VERTIV WHITEPAPER

Powering 5G: Understanding Challenges in Telecom Infrastructure

Introduction

We are entering the era of 5G – a next-generation mobile network that promises faster and more reliable internet connectivity. According to a joint survey conducted by Vertiv and 451 Research in 2019,[1] 53% of telecom operators globally expect to rollout 5G-related services in 2020, while 68% of those surveyed believe that 100% rollout will happen beyond 2028.

What's perhaps revolutionary about 5G is its promise to interconnect not just people but devices, machines, and everyday objects. This creates a new level of user experience that's bound to cause a shift across industries.

As 5G continues to gain momentum, telecom operators are faced with a multitude of challenges that needs to be addressed both on Greenfield and Brownfield sites. Ultimately, having the right infrastructure is critical for the success of 5G deployment.

In this white paper developed by Vertiv, we look at key considerations and challenges for telecom operators when it comes to 5G deployment, with the aim to address these challenges at two main fronts: the ***core access site*** and the ***telecom edge site***.

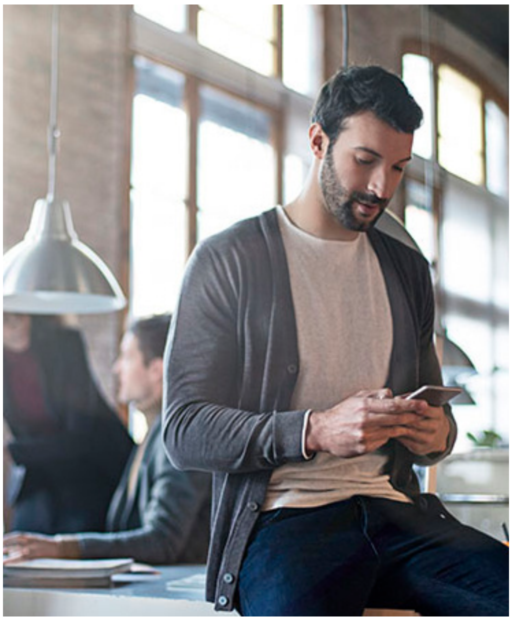
[1] 451 Research, 'Telco Industry Hopes and Fears: From Energy Costs to Edge Computing Transformation,' 2019.

Preparing Telecom Infrastructure for 5G Deployment

As 5G is poised to launch for some countries this year, the telecom industry is holding their breath with a mixture of fear and anticipation. On the one hand, there is the question of return of investment (ROI), as many operators have yet to see returns from their 4G investments, while some are still trying to upgrade their current 4G infrastructure to meet demands. On the other hand, the opportunities presented by 5G are vast, particularly with the widespread adoption of Internet of Things (IoT) and connected devices, making its potential difficult to ignore.

5G deployment will no doubt have an impact on the existing telecom network infrastructure. 5G will enable at least three major use cases: enhanced mobile broadband (eMBB), ultra-reliable low-latency communications (URLLC) and massive machine-type communications (mMTC). These use cases will require at least a 10-fold increase in network performance, which includes speed, latency and reliability of applications. In this light, telecom operators must invest in network domains, including core network infrastructure and radio access networks (RAN) infrastructure.[2]

But investing in new infrastructure can be costly. For some operators, another option would be to improve upon existing ones. At the onset of 5G deployment, many will likely opt for the latter.



[2] Ferry Grijpink, Alexandre Ménard, Halldor Sigurdsson, and Nemanja Vucevic, 'The Road to 5G: The Inevitable Growth of Infrastructure Cost,' McKinsey and Company, February 2018, https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/the-road-to-5g-the-inevitable-growth-of-infrastructure-cost

Regardless of the direction, below are areas that operators need to evaluate when preparing network infrastructure for 5G deployment:

Ensuring adequate power and cooling capacity
From minimizing AC-DC conversions; deploying DC power uninterruptible power supply (UPS) systems to handle the spike in power density; upgrading from VRLA to lithium-ion batteries; to investing in new cooling techniques to combat the expected increase in energy costs, operators would need to adopt new solutions to support the demand expected from 5G technology.

Mitigating high energy costs
Telecom operators will need to get more aggressive in deploying energy-saving technologies to mitigate the impact on operating costs resulting from the higher energy consumption of 5G technology. The move to 5G is likely to increase total network energy consumption by 150-170 percent by 2026, with the largest increases in macro, node and network data center areas.

Preparing existing sites for 5G deployment/architecture
While it is expected that the transition from 4G to 5G infrastructure is not immediate, operators would need to reevaluate their existing 4G sites to ensure that these are able to handle the initial phases of 5G deployment. These can be addressed through retrofitting without having to establish or invest in new site deployments immediately.

Expanding existing battery capacity for power continuity
According to 451 Research, upgrades from VRLA to lithium-ion batteries are expected to increase from 66 percent of those surveyed to 81 percent five years from now. Lithium ion batteries will be an important tool as networks densify to accommodate the shorter distances 5G millimeter waves can travel.

Management and monitoring of multiple access sites
To cope with 5G deployment and infrastructure, operators might consider massive roll outs of infrastructure in short periods of time to address demand. As a result, there is an expected number of access sites that need to be monitored and maintained. A remote monitoring solution would be essential to minimize operating cost and to ensure all sites are managed intelligently and efficiently.

Minimizing cost of 5G investment
Ultimately, with the opportunities presented by 5G, operators need to keep in mind how to maximize their investments into 5G architecture. Basic infrastructure readiness, site access and quality interconnection will be the main considerations to efficiently deploy 5G and edge topologies.

