



The Path to full Autonomy: e& UAE's Strategic Blueprint for Network Transformation in the AI Era

Featuring insights from TM Forum



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1. Executive summary

e& UAE is transforming from a connectivity provider to an AI-native digital infrastructure provider, and this white paper presents its strategic blueprint for advancing telecommunications networks toward High Level Autonomous Networks, where AI-driven, intent-based and fully closed-loop operations redefine how networks are designed, operated and experienced.

As telecom networks evolve into complex, multi-domain digital infrastructures supporting 6G, emerging next-generation capabilities and AI-powered services, traditional operational models—characterised by manual intervention, reactive processes and fragmented domain management—are no longer sufficient. This paper argues that achieving scalable efficiency, superior customer experience and sustainable operations requires a fundamental shift toward AI-native, agent-driven and cross-domain autonomous systems.

At the core of this white paper is the thesis that true network autonomy is not an incremental upgrade, but a systemic transformation enabled by the convergence of multi-agent AI architectures, intent-driven orchestration and unified cross-domain intelligence. e& UAE introduces its Autonomous Network (AN) “DNA”, a differentiated framework built on five foundational pillars and outlines a pragmatic pathway towards TMF L4/L5 through high-value scenario prioritisation and progressive architectural evolution.

This document is intended for telecom executives, network architects, operations leaders and industry stakeholders, including standardisation bodies and ecosystem partners, who are shaping the future of intelligent connectivity. It provides both strategic guidance and practical insights, including target architectures, deployment approaches and real-world use cases, to support the transition from partial automation to full autonomous network.

By sharing its vision, architecture and implementation roadmap, e& UAE aims to contribute to the global advancement of Autonomous Networks and to establish a replicable model for operators seeking to accelerate their transformation toward AI-native, self-evolving network ecosystems.

Industry challenges

As the evolution towards 6G and next-generation architectures progresses, the emergence of advanced services such as network slicing, URLLC, and large-scale IoT has made telecommunications networks increasingly complex and highly dynamic. Traditional, isolated, passive and manual operation and maintenance (O&M) models have reached their limits, not only leading to persistently high mean time to repair

(MTTR) and O&M costs but also failing to meet customers' expectations for a "zero-wait" ultimate experience. At the same time, the fragmentation of multi-vendor and multi-domain networks has severely hindered end-to-end cross-domain intelligent collaboration. Additionally, the rapid introduction of AI workloads with high computing power and low latency has further exacerbated the challenges of resource scheduling and network orchestration.

To address these challenges and bridge the gap between experience and efficiency, operators urgently need to implement AI-native architecture transformations and drive the digital and intelligent transformation of networks through AN (Autonomous Network).

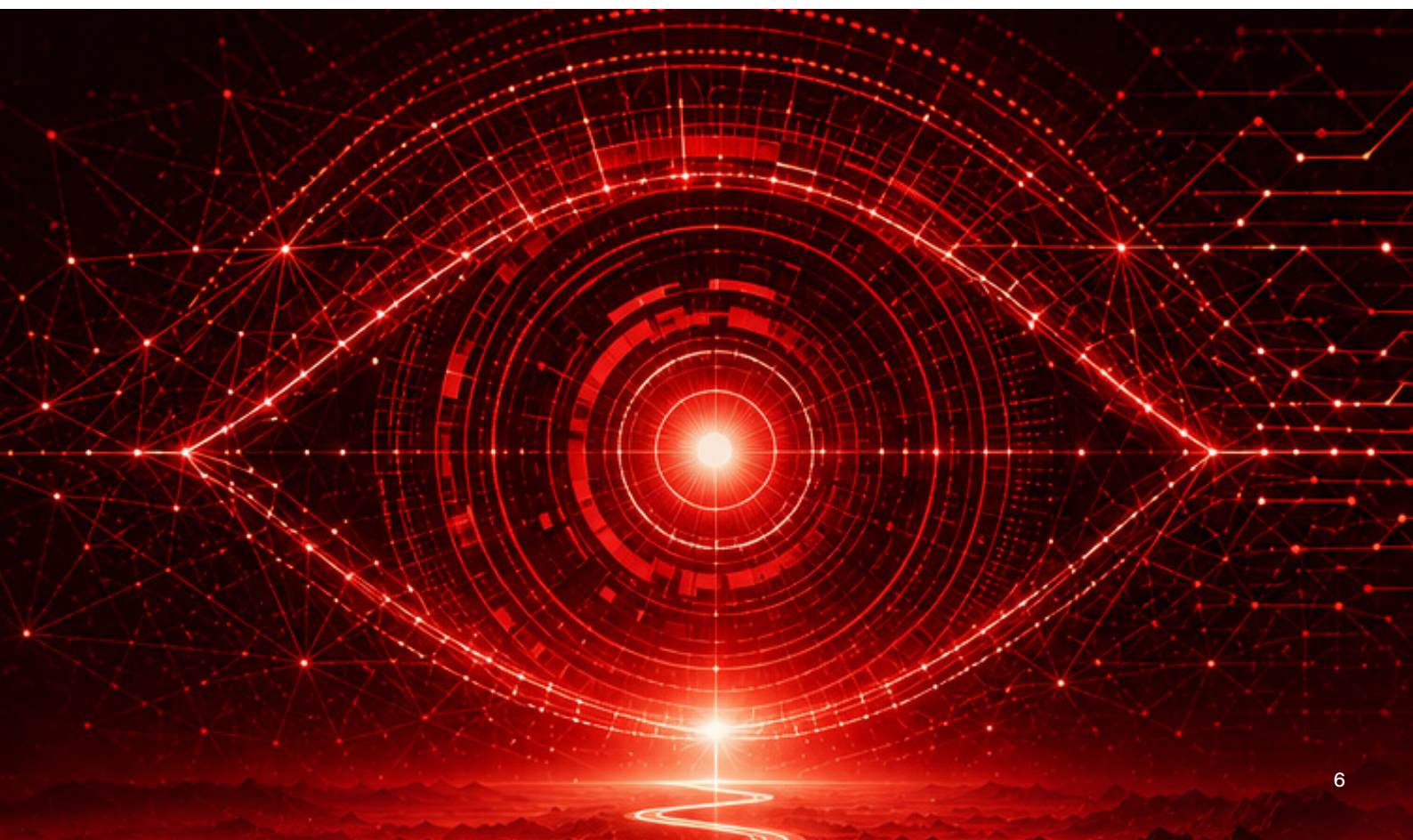
Vision & Roadmap

e&'s Autonomous Network strategic framework is designed to accelerate its evolution into a global technology group and to pioneer the transition toward a 6G AI-native future. At the heart of this vision lies the concept of “Self-Evolution”, where the network operates as a cognitive, adaptive system capable of continuous learning, self-configuration, self-optimisation and self-healing, with minimal human intervention.

This vision reflects a fundamental shift from automation to autonomy. Rather than relying on predefined rules and reactive operations, the network behaves as an adaptive, self-managing system that can perceive its environment, make decisions, and act dynamically in real time within human-defined policy boundaries.

Guided by the AI-Native concept and deeply integrated with the TM Forum AN architecture system, we have established two core foundational planes for the future evolution of intelligent networks: the AI-Plane and the Data-Plane, and developed a “three-layer, four-loop” collaborative framework. This drives the operational paradigm to transition from “automation assistance” to Level 5 “full autonomy”.

e& UAE plans to pilot single-scenario autonomy starting in 2026-2028, initiate cross-domain end-to-end collaborative autonomy pilots in 2028, gradually advance to multi-scenario autonomy from 2028 to 2030, fully realising the ultimate vision of an Autonomous Network L4 by 2030. We will start exploring AN L5 technology and value scenario from 2030. Ultimately, we aim to achieve self-configuration, self-optimisation, self-healing and even self-evolution of the network.



Extreme O&M Efficiency: Driving a fundamental shift from “human-driven” to “AI-autonomous” operations—aiming to reduce the MTTR by 40% at AN L4 Phase I, advancing toward L4/L5 full closed-loop autonomy and building an intelligent, agile O&M system.

Extreme Customer Experience: Establishing a proactive, visualised and automated assurance framework, aiming for consistently high SLA fulfilment levels aligned with enterprise expectations.

Extreme Energy Efficiency: Aiming for a 20% energy savings (compared with 2025 baseline) in the RAN domain while preserving service quality, thereby supporting carbon emission reduction, building a “high-performance, low-energy, high-reliability” green network that underpins sustainable operations.

Extreme Service Delivery Efficiency: Targeting a substantial compression of service delivery cycles for pre-integrated service classes, aiming for fully Autonomous Network Slicing capability, significantly shortening Time-to-Revenue and enabling second-level service activation.

Autonomous Network L4/L5 White Paper

Self-Configuration • Self-Optimization • Self-Healing

Self-Evolution

e& is evolving networks from automation to self-intelligence. L4/L5 autonomous networks deliver superior experience, higher efficiency, and sustainable value in the 6G era.

Sustainability

L5

SELF-EVOLUTION

Cross-Domain Intelligence

Customer Experience

THE ERA OF CHANGE

6G Complexity Surges

Rising Customer Expectations

Ops Efficiency Dilemma

AI Workloads Add Complexity

FIVE PILLARS OF SELF-EVOLUTION NETWORKS

01

Cross-Domain Intelligence

Break silos. Enable end-to-end awareness and decision-making.

02

AI-Native & Vendor-Agnostic Operations

Built for AI from the ground up. Adaptive, autonomous, evolvable.

03

Agentic & Open Source Enablement

Autonomous agents collaborate, innovate, and scale.

04

End-to-End Closed-Loop

Intent-driven loop: Assure, Analyze, Decide, Execute for self-healing and optimization.

05

Customer-Centric AI

Understand, predict, and deliver exceptional customer experiences.

