White Paper

The Path to 6G



RADCOM

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6G is expected to accelerate the mobile AI-powered era, which is just beginning. Analysts expect a substantial increase in data usage over the next five years. At the same time, operators must reduce operating costs and continually improve the customer experience in increasingly complex networks.

6G will offer even greater capacities, faster speeds, and system throughput than 5G, by an order of magnitude. If the move to 5G-Advanced takes us to around 20Gbps, with 6G we can expect speeds of about 100Gbps, and some anticipate reaching 1Tbps.

However, it will also demand higher levels of observability, flexibility, and automation. **Observability will be critical for end-user experience,** network usage, and granular network management in a more complex infrastructure, with AI capabilities integrated into use cases such as optimizing network performance, detecting security threats, planning capacity, isolating faults and troubleshooting.

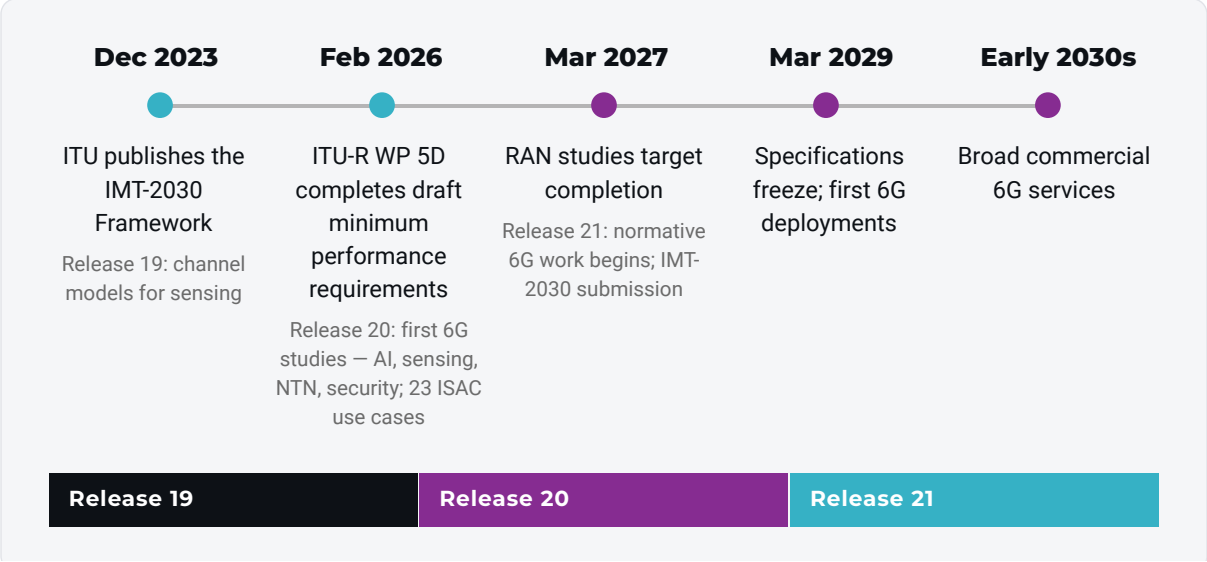
This white paper examines the main pillars of 6G networks. It discusses capabilities intended to augment future mobile communications, as well as key performance indicators. In particular, it urges a rethink of resilience that will prioritize adaptation and recovery as operators adopt 6G in an AI-enabled world.

What is 6G?

In December 2023, the International Telecommunication Union* (ITU) published a framework for developing standards and radio interfaces for 6G as part of its International Mobile Telecommunications strategy (IMT-2030) – see the timeline below. The proposed radio interface technology will make greater use of distributed RAN and terahertz (THz) spectrum to increase capacity, lower latency, and use spectrum much more efficiently through a number of mechanisms. The 3rd Generation Partnership Project (3GPP), a collaboration among telecom standards organizations, works closely with the ITU-Radiocommunications Sector Working Party (ITU-R WP) 5D to translate IMT requirements into detailed technical specifications and standards. **This** working party is responsible for the overall radio system aspects of the terrestrial component of IMT. Organizations worldwide are working on various aspects of 6G technology and sharing their research – see below.

*Source: ITU https://www.itu.int/en/ITU-R/study-groups/rsg5/rwp5d/imt-2030/Pages/default.aspx

Figure 1. The road to 6G: standards timeline



Sources: ITU IMT-2030; 3GPP Releases 19 to 21.

It takes a global community to raise a standard

There are many parties* around the world working on various aspects of 6G. They include:

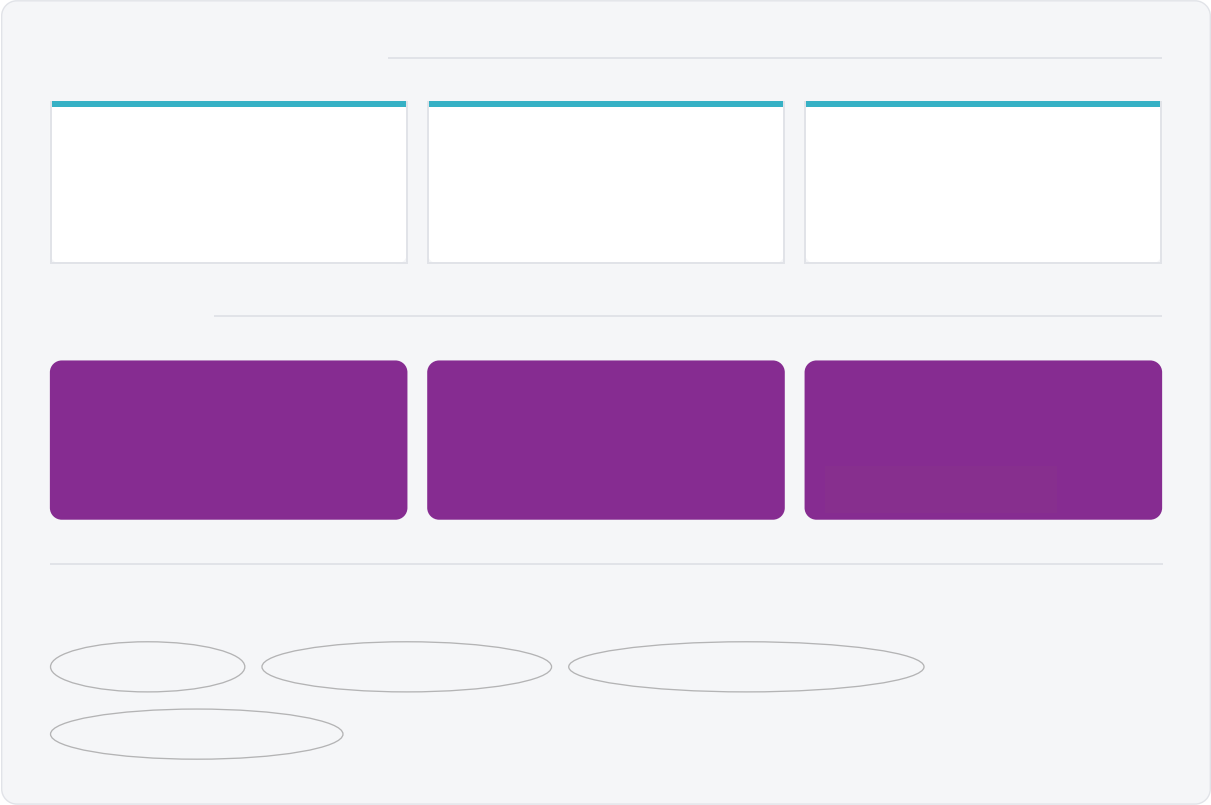
- The University of Oulu in Finland with the government-backed, Finnish 6G Flagship initiative
- The European Union's Hexa-X consortium led by Nokia
- China's Ministry of Industry and Information Technology
- The US Federal Communications Commission made 6G spectrum available in 2020 to universities and industry
- South Korea's Electronics and Telecommunications Research Institute is researching the THz frequency band for 6G
- ETSI's Industry Specification Group (ISG) on Multiple Access Techniques (MAT), alongside its published standards work on cybersecurity for AI systems
- Institute of Science Tokyo in Japan, where a phased-array antenna-in-package module has demonstrated 144 Gbps in the 150 GHz sub-terahertz band
- Shield-6G, an €8m EU Horizon Europe project led by University College Dublin, tasked with setting foundational 6G security, reliability and resilience guidelines
- The US National Telecommunications and Information Administration, which is studying the 4.4 GHz and 7.125-7.4 GHz bands for commercial 6G use
- The GSMA 6G Community and the Next Generation Mobile Networks (NGMN) Alliance, working on data frameworks, cloud-native architecture, and reducing operational complexity in the 6G transition

*This list is not intended to be exhaustive.

6G’s key characteristics

6G’s capabilities are best understood through the six usage scenarios in the ITU’s IMT-2030 framework. Three carry over from 5G: immersive communication, massive communication, and hyper-reliable low-latency communication. The ones that are new include ubiquitous connectivity, AI and communication, and integrated sensing and communication (ISAC). Four design principles run across all six: sustainability, security and resilience, connecting the unconnected, and ubiquitous intelligence.

Figure 2. The six IMT-2030 usage scenarios



Headline speeds and latency figures are therefore key performance indicators within these scenarios rather than the story in themselves. ITU-R Working Party 5D completed the draft minimum performance requirements for IMT-2030 radio interfaces in February 2026.

Figure 3. 4G, 5G and 6G compared



Sources: Recommendation ITU-R M.2160 (ITU, November 2023); ITU-R WP 5D, February 2026.

What changes with 6G?

Spectrum expands upward: near-term focus shifts to the 7–24 GHz upper mid-band, with sub-terahertz spectrum expected later for extreme capacity and sensing.

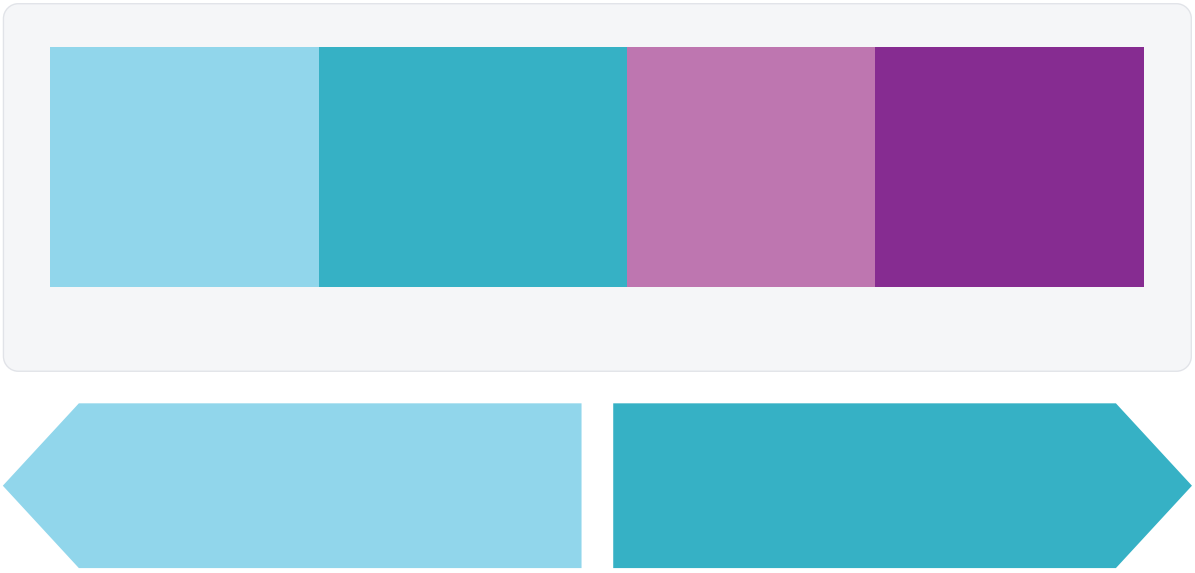
Latency moves toward microseconds: IMT-2030 targets roughly 100 microseconds to 1 millisecond, with sub-100-microsecond operation remaining a longer-term research objective.

AI becomes native to network operation: dynamic scheduling, observability, and automation move from supporting tools to core design principles.

