WHITE PAPER

MODERNIZE YOUR 4G/LTE NETWORK NOW FOR 5G SUCCESS

Four strategic investments to monetize your existing infrastructure and prepare for a staged migration to 5G

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DISCLAIMER

MOBILE OPERATORS NEED TO ACT NOW

Mobile 5G is closer than you think, in fact, it's already here. South Korea leveraged the experience gained from the 2018 Winter Olympics to launch 5G services for enterprises on December 1, 2018—the first country in the world to do so. The urgency to act cannot be overstated.[i]

Mobile operators and other service providers know that 5G technology has tremendous potential for their future—the question is how to get there. The enormous range of 5G use cases and architectural options make this situation quite different from the 3G to 4G transition. Providers are looking for ways to invest strategically, futureproof those investments, and manage the transition to 5G while maximizing revenues and building their subscriber bases.

A10 Networks has prepared this white paper with two primary goals in mind. The first three sections provide a technology overview of 5G technology with emphasis on the differences between LTE/4G and 5G in the packet core and the Gi-LAN. The rest of the document present practical advice about four strategic investments that operators can—and need to—consider today to guide near-term investments that will enable both short- and long-term benefits.

5G CHANGES EVERYTHING

For once, the hype may be an understatement: 5G promises to transform our world in ways that are virtually impossible to imagine. Projections from industry analysts are stunning: 27.1 billion connections by 2021 and more than $1.3 trillion revenues for mobile operators by 2025, which represents $160 annual spend for every human being on earth.[ii]

In terms of technical specifications, 5G represents a huge leap compared to 4G/LTE. With speeds of up to 20 gigabits per second, 5G will be significantly faster than 4G. Low latency is a key differentiator as well: 4G latency is typically about 50 milliseconds, while 5G will need to achieve sub-millisecond latency to enable applications such as autonomous cars and virtual reality (see Table 1).

FEATURE	*METRIC*
Network Traffic	10000 X 4G
Devices	Up to 100 X 4G
Latency	< 1 millisecond
M2M Battery Life	10 years
Peak Data Rate	> 10 Gbit/sec

Table 1: Performance requirements for 5G

Source: Nokia

The range of use cases for 5G is far more extensive than those for previous generation. 5G is an enabler for a wide range of new technologies, from virtual and augmented reality (VR and AR) and autonomous vehicles to smart agriculture and healthcare monitoring. Therefore, network architects must keep abreast of technology developments that may seem far afield from mobile networks as they plan for 5G deployments.

5G is not happening in a vacuum, rather, this new standard is intimately tied to a range of emerging technologies, especially the Internet of Things (IoT). 5G and IoT are poised to increase exponentially the number of monitored devices and data traffic. By 2022, it is estimated that data traffic will grow by 800 percent from its current levels with over 8 billion mobile broadband subscriptions.[iii]

THE MOBILE NETWORK IN FLUX

The transition from today's 4G/LTE networks to 5G will be an evolutionary process—think of it not as a destination but a journey. The winners will be organizations that start early, invest strategically and migrate skillfully. This white paper focuses primarily on 5G technology for mobile core deployments and related technologies. However, the concepts discussed here are applicable to fixed line deployments and the use cases are similar.

A full 5G implementation requires a virtualized packet core based on network function virtualization (NFV). By virtualizing network services, NFV enables mobile operators to more easily scale their businesses and deploy new revenue-generating services faster. NFV also simplifies network slicing, a way to partition the physical infrastructure into virtual networks customized for the needs of individual customers.

The evolution toward 5G requires new ways of designing networks to deliver on the promise of always-on, high-bandwidth, low latency, massive networks. Multi-access edge computing (MEC) is a foundational network architecture concept that helps operators move key applications and network services closer to the user. This requirement along with a virtual packet core puts a premium on the flexibility to virtualize specific services while implementing others in a physical form factor.

5G TECHNOLOGY OVERVIEW

A complete discussion of how 5G technology will change the mobile network is beyond the scope of this paper. The following sections highlight the impact on specific parts of the network (Figure 1).

