

Inside-out: choosing the right approach to accelerate cellular data indoors



inseego



Businesses need access to fast cellular data indoors

At some point, most of us have experienced the problem: We've had to step outside the building we work in to get a stronger cellular network signal. But going outside to get better cellular network access isn't a practical or efficient way to work.

Today, most businesses still rely on a copper, Ethernet, or fiber landline connection as their primary source of internet connectivity. Some do subscribe to cellular internet services as a backup to their wired connection, but it's typically only been businesses in remote or isolated areas that use cellular networks for their primary internet connectivity.

5G is changing these traditional approaches to business connectivity. And in the process, it's giving businesses new opportunities to strengthen their internet connectivity and business continuity strategies.



5G makes sense for business internet

As 5G connectivity becomes available in more locations, businesses of all types, sizes, and geographic reach are taking advantage of its many benefits. 5G is:

- **Extremely fast**, delivering speeds in the hundreds of megabits per second.
- **Extremely secure**, and includes built-in security mechanisms that make it ideal for enterprise Zero-trust Network Access (ZTNA) security implementations.
- **Extremely reliable**, with some service providers guaranteeing 99.9% network uptime in service level agreements (SLAs). [1]
- **Extremely low latency**, which is needed for consistent, high-quality access to voice and video applications.

These advantages mean more businesses want to use 5G as their primary source of internet connectivity, especially those that recognize the value a 5G private wireless network can bring to their operations. They're also looking at 5G as a backup to wired connections, and to meet temporary and mobile connectivity requirements. However, because 5G frequencies — particularly millimeter wave (mmWave) frequencies — don't penetrate well into buildings, businesses will need solutions to accelerate 5G data indoors.



Two main approaches to accelerate cellular data indoors

As businesses explore the potential to leverage 5G indoors, they'll have deployment decisions to make. The right partner works with businesses to choose the best approach for their requirements, goals, and budget, but it's important for businesses to understand the various considerations and their relationships to costs, complexity, and performance.

There are two main ways to accelerate cellular data indoors:

- An indoor-based approach
- An outdoor-based approach

With an indoor-based approach, equipment such as a 5G router or industrial gateway with an integrated or externally connected antenna assists in improving cell signals (Figure 1).

