NOKIA

Global network traffic report

Understanding the growing impact of advancing technologies on future networks

NOKIA BELL LABS

Network traffic through 2033

The global digital landscape continues to evolve rapidly, with network traffic surging in both consumer and enterprise sectors. The exponential rise in data consumption, driven by advancements in 5G, artificial intelligence (AI), augmented reality (AR) and virtual reality (VR), among other technologies, underscores the critical importance of network evolution to keep pace with demand.

The report offers insights into the projected growth in global network traffic from 2023-2033, segmented by key domains such as consumer mobile, fixed access, and enterprise networks. We explicitly studied AI traffic, examining how AI-powered applications are contributing to the overall increase. We also explore key drivers, including video streaming, AI-powered applications, cloud gaming and the emerging metaverse, as well as the impact of these trends on network architecture, capacity and services.

Explore our projections

Our methodology

Nokia, through its Bell Labs Consulting arm, forecasts global network traffic on an annual basis to assist network providers in their decision-making and planning. Our forecast covers from 2023 through 2033.

We have established the traffic baseline for our forecast using multiple sources and validated it with internal benchmark data, including insights from real-world customer network measurements. We estimate future developments based on macroeconomic trends, technological advancements, access technology penetration and changes in customer behavior. Additionally, we use industry surveys and analyst reports, as well as internal assumptions and analysis.

We have projected three possible scenarios: moderate, aggressive and disruptive, based on the uptake of traffic, demanding use cases and technologies.

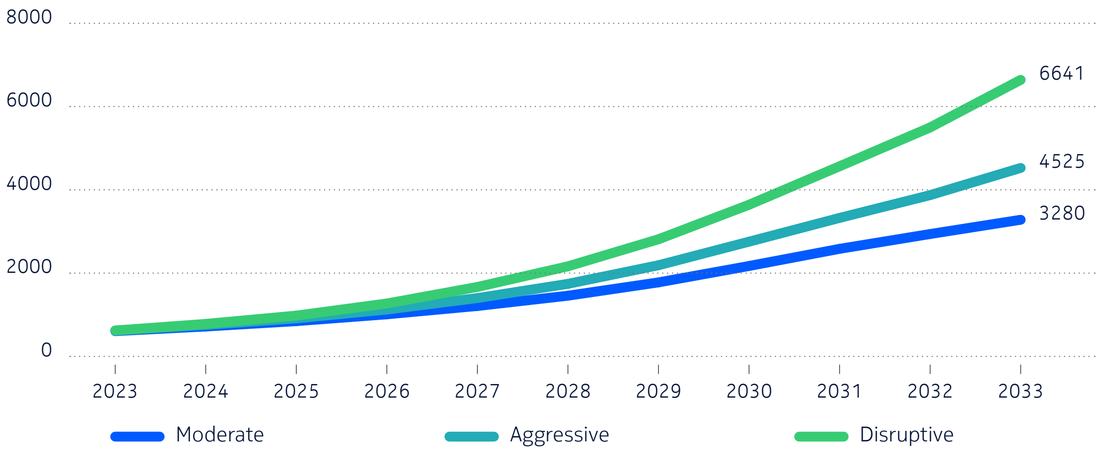
Our forecast encompasses wide-area network (WAN) traffic from the following sources:

- Traffic reaching the public adoption through any media—both consumer and enterprise subscriptions included.
- IPTV traffic is delivered via standard broadband consumer subscriptions.
- Managed IT traffic (private WAN traffic) for enterprise subscribers, including data traffic from point-to-point connections and service provider leased lines and direct connections to hyperscale clouds such as AWS, Azure and Google.

The forecast excludes LAN traffic from any infrastructure.

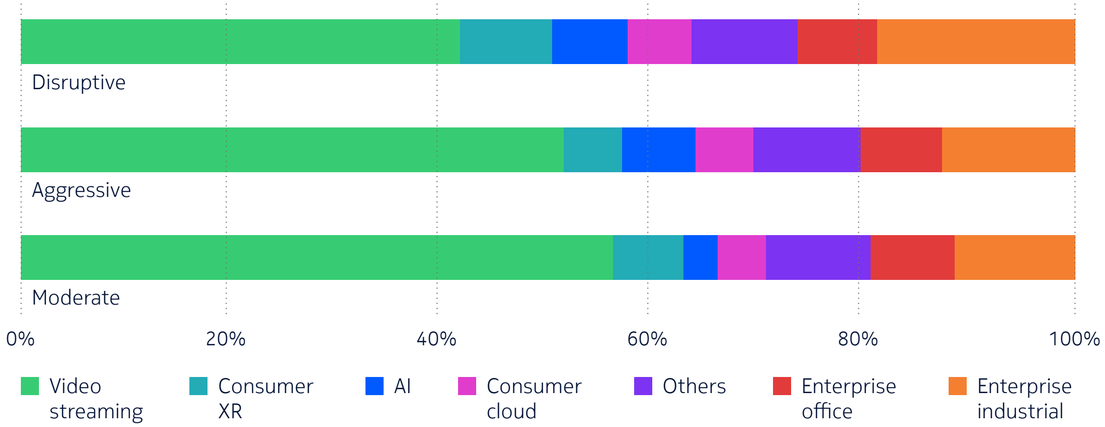
Our findings: total global traffic through 2033

Global WAN traffic, EB/month

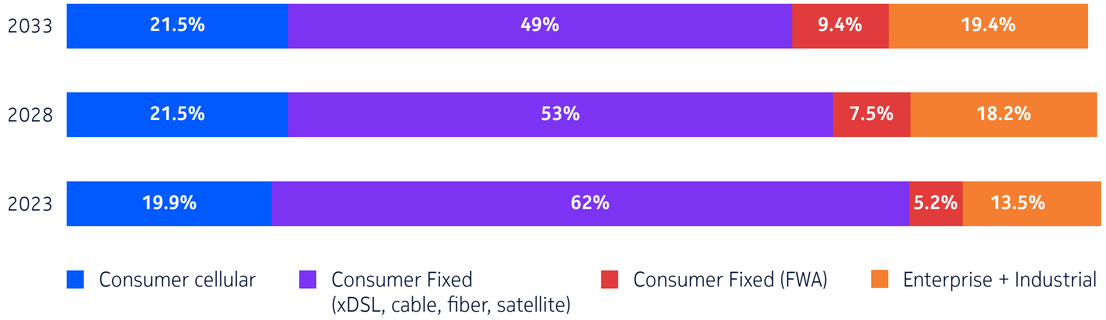


Note: Scale of the graph is expressed in EB/month to be consistent with the rest of the traffic report

