
Global Mobile Trends 2024

Enter AI and the
'open of everything'

February 2024

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Executive summary

5G's next wave

5G-Advanced

Fixed wireless access

Generative AI

Cloud and edge

The future of entertainment

Private wireless networks

eSIM

Satellites and NTN

Sustainability and circularity

This report is the latest edition of the Global Mobile Trends series.

Much has changed since our first publication in 2015. Technology has advanced and companies have come and gone.

As always, the purpose is simple: understand the biggest and most important things happening in telecoms and the broader TMT industries, and explain what they mean for people, companies and governments.

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Four cross-cutting themes

5G enters a new wave, with new urgency

5G adoption is edging towards 20% globally, up 7 percentage points (pp) over the last 12 months. This is positive news, given the tariff upsell potential from the transition from 4G, with plenty of room to move into.

However, the rise in 5G has not materially altered mobile revenue growth, which stands stubbornly low. Economic weakness has played its part, but a bigger issue is that price premiums are eventually competed away in the absence of a 'killer app' that people will pay more for. Meanwhile, the B2B story is still developing around private wireless networks, edge and IoT. B2B remains a focus for the industry, with the launch of the next iteration of 5G networks an important underpinning for growth over the next three years.

Generative AI (genAI) and the art of the possible

The rapid rise of AI is the biggest tech story of the last year, with far-reaching implications for commerce, employment and security. Telco forays into AI have started with internal priorities (e.g. troubleshooting network faults). This is pragmatic but only scratches the surface.

2024 is likely to see genAI supporting growth through smarter services and marketing. Data monetisation, in particular, deserves more attention, with products such as AWS Telco Data Lake proving valuable in leveraging diverse operator data sources.

Private wireless for all tastes

At the end of 2022, 50% of operators surveyed claimed to have private 4G, and 34% had launched or were testing private 5G. A year later, the 5G figure had almost doubled to 64%. This reflects a response to enterprise demand for customised solutions at or near their premises, alongside the ability to incorporate edge computing and IoT into service packages.

However, private 5G puts traditional competition layers in flux; Nokia, Ericsson and other vendors may well be lead contractors, supported by operators - rather than the other way around.

Satellites and non-terrestrial networks (NTNs): win-win?

Satellites have quietly moved into the mainstream since 2016 when SpaceX's original LEO constellation proposals were made. 2023 was a turning point, driven by improved economics, capacity gains and the enshrining of NTN standards into 5G new radio (3GPP).

Satellite provides telcos with a route to reach revenues not previously possible; GSMA Intelligence estimates an annual run rate of \$30-35 billion by 2035, equivalent to a boost of 2.0-2.5% to the current mobile revenue base. It also implies a closing of the coverage gap (still at 7% of the global population) and internet divide.

Satellites and NTNs are symbolic of a new, pragmatic approach to partnerships with other industries to solve mutual problems. This mentality and cultural shift will also form the bedrock of delivery models for 5G B2B services in vertical sectors.

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5G's next wave ▶

Monetisation,
monetisation,
monetisation

TOPIC OVERVIEW

5G's next wave

5G's next wave refers to the continued investment in and deployment of 5G networks around the world. This includes greenfield deployments but also brownfield rollouts where operators upgrade their networks to 5G standalone and eventually 5G-Advanced.

5G launches continue across the world

- Shifting geographies for 5G launches



Half of global mobile connections will be on 5G by 2030

- Growth evolution and geographic balance of 5G subscribers



5G FWA grows as a long-term alternative to fibre deployment

- Renewed momentum, with new device availability and a reduction in costs
- India and the US to drive significant new volumes for FWA



5G standalone: still promising despite slow adoption

- Transition to 5G SA slower than previously expected
- Acceleration driven by Asian groups



5G-Advanced and the return of multicast

- Marketing versus reality
- Getting the basics right



🌐 Regional variation



🕒 Considerations ahead



① Why it matters in 2024

A new stage of 5G

Financials

Operator priorities. Some 73% of operators surveyed by GSMA Intelligence highlighted revenue generation and user experience as their top priorities.

Revenues and investments. Increased attention on revenue-generating services such as FWA and private 5G, and prospective future drivers including generative AI (genAI) and network API exposure point to sustained investments through a second wave of 5G.

Data traffic

Capacity. Existing networks and capacity, especially at sub-6 GHz, will become increasingly constrained, especially for services such as FWA.

mmWave impact. mmWave spectrum can have a material effect on available capacity, especially in high-traffic areas.

Changing demand

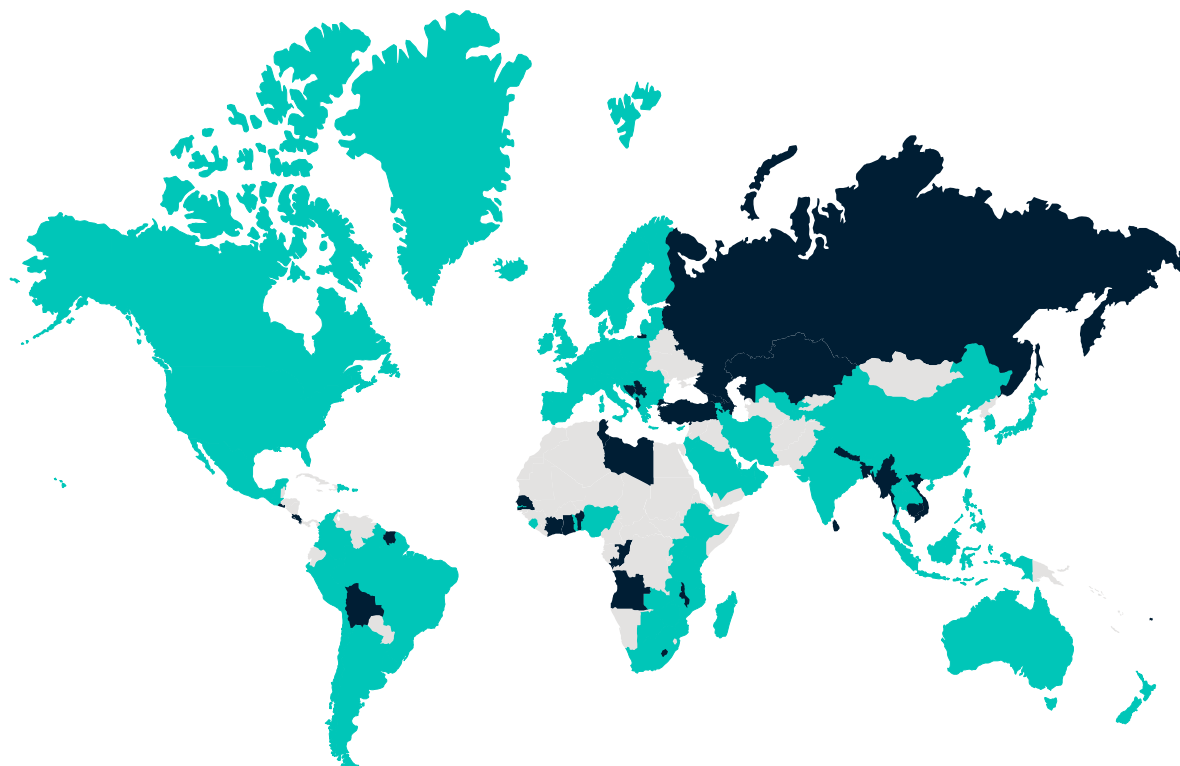
Consumer appetite. Consumer services such as AR/VR have not quite lived up to early hype. The ecosystem is catching up in terms of device availability, and network latencies need to improve.

5G SA and enterprises. Increasing momentum behind 5G standalone (5G SA) will help address enterprise demand.

5G launches continue across the world

The first 5G capex cycle has been completed in many markets

- 5G adoption continues to vary around the world, but 2023 saw a flurry of network deployments. 5G service is now available in most countries.
- North America, East Asia and the GCC markets continue to set the pace for 5G deployments, with operators there laying the groundwork for what comes next, including 5G-Advanced and 6G. Europe saw significant launch activity in 2023, with adoption beginning to grow.
- A second wave of 5G deployments began in 2023 and will continue in 2024, characterised by launches in many emerging markets, and new investments in standalone and 5G-Advanced.



■ Live commercial 5G network ■ Planned commercial 5G network

Note: Status assigned where an operator has stated a commitment/timeline (planned) or announced a commercial 5G launch (live). Status defined as live where at least one operator has commercially launched 5G services. Data correct to 30 September 2023. For updates, see gsmaintelligence.com

Source GSMA Intelligence

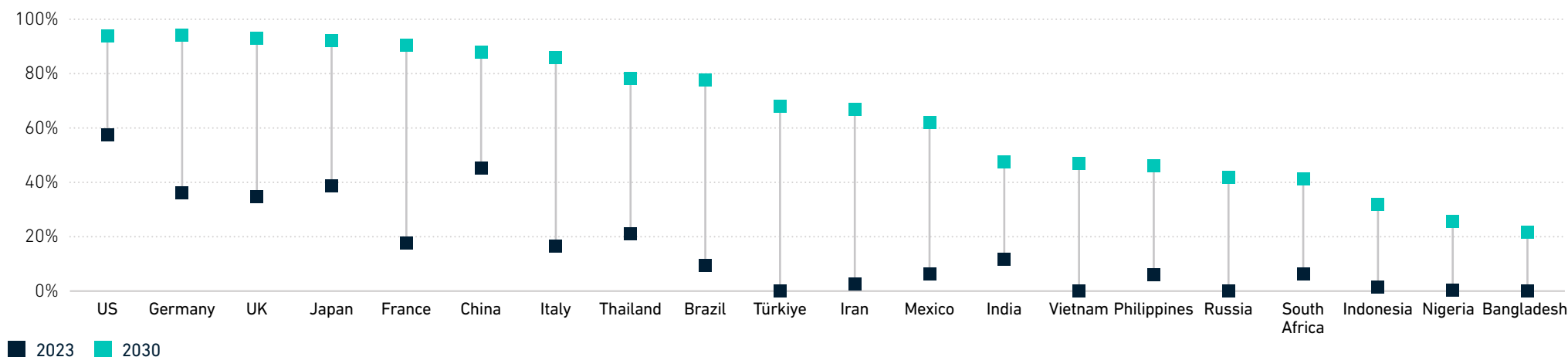
Half of global mobile connections will be on 5G by 2030

East Asia and the US lead, with Europe closing the gap

- **North America, East Asia and GCC states** continue to lead on 5G adoption. With the first wave of 5G deployments based on Release 16 complete, many operators in these markets are shifting attention to 5G SA. While some European markets are seeing increased traction, the majority across the region have been slow to ramp up 5G. Expanding coverage and 5G devices moving to mainstream will help.
- Several large markets in **Asia Pacific** have yet to launch 5G at scale. However, a significant 5G deployment in India will help push the region's adoption higher, as operators stand to benefit from improved unit economics. Smaller markets such as Vietnam, Thailand and the Philippines will see increased traction from 2025 onwards. **Western Asian** markets (e.g. Türkiye and Iran) will exhibit a similar adoption curve towards the latter half of the decade.
- **Latin America** has taken a wait-and-see approach. However, Brazil and Mexico are now recording growth in coverage and connections. **Africa** will continue to lag in 5G adoption due to the high unit economics for networks and devices. The exception is South Africa, which has seen early traction.

5G adoption growing around the world

5G as a percentage of total connections for the top 20 markets by 5G size (connections) in 2030



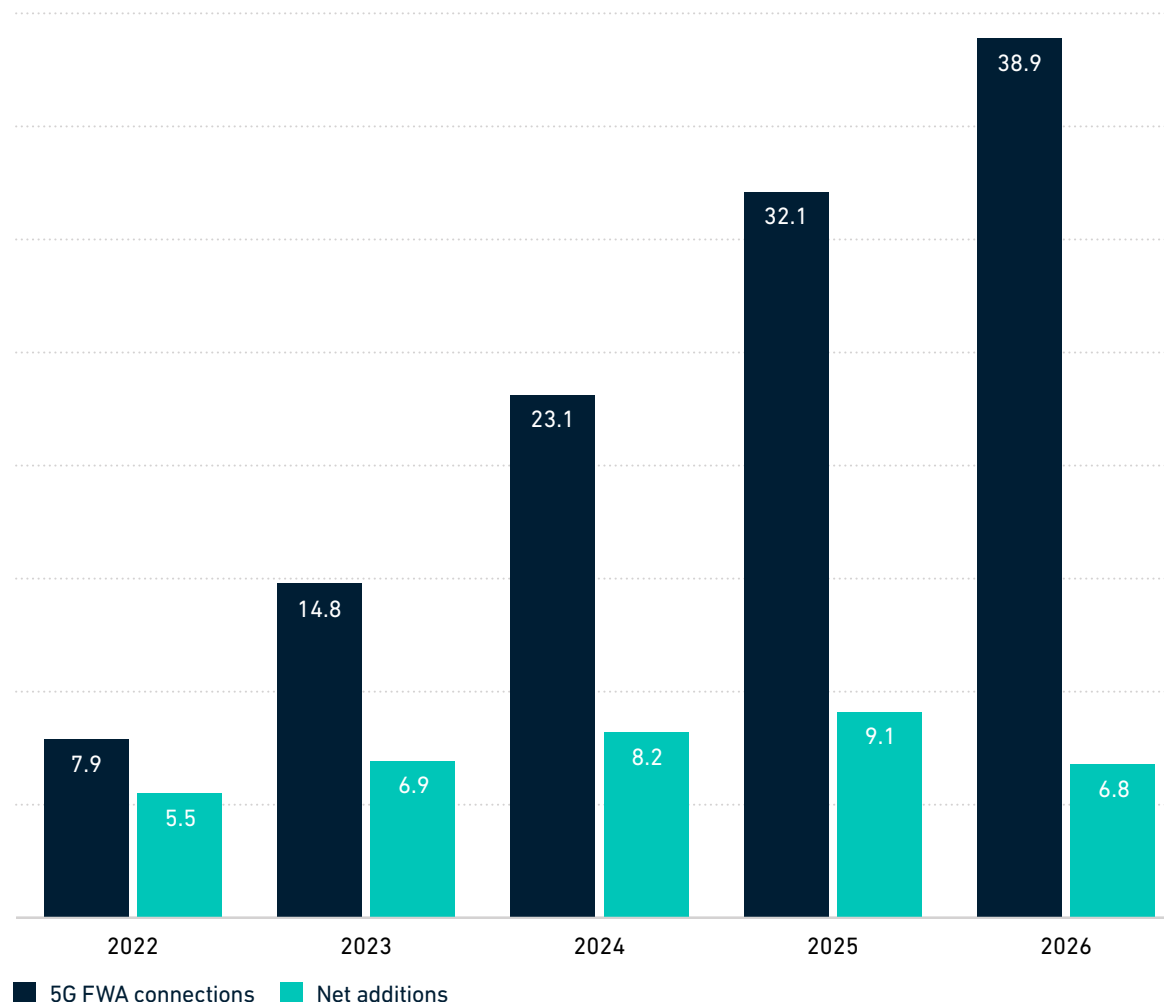
FWA grows as a long-term alternative to fibre deployment

Connections are growing; market conditions are improving

- An improved outlook.** In the GSMA Intelligence Consumers in Focus Survey, 34% of respondents saw 5G FWA as a very/extremely appealing proposition. The outlook for FWA has improved, reflecting increased coverage to areas where fibre connectivity does not extend, and ample capacity with carrier aggregation and the availability of mmWave spectrum. Extended-range mmWave will enable connectivity in remote areas with line of sight. Increased supply and availability of 5G CPE for both indoor and outdoor deployment scenarios has also boosted the relevance and appeal of FWA.
- Slow growth trajectory.** 5G FWA connections will continue on a slow but steady growth trajectory through to 2026. The rapid deployment of FWA in markets such as India and the US will go a long way to improving unit economics and CPE average selling prices (ASPs).
- Complementary rather than substitutive.** Most operators see FWA as an important complementary part of their broadband strategy. While some consumers will view it as a cheaper and/or better alternative to other more established fixed broadband technologies, FWA will be prioritised where it proves difficult or too costly to extend fibre connectivity.

FWA connections to continue growing out to 2026

Global 5G FWA connections and net additions (million)



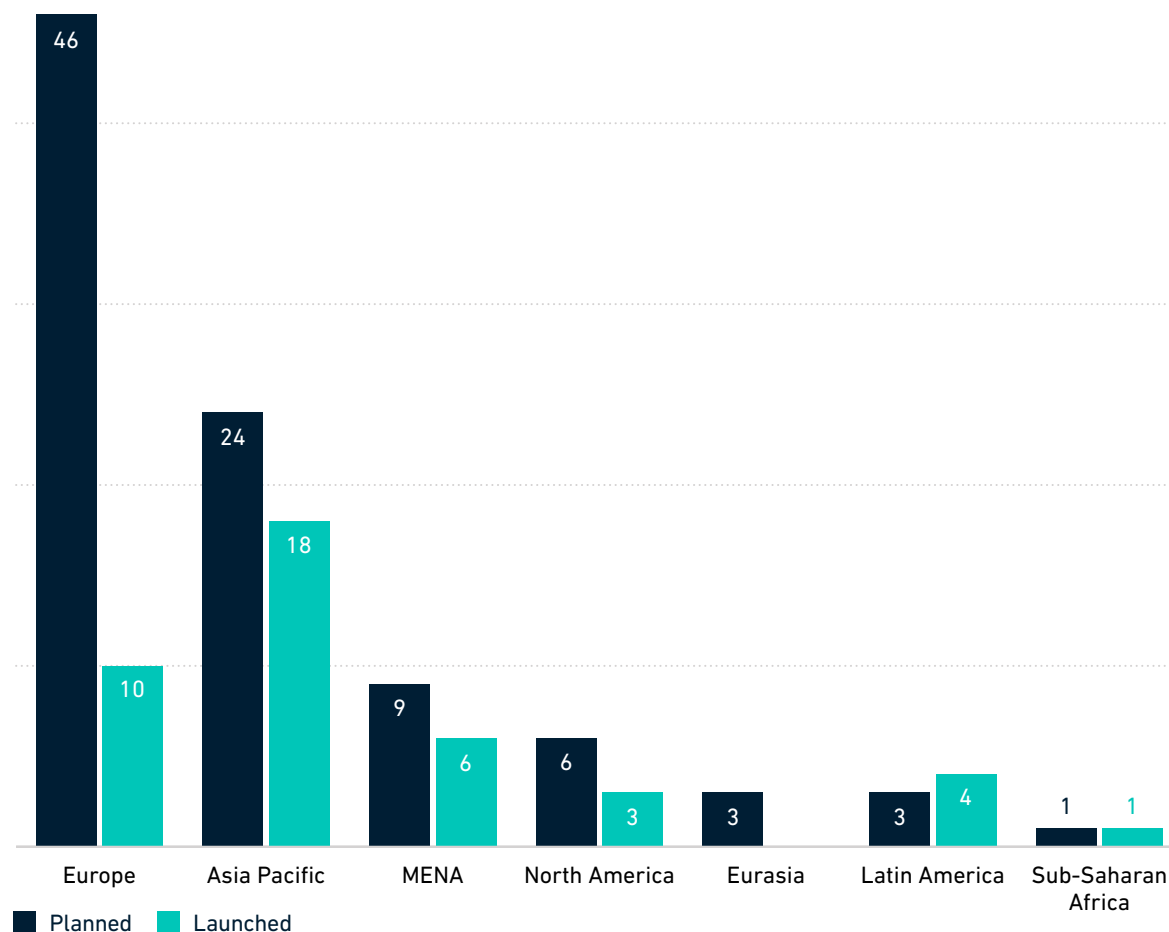
5G SA: still promising despite slow adoption

Asia Pacific leads in 5G SA deployment

- Standalone crucial to 5G vision.** The first wave of 5G investments focused heavily on coverage expansion, with capacity enhancements for mobile broadband. The greater opportunities from 5G will come from enabling low-latency, deterministic connectivity to drive new use cases for enterprises. 5G standalone (5G SA) is crucial for this vision to be realised, as it will enable features such as network slicing and ultra-reliable, low-latency communications (URLLC).
- Asia Pacific leads.** As of Q3 2023, a total of 134 operators from 60 countries had launched or demonstrated intent to launch 5G SA networks. Some 42 operators globally offered commercial 5G services on SA networks, with Asia Pacific accounting for nearly half of these.
- An investment priority.** The GSMA Intelligence Network Transformation Survey 2023 showed that nearly 80% of operators are looking at SA deployments in two to three years. While this suggests sluggish rollout, 5G SA RAN investments are an investment priority over the next two years.

Operators look to SA deployments to realise 5G vision

Number of operators with 5G SA network launch/plans by region



Data correct to 30 September 2023. For updates, see gsmaintelligence.com

Source GSMA Intelligence

5G-Advanced and the return of multicast

Driving revenues and delivering on foundational 5G values

- 5G-Advanced and multicast viability.** Last year, 5G multicast ranked as the top 5G-Advanced technology in the Network Transformation Survey. This year, framed as a 'use case', it topped the rankings by a larger margin. Multicast over mobile has been a concept since 3G but has never materialised. Whether 5G-Advanced can alter its trajectory is unclear, but the prospect of attractive unit economics with multicast services would help operators double down on streaming services and drive revenues.
- 5G-Advanced marketing versus reality.** AR/VR services and improved device positioning accuracy have been highlighted as key 5G-Advanced features in supplier messaging. Operators, however, do not seem to see them as important use cases or applications. This may explain why suppliers are evangelising them so loudly (educating the market) but it also suggests they shouldn't overplay their value.
- 5G-Advanced and getting the basics right.** Low-cost IoT is a core 5G value. Multicast services were not part of early 5G planning, but they speak to an interest in efficient data transmission with B2B applications. While new services and use cases are important for selling 5G-Advanced, operators see value in delivering on foundational 5G values.

5G-Advanced: the priority use cases driving network transformation

Which 5G-Advanced use cases and applications are most important to your network transformation priorities? (Top two – ranked)

5G multicast services



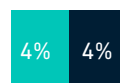
Low-cost IoT support



Enhanced integration with satellite resources



Enhanced integration with drone resources



Improved device positioning accuracy



Improved AR/VR support



Rank 1 Rank 2

🌐 Regional variation

Europe

- European markets have been slower to deploy and execute on 5G, but 2023 showed signs of acceleration. A number of operators are rolling out or have announced plans to deploy 5G SA. FWA and private 5G are key drivers for new investments.

India

- 2022 saw a massive and accelerated deployment of 5G in India, with nationwide coverage offered by Reliance Jio and Bharti Airtel. Jio has launched a 5G SA network, while Airtel remains on non-standalone (NSA). In 2024, focus is expected to shift to integrating new frequencies and commercialising mmWave.

Asia-Pacific

- North Asian markets such as China, South Korea and Japan continue to set the pace for 5G, with focus already shifting to deployment of 5G-Advanced and 6G. In Australia, Telstra continues its nationwide deployment of 5G, with investments in digital infrastructure to drive enterprise use cases. In Southeast Asia, Malaysia's Digital Nasional Berhad has achieved its target of 80% nationwide coverage, paving the way for the launch of the country's second wholesale network.

② Considerations for the year ahead

Will 5G be able to support the most demanding enterprise use cases?

- Most enterprise respondents to the GSMA Intelligence Network Transformation Survey identified coverage and capacity as their top requirements, which belies the much-hyped focus on network slicing and URLLC.

Will 5G FWA grow beyond a niche service?

- The increasing availability and affordability of 5G FWA CPE and innovative tariffs are boosting the outlook for FWA globally. This is especially true for those areas characterised by low penetration of fibre (including emerging markets but also rural and remote areas in developed countries).

Will rising interest in APIs help monetise 5G network investments?

- 2023 saw growing interest in and adoption of network API frameworks. An example is the GSMA's Open Gateway initiative, with nearly 40 of the world's largest operators signed up. The goal of network API exposure is to better monetise network assets and capabilities. 2024 should see increasing adoption by operators globally but also progress on the ecosystem front and with monetisation models.

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Taking the mobile ecosystem from '5G now' to '5G next'

TOPIC OVERVIEW

5G-Advanced

5G-Advanced represents the next iteration of 5G standards, beginning with the 3GPP's Release 18 specifications and promising enhancements over initial 5G technology deployments in terms of capacity (uplink and downlink), device positioning, IoT cost efficiency, coverage and connection reliability. Commercial availability is expected in 2025.

The use cases that will drive 5G-Advanced

- Solutions in search of problems
- Technology aims linked to service requirements
- B2B monetisation aspirations



5G-Advanced as an open networking trigger

- New standards and new networks
- Second wave of 5G
- Vendor support (of sorts)



5G-Advanced and network APIs: a clear connection

- API exposure already commonplace
- APIs and B2B services
- Internal hurdles



Intelligence beyond automation

- Automation is not new for operators
- 5G-Advanced and the acceleration of automation
- Automation versus intelligence



① Why it matters in 2024

5G-Advanced promises to build on today's 5G capabilities to deliver new (monetised) experiences

Standards and timelines

R18 on the horizon. 5G-Advanced, the next iteration of 5G standards, will arrive with 3GPP Release 18 – expected in mid-2024. With scaled commercialisation in 2025, planning is front of mind.

Early 5G-Advanced capabilities.

Even before the arrival of Release 18, some 5G-Advanced capabilities (e.g. RedCap IoT support) are already available.

5G-Advanced as a 6G bridge.

The majority of operators think 6G R&D will be used to improve 5G networks and services; 5G-Advanced will reflect that.

5G investment lull

5G follows 4G. Previous mobile technology generations have seen an initial wave of network spending buoy vendor fortunes, with spending then tapering off. By most accounts, 5G is following that pattern.

Capex forecasts. After flat growth in 2024, global capex is forecast to decline by about 10% through to 2030.

Network supplier messaging. To drive a new wave of investment, network suppliers will want to highlight 5G-Advanced's value.

Incomplete 5G monetisation

B2B as a central 5G promise. From the first days of 5G, support for enterprise verticals was a core tenet, promising access to a new revenue pool for operators.

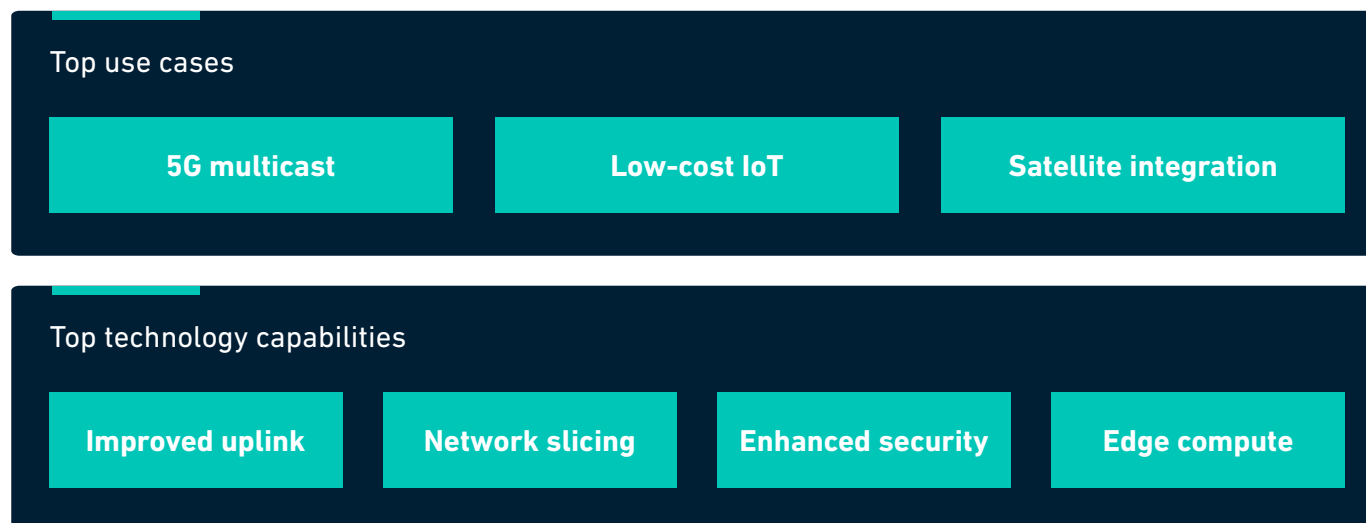
Mixed success. B2B revenue is growing for telcos – up from 26% in 2017 to 30% in 2022 for a cross-section of leaders. The role of 5G in delivering growth is still limited.

B2B 5G – take 2. 5G-Advanced promises evolved vertical support, including low-cost IoT, drone and satellite integration, integrated device sensing, and latency and capacity improvements.