Just as 5G networks can use higher frequencies than 4G, giving them greater capacity over shorter distances, 6G can go even higher. 5G's high-frequency use is called millimeter-wave, or mmWave. For 6G, the near-term focus is the upper mid-

band – roughly 7–24 GHz, and 7–15 GHz in particular – which balances coverage with additional capacity. Sub-terahertz spectrum of roughly 100–300 GHz is expected to follow in a later phase, for extreme capacity and sensing rather than mass-market coverage. **Higher frequencies allow wider channels and faster sampling and, therefore, greater transmission speed and throughput.**

Figure 4. The spectrum ladder, 4G to 6G



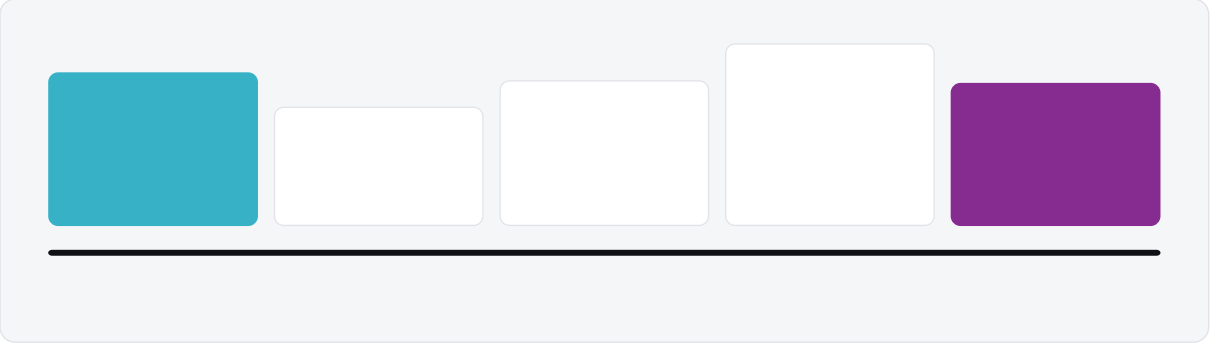
6G's air-interface latency is not yet settled: IMT-2030 sets a target range of roughly 100 microseconds to 1 millisecond, with sub-100-microsecond operation treated as a longer-term research objective. 5G aims for low single-digit-millisecond latency, and the typical latency for a 4G network is between 30 and 50 milliseconds. 6G will also add a capability no previous generation has offered: the network itself can sense its surroundings, using radio signals to detect, locate and track objects. This is expected to enable applications involving imaging, presence technology, and location awareness, ranging from production lines to public safety and beyond.

Up to
10X

The latency improvement 6G targets against 5G's 1-millisecond benchmark, with IMT-2030 aiming at 100 microseconds to 1 millisecond.

> “Humans can perceive a lag as short as 13 milliseconds for visual stimuli. For a voice call, a sub-50ms lag makes the call feel natural; communication becomes untenable when you get up to around 150ms. For other 5G low-latency applications, like when you need actual physical, haptic feedback, a 50ms lag is an eternity.”
>
> T-Mobile for Business

Figure 5. Network latency against human perception



Sources: Recommendation ITU-R M.2160 (ITU, November 2023) for the IMT-2030 latency range; T-Mobile for Business for the perception thresholds.

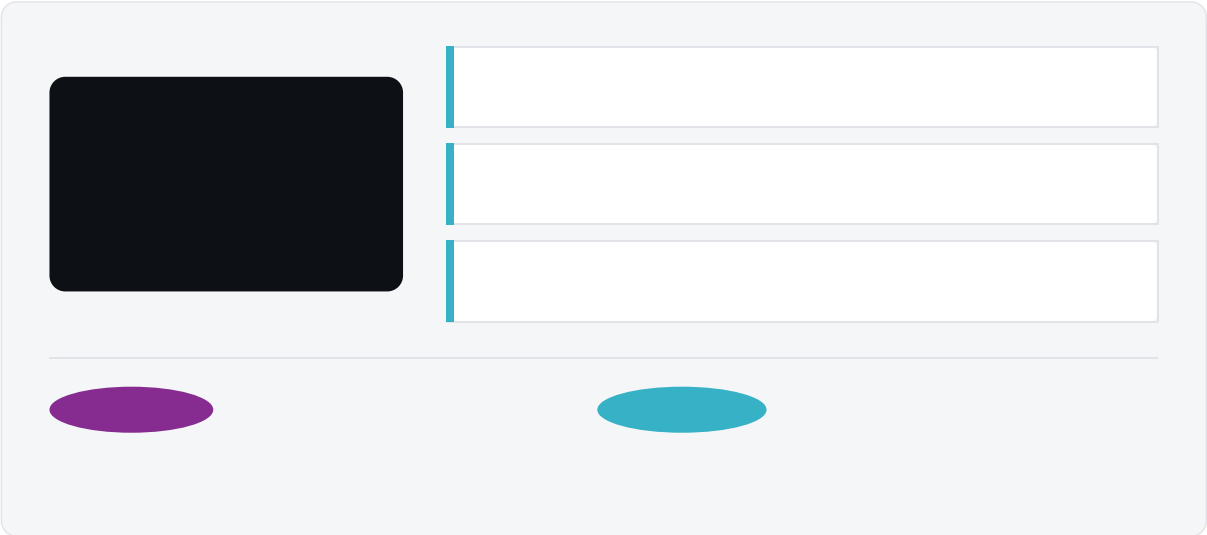
6G's sensing capability has a name in the standards

Integrated sensing and communication (ISAC) is one of the six IMT-2030 usage scenarios and is now within 3GPP's scope for 6G. Coupled with ultra-low latency, 6G could select frequencies to determine relative electromagnetic absorption rates. Why does this matter? TechTarget explains, “6G wireless sensing solutions will selectively use different frequencies to measure absorption and adjust frequencies accordingly. This method is possible because atoms and molecules emit and absorb electromagnetic radiation at characteristic frequencies, and the emission and absorption frequencies are the same for any given substance.”

This means 6G could be used, for example, in industrial settings or mining, as it could ‘sense’ dangerous levels of chemicals that are routinely used. It could also be used for public safety, including monitoring pollution levels and safeguarding critical and valuable assets.

ISAC is already moving through the standards process. 3GPP developed channel models for sensing in Release 19, and Release 20 has accepted 23 ISAC use cases for 6G, mainly unmanned aerial vehicle (UAV) tracking, smart transportation, and industrial robotics. Ericsson, for example, has demonstrated the principle in practice, using existing massive-MIMO radio equipment to detect and track drones alongside the first pre-standard 6G over-the-air session.