Services WAN traffic share, 2033



Global traffic growth by domain, moderate scenario



Projections for

2033

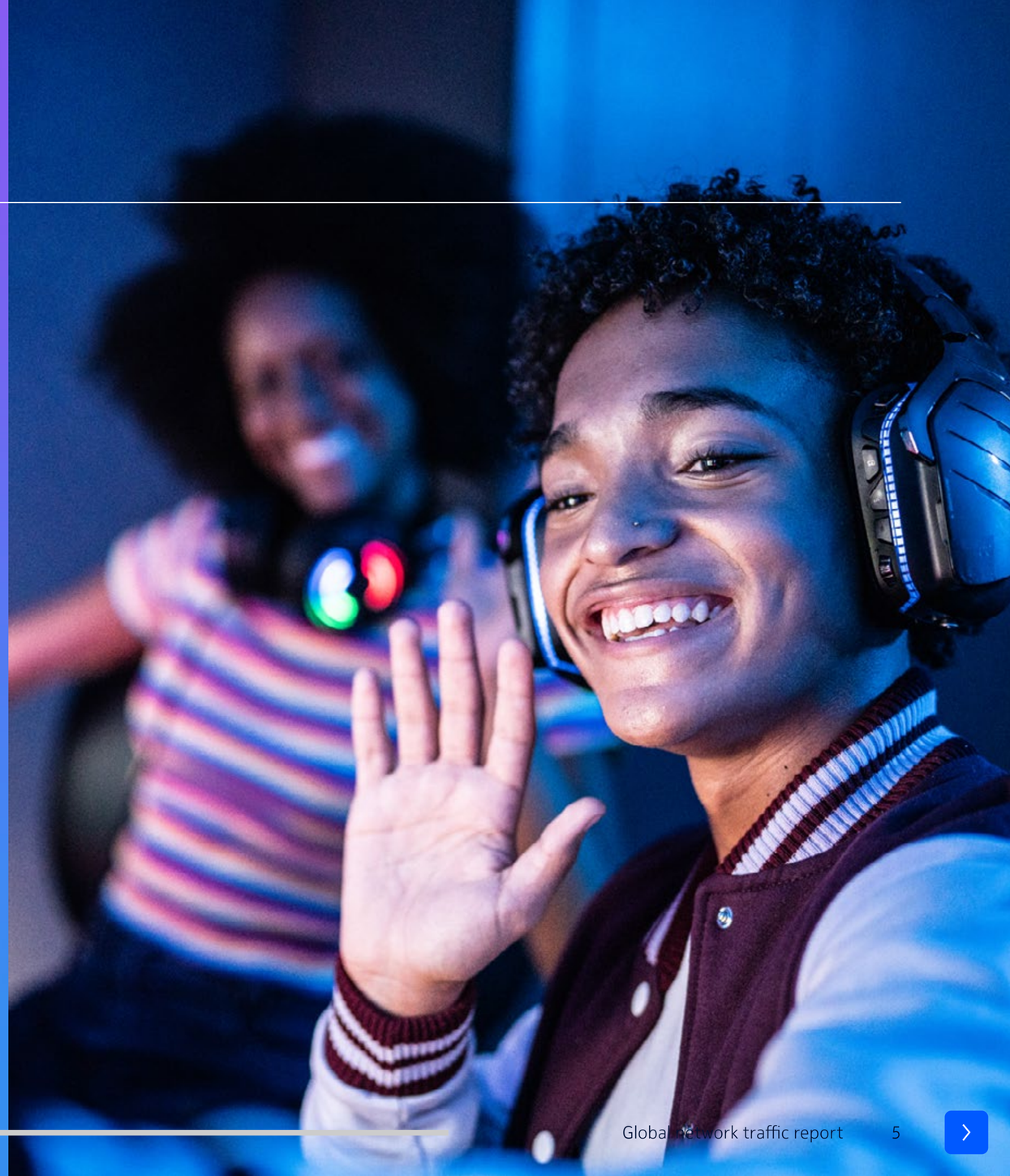
Global WAN traffic
3280–6641 EB/month
CAGR of 18%-27%

Streaming video and AR/VR will be the key drivers of traffic growth.

Share of enterprise and industrial traffic will increase with AI usage.

Consumer traffic

Mobile traffic is projected to grow 6 to 9 times by 2033, driven by increasing 5G adoption and the introduction of 6G, with video streaming accounting for nearly 75% of the traffic. In disruptive scenarios, new applications like AR, VR, and cloud gaming are expected to contribute over 13% of traffic by 2033. Similarly, fixed traffic is increasing due to the rise of data-heavy applications like video streaming and VR, especially in regions with advanced 5G and fiber networks, where CAGR could reach up to 25%. Cloud VR is also expected to accelerate this demand further, highlighting the need for continuous network modernization.



Consumer mobile traffic

Our forecast indicates a sharp rise in global consumer mobile traffic, expected to grow from 120 EB/month in 2023 to 706-1135 EB/month by 2033, marking a **6x-9x increase**. Key drivers include rapid 5G adoption, enhancements in streaming video quality, the rise of AR/VR ecosystems, cloud gaming and growing AI integration. The compound annual growth rate (CAGR) is forecasted at 19-25% over the decade.

Blended mobile usage per subscription will increase from 14 GB/month in 2023 to 69 GB/month by 2033 in the moderate scenario, potentially reaching 108 GB/month in aggressive scenarios. The projected 6.5 billion 5G subscriptions by 2033, accounting for 72% of total traffic, will coincide with this surge. Additionally, 6G will account for 0.84 billion subscriptions, comprising 10% of the total consumer mobile traffic.

Figure 1: Consumer mobile traffic, EB/month

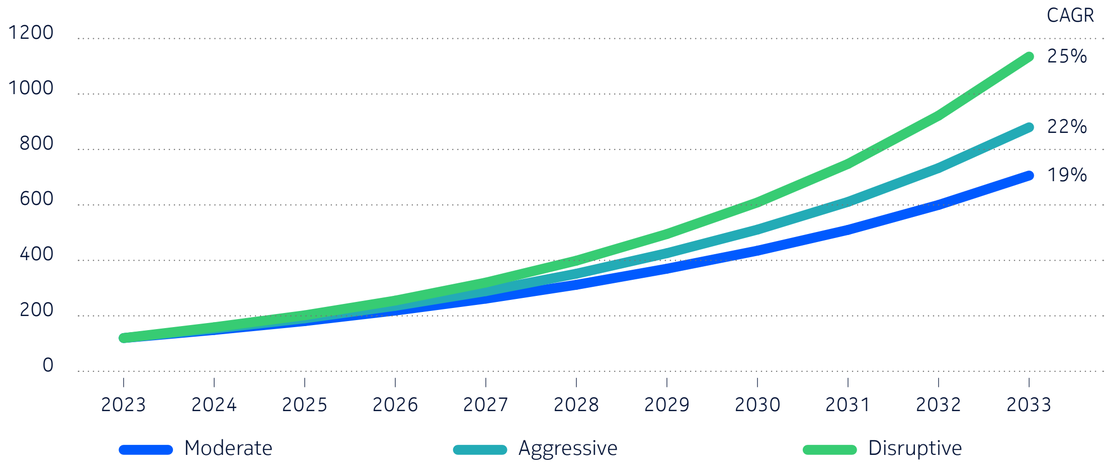
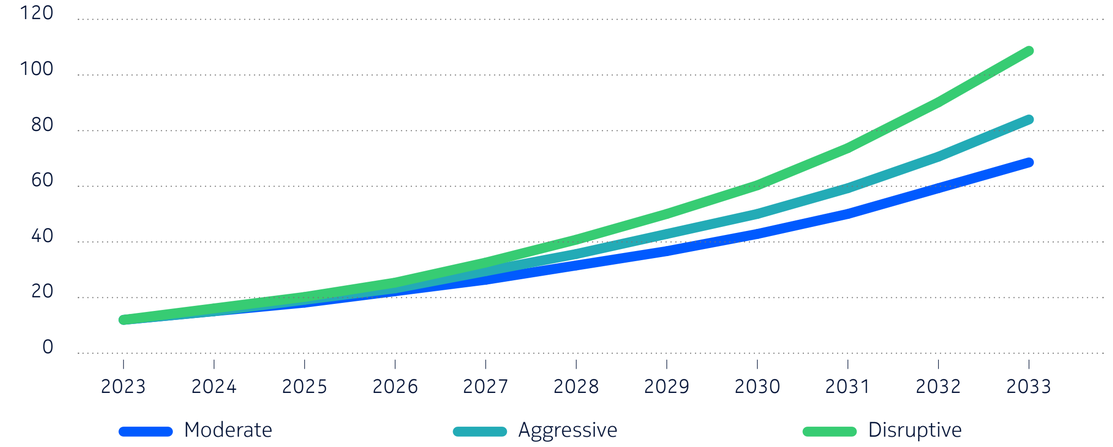


Figure 2: Consumer mobile traffic per subscription, GB/month

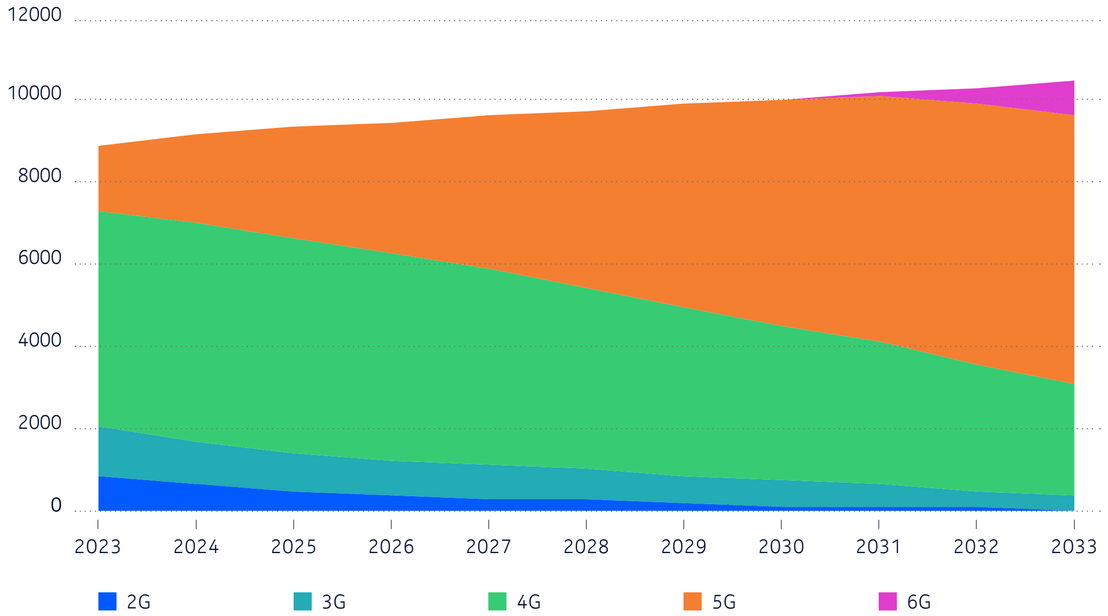


Consumer mobile traffic

As shown in Figure 3: Global mobile subscriptions by technology, the number of mobile subscriptions is projected to grow from 8.5 billion to approximately 10.3 billion by 2033. By then, 5G subscriptions will reach 6.5 billion, accounting for 63% of all mobile subscriptions, while 6G is expected to have 840 million subscriptions, making up 8% of the total.