FOUR “EXTREME” VALUE PROPOSITIONS

Extreme O&M Efficiency

Simpler operations, higher efficiency

MTTR Reduction (L4 Phase 1 target)

40% ↓

Extreme Customer Experience

Consistent experience, higher satisfaction

Experience Consistency (L4 Phase 1 target)

★★★★★

Extreme Energy Efficiency

Lower energy consumption, sustainable future

Energy Reduction (L4 Phase 1 target)

20% ↓

Extreme Service Delivery Efficiency

Faster delivery, maximum agility

Service Provisioning Time (L4 Phase 1 target)

From Weeks to Minutes ↓

ROADMAP TO L4/L5 FULL AUTONOMY

2026-2028

Single-Scenario L4 Pilot

- Validate L4 capability
- Build autonomous foundation
- Improve observability

Build Foundation

2028-2030

Multi-Scenario L4 Pilot

- Multi-domain coordination
- Self-healing & optimization
- Performance improvement

Strengthen Collaboration

2030~

Self-Evolution Full Autonomy

- End-to-end autonomy
- Full self-optimization
- Maximize business value

Full Autonomy

Self-Configuration • Self-Optimization • Self-Healing

e& UAE – Building Self-Evolving Networks, Shaping the Future of Connectivity

1. Industry vision and key challenges

1.1 Industry vision

The inflection point: Why autonomous networks are no longer optional

The global telecommunications industry stands at a defining inflection point. Networks are no longer passive conduits for connectivity—they are the foundational infrastructure upon which digital economies, smart cities, industrial automation and AI-powered services are built. Yet the operational model governing these networks remains fundamentally misaligned with this new reality: manual, reactive and fragmented management processes are structurally incapable of meeting the scale, speed and intelligence that modern network demands require. According to TM Forum, most operators globally remain at AN Level 2–3, while customer expectations, enterprise SLA requirements and energy cost pressures are advancing at a pace that legacy operations cannot sustain. The question facing every operator is no longer whether to pursue network autonomy, but how fast and how decisively to act. Figure 1 illustrates the industry-wide phased trajectory from early SON-era automation in the 5G window through the AN L3+ checkpoint and into the L4/L5 horizon that defines the 6G era.

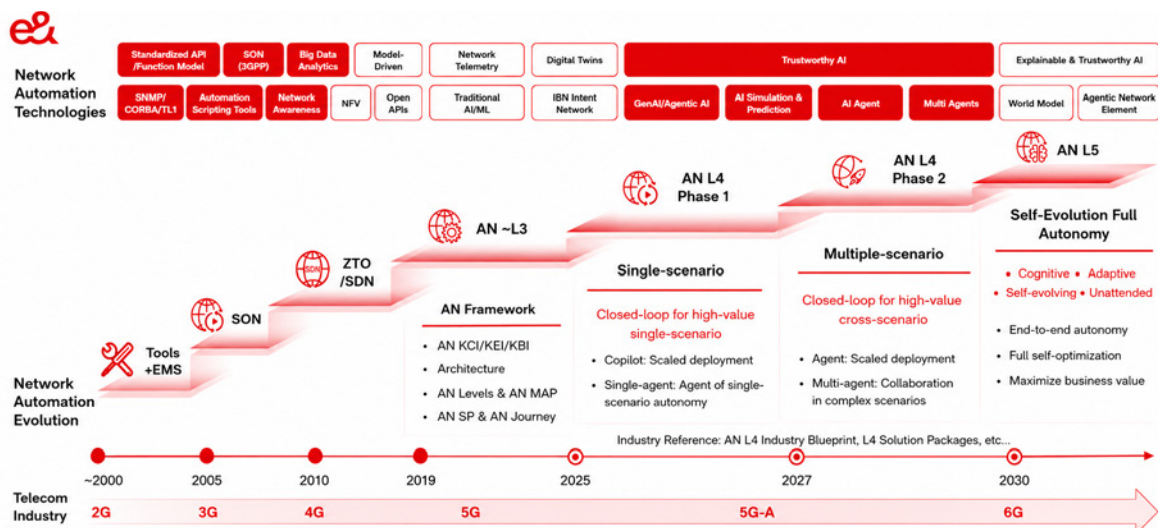


Figure 1: Advancing AN through phased approaches toward full autonomy

The industry vision: Zero-X, intent-driven, fully autonomous networks

TM Forum’s Autonomous Networks mission articulates a transformative vision for the telecommunications industry: networks that deliver zero-wait, zero-touch, and zero-trouble experiences, for both customers and internal operations, through the progressive evolution from assisted automation to full, intent-driven autonomy at Level 4/5. This vision is not theoretical. It is being actively constructed today through global industry collaboration, standardised frameworks and validated commercial deployments. Leading operators have demonstrated that selected AN Level 4 scenarios, where AI-driven closed loops autonomously manage network faults, optimise performance and assure service quality within a defined domain, are operationally achievable and commercially valuable, with leading deployments now independently validated through TM Forum ANLAV assessments. Level 5, by contrast, remains an exploratory research horizon, dependent on further advances in causal reasoning, continual learning and world-model architectures. The industry’s collective ambition is clear—to build networks that perceive, reason, decide and act autonomously, continuously aligning operational execution with evolving business intent, with minimal routine human intervention, while preserving human governance and exception handling for high-risk decisions.

As shown in Figure 2, the operator community ranks O&M cost reduction, automated fault detection and operations simplification as the highest-value drivers for AN adoption—a finding that closely mirrors e& UAE’s own four “Extreme” value priorities.

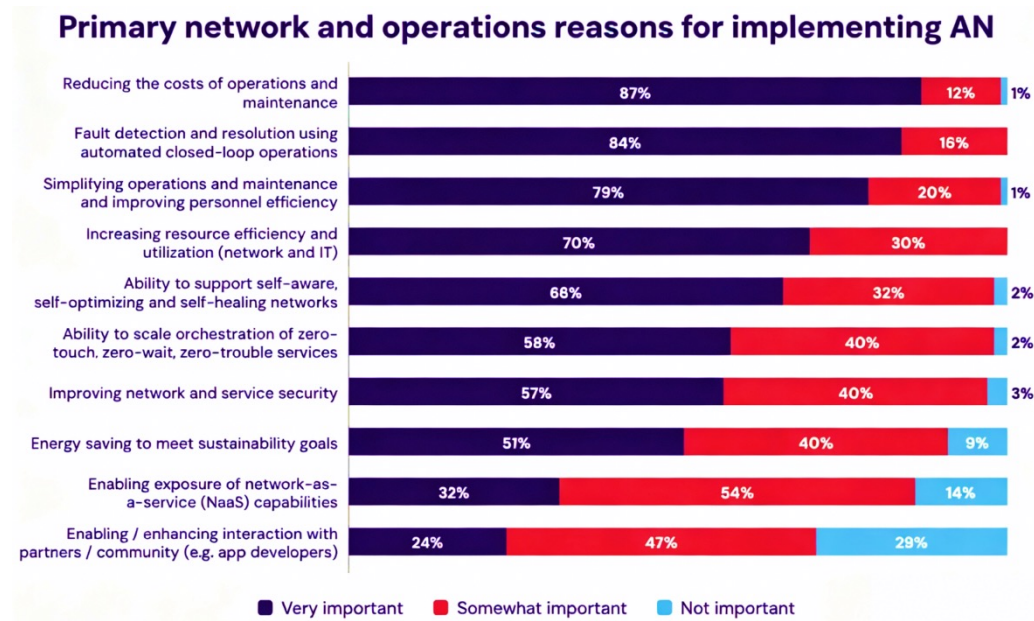


Figure 2: Primary network and operations reasons for implementing AN (Source: TM Forum Report, Assessing CSPs’ Progress Towards Level 4 Autonomous Networks)

Industry development trajectory: from blueprint to commercialisation

The AN industry is transitioning from framework definition to large-scale commercial deployment with accelerating momentum. In 2024, TM Forum released the AN Level 4 Industry Blueprint alongside 20 high-value scenarios, establishing the industry’s first validated commercialisation roadmap. In 2025, the “L4 is ON” initiative formally launched, signalling a pivotal shift from pilot to production. By May 2026, TM Forum had issued Level 4 progress certifications, with four high-value scenarios certified as L4 by operators. Combined with more than 16 CSPs completing the ANLET evaluation, this marked the transition from individual pilot success to industry-wide, independently validated maturity.

1.2 Operational challenges

The telecom industry faces rising network complexity, high operational costs and intense competition. To thrive, it urgently needs automation, intelligent O&M and agile service assurance. Embracing AI-driven operations is essential for efficiency, scalability, and faster innovation.

1.2.1 Low manual O&M efficiency

e& UAE operates a multi-generation, multi-domain network across RAN, Core, IP, transport, and fixed access, creating complexity beyond manual management. Cross-domain dependencies and fault propagation make traditional operations inefficient, while Autonomous Networks enable unified, intent-driven closed-loop automation at scale.

1.2.2 Poor experience for passive complaints response

With high customer expectations and strict SLA requirements, combined with leading 5G performance, demands continue to rise. Reactive, complaint-driven operations are no longer sufficient, requiring a shift to AI-driven predictive assurance with real-time detection and automated remediation.

1.2.3 Low energy and resource utilisation rate

Expansion of 5G Advanced and massive MIMO significantly increases energy and resource consumption, while national regulations impose strict decarbonisation targets. Static energy management cannot balance growth and sustainability, necessitating intelligent optimisation to achieve measurable resource, energy and carbon reductions. These three operational pain points—manual O&M, reactive complaint handling, and static energy management—directly map to three of the four “Extreme” value dimensions that anchor the strategic response described in the next section.



2. e& UAE AN strategy and definition

This section outlines the strategic objectives as well as the business and operational value they deliver. Systematically advancing network autonomy enhances efficiency and user experience, while offering a replicable model for the industry, contributing to broader telecom innovation and progress.

