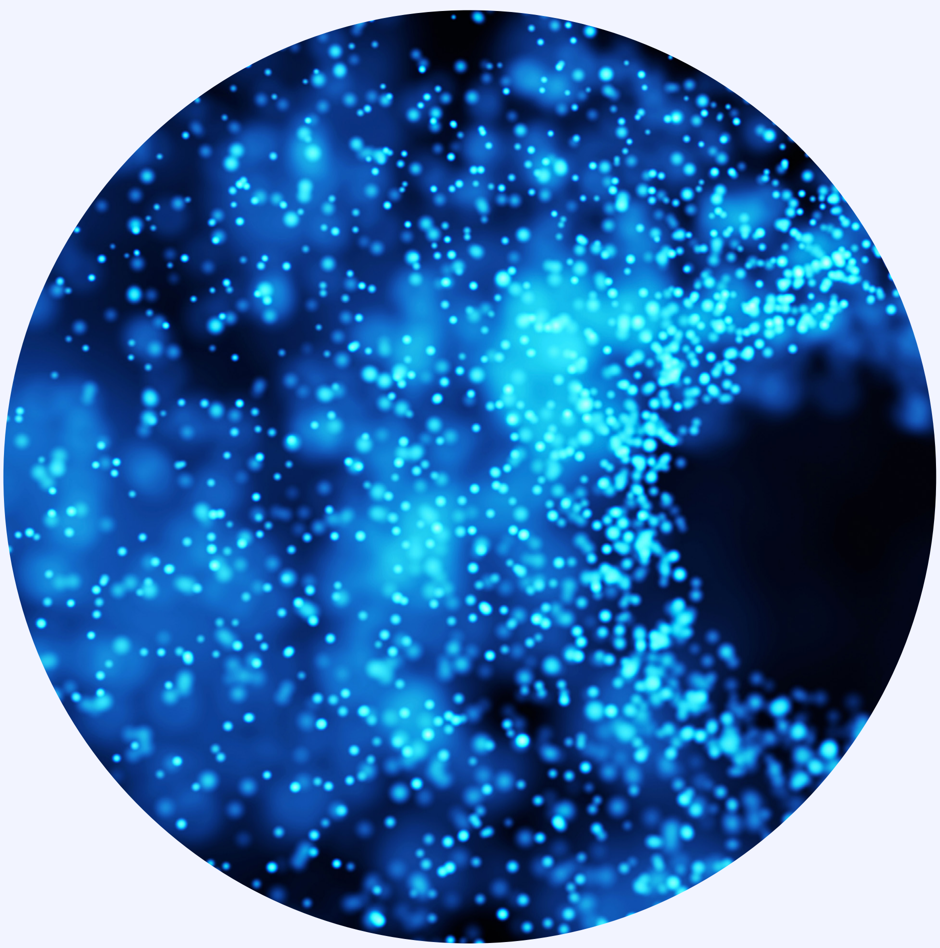
Telefónica

Mobile Technology Evolution Key Requirements

Continuous evolution vs "Gs" jumps



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As we all know, the technological evolution of mobile systems is of high relevance not only for operators or telco industry but for the whole society. Deploying the right technology that enables the most useful services for society, making possible the increase of sustainability for all industries and helping to close the digital divide are relevant tasks for the telco industry which counts on the technology progress of mobile communication systems. That is the reason why the importance of setting right requirements for the evolution of mobile networks while avoiding the generations ("Gs") gaps. It is about evolving incrementally network features to cope with commercial needs while defining the target system that enables the goals we pursue.

This document presents Telefónica's vision regarding the evolution toward future mobile communication systems. It outlines the fundamental principles underpinning this vision and proposes potential requirements to address the demands of emerging and enhanced services. This is not intended to be a comprehensive technical document, but rather an introductory overview of Telefónica's strategic perspective.

New generation or smooth evolution?

Telefónica believes it is more constructive to focus on the evolution toward future 3GPP Releases rather than discussing a future Generation in abstract terms. A Generation ("G") typically encompasses multiple 3GPP Releases (e.g., Rel 20, Rel 21, Rel 22). In today's rapidly evolving technological landscape, changes occur quickly and require swift time-to-market. The industry's shift toward software-defined networking enables shorter cycles for feature development, testing, and deployment. Talking about a future "G" creates a lot of promises and uncertainty about their delivery. Telefonica's preference would be to express our position about the benefits and expectations of future networks as a continuum, where releases (e.g. Rel 20) provide incrementally the solution for ever-changing market needs rather than trying to cover the lifespan of an entire "G". Moreover, incremental updates solve other challenges automatically, such as migration from the previous generation.

