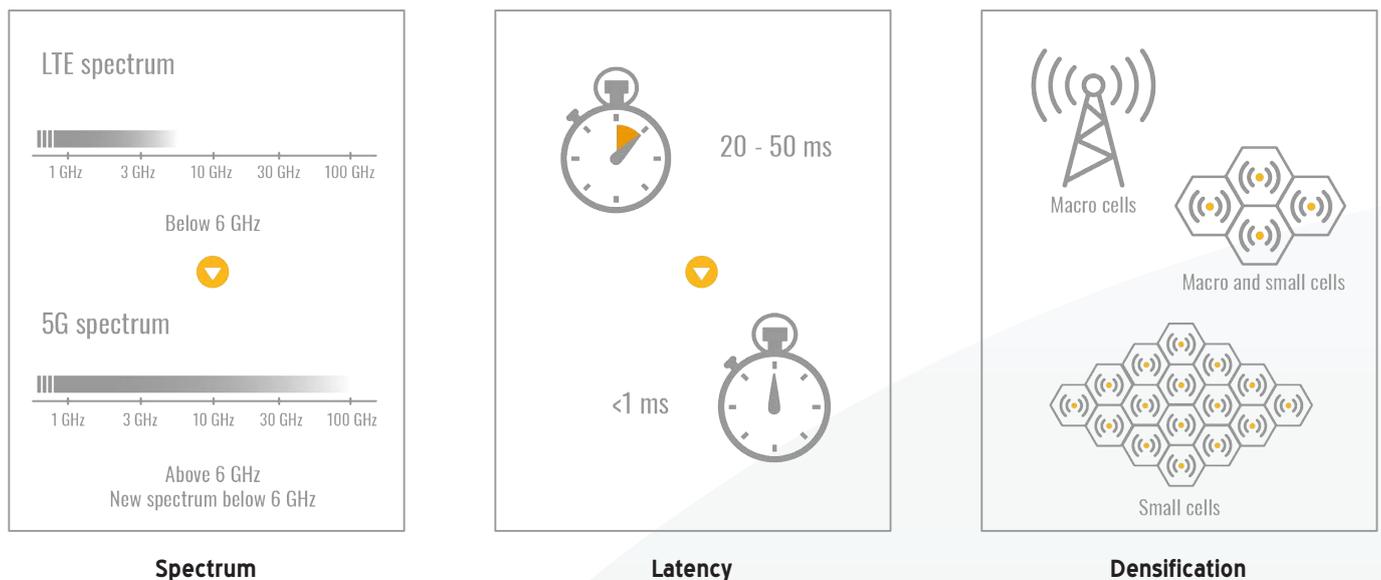


Next-gen real-time communication

The Promise of 5G

5G promises download speeds over 1Gbps. This is at least 10x faster than the typical 4G-LTE speeds of 100-200Mbps and faster than dedicated broadband services. Because it does not require fixed wire lines, an immediate use case of 5G is to act as a backhaul for mobile broadband services. The 5G network also promises significantly lower latency compared to previous generations: potentially down to an imperceptible 1ms delay compared to around 20-50ms delay typical of 3G and 4G networks. This enables 5G connections to be treated as if they were in real-time, opening up new possibilities in critical applications that are extremely latency sensitive, such as autonomous driving, drones, cloud gaming and robo-surgery.

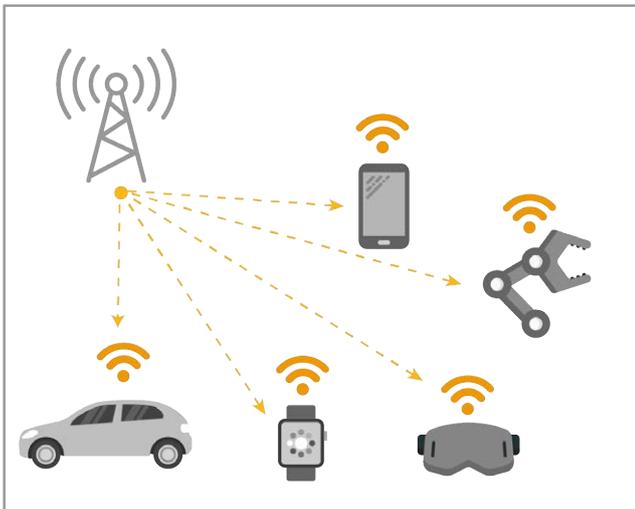
At the opposite end of the wave spectrum, 5G can also operate at low-band frequencies of around 800MHz to mid-band 3-5GHz range. Low band 5G trades speed for reliability. At these frequency ranges, 5G offers less dramatic speed improvements over 4G at similar levels of reliability.



