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The Know-How Network

Unleash 5G's potential

Editorial

Guillaume BOUDIN
CEO, Sofrecom

The symbolic threshold of one billion 5G subscribers has just been passed and 5G deployments are continuing around the world. According to the GSMA, 5G adoption in **Europe will reach 44% by 2025**; in the U.S. and some **Asian countries**, the rate is even expected to rise to around **70% by 2025**.

Until now, the major operators have launched 5G in NSA, Non Stand Alone, mode to meet the continued growth of mobile traffic and capacity needs of existing 4G networks.

With the gradual transition of 5G in SA, Stand Alone, mode, new consumer and enterprise uses will develop. Connected cars, cloud gaming, augmented reality experiences, robotized factory 4.0, smart cities, ..., are some of the concrete examples that will benefit from the innovations of 5G SA.

The benefits of 5G SA are numerous: **higher speeds**, **ultra-low latency**, **denser coverage**, the ability to virtually slice the network according to the services offered, not to mention the improvement of energy performance which is becoming increasingly important given our environmental challenges.

The opportunities offered by 5G SA are therefore multiple for telecom operators, and we are only at the beginning of the story. Through experience sharing, analysis and position papers, our experts and trusted partners propose today a new white paper «**Unleash 5G's potential**».

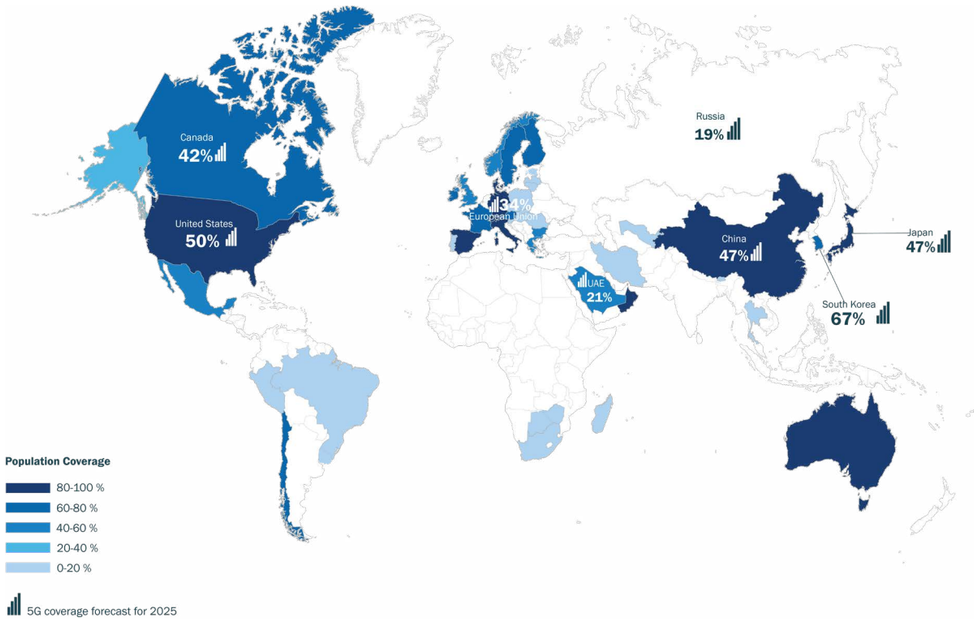
Enjoy reading !
Guillaume Boudin

SUMMARY

5G's worldwide rollout

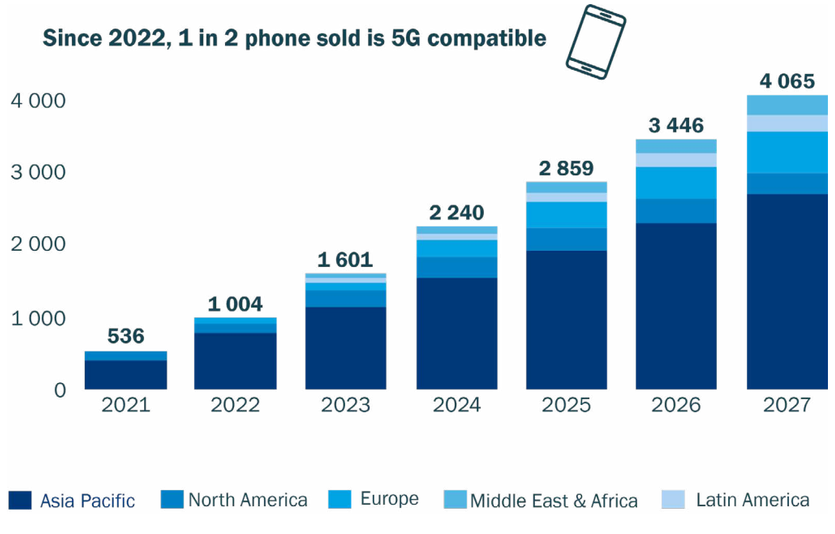
Long heralded as being the "Network of the Future", the deployment of 5G is now underway around the world. This mobile network generation, described as revolutionary, brings many new advances in technology, and promotes the emergence of new uses. Here is an overview of the progress of the global deployment of 5G and its main uses in different sectors of activity.

World 5G coverage



Source : Idate, World 5G market, June 2022
Statista

5G will reach 4 billions subscribers by 2027

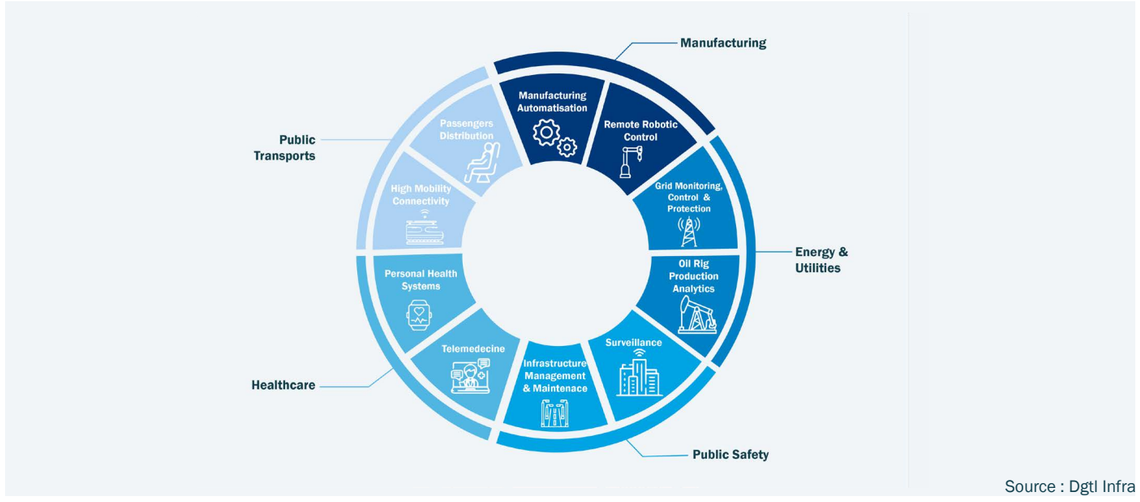


Source : Statista

5G will contribute $2.2 trillions to the global economy over 2034

Source : GSMA intelligence

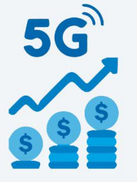
Specific 5G use cases in Industry



Source : Dgtl Infra

5G Private Market size will booming worldwide

According to Globe Newswire, the global private 5G network market size is expected to grow at a CAGR of over 42.4% and reach a market value of approximately USD 31,589 million by 2030.



31 589 millions USD

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stc achieves an early 5G launch: Key learnings

Haitham AL FARAJ
stc's Group Chief Technology Officer

Saudi Telecom Company (stc), one of the biggest telecom operators in the Kingdom of Saudi Arabia achieves an early 5G network build-out to boost digitalization as part of the ambitious country "Saudi Vision 2030 plan". stc increased its 5G infrastructure using an additional 5G spectrum to become the first operator in the Middle East and North Africa region to enable 5G carrier aggregation technology and one of the first High Global Performers in 5G availability and 5G reach for 35% of the population and continue its expansion to reach75 cities.

How did stc succeed in deploying 5G quickly? And what was the strategy for making technical and zoning choices?

The success of stc's 5G network deployment is a result of its continuous efforts and dedication to providing the latest technology to its customers. Our vision and strategy in mobile access network evolution have been well defined from the very beginning, and it clearly states the expectations of the company as well as the Saudi Vision 2030 plan when it comes to technology and digital transformation.

One of the main advantages that helped us on successfully rolling out 5G for majority of population on the major cities was having an excellent infrastructure from previously adopted technologies. Prior to 5G, with 4G Network, majority of our towers were already connected with fiber backhaul which allowed us to provide fundamental requirements of high backhaul capacity with low latency. This helped us to establish a leading position in the 5G market.

In addition to infrastructure readiness, spectrum readiness with the help of regulatory allowed us to deploy immediately without refarming of existing spectrum resources.
Where to start was a challenge? We had to ensure effective monetization and utilization of the 5G investment meanwhile considering the synergy with the existing 4G & the FTTH Network.

For that purpose, we used advanced data analytics to steer our 5G investment. Our analytics framework was developed to analyze, study, and explore various business and technical criteria of sites that are expected to benefit from a 5G investment (like revenue, utilization, 5G device availability, 4G network utilization, availability, and utilization of FTTH network), allowing the company to identify the ideal 5G sites that will offer the best user experience to the largest number of users.

As the early stage of 5G was mainly focusing on the EMBB[1] (enhanced Mobile Broadband) across the globe, KSA was not different. As zoning choices, we started deployment in 5 main cities aiming to enhance speed and capacities for the 35% of KSA population and continue to expand footprint by targeting new cities (reaching 75 cities) to cope with consumer's demand.

Today stc is moving forward to maintain its coverage and speed leadership in KSA with commercial mindset, many 5G coverage and expansion project are planned with main objective to improve the network capacity, performance and coverage.

[1]eMBB (enhanced Mobile Broadband): data-driven use cases requiring high data rates over a wide coverage area. One of the three main use cases of the new 5G radio (NR) defined by the 3GPP standard

What have been the major constraints and difficulties for 5G deployment?

