White Paper

5G Networks: Driving Business Value in the Next Mobile Era

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IDC OPINION

The continued rise in digital communication and commerce presents significant opportunity for the telecommunications sector. Existing services are rapidly being commoditized, while data traffic continues to skyrocket. As such, operators require a renewed focus on innovation to deliver value to customers. Already, technologies are being deployed en masse to improve network resiliency and drive down costs, including virtualization, artificial intelligence/machine learning (AI/ML), and big data and analytics. Whereas reducing costs is one benefit, the ability to create new revenue streams, and broaden service portfolios, is also top of mind.

The commercial introduction of 5G networks will enable mobile operators to evolve by significantly enhancing throughput, reducing latency, and connecting millions of end devices. As such, 5G will help mobile operators breathe life into their traditional consumer business while unlocking new revenue opportunities across a range of enterprise verticals. In conjunction, as enterprises increasingly embrace digital transformation (DX) themselves, cloud and mobility are combining to rapidly shift the paradigm governing voice and data traffic across cellular networks. As such, mobile operators are uniquely positioned to capture business value by transforming themselves from connectivity agents into agile, business platforms in the 5G era.

This white paper reviews the current state of cellular networks, demand trends, and how 5G will help define the 2020 mobile services landscape. Further, this white paper discusses Samsung's track record and end-to-end portfolio and how its unique heritage positions the company to succeed in the 5G era.

SITUATION OVERVIEW: WITH INITIAL 5G SERVICES INTRODUCED, THE STAGE IS SET FOR BROADER ROLLOUTS IN 2019

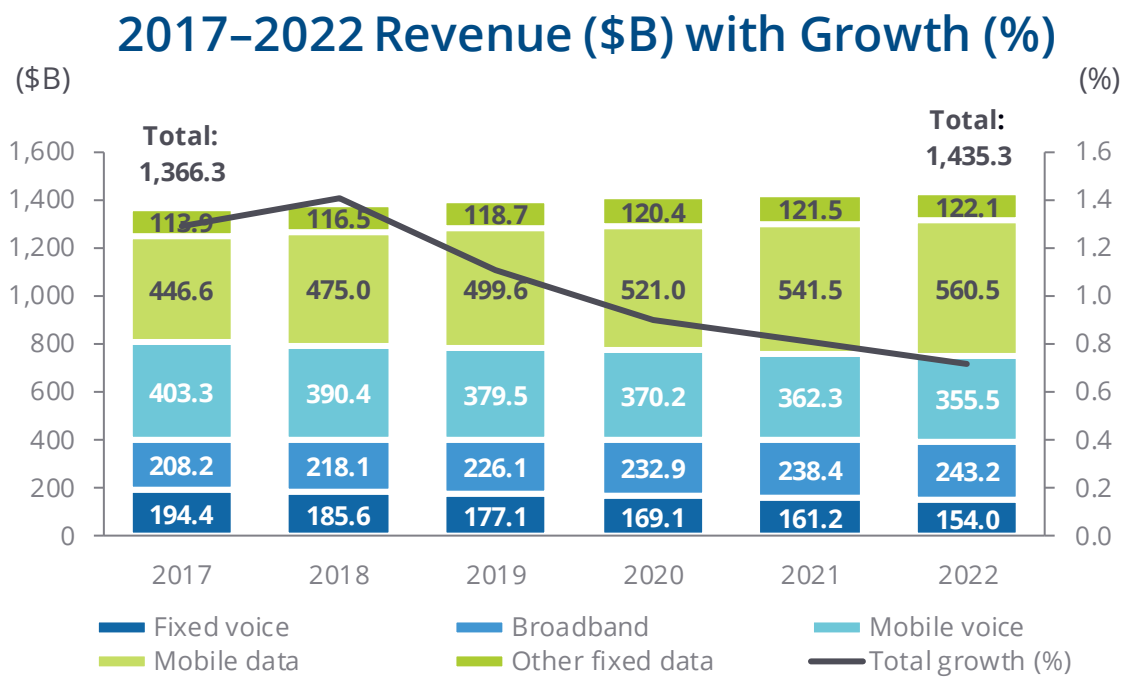
5G Will Be Instrumental to Operator Evolution

The commercial introduction of 5G began when Verizon launched the first U.S. fixed wireless 5G services at the beginning of October 2018. In addition, 5G mobility services have been launched in several countries along with the first generation of 5G-compatible devices. While it may take several years for 5G services to become mainstream, the market for 5G is moving in positive direction, with all four major U.S. carriers expressing commitment to the deployment of fixed and mobile 5G services in the coming years.

Further, operators in both developed and in developing markets are signaling the intent to rapidly scale their 5G footprints in 2019 and 2020, leveraging a wide range of spectrum spanning low band and midband (below 6GHz) to millimeter wave (mmWave) (24 GHz and above) for both 5G fixed wireless access (FWA) and 5G mobility. As such, it is clear that in the 5G era, mobile operators will have a broader set of tools from which to design, deploy, and monetize an expanded set of 5G services than in prior mobile generations. IDC forecasts total worldwide telecom operator service revenue to grow from $1,366.3 billion in 2017 to $1,435.3 billion in 2022 (see Figure 1).

FIGURE 1

Worldwide Telecom Operator Service Revenue Forecast, 2017-2022



Selected Segment Growth Rate

- ▼ Fixed voice CAGR -4.6%
- ▲ Broadband CAGR 3.2%
- ▼ Mobile voice CAGR -2.5%
- ▲ Mobile data CAGR 4.6%
- ▲ Other fixed data CAGR 1.4%

Total Market CAGR

1.0%

Notes:

See *Worldwide Telecommunications Services Forecast, 2018-2022* (IDC #US43786318, May 2018) for more information.

Chart legend should be read from left to right.