We anticipate that by 2030, 5G subscriptions will reach 5.6 billion, accounting for roughly 50% of all mobile subscriptions. Furthermore, we expect approximately 92% of all mobile subscriptions to utilize either 4G or 5G technology by 2030.

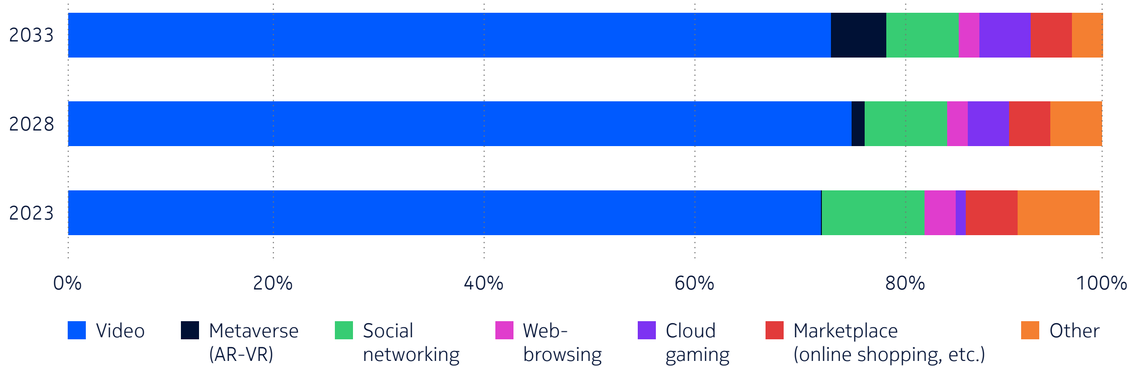
Figure 3: Mobile subscriptions by technology, global



Consumer mobile traffic

Video streaming dominates consumer mobile traffic, contributing 73% of the total today. It is expected to maintain its lead, staying above 70% through 2033. Social networking is the second-largest contributor, with around 10% of traffic in 2023, but it will see a slight decline to 7% by 2033. Advances in 5G and immersive applications are driving the significant growth of emerging technologies like AR/VR, which will rise from a negligible 0.1% today to 5.4% by 2033. Cloud gaming will also increase from 1% to 5%, driven by demand for real-time, high-quality gaming experiences supported by faster networks.

Figure 4: Consumer mobile traffic distribution, moderate scenario



Consumer mobile traffic

Driven by high mobile subscription rates and solid adoption of 4G and 5G technologies, APAC accounted for 24% of global consumer mobile traffic in 2023, a position it will maintain through 2033. China, as the second-largest contributor to global traffic, is expected to see significant growth, not only from the continued adoption of traditional mobile applications but also from the rise of the metaverse, which will account for 6% of China's consumer mobile traffic by 2033.

While regions like North America and Western Europe will experience slower growth in mobile subscriptions, their contribution to global traffic will remain steady at around 7% each, largely due to high adoption rates of AR/VR technologies, which are projected to make up 20% of consumer mobile traffic in these regions by 2033.

Several key drivers will contribute to this traffic growth. These include an increasing number of mobile subscriptions globally, especially in APAC, MEA and India, along with the accelerating adoption of 4G, 5G and emerging 6G networks. In addition, the expanding use of AR/VR ecosystems, cloud gaming and extended usage of mobile applications will further drive traffic across all regions.

Figure 5: Mobile traffic, regional, moderate scenario

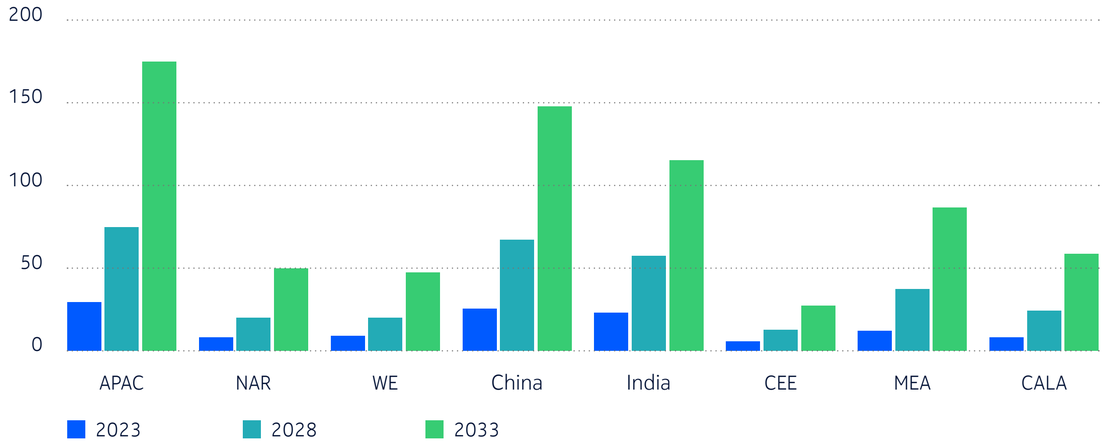
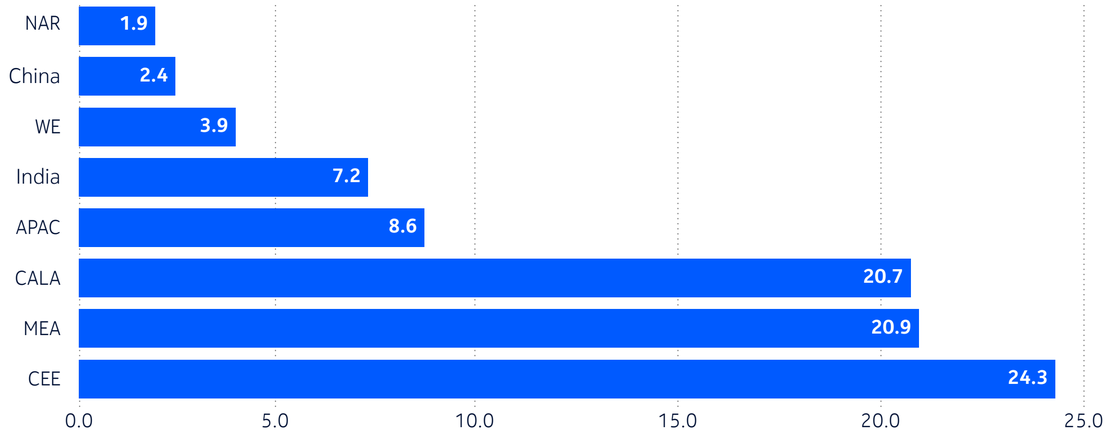


Figure 6: Normalized 5G+6G subscription increase (2023–2033)



Consumer fixed traffic

We project a significant increase in overall traffic, with a compound annual growth rate (CAGR) of 17% in a moderate scenario and 25% in a disruptive scenario. The key drivers in the disruptive case are increases in video bitrate and the emergence of cloud-based virtual reality (Cloud VR). While Cloud VR had only started gaining traction in late 2023, the projection assumes rapid growth, particularly in North America (NA), Western Europe (WE), and Eastern Europe (EE).

Content-heavy applications like video and VR, which demand more bandwidth as resolution and immersive experiences improve, are primarily responsible for the traffic growth. Investments in higher-capacity networks, such as fiber and 5G, are crucial to meet this demand, particularly in regions anticipating high adoption of VR and advanced video services. It also indicates an opportunity for service providers to explore new revenue streams in cloud VR and high-definition video services.