To make reading easier, we will continue with the "6G" naming along this document, although we mean a progressive evolution as just explained above.

Have we made the most of 5G?

5G mission is to evolve our communications, with faster throughput, low latency, and the capacity to handle a massive number of connected devices. 5G sparks innovation in the consumer market and especially in verticals such as automotive, industrial automation, smart cities and healthcare. However, 5G SA (Stand Alone) should have a bigger impact on society and commercially, 5G SA has capability to improve the commercial performance demonstrated till now with many more new use cases both for B2B and B2C segments.

The consequence, when analyzing 6G, is that there are not enough insights or lessons learnt to make it easier to define requirements for a future Generation.

Mobile communications are essential for society. 5G aims to contribute to the digital transformation, and network capabilities are growing and expanding. 5G SA capabilities are being deployed on networks. On top of that, there are further releases between 5G and 6G that are adding capabilities and enhancements to 5G. 5G Advanced, that starts from Rel 18, is emerging, and as it happened in LTE with LTE Advanced, 5G Advanced capabilities will be added progressively to our networks to make the most of the existing deployed infrastructure, Still, the lessons learnt from deployment, usage and operation of 5G SA and 5G Advanced networks (e.g. high amount of migration options and system complexity) need to be considered to ensure that 6G evolves smoothly and is able to support continuous updates and innovation.

Why another evolution of mobile systems?

6G will support society progress in many ways, including sustainability, economic and environmental aspects. In addition to new 6G use cases and services, other considerations are needed, e.g. interworking with legacy generations, migration from 5G, CAPEX/OPEX reduction, improvement of end-to-end system performance, and more importantly, the need to provide additional value and usefulness to the society and additional revenues to the Telecom Industry being extremely efficient in the use of spectrum, economic and environmental resources.

This document intends to define this evolutionary path attending all expected requirements of enhancements and new features needed for the next generation of global telecommunication services, pointing at requirements and high-level principles to be supported on top of 5G systems.

The document is organized by technical layers and subjects and, as said before, it is not a detailed technical document.

Radio Access Network aspects

The evolution of radio network capabilities is fundamental to mobile system advancement, as it largely determines the system's overall performance, capabilities, and cost structure.

Normally, an increase in performance is requested in terms of capacity, user experience and coverage. Of course, 6G should increase these capabilities from 5G but we should take into account several aspects of this. Primarily, what serves as our basis for comparison. 5G has evolved (and is evolving towards 5G Advanced) so the performance of 5G is a moving target. In our opinion the base of comparison should be the capabilities and performance of 5G radio defined in 3GPP Rel 18 (5G Advanced).

A single architecture that supports stand-alone operation only is needed to facilitate the migration from 5G and reduce network complexity. Another relevant aspect is that 6G should be modular in its implementation. 6G should not mean directly a 5G RAN hardware refresh; in fact, HW upgrade and update will be required as in previous investment cycles because of end of life, adding new capabilities, etc., and existing infrastructure should be maintained and upgraded via SW. Single RAN principles of 4G and 5G should be present and be a must for developing 6G by the ecosystem. Flexibility is the key.

Some of the services to be provided by cellular network will have specific requirements that will be impossible to provide to all the customers. Clear mechanisms to provide special services (through prioritization or any other means that respects net neutrality regulation) should be part of the standard. These capabilities should be built on top of what is already included in 5G SA standard.

Apart from performance, openness will be another key element. 6G radio should follow the Open RAN principles, allowing elements of the RAN to be sourced from different suppliers and implemented based on O-RAN Alliance interfaces. Additionally, cloudification in 6G RAN should allow bringing all cloud-native principles to the RAN, benefiting for higher scalability, portability and greater automation, which allows to introduce further innovation in the RAN.

In addition to these general considerations, you can find more detailed requirements for the radio below.