Source: IDC, 2018

Present Market Conditions Expected to Persist, Driving a Renewed Focus on New Opportunities for Services Growth

IDC estimates that the telecommunications services market will achieve a 1% CAGR for the 2017-2022 period, driven by broadband and mobile data services, partially offset by declines in spending on traditional fixed and mobile voice and messaging services. Indeed, mobile service commoditization will continue to limit revenue and margins, with ARPUs remaining relatively flat and industry players interlocked in heightened competition to protect their traditional profit pools.

Therefore, the business value of 5G will hinge on the ability of mobile operators to drive new opportunities not only with consumers but also with enterprise verticals. To accomplish this, mobile operators will deploy a range of new technologies alongside 5G New Radio (NR), including multiaccess edge computing (MEC), machine learning and artificial intelligence, and broad network virtualization. Doing so will better equip mobile operators to unlock new use cases that fall into three main buckets.

5G MONETIZATION: CREATING THE ROAD MAP

Based on feedback from communications service providers (SPs), 5G network suppliers, and potential enterprise customers, the 5G services market is expected to develop across three categories and encompass two main phases.

The three 5G service categories are:

- Enhanced mobile broadband (eMBB)
- Ultra-reliable low-latency communications (URRLC)
- Massive machine-type communications (mMTC)

Phase 1 (Late 2018+)

Network infrastructure will be deployed to support enhanced mobile broadband. In this phase, networks take a big step forward in throughput and capacity, leveraging low-, mid- and high-band spectrum previously unused for fixed and mobile communications. Most notably, some service providers will leverage mmWave spectrum (24GHz and above) to address network bottlenecks in urban and other high-traffic areas. In this phase, the non-standalone (NSA) 5G configuration will be the de facto approach, whereby 5G NR is paired with an existing LTE core network. The net of these technologies will essentially represent an improved connectivity service above and beyond what LTE is capable of today.

As noted, mobile operators are expected to target the enterprise segment to drive new revenue opportunities. IDC's research indicates that mobile operators and enterprises alike are optimistic about the potential of 5G to positively impact the enterprise space, even in phase 1.

Phase 1 5G will enable operators to begin to monetize 5G through various approaches:

- Higher performance from existing networks supported by guaranteed service-level agreements (SLAs)
- Enhanced performance of current services, such as unified communications

- Fixed-mobile convergent (FMC) communications, or extension of fixed-line services into mobile, such as broadband access and SD-WAN
- Fixed-mobile substitution (FMS), or replacing existing fixed-line links with mobile links or in places where fixed line is unfeasible
- eMBB use cases deployed to consumers (e.g., mobile connectivity, AR/VR, and enhanced gaming)
- 5G fixed wireless access for both consumers and enterprises

Phase 2 (2020+)

The combination of 3GPP standards-compliant Release 16 5G NR with the new standalone (SA) 5G core, software-mediated networking, ML/AI, and a distributed cloud architecture will enable rapid provisioning and near-real-time response from services. Further, the migration to an end-to-end virtualized network will enable 5G network slicing.

As such, the recombinant use of technologies will enable service providers to unlock two new classes of services, commonly bucketed under the terms massive machine-type communications and ultra-reliable low-latency communications. This longer-term view is where IDC expects the "material" business value of 5G to emerge. 5G SPs will be able to provision services based on strict service-level agreements aligned to specific verticals and use cases. Moving past the rapidly commoditizing consumer market and targeting enterprise verticals is critical to service providers overcoming their present-day revenue growth barriers.

Phase 2 is expected to support further monetization, particularly across a range of industry verticals:

- The ability to develop premium pricing models for connectivity services
- The potential to develop applications and charge a fee on top of existing connectivity services
- The ability to deliver service-level agreement-based services in a tiered model
- The ability to supply connectivity and other capabilities to third parties, which aligns to a revenue sharing model
- The ability to define, design, and customize a mobile service for a specific vertical or use case, a significant pain point in the enterprise where customers are often charged for an underutilized service
- The recombinant use of multiaccess edge computing in conjunction with an end-to-end telco cloud and 5G NR that will drive the ability to offer new services on-demand

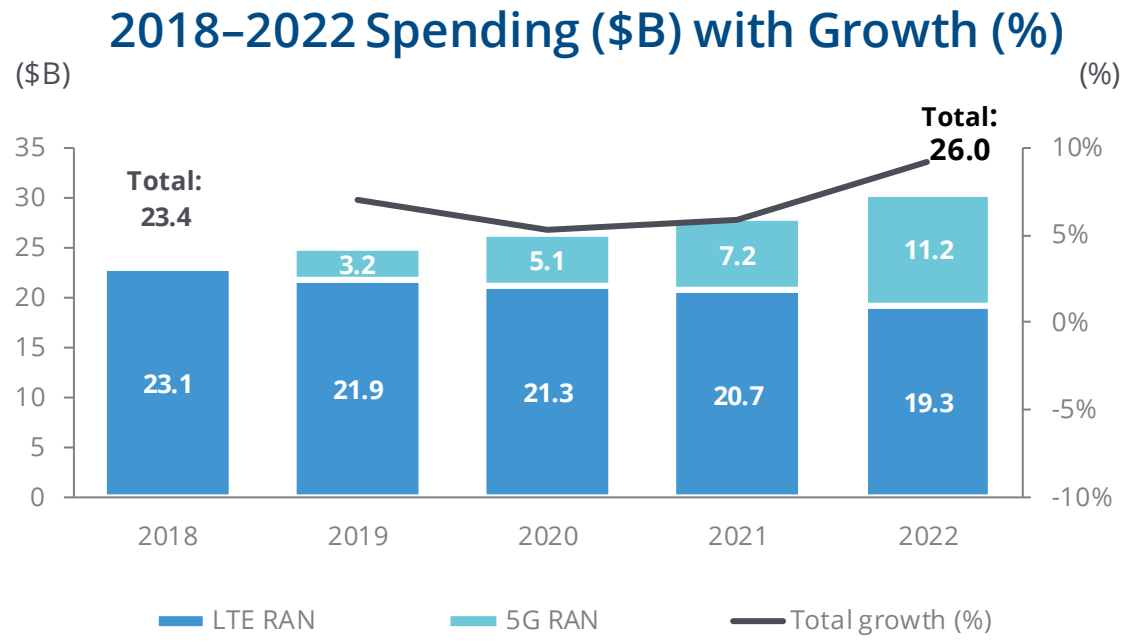
While the present consensus about how 5G will be monetized has prompted some communication SPs to limit trials until the 5G business case solidifies further, those in the industry that are forging ahead are likely to separate themselves from peers in both service delivery and business outcomes, particularly when demand for 5G-based services reaches critical mass in the 2020s. The net of these enhancements will help operators move past their present condition and facilitate a transformation from simply connectivity agents to robust, 5G platforms. Achieving the platform vision will then help operators generate greater business value by further addressing industry verticals.

