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6G Race Explained

5G Future, Global Leaders & 2030 Outlook

H1 2026

Content

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From 4G to 6G, mobile networks evolve from basic services broadband to AI-native platforms enabling immersive and intelligent services

Mobile network generations and service capabilities overview

Mobile network generation | Basic level | Advanced level

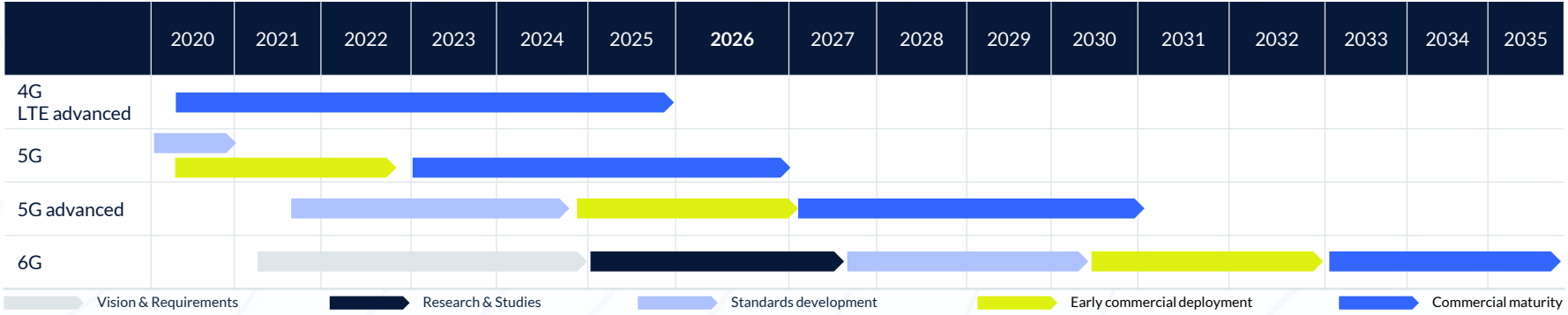
	Marketing / Industry name	Technology name	Official ITU[1] framework (primary requirements)	Primary role	Core capabilities	Key services enabled
4G (2010s)	**4G / 4G LTE**	LTE (Long Term Evolution)	IMT-Advanced	Mobile broadband for consumers	▸ Peak data rate: ~1 Gbps[2] ▸ Latency: ~30-50 ms ▸ Limited device density	Mobile internet, apps, HD video streaming, basic IoT
	4G LTE-Advanced	LTE-Advanced	IMT-Advanced	Enhanced mobile broadband	Carrier aggregation, higher spectral efficiency, improved peak rates	Higher-quality video, improved capacity, better user experience
5G (2020s)	**5G**	5G NR (New Radio)	IMT-2020	Digital connectivity platform for consumers and industries	▸ Multi-Gbps data rates ▸ 1-5 ms latency (theoretical) ▸ Massive connectivity	eMBB (enhanced Mobile Broadband), massive IoT, early low-latency services
	5G-Advanced	5G NR (Advanced features)	IMT-2020 (evolved)	Advanced service platform and bridge to 6G	Network slicing, enhanced URLLC (Ultra-Reliable Low-Latency Communications), AI-assisted operation, improved energy efficiency	Advanced XR, private networks, industrial automation, AI-enabled services
6G (2030s)	**6G**	6G (TBD[4] radio technologies)	IMT-2030	Intelligent, immersive, cyber-physical service platform	▸ Peak data rate: up to 1 Tbps[3] ▸ Sub-ms latency ▸ AI built into the network ▸ Integrated terrestrial and satellite (non-terrestrial) systems	Holographic and immersive communications, AI-native services, digital twins, integrated sensing and communication

ITU is a **United Nations specialised agency for information and communication technologies**, comprising 193 member states and a broad membership of industry, academia, and other stakeholders. It provides global coordination on spectrum management and **defines high-level performance frameworks, such as the IMT series**, to ensure interoperability and **efficient use of telecommunications infrastructure worldwide**. These ITU **frameworks are voluntary but widely adopted**, as they establish globally harmonised requirements that underpin economies of scale and cross-border compatibility. They are implemented through **3GPP Releases**, which translate ITU requirements into detailed, **versioned technical specifications that guide the development, deployment, and evolution of mobile networks by vendors and operators**.

Source: ITU website; ITU — IMT-2030 Framework — [2023]; Media overview
Notes: (1) International Telecommunication Union; (2) Gigabits per second; (3) Trillion bits per second; (4) Indicates that the specific 6G radio solutions are still under research and will be finalised during standardization

In 2026, 5G-Advanced will drive commercial expansion and advanced services, with 6G progressing towards further standardisation

Phases of mobile network development on the global level



Summary:

4G LTE advanced

4G LTE-Advanced is a **fully mature technology,** well-suited for mobile broadband but **not capable of supporting real-time, mission-critical, or highly immersive** services. Consequently, **investment is declining**, and 4G increasingly serves as a coverage and legacy fallback layer.

