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Perspective

5G scenario assessment: optimal deployment priorities for MNOs

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RESEARCH

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1. Executive summary

The 5G network will enable many industries worldwide to carry out digital transformation projects throughout the 2020s. This is partly because of 5G's high data rates, which support fibre-class speeds combined with mobility. More importantly, 5G's flexibility enables it to support a wide variety of capabilities, including ultra-low latency and critical availability, depending on the requirements of each use case. This will be critical to ensure that each industry and application can access the exact performance that it requires.

This combination of versatility and performance is enabled by the cloud-native 5G core, which mobile network operators (MNOs) started to deploy commercially in 2020. The core will give MNOs considerable flexibility to support any application that has the potential for strong revenue growth, and to ensure that each use case is supported with the right network resources and capabilities. The core provides the foundations for a broad-ranging 5G business model that addresses many industries, but to maximise its commercial impact, MNOs need to make clear choices about the best markets to target first.

A return on investment and revenue growth will both be maximised if the MNO selects some business-to-business (B2B) targets that will deliver quick wins, and others that will take longer to be adopted at scale but will enhance the business case from the mid-2020s. The effort of optimising the network and building channels and ecosystems can then be prioritised for the most-immediate target markets first, while the flexibility of the core will enable additional new revenue streams to be added smoothly in the coming years.

This report identifies the six strongest B2B 'scenarios' on which MNOs can build a strong 5G business case that provides some immediate gains and also grows over the whole period to 2030. A scenario – as distinct from an individual application, service or use case – is a broad capability that is enabled or significantly enhanced by 5G and can be applied to multiple industries and multiple applications, and so delivers maximum returns when supported by the 5G network.

In the first quarter of 2021, Analysys Mason undertook a detailed assessment of a long list of scenarios and use cases to understand those with the greatest potential to enhance the 5G business case. We defined a methodology to identify those B2B scenarios that will support the best commercial opportunities for 5G MNOs in the near, medium and longer term, and that align best with the timescales for enterprise demand. Each scenario was rated according to a complex matrix of technical, ecosystem and commercial criteria (see Figure 2.5). The six scenarios that were selected were as follows.

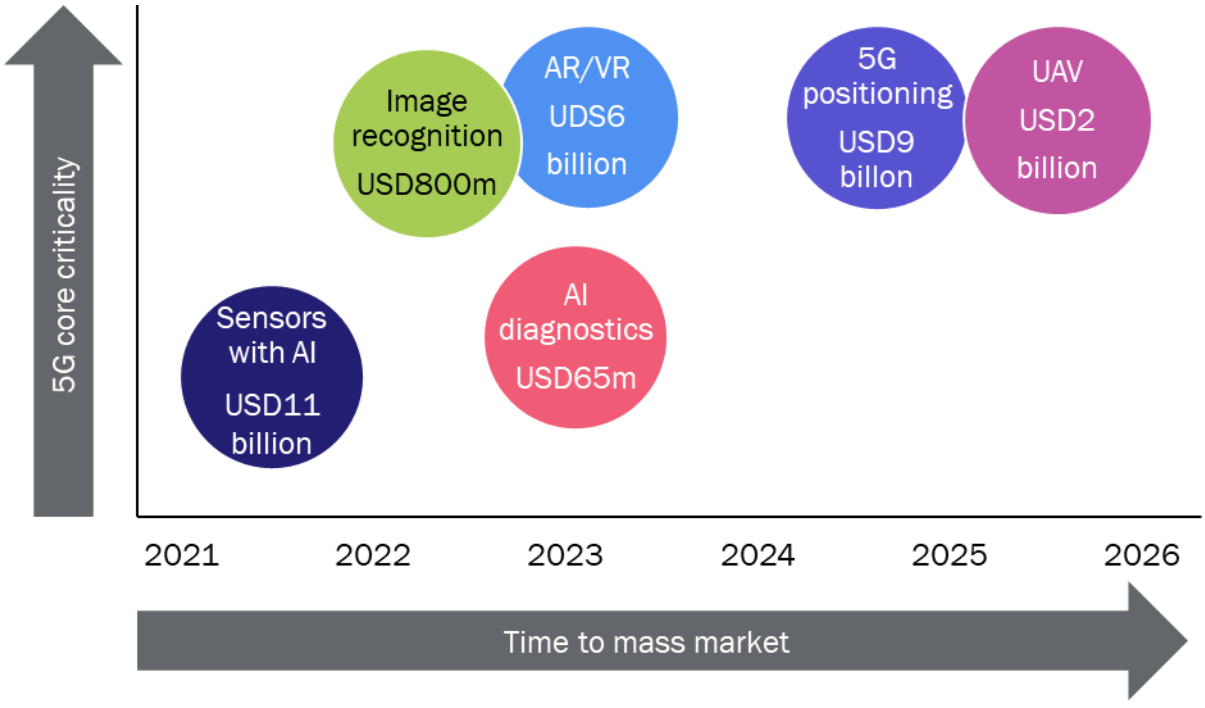
- 5G-enhanced augmented reality and virtual reality (AR/VR) for B2B environments (for example, in industrial digital twin or training systems)
- Large-scale sensor networks, including AI-enabled data analytics (for instance, in smart cities)
- Industrial vision and image recognition
- Remote-controlled 5G UAVs (unmanned aerial vehicles) or drones
- AI-assisted remote diagnostics (for example, in healthcare or preventative maintenance)
- 5G positioning (for example, in emergency response applications).

Analysys Mason also conducted a survey of 78 MNOs worldwide, in the 4Q 2020, which focused on 5G deployment plans and timescales, and the most-important use cases. This survey found that MNOs have a high awareness of the value of a scenario approach, which can deliver greater commercial benefits than focusing on individual use cases on an ad hoc basis. Among Tier-1 and Tier-2 MNOs with commercial 5G non-standalone (NSA) networks, 42% expect to support at least three of the six selected B2B scenarios by 2024.

The survey also showed that those MNOs with a strong B2B plan will be the first to deploy 5G cloud-native cores at scale. Across the full sample, 41% expect to begin to deploy the 5G core by 2024, but among those MNOs planning to support at least three different B2B scenarios, the adoption of the 5G core is far more rapid, with 70% planning to start deployment by 2024.

This highlights the fact that MNOs with the most-ambitious plans to expand their B2B business with 5G will combine early deployment of a cloud-native 5G core with careful assessment of the best scenarios to target in their particular markets. The most-successful B2B MNOs will undergo migration to the 5G core at an early stage, in parallel with the work of defining target industries and use cases and building ecosystem and channel partnerships. These activities will put these MNOs in the strongest position to take advantage of many 5G B2B opportunities as they emerge at different stages during the 2020s, because they will have the technical and commercial platforms in place to support a huge diversity of services and requirements.

Figure 1.1: Summary of the results of the 5G B2B scenarios assessment, indicating the timescale and projected scale of the opportunity, its reliance on the 5G core[1] and the revenue potential for MNOs,[2] 2021–2026



Source: Analysys Mason

[1] The performance capabilities required by each scenario were assessed in relation to seven key capabilities enabled by a 5G core (see Figure 4.2), to arrive at a rating of how far the 5G core is critical to supporting this scenario, on a scale of one to seven

[2] Revenue refers to the sum that we forecast will be addressable by MNOs in the year 2026, and not the total revenue available across the value chain for this scenario.

It should be noted that this report focuses on B2B opportunities for 5G MNOs based on 'scenarios', as distinct from individual applications, services or use cases. These scenarios are examined in detail in Chapter 4. An example is 5G-enhanced AR/VR, a capability that, once deployed, can enable many services for many sectors, including the entertainment and media industry, training and education, manufacturing, and retail. Deploying these foundational capabilities – in order to enable a wide range of services for multiple industry sectors – is made possible by the introduction of the 5G core.

2. B2B services will be essential to the 5G business case, but MNOs must prioritise the most attractive scenarios

2.1 B2B services will be central to many MNOs' 5G business cases

The business case for 5G relies on the new networks generating significant new revenue. Some of these high-growth, 5G-enabled services will be consumer-focused, such as enhanced cloud gaming or media streaming. However, there will be even higher potential for MNOs to increase 5G-enabled revenue in the B2B sector, where there is rising demand for high-quality mobile connectivity to support critical processes and underpin digital transformations. Analysys Mason estimates that, while consumer services will remain the largest element of 5G revenue in 2026, MNO revenue from 5G B2B customers will grow at a high rate, at a CAGR of 56% between 2019 and 2026, which represents significant growth opportunities.

Investments in 5G networks will reach USD1 trillion worldwide by 2025 according to the GSMA,[3] which also cites several studies of the economic impact of 5G. Much of this will be achieved by enabling advanced B2B services that will allow enterprises to accelerate their digital transformation within frameworks such as Industry 4.0.[4]

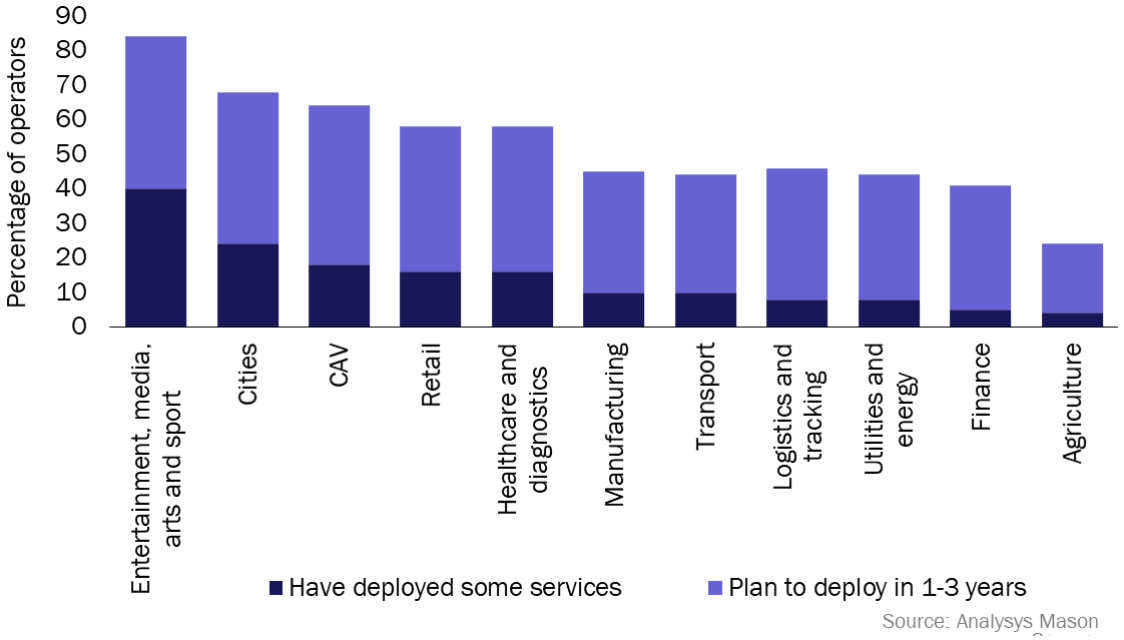
Many MNOs recognise that the potential for growth will be higher by expanding their platforms to support new 5G-enabled B2B use cases. Some are already beginning to deploy some services and are reporting a positive impact on their KPIs. For example, China Mobile deployed the 5G core in 2020 and has developed 470 5G private network projects covering 100+ application scenarios.

Figure 2.1 below shows the significant number of MNOs worldwide that plan to leverage their 5G networks to deploy some B2B services in the early stages of their commercial 5G roll-outs, in the period to the end of 2024. Analysys Mason conducted a survey of 78 Tier-1 and Tier-2 mobile MNOs worldwide, all of which will have commercial 5G networks in operation between now and 2024. It found that over 85% of MNOs plan to launch new commercial 5G B2B use cases for at least one industry sector by 2024. The industries in which MNOs have most commonly launched commercial 5G use cases already include entertainment and media, smart cities, automotive, retail and healthcare. In many cases, MNOs are first extending mobile broadband capabilities to these B2B segments, and then planning to offer a greater diversity of use cases to these enterprises when they have implemented the 5G core and enabled features such as ultra-low latency.