THE 5G TECHNOLOGY DISCUSSION: MAKING 5G A REALITY

IDC forecasts LTE RAN and 5G RAN spending to grow from $23.4 billion in 2018 to $26.0 billion in 2022 (see Figure 2).

FIGURE 2

Worldwide 5G and LTE RAN Capex Forecast, 2018-2022



Selected Segment Growth Rate

- LTE RAN CAGR -4.0%
- 5G RAN CAGR 145.0%

Total Combined Market CAGR

6.8%

Notes:

Chart legend should be read from left to right.

Data shows only hardware and software capex.

Source: IDC, May 2018

After initial rollouts in the 2018–2019 period, 5G uptake will accelerate in the 2020s. Alongside 5G, LTE will remain a foundational aspect for both mobile operators and their suppliers. It is important to note that the planning for 5G networks, if absent, needs to begin now, as it remains a stark possibility that many operators may potentially exhaust LTE network capacity without supplementary or new investment in 5G network infrastructure as soon as the early to mid-2020s.

Open RAN: Essential to the Vision of an End-to-End 5G Cloud Network

A subsegment of the 5G era is emerging interest in Open RAN. Open RAN follows the continuum of RAN evolution commonly discussed as Distributed RAN, Centralized RAN, and Cloud RAN. Open RAN embodies all of Cloud RAN's base principles but includes standardizing hardware and software interfaces such as the Common Public Radio Interface (CPRI) and X2 interface. The X2 interface supports handover between base stations. CPRI, in particular, provides the link between baseband equipment and radio units. In an Open RAN configuration, communications SPs would be better positioned to mix and match suppliers, further moving away from a single-supplier, lock-in model.

As such, CPRI and other proprietary interfaces essentially become a sticking point in RAN market dynamics as traditional vendors have leveraged proprietary extensions of CPRI, and other interfaces, to lock RAN customers into large, monolithic contracts. The result of this is borne out in most carrier macronetworks, where only one or two large vendors are often present. The idea behind Open RAN could disrupt this model, whereby best-of-breed solutions are leveraged across the whole of a carrier's network footprint. At the very least, enabling additional vendors to compete for RAN contracts would positively affect pricing, which is one reason communications SPs are interested in Open RAN's efforts.

From an operator perspective, Open RAN could be beneficial for several reasons:

- A cloud-based Open RAN that will provide the flexibility, agility, and centralized control to better address new use cases
- Lower RAN capex outlays
- Increased competition between suppliers
- Open RAN constituting a cloud-driven approach that aligns with a broader telco cloud initiative

As part of this effort, the industry has formulated several consortia, including the Telecom Infra Projects (TIP) vRAN working group, and most notably the O-RAN alliance, which includes tier 1 operators from China, the United States, South Korea, and Japan. Many of these operators have already invested capex to construct Cloud RAN in portions of the networks. However, several have stated that the goal remains to eventually move to an Open RAN model, whereby it becomes easier to mix and match baseband (BBU) and radio elements in the network. The resulting dynamic would enable more suppliers to compete, enhance competition, and help mobile operators accelerate RAN transformation toward use case creation.

Networks Require Enhancement, But Don't Forget Operation and Monetization Platforms

If mobile operators are to fully benefit from the shift to 5G, they must make major changes to their OSS and BSS to address new services. In particular, a 5G service launch, which may target multiple verticals from a single platform, will not be effective without first addressing the need for upgraded OSS and BSS.

A great deal of work will be needed to upgrade most operators' operations and monetization systems so that they can deliver advanced 5G services securely, smoothly, and at scale. Given the evolutionary approach that operators tend to take with IT systems deployment, this work should commence early. High-priority items include real-time charging, end-to-end order/service management from the customer side through to the network side, service assurance, and partner management.

Given the scope of the task, it would be advisable for operators not to avoid attempting the whole upgrade and transformation process themselves. Trusted partners can provide the guidance that is clearly needed about objectives and implementation, and they can make it easier to try new approaches in satisfying 5G technology demands, such as cloud-based solution offerings.