2.1 e& UAE AN strategic objectives

1. Top vision: Self-evolution

Core concept: Moving beyond static, rule-based telecom architectures toward a cognitive, adaptive infrastructure operating under defined governance and policy controls. In the 6G era, the network will not only adapt to immediate conditions but also improve itself over time by learning new behaviours without explicit human programming. Through AI-native architecture, continuous learning, reasoning and autonomous decision-making become part of the Autonomous Network's DNA.

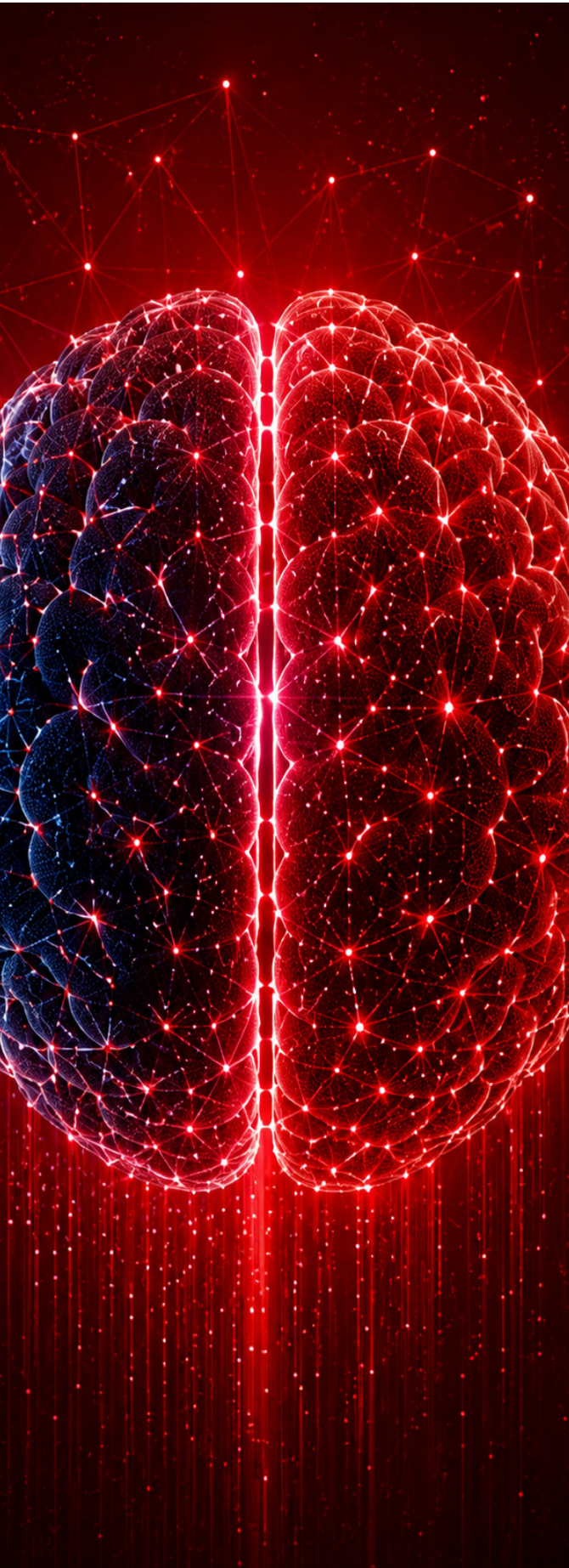
2. Core sub-vision: Self-X (autonomous capabilities)

To realise the ultimate vision of self-evolution, the network must natively possess four core autonomous ("Self-X") characteristics across its lifecycle:

Self-configuration (zero-touch provisioning) – achieving true "plug-and-play" deployment. The network autonomously learns optimal settings (e.g., power, tilt, frequencies) by observing its environment and negotiating via AI agents, drastically reducing manual engineering efforts.

Self-optimisation (predictive tuning) – transitioning from reactive adjustments to proactive, real-time tuning. By utilising predictive analytics, the network foresees congestion and dynamically allocates resources (e.g., adaptive radio optimisation, dynamic spectrum sharing) to ensure optimal performance.

Self-healing (instant fault mitigation) – AI-based anomaly detection pinpoints issues instantly. The network autonomously reroutes traffic or adjusts neighbouring cell parameters to compensate for failed components, effectively healing coverage gaps in seconds before customers are impacted.



3. Value propositions: The four “Extreme” values

The transition to an AI-native AN translates into measurable business outcomes, driven by four “Extreme” value pillars:

Extreme O&M Efficiency: Shifting from human-led monitoring to agentic AI operations. By embedding AI-driven Robotic Process Automation (RPA) and agentic AI into the NOC and Service Operations Centre (SOC; distinct from a Security Operations Centre).

Extreme Customer Experience: Delivering highly personalised, context-aware digital interactions. e& utilises AI to anticipate customer needs, prevent issues before they occur and deliver hyper-personalised support.

Extreme Energy Efficiency: Embedding sustainability by design. Leveraging AI to dynamically optimise resource allocation and energy consumption, e& aims for a massive leap in energy efficiency.

Extreme Service Delivery Efficiency: By breaking down legacy silos and utilising automated, intent-driven orchestration, the network accelerates the deployment of innovative services, reducing the time-to-market for complex solutions and digital marketplaces.

4. Five key technology pillars

e& UAE’s Autonomous Network is built on five technology pillars: (1) Cross-Domain Intelligence, with hierarchical agents and an end-to-end service orchestration layer; (2) AI-Native & Vendor-Agnostic Operations, replacing bolt-on AI with a true AI Plane and standardised Open APIs. (3) Agentic & Open-Source Enablement, anchored on multi-agent collaboration over A2A-T and a hybrid model strategy; (4) End-to-End Closed-Loop, autonomy through the I-AADE mechanism (Intent → Awareness → Analysis → Decision → Execution), amplified by high-fidelity Network Digital Twins; (5) Customer-Centric AI, embedding sentiment- and context-aware experience intelligence into consumer touchpoints. Each pillar is described in detail in Section 3 (Definition and Differentiation: Our AN DNA).

5. Ecosystem collaboration

Strategic foundation: The AI-native 6G future cannot be built in isolation. e& is transitioning from a traditional connectivity provider to an ecosystem orchestrator and platform enabler.

Partnerships and alliances: Collaborating with global hyperscalers (e.g., AWS, Microsoft Azure), ICT solution providers and technology partners (e.g., Huawei), accelerator and platform partners (e.g., NVIDIA, Oracle, Intel, Dell), academic institutions (Khalifa University) and standards bodies (TM Forum, 3GPP, ETSI, ITU-T).

Sovereign AI and Talent: Co-developing sovereign AI infrastructure (such as the UAE Sovereign Launchpad) and domain-specific Telco LLMs while aggressively upskilling the workforce through programmes like the AI Academy and Citizen X. The integrated view of the top vision, Self-X capabilities, four “Extreme” value propositions, five technology pillars and ecosystem foundations is presented in Figure 3.