5G/5G advanced

3GPP[1] Release 18, the first official phase of 5G-Advanced, marks the **transition beyond basic 5G by enabling early future-oriented services** and **laying the technical foundation toward 6G**. As of January 2026, 5G consumer eMBB services are largely mature, supporting high-quality video, gaming, and early XR use cases, while industrial URLLC remains emerging due to ecosystem readiness, cost, and operational complexity. Private networks are scaling in enterprise and campus environments.

6G outlook

In 2026, 6G remains in the research and studies phase, progressing towards formal technical standardisation. At **WRC-27[2], which is organised by ITU in 2027**, countries will determine globally harmonised spectrum for 6G, a prerequisite for final standards, interoperability, and large-scale commercial deployment.

Source: ITU website; ITU — IMT-2030 Framework — [2023]; Media overview
Notes: (1) 3GPP is ITUs global standards body that develops the technical specifications for 4G, 5G, and future 6G mobile networks through a series of standardised Releases; (2) World Radiocommunication Conference 2027

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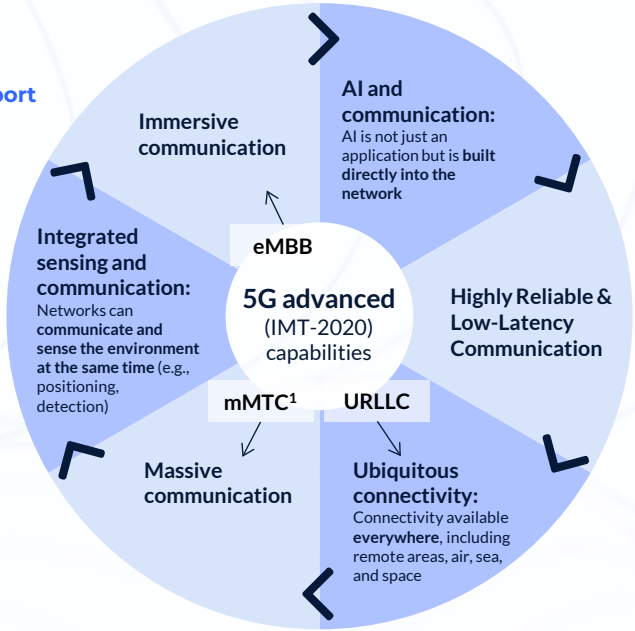
In 2026, success depends on monetising 5G-Advanced while using networks as experimental platforms to prepare for future 6G services

In 2026, **the telecom industry stands at a strategic transition point**: 4G is in decline, 5G-Advanced is emerging as the primary innovation platform, and 6G is being defined. **The services of the 2030s must therefore be planned, tested, and economically framed today, well before 6G networks are commercially available.**

Types of services that future 6G networks (IMT-2030) are designed to support

- Entirely new service types introduced by 6G
- Extension of today's 5G services



Four common principles for 6G networks:

- **Sustainability:** energy efficiency and reduced environmental impact
- **Connecting the unconnected:** global inclusion
- **Ubiquitous intelligence:** intelligence everywhere in the network
- **Security and resilience:** robust and trustworthy operation

What this means for today (2026) and future services:

- Focus should be on 5G-Advanced deployment and monetisation
- Networks should be treated as platforms for experimentation, not just connectivity
- Adoption of AI-enabled networking, private 5G, and advanced automation is critical
- Future services design should start before 6G exists commercially
- Business models, ecosystems, and regulatory frameworks should be aligned with ultra-low latency, high reliability, AI-native and immersive services
- Strategic decisions taken today will determine competitiveness in the 6G era

Source: ITU website; ITU — IMT-2030 Framework — [2023]; Media overview
Notes: (1) Massive Machine-Type Communications

Expert opinion (1/2)

Telecommunications today are the foundation of digitalisation in any country

In the context of the war in Ukraine, the flexibility and availability of wireless communication systems have ensured the effective operation of many companies. The high quality of **4G LTE Advanced** services enables reliable video communication, simultaneous data transmission, and voice calls. This has made it possible for the **banking system and government digital services** to continue operating efficiently. Millions of people have managed to keep their jobs thanks **to high-quality connectivity in Ukraine** and technological solutions that increased network resilience during wartime. One such solution is **national roaming**, which allows subscribers to switch between different operators' networks and remain connected under any circumstances.