Figure 6. Where ISAC lands first



How integrated sensing and communication moves from standards to real-world use cases. Sources: 3GPP Release 19 and Release 20 ISAC studies (TR 38.765); Ericsson.

Regarding transmission speed, 5G’s theoretical upper limit is 10Gbps, with peaks of up to 20Gbps as 5G-Advanced is adopted. 6G is expected to deliver speeds of about 100Gbps and has already achieved this in lab conditions; some even anticipate speeds reaching 1Tbps.

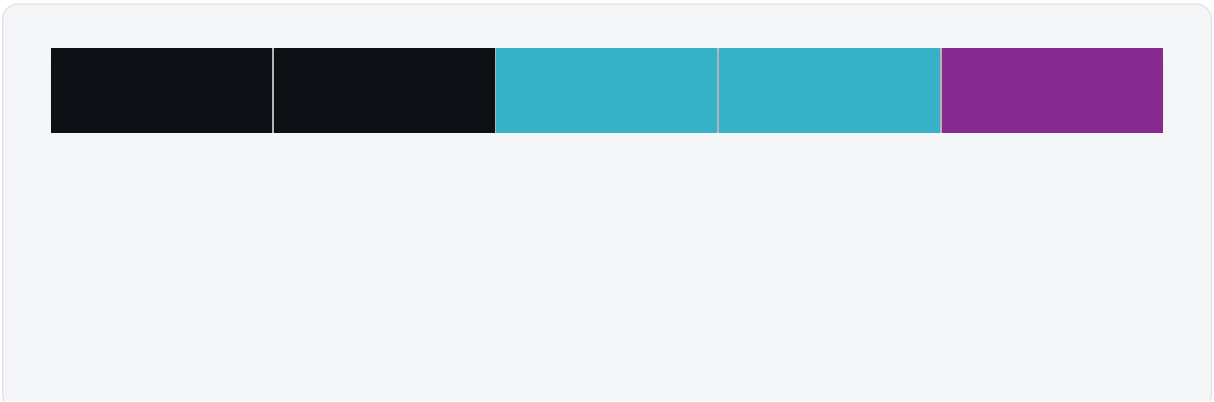
6G’s spectrum-efficiency story is not orthogonal frequency-division multiple access (OFDMA), which is already core to 4G and 5G. It rests instead on new waveform designs suited to the upper mid-band and sub-terahertz frequencies, wider channel bandwidths, and AI-native scheduling that allocates spectrum dynamically across users and cells.

Non-terrestrial networks and direct-to-device

Ubiquitous connectivity is one of the six IMT-2030 usage scenarios, and non-terrestrial networks (NTN) are how it will be delivered. 3GPP introduced NTN in Release 17 to support satellites and high-altitude platforms (HAPS) for direct-to-device communication. The difference in 6G is architectural: non-terrestrial access is expected to be native, co-designed with the terrestrial network rather than retrofitted onto it.

Commercially, this is already underway. A satellite operator, a chipset vendor, and an aerospace manufacturer completed the first 5G NTN connection over a low-earth-orbit constellation in February 2025; a major US operator launched satellite texting a month later; the largest LEO constellation passed 10,000 satellites in early 2026; and a second constellation is scaling toward standards-aligned direct-to-device services. Not everything arrives at once. ISAC over NTN is not in scope for the Release 20 6G architecture study, so sensing via satellite is unlikely on day one.

Figure 7. Direct-to-device: what has already happened



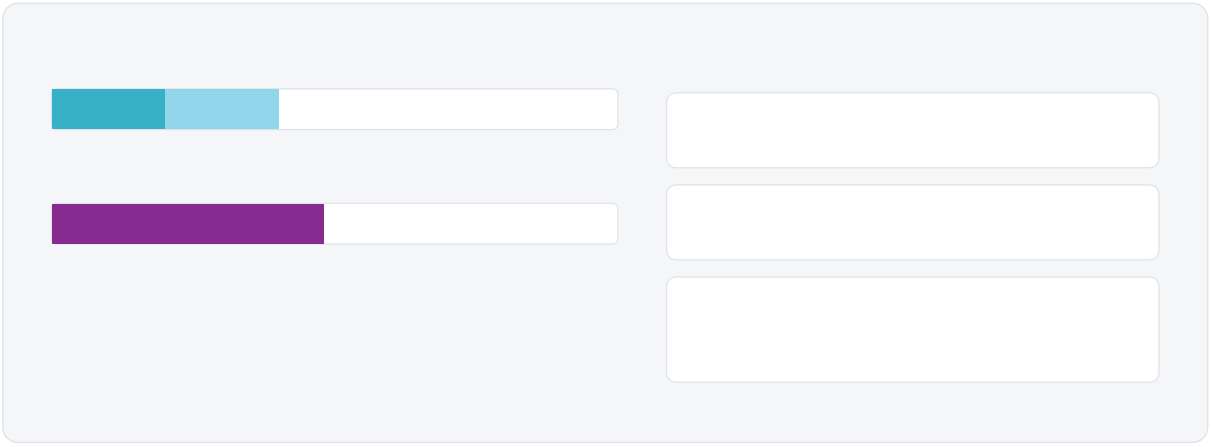
Sources: 3GPP Releases 17 to 20 (NTN); Ericsson Technology Review; 3GPP SA2 Release 20 6G study scope.

Energy efficiency and sustainability

Energy efficiency is one of IMT-2030's core capability metrics, and the ITU* treats sustainability as a principle running across all six usage scenarios rather than a separate objective; 3GPP has carried both into its Release 20 studies. For operators it is a margin question as much as an environmental one: energy accounts for an estimated 20-40% of network operating costs, and STL Partners puts it at close to half of RAN opex. Yet 6G pushes the other way: higher frequencies mean denser deployments and larger antenna arrays. Sensing adds processing load, and AI-driven control adds computation at the RAN site. Efficiency therefore has to be measured and managed rather than assumed, which makes real-time visibility into energy consumption critical.