The adoption of 5G technology has brought many significant challenges that must be addressed to ensure its success. Despite the rapid evolution of the 5G ecosystem in the telecom vendor site, consumer device ecosystem maturity was, and still is a challenge for telecom industry. Early devices with the lack of support on the KSA available spectrums in addition to no carrier aggregation capability slowed the 5G uptake on the consumer side. Today only around 30% of mobile subscribers are able to access the latest version of 5G services due to the limited capabilities of customers' mobile devices.

In the early stages of our 5G deployment, we were only able to use C-Band which provided high capacity in the Hot Spot and dense areas. Yet lack of Low Band Spectrum availability at the beginning limited us to maximize the experience and assurance of 5G service continuity and coverage.

Covid-19 that were impacting the global supply chain was posing a risk of completing of our rollout & project timeline. Although we successfully navigated through those difficult situations.

Vendor latest hardware readiness specifically on Massive MIMO[2] impacted us in some region to take full advantage of 5G Features.

How does 5G drive innovation in stc's digital services?

The potential of developing enhance digital services ecosystem is immense in Saudi Arabia.

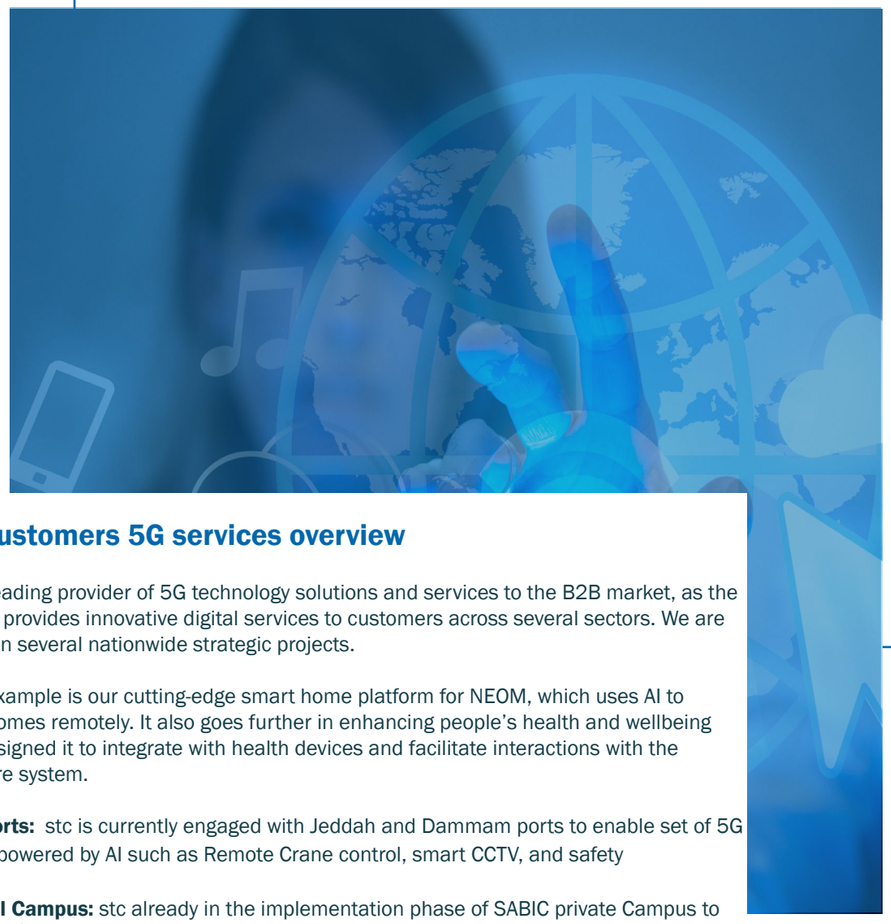
stc has built comprehensive set of capabilities to ensure having end-to-end components to drive effectively and successfully the digital transformation for itself and the market.

Center3 – our carrier-neutral data center and submarine fiber optic network - is a significant milestone in stc's aim to provide world-class connectivity and in our commitment to positioning the Kingdom as our region's digital center. It has cohesive ecosystem of cables and data centers designed to attract hyper-scalers, big data, local and international service providers to have content hosted close to enterprises and consumers.

Our subsidiary IoT focusing on the development of our capabilities to develop use cases for smart city applications, industrial automation, smart logistics and smart home applications and AI based 5G Digital Services.
We have a joint venture company with Alibaba Cloud that will offer a range of cloud computing solutions, including elastic compute and network to the database, to meet the demand of sectors such as retail, fintech and more in the cloud service domain.

In terms of mobile connectivity infrastructure, stc has made significant progress forward in recent years with the continuous expansion of its 5G network footprint and capabilities (like Network Slicing and End-to-End orchestration, Standalone Core etc).

The 5G Infrastructure is the main component and catalyzer for stitching all these capabilities together and drive acceleration of new technologies throughout the Kingdom, enabling for the development of more efficient and cutting-edge products and services, thereby driving competitiveness and economic growth and strengthening the Kingdom's leadership position in the digital economy.



B2B customers 5G services overview

stc is a leading provider of 5G technology solutions and services to the B2B market, as the company provides innovative digital services to customers across several sectors. We are involved in several nationwide strategic projects.

A great example is our cutting-edge smart home platform for NEOM, which uses AI to control homes remotely. It also goes further in enhancing people's health and wellbeing as we designed it to integrate with health devices and facilitate interactions with the healthcare system.

Smart Ports: stc is currently engaged with Jeddah and Dammam ports to enable set of 5G services powered by AI such as Remote Crane control, smart CCTV, and safety

Industrial Campus: stc already in the implementation phase of SABIC private Campus to utilize MEC[3] for mission critical functions such as connected drones and 3d augmented reality. And there are plans currently to move on with Aramco.

Our 5G capabilities enable us to empower the digital transformation of our customers and meet their requirements. Today, there are several innovative services being offered to our customers, including Smart Video Surveillance integrated with Artificial Intelligence, Assisted Operations with 3D Augmented Reality, Environment Monitoring, and many more services.

We firmly believe that 5G will have a profound impact on the vertical markets and continues to provide pioneering technologies and services to our customers throughout the Kingdom.

[2]Massive MIMO (Multiple Input Multiple Output) : a wireless network that allows the transmission and reception of more than one data signal simultaneously on the same radio channel.

[3]Multi-access Edge Computing (MEC) formerly mobile edge computing, is an ETSI-defined network architecture concept that enables cloud computing capabilities and an IT service environment at the edge of the cellular network and, more in general at the edge of any network.

Jean-François THOMAS
Chief Strategy Officer, Orange Middle East and Africa

Mona EL KHOURY
Strategy & Business Development Manager

5G in Africa : Orange challenges

As a digital transformation partner in the 18 MEA countries where it operates, Orange launched its first 5G commercial offerings in Botswana in 2022. Other subsidiaries are in the starting blocks. Orange's 5G deployment strategy meets its ambition to bring innovation to MEA and be the reference operator. But it adapts to the maturity levels of local markets.

Despite the difficulties associated with the health crisis, Orange has maintained its strategic focus on the MEA region. In November 2022, Orange Botswana became the first Orange subsidiary in Africa to launch a commercial 5G NSA network after significant preparation and technical adaptation work.

Promoting innovation to support the economy and reduce the digital gap in MEA

Covering 30% of the population of the Gaborone and Francistown regions, 5G technology will provide new health, education and security services to the people of Botswana. In particular, it will act as a lever for promoting the development of a connected ambulance project. It offers new value-added broadband services to individuals and SMEs.

The release fulfills the Botswana government's ambition to leverage 5G innovations to transform the country into a more inclusive, knowledge-based economy. This fully aligns with Orange's mission to support local economies and job creation by deploying innovative technologies to continue reducing the digital divide on the African continent.

Drawing on its extensive experience in deploying 2G, 3G and 4G networks, as well as monetizing new uses related to these successive technological shifts, Orange will continue its commercial 5G launches in the region in 2023, in three to five other countries.

A 'First and Right' launch strategy

While aiming to be the first to offer 5G services to its customers in to become or remain the leading operator in the markets within its footprint, Orange remains attentive to the situation and the needs of its customers, both individuals and businesses, to best support them in their digital transformation. The challenge is to arrive to the market at the right time, while remaining attentive to the initiatives of competing operators. Indeed, given the geography of countries, the GDP per capita and the fact that half of the population lives in rural areas, 5G is not yet a priority across the African continent:

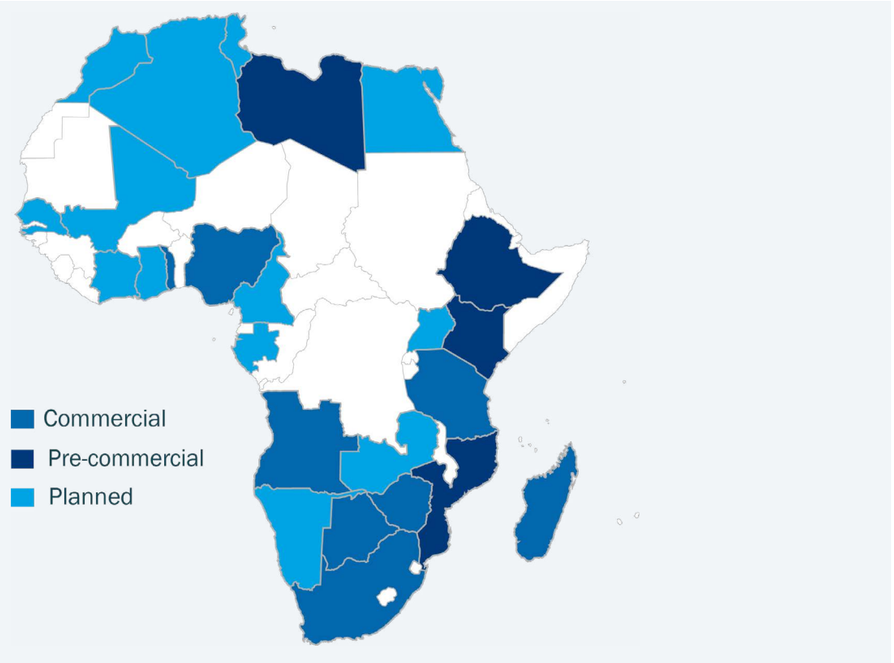
- The primary demand from individuals and businesses is for better throughput, better network quality without congestion and ever-expanding network coverage at home, in the workplace and while traveling.
- Many countries remain focused on the broadband deployment of high-speed broadband, whether it's mobile data or fixed. Therefore, on mobile, Orange is continuing the deployment of 4G, already present in 17 out of 18 countries, but unevenly, as some populations are still connected only in 2G/3G. Orange's priority is to improve the quality of coverage by bringing 4G to rural areas, for example.