Spectrum

- Spectrum considerations are paramount for any evolution of the radio standard. Greater flexibility in the usage of the spectrum with the introduction of new spectrum bands covering wider channel bandwidths (in excess of the up to 400 MHz supported by 5G) and higher spectrum efficiency are needed to deliver extreme performance and use cases:
- Full allocation of the upper 6 GHz band for mobile networks is essential to make 6G a success in Europe.
- FR3 (Frequency Range 3: 7.10 GHz to 24.25 GHz) should be considered in 6G standard (and even for 5G Advanced) including the enablement of new radio technologies and protocols to efficiently utilize FR3 bands, addressing challenges such as high path loss and atmospheric absorption.
- Standardization of protocols for coordination and coexistence between 6G networks and other FR3 spectrum users to minimize interference and maximize overall spectrum efficiency.
- Utilization of higher frequency bands, including terahertz spectrum, will be critical for specific use cases in 6G RAN. Standardization efforts should focus on overcoming propagation challenges and developing suitable hardware for terahertz communications.
- Enhanced spectrum aggregation mechanisms such as 6G CA (carrier aggregation) to provide high throughput on 6G from day one.
- Highly efficient multi-RAT spectrum sharing (MRSS) between 5G and 6G should be implemented to provide all 6G benefits and wide area coverage from the start.
- Sharing spectrum in 6G with other services such as satellites, radio links or military networks is technically feasible and presents several potential benefits, such as more efficient use of spectrum and potential cost reduction. However, interference management represents the primary technical challenge that must be addressed. Interference management technologies, such as cognitive spectrum sensing and dynamic spectrum allocation, can help mitigate this problem. These mechanisms must be complemented by clear regulatory frameworks and standardized protocols for inter-service coordination.
- Increase spectrum efficiency by native in-band full-duplex. 6G system should provide full-duplex capability for FR1, FR2 & FR3 to utilize existing and new spectrum the best way for better customer experience and new use cases, coming with efficient techniques to overcome current challenges of in-band full-duplex.

New air interface

Clearly some of the improvements in performance may be found by the change of the air interface. New waveforms could be used for the 6G radio interface, and this should be explored. Particular weaknesses of OFDM might be overcome by better suited waveforms. Additionally, some enhancements to the existing protocols as well as the processing technologies must be explored to efficiently manage the heavy data traffic generated in the air interface.

Reconfigurable Intelligent Surfaces

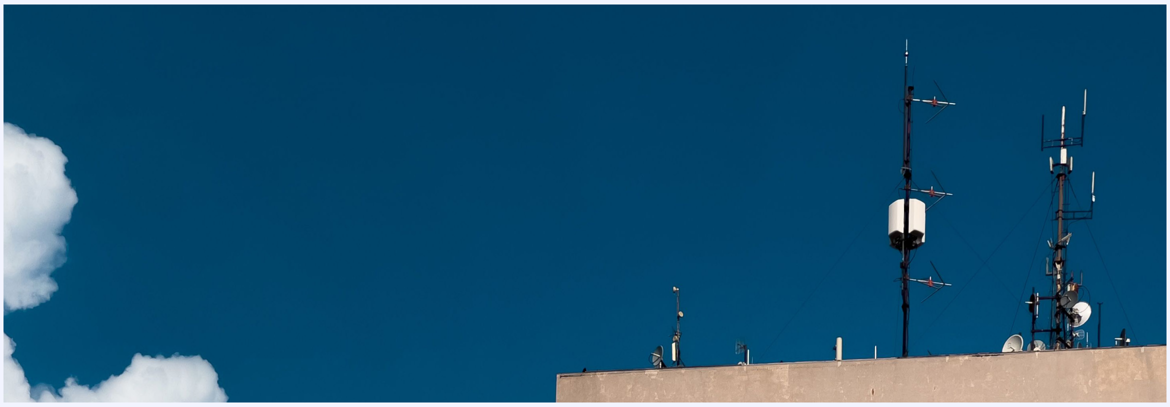
- Integration of Reconfigurable Intelligent Surfaces (RIS) in 6G RAN architecture.
- RIS should be standardized as a key component of 6G RAN to improve coverage, capacity, and energy efficiency in specific scenarios.

Advanced Antenna Technologies

- Support for ultra-massive MIMO and holographic MIMO.
- Standardization efforts should focus on enabling these advanced antenna technologies while ensuring backward compatibility for improving coverage and capacity.
- The silicon and chipset industries should explore new technologies and design processes to deliver high performance, high efficiency components that will be used in a significantly reduced footprint due to the large bandwidths and high frequency bands.