During the initial stages of 5G deployment, much of the developments will be happening on the infrastructure side. Upgrading existing infrastructures, investing in new hardware to support the increased demand, but on the services front, consumers are not expected to see a drastic difference between 4G and 5G. In fact, according to the same 451 Research survey, 96% of telecom operators surveyed said that they will be deploying “existing data services” in relation to 5G until at least 2021.

The Shift to the Edge

To deliver high-speed internet to consumers, 5G radio access technologies will use millimeter wave (mm WAVE, >6GHz) spectrum to enable the bandwidth capacities (~1Gbps) to transfer data. Millimeter waves are significantly smaller than submillimeter spectrum (such as 700MHz) used in 4G and earlier cellular generations, which will improve the speed and control of data exponentially.

But because of their size and propagation characteristics, millimeter waves can't travel as far as traditional radio waves and can be more easily blocked or disrupted by rain, trees and concrete walls, etc. It is in this light that traditional cell towers, which are typically located in remote, large areas will have to be shifted into smaller, more densely populated areas that are closer to the users. According to 451 Research, this "massive densification will potentially require operators to double the number of radio access locations around the globe in the next 10-15 years."

As 5G progresses, the telecom infrastructure is also expected to utilize network function virtualization (NFV) and software-defined networking (SDN) to enable operators to provide services quickly with a "cloudlike" deployment. This provides a platform for edge deployment in the telecom space. 5G and edge computing will work hand in hand as the edge will provide the capability to process, manage, and analyze digital content in near-real time, closer to where applications are accessed, and devices located. In addition, operators will need to deploy smaller edge sites characterized by micro data centers or nodes to support data processing, which traditional data centers may be unable to handle.

Edge computing use cases

To better understand how 5G and edge computing will work together, Vertiv analyzed over 100 edge use cases where 5G will play a critical role. Some will need 5G to achieve the performance required to support adoption of the use case while others are working without 5G today but will be inherently improved by the capabilities 5G delivers. These archetypes will help operators identify the infrastructure needed to enable these use cases:

- **Data intensive** includes use cases where data volume, cost, or bandwidth issues make it impractical to transfer over the network directly to the cloud or from the cloud to point of use. Examples include smart cities, smart factories, smart homes/buildings, high-definition content distribution, high-performance computing, restricted connectivity, virtual reality, and oil and gas digitization.
- **Human-latency sensitive** use cases include those where anything but the speedy delivery of data would negatively impact a user's technology experience – potentially reducing a retailer's sales and profitability, for example. Use cases include smart retail, augmented reality, website optimization, and natural language processing.
- **Machine-to-machine latency sensitive** use cases also feature speed as a defining characteristic because machines are able to process data much faster than humans. Examples include the arbitrage market, smart grid, smart security, real-time analytics, low-latency content distribution, and defense force simulation.
- **Life-critical** use cases encompass those that directly impact human health and safety and where speed and reliability are vital. They include smart transportation, digital health, connected/autonomous cars, autonomous robots, and drones.

Realizing the potential benefits and impacts of edge applications to 5G, telecom operators are now pushing their new network infrastructure and services into regional data centers and local networks that are located closer to customers. According to Omdia, "the shift to 5G is driving more of this transformation and lets providers inject new network features in different locations across their footprint."[3]

Given the above use cases and the role 5G will play in enabling or supporting them, it is important for telecom operators to consider investing in infrastructure for their edge applications. Below are key considerations for preparing their edge spaces:

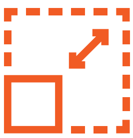
High-efficiency, flexible micro data centers

To support edge deployments, traditional infrastructure approaches need to be revisited. From brick-and-mortar designs, infrastructure deployments will shift to micro data centers which are fully integrated and easily deployable that can be virtually deployed anywhere. These micro data centers provide compute, storage and access to reduce latency and support 5G and IoT applications.

Location, location, location.

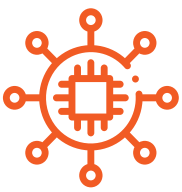
One of the challenges faced by telecom operators is identifying where to setup these edge locations. Because of the capital investment it entails, setting up a new data center may not look attractive for some. But for others, a novel approach would be to set up micro data centers at the base of their cell towers to save on cost and also to optimize on infrastructure investment.

Some would also opt to set up micro data centers in high traffic areas as these are closer to users and would address any latency issues.



Provision for speed and scalability for future growth

Owing to the expected spike in data brought by 5G applications, the challenge is finding out the scale needed to support these applications. Hence, infrastructure at the edge must be designed for flexibility and scalability. Rack to row-based micro data centers can be scaled up easily depending on the demands and with little floor space required.



Increased intelligence for remote management across multiple sites

As new edge locations are expected to rapidly materialize with 5G, the ability to remotely monitor and manage these locations will become critical because the sheer quantity of locations will be difficult to manage through regular human visits. Data center infrastructure management (DCIM) will be critical to the success of 5G networks at the edge.

[3] Julian Bright, 'Telcos and Edge Computing: Opportunity, Threat, or Distraction?' OMDIA, February 19, 2020.

Jumping into the unknown

There is still a lot we don't know about 5G and what its actual impacts will be to the overall telecom infrastructure. What is clear is there needs to be a shift in the approach to designing and upgrading both the network and IT infrastructure to accommodate and enable 5G and the applications that it will support. What is also certain is these applications – IoT, 5G and machine-to-machine applications – will require huge amounts of data to be processed and stored at the edge. Thus, there will be a shift from centralized, core data centers to edge sites with low-latency services. There is a need to reimagine and reassess the infrastructure strategy as early as now to futureproof for the eventual 5G deployment.

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