Translating 5G use cases into viable business cases

White Paper

Financial analysis of six 5G business cases to support communication service provider investment decisions
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Executive Summary: Taking the guesswork out of 5G business planning

2G, 3G, 4G – as each new mobile technology generation has come to market, the time taken to turn new capabilities into profitable communications service provider (CSP) business has shortened. 5G will be no different. With 5G standardization on the near horizon, CSPs globally are already running 5G trials to develop the technology and understand what it could mean for their businesses.

The proven financial benefits of being first to market with a new service are driving a flurry of activity across the communications industry. Yet 5G is far more than just a new radio interface with faster throughput. It has the potential to change the way people live and transform the way businesses work in nearly every vertical industry.

Recognizing the potential for 5G performance to run innovative services is one thing, squaring these against the financial commitments needed to turn in a profit is more difficult, simply because no commercial deployments yet exist. At the same time, delaying investment risks losing a competitive advantage that will be hard to regain.

Understanding what 5G can do begins with an analysis of the potential ways that 5G can deliver new services. To explore the possible business cases, Nokia has conducted in-depth modelling to give CSPs and verticals realistic insights into the technical and commercial factors that affect a business case’s profitability and investment return. Focusing on specific business cases will enable CSPs and vertical players to invest wisely at a controlled pace, certain they are building a reliable technology base and developing the right business processes for success in the 5G future. As well as exploring the CSP business cases, many of which will be entirely new, the Nokia research has also investigated the value of new services for end users, different industries and the entire ecosystem.

Innovative services at home, on the move and at work

One of the earliest business cases that could be deployed will be fixed wireless access to bring ultra-broadband to buildings hard to reach with fiber. 5G-to-the-home has the potential to open up the home broadband market to new entrants and deliver attractive returns in a relatively short time.

In other business cases aimed at consumers, 5G can deliver exciting infotainment services to passengers on public transport and enable spectators at large sporting and entertainment events to experience the action in new ways. Both cases offer a strong return on investment (ROI) for CSPs and other involved parties.

In the enterprise segment, 5G has the potential to reduce road transport costs and relieve traffic congestion through truck platooning, and replace inflexible fixed communications infrastructure that meets the stringent performance requirements of the automated factory while also providing new flexibility for more dynamic manufacturing systems.

Meanwhile, 5G can bring new capabilities that will help to alleviate the pressure on hard-pressed healthcare systems.

These are just a few of the early business cases that Nokia is exploring for 5G. Nokia recognizes that 5G is not just about the technology, nor is it only about simply providing exciting new services. CSP success will depend on making investments in phases that will each bring a positive financial return and will create completely new business opportunities. With in-depth insight into network and 5G technology, backed by financial and technology expertise, Nokia is helping CSPs and vertical players to connect the possibilities of 5G to reality.
As 5G technology is adopted, the economics must follow

The underlying technologies of 5G communications are being developed rapidly. Although standardization of 5G is yet to be finalized, there is general agreement across the communications industry about the key enabling technologies, the architecture and deployment scenarios of 5G networks.

This has enabled infrastructure manufacturers and CSPs to run increasingly advanced trials to show that the different technological components of 5G will perform as expected to be able to deliver exciting new services. Recent examples (February 2017) include Nokia and AT&T successfully testing the capability of fixed wireless access using the 39 GHz band to deliver an Internet streaming service. Similarly, Nokia joined forces with Sprint to demonstrate the benefits of massive multiple input multiple output (MIMO), a key element of 5G, to boost cell capacity many-fold.

There is little doubt that the extremely high performance of 5G has the potential help transform the ways businesses operate and how people live and work. It is also clear that early adopter CSPs that begin to plan today for the 5G future and make decisions about how they will deploy and use the technology will gain an important lead in what are likely to be intensely competitive and rapidly moving markets.

Planning begins with the business cases that a CSP targets as part of its business strategy. However, at this early stage, no commercial 5G deployments are yet in action. Many CSPs lack the business information they need to recognize the trends, identify the opportunities and understand what 5G can do for their brand. It must be very clear how additional revenues can be secured with 5G, what investments will be required and at what point a business case will break even. Investments in 5G will be needed and CSPs cannot afford to gamble.

To help address the shortfall in the business justification of 5G, Nokia is conducting in-depth research into a variety of areas in which 5G is most likely to bring the first benefits for CSPs and their customers. These fall broadly into three categories:

- **5G immersive and interactive experience**: How 5G will create life-changing experiences for consumers in their homes and on public and private transportation systems.