END-TO-END TELCO CLOUD AND VIRTUALIZATION: NETWORK SLICING AND EDGE CLOUD SEEN AS KEY APPROACHES TO UNLOCKING NEW IOT USE CASES

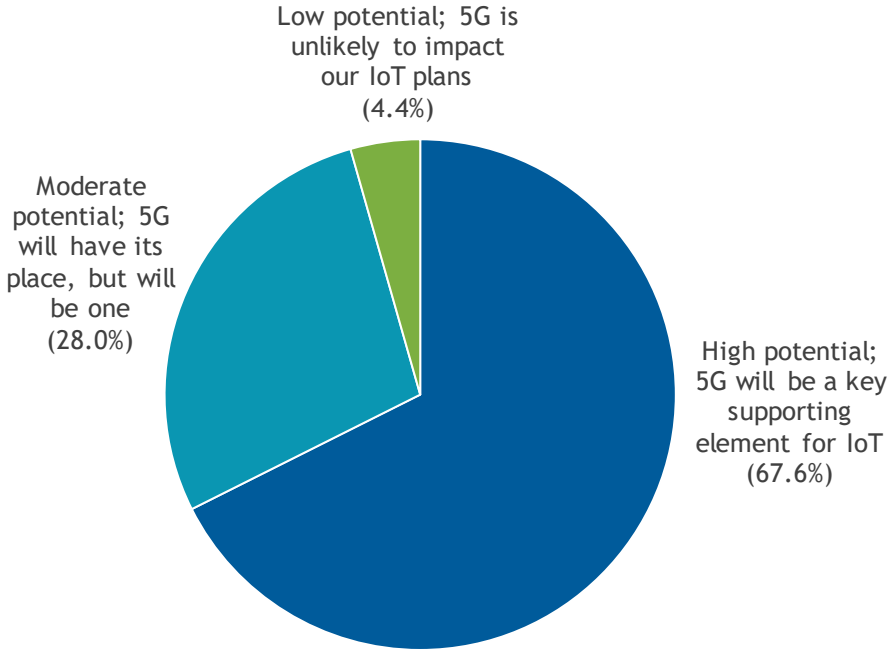
Enterprises Expect 5G to Play a Key Role in IoT Use Cases

To drive new vertical opportunities, including those for IoT use cases, the overarching sentiment is that operators will need to invest in new architectures to achieve this. As shown in Figure 3, a majority of surveyed enterprises expect 5G to play a key role in the development and deployment of IoT. Still, it is unrealistic that mobile operators will address multiple IoT use cases on today's network architecture.

FIGURE 3

Enterprise Sentiment on 5G for IoT Use Cases

Q. What is your position on 5G networks for IoT?



n = 250

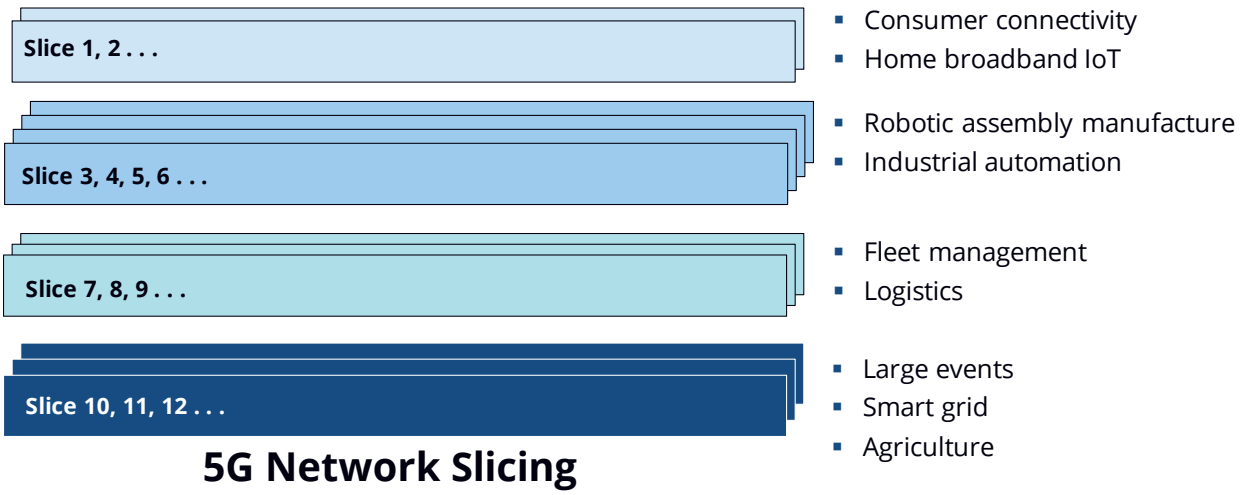
Source: IDC's *IoT Infrastructure Survey*, January 2019

Network Slicing: What Is It and Why It Matters

"Network slicing" refers to the concept of logically partitioning "end to end" networks into "virtual" slices all the way from radio access to core (see Figure 4). In essence, network slicing entails a service provider creating very versatile end-to-end "virtual private networks," leveraging resources across all elements of the telco infrastructure. While each network slice is resident on the common physical hardware infrastructure, because it is created in software, it can have its own network architecture, engineering, and network provisioning mechanisms. Each slice can then be optimized for a specific use case or a network service.

FIGURE 4

5G Network Slicing



Source: IDC, February 2019

This optimization, depending on the specific use case being delivered by the slice, can be based on latency, capacity, throughput, and speed. Several network slices can reside on the same underlying infrastructure. While one network slice can be optimized to deliver maximum bandwidth in order to deliver rich media such as video, another slice can be optimized to deliver an IoT smart grid for a utility with thousands of low-latency connections. A common infrastructure can thus deliver network services with a broad diversity of bit rates, device densities, and latencies. It can be designed to have a high degree of flexibility in addressing very diverse use cases concurrently. Current research indicates interest from mobile operators remains very high, as the potential to address new enterprise verticals from a single 5G network platform has the potential to unlock new revenue streams.