*Sources: Recommendation ITU-R M.2160 (ITU, November 2023); 3GPP Release 20 (Stage 1); GSMA, Energy Efficiency: An Overview; STL Partners

Figure 8. **Energy as a share of operating cost, and what 6G adds**



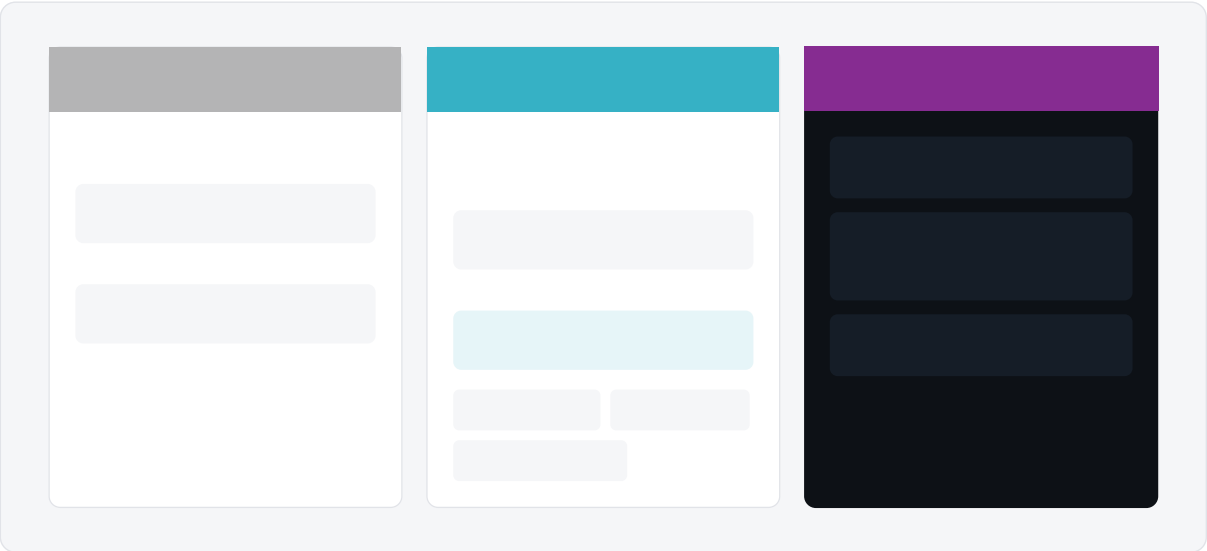
Sources: GSMA, Energy Efficiency: An Overview; STL Partners.

Finally, AI, combined with 6G's communications and computational infrastructure, will determine the optimal location for computing. 6G is expected to automate decisions about where data is stored, processed, and distributed. In other words, the mobile 'edge' will be built into the fabric of the infrastructure rather than added as the need arises, as in 5G.

The impetus for 6G

How difficult it is to reach any destination is largely dictated by the starting point. Many in the industry question why we are thinking about 6G when 5G has 'failed' to fulfill its predicted potential. One reason 5G has not delivered new services and revenues is that its deployment is far behind where we expected it to be at this point, particularly for new cloud-native core technology, 5G SA. Most 5G deployed so far is non-standalone (NSA), meaning the 5G RAN runs on top of a 4G core.

Figure 9. Why standalone 5G matters for 6G



The delay in SA's deployment is due to several factors. These include fallout from the pandemic and adverse economic conditions since then, particularly the soaring price of energy, as well as geopolitical tensions. But there is a technological element, too: operators have generally found the shift to cloud-native daunting.

Also, early excitement around 5G raised expectations higher than the technology could deliver at first. Back in 2016, we expected a world dominated by self-driving vehicles, AR/VR/XR (which temporarily morphed into Metaverse mania in 2020), remote medical care, especially surgery, Industry 4.0, and smart cities. The hype made 5G feel like a technology looking for a purpose rather than one born of necessity.

> “I think operators have been sitting on these questions for the last two or three years, not just SA, but what do we do about public cloud? And do we go for a fully multi-cloud model? It all hangs together; you can’t really take one in isolation from the bigger picture.”
>
> David Martin, Senior Analyst and Telco Cloud Lead at STL Partners

Born of necessity

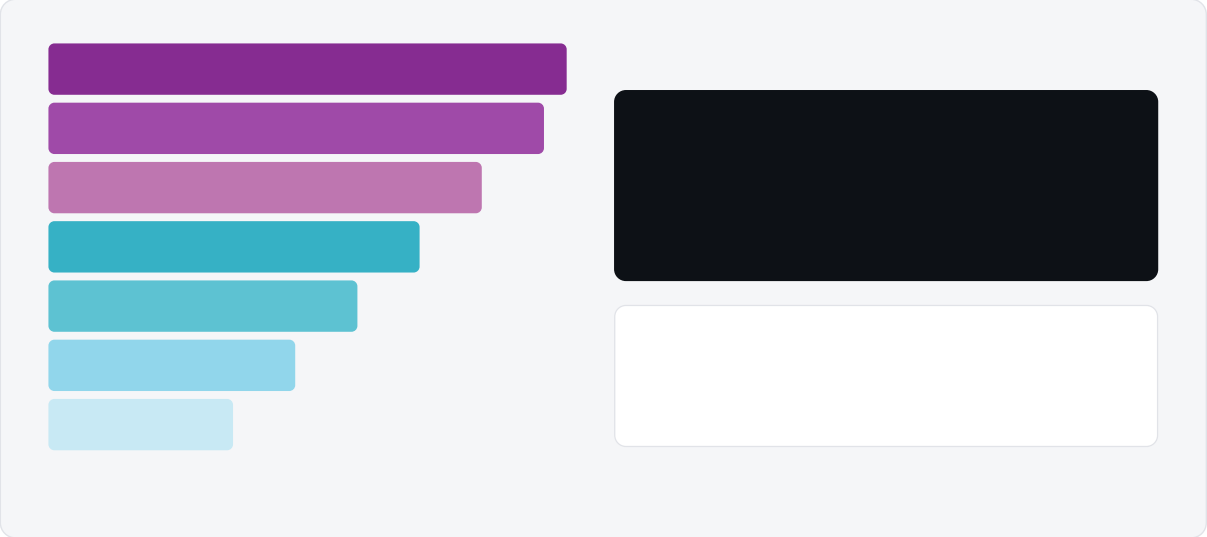
But 5G (and 6G) are born of necessity. Telecom is a low-growth business; S&P Global Ratings predicted operators’ revenues would increase by only 1-2% in 2025. Yet data volumes keep rising, even without the applications we expected 5G to kick-start. In January 2026, DE-CIX, a leading global internet exchange operator, reported that worldwide traffic volumes hit another record high. Traffic throughput has more than doubled since 2020, increasing by 16% in 2025 to reach 79 Exabytes (see below).