5G technologies and future generations of mobile communication will provide even more advanced services. These technologies will form the basis of **Industry 4.0 solutions**, including robotic production lines and real-time quality control, as well as massive connectivity of energy-efficient sensors (up to **1 million devices per square kilometre**). They will also unlock new opportunities for **remote medical procedures (telemedicine)** and enable **secure vehicle-to-vehicle and vehicle-to-infrastructure communication**, contributing to safer and smarter transportation systems. Ultra-low latency and high data transmission speeds in next-generation networks will unlock new opportunities for the development of user-oriented digital services.

Next-generation networks are transforming the services market from fragmented, locally delivered offerings into integrated, cross-industry digital ecosystems, where telecommunications evolve from a basic connectivity provider into a scalable platform enabling data-driven, remote, and service-oriented business models.

Prof. Dr Mariia Skulysh
Director of Educational and Research Institute of Telecommunication Systems, Igor Sikorsky Kyiv Polytechnic Institute

The overall impact of the next-generation network on the services market

Before

- **Industries operated in silos**
- **Telecommunications acted mainly as a ‘data pipe’**
- **Services were local and limited in scale**

Now

- **Cross-industry digital ecosystems**
- **Telecommunications become service platforms**
- **Services are digital, remote, and highly scalable**

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Expert opinion (2/2)

Next-generation networks (5G/6G) are reshaping industries by enabling new service models

Prof. Dr Mariia Skulysh
Director of Educational and Research Institute of Telecommunication Systems, Igor Sikorsky Kyiv Polytechnic Institute

5G and future-generation networks are reshaping service markets across multiple industries by creating new business models, roles, and value chains.

Transportation & Logistics

- Transition from traditional 'transportation' to **Mobility-as-a-Service (MaaS)**
- New services include:
  - Autonomous vehicle management
  - Remote fleet monitoring
  - Intelligent traffic management
- Emergence of new market players: data operators, edge service providers, AI platforms
- **The service** is no longer the vehicle itself, **but connectivity, data, and algorithms**

Industry & Manufacturing

- Shift from one-time equipment sales to **'as-a-Service' models**:
  - Robot-as-a-Service
  - Predictive maintenance-as-a-Service
- Real-time connectivity and ultra-low latency enable:
  - Remote control
  - Digital twins
  - Flexible production systems
- **Manufacturers evolve into service providers,** not just equipment suppliers

Healthcare

- Accelerated development of:
  - Telemedicine
  - Remote diagnostics
  - Robotic rehabilitation
- Emergence of a new market focused on **digital medical services** rather than physical facilities
- Hospitals transform into service platforms accessible from anywhere

Urban Infrastructure & Utilities

- Smart City initiatives move from pilot projects to **large-scale service deployment**:
  - Smart lighting control
  - Energy management
  - Security and video analytics
- Emergence of **urban data operators**
- **The service becomes real-time management of urban processes**

Education, Media, and Creative Industries

- Development of:
  - XR-based education (AR/VR)
  - cloud laboratories
  - real-time interactive events
- Shift from static content to **interactive digital services**
- **Educational services focus on experience, not just access to materials**

Agriculture

- Expansion of precision farming:
  - Sensors
  - Drones
  - Autonomous machinery
- **Farmers increasingly purchase decision-support services** rather than equipment alone

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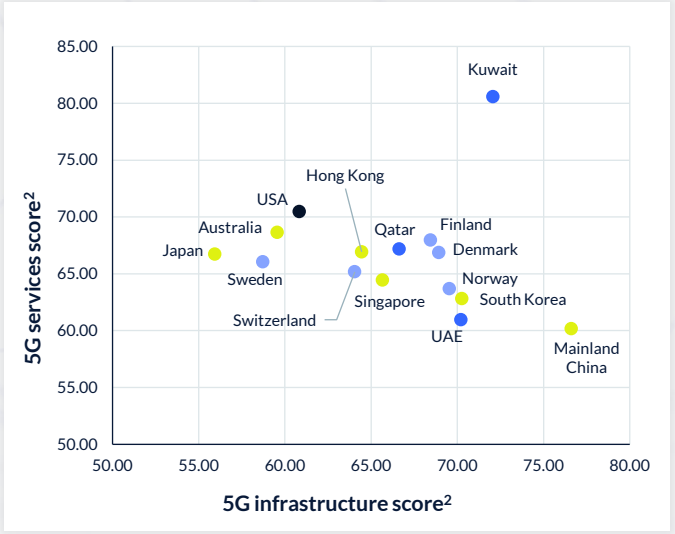
Global leaders and advanced adopters of 5G combine strong infrastructure deployment with high service quality and innovation

15 leading countries by 5G connectivity index[1] provided by GSMA Intelligence as of Q3 2025



Country	Index
Kuwait	76.20
Finland	68.21
Mainland China	67.89
Denmark	67.88
Qatar	66.90
Norway	66.55
South Korea	66.44
Hong Kong	65.68
USA	65.48
UAE	65.43
Singapore	65.05
Switzerland	64.61
Australia	63.93
Sweden	62.27

