AI FOR NET5.5G AND NET5.5G FOR AI

WORLD BROADBAND ASSOCIATION

This white paper explores how AI integrates with Net5.5G, using its architecture as a foundation. It details embedding AI models into all Net5.5G components to enhance interactions and explains how AI makes the IP network more intelligent, resilient, secure, and optimized for an AI-driven future.

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EXECUTIVE SUMMARY

Rapid advances in artificial intelligence (AI) are transforming the world at an unprecedented pace. The benefits of AI-driven change are widely recognized. The communications industry, which includes telecom and cloud service providers, is developing strategic plans to promote innovation by harnessing the broad potential of AI trends such as generative AI (GenAI), edge AI, and agentic AI capabilities. Despite these major AI developments, the key question remains: Can the current IP transport network infrastructure meet the demanding requirements and handle the large volumes of AI traffic without causing load imbalances or data inconsistencies?

The digital landscape is evolving, fueled by a strong synergy between AI and 5G. As AI workloads and their inferencing capabilities expand at the edge, requiring high throughput, bandwidth, and performance, modernizing IP networks with Net5.5G becomes a vital choice for service providers. This well-considered and timely white paper from World Broadband Association Working Group 4 (WBBA WG4) is based on the Net5.5G network architecture. This link between AI and Net5.5G ensures intelligent, resilient, secure, and optimized IP network performance. The white paper also thoroughly explores the need for AI to improve networking intelligence, automation, autonomy, and intent-based networking and addresses the infrastructure requirements to support AI workloads.

In summary, the white paper provides guidance for the industry on Net5.5G R2 (Release 2), focusing on the ideas of “AI in Net5.5G” and “Net5.5G for AI,” and addressing the following key aspects.

- Leverage Net5.5G as the foundation and blueprint.
- Wrap Net5.5G under “AI for Net5.5G” and “Net5.5G for AI.”
- Embed AI models/agents into all Net5.5G building blocks for interactions.
- Collect, monitor, and process Net5.5G traffic (derive the dataset) to be selectively consumed by operator case studies.
- Make the dataset available to the Net5.5G operator layering models and their respective GenAI-driven case studies, and assess the benefits using a dashboard of key performance indicators (KPIs) and key value items (KVIs).

AI BRINGS A NEW SURGE IN NETWORK TRAFFIC

The development of digital environments powered by AI is advancing quickly, enabling businesses and consumers to work more effectively and enjoy entertainment at home more fully. The AI market is projected to reach a trillion dollars. Network providers have a vital opportunity to connect customers to their AI instances. Telcos need to focus on the potential of their AI networks. According to Omdia's research report *AI Network Traffic Report Forecast: 2022–31 – Analysis Update*, although the growth in network traffic for telcos may be slower than for premises and cloud/data centers, a projected 26% CAGR from 2025 to 2030 still offers a strong revenue opportunity. Telcos must adopt flexible, automated orchestration to support evolving business-to-business (B2B) connectivity between AI resources and meet clients' performance goals. The increase in AI adoption is a major driver of network traffic. Service providers' network traffic in terms of AI and non-AI traffic applications is classified into three categories:

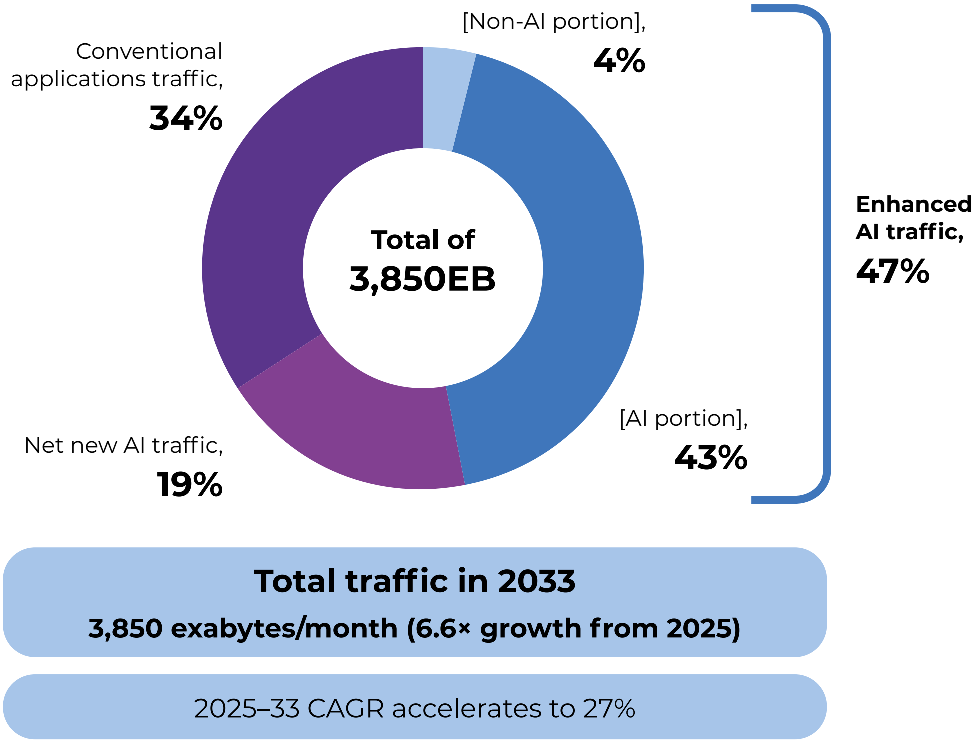
- Conventional network traffic involves applications that are not powered by AI and rely on contract renewals for simple capacity and network services. Buyers may increase bandwidth, but their needs and purchasing methods stay the same. Current traditional internet applications may use AI tools internally, but they do not provide AI-driven features to users. Common examples of conventional traffic applications include email, text messages, forms, basic online games, web browsing, and file transfers.

- Enhanced AI traffic includes contract renewals from clients, now with new or basic variations of AI. These applications existed before the advent of AI, which is now enhanced with AI features and capabilities. There are additional opportunities to meet AI capacity needs within existing applications. The applications generating enhanced AI traffic include content summaries, intelligent analytics, media recognition, and natural language queries. The service provider may need to support the AI segment with additional network quality and performance guarantees as traffic from today's AI-enabled applications results in increased demand.

- New AI traffic stems either from new clients or from entirely new opportunities with existing clients that are unlocked solely through AI capabilities. These applications may have higher network performance needs and are likely to be fast-growing contracts that contribute to overall growth in the networking market. To win these contracts, providers usually need to demonstrate specific capabilities and expertise in supporting specialized connectivity (e.g., dynamic provisioning/billing, high quality, low latency). Traffic from applications built with or enabled by AI varies from very simple (e.g., counting widgets) to complex (e.g., autonomous interactions and decision-making). The common element is that these applications exist because of AI enablement. Applications generating new AI traffic include sensor-based closed loops, visual processing-driven apps, content and pattern ingestion, intelligent surveillance, and response systems.

As shown in **Figure 1** below, in *AI Network Traffic Report Forecast: 2022–31 – Analysis Update*, Omdia analysts, considering all types of applications, estimate that the projected growth of AI and non-AI network traffic in 2033 will reach 3,850 exabytes per month, which is a 6.6× growth increase from 2025.

FIGURE 1: PROJECTED GROWTH OF AI AND NON-AI NETWORK TRAFFIC IN 2033



SOURCE: OMDIA

NET5.5G ARCHITECTURE AS THE FOUNDATION

Net5.5G represents the sustainable evolution of data communication network infrastructure in the era of 5.5G and widespread AI computing. It supports the industry's digital growth and emerging application trends. It lays the foundation for a digital IP transport network, ensuring security and operations, reducing network construction costs, and increasing efficiency. WBBA WG4 outlined the Net5.5G architecture in the white paper "Network Evolution for the 5.5G and 6G Era." The main capability enhancement enables intelligent internet connectivity and intersensing of everything through cloud-network convergence at the IP layer, using end-to-end IPv6/SRv6 technology as the core innovation. Net5.5G facilitates the deployment of Wi-Fi 7, end-to-end 400GE, deterministic networking, and an application- and computing-aware network, creating an intelligent infrastructure that bridges physical and digital worlds. It is expected to be operational by 2030. Though Net5.5G is unlikely to support basic traffic flows, it will enable ultra-reliable, low-latency use cases in fixed-mobile convergence.

Net5.5G highlights three key features of the next-generation IP target network for advancement in the 5.5G/6G era:

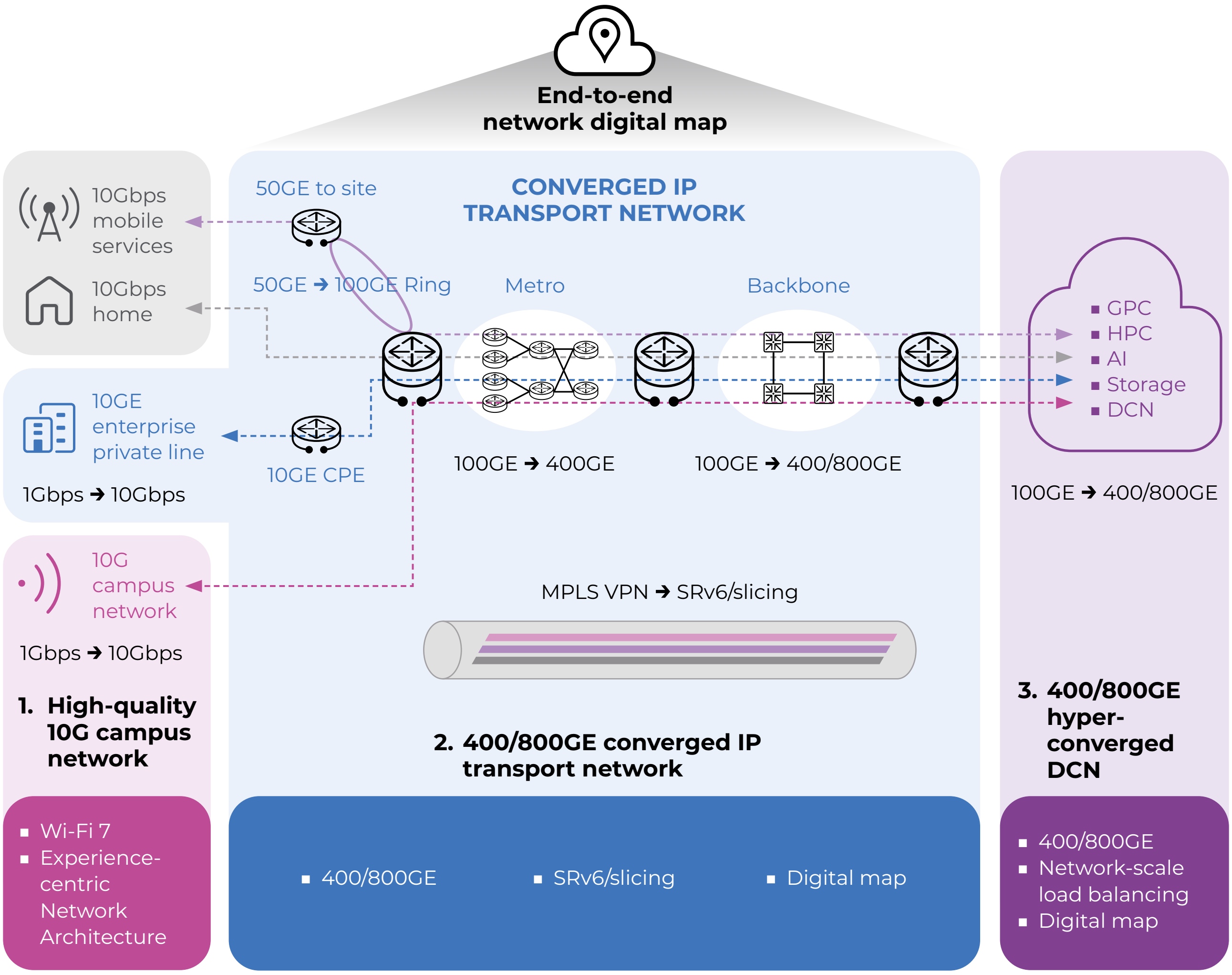
- A unified network for all services
- A single network supporting multiple clouds for cloud-network synergy
- Network as a service with intelligent operations and maintenance

Net5.5G is the foundation that underpins the industry's digital and new applications trends with consideration of four main areas:

- IP transport network
- Data center networks
- Campus networks
- Intelligent operations and maintenance (O&M)

By 2030 and beyond, remote sensing technologies, extended reality (XR), virtual reality (VR), augmented reality (AR), remote AI applications, and supercomputing will drive widespread deployment of 10Gbps ultra-broadband networks. IP transport infrastructure must be developed to meet demand for high bandwidth and low latency and will be managed by intelligent, end-to-end network digital maps, including AI agents offering Level 4 autonomous network capabilities.

FIGURE 2: NET5.5G ARCHITECTURE RELEASE 1



SOURCE: WBBA

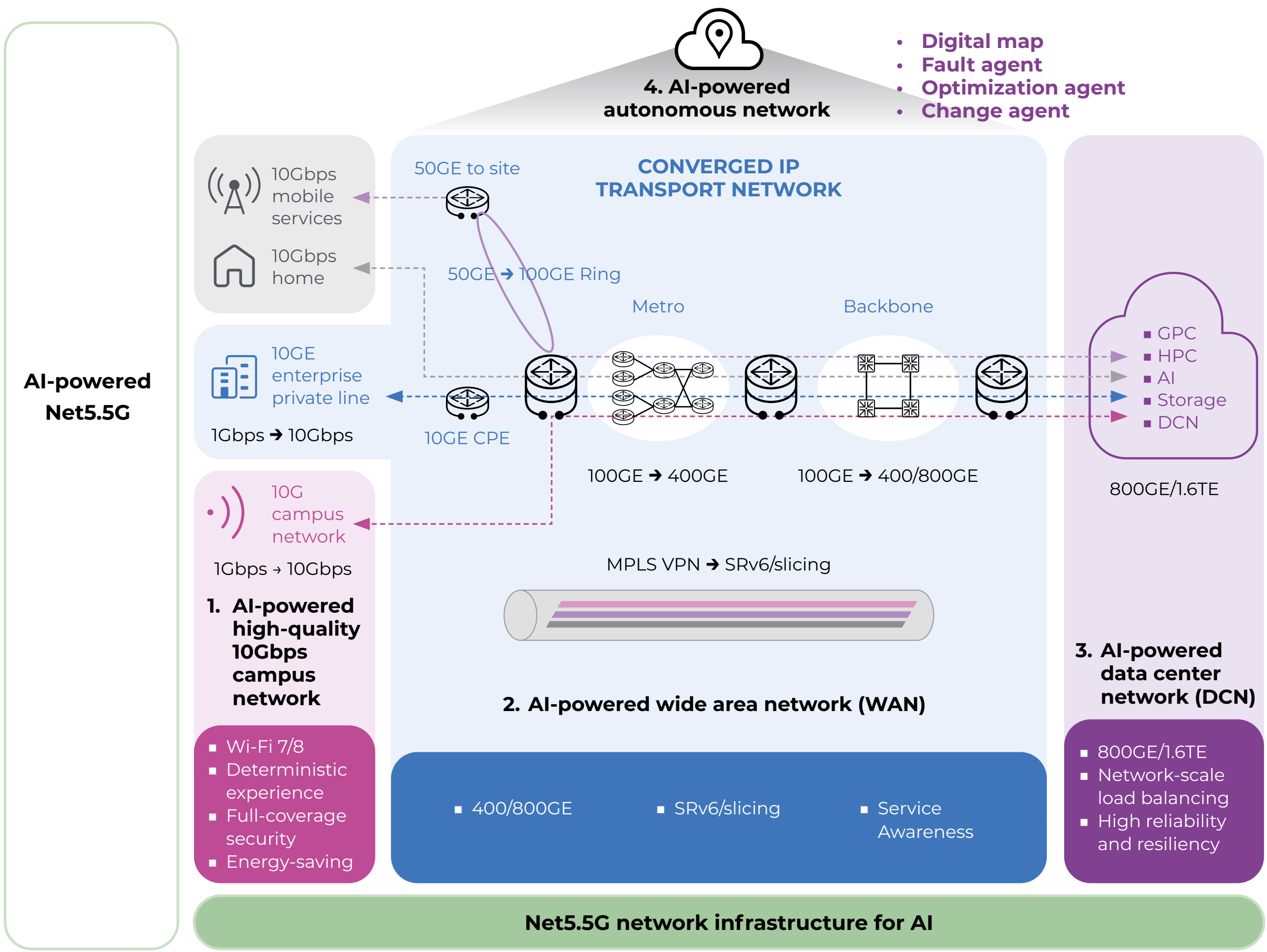
As shown in **Figure 2**, the end-to-end network architecture for next-generation networks comprises four parts:

- **Access networks** are being upgraded to 10Gbps, encompassing mobile broadband, home broadband, campus networks, and enterprise private lines. Wi-Fi 7 and experience-centric network architecture are essential for ensuring high-quality service in campus networks.
- **IP transport network**, including metro and core networks, must be upgraded to 400 or 800GE, incorporating Segment Routing over IPv6 (SRv6) and network slicing.
- **Data center networks** also require upgrades to 400 or 800GE and network-scale load balancing.
- **End-to-end network management** creates an efficient digital map of the network, including data center networking (DCN), IP transport networks, and access networks.

AI FOR NET5.5G AND NET5.5G FOR AI: THE AI WRAPPER CONCEPT

AI is becoming the driving force behind the evolution of networks, particularly IP transport networks. Its role has become more crucial than ever because of substantial increases in AI traffic workloads, mobile backhaul, and cloud or edge computing. WBBA WG4 proposed that the convergence of AI and Net5.5G is not just for network optimization strategies but also represents a transformative paradigm shift. The symbiotic relationship, under a wrapper concept, grows stronger as networks become more intelligent and AI becomes increasingly pervasive.

FIGURE 3 THE AI WRAPPER CONCEPT WITH NET5.5G R2 (RELEASE 2) ARCHITECTURE



AI-powered domains	AI-powered campus	AI-powered wide area network (WAN)	AI-powered data center
AI-domain use cases	· Standardized hybrid office approach · Large-scale AI application · Evolution to new wireless technology	· Mobile broadband DoU improvement · QoE measurement and analysis · AI computing	· AI large model training · Real-time applications
AI-domain technical solutions	· AI for access · Campus for AI · AI for network	· Physical network layer with AI routers · IP transport layer through new AI connections · AI network management	· AI switches · AI connections · AI management · AI network management

SOURCE: WBBA

The connection between AI and machine learning enables intelligent, resilient, and secure performance in transportation networks. “AI for Net5.5G” enhances autonomous, smart, efficient, and secure network operations, while “Net5.5G for AI” provides high-bandwidth, deterministic, and low-latency capabilities for real-time AI tasks.

Figure 3 illustrates this AI wrapper concept with NET5.5G R2 (release 2) architecture.

- **AI-powered Net5.5G:** An AI model has been symbolically embedded in each of the building blocks of the Net5.5G R2 architecture (**Figure 3**).

- **AI-powered domains:** The end-to-end Net5.5 R2 architecture has been partitioned into three AI-powered domains.

- **AI-domain use cases and technical solutions:** We capture the main use cases that are of high interest to the industry and address them from two perspectives: state the problem the case study intends to solve; provide the appropriate technical solutions that help stakeholders solve this identified problem.