[3] GSMA = Global System for Mobile Communications

[4] Industry 4.0 refers to the 'fourth industrial revolution', in which physical production and operations are transformed with smart digital technology, machine learning and big data.

Figure 2.1: Commercial deployment of 5G B2B services by MNOs as of 4Q 2020, and plans to deploy in 1–3 years, by industry sector. Source: Analysys Mason's survey of 78 Tier-1 and Tier-2 mobile MNOs (4Q 2020)



MNOs' plans to enable innovative new services for enterprise customers demonstrate how important B2B use cases will be to the business case. Projections by GSMA and other MNO groups[5] suggest that a B2C-only 5G business model will deliver single-digit annual revenue growth between 2021 and 2026 but adding B2B services for multiple industry sectors can improve an MNO's revenue, and other KPIs, significantly.

Analysys Mason's survey of 78 MNOs revealed that only 15% of MNOs believed that they would achieve strong return on investment (ROI) on their 5G deployment without also generating significant brand-new revenue streams in enterprise, industrial and IoT markets within 5 years of launch.

The targeted business benefits of a 5G B2B roadmap include the following.

- The ability to target new enterprise customers, or to improve strategic position with existing enterprise users using added-value services.
- Improved connectivity revenue. The addition of high-value capabilities such as enhanced security or ultra-low latency can increase ARPU and revenue per GB by a projected 6–7 times compared to consumer mobile broadband.
- The 5G core enhances the MNO's ability to participate in a bigger share of the value chain for a particular scenario such as AR/VR, diagnostics or sensor networks. For instance, the MNO can provide analytics, end-to-end services and developer platform services, on top of the connectivity.
- Reduced churn since strategic enterprise services have greater 'stickiness' than consumer services.
- Improved profitability. In order to support high-value B2B services, MNOs need to invest in advanced 5G capabilities, as well as new partnerships and customer relationship resources. However, once platforms are

[5] For more information, see GSMA Intelligence (2020), *The 5G era for MNOs: investing in core networks, capturing B2B opportunities.* Available at: https://data.gsmaintelligence.com/api-web/v2/research-file-download?id=54165509&file=200520-5G-B2B.pdf.

in place, MNOs will be able to activate an increasing number of services and cater to more industries on common foundations, which will steadily improve margins and ROI.

2.2 5G will also help to improve enterprises' business cases

These projections by MNOs, as summarised in Figure 2.1, are reliant on the strength of enterprise demand for 5G and, indeed, enterprises across many geographies and vertical sectors also increasingly see 5G as an important enabler of their digital transformation strategies.

Many of 5G's capabilities were only previously available with fixed networks, but in the 5G era, many enterprises and industrial sectors also want the mobility, flexibility and ubiquitous coverage that mobile connectivity brings. Many enterprises require more than just fast, high-quality mobile broadband to support their transformation, and 5G can deliver all their requirements.

This is because it can deliver high-quality, ubiquitous connectivity that can connect millions of users – and potentially billions of devices – to enterprise data processing and cloud platforms. It can also be integrated with mobile edge and artificial intelligence/machine learning (AI/ML) systems to deliver rich analytics and predictions to support rapid and high-quality decision making.

5G is expected to increase the impact of other emerging enablers of digital transformation such as cloud services, AI/ML, automation and industrial AR/VR. When these are supported by high-quality 5G connectivity, they are expected to have an enhanced effect on improved customer experience, decision making and operational efficiency.

On one hand, 5G will improve the performance of existing applications (for example, solutions leveraging IoT and cloud technologies). In the public sector, for example, the wide availability and strong device density capabilities will enhance the delivery of broadcasting video of city-wide surveillance cameras over wireless networks and will enable the use of advanced technologies such as facial recognition. However, combined with the use of technologies such as AI, robotics or advanced AR/VR, it will enable a variety of new solutions across different sectors (such as remote control of industrial drones, or VR video conferencing between patients and doctors with AI-assisted diagnosis).

Most importantly for many enterprises, 5G can do all this in a way that can be uniquely tailored to the organisation's specific requirements for capabilities such as real-time response, or support for vast numbers of sensors.

2.3 The 5G core will be essential to enable MNOs to address these complex requirements

Enterprises have high expectations of 5G, and their needs will be complex and highly specific to their own industry. This presents some challenges for MNOs.

The main challenge is that each industrial sector or enterprise will have different requirements. In one scenario, a manufacturing plant (for example) may prioritise ultra-low latency combined with high traffic flows; in another scenario, a public safety provider may require a constant stream of information with low data volumes, but with a requirement for unbroken availability and complex analytics.

In the past, it would have been economically challenging for an MNO to support a different combination of network capabilities for each sector or enterprise. The 3G and 4G business model was predicated on delivering

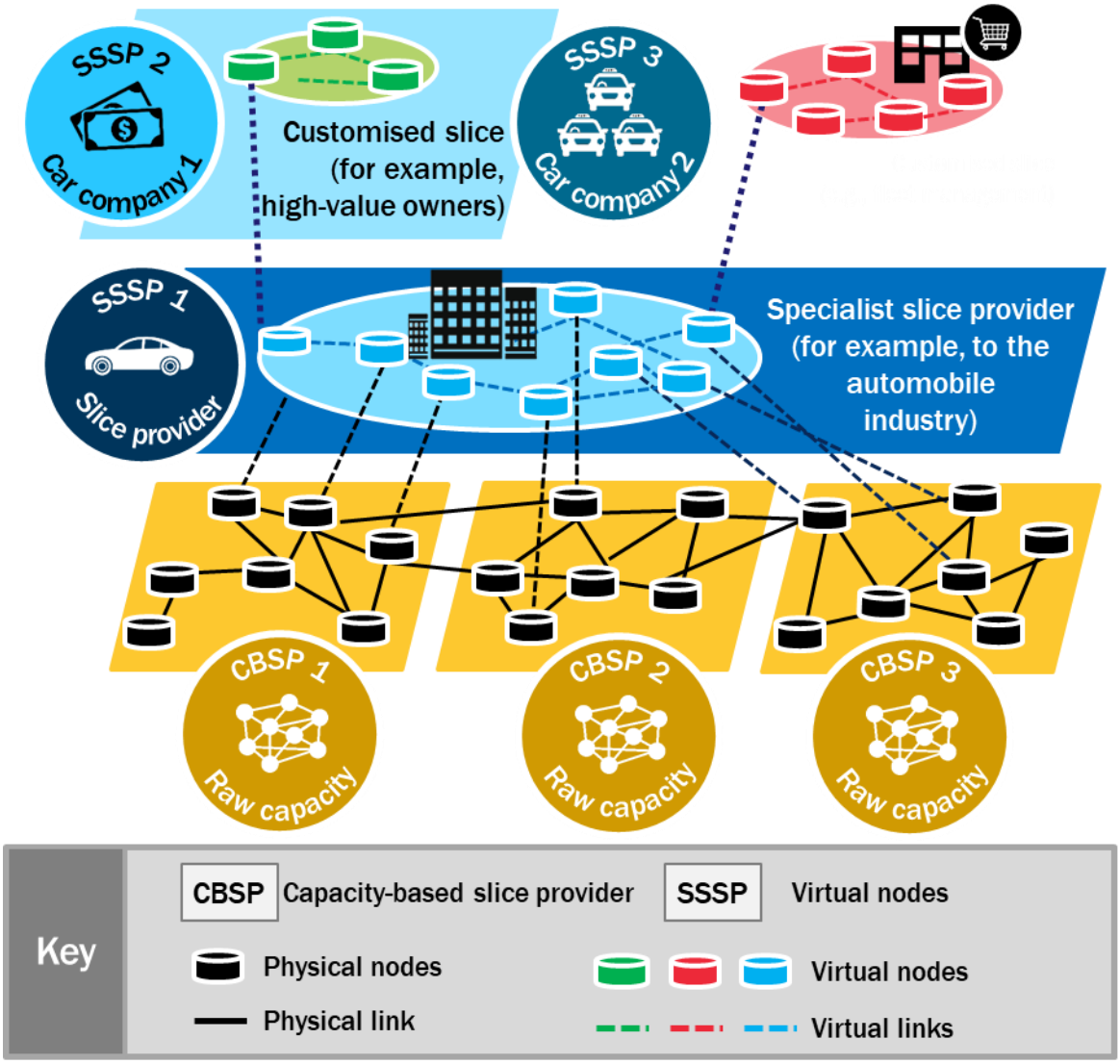
high-capacity mobile broadband connectivity in a common way to all users and applications. Customising a network for a specific customer was, in most circumstances, cost-prohibitive for the MNO and the user.

The situation is very different in 5G because of the radical new architecture of the 5G core network. The 5G core does not just deliver higher data rates than its predecessors, but it also supports a wide variety of other capabilities. These include ultra-low latency, critical availability, enhanced security and support for massive numbers of sensors and devices. A single 5G network can be implemented to optimise any combination of these capabilities, according to the requirements of different use cases and usage scenarios. That enables the network to support a wide diversity of applications, including mission-critical functions for enterprises.

The architecture of the cloud-native 5G core therefore greatly increases the versatility of the network to support many different enterprise requirements and use cases. The 5G core is multi-access, which means it can provide intelligent management of many connectivity types, not just 5G – many enterprise applications may use specific IoT connections such as LTE-M, as well as 5G and 4G.

More importantly, the 5G core is implemented as microservices, which allow network resources to be scaled up and down on-demand to suit the needs of individual services or users and enable the MNO to create virtual ‘slices’ of the network, optimised for the needs of a particular sector, enterprise or use case. For instance, an ultra-low latency slice would ensure that sub-millisecond response times were guaranteed for users or applications that rely on that capability, allowing the MNO to deliver high-value applications in sectors such as public safety.

Figure 2.2: Constructing service-specific slices from cross-domain capacity-based slices, shown using an example from the automobile industry