- The 5G Connectivity Index **benchmarks leaders and advanced adopters of 5G,** measuring observable 5G outcomes using high-quality, comparable data, which is currently available only for markets with sufficiently mature and scaled 5G deployments
- The Index scores range from 61.09 to 76.20, indicating a clear performance gap even among top performers
- Kuwait is the clear leader among the 15, with a robust infrastructure combined with exceptional service performance. This indicates that Kuwait has not only built 5G networks rapidly but has also successfully translated infrastructure into real usage and service quality. Its small geographic size, high investment intensity, and fast adoption explain why it outperforms larger economies
- Mainland China, South Korea, and the UAE prioritised **rapid network rollout**, but service innovation, uptake, and monetisation is still catching up
- The USA, Australia, and Japan show **strong service performance relative to infrastructure, mainly due to advanced digital ecosystems, strong enterprise demand, and innovation in applications and platforms**
- Top-performing countries succeed not merely by building infrastructure, but by converting it into widespread, high-quality services. The highest index scores are achieved where **infrastructure deployment, adoption, and service innovation advance together**

Source: GSMA Intelligent website; GSMA — 5G Connectivity index — [2025]
Notes: (1) Index to help enable increased 5G mobile network coverage, adoption, and usage. It currently measures the performance of 46 countries against the key outcomes for 5G infrastructure and services; (2) Each category (infrastructure and services) is scored between 0 and 100, with a higher score indicating a more enabling environment for delivering 5G mobile internet connectivity

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China, South Korea, the USA, the EU, and Japan are setting the direction of 6G through standards, spectrum, and technology leadership

Global forerunners in the 6G race (Tier 1 forerunners)

Country / Region	6G status & timeline	Key strengths & activities	Strategic positioning
China	Target commercialisation around 2030	Strong state-backed R&D; patents in satellite-terrestrial integration; experimental terahertz satellite; major vendors (Huawei, ZTE); IMT-2030 (6G) Promotion Group	Leading in early research and system-level experimentation
South Korea	Early deployment ambitions (~2026-2028)	Heavy public funding; strong industrial base (Samsung, LG); recognised candidate 6G frequency bands at WRC; active international projects; WISECOM project	Aggressive and fast-moving contender
United States	Research-led; commercialisation around 2030	Strong university–industry ecosystem; FCC enabling terahertz experimentation; AT&T, Verizon, Next G Alliance; multinational 6G cooperation initiatives	Innovation-driven ecosystem builder
European Union	Coordinated research; commercialisation around 2030	Horizon Europe funding; Hexa-X flagship project; strong vendor presence (Ericsson, Nokia); 100 Mn EUR 6G initiatives	Collaborative, standards-focused strategy
Japan	Clear national roadmap towards 2030	Large public R&D funding; Beyond 5G/6G Promotion Consortium; strong operators (NTT, NTT Docomo); Japan-US cooperation	Structured long-term national programme

Tier-1 countries are global leaders that actively shape the direction, standards, and core technologies of 6G, rather than simply adopting or piloting them.

Core characteristics of Tier-1 leaders:

- **Huge public and private 6G R&D investment**
- **Global telecom system vendors** (infrastructure, devices, chipsets)
- **Leadership roles in ITU and 3GPP** (agenda-setting, not just participation)
- **System-level trials** (e.g., THz, satellite–terrestrial integration)
- **Ability to influence spectrum outcomes** (e.g., WRC decisions)
- **Clear national 6G roadmaps** linked to industrial policy

Global Tier 2 contributors / enablers

- Singapore – advanced testbeds, strong regulatory framework, international research hub
- Australia – academic research (THz, radio science), policy and spectrum studies
- UAE – strong 5G base, early 6G research, satellite and non-terrestrial focus
- Saudi Arabia – strategic investor, Vision 2030 alignment, advanced spectrum policy
- Qatar – high 5G penetration, smart city and campus pilots
- UK – strong academic research and testbeds, limited system-vendor scale
- India – strong national vision and growing R&D with increasing standards participation

Tier-2 countries actively shape the 6G ecosystem through research, pilots, regulation, and investment, but do not yet drive global standards, core technologies, or large-scale system deployment.