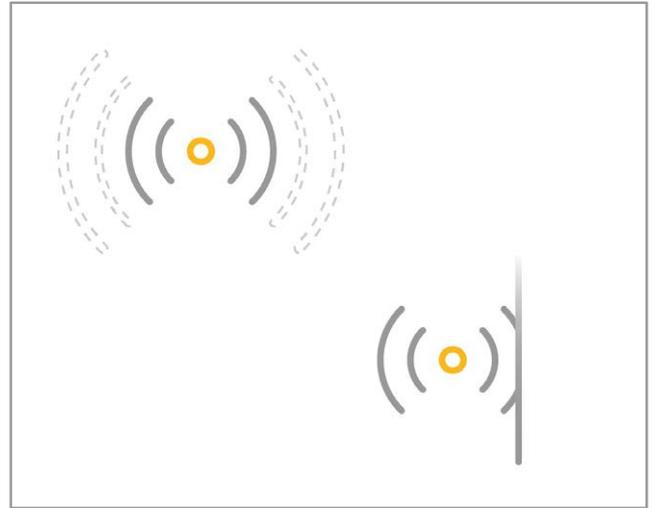
Limitations of 5G

Network Congestion and Short Range

The 5G network is designed to connect an unprecedented number of devices: billions of consumer mobile devices streaming data-intensive apps, critical IoT networks that cannot be disrupted and mobile broadband users expecting stability and quality of service of a fixed line, all at the same time. Coupled with mmWave's short range and its inability to penetrate walls and windows, 5G network conditions at any given moment are subject to a high degree of uncertainty.



Billions of connected devices causes potential network congestion



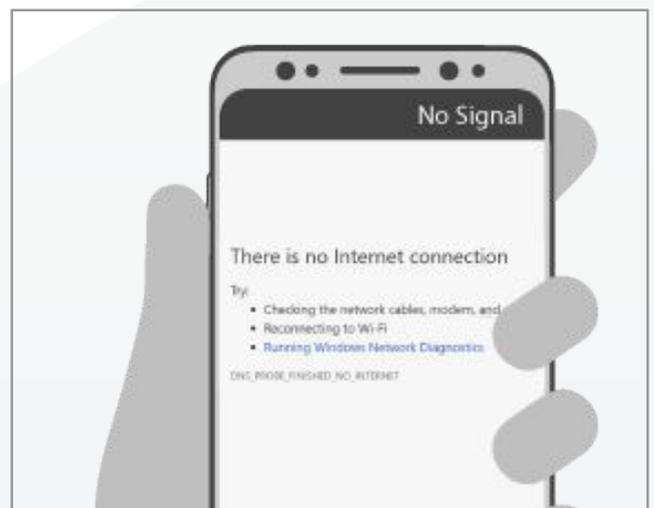
Unstable network signal due to short range & low penetration of millimeter wave

Operators can partially overcome this challenge by increasing the density of network infrastructure. However, this is a function of cellular operator's ROI. According to market forecasts, 5G spending will balloon up at a rate of 118% CAGR, reaching approximately \$26 billion in 2022. Mobile devices can be equipped with antenna enhancements such as beamforming and MIMO, but can hardly achieve the 99.999% reliability required by business users. In conclusion, 5G network and user requirements pose significant engineering challenges.

Cellular Dead Spots

Although 5G brings improved performance, each network still has gaps in their coverage. Effects of a cellular dead spot can range from stream jitters due to packet loss all the way to dropped connections. This limitation is inherent in all cellular technologies to date.

To overcome this limitation, system integrators need to employ SpeedFusion SD-WAN technology: combining the bandwidth of multiple cellular providers and WAN technologies into a single VPN connection. This technology enables reliable connectivity and session persistence even in cellular dead spots.