Source: Analysys Mason

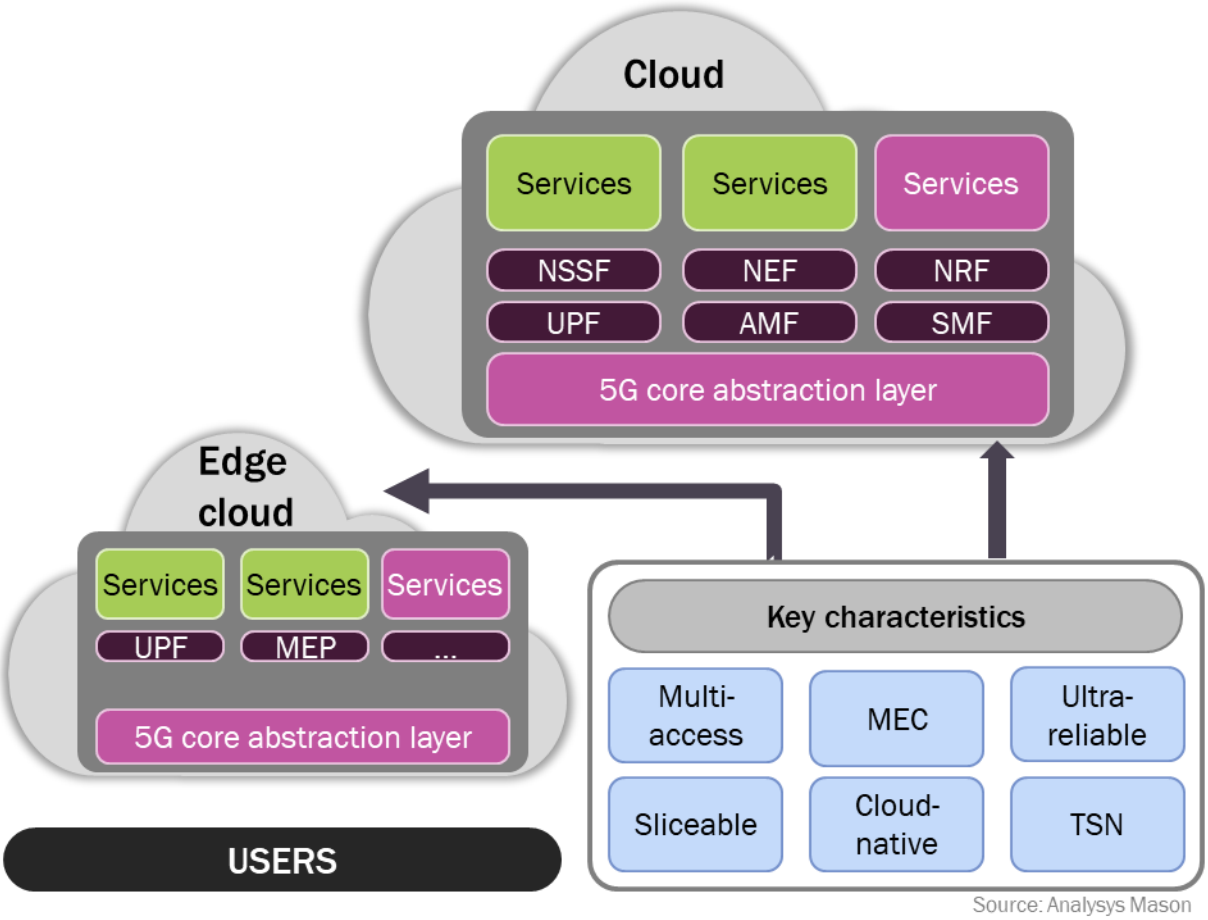
This enables MNOs to build a common service platform that can automatically and flexibly assign the appropriate connectivity, application and analytics resources to each customer or use case. That, in turn, allows the unique requirements of each scenario to be supported, which will generate new revenue and enterprise market share for the MNO, while retaining attractive economics because all the capabilities are enabled from a common platform.

This flexibility also considerably improves the economics of supporting many use cases. Typically, the percentage of total 5G investment that goes towards the 5G core and associated multi-access edge computing (MEC) will be far higher than in 4G – in which the figure was only 10–20%. Yet the new platform can support many more revenue streams. High-quality services are more practical and affordable to support when networks are deployed in a distributed way, bringing core, MEC and data processing capabilities close to the users. China Mobile, for example, has deployed MEC in 290 cities, by contrast with a 4G province-based layout of only 31 sites to support the core. Many MNOs are, similarly, considering a very distributed 5G core deployment to improve bandwidth and latency.

5G has the capability to play a broader role in enabling social and economic change than 4G or 3G did, and to drive digital transformation in many industries worldwide.

Figure 2.3 summarises the 5G core's capabilities.

*Figure 2.3: Key capabilities of the 5G core, with central and local enterprise instances**



* The local enterprise core runs on an edge cloud platform that is close to the users, and only needs to support a subset of the 5G core's components.

The impact of the 5G core is not only seen in an improved business model for MNOs or enhanced performance for enterprises. If industries can accelerate and improve their digital transformation processes, they will also achieve efficiencies, revenue growth and a competitive advantage that will have an impact on the whole socio-economic success of their region or industry. This has led many governments to give 5G a central role as an enabler of their national strategies for digitalisation, to support social and economic progress and to provide an environment in which industries can be as competitive as possible.

These trends provide powerful incentives for MNOs to deploy a sliceable, cloud-native 5G core, since this will support the service delivery capabilities of 5G to the maximum. Most MNOs have deployed 5G first in NSA mode, which still relies on the 4G packet core. While this delivers immediate commercial and user experience benefits in established mobile broadband services, the migration to the 5G core will open up the new B2B opportunities as outlined above.

At the start of 2021, a small number of MNOs began to implement 5G standalone (SA), including the three MNOs in China, which have already reached scale, plus Telstra in Australia and T-Mobile in the USA. During 2021, that number will increase significantly.

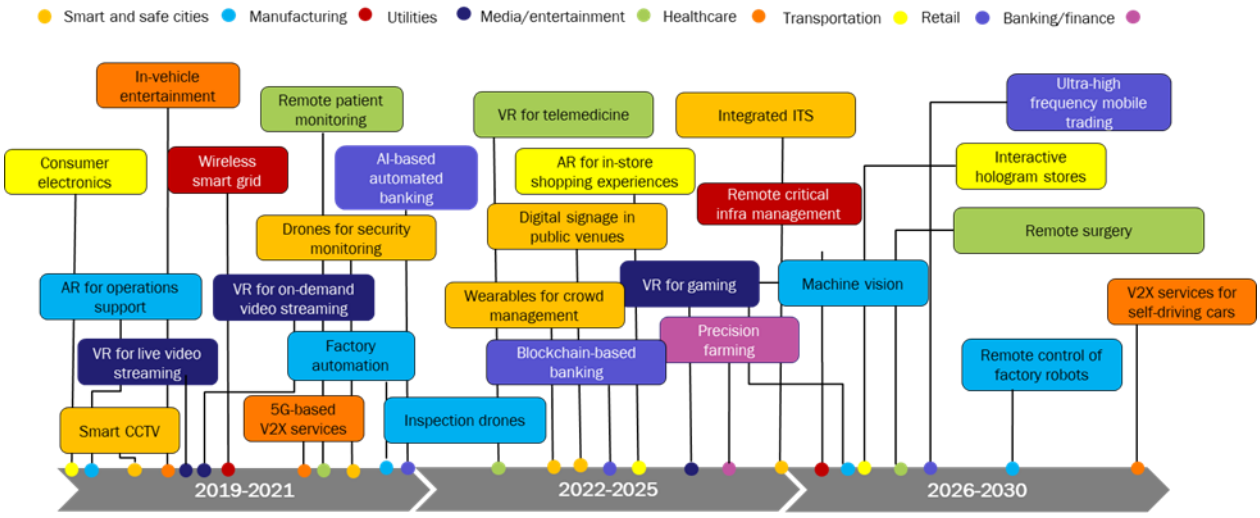
2.4 MNOs must identify the optimal combination of near- and longer-term B2B scenarios, and align their plans with enterprise needs

Despite all its advantages, the 5G core represents considerable cost and migration effort for MNOs, so it is essential that they define a clear ROI case. This will entail identifying the B2B scenarios, in their own markets, where they can achieve revenue growth and other KPIs such as increased profitability or market share.

Ideally, MNOs will identify some scenarios that will deliver these benefits in the short term, and others that may have longer-term potential but will continue to enhance the ROI case for the 5G core throughout the life of the network. Figure 2.4 indicates the complexity of the B2B landscape for MNOs. Based on profiling of a group of developed 5G markets, the chart highlights just a small selection of potential 5G B2B applications, targeting a variety of different vertical sectors and maturing in different timeframes throughout the decade. None of these applications on their own will deliver sufficient revenue to justify investment in a high-quality 5G network, but MNOs that implement an agile platform based on the 5G core will be able to develop and launch new services on a continuous basis, in response to changing market demands.

This will result in a wide portfolio of applications that can address diverse requirements from a unified platform, and that will, collectively, increase the MNOs' revenue significantly. On average, according to our survey of 78 MNOs, MNOs are targeting an increase in enterprise revenue of 120% and 360% in the first 5 years of deployment of the 5G core and a B2B services platform, compared with 4G enterprise revenue (excluding connectivity-only).

Figure 2.4: Examples of 5G B2B applications by projected timescale for mass deployment, and by vertical sector, 2019–2030

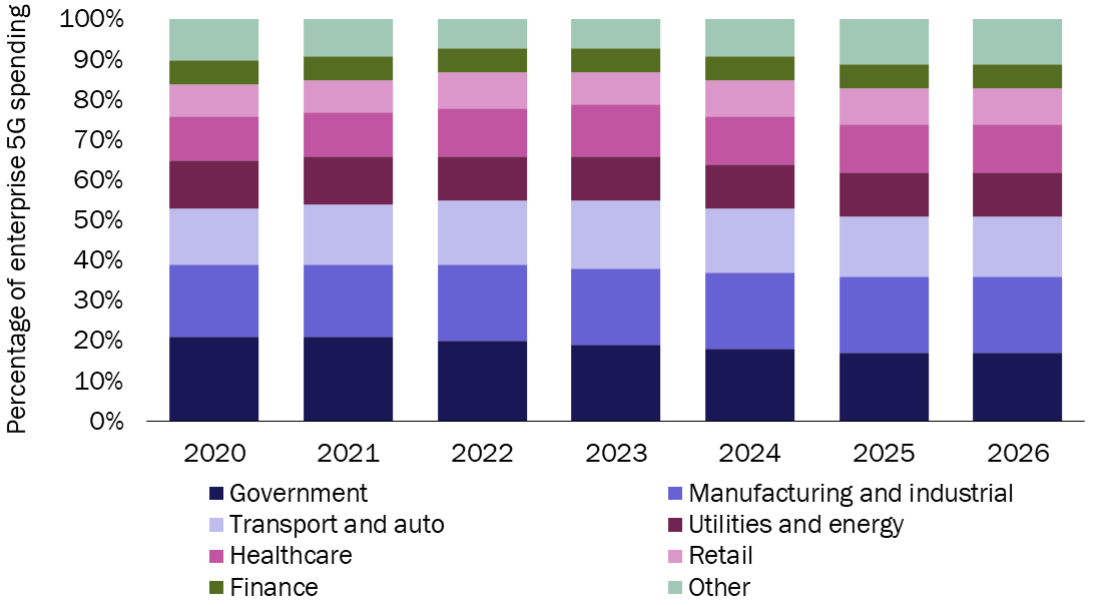


The industries that most value the potential of 5G may also be the most demanding in terms of their 5G requirements. For instance, it may be relatively easy for an MNO to adapt a 5G video capability that was deployed for consumers in order to support the B2B2C needs of an enterprise such as a broadcaster. It is likely to be more challenging to enable a remote-controlled UAV system from scratch, and so the value to the

customer base must be clearly proven. Most MNOs will aim for a mixture of low hanging fruit and more challenging services when they consider their B2B roadmaps.

Geography and vertical industry will be two of the main considerations in selecting the 5G capabilities to prioritise for short-term investment, and those that will promise returns in a longer period of time. According to Analysys Mason modelling, key verticals are moving at different rates in their plans to adopt 5G to support their own digital transformations. Figure 2.5 shows the industries that expect to adopt 5G – often in conjunction with new cloud/edge platforms – to support new or significantly enhanced digital processes.

Figure 2.5: Percentage of enterprise spending on 5G services by key vertical, worldwide, 2020–2026



Source: Analysys Mason

There are also certain geographical markets where adoption of advanced 5G B2B services will be faster than others due to a combination of factors. These include the progress of digital programmes such as Industry 4.0 in that market; the status of 5G deployments, especially including 5G SA; and facilitation by government incentives and testbeds or regulatory policy. China, Japan, Germany, the USA, the United Arab Emirates, South Korea and the UK are among the markets where all three of these conditions have been met, and adoption of 5G B2B services is expected to grow rapidly in multiple industries in the early 2020s.

3. Six scenarios provide the maximum potential for MNOs to monetise 5G in B2B markets

The 5G core will be the critical enabler of a B2B business model that can support multiple industries, use cases and network requirements from a common platform. However, it is impractical for MNOs to support every possible 5G capability and service from day one. That may be technically possible because of the flexibility of the 5G core, but each industry and scenario will also require investment in new channels to market, delivery and management frameworks, as well as ecosystem partners.