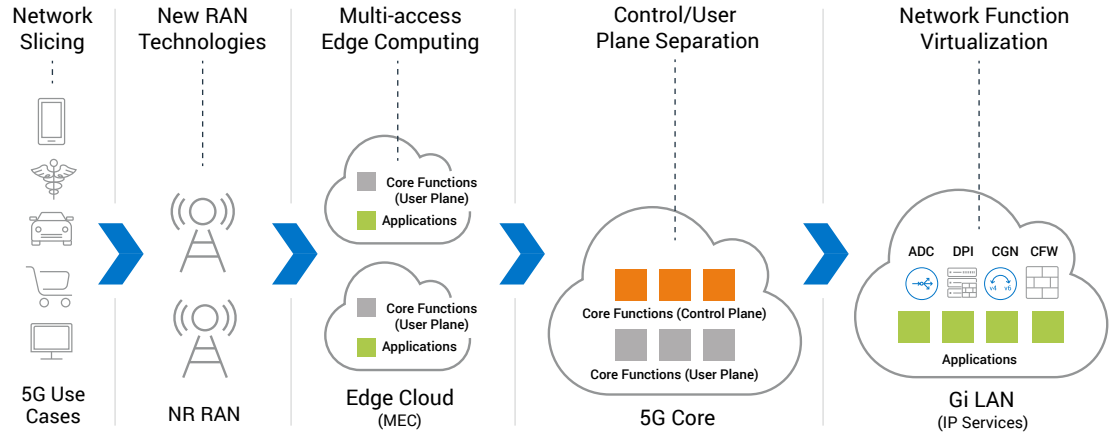

Figure 1: 5G technology overview

NETWORK FUNCTION VIRTUALIZATION

NFV gives operators a new and innovative way to design, deploy and manage network services such as network address translation (NAT), firewalling, intrusion detection, domain name service (DNS), and caching. As a virtualization technology, NFV decouples services from proprietary hardware appliances and instead runs them as software applications on commodity hardware.

NFV brings a high degree of agility and flexibility to the infrastructure, allowing operators to scale services quickly and cost-effectively to accommodate fluctuating demand. By reducing power, space and cooling requirements and simplifying the rollout of new services, NFV cuts operating expenses. Virtualized network functions (VNFs) run on commodity off the shelf hardware, which leads to a reduction in capital spending.

CONTROL AND USER PLANE SEPARATION

In recent years, mobile operators have seen dramatic increases in traffic—in some cases, doubling year over year. That trend will accelerate with 5G, putting tremendous pressure on the network to scale. Many legacy networks won't be able to meet this and other 5G requirements without significant architectural changes, of which the most important is control and user plane separation (CUPS).

In CUPS, the control plane and data plane resources can scale independently. As data traffic increases, operators can add more user plane nodes without having to increase the number of control plane components. With the removal of the co-location requirement, network architects can reduce latency by moving the user plane closer to the edge while keeping control plan functions in the central office. Finally, the CUPS architecture enables more efficient delivery of data in software-defined networking (SDN) architectures.

MULTI-ACCESS EDGE COMPUTING

The evolution toward 5G requires new ways of designing networks to deliver on the promise of always-on, high-bandwidth, low latency, massive networks. The concept of multi-access edge computing (MEC) is integral to this vision. MEC is a foundational network architecture concept that will help 5G networks meet the demands of use cases such as IoT.

MEC brings the computing capabilities of the core network closer to the RAN and the subscriber, enabling low-latency and high-bandwidth access to content, applications and services. The distributed MEC architecture is also ideal for supporting the large numbers of connected 5G devices, which will generate enormous amounts of data. MEC reduces network traffic between the RAN and the core and improves security. MEC applications and functions are usually deployed on an NFV infrastructure and operates as a Virtualized Network Function (VNF).

As functionality is positioned closer to the end user, operators are looking for ways to implement lightweight edge infrastructure, for example, Akraino. The industry can expect to see significant investment in edge computing technologies as 5G adoption increases.

NETWORK SLICING

One of the challenges that network operators face today is supporting the diverse requirements of individual customers. The answer to this dilemma lies in network slicing, a technique made possible by NFV. Networking slicing allows operators to partition the physical infrastructure into virtual networks customized for the needs of individual customers or services, in fact, this technique is also called network as a service (NaaS).