At the same time, for fixed broadband uses, Orange is deploying FTTH and FTTB fiber, but in a targeted way – especially in areas of major economic activity or towards middle-to-high socio-professional categories in city centers.

5G as a lever for a high-performance technology mix

Despite these obstacles, 5G will provide a strategic addition to 4G mobile data and fixed broadband technologies. Disruptive evolution of 4G, particularly in the B2B market, 5G offers, broadcasts and carries very high-speed data services. It will also enable advanced and personalized services (slicing) that involve low latency requirements and the management of large volumes of connected objects. It will thus contribute to a high-performance mix of technologies. Initially, it will complement and improve the efficiency of the Fixed Wireless Access (FWA) coverage that Orange is currently providing in 4G, and which can be implemented in 5G; from mobile network access via a possibly portable modem, customers will benefit from high-speed connectivity like that of fixed uses.

5G footprint across Africa



Prerequisites for launching 5G commercial services

To launch 5G commercially in MEA, several conditions must be met:

- Regulatory conditions: operators depend on governments' willingness to open frequencies and grant 5G licenses at affordable prices. Some countries have shown a clear desire to make 5G spectrum available quickly at an economically attractive cost. In other countries, regulatory authorities have still not initiated a process for licensing/ frequency 5G. Sometimes it is necessary to rearrange the spectrum occupied by other uses. To support deployments, Orange is working with several regulators to develop a roadmap while testing the technology and developing use cases that meet the needs of local populations.

- Multiple technical conditions: the maturity of the ecosystem plays a significant role. First, the fiberizing of telecommunication towers is an essential prerequisite for the broadcasting of 5G services. Then, the deployment of 5G networks is an opportunity to put suppliers back in competition. In a newly emerging market, the calibration of tenders is delicate and time-consuming. Indeed, in the MEA, the average ARPU is 3 € compared to 15 or 20 € in Europe. For the pricing structures of 5G to be compatible with the economies of African countries, it is necessary to wait for their large-scale production, which raises the question of the “right time” to launch. The same problem applies to smartphones and 5G-compatible boxes; for the time being, their prices are incompatible with mass distribution. Finally, sometimes lengthy work on the integration of 5G terminals into the networks, in conjunction with the suppliers, must be anticipated in the pre-launch roadmaps.

Price conditions: the monetization of 5G offers is a complex subject. The qualitative jump between 4G and 5G is less noticeable for the individual customer than when switching from 3G to 4G. The price must take into account the value added that is initially perceived: better coverage, better throughput, better quality and better value-added services.

The specific challenges to address for launching a commercial 5G network in the Middle East and Africa region explain a progressive strategy as well as a desire to complement everything that has been deployed so far. Nevertheless, 5G holds many promises and innovations such as the Internet of Things and slicing. It will bring value in various sectors- the management of the continent’s numerous port areas, for example. Through the opening of 5G Labs in Dakar, Abidjan and recently in Amann, Orange is already fostering interactions with local, public, and private economic players, as well as start-ups and the entire ecosystem in order to anticipate the future uses and needs of its customers.

Uses Cases & *Marketing Strategies*

Bénédicte JAVELOT
CEO, Orange Wholesale France

The wholesale market for 5G: A bright future

Orange launched its 5G "Non Stand Alone" (NSA) service in late 2020 in France, for the Consumer, Enterprise and Wholesale markets. After 2023, Orange will use the deployed antennae for 5G NSA with a 5G core network, making it a "full" 5G network (known as SA, Stand Alone). This will increase the technical features and pave the way for new business prospects.

Where are we today with 5G on the wholesale market?

Since 2018 we have supported our MVNO customers in carrying out 5G pilots to test the features of this new technology. Then, in December 2020 they launched 5G for their own retail and B2B customers, simultaneously with the commercial operator Orange France.

The vast majority of our French MVNO customers have already chosen Orange's 5G to benefit from speeds 3 times and tomorrow 10 times higher than those of 4G! We also now offer 5G as part of our Sponsor Roaming offers (i.e. resale of our international roaming agreements). One of our MVNO clients was thus able to cover the 2022 Football World Cup in Qatar by taking advantage of the very high speeds of 5G.

5G requires colossal investments and our operator customers see the value provided by the 5G massive investments we made: it allows us to monetize a “5G premium” in our offers.

What are the strategic challenges of mobile wholesale around 5G ?

We are an infrastructure operator: we innovate to offer new network enablers to our MVNO clients. Our main challenge is to give them access, through our offers, to all the benefits of 5G SA, while optimizing our networks.

The three key promises of 5G SA are increased speed, ultra-low latency, and the ability to make massive Internet of Things (IoT) possible. Increased speed is already effective with 5G NSA since 2020.

After 2023, 5G SA will give us access to Ultra-Low Latency (with latencies close to one millisecond) and Massive IoT, which will make it possible to accommodate a very large number of connected objects per square kilometer. 5G SA will also allow us to structure the network into slices to dedicate network sub-slices to specific customers or traffic, associated with service guarantees. For example: emergency services will be able to have dedicated network resources, guaranteeing their communications even in case of network saturation. In other words, they will benefit from "priority" access.

To fully take advantage of 5G, the network architecture needs to be fine-tuned: virtualization will enable in particular the automation of certain network functions and facilitate their deployment. Combined with Edge Computing, this architecture will further reduce latency by placing content and data closer to the end customer.

At Orange Wholesale France, we are working to simplify this technology in our offerings for our operator clients.
This evolution from 4G to 5G must be done in accordance with our social and environmental responsibility goals.
The Group has set a very strong ambition in this area with a carbon neutrality target by 2040. With the explosion of usage and data volumes, our networks play a central role in achieving this objective. It is estimated that to carry one gigabyte of data, 5G uses 2 times less energy than 4G at its launch, will use 10 times less by 2025, and up to 20 times less by 2030.

What are the possible perspectives for 5G wholesale ?

The possibilities offered by 5G are very broad. We are working closely with our operator clients to identify future needs of end customers and develop use cases.
These use cases will primarily be industrial, such as industry 4.0, Smart Cities, broadcasting, remote control, teleoperations, and transportation. 5G will also benefit the consumer market with use cases such as gaming, augmented reality for sport events (on-site or remotely), virtual reality for culture and tourism, etc.
If industrial MVNOs begin to emerge on the wholesale market, it is likely that many of our future clients do not exist yet!

Mobile Private Networks (MPNs) should be the main users of differentiated services (service slices). Some integrators of these private networks are also becoming MVNOs to offer their customers a "continuum of service" on the Orange network.

Gradually, players are emerging, and the 5G market will slowly structure around the growth of network capacities and the development of dedicated slices for clients or services.

Operators coming from the world of Private Networks as well as those specializing in transportation - automotive and rail - will be strong consumers of differentiated services. We can also imagine, for example, a "vertical" made of communities of municipalities operating both a layer of private network for themselves and a layer of public network as an MVNO.

Finally, the fragmentation of the mobile network value chain into “bricks” caused by virtualization could enable us to offer infrastructure services beyond mobile connectivity.

In conclusion, the technological leaps made possible by 5G are disrupting ecosystems and will lead to new needs and new business models.
With its operator customers, Orange Wholesale France is fully committed to anticipate and answer these new needs. We are already at the forefront of 5G to monetize these new infrastructures, serving the Group.

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5G use cases & monetization: A paradigm shift for operators

Jérôme BASSELER
Chief Commerial Officer, Orange Consulting

Eric LUCAS
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David KERNANEC
Manager senior, sales Division, Orange Consulting

While 5G NSA has been deployed on a large scale in Europe and the Middle East, and 5G SA is on its way, operators are still struggling to find a monetization model for this new technology in all their markets: BtoC, BtoB, wholesale. The first use cases of private 5G in industry 4.0 or in smart cities show the way. The operator must rise in the value chain...

From a techno-push approach to a usage-driven approach

Until the 4th mobile generation, everything was simpler for operators. 3G was driving the growth of mobile Internet usage, while 4G was driving the explosion of data usage, especially video and videoconferencing. At each switchover, operators increased the price of their mobile package to value the additional speed brought by the new technology. Customers were buying.

With 5G, everything is different. The massive speed increase it offers does not meet the needs of consumers in the BtoC market, who are still satisfied with their 4G experience. In the BtoB market, the promises are attractive, including slicing, massive IoT, smart city... But 5G standalone network cores are not yet deployed in all territories, especially in France. They often come up against a technological limit: certain functionalities are not yet available, and existing terminals are not 5G compatible. In this emerging ecosystem, operators are still having difficulty assessing the value that 5G can generate for their customers. They are still looking for a business model that will allow them to justify and make profitable heavy investments in a 5G SA network. So how do we get out of this vicious circle?

5G use cases privately deployed by Industry 4.0

The first applications of 5G deployed in private mode are a source of inspiration. In France, Germany and Japan, major industrial companies in various sectors have started deploying 5G. To move towards Industry 4.0, they have replaced the proprietary networks (TEC, TETRA, Wifi) they had deployed on their sites, large complex estates or smaller but highly automated factories, with 5G in private or hybrid mode. They started with a use case that met a strong performance challenge and justified the investment. Then they leveraged their new 5G platform to deploy other uses:

- For instance, a specialist in energy management and automation, has invested in 5G to optimize maintenance using augmented reality: its maintenance technicians can now view data related to superimposed virtual objects (a machine, a production line, the entire factory) on an application and intervene in real-time, thus reducing machine downtime and human errors. Then, the company relied on a mobile telepresence robot connected to 5G to develop remote site visits with very high video and audio quality.
- German or Japanese car manufacturers who use a lot of automatic robots have switched to PMR5G (Private Mobile Network) because the Wifi network on which their AGVs (automatic guided vehicles) were connected was reaching its performance limit. Then, they deployed other uses: communication on terminals between operators and screwdrivers or other machines connected with data.