- **5G live experience**: How 5G will provide new experiences for people attending large events and meet very high demand at traffic hot spots.

- **5G industry experience**: How 5G can become the communications standard of the fourth industrial revolution.

Analysis of business cases

Nokia has conducted techno-economic analysis of key business cases that are likely to be among the first applications running over 5G networks. Advanced simulation modelling reveals the viability of these business cases by considering the technological requirements and the business potential.

Business modelling calculates the total available market based on actual market analysis, 5G market projections, services uptake, traffic prediction, a CSP’s market share, the competitive environment and other relevant market data. Combining this with the infrastructure requirements to support the business case, the analysis predicts revenues, capital costs and operational expenditure to provide likely cash flow forecasts. These lead to an assessment of the return on investment and profitability of the business case for the CSP and other players involved in the overall solution.

Business case 1: 5G-to-the-Home

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<th>User viewpoint</th>
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<td>Consumers living in households without fiber access can be frustrated by slow broadband speeds. Many are willing to pay more for the smooth gaming, ultra high-definition and 360-degree video streaming and delay-free access that fiber delivers, they just can’t get it. With 5G bringing fiber-like speeds to their doorsteps, they can join the ultra-broadband party including the world of Virtual and Augmented Reality.</td>
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Figure 1: Using mmWave spectrum each 5G base station can reach tens of households, each fitted with an antenna
5G presents an opportunity for CSPs to offer massive broadband access to homes in areas where conventional fiber-to-the-home (FTTH) is difficult or expensive to deploy. Avoiding the need for time-consuming and high-cost civil works to lay fiber, 5G delivers faster time to market and opens up the home broadband market by enabling new entrants to compete against fixed line CSPs.

In its analysis for one European CSP, a Nokia 5G solution using mmWave spectrum allows each base station to serve tens of households. The 5G short-range fixed wireless access is expected to sustain up to 1 Gbps per household, in the downlink (DL). To achieve such a high speed and longer ranges for 5G fixed wireless service, for example beyond urban and more densely packed suburban markets as well as rural applications, cmWave and mmWave radio technology must support large bandwidths and MIMO antenna beam forming techniques.

The business modelling is based on an addressable market of 100,000 households with 6 percent served by fiber and a CSP market share of 35 percent with a 30 percent take rate for the service. The discounted cash flow (year on year) is yielded by the difference between the CSP costs (capital and operational expenses) and revenue (present value of the money) from connected households (domestic units, people who live together along with non-relatives).

Figure 2: Flow-chart (logic) for 5G-to-the-Home business case calculation
The analysis shows that the CSP’s business case most depends on the number of households served per site, the site capital expenditure (CAPEX) and the average revenue per user (ARPU). Simulation results in terms of discounted (7.6 percent) cash flow (€ millions), from 2019, when the service is launched, to 2028, show that the CSP business case appears quite sensitive to ARPU, which needs to be kept above 40€ (premium) and number of households per site, which should be at least 30 for a positive business case, under the above assumptions. The price erosion is insignificant, hence the sooner the service is launched, the better.

Figure 3: The 5GtH business case is heavily dependent on three key criteria – number of households served by each base station, site CAPEX and achievable ARPU
Business case 2: 5G for in-vehicle infotainment

User viewpoint

Whether making the daily commute, or traveling for pleasure, public transport users with ultra-broadband connectivity can make more of their time. Watching streamed high-definition augmented reality or conducting business meetings via video calling, many passengers will welcome new experiences on the move enabled by 5G.

Figure 4: A dense city center deployment of 5G would deliver mobile broadband and infotainment services to customers using public transport

5G will undoubtedly enable CSPs to win revenue by delivering information and entertainment services to traveling subscribers, particularly in dense urban areas. Such services are likely to include high-quality video streaming, augmented and virtual reality applications, online gaming and video calling. The network must be able to deliver services consistently across the area and with good performance simultaneously to many users on public transport, often traveling at relatively high speed.

High performance services could also be provided for users of non-5G devices by transmitting 5G to a vehicle and distributing bandwidth via Wi-Fi, for example on a train. This gives CSPs the chance to use early 5G deployments to win new revenue ahead of the widespread availability of 5G devices.