Each network slice functions as an independent subnetwork with its own RAN and core network resources tailored for a specific use case. The use of virtual networks enables an agile and flexible network infrastructure that can be reprogrammed easily for new use cases with no capital outlays—an important capability for extending the life of 4G/LTE investments and capitalizing on the opportunities of 5G.[iv]

PLANNING YOUR MIGRATION: WHAT YOU CAN DO NOW

When it comes to 5G, waiting is a risky strategy. Most mobile operators are moving ahead with their 5G plans, some tentatively, others aggressively. Those who don't act face the very real prospect of being left behind in the greatest technology transformation in decades.

Fortunately, operators have choices. They can choose an aggressive approach by transforming the entire infrastructure simultaneously or move stepwise by targeting specific use cases that drive near-term revenues and position the organization for 5G success.

The next sections describe four strategic investments that mobile operators should consider today. Each of these options has short-term payoffs while paving the way for a smooth transition to 5G.

INVESTMENT 1

UPGRADE NETWORK MANAGEMENT

Of all the things that operators can do to prepare for 5G, upgrading their network management tools is perhaps the most logical and cost-effective place to start. The investment pays off immediately in existing 4G/LTE networks by making them more agile, facilitating service rollout, and preparing the way for fixed-mobile convergence at a later stage of network evolution.

Management and orchestration (MANO) is an NFV framework for managing and orchestrating network functions and other software components (Figure 2). MANO facilitates the deployment and connection of services as they are decoupled from dedicated physical devices and moved to virtual machines. Because network components can be deployed in hours rather than months in virtual environments, MANO can reduce OpEx by managing and orchestrating compute, storage and networking resources and virtual network functions such as routing, firewalls and load balancing.

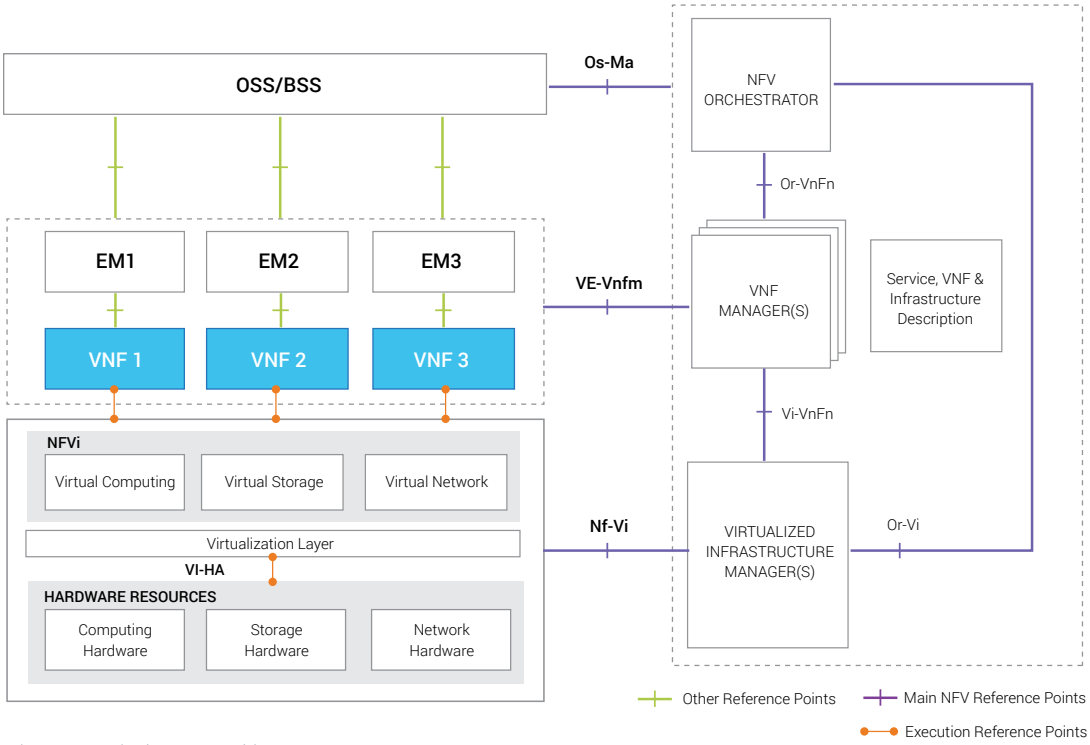

Figure 2. Typical MANO architecture

Source: SDXcentral.com

NETWORK MANAGEMENT

MYTH: MANO is only relevant for virtualized network functions.