Cellular dead spots will lead to packet loss and dropped connections

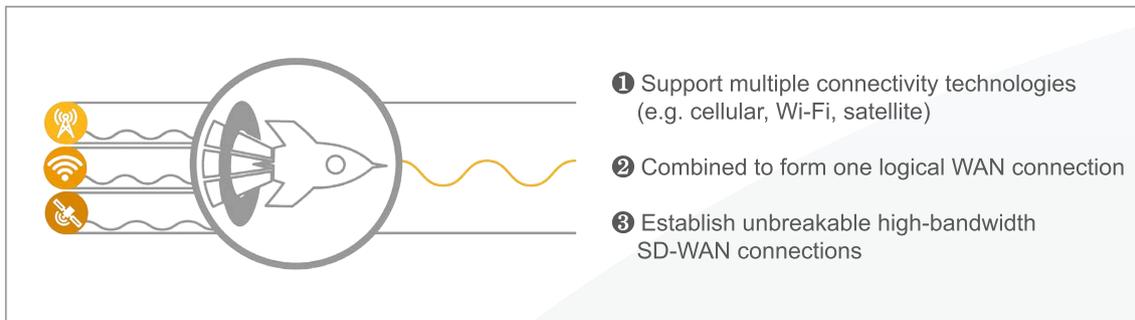
5G Wireless SD-WAN

Applying SD-WAN Technology to 5G

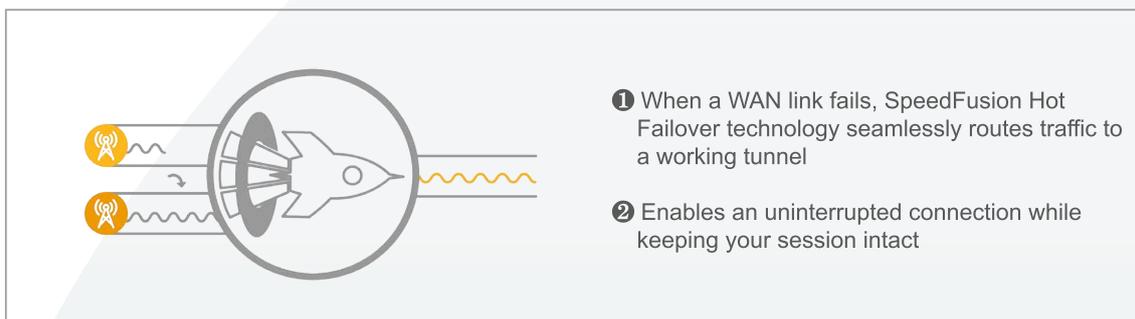
Businesses and government agencies are adopting SD-WAN at a rapid pace to replace legacy WAN running on MPLS. In the mainstream enterprise market, SD-WAN is typically used to add broadband, DSL or mobile links to their existing connection. This enables organisations to increase the bandwidth of existing MPLS connections while providing a failover backup, all at substantial cost savings compared to directly upgrading the MPLS line to the same standard of bandwidth and reliability. Other typical features include WAN optimisation, application-specific network rulesets and centralised control of branch network via cloud.

Peplink goes a step further than the above feature sets with our patented SpeedFusion technology. SpeedFusion allows users to combine any number of connections together to form a point-to-point link to achieve what others cannot:

Untethered from fixed line - Combine the bandwidth of several mobile connections to form an ultra-fast data link. Sustain bandwidth-hungry and latency sensitive tasks without the need for fixed lines, such as rolling workplace with full access to multi-cloud and security services, HD video streaming and mobile clinic.

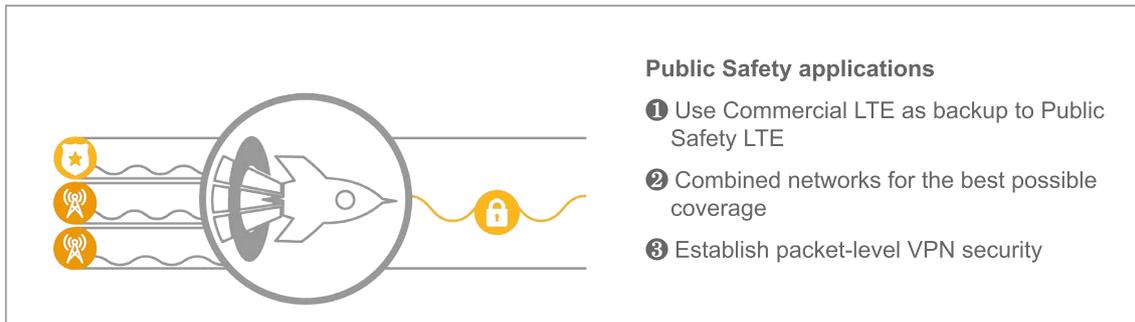


Unbreakable connectivity - SpeedFusion Hot Failover maintains secure tunnels over all available WAN links to keep the network up and running when a connection drops out. If a WAN link fails, SpeedFusion instantly routes traffic to a working tunnel for uninterrupted VoIP sessions.