Nokia has analyzed the business case for infotainment services on public transport for one UK CSP as part of a 5G deployment across a dense city center area using 50 MHz at 3.5 GHz (Band 42). To meet the predicted rise in mobile and video traffic demand, cell capacity needs to be increased from 1 Gbps in LTE to 10 Gbps downlink and 3 Gbps uplink peak, with more users being supported by each cell. In addition, 5G ultra-low latency performance will be needed to support virtual reality, gaming and other delay-sensitive applications.
The CSP could win revenue from high value passengers and from governments for supplying 5G bandwidth to public transport. Charging could be per trip for public transport, per time or per data volume.

Launching 5G in 2019 as an early adopter, the CSP could gain a 3 percent larger share of the 5G market than its rivals that launch a year later. Assuming that 5G ARPU increases in a similar way as 4G when that technology was introduced, the business analysis for the city center area shows the CSP could achieve approximately Euro 800 million additional NPV over ten years.

Figure 5: Flow-chart (logic) for 5G Infotainment business case calculation

Figure 6: Profit and loss analysis shows a positive and growing cumulative discounted cash flow that results in an NPV of about Euro 800 million over 10 years
Business case 3: 5G for hot spots

Imagine a completely new dimension to the experience of being a spectator at a major event. 5G enables visitors to get close to the sporting or entertainment action without needing a high-priced VIP ticket. Using real-time virtual reality to experience being track-side at a critical moment in a race or in the middle of a pit-stop is a powerful attraction. Combining this business case with the 5GttH business case would enable CSPs to deliver immersive event experiences to homes.

Figure 7: With 5G, CSPs can offer multiple camera views and virtual reality to thousands of spectators at a major sporting event

The high throughput, low latency of 5G is well-suited to deliver services that provide alternative live views of sporting action at a major event, and doing so simultaneously to thousands of spectators. Consumers can experience being at the heart of the action with live streaming virtual reality. Or they can select from a choice of cameras to see what’s happening from any angle they want, click to see instant replays or enhance their experience with insights provided through augmented reality.

Furthermore, with 5G capacity in place, CSPs can be sure of supporting their subscribers through a range of other services at the event, from betting online to buying merchandise, from pre-ordering refreshments to instantly sharing their experiences on social media.

The high density of users and extreme throughput and latency demands of these applications cannot realistically be met by Wi-Fi or LTE. Only 5G can support more than 500 users per cell, provide high cell edge performance for an acceptable quality of experience and deliver an end-to-end latency of less than 5 ms to avoid virtual reality motion sickness.
A business case analysis by Nokia has shown that a US CSP providing services at five events per month at a major stadium could achieve $7.7 million in NPV over 10 years from its investments in 5G. The findings show the business case’s viability is highly dependent on the number of events being held at a venue. At least five events per month are needed for the business case to be profitable. Another analysis for a UK CSP shows that at a major London stadium, the CSP could achieve break even in two years by supporting five events per month, while more than six events monthly would hit break even during the first year, based on a Euro 10 rental fee for the virtual reality set.

The choice of venue is therefore critical.

Operator Cash Flow, '000 USD

Figure 8: Flow-chart (logic) for 5G Hotspots business case calculation

Figure 9: A rapid payback time can be achieved on a US CSP’s investments in 5G infrastructure at a major sporting venue based on seven events per month
Business case 4: 5G for truck platooning

User viewpoint

In many countries, roads are clogged with traffic, creating jams that are a frustrating part of the daily drive. Truck platooning, in which several trucks travel in a tightly-knit, automatically-controlled convoy behind a lead human-driven vehicle, promises not only to reduce congestion and lower fuel consumption, but also to cut transport costs for logistics companies.

Figure 10: 5G is the most promising enabler of truck platooning in which long convoys of trucks are automatically governed and require only a single driver in the lead vehicle

While the concept of truck platoons as a means of cutting operating costs and reducing road congestion has been around for many years, the advent of 5G looks to be finally bringing the idea to reality. Safe platooning depends critically on 5G’s ultra-low latency and high reliability.

Small platoons are possible using LTE and multi-access edge computing (MEC), however longer platoons are more cost-effective and require 5G technologies. Platooning will also become an integral part of the connected vehicle future enabled by 5G that will also include infotainment, telematics and assisted driving. Ultimately this will lead to autonomous driving.