The benefits and goals of Net5.5G for AI and AI for Net5.5G are as follows:

- Net5.5G for AI
    - Network scalability to meet AI traffic demands
    - Intelligent traffic engineering with dynamic resource allocation
    - Optimization of traffic and enhancement of quality of service
    - Proactive network management, zero-touch operations, and IP network automation
    - Predictive analytics along with self-healing capabilities
    - Strengthened security for identifying threats
    - Improved energy efficiency through optimized power consumption

- AI for Net5.5G
    - **AI-enabled devices:** 400/800GE links with fast speeds, traffic detection, and classification; millisecond-level sampling; Layer 2 to Layer 7 traffic identification; AI-driven dynamic hibernation for energy savings.
    - **AI connections:** SRv6-based end-to-end connection; remote direct memory access (RDMA) offers millisecond-level low latency, 10E-9 reliability, 90% link utilization, and flow path scheduling.
    - **AI-enabled end-to-end intelligent O&M** includes a network digital twin and AI agents for error recovery, network optimization, and deployment verification.

BUSINESS CHALLENGES AND KEY REQUIREMENTS

BUSINESS CHALLENGES FOR CONSUMER SERVICES

The primary challenge for to-consumer (2C) services is limited bandwidth, which can lead to a poor user experience. As new services, such as real-time interaction, video, and live broadcasts powered by generative AI, continue to develop rapidly, they are expected to require more bandwidth. However, inconsistent network quality worsens the user experience, discourages data usage, and causes bandwidth growth to fall short of expectations. The following factors influence network quality and user experience:

- **Insufficient high-quality access coverage:** Limited optical-fiber resources and high construction costs cause the backhaul network to depend on microwave. External factors, such as weather and clock synchronization issues, significantly affect transmission quality, resulting in substantial fluctuations in bandwidth. This often results in frequent freezes during live broadcasts and video services, which further worsens the user experience. Consequently, users tend to spend less time engaging with the service.

- **Frequent fiber quality faults:** Aging and damage to fiber cores during installation cause delays or service interruptions. The lack of efficient fault detection and repair methods results in prolonged downtime, which worsens the user experience.

- **Packet loss caused by network congestion:** During peak hours, high bandwidth usage and increased convergence rates lead to brief network congestion, resulting in TCP retransmissions and packet loss. Real-time interactive AI applications are sensitive to delays, and even slight packet loss can noticeably impair user experience, reducing overall engagement.

BUSINESS CHALLENGES FOR SERVICES TO THE HOME

Development of to-the-home (2H) services is facing a key contradiction: bandwidth demand continues to surge, but ARPU increases only gradually or even declines. Behind this contradiction are many challenges in business models, competition strategies, and service innovation for 2H services.

- **Bandwidth increases do not generate more revenue:** With the rise of new applications such as 4K/8K video, live streaming, cloud gaming, cloud gym, cloud network attached storage (NAS), and GenAI, users' bandwidth needs skyrocket. Carriers must continually invest in expanding network capacity and upgrading user access speeds from 100Mbps to 1,000Mbps. However, increasing bandwidth does not lead to higher revenue for carriers.

- **Homogeneous competition:** The broadband service is highly standardized, making it difficult for carriers to establish competitive advantages based on basic bandwidth differences. As a result, carriers end up in price wars. The average internet user, telecommuting workers, and cloud-gaming enthusiasts (who are extremely sensitive to latency and jitter) all receive the same “best-efforts” service, and high-value needs cannot be upgraded to premium revenue.

- **Limited operational ability and innovation:** Carriers often depend only on bandwidth rates for package classification, ignoring differences in real user scenarios. Additionally, the absence of data-driven user profiling hinders carriers’ ability to identify high-potential users and accurately develop personalized services.

BUSINESS CHALLENGES FOR ENTERPRISE SERVICES

The migration of mission-critical services, such as financial transactions, remote conferencing, and smart manufacturing, to the cloud requires higher standards for IP networks, including wireless challenges, digital and intelligent challenges, converged challenges, energy-saving challenges, and security challenges.

- **Wireless challenge:** According to statistics and forecasts from Gartner and ABI Research, the number of personal terminals has increased by 3–5× in the past three years. According to IoT Analytics, the number of Internet of Things (IoT) terminals has reached 7 billion. About 80% of IoT terminals are connected to networks wirelessly, and their number is still growing annually by 17%.

- **Digital and intelligent challenge:** By 2030, the total number of connections worldwide will exceed 200 billion. Currently, the independent construction of campus infrastructure results in isolated systems and data, leading to failure to meet the sustainable development needs of the campus digital economy.

- **Converged challenge:** Traditional campuses adopt a fragmented subsystem construction mode. As a result, their security protection, energy efficiency, and conferencing subsystems run independently of each other, leading to resource fragmentation and complex O&M.

- **Energy-saving challenge:** Campuses generate over 60% of urban carbon emissions and play a critical role in achieving the goal of carbon peak / carbon neutrality. Under the guidance of this goal, green transformation is now central to campus strategies, shifting from individual energy-saving measures to systematic zero-carbon operations.

- **Security challenge:** The IoT trend and multinetwork convergence (5G/Wi-Fi and cloud-edge synergy) have completely broken the traditional "castle and moat" security boundary model that implements physical isolation, resulting in an exponential expansion of the attack surface and ubiquitous security threats. Network security has evolved from a support system to a core productivity element and has become equally as important as the services it protects.

In addition to the challenges mentioned above, AI has emerged as a critical aspect of enterprise digital transformation, but it necessitates the real-time transfer of vast volumes of sample data from edge nodes to data centers, a task that traditional networks struggle with because of their inability to deliver the required high throughput, low latency, and lossless transmission capabilities. For example, petabyte-scale data backhaul for autonomous vehicle companies and real-time imaging analytics for medical AI both rely on highly flexible and reliable dedicated-line services. In addition, to comply with data regulations, many enterprises use the remote data training mode, where sensitive data is stored locally and only computing tasks are scheduled to the cloud. This mode places higher requirements on the real-time transmission capability of the network. Any packet loss or latency may affect the model training efficiency.

AI-ENABLED PRACTICES ARE BOOSTING NETWORK TRAFFIC

As the intelligent era accelerates, AI-enabled applications are reshaping traffic patterns and service requirements across vast area, data center, and campus networks, pushing operators to rethink infrastructure design for Net5.5G. To address these challenges, the WBBA's "Net5.5G Best Practices and Deployment Guide" defines four new "connecting X" scenarios—computing connection, intelligence connection, data connection, and airspace connection—which together provide a blueprint for next-generation digital infrastructure. These scenarios enable operators to integrate intelligence into networks, enhance efficiency and reliability, and unlock new business models that sustain growth in the AI-driven economy. The following section examines concrete AI-powered use cases across WAN, DCN, and campus networks, illustrating how these scenarios are being implemented in practice.

AI-POWERED WAN PRACTICES

Over the past decade, internet services have expanded rapidly, and high-value offerings such as high-definition (HD) video, live broadcasts, e-commerce, AI training, and reasoning have emerged one after another. However, as providers of network infrastructure, operators have not achieved the highest returns from this wave. Over-the-top (OTT) services now dominate, increasing competitive pressure in service development on carriers. Additionally, IP networks support an increasingly broad range of services. Small faults or accidents can cause major social and business disruptions, which directly lead to a rapid rise in operators' opex.

Practice 1: Improving the dataflow of usage of the mobile broadband network
Dataflow of usage (DoU) is a key indicator that affects an operator's revenue. The quality of the transport network directly affects user experience. When issues such as congestion and packet loss arise, user experience deteriorates, resulting in DoU suppression. This ultimately slows revenue growth and reduces ROI for the operator. The AI-powered WAN could analyze historical data from base stations across the entire network to identify instances of DoU suppression and their correlation with transport network congestion.

Practice 2: Quality of experience measurement and analysis
Quality of experience (QoE) refers to users' overall subjective perception of the quality and performance of devices, networks, systems, applications, or services. With expertise in O&M scoring, operators can quantify how users evaluate the overall service quality and performance and use these insights to optimize the network. As application encryption becomes increasingly common, traditional QoE measurement technologies are becoming less accurate and cannot accurately reflect the experience. The AI-powered WAN solution introduces AI technologies to simulate user behavior in real time for QoE model training and infer application quality issues.

Practice 3: AI computing
In the intelligent era, leasing computing power has become a new business model. New service opportunities also bring daunting challenges to networks. New services mainly involve the following three major scenarios: sample transmission to computing centers, AI training based on local storage and remote computing power synergy, and cross-data-center collaborative training. The AI-powered WAN can provide a high-quality, low-latency, and flexible backbone for sample transmission and training.

AI-POWERED DCN PRACTICES

In recent years, with ChatGPT leading the way, the AI industry has entered an era of GenAI. AI innovation has shifted from *prediction and inference to content creation*, and AI training models are evolving from many small models to a single large model with trillions of parameters. The rise of large models further drives innovation and progress, sparking a new wave of transformation. Behind this growth is a strong push for digital transformation across different sectors. In healthcare, AI applications such as auxiliary diagnosis and drug development require the processing of vast amounts of data and the training of complex models. An intelligent computing cluster enables accurate decision-making and fast responses. Meanwhile, the scientific research field has expanded into large-scale scientific computing and gene-sequencing analysis. Intelligent computing clusters continue to fuel market growth.

Practice 1: AI large-model training/reasoning – explosive growth of east-west traffic

- **Continuous growth in scale:** Billions of parameter models (e.g., AlphaFold, GPTSeries) need to be trained on hundreds of GPUs. Gradient data, which is generated during a single training operation, is synchronized between servers, driving data center network internal interconnect bandwidth from 200GE/400GE to the 800GE/1.6TE evolution.

- **Traffic density requires higher network bandwidth utilization**, such as model parallelism and data parallelism. This technique causes frequent exchanges of intermediate parameters between servers, resulting in an internal bandwidth 80% higher than the baseline. Balancing the load in the data center network presents an even greater challenge. Improving network bandwidth utilization and reducing the proportion of network communication time during training to enhance training efficiency have become urgent issues that the current data center network must address.

