



How to Operationalize & **Bring the Opportunity to Life**

A practical guide for private network service providers and enterprise IT InfraOps teams



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Executive summary

From smart warehouses and factories to Industry 4.0, automated guided vehicles (AGVs), and so much more, today's enterprise across almost every industry is powered by digital.

And while the move to digital is on at full speed, this transformation is not just about cloudification and the digitalization of apps and systems. To achieve this strategic goal, just as important is fast, secure, and reliable networking with ultra-low latency for enabling the many revolutionizing business use cases of the digital enterprise.

Such networking capabilities are only possible with a private 5G network. Yet, with all of its benefits, there are still formidable challenges standing in the way of widespread operationalization and monetization of private 5G.

So, with the installation and integration service segment to account for the largest market share of private 5G, it is critical for system integrators (SIs) and private network (PN) service providers to understand what these challenges are and how they can overcome them.

In this paper we will cover all this, including the hurdles of network complexity and demanding customization requirements, among others, as well as how the "IT-fication" of the 5G private network can help system integrators, PN service providers, and enterprise IT teams to overcome the challenge and make the promise a reality.



The perfect pair: The digital enterprise & private 5G

Digitalizing the modern enterprise



This is a game-changer for enterprises . . . who require 5G capabilities to implement the transformative applications that drive smart factories, digital transformation and the internet of things (IoT)."

Forbes

From smart warehouses and factories to Industry 4.0, autonomous guided vehicles, robotic process automation, and AI-driven asset tracking, today's enterprise across almost every industry is powered by digital.

Industrial private 5G use cases



Logistics

- Teleoperated robots/machinery
- Video-based surveillance of plants/sites
- Massive sensor networks for predictive maintenance
- Collaborative robots
- Human machine interface



Airports, ports & railways

- Video-based site inspection
- Massive sensor networks for predictive maintenance
- Collaborative robots
- Human machine interface
- Over-the-air upgrades



Energy

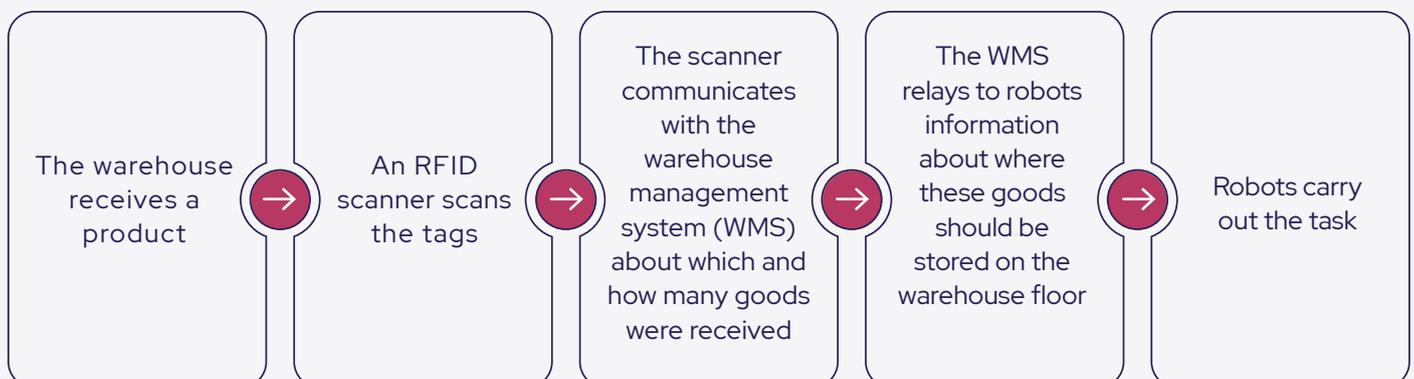
- Video-based site inspection
- Video-based surveillance of sites
- Teleoperated robots/machinery
- Mission critical voice, data and video
- Collaborative robots



Utilities

- Video analytics for quality inspection
- Teleoperated robots/machinery
- Asset tracking
- Collaborative robots
- Supplier/partner connectivity

Asset tracking in the smart warehouse



In fact, IDC predicts that spending on enterprise digitalization will grow to more than 53% of information and communications technology (ICT) investments by 2023.

Yet, investing in these technologies alone won't make digital dreams come true. Transforming an enterprise into a digital powerhouse requires robust networking capabilities, such as ground-breaking speed, reliability, security, and ultra-low latency, all of which enable the sophisticated and even revolutionizing use cases of the digital enterprise.

The premier wireless networking technology for the modern enterprise is private 5G, with performance that includes:

10x

Decrease in latency, coming in at **as low as 1 ms.**

10x

Connection density, enabling **more efficient signaling** for IoT connectivity.