Source: TechSci Research — Global race to 6G: Which countries are leading the charge? — [November 2025]; Media overview

The telecom ecosystem includes multiple layers of the 5G value chain, transforming networks into end-to-end digital service platforms

Services ↑ **Technology**

	Key players					
Cloud and software providers **Provide:** Cloud-native cores, AI, network slicing, industry applications	AWS Google Cloud Microsoft (Azure)			NVIDA IBM Oracle		
Device vendors **Provide:** Smartphones, IoT devices, XR hardware	**5G Smartphones**	Samsung Huawei OnePlus	Xiaomi Oppo Apple	**IoT / Network Equipment**	Cisco Huawei Ericsson	
Mobile Network Operators (MNOs) **Provide:** Connectivity and digital services to consumers and enterprises	Mobile Network Operators (MNOs) are typically national or regionally licensed entities, operating under country-specific regulatory, spectrum, and policy frameworks.					
Network Equipment Providers (NEPs) **Provide:** Network hardware, software, and systems (RAN, core, antennas)	**Global infrastructure players**	Huawei Ericsson Nokia	ZTE Samsung NEC	**RAN/open RAN[1] players**	Altiostar Parallel Wireless Mavenir	
Chipset and semiconductor manufacturers **Provide:** Modems, RF chips, baseband, AI acceleration	**5G chipsets**	Qualcomm Samsung Semiconductor	Huawei (HiSilicon) MediaTek	**Radio chipsets**	Qualcomm Intel HiSilicon NXP Semiconductors Ericsson	

Source: GSMA website; GSMA Intelligent website; Media overview
Notes: (1) Radip Access Network

Success in 5G/6G depends on the ability to develop multiple layers of the ecosystem, from infrastructure and chips to software and R&D

The conducted analysis highlights a **highly concentrated and layered global** telecom ecosystem in which **leadership** in 5G commercialisation and future 6G deployment **is driven by control over infrastructure, semiconductor technologies, and increasingly software-defined network architectures.** Countries that host providers across multiple layers of this ecosystem hold strategic advantages in shaping both current and next-generation mobile networks.

Geographic concentration of 5G market players

There is a high geographic concentration of key telecom ecosystem providers in a limited number of countries, primarily China, the USA, South Korea, Japan, and Northern Europe (Sweden, Finland, and the Netherlands). These countries dominate multiple layers of the 5G value chain, spanning devices, network infrastructure, semiconductors, and software-defined networking, giving them structural advantages in both commercialisation and standard-setting.

Vertically integrated scale advantage

China exhibits a high degree of vertical integration, with domestic firms active across devices, infrastructure, and chipsets. This integration reduces reliance on foreign suppliers, accelerates large-scale deployment and commercialisation, and enables China to influence global standards through deployment scale and operational experience. As a result, vertical integration represents a key competitive advantage in China's 5G leadership and early 6G research positioning.

Platform-driven customisation

The USA follows a distinct strategic model, emphasising platform control and architectural influence rather than large-scale traditional RAN hardware deployment. The dominance of US-based cloud and software providers in 5G and 6G, combined with leadership in AI, virtualisation, and edge computing, gives the USA a strategic advantage at the platform layer of next-generation networks. Cloud and software providers enable cloud-native, AI-driven, and virtualised network architectures that increasingly shape 6G system design.
The presence of Open RAN players such as Altiostar, Parallel Wireless, and Mavenir, also concentrated in the USA, signals a structural shift from vertically integrated hardware towards modular, software-centric networks. This transition lowers entry barriers, reshapes vendor competition, reduces dependence on a small number of traditional infrastructure providers, and is likely to influence the architectural foundations of 6G.

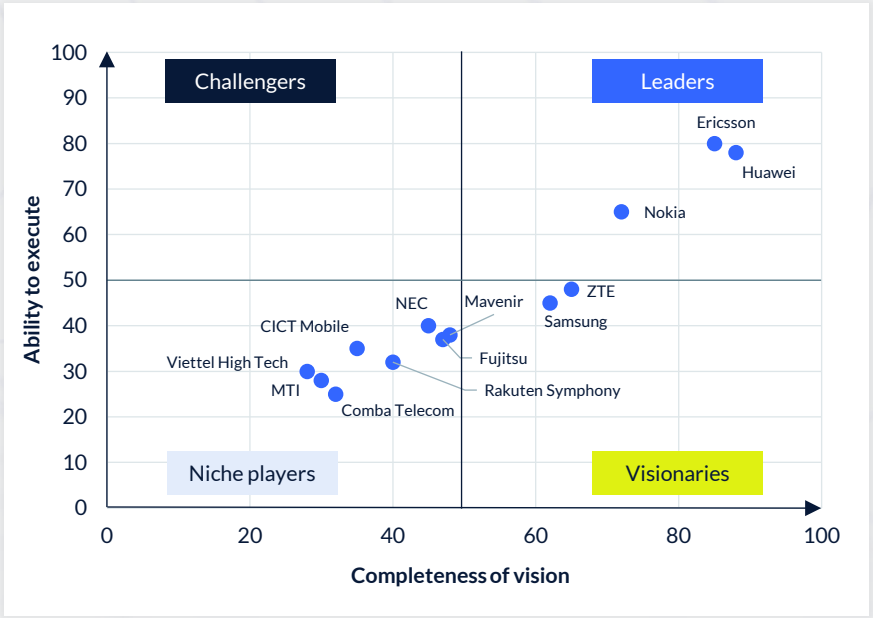
Specialised infrastructure leadership

Europe, by contrast, is characterised by specialisation in core infrastructure and radio technologies. While it has fewer globally dominant device or chipset manufacturers than China or the USA, European infrastructure vendors remain indispensable to global 5G deployment and play a central role in early 6G system design and standardisation.