REALITY: MANO works with both PNFs and VNFs, which will be the case during the transition period. Network operators should consider this upgrade sooner rather than later to reap the OpEx benefits of more effective management and orchestration.

INVESTMENT 2

CONSOLIDATE NETWORK FUNCTIONS

The typical Gi-LAN today is a complex mix of physical appliances, each of which implements a single network function, for example, carrier grade network address translation (CGNAT) or application delivery controller (ADC). Network operators can add value to their current 4G/LTE networks and prepare for the 5G transition by consolidating a number of these functions into a single converged firewall (Figure 3). Deploying a converged firewall dramatically reduces latency and simplifies Gi-LAN management to reduce CapEx and TCO.

When considering Gi-LAN consolidation, it's critical to choose a solution that has the flexibility to be deployed in multiple form factors. An optimum strategy is to consolidate the Gi-LAN with a physical appliance today, then migrate the physical functions to bare metal hardware or virtual form factors.

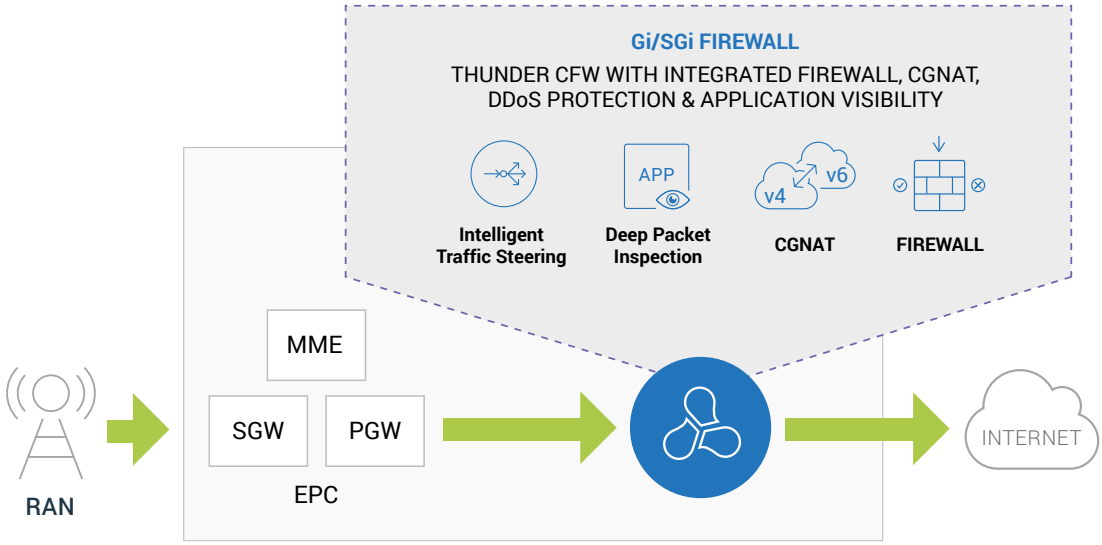

Figure 3. Converged Gi-LAN

CONVERGENCE

MYTH: Virtual machines top out at 20 Gbps, which makes them impractical for telco environments.

REALITY: Virtual machines as high as 100 Gbps are available today and are going much higher soon. Multiple vendors are working on integrated and validated solutions.

INVESTMENT 3

BOOST SECURITY AT KEY PROTECTION POINTS

As discussed earlier, 5G ratchets up the threat landscape throughout the network. Enhancing the security of your 4G/LTE network pays off today and futureproofs your network for the journey to 5G.

While 5G is still largely in the future, new attacks from partner networks and the RAN are happening now, threatening the integrity of your 4G/LTE deployment. In addition, the rapid rise of IoT is exposing the threat of malicious actors taking control and weaponizing devices against a service provider. To date, cyberattacks such as the WireX botnet have only targeted Internet hosts but it's only a matter of time until the core network becomes ground zero. Deliberate DDoS attacks as well as inadvertent signaling storms from malfunctioning IoT devices can bring down the network and cause outages if the core is not properly secured.