Requirements focused on turnkey usage solutions

Furthermore, the way in which the expectations of players formulating 5G deployment projects are expressed is another guide to the path to follow. Their requests are not about technological expectations, but about providing turnkey solutions oriented on very operational use cases. Here are two examples:

- In the Middle East, a country sees 5G as a powerful driver for the development of smart cities. In order to a guarantee 5G coverage of its cities, this country wants to put the new technology at the service of a very pragmatic challenge: to make the operational management of life transparent and easy. To this end, 5G must meet several specific and measurable expectations: improve the quality of public accounts management to make from the country a reliable and attractive financial center for investors; better organize the vital resources (water, energy) and that of mobility and road safety, in a context of resource scarcity and rapid expansion of cities related to the demographic boom; support the promotion of the country's modernity.
- In France, a large city is considering the switch to 5G as a way to rationalize and unify a multitude of very heterogeneous proprietary networks (TRETRA, Wifi, wireline...) attached to as many contracts independent of each other, based on a detailed analysis of 80 specific use cases: security, safety, computer vision, video protection, development of autonomous vehicles, massive IoT...

Strong industry expectations

The same operational expectations are expressed in many sectors of activity and in business verticals where various experiments are underway.
In the transportation sector, the use cases aim to:

- Increase network security. While TETRA networks for communication between security or intervention agents only use voice, a 5G PMR network opens access to video or data-based functionalities that significantly improve the operational efficiency of agents. As for slicing, it will enable networks to be prioritized according to security criteria.
- Accompanying and helping travelers who are faced with the gradual disappearance of station agents, but are waiting for a human presence. Carriers are testing the development of 5G services around the virtual counter: via video chat in mixed reality, a human interface helps travelers change their tickets or guides them through transit areas.
- Accelerate the development of autonomous transports, which is a step towards decarbonization and cost optimization in all the sectors: road, railway, river and sea transport. The 5G low latency will herewith establish a new model for the sector. It will also leverage the transit points management (stations, airports, ports) and will enable to develop new services for the users and the customers.

In industry, the experiments are targeted at the production, maintenance and logistics sectors. The use cases concern the mobility of people in a work situation, mobile maintenance, optimizing maintenance safety in the practice of gestures, optimizing intervention processes, securing sensitive industrial data, and developing distance learning around virtual reality.

Moving from operator's approach to an integrator one with end-to-end solutions

The previous analysis shows that in order to switch to 5G, an economic player does not expect us to tell him about technological performance, he wants us to tell him about himself and address his business operational needs. In the same way, a government or a city player does not expect to be told about "smart" if the needs of the "city" and citizens have not been taken into consideration beforehand. So, to monetize 5G on the BtoB market, the operator will have to go beyond its usual role: penetrate its customers' businesses, have a detailed understanding of their value chains to imagine with them a specific solution and identify the value that it will generate for the customer's business and for itself. However, building a business model based on specific offers is not in the DNA of a telecom operator. Moving up the value chain to get closer to the customer is a real paradigm shift. But it is towards this role of

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integrator of operational services and developer of digital territories that the Telco must evolve.

If it wants to bring a customer's global digitalization roadmap to the 5G market, the operator will have to start with a turnkey use case that makes real operational sense for the customer because it increases its operational efficiency and reduces its costs. To determine these use cases that generate value for the customer and business for the operator, the operator can benchmark the practices of mature 5G SA markets in Europe and the United States, where operators have identified 5 or 10 offers in each business sector. Then, progressively, the operator will be able to co-develop other use cases with the customer. It is through this new operational intimacy that the operator will succeed in driving the digital transformation of its customer.

unavailability of antennas, sensors, processors, rare lands, and even production disruptions in the supply chain, will undoubtedly lead to delays in the implementation of 5G SA.

- While 5G SA will create value through its ability to fine-tune the orchestration of expenses and processes, it will lead to ever more automation. This dynamic will reduce human intervention. Already, autonomous ships piloted remotely are sailing without a crew on board. It will be necessary to determine the threshold of social acceptability of a disruptive transformation that raises the question of the transformation of work, professions, and skills.

The Orange 5G Lab, a tool for 5G operationalization

To help economic players bring their 5G projects to life, Orange has already deployed 16 5G Labs in 9 cities in France, Europe (Antwerp, Liege, Warsaw, Bucharest), Africa (Dakar, Abidjan) and the Middle East (Amann). In these structures, companies benefit from the support of Orange's technical, network and product experts to co-construct and rapidly test, on the scale of a lab, a 5G solution that they have imagined for their business. They can rely on the 5G equipment of tomorrow (augmented reality glasses, virtual reality headsets, engines, 5G terminals, 5G modules). These structures allow companies to test and learn on use cases, up to the economic evaluation of the solution and the validation of its relevance to the promise.

Consider the limits of a massive 5G deployment

Despite its promises and disruptive virtues, 5G architecture will never be the universal solution capable of replacing all existing networks to deliver all expected services.

Its massive deployment will encounter several limitations to be taken into consideration:

- 5G will require more energy in a context of scarcity, accentuated by the war in Ukraine, and frugality objectives to meet decarbonization commitments by 2030. This is an obstacle to 5G in emerging countries that are still not very electrified and not sovereign in terms of electricity production. It is a new constraint in developed countries where we will have to learn to count better.
- The supply difficulties of some materials, generated by the health crisis related to Covid-19, will persist. The

Despite these limitations, 5G is going in the direction of history: it is here to stay. It represents a first step towards increasingly organized economic and public action logic. It will generate, through new services and use cases, many disruptive transformations aimed at modernization and operational efficiency. It will lead to a repositioning of all the players in the ecosystem. It is also the first step in opening up the world of data on a massive scale. It offers companies the opportunity to start embarking on the transformation of their operational model, their business model, and the development of data.

Saleem AL BLOOSHI
Chief Technology Officer,
du from Emirates Integrated Telecommunications Company (EITC)

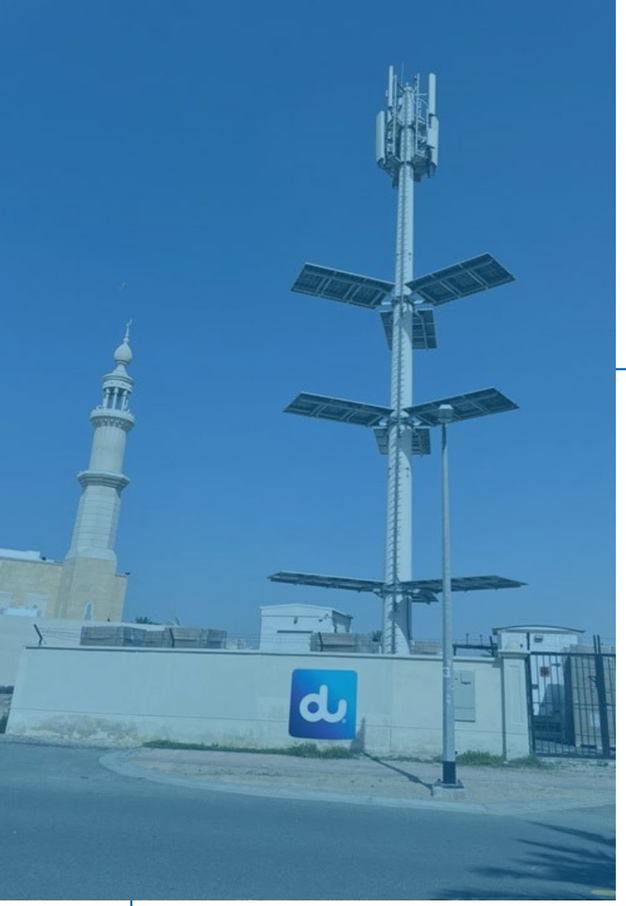
Green challenges, as a cornerstone of the du's 5G strategy

The operator du (EITC), is one of the two leading operators in the United Arab Emirates. Since 2019, du has been one of the first providers in the world to rollout a 5G network widely and successfully to reach 95% nationwide population coverage today. What are du management experience and ambitions to continue the 5G roll out expansion and digital transformation while complying with the "UAE 2050 net-zero targets"?

What are the first lessons learned of 5G rollout?

We started the 5G journey with our deployment back in 2019 and were among the first operators in the world to start this 5G rollout. As any other telecom operator, we faced some technical as well as monetization challenges. On the technical management, we had to anticipate and prepare our technical capabilities to the 5G prerequisites. First was the virtualization of our packet-core, then the fiber deployment, and finally the fitment of the towers to support 5G equipment. The co-existence of 2G,3G, 4G and now 5G equipment significantly impacted our energy consumption, utility expenses and greenhouse gas emissions.

We couldn't succeed without the strong support of the local regulator (TDRA) which gave us, from day one, incentives to roll out 5G from the very professional spectrum allocation to financial subsidies that lifted the main barriers for this challenge. Four years later, we have learned more and have greater control over our deployment and its acceleration. To date we have reached 95% of nationwide population 5G coverage and now the UAE can proudly say it has established one of the most reliable 5G mobile networks in the world. Now, for du, the next expansion plan is to have



deep indoor 5G wireless access network coverage to accelerate our fixed footprint nationwide. So, we continue our fiber extension, which is more long term and sustainable but 5G gives us a more competitive advantage for time to market and to meet our customer's demand. We are also developing new verticals such as manufacturing industries, and other entities to accelerate the digitalization of their business processes and activities with 5G capabilities. We are also releasing our 5G standalone capability that will help developing the use cases and their delivery. We continue our 5G journey and continue to pioneer in delivering the best-in-class network infrastructure and the best customer experience.

How do you address Green challenges in your 5G roadmap?

At du, green future and sustainability are key strategic pillars to our values. We are aware of the impacts that network infrastructure has on greenhouse gas emission and therefore have invested in several energy efficiency programs such as hybrid generators to replace fuel-powered generators on mobile sites and link them directly to the electrical grid.