3x

Spectrum efficiency with **more bits per Hz per sec.**

100x

Traffic capacity for network **hyper-densification.**

10x

Experienced throughput, with more uniform **multi-Gbps peak rates.**

100x

Network efficiency, optimizing energy consumption, and processing.

source: [visualcapitalist.com](https://www.visualcapitalist.com)

Additional features of private 5G that drive a powerful private network include:

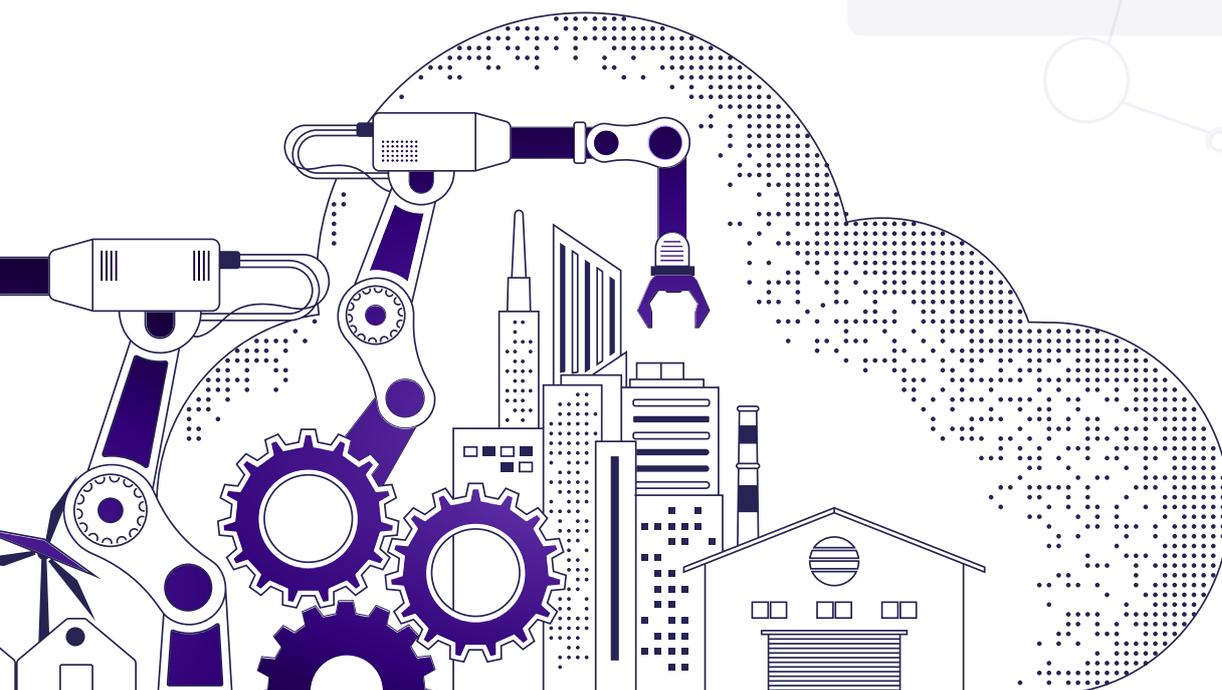
TCO savings at up to 40%

Increased speed which is slated to reach up to 10 Gbit/s, at the equivalent of a 20-fold increase.

Higher reliability at 99.9999% or only five minutes per year.

Greater security with controls such as mutual authentication, enhanced subscriber identity protection, and more.

Increased control of the network, devices, user access, resources, and connectivity SLA.



On the spectrum

// Most regulators have continued to make spectrum available for 5G in conventional ways (i.e., by auctioning nationwide, exclusive 5G licenses). However, some regulators have set aside a portion of spectrum in priority 5G bands (for example, a portion of the 3.5 GHz range) for local users (e.g., businesses) so they can build their own private 5G networks. //

GSMA

The 5G PCN market is still in its infancy, though it is expected that once the issue of spectrum allocation will be settled, we will see a huge increase in its global proliferation.

// Countries differ, but most of the focus is on releasing additional 5G spectrum (mid-band and mmWave high-band) because 5G is seen as a key enabler of industrial competitiveness. //

Ericsson

Recent examples of developments include

US

The Citizens Broadband Radio Service (CBRS), a spectrum sharing framework in the 3.5 GHz range which was established to meet the needs of different users including the military, mobile operators, and businesses.

UK

The Office of Communications is dedicating the 3.8-4.2 GHz band for local deployments, requiring national operators to hand over unused licensed spectrum to enterprises.