Figure 7: Consumer fixed traffic, global, EB/month including FWA

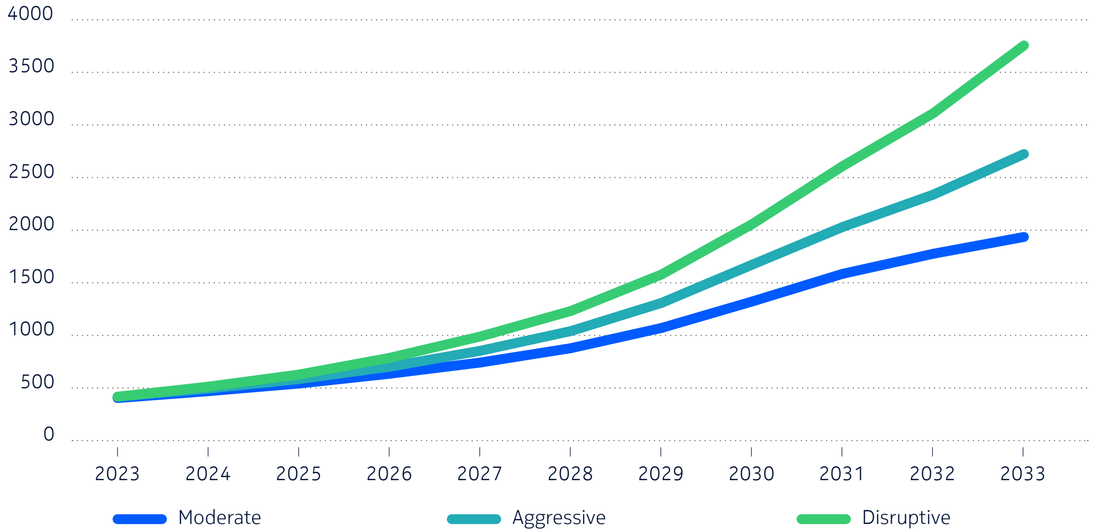
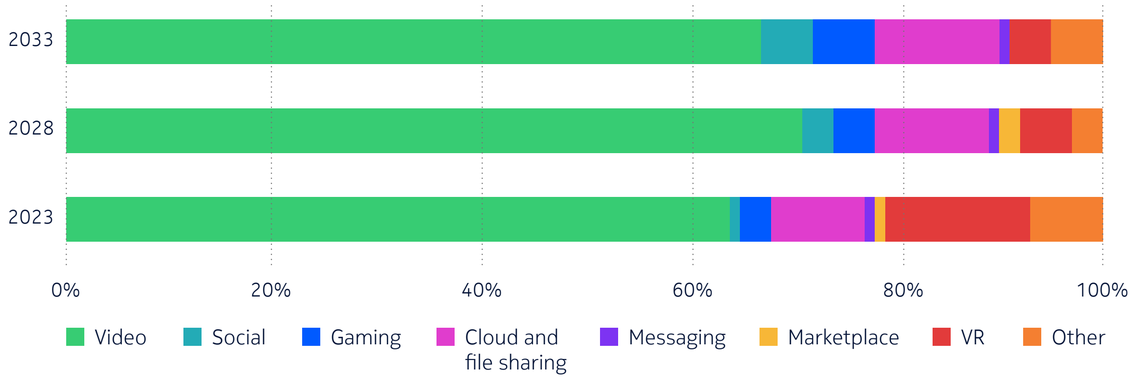


Figure 8: Share of services, North America, moderate scenario



Consumer fixed traffic

Both the average internet speed and the bandwidth available during the "busy hour," the time of highest demand, heavily influence traffic growth. Regions that rely on mixed access technologies like ADSL and 4G fixed wireless access (FWA) generate 10–15% less traffic compared to regions with uniform high-speed connections like fiber, even if their average internet speeds are similar. This points to the need for continuous investment in modernizing networks, moving away from legacy technologies and embracing fiber and 5G to support higher traffic volumes.

Fixed wireless access (FWA) is steadily growing, with the share of 5G FWA subscriptions rising from 14% in 2023 to 61% by 2033. This shift underlines the increasing role of 5G in fixed broadband services, helping bridge the digital divide and ensuring higher bandwidth availability, particularly in areas with limited fiber access.

As demand for data-intensive applications like video streaming and VR accelerates, service providers must focus on expanding high-capacity networks. The rise of FWA and satellite broadband is essential in regions where fiber deployment is challenging. DSL/cable/fiber will account for 83% of global fixed broadband traffic by 2033, with FWA expected to account for 16%. This shift underscores the need for both wired and wireless infrastructure to meet the growing demand for high-definition video and immersive services.

Figure 9: Consumer fixed traffic, global share

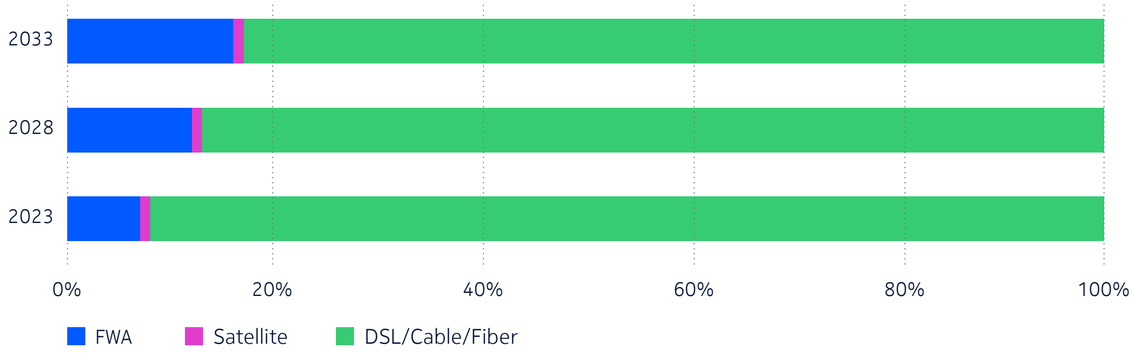
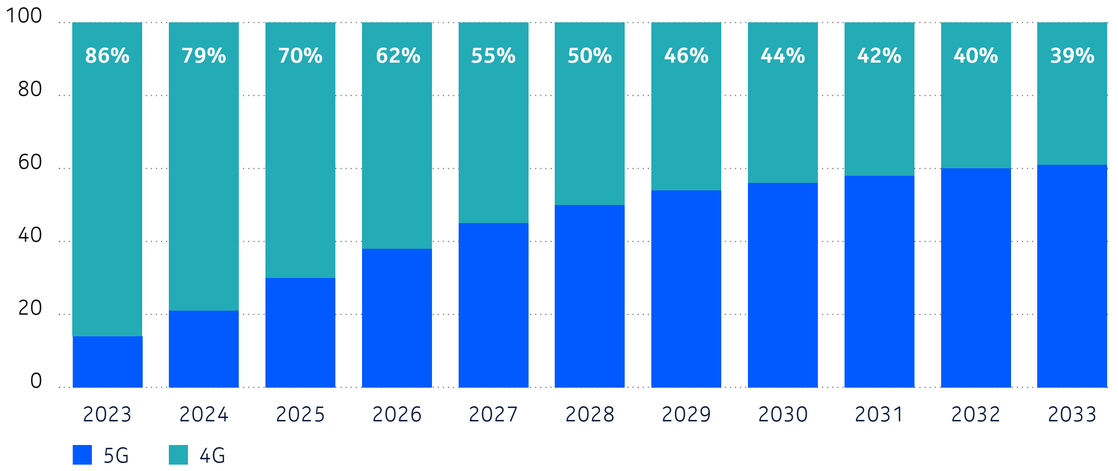


Figure 10: Consumer FWA subscription percentage, by technology



Consumer fixed traffic, regional

In high-bandwidth regions like China, North America and Western Europe, the main driver is the increasing bitrates of services such as video streaming, cloud applications, and gaming. In contrast, regions like Asia-Pacific (APAC) and MEA, where 4G fixed wireless traffic (FWA) dominates, are constrained by lower bandwidth. Even though these regions are experiencing a shift towards 5G FWA, overall growth is expected to be slower due to the limitations of FWA compared to fiber.