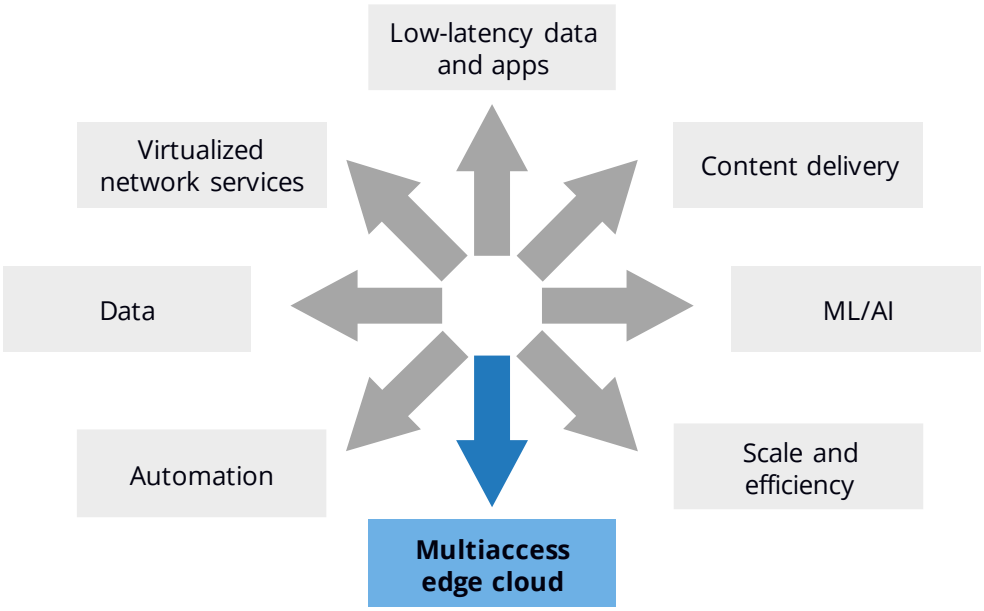
Building the Multiaccess Edge Cloud Is Not Only Strategic But Also Urgent

To support the diverse set of future use cases that require extremely low levels of latency, network cloud instances will need to be closer to customers. This is driving the notion of the distributed telco edge cloud (see Figure 5). As 5G IoT connections spawn massive data lakes, they will necessitate the provisioning of cloud infrastructure that can scale elastically and efficiently to analyze the data for

insight and subsequent action. Considering that a significant number of IoT use cases will be latency sensitive, they will require the data to be processed for insight in a cloud that is in closer proximity than a typical hyperscale datacenter. Carriers with their central office–based edge clouds will be in great position to support this endeavor. The data over time can also be mined using ML and AI tools to act on even more sophisticated applications within the IoT realm.

FIGURE 5

The Multiaccess Edge Cloud Imperative



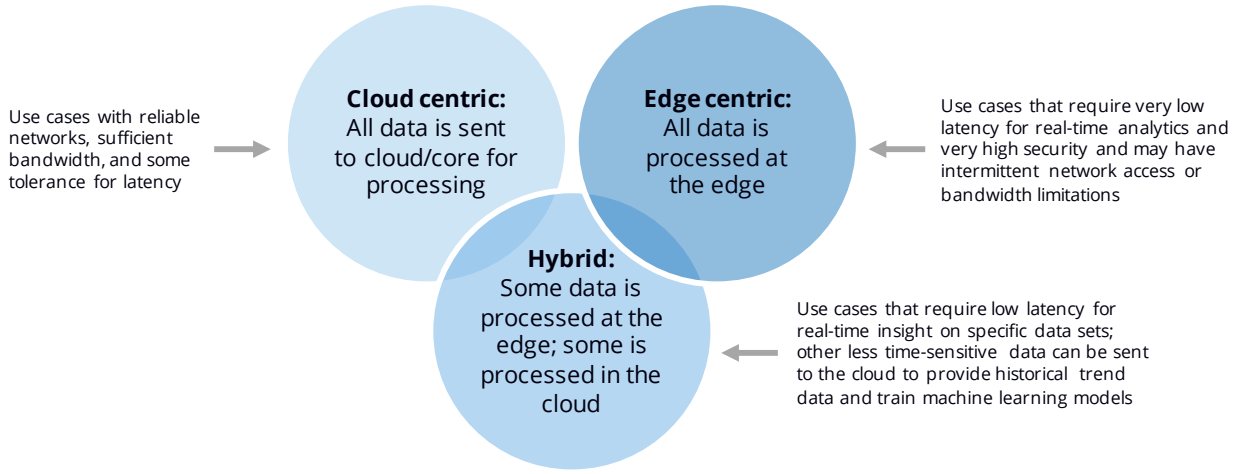
Note: See *The Strategic Importance and Urgency of a Near-Term Carrier Multi-Access Edge Cloud Buildout: Key to 5G, Virtual Network Services, Content Delivery, and AI/ML-Enabled Services and Operations* (IDC #US44871717, February 2019) for more information.

Source: IDC, 2019

Besides the IoT realm, carrier network infrastructure is increasingly being architected to provide streaming telemetry that can be harvested for analytics and to glean greater insight into the behavior of network elements and the end-to-end network. Over time, this data can be analyzed for patterns using machine learning and AI to optimize and automate carrier networks. Considering that the edge clouds are likely to host the data infrastructure for use cases such as IoT, carriers can be expected to utilize the same infrastructure to analyze the streaming telemetry data from network elements and provide the foundation for closed-loop automation and orchestration of the end-to-end network infrastructure (see Figure 6).

FIGURE 6

IoT Will Increase the Significance of the Carrier Edge



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Source: IDC, 2019

Further Application of NFV/SDN in Mobile Networks

It is apparently clear that LTE and 5G networks will continue to migrate to NFV/SDN-based solutions. Indeed, many mobile operators are several years into their software-mediated network journeys. 5G will represent the first mobile generation designed with long-term vision of a fully cloud-based, virtualized environment. While this paper has highlighted some of the top-of-mind concerns for 5G, it is important to call out some concurrent actions, which will be important to optimizing network infrastructure, and by extension, business results.

Virtual IP Multimedia Subsystem

Like vEPC, many mobile operators have taken the first step by virtualizing their IMSs. This initial move has been mostly about reducing opex and enabling rapid provisioning of new services. However, to align with the proposed 5G framework, most mobile operators will need to redeploy virtual IP multimedia subsystem (vIMS) from the ground up to optimize opex and remain competitive in the voice over IP (VoIP), voice over Wi-Fi (VoWiFi), and rich communication services (RCS) markets.