To ensure that the effort of developing these ecosystems is aligned to a revenue opportunity, it is essential that MNOs clearly identify the best B2B opportunities to target in the near, medium and longer term in order to maximise ROI. The core and RAN can support a diversity of use cases, but the MNO must also consider other factors that need to be put in place for each industry and service. These include channels to market, sales and marketing strategies, developer and ecosystem partners, and device portfolios.

In other words, an MNO cannot pursue every B2B opportunity simultaneously, but must identify and prioritise the scenarios that deliver the best opportunities for incremental revenue, strategic customer relationships, value chain enhancement and future growth.

3.1 We developed a method to identify the most-promising 5G B2B scenarios

For this report, Analysys Mason defined a methodology to identify those B2B scenarios that will support the best commercial opportunities for 5G MNOs in the near, medium and longer term, and that align best with the timescales for enterprise demand. We defined a prioritisation framework in which to assess the attractiveness of a long list of 5G use cases and scenarios for the MNO business model. Each scenario was rated according to a complex matrix of technical, ecosystem and commercial criteria, which are summarised in Figure 3.1.

This resulted in the selection of six scenarios that we believe provide MNOs with the best combination of short-term market opportunities that have significant potential for revenue growth over the period to 2026. These scenarios help MNOs to identify key opportunities at a high level, though the precise commercial strategy will vary according to the status of a particular market.

The six scenarios that were selected are:

- 5G-enhanced augmented reality and virtual reality (AR/VR) for B2B environments (for example, in industrial digital twin or training systems)
- large-scale sensor networks including AI-enabled data analytics (such as in smart cities)
- industrial vision and image recognition
- remote-controlled 5G UAVs (unmanned aerial vehicles) or drones
- AI-assisted remote diagnostics (for instance, in healthcare or preventative maintenance)
- 5G positioning (for example, s in emergency response applications).

These scenarios are described in detail below.

Figure 3.1: Criteria for assessing 5G B2B scenarios by 5G core criticality, 5G network readiness, and commercial readiness.

Criticality of 5G core capabilities	5G network readiness by timescale	Commercial readiness by timescale
High reliability enabled by cloud-native, stateless design, and ultra-reliable with service-based architecture.	Commercial deployment of 5G core	Market size – revenue
Low latency enabled by control/user-plane separation and TSN	5G networks supporting URLLC (high reliability and low latency)	Market size – users or devices
Very high coverage enabled by multi-access technology and multi-layer user plane deployment	5G networks supporting guaranteed multi-Gbit/s throughput	Timescale to first adoption
Device density requirement enabled by service-based architecture and sliceable design	5G coverage	Timescale to adoption at scale
Reliance on edge compute, enabled by MEC	5G density	Number of developers and platforms
Guaranteed throughput enabled by MEC and sliceable design	Deployment of 5G-enabled edge computing	Number of MNO partnerships
Media enhancement enabled by MEC and heterogeneous cloud-native computing		Number of devices

3.2 MNOs are already adopting the scenario approach to 5G planning

Another important contribution to understanding the most-important 5G scenarios for enterprises, and therefore for MNOs' commercial opportunities, came from a survey of 78 mobile MNOs worldwide, conducted by Analysys Mason in 4Q 2020. The survey asked MNOs about their 5G deployment plans and timescales, their drivers and barriers, and their most-important use cases, and the results were mapped against several Analysys Mason surveys of enterprises about their 5G requirements.

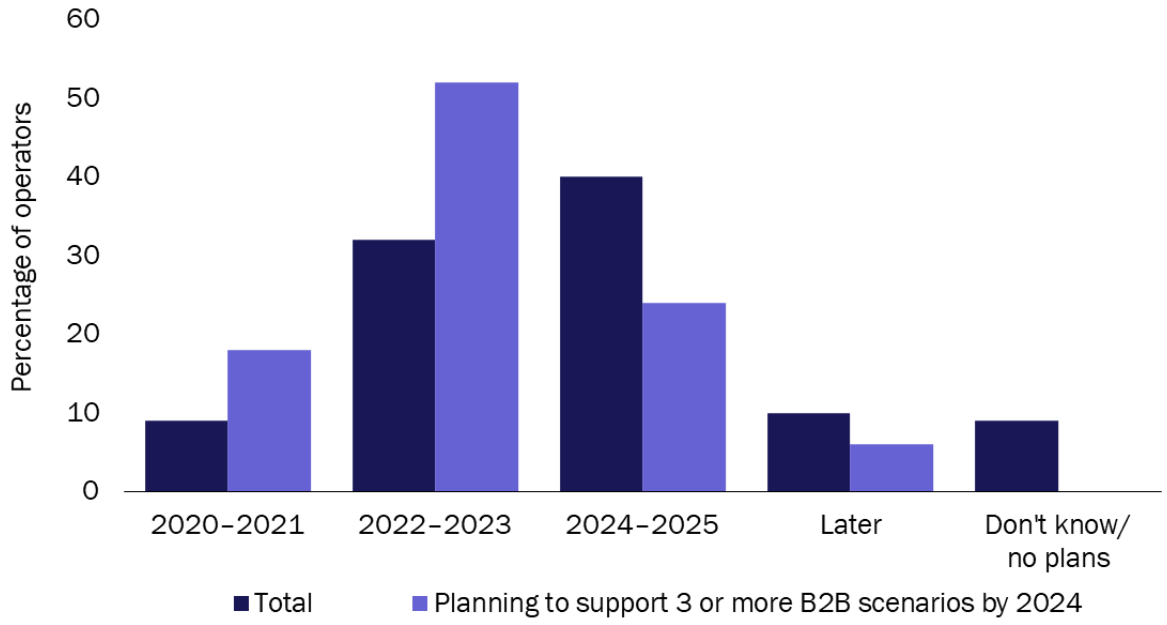
As explained in Section 1 in assessing 'scenarios', the focus was not on individual applications or sectors, but on broader services and capabilities that can enable multiple new use cases across multiple industries, and so maximise the value for the MNOs and their B2B customers. These scenarios are enabled by foundational capabilities, all supported or enhanced by the introduction of the 5G core.

Our survey found that MNOs have a high awareness of the value of a scenario approach, which can deliver greater commercial benefits than focusing on individual use cases on an ad hoc basis. Among Tier-1 and Tier-2 MNOs with commercial 5G NSA networks, 42% expect to support at least three different B2B scenarios by 2024.

The survey shows that those MNOs with a strong B2B plan will be the first to deploy 5G cloud-native cores at scale. Across the full sample, 41% expect to begin to deploy the 5G core by 2024, but among those MNOs planning to support at least three different B2B scenarios, the adoption of the 5G core is far more rapid, with 70% planning to start deployment by 2024.

The MNOs that have stated publicly that they will start deploying 5G SA in 2021 include NTT Docomo, SK Telecom and Vodafone German.

Figure 3.2: MNOs' expected first year of deployment of commercial 5G SA core –total sample of 78 MNOs surveyed, and those MNOs planning to support at least three B2B scenarios by 2024



Source: Analysys Mason

The following sections describe the six selected scenarios in detail, including their benefits for 5G MNOs' business models; as well as the size and timescale for the market opportunity in the period to 2026, with some visibility of the later 2020s. The scenarios assessment is presented on a global basis, but with examples of country-specific activities that indicate some key initial geographies. These real-world trials and deployments were among the important inputs to the prioritisation model.

3.3 AR/VR in enterprise environments

Description

AR/VR is one of the most-discussed 5G use cases, though often in a consumer context for early 5G applications such as gaming. However, it also has many enterprise applications, and an MNO that has invested in advanced AR/VR capabilities to support consumer services may find it can cost-effectively leverage this platform to expand into B2B environments.

In the case of AR, incremental information is superimposed on real-world objects, such as a piece of factory machinery. The device used is typically either a smartphone or special glasses, so the level of graphics rendering is not significant. VR, however, is a real-time immersive display of a situation, such as a live-action gaming. The image processing requirements can be less stringent if the 360° video is based on the user being stationary to accurately align the graphics at a single location. However, should the system give the user the freedom to move around the physical environment, the demands on the graphics rendering, data rate and low latency requirements are significantly higher.

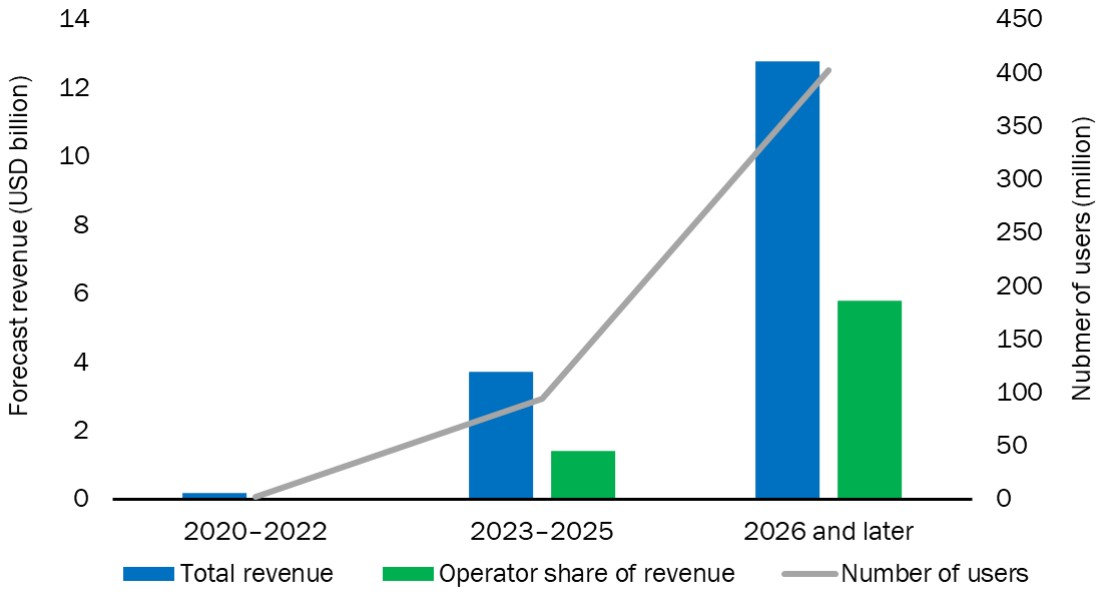
Importance to the MNO business model

The AR/VR video market is nascent, but the use of VR headsets (a prerequisite for VR becoming popular) is increasing. 2.4 million VR headsets were in circulation by the end of 2020, and the figure is forecast to rise to 402 million by the end of 2026.

Although AR/VR use case can be delivered using the 4G mobile networks, both the high bandwidth and the ultra-low latency requirements would impede 4G from delivering a good customer experience. 5G will deliver the required high bandwidth, but both the 5G core and edge computing will be necessary to avoid motion sickness, especially in the case of VR.

MNOs can leverage AR/VR demand to drive additional B2B connectivity revenue, because of the bandwidth required, as well as revenue from applications, devices and from enabling complex services from a 5G platform. Some of these opportunities will involve revenue share deals with partners such as device providers, application developers and content producers. We estimate the total revenue forecast from 5G AR/VR will grow at a CAGR of 85% in the 7 years to 2026 to USD12.7 billion.

Figure 3.3: Revenue from 5G-enabled AR/VR, and the share taken by MNOs, 2020–2026 and later



Source: Analysys Mason

This scenario results in a large revenue opportunity for MNOs, especially as investment in AR/VR capabilities can support many revenue streams in different industries, from industrial to entertainment to smart cities. To support strong user experiences for B2B environments, advanced 5G capabilities including the 5G core, ultra-low latency and potentially dedicated slices will be essential, so while there will be some early wins, the full potential of this scenario will be realised in the medium term, when new platforms and partners are in place.

Aspect	Description
Size of opportunity	High, and will support many revenue streams
Challenge and cost of deployment	Medium
Timeframe for maximum impact on the MNO business model	Medium term
Importance of 5G (rather than other technologies) to deliver services	High

Capabilities and requirements

The 5G capabilities that are required for this scenario are summarised below. There is a high reliance in this scenario on the 5G core.