France

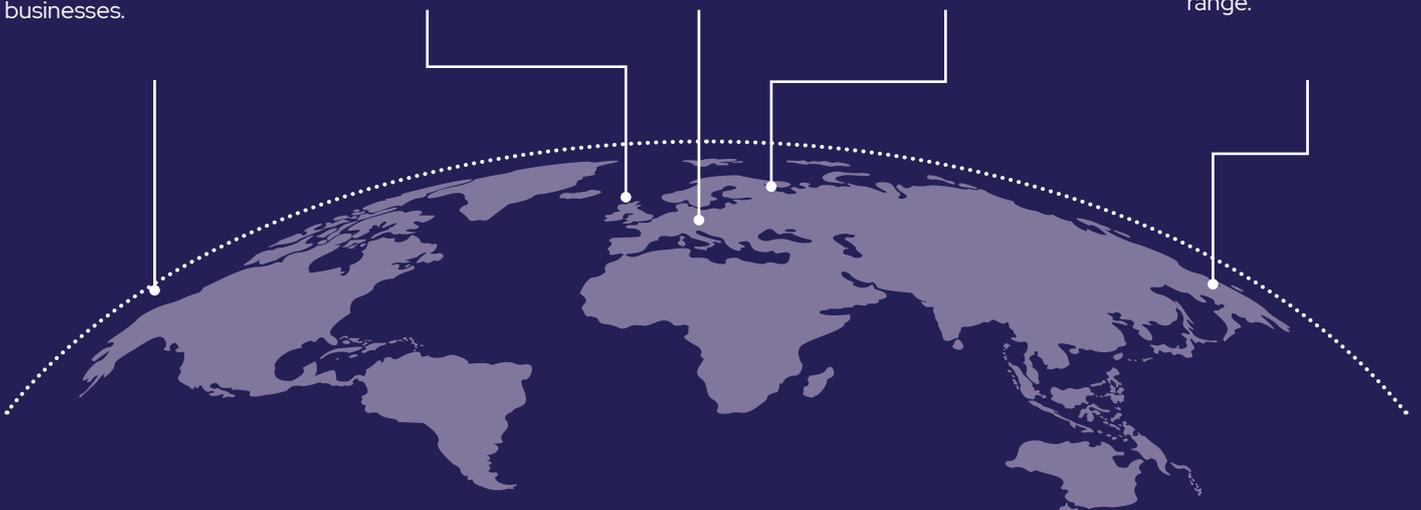
The regulator ARCEP has offered licenses to businesses in frequencies in the 2600 TDD MHz band (band #38, 2570-2620 MHz).

Germany

The telecoms regulator BNetzA has reserved 100MHz of spectrum in the 3700MHz-3800MHz band for private companies, with 33 having bought 5G private licenses, including Bosch, BMW, BASF, Lufthansa, Siemens, and Volkswagen.

Japan

Licenses have been made available, with Fujitsu announcing in February of 2020 that it received Japan's first private 5G provisional license in the 28.2 GHz to 28.3 GHz range.





With the frequencies for local 5G networks, we create room for innovation. We are registering great interest in the frequencies and are still counting on numerous applications."

Jochen Homann, BNetzA president, in [Telecoms.com](#)



Licenses for spectrum allocated to mobile networks have previously been reserved for MNOs but many European countries look likely to set aside mobile spectrum for private licensing."

European 5G Observatory

With the allocation of spectrum for business expected to accelerate, projections for the private 5G market worth are likewise increasing.

According to a report by [Polaris](#), **the installation and integration service segment accounted for the largest market share**, and is estimated to exhibit a faster CAGR over the forecast period.

In 2020



Which spectrum is best for you?

Mid-band spectrum (1-6 GHz)

- Good for indoor environments.
- Wide coverage with a small number of transmission points.

Millimeter-wave spectrum (24-29 GHz, 37-43.5 GHz, and 66-71 GHz)

- Good for higher speeds.
- Lower latency.
- Easier to contain signals in a building.
- Less interference.
- Requires denser radio deployment.



Real-world deployments

// A private 5G network provides industries with high-performing networks and helps in operations of several technologies such as automated guided vehicles (AGVs), drones, sensor technology, heavy machinery automation, robotics, and others. //

ResearchAndMarkets

Manufacturing: Inventec Taiwan

This industrial manufacturer launched a fully virtualized 5G standalone private network in its Taoyuan Guishan plant in Taiwan, as part of its Smart Manufacturing initiative.

The goal of the network is to introduce automation and intelligence to its Industry 4.0 production line, as well as to enable smart manufacturing benefits.

// Our goal is to significantly improve our factory efficiency and reduce manpower by implementing AI-based AOI (Automatic Optical Inspection) in the assembly line. Previously, due to the network limitations, production machines were connected to a local computer to perform AI functions. //

Dr. Albert Chen, Inventec SVP and project lead

Among the results achieved by Inventec further to the move to private 5G is an impressive increase to 85% from 70% in production line straight-through rate (FPY, First Pass Yield).

Transport: Port of Antwerp

With a continual flow of goods coming in and out of warehouses, distribution centers, and ports, and which need to be tracked, private 5G is ideal for logistics. These facilities house a large number of connected devices, including cameras, shipping containers, and heavy machinery, all of which mandate reliable, real-time, high-speed communications.