To increase security in existing 4G/LTE networks and prepare for 5G, mobile operators need to boost security at several key protection points (Figure 4).

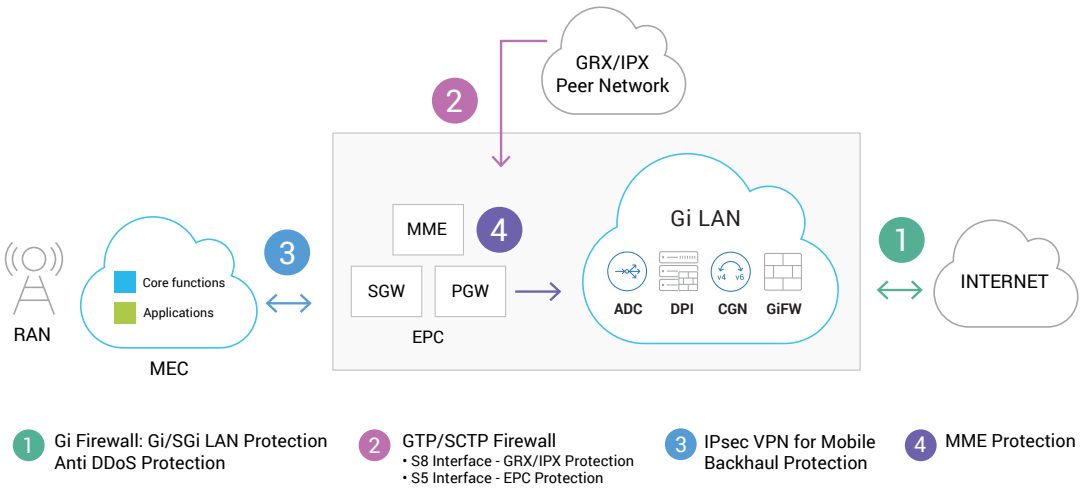

Figure 4. Key points for security upgrades

SECURITY

MYTH: CGNAT provides adequate network security.

REALITY: CGNAT can provide protection for certain scenarios but not others, it was not designed as a firewall or security function, plus some protocols are not serviced by CGNAT for example, IPv6 traffic.

MYTH: GTP (GPRS tunneling protocol) traffic is secure.

REALITY: While the concept of GTP threats has been long recognized, recent incidents show that they are becoming a reality. GTP attacks continue to increase in frequency and virulence, requiring network operators to deploy countermeasures such as firewalls at the GRX/IPX interface.

MYTH: Protecting the user plane with a Gi/SGi firewall or DDoS protection device offers adequate security.

REALITY: Control plane security is equally important, because a successful DDoS or other attack on the control plane can bring down the entire network.

MYTH: DDoS attacks only occur on the user plane.

REALITY: Signaling storms can also occur on the control plane, often as the result of a faulty stack. Some narrow-band IoT protocols use the control plane exclusively, which heightens the risk of DDoS attacks.

FIREWALLS

The essential interfaces that require firewall protection are shown below.

INTERFACE	FIREWALL FUNCTION
Gi/SGi	Protect against IP-based threats from the Internet and other packet data networks (PDNs)
GRX/IPX	Protect against threats from roaming devices via peer networks. CGNAT protection is also required to obscure details of the internal network, which can be exploited by cyberattackers
MEC	Extend threat protection closer to the RAN and provide additional defense for traffic-intensive use cases such as IoT

Table 2. Firewall protection by network interface

RAN SECURITY

Radio towers must be authenticated to intercept attacks based on rogue devices. Traffic from the radio access network should be encrypted to secure user communications.

DDOS PROTECTION

The entire network must be protected from DDoS attacks, which can come in via any interface. Integrated DDoS protection is also needed for selected components such as CGNAT pools and DNS services in addition to the more encompassing security required for the entire Gi-LAN.