Capability	Requirement
High reliability	Moderate (4x9s)
Low latency	Low (sub-1ms)
Coverage (including indoor)	High
Device density	Low (<500K/km^2)
Reliance on edge compute	High
Guaranteed throughput	Moderate (3–5Gbit/s)
Media enhancement	High
Overall 5G core criticality	High

Examples from other countries

- In the **UK**, multiple universities have started using 5G-enabled VR platforms to deliver interactive seminars to remote students. For example, Coventry University is working with Vodafone on such a project.[6]
- In **China**, China Mobile announced a pre-commercial 5G and 8K VR solution to support video services.
- In the USA, Verizon plans to bring 5G to 100 schools in a pilot of AR/VR learning to support digital inclusion.[7]

3.4 Sensor networks with AI

Description

There are many types of machine-to-machine (M2M) and IoT applications that will rely on connecting hundreds of thousands of objects via sensors, and then collecting and analysing the data from all those sensors to make intelligent decisions. Smart cities and asset tracking are common areas of large-scale sensor systems.

Importance to the MNO business model

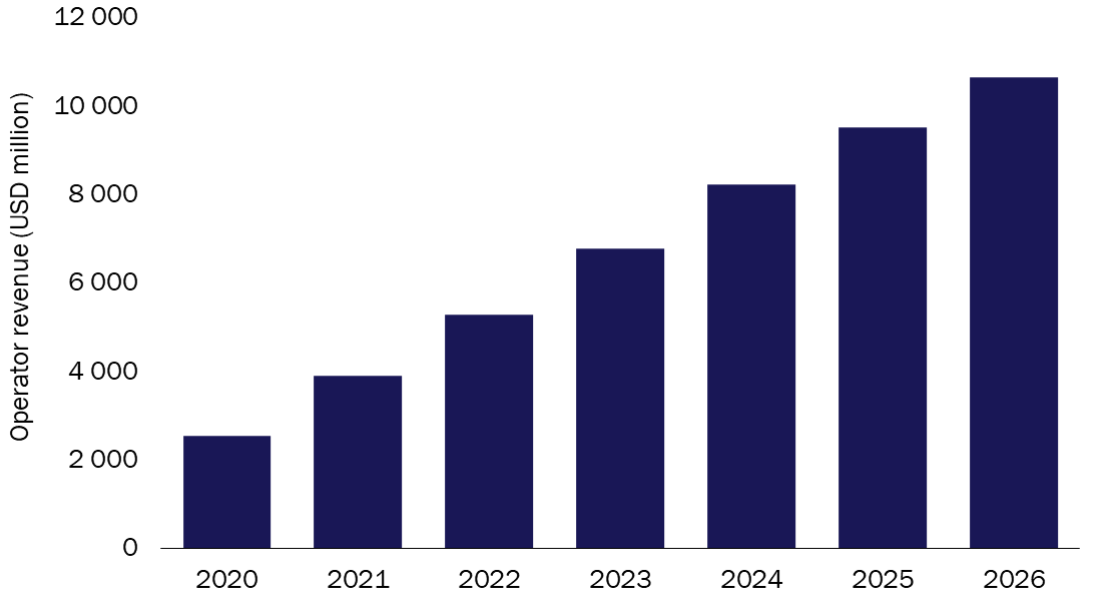
Some networks support just one application, such as smart street lighting in a city, or a parcel tracking service for a single courier company. The 5G core provides MNOs with an enhanced ability to build IoT platforms that support large numbers of different applications, and so deliver greatly improved ROI. For instance, a smart city network might enable many applications including smart lighting, transport management, waste disposal and air quality monitoring. A broad logistics network – perhaps run in its own network slice – could support asset tracking and delivery monitoring for multiple delivery companies or supply chains.

[6] Vodafone UK News Centre (9 September 2020), *5G Standalone takes virtual reality teaching to the next level*. Available at: https://newscentre.vodafone.co.uk/features/5g-standalone-takes-virtual-reality-teaching-to-the-next-level/.

[7] Verizon. *Technology. Education. Opportunity.* Available at: https://www.verizon.com/about/responsibility/digital-inclusion/verizon-innovative-learning.

This is where the best opportunity for new 5G-driven revenue will be seen. Sensor network connectivity does not generally involve large quantities of data and so revenue from connectivity alone is unlikely to be significant compared to mobile broadband applications. However, MNOs that can provide services throughout the value chain (including data analytics, security and developer platforms) will be able to add incremental income. Figure 3.4 below indicates the projected growth in MNO revenue from tracking services based on IoT sensor networks, including connectivity and associated data services.

Figure 3.4: MNO revenue from tracking services based on IoT sensor networks, 2020–2026



Source: Analysys Mason

The pattern of adoption shown in Figure 3.4 means that MNOs can achieve some quick wins, especially where they have invested in networks such as NB-IoT to support selected IoT sensor applications, but to derive the maximum upside, they will need to put new partnerships and services in place, which may take a few years to complete.

Aspect	Description
Size of opportunity	Very high, and MNOs can build on existing 4G systems in some cases. High revenue opportunity.
Challenge and cost of deployment	Easy to enable initial services and connectivity, but medium complexity to support full platform.
Timeframe for maximum impact on the MNO business model	Short to medium term
Importance of 5G (rather than other technologies) to deliver services	High

Capabilities and requirements

In all cases, the networks themselves may support multiple radio access technologies (RATs), since it will not be essential for every item to be connected by 5G, and other standards such as NB-IoT will be important. However, the 5G core, combined with advanced AI analytics, will enable MNOs to provide high-value services

to B2B customers. These could include a dedicated slice to guarantee data response times or real-time monitoring, or data analytics services provided directly or via a partner.

In addition, the requirement for very high device density means that 5G considerably enhances the performance and the range of services that can be delivered. 5G core also provides the MNO with the flexibility to add new sensor-based services in the future that may require more-demanding capabilities such as real-time feeds to AI-enhanced analytics engines, or very high security/privacy ratings.

The 5G capabilities that are required for this scenario are summarised below.

Capability	Requirement
High reliability	Moderate (4x9s)
Low latency	Low (sub-1ms)
Coverage (including indoor)	Very high
Device density	Very high (1m/km^2)
Reliance on edge compute	High
Guaranteed throughput	Low (<1Gbit/s)
Media enhancement	Low
Overall 5G core criticality	Moderate

Examples from other countries

- In **Brazil**, Telefónica Brazil (VIVO), São Paulo Municipality and the GSMA have collaborated on pollution monitoring and prediction system.[8]
- Hamburg, in **Germany**, was the testbed for the European Union's 5G-MoNArch project and is now implementing 5G-enabled sustainable asset tracking and logistics.
- **China's** Port of Qingdao, one of the 10 busiest in the world, is deploying a 5G smart harbour system.
- China Mobile and ZPMC are trialling 5G at multiple ports in **China** including Shanghai Yangshan.

3.5 Industrial vision and image recognition

Description

Image recognition is a process to identify, label, classify or distinguish elements inside an image. Data collected through sensors or cameras can be fed to AI-based decision systems for applications such as object detection, QR/barcode recognition, facial or pattern recognition. Image recognition has been extensively implemented across many verticals, including retail, banking, government and IT for security and surveillance applications.

Image recognition can be performed at different degrees of accuracy, depending on the application and the type of information requested. Basic levels of image recognition can be achieved over 4G, but the advanced capabilities (such as ultra-low latency and high availability) delivered by 5G connectivity will maximise the commercial impact of this scenario.

[8] GSMA (February 2018), *Air Quality Monitoring Using IoT and Big Data*: A Value Generation Guide for Mobile MNOs. Available at: https://www.gsma.com/iot/wp-content/uploads/2018/02/iot_clean_air_02_18.pdf.

The use of 5G-supported image recognition applications will also be relevant for other use cases, such as AR or self-driving vehicles, which will have high requirements in terms of data rate and latency.

Importance to the MNO business model

Applications that are based on image recognition can be further enhanced with 5G connectivity. By deploying critical edge computing nodes and 5G SA architecture, MNOs can improve the connectivity offered to the camera and therefore guarantee the required near-real-time image processing and the low latency for high-quality video. With these advanced 5G capabilities, the system can support new and more-complex services and can become a larger source of revenue for MNOs. For example, a 5G-enabled network of CCTV cameras that support near-real-time facial identification of suspects can become a critical tool for public safety applications and crime prevention.

The MNOs' share of revenue from image recognition with 5G or 5G-ready connectivity will grow at a CAGR of 110% between 2020–2026 to reach almost USD0.8 billion by 2026. The development of AI/ML techniques and the decreasing costs of camera size will be important factors for the take-up of this use case.

Like AR/VR, the industrial vision and image recognition scenario can support a broad range of applications for multiple industries and can be seen as a foundational capability for many services. However, Analysys Mason believes that this scenario has a lower revenue potential for the MNO than AR/VR because it will be used less widely in the period to 2026, and there is already a complex, established value chain in which MNOs may not always achieve the highest position. However, with a 5G core in place, the MNO can enable new industrial processes and a differentiated experience, and this is a good example of a scenario where the MNO can deploy relatively quickly and easily and score some quick commercial wins. In some cases, additional capabilities such as VR may be built on top of an image platform.

Aspect	Description
Size of opportunity	Medium
Challenge and cost of deployment	Low, although there are privacy and regulatory concerns about the use of applications based on facial recognition technology.
Timeframe for maximum impact on the MNO business model	Medium term
Importance of 5G (rather than other technologies) to deliver services	High

Capabilities and requirements

The 5G capabilities required for this use case are summarised below.

Capability	Requirement
High reliability	High
Low latency	Low (sub-1ms)
Coverage (including indoor)	Moderate
Device density	Low (<500K/km^2)
Reliance on edge compute	High

Capability	Requirement
Guaranteed throughput	High (>5Gbit/s)
Media enhancement	High
Overall 5G core criticality	High

Examples from other countries

- In **Japan** in January 2019, NEC and NTT Docomo completed a proof-of-concept demonstration of an instantaneous facial recognition system that uses 5G and MEC technologies.
- In Japan in April 2020, Japan Computer Vision Corp (JCV) and SoftBank launched a solution that integrates facial recognition capabilities with a thermal imaging camera.
- In **Finland** in August 2019, Telia and Finnish OP bank demonstrated facial recognition-enabled payment supported by 5G connectivity.

3.6 Remote-controlled 5G UAVs

Description

Unmanned automated vehicles (UAVs) such as drones can be used extensively in many different vertical sectors to support inspection, monitoring, maintenance and delivery of goods. Oil and gas, telecommunications, agriculture, utilities and logistics are among the verticals that benefit significantly from the use of UAVs. For example, the use of drones for public infrastructure, farmland, oil and gas ring inspections can save both routine and emergency maintenance costs by spotting potential problems before they occur and taking preventative action.

A new array of use cases could be enabled by remotely controlling drones over a 5G network. The wide-area connectivity would remove the line-of-sight requirement for controlling drones, and the ultra-low latency connectivity (potentially employing mobile edge computing and 5G SA core) would support near real-time data transfer. Remote-controlled drones with low-latency continuous connectivity have the capability to stream images that can be used by an analysis engine for applications such as preventative maintenance, or by emergency response teams to remotely assess damage after a natural disaster.

Importance to the MNO business model

The market for commercial drones is currently small and mainly includes drones that do not require wide-area connectivity because they are only used in line of sight. However, long range UAV-based applications will have a profound impact on the market by the mid-2020s.