Truck platooning should prove attractive to logistics companies by reducing their staff costs, fuel use and supporting more efficient use of the truck fleet. CSPs could offer Truck-Management-as-a-Service (TMaaS) in which logistics companies pay a monthly fee according to the number of trucks covered. CSPs are also likely to partner with vehicle makers to provide an end-to-end solution.
In its analysis, Nokia based its business calculations on average truck fuel consumption data and delivery distance statistics, taking into account fuel savings of 4 percent for a lead truck and 10 percent for following trucks. Other cost savings arise from deploying four trucks per platoon with one driver instead of four, using average driver salary and average seven hours one-way trip duration.

The findings, based on measurements by a truck manufacturer, show that the CSP could reach break-even on its 5G investments in six years if it received a 12.5 percent share of the logistics company’s cost savings. The CSP would gain a cumulative discounted cash flow of $1.6 million over ten years dealing with a logistics company that handles from 100 to 300 trucks per day in 2020 and 2029, respectively, over a route of 500 km (a typical journey in Europe).

It has been forecast that more than 7 million truck platooning systems could be shipped by 2025. With hundreds of private transportation companies running more than 100 trucks in their fleet, the overall revenue opportunity for a CSP is large. The business case is no longer profitable if the CSP’s share of the cost savings drops below 11 percent.

Figure 12: The US CSP analyzed could achieve a break even on its 5G investments in about six years when it receives 12.5 percent of the logistics company’s cost savings.
Healthcare systems globally are under intense pressure as populations age and economic limitations are applied. 5G can address the issues in many ways, such as enabling skilled surgeons to work remotely and through the application of intelligent robotics to provide basic care needs. It’s all about making more efficient use of limited resources to improve access to healthcare services for people wherever they are.

**Business case 5: 5G for connected healthcare**

**User viewpoint**

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**Figure 13:** Wireless telesurgery (top) and wireless service robots are two connected health business cases whereby 5G can help to alleviate resource pressure on healthcare services.
Nations worldwide are searching for innovative ways to meet endlessly-growing demand for healthcare services that have restricted resources. Innovation in healthcare is a major focus across both the private and public sectors and one in which 5G can play an important role.

Two business cases illustrate the possibilities.

Wireless telesurgery brings telecommuting to the surgical world. Procedures are performed on remotely-located patients by surgeons with the aid of a robot. The target is to provide a remote surgeon, who could be located hundreds of kilometers from patients, with the same sense of touch (essential for localizing hard tissue or nodules) while substituting doctor’s hands with robotic probes (arm or finger). To achieve such an experience, delay and stability are crucial in transmitting the haptic feedback (kinesthetic, as force or motion; and/or tactile, as vibration or heat), in addition to audio/video data, as substantial delays can seriously impair the stability of the feedback process and lead to cyber-sickness, which may occur when eyes perceive a movement delayed compared to what is perceived by the vestibular system. 5G is the only wireless technology capable of providing the low latency and high availability required.

The second business case is wireless service robots, or personal assistant robots, that use artificial intelligence (AI) to help the elderly and other patients remain active and independent with a good quality of life, while also reducing care costs. Service robots for care are being primed to join the labor force in roles, such as logistics, cleaning and monitoring, which can be fully automated. Beyond these simple tasks, androgynous robots are anticipated to interpret human emotions, interact naturally with people and perform complex care or household jobs. They could also assist patients and elderly people in hospital and hospice campus areas, and at home to reduce care costs, and help ageing people remain active and independent with a good quality of life.

The target with 5G wireless is to meet the required latency and throughput, with ultra-high reliability, between wireless robots and mobile edge computing centers (reasoning systems), where most of the intelligence is located, for example for object tracking, recognition and related application. Particular attention should be paid to the control loops, which cannot be executed locally. For instance, visual processing cannot be handled locally (because of the computational load/amount of data) and therefore is managed by a reasoning server remotely. This means a 5G wireless connectivity between peer points of Gbps, extremely low latency (below 5ms) for force control, and with failure rates below $10^{-7}$, 3.17 s of outage/year. Also, for fully autonomous robots to meet the required performance, it is very important to decide where and what to compute, and how to transmit data and signals, at a given bandwidth.

Nokia analysis of the wireless service robot business potential shows a break-even point of less than one year for the CSP’s capital and operational expenditures on the connectivity. A care provider working in partnership with the CSP would achieve break-even in less than six years for its robot and backend server costs.