This highlights the disparity in technological advancement across regions, with some, like China and North America, driving traffic growth through advancements in service bitrates, while others face bottlenecks due to reliance on lower-bandwidth technologies. The shift from 4G to 5G FWA is critical for APAC and MEA to experience meaningful traffic growth. Still, this will not be enough to match regions that already have more widespread fiber deployment. For operators in these regions, investing in fiber or alternative high-speed access technologies could unlock higher growth rates.

Figure 11: Consumer fixed traffic, moderate scenario, EB/month

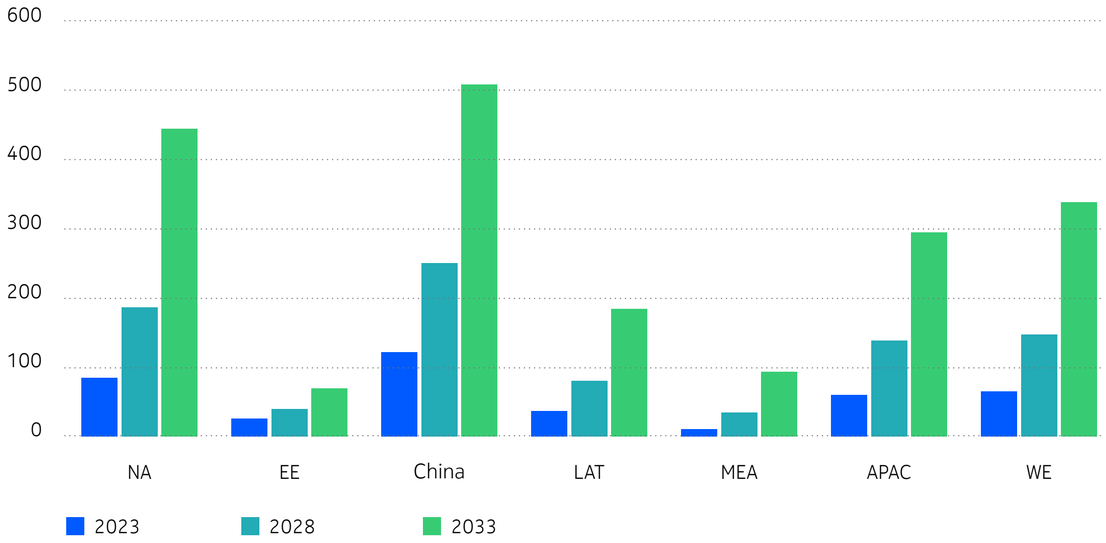
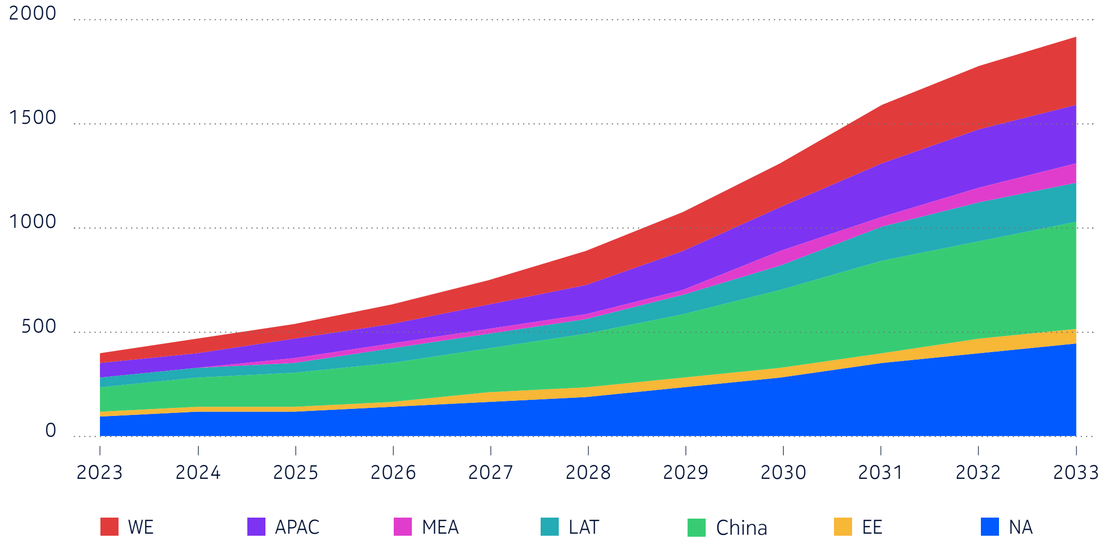


Figure 12: Consumer fixed traffic, by region, moderate scenario, EB/month



Enterprise traffic

Enterprise traffic will witness significant growth as businesses adopt cloud-based services, IoT, and AI. We project an 8- to 21-fold increase in enterprise traffic by 2033, with industrial sectors like manufacturing, healthcare and retail driving much of the demand. Private networks and direct cloud connectivity will also contribute to this expansion.

Enterprise and industrial traffic

We projected the compound annual growth rate (CAGR) for both global enterprise and industrial traffic from 2023 to 2033. The forecast predicts massive growth, with enterprise traffic growing at a CAGR of 14%-22% and industrial traffic at a much steeper rate of 40%-58%. We expect the combined global enterprise and industrial traffic to reach between 638 EB/month (moderate scenario) and 1749 EB/month (disruptive scenario) by 2033, indicating an 8x-21x growth.

The rapid expansion of Industrial IoT (IIoT) and emerging technologies such as extended reality (XR) are driving factors for this increase. Notably, private enterprise networks, especially in industrial applications, will have higher traffic volumes confined within LAN environments due to security and QoS considerations. As enterprises undergo digital transformations, WAN traffic growth will primarily come from applications incorporating AI, IoT and XR.

The explosive growth in industrial traffic suggests a continued focus on private network solutions, especially in sectors like manufacturing and Industry 4.0 applications. Enterprises will need to adopt advanced traffic management solutions to handle the exponential rise in data traffic, especially with AI, XR and IIoT taking more bandwidth.

Figure 13: Enterprise and industrial traffic, global, EB/month

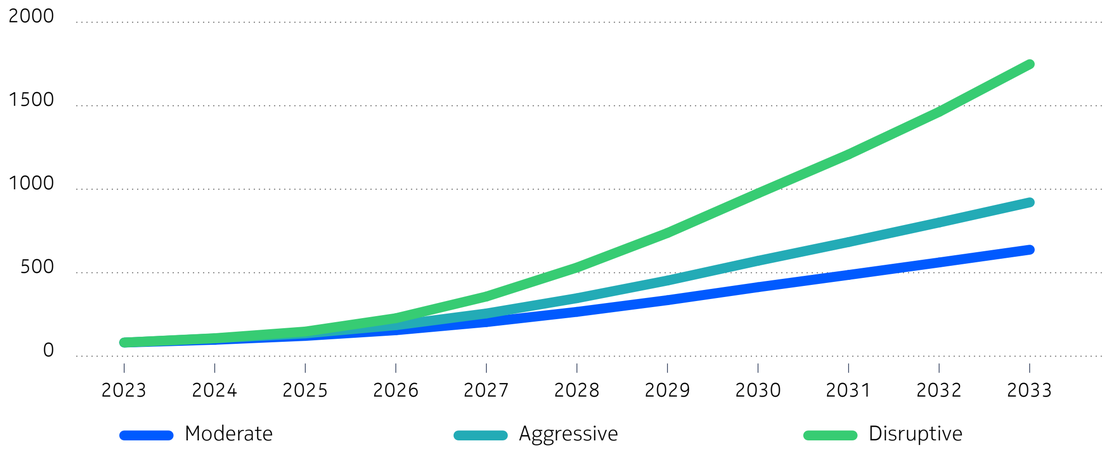
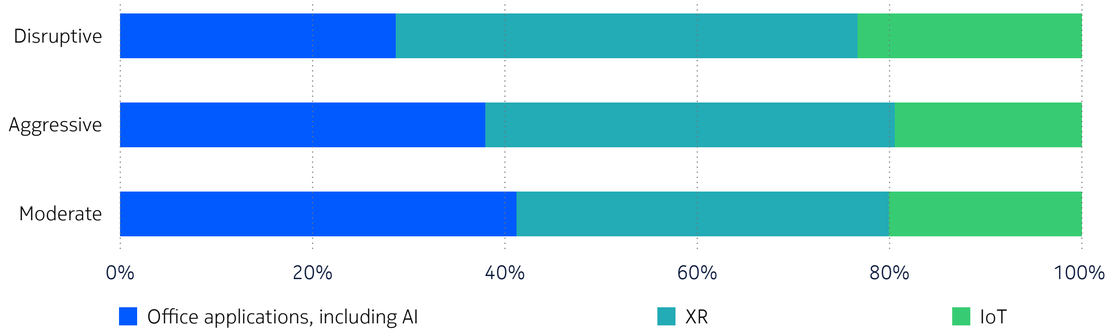