Practice 2: Real-time application – increase in north-south traffic and low-latency challenges

- **Rapid growth of data center ingress traffic:** With the increasing demand for 4K/8K real-time video rendering (such as virtual anchors) and AI applications (e.g., in the drawing scenario), the bandwidth of a single user flow exceeds the 50Mbps threshold. Consumption by millions of concurrent users reaches the terabits per second level of egress bandwidth, driving the data center network's ingress bandwidth to evolve from 10GE/25GE to 100GE/400GE.

- **Rigid low-latency requirements:** According to 3GPP TS 22.261 (5G service requirements) for vehicle to everything (V2X) and industrial control, end-to-end latency targets are set at 1–10ms, depending on the scenario. And from the 3GPP TS 22.26 remote surgery use case, a round-trip latency of 10ms is required. These services all require the data center network to reduce latency, necessitating an improvement in internal forwarding from the millisecond to nanosecond level.

AI-POWERED CAMPUS PRACTICES

The global economy is expected to grow slowly, prompting companies to exercise caution when replacing outdated equipment. Instead, they are more likely to allocate their limited budgets to AI computing infrastructure such as DCN, GPU, and storage rather than to traditional campus network equipment. Gartner predicts that by 2026, 80% of enterprises will deploy or use GenAI for office tasks, AI robotics, or industrial applications. Additionally, Gartner forecasts that by 2027, 30% of enterprise office scenarios will adopt metaverse technology, with AI-driven automation significantly boosting efficiency. Companies such as Meta, Microsoft, Tencent, and Feishu, among others, are establishing their presence in the office metaverse, exploring new immersive office experiences. Meta has launched Workrooms and expects to achieve shipment of 100 million 4X devices by early 2030. AI-enhanced collaborative office efficiency is also projected to increase by 30%. Some businesses, such as Yunlou SOHO, demonstrate that the metaverse office model can reduce ineffective communication, optimize task management, and improve efficiency by approximately 20–30%. Below are some scenarios explaining the reasons for upgrading to AI-powered campus networks.

Practice 1: Standardize the hybrid office approach
In the postpandemic era, about 70% of companies have adopted a hybrid work model, which has increased the demand for enterprise network security. The number of daily average users for applications such as Microsoft Teams and Zoom has surpassed 300 million, and their sensitivity to network latency is growing, prompting enterprises to upgrade their networks and enhance user experience.

Practice 2: The large-scale application of AI
The large-scale application of AI in enterprises, education, manufacturing, the internet, and other industries has driven the accelerated development of collaborative applications, leading to constant increases in bandwidth and delay requirements. At the same time, the large-scale deployment of AI applications has created new requirements for delay guarantees and security control of the campus network in the air interface and wide area, and network demand has evolved from “pursuing bandwidth” to “pursuing bandwidth with experience”. This has stimulated increased demand from customers for upgrading their networks.

Practice 3: AI for wireless operations
Enterprises are speeding up the intergenerational evolution of wireless technology such as over-the-air (OTA) upgrades in the automotive industry, smart classrooms in the education sector, and shared-desktop teaching. In the AI era, there is an increased need to enhance wireless AI operations (AIOps) capabilities. Traditional wireless tuning and fault analysis will shift from optimizing current logical states to AI-based inference for real-time analysis and optimization. AI-driven operation and maintenance for wireless networks will be further advanced.

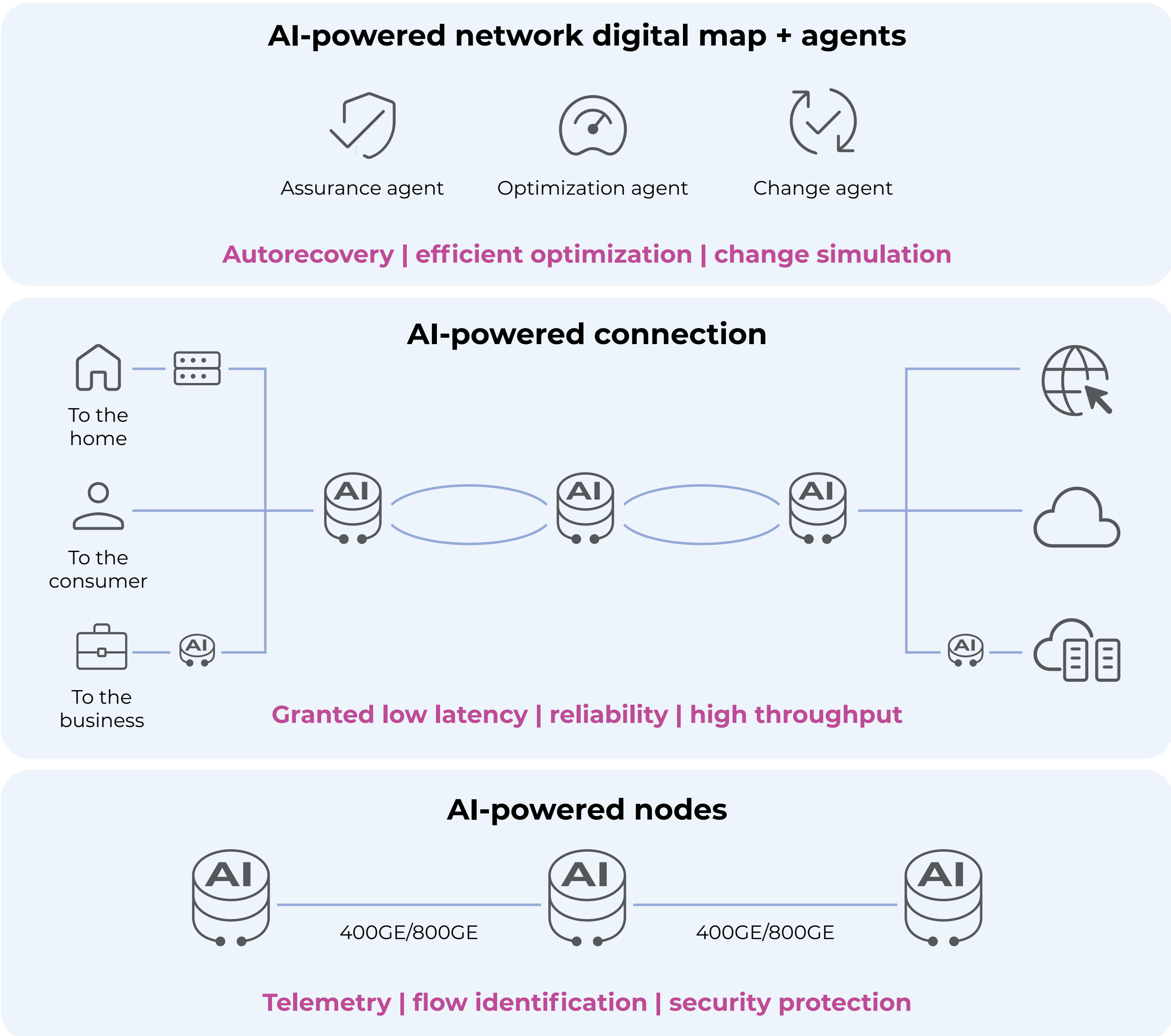
AI-POWERED NET5.5G SOLUTION ARCHITECTURE

This section provides guidance on the role and implementation of AI in Net5.5G solution architecture, covering WAN, DCN, end-to-end network management, and campus solutions.

AI-POWERED WAN SOLUTION ARCHITECTURE

As shown in **Figure 4**, AI-powered WAN adopts the three-layer architecture outlined by Net 5.5G R1, consisting of a physical network layer, service bearer layer, and network management layer. The core of this AI-powered WAN solution is to leverage AI technologies to enhance R1, enabling it to address the service challenges of the AI era and meet the requirements of new services on IP transport networks.

FIGURE 4: AI-POWERED WAN SOLUTION ARCHITECTURE



SOURCE: WBBA

Solution 1: Upgrading the physical network layer of AI routers
Unlike traditional routers, AI-enabled routers for software-defined networking (SDN) have integrated AI features, enabling millisecond-level precise flow collection and traffic behavior detection. They also provide end-to-end 400GE/800GE ultra-high bandwidth. An IP network built on AI routers supports differentiated, deterministic, and intelligent services, combining many functions such as broadband remote access server / Carrier-Grade NAT / Segment Routing (BRAS/CGN/SR), service routers, service awareness, IPsec, and AI engines into service gateways. Additionally, they enable multinetwork integration, such as merging the mobile bearer network with the to-business dedicated network. Dynamic energy-saving technologies help to optimize the total cost of ownership.

Solution 2: Upgrading the IP transport layer through new AI connections
Technologies such as software-defined networking, SRv6, and network slicing form the foundation for intelligent and programmable networks. They enable new AI-native connections with deterministic latency (~1ms), ultra-reliability (a packet loss rate of 1E-9), and guaranteed high throughput (≥90%), supporting latency-sensitive and compute-intensive tasks such as distributed AI training and real-time inference. These capabilities help meet the high-quality and high-standard network requirements of emerging services such as finance, gaming, and intelligent computing. When they are combined with the flow collection and identification features provided by the presence of AI in routers and connections, it is possible to deliver differentiated service experiences for various users and services, enabling carriers to conduct more refined operations. Ultimately, with the support of new services and refined operations, revenue increases rapidly.

Solution 3: Upgrading to AI network management
Integrating breakthroughs in AI technology into the network management layer is crucial. Our focus will be on the three main categories of specialized agents:

- **Assurance agents** can perform real-time fault detection, localization, and self-closed-loop operations in 90% of cases.
- **Change agents** enable online change simulation, helping to prevent network accidents caused by human errors.
- **Optimization agents** offer real-time network optimization and capacity expansion recommendations based on network key quality indicator (KQI) data, helping to release suppressed traffic and increase ARPU.

With support from these three categories of specialized agents, the network management layer can progress from AN L3 to AN L4.