Cell-free Massive MIMO Evolution

- Evolution from traditional cell-based to cell-free massive MIMO architectures.
- Cell-free massive MIMO should be supported in 6G standards to enhance spectral efficiency and user experience.



AI/ML Integration in RAN

- Deep integration of AI/ML capabilities within RAN functions (including the air interface).
- AI technology as a key element in 6G, for network automation and improving performance of RAN network.
- Standardization of AI/ML should focus on models and interfaces for RAN functions implementation (e.g. adaptive beam management), optimization, planning or predictive maintenance.

Ultra-dense Network Support

- 6G RAN architecture should support ultra-dense deployments, including simplified management and self-organization capabilities.
- Standardization of new LPWA protocols for IoT devices, enabling longer battery life, energy-harvesting integration, and adaptive transmission power control.
- Continuous harmonization of IoT standards under a 6G-native IoT architecture, ensuring backward compatibility while introducing AI-driven resource allocation.

3D Network Architecture

6G RAN should provide seamless integration and management of multi-layer networks, including standardized interfaces between different network types (terrestrial, aerial and satellite) in order to enable connectivity of services for end users.

Mobility between Cellular and WiFi

6G should support dual connectivity with evolved WiFi networks and support seamless mobility with non 3GPP networks.

Energy Efficiency and Sustainability

- Implementation of enhanced energy-saving features, efficient radio solutions and support for sustainable operations.
- Energy efficiency metrics and sustainability features should be essential requirements in 6G RAN standardization.

Integrated Sensing and Communication

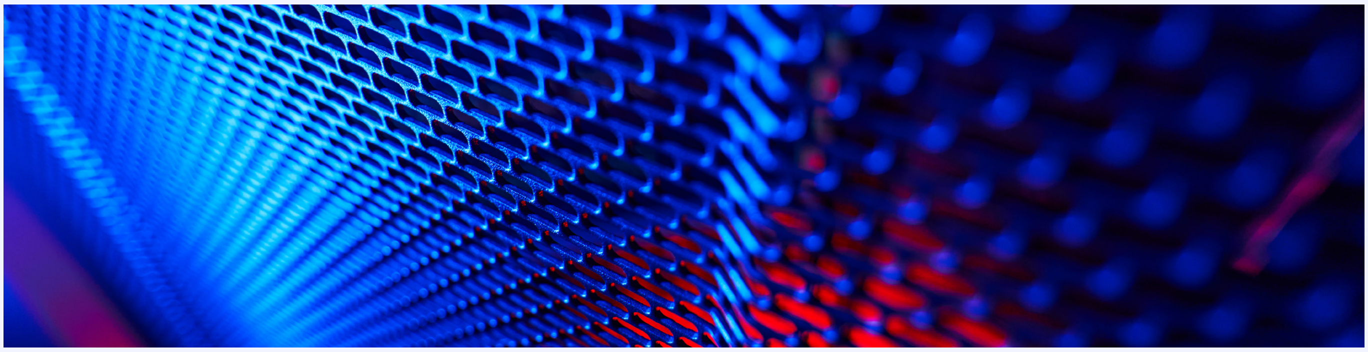
Standardization protocols and interfaces to support ISAC should be included in 6G RAN.

Ultra-high Accuracy Positioning

6G standardization shall offer different AI supported SW based methods to reach centimeter/millimeter location accuracy, without the need of additional specific hardware at RAN site.

Technologies to enhance RAN infrastructure Sharing

RAN Sharing should be considered in a future generation, including trusted data storage and secure sharing. With the expansion of RAN infrastructure sharing, it is necessary to consider distributed AI technologies, such as Federated Learning to satisfy the needs of multi-party cooperative computing between operators' RAN networks.



Core Network aspects

6G core network should evolve from 5G SA core. This evolution should be smooth and justified by the need of new services and use cases hiding from any additional complexity. SBA architecture should be preserved.

Network Slicing

As stated, when analyzing the RAN evolution, providing differential connectivity to satisfy specialized services and additional customer demands is critical. The capabilities to provide differentiation in 6G should be enhanced compared with what it is available in 5G SA. In our opinion, slicing and its evolution should be the way to support differential connectivity required by new use cases.

SBA architecture enhancement

The complete revolution that represented the implementation of SBA architecture have consumed a tremendous effort in our industry. Simplification or enhancement of the core should not mean rebuilding SBA capabilities and its concepts.