The use cases that will drive 5G-Advanced

- **A solution looking for a problem?** The introduction of new technology is often accompanied by the question of why it is needed and what it accomplishes. Does it represent innovation for the sake of innovation or does it address a market need? 5G-Advanced is no different here.
- **Tech linked to services.** The most-cited 5G-Advanced capabilities and use cases centre on technology innovation. Yet, all can be linked to more specific business outcomes and services: metaverse support, connected things, efficient media delivery, etc.
- **B2B monetisation.** A common theme across 5G-Advanced priorities is B2B support. Edge, slicing and security have all been identified as key to meeting enterprise needs, with low-cost IoT (including passive IoT) helping to justify deployment return on investment (RoI) for a broader set of enterprise use cases and applications.

5G-Advanced priorities among operators

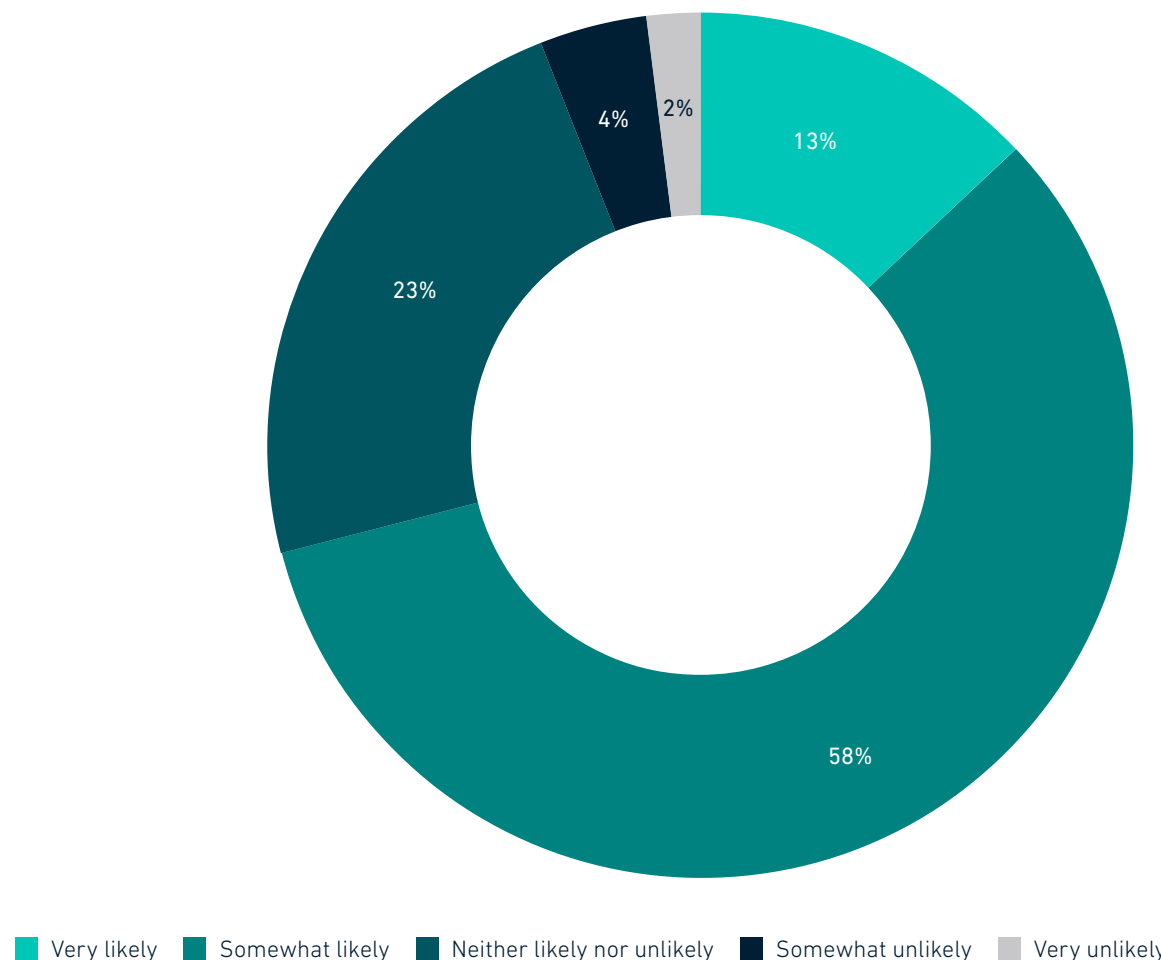


5G-Advanced as an open networking trigger

- New standards and new networks.** New technology generations yield an opportunity to evolve networks, including suppliers and architectures. Whether 5G-Advanced is a big enough evolution to drive open networking and open RAN is unclear, but 71% of operators see it as a trigger to do so.
- Second wave of 5G.** As contracts attached to initial 5G rollouts come up for renewal, operators have a chance to demand more from suppliers. This means 5G-Advanced planning and broader open networking initiatives may well coincide.
- Vendor support (of sorts).** While some leading network infrastructure vendors remain open RAN naysayers, 2023 saw high-profile support from Ericsson, Nokia and Samsung, alongside open RAN stalwarts such as Mavenir. Broad supplier support helps make the case for open networking in the 5G-Advanced era.

Can 5G-Advanced help drive open networking technologies?

Likelihood to leverage 5G-Advanced to introduce open networking technologies (percentage of operators)

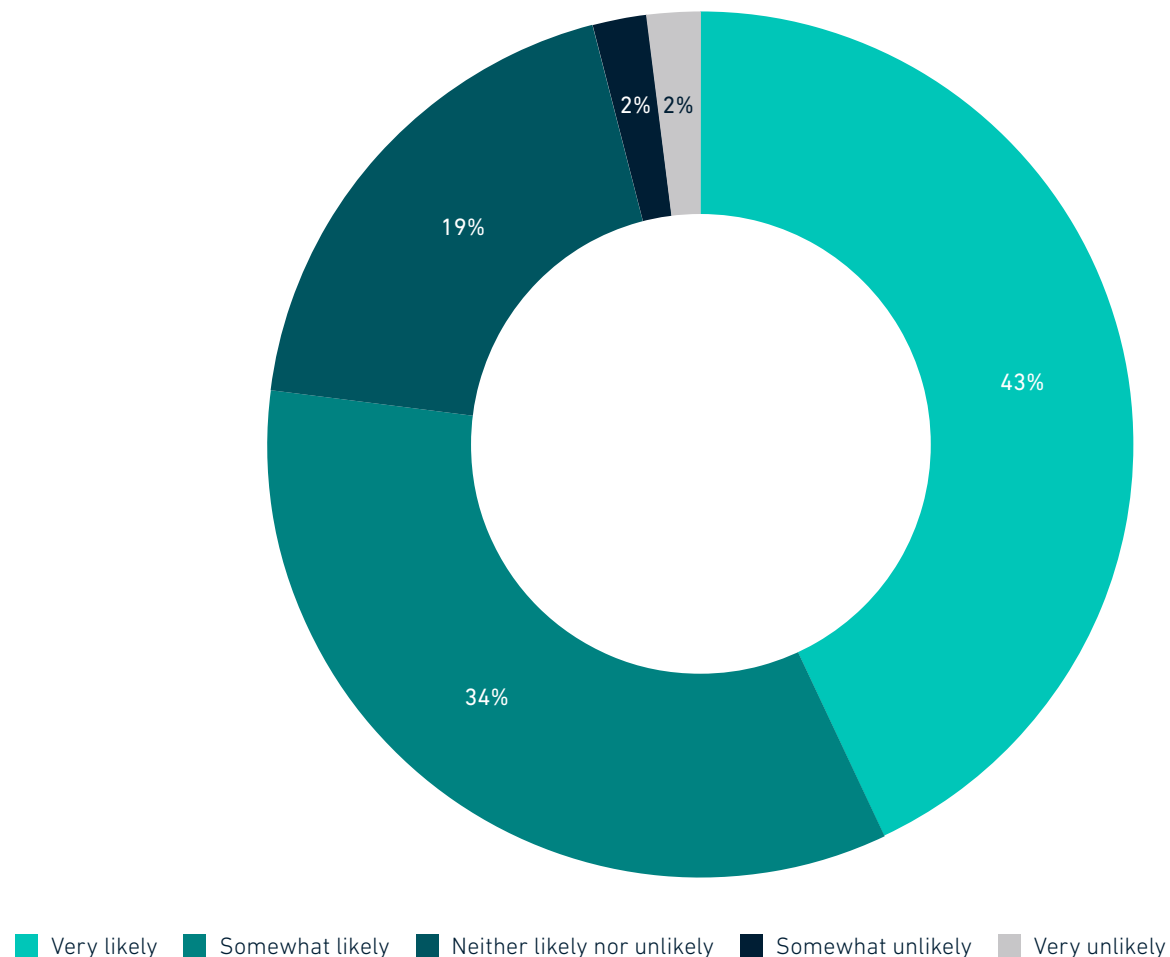


5G-Advanced and network APIs: a clear connection

- **API exposure already commonplace.** API exposure and monetisation efforts are not new for operators; 70% claim they have commercial exposure initiatives in place. This bodes well for efforts such as the GSMA's Open Gateway, which aims to develop and promote a common exposure framework.
- **APIs and B2B services.** While network API exposure will support B2B and B2C services, it aligns well with aspirations to monetise vertical-focused 5G-Advanced capabilities. It is logical, then, that more than three quarters of operators think it likely that 5G-Advanced will be a driver for API exposure.
- **Internal hurdles.** As a technology effort crossing multiple operator departments, uncertain internal ownership is cited as the biggest challenge to network API deployment. Linking deployment to the rollout of 5G-Advanced could be key to overcoming that.

Can 5G-Advanced help drive API exposure?

Likelihood to leverage 5G-Advanced to introduce network API exposure initiatives (percentage of operators)

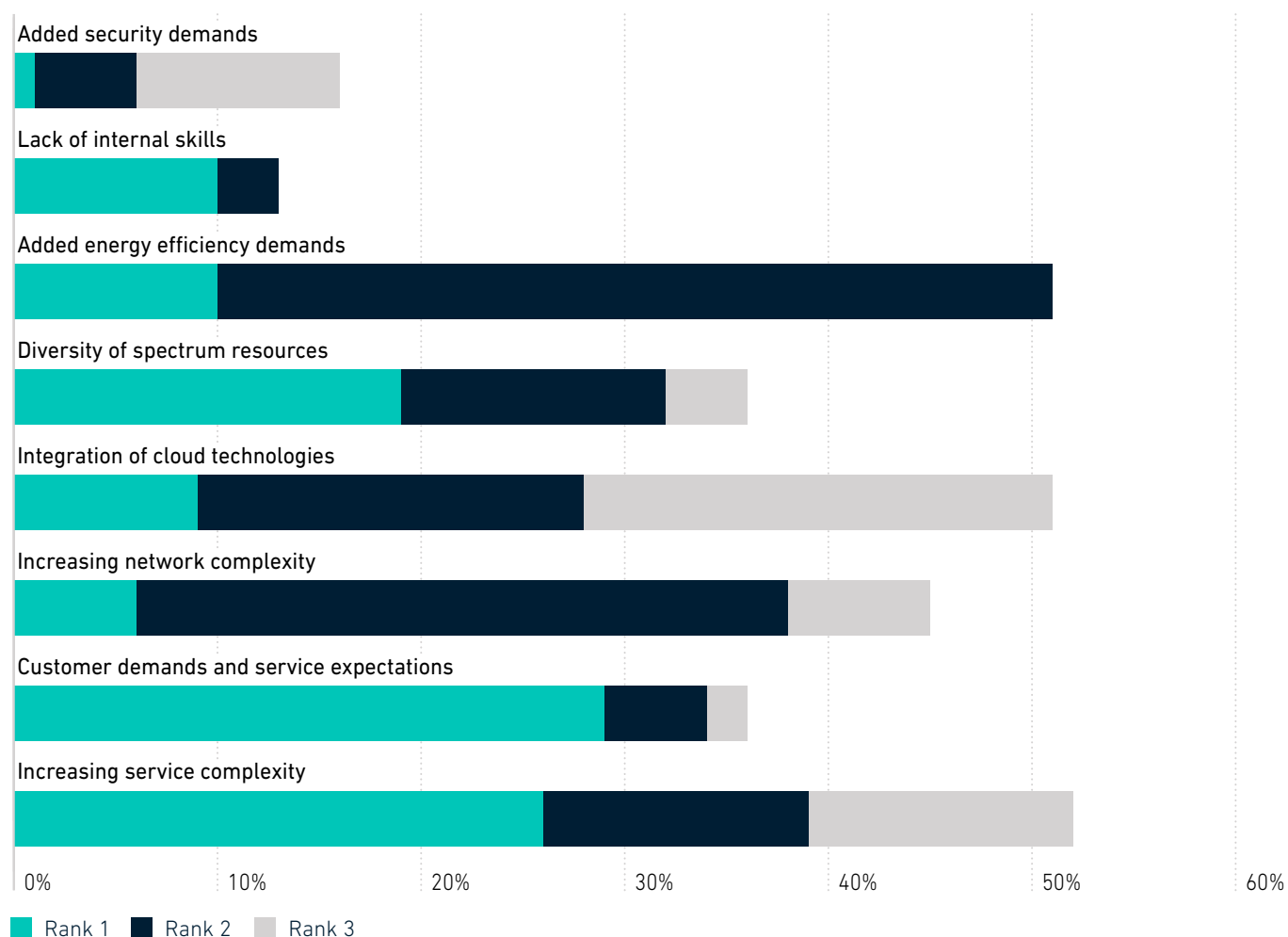


Intelligence beyond automation

- **Automation is not new.** Operators have been automating network functions for years. While no mobile network is fully automated (and will not be for some time), most parts of network and service operations are at least partly automated.
- **5G-Advanced will accelerate it.** The top drivers for operator network automation include service complexity, demanding customer expectations, network complexity and cloud adoption. 5G-Advanced should drive service and network complexity and a move to the cloud in support of new customer demand.
- **Automation versus intelligence.** Beyond the automation of specific network and service tasks, 6G envisions embedded intelligence, including an AI-native RAN and the holistic use of AI for continuous optimisation, service support and operations. As 5G's bridge to 6G, 5G-Advanced will introduce this shift.

5G-Advanced to accelerate operator network automation

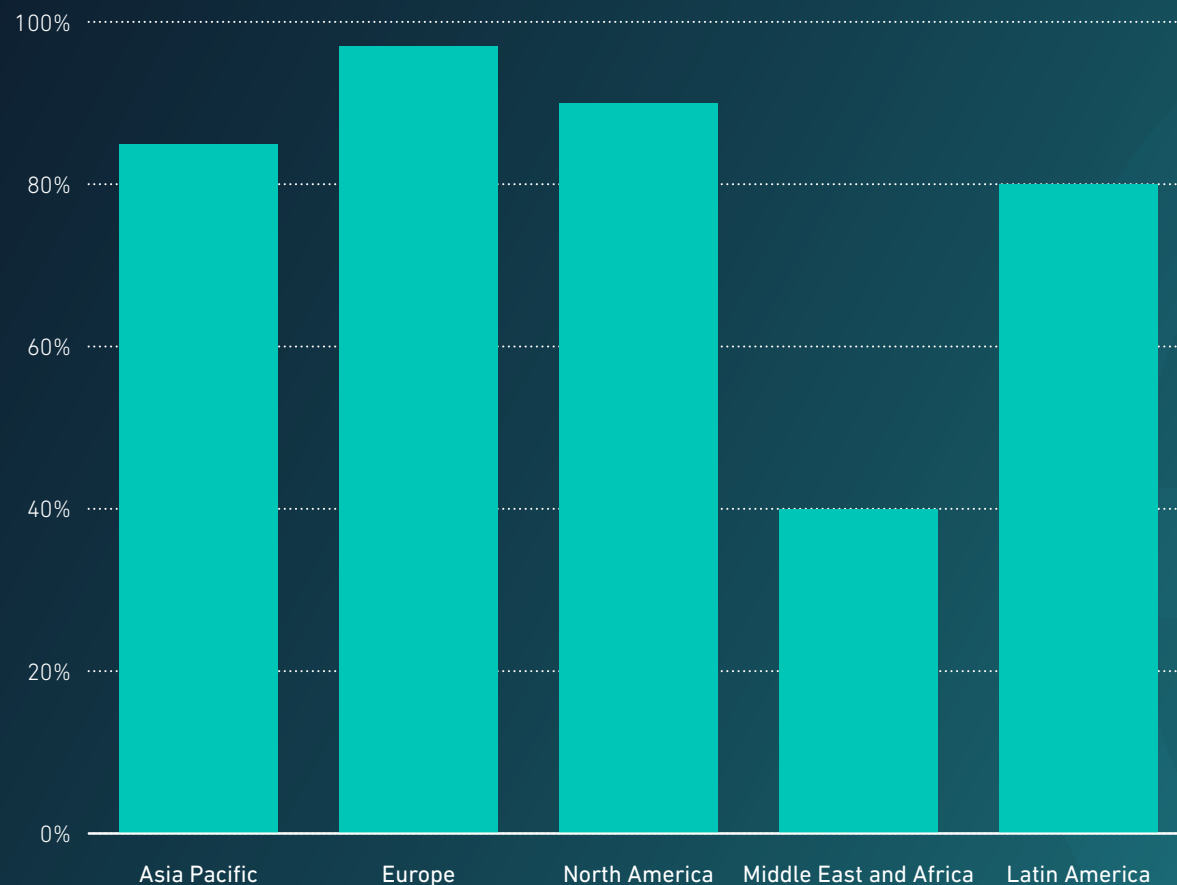
Ranking of drivers of automation across operator network assets



🌐 Regional variation

5G-Advanced deployment plans: global outlook

Plans to have 5G-Advanced deployed within two years of standards release (percentage of operators)



Source GSMA Intelligence Operators in Focus: Network Transformation Survey 2023

How advanced are 5G newcomers?

- **Leapfrog or fast follower?** As 5G-Advanced approaches, there are two options for operators that have not deployed 5G: start with the mature version or begin with the latest iteration – in this case, 5G-Advanced. Costs (network and device) are usually the deciding factor.
- **A tale of two regions.** Latin American operators seem on par with the rest of world for 5G-Advanced deployment plans. Middle East and African operators expect to be slower. This may reflect an understanding of their needs when weighed against costs and tech maturity.
- **Use cases will decide.** Timing will ultimately be decided by the RoI attached to 5G-Advanced, including new services, network efficiencies and cost of rollout. With many 5G capabilities untapped, 5G-Advanced may not be a logical near-term priority in emerging markets.

② Considerations for the year ahead

How will 5G-Advanced impact 5G SA investment?

- Despite its value in supporting key 5G capabilities, the deployment of 5G SA has been slower than most expected.
- Migration to a 5G core has proven to be the key blocker to SA deployment. Yet that same migration will be needed to enable 5G-Advanced capabilities.
- A near-term focus on SA could delay 5G-Advanced decisions given tight budgets. Alternatively, waiting for 5G-Advanced to arrive could push out SA deployment.

With 6G on the horizon, will operators see a justification for 5G-Advanced?

- 87% of operators see 6G R&D improving 5G capabilities. 5G-Advanced reflects that and represents a stepping stone to future 6G networks and services.
- 6G timing could delay 5G-Advanced deployment. But it will likely be five years before the availability of 5G-Advanced and the arrival of 6G.
- Monetisable services determine when technologies are deployed. If 5G-Advanced can deliver new revenues, operators will not wait for 6G.

Beyond the B2B opportunity, will consumer use cases contribute to 5G-Advanced momentum?

- Enterprise use cases have dominated a lot of 5G-Advanced thinking, driven by B2B revenue growth aspirations and 5G-Advanced capabilities aimed at enterprise needs.
- Many 5G-Advanced capabilities should support consumer use cases: lower-cost IoT, uplink improvements supporting consumer metaverse and video applications, etc.
- Operators still derive most revenues from B2C services, making consumer applications a natural focus for any new technology.

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Turn it up

TOPIC OVERVIEW

Fixed wireless access

5G fixed wireless access (FWA) enables operators to deliver fixed, ultra-high-speed broadband services over a cellular network, leveraging the increased capabilities of 5G.

Various factors are driving 5G FWA momentum

- A viable alternative to other fixed broadband technologies
- 5G deployments and coverage increasing steadily



FWA remains one of the hottest 5G use cases for consumers

- Most popular use case among consumers for the third year in a row



5G commercialisation shows good momentum

- Monetising 5G spectrum by launching FWA alongside other 5G-powered services



5G FWA connections grow, from a low base

- 5G FWA is the fastest growing fixed broadband technology
- 5G's share of FWA connections crosses the 50% threshold in 2024.



5G FWA will remain a niche solution in most markets

- 5G gives FWA a new lease of life, but still has limited appeal
- A disruptor but not mainstream in most countries



🌐 Regional variation



🕒 Considerations ahead



① Why it matters in 2024

5G emerges as the dominant FWA technology

5G gives FWA a new lease of life

4G FWA was only viable in areas of poor fixed coverage. With its relatively low speeds, 4G FWA was unattractive where alternative fixed broadband technologies were available.

Speeds comparable to fixed. FWA is becoming a more competitive solution thanks in part to the high speeds offered by 5G FWA, significantly reducing the deficit against established high-speed access technologies.

Availability of 5G FWA is increasing

Steady pace of 5G commercialisation. As of Q4 2023, 5G FWA services were available from 122 providers across 61 countries.

5G – the majority of FWA connections. In 2024, for the first time, 5G FWA will surpass non-5G FWA in terms of number of connections. Across the 36 fixed broadband markets GSMA Intelligence tracks, 5G FWA is forecast to account for more than 60% of the total number of FWA connections by the end of 2024.

5G FWA could be a double-edged sword

Extending reach. 5G FWA enables operators to provide fixed broadband in areas where it is not viable to do so using traditional wired technologies, such as cable and fibre.

Potential increased fixed-mobile substitution. Mobile-only providers can promote 5G FWA as an alternative to other technologies, leading consumers to abandon their fixed line altogether, relying on mobile networks for voice and data.

Various factors are driving 5G FWA momentum

- As 5G becomes more widely deployed, 5G FWA services provide an opportunity for operators to help monetise their 5G network investments and spectrum acquisitions.
- Consumers are increasingly aware of 5G and its benefits over older technologies, notably 4G, and are interested in 5G FWA services.
- New players, such as 1&1 in Germany, are entering the market to capitalise on the 5G FWA opportunity.
- As the ecosystem matures, more 5G FWA CPE is coming to market, driving down prices and stimulating demand.
- 5G FWA is a viable alternative in locations where it is not cost-effective to deploy fibre.



Increasing availability of 5G networks and spectrum

- 5G services being launched at a steady pace
- Enhanced 5G network coverage
- FWA as a complement to 5G consumer services, helping monetise 5G



Maturing ecosystem

- Growing number of 5G FWA devices
- New players entering the market
- Increasing consumer awareness of 5G FWA, leading to rising demand



Other factors

- Initiatives promoting digital inclusion, e.g. broadband connectivity in rural areas
- Sunsetting of legacy fixed broadband technologies, notably DSL



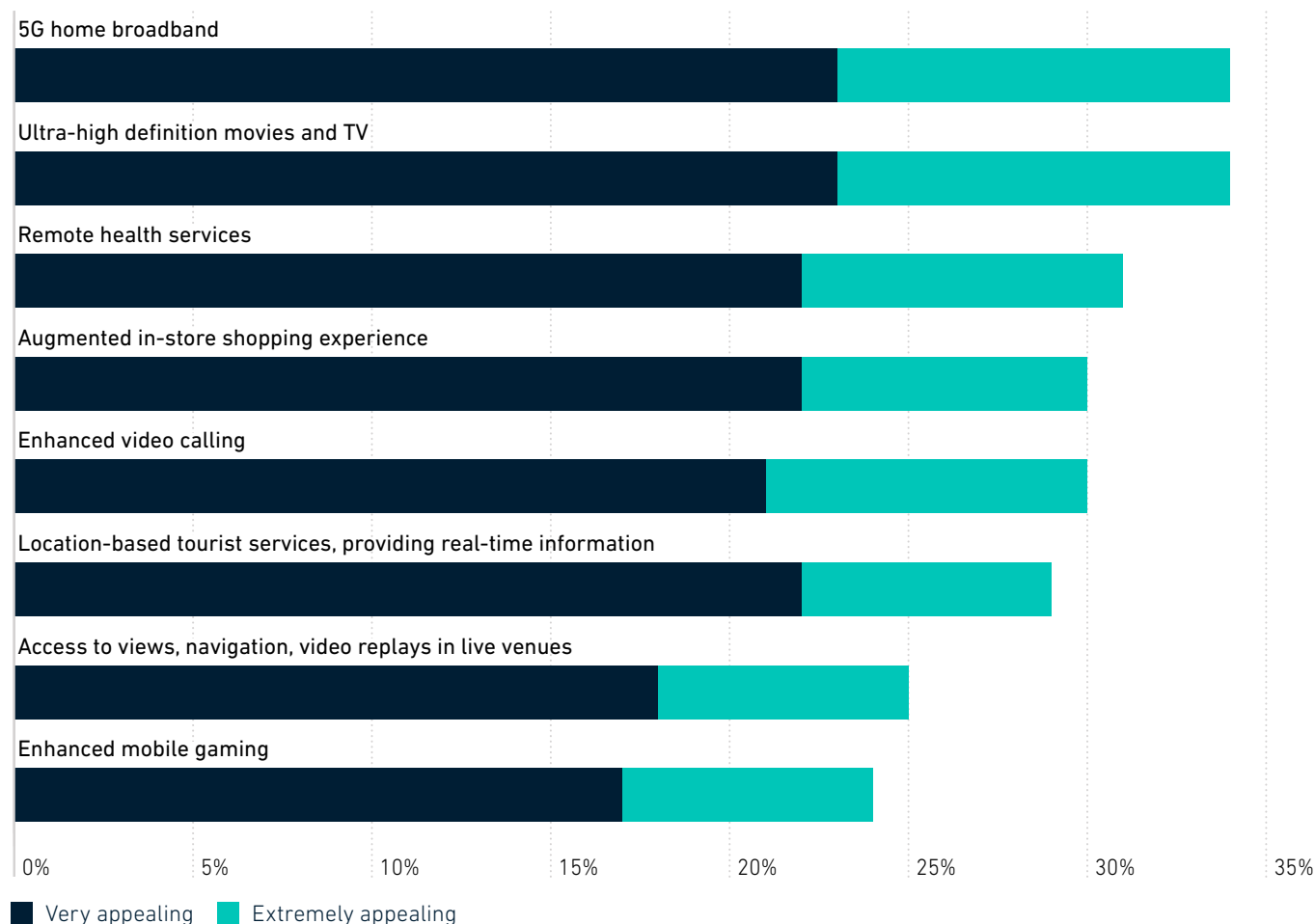
5G FWA growth

FWA remains one of the hottest 5G use cases for consumers

- **A leading 5G use case for the third year in a row.** Some 34% of respondents across all countries surveyed find 5G home broadband either very or extremely appealing.
- **Wide variations between countries.** Although 5G FWA is cited as the most appealing 5G application in five out of eight countries (France, Germany, Italy, UK and US), the percentage of respondents selecting it varies significantly from one country to another, ranging from 23% in France to 45% in the US. The US is currently the world's largest 5G FWA market, with 7.7 million connections at the end of 2023, representing 6.1% of the total fixed broadband market. In China, Japan and South Korea, UHD video streaming is cited as the most appealing 5G use case.