The network now becomes highly complex due to the cohabitation of multiple technologies 2G/3G/4G and now 5G which is highly consuming in terms of energy. At du, we aligned with Telecommunications Regulatory Authority's decision (TDRA) to implement shutdown of 2G network (GSM) at the end of 2023. We took proactive steps to increase our 5G power efficiency and offload traffic towards 4G and 5G technologies. This strategy is aimed at boosting the usage of the 5G network (only 10% of capacity is used today) hence leveraging our energy efficiency. We are also planning the reuse of 2G equipment in different contexts which will be the trigger for our circular economy.
With the support of our procurement, we implemented energy-efficiency evaluation plans to assess our partners (Ericsson, Nokia, Huawei) in providing the 5G equipment to ensure the power efficiency is leveraged by embarking these 5G power consumption KPI's into their road map.

All telecom operators have started these initiatives around the world and to ensure we comply with our country "UAE 2050 Net Zero Targets", last year, we signed a memorandum of understanding together with six regional telecom operators: stc Group, e& (formerly Etisalat), du, Zain, Batelco, Omantel, to accelerate cooperation in protecting the environment, tackling climate change challenges as well as reducing the carbon footprint of our operations. At du, we think cooperation on sustainability and sharing of best practices are key to speed up the green agenda.

We also have put in place sustainability objectives that aim to guide us towards achieving our vision in alignment with the region's leadership vision.

What innovative solutions have you pioneered to reduce the mobiles sites power consumption?

We have implemented multiple energy- saving solutions such as **traditional solar power**, VRLA battery-Generator hybrid systems and free cooling systems. Further, in an effort to reach our "net-zero targets by 2050", and reduce our direct and indirect gas emission, we have been among the first operators in the world to **adopt innovative solar panel solutions**. The latest two initiatives are the **Li-Ion Battery-Generator smart hybrid system and the innovative Solar-on-Tower (SOT) power system**.

SOT helped us deploy solar power in the sites where footprint is limited and by connecting it to the utility grid, and with it, we managed to dramatically reduce our CO2 emissions and utility expenses.

The project started with a POC which ran for almost a year to ensure that the design parameters from all aspects (electrical, mechanical and structure) were working perfectly.

Today we have 78 mobile sites which are run completely on solar panels, helping us save 360 tCO2 during the year and for 2023, we have a wave of expansions to increase this innovative program by adding an additional 100 solar sites.

Has du taken any other specific initiatives to serve Green issues?

We are currently implementing **power reduction guidelines and programs** within our shops, offices, warehouses, and call centers **to foster a green culture** within our organization. Solar panels have also been installed on these buildings to control our energy efficiency and operate more responsibly and ethically. Today our LEED-certified stores have saved a total of 696,468 KWhr, which is only a start, but looks promising.

We are also focused on educating our people internally and have launched an internal awareness campaign to **encourage employees to reduce disposable plastic consumption** and we stopped selling plastic bottles through vending machines or catering partners. Our company joined an innovative citywide sustainability initiative "Dubai Can" launched by H.H. Sheikh Hamdan bin Mohammed bin Rashid Al Maktoum, Crown Prince of Dubaï and Chairman of The Executive Council of Dubaï last year, to encourage communities to reduce the use of single-use plastic bottles in the city. It has stopped the purchase of plastic water bottles for employees with plans to distribute reusable water bottles amongst staff. Additionally, we managed **to reduce the number of water dispensers and installed water filters** in the new offices to empower everyone to take small, everyday actions to foster an eco-friendlier society.
Providing the benefits of ICT to all individuals is a core tenet of du's sustainability approach. du is devoted to delivering cutting-edge innovations in the ICT sector and displaying its efforts to provide best-in-class IoT products technology supporting the UAE's smart city vision. du offers countrywide services like WiFi UAE as a result of its expenditures to improve its network infrastructure. It is also aiming to reshape the future of the UAE through 5G, IoT Smart City products and offering a variety of innovative goods and services to customers to ensure that everyone has access to the most advanced telecommunications technology.

We recently developed a partnership with Masdar City, one of the world's most sustainable urban developments and a global leader in innovation to leverage our world-class Internet of Things (IoT) technology to build a 5G Centre of Excellence (CoE) and implement a Smart City Platform which combines physical infrastructure, open and shared data, and smart applications to deliver unprecedented value.

Honored as the "Best Middle Eastern 5G Innovation Operator" by Telecom Review Excellence Awards in 2022, we will continue our 5G journey by exploring and harnessing the latest technologies to deliver a digitally inclusive future and above all to operate ethically and responsibly.

David ERLICH
Business Consulting Director, Sofrecom

Where the NaaS come from ?

The traditional network architectures were separated from IT domains. In particular, software was proprietary and ran on machines supplied by equipment manufacturers (Nokia, Ericsson, Alcatel, Cisco...). It provides functions like core mobile network or components, call control, Radio Access Networks (RANs), routers, firewalls, etc. Virtualization, which allows virtual machines to run on commoditized hardware, has been imposed in IT and has also impacted telecommunication software, and for 5G stand-alone it is a standard.

5G architecture and Network Exposure Function

Within the 5G architecture, the Network Exposure Function (NEF) is the layer that exposes the 5G functions to third party via Application Programming Interfaces (API). Downstream, NEF interacts in real time with many of 5G core functions, for example PCF (Policy Control Function) for provision of dynamic policy enforcement, NWDAF (Network Data Analytics Function) providing network analytics to assist an external application to make efficient decisions and SMF (Session Management Function) influencing the traffic by steering a connection to an Edge Server.

In concrete terms the 5G can be connected to an external application for :

- Adapting the quality of service on demand. This can give priority to some devices/applications : real-time robots, media/event streaming, emergency services, specific XR, ...
- Providing real-time information for advanced security and analytics. It can guarantee for example the integrity of connected objects.
- Enforce specific network routing in giving access to resources. This can optimise the routing of some application to get some computing resources to reduce time or to decrease costs.

This capability is called “Network as a Service” (NaaS). For Telcos, NaaS are seen as a “second chance” to recover the value they lost to the “over the top player”. But disruption is not simple, and it must overcome several challenges to be monetized. Poor adoption can be a consequence of different factors including prohibitive pricing, lack of cross-carrier compatibility, complex go-to-market.

Let’s review these challenges.

#1 Challenge

NaaS customers are not the usual telco customers

The customer of NaaS is not the end user (with the SIM and the Terminal) but an Application Service Provider which offers to the end user a service which integrates the Naas function.

Third party developers can be in theory entrepreneurs looking to “call” a NaaS API from a mobile app following the example of google map (the most popular API). But according to the nature of the NaaS, it will more likely structured application service providers : an E-agriculture software willing to enhance capabilities of their connected sensors, a Business Video OTT (like Zoom) looking to enhance the efficiency of corporate communications.... The operator may not necessarily know or understand how the NaaS service is used, or how it is included within the value chain. This is a real challenge to market promote it and to price it. A feature may be extremely valuable in one use case while being of less value in another.

#2 Challenge

Customer base is fragmented across telcos

Assuming an application targets a given geography (for example a country) an application service provider will look to serve all users. Operators have to forget about using these NaaS as market differentiators on their own customer base. A telco- specific solution which is not compatible with another telco will be seen as a reduced market for the application service provider. Operators should move away from this by developing together tools that abstract away complexities for designing, building, deploying and publishing APIs. This leads to the adoption of cross-operators standards, but these initiatives have a poor tack-record in term of speed-to-market.

#3 Challenge

Who does run the ecosystem?

Operators cannot offer the NEF (Network Exposure Function) directly to third parties, and will need to create another layer to define specific services for them. Third parties will not have access to the NEF API, but only to the operator-defined API. It is unlikely that all operators will independently offer the same APIs to third parties. This could lead ultimately to a complete fragmentation of the ecosystem (there are over 750 mobile operators worldwide !) that would discourage service adoption. There is therefore a contest around this upper layer and its standardization. It can be more efficient to give the task to design this upper layer to a telco-independent actor that would be more customer focus, and above all carrier neutral. As a paradox hyperscalers ((AWS, Microsoft Azure, Google Cloud,...), which were supposed to lose some value back to telcos, position themselves as go-between to federate the operators.

#4 Challenge

Operators must adopt a business use case approach rather than a feature approach

The focus of developers is likely on the application they are building. Developers using NaaS may specialize in specific use cases, driven by technical challenges or the intended industry or sector of the application, such as industrial, agriculture, or transportation. If marketplaces for software become prevalent, their success will likely be determined by business considerations rather than technical factors. For example, the success of companies like Twilio in the CPaaS (Communications Platform as a Service) market can be attributed to their ability to offer a range of services for customer relationship management in one place, making it easier for developers to access the necessary API's. Telcos are unlikely the best to animate the marketplaces of their NaaS.

#5 Challenge

They are “good enough” alternatives

Most of the NaaS have an equivalent in OTT mode. Applications have overcome network weaknesses by developing a range of strategies, without waiting for operators to deploy remedies. So when the solution arrives, it's too late, the ecosystem has adapted, even if it's sometimes at the cost of performance compromises.

To give an historical equivalent, let’s remember that in the course of the year 2000 there was many debates between whether ATM was better or not than IP to carry voice/video traffic. Even though ATM/Telco tend to be optimal, Internet/ OTT networks demonstrated since their capabilities to carry professional communications. Internet being simple, plastic, cheap and universal, it proved to be “good enough”, though not to be the best.

A closer example is SD-WAN (Software Defined Wide Area network), which is an overlay layer above (internet) networks. SD-WAN has an end-to-end view of the application and a privilege connexion to the public cloud. This can be done by corporate networks based on MPLS, but on a less universal manner.

The competition for NaaS APIs is not against other NaaS APIs, but rather against OTT (over-the-top) alternatives. There is no hidden plan for hyperscalers/ OTT against telcos, and they can even be facilitators of NaaS. For telcos, to secure this opportunity, they must relinquish certain privileges such as direct customer access, exclusivity on features, control of final usage. This requires re-evaluating their value within the entire chain and potentially reassess opportunities on a case-by-case basis. Customer demand for 5G SA specific features such as reduced latency, hybrid mobile networks, real-time trusted analytics will ultimately determine NaaS take off, and subsequent operators copernician revolution.

Key assets *of evolving technologies*

Arnaud VAMPARYS
Chief Technology and Information Officer, Orange Europe

5G rollout: Advances, uses and technological promises

Since the end of 2019, Orange has been deploying its 5G NSA (non-standalone) technology in many cities across Europe. The arrival in 2023-2024 of 5G SA (standalone) technology and the 26 GHz frequency band opens a new realm of possibilities for operators, businesses, and cities alike.