Further to these needs, the Port of Antwerp in Belgium is deploying a 5G PCN, with coverage for the entire area of the port.

The port is also partnering with the local police and other authorities to leverage the private 5G network for high-definition security camera monitoring and other safety applications.

Business-critical application at the Port of Antwerp: connected tugboats

By connecting tugboats on the private 5G network, the Port of Antwerp is using connected tugboats for various needs such as directing ships in the area and leveraging connected high-definition cameras that are put on boats to detect irregularities, such as oil spillages.

Logistics: Guangdong Midea Kitchen Appliances Manufacturing

This Chinese manufacturer, also known as "MCA" and which is located in Malong, China, has 9,000 employees, and produces microwave ovens, large and small ovens, and food steamers.

Among the logistics challenges that needed to be solved were AGV signal interference, unreliable connectivity when roaming the product warehouse (which impacts scheduling), and support for vehicle position and dispatch.

To overcome these challenges, MCA turned to private 5G.

Other examples of private 5G deployments around the world include:

Sector	Enterprise	Supplier	Site	Use Case
 Manufacturing	Ford UK	Vodafone	Factory	Real-time monitoring and control of industrial equipment (e.g., welding machines).
 Transport	Ningbo Zhoushan Port Authority	Huawei	Port	Remote monitoring, control and video surveillance of gantry cranes.
 Mining	Sandvik	Nokia	Mine	Support for AGV's.

The roadblocks to private 5G

With all the benefits and promise, beyond the need for spectrum and greater availability of higher frequencies, there are still formidable challenges standing in the way of widespread operationalization and monetization of private 5G.

As noted earlier, **the installation and integration service segment will account for the largest market share of private 5G**, so for system integrators (SIs) and private network (PN) service providers, it is critical to understand what these roadblocks are and how they can overcome them.

Furthermore, with some of the larger enterprises getting ready for 5G PCN with their own IT infrastructure, IT InfraOps, and automation teams, it is just as important for these professionals to also be well acquainted with

the complexities and how to address them.

Let's now take a look at the five main roadblocks to the mass proliferation of private 5G.

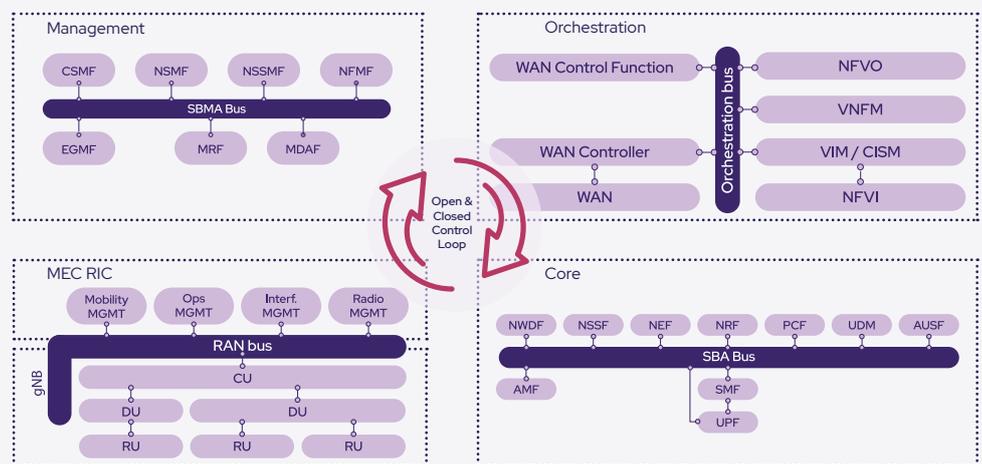
Network complexity

However, the requirements for private LTE/5G networks are complex and highly bespoke, and as such, the market is difficult to scale.

Analysys Mason

The 5G cellular network is very complex. Unlike with other technologies, self-installation is not an option, especially for mission and business critical applications.

The complex 5G network



Operationalizing private 5G requires **extensive expertise in multiple disciplines** that are typically hard to find. The expertise required includes the following:

- The radio access network (RAN), including radio units (RUs), distributed units (DUs), and central units (CU-CP and CU-UP)
- Transport and connectivity, including fronthaul, midhaul, and backhaul
- The core network, including all required network functions
- Managing users, IoT devices, and other UEs (user equipment)
- Orchestration, enterprise edge cloud, and network function virtualization (NFV)
- Spectrum and radio resources
- Configuring thousands of network parameters
- Network optimization and assurance

5G networks that use coordinated shared spectrum will require even more careful RF planning, network design, installation, test, management and operation.