How much is 79 Exabytes?

8 terabits = 1 Terabyte (TB); 1,000 TB = 1 Petabyte (PB); and 1,000 PB = 1 Exabyte (EB). 79 Exabytes is the amount of data required to stream a soccer match that lasted 2.2 million years in high definition.

Source: DE-CIX, January 2026. https://www.de-cix.net/en/about-de-cix/media/press-releases/de-cix-global-data-traffic-volume-hits-record-breaking-79-exabytes-at-internet-exchanges-in-2025

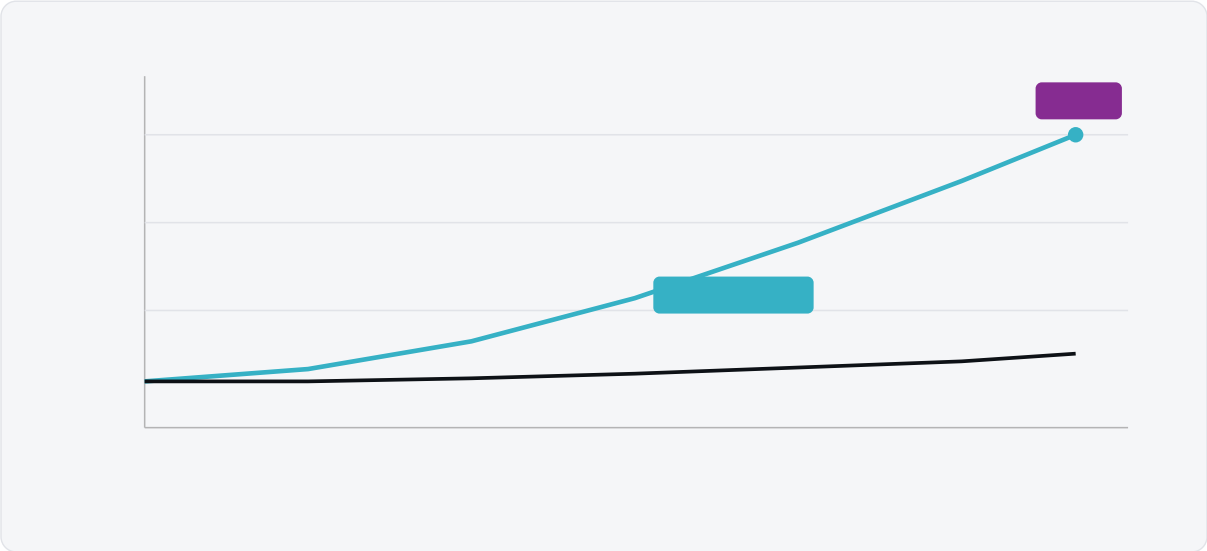
Figure 10. How much is 79 Exabytes?



Source: DE-CIX, January 2026.

This curve is still steepening (see Figure 11). Baseline projections from Ericsson's Mobility Report suggest total mobile traffic will grow 15% to 20% per year over the next five years. Those projections assume usage patterns remain largely unchanged, driven by existing smartphone behavior. If AI-native devices change how people use networks, with more data recorded, analyzed, and uploaded throughout the day, traffic could rise even faster. Then there is AI. When 5G was designed, generative AI was not part of the picture at all. That changed when ChatGPT arrived in late 2022, and the question has already moved on again: from models that answer to agents that act. Agents work continuously, in parallel, and without waiting for a person.

Figure 11. Traffic is growing far faster than revenue



Sources: DE-CIX, January 2026 (traffic); S&P Global Ratings (operator revenue growth of 1 to 2%).

The direction of travel is the same either way. More traffic, more autonomous decisions, and greater dependence on data the operator can trust. That is the backdrop against which 6G is now being specified.

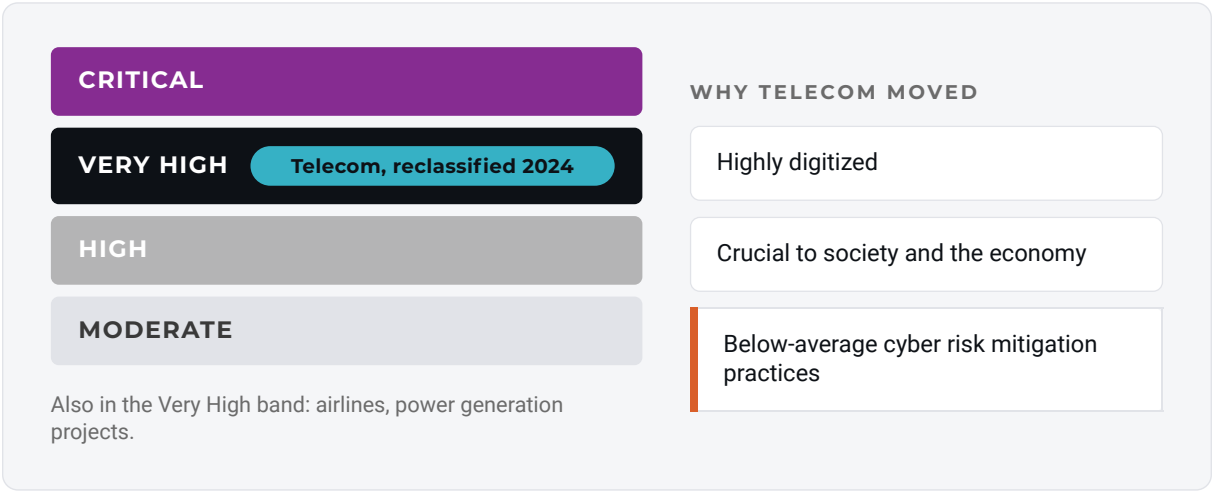
Standardization

As 6G standardization progresses, the focus has shifted from exploration to convergence. In 3GPP, Release 20 is running two tracks: completing normative work on 5G-Advanced while initiating the first 6G studies. The study on 6G service requirements is complete, and architecture work is underway, covering the control and user planes, AI integration, computing, sensing, data frameworks, and non-terrestrial networks. Security work has also begun, including the move to post-quantum cryptography. Release 21 marks the start of normative 6G work and the submission to IMT-2030, with specifications targeted for 2029 and broad commercial services following in the early 2030s.