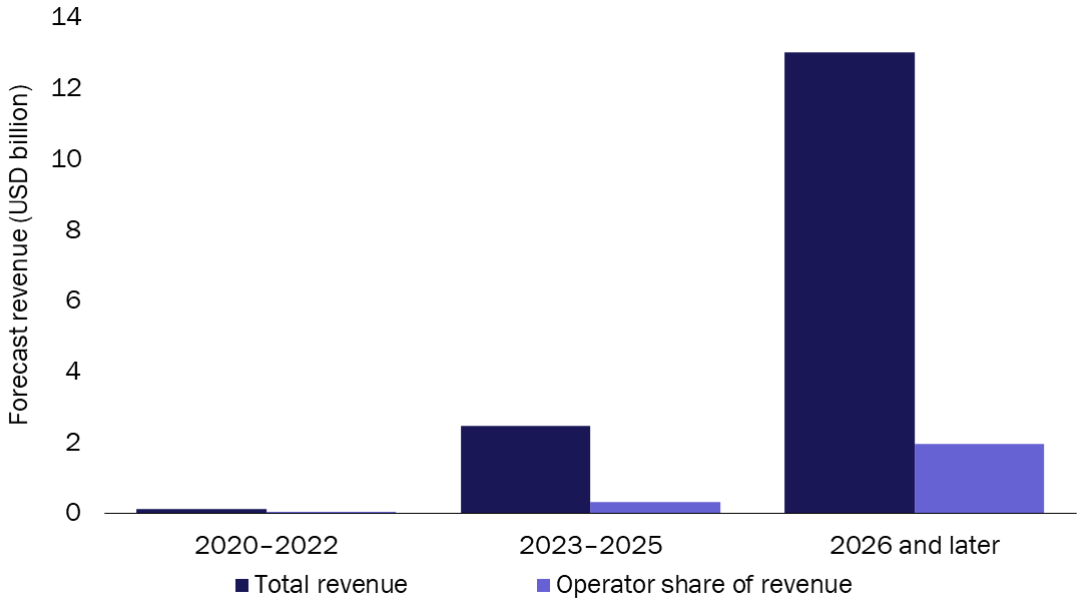
Analysys Mason's forecasts indicate that the total number of commercial drones in use with 5G connectivity will grow at a CAGR of 107% during 2020–2026, driven by 5G-enabled use cases and the easing of regulations that concern non-line-of-sight drones.

The market for long distance drones can create new revenue opportunities for telecoms MNOs: they can gain a larger share of the market by building additional value on top of connectivity. They can provide end-to-end services to the whole chain, or offer value-added services such as analytics, insurance and drones-as-a-service.

Another revenue-generating possibility may arise from the requirement to survey remote areas that do not have existing infrastructure to support airborne communication on standardised, scalable technology. MNOs are in a strong position to work with partners to build out private or semi-private networks in these locations.

Analysys Mason forecasts that the total MNO share of revenue for 5G-connectivity services for drones will grow at a CAGR of 104% in the 7 years to 2026 to USD2 billion.

Figure 3.5: Total revenue from UAV services and MNOs' share of that revenue, 2020–2026 and later



Source: Analysys Mason

This scenario will result in an opportunity that has a very high requirement for 5G capabilities, ensuring that MNOs play a pivotal role in the value chain. However, revenue will be somewhat limited by the specialist nature of the sector, and the need to share significant value with the drone MNOs. The opportunity is summarised below.

Aspect	Description
Size of opportunity	High
Challenge and cost of deployment	Medium. It is important that MNOs work with the aviation industry to understand their requirements.
Timeframe for maximum impact on the MNO business model	Long term
Importance of 5G (rather than other technologies) to deliver services	High

Capabilities and requirements

The 5G capabilities required for this use case are summarised below.

Capability	Requirement
High reliability	High (5x9s)
Low latency	Low (sub-1ms)

Capability	Requirement
Coverage (including indoor)	Very high outdoors (wide area)
Device density	Low (<1K/km^2)
Reliance on edge compute	High
Guaranteed throughput	Moderate (3–5Gbit/s)
Media enhancement	Low
Overall 5G core criticality	High

Examples from other countries

- In the **USA**, Verizon has integrated its Skyward acquisition into its fleet and logistics business, Verizon Connect, to target key verticals with drone services. In January 2021, Verizon Connect worked with UPS Flight Forward to deliver retail products with drones connected to Verizon LTE, as well as 5G testing and integration for delivery.
- In August 2018, AT&T in the **USA** took part in a proof of concept to deliver medical supplies carried by drones. Trials were conducted with Merck and Softbox.
- In April 2019, KDDI launched, together with TerraDrone, infrastructure inspection services using drones in remote areas of **Japan**.
- In October 2018, Zain Group launched its DaaS business in **Kuwait**. The MNO will offer survey and inspection services to several industry sectors including oil and gas, utilities, construction, real estate and agriculture. It will provide image data services to these industries.

3.7 AI-assisted remote diagnostics

Description

5G's network reliability and ultra-low latency communications will be a driver for new capabilities such as AI/ML to add new dimensions to many activities that take place remotely. These include healthcare diagnostics, maintenance of machinery, and infrastructure and aircraft inspection. Real-time computation and faster decision making based on cloud data will be made possible to help deliver improved quality of care at reduced cost.

Importance to the MNO business model

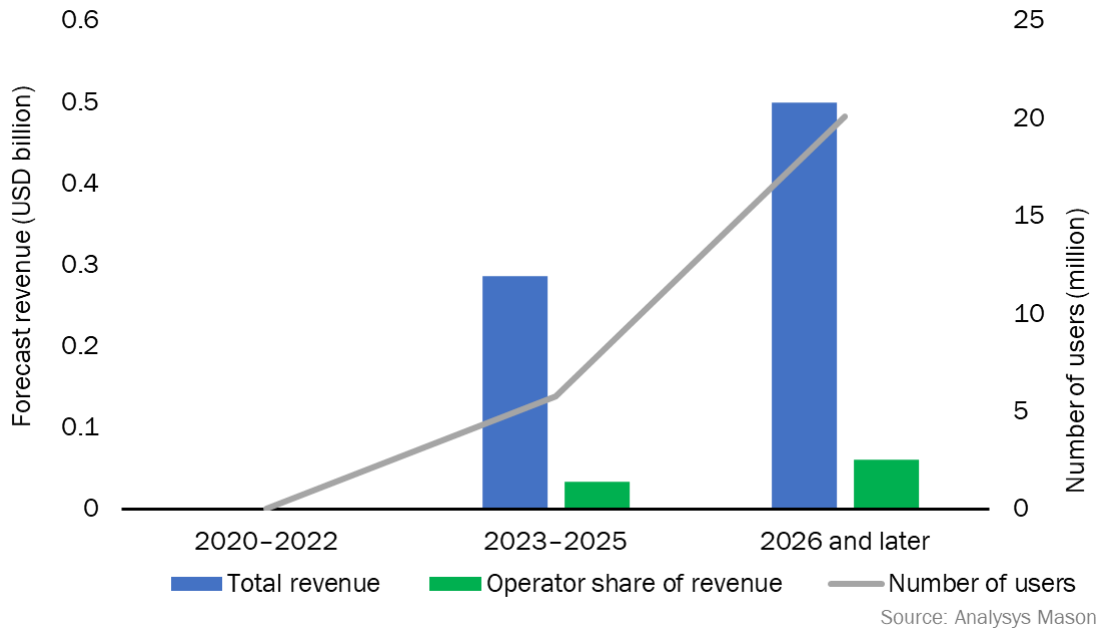
Delivering critical care or supporting preventative maintenance of critical infrastructure using 5G networks requires more than just meeting the high bandwidth requirements for video and image transmission. For instance, paramedics travelling to an emergency will need access to not just a highly reliable network to maintain two-way communications (which requires high bandwidth in both the downlink and uplink,) but just as importantly, will need access to a secure network in order to maintain data privacy.

MNOs can take a greater share of the healthcare value, beyond just the connectivity, by creating and maintaining on-premise critical edge computing nodes, which together with the 5G SA core will deliver access to low latency connectivity for AI and ML tools to deliver rapid diagnosis. The patient's critical healthcare data, including all 4K video streams will also always remain within the hospital campus data centres.

Other 5G SA core network features, such as network slicing, will guarantee specific service level agreements for the different services. This, together with different instances of edge computing nodes, whether at the hospital or in the ambulance, can create network security and reliability to ensure that the tsunami of data generated on a

daily basis remains both secure and accessible for healthcare professionals to deliver fast and reliable diagnosis. For this, we forecast that the total revenue from remote AI diagnostics will grow at a CAGR of 205% in the 7 years to 2026 to USD501 million. The MNOs' share of revenue with grow at a CAGR of 213% in the same period to USD65 million.

Figure 3.6: Total revenue from AI-enabled diagnostics services, and the MNOs' share of that revenue, 2020–2026 and later



Source: Analysys Mason

This scenario represents an important opportunity for MNOs, though the benefits will be shaped by the place that the MNO can secure in complex value chains such as healthcare or critical infrastructure management. It will require considerable investment in ultra-reliability, which together with forming the necessary partnerships, may delay the impact.

Aspect	Description
Size of opportunity	Medium to high, depending on access to level of value chain.
Challenge and cost of deployment	Medium
Timeframe for maximum impact on the MNO business model	Medium term
Importance of 5G (rather than other technologies) to deliver services	Medium

Capabilities and requirements

The 5G capabilities required for this use case are summarised below.

Capability	Requirement
High reliability	High (5x9s)
Low latency	Low (sub-1ms)
Coverage (including indoor)	High

Capability	Requirement
Device density	Low (<500K/km²)
Reliance on edge compute	High
Guaranteed throughput	Moderate (3–5Gbit/s)
Media enhancement	Moderate
Overall 5G core criticality	Moderate

Examples from other countries

- Dell Technologies, VMware and Telenor have collaborated on 5G, edge and machine learning applications for a TeleHealth use case **in Norway**.[9]
- NTT DATA's AI-based Diagnostic Imaging Support Solution aids COVID-19 diagnoses, reduces time and increases accuracy in a pilot in Tokyo, **Japan**.[10]
- In the **UK**, the government allocated GBP3.5 million to a project called Sensor City in Liverpool. The project uses technologies such as open-source 5G networks, artificial intelligence, virtual reality and IoT to reduce the digital divide. In addition, the project seeks to improve communication between hospitals and deprived communities in Liverpool by measuring the impact on patient monitoring in older adults? Vodafone is now beginning commercial deployment.

3.8 5G positioning

Description

Of the scenarios and capabilities that we have assessed for this report, 5G positioning is the most recent to emerge. Unlike AR/VR or sensor networks, positioning has not been a key feature of 4G networks and business models because most positioning has been supported by satellite-based systems such as GPS, sometimes augmented by cellular triangulation or Wi-Fi. In 5G, however, there are many applications and industries in which a more-advanced approach to positioning will be required, and ultra-precise location data will be an important input to AI-based analytics in areas such as smart factories, digital twins, autonomous vehicles, emergency response and AR/VR. In particular, connected and autonomous vehicle (CAV) and Industry 4.0 applications will only advance to the next stage of sophistication if they can rely on very high positioning accuracy, which in turn will require ultra-low latency and highly reliable connectivity that covers every possible location. Indoor accuracy, as well as reach to challenging locations such as mines or (in an emergency) fallen buildings, are examples of areas that are not well served by current technologies.

In the first release of 5G standards, 3GPP Release 15, 5G device positioning was enabled by an overlay 4G network, and support for non-3GPP technologies such as GPS, Bluetooth, barometric pressure, Wi-Fi signal strength, inertial sensors and others was included. In Release 16, dedicated 5G positioning reference signals, measurements and procedures were introduced. In Release 17, these specifications will be extended to advanced capabilities for Industrial IoT applications. 5G positioning promises to increase accuracy while minimising

[9] Slicenet (2020), *Telehealth: A Mission Critical 5G Use Case*. Available at: https://slicenet.eu/wp-content/uploads/2020/04/BLOG-TeleHealth-FINAL-post-.pdf.