Consumer interest in 5G use cases

Percentage of smartphone users who find the following 5G use cases or 5G-enhanced services 'very' or 'extremely' appealing (aggregate figures across China, France, Germany, Italy, Japan, South Korea, UK and US)



5G FWA commercialisation shows good momentum

5G FWA service commercialisation

Q4 2023



122

Live networks

+



21

Planned

=



143

Total networks

across **68** countries
worldwide

Use case scenarios

1

Targeting new fixed broadband users in underserved markets

Countries with limited fixed broadband infrastructure coverage and low service penetration

2

Targeting fixed broadband users looking for faster speeds

Replacement of copper-based solutions in countries with limited fibre coverage

3

Complementing fibre offerings

FWA has lower upfront deployment costs than fibre

4

Entering the fixed broadband market

5G FWA enables mobile-only operators to offer a viable alternative to other technologies

5

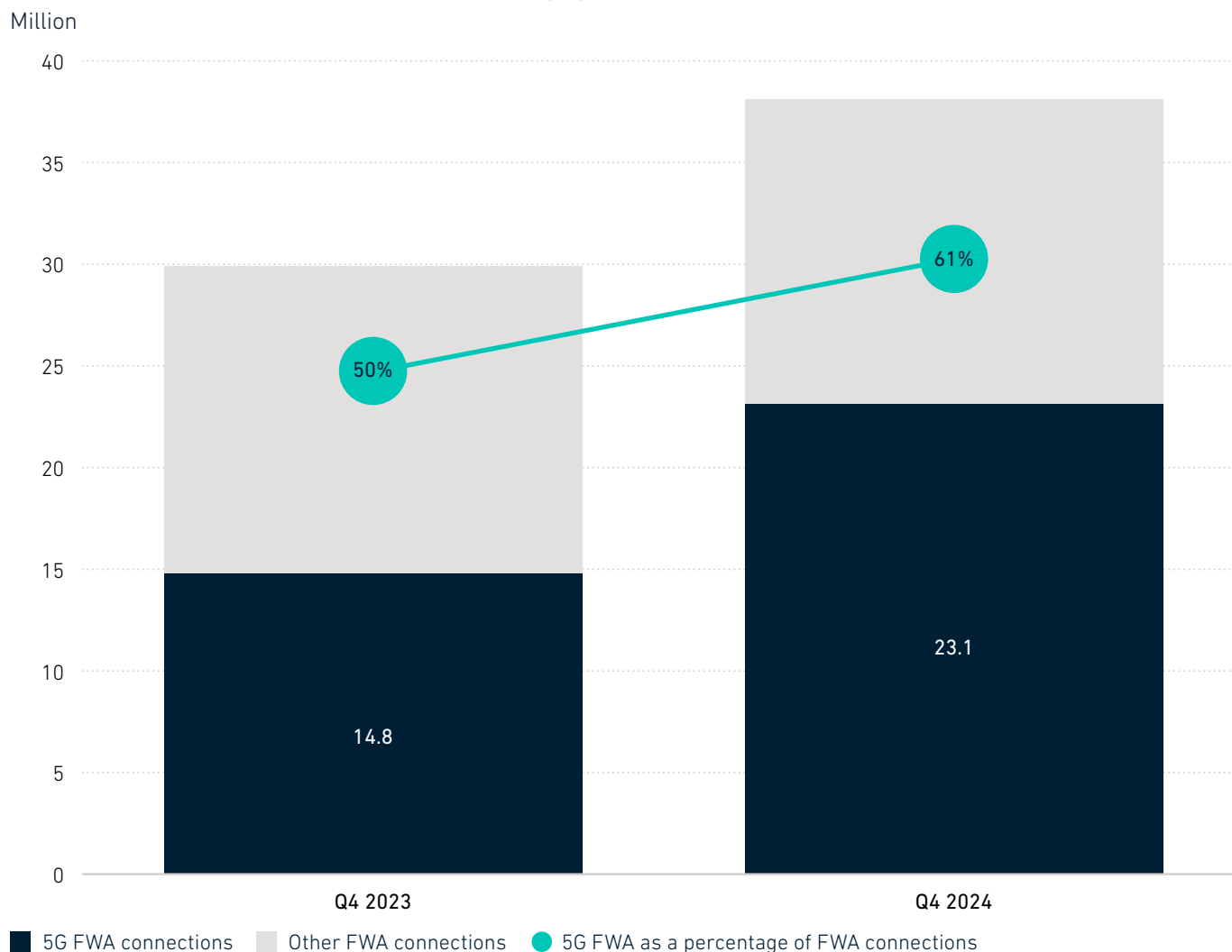
Targeting the enterprise market

Small and medium-sized companies are the most likely target

5G FWA connections grow, from a low base

- **Strong 5G FWA growth.** The number of 5G FWA connections across the 36 countries included in the GSMA Intelligence forecast will increase by 55.4% during 2024 - from 14.8 million to 23.1 million.
- **5G FWA as percentage of all FWA connections crosses the 50% threshold.** The number of non-5G FWA connections will decline by 0.6% in 2024, from 15.1 million to 15.0 million, resulting in a growth rate of 27.1% for total FWA connections, which increase from 30.0 million to 38.1 million. 5G's share of FWA connections therefore increases from 49.5% to 60.5% over the period.

5G FWA connections show strong growth

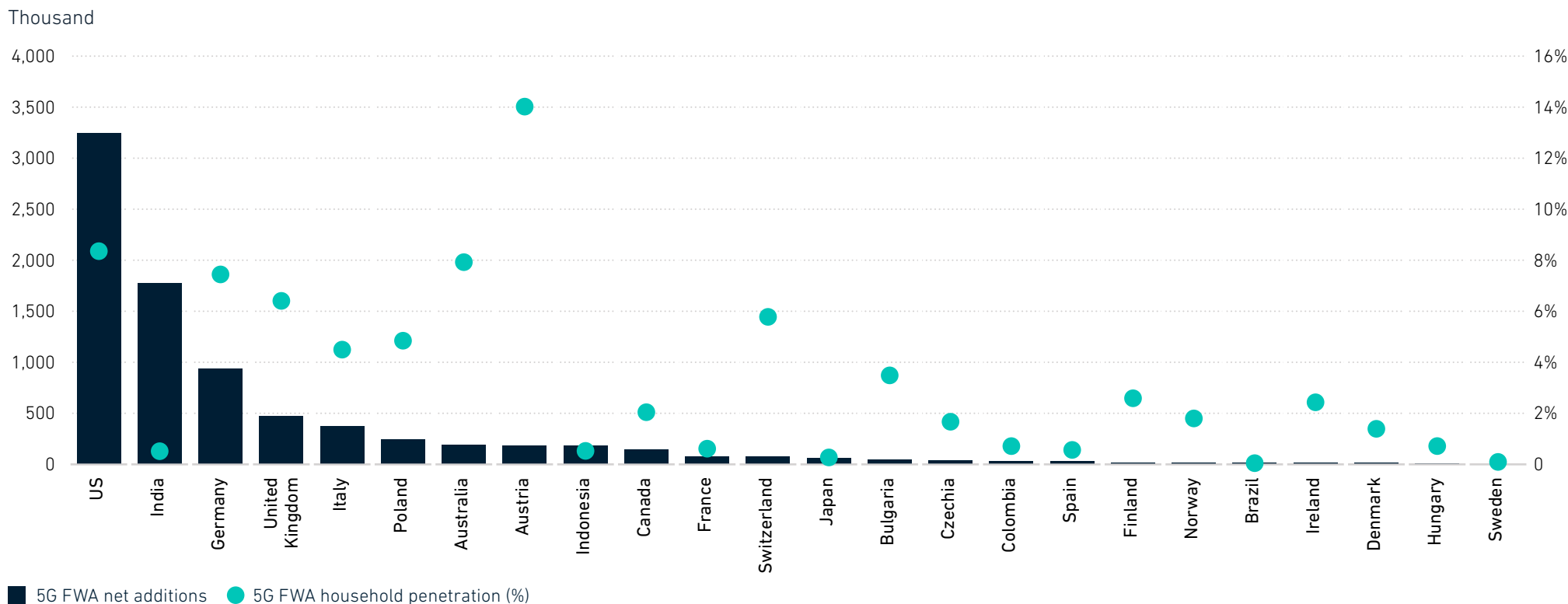


5G FWA will remain a niche solution in most markets

Most 5G FWA net additions during 2024 will be in the US and India. The two countries will account for more than 60% of total 5G FWA net additions in 2024, with Germany, the UK and Italy representing another 20%. Despite strong growth in India, 5G FWA remains a niche technology, with household penetration at 0.5% at the end of 2024. This is the case in most countries, as

average household penetration across the 24 countries included in the GSMA Intelligence forecasts that have 5G FWA services is just 3.3%. Only a handful of countries will have household penetration that exceeds 5% by the end of 2024: Austria (14.0%), US (8.4%), Australia (7.9%), Germany (7.4%), UK (6.4%) and Switzerland (5.8%).

5G FWA net additions and household penetration in 2024



🌐 Regional variation

Europe

- Germany remains the world's second largest market for 5G FWA, with 3.1 million connections, representing 8.0% of total fixed broadband connections at the end of 2024.
- Austria remains the country with the highest percentage of 5G FWA connections, reaching 18.4% of total fixed broadband connections. Operator Drei (Three) uses network slicing to offer guaranteed speeds.
- Italy and the UK are examples of other markets where 5G FWA is gaining traction, with their share of total fixed broadband connections reaching 6.3% by the end of 2024.

North America

- 5G FWA has gained a foothold in the US, where it will account for 8.5% of all fixed broadband connections by the end of 2024. With just under 11 million connections at the end of 2024, it remains the world's largest market for 5G FWA. T-Mobile and Verizon reported nearly 7.4 million FWA subscribers between them as of Q4 2023.

Asia

- With just under 2 million connections at the end of 2024, India will be the world's third largest 5G FWA market, and the biggest in Asia. Australia will be the second largest market in Asia, with nearly 718,000 5G FWA connections at the end of 2024.
- There are no 5G FWA services in major markets such as China and South Korea. Both have high fibre penetration, which is forecast to account for more than 90% of all fixed broadband connections at the end of 2024.

② Considerations for the year ahead

How should operators position 5G FWA?

- Converged operators can use 5G FWA to target subscribers where it is not viable to do so via fixed infrastructure, but will need to ensure 5G FWA does not cannibalise fixed broadband alternatives (e.g. cable or FTTP/B) offered within their footprint.
- Mobile-only operators can position 5G FWA as an alternative to existing fixed broadband technologies, and could bundle it with streaming video services to better compete against fixed multiplay bundles.

How should operators price and package 5G FWA?

- Pricing needs to be competitive versus other fixed broadband technologies. Operators could pass on savings made from lower deployment costs to subscribers.
- Operators could consider usage-based pricing in line with current practice for mobile data, giving low users an opportunity to pay less for the service, as they place fewer demands on network capacity.

How can operators defend against fixed-mobile substitution?

- Fixed/converged operators should emphasise the reduced risk of congestion and/or interference with wired technologies, and can reinforce this advantage through emerging services such as fibre-to-the-room (FTTR). FWA requires trade-offs between capacity and coverage that need to be carefully managed to optimise the user experience.

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5G-Advanced

Fixed wireless access

Cloud and edge

The future of entertainment

Private wireless networks

eSIM

Satellites and NTN

Sustainability and circularity



Generative AI

Is there a future for the generative telco?

TOPIC OVERVIEW

Generative AI

Leveraging foundation and large language models, generative AI (genAI) is a branch of AI focused on content generation beyond content explicitly present in training data. Thanks to tools such as ChatGPT, genAI has been made accessible to a broad set of skilled and unskilled users, driving scale, reach and impact.

**GenAI Rol:
operators pay attention**

- Rol guides new tech deployment decisions...
- ...assuming the technology is mature enough
- Successful examples pave the way in 2024



**Internal versus external
use cases**

- Making money versus saving money – an eternal trade-off
- Internal use cases and easy wins
- External use cases and the operator growth imperative



**It's everywhere:
distributed genAI**

- Where will genAI live?
- Where do operators expect data traffic to be processed?
- Distributing genAI to where it is needed



**Silicon battleground:
v2 and beyond**

- What exactly is AI silicon?
- Hype + supply chain = opportunity



① Why it matters in 2024

Generative AI has the power to revolutionise the way people, society and businesses operate – operators included

Scale and use cases

GenAI democratisation. The ability of people with a broad array of skills to leverage genAI tools has been key to its rapid uptake and value exploration.

User, application and stakeholder scale. GenAI usage scale – across users, applications and engaged stakeholders – leads to network effects which further drive its applications, visibility and value.

2023's examples set the stage. Operator efforts to leverage genAI will serve as a foundation to the exploration and development of use cases and applications in 2024.

Models, models, models

Open source savings. As operators develop genAI applications, open source models will take on new importance as a starting point.

Operator-specific LLMs. Whether there is a need for telco LLMs and what value they provide were questions in 2023 which may get answered in 2024.

Beyond ChatGPT. Open AI took genAI into the mainstream, but a proliferation of tools, models and use cases signals the growing options available to operators. This will only accelerate in 2024, making flexible model support and customisation key.

Skilling and exposure

Familiarity versus skills. GenAI skills development will be critical for putting it to use. But a basic understanding of how genAI can be used will drive broader usage across companies and society.

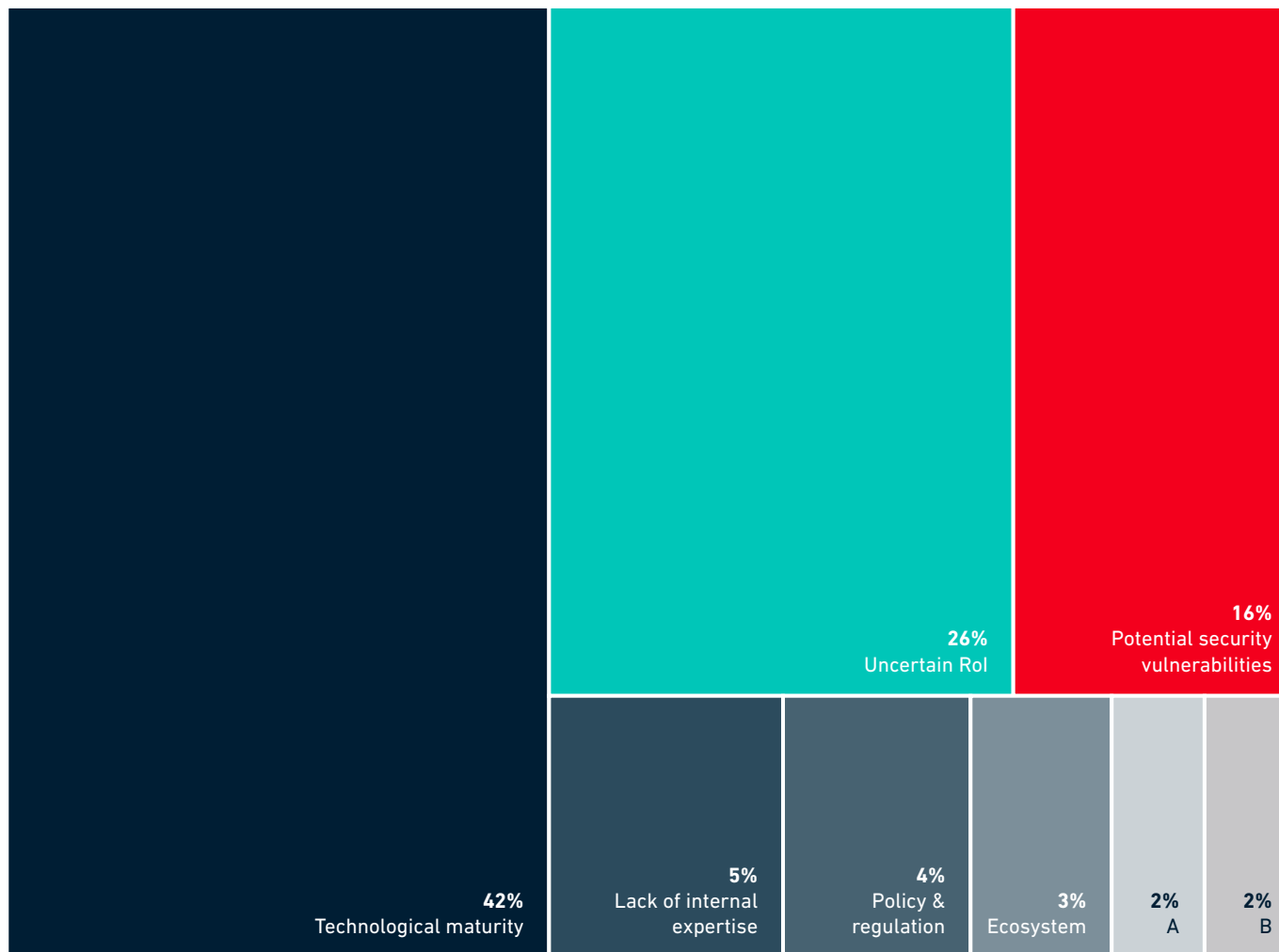
Simple tools versus expert users. If limited to expert users, genAI value will not spread. Accessibility across operator users will be key.

In-house versus partner capabilities. Few companies maintain the expertise to fully exploit genAI's capabilities. Partners are critical. Operators will need to balance homegrown versus outsourced effort.

GenAI Rol: operators pay attention

- **Does it work?** The first concern with any new technology is whether or not it can be made to work and deliver on its promise. It should not be surprising that technology maturity is the top genAI deployment concern for operators going into 2024.
- **Is it worth it?** Whether or not a technology can be made to work, there needs to be an investment case behind it, including the costs involved in deployment and operation. The Rol for new technologies is not always clear, and genAI is no exception.
- **Success guides the way.** If tech maturity and Rol dominate operator thinking as they plan their genAI rollout, deployments that prove the technology’s capabilities and its business value will make or break its reputation. Quick wins are key. Working with partners who have off-the-shelf genAI solutions in place – for internal and external use cases – will help.

Top obstacles to operator genAI deployment

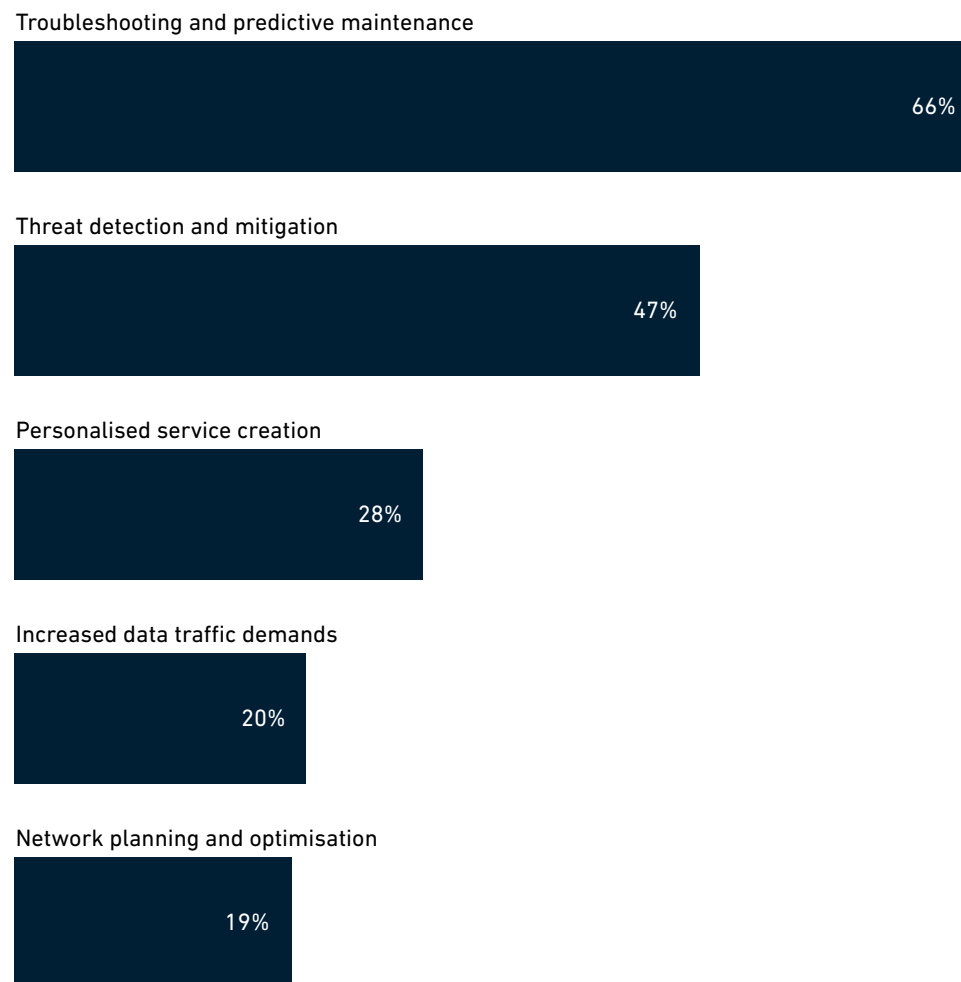


A – Uncertain internal ownership/coordination B – Integration of technology into existing network

Internal versus external use cases

- **Making money versus saving money.** Beyond regulatory compliance, operators embark on new activities either to drive new revenues or improve operational efficiency. One looks externally to grow the business; the other looks internally at the operator's operations.
- **Network-focused wins first.** When operators were surveyed about how they expect genAI to impact their business, the top responses were inward-looking: network troubleshooting and threat detection. This is a natural place to start with any new technology, as operators understand their own networks very well and can control them more than they can external business factors.
- **Growth imperative.** Revenues and customer experience dominate operators' strategic focus. GenAI deployment therefore needs greater focus on external use cases. Data monetisation, in particular, deserves more attention. Data lake development can support this, with products such as AWS Telco Data Lake proving valuable in leveraging diverse operator data sources.

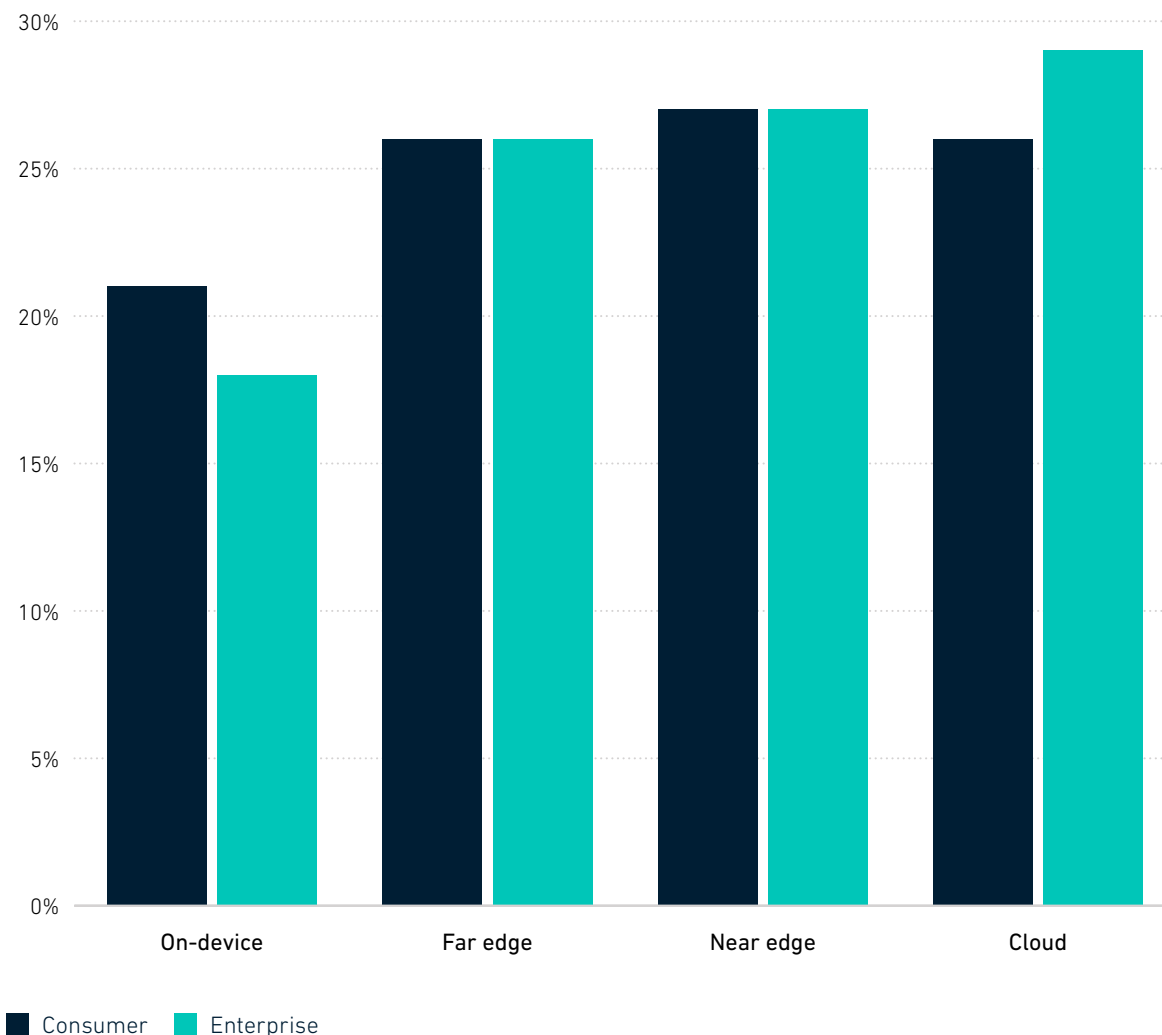
Greatest business impact from genAI deployment



It's everywhere: distributed genAI

- **Where will genAI live?** Most familiar genAI use cases have been driven by applications residing in the cloud. However, large enterprises, including operators, may look to on-premise support based on security, privacy, governance or performance requirements.
- **The distributed telco.** What does “on-premise” mean for an operator? GSMA Intelligence probed operators on where data traffic is processed across their networks. The distribution of operator networks is clear, with most workloads in the core of the network (cloud) but with traffic also spread across the device and network edge.
- **GenAI at the edge.** Given the distribution of operator networks, it is not surprising that edge compute is the No.1 area of investment expected to result from genAI. Operators’ edge nodes may not have the powering or real estate required to support demanding genAI workloads. Hyperscaler edge assets – such as AWS Local Zones, AWS Wavelength and AWS Outpost – can yield a solution.

Where data traffic is processed in operator networks



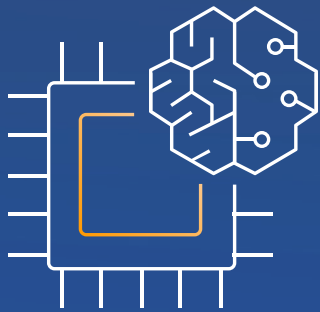
Silicon battleground: v2 and beyond

- What is AI silicon?** During the second half of 2023 alone, there were many high-profile chipset launches all invoking AI as a core value proposition. Some were server CPUs with AI enhancements. Some were AI-specific solutions aimed at functions such as model training. Some were client-side solutions promising to imbue smartphones and PCs with new AI capabilities.
- Hype + scarcity = opportunity.** GenAI fervour combined with limited availability of some AI silicon drove the development of new solutions – as did the need for specialised functions. This will only accelerate in 2024.
- ‘Horses for courses’.** While AI support is a common marketing message, operators need to understand how to leverage diverse solutions for specific purposes, ultimately relying on a mix – and evolving that mix over time. This will require deployment and operational flexibility, with cloud providers that host diverse AI silicon assets playing well into the mix.

Key AI-related chipset launches: H2 2023

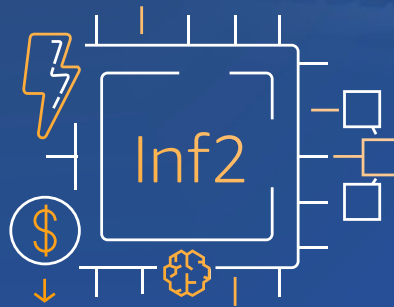
Date	Supplier	Product
August	Nvidia	GH200 (Grace Hopper)
August	Google	TPU v5e
October	Google	Tensor G3
October	Qualcomm	Snapdragon X Elite
November	Nvidia	HGX H200
November	Qualcomm	AI 100 Ultra
November	AMD	Instinct MI300X/A
November	Microsoft Azure	Maia AI Accelerator
November	AWS	Trainium2
November	AWS	Graviton4
December	Intel	Core Ultra
December	Intel	5th Gen XEON

AWS is the best place to train and run inference at scale with infrastructure purpose-built for ML.



AWS Trainium2

4x faster



AWS Inferentia2

4x higher throughput
10x lower latency

Deutsche Telekom are **improving throughput and latency** at a fraction of the cost with AWS



Angel Mario Castro Martinez
Lead Architect Speech Technologies and NLP, AI Platforms,
Deutsche Telekom

Watch video



🌐 Regional variation

- **Common concerns resonate.** Queried on the top obstacles to genAI deployment, operators across regions cited a core set of issues: technology maturity, uncertain RoI and security concerns.
- **Emerging market skills.** Lack of internal expertise was one of the least cited genAI deployment concerns across all regions. While skills shortages and development should be on the mind of all operators, those in emerging markets may find themselves at a disadvantage, particularly if they lack the scale to drive skills development programmes.
- **Partners and developers.** A lack of concern around genAI skills would be understandable if operators planned to engage developers and consultants to support their genAI use cases. However, partnerships came last for expected genAI investments – a view that will need to change in 2024.

Top three obstacles to operator genAI deployment, by region

	📍 Asia Pacific	📍 Europe	📍 North America	📍 Middle East and North Africa	📍 Latin America
1	Tech maturity	Tech maturity	Tech maturity (tied first)	Tech maturity	Tech maturity
2	Uncertain RoI	Uncertain RoI	Uncertain RoI (tied first)	Uncertain RoI	Security
3	Security	Security	Security	Ecosystem, expertise, policy (tied third)	RoI, policy, expertise (tied third)

② Considerations for the year ahead

Can operators get out from under a traditionally cautious mindset to fully exploit genAI?

- Operators have many reasons for moving slowly with new technologies: security or reliability issues impacting networks could yield churn or even regulatory penalties.
- As operator use of genAI takes off, a high-profile data leak becomes increasingly likely. The reputational impact could be major.
- Guarding against security, privacy or ethics risks means strict data controls, system safeguards and partners committed to comprehensive security across physical infrastructure, hardware, software, people and processes.