SBA should become the network control layer of capabilities across multi domain and technology accesses, core, IA, etc. SBA enhancement should not involve a re-deployment of core network but should be achievable through simple upgrades.

Cloud Nativeness for Life Cycle Management Automation

Automation is a need to increase efficiency and quality of our networks. In the case of the core network, it is key the automation of the life cycle management taking advantage of the cloud native paradigms bringing automation as the implementation CI CD CT pipelines and In-Service Software Upgrades (ISSU) for CNFs.

Platforms and architecture should be able to run over multi cloud environment providing same level of automation. There is a need of Standards for the Infrastructure stack, which will allow this multicloud environment, without spending tireless efforts on certification and deployment. Maybe Open Source Organizations (e.g. Linux Foundation) should address this task.

Richer interfaces between SW&HW

Decoupling SW and HW gave us the flexibility to start multi cloud approach. However, industry objectives in term of AI and energy efficiency require a tight collaboration between layers (e.g. workload, power consumption information to be visible at the platform/SW layer).

Architectural evolution requires richer interfaces between infra and others platform layers in order to thrive in implementing IA and offering sustainable systems.

New form factors

Distribution of the user plane on the edge and far edge (on premises) requires new form factors for the HW which are proprietary up to now. There is a need for the industry to standardize this type of infrastructure in order to have a single/common standard automation framework controlling the SW-HW life cycle.

Market driven for deep changes

Very complicated features and changes in the specifications should only be allowed when there is a clear market demand or driver. Making very complicated and expensive changes which are not requested by the market and does not have an investment return should be avoided.

Scaling to hundreds of Core Nodes

Today a medium size core network is composed of 10s of nodes. 5G massification and 6G introduction will require more and more user plane distribution and our core will have to support 100s of nodes.

Whilst the existing architecture allows to grow in scale, more standardization work is needed (e.g. native support of inventories). We need to ensure the best user plane performance for standard form factors allowing bigger scales (e.g. many form factors on customer premises deployments are proprietary).

Mobile Networks will support more and more critical services

Mobile network will support critical services for different industries including public safety usage. Solutions, to satisfy very high network availability requirements are needed. 99,9999% availability is already a requirement in some industries and our network architecture and capabilities need to meet this objective.

Network connectivity shall be tailored and granted based on applications needs. This requires mechanisms to identify applications meanwhile maintaining user privacy. This also requires the ability for the network to receive connectivity requirements from the different applications through meta data exchange or other means.

Core IA and network visibility

Whilst the NWDAF has been thought to perform initial IA use cases in 5G, its concept has to be reinforced in 6G ensuring a native exposure of network information from all network components to satisfy operational use case but also define relevant information that could be exposed for network monetization.

Network real time information

KPIs (e.g. "E2E average user latency", jitter, etc) available at service level (to SBA NFs) can enrich every decision made by NFs. In this sense, KPI analysis could allow a better assignation of UPFs by SMF, or allow/deny specific services when the value of these KPIs is beyond a certain threshold. These KPIs can also be included in NWDAF analysis, to enable intelligent decisions.

IMS-DC (Data Channel)

Communication capabilities will continue to be part of mobile network. To satisfy the requirements of new communications services (e.g. New Calling, XR / Holographic / Immersive communications, IA based assistant, etc.) IMS Data Channel should be native in 6G, to ease the adoption of services supported by this new technology.

There is a risk that, without IMS-DC, communication services will be limited to Voice as a regulated service.

IMS Data channel must be supported by the all ecosystem (network, devices, diallers etc..) if mobile industry wishes to guarantee universality of future communication services.

Device aspects

Devices are a key part of a mobile network. Cooperation between devices and network is needed to provide the right performance in an efficient way.

Device Management improvement

Device configuration and feature activation is currently a clear limitation in time to market when launching new services (as experienced in the launch of VoLTE services). This should be solved in 6G including standardized mechanisms to activate features in a simpler way including reducing the degree of optionality. For instance, URSP provisioning rules and management, the degree of optionality gives little flexibility in launching new services with a fast time to market.

6G should offer better capabilities in terms of device management and the level of mandatory features should be enough to allow the launch of key services in an adequate time to market.

New services

Network services must be device platform agnostic. Since these services must be offered to all customers in the network; it is requested that these services were available to developers so that they can create exceptional experiences on them.

Secure IMEI and SVN

IMEI shall be based on certificates issued by a recognized authority (e.g. GSMA), ensuring it cannot be forged and that it accurately identifies the specific device model.