Source: GSMA website; GSMA Intelligent website; Media overview

Market leaders in 5G RAN infrastructure succeed by combining end-to-end portfolios, large-scale deployment experience, and sustained R&D

The Gartner's Magic Quadrant for CSP[1] 5G RAN infrastructure solutions providers, as of July 2025



Shared success features of leaders

1. **3GPP standards leadership**
   Deep involvement in global mobile standards ensures interoperability and future-proof networks
2. **End-to-end RAN portfolio and strong professional services**
   Full stack (radios, baseband, cloud RAN, orchestration, services) reduces CSP integration risk; Global delivery, optimisation, and lifecycle support for CSPs
3. **Large-scale deployment experience**
   Proven ability to deliver and operate nationwide 5G networks
4. **Heavy long-term R&D investment**
   Continuous innovation across 5G, 5G-Advanced, and early 6G
5. **Energy efficiency focus**
   Network designs optimised to reduce power consumption and OPEX
6. **Cloud RAN readiness**
   Software-based RAN evolution supporting private and public cloud models

R&D is the **core enabler of leadership** for Ericsson, Huawei, and Nokia, allowing them to shape standards, deliver scalable 5G networks, and maintain long-term technology roadmaps. Sustained R&D investment gives CSPs confidence in **performance, energy efficiency, and future readiness** across the full network lifecycle.

Source: Companies' websites; Gartner — Magic Quadrant for CSP 5G RAN Infrastructure Solutions — [September 2025]; Media overview
Notes: (1) Communication service providers refer to organisations that provide telecommunications, media, internet, and cloud-based services to customers

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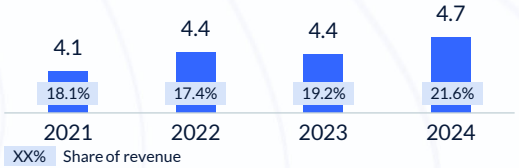
Ericsson, Huawei, and Nokia all demonstrate leadership in 5G and early 6G through high R&D investment and large, skilled R&D teams

ERICSSON

R&D expenses, Bn EUR

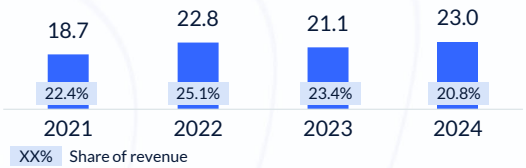


STEM[1] workforce, % of total employees

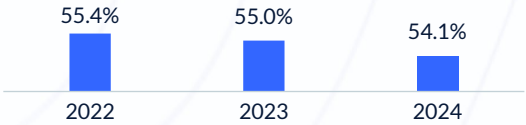
- The company's **R&D expenses grew by 6.0% YoY** and accounted for **4.7 Bn EUR in 2024**, underscoring its long-term commitment to sustained innovation
- In 2024, Ericsson held a patent portfolio of more than **60,000 granted patents**, supporting both technology leadership and high-margin licensing revenues
- The company also maintains a consistently **high STEM workforce share** of around 74%. In 2024, this included 70,128 STEM professionals, of whom 26,744 were engaged in R&D activities, highlighting the central role of research and engineering talent in Ericsson's business model

HUAWEI

R&D expenses, Bn EUR



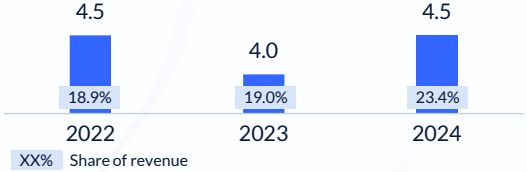
R&D professions, % of total workforce



- In 2024, Huawei continued to increase investment in future-oriented R&D across areas such as AI, foundational technologies, and intelligent vehicles. As a result, R&D expenses rose to **23.0 Bn EUR**, representing an **8.7% YoY increase**. However, due to revenue growth, R&D spending as a percentage of revenue declined YoY
- Huawei maintains a strong intellectual property position, with **more than 150,000 active granted patents** as of the end of 2024
- The company has a high proportion of R&D professionals within its workforce, with approximately **113,000 employees engaged in R&D activities** as of December 2024

NOKIA

R&D expenses, Bn EUR



R&D related acquisition

Rapid Now part of Nokia

In 2024, Nokia **acquired** Rapid's technology and R&D unit to strengthen the development of network API solutions and the ecosystem.