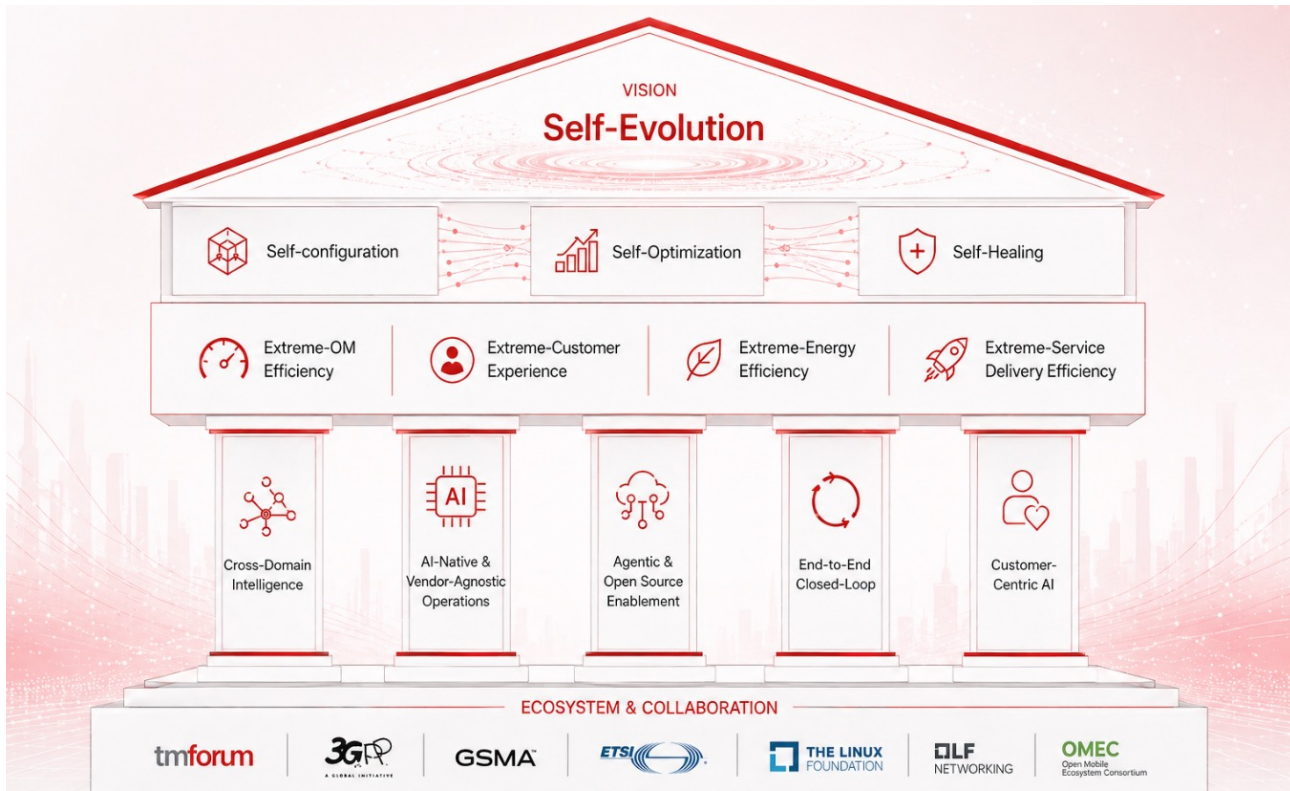


Figure 3: e& UAE AN strategic objectives

2.2 Value delivered by the strategy

Autonomous Network implementation needs to balance technical depth, business value and operational impact. Technical depth defines the sophistication of autonomous capabilities deployed—the maturity of closed-loop logic and the degree to which human intervention has been eliminated. Operational impact captures how those capabilities translate into measurable day-to-day improvements in fault resolution speed, automation rates and NOC efficiency. TM Forum benchmarking now indicates that mature AN deployments can deliver up to 55% reduction in operations and maintenance costs, a 71% rise in customer satisfaction and a 21% improvement in energy efficiency, providing a concrete reference envelope for AN business cases. Business value represents the ultimate strategic outcome, including cost reduction, revenue growth, customer experience uplift and sustainability gains, that AN delivers to e&'s TechCo ambition. These three dimensions are causally linked but operate at different time horizons, making their explicit alignment a prerequisite for credible AN strategy execution. Within the TMF AN framework, these dimensions map directly to the 3K indicator system: technical depth is measured by KCIs, which quantify autonomous capability maturity per scenario; operational impact is captured by KEIs, translating capability into performance outcomes such as MTTR reduction, energy efficiency and SLA compliance; business value is represented by KBIs, connecting operational gains to enterprise results, including OPEX reduction and NPS improvement. Strategically, e& UAE's AN journey must navigate the tension between all three: investing in technical depth without a clear KEI improvement path risks capability without return; optimising for short-term KBIs without sufficient KCI maturity risks overpromising on outcomes the automation cannot yet deliver. Sustainable AN execution demands disciplined, iterative balancing—using KCIs to validate readiness, KEIs to confirm impact and KBIs to sustain executive commitment.



Having articulated the strategic objectives and business value framework, the next section turns to the architectural “DNA”, the five core technology pillars that operationalise this strategy. To ensure technology investments translate into tangible business value, three categories of metrics are defined:

- **Key Business Indicator (KBI):** Focuses on board-level strategic goals, such as reducing overall O&M costs, digital human, increasing new business revenue and optimising resource utilisation
- **Key Effectiveness Indicator (KEI):** Measures specific operational benefit, including shortening customer complaint resolution time, reducing MTTR and improving equipment energy-saving rates
- **Key Capability Indicator (KCI):** Assesses underlying technology maturity, with emphasis on improvements in network automation and intelligence levels. Figure 4 illustrates the hierarchical relationship between KBI, KEI and KCI as defined in TM Forum IG1256



Figure 4: TMF IG1256 Autonomous Network effectiveness indicators

e& UAE leverages TM Forum’s AN effectiveness metrics and integrates its own value scenarios (e.g., intelligent operations and customer experience) to build a tailored Value Measurement System, embedding four key dimensions: Extreme O&M Efficiency, Extreme Customer Experience, Extreme Energy Efficiency, and Extreme Service Delivery Efficiency. This framework quantifies how network automation drives business KPIs, closes the loop from technical metrics to commercial value, and enables precise investment decisions and continuous improvement. The complete mapping between e& UAE’s four “Extreme” value propositions and their associated KBI, KEI and KCI metrics is provided in Table 2.

Table 1: e& UAE Autonomous Network effectiveness measurement

AN VALUE PROPOSITION	KEY BUSINESS INDICATORS (KBI)	KEY EFFECTIVENESS INDICATORS (KEI)	KEY CAPABILITY INDICATORS (KCI)
Extreme O&M Efficiency	<ul style="list-style-type: none"> Reduced O&M costs Network availability and stability Automation value 	<ul style="list-style-type: none"> Mean time to recovery Duration of quality optimisation Number of fault tickets Number of proactive maintenance tickets 	
Extreme Customer Experience	<ul style="list-style-type: none"> Customer SLA fulfillment rate Net promoter score 	<ul style="list-style-type: none"> Number of complaints First call resolution Service interruption reduction 	Automation ratio
Extreme Energy Efficiency	<ul style="list-style-type: none"> Energy cost reduction Green network transformation 	<ul style="list-style-type: none"> Energy consumption per unit of flow rate for equipment Carbon emission reduction Time-to-market reduction 	Intelligent ratio
Extreme Service Delivery Efficiency	<ul style="list-style-type: none"> Zero-touch service delivery Agile service orchestration Revenue from open capabilities 	<ul style="list-style-type: none"> Service activation time reduction 	

As an example, Reduced O&M costs measure the reducing of O&M expenses achieved through deploying Autonomous Networks. The 3K indicator framework for IP network quality optimisation is defined as follows:

KBI: Reduced O&M costs = Number of optimised work items from the previous year * (Average duration of quality optimisation in the previous year - Average duration of quality optimisation this year) * Salary/person

KEI: Average duration of quality optimisation (min) = The total time taken from the creation to the closure of all network quality issue work orders within the statistical period ÷ Number of network quality issue work orders

KCI: Automation ratio of quality optimisation (%) = Number of work items of automated quality optimisation/Total number of work items of quality optimisation * 100%

3. Definition and differentiation: Our AN DNA

In the process of transforming to all-round digitalisation and intelligence, e& UAE is reshaping the underlying logic of the next-generation telecom network with a forward-looking vision. Traditional network evolution is usually limited to incremental performance improvement or partial automation reconstruction. However, e& UAE aims to achieve the fundamental paradigm leap from “automation” to “high-level progressive, governed, scenario-based autonomy”. To achieve future-oriented high-level Autonomous Network (L4/L5), e& UAE has embedded five core pillars (illustrated in Figure 5): Cross-Domain Intelligence, AI-Native & Vendor-Agnostic Operations, Agentic & Open Source Enablement, End-to-End Closed-Loop, and Customer-Centric AI to propose a disruptive evolution path.

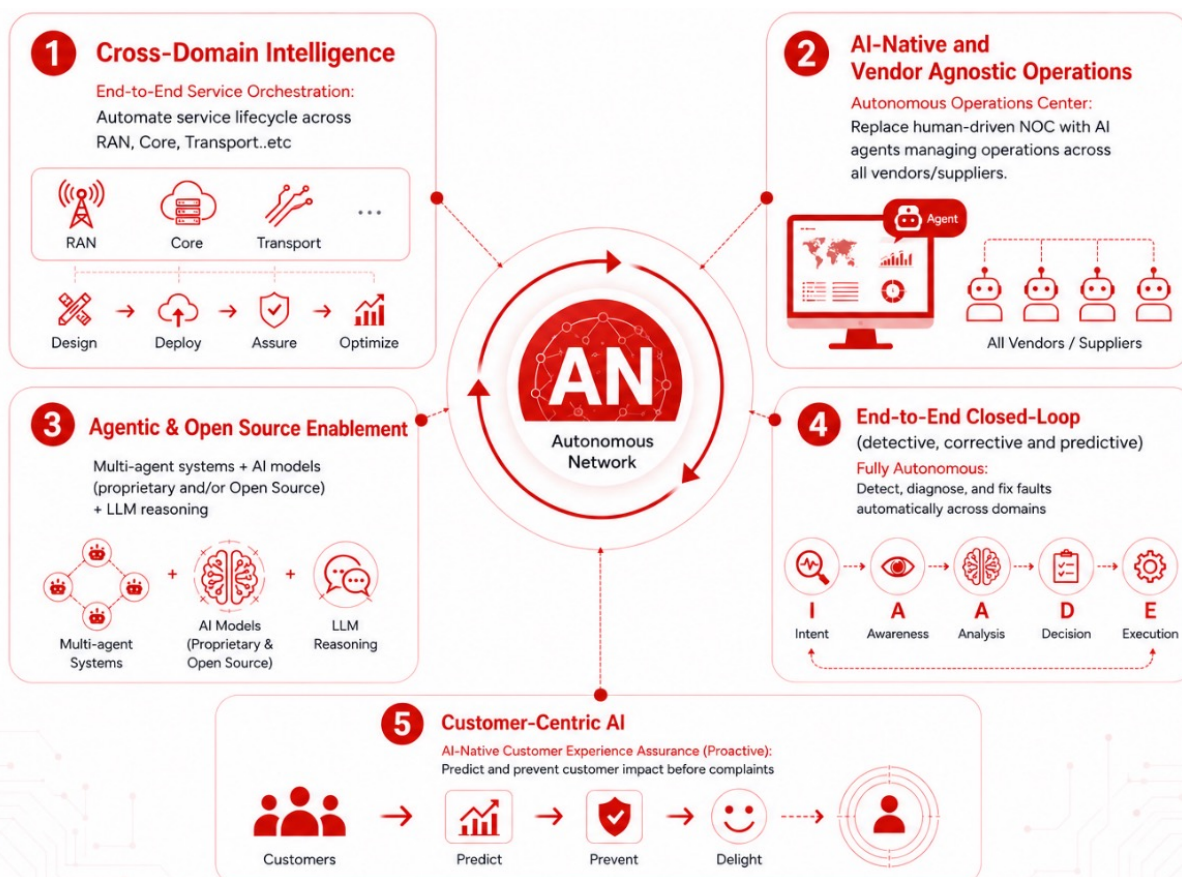
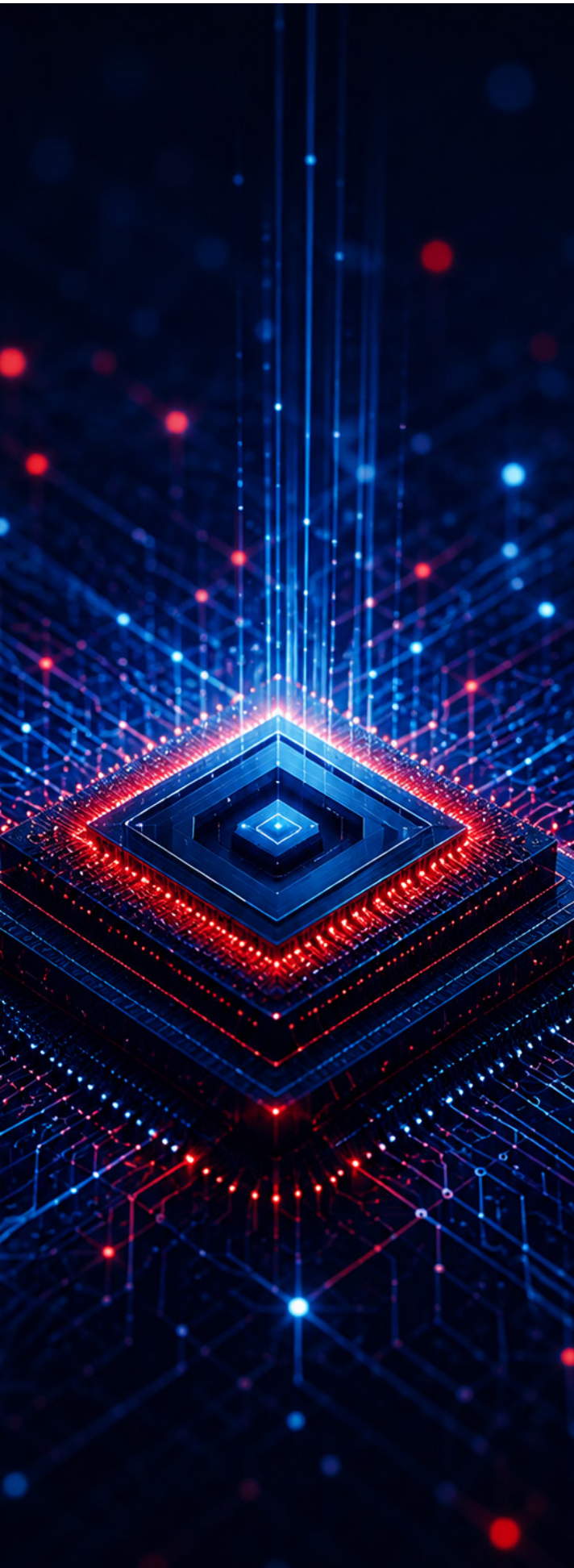