ComputerWeekly.com

And the professionals that do have such knowhow are experts that are not often found on non-5G networking teams, e.g.:



“ How to attract, educate and retain workers to fill a projected skills gap of up to 25,000 employees needed to build out 5G networks is a persistent topic in the wireless infrastructure industry. ”
Wireless Infrastructure Association

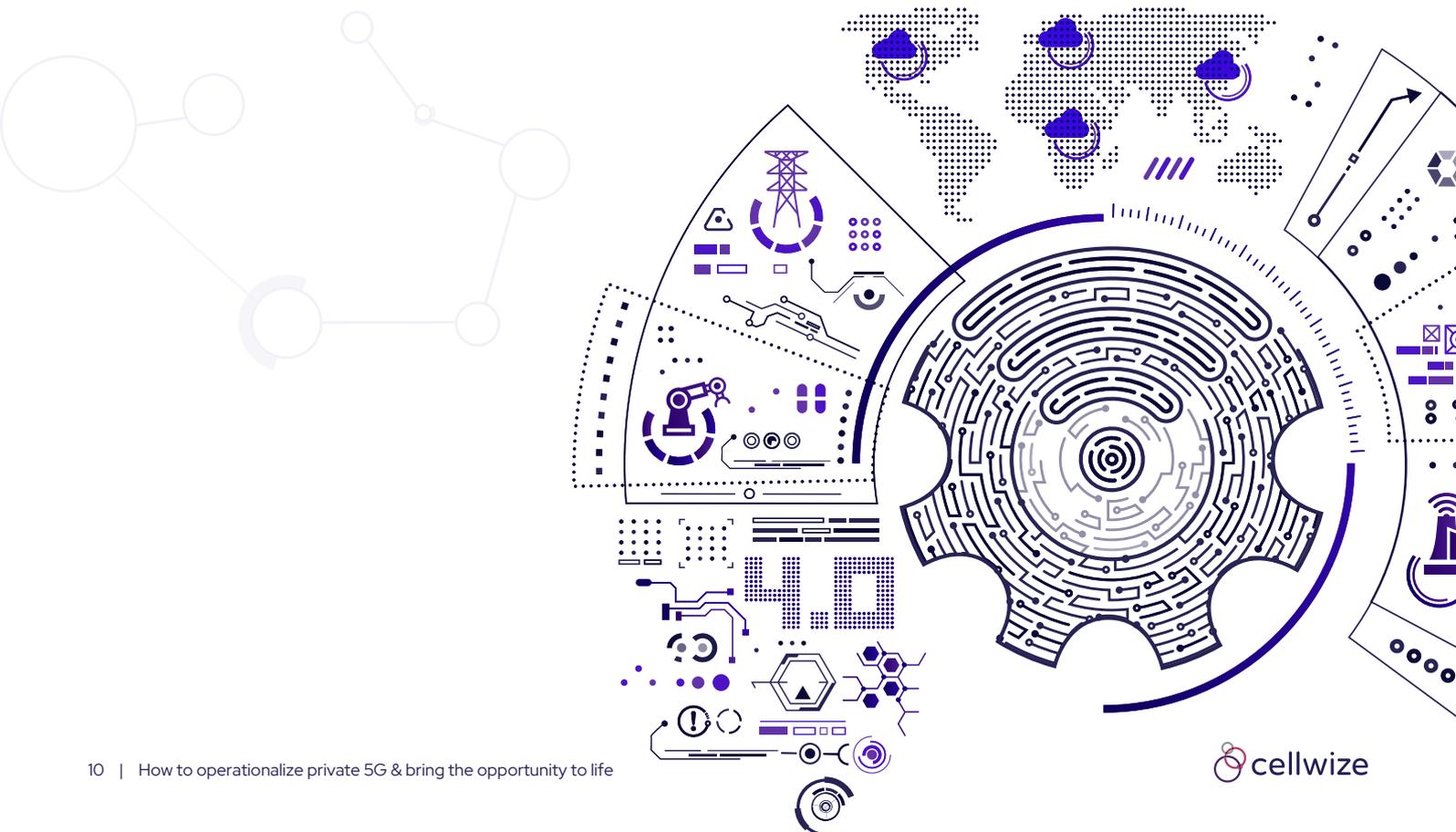
To complicate matters even more, **when deploying private 5G globally**, the different spectrum, equipment, and installer requirements of each country must also be taken into account.

Furthermore, **each 5G PCN project requires its own selection** of vendors, equipment, bill of materials, spectrum definitions, and RF planning, among others.

69% of organizations say that managing and orchestrating a multi-vendor environment is a key challenge they are facing or foresee they will face with their 5G implementations.
(CapGemini, State of 5G and Edge – industrial operations, 2021)

Without the ability to simplify the deployment, customization, and programmability of the private 5G network, the economic viability of such potentially very lucrative projects is in question.

“ An intimate understanding of the benefits, deployment challenges, and ROI timelines is critical to make the most of any private 5G network investment. ”
IDC



Customization requirements



Remember, this is not a one-size-fits-all paradigm, and there will be countless permutations to the actual constructs of private 5G networks depending on what purpose they serve and what frequencies are in play.