How much will a pragmatic approach to getting started with genAI impact deployment flexibility?

- Given the magnitude of potential genAI risks, 'analysis paralysis' is understandable. Outsized opportunities, nonetheless, are driving trials and starter deployments.
- Moving forward on initial launches, operators are spoilt for choice in terms of models and their application – a set of choices that will only grow over time.
- Deployment starting points may not represent the most appropriate genAI applications. An ability to easily adopt new tools and models will be critical.

Can operators move beyond a focus on AI experts to become truly AI native?

- The concept of an AI-native organisation is one where AI tools and processes are integrated deeply across business units, delivering synergies and spreading the value.
- Realising the AI-native operator will require expertise development and upskilling to ensure that genAI does not remain the domain of experts alone.
- Training employees on AI tools, capabilities and best practices will be critical for operators, but not necessarily easy. Partners will play an important role. AWS, for example, has worked with operators such as Telia on cloud training that could be extended to genAI.

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Cloud and edge



Equal parts brawn and brain

TOPIC OVERVIEW

Cloud and edge

Cloud compute is the foundation for processing a sizeable share of global internet traffic and, in particular, the services that collectively make up the digitisation taking place across the economy. Edge refers to a continuum of nodes that allows compute services to be deployed closer to where data is created and consumed.

Inexorable rise in compute demands

- Drivers and pull factors
- Cloud and edge investment
- AI influence



Cloud-native 5G (and eventually 6G) demands more compute capacity

- Cloud-native everything
- 5G and 6G outlook



Localisation is driving demand for edge

- Heart of enterprise digitisation
- Cloud versus on-premises
- Partnerships



Top industry targets for 5G

- 5G sales across multiple sectors
- Leading examples in action



Outlook: priorities and proof points

- Operator investment priorities
- Proof points



🌐 Regional variation



🕒 Considerations ahead



① Why it matters in 2024

Underpinning digitisation across the economy

Insatiable rise in compute

Demands grow ever higher. Data traffic (mobile and fixed) will grow sixfold between 2022 and 2030. The challenge is managing the shift in processing as more moves to the cloud and edge, particularly on-premises.

GenAI phenomenon. GenAI represents a paradigm shift in computing, which also implies a significant increase in processing power for workloads, with both silicon and infrastructure-level innovation key.

Localisation

Power to the users. Companies will increasingly prefer to place compute infrastructure near to their operations to enable low-latency applications such as robotics and AR (in an industrial context).

Cloud everywhere. Edge servers combined with 5G links should help MEC upgrades, though the public cloud is also moving out to more end points to create a larger compute footprint.

B2B – the main 5G driver

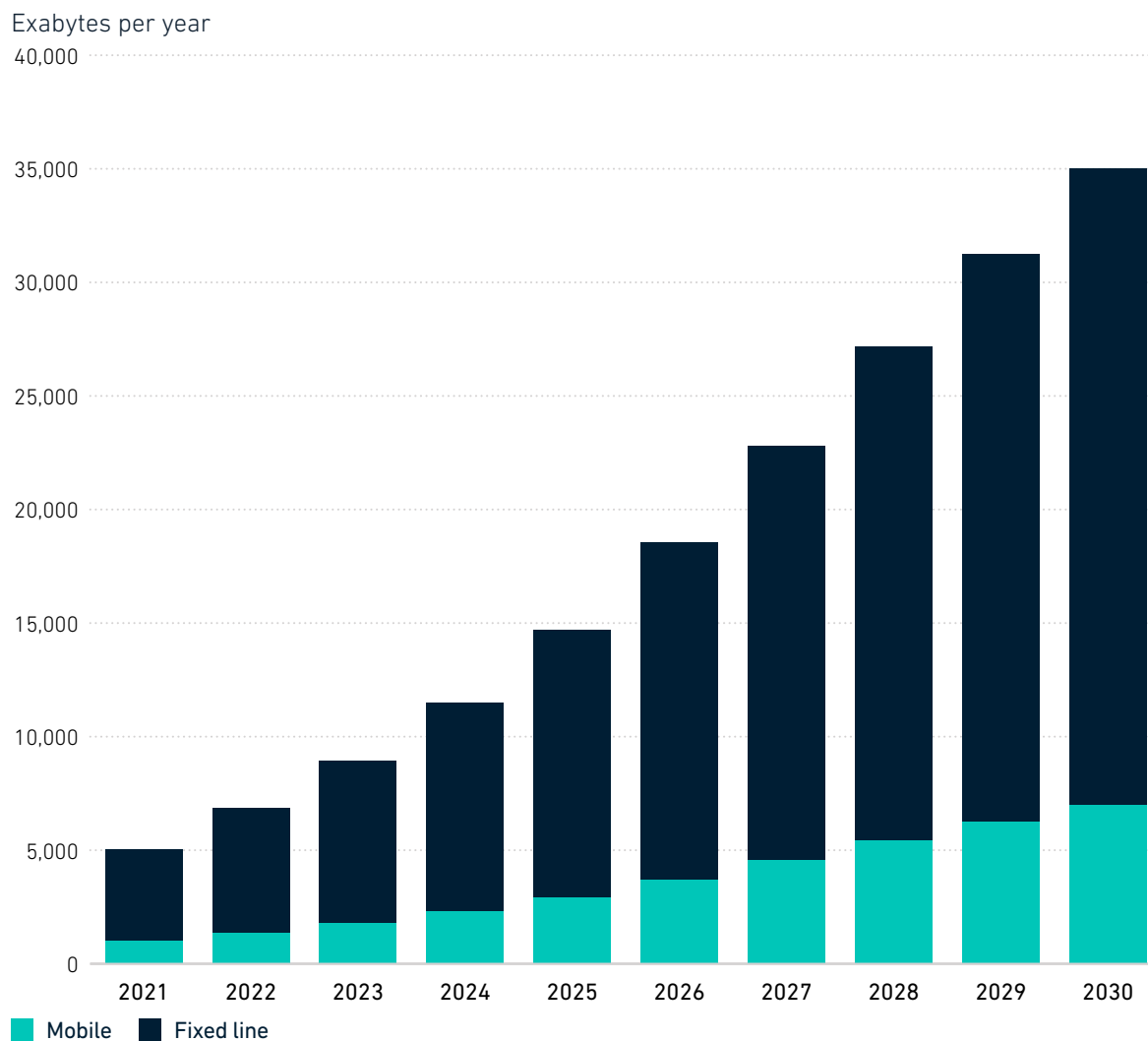
Newcomers. Which industries are most fertile for 5G sales? Manufacturing is still seen as promising but media, broadcast, retail and agriculture have recently risen up the agenda, playing to private 5G and localised compute.

Sustainability to the fore. Energy efficiencies are becoming a competitive USP, but most operators view themselves as behind (50%) rather than ahead (30%) on a product level, opening a new competitive front.

Inexorable rise in compute demand

- Pull factors.** The combination of 5G subscriber upgrades and increased household fibre penetration means data traffic will continue to rise exponentially. In total, GSMA Intelligence forecasts this to increase sixfold on 2022 levels, with fixed reaching about 28,000 exabytes per year globally in 2030, and mobile roughly a quarter of this (but with the same growth rate).
- Bedrock investments.** Even though each successive generation of mobile carries a higher spectral efficiency, the sheer volume of traffic necessitates investment in and reliance on cloud and edge infrastructure to help carry the load. AWS, Microsoft and Google have all made major datacentre investments to augment capacity needed for AI training (which could be 5-10× current processing capacity).
- AI x-factor.** The other key change in the last year is the rapid rise in AI. Large language models (LLMs) will develop further, potentially much further, than the current performance from ChatGPT and the like, in turn placing additional pressure on computing resources to satisfy algorithm processing. AWS' announcement of new chips in November 2023 (Graviton4 and Trainium2) speaks to this need, bringing price-performance improvements of 30%.

Global internet traffic: a sixfold rise by the end of the decade

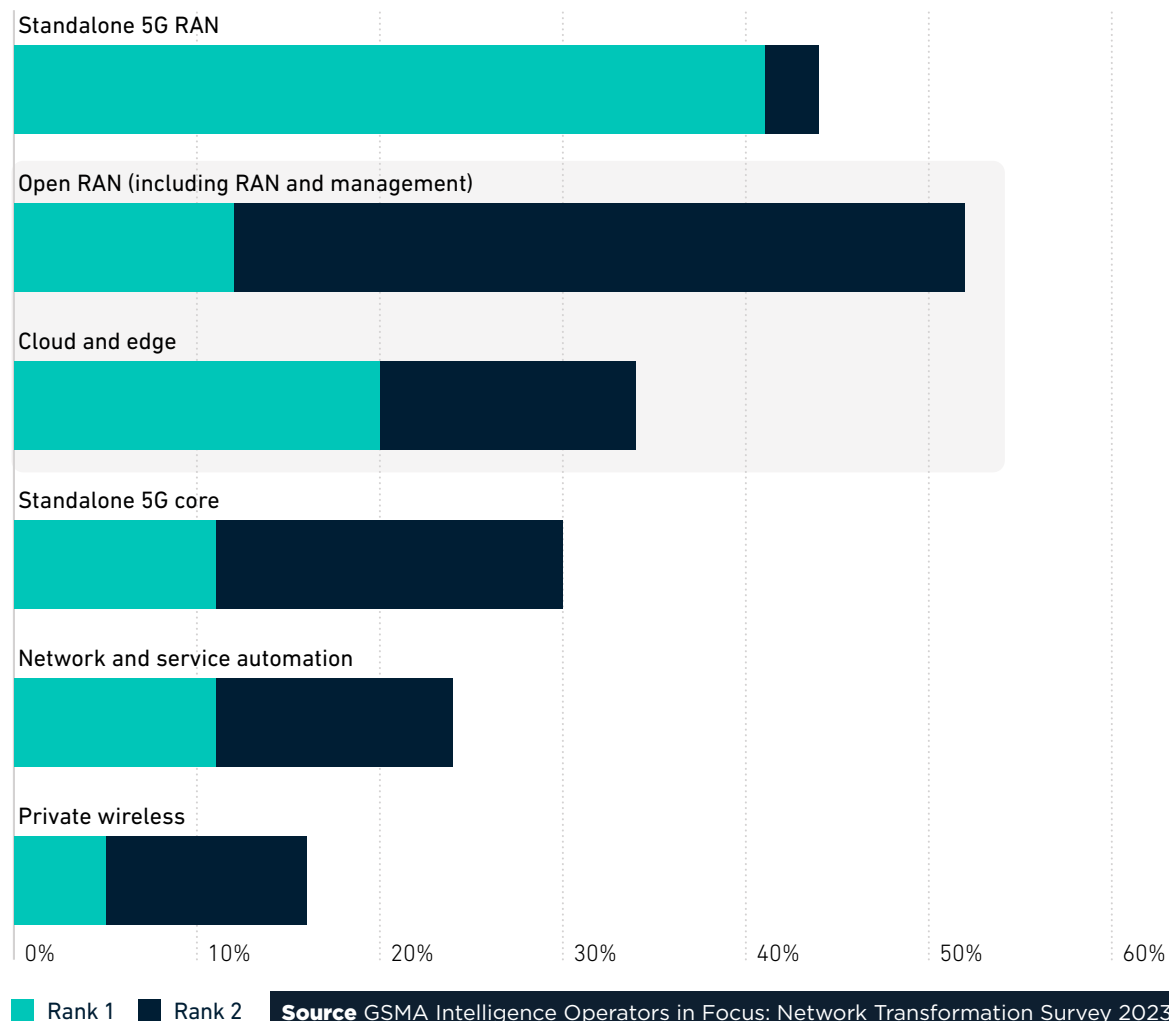


Cloud-native 5G (and eventually 6G) demands more compute capacity

- **Rewind five years.** The concept of a cloud-native network is not new. 5G builds were envisaged as being hosted in the cloud from the get-go in some of the early-adopter countries (notably China), particularly where infrastructure was built as structurally separate from LTE (standalone networks).
- **Early builds on non-standalone.** Standalone was a more expensive option; for this reason, it was not widely adopted in regions where revenue growth and cashflow margins were more difficult, such as Europe.
- **Standalone revival.** It is only now, five years after 5G first launched, that standalone 5G radio networks are a top buying priority for operators.
- **Link with cloud and edge.** Cloud and edge compute was positioned as a separate category in the survey (see chart), with 35% of operators rating these as a No.1 or 2 priorities. In reality, though, the line between cloud/edge and standalone 5G RAN is blurred as one often feeds the other. The same linkage will hold once 6G standards are formed towards the end of the decade.

How operators are thinking about network investments in 2024

Over the next 24 months, in which technologies and capabilities do you expect to make the greatest network investment? (Top two choices – ranked)

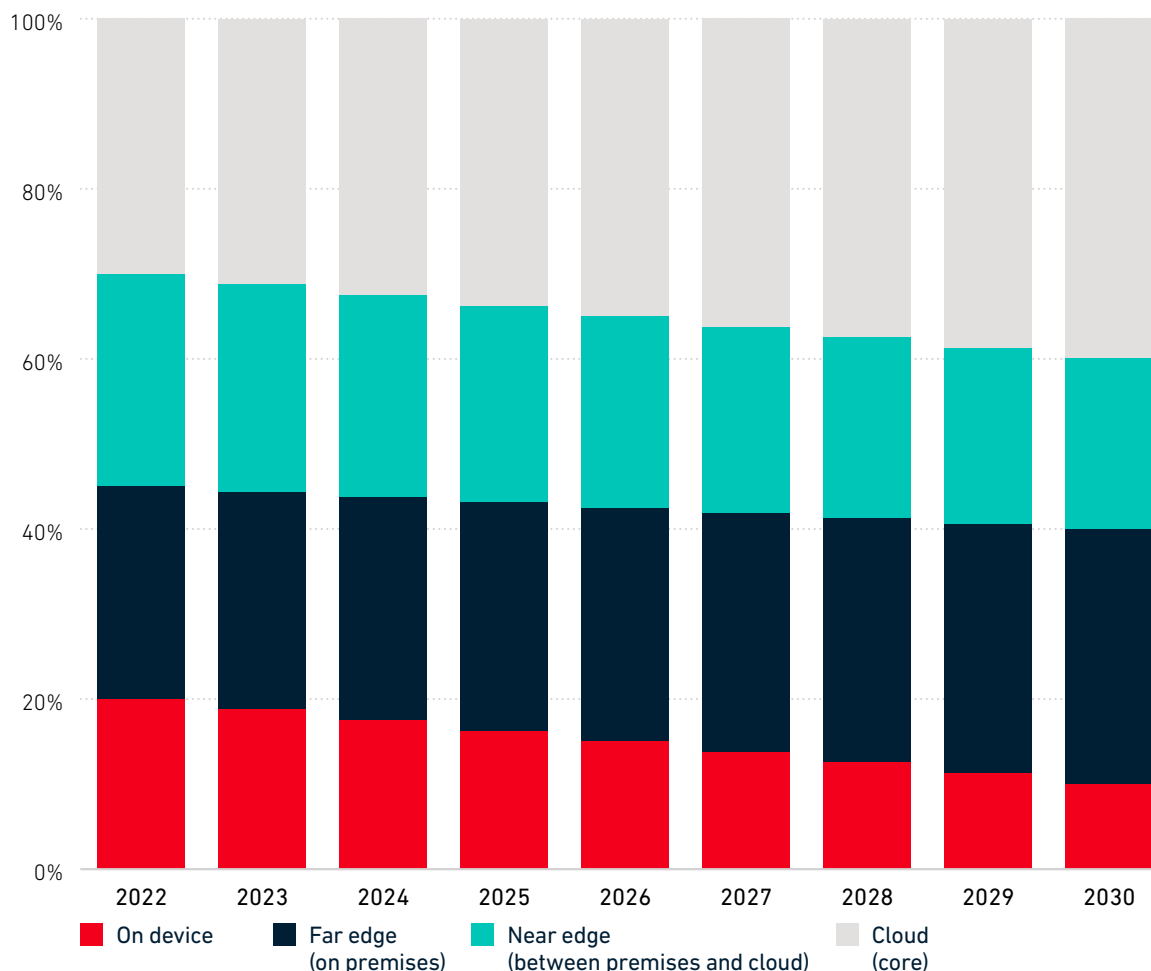


Localisation is driving demand for edge

- It takes a village.** Where traffic is processed is just as important as the rise in traffic. Operator networks are not a single ‘thing’ per se; rather, they are a collection of nodes that span the edge (itself a continuum) out to the public cloud (i.e. datacentres owned by AWS or other hyperscalers).
- Up and down the stack.** At present, around 30% of enterprise traffic is processed in the cloud, 25% on-premises (such as at a factory), 25% between premises and datacentres, and 20% on the device itself (be that a smartphone, car or industrial form factor such as a VR headset).
- Shifting trend.** Operators expect the cloud and on-premises edge to soak up the majority of incremental traffic over the years to 2030, with device compute commensurately lowering – perhaps reflecting the high costs associated with doing this.
- Local digitisation.** The edge point underscores a broader trend of B2B clients seeking to have more compute handled on-premises as part of industry digitisation. MEC and cloud compute are two sides of the same coin in facilitating the private wireless networks required for these operations. The next few years will see considerable growth in private wireless.

Cloud and on-premises edge to soak up the majority of the load, with share for devices falling

Percentage of enterprise data processing



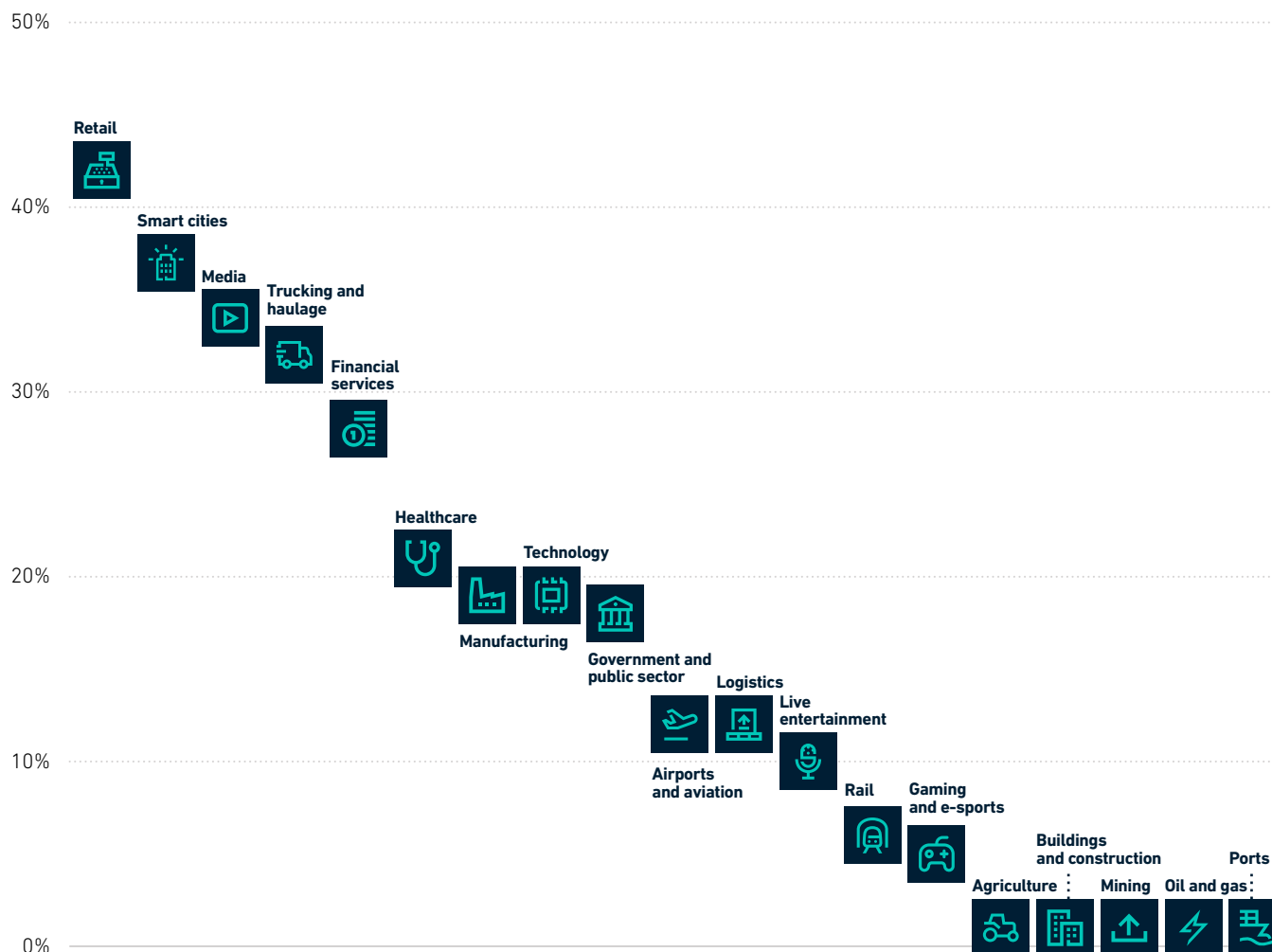
Source GSMA Intelligence survey on operator edge compute (June/July 2023)

Top industry targets for 5G

- **‘Killer apps’.** The question of what will be the next ‘killer app’ or new revenue opportunity is perennial for any technology that has had a lot of investment.
- **B2B remains the prize.** Five years on from the first commercial launches, subscriber upgrades are starting to feed through to improved revenue growth on the consumer side. However, B2B is the larger opportunity if it can be successfully executed on.
- **The long tail.** Survey sentiment suggests operators have a broad view of industries that are fertile ground for 5G revenues. Retail, smart cities, media and healthcare are examples in a long list.
- **Examples abound.** Numerous industry examples show the potential. AWS, as an industry leader, has good disclosure on its collaborations with the likes of Telia (logistics use case in Finland), Telefónica (API developer outreach) and Verizon (MEC resources for private wireless).

Top industries for 5G revenue potential

Percentage of operators ranking industry as top 1–3



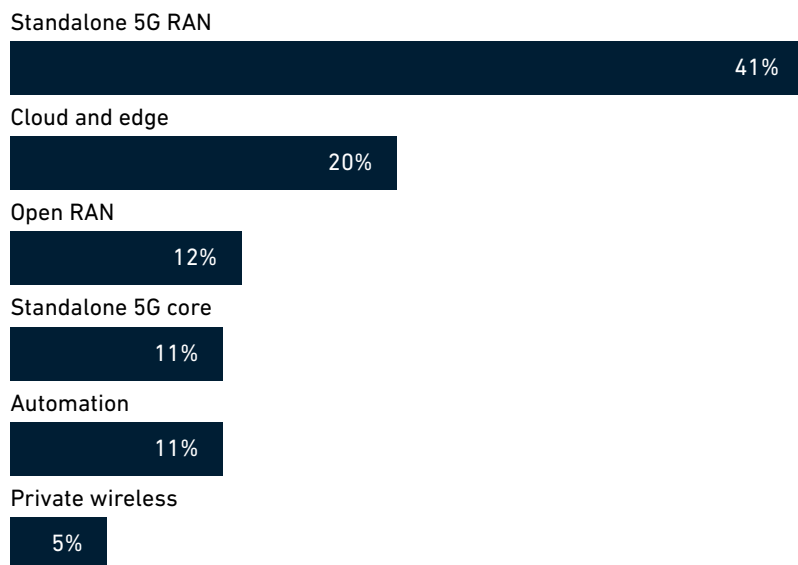
Source GSMA Intelligence survey on operator edge compute (June/July 2023)

Outlook: priorities and proof points

- **Investment priorities.** The investment implications for operators mean cloud and edge infrastructure will become crucial enablers to the 5G B2B story. Using the survey data, this time showing the No.1 ratings, standalone 5G and cloud & edge are on top.

Operator network investment priorities centre on going standalone and cloud & edge

Percentage of operators rating category as No.1 network investment priority



Source GSMA Intelligence Operators in Focus: Network Transformation Survey

- **Proof points.** It is hard to put a figure on how much this means in money terms, but this can be estimated using projections of mobile operator capex. Taking the US and Europe, where operators invest 16-18% of their revenues, the implied spend on cloud and edge would be approximately \$90 billion over the next two years. Key will be tracking returns in the form of enterprise deployments and B2B revenue. Disclosure here has been limited so far.

A potential \$90 billion on cloud and edge in the US/Europe alone over the next two years

Mobile revenue (\$ billion)	2024	2025
US	280	286
Europe	188	191

Capex (\$ billion)	2024	2025
US	47	43
Europe	35	33

Capex intensity (% revenue)	2024	2025
US	16.8%	15.0%
Europe	18.6%	17.3%

Source GSMA Intelligence

AWS Cloud Continuum

AWS WHEREVER YOU NEED IT

← Same infrastructure, services, APIs, and tools for a consistent experience →

REGIONS



AWS Global Infrastructure

METRO AREAS & TELCO NETWORKS



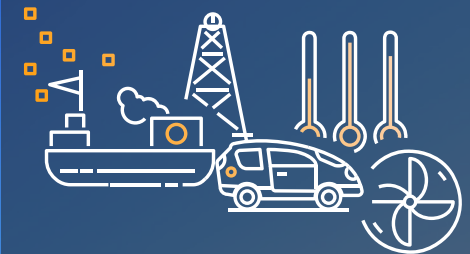
AWS CloudFront
AWS Local Zones
AWS Wavelength

ON PREMISES



AWS Outposts

FAR EDGE



AWS Outposts
AWS Snow Family of Devices

Visit aws.com/telecom for more information.

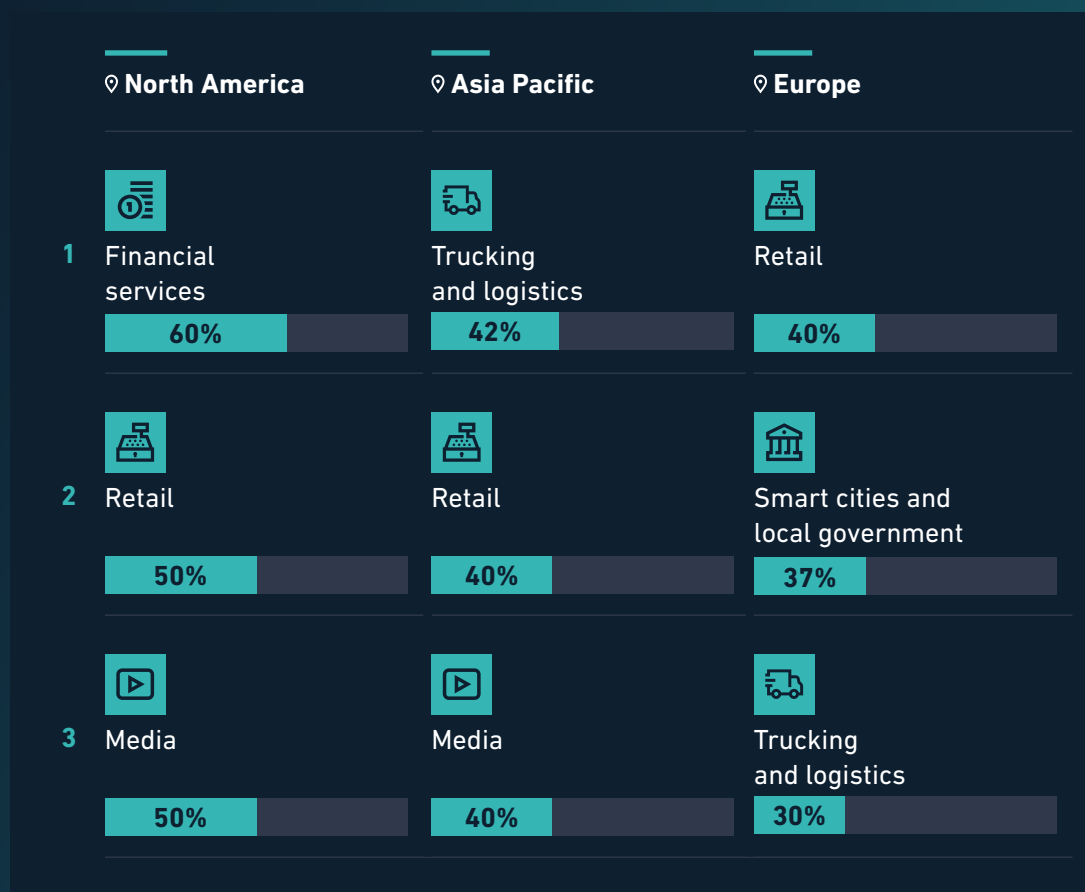


From 20% to 70% 5G coverage in 12 months

🌐 Regional variation

Which industries do operators view as the top prospects to sell 5G into?