Figure 14: Enterprise WAN services traffic, share, 2023



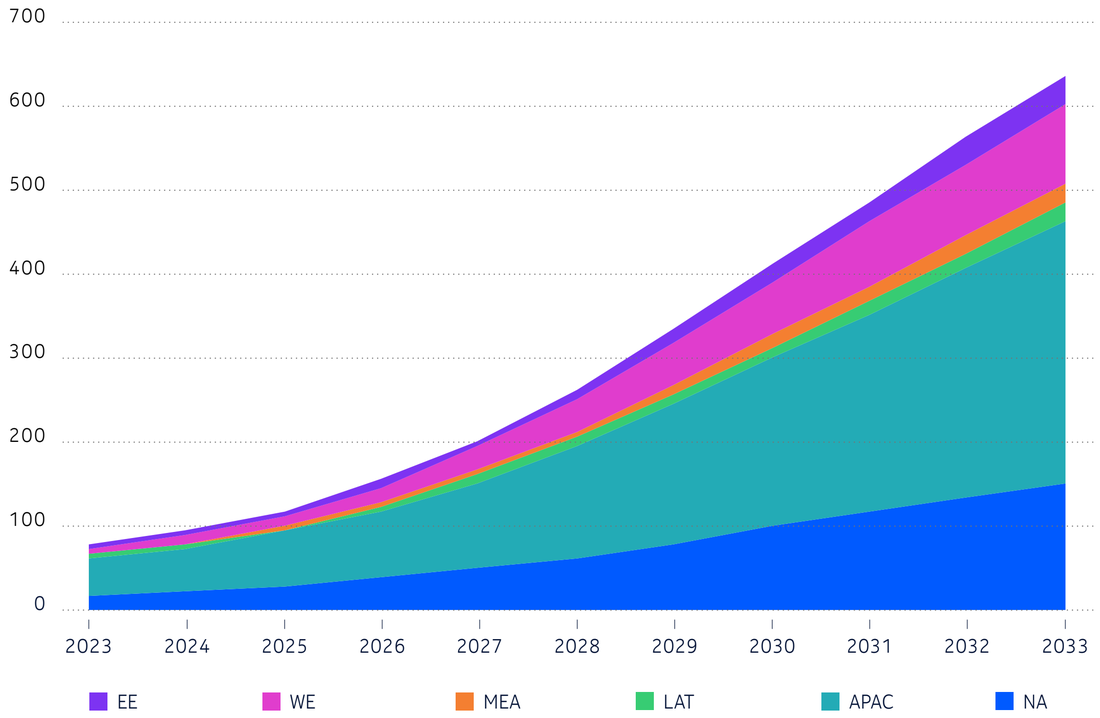
Enterprise and industrial traffic

APAC, including China, along with NA, and WE, is projected to lead in generating enterprise traffic, accounting for 49%, 24%, and 15% of global enterprise traffic respectively by 2033 in the moderate scenario.

The major driver of this is the high level of digitalization in various industries in North America, Western Europe, and China. Closer to 2033, we expect that highly populated countries in the APAC region, such as India, will increase both their Internet penetration and level of digitalization. This will help the overall APAC region maintain a CAGR of 22%, even with a saturated Chinese market.

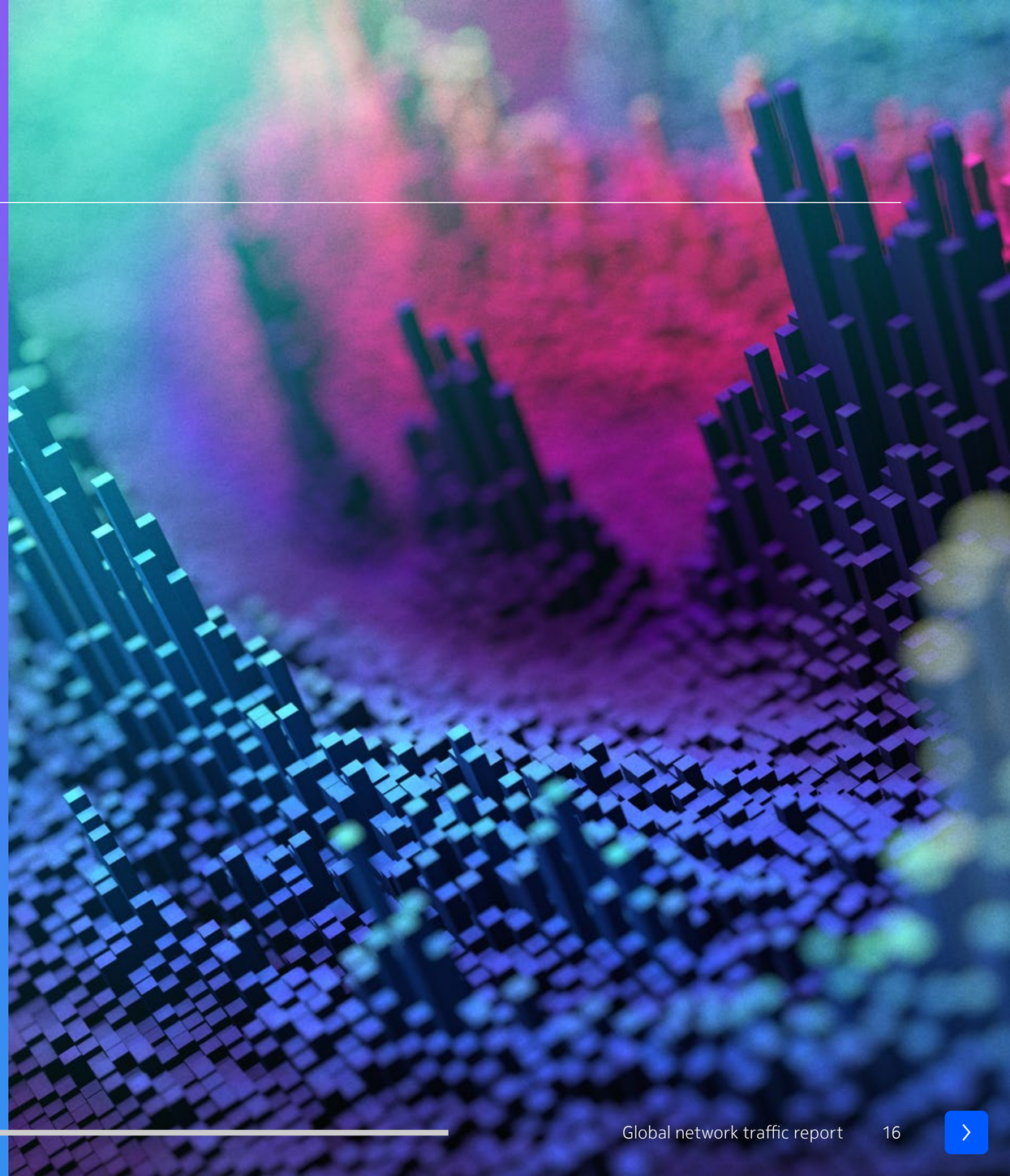
The MEA region demonstrates the highest CAGR of 30% among all regions due to its growth in Internet penetration. However, compared to APAC, the MEA region has a lower share of high-speed link penetration and fewer large and corporate enterprises, resulting in significantly lower absolute traffic volume.

Figure 15: Enterprise traffic, global, EB/month



AI traffic and impacts

AI is poised to transform global network traffic, with the consumer traffic forecast projecting 1088 EB per month by 2033 and enterprise traffic projecting 2192 EB per month. Consumer AI traffic will dominate, while enterprise AI is expected to grow at a CAGR of 57%. This rapid expansion will require significant investments in network infrastructure by CSPs and hyperscalers, as total traffic across inter-data center links could increase by 3386 EB per month by 2033, highlighting the need for robust, scalable networks to support rising demand.



AI traffic segmentation

To perform AI traffic forecasting, we first classify it into two categories – Direct AI traffic and Indirect AI traffic.

