

# The indoor quality of experience for 5G is just as important as the outdoor experience

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Outdoor deployments took priority over their indoor counterparts in previous generations of mobile networks. This often led to a situation where users received a strong, reliable signal when moving around outside, but inconsistent performance within buildings. This resulted in black spots and dropped calls in large buildings, which undermined many enterprises' efforts to implement mobile-first strategies as part of their digital programmes. In turn, this limited operators' ability to monetise their networks.

It is more important than ever for users to have a consistent, seamless and high-quality experience with 5G, whether they are outdoors or deep within a building. 5G has the ability to enable a very wide range of applications and use cases because of its support for high bandwidth, low latency and high device density. It is central to the digital transformation initiatives within many industries, and supports new ways of communicating, working and playing, from extended reality to sensor-based automation.

## The indoor 5G experience needs to be fully aligned with the outdoor experience

The capabilities of 5G must be supported just as well within enterprise buildings as outside them, and users must have an unbroken experience as they move in and out of premises. This means that, for the first time, operators and businesses have a strong motivation to invest in in-building wireless networks to the same extent as outdoor networks. Innovations that are emerging in the 5G era will not only have enhanced business cases, but they will also use advanced technologies in order to enable a superior in-building mobile experience.

For the first time, networks will be deployed where the importance of the indoor quality of service is equal to that of the outdoor quality of service, rather than being an afterthought. Indoor and outdoor coverage must therefore be planned and optimised as a single network, supporting a holistic experience and a common set of applications.

This has challenges. Indoor cellular systems need to behave in different ways to those outdoors. They have different power limitations and backhaul requirements. They often need to support more people and devices per square metre and they may need to integrate with other IT systems such as LANs or edge computing.

Technologies have been evolving to meet these indoor needs, but each solution had its shortcomings in earlier network generations, and there was very limited alignment with outdoor networks.

## A range of solutions is needed, from massive MIMO to small business units

At first, the main indoor solutions were distributed antenna systems (DAS) for large premises and small cells. In recent years, we have seen the emergence of digital indoor systems (DIS), which have addressed the

disadvantages of both of the first-generation approaches using powerful centralised baseband units with Ethernet and fibre cabling to maximise scalability and ease of deployment.

DIS have evolved significantly for the 5G era and now incorporate technologies such as massive MIMO to enable even greater performance and scalability. Most importantly, DIS allow indoor networks to be planned and deployed in parallel with outdoor networks. Massive MIMO has typically been associated with outdoor macrocells, but its capabilities now extend indoors as well, in solutions such as Huawei's LampSite. In this case, the outdoor base station has a 64T64R antenna and the indoor system (LampSite with massive MIMO) incorporates a virtual 64T64R architecture within a single cell in order to support multi-user MIMO and distributed beamforming. This improves the quality of experience for every user, even in difficult-to-reach parts of the building, and makes it more practical to use high-frequency spectrum bands, which offer high capacity but very short range.

Approximately 20% of indoor sites have high traffic levels and will need a capacity expansion in the next 2–3 years, but others have low traffic levels and may be harder for operators to monetise. This is why indoor solutions must come in a variety of form factors that can be combined to achieve the optimal balance of cost, capacity and coverage for operators and users. For example, Huawei's family of DIS ranges from top-end MIMO and metro and campus models to LightSite (suitable for a smaller premises) and LampSite Spartan (a low-cost, small-footprint design for small businesses). The portfolio also includes LampSite Sharing, a multi-operator solution for locations (such as shopping centres) in which customers of several MNOs will be using the network.

## Operators in Europe and China are leading the early large-scale indoor 5G deployments

The early demand for indoor 5G networks has been high; over 30 operators in more than 20 countries have deployed 5G DIS in indoor/outdoor environments such as stadiums, campuses, large hotels and transport hubs.

For example, there have been projects to replace DAS with 4G and 5G DIS in locations in Europe such as the Zurich Messe conference centre and hotels in Switzerland. Shopping centres and events venues have been the main focus so far in the Middle East, while the top five environments for 5G DIS adoption in China are traffic hubs, commercial offices, operators' own shops, large events venues and government buildings.

Cities and governments are demanding excellent indoor coverage to enable a wide range of services for their citizens. For instance, the municipal government of Shanghai, China publishes a report measuring the mobile user experience in different parts of the city. In the 4G era this mainly focused on outdoor environments, but in the 5G era, the ratings also apply to hospitals, shopping centres, transport hubs, university campuses and other indoor/outdoor areas, which shows how governments are now pushing operators to enhance the mobile experience wherever users go.

As more businesses and consumers adopt 5G and use it to support new applications and ways to work and play, there will be an even wider variety of environments in which excellent indoor/outdoor 5G experience will be essential. This is why it is so important that a flexible, scalable solution is available, which can be deployed now to support current usage patterns, and then be extended or adapted in an elastic way to enable future locations and use cases. In this way, for the first time, there will be no quality of service difference for 5G users, whether they are indoors or outdoors, and this in turn will provide operators with many new ways to monetise their 5G networks.