Share of operators that rated a given sector as top 1, 2 or 3 of all the industries available



Source GSMA Intelligence

- Prospects and potential.** While 5G is a cellular technology, most of the B2B services tied to it also require the support of edge and cloud infrastructure. This satisfies processing and latency requirements inherent with companies wanting to have services running close to, or on, their own premises. The question of which industries have the highest potential is interesting because it is a sentiment indicator that (should) reflect sales activity on the ground.
- Regional variation.** There is broad consensus that media and retail are two industries with ample use cases that 5G can enable. Beyond that, operators in North America, for example, view banks and other financial services groups as most fertile, meeting the need for secure high-frequency trading and potentially private wireless. Groups in Asia and Europe see commercial freight and logistics as offering high potential. Some of this may be telematics but it also reflects the need to have just-in-time connections with shipping ports, which are increasingly equipped with private 5G.

🔗 Considerations for the year ahead

How should we think about the impact of genAI

- GenAI is a fundamental shift in the history of computing for its capabilities and its demand on resources. Putting aside the former, the capacity upgrades cannot reliably be forecast (yet), but estimates are for a 5-10× increase even on current levels by 2030.
- This means more datacentres and more productivity gains within a given datacentre. R&D investment in the chipset and datacentre processing capabilities will be crucial to meeting LLM compute demands. AWS has, for example, targeted \$15 billion for its cloud infrastructure in Japan, following a \$12 billion cumulative commitment in India by 2030.

Will the private wireless story continue?

- The cloud and edge compute infrastructure required to host private 5G is widely available in the US and Europe (as well as elsewhere), with clear momentum in deployments.
- The question is less about the infrastructure side and more the revenue model. Despite rising private wireless network deployments, disclosure on commercial results has been minimal.

To what extent does energy efficiency become a competitive USP?

- Energy efficiency, as with sustainability more broadly, is no longer a CSR domain, having firmly moved to a corporate priority.
- Boardroom commitments have not necessarily trickled down to the product level. Half of operators see sustainability as a competitive weakness, compared to 30% as a competitive strength. This implies a window of opportunity to move it to a USP, particularly for enterprise IT buyers.

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The future of entertainment

Taking in the influence
of AI

TOPIC OVERVIEW

The future of entertainment

The entertainment category covers video streaming, gaming and forays into immersive reality, which may use virtual reality (VR) and augmented reality (AR). 5G and cloud computing gains have made faster processing and latency improvements possible, while innovation in content creation continues apace.

XR remains a tantalising but niche technology

- Progress check: XR advancement continues but some way to go
- Apple's entry: an inflection point?



Gaming ushers in the age of streaming

- Cloud gaming growth – how and why?
- The advent of live viewership
- The influence of continued cloud innovation



AI promises a broad impact on entertainment

- AI appears across video and gaming workflows
- Video's evolution turns AI from novelty to necessity
- Digital gaming has been a natural fit for AI



AI is impacting the devices landscape too

- A push for on-device AI
- Hardware advances needed and being delivered



The multi-strategy route to entertainment for operators

- Operator routes: direct versus partnerships
- Mobile bundling trends support operator efforts



🌐 Regional variation



ⓘ Considerations ahead



① Why it matters in 2024

Operators and digital entertainment: partnering for mutual benefit

Digital entertainment: a focus area for operators

Increasing involvement. Operators are increasingly involved in partnerships and initiatives that are helping forge the future of digital entertainment, such as the Niantic AR Alliance and the Telco AI Alliance.

Good for growth. Operator interest in digital entertainment fundamentally stems from its popularity among consumers and the potential to monetise this as part of, or on top of, 5G bundled tariffs.

Diversification for growth

Growing presence in the digital ecosystem. If done well, digital entertainment is a good fit for operators' strategy of service and revenue diversification to offset low revenue growth in mobile and fixed connectivity.

Direct versus partnerships. Operators can go directly to consumers (D2C) or play an intermediary role, typically as a distribution partner. Both are used; the key is understanding the trade-offs, especially when D2C involves large investments in content generation.

A symbiotic relationship

Future is tied together. Future advances in digital entertainment rely on advances in connectivity such as 5G and related network innovations like edge compute and network slicing.

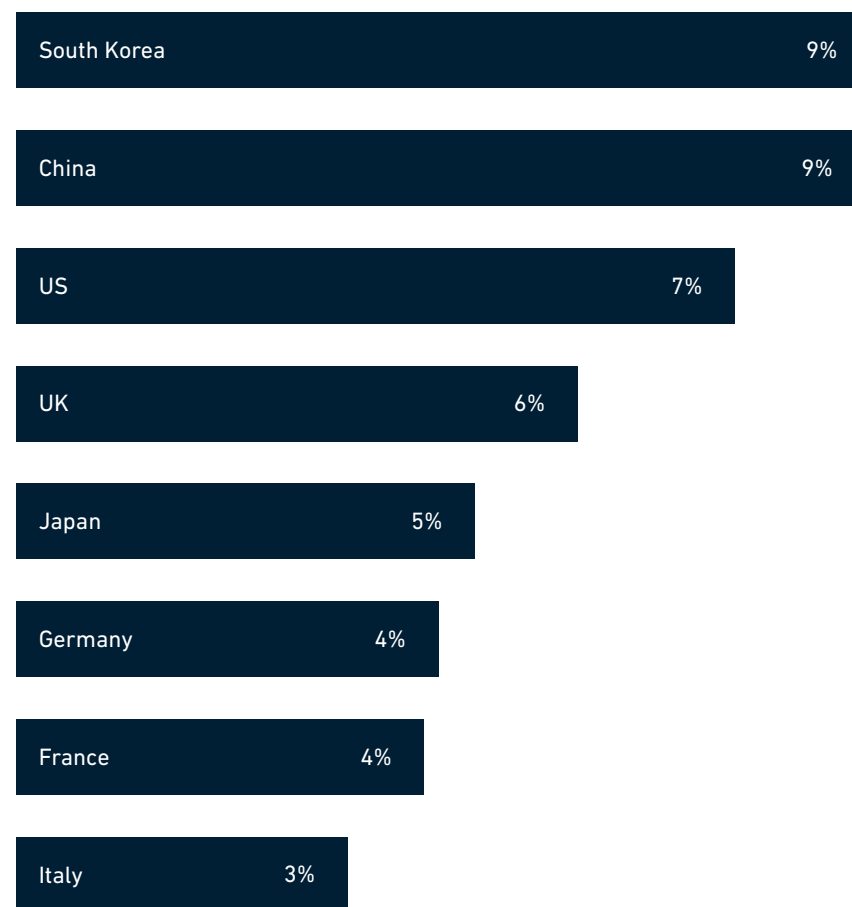
A key 5G use case. Entertainment is a category that can influence 5G revenues directly (via tariff uplift from 4G to 5G) and indirectly (where operators charge for a service or upsell features within it). The indirect contribution is larger, even if it is less headline grabbing. More third-party partnerships are expected in the sports and music categories.

XR remains a tantalising but niche technology

- **B2C and B2B.** Extended reality (XR) – encompassing AR, VR and MR – has multiple applications in media and entertainment spanning both the B2C and B2B segments. Examples include gaming, live event streaming, immersive format movies and TV shows, and the creation and capture stage of media workflows.
- **Content still weak.** Advances in XR and supporting tech (such as mobile and fixed broadband networks, network edge and slicing, and cloud) offer a future where XR is closer to mainstream. However, XR needs to overcome the significant challenge of weak content libraries, particularly in non-gaming categories.
- **Ownership barriers.** VR headset ownership still languishes in the mid-single percentages in survey data. Enterprise adoption of XR has been more successful than consumer adoption, in part due to use cases being targeted at specific enterprise needs (such as training and product design) and providing companies with clear cost savings.
- **An Apple halo effect?** Apple’s entry into XR with its Vision Pro could help break the stasis. Its efforts across hardware, content and user experience should help boost the overall XR ecosystem, including through heightened competition, in turn supporting the wider metaverse initiative and bolstering XR’s chances of becoming a popular technology.

VR headset ownership is still limited

Percentage of respondents

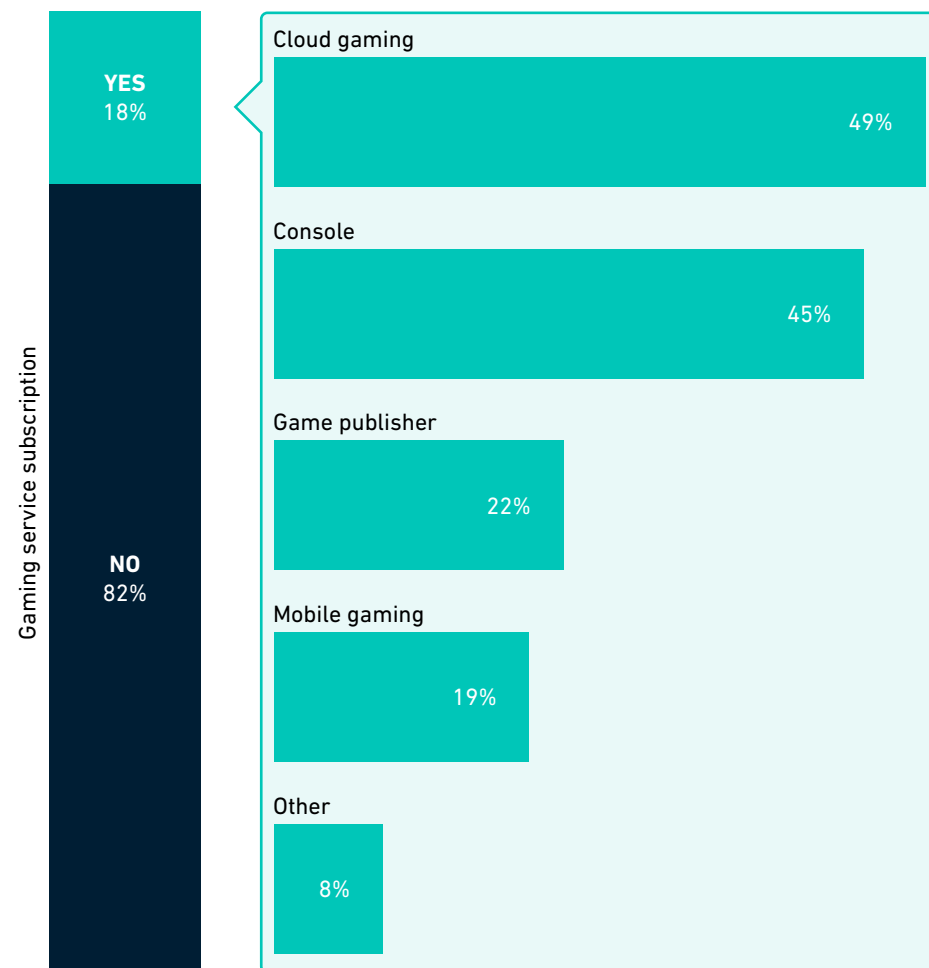


Gaming ushers in the age of streaming

- **Gradual change.** The shift from traditional gaming on consoles and PCs to streaming has been gradual. Enabling factors include:
 - advances in streaming technology and the proliferation of cloud infrastructure
 - millennials' on-demand consumption habits driving the transition to broader digital gaming
 - the rise of paid-for gaming including cloud gaming subscriptions
 - the growing appeal of digital gaming bundled with mobile subscriptions.
- **Teething issues?** Cloud gaming can still be held back by issues with latency and lag, packet loss and inadequate bandwidth.
- **Cloud infrastructure upgrades.** Continued cloud innovation across areas such as compute, storage, streaming quality monitoring, relational database services and kubernetes from public cloud providers such as Amazon and Google should help. So too will improving connectivity infrastructure which, combined with cloud advances, is laying the groundwork for new gaming experiences such as AAA multiplayer gaming on smartphones while on the move.
- **Live viewership offers promise.** GSMA Intelligence survey data shows the share of gamers watching live or recorded streams of gamers or watching e-sports competitions was 43% in 2023, with an increase in viewership of 5 pp year-on-year.

Subscriptions to gaming services

Percentage of respondents subscribing to a gaming service and type of gaming service subscription.* Aggregate figures across eight countries analysed.



*Of those who play games on any device.

AI promises a broad impact on entertainment

- **A must have rather than nice to have.** The application of AI is now a necessity rather than a novelty for video providers. Reasons include the vast amount of content being handled, the high quality of service required, the need to boost service monetisation, the variety of user functionality being made available, and the degree of personalisation that providers are aiming for. Advances in AI are now also allowing consumers to create their own video content through prompt to video.
- **Agility.** AI can make content delivery more flexible. As an example, Amazon Bedrock can be used in combination with ReAct agents to build a better customer experience for content discovery. AI-enabled video platforms that serve multiple functions in the video workflow are also increasingly available.
- **Gaming at the vanguard.** Digital gaming has often led the field in adopting new technologies; AI is no exception. Gaming's characteristics make it a prime candidate for the application of AI. These include its wide use of non-player characters, demanding and photorealistic visuals, rich gameplay environments involving multiple assets, an almost unlimited combination of game stories and landscapes, and the evolution to gameplay being adjusted in real time. For these reasons, venture-capital interest in AI software companies serving the gaming sector is strong.

Select VC-backed generative-AI gaming startups

Data as of end of March 2023

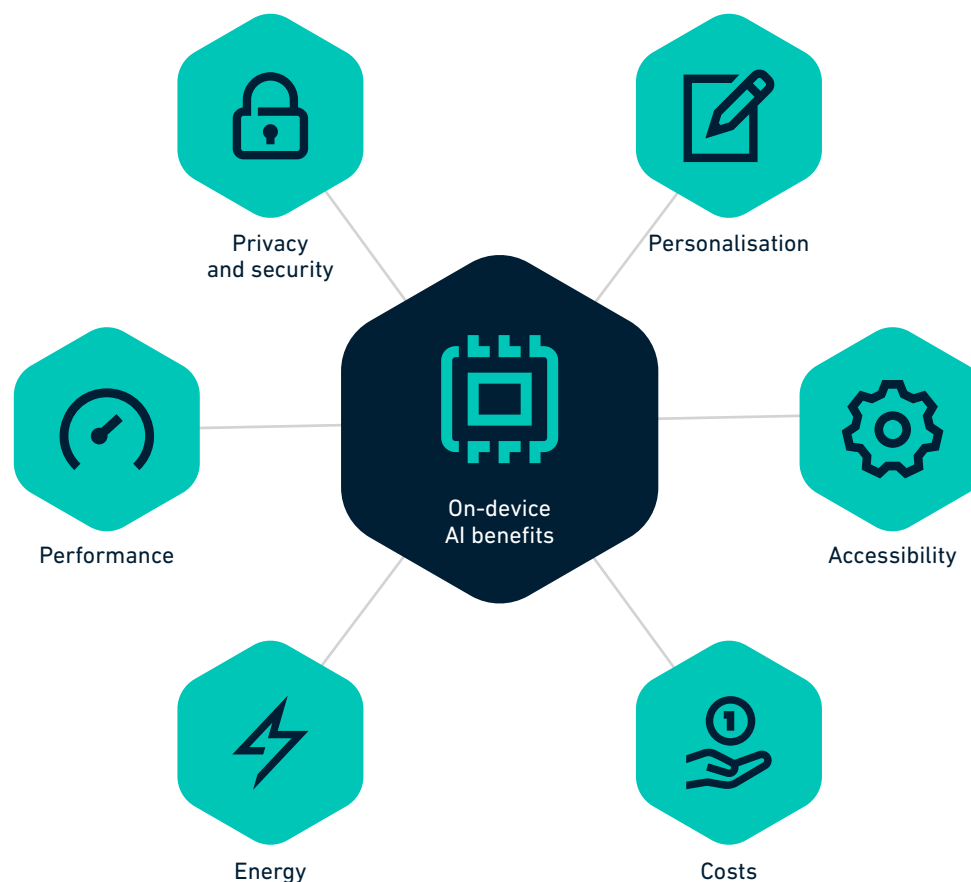
Company	Last financing date	Total raised (\$ million)	HQ location
Inworld AI	8 Jul 2022	\$83.3	Mountain View, CA
Promethean AI	30 Jun 2021	\$39.5	Los Angeles, CA
Voicemod	24 Feb 2023	\$22.5	Madrid, Spain
rct AI	1 Feb 2023	\$22.1	Beijing, China
Alethea AI	N/A	\$16.2	N/A
Wonder Dynamics	8 Dec 2021	\$11.6	Los Angeles, CA
Hidden Door	13 Jul 2022	\$9.0	New York, NY
Replica	28 Aug 2021	\$5.5	Brisbane, Australia
Convai	28 Dec 2022	\$5.0	Mountain View, CA
Regression Games	15 Aug 2022	\$4.2	Philadelphia, PA

Source PitchBook Data, Inc. This figure is from PitchBook's Q1 2023 Gaming Report

AI is impacting the device landscape too

- **AI impacts.** As digital entertainment evolves, so too are the devices used to consume it (such as smartphones, XR devices and TVs). While each device category has its own specific innovations, some broad themes are emerging, such as better display technology, faster compute and now AI. The potential transformative impact of AI on the future of entertainment is one of the factors abetting the push for enabling on-device AI on equipment used for digital entertainment consumption.
- **Infrastructure upgrades.** On-device AI running large language models (LLMs) on devices (as opposed to the current cloud-based processing) will require device hardware advances in chipsets, on-board AI accelerators, memory systems and chip power delivery systems. Progress is being made in this regard. Examples include Qualcomm unveiling its new Snapdragon 8 Gen 3 mobile processor and LG showcasing its new Alpha 8 AI processor for TVs.
- **Consumer benefits.** Overall, the infusion of AI in digital entertainment devices should bring consumer benefits including new device functionality, better adaptation of devices to user preferences, and new ways of interacting with the devices. As with most innovations, flagship models from OEMs will likely act as a showcase for on-device AI, before it cascades down to mid-range and entry-level models.

Example benefits of on-device AI

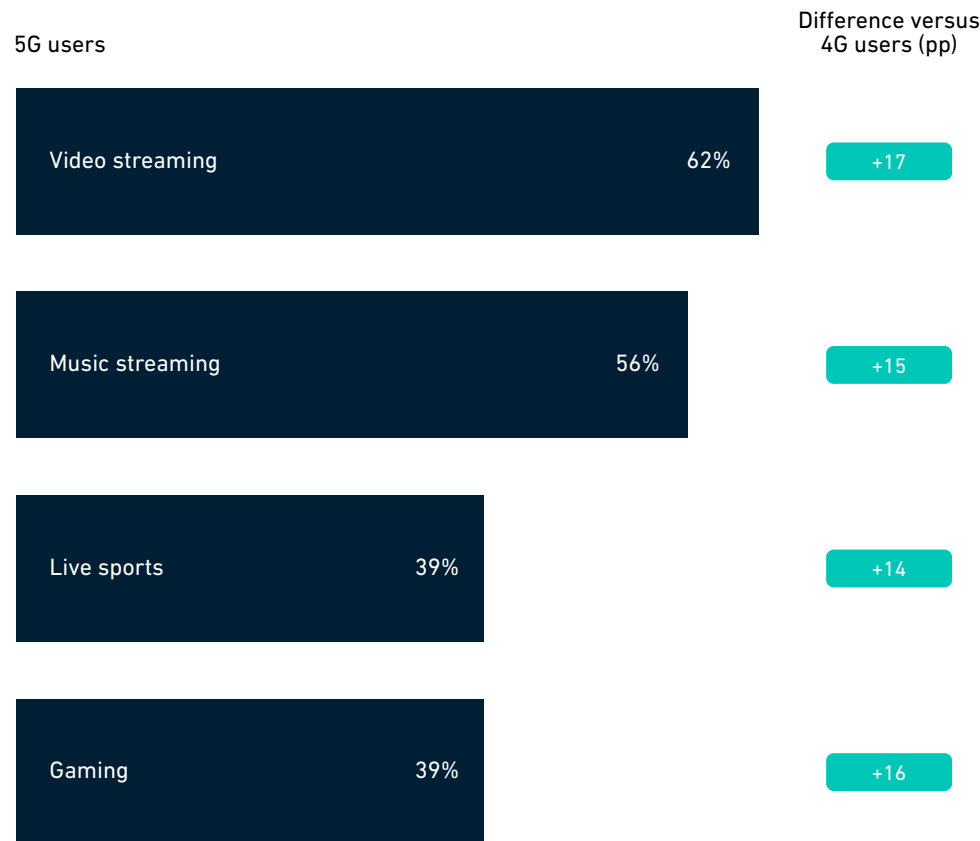


The multi-strategy route to entertainment for operators

- Different strategies.** Operators' commercial strategies for video have ranged from vertical integration (in limited cases), to premium video content involving the acquisition of content rights, to partnerships with third-party video streaming services such as Amazon Prime Video and Netflix (the most prevalent strategy). The partnership route is also the most widely deployed for the gaming opportunity, with third parties developing cloud gaming services and e-sports for network and pay-TV benefits. Across both video and gaming, operators are also providing B2B infrastructure and other services such as IT services.
- Distribution focus.** Operators' distribution partnerships can include carriage agreements, more involved technical and service integration partnerships, or commercial deals where revenue sharing takes place. Examples of such partnerships in video include Vodafone and Airtel with Amazon Prime Video, and Telefónica with Microsoft in gaming.
- Still about revenue and churn.** Operators' digital entertainment strategies are part of broader service and revenue diversification to attempt to offset low revenue growth in mobile/fixed connectivity and reduce churn. These efforts are also aided by increasing interest among consumers (particularly 5G users) in bundling non-connectivity services with mobile subscriptions.

The digital entertainment offerings consumers want packaged with their mobile subscriptions

Percentage of contract mobile subscribers who have added or are interested in adding the following to their contract subscriptions (aggregate figures across eight countries analysed)



Base: Smartphone users who are most frequently connected to 4G or 5G networks

AWS is partnering with key operators to reinvent entertainment

MUSIC

CONTENT

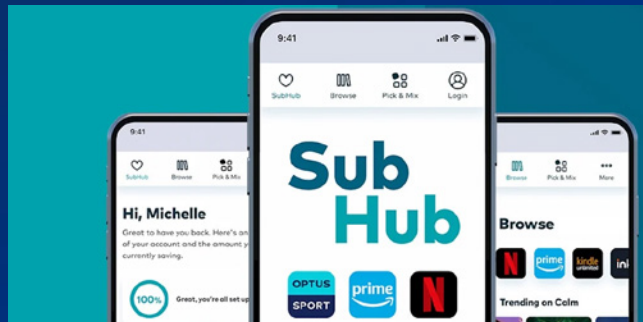
SPORT



Automated video streaming production using 5G, MEC and QoD Mobile API



Learn more



Digital subscription hub using AWS generative AI



Learn more



Enhancing the fan experience using 5G and MEC in sports arenas



Learn more

🌐 Regional variation

China

- China leads significantly in adoption of gaming subscriptions. These are almost exclusively cloud gaming subscriptions. In the seven other countries surveyed by GSMA Intelligence, console subscriptions lead. China also has one of the highest adoption rates for VR headsets, at 9%. These findings tie in with China's overall leading position in digital entertainment consumption.

Europe

- European operators were among the first to introduce quad-play bundles and remain some of the most committed to convergence-based consumer strategies; they are now developing n-play propositions. For some context on this cohort's service convergence leadership, around 40% of the major European fixed broadband service providers (the vast majority operators) currently provide quad-play bundles. European operators' n-play push has involved bundling digital entertainment, cloud, security, smart home and other services.

US

- According to the GSMA Intelligence Consumer Survey 2023, the US had the second highest share of gamers who do not use a gaming subscription service. This is somewhat counterintuitive considering the US's position as a leading gaming producer. Gaming service subscription prices and unmet expectations around title choice on these services are cited as reasons for the lack of interest.

② Considerations for the year ahead

Will XR witness a revival in momentum, and are operators positioned to benefit?

- An Apple-led revival could be on the cards, moderated by headwinds such as the pricing of the Vision Pro headset. Operators should be well-positioned to capitalise on XR's turnaround through their connectivity services (e.g. 5G, FTTx and FWA), but the impact on overall revenue growth is likely to be marginal as fibre would handle most of the traffic.

Can genAI establish its value in the digital entertainment ecosystem?

- GenAI progress will be needed at the engineering, product, training and policy levels to ensure its success. Operators are slowly but steadily building in-house genAI expertise to help innovate their digital entertainment offerings and provide AI-as-a-service, but how far does this go?

What is the operator role for helping AI in entertainment?

- Cloud gaming tech and big-ticket business developments (e.g. Microsoft-Activision, Amazon Luna global expansion) augur well for much wider gamer adoption. Operators can contribute through more initiatives such as Vodafone's 5G SA cloud gaming trial and by pressing further on distribution partnerships.

GLOBAL MOBILE TRENDS

Executive summary

5G's next wave

5G-Advanced

Fixed wireless access

Generative AI

Cloud and edge

The future of entertainment

eSIM

Satellites and NTN

Sustainability and circularity

Private wireless networks ▶ Choose your flavour

TOPIC OVERVIEW

Private wireless networks

Private networks are mobile networks intended for non-public, or private, use. While such networks have existed for some time, 3GPP developed the concept further in the 5G specifications. Private networks allow greater flexibility to meet an enterprise's requirements, such as low latency, low jitter and bandwidth aggregation, as well as enhanced data security and privacy.

Private wireless networks move on from niche

- Operators' private 4G/LTE and private 5G launches
- Number of private wireless projects



Competition grows fierce for private wireless suppliers

- Private wireless vendor landscape
- New challengers enter the market



Vertical-sector adoption and trends

- Operators' ranking of vertical-sector adopters of private wireless



Expanding customer base

- Share of operators who have more than 200 customers
- Customer experience with private wireless



The operator view of the revenue opportunity

- Revenue components of private networks
- Contribution to total enterprise revenues



🌐 Regional variation



📌 Considerations ahead



① Why it matters in 2024

Private wireless networks are becoming an essential component of digital transformation for enterprises

5G revenue monetisation

Monetising 5G. For mobile operators and vendors, new revenue generation is a core objective for 5G. New mobile use cases targeting enterprises are possible with 5G, and private networks are key enablers.

Expanding the customer base and laying a growth path. Services targeting enterprises help expand into new markets, unleashing new growth trajectories for the mobile ecosystem, with the potential to upsell value-added services.

Fit with enterprise needs

Modernising legacy networks. Private wireless networks bring benefits when it comes to upgrading legacy networks such as Wi-Fi and cable, as they enable higher data transfer speeds and increased security, and rely on simpler, wireless installations.

Supporting enterprise transformation plans. Private wireless networks enable new use cases relying on video recognition, operations in remote sites, and connectivity with devices such as tablets, smart glasses, IoT devices and drones.

Fast evolving ecosystem

New entrants. Vendors are sharpening their focus on private networks for enterprises (e.g. Ericsson's acquisition of Cradlepoint, and Nokia's focused enterprise strategy), as are specialised software vendors and systems integrators.

New resources available. As more 5G-compatible devices hit the market, enterprises will see proof of the value of private networks. Enterprises can also tap into shared and private spectrum schemes in support of deployments.