AI-POWERED DCN SOLUTION ARCHITECTURE

The rise of AI technology has prompted telecom service providers to modernize their traditional DCN infrastructure to ensure secure, nonblocking, high-throughput, and lossless performance for all new AI and AI-upgraded enterprise and at-home consumer applications. The following improvements with respect to AI technologies have had a significant impact on the architecture of DCN:

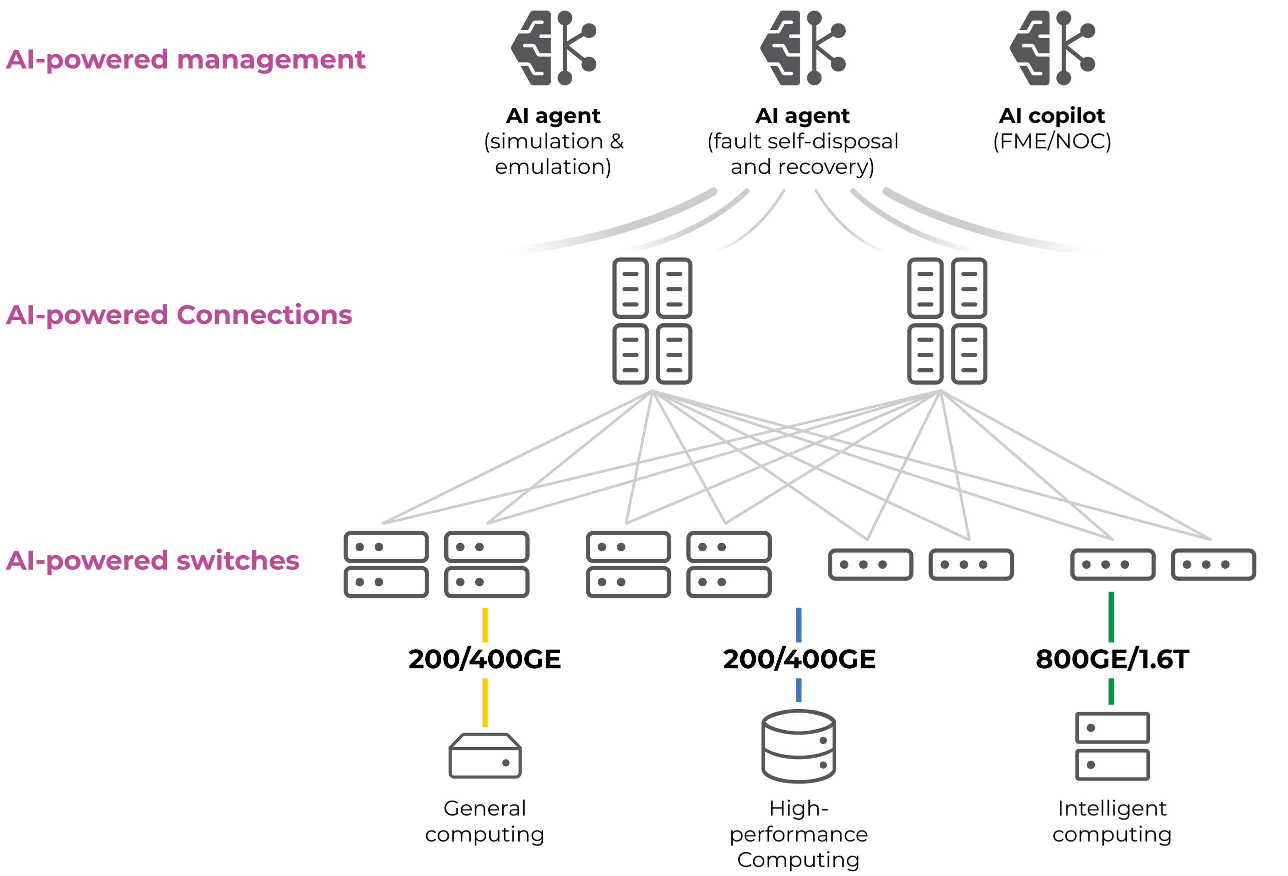
Solution 1
Mixture of experts (MOE) has become the main framework for developing large models in the future. All2all—collective communication, which involves data exchange among all servers in a high-performance computing (HPC) distributed computing task—introduces additional challenges to the backend network. Because communication is random, the balancing solution must shift from a per flow approach to a per packet approach. At the same time, device-network collaboration reduces communication times and enhances the efficiency of training and inference.

Solution 2
The AI agent era has arrived and is gradually being adopted in production scenarios across various industries, delivering business value. Inference must be used to detect when a burst occurs, which can cause 5× the usual traffic volume. It needs to evolve toward zero packet loss and support high bandwidths (100GE and 200GE).

Solution 3
AI agents are deployed within production systems that have high reliability requirements and involve significant investment. The performance, reliability, and availability of the entire cluster have a significant impact on customer investments.

Among the challenges in networking for AI modernization, building a secure, larger-scale, multicomputational, high-performance, and lossless DCN fabric is crucial for service providers to succeed in the AI era.

FIGURE 5: AI-POWERED DCN SOLUTION ARCHITECTURE



SOURCE: WBBA

The core of the AI-powered fabric solution is the use of AI technologies to address the service challenges of the AI era and meet the requirements of new services on DCN networks:

- **Upgrading the switches:** Unlike traditional switches, AI switches incorporate AI capabilities, enabling native AI-driven forwarding to predict traffic changes in advance. Because most of today's data centers are software defined, they consist of SDN-based switches. AI will be introduced by keeping SDN as the base. This guarantees optimal throughput and latency for individual devices, in addition to high system bandwidth and throughput at 800GE/1.6TE. Data plane fault checks must ensure a switchover within milliseconds during device link failures. Warm reboot technology should be used to maintain uninterrupted forwarding after a device restart. Physical-layer encryption technology is crucial for meeting strict security requirements for AI model parameters, especially in terms of enterprise security and the secure transmission of sensitive data within an intelligent computing center.

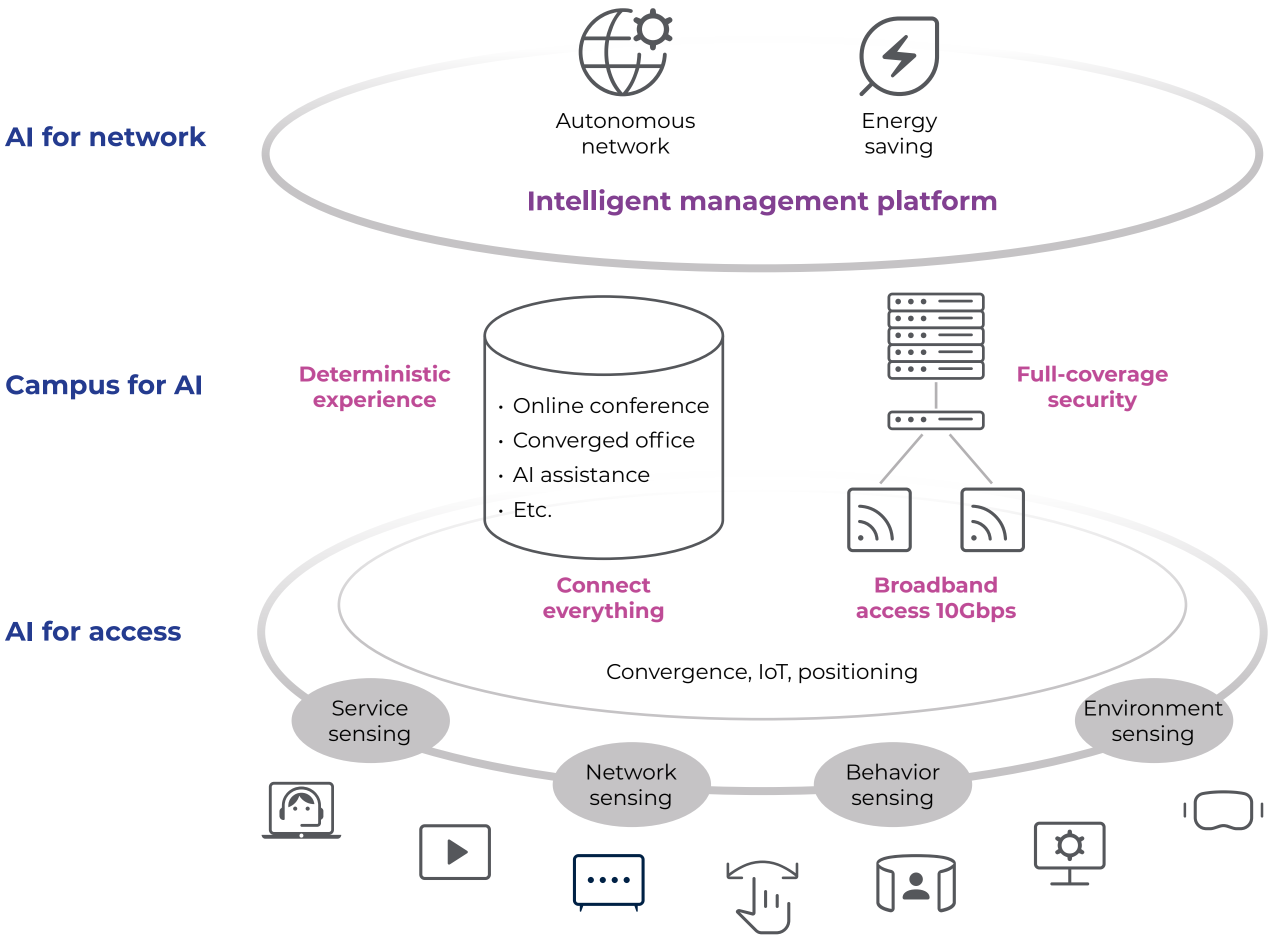
- **Upgrading the connections:** New AI connections can offer high throughput and load balancing, meeting the demanding network needs of new services such as finance, gaming, and intelligent computing. The entire fabric is nonblocking. The load is evenly distributed across all links. The overall bandwidth of the fabric is fully utilized to ensure the lowest latency and maximum bandwidth for communication between any two points. Device-network collaboration technology enables the device side to understand the network's communication capabilities, ensuring it can fully leverage the network bandwidth and optimize throughput. Hop-by-hop flow control technology is employed to achieve zero packet loss throughout the entire network, thereby creating a lossless network.