Direct AI traffic

AI traffic generated as a result of direct user or system interaction with AI applications and services. This is further classified into:

- Consumer direct AI traffic: This consists of traffic from user interactions with AI-driven applications, including generative AI, AI-assisted tasks, AI-powered gaming, and extended reality (XR) experiences.
- Enterprise direct AI traffic: Generated by use cases improving operational efficiency, such as predictive maintenance, autonomous operations, video and image analytics, immersive media applications, AI-enhanced customer interactions, and other enterprise-focused AI solutions.
- Digital workers AI traffic: AI productivity tools generate traffic by augmenting employee productivity.

Indirect AI traffic

AI traffic generated, not directly by AI applications, but as a result of AI algorithms influencing and increasing user engagement. Only net delta change in traffic generated due to increased user engagement is captured as Indirect AI traffic.

- This reflects traffic growth resulting from personalized AI-driven recommendations across platforms such as video streaming, social media, audio streaming, and online marketplaces.
- We also capture potential reduction in web-browsing and search traffic due to the use of generative AI.

Global WAN AI traffic projections

Forecasts indicate that AI traffic will significantly alter global network demand, with projections reaching 1088 EB per month by 2033 at a compound annual growth rate (CAGR) of 24%. Consumer AI, including both direct and indirect traffic, will dominate this surge, comprising a substantial portion of overall global WAN traffic. As a result, communication service providers (CSPs) and hyperscalers will need to invest heavily in network infrastructure to accommodate this rapidly growing demand.

We expect consumer direct AI traffic to grow at a CAGR of 51%, reaching 174 EB per month, while indirect AI traffic will grow by 21%, reaching 832 EB per month. Enterprise AI traffic, though a smaller EB per month, will see dramatic growth at a CAGR of 57%, highlighting the increasing importance of AI-driven applications across both consumer and enterprise segments. These shifts emphasize the critical need for robust, scalable networks to support the ongoing AI revolution.

Global WAN AI traffic
1088 EB/month – CAGR: 24% (33% of Global WAN traffic)

Consumer WAN AI traffic
1006 EB/month – CAGR: 23%

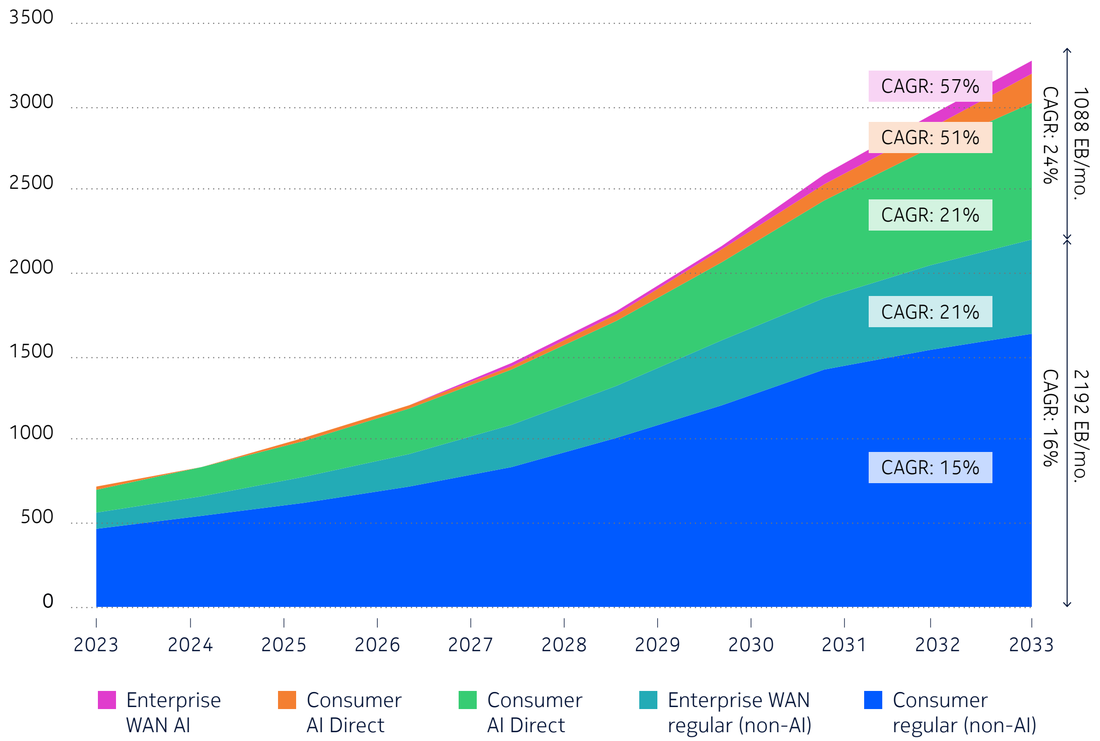
Enterprise WAN AI traffic
81 EB/month – CAGR: 57%

Global consumer AI traffic
(38% of Global consumer traffic)

Consumer direct AI traffic
174 EB/month – CAGR: 51%

Consumer in-direct AI traffic
832 EB/month – CAGR: 21%

Figure 16: WAN AI traffic, global, moderate scenario, EB/month

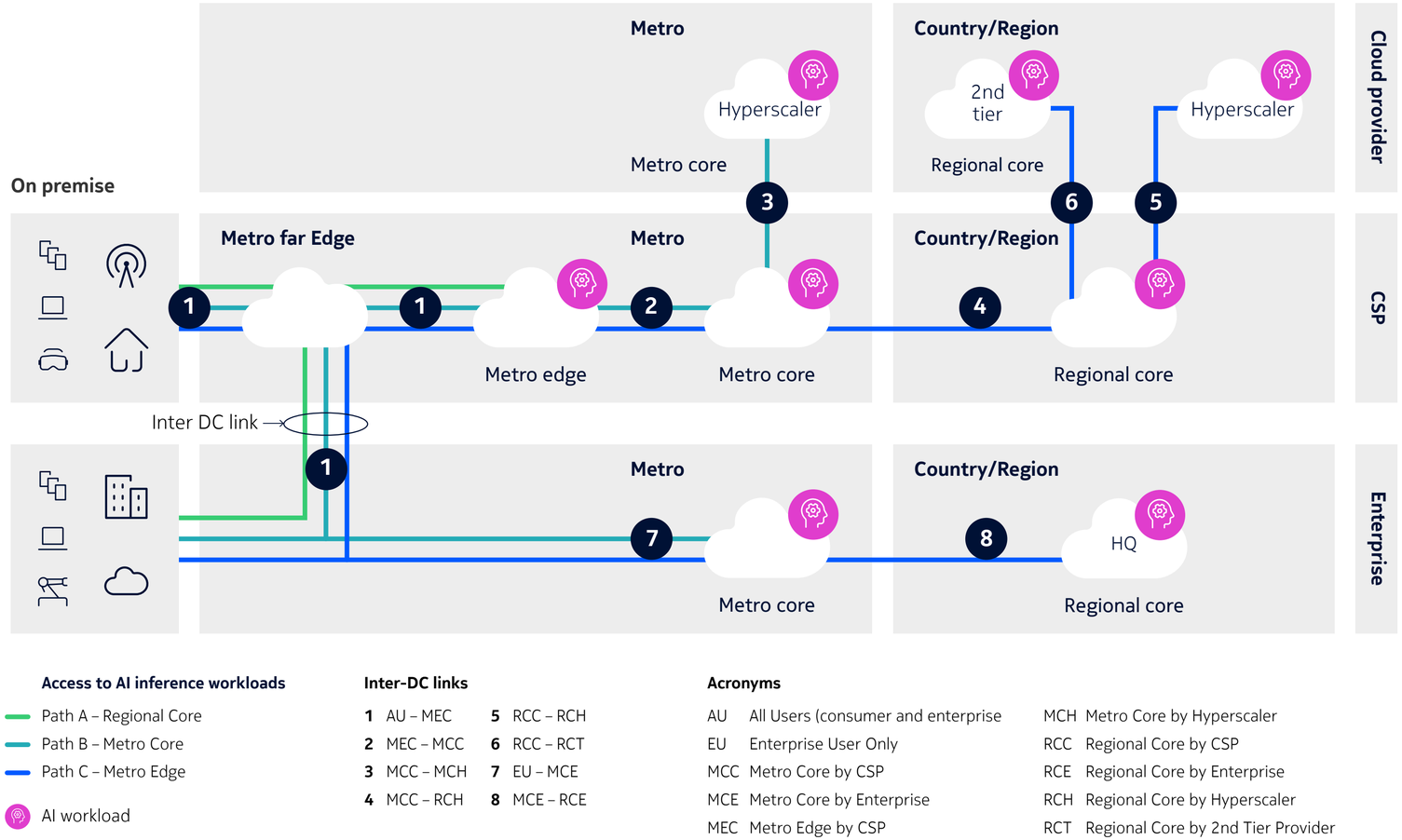


AI traffic over inter-DC links

Consumer and enterprise-generated AI traffic drives AI inferencing and training workloads, distributed across a range of deployment environments. Based on latency requirements, we place these workloads at various locations—on-premise, metro edge, metro core, and regional core. The deployment options span hyperscalers, second-tier cloud providers, CSPs, and enterprises, influenced by data privacy and security considerations.