Orange has launched 5G in NSA mode in the 3.5 GHz band. What are the features of this first 5G release?

The 5G that Orange and other operators have been deploying in Europe for three years is called “non-standalone” because it is still partially supported by the existing 4G LTE infrastructure. In this first phase, we are deploying new 5G relay antennas on a 4G network core. These “smart” antennas, installed on city roofs and rural towers, are equipped with innovative technologies that offer advanced features:

- **Massive MIMO** (Multiple Input, Multiple Output) allows a very large number of users to be connected simultaneously, thanks to a network of smart micro-antennas located on the same equipment.
- **Beamforming** focuses the signal of 5G antennas only on users who need it, at the precise moment they need it. This advancement limits the public’s exposure to the waves as well as the energy consumption of the 5G network.

Orange has made the strategic choice to launch a 5G that differs from 4G; our customers covered by Orange 5G NSA already have excellent ease of use, especially with video.

The 2nd step is to completely move away from 4G infrastructure. Which features will 5G SA have?

The standalone 5G that Orange has started to deploy on private networks, particularly industrial ones, and that we will gradually deploy on the entire public network in different European countries is based on a renewed end-to-end architecture: new signaling, a new information system for network operation, and a new network core for managing the connection between users and the network.

This 5G network is developed using a “cloud-native” approach that allows software and hardware to be separated and network functions to be flexibly placed on servers.

This fifth-generation standalone mobile technology provides higher bandwidth, ultra-low latency and an expansion of connectivity within the same area. It allows massive IoT and network slicing, both of which are highly requested by companies. Virtual network slicing allows for the creation of bands to manage uses, qualities of service and security levels in a more personalized manner, with very high bandwidth and near-zero latency...

What other benefits will 5G SA and slicing bring to an operator?

With 5G technology, the operator will address very specific needs. It will be able to prioritize flows and reserve capacity, for example, for emergency services (police and military vehicles), critically connected infrastructure and various necessary businesses. Diverse mobile usage is increasing by 40% annually. Connecting a sensor, an object control, a smartphone, or an HD camera to a mobile network does not require the same bandwidth or security levels. 5G SA will offer operators a much more flexible toolkit to ensure the best connectivity for each of their customers, whether they are consumers, companies or even wholesale customers.

You are currently investigating different technologies for 5G applications, including the Open RAN. Could you tell us more about this ?

The deployment of Open RAN (Radio Access Network) occurs after the installation of various elements of the 5G core network. It aims to improve the quality of service and operation of radio access networks, reduce their deployment and operating costs and make networks more flexible and programmable using technologies based on artificial intelligence and machine learning.

Through open protocols and interfaces, the Open RAN network architecture allows the use of non-proprietary sub-components from various suppliers. To accelerate the development of an open, intelligent, cloud-based RAN and a rich ecosystem around Open RAN, Orange inaugurated the first Open RAN Integration Center in France in November 2021.

Will Open RAN bring significant benefits?

I see three common advantages: to evolve their networks throughout their lives and adapt them to customer needs, operators will be able to buy their software and hardware interfaces from different suppliers without being beholden to a single supplier. They will also be able to integrate the mobile access part onto the same infrastructure as the core network and add intelligence to the network through the optimization of beamforming. This beamforming optimization is a strong challenge for Orange, which already ranks number one in quality on the 5G NSA in France and Spain and also intends to do so on the 5G SA, as well. Slicing the beamforming network requires automating millions of parameters. Being able to do so natively in the equipment will become a differentiating factor among operators.

How does the 26 GHz frequency band fit in with another long-await shift?

The low frequencies (700 to 900 MHz), used since 2G, are very well suited to cover both outdoor and indoor areas. These frequencies have allowed us to determine where to set up our various sites.

Thanks to the intermediate bands (from 1.8 to 3.4 GHz), which are very similar to those used at home with Wi-Fi, we have been able to add capacity to the network to meet usage growth.

The 26 GHz band will offer fiber-like bandwidths, allowing, for example, 10 gigabits to be shared locally. However, it has a disadvantage: it does not penetrate buildings well. It will be very useful in very specific contexts that we are currently testing very busy waiting areas such as train stations, stadiums that attract large gatherings at the same time and industrial sites with heavy use of HD cameras. We will therefore deploy the band in a reasonable manner: in densely populated areas in Europe, but also in developing countries where the fiber deployment is not very advanced and where it will provide bandwidths that are comparable to those of fixed use.

Does Orange carry out all these techno evolutions internally?

Orange’s innovation teams have researched and developed various generations of mobile networks based on a wide ecosystem of industry partners. They’re already working on 6G technology! We also contribute a lot to the standardization of these networks, which we test with partners before deploying them in the Group’s 27 countries.

The 5GC core network, the cornerstone of 5G Standalone

Mustapha CHERIFI
OSS & Services Network Manager, Sofrecom

If 5G promises to revolutionize many fields, yet it is to release all its hoped-for potential. In order to introduce this technology to the market quicker, many operators have chosen to deploy it with a 5G NSA (Non standalone). However, this approach limits the implementation of new technological promises: speed, latency, security, slicing, ...

The core of a 5G mobile network, called 5GC (5G Core) completely changes its organization and opens important challenges in terms of deployment strategy. As for the virtualization of network functions (NFV), it promises both structural and organizational transformation between operators and integrators.

The specific features of 5GC mobile network core

A mobile network consists of 3 elements: the radio access network, the core network, that allows to route the calls to the destination, the information systems that manage network operations and customer management (invoices, subscriptions, etc.).

The core manages several functions: the accesses and their security management, the subscribers' authentication, the routing of calls, the management of subscriber services, the control of the communication throughout the duration of the call particularly during the movements of users, the quality of service.

The distinctive feature of the 5G network core (5GC) is its advanced virtualization that allows to separate the software applications of telecommunications from the hardware infrastructures hosting them. Thus, the network can evolve and adapt.
The 5G Core Architecture presents functional similarities with the EPC (Evolved Packet Core) architecture of 4G network. The main evolution consists in the division of network functions (Network Function: NF) in an agile environment.

Among the new functions of this architecture are:

- The NRF (Network Repository Function) catalogue function which acts as a centralized source of information, helping to simplify network management, improve network visibility and support the dynamic deployment of new services and applications.
- The NEF (Network Exposure Function) service exposure feature, which provides different mobile function discovery service, and a service registration management, and a discovery mechanisms service.

AMF	Access & Mobility Management Function
AUSF	Authentication Server Function
NRF	Network Repository Function
UDM	Unified Data Management
DN	Data Network
SMF	Session Management Function
UPF	User Plane Function
AF	Application Function
PCF	Policy Control Function
NEF	Network Exposure Function
NSSF	Network Slice Selection Function
NWDAF	Network Data Analytics Function

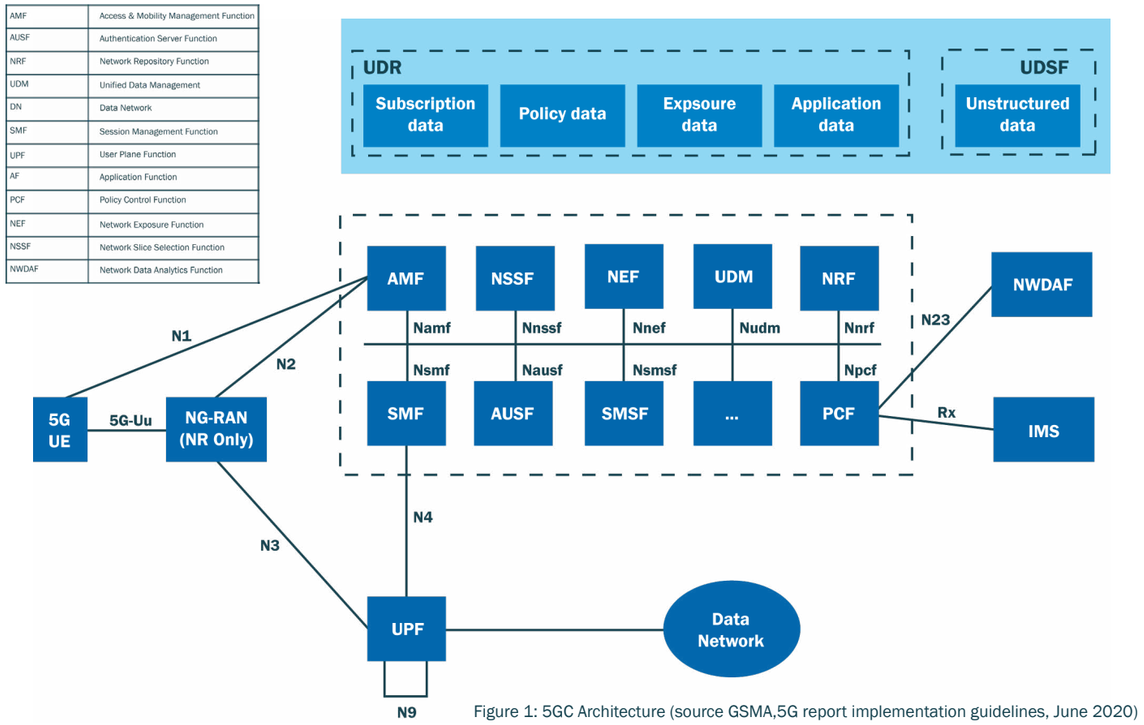


Figure 1: 5GC Architecture (source GSMA,5G report implementation guidelines, June 2020)

The main new concepts of 5G Core networks

5G Orchestration is a process for controlling and managing 5G resources both on the radio access (NR) side and on the transport side. In a 5GC network, orchestration is responsible for the coordination of network resources: bandwidth, power, and spectrum. 5GC Orchestration also includes functions such as Service Management, Security Management and Network Delineation. It enables the efficient and effective delivery of 5G services to users too.

An example: a group of connected cars could use orchestration to create a network slice specifically for connected cars, which would constitute a dedicated network with adapted specific characteristics (low latency, high bandwidth). The orchestration system would then manage the allocation of network resources (radio access points, transportation network) to ensure that the network slice meets the required Service Level Agreements (SLAs).

The architecture based on services (SBA) defines a set of services, each with its own interface that can be combined as needed (add or delete a service as needed) which gives it flexibility.