As such, a truly cloud-based approach, leveraging microservices, DevOps, and aligning to network slicing principles, will be key to addressing this challenge.

Addressing the Expected Data Deluge

Subscriber data management (SDM) applications are also being targeted for virtualization. As 5G will encompass a range of access methods, the mobile network can expect to receive a wider range of data from an ever more diverse set of end devices. Collecting, aggregating, and managing the data for business action will require SDM solutions to align with the virtualized 5G architecture.

The general idea will be to create a central data repository, which can connect to in-house or third-party applications. The result will be increased efficiency and the ability to better provision and manage new services.

As mentioned, vSDM solutions will also need to align with a cloud-first approach, enabling VNF and subscriber data transfer to a shared data layer, separating the data from the application software logic. Said differently, microservices is expected to be a leading approach in many NFV-based clouds.

THE OTHER CHALLENGE: INCREMENTALLY EMPOWERING PERVASIVE NETWORK AUTOMATION

With network complexity expected to increase dramatically, the reality is manual provisioning, and management is fast becoming untenable. IDC expects many mobile operators will be driven to automate many network-related tasks in lieu of manual provisioning. The improved outcome will be a network able to self-diagnose, manage, and ultimately prevent a higher percentage of network faults. This migration will require a concerted effort by mobile operators to build new skill sets and by putting trust with vendors to help them migrate any number of tasks to an automated framework.

Network Management Moves from Reactive to Proactive

Network management platforms are emerging as an early test bed for AI/ML-led initiatives. The idea is to enable networks to benefit from the computing power associated with AI and the construction of self-enhancing algorithms. Indeed, the stuff of science fiction is slowly making its way into mobile operator network architectures.

In the past, network management systems served as network custodians, cleaning up the mess after the fact. For example, if a preprogrammed threshold is reached, the network can notify a human that action is required. The idea with leveraging AI/ML and collected data is to let networks teach themselves how to improve, often before a problem presents itself.

For example, the accrual of customer big data can be useful for many reasons such as outbound marketing, customer relations, and service launches. Internally, network-related data is better served to improve operations. Pair that data with a prescriptive algorithm and infuse AI/ML, and the network can begin to learn from its past mistakes and head off future issues. This is also referred as predictive analytics.

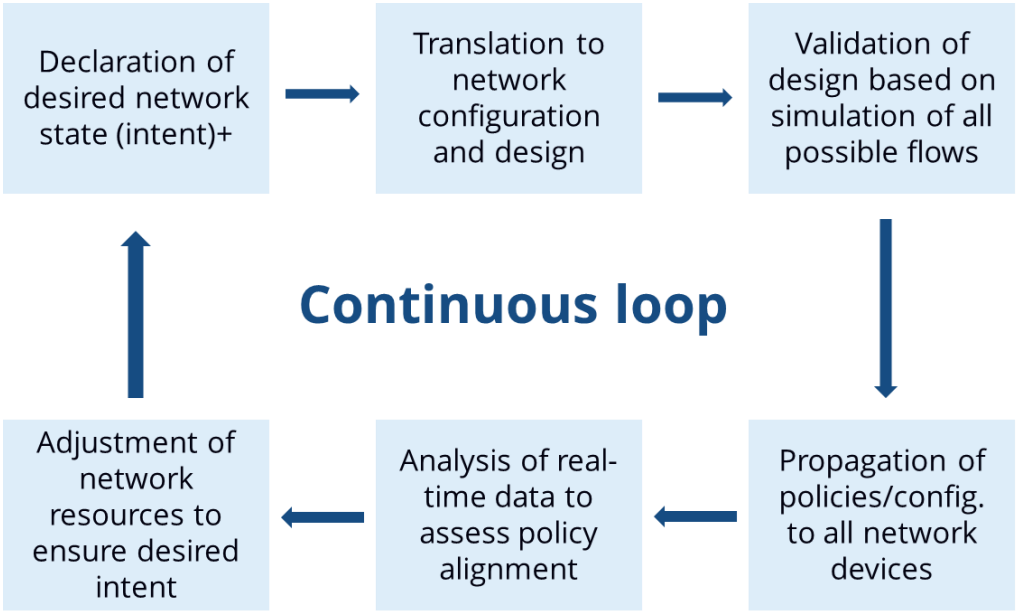
A key requirement to make this all work is to ensure that the virtual networks align to an open API framework. In this instance, it becomes easier for IT teams to access data. Once you have the data, you can analyze and identify patterns. Lessons learned can then be applied, and your network is on its way to becoming more intelligent. While AI/ML cannot necessarily predict the future with certainty, it will provide network professionals with a significant advantage to adapt to ever-changing conditions.

Closed-Loop Automation Can Improve Service Assurance

Another proposed method to create network intelligence over time is by creating a closed-loop environment (see Figure 7). First, the mobile operators define the "intent" of the network. The intent can vary based on a specific service or customer requirement. For many of us sharing a cellular service, the intent would be very similar. For enterprise verticals, it is likely to differ greatly.

FIGURE 7

Creating the Closed-Loop Environment



Note: See *The Case for Cloud-Native Mobile/5G Network Infrastructure* (IDC #US43770817, May 2018) for more information.

Source: IDC, 2018

The idea of closed-loop automation is to consistently monitor the network and program it to take corrective actions to match the intent. Closed loop incorporates telemetry data, analytics, and orchestration platforms to accomplish the task. Doing so can ensure that network performance aligns or exceeds a service-level agreement, or simply meeting the threshold for baseline operation. As such, close-loop design will need to incorporate the ability to communicate with both physical and virtual infrastructure.