- **Upgrading the management:** AI-powered management, powered by techniques including AI agent and AI copilot, is crucial for enhancing the DCN network's autonomous level from L3 to L4. An AI agent for network simulations and emulation is introduced to ensure that changes to the network have no impact on the applications. An AI agent for fault self-disposal and recovery is used to enhance the fault demarcation and localization. An AI copilot is utilized in both field maintenance engineer (FME) and network operations center (NOC) scenarios to enhance O&M efficiency through natural language interaction.

AI-POWERED CAMPUS SOLUTION ARCHITECTURE

The increasing complexity of campus environments, driven by the growing adoption of cloud applications, has created a pressing need for AI-enhanced campus networks. Traditional network management methods struggle to keep up with these changing demands. AI-powered campus networks are becoming crucial for scalability, agility, and resilience in today's enterprise infrastructure.

FIGURE 6: AI-POWERED CAMPUS SOLUTION ARCHITECTURE



SOURCE: WBBA

Solution 1: AI for access – upgrading the access layer through AI technology

Different types of terminals are the main service targets of campus networks and also major sources of threats. Therefore, gaining visibility, manageability, and security control at the network access layer is a significant challenge for campus networks. AI technology can help to identify terminal types and control behavior, enabling features such as automated configuration and security policies. Additionally, spatial awareness can improve overall security by extending protection from connections to the physical space.

The campus network includes the terminal layer, access/aggregation/core network layer, exit layer, and control layer. The terminal consists of various types, such as smart terminals, dumb terminals, and industrial terminals. The access layer comprises wired and wireless network access devices. The aggregation/core layer consists of L2/L3 switches. The exit layer includes routers and firewalls. The control layer comprises SDN controllers and analyzers, which serve as the brains of network management.

Solution 2: Campus for AI – upgrading the network experience for AI applications
Based on AI application intelligent recognition and assurance technology, AI sessions can achieve millisecond-level deterministic latency and a packet loss rate of 1E-9, meeting the high standards and quality requirements of new AI terminals and services (such as embodied intelligence and AI OS systems). Combined with AI-driven traffic collection and recognition analysis capabilities, the network can deliver differentiated experience services for various AI applications and users, providing real-time capabilities for AI. Additionally, the campus can enhance security for AI applications by encrypting both wireless and wired physical links, using AI to identify potential threats and implement targeted security measures, ensuring comprehensive coverage.

Solution 3: AI for network – upgrading the network management with AI
By integrating innovative technologies such as large models and natural language translation, the network can progress toward a Level 4 autonomous network. On one side, the campus network provides more information for AI, including terminal, service, traffic, location, and environment data, helping AI improve its overall capabilities. On the other side, large models support automated inspection and maintenance; enable real-time visibility at device, network, and application levels; allow real-time journey replay at user and application levels; and facilitate minute-level problem localization. Network-intelligent agents automatically analyze fault root causes through fault analysis models, achieving 90% Wi-Fi fault detection and a closed-loop system.

AI-POWERED AUTONOMOUS NETWORK

O&M automation is crucial for ensuring network performance and reliability
During unexpected network faults or performance issues, the forwarding chip's native capabilities are used to monitor network status and data in a high-performance, visual way. For instance, network congestion and load imbalance are shown to support automatic scheduling and optimization, enabling end-to-end visualization and automatic O&M, as well as quick fault detection and one-click correction.

Change automation is the basic guarantee for network capability self-evolution
On an AI network, updates are frequent as a result of changing service needs, emerging technologies, fault repairs, and network configuration improvements. Automating these updates is crucial for maintaining process security and is a key step toward the network's self-optimization and self-evolution. Integrating advances in AI technology into the network management layer is essential. With the support of digital-twin networks and large-scale network models, the management layer will facilitate the transition from AN L3 to AN L4.

KEY AI TECHNOLOGIES TO SUPPORT NET5.5G FUNCTIONALITIES FOR WAN, DCN, NETWORK MANAGEMENT, AND CAMPUS NETWORKS

In the Net5.5G era, networks must evolve to meet the unprecedented demands of AI-driven applications, from large-model training and enterprise intelligence to immersive campus services and fully autonomous operations. Traditional architectures can no longer cope with the massive traffic, strict latency requirements, and real-time adaptability needed for the intelligent economy. To guide this transformation, the "Net5.5G Best Practices and Deployment Guide" defines four key technologies that underpin next-generation networks:

- Ultra-broadband connections, which extend from 100Gbps air interfaces to 400/800GE WAN and 800GE/1.6TE DCN, enabling high-capacity, lossless, and efficient utilization of network and computing resources
- IPv6 Enhanced functionalities, which strengthen IP capabilities with lossless forwarding, APN-based service awareness, and time-varying routing
- Autonomous driving network (ADN) L4, which provides intelligent, closed-loop optimization, assurance, and O&M
- Integrated security protection, which delivers end-to-end trust across devices, networks, cloud, and data flows

Building on these foundations, the following sections present AI-powered WAN, DCN, campus, and autonomous network technologies, showcasing how they converge to deliver secure, intelligent, and deterministic connectivity for the future digital infrastructure.

AI-POWERED WAN TECHNOLOGIES

In the AI-powered WAN solution, SDN-enabled AI routers must provide more precise sampling and measurement data for the service bearer layer and network management layer. Additionally, AI routers should be capable of implementing key features such as application identification, a multiservice gateway, and integrated security:

- **Programmable chips:** Unlike in traditional routers, the chips in AI routers need to meet the measurement and sampling requirements of AI training and inference, including millisecond-level sampling, 1:1 accurate sampling, elephant flow detection, and distributed denial-of-service (DDoS) attack flow detection.
- **AI application identification:** Identifying applications is essential for AI-powered WAN to support carriers' detailed management and experience-based operations. For privacy reasons, AI routers should identify applications based on traffic behavior rather than packet content analysis, with an accurate rate exceeding 95%.
- **All-in-one service gateway:** Different access services require various gateways. AI routers must integrate multiple service gateways onto a single hardware and software platform to support converged bearers.
- **Dynamic energy saving:** AI prediction and training algorithms analyze historical peak flow rate data to forecast future peak flow limits and develop energy-saving policies for various periods. This enables dynamic tidal energy saving without service loss.

Thanks to the flow identification and application identification capabilities provided by AI routers, new connection technologies can be leveraged at the service bearer layer to implement AI connections, enabling services for high-value emerging applications such as those for enterprise applications and AI training.

- **Deterministic latency at the millisecond level:** Based on the application identification result, SRv6 CPEs deployed at the enterprise egress can select different SRv6 paths or slices for other services or applications and then choose service gateways and data centers in various locations to ensure the deterministic latency. The IPv6 and SRv6 Ready Logo Programs, promoted by the IPv6 Forum, are globally recognised certifications that validate products for conformance and interoperability with IPv6-related standards. By obtaining this logo, manufacturers demonstrate their commitment to quality, ensuring seamless integration into next-generation networks. It is recommended to consider network equipment with the IPv6 and SRv6 Ready Logos.

- **Low (e.g., <1E-9) packet loss rate:** The new AI connection features an end-to-end flow-level backpressure mechanism. This system ensures that backpressure applies only to the congested flow, preventing header blocking. As a result, congestion in a single flow does not trigger backpressure across all flows on the entire link. A packet loss rate of less than 1E-9 can be maintained. This is crucial for AI training and inference data transfer protocols, such as RDMA, which utilizes the Go-back-N retransmission mode and is sensitive to packet loss. According to the NSDI '18 paper "Multi-Path Transport for RDMA in Datacenters," if the packet loss rate is 0.1%, the RDMA throughput decreases to 50%. If the extremely low packet loss rate cannot be achieved, the efficiency of AI training and inference will be significantly affected.

- **Over 90% network throughput:** Emerging intelligent computing services, such as AI training, lead to frequent elephant flows. With the elephant flow identification capability of AI routers, the million-level intelligent flow scheduling technology can maintain over 90% network throughput.

AI-POWERED DCN TECHNOLOGIES

Ultra-broadband 800GE/1.6TE and beyond

The 800GE/1.6TE Ethernet offers a large transmission capacity and high efficiency. It ensures interoperability, making it suitable for network evolution and current services. It is the ideal choice for cloud service providers with high-density data centers and for telecom carriers urgently seeking high-speed, high-bandwidth traffic growth solutions. The main features and advantages of 400GE/800GE Ethernet are as follows:

- **Higher data rate:** Compared with previous generations of Ethernet, 800GE/1.6TE provides a higher media access control rate and supports higher data transmission speed per port for data centers, enabling cloud computing and high-performance computing scenarios that require higher network bandwidth.

- **Multichannel and wavelength-division multiplexing (WDM):** Multiple channels transmit data simultaneously, increasing the overall data transmission capacity per port and improving network flexibility. WDM allows the simultaneous transmission of "N" wavelengths (each carrying data) as optical channels in the same fiber, thereby increasing the overall data transmission capacity. "N" can be programmable and reconfigurable, which improves network flexibility and scalability.

- **Higher efficiency:** The primary advantage of 800GE/1.6TE is its ability to reduce network construction costs. Higher capacity per switch and a higher rate per channel will significantly reduce the overall rack and fiber counts for the same data center capacity, thereby lowering capex requirements. Lower power per bit using higher-speed serializer/deserializer (SerDes) and optical devices will reduce the long-term power bill.

- **Four-level amplitude modulation (PAM4):** The 800GE/1.6TE high-speed optical modules use the PAM4 modulation technology. Each symbol consists of two bits of information and is represented by four different power levels during transmission.