TechTarget

While the 5G network is inherently complex, what makes operationalizing the private 5G cellular network an even greater challenge than any other private wireless networking approach is the customization required for the varying applications of different enterprises.

Namely, SIs and PN service providers, and any other entity deploying private 5G will not only need to have full control of the multiple relevant technology disciplines. They will also need to be able to **tailor the network, its setup, and configuration** to the specific SLAs and needs of each enterprise and the multiple applications and uses cases that the private 5G network is required to power.

Additional customization mandates include being able to **adapt network behavior** to address a specific need or to deliver a special service. These needs or services can include, among others, custom reliability and healing protocols, specialized assurance algorithms, and intelligent management of a dynamic spectrum.

Furthermore, there is also the need to be able to **tailor network design** to the type and number of devices, traffic requirements, SLAs, and spectrum availability.

Ultimately, to win the private 5G business, SIs and PN providers need simplified customization so they can better align the solution to the unique needs of each customer.



Configurations can vary by site, depending on the type of work undertaken in each venue, and customized to an organization's specific location and operational needs

5G Technology World

Limited (to no) flexibility

Another challenge for operationalizing 5G in a way that enables SIs and PN service providers to capture the opportunity is the limited to no flexibility in:

- Being ready to **adapt the continual and fast-paced introduction** of new technologies and standards, such as Release 16, URLLC, and O-RAN.
- Selecting the **vendor best suited** for the specific project.
- Selecting vendors and **implementing architectures** to address industry innovations.
- Managing a **multi-vendor operation** with efficiency.

Lack of operational scalability

As noted earlier, operational scalability is a primary objective, which – without addressing current complexities and challenges – is unattainable.

First, there is a great **shortage of professionals** with 5G networking skillsets and expertise. Furthermore, **the inability to 'copy/paste' projects** and to **adapt the network to an inordinate number of use cases** and industry variables makes for an insurmountable hurdle.

Also, **assuring SLAs** and being able to **accommodate for brownfield deployments** that upgrade legacy to 5G or hybrid networks are additional barriers to scalability.

High OpEx (operating costs)

For 5G private networks to be financially viable with attractive OpEx levels, it has been noted that it is essential to adopt a “radically different approach” to planning and running this next generation network.

The typical staggered approach to capital investment is simply not enough. Expenses related to configuration work, network testing and management, and software updating, among others, will also need to be dramatically reduced.

“ 5G still too costly, inflexible for private network.”

LightReading

Eliminating the roadblocks

Eliminating the roadblocks to 5G and reaping the benefits means that system integrators, private network service providers, and internal teams need to find a way to do the following:

- Simplify** private 5G deployment and operations so as to avoid having to find specialized talent.
- Streamline** customizations to be able to better align to customer needs.
- Automate** assurance of connectivity services and SLAs.
- Assure** flexibility to support future applications and technologies.
- Achieve** scalability of the project and operations teams.

Key pillars for eliminating the roadblocks

The pillars upon which all of this rests and which will enable anyone to implement, integrate, and operate private 5G, are:



Let’s take a closer look

The importance of intelligent algorithms

Intelligent algorithms can automate complex deployments by doing the actual configuration for you. For example, such algorithms can determine which network parameters are best for each environment and use case.

Based on the data that’s collected, they can also invoke automated optimizations and assure that network SLAs, policies, and KPIs, such as latency, mobility, reliability, and throughput, are met.

Furthermore, automating configuration, customization, and other tasks will also greatly reduce the operating costs associated with operationalizing private 5G networks.