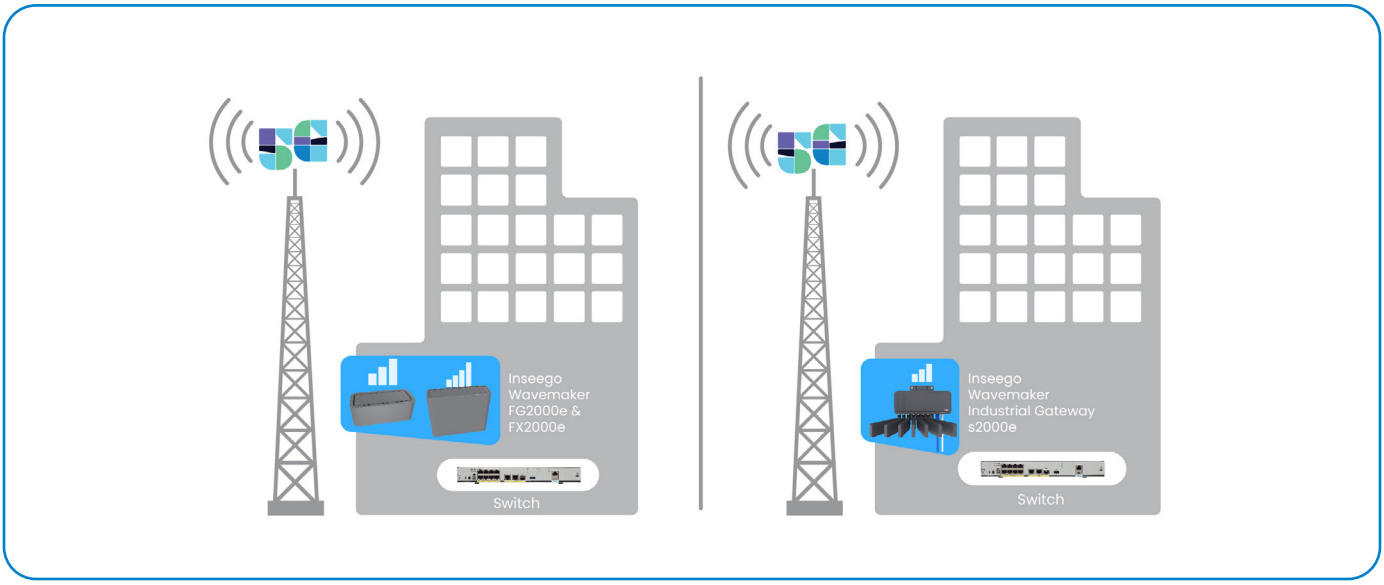


Figure 1. Indoor-based approach to accelerating cellular data indoors

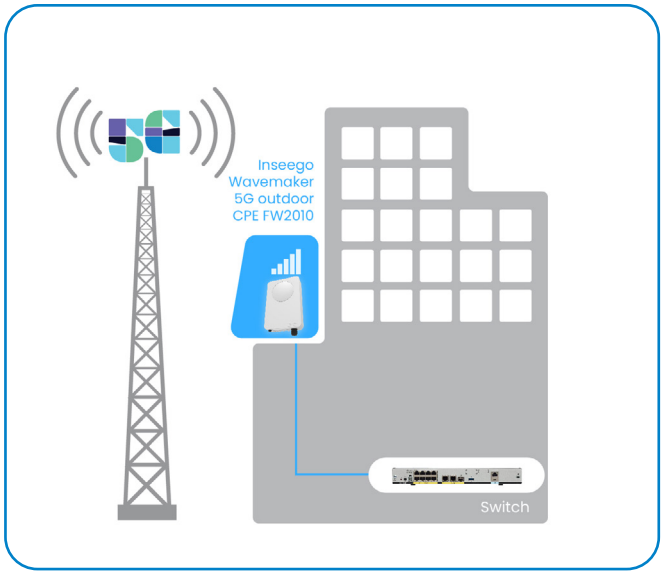


Figure 2. Outdoor-based approach to accelerating cellular data indoors

With an outdoor-based approach, a single customer premises equipment (CPE) unit that integrates antenna, router, and gateway is installed on the building to capture the cell signals, and a single Cat-6A or better Ethernet cable brings the data connectivity indoors (Figure 2).

It's also important to remember there is no one-size-fits-all approach that will work for every business. Each business location is unique, and each business has different requirements, goals, and constraints. A step-by-step analysis that starts on the inside of the building and moves to the outside helps businesses choose the right deployment approach for their situation.

An outdoor-based approach uses an integrated CPE to capture cell signals and bring connectivity indoors.

It's important to remember there is no one-size-fits-all approach that will work for every business.







Exploring the potential for indoor-based cellular data solutions

The first step is to determine whether an indoor-based solution can deliver the indoor cellular speeds needed.

If the business is located close enough to a cell tower or to rooftop antennas, the 5G signal may be strong enough to penetrate the building and deliver adequate data speeds. In these cases, the integrated antenna array, an attached paddle-style antenna, or a wall-mounted antenna captures the cell signals in the building (Figure 3).

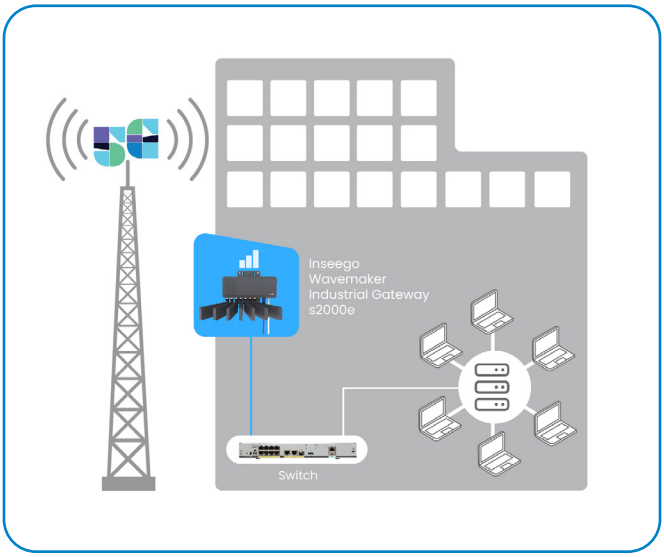


Figure 3. A 5G router or gateway with direct attached whip antennas, improves cell signals indoors