5G APPLICATION LAYER SECURITY

In the 3GPP roaming architecture, a roaming network connects to the 5G Next-Generation Core (NGC) through the Security Edge Protection Proxy (SEPP). The SEPP implements application layer security for all information exchanged between two different mobile networks. The SEPP guards against attacks such as key theft, network node impersonation and source address spoofing in Diameter messages.[v]

INVESTMENT 4

VIRTUALIZE NETWORK FUNCTIONS

Pervasive virtualization—from the core network to the edge—enables operators to monetize their investments in existing 4G/LTE infrastructure and modernize the network for 5G at the same time. Key technologies for this strategy are software-defined networking (SDN) and network functions virtualization (NFV). Virtualization provides the framework for end-to-end integration and operational efficiency, essential in the multivendor world that most operators seek.[vi]

The transition to NFV requires careful consideration of the needs of each use case. When creating a strategy for function virtualization, each form factor should be considered on a per-slice basis.

Physical network functions (PNFs) often are best for use cases such as enhanced mobile broadband (eMBB) that require higher scale, consistent latency and low cost. For the foreseeable future, PNFs will remain the form factor of choice in the Gi-LAN because of their deterministic latency and high throughput.

On the other hand, VNFs are extremely flexible and can be containerized for enhanced portability. VNFs and CNFs (containerized network functions) are better suited for the EPC and MEC, especially for IoT applications that need maximum flexibility. Because of their dynamic natures, VNFs require new tools and processes for monitoring, management, and orchestration.

The 5G NGC architecture requires a set of network functions that must be implemented in the core for session management, authentication, data management and more. Some of these functions build on functionality that is already present in the EPC, while others must be developed from scratch or obtained from third-party sources. Cloud native development is ideally suited for architecting the 5G NGC functions in a way that maximizes productivity, boost release quality and reduces time to market for new services.

While the goal is to virtualize as much as possible, this objective can be achieved in multiple steps. One good place to start is partitioning large devices, such as firewalls and application delivery controllers, to serve multiple functions prior to virtualization. Used by many operators today, ADPs (application delivery partitions) can scale up to 1,000 ADPs in a single instance. Each ADP is made up of discrete computing elements designed to efficiently segment administrative, system, network, and application resources without a hypervisor. ADPs provide very high density and very high performance. Organizations should evaluate whether ADPs, CNFs, or VNFs meet their organizational needs, or even mix and match technologies as needed.

VIRTUALIZATION

MYTH: All network functions should be virtualized as soon as possible.

REALITY: The specific requirements of individual use cases and network architectures must be considered when deciding which functions to virtualize. PNFs are still preferred in the Gi-LAN because of their deterministic latency and high throughput. VNFs and CNFs (containerized network functions) are better suited for the EPC and MEC because of their flexibility and lower cost. When it comes to virtualizing network functions, one size does not fit all.

MYTH: All VMs are created equal.

REALITY: Different types of network adapters and kernel stacks often have specific latency and performance characteristics that must be supported by the virtual machine. Operators must understand the entire ecosystem to ensure optimum performance for | virtualized functions.

A10 NETWORKS: YOUR PARTNER FOR 5G SUCCESS

When it comes to starting the 5G journey, many network operators can feel conflicted. If they wait too long, they risk losing ground to their competitors. On the other hand, investing too much too soon can divert scarce resources that could be better used elsewhere. Executives can see themselves in the unenviable position of trying to predict the future to formulate their long-term strategic plans. Many chose to default to a wait-and-see approach.

From A10's perspective, there's no need to wait. From A10's perspective, there's no need to wait, as there are concrete improvements that you can—and should—make in your existing 4G networks today that will pay dividends immediately and set you on the road to 5G with minimal risk. By being proactive, you can consolidate key parts of your existing network and become agile and secure enough to take full advantage of 5G features on your timeline—not your competitors'.

A10 Networks has a comprehensive strategy of targeted investments that monetize their existing 4G/LTE investments and modernize key components of the network architecture to prepare for a smooth and timely migration to 5G (Figure 5 and Table 3).