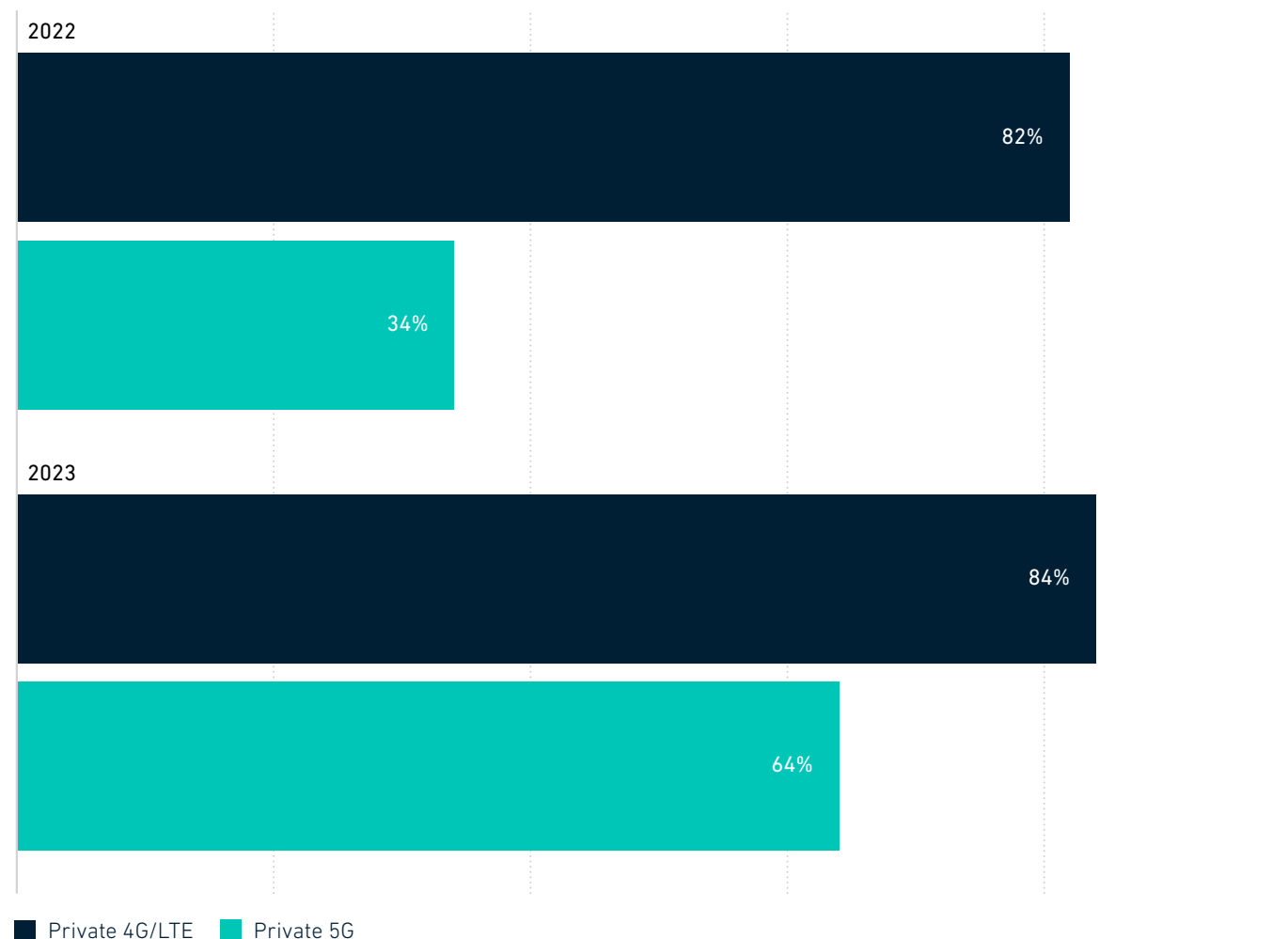
Private wireless networks move on from niche

Number of adopters grows

- Operators accelerate launches.** At the end of 2022, almost half of operators surveyed claimed they had launched private 4G/LTE and around 30% were in testing. Some 34% were at the launched or testing stage with private 5G. A year later, that share had increased to 64%.
- Operators and vendors report growth.** According to company reporting, enterprise customer bases have been growing, at double-digit rates. For example, in Q3 2023, Nokia reported a 31% increase versus Q3 2022 in the number of private network deployments.

Already launched or testing private 4G/LTE or private 5G

Percentage of operators

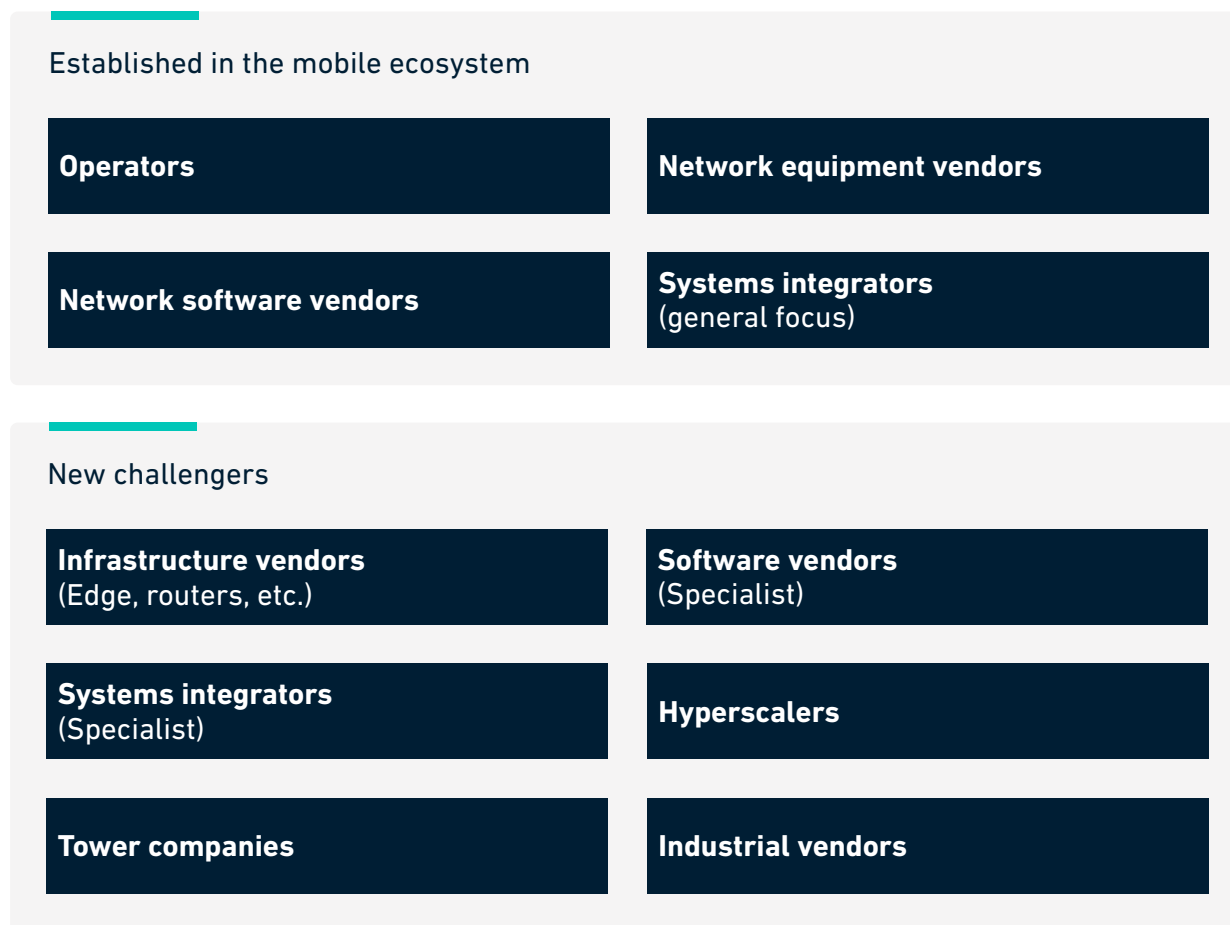


Competition grows fierce for private network suppliers

Grabbing market share as quickly as possible

- **More companies are becoming private network vendors.** The private wireless network space is seen as a key opportunity by mobile operators and vendors (e.g. Nokia and Ericsson). In addition, other companies that are established in the mobile space are launching services related to private networks, such as systems integrators (e.g. Accenture and Capgemini) and network software vendors (e.g. Amdocs).
- **Competition grows fierce.** Private networks for enterprise users are seen as an area of opportunity by vendors outside the traditional mobile ecosystem. This category of new challengers includes specialist software vendors, specialist systems integrators (e.g. Kyndryl) and industrial vendors (e.g. Siemens).
- **Too early to call the winners.** The fact that so many vendors are launching relevant solutions for private networks does not necessarily indicate sustainable market growth and commercial success. As the market is only just moving beyond the niche stage, more time is needed to assess the viability of commercial models and reach standardised solutions and offerings.

A diverse and growing ecosystem



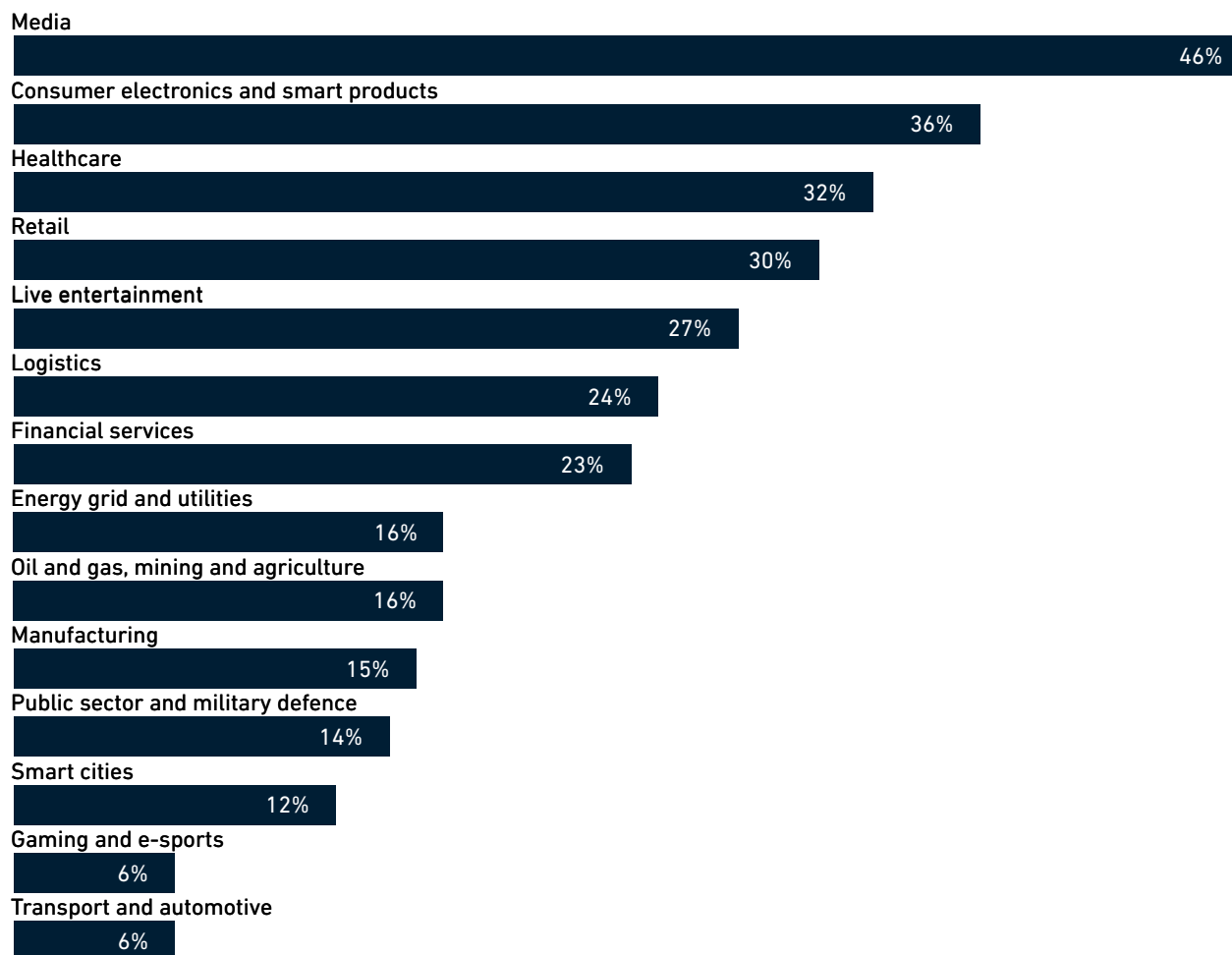
Vertical sector adoption and trends

Expectations in line with needs of verticals

- Addressing demand in vertical use cases.** Operators have high expectations for experiences that leverage multimedia content in specially designed spaces such as venues, stadia and retail stores. Operators also see high demand in healthcare and logistics, with hospitals and airports needing highly secure and reliable networking, for example.
- Industries with remote sites gain attention.** Compared to previous years, oil and gas, mining and agriculture are higher among operators' expectations. In these areas, remote connectivity and ensuring worker safety in difficult conditions make the private wireless value proposition compelling in terms of coverage, reliability and security.
- Evidence from the ground.** While manufacturing may be proving complex to deal with, numerous private wireless deployments are already in place. The same applies to the defence and public safety sectors, where large deployments proliferate.

Vertical demand for private wireless networks

What are the top industry verticals where you see the highest demand for private wireless networks (4G/5G)?



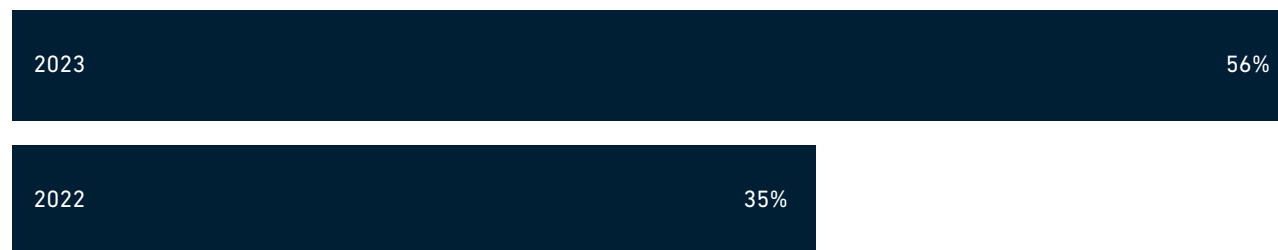
Expanding customer base

The outlook for private 5G is as good as it could be

- **An expanding customer base.** At the end of 2022, around 1 in 3 operators stated they had more than 200 private wireless customers. By the end of 2023, 1 in 2 operators globally had surpassed that level for their customer base.
- **Early positive feedback on private 5G.** Feedback from early enterprise customers is positive for 65% of operators. This is split between 24% who say their customers have already achieved the expected benefits and significant financial returns, and 41% who say their customers have achieved the expected benefits and need more time to validate whether they have achieved significant financial returns.

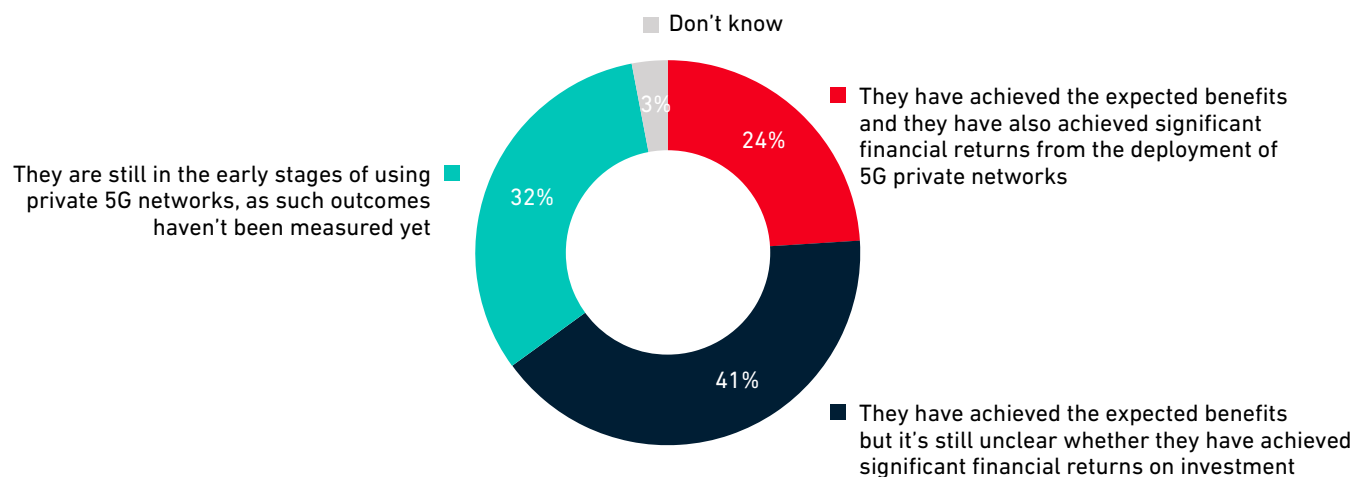
Growing customer base for private wireless networks

Percentage of operator respondents globally that have more than 200 private wireless network customers



Customer experience with existing 5G private wireless networks

Percentage of operator respondents, globally



The operator view of the revenue opportunity

Identifying the most lucrative parts of private wireless networks

- **End-to-end deployments require partnerships.** Offering a private network end to end will involve a variety of partners, including network service providers, systems and network integrators, and network and device OEMs. For operators, core capabilities typically lie in network management (managed services) and provisioning, and spectrum management.
- **Most operators believe 20% is the maximum.** The majority of operators expect private wireless networks to account for up to 20% of their total enterprise revenues by 2025, with an average of around 15% of total enterprise revenue. This trend holds across all sizes of operator and across regions. Operators need to ensure sufficient resources are invested to reap the maximum returns.

Example private wireless solution elements

Private 4G/5G network system components

- Network access points
- Devices
- SIMs, eSIM, iSIM and connectivity management
- Network management software

Network services

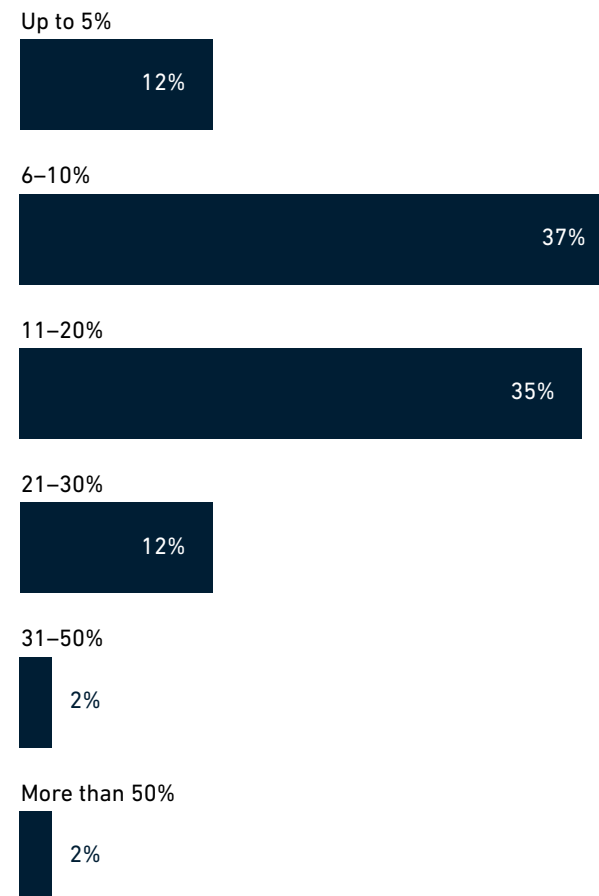
- Managed services
- Network design
- Spectrum access management
- Network deployment and commissioning
- Installation and integration

Professional services

- Consulting
- Use-case discovery
- Project management
- Maintenance
- On-site support
- SLA maintenance

How do you expect private wireless network revenues to contribute to total enterprise revenues by 2025?

Contribution



🌐 Regional variation

North America

- Throughout 2023, the North American mobile ecosystem made significant progress growing private wireless deployments across all sectors, with notable activity taking place in the defence sector and in large utilities. While operators and vendors are ramping up private 5G, the CBRS spectrum sharing scheme continues to drive interest in private wireless networks.

Europe

- While private wireless activity primarily came from Germany and France in 2023, the UK, Nordics, Spain and a number of other country markets and pan-European enterprises are now accelerating adoption. Shared spectrum schemes in Germany and the UK have been attracting enterprises into private wireless networks, though considerations around pricing and efficiency of use remain. Use cases are found in the typical enterprise sectors such as manufacturing and services (financial services, media), but large deployments are also taking place in infrastructure projects such as construction, mining, airports and ports, as well as in healthcare.

Asia

- In South Korea, adoption of private networks is expanding in the enterprise, research and government sectors. According to the Ministry of Science and ICT (MSIT), private 5G is now operational in 48 locations, 36 of which are operator service offerings, more than doubling the 2022 number. Meanwhile, the Chinese ecosystem has been making progress in private wireless networks over the last few years, with the three largest operators leading in implementations, as well as Huawei and ZTE. In addition to private 4G and 5G, there are reports of deployment of the Future Railway Mobile Communication System (FRMCS) in railway projects.

② Considerations for the year ahead

Can private 5G provide value to enterprises?

- Most enterprises that have already started their private wireless journey did so by adopting private 4G. From 2024, appetite for private 5G will increase, with 5G accounting for the majority of new deployments. Private network operators and vendors need to work with enterprise adopters to identify use cases where 5G adds value versus existing IT equipment. This will lead to longer innovation cycles and more revenue-generating opportunities.

Can operators become the go-to partners for private wireless networks?

- Professional services will be essential, as most enterprises are in the early stages of their private wireless journey. However, such services have not been a typical capability of operators. To successfully address the private wireless market and meet expectations for revenue growth, operators need to make sure they have the right skills in place in business development, solution design, systems integration and application development, or explore partnerships and acquisitions in that space.

Will operators and vendors sustain interest and investment in their private wireless strategy?

- Private wireless networks are only just moving on from being niche. Early learnings point to positive results for enterprise adopters. At the same time, 5G has several years ahead of it to further mature and increase penetration in end-user enterprise environments. Operators and vendors therefore need to plan on the basis of a reasonable pace of adoption of private 4G/5G, allowing time to innovate in services such as network slicing and edge compute. If an overly ambitious adoption horizon is assumed, the ecosystem might not see the incentive to continue with the necessary investments and could prematurely call off their enterprise strategies.

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eSIM ▶
Making life easier

TOPIC OVERVIEW

eSIM

eSIM is a new technology that is gradually replacing the traditional, removable SIM across both consumer and enterprise IoT devices. It brings new business opportunities to mobile ecosystem players and new benefits to consumers and enterprises. eSIM devices and services are commercially available worldwide, but adoption rates vary by region and use case.

**eSIM in smartphones:
acceleration of commercial
launches**

- 2023 – the strongest year ever: solid base to build on
- More than half the world’s countries have launched eSIM service
- eSIM availability beyond flagships remains low



**MNOs take a mixed approach:
launching versus promoting**

- A third of MNOs have launched eSIM service
- MNO commercial push remains low
- Reasons for holding back



**eSIM supports the rise of
digital brands**

- Growing importance of online channels, including for travel segment
- Digital-first or digital-only consumer propositions
- eSIM as a main connectivity form factor



**Consumer transition to eSIM
in the smartphone market will
take time**

- North America leads (eSIM-only iPhone effect in the US)
- China has yet to launch eSIM in smartphones
- Substantial acceleration of eSIM adoption from 2026 onwards



**eSIM for enterprise IoT: seeking
scale beyond automotive**

- Moving beyond connected vehicles
- Leveraging key benefits and playing to the green imperative
- Making inroads in private networks



🌐 Regional variation



⌚ Considerations ahead



📌 Why it matters in 2024

Time to turn eSIM availability into customer adoption at scale

Building on 2023 progress is key

2023 – the strongest year for eSIM yet. In the smartphone market, the launch of eSIM-only iPhones in the US in 2022 has accelerated eSIM deployments globally.

Availability versus adoption.

eSIM service is widely available in flagship smartphones and in more than half the world's countries. However, beyond the US, consumer adoption remains low.

Specifications keep evolving.

Ecosystem work on global specifications continues, including for IoT, consumer and integrated eUICC.

eSIM for consumers: seeking scale beyond the US

All eyes on adoption. Turning eSIM availability into consumer adoption at scale will be key in 2024.

Transition to eSIM-only beyond the US may help. Several eSIM vendors expect Apple to make such a move in selected European countries in 2024.

Stronger commercial push needed. We expect MNOs to start talking more about eSIM to customers, especially in the context of digital-first or digital-only consumer propositions targeting digital-native and tech-savvy customers.

eSIM for enterprise IoT: seeking scale beyond automotive

Beyond automotive. While eSIM is mainstream in connected vehicles, adoption in other vertical sectors has been slower. Throughout 2024 we expect new eSIM deployments for utilities, logistics and beyond.

eSIM versus iSIM. This is not an either/or scenario; both are valid solutions that will coexist for years to meet the specific requirements of varied IoT use cases.

Making inroads in private networks. Private wireless networks represent an incremental use case to watch for eSIM and iSIM, as the rollout of customised networks accelerates.

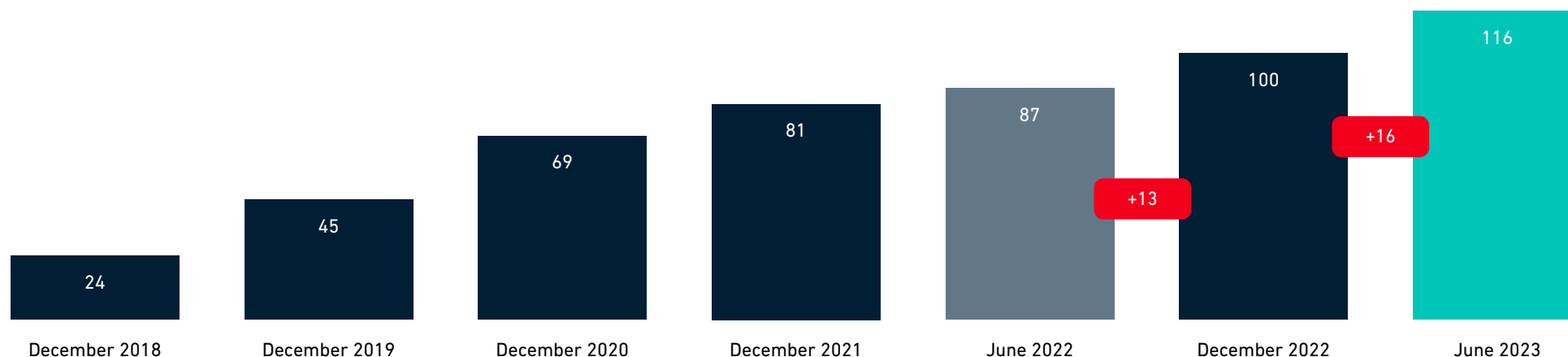
eSIM in smartphones: acceleration of commercial launches

More than half the world's countries have launched eSIM

- The number of eSIM consumer devices launched has been growing significantly over the last five years. These include smartphones, smartwatches, tablets, laptops and a range of consumer IoT devices. As momentum for 5G FWA grows, various eSIM-enabled 5G FWA devices (routers/CPE) have also been launched. The total number of eSIM smartphones, smartwatches and tablets launched surpassed 200 at the end of 2023. Smartwatches led the first wave of eSIM launches (2016–2018), but smartphones have recently taken the lead – unsurprisingly. While most flagship smartphones are now eSIM-enabled, eSIM availability remains low beyond flagship smartphones.
- As of June 2023, commercial eSIM service for smartphones had been launched in 116 countries around the world. In Europe, eSIM service for smartphones is now available in the majority of countries. In the US, Apple has launched eSIM-only smartphones. Africa is catching up. China is still a notable exception; eSIM service is available for smartwatches and some IoT applications but not for handsets. The timeline is uncertain, but eSIM will eventually be launched for smartphones in China.

Commercial availability of eSIM service for smartphones

Number of countries*



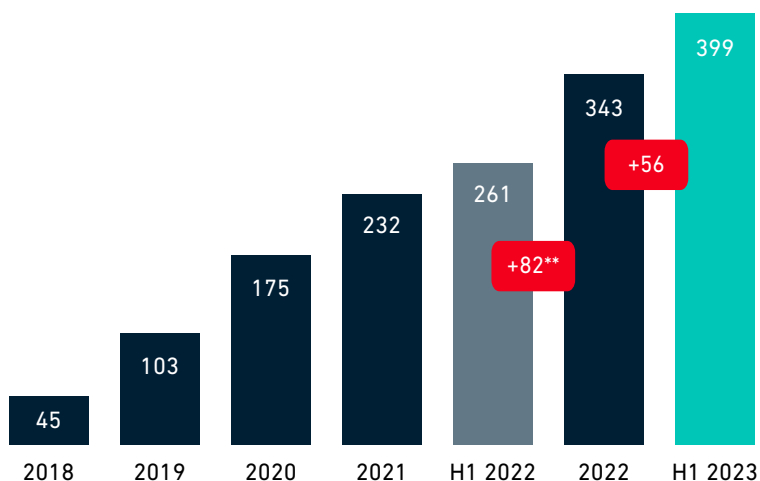
* Minimum number of countries, based on the lists provided by Apple, Huawei and Samsung (publicly available information) and GSMA Intelligence research of the top 30 mobile markets by revenue.