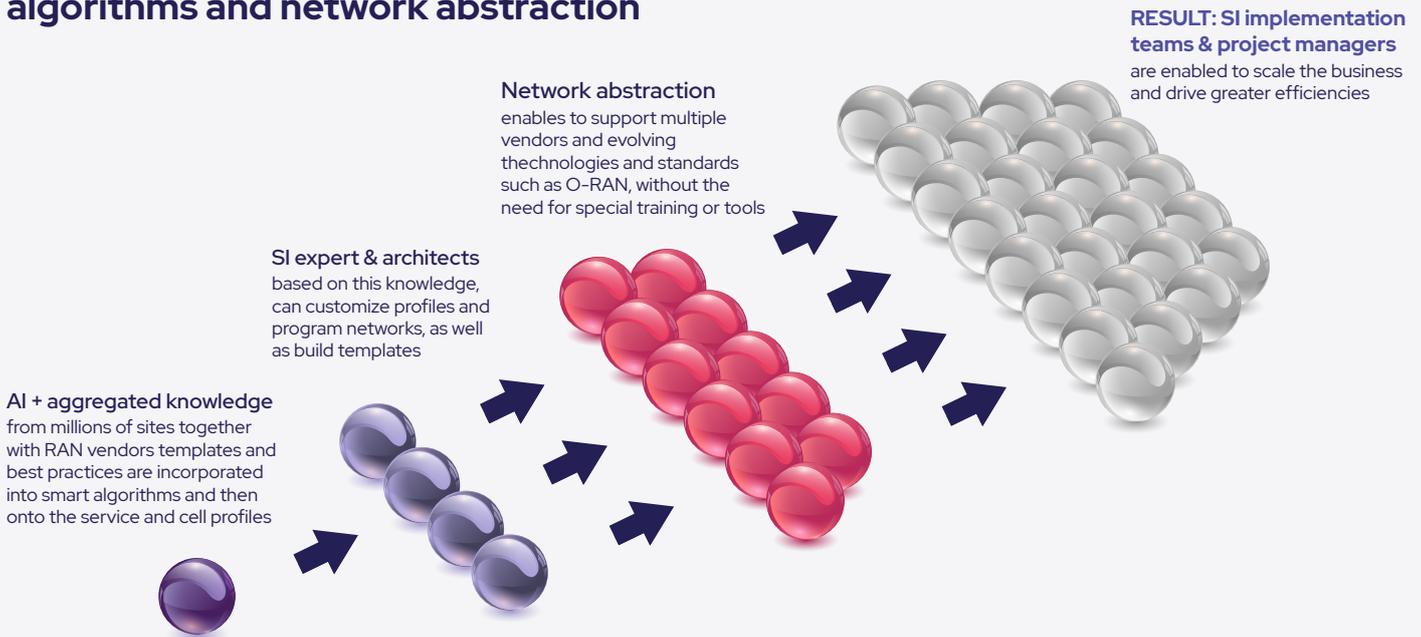
The importance of network abstraction cannot be underestimated. Creating a global data model that will act as abstraction layer for all supported vendors, empowers the network administrator to set up the network without reliance on any one equipment vendor.

At the same time, it enables the administrator to take advantage of the “build once deploy everywhere” approach.

Among the multiple benefits of network abstraction are:

- **Scalability** by being able to extend the offerings of multiple vendors to customers without having to expend additional resources.
- **Efficiency** by serving as a single NOC.
- Consistency by providing the private 5G service to customers who have multiple sites with diverse equipment from different vendors that is deployed at each site.
- **Simplicity**, by eliminating the need to model thousands of parameters.
- **Future readiness** by being able to seamlessly evolve to new architectures, such as O-RAN, with the same model.
- **Business flexibility** by being able to do business with numerous vendors, selecting the right one for each project, supporting customer-mandated vendors, and optimizing pricing for specific conditions.

Scaling expertise & operational capacity with intelligent algorithms and network abstraction



The role of profiles

Profiles are the key to enabling the organization to scale, as they reduce the reliance on expert skillsets that are hard to find. In this case, there are two sets of profiles that can be leveraged:



Service profiles, such as for AGVs, cameras, and sensors, for example



Site profiles, for the production floor, warehouse, office, and outdoors

Profiles use cases

Cell-specific profiles: manufacturing

Set network parameters that are aligned with the industry-specific environment and for the overall use case and relevant devices.

Invoke automated optimization after collecting data and assure network KPIs, SLA, and policy.

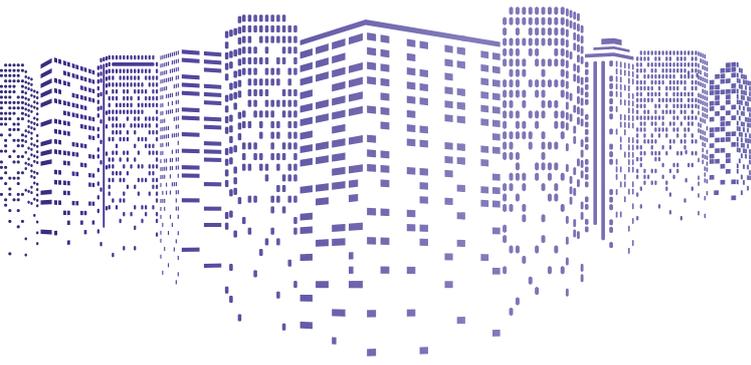
The result is improved latency, mobility, reliability, and throughput.

Device-specific profiles: augmented reality

Set device specific parameters to optimize performance on a per device or on a per device class basis.

Invoke automated optimization and assurance to meet device specific QoS, KPI, and SLA.

The result is improved experience and reduced device latency per AR requirement.



Achieving repeatability

Templates are the key to driving repeatability, as they enable any user to:

- Plan once and deploy as many times and as often as needed, wherever it's needed
- Copy/paste project design, configuration, etc.
- Create a tailored catalog of project, service, and site templates and profiles
- Empower one group of SMEs to focus on designing project templates, while freeing up others to deploy as often as needed as based on these templates

The admin console

An admin console is important for providing users with access to performance dashboards and for receiving fault alarms, as well as for activating profiles, RAN features, and apps.