5G, IoT, and Blockchain: Creating Economic Value Through Intersecting Technologies

While 5G will address the capacity and latency of network, and enable millions of IoT devices to come online, it can also provide the enhanced connectivity needed between devices to interact with a blockchain-based network. For example, envision a supply chain where multiple stakeholders are looking for rapid and reliable data about the progress of goods being shipped based on a blockchain framework. 5G's inherent performance characteristics can provide the near-real-time information flow required for this.

SAMSUNG: UNIQUELY POSITIONED TO DRIVE 5G PROGRESS

Apart from devices and chipsets, Samsung is a leading supplier of mobile network solutions, encompassing a rich history of providing mobile core, RAN, and enterprise WLAN solutions across both physical and virtual networks. Unique to Samsung is the company's proximity and deep involvement in the forward-thinking South Korea mobile landscape. Mobile operators in this country are often at the forefront of wireless technology, providing Samsung with the ability to often test, trial, and deploy solutions to address a wide array of use cases ahead of other regions.

Innovation at the Forefront of Samsung's End-to-End Strategy

Samsung's fast-growing presence in the mobile networks space is largely attributed to its traction in the LTE markets and strategic investment in 5G-related technologies, which began almost a decade ago. Indeed, Samsung was the first vendor to have its 28GHz (mmWave) FWA equipment certified by the U.S. Federal Communications Commission (FCC). The certification covered Samsung's access solution and its indoor and outdoor 5G home routers. Samsung will also play a vital role as operators move to roll out 5G mobile services. It's important to note, Samsung's 5G network research coincides with its ongoing R&D related to chipsets and devices, which differentiates Samsung from many of its competitors that focus almost entirely on network solutions. To enable a full 5G service, operators will need to actively work with equipment vendors and device manufacturers, of which Samsung can fully address end to end. Of note, Samsung estimates approximately two-thirds of U.S. households contain a Samsung device, providing direct insight into the challenges 5G will help address, particularly as it relates to smart systems and IoT use cases.

Key Roles in a Number of Early 5G Rollouts Indicate Samsung Poised to Be Leading Enabler in 5G Era

Samsung's commercial success in the South Korea market helped it expand its global presence during the LTE era, as it has become a leading player in several major mobile markets, such as the United States, Japan, India, and Europe. With 5G rollouts beginning in earnest, Samsung is poised to continue its success by addressing the unique demands 5G networks will bring across a range of spectrum on mobile and fixed wireless networks, virtual network infrastructure, and the devices required for a full mobile service.

Indeed, South Korean mobile operators will be some of the first to roll out 5G nationwide, with early commercial services launched in April 2019. The world will be watching the South Korean launches closely in 2019, as Korea Telecom (KT), SK Telecom, and LG Uplus invest a combined $3.6 billion to establish a pan-nation 5G network.

Outside South Korea, Samsung has won a number of 5G eMBB contracts with leading United States-based operators such as Verizon, AT&T, and Sprint. For Verizon, Samsung will be a key supplier to test and trial 5G mobility in the 28GHz bands. In addition, Samsung is a major partner in Sprint's 5G rollout plans, supporting mMIMO rollouts across the United States. AT&T also plans to leverage Samsung's 5G NR equipment for its mobile service starting 2019. Taken as a whole, Samsung's forward-thinking approach to 5G mobility has enabled it to increase its market presence in leading 5G markets, positioning it to play a leading role in 5G's global rollout.

Considering FWA use cases, AT&T selected Samsung to begin testing 5G-ready CBRS equipment in addition to being a named 5G NR vendor. Samsung has also leveraged its momentum in 5G FWA to begin trialing its solutions with MSOs, such as Charter. 5G FWA is a compelling solution set, particularly in scenarios where laying fiber is uneconomical. In Europe, Samsung is working with partners like Cisco to trial 5G FWA with Orange, Arqiva, and Telefonica Deutschland. As such, Samsung is rapidly gaining traction as a global leader in the supply and deployment of the 5G FWA use case in both licensed and unlicensed spectrum.

Samsung's Automation Prowess Will Also Play a Role in 5G Efficacy

While 5G NR is a flagship component of 5G networks, supporting technologies, such as broad-based network automation, will contribute to overall 5G efficacy. As such, Samsung's acquisition of Zhilabs is notable in that it demonstrates Samsung's commitment to helping operators reap further value from networks, as opposed to simply enhancing throughput. Zhilabs' AI-based automation scheme will be critical when the time comes to deploy new services, particularly across a diverse set of enterprise verticals, with each requiring different network characteristics. AI-based automation will help operators overcome 5G complexity by analyzing user traffic, monitoring applications, and generating actionable insights, which can automatically be applied to 5G networks. The net result will be higher service quality.

A Note on 5G Technology Leadership

With any new technology era, the opportunity to disrupt is present. While 5G is still in the early stages, the early tally signals that Samsung's team has established itself as a lead vendor across both fixed and mobile deployment scenarios. In South Korea, Samsung's 5G base station shipments position it by far the largest supplier in the country.

In other regions, such as the United States, where network demands remain high, gaining early experience as well as demonstrating the ability to meet customer needs will be a key performance indicator as 5G rollouts accelerate globally.

5G USE CASES: SAMSUNG'S END-TO-END PORTFOLIO PLACES IT AT THE FOREFRONT OF 5G USE CASES

As noted, Samsung's expertise across a range of networking, chipset, and device categories will play a role in its ability to address 5G use cases, particularly as these use cases are adopted both in the consumer and in the enterprise arenas.

Manufacturing

IDC has observed particular thought leadership from the manufacturing community about how to leverage 5G and its related advancements (e.g., edge computing and network slicing). One such use case is the development of a modular factory able to continuously retrofit itself to particular manufacturing goals. This idea incorporates the use of automated robotics connected by a 5G network platform. 5G supports this vision because of its inherent characteristics such as ultralow latency, software programmability, and end-to-end automation. Samsung's work to date, including its Nexplant platform, in conjunction with 5G networks has the potential to create a formidable industrial automation solution combining ultralow-latency networks with near-real-time data collection, analysis, and actions taken in a manufacturing setting.