- **The 800GE/1.6TE high-speed optical modules have higher spectral efficiency** and reduce the power per bit by more than 15% compared with the 100GE optical module.

- **Compatibility and interoperability:** Since 800GE/1.6TE devices can be used to upgrade the end-user network within an existing network architecture, large-scale infrastructure replacement can be avoided. Interoperability is ensured between devices from different vendors through standards-based implementation, which can promote market competition and technological innovation in the field.

Intelligent scheduling: Load balancing
Network load balancing is a technology created for AI training scenarios. It determines the best traffic distribution by analyzing a global traffic matrix and automatically redirects traffic through network devices. This large-scale load-balancing technology uses a comprehensive view of both network and AI training tasks to achieve 100% traffic balancing across the network, thereby improving performance in AI training environments. During the training of large AI models, parameters are synchronized and exchanged between servers over a high-speed network. The communication traffic typically exhibits periodic bursts, involves a small number of flows, maintains persistent connections, and necessitates strong real-time synchronization among parallel tasks.

Communication efficiency largely depends on the slowest node. Additionally, AI cluster training involves transmitting a large volume of data. Because of the current per-flow equal-cost multipath (ECMP) mechanism, load balancing often becomes uneven, leading to network congestion and a notable decline during AI training. Therefore, enhancing network throughput through comprehensive network scheduling is essential for effective load balancing.

The key points and benefits of network-scale load balancing are as follows:

- **Effective bandwidth improvement:** Obtain global topology and task information, apply network-scale load balancing to compute paths, and dynamically deliver device policies quickly. This prevents traffic conflicts caused by random ECMP hashing and improves adequate bandwidth during training. In the AI single-task scenario, effective bandwidth utilization increases to more than 90%, and the efficiency of the AI training task improves by over 20%, resulting in a significant reduction in AI task completion time and a corresponding decrease in customers’ costs and expenses.

- **AI training performance improvement in multitask parallelism:** Centrally manage and analyze multitask information and use global path computation to relieve multitask communication conflict, efficiently carry multitask traffic, and thus improve AI cluster utilization. AI training performance is enhanced by more than 50% in multitask scenarios.

- **AI technologies bring new requirements and challenges to networks:** Networks need continuous technological innovation to better adapt to the future. Improving AI training efficiency by achieving overall load balancing is the beginning of network technology innovation.

- **Device-network collaboration:** The device-network collaboration technology enables the device side to understand the network’s communication capabilities, ensuring that the device side can fully utilize the network bandwidth and optimize throughput.

AI-POWERED CAMPUS TECHNOLOGIES

Based on business scenarios and capabilities, the campus network can be defined as having six key technological directions.

Autonomous network

The key technologies of L4 autonomous driving network are generative AI and AI agents. Dialogue-based O&M is supported through natural language interfaces. Intelligent task planning and execution enable the system to proactively optimize user experience and detect exceptions. Except for a few scenarios that require manual handling, most O&M scenarios can be automated or handled with minimal human assistance. That is, L4 supports dialogue-based proactive O&M on the basis of L3's visualized O&M, further reducing manual operations during O&M. The benefits include 100% success in deployment without the need for a remote site visit, 100% autosolving of faults that do not require site visits, automatic detection and solving of 80% wireless issues, and AI-based user experience scoring. This achieves one-stop management of networks, security, and users, one-map visibility of terminals, and quality visualization and locating.

Broadband Access 10Gbps

Wi-Fi 7 and 8 technologies boost access bandwidth to 10Gbps. Wi-Fi can provide high-performance coverage within 10 meters by utilizing integrated scheduling, spatial reuse, and smart zoom antennas, thereby increasing capacity by 60–80%. Reliable, always-on networking with zero packet loss, along with a simplified bearer network, transforms the three-layer architecture into a single layer, enabling one device to support multiple networks.

Connect everything

WLAN+X ubiquitous wireless connectivity provides a vital technical foundation for extensive access connections across the campus. Wi-Fi long-distance integrated perception (over 15 meters) using Fine Timing Measurement (FTM) for precise positioning, channel state information (CSI), and millimeter-wave accurate perception can offer safe and energy-efficient solutions. Wi-Fi IoT transitions from a distributed, passive approach to a centralized one, enabling co-station deployment within a 10-meter radius. This further simplifies IoT integration in asset management, medical, retail, and industrial environments, fulfilling the requirements for flexible manufacturing and safe production in next-generation industrial processes.

Deterministic experience

With the widespread adoption of AI terminals, embodied intelligence, and intelligent manufacturing scenarios, campus networks urgently need to ensure a deterministic network experience. By applying intelligent identification techniques, key applications such as audio and video, cloud desktops, and collaborative office tools can be recognized based on their traffic patterns. Through intelligent full-flow scheduling, AI, and XR service, jitter can be reduced to less than 1% through end-to-end slicing and collaboration across the network. Intelligent full-flow analysis enables features such as million-level full-flow quality analysis, application-level journey replay, and comprehensive network visibility. VIP user and terminal service guarantees allow VIPs to receive priority access anytime and anywhere, with deterministic latency under 50ms and guaranteed bandwidth. Additionally, VIP proactive care, real-time experience monitoring, and timely fault alerts can be provided.

Energy saving

Energy conservation has become a common goal in the industry. Network equipment must address its energy consumption issues while considering the overall energy savings of the campus. By utilizing AI tide prediction, new energy-saving protocol standards, and chip-enabled sleep modes, network equipment can achieve 20% energy savings. Wireless sensing technology can enable wattage control of devices and management of air conditioning, lighting, and other facilities by sensing personnel movements, resulting in overall campus energy savings of 20%.

Full-coverage security
The campus environment has a high level of personnel activity and weak security infrastructure, often making it the weakest link in the entire system. For example, ransomware can easily spread through internal campus devices. Therefore, we need to focus on strengthening the campus's network security system, including zero-trust network access (ZTNA), which establishes zero-trust access with AI support and detects more than 95% of abnormal behaviors in real time. By using wireless and wired link-layer encryption technology, we can prevent data leakage from end to end, especially with wireless air interface link-layer anti-eavesdropping technology, which effectively addresses wireless security risks. Through CSI and other Wi-Fi spatial sensing and detection technologies, we can achieve second-level intrusion detection and identify abnormal devices such as cameras. By implementing a device security protection architecture and situational awareness system, we can ensure security for both endpoints and network elements.

AI-POWERED AUTONOMOUS NETWORK

One of the significant achievements in AI technology development is the rise of many agents. Agents are no longer just helper tools but are now capable of completing specific end-to-end tasks. The solution should include at least three agents at the network management level: an assurance agent, a change agent, and a network agent. These agents help advance network automation from Level 3 (conditional automation) to Level 4 (high automation).

- **Fault agent:** Through collaboration between the large model and professional algorithms of the network agent, self-diagnosis of typical faults—including device, link, optical module, and service faults—is carried out using a logical process. This approach reduces the dispatch of invalid tickets, enhances fault management efficiency, and enables known faults to be fixed within five minutes. Optimization agents utilize application-level KPI/KQI awareness, measurement, historical bandwidth data, and AI analysis and inference to dynamically generate and adjust network thresholds, providing minute-level optimization and capacity expansion suggestions for 100,000 links.

- **Change agent:** The change agent reshapes the network configuration change mode and implements automatic configuration generation, online simulation, and intelligent automatic checks. To improve configuration change efficiency, implement configuration delivery error verification to ensure that no configuration errors occur on the network.

- **Optimization agent:** This is an end-to-end functional entity that serves a specific customer target through self-perception, self-analysis, decision-making, and self-deployment verification. TM Forum defines two stages for AI agents. The first is the single-agent self-loop stage, where the agent accelerates the self-loop of single-domain applications. The second stage involves multiple agents collaborating to achieve end-to-end scenario self-looping. The network revolves around five major value scenarios: network planning—network deployment, network maintenance, network optimization, and business operations—to achieve closed-loop self-intelligence for various agents. In each network domain, L4 acceleration is promoted.

- **Precise language understanding and generation capabilities, conversational intelligent Q&A:** The original interface menu relies on professional understanding and familiarity to solve issues through logical mouse clicks. For employees in other fields or general staff, this can be challenging. A key capability introduced by AI is the ability to understand language precisely in a conversational manner, offering a new experience in handling issues. It can cover all network scenarios, such as network resource and status inquiries, network knowledge Q&A, and conversational network changes/troubleshooting, enabling ordinary employees to handle network tasks quickly.

- **High-performance data analysis report capability:** Resources and data analysis are common methods for network operation and maintenance. Compared with the visualization of digital maps, process-based data information acquisition, and manual-assisted analysis methods, AI offers a flexible approach to capturing natural language intentions. The system automatically acquires relevant data based on language intentions and further reasons, analyzes data that meet customer intention conditions, and integrates the results to generate analysis reports, completing the automatic analysis of required information within minutes.

- **Network agent autonomous loop:** The traditional operation and maintenance model depends on communication between the network operations center and frontline engineers via phone, and relies on manual experience for operation and maintenance. This approach is time-consuming and labor-intensive: manual experience can address some known scenarios but lacks effective means for solving unknown issues. AI integrates a knowledge system that encompasses essential theories and logic of network scenarios, including how to change, troubleshoot, and optimize the network. Learning methods are diverse, including APIs, command lines, and other documents. AI also employs reasoning based on the knowledge system to infer the most appropriate business logic, enabling autonomous achievement of business goals. The input for the agent can come from the user’s natural language or be triggered by the system’s own perception logic.

NETWORK INFRASTRUCTURE READINESS INDEX DEFINITION: A NEXT STEP

DEVELOPMENT OF THE INDEX SCORING RULES AND THEIR VALIDATION

WG4 introduced the concept of “network index” in 2024 as an additional index to be developed in the same way as the two existing ones: the Broadband & Cloud Development Index (BCDI) developed by WG5 and the Fiber Development Index (FDI) developed by WG1. This network index was presented at the Africa Net IP Gala summit on 5.5G, Africom 2024, as part of the Net5.5G maturity tool kit. It was also presented at the WBBA BDC event during Network X 2024.