MNOs take a mixed approach

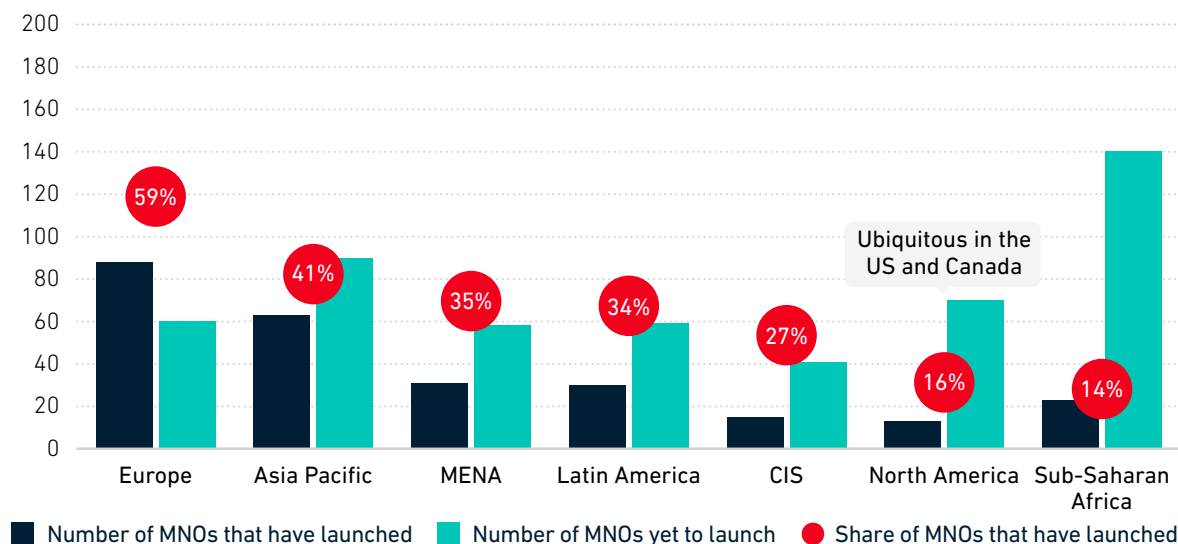
Launching eSIM service but not talking much about eSIM to customers

- As of June 2023, around 400 mobile service providers had launched commercial eSIM service for smartphones across 116 countries. Two thirds are mobile network operators (MNOs); the rest are MVNOs, MNOs with a non-nationwide footprint (e.g. the US) or global providers of international roaming services. Globally, a third of MNOs have launched eSIM service. Nearly 400 launches represents good progress. Further, a range of MNOs and MVNOs are working with eSIM vendors to implement eSIM technology. While MNOs are increasingly launching eSIM services, they are not talking much about eSIM to their customers.
- The top reason for holding back on the commercial promotion of eSIM, according to a survey of eSIM vendors, is MNOs not being ready for full digitisation of subscriber management and associated backend services. Competitive dynamics are the next biggest reason. This includes concerns over churn and losing in-store engagement with customers. Furthermore, nearly half of eSIM vendors pointed to MNOs lacking medium- or long-term eSIM strategies/plans.

Number of mobile service providers offering commercial eSIM service for smartphones*



eSIM service for smartphones: MNOs that have launched / yet to launch



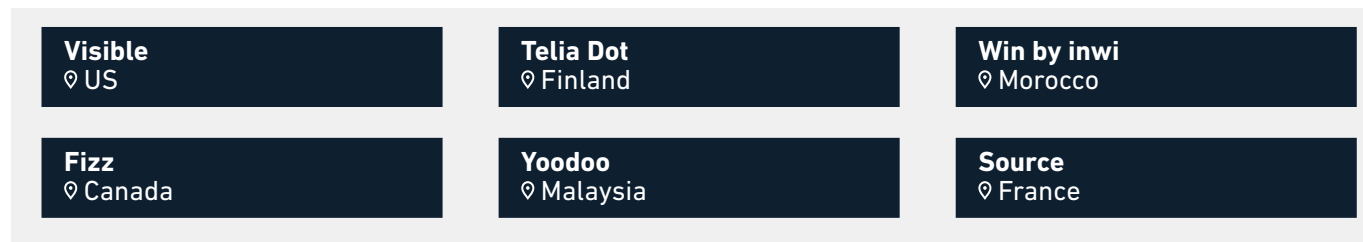
* Minimum number of countries, based on the lists provided by Apple, Huawei and Samsung (publicly available information) and GSMA Intelligence research of the top 30 mobile markets by revenue. **~40 in the US

eSIM supports the rise of digital brands

A range of operators have launched digital-first or digital-only consumer propositions

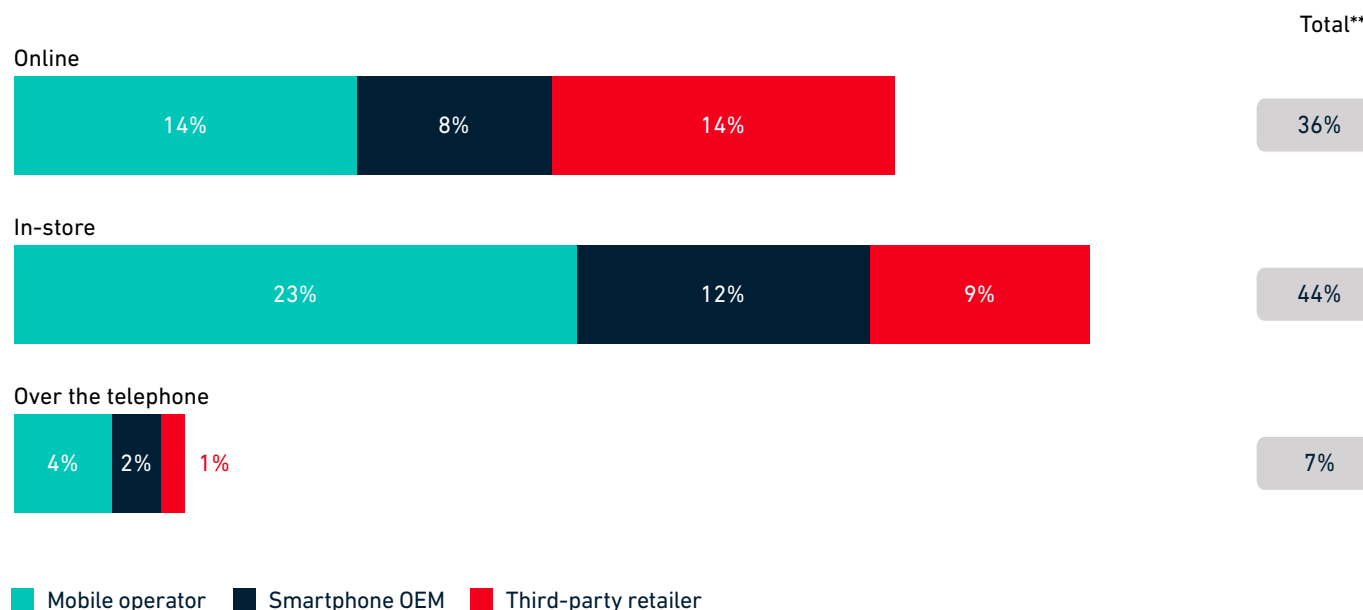
- Rise of digital brands.** To capitalise on the accelerated shift to digital while continuing to drive innovation in consumer offerings, a range of operators have launched digital-first or digital-only consumer propositions, including digital brands. These consumer propositions mostly target digital-native and tech-savvy customers while leveraging eSIM as a main connectivity form factor.
- Online channel grows in importance.** GSMA Intelligence consumer survey data shows that although in-store maintains its position as the leading sales channel when consumers purchase smartphones (especially when buying from operators), the importance of online channels is growing. On average across seven major developed countries, 44% of smartphone users who expect to replace their handsets will make their next purchase in-store; the counterpart figure for online is 36%.

Examples of digital brands targeting digital-native and tech-savvy customers



Retailer and sales channel preferences among those expecting to replace their smartphone

Percentage of respondents (aggregate figures for seven countries*)



* France, Germany, Italy, Japan, South Korea, the UK and the US.

** Percentages do not add to 100% because there are other minor categories.

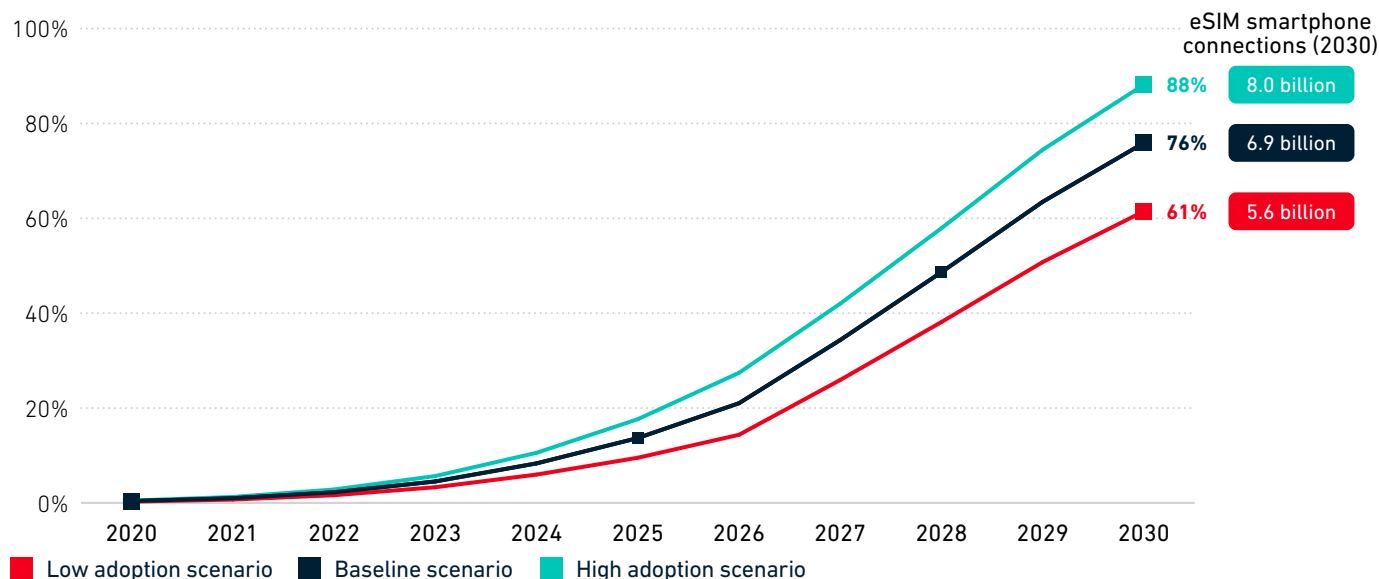
Consumer transition to eSIM in the smartphone market will take time

Acceleration from 2026

- Gathering momentum.** After a slow start, eSIM adoption in the smartphone market will gain momentum over the next two years, followed by a more substantial acceleration from 2026 (due to the scale of China, where we assume eSIM service for smartphones will be launched during 2024/2025). By 2025/2026, most operators will offer commercial eSIM service to their smartphone customers, and eSIM-only phones (a major factor driving eSIM adoption) will likely be more widespread globally.
- Around 1 billion by 2025.** Given the two- to three-year smartphone replacement periods in most countries, a sizeable base of smartphones with removable SIMs will remain in place for several years. GSMA Intelligence’s baseline scenario predicts around 1 billion eSIM smartphone connections globally by 2025, growing to 6.9 billion by 2030 (76% of the total number of smartphone connections).

eSIM smartphone connections to 2030

Percentage of total smartphone connections (installed base) globally



Milestones
Baseline scenario (globally)

- 2025**
1 billion eSIM smartphone connections
- 2028**
Half of smartphone connections use eSIM
- 2030**
Nearly 7 billion eSIM smartphone connections

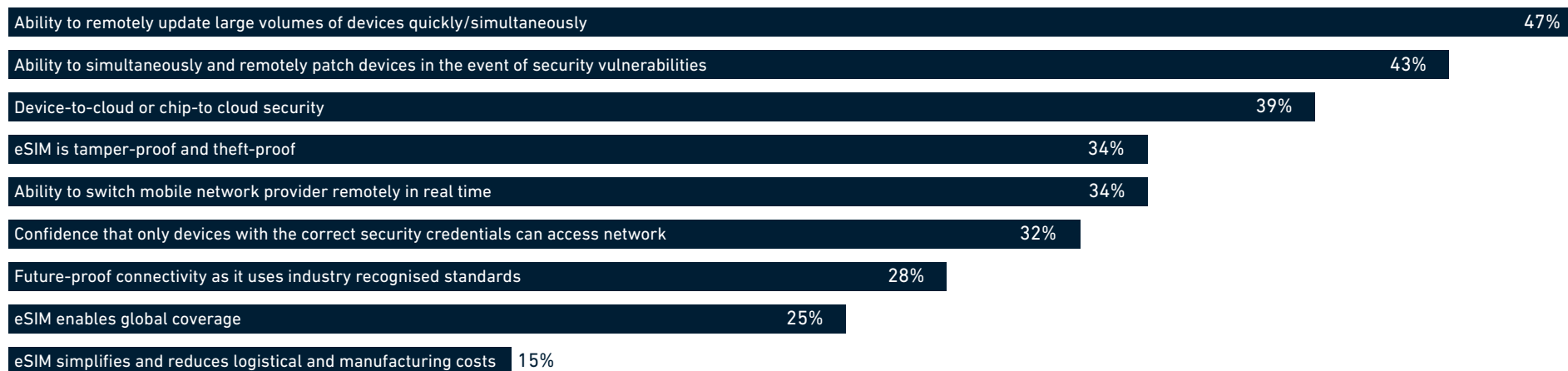
eSIM for enterprise IoT: seeking scale beyond automotive

Best-in-class security and scalability are top benefits for IoT deployments

- Potential for growth.** eSIM has long been seen as a significant enabler of IoT deployments. However, beyond automotive, its adoption has yet to reach critical mass. Recent developments such as enhanced eSIM specifications, iSIM and RedCap, combined with continuous product innovation from eSIM vendors, should help accelerate adoption. Further progress with network technologies (e.g. LTE, 5G, LPWA and NTN) will also help OEMs boost device coverage. The growth potential is significant (we forecast 5.8 billion cellular IoT connections globally by 2030, up from 3.5 billion in 2023). It is also encouraging to see an alignment between the benefits of eSIM for IoT deployments expected by enterprises and those promoted by operators. These centre on best-in-class security and scalability.
- eSIM versus iSIM.** While the industry is currently focused on eSIM, iSIM technology is also being explored both as integrated eUICC and integrated UICC. eSIM versus iSIM is not an either/or scenario; both are valid options that will coexist for years to meet the requirements of varied IoT use cases. Mass deployment of IoT is possible with both eSIM and iSIM, and each satisfies a specific use case that may be more fit for purpose in a specific market or business function.

Operator views: benefits of eSIM for enterprise IoT deployments

When your company talks to enterprise customers about the benefits of eSIM for IoT deployments, which of the following are most often included in your conversations as the eSIM key value-add elements? Percentage of respondents. Respondents could select top three.



eSIM LIKE NEVER BEFORE

Security for scale.

Whether it is to optimize the performance of one of the world's most ambitious solar power stations, or to double the throughput of the world's largest smart metering manufacturing plant, or to disrupt the market with innovative new consumer services using NTN satellite – OEMs turn to Kigen as the forerunner in energy-efficient eSIM solutions built for scale.

Kigen invites you to discover what's possible together, with eSIM.
kigen.com/esim



Let's meet



Join the #FutureofSIM conversation on:



@Kigen



@Kigen_Ltd

Manufacturing for scale

- › Late-stage connectivity provisioning in the factory
- › Built for mass roll outs worldwide

Flexible management solutions

- › Elastic eSIM (M2M, Consumer and IoT) onboarding suite
- › Chip-to-cloud security for trusted data service acceleration

Industry-leading innovations

- › Future-proof with 5G-ready
- › Pioneering Integrated eSIM (iSIM) for novel IoT solutions

Ecosystem committed to scale

- › World's leading IoT and connectivity modules
- › Highest quality LPWAN and NTN connectivity ecosystem

🌐 Regional variation

North America

- North America is the region with the fastest rate of eSIM adoption in the smartphone market due to Apple's launch of eSIM-only smartphones in the US in September 2022. GSMA Intelligence forecasts that 50% of smartphone connections in the region will use eSIM by the end of 2025.
- The US is also a leading market for eSIM adoption in enterprise IoT, as many of the eSIM vendors pushing developments have established a presence in the country.

Europe

- Europe leads in terms of share of MNOs that have launched eSIM service for smartphones (59% as of June 2023). The region will have the second-fastest rate of eSIM adoption in the smartphone market; we assume Apple will launch eSIM-only smartphones in selected European countries in 2024, boosting eSIM adoption. Looking ahead, more than half of European smartphone connections are forecast to use eSIM by the end of 2027.
- For eSIM in enterprise IoT, operators believe smart cities and shipping/logistics will see the highest demand for eSIM-enabled solutions during 2024/2025.

China and developing markets

- China will begin its transition to eSIM in smartphones later than other countries, as the technology has yet to be launched for use in smartphones. However, it will catch up over the medium term. GSMA Intelligence forecasts that China will become the largest market by eSIM smartphone connections in 2027 (with around 0.5 billion connections; 32% eSIM penetration). China launching eSIM for smartphones is seen by eSIM vendors as a major factor that could accelerate adoption globally.
- eSIM adoption in the smartphone market will be slower in developing markets, especially in Sub-Saharan Africa (55% eSIM penetration by 2030) and India (65%).

🔗 Considerations for the year ahead

Will Apple launch eSIM-only smartphones beyond the US?

- Apple's transition to eSIM-only iPhones beyond the US will be gradual. The expectation from eSIM vendors (based on GSMA Intelligence survey data) is that Apple will introduce eSIM-only iPhones in selected European countries in 2024, followed by a full launch in Europe in 2025 and a global launch during 2025/2026. These are realistic expectations.

Will mobile operators start to push eSIM commercially?

- Operators and OEMs are increasingly launching eSIM services and devices, respectively, but not talking much about eSIM to their customers. Raising consumer awareness of eSIM while explaining and promoting its benefits is key to driving eSIM adoption. Operators and OEMs have a key role to play here as the main contact points with end users. Mobile operators will likely start talking more about eSIM to their customers in 2024, especially in the context of digital-first or digital-only consumer propositions that target digital-native and tech-savvy customers.

Will eSIM gain momentum beyond flagship smartphones?

- While most flagship smartphones are now eSIM-enabled, eSIM availability remains low beyond flagship smartphones. A wider portfolio of eSIM smartphones, including mid-range and low-end models, is needed to drive eSIM adoption in the low- and medium-income customer segments and in developing markets. Half of eSIM vendors expect greater availability of eSIM beyond flagship smartphones within the next two years. GSMA Intelligence considers 2025 to be more realistic than 2024.

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Satellites and NTNs

Passing an
inflection point



TOPIC OVERVIEW

Satellites and NTN

Non-terrestrial networks (NTNs) refer to connectivity technologies broadcast at altitude, including drones, high-altitude platform station (HAPS) and satellites. The viability of these options has greatly improved over the last four years as costs have decreased, capacity has increased and NTN standards have become part of 5G new radio (3GPP).

Commercial launches gather momentum

- 2024 is a transition year
- Market share and positioning
- Outlook



Consumer segment: extending coverage

- Challenge: the coverage gap
- Monetisation options: new subscribers, roaming
- Regional factors



B2B segment: IoT and a range of sectors

- Challenge: the coverage gap
- Monetisation options: connectivity and managed services
- Industry factors



Chipsets and devices: making provision for satellite seamless

- NTNs in 3GPP
- Technology alignment
- Lead times



① Why it matters in 2024

It's here, and it works

Pragmatism

Filling the gap. The economics are prohibitive for extending land networks to reach the 7% of people still in a coverage gap. Satellite is the only feasible option.

P&L. Satellite's economics have made backhaul more competitive than previously. Revenue upside exists in the consumer and B2B segments.

Proof points. Despite momentum, proof points remain key for product and pricing strategy.

Tapping new revenues

Consumers. Revenues will come from extended roaming tariffs and new subscribers. GSMA Intelligence estimates this to reach \$20–25 billion per year by 2035 (two thirds of the total satellite-enabled connectivity revenue available to telecoms operators).

B2B. This is the newest and fastest growing dimension in the operator revenue opportunity. This targets IoT service to a range of industries, with a forecast of around \$10 billion per year by 2035 (just under a third of the total).

Laying the groundwork for the long term

NTN standards. 3GPP standards now incorporate NTNs, vastly increasing the addressable universe of devices. However, fragmentation risk will remain if prominent hold-outs such as Starlink and Kuiper continue to pursue proprietary models.

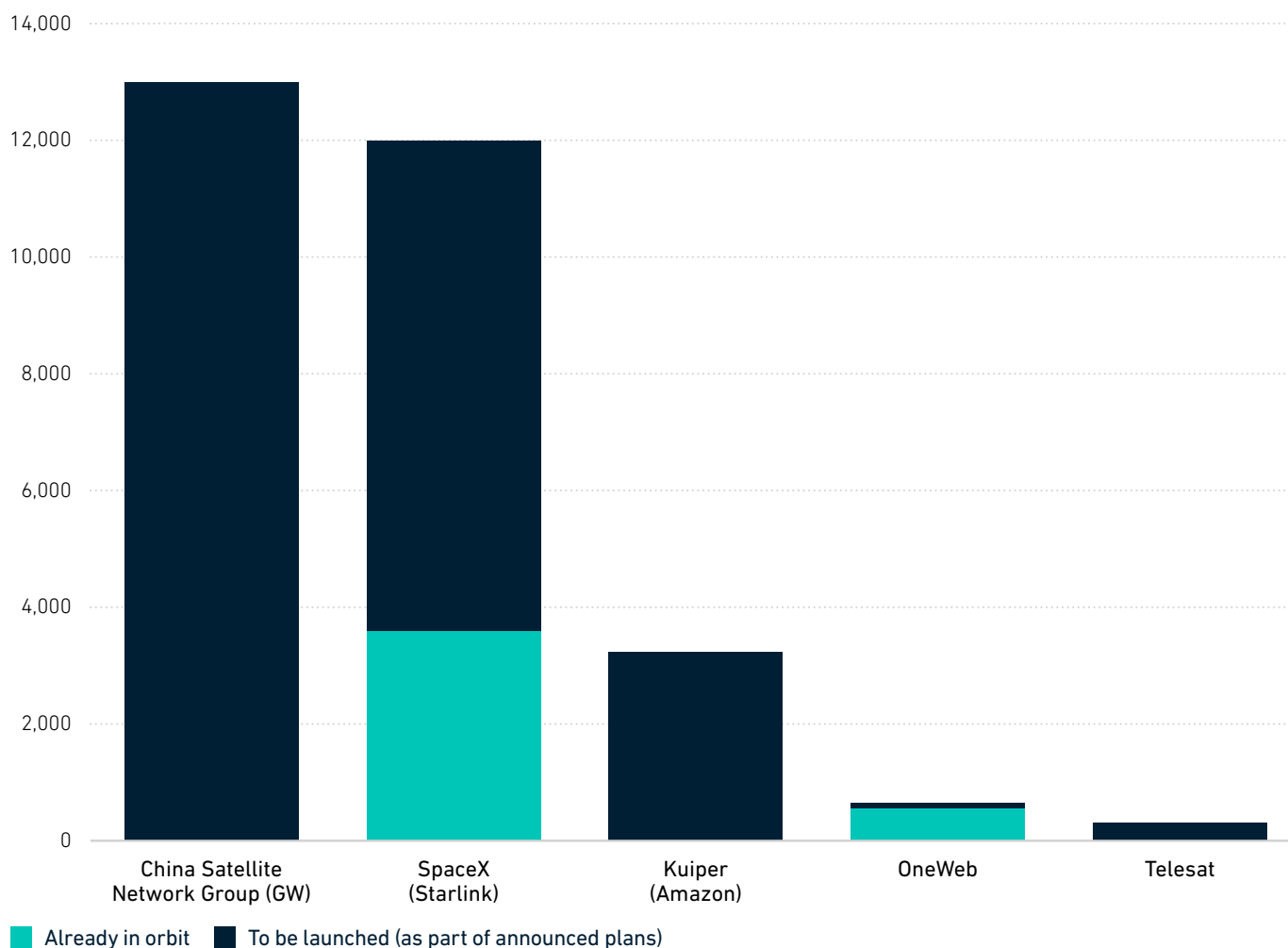
Devices. Direct-to-device (D2D) service continues to be a model major companies are pursuing. However, this depends on if and when device OEMs incorporate functionality, presenting a competitive choice.

Commercial launches gather momentum

- **Trials and deals.** Much of 2022 and 2023 was spent on trials of service performance from new LEO constellations, as well as making distribution deals between satellite groups and mobile operators.
- **Shift to launch activity.** Many of the above are still active, and several satellite groups are still raising private capital to fund their planned launches. Nevertheless, 2024 will see a transition to commercial launches.
- **A crowded field.** Starlink maintains a first-mover advantage, having soft-launched in parts of Europe (UK) and Africa (Nigeria), and conducted a headline trial with T-Mobile in the US. Its forward capacity is eye-watering, with more than 12,000 satellites (and more if the FCC approves its next application). However, this is a crowded field, with Amazon, OneWeb (now owned by Eutelsat) and others in pursuit.

Starlink and OneWeb are the global leaders in LEO satellites deployed

Number of satellites

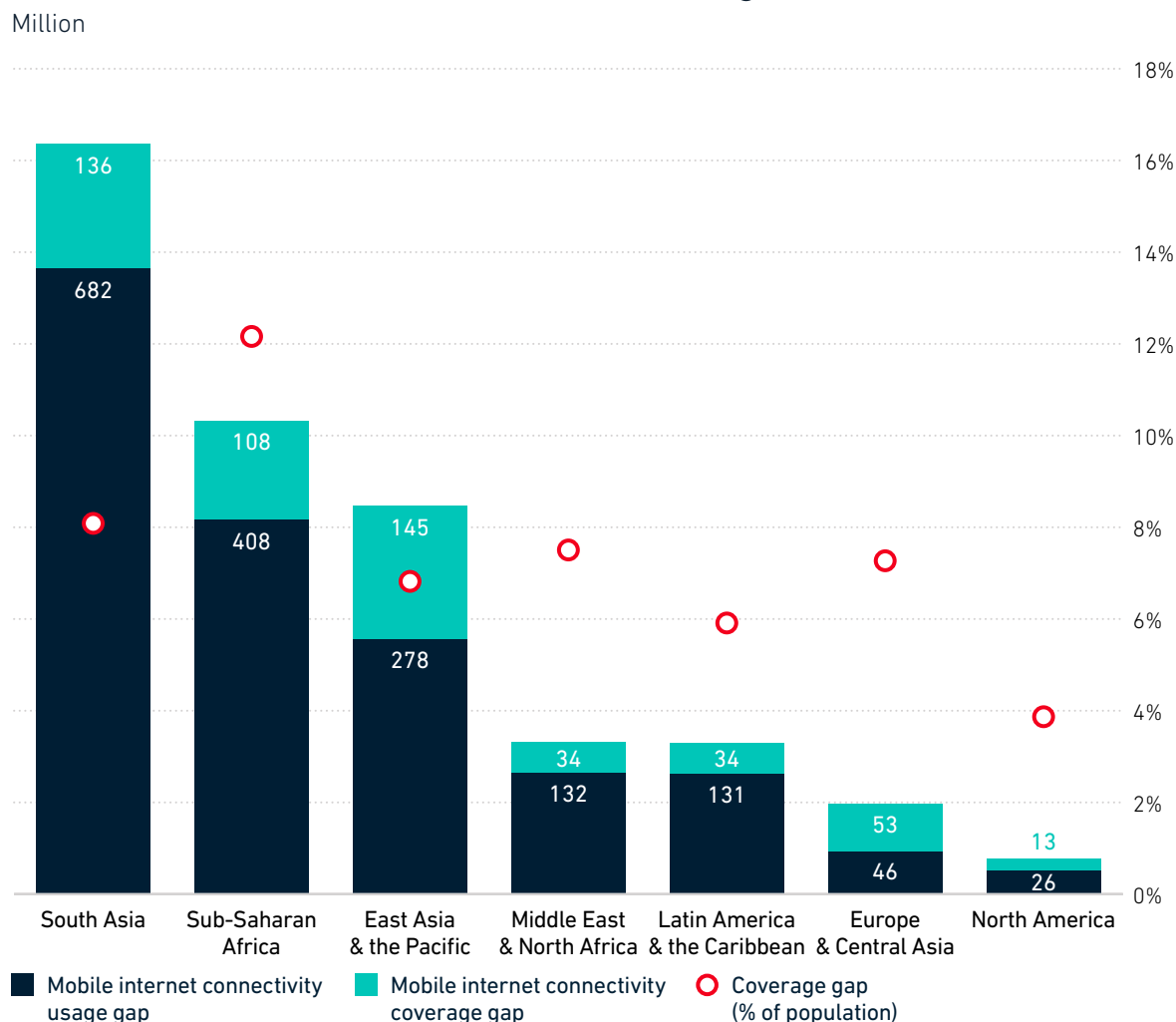


Consumer segment: extending coverage

The consumer side of the satellite opportunity is primarily about two things: coverage for the uncovered, and roaming.