Numerous factors eliminate the possibility of an indoor-only approach

However, in many cases, an indoor-only approach isn't adequate to accelerate data speeds indoors, even when cell towers or rooftop antennas are within sight. There are several different reasons 5G cell signals are weak in buildings:

- Most modern building materials block, or significantly weaken, 5G signals. Concrete, steel, thick insulation, drywall, plaster, wood, and windows with low-E glass, tinting, and coatings such as copper alloy are all very difficult for 5G signals to pass through.
- In dense urban areas, 5G signals can bounce off buildings and other barriers and collide, significantly reducing the ability for signals to even reach the building.
- In some businesses, indoor equipment and systems generate significant electromagnetic interference that weaken whatever 5G signals have managed to permeate the exterior of the building.
- Businesses may be located at the edge of the 5G signal's reach due to the radiation pattern configured for the 5G antenna or the frequency being used.

- Businesses may be located in geographic areas that suffer from "dead zones" where cell coverage is poor or non-existent despite their proximity to towers and rooftop antennas.

Using outdoor antennas helps, but creates new challenges

In the situations listed above, and when businesses are located further from 5G antennas, a combination of indoor and outdoor equipment can be used to strengthen the cell signal in the building. With this approach, one or more outdoor antennas are installed on the rooftop of the building to capture the cell signals, and coaxial cable is used to bring the data connectivity to the router or gateway that's located indoors (Figure 4).

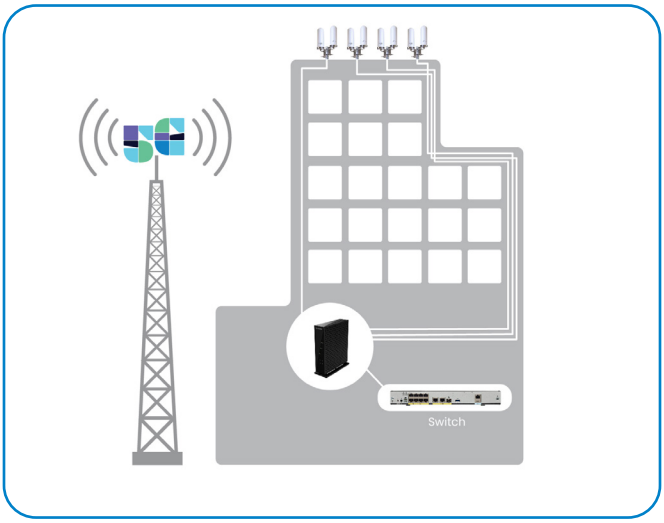


Figure 4. Outdoor antennas connected over coaxial cable to an indoor router or gateway

Unfortunately, the need to install multiple outdoor antennas and run coaxial cables from each antenna into the building increases deployment complexity and cost. Before choosing this type of deployment, it's crucial to understand all the considerations and trade-offs involved.

For example, the building location and proximity to 5G antennas determines whether high-gain directional antennas or 360-degree omnidirectional antennas are needed.

A directional antenna is more expensive to purchase, and more complex and time-consuming to install than an omnidirectional antenna, but it can focus RF energy over a longer distance to help avoid interference and capture a stronger cell signal. However, a directional antenna can usually only pick up cell signals from a single tower or rooftop. On the other hand, an omnidirectional antenna can pick up cell signals from multiple sites, but typically has shorter reach, lower gain, and can be susceptible to interference.

The building location and proximity to 5G antennas determines whether high-gain directional antennas or 360-degree omnidirectional antennas are needed.

Depending on the frequency bands being used in the facility, several outdoor antennas may be required. And every antenna requires a coax cable connection to the router or gateway in the building.

Coax cables add costs and complexity, but reduce performance

Coax cables have a major impact on overall solution cost, complexity, and performance, no matter how many outdoor antennas are required.

- **Cost.** Coax cable is considerably more expensive than Ethernet cables, particularly outdoor-grade coax cables such as LMR-400. In many cases, the cable run from the antenna on the rooftop to the indoor equipment is lengthy, which further increases the cost. And each coax cable must be connected to lightning arrestors and grounded, which requires the services of an electrician.