Figure 5: Autonomous Network Evolution DNA



Pillar 1: Cross-Domain Intelligence – Hierarchical architecture and E2E service orchestration

The radio access network (RAN), core network (Core), transport network (Transport), and IP network are usually controlled by different management systems. This separation leads to slow provisioning of cross-domain services, difficult fault locating and low resource utilisation. The first gene introduced by e& UAE in the advanced evolution of the AN is the Cross-Domain Intelligence based on the layered architecture, which aims to fully automate the end-to-end service life cycle.

Cross-Domain Intelligence does not simply aggregate data from all domains. Instead, e& UAE implements a TM Forum IG1443-aligned three-layer intelligent architecture: the Network Infrastructure and Autonomous Domain Layer deploys domain-specific agents (wireless/cloud core/access/IP) equipped with sensing, analysis and execution capabilities to handle localised data processing and control (e.g., beamforming, domain fault management); the Service Layer utilises cross-domain orchestration agents (HBB/MBB/fault management) to coordinate resources for automated broadband service provisioning, dynamic mobile service optimisation and cross-domain fault root-cause analysis within seconds; the Business Layer translates high-level objectives (e.g., VIP experience enhancement, 20% energy reduction) into digital intents, driving lower-layer agents to autonomously optimise network strategies, thereby establishing an end-to-end intelligent closed loop from business intent to physical network resource execution.

Pillar 2: AI-Native & Vendor-Agnostic Operations – Building an independent operation centre

If cross-domain intelligence solves the problem of hierarchical architecture responsibilities, AI-native vendor-agnostic design clearly defines the guiding principles for implementing AI native evolution at each layer. e& UAE is acutely aware that in the 5G era, AI is more often used as a “bolt-on” or “AI-assisted” tool. In the evolution to the L4/L5 or even 6G era, the network must be AI-native.



Simultaneously, by utilising full-stack AI agents to replace traditional human-dependent NOCs, it evolves into an autonomous operations centre, with AI progressively taking over a majority share of monitoring, diagnosis and repair tasks (with an aspiration of automating 90% NOC workloads for TMF high value scenarios at L4 Phase II, subject to scenario-by-scenario validation, governance-council approval and demonstrated drift-free operation), allowing human engineers to transition into “intelligent strategy makers”. Furthermore, by fully embracing open standard interfaces (such as TM Forum Open API), it reduces vendor lock-in through open APIs, common data models, modular integration and portability requirements, breaking down the barriers of single-vendor dependency. This enables cross-vendor data and model invocation on a unified “digital twin” foundation, granting the network unprecedented agility and inclusivity.

Pillar 3: Agentic & Open-Source Enablement – Building the brain of group intelligence

In the era of Large Model, a single task-specific small model (traditional ML) cannot cope with the infinitely complex burst scenarios of telecom networks. e& UAE fully embraces agentic and open-source technologies, empowering network intelligence to leap to the “multi-agent system” level.

1) The multi-agent collaboration architecture, utilising the standardised A2A-T (Agent-to-Agent for Telecom) protocol, enables seamless communication and orchestration among hundreds of distributed, cross-domain AI agents (across vendors like wireless, core and transmission).

2) A pragmatic hybrid AI model strategy deeply integrates domain-specific proprietary models (for core network signalling, data sovereignty and security-sensitive Telco LLMs) with cutting-edge open-source models and frameworks (for general network optimisation, multi-modal processing and NLP). This balances stringent security needs with rapid access to global AI innovation, significantly reducing R&D costs.

3) Intent-driven network operation via LLM Inference leverages large language models as a natural language interface, transforming network management from CLI commands to intent-driven operations aligned with TM Forum’s intent-based networking model (IG1253). Operators state goals (e.g., “Optimise VIP Customer video experience in Dubai Financial District AM peak, keep energy within threshold”), and the LLM translates this into a structured plan – not directly into network commands. That plan is then validated by deterministic workflow engines, policy and safety checks, digital-twin simulation and approval gates calibrated to the action’s risk class (per Section 5.6 governance) before any change is executed by the underlying orchestration layer. This explicit separation between intent interpretation by the LLM and deterministic execution by the orchestration layer preserves audit traceability, prevents hallucinated actions from reaching production and keeps accountability with the e& UAE governance council.

Pillar 4: End-to-End Closed-Loop – Fully autonomous network lifecycle

The most significant difference between L4/L5 autonomous networks and earlier networks lies in the end-to-end closed-loop capability that maintains self-running and self-healing of the network without manual intervention. e& UAE implements a full lifecycle closed-loop mechanism – Intent, Awareness, Analysis, Decision, Execution (I-AADE) – to autonomously detect, diagnose and resolve issues across domains. This shifts operations from reactive troubleshooting to proactive and predictive self-healing.

Pillar 5: Customer-Centric AI – Proactive experience assurance

With all technological innovation, the ultimate touchstone is the customer experience. In the traditional operation mode of the telecom industry, network maintenance and customer experience are often disconnected. Operators usually check network problems only after receiving many complaints from users. e& UAE regards “Customer-Centric” as the ultimate destination. With the AI native capabilities, e& UAE completely reverses the passive situation.

e& UAE is shifting from KPI-driven networks to AI-powered Customer Experience Intelligence (CEI). Using digital twins and predictive AI, the system detects potential service degradation before customers complain. For example, if the CEI of FTTH customers decreases, automatic analysis and optimisation can be triggered within 30 minutes to ensure user experience. Software problems can be remotely optimised, and hardware problems can be proactively rectified on-site, triggering automatic optimisations like bandwidth adjustment and route rerouting to prevent issues before users feel them. This proactive approach slashes complaint rates and operational costs. Beyond reliability, AI adds context- and sentiment-awareness, learning user behaviour, preferences and engagement patterns to deliver personalised, conversational interactions. The outcome is a network that goes beyond connectivity, actively anticipating user needs, sustaining service quality and co-creating value through context-aware, personalised interactions. With the five pillars defined, the next natural question is what their phased deployment looks like in practice. The next section presents the capability evolution from L4 Phase I through L4 Phase II to L5.

4. Before vs After: Transformational leap in Autonomous Network

Table 3 illustrates the phased capability evolution from L4 Phase I (single-scenario autonomy) through L4 Phase II (multi-scenario, cross-domain autonomy) to L5 (cognitive self-evolution), across five key dimensions: technical features, fault management, experience assurance, energy efficiency and resource efficiency, summarising the transformative changes brought by Autonomous Network L4/L5.