- Coverage.** It can be easily overlooked that around 7% of the world's population still lives outside the range of a mobile network fast enough to deliver mobile broadband speeds (3G/4G). Africa has the highest such group as a percentage of population, but this is not purely a developing world problem. Indeed, there are parts of the US Midwest and rural areas of Europe still out of range and reliant on patchy signals or expensive 'old-school' satellite. The D2D movement could well change this now that NTN is enshrined in common 3GPP standards. Over the next five years, this will trickle through to service availability for most people once they have upgraded their handset.
- Roaming.** Satellite goes beyond the 7% outside of coverage, to areas of weak or intermittent service. Ubiquitous roaming tariffs are also in play, with perhaps a 10-15% price premium to justify service availability. The Apple/Globalstar service is a template, though for now this only covers SMS for emergency purposes.

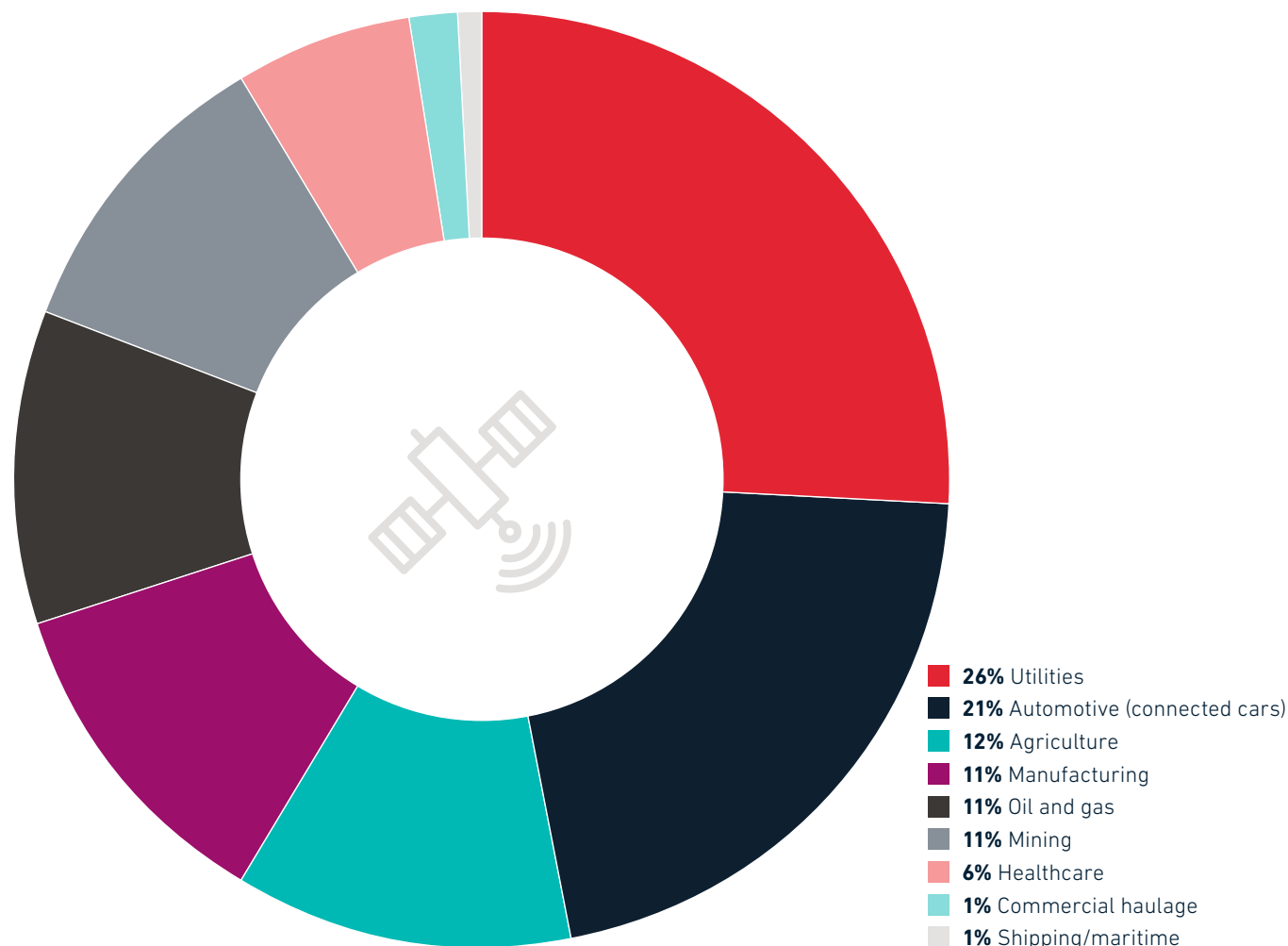
Satellite is the only realistic means of reaching the 7% of the world outside of mobile network coverage



B2B segment: IoT across a range of sectors

- The B2B opportunity.** The B2B side of the satellite equation is the newer area of interest. Most of the applications in play are lower power in nature (e.g. weather sensors, telematics for logistics, and monitoring agricultural operations). Backhaul can also be monetised, should operators have local sites for the last mile that are serviced by satellite connectivity.
- Addressable base.** Nearly 2 billion IoT devices are addressable from satellite-enabled connectivity (10% of the IoT base by 2035), though this is probably conservative. Public safety, emergency services/first responders and smart-city applications are also in play.
- Revenue uplift.** The potential revenue uplift for IoT is \$10 billion per year over the same horizon, which accounts for 25% of the connectivity revenues associated with IoT (i.e. the revenues mobile operators make from IoT). That may be small in the context of overall sector revenues, but it is not to be overlooked when any growth is good.

Sector split of the IoT base addressable via satellite, 2035



Chipsets and devices: making provision for satellite seamless

- **Standards integration matters.**
The inclusion of NTN integration in the 3GPP standards matters because it gives the underpinning for global device and chipmakers to incorporate satellite compatibility into their own portfolios. Some device makers have longstanding support for GEO satellite services, but these have been on limited spectrum bands and at low scale, which has translated into high costs for customers. Qualcomm, Mediatek, Kigen, Thales and others are updating their chipsets, and bootstrapping to make provision for satellite seamless on new devices.
- **Things won't change overnight.**
The handset replacement cycle needs to play through for people to own devices compatible with 3GPP Release 17 or later – i.e. those capable of receiving satellite service. Infrastructure upgrades are also needed for NTN systems and orchestration software to coordinate with terrestrial spectrum carriers for seamless connectivity. This takes time and money.
- **A differentiator.** Numbers should progressively grow from now until the end of the decade. This also implies satellite support will become a competitive differentiator. We expect to see more of this made in operator marketing for key handset launches – a category starved of innovation for years. GNSS and other satellite positioning systems also help open the door to location-based services not currently possible when outside coverage (e.g. medical or food deliveries in rural areas). These may be marketed with handsets with satellite capability.



SPACE FOR 5G/6G

Drives standardisation

**Convergence of Terrestrial Networks (TN)
and Non-Terrestrial Networks (NTN)**

Funds industry and academia

Innovates hubs and testbeds

Fosters use cases and applications

Overcomes the digital divide

LEARN MORE: [CONNECTIVITY.ESA.INT/SPACE-5G-6G](https://connectivity.esa.int/space-5g-6g)

🌐 Regional variation

- Telco-satellite partnerships now cover an addressable subscriber footprint of more than 2 billion.
- That is not the number of people actually using satellite but the base that could tap into it – something that will rise as other partnerships take root.
- A lot of the first activity in the late 2010s concentrated on Sub-Saharan Africa, where the coverage gap is most acute. However, many partnerships now cover Europe, the US, Canada and parts of rural Australia.
- The satellite phenomenon is, in short, a global story.

Examples of partnerships between telecoms operators and satellite/NTN companies

Operator, satellite company, market(s) where operator is present, mobile connections (million) of operator



A: Telstra and Optus; Starlink, Australia, 28. B: STC; AALTO, Saudi Arabia, 25. C: BT; OneWeb, UK, 22. D: Rakuten; AST SpaceMobile, Japan, 6. Data is correct as of December 2023.

Source GSMA Intelligence based on company announcements

② Considerations for the year ahead

Will direct-to-device services launch beyond pilots at scale?

- The fact that several major satellite groups, most notably Starlink (through its partnership with T-Mobile US), have D2D pilots ongoing indicates their serious consideration for the service. GSMA Intelligence expects launches to materialise in 2024.
- The main enablers are having devices in people's hands to connect to satellite, and a viable spectrum approach. 5G NR standards mean satellite will be compatible with any device on 3GPP Release 17 or later, but this will take several years to reach the mass market because of the handset replacement cycle.

How will chipset and handset makers respond to NTN in their portfolios?

- Support for satellite in the past (10+ years ago) existed from device manufacturers but only for specialised handsets with radios tuned to specific frequencies. NTN integration into 3GPP provides the underpinning OEMs need to provide satellite support across their portfolio. How much and when this happens in practice will be down to individual manufacturers, but most are expected to do so.
- If operators put sufficient marketing behind it, we expect satellite to become a new competitive USP for handsets, in much the way cameras and content access have been to now. This is likely to be accompanied by price premiums on airtime for roaming tariffs that offer ubiquitous coverage.

Can B2B sustain its momentum?

- Survey evidence suggests businesses are pragmatic in the type of connectivity they use, provided it is good enough and affordable. Logistics, agriculture, forestry, healthcare and emergency response are all examples of where we expect to see sell-in from operators, playing to ubiquitous coverage.
- We're likely several years away from satellites servicing higher bandwidth applications (e.g. video, XR), unless network upgrades or more smarter use of spectrum materialise sooner than expected.
- Monetisation will be key. IoT tariffs are already price competitive (and often less than \$1 per device per month). To raise this sufficiently (30%+), we will likely see more bundling of services and analytics alongside connectivity.

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Sustainability and circularity

Creating opportunity
from challenge

TOPIC OVERVIEW

Sustainability and circularity

Sustainability covers a broad set of topics including energy efficiency, access to renewable energy, and circularity. This tends to be consolidated into environmental, social and governance (ESG) reporting. The primary focus for this analysis is energy and the circular economy.

<p>The road to net zero</p>	<ul style="list-style-type: none"> • Operator commitments to net zero • Implementing circularity practices • Impact on operator strategy 	
<p>Benchmarking progress on energy efficiency</p>	<ul style="list-style-type: none"> • Healthcheck • Drivers • Tech improvements in the pipeline 	
<p>Advancing the circular economy</p>	<ul style="list-style-type: none"> • Reuse of devices and network equipment • Tackling circularity progress • Key practices for operators 	
<p>Knowing what makes customers tick</p>	<ul style="list-style-type: none"> • Consumer awareness of circularity • Understanding consumer behaviour • Consumer insights to develop a circular strategy 	
<p>The circular economy needs to do the little things right</p>	<ul style="list-style-type: none"> • Reporting and transparency as preconditions • Converging circularity and ESG • Circularity metrics to watch 	
<p>🌐 Regional variation</p>		
<p>📌 Considerations ahead</p>		



① Why it matters in 2024

Circularity at the top of the business agenda

Environment

Background. Greenhouse gas (GHG) emissions associated with Scope 3 account for more than 65% of the total telecoms industry's GHG footprint. Supply chain emissions, which include the purchase of goods and services (Cat. 1), account for the largest part of Scope 3 emissions.

Decarbonisation opportunities. The circular economy has emerged as an opportunity to help with decarbonisation and, to some extent, revenue growth across the value chain. Circular procurement is the main strategy operators can use to reduce their supply-chain emissions.

Financials

Stubborn costs. Between 2023 and 2030, cumulative mobile operator capex will reach \$1.5 trillion, with the vast majority on equipment related to the rollout of 5G and beyond. This includes 5G-Advanced and investment in 6G launches.

Financial relief. Energy efficiency and circularity enable operators to cut costs to mitigate against network capex.

Relationships

Circularity is not easy. Complexities include the logistics of recycling equipment and how to incorporate refurbished parts into existing equipment.

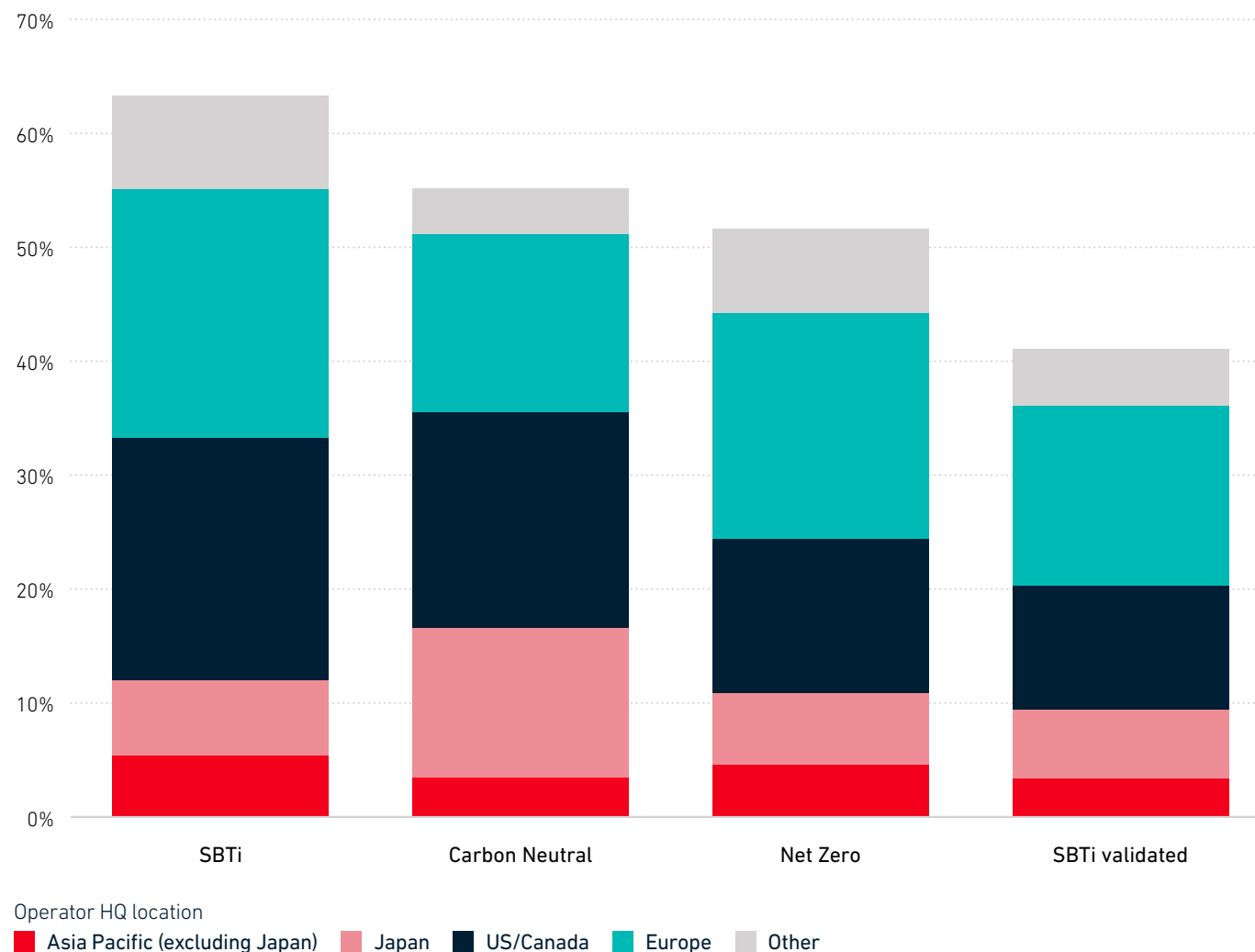
It takes joint efforts. Being able to implement circularity efficiently requires collaboration and coordination among players in the value chain.

The road to net zero

How commitments stack up

- **Commitments.** At the end of 2023, operators accounting for 63% of market share (by revenue) had committed to the Science Based Targets initiative (SBTi) carbon reporting framework, with 41% being validated. Around 52% had committed to the UN Race to Zero pledge.
- **Stark regional variation.** Global averages mask significant regional variation. Sustainability policies enabled European and North American operators to remain at the vanguard, with many introducing circular economy practices. Take-back schemes are the main circular economy initiatives implemented by operators, allowing them to capture a refurbished device mobile market forecast to be worth more than \$140 billion by 2030.

Global market share (mobile revenue) of operators by commitment



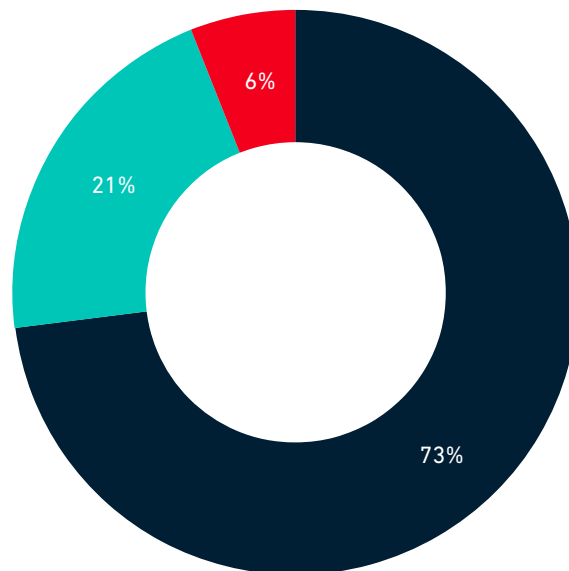
Benchmarking progress on energy efficiency

Making energy efficiencies translate into actual reductions

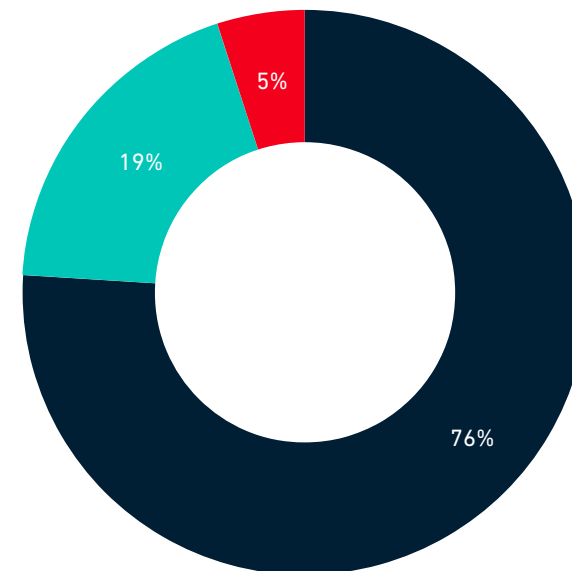
- GSMA Intelligence tracks industry-level progress on energy efficiency through the Mobile Energy Efficiency Benchmark study. In 2023, it built a dataset based on 65 networks and 1.6 billion connections.
- As there are no single metrics to measure energy efficiency, GSMA Intelligence uses a combination of four KPIs. Based on the sample analysed, overall efficiency in 2022 was 0.15 kWh per GB, 14 kWh per connection, 22 MWh per cell site and 227 MWh per €1 million in revenue.
- The RAN accounts for 76% of direct energy usage for an average operator so is the lowest-hanging fruit and the target of most vendor-led upgrades.
- European groups continue to lead in both energy efficiency and percentage of renewable energy consumption. Africa and Asia are playing catch up.
- Operators are optimistic about 5G's long-term impact on energy efficiency and believe the improved power efficiency will also help lower costs later in the 5G era.

Energy sourcing and energy usage for operators

Source of energy



Use of energy



■ Traditional grid (Non-renewables)
■ Renewables (Including grid and non-grid)
■ Diesel
■ Radio access network
■ Core and datacentres
■ Others

Advancing the circular economy

Still a long path ahead

- **Defining circular.** The circular economy is a growing economic model where products, parts, components and materials are reused in successive production cycles, repaired or recycled to reduce waste and pollution.
- **Operator role.** The role of the telecoms industry is most obvious in smartphones, consumer electronics and CPE. Some operators are repairing or reusing network equipment, or offering device-as-a-service.
- **Still early.** Despite some progress, much work is still needed to increase repair and reuse rates, especially in low- and middle-income countries. The GSMA estimates that more than 5 billion mobile phones are currently sitting unused around the globe, while only 10-15% of handsets are recycled or repurposed.
- **Solutions required.** To improve those rates, several drivers are required, such as developing enabling policies in Africa and Asia, improving take-back programmes, increasing customer awareness and understanding of their behaviour, strengthening coordination with third parties within the value chain, improving device longevity, and implementing tracking systems.

Key circularity practices for operators



Supply chain

- Sourcing of sustainable materials
- Reusing and refurbishing products taken back
- Sales of refurbished devices
- Sales of long-lived devices
- Device recycling
- Design equipment for responsible end-of-life disposal
- Tracking system and standardised metrics
- Understanding consumer behaviour



Operations

- Reusing and repairing network equipment
- Recycling network equipment
- Refurbishing network equipment
- Resale of network infrastructure
- Network softwarisation



Products and services

- Attractive device take-back programmes
- Device repair offers
- Device-as-a-service
- Raising consumer awareness of the environmental impact of device disposal

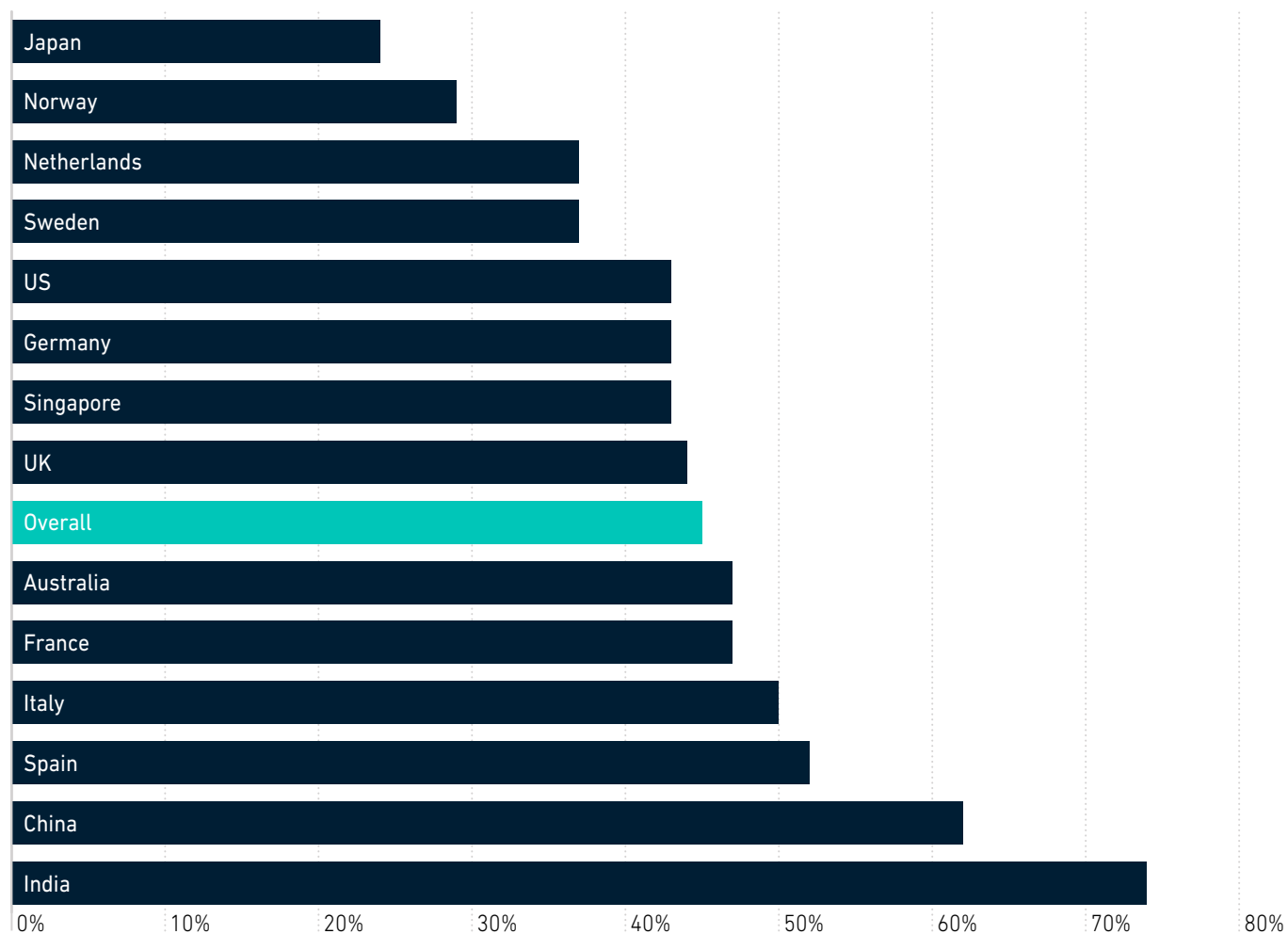
Knowing what makes customers tick

Key to success

- Understanding behaviour is critical.** Consumer awareness of sustainability and circularity is on the rise. Understanding consumer behaviour is critical to achieving a circular transition for devices.
- Can do more.** Some 51% of consumers globally think that the consumer electronics sector can do more to reduce, reuse and recycle waste. In addition, 72% of consumers would like to buy more durable products and 47% want to buy second-hand instead of brand-new items. Some 53% of consumers are comfortable using second-hand phones.
- Purchasing decisions.** When it comes to purchasing a device, consumers feel less engaged and aware. A majority (80%) of EU citizens think it is hard to find information on durability and repairability, and 64% think that it is hard to tell how long a device will last.

Consumers are increasingly putting their money where their mouth is

Percentage of respondents who say they are interested in buying exclusively from brands that concentrate on circular and sustainable practices (N=7,819)



Source GSMA, Capgemini Research Institute, circular economy survey, August/September 2021

The circular economy needs to do the little things right

Measurement and reputational value

- **Work to be done.** When it comes to the broader view of sustainability, circular economy principles fit into the ESG domain. Reporting disclosure has improved but there remains a general paucity.
- **A common framework is key.** Investors understand that by integrating ESG standards and circular economy practices into a business, companies can gain a competitive advantage. Establishing common frameworks to assess ESG metrics and the circular economy across the telecoms industry is therefore key to improving reporting consistency. Reporting suitable metrics that measure the device and network equipment flow is vital to track progress towards a more sustainable business model.

The circular economy: suitable metrics to measure device and network flow

Entry-level action



- Set up a structure (e.g. system tool) to collect data on devices and network equipment
- Quantify the number of collected devices and the number of devices being incinerated / sent to landfill, recycled, repaired and reused
- Quantify the units (tonnes) of network equipment incinerated / sent to landfill, recycled, repaired and reused

Entry-level metrics



- Mobile device and CPE waste generated in tonnes per fiscal year
- Percentage of mobile devices and CPE recycled by unit sold per fiscal year
- Percentage of mobile devices and CPE recycled by purchase price per fiscal year
- Percentage of mobile devices and CPE repaired and reused by unit sold per fiscal year
- Percentage of mobile devices and CPE repaired and reused by purchase price per fiscal year
- Network waste generated in tonnes per fiscal year
- Network waste recycled in tonnes per fiscal year
- Network waste repaired or reused in tonnes per fiscal year

🌐 Regional variation

Europe

- Europe is set to be the regional leader in terms of the extent to which operators are committed to climate change and circularity. This has been helped by the regulatory environment, a good supply of renewables, faster access to sufficient funding, and building and enhancing skills. Regardless of progress made towards a circular economy, evidence suggests there remains work to do to enable operators to progress to more sustainable business models.

Africa

- There are some initiatives from operators in Africa to create awareness around the importance of the safe disposal, handling and recycling of e-waste. However, data concerning circularity in the telecoms sector is lacking in Africa as most ICT waste (87%) goes through informal recycling. There are limited organised or formal systems for taking back e-waste. This highlights the importance of legally binding e-waste policies to support circular economy initiatives in the telecoms industry.

Asia

- Asia is a mixed region in terms of sustainable and circular economy commitments. Operators in Japan are taking circularity seriously, growing the average recycle/repurpose rate for handsets to 16%, in line with Europe and the US. China remains the largest developed telecoms market to hold out on circular initiatives, with 1–2% of handsets recycled or repurposed. Government policies to establish a resource recycling industry by 2025 may spur operators to become more ambitious.

② Considerations for the year ahead

Do circularity commitments spread south and east?

- The tide is gradually beginning to turn towards emerging markets for circularity as a business model.
- Acceleration will depend on regulatory policies, internationally developed standards, operator efforts and consumer awareness.

Can operators effectively 'sell' circularity as part of 5G?

- Advanced technologies such as 5G and IoT are crucial elements of a circular system. By deploying those technologies, enterprises can gain better visibility of supply chains, enabling the creation and processing of the data required to fulfil the demands of circular supply chains such as material tracing.
- Sustainability will be the focus of future technologies such as 6G, which will enable vertical industries to achieve sustainability and circularity goals.

Does circularity become a valuation driver?

- Whether circularity criteria are formally incorporated into valuation models remains to be seen. Regardless, circular economy practices fulfil several ESG standards and offer a way to tackle primary resource scarcity and biodiversity loss.

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