- **Complexity.** Because different coax cable grades are needed for different sections of the overall cable run — outdoor, indoor, and connection to the router or gateway — it's extremely important to choose the right cable grade for each section of the run. Choosing a higher cable grade than needed can unnecessarily increase solution cost and put high physical strain on antenna ports, but choosing a lower cable grade than needed can unintentionally decrease overall solution performance.

  For example, outdoor-grade coax cables are rigid and have a specific bending radius, which makes them challenging to install. They're also difficult to terminate.

- **Performance.** The longer the coax cable runs from the antenna to the indoor equipment, and the more connection points along it, the higher the signal loss before the cable reaches the equipment. Lightning arrestors also contribute to signal losses, as do imperfect cable terminations. In some cases, a higher gain, higher cost antenna may be required to compensate for the losses along the cable. Considerable radio frequency (RF) expertise is required to account for all the factors that influence overall solution performance.

With the widespread shift to Ethernet for enterprise networking, most enterprise IT teams aren't familiar with the intricacies, interconnected considerations, or skills associated with coax cable installations. These challenges add to the risk the solution will be improperly deployed and challenging to support. In many cases, third-party experts must be called in, which further increases costs and complexity.







Moving to more advanced, integrated outdoor solutions

Outdoor-based solutions are often the most cost-efficient, straightforward, and effective way to accelerate cellular data indoors when indoor-only approaches don't work. They reliably and securely deliver the required cellular data speeds, but eliminate the costs and complexity associated with deploying multiple antennas and coax cables.

With an outdoor-based solution, businesses can also take advantage of the enhanced performance and security features these solutions provide to support future use cases such as:

- New digital technologies and automation solutions that will accelerate digital transformation at their facilities
- A private wireless network that's dedicated to their facilities

With an outdoor-based solution, a single, fully integrated CPE is installed on the rooftop or wall of the building. Instead of bulky and expensive coax cables, outdoor-grade Cat6A Ethernet cable is used to carry the IP data traffic into the building (Figure 5).

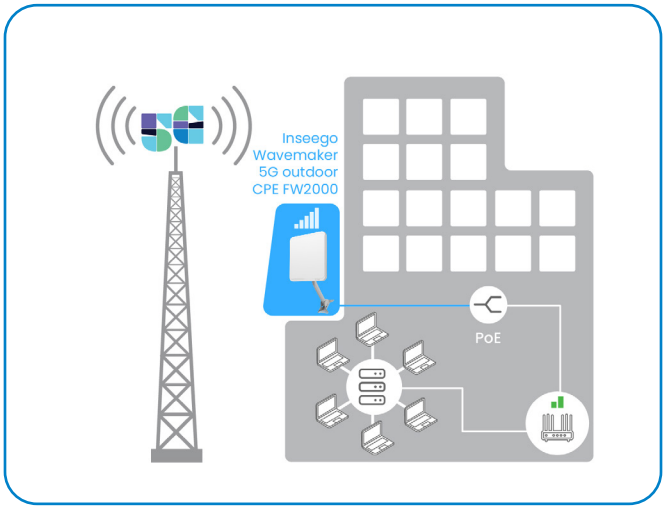


Figure 5. Outdoor antenna connected over Ethernet cable to an indoor router or gateway

Because the all-in-one CPE integrates antennas, routing, and gateway capabilities, an indoor cellular router is not required.

Advanced features and functions increase reach, performance, and security

The CPE integrates multiple high-gain, omnidirectional, and directional antennas to increase data throughput from tower and rooftop cell sites over long ranges. It also integrates advanced networking features and enterprise-grade security features that protect network connections and data against intrusion and cyberthreats.

To ensure business continuity, the CPE supports separate connections to primary and backup cellular networks with automatic failover to the backup network when needed. The individual network connections can also be used to support a public and a private wireless network with the ability to switch between the two. A robust and waterproof design protects the CPE components from physical and environmental damage in a wide range of environmental conditions.