Unrivaled coverage - SpeedFusion is carrier agnostic and our products are certified with multiple carriers. By combining the coverage network of several mobile carriers, chances of running into a network blindspot or congestion is minimised.



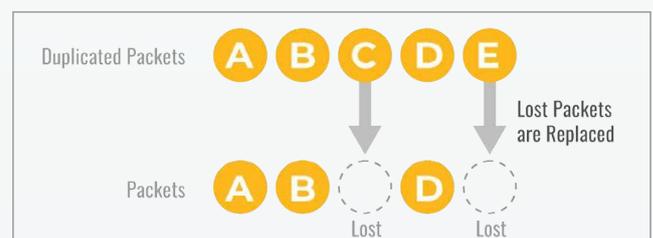
In the coming years, 5G will bring connectivity to billions of devices outside the reach of any fixed line infrastructure. Furthermore, enterprises will increasingly move to a fixed + mobile network architecture to take advantage of the extreme bandwidth of 5G. Wireless SD-WAN with the capability to intelligently manage thousands of connected devices will become the key technology to power branch networks.

Connection Reliability vs Consistency

Reliable connections are not necessarily consistent connections. Although a connection may stay up, it can still suffer from significant packet loss. This results in jitter during VoIP and video streaming, disrupting important communications with lost sentences and distorted video. Peplink has developed technologies to combat the effects of packet loss: WAN Smoothing and Forward Error Correction.

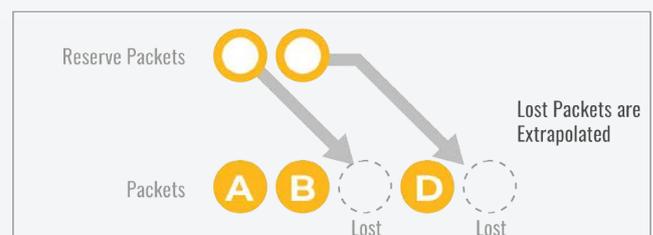
WAN Smoothing

This Peplink technology duplicates packets. When packet loss occurs, the duplicated packets replace the lost packets. This technology is best suited to two-way communications such as VoIP or video conferencing.



Forward Error Correction (FEC)

This Peplink technology generates reserve packets. When packet loss occurs, FEC uses the information within the reserve packets to extrapolate the lost data. This technology is best suited to one-way video streaming.



Building 5G SD-WAN with Peplink

Get Started on 5G with Peplink

Peplink, since its founding in 2006, has long focused on wireless SD-WAN technologies. Now, we are ready to propel customers into the 5G-era with a range of brand new flagships featuring an innovative modular platform architecture for different use cases.



EPX
Extreme Performance SD-WAN Platform



SDX
Modular Enterprise Grade Router



HD4 MBX
Quad Cellular Gigabit LTE Mobile Powerhouse



PDX
Portable, Rapid Deployable SD-WAN

Focus markets:



Enterprise



Industrial



Transportation



EPX

Extreme Performance SD-WAN Platform

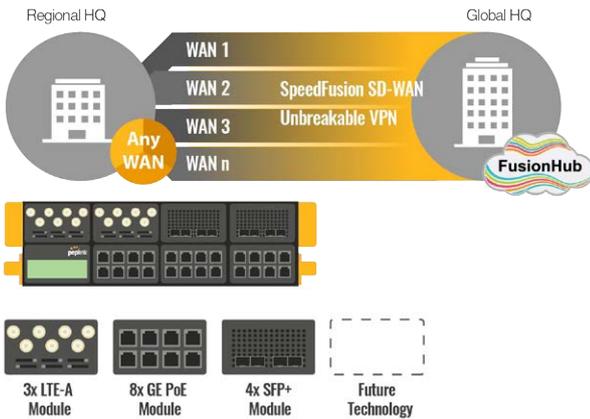
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Enterprise

7x
expandable module slots



[> Learn More <](#)