It should be noted that the proposed 5G solution to Wireless Tele Surgery (WTS) and Wireless Service Robots (WSR), for tele-health and tele-care services, are applicable to many more business cases, because the haptic control is inherent to a number of tactile applications, and control loops between edge cloud and machines are needed for handling traffic of connected vehicles, industry robots and more.

A more attractive business case for CSPs would be to support other uses in order to cover the costs of a dedicated 5G indoor infrastructure for tele-healthcare, especially OPEX. Network slicing could be a fundamental enabler for this.

For care providers, the business case is quite sensitive to rising OPEX and CAPEX per robot, including its replacement. The business case will unquestionably fly when more powerful robotic platforms will help save more costs of care, and their price will be much more accessible to consumers. Business to business is where a Return on Investment (RoI) business can be easily made, as long as the price to lease the robot is much cheaper than hiring people.
Figure 14: The wireless service robots business case achieves a fast payback for the CSP providing the 5G connectivity (a) and a slightly longer break-even point for the partner care provider (b).
Business case 6: 5G for Industry 4.0

**User viewpoint**

There’s a new game in town for the world’s manufacturing industries. As part of the so-called fourth industrial revolution, smart factories will deploy greater automation, interconnecting all their areas and activities to vastly improve productivity, increase staff safety and become far more flexible to meet rapidly evolving market needs. The factory floor is about to change forever.

One of the most important enablers of the smart factory of the future will be vastly increased connectivity that will link machines, processes, robots and people to create more flexible and more dynamic production capabilities. About 90 percent of industrial connectivity today uses wired connections which provide the high performance and reliability needed for automation, but lack flexibility to be able to rapidly meet changing production demands.

5G is the first wireless technology with the high throughput, low latency and extreme reliability that can replace wireline connectivity in the factory. Effectively, 5G is a drop-in replacement for today’s wired networks. Wireless connectivity allows additional machines to be connected by simply equipping them with wireless sensors and actuators and if required, scaling the network capacity to handle new traffic.

A study in one of Nokia’s factories has shown that 5G wireless connectivity has up to five times lower costs than wired systems. Wireless 5G connectivity can replace wired systems in an existing facility with a payback period as short as one year or less (For further details, see the Nokia 5G Use Case Insights White Paper https://resources.nokia.com/asset/201088).

Nokia 5G FIRST puts business cases into practice

Being an early adopter is proven to deliver a substantial market advantage. North American CSPs that were first to market with LTE enjoyed $6.6 Billion in extra revenue over the second mover within five years.

With Nokia 5G FIRST, CSPs can deploy the right 5G infrastructure to run these and other business cases before final 5G standardization is complete. Yet CSPs can be confident that their investments will stand the test of time because Nokia 5G FIRST is based on well-defined market requirements covered by Verizon TF (Technology Forum) and KT SIG (Special Interest Group) specifications. The system will be made 3GPP compliant once the standards are ready.

5G FIRST is a complete network solution comprising:

- Nokia AirScale massive MIMO Adaptive Antenna, initially available for 3.5, 28 and 39 GHz
- Nokia AirScale Radio Access baseband and AirScale Cloud RAN complying with 5G TF/KT SIG and 3GPP standards as they are finalized
- Cloud-native packet core to support primary 5G capabilities such as network slicing and Dev-Ops cloud systems
- 5G-ready Mobile Anyhaul provides ultra-low latency transport using microwave, IP, Optical and PON technologies.

The Nokia FIRST solution includes a range of expert services. Nokia 5G Acceleration Services help CSPs to evolve their networks and operations to 5G. Services experts from Nokia Services and Bell Labs Consulting provide further help, from envisioning the use cases to validating the business and deployment plans. The business case driven approach to design ensures the optimal transformation journey to 5G.
Conclusion: Early adoption is the winning business plan

5G will create many new opportunities for CSPs to do business with nearly every vertical industry, but it will also increase the competitive pressure they face, not just from their peers but also from new entrants. Taking the initiative by deploying 5G to run early business cases will give a CSP a foothold in the burgeoning 5G market and develop new ecosystems. Investments can be staged and rooted in accurate and realistic analysis of the financial returns of each business case.

Nokia has been at the forefront of 5G developments from the earliest days and works with world-leading players to help shape the global 5G ecosystem. We offer the expertise, experience, and understanding of a CSP’s business and operational needs to help them realize the opportunities that 5G promises.