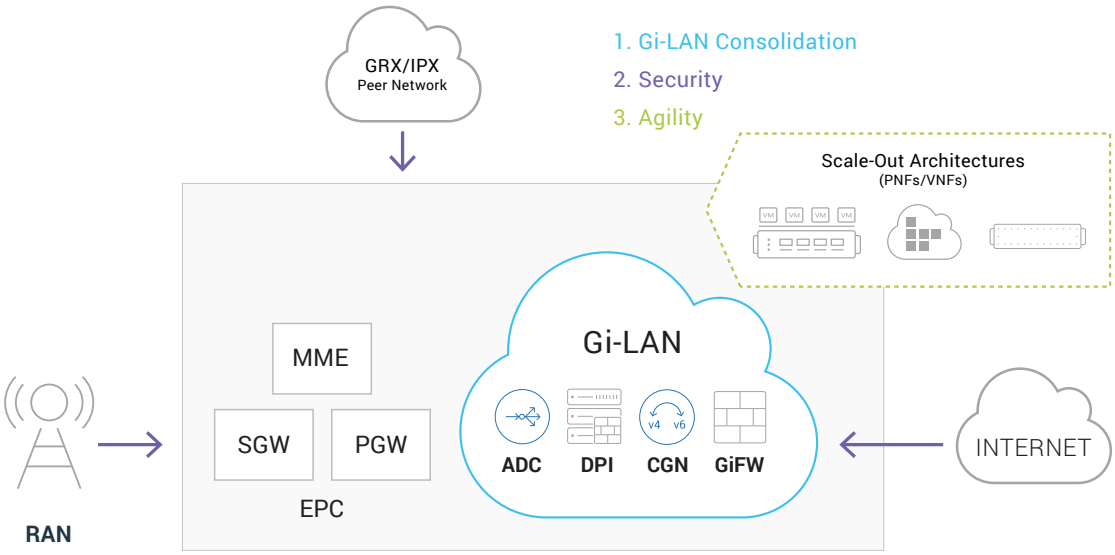

Figure 5. A10 Networks—A strategy for 5G success

A10 ADVANTAGE	OPERATOR BENEFIT
Proven	Ensure 4G to 5G standard compatibility and investment protection with proven deployments
Scale and Consolidation	Scale for increased subscriber demand with high performance and functional consolidation
Security	Enhance core infrastructure security
Orchestration & Analytics	Utilize orchestration and analytics for lower TCO and reduced downtime

Table 3. Key features and benefits of the A10 strategy

A10 Networks can help you win the 5G race, and provide tailored advice based on valuable insights garnered from previous 5G pilot and production networks. We have proven 5G-ready products that you can deploy today to realize immediate ROI in your 4G/LTE networks. At the same time, every step you take to adapt your existing networks for the demands of 5G is an investment in your future. Find out more today at www.a10networks.com.

CONCLUSION

To realize the tremendous potential of 5G, mobile operators and other service providers must chart a strategic approach to the migration from 4G/LTE to 5G. Unlike previous generational changes, the 5G rollout will be an evolutionary process—think of it not as a destination but a journey. However, operators should not wait until the marketplace shakes out—that just gives competitors the first-mover advantage. The winning strategy is to act NOW. By carefully investing in upgrades to support specific 5G use cases, network operators can monetize their near-term investments and at the same time modernize the existing infrastructure in preparation for the eventual migration to a full 5G architecture.

ABOUT A10 NETWORKS

A10 Networks (NYSE: ATEN) provides Reliable Security Always™ through a range of high-performance solutions that enable intelligent automation with deep machine learning to ensure business critical applications are protected, reliable and always available. Founded in 2004, A10 Networks is based in San Jose, Calif., and serves customers globally with offices worldwide.

For more information, visit: a10networks.com or tweet @A10Networks.

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[i] https://www.sdxcentral.com/articles/news/south-korea-launches-5g-but-only-for-enterprise-users-initially/2018/12/

[ii] The United Nations forecast Thursday that the world's population will increase from 7.2 billion today to 8.1 billion in 2025, with most growth in developing countries and more than half in Africa.
https://www.usatoday.com/story/news/world/2013/06/13/un-world-population-81-billion-2025/2420989/

[iii] https://www.ericsson.com/en/blog/2017/11/five-essentials-for-winning-in-5g-network-management

[iv] https://www.gsma.com/futurenetworks/wp-content/uploads/2017/11/GSMA-An-Introduction-to-Network-Slicing.pdf

[v] http://www.3gpp.org/news-events/3gpp-news/1975-sec_5g

[vi] https://www.sdxcentral.com/5g/definitions/5g-virtualization/

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