However, there is an additional critical factor to consider. In November 2024, Moody's Ratings moved telecom into the Very High-Risk category in its annual cyber heat map for the first time. The ratings agency said that, like other high-risk industries (airlines and power generation projects), telecom operators are "highly digitized and play a crucial role in the functioning of society and the economy."

Another factor that contributed to higher cyber risk scores was “below-average cyber risk mitigation practices,” Moody’s added.

Figure 12. Telecom’s move into the **Very High Risk** band



Source: Moody's Ratings cyber heat map, November 2024.

The standards community has begun to respond. Driven by AI threat intelligence, ETSI has published its first standard for AI system cybersecurity, with more expected to follow. As Ultan Mulligan, ETSI’s chief services officer, explains, “assurance in the quality and performance of AI systems and security in the data … is crucial.”

Why the urgency?

6G will be the connective tissue linking cloud infrastructure, edge computing, autonomous systems, and critical national infrastructure. The architecture therefore has to be right before rollout, not after.

Rethinking resilience

This is a major wake-up call about resilience in 6G. Professor Mehdi Bennis is the Head of the Intelligent Connectivity and Networks/Systems Group (ICON) at the University of Oulu and an IEEE Fellow. In his view, resilience is "a quality that's ill-defined today, partly because telecom networks hadn't previously been able to predictably and reliably handle adversity...But the age of pervasive AI has changed that equation. So it's important that resiliency not only be recognized as a 6G priority – but also that benchmarks and metrics be put forward to measure it."

> "In the race to prioritize higher data rates and lower latencies, telecom is not fully prioritizing what should also be a push toward networks that can better withstand adversity and adapt to unforeseen challenges."
>
> Mehdi Bennis, Head of the Intelligent Connectivity and Networks/Systems Group (ICON)

He notes that, so far, resilience in telecom is typically understood to mean reliability (that is, performance such as 99% reliability, meaning, on average, one packet out of 100 is lost within a predefined timeframe) or robustness (preparedness for the network's worst-case scenario). In his view, neither properly addresses consecutive packet loss over extended periods or unforeseen disturbances to the network.

6G resilience must be rooted in real-time adaptation and recovery.

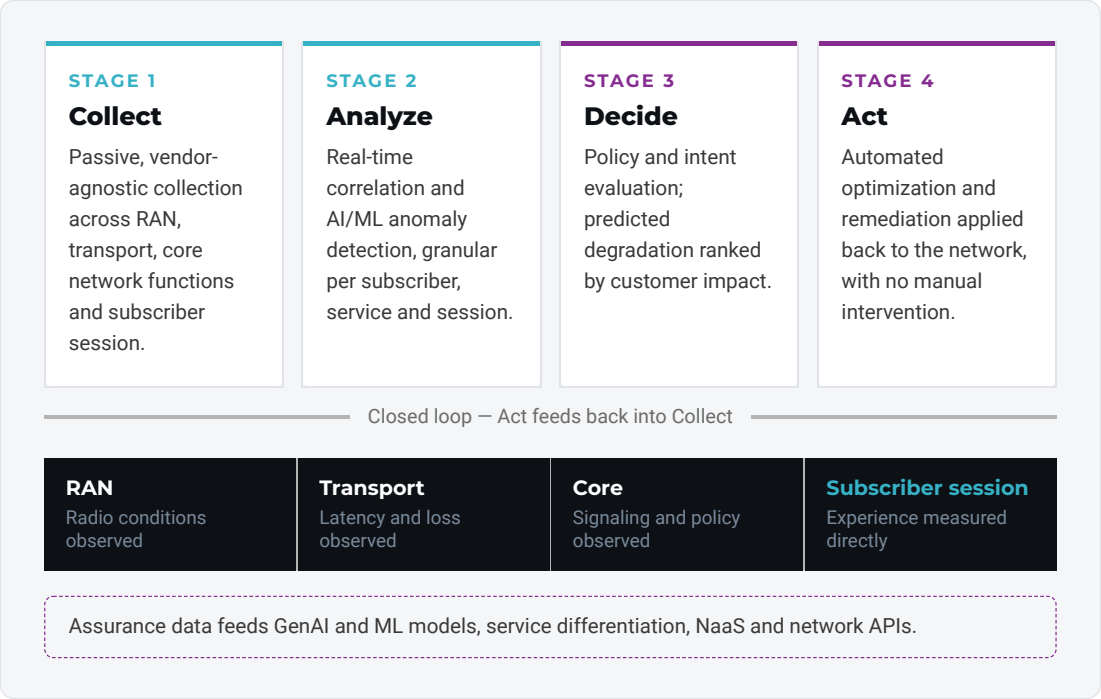
> “Resilience should be defined as the recognition and anticipation of unanticipated events. A resilient network would require the system to adapt, recover, and withstand various stressors – whether known or unknown, such as node failures, misinformation, adversarial attacks, network outages, and malicious agents injecting false information.”
>
> Mehdi Bennis, Head of the Intelligent Connectivity and Networks/Systems Group (ICON)

He stresses that resilience should be rooted in real-time adaptation and recovery. The good news is that we already have technologies that support adaptation and recovery, such as assurance, which draws on observability. These technologies will play a key role in next-generation networks because they are vendor-agnostic and can help operators transition to proactive network management, enabling them to review, verify, and predict anomalies. This includes providing device and service data across millions of users and devices at a granular level.

Expanding the role of automation

A modern, cloud-native assurance solution should include a closed-loop Network Data Analytics Function (NWDAF), a 5G network function defined by 3GPP to drive automation by extending closed-loop capabilities. The NWDAF collects data from across the network, from the RAN to the core, and applies real-time analytics to detect issues. It then automatically provides information to optimize network operations and the user experience without manual intervention.

Figure 13. NWDAF closed-loop automation



Source: 3GPP NWDAF (service-based architecture); RADCOM.

The 5G standard provides frameworks, architectures, and interfaces, including 3GPP's NWDAF, the service-based architecture (SBA), and management and orchestration functions. It also includes guidelines for data monitoring for functions such as network slicing. How data analytics are implemented is not specified; it is left to individual operators and vendors and executed with varying degrees of success.