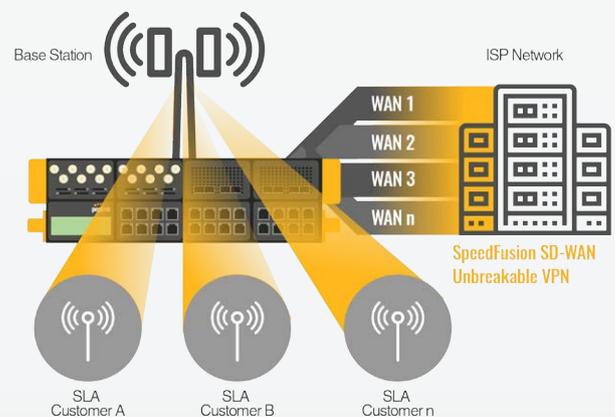


Futureproof, Scalable, Unbreakable Cellular Backup for Regional Offices

With its modular construction, the EPX enables regional offices to add WAN connections of any type as they grow in size. With the ability to add cellular modules, the EPX also provides as much cellular connectivity as needed for the company network to operate at full speed even if land lines lose connectivity. In the future when 5G gains popularity, there will be modules for it too. This makes the EPX futureproof for both bandwidth demand and for upcoming technology.

Mobile Broadband by ISP

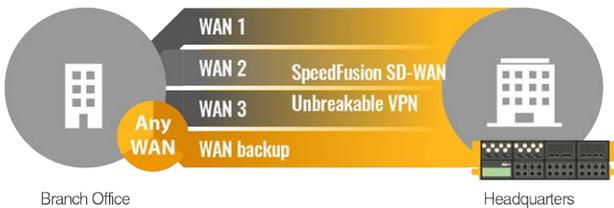
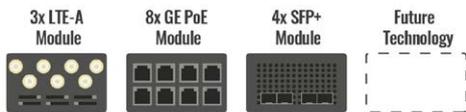
Whether providing Internet service with a Service-level agreement (SLA), or building a video surveillance streaming network, ensuring service continuity is crucial. The EPX enables service providers to build a flexible SD-WAN backhaul to the main network, incorporating as many Ethernet, Fiber, and cellular links as needed to provide fast and solid connectivity. What's more, Peplink's cloud-based management software provides you with complete visibility and control of WAN usage.



SDX

Modular Enterprise Grade Router

The SDX brings Peplink's modular technology into an enterprise branch router. In addition to popular features such as SpeedFusion SD-WAN and InControl centralised management, the SDX has an expandable module that you can change according to your needs. The SDX includes two integrated SFP+ WAN Ports, as well as eight PoE-enabled LAN Ports. These ports are available no matter which module you use.



Enterprise

1x
expandable module slots



Branch Office Network Resilience

Using SpeedFusion bandwidth bonding technology, you can combine multiple DSL, cable, 4G LTE, and future 5G links into a single high-speed SD-WAN connection. This allows access to headquarters at greater speed and reliability than you could achieve with a single link.

With each link you add, the SD-WAN connection increases its reliability. Use multiple connection technologies from diverse ISPs to provide connectivity resilience at a fraction of what it would cost using traditional WAN alone.

Expandable modules for EPX/SDX

3x LTE-A Module



Interface:

- 3x Embedded LTE-A Cellular Modems with Redundant SIM Slots

Antenna Connectors:

- 6x SMA Cellular Antenna Connectors
- 1x SMA GPS Antenna Connector

8x GE PoE Module



Interface:

- 8x 10/100/1000M Ethernet Ports*
- Capable of PoE

4x SFP+ Module



Interface:

- 4x SFP+ Ports*

* Module can be configured with LAN or WAN ports as needed.

HD4 MBX

Quad Cellular Gigabit LTE Mobile Powerhouse

Right out of the box, the HD4 MBX supports Gigabit LTE. For future technologies, the MBX features a swappable cellular module, so when you need to upgrade to 5G, you can simply swap your old one with a new one. The MBX is also capable of 2.5Gbps of throughput, giving you plenty of bandwidth for Gigabit Ethernet, 5G, or any future mobile technologies.