DIMENSION	 L4 PHASE I (2026–2028)	 L4 PHASE II (2028–2030)	 L5 (6G/2030+)
 KEY TECHNICAL FEATURES	Single-scenario agent and large-scale deployment of Copilot <ul style="list-style-type: none"> Predictive AI and large-scale deployment of Copilot has begun, with the application of Agents The system is equipped with capabilities for network convergence awareness, AI Agent tool invocation, and complex task planning 	Multi-scenario autonomy and multi-agent collaborative closed-loop operations <ul style="list-style-type: none"> Large-scale deployment of agents, exploring multi-agent applications Multi-agent collaboration enables end-to-end closed-loop solutions for complex scenarios 	 Cognitive adaptation and self-evolution
 FAULT MANAGEMENT	Autonomous fault handling and manual takeover in a single scenario <ul style="list-style-type: none"> A single-domain fault agent can automatically identify, diagnose and repair faults and risks within a single domain (single vendor) For complex issues, Copilot provides guidance to assist manual takeover and handling 	End-to-end cross-domain fault collaboration <ul style="list-style-type: none"> Focus on end-to-end complex complaint handling and troubleshooting The cross-domain fault agent achieves automatic aggregation and analysis of faults across suppliers and network domains, as well as automatic diagnosis and repair of cross-domain faults 	 Predictive self-healing and “zero faults”
 EXPERIENCE ASSURANCE	Single-scenario quality optimisation and single-service assurance <ul style="list-style-type: none"> Focus on ensuring the experience of personal services, home broadband, and private line businesses, as well as handling complaints Provide daily business assurance based on intent, with AI-assisted intent parsing 	End-to-end service and cross-domain proactive closed-loop management <ul style="list-style-type: none"> Achieve experience optimisation for end-to-end network services and commercial operations In complex cross-domain environments, proactive closed-loop management is conducted based on predictions, driven by service and customer experience 	 Zero-wait and absolute autonomy of intent
 ENERGY EFFICIENCY IMPROVEMENT	Optimisation of static/dynamic strategies based on predictions <ul style="list-style-type: none"> Automatically generate a complete plan covering energy-saving time periods and methods 	Cross-domain collaboration and simulation for energy saving <ul style="list-style-type: none"> Evolve from single-domain energy saving to multi-domain collaborative energy saving. By integrating digital twin technology (e.g., 3D simulation of the data centre environment) 	 Global real-time optimisation; optimal energy-proportional control and optimal deep sleep duration
 IMPROVED RESOURCE EFFICIENCY	Dynamic resource allocation for single scenarios <ul style="list-style-type: none"> Establish a resource closed loop, where autonomous agents optimise resource allocation and utilisation at the single-domain level 	Cross-domain end-to-end resource orchestration <ul style="list-style-type: none"> Coordinate necessary operations across multiple resource domains to ensure consistent service quality and full lifecycle management 	 Predictive elastic scaling and self-reconfiguration

5. Target architecture and key technologies

5.1 Architecture and technology challenges

In the evolution toward 6G and future next-generation networks, there is a shift from a mere connection channel to a cognitive infrastructure capable of perception, computation, and intelligence. However, this transformation brings unprecedented complexity. Translating the phased capability evolution shown in Table 3 into a concrete network requires a deliberate architectural redesign rather than incremental tooling on top of legacy systems. e& UAE has proposed a strategic blueprint to restructure network architecture and core technologies for end-to-end closed-loop autonomy and global optimisation. Nevertheless, as digital transformation deepens, e& UAE and its telecom network face severe challenges across multiple dimensions in advancing toward higher-level autonomous networks, which are summarised in Table 4.






 CHALLENGE DIMENSION	 KEY ISSUES
 <p>1. Network complexity and limitations of “bolt-on” AI</p>	<p>Traditional 5G networks involve thousands of parameters and heuristic rules, with spectral efficiency in single-user SISO regimes approaching theoretical limits, with continued gains available through massive MIMO, MU-MIMO and joint communication-sensing. The explosion of massive IoT, low-latency XR and other scenarios has rendered manual intervention and static rules ineffective. Current AI applications are mostly “bolt-on” or “AI-assisted”, focusing on localised optimisation (e.g., traffic prediction or anomaly detection) without global coordination, unable to meet millisecond-level decision-making and ultra-large-scale concurrency.</p>
 <p>2. AI model interoperability and integration barriers in multi-vendor environments</p>	<p>Future networks may need to orchestrate large numbers of concurrent AI models. Substantial standardisation work is already underway – across 3GPP SA5 (TS 28.105 AI/ML management) and SA2 (TS 23.288 NWDAF), ETSI ENI/ZSM, O-RAN ALLIANCE WG2/WG3; TM Forum (AN reference architecture and AIOps Toolkit), ITU-T (Y.3170-series), the MLOps ecosystem (ONNX, MLflow, Kubeflow), and AI-governance frameworks (NIST AI RMF, ISO/IEC 42001) – but the landscape remains fragmented rather than converged. No single framework spans the full AI model lifecycle across multi-vendor heterogeneous networks yet, which leaves reliable exchange, execution and secure “plug-and-play” of AI algorithms, large models and distributed agents from different vendors as a key technical barrier to breaking data and capability silos.</p>
 <p>3. Trust, security and governance risks in intelligent decision-making</p>	<p>With AI deeply embedded in network infrastructure, traditional “black-box” AI lacks transparency and explainability (XAI). Critical issues include defending against adversarial attacks (e.g., data poisoning), ensuring secure multi-stakeholder data sharing while protecting user privacy, and establishing robust AI governance and regulatory frameworks to oversee autonomous network behaviour, user privacy, and establishing robust AI governance and regulatory frameworks to oversee autonomous network behaviour.</p>

Figure 4: Autonomous Network Evolution DNA

5.2 Three-layer target architecture

Anchored on TM Forum IG1443, the e& UAE target architecture is structured as three vertically integrated closed loops—Business Operations, Service Operations and Resource Operations—each driven by intent and governed by AI-native control. The conceptual reference, adapted from TM Forum IG1443, is shown in Figure 6.

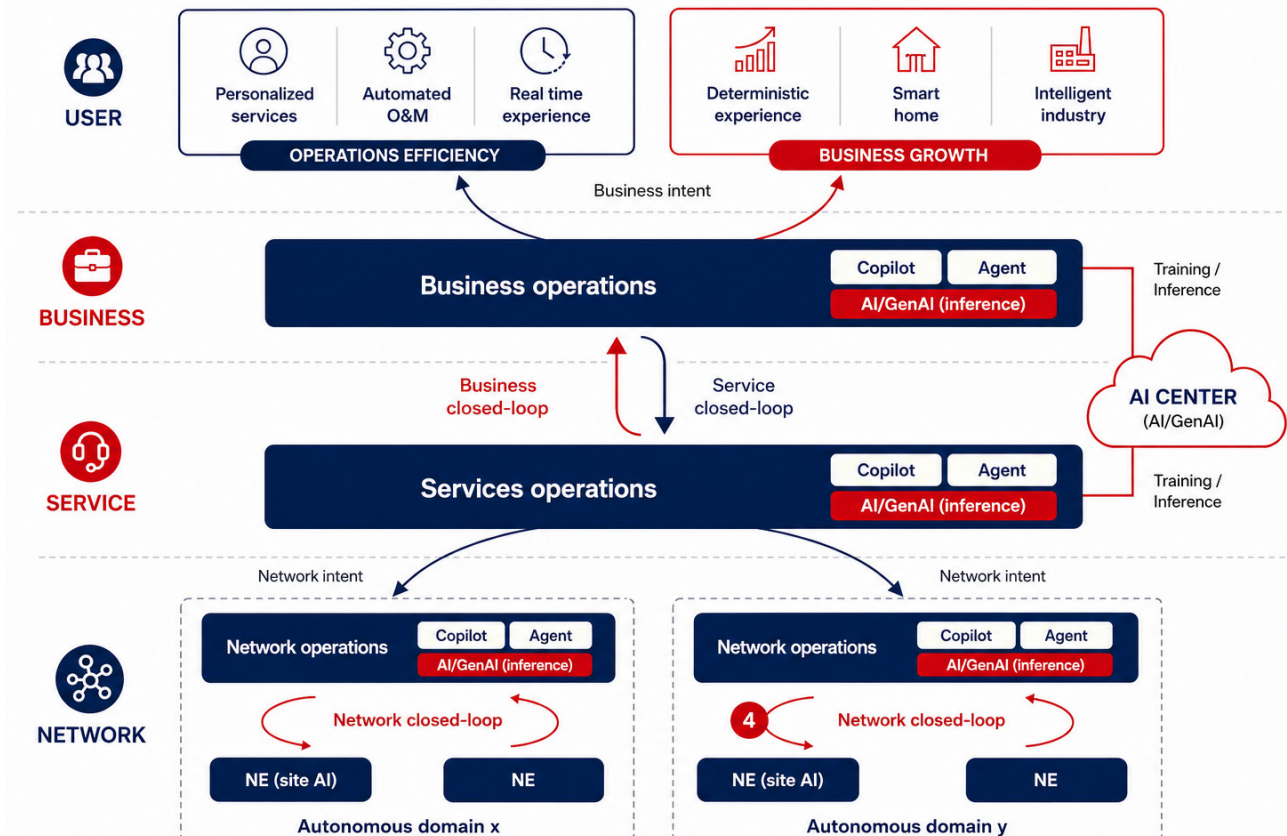


Figure 6: Conceptual Architecture, TM Forum, IG1443 Autonomous Networks Implementation Guide

- Business operations closed-loop: Oriented to customers and business goals, defines experience, SLAs and business policies. Converts business requirements into executable objectives through intent-driven mechanisms, enabling network operations management centred on customer value
- Service operations closed-loop: Takes business intents as inputs, responsible for service orchestration and lifecycle management. Maps business needs to end-to-end service capabilities, achieving cross-domain coordination and service-level closed-loop control
- Resource operations closed-loop: Focuses on network infrastructure, responsible for monitoring, controlling and optimising RAN, core network and transport resources. Leverages automation and AI to realise resource-level autonomy and efficient utilisation.

5.3 AN L4/L5 functional architecture

Within the AN architecture, AI agents are deployed across a three-layer hierarchical structure spanning business, service and resource operations layers. Each domain hosts dedicated agents responsible for closed-loop perception, analysis, decision and execution. Cross-layer and cross-domain agent collaboration is governed by the A2A-T protocol, enabling coordinated, intent-driven autonomy at scale.

5.3.1 Evolution at the architecture layer

Figure 7 presents the e& UAE AN L4/L5 functional architecture, which spans the Business Layer, Service Layer and Network Layer (RAN, IP and Core domains), all unified by a dedicated AI Plane and supported by Telco LLMs/GenAI, AI/ML lifecycle (MLOps), and Model Serving. At the architectural level, e& UAE is undergoing a paradigm shift from traditional “AI-assisted” systems to truly “AI-native” systems, with a focus on reshaping the network DNA through the following three dimensions.