Ethernet cabling reduces costs and complexity

The ability to use Cat 6 Ethernet cabling to connect the CPE to indoor devices eliminates the high costs, complexity, and performance issues associated with using coax cables for the same purpose. Cat 6 Ethernet:

- Costs considerably less than coax cables
- Significantly simplifies cable selection as only outdoor- and indoor-grade cables are required
- Maintains signal integrity over the full length of the cable run
- Can be installed by most enterprise IT staff as they're already familiar with the task.

Physical and strategic business considerations also influence decisions

In addition to exploring the cost, complexity, and performance of the various approaches to accelerating cellular data indoors, businesses must also consider factors related to the building itself.

For example, if the building is leased, there may be restrictions that limit or prohibit equipment installations on the building roof or exterior walls. In some cases, businesses may be required to submit detailed plans for installation and risk mitigation before approvals are granted. Similarly, there may be restrictions on creating new entry points into the building for coax or Ethernet cables.

Businesses must also consider their own operations. For example, businesses with multiple departments, or that host other businesses, may need to provide different cellular data speeds, performance levels, and security to the various parts of their overall operations. In these cases, multiple solutions may be required to meet different requirements and keep data separate.



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Inseego brings 5G to businesses in whatever way they need

Inseego has deep experience developing 5G solutions and understands all the factors that must be considered before choosing solutions to improve cellular data speeds in buildings. We partner closely with each business to discuss the pros and cons of each approach based on their unique needs, budget, constraints, and short and long-term goals.

To support businesses of any size, in any location, and with any combination of use cases and requirements, we offer a complete range of field-proven, cloud-managed, indoor & outdoor connectivity solutions. Our portfolio includes:



Inseego Wavemaker 5G indoor router FG2000 supports public and private networks, including those that use the Citizens Broadband Radio Service (CBRS) band. FG2000 offers advanced routing capabilities such as concurrently connecting 128 Wi-Fi enabled devices with dual-band Wi-Fi 6, 4x4 MIMO, and multiple Ethernet LAN ports for high powered data usage and versatility to fit your business needs. Dual-SIM support is a great option for businesses looking for flexibility in their connectivity solutions.



Inseego Wavemaker 5G indoor router FX2000 is a cost-effective and flexible indoor router that offers dual-band Wi-Fi 6 for up to 30 connected devices, with USB, and an Ethernet LAN port that supports up to 1 Gbps. FX2000 is a compact, plug & play solution for businesses looking for a secure and reliable solution for day 1 connectivity at their job site.



Inseego Wavemaker 5G industrial gateway S2000 brings secure, reliable, high-performance 5G connectivity to multiple remote devices and offers flexible external antenna and mounting options as well as multiple power inputs, for almost any application in any environment. S2000 is optimized to operate in an extended temperature range and has proven to sustain the fastest speeds longer than other competitive devices.



Inseego Wavemaker 5G outdoor CPE FW2000 combines multiple high-gain directional antennas with routing and gateway capabilities in a secure and robust outdoor device that can sustain 5G speeds 24x7 and is built for harsh environments with an IP-67 rating. Our custom internal antenna design extends the carrier's network and provides connectivity to previously hard to service locations.



Inseego Wavemaker 5G outdoor CPE FW2010 boasts multiple high-power mmWave antennas in a single device to extend the reach of 5G so businesses can support new use cases and deliver new experiences to more places. FW2010 is built to support the sustained high speeds that 5G offers and is built for harsh environments as it is IP-67 rated.

Businesses trust inseego to accelerate cellular data indoors

We've helped a wide range of businesses improve cellular data speeds indoors to increase flexibility and improve business continuity. Here are just three examples:

- The fastest-growing independent hardware distributor in the world relies on our Inseego Wavemaker FW2000 series 5G outdoor CPE for backup connectivity at distribution locations and for temporary internet access at industry trade shows.
- A privately held retailer with more than 1,000 stores across 46 U.S. states relies on our FX2000 series 5G indoor routers and FW2000 series 5G outdoor CPE to reduce downtime for processing retail transactions and as a low-cost alternative to a secondary wired connection.
- A government medical group relies on the FW2000 series 5G outdoor CPE for primary internet connectivity at new sites and for backup internet connectivity at existing sites.

To learn more and set up a demo with one of our experienced Solution Architects click here.



Learn More

To learn how we can help your business take advantage of 5G and accelerate cellular data indoors, visit our website or contact us.

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