[10] NTT Data Corporation (1 June 2020), *NTT DATA's AI-based Diagnostic Imaging Support Solution Aiding COVID-19 Diagnoses*. Available at: https://www.nttdata.com/global/en/media/press-release/2020/june/ntt-datas-ai-based-diagnostic-imaging-support-solution.

power and bandwidth consumption compared to other methods, and it will be particularly deployed as part of ultra-reliable low latency communications (URLLC), often in a dedicated slice.

Importance to the MNO business model

The opportunity is currently nascent because the standards and ecosystem are also at an early stage. However, the broader market for location-based services (LBS) is substantial. Analysys Mason estimates that global revenue from mobile LBS reached almost USD35 billion in 2020. This is expected to grow to USD140 billion by 2025. Within that market, MNOs can be expected to address about USD9 billion in revenue from 5G positioning and location services, including dedicated connectivity and value-added services such as data analytics and navigation applications. This figure will grow rapidly in the late 2020s, when 5G will become an integral part of positioning and location systems worldwide.

Aspect	Description
Size of opportunity	Very high
Challenge and cost of deployment	Medium
Timeframe for maximum impact on the MNO business model	Medium to long term
Importance of 5G (rather than other technologies) to deliver services	High

Capabilities and requirements

The 5G capabilities required for this use case are summarised below.

Capability	Requirement
High reliability	High (5x9s)
Low latency	Low (sub-1ms)
Coverage (including indoor)	High
Device density	High (>1m/km^2)
Reliance on edge compute	High
Guaranteed throughput	Low (<1Gbit/s)
Media enhancement	Low
Overall 5G core criticality	High

Examples from other countries

- In **China**, China Mobile and BeiDou announced a high-precision positioning system at the 5G Autopilot Summit, which provides sub-metre, centimetre, and millimetre high-precision positioning services in real time through 5G networks.[11]
- China Mobile and Huawei verified 5G live indoor positioning on live networks on metro transport in Suzhou, **China** in 2021 and achieved precision of 3–5m in 90% of cases.

[11] CNTechPost (30 October 2020), Baidu Maps supports BeiDou high-precision positioning system on China Mobile's 5G network. Available at: https://cntechpost.com/2020/10/30/baidu-maps-supports-beidou-high-precision-positioning-system-on-china-mobiles-5g-network/.

- The **European Union** is studying ubiquitous sub-metre accuracy positioning with a combination of its Galileo satellite system and 5G wireless for all member states.[12]
- Verizon has collaborated with HERE Technologies in the **USA** to create safety and navigational systems. The companies are launching two proofs of concept (PoC) relating to collision avoidance and a visual positioning service (VPS).[13]

4. MNOs must prepare to support these priority scenarios with the right 5G core investments

The scenarios outlined in Section 3were specifically called out for the value that they bring to MNOs and the broader society. Many of the scenarios will nevertheless be challenging to deploy and will depend on both MNOs' expertise and other ecosystem and regulatory enablers. Some of these are:

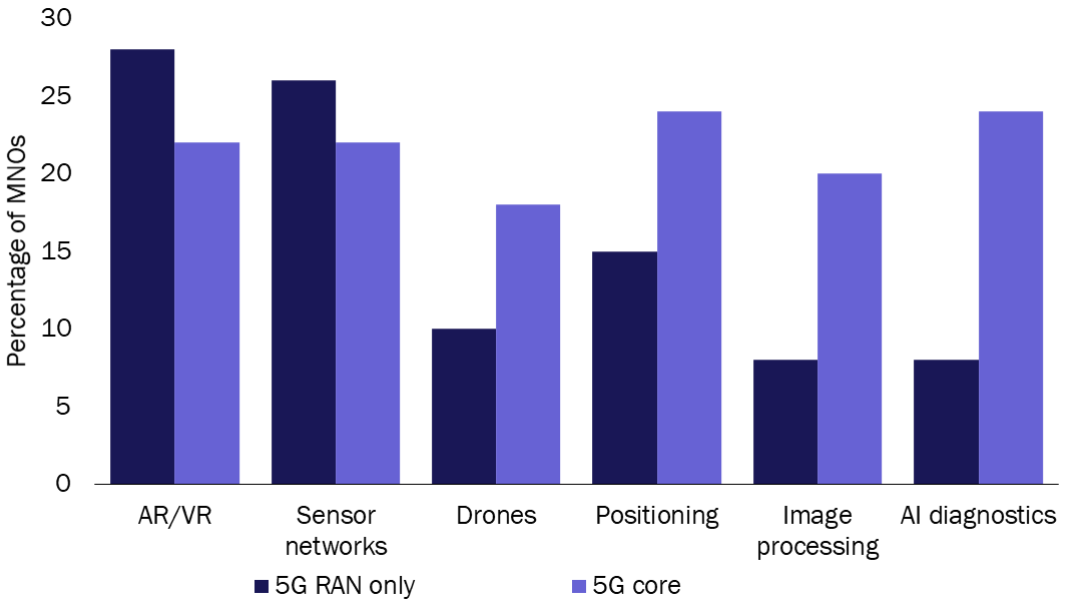
- the timely availability of a fully functional 5G SA core that can deliver ultra-low latency and network slicing capabilities
- access to spectrum and a regulatory policy that incentivises investment
- the ability of the MNOs to establish a position in the value chain and ecosystem for each different vertical.

Despite the investments required – and the potential hurdles – many MNOs are already preparing to take steps to support the 5G B2B scenarios, recognising their importance to an enhanced 5G business model in the medium term. Figure 4.1 is based on Analysys Mason's survey of 78 MNOs. They were asked which of the scenarios they expected to support before 2023, whether by optimising their 5G RAN or their 5G core to support the services. The survey found that two-thirds of MNOs expect to support at least one of the scenarios by 2023, and to invest in capabilities and partnerships to enable it. At least one in five MNOs expects to support each scenario, with the exception of drones, for which the figure is 18% of MNOs.

[12] European Commission Research & Innovation (31 May 2017). *Ubiquitous sub meter accuracy positioning with Galileo and wireless network features.* Available at: https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5b2b061d6&appId=PPGMS

[13] SmartCitiesWorld (8 January 2020), *HERE and Verizon partner for 5G-enabled safety and navigation.* Available at: https://www.smartcitiesworld.net/news/news/here-and-verizon-partner-for-5g-enabled-safety-and-navigation-4915.

Figure 4.1: Percentage of MNOs that expect to deploy 5G RAN or core capabilities specifically to enable optimised services for each B2B scenario, 4Q 2020



Source: Analysys Mason

The 5G core is a critical enabler

Although some MNOs will start by supporting the scenarios by enhancing their 5G RANs only – for instance, by increasing bandwidth in targeted areas such as industrial zones or enabling very low latency – they recognise that full support of these scenarios will require the 5G core.

The 5G SA core is an important component in the 5G architecture, especially the agility that it enables via its service-based architecture (SBA) design, where network functions are broken into smaller entities than those present in the previous generations of mobile networks. This new architecture is empowered by using cloud-native methodology, a new way to design and build applications. Cloud-native architecture further supports the separation of the network control and user planes so that various network components can be flexibly deployed in different locations that optimise core functionality for low latency and/or massive scale.

MNOs can distribute functions closer to the end customer in MEC nodes to deliver ultra-low latency communications, protect data privacy, and to save on transmission costs to the cloud. The ultra-low latency can be achieved because the MEC carries out the intensive computing tasks, such as those needed for image rendering for AR/VR or AI diagnostics scenarios, closer to the end user without the added time that it takes for the data to travel up and down the MNOs' transport networks.

Other 5G SA features, such as the ability to scale network resources up or down quickly and dynamically, will deliver improved access to resources. This capability will enable the network to handle a far larger number of devices (such as IoT, sensors or UAVs) on the network than in previous generations.

Network slicing is a further benefit from using cloud-native architecture and the ability to scale resources up and down. Slicing allows multiple, separate virtual networks to be created. These provide differentiated and deterministic latency, performance, reliability, availability and other characteristics that are tuned to the needs of

each scenario. Network slicing allows MNOs to deliver virtual, self-contained, deterministic networks that fulfil the specific quality of service (QoS) requirements of consumer and enterprise customers.

Although 3GPP Release 15 was the first to deliver 5G standards, specifically targeting enhanced mobile broadband use cases, it will be Release 16 (made available in September 2020) and Release 17 (set for March 2022) that will fully enable the most-demanding features, such as ultra-low latency communications and network slicing.

In Analysys Mason's assessment of the 5G capabilities required, the 5G core was important for all six scenarios, and completely critical for four of them (advanced AR/VR, image recognition, remote-controlled UAV and 5G positioning).

Figure 4.2: The criticality of the 5G core for fully enabling the six priority scenarios by 2026, according to Analysys Mason's assessment, conducted in 1Q 2021

Scenario	AR/VR	Sensor networks with AI	Image recognition and industrial vision	Remote controlled UAV	Remote AI diagnostics	5G positioning
High reliability	Moderate	Low	High	High	Moderate	High
Low latency	High (5ms)	High (5ms)	High	Low	Moderate	Low
Very high coverage requirements, including indoors	High	Moderate	Moderate	High	Moderate	High
Device density requirement	High	Moderate	Moderate	Low	Low	Moderate
Reliance on edge compute	High	Moderate	High	High	Moderate	High
Guaranteed throughput	Moderate	Moderate	High	Moderate	Moderate	Moderate
Media enhancement	Moderate	Moderate	High	Moderate	Moderate	Low
Importance of 5G core	High	Moderate	High	High	Moderate	High

Source: Analysys Mason

The 5G core works with a range of other network capabilities to optimise the scenarios

The 5G core is critical because it integrates all the various actions of the 5G network and ensures that the right capabilities and resources can be allocated precisely when they are needed by a particular application or user. For the B2B scenarios, the optimal performance and customer experience will be enabled by supporting the particular combination of requirements of each of the six.

The figure below indicates the areas in which the maximum capabilities of 5G (for reliability, latency, coverage, device density, reliance on edge computing, guaranteed throughput and media enhancement) will need to be supported. It shows that, to support all six selected scenarios, MNOs would need to support most of the key performance capabilities of 5G, rather than just those required for consumer mobile broadband applications.

This indicates that the higher the number of demanding scenarios an MNO can support, the better the return it will receive on its investment in advanced 5G capabilities, and the more high-value revenue opportunities that it will be able to address.