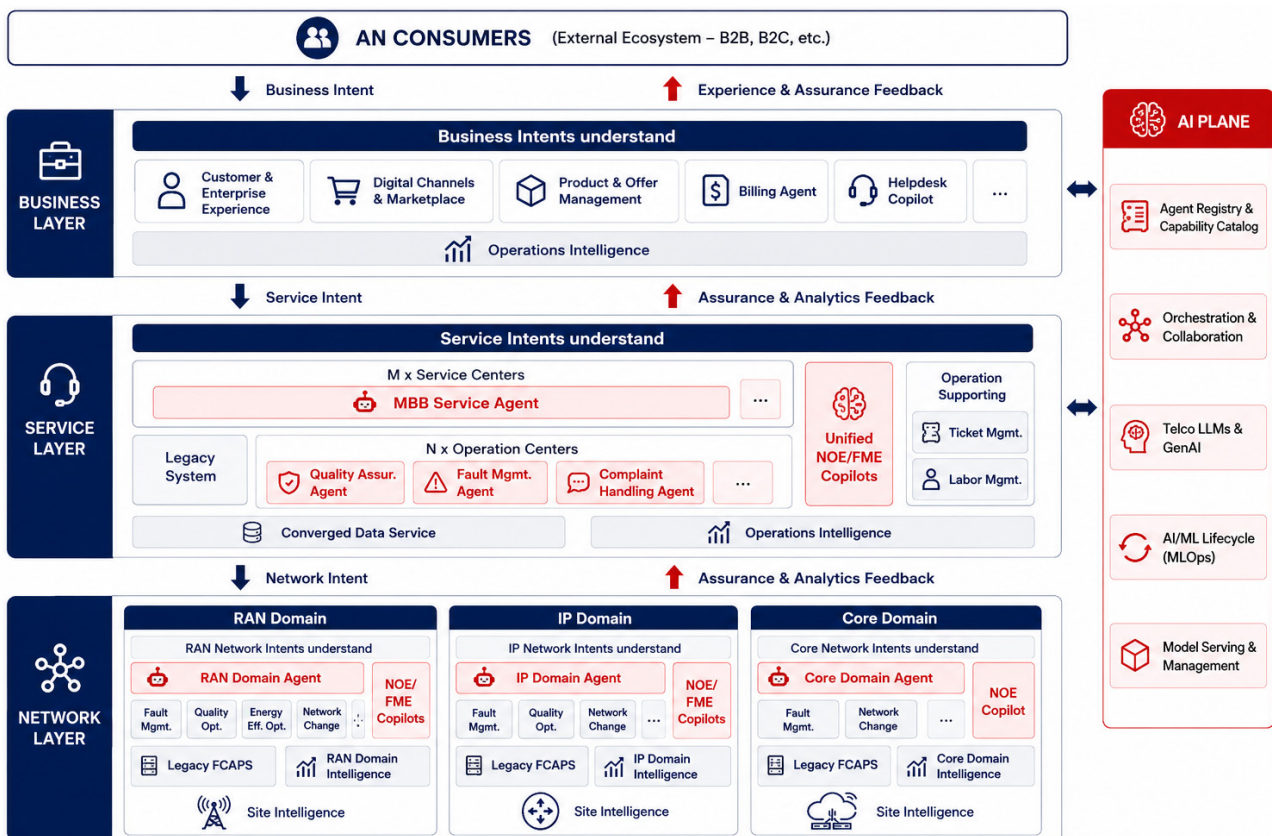
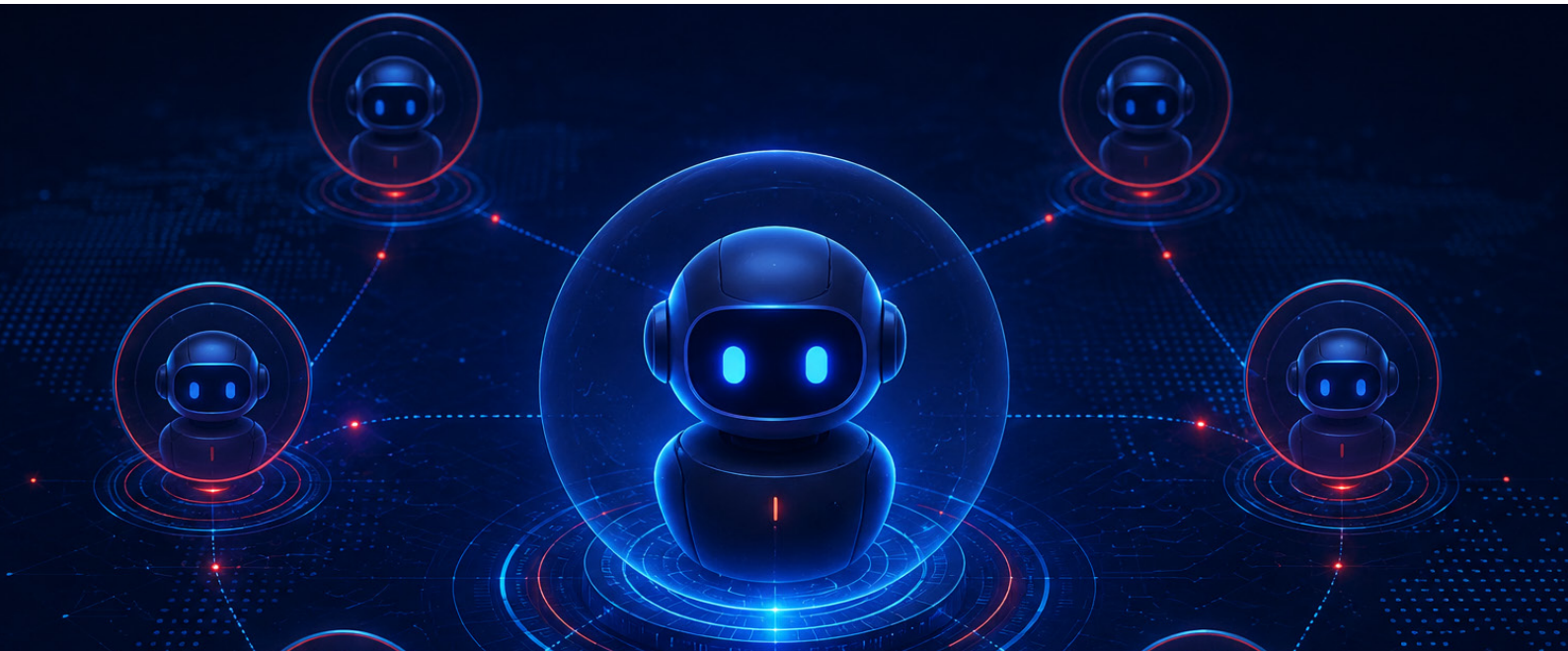


Figure 7: e& UAE AN L4/L5 Functional Architecture

- **Agentic AI: Fully aligning with TM Forum’s AN architecture, e& UAE has established a “three-layer, four closed-loop” intelligent foundation**

e& UAE’s AI-native design introduces a dedicated AI/management layer that operates alongside the 3GPP user plane, control plane and OAM plane that is anchored on TM Forum’s Autonomous Networks reference architecture (IG1230, IG1443). This AI layer carries decision, orchestration and learning workloads—distinct from packet-handling planes—and forms a three-dimensional autonomous system with “three layers and four closed loops”.



Three-layer architecture: The system is vertically decoupled into the Network Layer, Service Layer and Business Layer. AI perception, analysis, decision-making and execution (AADE) capabilities are natively embedded into these three layers, enabling each layer to possess independent autonomous capabilities.

Four closed loops collaboration: Based on the three-layer architecture, the network utilises AI agents to establish closed loops for resources, networks (services), business and end-to-end customer experiences (Customer Closed Loop). This multi-dimensional closed-loop mechanism ensures that the network can optimise from the underlying hardware level all the way to the top-level customer experience, achieving full lifecycle self-configuration, self-optimisation and self-healing, and truly internalising learning and reasoning capabilities into the network DNA.

- **Distributed and hierarchical AI Agents: Foundation for high-level full autonomy**

A communication network is a heterogeneous and complex system comprising multiple vertical domains, such as Radio Access Networks (RAN), IP Networks, Transport Networks and Core Networks. Each domain exhibits significant disparities in domain knowledge across the physical layer, protocol stacks, and service logic. Consequently, a monolithic agent faces immense challenges in aligning with the domain-specific knowledge of all these heterogeneous fields.

By adopting a hierarchical and distributed AI agent architecture, specialised domain agents can establish independent “Domain Knowledge Bases”, enabling them to curate professional corpora and expert experience within specific fields. This ensures that decision-making logic strictly adheres to the unique physical mechanisms of each domain.

Furthermore, Large Language Models (LLMs) are constrained by a limited Context Window when processing large-scale network data. A monolithic agent tasked with handling massive, granular underlying data—particularly for complex network complaints and user experience diagnostics—is highly susceptible to Context Overflow. This leads to the failure of Root Cause Analysis (RCA) or a catastrophic drop in decision accuracy.

Therefore, in the evolution toward L4/L5 Autonomous Networks, a hierarchical distributed architecture is essential. By deploying agents across the Network Layer, Service Layer and Business Layer, the system utilises a “cascading abstraction” mechanism. This process filters data and compresses information, maintaining the core decision-making pressure within the model’s optimal context window. This hierarchical agent architecture effectively shields the intricate details of different network domains; agents at each level maintain high-frequency autonomous loops within their respective scopes, reporting only refined summaries to cross-domain agents for global coordination. In this way, the agents at each level are fully decoupled; each agent maintains its responsibility boundaries, focuses on its unique strengths, achieves full autonomy, collaborates to deliver value and ultimately realises a business closed loop of cost reduction, efficiency improvement, innovation and revenue generation.