The Net5.5G architecture is clearly outlined in terms of technologies, benefits, and use cases. This new index aims to evaluate or assess compliance with Net5.5G adoption for specific networks or regions. Developing this index will enable the tracking of future deployments and measuring the pace of global network modernization. It will also encourage network owners to modernize their infrastructure, reassured by the widespread adoption of the target technologies.

The plan is to develop an index for each of the main Net5.5G/6G domains: WAN, campus, DCN, and autonomous network. A final Network Infrastructure Readiness Index will be helpful in calculating a weighted sum of these four Net5.5G-domain-associated indices.

Next steps and future work include refining the definition of the Index and developing associated scoring rules.

The proposed index components and their respective definitions can be summarized in **Table 1**.

TABLE 1: COMPONENTS OF THE NETWORK INFRASTRUCTURE READINESS INDEX

Domain	Index	Definition of indicators
WAN	400GE/800GE penetration	The total number of 400/800GE ports in the metro/backbone network divided by the total number of ports of the network-to-network interface (NNI), presented as a percentage
	Service Awareness Capability	Percentage of total network traffic whose service type can be accurately classified without payload inspection The ability of AI powered WAN Network to classify and manage different service types in real time, using metadata and AI/ML methods without inspecting payloads, in order to deliver differentiated QoS/QoE and enable intelligent network operations.
	IPv6 adoption	IPv6 access percentage: the number of IPv6 connections divided by the total number of connections, presented as a percentage
	SRv6 slicing adoption	Proportion of SRv6 supported by network nodes: the number of network devices with SRv6 slicing support divided by the total number of devices
Campus	Wi-Fi 7/8 adoption	Number of Wi-Fi 7/8 devices in the campus divided by the total number of Wi-Fi devices in the campus, presented as a percentage
	10Gb Ethernet port	The total number of 10 Gigabit Ethernet ports divided by the total number of switch ports on the campus, presented as a percentage
	Link-layer security device deployment	Wired and wireless supported link-layer security devices divided by the total number of devices, presented as a percentage
DCN	400GE/800GE/1.6TE port deployment	The total number of data center network 400GE/800GE/1.6TE ports divided by the total number of ports, presented as a percentage
	Ethernet port adoption	The total number of Ethernet ports divided by total number of ports in AI/HPC data center network, presented as a percentage
	Multisite, multi-DC architectures of redundancy adoption	The total number of multisite, multi-DC architectures divided by the total number of new data centers, presented as a percentage
Autonomous Network	AI agent and network digital map deployment	The total number of networks divided by the number of networks where digital maps and agents are deployed, presented as a percentage
	ANL score of key scenarios	Achieve the L4 AN score in at least one scenario among all high-value scenarios defined by TM Forum

SOURCE: WBBA

CONCLUSION AND A WAY FORWARD FOR THE INDUSTRY

In summary, AI will revolutionize how networks operate, prompting service providers to address their network limitations. Widespread AI adoption requires an urgent update or strategic evolution of existing IP transport networks into modern IP architectures. Net5.5G emphasizes the sustainable evolution of data communication infrastructure, creating a foundation for a digital, AI-enabled IP transport network. It also offers guidance on how AI will be integrated into the Net5.5G architecture, focusing on IP layers across WAN, DCN, campus, and end-to-end network operations.

So far, the Net5.5G Pioneer Program led by WBBA has made steady progress. Several Pioneer service providers have emerged worldwide, including 26 Visionary Pioneers, 3 Regional Pioneers, and 33 Business Pioneers. These providers follow Net5.5G guidelines and utilize the key technology toolkit to modernize IP transport networks in the AI era, covering campus, IP WAN, DCN, and end-to-end network operations. Some of the use cases are introduced in ***Appendix A***.

Looking ahead, WBBA WG4 intends to initiate the Net5.5G readiness assessment and certification processes and develop a comprehensive white paper that details scoring indices for network readiness in Net5.5G areas, including campus, WAN, DCN, and autonomous networks. A set of indices to evaluate the readiness of Net5.5G in various domains has been proposed in this document, and this set will evolve in the future to better assess the network infrastructure. This network readiness index will be unique and will assist in calculating a weighted sum of the indices for these four Net5.5G domains, based on industrywide surveys and analysis evaluations.

APPENDIX A: GLOBAL NET5.5G PRACTICES

Under the advocacy of WBBA, the Net5.5G Pioneer Program continues to accelerate commercial deployment globally. Following the release of the “Net5.5G Best Practices and Deployment Guide” at the Mobile World Congress in March 2025, we have collected and shared outstanding practices from more than 10 leading operators across five major regions worldwide in the past six months. These practices outline the utilization of key technologies, including 400GE/800GE, SRv6, network slicing, and network digital maps, along with the commercial value they bring. Some of these leading operators have also shared their explorations and leading practices based on AI WAN.

Region	Stakeholder
Europe	**Türk Telekom** in Türkiye builds a future-oriented 5G-Advanced IP 400GE/800GE converged transport network to enhance network performance and operational efficiency, providing users with high-quality network services
	A leading operator in Luxembourg deploys 400GE with flexible bandwidth allocation and SRv6 to meet the needs of the future, offering future-proof hardware facilities and the optimal cost per bit solution. SRv6 with FlexE slicing and network digital map guarantees service-level assurance (SLA) and optimizes opex through protocol simplification and AI.
Asia & Oceania	**Thailand operator AIS** has launched the "Smart Network, Smart City" initiative, which has already commercialized 400GE and a network digital map, aiming to build a next-generation IP network based on Net5.5G with ultra-broadband, high reliability, and intelligence. It enables value-driven operations, potential customer mining, and application acceleration while also enhancing operational efficiency and providing differentiated user experiences.
	Hong Kong Telecom takes the lead in upgrading its 400GE to-business backbone network, achieving ultra-large bandwidth, ultra-low latency, and ultra-high reliability for enterprise and computing interconnections based on Net5.5G and maintaining its industry leadership.
	Indonesian operator XLSmart deploys Net5.5G with SRv6 optimization and network intelligence to enhance network operation and maintenance efficiency, build a differentiated all-IP network, optimize fault mean time to resolution (MTTR), improve service latency SLA, and boost market competitiveness.
	Malaysian operator TIME leverages Net5.5G technologies, including 400GE, SRv6, and a network digital map, to create an ultra-low-latency dedicated line for high-value financial services, delivering an exceptional experience. This shortens the time to market (TTM) and introduces low-latency service bundles, meaning business opportunities can be seized.

Region	Stakeholder
Middle East and Central Asia	**Saudi operator STC** has established the world's first end-to-end 400GE backbone to the DCN network through 400GE/800GE, SRv6, and network digital maps. By leveraging an AI-driven network, it has achieved end-to-end service-level visibility, enhanced user experience through AI application awareness, and reduced operational costs through automatic traffic optimization.
	Saudi Arabia Mobily has built a Net5.5G target network by deploying IP 400GE/800GE ultra-band backbone and network digital map technology, which improves network performance and operational efficiency. This has established an end-to-end AI-ready network with optimal user experience.
	Saudi Operator Salam is building a target network for Net5.5G, utilizing technologies such as SRv6 and digital maps to simplify the network, reduce operational costs, enhance network reliability, and improve user experience.
	UAE operator e& has established a Net5.5G bearer network that ensures experience quality, enhances business capabilities, and drives AI-based automation through 400GE/800GE, service soft slicing, and a full-network digital map. This network delivers high-stickiness connectivity while reducing customers' opex costs.
Africa	**A leading operator in South Africa** deploys 400GE, SRv6, and network digital map / iFIT to improve the overall performance of the converged transport network and improve DoU, especially the private-line competitiveness in the to-business market. SRv6 is used to reduce cross-department and hop-by-hop service configuration. This simplifies service provisioning procedures and shortens the TTM for private lines. IFIT is used to accurately measure and display the SLAs of private-line services. In addition, automatic hop-by-hop detection is used to reduce fault locating time significantly. The AI WAN technology also helps optimize the network automatically to avoid potential congestion.
	A leading operator in Algeria deploys 400GE and SRv6 with network slicing to ensure a deterministic experience and deliver optimal network performance for major sports events such as the Mediterranean Games.
Americas	**Argentina Telecom** has accelerated the rapid development of 5G and FTTH services through the large-scale deployment of Net5.5G 400GE, achieving network speed enhancement and KPI improvement. The company is currently conducting laboratory homologations for the adoption and deployment of SRv6, maintaining technological leadership and gaining a competitive edge in market development. Facing the comprehensive arrival of the intelligent era, Net5.5G will leverage its leading technological advantages and innovative application capabilities to help customers seize new opportunities in digital transformation and achieve greater commercial success in the wave of intelligence.
	XONA Partners (US, San Francisco) published on August 28, 2025 an Insight Note on "Powering the AI Revolution." It highlights the forecast of AI infrastructures in the US market for the necessary upgrade of broadband longhaul and backbone to interconnect data centers by key stakeholders, including Zayo, Lumen, and recent partnerships between Meta and Microsoft. This highlights the "urgent need to reinvent the network" to meet the new requirements imposed on IP transport networks and data centers, driven by the physical movement of data within data centers and between them and by AI model training and synchronization, which require the transfer of petabytes daily. This is driving an unprecedented need for high-performance, low-latency, high-throughput, and power-efficient connectivity. All are aligned with AI for Net5.5G scenarios. This creates a significant and long-term investment opportunity in the underlying fiber and broadband infrastructure that forms the central nervous system of the AI revolution.

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We encourage your feedback and would welcome the chance to discuss with you how you can benefit from, and contribute to, the success of the WBBA. Please submit enquiries for free membership via https://worldbroadbandassociation.com/