Regarding the SVN (Software Version Number), It must reliably identify the firmware version. Currently it is limited to only two digits, which is clearly insufficient to cover the wide range of firmware versions available across countries, models, and maintenance releases. As a recommendation, SVN could be replaced with a UUID-type string to provide a more scalable identifier.

Facing new form factors

The smartphone, as we know it today, will not be the main device type, as the technology is evolving, allowing many different form factors, that have to be considered in the definition of new specifications and requirements, including "body worn devices" (in the user's arm, hand or even the brain- BMI/BCI (Brain Machine/Computer Interface), etc.) or passive IoT devices.

Also, with AI matureness, the way we interact with the devices will change completely, affecting screen sizes (that will probably reduce).

Accessible services

This is not only a matter of being compliant with each local regulation, but to consider accessibility in every device, service and application, from design, to ensure it is completely embedded, and not an extra addition at the end of the process/ funnel.

Device components traceability

It could be useful to use new tools like blockchain (for example) for fully track the device components. This could help a lot on post-sales events.

Next generation media formats

New media format adoption is really slow by SDOs, and this situation is placing an extra burden to operator networks. A faster adoption of next generation voice and video codecs is a must, especially if we want to be able to face the new use cases that are coming. These next generation video-codecs are more efficient not only in data transmission, but also in energy consumption.

General System and Operational Aspects

System and Operational Aspects are those that facilitate system and network operation features that underpin overall operation, covering aspects that apply across use cases and services, and those that relate to network operations. These aspects include, for example: migration scenarios, interworking with earlier Generations, interworking with non-3GPP systems, roaming and interconnection, network simplification, network sharing, security, resilience, sustainability and energy efficiency, device diversity, support of legacy services or charging.

Intelligent autonomous networking

The implementation of 5G networks, where there is a large number of interconnected elements and devices, resulted in a new way of operating networks, in a more automatic and autonomous manner. In future 6G standards, the progress and learning achieved must continue. Telefónica must continue its goal of developing more autonomous, zero-touch networks and implementing use cases based on AI techniques in all network operation processes. The emergence of new services like slicing should apply this learning and new achievements during their operation.

The operation of 6G networks should enhance the use of ML/AI capabilities, increasing the visibility of elements and applying closed-loops for incident resolution. It should also be service-oriented, with an end-to-end (E2E) vision that allows for analyzing where the fault is in the entire lifecycle, rather than monitoring elements one by one.

Some considerations to achieve more intelligent and autonomous networks within 6G standards:

Usage of AI/ML in the processes

6G should enable intelligent network operations by applying AI/ML techniques and the AI-assisted optimization of processes.

Especially relevant are the aspects of collection of data from the network for AI transversal processes to work with them in the automation of the network.

Multidomain operations

Networks should be able to know the status of other domains and have a complete vision at the same time.

Alarm correlation and incident monitoring should be easy with this full E2E vision of the domains.

Service-oriented vision in networks and processes

Operating the networks with a focus on the service. The number of elements (NF and OSS) will increase, making it difficult to monitor them individually so E2E vision and simplification are key. This should be achieved by the service-oriented vision that will also enhance the customer experience and the quality of services offered by the 6G standards.

Auto management and self-healing

Networks should have capabilities for auto-management, auto-discovery, and self-healing. Auto operation will improve the autonomy of the networks with less human interaction and uninterrupted services.

Implementing Closed-loops in networks

The 6G standard should help implement use cases where closed loops can be applied. The integration between orchestrators and network elements must comply with the development of closed loops to increase the autonomy and automation of future networks.

Network Digital Twin

The usage of digital twins should be generalized in 6G. Again, the collection of data from the network to be replicated in the digital twin with the needed level of detail is something that need to be solved. Standardization of data models and collection processes are needed. Especially relevant is the detailed simulation of network nodes. Clearly some processes, such as planning and operation, should be simulated using Digital Twins. This will help to have a full vision of the network and analyze different behaviors.

Security Aspects (privacy, trust, resilience)

6G system security architecture will be designed for openness. As 6G is intended to be a more open network than 5G, the line between inside and outside the network will become progressively thinner. As a result, current network security measures, such as IPsec and firewalls, will not be powerful enough to protect the network from outside intruders.