- R&D intensity increased from **~19% of revenue in 2022-2023** to **23.4% in 2024**, highlighting a stronger strategic focus on innovation, particularly in 5G evolution, cloudification, and long-term research through Nokia Bell Labs
- In 2024, Nokia filed **patent** applications on a record number of more than **3,000 new inventions** in areas such as 5G and upcoming 6G networks, Wi-Fi connectivity, next-generation video coding, etc.
- **Nokia Bell Labs serves as the company's industrial research arm, leading work in 6G, AI, semiconductors, network fundamentals, and software systems**

Source: Companies' annual reports; Companies' websites; Media overview

Notes: (1) Non-managerial employees in roles within the fields of science, technology, engineering, and mathematics (STEM)

Telecom leaders maintain a strong presence in Ukraine through infrastructure deployment, 5G initiatives, and talent development

Ericsson Ukraine LLC

1997 Establishment of a wholly foreign-owned subsidiary in Ukraine

Critical national infrastructure supplier. Ericsson's equipment is critical to national connectivity, carrying **more than 65% of mobile voice traffic in Ukraine**.

Network evolution rollout: 2G, 3G, 4G

5G readiness:

In **2019**, Ericsson conducted the first 5G test in Ukraine in cooperation with **lifecell**, and in **2021,** opened a **5G demonstration centre**. The company also implemented the first **5G-based smart manufacturing pilot project** together with **Vodafone Ukraine** and **DTEK**.

Talent development:

The Ukrainian office serves as a **talent centre for telecommunications projects across Eastern Europe and Central Asia.** Ericsson actively cooperates with **Ukrainian universities,** such as Igor Sikorsky Kyiv Polytechnic Institute, Taras Shevchenko National University of Kyiv, and Kharkiv National University of Radio Electronics.

Huawei Ukraine LLC

2005 Establishment of a company in Ukraine

Huawei has been one of the **major telecom equipment suppliers** in Ukraine, with a significant installed base in mobile and fixed networks.

Network evolution rollout: 2G, 3G, 4G

5G readiness:

Huawei participated in **5G trials and technology demonstrations** in Ukraine primarily during 2019-2021, showcasing 5G-ready radio access and core network solutions ahead of commercial deployment.

Talent development:

Huawei **supports local talent development** in Ukraine **through cooperation with leading universities** such as Igor Sikorsky Kyiv Polytechnic Institute, Taras Shevchenko National University of Kyiv, Kharkiv National University of Radio Electronics, and Lviv Polytechnic National University.

Nokia Solutions and Networks Ukraine LLC

2009 Establishment of Nokia's local legal entity in Ukraine

Nokia is a key **telecom infrastructure supplier** in Ukraine, with a solid installed base in mobile and fixed networks, serving major Ukrainian operators.

Network evolution rollout: 2G, 3G, 4G

5G readiness:

Nokia **participated in 5G trials and testing** in Ukraine, including 5G NR technology demonstrations with mobile operators. The company supported 5G readiness activities during 2019-2021, ahead of commercial deployment.

Talent development:

Nokia's formally documented academic cooperation in Ukraine includes **partnerships with Igor Sikorsky Kyiv Polytechnic Institute** and **Kharkiv National University of Radio Electronics**, focusing on telecommunications education, engineering skills development, and knowledge transfer.

Source: TechSci Research — Global race to 6G: Which countries are leading the charge? — [November 2025]; Media overview

Expert opinion (1/3)

5G and next-gen networks are reshaping employment structures in telecoms and related industries

Prof. Dr Mariia Skulysh
Director of Educational and Research Institute of Telecommunication Systems, Igor Sikorsky Kyiv Polytechnic Institute

The deployment of 5G and future-generation networks, along with the development of Software-Defined Networking (SDN), Network Functions Virtualisation (NFV), Multi-access Edge Computing (MEC), and service-oriented architectures, is driving a profound transformation of the employment structure in the telecommunications sector and related industries.

The demand for narrowly specialised operational roles is declining, while the **need for professionals capable of working at the intersection** of telecommunications, software engineering, data analytics, and AI is **steadily increasing**.

The labour market is increasingly oriented towards **engineers with integrated skill sets**, particularly in the areas of cloud and edge infrastructure design, network automation, cybersecurity, digital service lifecycle management, and big data analytics. Growing importance is also placed on systems thinking, expertise in distributed computing, DevOps and NetDevOps practices, and the ability to manage complex cyber-physical systems.

At the same time, employment models are evolving: the **share of project-based, service-oriented, and remote work** is expanding, creating demand for specialists who can **rapidly adapt to technological change and operate effectively within multidisciplinary teams.** This shift requires the modernisation of educational programmes, focusing not only on individual technologies but also on the development of sustainable digital and engineering competencies aligned with the future labour market.