From a functional point of view, the 5GC architecture can be divided into three main parts:

- The control plan is used to manage network signaling and control
- The user plan manages the transfer of useful data into the network
- The service plan allows for the creation of new services and features

It is also possible to separate the control and user functions, which facilitates the creation of new services, and the optimization of existing services.

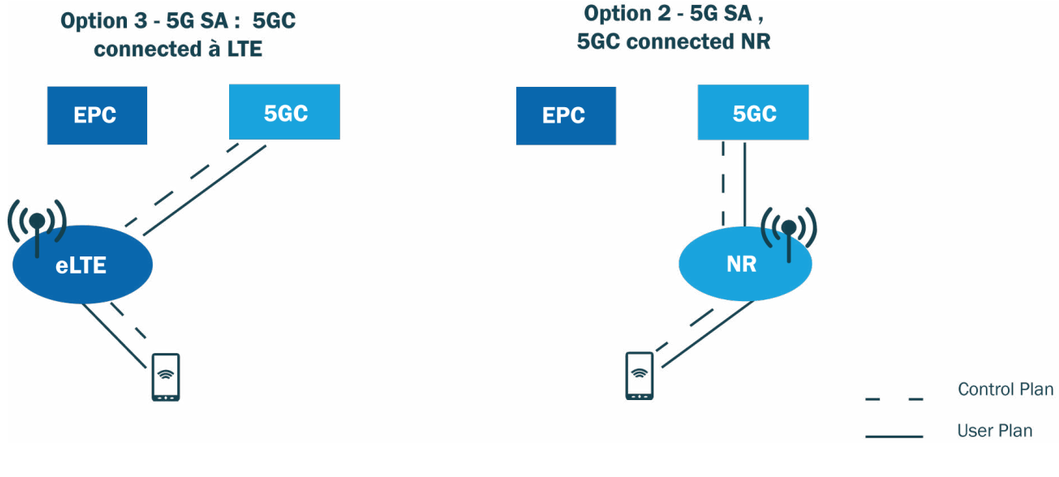
The 3GPP standard introduced stateless architecture for better network optimization and high degree of reliability and resilience. In this network design, the network functions do not retain any status information for individual sessions and instead rely on information from the control plan to make decisions. This enables faster processing and scalability, reduced network latency and improved reliability.
The network slicing is the ability of a 5G network to divide or to allow the network to be broken down into several virtual networks, each having its own resources and characteristics. These logical networks are called slices and can be adapted to the specific needs of each use case. For example, a network slice for autonomous vehicle use will have high performance, safety and reliability requirements compared to a slice for consumer mobile high bandwidth. Another slice network can be created for critical communications with very low latency and high reliability. The slicing can support many services.

Transition to 5 SA architecture with 5G network core

An architecture deployed in NSA 5G mode combines 4G radio access (LTE) and 5G NR (New Radio) radio access controlled by a 4G EPC (Evolved Packet Core) core network. A 5G SA mode network is separate from the 4G network and consists of 5G NR radio access and a 5GC core network. The new 5G antennas (gNodeB) will land at the core of the EPC or 5GC network depending on the NSA/SA mode chosen.

The 3GPP standards (3rd Generation Partnership Project) define 2 options for 5G SA deployment:

- **Option 5: 5G SA- 5GC connected to LTE**: the 5GC core network is deployed but continues to use a 4G LTE access network updated. Most of the new 5G services require NR access, so this option seems unlikely.
- **Option2:5G-SA-5GC connected to NR**: this full 5G SA configuration allows operators to reach the full potential of 5G NR. This scenario for suitable for areas where there is no 4G network.



A progressive and incremental transformation

The migration from 5G NSA to 5G SA requires upgrading or replacing the existing network infrastructure, as well as introducing new software features and protocols to the network. Sometimes complex and time-consuming, this migration is nevertheless an opportunity to introduce new services on a more efficient and secure 5G network.

The migration from EPC (Evolved Packet Core) to 5GC (5G Core) is done in a progressive way by introducing the functionality of 5GC while maintaining existing EPC services. Most operators that have deployed their 5G network have done so with a 5G NSA architecture consisting of a new 5G RAN access and an EPC (4G) network core. Some others have already taken the step of the 5G SA by deploying a 5GC network core and have launched 5G services or are in trial phase with their suppliers.

With the 5G SA - 5GC the operator takes full advantage of the **enhanced mobile broadband (eMBB)** of 5G, **ultra-reliable low latency (URLLC) communications**, and **massive machine-like communications (mMTC) capabilities**. Moreover, the network slicing functionality provides the ability to create virtual networks with different features and Services Level Agreements (SLAs) with a high level of availability ensuring the continuity of service for customers.

This transformation is the essential condition to finally offer all the promises of 5G and enable the scaling up of new business models. Throughout the migration process, it is important to ensure that existing EPC-based 4G services are not affected. 5GC is built on a native cloud design to provide an agile, high-performance, scalable solution.

Private mobile networks towards 5G: An essential shift

Marouen ENNIGROU
Senior Project Manager Consultant, Sofrecom

In the field of industry and smart cities, a number of players are interested in private 5G. Globally, the private 5G market is rapidly expanding due to the rapid growth of industrial and commercial applications requiring high-quality connectivity and reduced latency. Private 5G offers dedicated, secure and flexible connectivity for businesses and industries, allowing them to enjoy 5G speed and reliability without having to connect to a public network.

&The main industries subject to the private 5G are automated factories, smart warehouses, intelligent transportation systems, health and medical care, mining, etc.

Let's take the time to understand what a private network is and how this network will technically contribute to the transformation of uses in the industry and in large public complexes (stations, airports, concert halls, etc.).

What is a private mobile network?

Private mobile networks[1] (PMN) are different than mobile networks open to the general public, and are used by companies (airports, stations, stadiums, motorways, etc.) and public services (local authorities, etc.) on a given geographical footprint (local, regional or national) for their critical and non-critical communications. These companies want their communications to pass through a high-performance network (in terms of quality of service, capacity, security and availability).

The origins of PMN: from narrowband PMR[2] to private 5G ...

PMN initially centered around Wifi and voice uses of PTT:

Up to the early 2010's, private networks were limited to **WIFI**, a wireless connectivity technology widely deployed in offices, but mostly to **narrowband PMR networks.**

Those networks rely on disparate technologies that have not evolved much (TETRA, DMR, etc.). These solutions have been very successful in the past but no longer meet the needs of today's users :

- They are generally limited to a PTT[3] (Push to talk) voice service of the walkie-talkie type, and sometimes a short messaging service;
- The number of enabled devices is limited;
- They are often expensive to maintain.

The rise of PMN with the arrival of 4G then 5G :

To meet new demands for high bandwidth multimedia services, the ecosystem has moved towards 4G and is now preparing to migrate to 5G.

As a matter of fact, 4G/5G technologies offer several advantages over narrowband PMR technologies:

- Service quality management (prioritization and preemption for the most critical flows)

[1] *PMN : Private/Professional Mobile Network (in french : Réseau Mobile Privée/Professionnel ou RMP)*
[2] *PMR : Private/Professional Mobile Radio*
[3] *PTT: Push To Talk - voice service to make a group call without the need to dial a number. Just press a button and talk to reach multiple predefined recipients simultaneously.*

- 3GPP standardized technologies
- Improved security of trade and infrastructure
- Management of Internet of Things communications (IoT is one of the challenges of industry 4.0)
- Reduction of costs because they are less expensive to maintain than legacy solutions

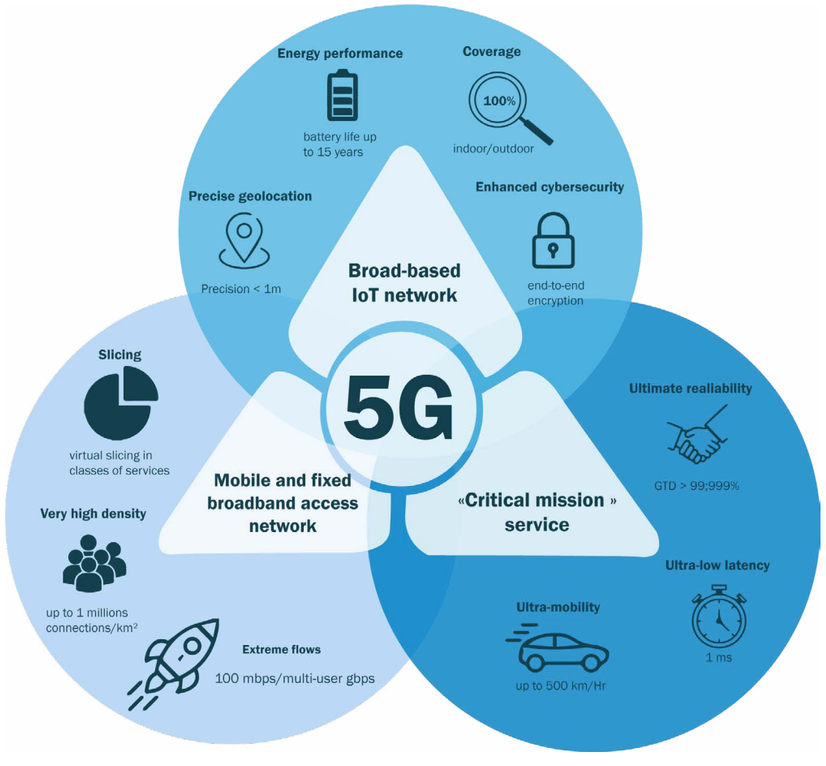
Each player seeking to enter the private mobile network market, alone or in partnership with other players, offers various solutions to meet the needs of companies and their uses. For example, Orange now offers companies, through its subsidiary Orange Business Services, its own range of “Mobile Private Networks” offers, with three different technical solutions (https://reseaux.orange-business.com/solutions/mobile-private-networks/):

- **Mobile Virtual Private Network**, a virtual private network using the Orange network. Radio access is managed by base stations deployed by Orange with guaranteed minimum bandwidth and customized coverage. The network core used also belongs to Orange.
- **Mobile hybrid Private Network**, a hybrid private network that relies on both Orange’s network equipment and customer-specific equipment on its site to maintain its data on campus.
- **Standalone Mobile Private Network**, a fully dedicated private network (including frequencies and core network) for the customer on their site.