6G security architecture should support the basic security concept of Zero Trust Architecture (ZTA) in the mobile communication network to help with this issue. Zero trust architecture (ZTA) is a security architecture that uses the Zero Trust concept and comprises relationships between network entities (NEs), protocol processes, and access rules So, ZTA should be the foundation of 6G security architecture.

In addition to ZTA and different security enablers, there are several key points 6G can start working on:

- Physical layer security
- Encryption and anonymization
- AI and machine learning for security
- Quantum-safe security
- Comprehensive security standardization under the principle, security by design
- Users' Privacy-preserving
- User awareness and education

Quantum Computing challenges and opportunities

Quantum computing threats for security are likely to be materialized in the life of 6G networks so 6G should be designed as quantum safe. This is a challenge but also an opportunity to enhance security and being able to offer more security services. For instance, QKD and postquantum security as a service, if these elements are already integrated in 6G network.

Sustainability and Energy Efficiency

In the development and deployment of the 6G network, energy efficiency must be regarded as a fundamental priority due to the significant increase in the number of connected devices and the rising demand for data.

The transition from 4G to 5G has already brought substantial improvements in energy efficiency. With 6G, we the target should be at least doubling energy efficiency compared to 5G, while also supporting ten times the capacity. Additionally, energy consumption is expected to be nearly zero when there is no traffic at a given node. Therefore, unlike previous technologies, one of the key objectives of 6G is to ensure sustainability from its initial design, rather than developing the network and subsequently attempting to enhance its efficiency and environmental impact. Consequently, several aspects must be addressed from the outset of its design and development. Some of the most pertinent considerations for achieving efficient development in terms of energy consumption include the following:

Intelligent traffic and network resource management

Dynamic component deactivation: following the approach of 5G networks, "Power Saving Features" should be implemented in nodes and base stations to reduce energy consumption when not in use, activating only when there is demand.

Artificial Intelligence for energy usage optimization: Artificial Intelligence (AI) and machine learning should be utilized to optimize the network's energy consumption by dynamically adjusting the distribution of network resources according to real-time traffic conditions.

AI-managed networks can be autonomous, optimizing network configuration and dynamically adjusting energy consumption based on user demand, contributing to greater efficiency.

Minimizing the carbon footprint over the lifecycle

Sustainable device lifecycle: Ensuring that the carbon footprint throughout the lifecycle of devices (from manufacturing to recycling) is minimized.

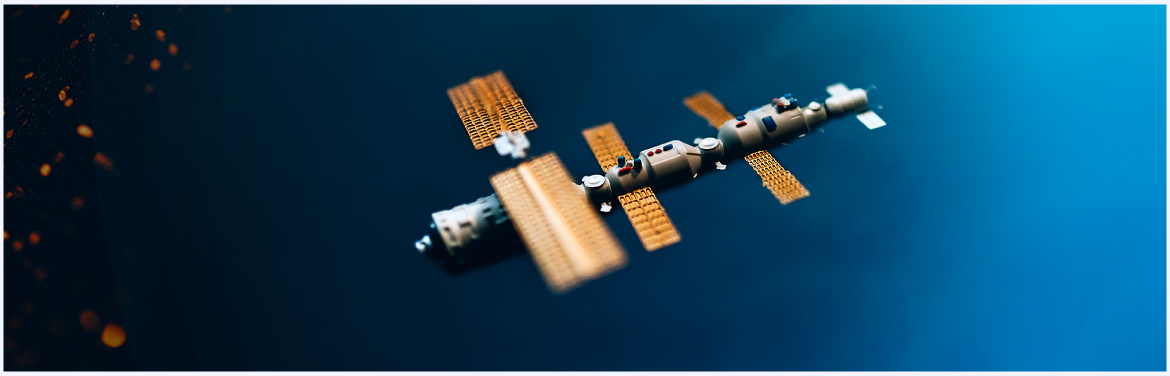
Optimized software for Energy Efficiency: the development of energy-aware applications and services will be crucial to avoid waste and ensure that applications are energy-efficient.

Other relevant aspects

Employing more efficient modulation and coding in the design and operation of 6G to enhance adaptability and energy management.

Utilizing more efficient transmission technologies than those employed in previous networks.

"zero-energy (ZEDs) devices”: Low-cost, resource-constrained, maintenance-free, and energy-harvesting (EH) Internet of Things (IoT) devices.