As AI traffic moves from end users to AI data centers (DCs) within the WAN, it generates diverse traffic flows across multiple inter-DC links. A single AI traffic flow can potentially traverse several inter-DC links, amplifying the overall traffic volume by a multiplying factor. This dynamic creates an increased demand for efficient routing and inter-DC link capacity to handle the growing complexity of AI traffic patterns.

Figure 17: Wide area network (WAN)

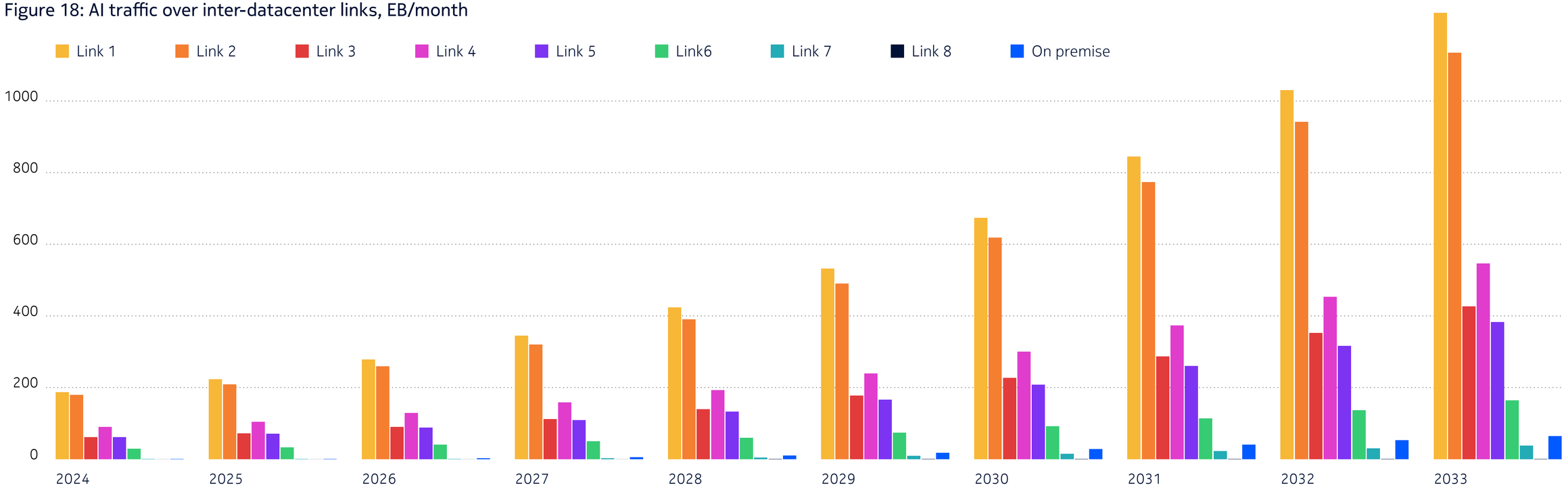


AI traffic demands major network capacity expansion

Previously discussed projections indicate that in 2033, AI traffic from consumer and enterprise applications will reach 1,441 EB/month. This, in turn will result in a total of 3,386 EB/month of traffic across the several inter-DC links as highlighted in figure 16. Among these, the access and aggregation network (inter-DC link 1) of CSPs will bear the heaviest load, roughly 31% of the total AI traffic. The CSP's metro network (inter-DC link 2) is next with 28%, followed by the regional network (inter-DC link 4) with about 14%.

To support this growing demand, significant additional transport network capacity will be needed in the future across CSPs, hyperscalers and enterprise network backbones. This expansion in network capacity will be pivotal in scaling and ensuring the reliable, high-quality delivery of AI traffic across the network.

Figure 18: AI traffic over inter-datacenter links, EB/month



Our conclusions

In 2024, the global digital landscape continues its rapid transformation, driven by surging consumer and enterprise network traffic.

New applications such as AI, AR/VR, and the metaverse are revolutionizing how data flows across networks, underscoring the critical role of network modernization. We project industrial and enterprise use cases, particularly in sectors like manufacturing, healthcare and AI-driven services, to be the most significant growth drivers.

Over the next decade, global network traffic is expected to grow by 5x to 9x, propelled by the adoption of advanced technologies such as 5G and 6G and the increasing integration of AI applications. Video streaming remains a dominant force, but emerging services like AR/VR and cloud gaming will account for a growing share of traffic, especially in regions with advanced network infrastructure.

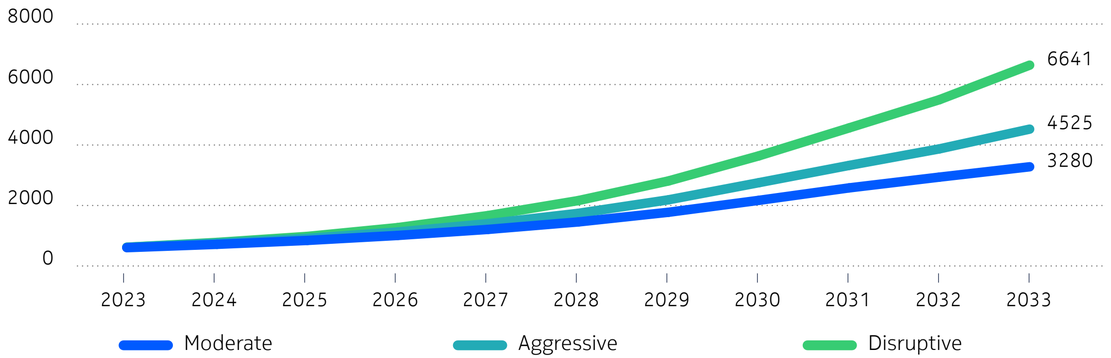
Enterprise traffic, fueled by AI, XR, and Industrial IoT, will be a critical component of this growth, with private networks and edge computing solutions emerging as pivotal infrastructure.

By 2033, enterprise and industrial traffic will make up a substantial portion of global WAN traffic, especially in highly digitalized regions.

To meet these demands, networks will need to evolve toward a more cognitive and automated architecture. Investments in high-capacity infrastructure and new technologies are essential to address the increased demand for bandwidth, lower latency, and resilience. The network of the future must be adaptable, able to support the unique requirements of both consumer and enterprise applications while maintaining the high levels of performance and reliability that these applications demand.

Global network traffic is projected to grow 5x to 9x through 2033.

Figure 19: WAN, global, EB/month



Global telecom bandwidth demand is projected to increase at a CAGR of 18%-27% from 2023 to 2033 to reach 3280-6641 EB per month.

References

Our global network traffic forecast draws upon a diverse range of authoritative sources to ensure accuracy and relevance. Industry data, such as wage statistics from the Bureau of Labor Statistics and digitalization insights from Brookings, provides valuable context for workforce and technology trends.

We also incorporate demographic and infrastructure data from global sources, including the US Census, China's Statistical Yearbook, and reports from statistical agencies across countries like South Africa, Brazil, and Poland. For insights into fixed and mobile communications, forecasts from GlobalData and GSMA Intelligence play a crucial role.

In evaluating AI's impact on network infrastructure, we utilize reports from Altman Solon and Silicon Angel, as well as research on AI's influence on data center bandwidth from Driehaus Capital Management and OSIGlobal. These sources underpin our comprehensive analysis of network trends and inform our long-term traffic projections.

Bell Labs Consulting, the renowned research and consulting arm of Nokia, plays a critical role in analyzing and validating data for the annual Nokia Global Network Traffic Report. Leveraging deep expertise in network technologies, Bell Labs Consulting combines insights from real-world customer network measurements with cutting-edge research to provide accurate and forward-looking forecasts. Their rigorous methodology ensures that the report reflects the latest trends in macroeconomic shifts, technological advancements and evolving customer behaviors, offering valuable insights for network providers worldwide.

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Through networks that sense, think and act, we work with our customers and partners to create the digital services and applications of the future.