Features and benefits of private 5G

5G technology represents a real opportunity for the private mobile network market. It was designed to address professional uses.

- A user with a 5G enabled device and a Mobile 5G offer could eventually benefit from a throughput of 10 Gbps in reception. Today, 5G (3.5 Ghz band) already allows to reach up to 1 Gbps of throughput in reception (up to 10 times more than 4G).
- The other benefit of 5G for businesses is responsiveness with latency (response time) that goes from 10 ms to 1 ms.
- The last major promise of 5G is the ultra-connectivity allowing a higher density of connected devices per km². The 5G will be able to support 1 million devices per km², a density of connection multiplied by 10 compared to 4G. 5G will allow the IoT market to continue to expand.



Network slicing to open new use cases

Unlike 4G, Private 5G allows you to benefit from the «E2E network slicing» functionality, which is the slicing of the end-to-end network.

On the same private 5G network, the "E2E network slicing" allows to create different classes of services to which **different priority levels** can be assigned to better meet the specific needs of certain uses (in terms of bandwidth, latency, etc.). In this way, it will be possible to keep a network slice for uses such as critical communications or a very high level of security.

Source : Nokia

Operators accelerating and investing in 5G Standalone

There are two modes in 5G: NSA mode (non standalone) and SA mode (standalone). The 5G NSA is the one that has been put into service in priority by the majority of operators all over the world in order to set it up quickly and limit investments. The main objective is to provide higher bandwidth than 4G. From an architecture point of view, the 5G NSA uses the same existing 4G network core, while the antennas are 5G.

However, the long-term purpose of 5G is “the transformation of industry, services and mobility that it aims to enable said [4]” In France, the deployment of the 5G SA began in 2023. The majority of operators all over the world are preoccupied by this transition to 5G SA because it involves transforming all components of the network including the core of the network. This important deployment will be progressive, incremental and time-consuming.

Regulators need to open more frequencies to meet the rising of 5G

The growth of the private mobile network market will be more important if access to dedicated frequency bands is facilitated by telecom regulators.

While it is possible for companies to meet part of their needs by subscribing to commercial mobile operators, the deployment of private mobile networks may require access to dedicated frequency bands for, for example, limiting the risk of interference or congestion. In France, ARCEP opened a frequency allocation window for 4G in 2019 for 2.6 Ghz band (band 38) in TDD mode (with a bandwidth of 2x20 Mhz). For access to 5G private networks, ARCEP offers the following bands:

- The band spectrum from 3.800 Ghz to 4.000 GHz (a 5G test window in this band is open by ARCEP until 31 December 2023[5])
- Millimeter bands: 26 GHz
- 2.6 Ghz TDD band, originally planned for 4G, could also be used for 5G

The development of private mobile networks on a 5G technology basis will better meet the growing need for connectivity from companies that have higher coverage, bandwidth and security requirements. This is the case, for example, for a company that has a large industrial campus and needs reliable and efficient connectivity both in-buildings and outdoor.

According to GlobeNewswire, the global market size of private 5G networks is expected to grow by more than 42.4% and reach a market value of around USD 31,589 million by 2030. The private 5G network is a real catalyst for the fourth industrial revolution and a necessary investment choice for companies and large institutions.

[4] Report of l’Académie des sciences, « Report on 5G and mobile communications networks »
5 https://www.arcep.fr/demarches-et-services/professionnels/transformation-numerique-des-entreprises/plateformes-experimentation-5g-bande-38-40-ghz.html

Conclusion

As most operators are undertaking network transformation to gradually move to 5G Stand Alone, there are many remaining questions about 5G deployment. 5G, the cornerstone of digital transformation and a new era of innovation, is a huge disruption for the world. Today, some business models seem to be taking shape, but many challenges remain.

Here are some of them :

- **High costs:** Building a 5G SA infrastructure is an expensive and complex process that requires significant investment from network operators, equipment manufacturers and governments. Therefore, defining new services and applications will drive economic growth and create new opportunities.

- **Security:** Security: Due to the highly distributed and highly scalable 5G, there are ongoing questions about technology security and data protection. The virtualization of telco network functions is transforming and reshaping the market. It highlights data protection and sovereignty issues for countries. As part of this context, setting up relevant regulations and standards is necessary to protect national interests while allowing its development.

- **Regional inequities:** 5G deployment is highly unequal between countries, creating a gap in coverage and connectivity in some markets, and this is one of the main reasons for the unevenness of 5G deployment in developing countries. To address these inequities, it is important to encourage equitable 5G rollout, ensuring that less developed countries have the needed resources and opportunities to deploy it effectively. This can include investments in infrastructure and qualified people as well as greater collaboration between governments, industry and international institutions.

- **Energy and environmental impact:** 5G, thanks to its features, can relieve the 4G network that has reached saturation in many areas. However, it can have a negative impact on environment, especially on energy consumption of new infrastructures (base stations, transmission towers,.). Some market players are undertaking new initiatives to improve the energy efficiency of these infrastructures. These include solarization models for stations and equipment standby functions during low traffic periods. For most players, the deployment of 5G must be sustainable and eco-responsible to reduce their environmental impact.

- **Interference:** 5G uses higher frequencies than previous networks, which can potentially introduce interferences with other radio systems, as well as other systems including navigation and public safety systems. However, these risks can usually be reduced by using suitable design and spectrum management technologies to avoid interference. Regulators, such as the International Telecommunications Union (ITU), are working to implement standards to help reduce these risks.

- **Standards:** 5G standards define the engineering specifications for radio frequencies, communication protocols, data rates, quality of service, security, and other key network features. Today, there remain compatibility issues between different devices and networks as 5G standardization is underway. Bringing together clear and universal 5G standards will enable easier broad-based delivery. They will also allow interoperability between different operators' networks.

In spite with these challenges, when well deployed, 5G can truly drive great benefits in many areas of our daily lives and work environment. We are at the dawn of a new era and can shape the future. It is up to innovation players across all sectors to continue to discover the 5G's potential to fully leverage it.

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Sofrecom, an Orange subsidiary, has developed over 50 years a unique know-how about operator businesses, making it a world leading specialist in telecommunications consultancy and engineering.

Its experience of mature and emerging markets, combined with its deep understanding of the structuring changes affecting the telecoms market make it a valued partner for operators, governments and international investors.

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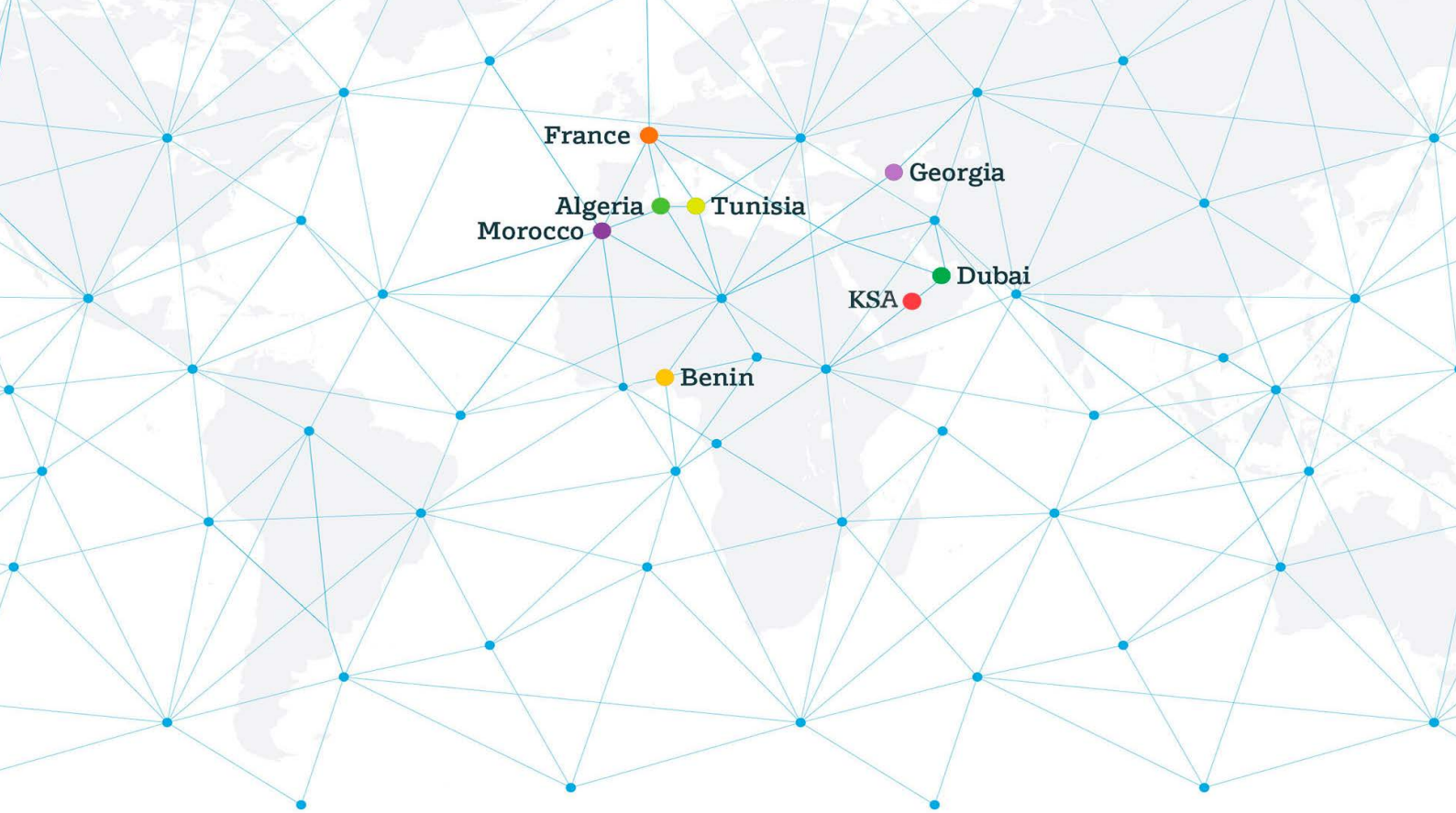
Edition
Printed in France on site Imprim'Vert - PEFC FSC Papier Creator Silk Blanc 135g et 250g



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