Figure 4.3: Summary of 5G network requirements of each selected use case

Scenario	High reliability	Ultra-low latency	High coverage	Very high device density >1m/Km²	Reliance on edge computing	Very high throughput >5Gbit/s	Media enhancement	Importance of 5G core
AR/VR		✔	✔		✔			✔
Sensor networks with AI				✔				✔
Image recognition and industrial vision	✔				✔	✔	✔	✔
Remotely controlled UAV	✔	✔	✔		✔			✔
Remote AI diagnostics						✔		✔
5G positioning	✔		✔		✔			✔

Source: Analysys Mason

It will be essential to align MNOs' plans with enterprises' interest and timescales

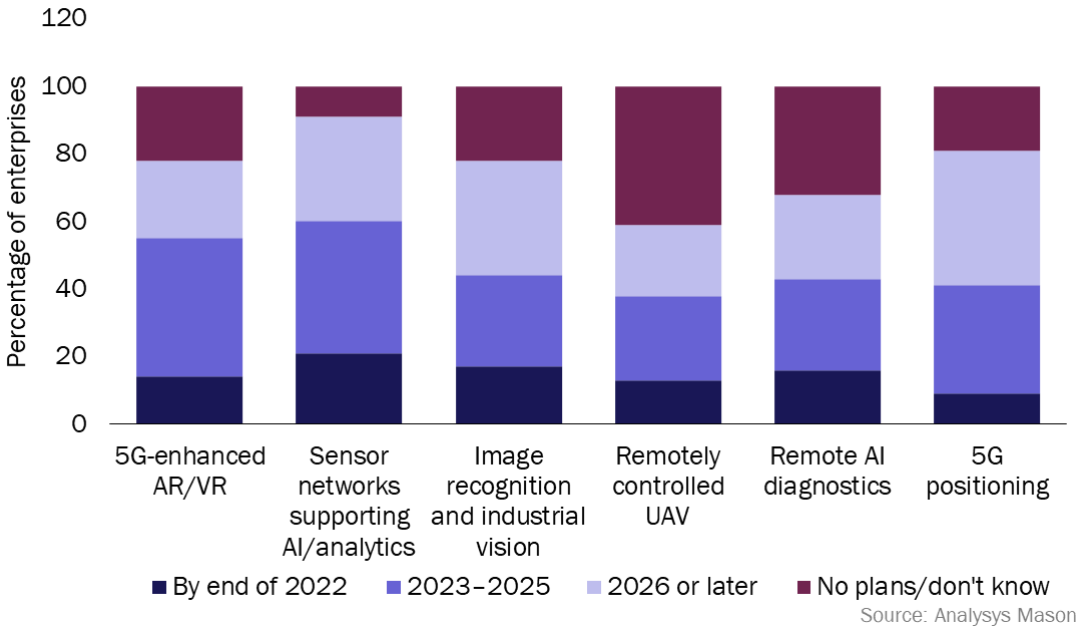
5G will be important both to MNOs and to enterprises to enhance processes and business models. To achieve the best results on both sides, it is essential that they understand one another's priorities and align MNOs' delivery of 5G capabilities with the timescales and requirements of key verticals.

It is not enough for MNOs to deploy the correct 5G core and RAN capabilities. They must also select the scenarios that are most important to enterprises in the near term, while planning for those that will be significant in the medium term. This will vary according to the industry and geography, but Analysys Mason's surveys indicated some important trends that MNOs must build into their 5G B2B planning.

Figure 4.4, which uses data from Analysys Mason's survey of over 100 enterprises conducted in 4Q 2020, shows that AI-enabled sensor networks and image recognition are having the most immediate take-up, partly because there are existing applications and ecosystems in place based on 4G. By 2025, AR/VR and AI-enabled sensor networks will be most commonly deployed. Drones and AI-enabled remote diagnostics have lower levels

of expected adoption because they are less broadly relevant across many different industries than, for example, AR/VR, but as we saw in Section 3, they are of substantial value to the industries where they will be used.

Figure 4.4: Timescales for enterprises to adopt applications within the six scenarios, using data from Analysys Mason's survey of 104 enterprises, 4Q 2020



Source: Analysys Mason

Spectrum availability and regulatory environment are also key to commercial success

There are many other factors that must be in place to ensure the best commercial outcome in the B2B scenarios. Many of these relate to regulation and spectrum. Each country's telecoms regulator must release the right amount of spectrum in the low, mid and high bands to ensure successful commercial launches can occur, in line with standard practice in the benchmark countries. MNOs need clarity about this roadmap to plan their network deployments effectively according to their business cases.

Spectrum in the low bands, such as 700MHz, is good for wide-area coverage and deep indoor penetration, unlike that in both the C-band and the millimetre wave ranges. It enables full nationwide coverage at a lower capex cost that those in the higher bands. To avoid coverage loss and a ping-pong effect between 5G and 4G networks, MNOs require access to this band ahead of their 5G SA core deployments. However, it does not deliver the same level of customer experience in terms of speed, due to the limited bandwidth available. Also, MIMO antennas (one of the key pieces of 5G technology) are not suitable in sub-1GHz bands because they would be very large. Therefore, the high spectral efficiency gained through spatial multiplexing will not be possible.

The mid-band, such as 3.4G–3.8GHz, is the principal spectrum band used for 5G services in most countries. It delivers a good mix of coverage and capacity, in part thanks to the spectral efficiency and beamforming capabilities of MIMO antennas. The bandwidth available to most MNOs is in the range of 80–100MHz (which is up to 5 times what was available to 4G networks) and can deliver multi-gigabit speeds.

The high spectrum bands, such as 26GHz and above deliver speeds up to 10Gbit/s over very short distances. These bands are not suitable for macro level coverage, and for this reason, they are designated as point-to-point

technologies. Although one of the main use cases is fixed-wireless access (FWA), the technology has now evolved to the stage where they can be used for high-capacity indoor connections, such as AR/VR.

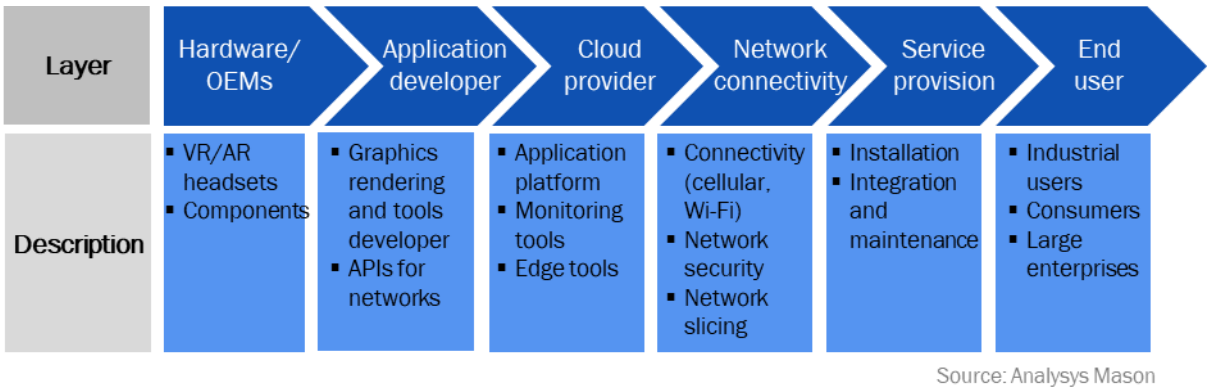
Ecosystem readiness

Beyond planning and deploying the 5G SA core, and access to the relevant spectrum assets, MNOs will need to build robust partnerships with other players in the ecosystem to build a strong value chain and a successful business case.

Each scenario has a different value chain and can only be successfully deployed once there is collaboration between the various parties. Ecosystem players (such as device manufacturers, application developers, analytics tools providers and cloud providers), as well as engagement with the industry verticals (such as healthcare, manufacturing and other heavy industries, such as mines and ports) will be necessary to ensure success.

As an example, Figure 4.5 below shows a typical ecosystem for AR/VR scenario, including hardware providers, application developers, cloud providers, MNOs, providers of services such as billing, systems integrators and the end users themselves.

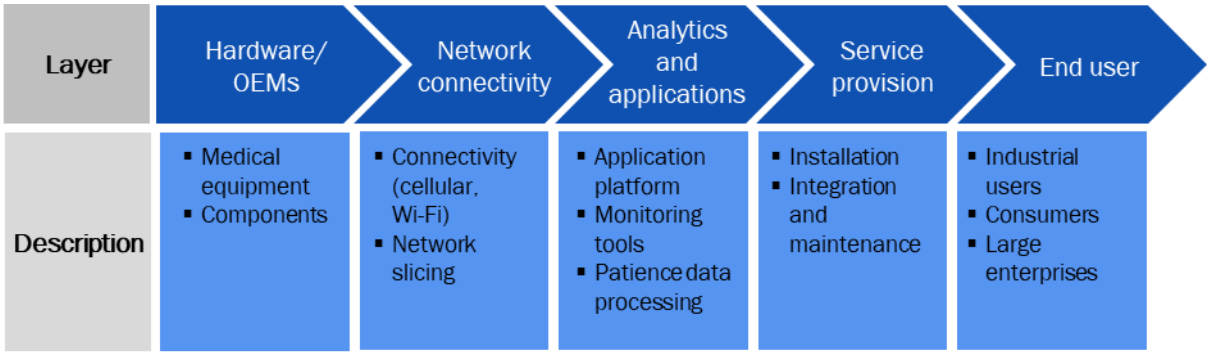
Figure 4.5: Illustrative value chain for the B2B AR/VR scenario



In each value chain, the MNO must select the role in which its expertise and capabilities can best deliver the right KPIs, and that will help to determine its relationships with other members of the ecosystem. In the example of the AR/VR scenario, an MNO may decide to provide, on its own, the cloud platform (such as MEC) connectivity and related services such as network security, or it may aim to pull together an end-to-end service, providing a one-stop shop for the customer.

The right balance of ecosystem partners will help to optimise the business case for a particular service, from the MNO's point of view. For instance, strong partnerships may reduce the cost of entering a new sector by building on existing relationships and may enable the MNO to address more revenue than just that available from connectivity. The revenue from value-added services (such as installation and integration services or edge services discussed in the example above) will have to be shared with other value chain participants but can still enhance the overall revenue case for the MNO.

Figure 4.6: Illustrative value chain for the remote AI diagnostics scenario



Source: Analysys Mason

In some scenarios, the relatively low risk of offering connectivity alone can still support a strong business model, especially because a high-performance, low-latency 5G network is a unique differentiator for MNOs compared to other players in the market. However, to realise the maximum opportunity, the solution is to build a flexible platform that can accommodate not only a wide variety of scenarios, but many partners. This will also allow MNOs to choose the best role in each value chain, according to their skills and economic objectives, and to make the biggest impact on their broader social and economic objectives.

5. Conclusions and recommendations

The study of 5G B2B scenarios, outlined in this report, highlights the importance of expanding the 5G business case into enterprise environments if MNOs are to maximise the returns on their investment. In targeting enterprises, it will be essential to plan the technical foundations, especially the cloud-native core deployment, in parallel with the commercial framework of partnerships, ecosystem and use case priorities.

A view from the Chinese Government Work Report of 2021 sums up the thinking that even moderate increases in investment and deployment of 5G core networks will enable B2B service development. It says: "The overall keynote for the construction of 5G base stations in 2021 is to steadily promote 5G network construction with appropriate advances; closely follow the requirements of different scenarios; and build on-demand, deep-coverage and high-quality 5G networks."

5.1 Recommendations for MNOs embarking on a 5G B2B strategy

- MNOs should plan their deployment of the cloud-native 5G core now and invest in key enablers of a broad and flexible B2B platform, such as network slicing. This will enable them to add new services and capabilities in a simpler way as new opportunities emerge.

- MNOs should ensure that their 5G core and RAN are planned and optimised to support several of the most-promising broad scenarios, as described in this report. Support for core and RAN capabilities that are essential for at least three of the six scenarios will enable the MNO to address multiple industries and use cases from the same platform and maximise return on investment.

- MNOs should identify a mixture of use cases that will continually enhance the business model. They should target some industries and services that will deliver new revenue in the short term, while also laying the foundations for others that will take longer to achieve large-scale take-up but have significant commercial potential.

- MNOs should, in parallel, work with many stakeholders to encourage the best commercial environment in which to launch new B2B services. They need to form partnerships with industry vertical specialists, application developers and channel players. They need to co-operate closely with their suppliers to optimise the 5G network for their targeted scenarios. Finally, they need to work with regulators and policy makers to influence the release of suitable spectrum.

6. About the authors

Caroline Gabriel (Research Director) leads Analysys Mason's Networks research practice, as well as leading many 5G-related research activities across multiple programmes. She is responsible for building and running Analysys Mason's unique research base of mobile and converged MNOs worldwide. She works directly with Analysys Mason's research clients to advise them on wireless network trends and market developments. She has been engaged in technology analysis, research and consulting for 30 years, and has focused entirely on mobile and wireless since 2002. Her focus is on critical issues and trends related to mobile and wireless infrastructure, particularly MNO deployment intentions for 4G, 5G, cloudRAN and other technologies. She has led research and consulting projects with a wide range of clients, including mobile infrastructure vendors, large and start-up MNOs, regulators, trade bodies, government agencies and financial institutions

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