As part of this vision, Samsung and AT&T are constructing a manufacturing-focused 5G "innovation zone" within Samsung's Austin Semiconductor (SAS) factory located in Austin, Texas. SAS comprises nearly 2.4 million sq ft, providing ample space to explore new use cases based on 5G. Further, the innovation test bed will generate shared insights into the real-world impacts 5G can make in a smart factory. Focus areas include IoT sensors, plant security, AR and VR for employee training, and location-based services for enhanced safety.

Public Safety

As the needs of first responders continue to evolve, 5G's inherent characteristics can help public safety agencies, particularly those that wish to build faster, more reliable broadband applications and improve their overall response to emergencies. Expected use cases include mission-critical push to talk (MCPTT), drones, and vehicle-to-vehicle (V2V) communications. Together, 5G can help public agencies plan, avoid, and if needed, better respond to emergency scenarios. Samsung's expertise and solutioning related to PS-LTE, as demonstrated by its rollouts in South Korea, will help the company position itself well to address the critical communications space when 5G is ultimately introduced.

Healthcare

The booming healthcare industry is already exploring ways to make use of 5G networks. Examples include real-time transmission of data sets, which could prove vital depending on the particular scenario. In addition, the creation of "smart hospitals" could include connecting beds, medical devices, and patients to develop new patient protocols by enhancing real-time monitoring. Longer term, some healthcare entities envision the potential for remote surgery, where surgeons are able to deliver life-altering care with ease through ultralow-latency networks. Realistically, that use case is years away, but the technology to support it will be in place much sooner.

Connected Car

Pending the finalization of Release 16, expected in early 2020, the mobile industry will have formal standards enabling them to deploy 5G-based connected car solutions. Long a member of the 5G Automotive Association, Samsung and its subsidiary, Harman, are well positioned to capture a leading role in the realization of 5G connected car solutions that will include the network infrastructure required to support such services and also the services themselves.

In particular, Harman's Telematic Control Unit (TCU) will enable vehicles to interact with external devices, such as traffic lights, traffic management systems, and other cars. Part of the broader cellular vehicle-to-everything (C-V2X) road map, Harman is working closely to align these efforts with 5G network rollouts.

Smart Agriculture

Early work is beginning to drive the intersection of 5G and agriculture. Smart agriculture includes the deployment of thousands of sensors around a farm, which can provide real-time information related to soil moisture, nutrients, spoilage, and other aspect of farming. Samsung is a leading partner in India, helping test, trial, and deploy solutions at scale.

Even across a single use case, connectivity requirements will be layered and diverse. For example, while 5G can help handle the sensor load, it can also be used to connect machine farming equipment, which could lead to self-driving machinery, or around-the-clock operations. As such, 5G's multiuse characteristics make it an ideal solution for almost any multilayer use case.

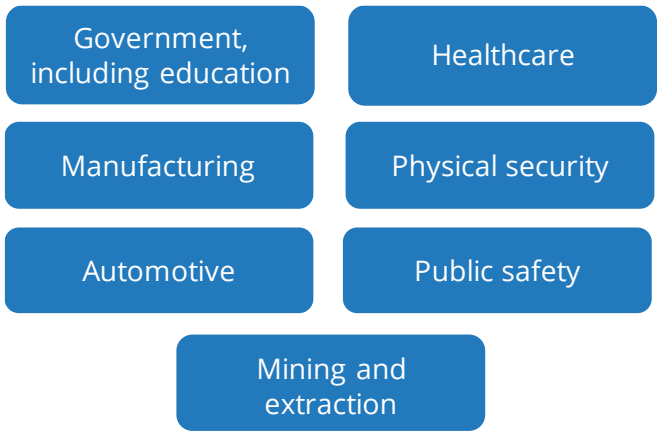
LOOKING AHEAD: THE FUTURE OF MOBILE NETWORKS AND INDUSTRY VERTICALS

With many of today's innovations, such as 5G, NFV/SDN, and AI/ML, being combined to accelerate network innovation, the future looks stronger for mobile operators. It is worthwhile to envision the result of combining multigigabit speeds with a fully virtualized, automated network platform capable of delivering hundreds of network slices, all with their own unique latency and capacity.

Indeed, if mobile operators are to regain market momentum from the large cloud players, they will need to accept risks and be willing to disrupt the status quo. While this vision is exciting, it will mean very little if mobile operators are unable to turn network investment into business value. As such, the 5G network is expected to empower mobile operators to enhance their consumer services but, more importantly, better address the specific needs of enterprise verticals (see Figure 8).

FIGURE 8

Enterprise Verticals



Source: IDC, May 2019

As such, 5G solutions will enable mobile operators to address a far wider range of enterprise needs than they do today. Moving beyond SIM cards and price plans, operators of 5G networks will support mission-critical enterprise communications, with quality and performance backed by service-level agreements. In addition to enhanced mobile broadband, services will require such capabilities as ultralow latency, dense cell connectivity, and high reliability. In addition to the 5G New Radio (NR), these capabilities will need major architectural changes, such as multiaccess edge computing, which will allow for network resources to be distributed across a holistic cloud framework.

From a service perspective, 5G operators will become well versed in industry verticals and address specific vertical needs based on regional, national, and global demand. This vision will take time to develop, but today's investments indicate mobile operators around the world are beginning this journey. To fulfill this promise, operators will need to evolve to manage their networks as platforms rather than pipes. 5G has an integral role to play in the network-as-a-platform approach, thus the need to be underpinned by ICT systems that are sufficiently capable and flexible to enable its full potential.

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