NWDAF's success depends on having a solid data strategy in place so that data analytics can enable service differentiation: the extracted data can drive GenAI and machine learning models and/or support applications ranging from IoT to smart cities and autonomous vehicles, and many other use cases, to meet customers' demands.

Conventional service assurance and network analytics are network-centric, relying on data that is not real-time and drawn only from some network functions because network data is typically siloed. In this scenario, operators infer customers' experience rather than having direct, real-time insight. This incomplete data cannot be correlated with data from subscribers' network sessions and lacks sufficient detail. This limited visibility hampers the identification of root causes and accurate, rapid troubleshooting.

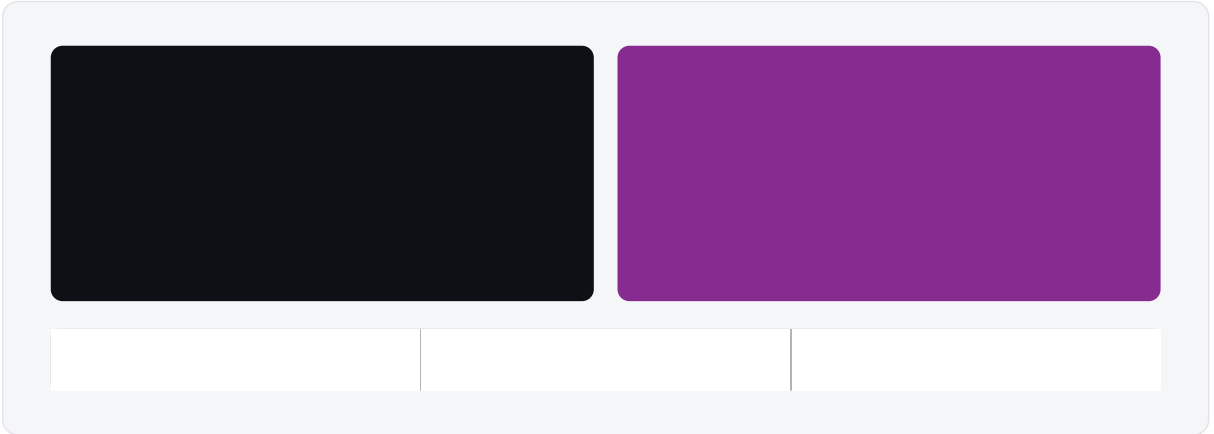
AI-native air interface and AI-RAN

The most consequential decisions about 6G may not concern spectrum or speed, but how deeply artificial intelligence is built into the radio itself. 3GPP is in discussions as to how present-day 5G networks can migrate to the emerging 6G standard with AI's place in radio equipment a key point. RAN studies are aligned to a March 2027 completion target, with hardware-oriented features targeted for decision at the next RAN plenary.

Vendors are not waiting for the standard to settle. Chip designers want the silicon inside 5G-Advanced and 6G radio access networks to look less like specialized telecom hardware and more like the servers running large AI models, while equipment makers are already shipping software that adds AI to installed radios and base stations with no new hardware, radios with built-in neural network accelerators, and tools that let networks diagnose and fix themselves. Architecturally, this points to a RAN that incorporates AI from the start rather than bolting it on, with multi-vendor openness giving way to programmability and software-centric operations. Dell'Oro Group projects cumulative 6G RAN revenue and wireless capex during the first six years of the commercial cycle to exceed $100 billion and $500 billion respectively.

Sources: IEEE Spectrum (https://spectrum.ieee.org/ai-ran-6g); GSMA 6G Community Industry Progress Report, May 2026; Dell'Oro Group, 6G RAN – what are the knowns and unknowns.

Figure 14. The scale of the 6G RAN opportunity



Source: Dell'Oro Group, 6G RAN – what are the knowns and unknowns.

Service assurance for the AI-driven 6G era

6G will put more traffic, more autonomous decisions, and more AI agents onto the network than any previous generation. With AI becoming native to network operations, service assurance must keep pace.

We're already seeing how granular, real-time data across subscribers, services, sessions, and the network itself is critical. This level of observability will continue to enable operators to move beyond monitoring what is happening on the network, to predicting what is likely to happen, identifying issues earlier, and enabling the network to adapt and recover in real time.

This is a shift that RADCOM sees at the heart of next-generation assurance: from reactive monitoring to continuous, AI-driven visibility, prediction, and action, helping build the resilience that 6G networks will require.

The network will increasingly sense what is happening, make decisions, and act on them autonomously. This makes observability fundamental to closed-loop operations: the network can only adapt, recover, and remain resilient if it has the real-time intelligence to understand what is happening and determine what to do next. As AI increasingly drives that decision-making in 6G, the quality of its actions will ultimately depend on the quality of the data behind them.

Figure 15. **Service assurance in the age of AI**

DIMENSION	REACTIVE ASSURANCE (TODAY)	PREDICTIVE, AI-POWERED ASSURANCE (6G)
Data scope	Selected network functions, siloed by domain	RAN to core to subscriber session, correlated end to end
Granularity	Aggregated network counters	Subscriber, service and session level
Timeliness	Batch or near-real-time, minutes to hours	Real time and continuous
Customer experience	Inferred from network KPIs	Measured directly, per session
Fault handling	Root cause investigated after customer impact	Anomalies predicted before degradation occurs
Operating posture	Ticket-driven, manual triage	Closed loop, automated remediation
Business outcome	Churn and SLA credits absorbed as cost	Differentiated service, assured SLAs, lower opex

Summary

6G will be essential to meet growing data volumes and reduce operating costs, mainly through more efficient use of spectrum and better, more extensive automation. This is despite networks becoming increasingly complex and the challenges of effectively leveraging AI everywhere.

A solid data strategy that makes high-quality data accessible as required remains fundamental to achieving resilient infrastructure, service assurance and differentiation, and a sustainable business in every sense. The other essential step to success for those who deploy 6G is to be crystal clear about the business outcomes they aim to achieve.

The 6G conversation has already moved beyond ‘headline speeds’ to efficiency, automation, and trust. Each depends on data and the ability to see, understand, and act on what is happening across the network. Assurance must therefore be built into 6G from the start, not as a layer that monitors the network, but as an intelligence foundation that helps it adapt to change, withstand disruption, and deliver resilient performance.

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