Ubiquitous Connectivity

Ubiquitous Connectivity is intended to enhance connectivity to uncovered or scarcely covered areas, particularly rural, remote and sparsely populated areas, and indoor connectivity. This includes Satellite communications.

Non-Terrestrial Networks (NTN)

Progressive developments in the satellite industry have made it possible to consider GSO and NGSO satellites and constellations as a complement to terrestrial mobile networks for low density scenarios, not only for traditional backhauling applications but also to provide access services (IoT and voice/broadband) using different types of architectures and frequency bands. Besides public mobile network mobile application scenarios, non-terrestrial networks bring also potential to extend the reach of terrestrial mobile services in vertical-oriented applications, in relevant sectors (also part of the 6G focus) as public safety, transportation/aero/maritime, agriculture, drone applications, etc. In addition to satellite systems in different orbits/ architectures, other non-terrestrial solutions as HAPs are also developing offering in longer term the potential to address also specific use cases, bringing additional options to complement.

Therefore, non-terrestrial networks can be seen as key element to address ubiquitous connectivity targets in the 6G era, especially in low-density outdoor applications. As main considerations:

- Full integration of NTNs from early 6G definitions should be considered, maximizing similarity with 6G terrestrial network definitions instead of adaptations and particularizations for integration, as it was the case in 5G. NTN should be considered when designing and specifying the 6G radio protocols targeting common sets of specifications whenever possible (non-terrestrial operation pose specific challenges), favoring support in components as 6G baseband and UE chipsets and simplifying seamless integration.
- In parallel, the development of standard specifications for devices aiming at transport-like applications (e.g., backhauling) as interoperable universal modems with active steerable antennas and multi-band support, commoditizing NTN commu-

nication terminals can have a large positive impact in adoption of complementary NTN solutions.

- Focus should be put on achieving global harmonized spectrum definitions for 6G NTN, with flexibility to accommodate flexible operational models between space companies and network operators, with a common definition of bands (low-mid-high) that provide the necessary flexibility to address different application scenarios, while developing the necessary framework and specifications to ensure co-existence, tight integration and no impact between non-terrestrial and terrestrial segments.
- 6G NTN architectural definitions need to focus on the flexible integration with the terrestrial network of multiple layers of interoperable NTN systems, with the additional complexity of addressing multi-tenancy scenarios. Seamless integration between multiple GSO/NGSO/HAP NTN solutions and terrestrial networks (3D-network concept) needs to be set as a target, ensuring a flexible and dynamic service orchestration of SLA-backed services complementing and in coordination with terrestrial networks.

Network Exposure Capabilities

Open Gateway led by the GSMA has defined a new paradigm for creating customer value on top of network capabilities. While CAMARA is defining the set of Service APIs to external consumers (developers), key 3GPP network functions should define north bound exposure capabilities, through simple and open APIs.

Demand from aggregators, developers and B2B customers should be taken into account when developing service APIs to external parties; in turn, APIs of network elements should inherit the corresponding service requirements.

6G Services

6G Voice

6G voice definition will be paramount for 6G. Basic voice service should be supported with enhanced user experience features, such as stereo sound. Key KPIs like "call set up time" should be improved compared to 5G.

Voice shall be supported in 6G from day-1. The industry has observed a continuous decline of voice traffic year over year in mobile network. This makes it challenging for operators and manufacturers to keep on investing in this service. Commitment to support voice in 6G must be made by all the industry to support new communication use cases enabled by IMS DC.

6G Roaming

Roaming technical implementation should be defined by the standards from the initial point of 6G technology. It should be taken into account that roaming capabilities are not only used international roaming but also for national roaming agreements what means that national roaming will be use likely before international roaming and is needed from an early stage.

XR services

Future XR communication services will be enabled by 6G. These means that some enablers should be standardized taking these services in considerations. For instance, IMS Data Channel and slicing will be used by these services.

Gen AI and immersive contents

New type of contents will be generated by Gen IA and for immersive experience. The volume of data generated, and latency requirements will drive demand for edge computing in 6G networks.

Industrial networking

We consider that industrial networking will be deliver by private 6G networks. Today 5G covers manyindustrial requirements but not all. Standardization of 6G should take this into account widening the scope of services that private network can provide for industrial customers.

Ambient IoT

Ambient IoT (IoT devices that can obtain energy from the environment) could mean extending the usage of IoT for applications that today cannot make use of this technology. 6G should include ambient IoT as feature to be standardized.

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