Among the tasks that such a console simplifies are:

- User and device management
- SLA monitoring and analytics
- Network configuration, reconfiguration, and updates
- NOC (network operations center) and AI-Ops
- Replicating network configuration to new sites
- Customizing the network to customer needs
- Integrating the 5G network with the existing IT infrastructure

Programmability

With 5G private network programmability, SIs and PN service providers can write any app that is required for meeting customer requirements.

And when the 5G private network is driven by Open RAN, programmability can be further standardized by the RAN Intelligent Controller (RIC). The RIC serves as an open platform that can host RAN control applications developed by specialist software suppliers which are external to the RIC vendor itself.

There are two kinds of apps in this case – xApps” (near-RT) and “rApps” (non-RT), which, through RAN control algorithms, enable the creation of differentiated network experiences that are tailored to specific service types, user groups, or locations.



In enterprise markets, automation and support for specific connectivity requirements are the most essential factors in accelerating progress"

Small Cell Forum

The IT-fication of 5G PCN

Ultimately, what SIs and PN service providers need is the ability to control, monitor, and configure all their customers from a centralized network operating center (NOC).

And what IT teams need is the ability to monitor the private 5G network as an integral part of their overall IT infrastructure, like they would any other IT infrastructure system or app.

This is the **“IT-fication”** of private 5G and this is the key to operationalization and monetization of this next gen wireless network in the enterprise.

In conclusion

The future of the digital enterprise is here, and the engine that's driving it is private 5G. The only way to bring the 5G promise to life for the modern enterprise is through the IT-fication of the private 5G network.

How Cellwize Simplify can help

To help system integrators, private network service providers, and internal teams eliminate the road blockers to operationalizing private 5G, Cellwize Simplify offers:

.....
Profile-based network setup that powers the 'build once deploy everywhere' approach and which enables anyone to set up a new project

.....
Abstraction of vendor and network complexities from the users

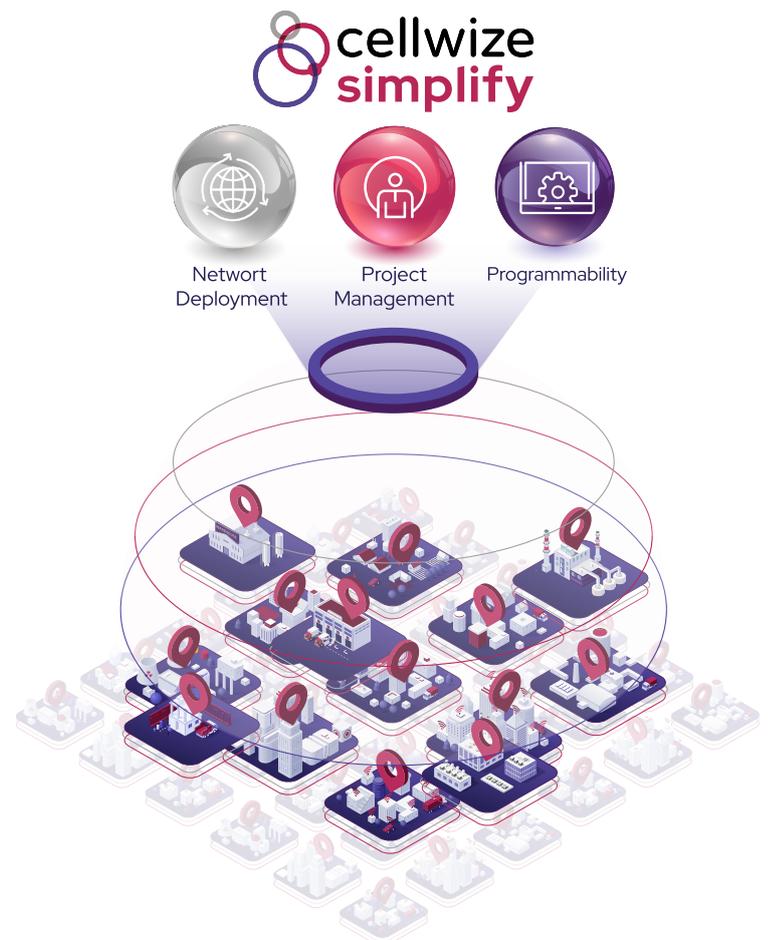
.....
Automated assurance

.....
Centralized private 5G operations

.....
Integration with IT tools so that teams can gain visibility and monitor 5G networks in the same way they monitor other internal networks

.....
Network programmability and an **app marketplace**

.....
Reduced private 5G operating expenses



To learn how Cellwize can help you to make private 5G dreams come true, we invite you to reach out to us at <https://www.cellwize.com/contact/>.