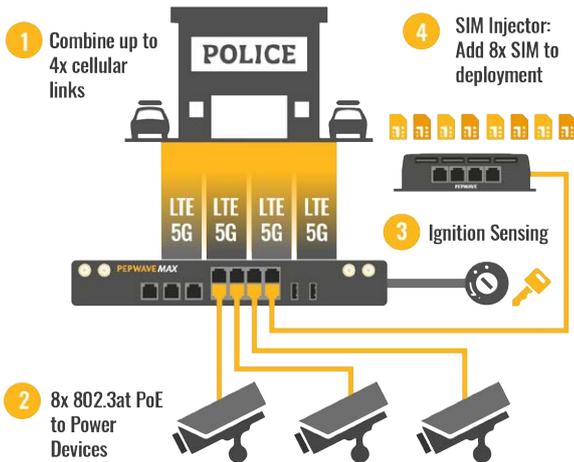
Industrial

Transport

▼ Upgradable Cellular Module, 5G



> [Learn More](#) <

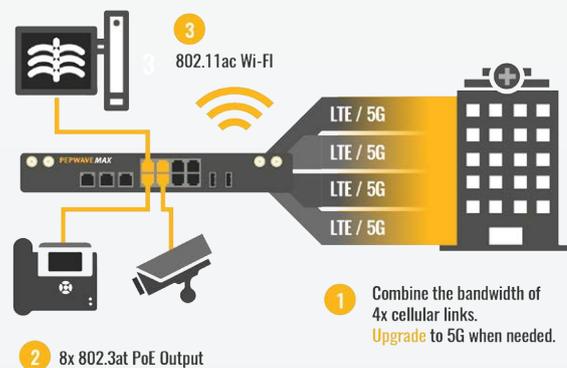


Public Safety Mobile Command

The HD4 MBX combines the bandwidth of 4x Gigabit LTE links into a fast, reliable, and secure SD-WAN connection, enabling you to stream high-definition video in real-time. This can all be achieved without investing in any infrastructure. With SpeedFusion-enabled devices on multiple vehicles and aerial resources, you can monitor the situation from multiple perspectives without needing a line-of-sight connection.

Mobile Clinic – Telemedicine

Telemedicine has the potential to improve the lives of many patients, particularly those living in remote locations without access to specialist doctors. However, x-ray images and videostreams require large amounts of data, more data than a single cellular link can transfer in a timely manner. Our Solution: SpeedFusion SD-WAN. Using this technology, the HD4 MBX can combine the bandwidth of 4x Gigabit LTE connections to form a fast and reliable VPN connection that can handle the requirements of remote diagnosis.



PDX

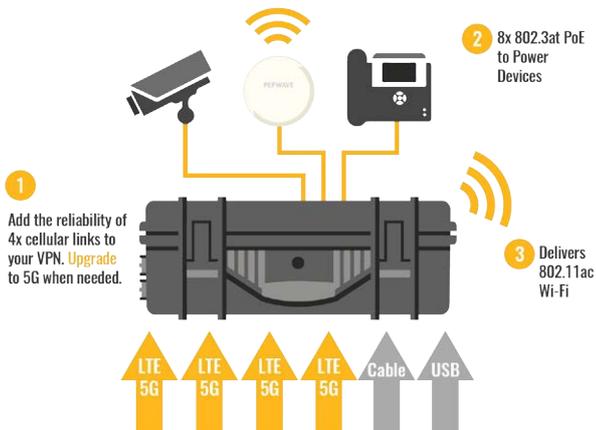
Portable, Rapid Deployable SD-WAN

The PDX instantly delivers outstanding performance from all your connections with the help of SpeedFusion bandwidth bonding and intelligent load balancing. Quad Cellular Modems and Redundant SIM slots allow you to use up to four different cellular providers for bandwidth bonding, data overage protection or eliminating blind spots. It also has a modular cellular modem, so it's ready to upgrade to 5G anytime you are.

Industrial



Upgradable
Cellular Module
Inside



Instant Connectivity for Temporary Sites

The PDX provides you with instantly deployable connectivity, available right when the first boots hit the ground. By combining the bandwidth of up to 4x Gigabit LTE connections, you can perform fast and reliable connectivity no matter where the site is located. Quickly and safely transmit project data, emails, plans, and blueprints between personnel, sites, and headquarters.

Event Live Streaming and Connectivity

Keep your event connected and your cameras streaming. With support for 4x Gigabit LTE connections, the PDX can keep your event connected no matter where it is held. The PDX has 8x 802.3at PoE ports, so you can simplify your cabling when connecting and powering your devices. It can deliver 802.11ac Wi-Fi which supports a customisable captive portal with advertisements.