High-technology telecommunications solutions are transforming telecom-related industries (transport, industry, healthcare, urban infrastructure, education, and the agricultural sector) into digital ecosystems, where the key role is played not by individual technologies, but by **integrated systems that combine connectivity, data, and intelligent information processing.**

New specialities in telecom-related industries:

- **Telecom Platform Engineers**
- **Cloud & Edge Engineers**
- **AI & Data Specialists**
- **Cybersecurity Experts**
- **Automation & Integration Engineers**
- **Digital Service Professionals**

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Expert opinion (2/3)

A new type of professionals is emerging — engineers and analysts with interdisciplinary competencies

Prof. Dr Mariia Skulysh
Director of Educational and Research Institute of Telecommunication Systems, Igor Sikorsky Kyiv Polytechnic Institute

Category	Role / Specialty	Key Responsibilities & Skills	Key Shift / Value
Next-Generation Telecom Engineers	**Network / Telecom Engineer (NextGen)**	▸ 5G/6G network design and deployment ▸ Network slicing, QoS, URLLC ▸ Integration of RAN with cloud infrastructure	From network operation to **service orchestration**
	Cloud & Edge Engineer (Telecom Cloud)	▸ Cloud and edge infrastructures (MEC) ▸ Kubernetes, microservices ▸ Cloud-based telecom network functions	Core enablers of **software-defined telecom**
Telecom + IT Convergence	**AI / ML Engineer for Telecom**	▸ AI-driven network optimisation ▸ Self-Organising Networks (SON) ▸ Traffic analytics and load prediction	Networks become **intelligent systems**
	Data Engineer / Data Analyst	▸ Processing large-scale telecom data ▸ Real-time analytics ▸ Data-driven decision-making	Data as a **strategic asset**
	Cybersecurity Engineer (Telecom Focus)	▸ 5G core security ▸ IoT and critical infrastructure protection ▸ Zero Trust, security-by-design	Security as a **built-in service component**
Automation & Dev Practices	**DevOps / NetDevOps Engineer**	▸ CI/CD for network services ▸ Network automation ▸ Infrastructure as Code (IaC)	Networks managed **like software**
	Systems / Integration Engineer	▸ Integration with IoT, Smart City, Industry 4.0 ▸ Cross-domain system integration	Enabler of **cross-industry ecosystems**
Service & Business-Oriented Roles	**Digital Systems Architect**	▸ Design of cyber-physical systems ▸ End-to-end architecture (connectivity → data → services)	Holistic **system-level thinking**
	Product / Service Manager (Telecom & Digital)	▸ Development of digital services on top of networks ▸ Business-technology alignment	Telecom as a **business and service platform**

The **specialist of the future** will not be a specialist with a narrow profile in one field, but rather an **interdisciplinary engineer or analyst** capable of working at the intersection of:

- Telecommunications
- Information technology
- Data analysis
- Artificial intelligence
- Industry-specific knowledge

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Expert opinion (3/3)

Today, Ukraine has a unique environment for the formation of a new type of R&D

Prof. Dr Mariia Skulysh
Director of Educational and Research Institute of Telecommunication Systems, Igor Sikorsky Kyiv Polytechnic Institute

What makes Ukraine an attractive location for telecommunications leaders to establish R&D centres?

1

Today's Ukraine differs from stable environments in which innovations are often tested under controlled conditions. But this environment shapes engineers and researchers who think not theoretically but practically and systematically.

Ukraine's context:

- Technological solutions are immediately stress-tested for resilience
- Communication, information, and control systems operate under physical, cybernetic, and organisational threats
- Failures have real consequences, and successes have a tangible effect

2

This environment shapes specialists with anti-crisis thinking, high stress resistance, a focus on practical results, and the ability to learn and retrain quickly.

Studying in Ukraine today means:

- Combining a strong foundation in engineering with real-world challenges
- Working with live cases in digital government, telecommunications resilience, cybersecurity, logistics, and healthcare
- Gaining experience that cannot be simulated in peaceful laboratory environments

3

This generation of specialists:

- Works at the intersection of people, machines, and data
- Thinks in terms of sustainability and security
- Is results-oriented in complex environments

These are the specialists required for R&D in the domains of 5G/6G, autonomous systems, cyber-physical platforms, Industry 4.0/5.0, and digital government services

The **creation of R&D centres in Ukraine by global leaders in the telecommunications** industry is **strategically justified**, as the **country is forming a unique environment** with **high intellectual intensity, crisis thinking**, and a **strong focus on results**. Specialists who are currently studying and working in Ukraine are gaining experience that combines deep technological knowledge with **practical experience of working in conditions of real threats**, forming a new generation of 'cyborgs' – engineers and researchers capable of creating sustainable innovations for the global market.

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