- **Multi-agent collaboration: Elevating “local intelligence” to “global wisdom”**

Multi-agent collaboration serves not only as the vital link connecting various autonomous domains but also as the core engine for elevating “local intelligence” to “global wisdom”. While hierarchical architecture ensures deep specialisation within each domain, telecommunication services are fundamentally end-to-end (E2E). An agent confined to a single domain possesses only a localised perspective, making it difficult to independently resolve complex issues that span multiple physical boundaries. Multi-agent collaboration aggregates discrete intelligent units into an organic “nervous system”, significantly enhancing the agility and precision of service assurance across all scenarios.

In complex troubleshooting scenarios such as “HD video lag,” cross-agent collaboration enables a logical closed-loop through the aggregation of evidence across the entire chain: the Business Layer agent initiates the service request, the Service Layer agent performs cross-domain demarcation, and agents across various Network Layer domains conduct parallel investigations and provide real-time feedback. Finally, the cross-domain agent completes the joint reasoning based on multi-dimensional information. Compared to traditional manual cross-team coordination, this collaborative model achieves an order-of-magnitude increase in efficiency, driving Root Cause Analysis (RCA) to leap from “minutes” to “seconds”.

As a critical enabler for Autonomous Networks (AN) evolving toward L4 and L5, Multi-Agent Collaboration provides Large Language Models (LLMs) with a broader and deeper context window. Rather than being overwhelmed by massive raw underlying data, the models focus on processing “knowledge summaries” highly refined by domain agents. This not only significantly reduces computational costs but also provides the technical feasibility for constructing a “Network Brain” equipped with holistic, grid-wide thinking.

5.3.2 Evolution at key technologies

In terms of the technical support system, e& UAE has fully integrated the following three cutting-edge technologies to propel network operations toward higher levels of autonomy:

- Intent-driven workflow orchestration:** Intent-driven workflow orchestration serves as the core command centre for achieving “goal-oriented” operations in high-level Autonomous Networks. Its primary value lies in integrating the sophisticated task decomposition and strategic planning capabilities of agents into the network operational framework. This technology allows operators to input high-level business intents, which the system then processes through deep logical reasoning, much like a human expert, to deconstruct broad objectives into a sequence of specific execution directives and operational steps spanning multiple domains and layers. This complex decomposition is not a mere invocation of scripts; it is an intelligent mapping of the “desired state” into an optimal “operational path,” based on a profound understanding of network semantics, protocol dependencies and resource status. By deeply integrating complex intent understanding and object decomposition, dynamic workflow orchestration, this technology completely breaks the reliance on predefined manual workflows. It achieves a generational leap from “static workflows” to “generative adaptive workflows,” providing a robust technical guarantee for agile service deployment and ultra-lean network operations
- A2A-T:** The introduction of the A2A-T (Agent-to-Agent Telecom) protocol represents a pivotal strategic move for e& UAE in its evolution toward L4/L5 Autonomous Networks (AN). Within the intricate telecommunications ecosystem, A2A-T not only dismantles linguistic barriers between agents but also provides a production-grade collaboration framework tailored to the specific demands of the ICT sector. As a universal language and open standard, A2A-T facilitates seamless communication across heterogeneous vendors and technical frameworks, enabling e& to build a distributed, hierarchical AI agent architecture spanning RAN, Core and Service layers. A2A is the broader open standard hosted by the Linux Foundation (with more than 150 member organisations and v1.0 production-ready specifications including Signed Agent Cards). A2A-T is the emerging telecom-specific profile being shaped by TM Forum and industry contributors, including the open-source software contribution announced for MWC 2026, to provide carrier-grade traceability, structured task lifecycle management, domain-specific semantics and multi-vendor agent collaboration. Together, they balance the flexibility of natural-language coordination with the precision telecom operations require. A2A-T also complements the Model Context Protocol (MCP), with A2A-T defining how telecom agents communicate with each other and MCP defining how those agents access internal tools and data sources. To address the extreme professional complexity of telecom operations, such as wireless fault diagnosis involving many distinct root causes, A2A-T incorporates specialised meta-models, structured prompt templates and Agent Card expansion mechanisms. These ensure that high-stakes tasks like fault recovery and performance optimisation are executed with high accuracy and traceability via A2A-T extended task-history mechanisms. Finally, through its extended task history linking mechanism, A2A-T meets stringent security requirements, providing comprehensive auditability and accountability for all collaborative AI activities.

To clarify how A2A-T fits within the broader interface and protocol landscape used in e& UAE’s autonomous network, the table below compares its purpose, scope and maturity against neighbouring standards.

Table 5: Comparison of A2A, A2A-T, MCP, Open API, Orchestration interfaces

Protocol/Interface	Purpose	Scope	Maturity	Typical use in AN
A2A (Agent-to-Agent)	General-purpose agent-to-agent communication and coordination	Cross-domain, cross-industry	Linux Foundation v1.0, April 2026; 150+ member organisations; signed agent cards	Inter-agent coordination across telecom and non-telecom domains; agent discovery and trust
A2A-T (A2A for Telecoms)	Telecom-specific profile of A2A, with carrier-grade traceability and extended task history	Telecom-domain agents (RAN, core, transport, services)	TM Forum IG1453 v1.0.0 Alpha, November 2025; open-source software at MWC 2026	Multi-vendor telecom agent collaboration with audit trail; fault diagnosis; performance optimisation
MCP (Model Context Protocol)	Standardised access from agents to tools, data sources and external systems	Agent-to-tool/ agent-to-data	Production-ready; broad multi-vendor adoption	LLM-agent access to OSS/BSS data, ticketing, knowledge bases; internal-tool invocation
TM Forum Open APIs	RESTful APIs for OSS/BSS system integration	Inter-system integration (provisioning, inventory, ordering, billing)	Mature; 60+ APIs deployed industry-wide	Service ordering (TMF641), service activation (TMF640), service inventory (TMF638), intent intake
Orchestration Interfaces	Domain-specific control and configuration of network elements	Network elements (RAN, core, transport, IP, cloud)	Mature, domain-specific	O-RAN O1/O2 (RAN management, cloud infra), 3GPP NF-NF (e.g., NWDAF-AMF), NETCONF/YANG (IP), gRPC (cloud-native NFs)

- Site intelligence: The infrastructure of each network domain achieves closed-loop capabilities for intelligent network awareness and control by introducing smart hardware.

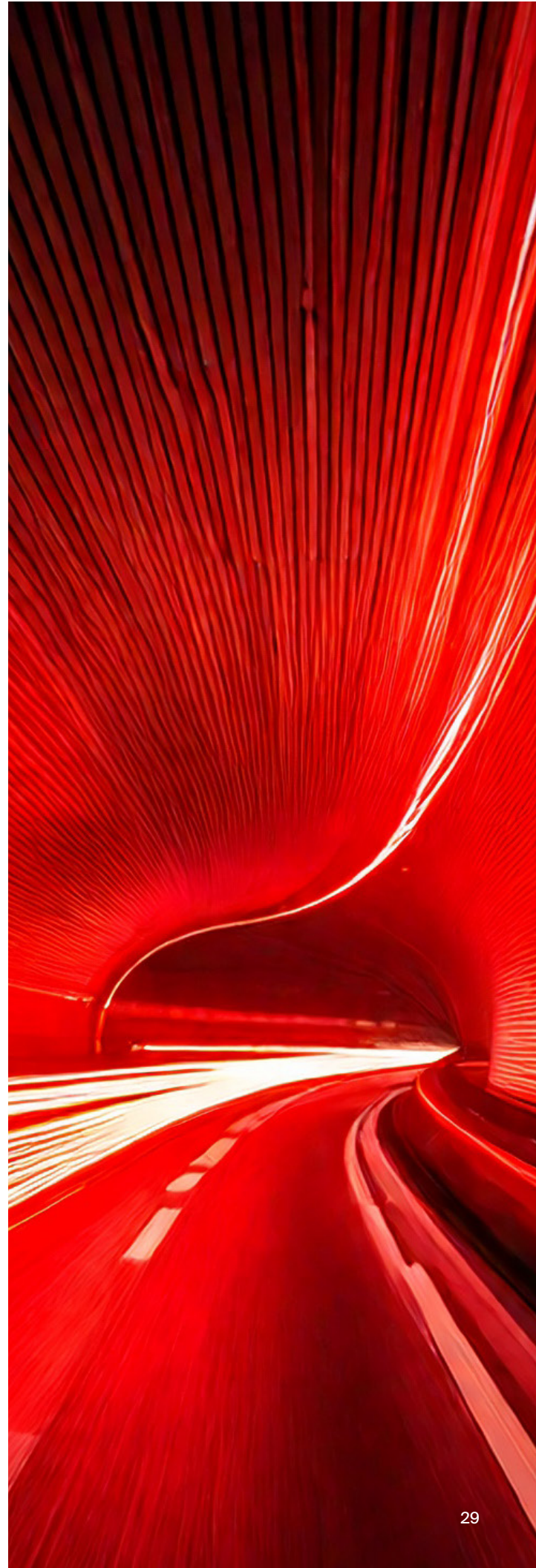
In terms of intelligent awareness, using eOTDR/OTDR technology, IP networks detect optical path interruptions, wireless networks locate fronthaul faults, and transport networks diagnose optical link faults. Wireless base stations and home broadband OLTs use smart boards to detect quality degradation in individual mobile services and home broadband services. The core network uses NWDAF to intelligently detect service health status.

In terms of remote control and closed-loop management, the wireless network's tracking antennas can remotely adjust hardware parameters such as tilt angle, azimuth and beam width, enabling remote adjustment of antenna posture and avoiding the need to climb towers or visit sites. Home broadband FTTR uses CEI experience quantification and evaluation to remotely and accurately optimise various poor-quality issues. The core network uses MDAF to isolate Network Element (NE) and link faults. These site intelligence capabilities form the foundation for achieving L4/L5.

5.4 Data Plane and data architecture

Just as the AI Plane provides the cognition layer, the Data Plane provides the substrate on which that cognition operates. e& UAE treats data as a first-class architectural concern, not a by-product of network operations. The Data Plane is structured around four design principles aligned with TM Forum AN data-fabric guidance and 3GPP SA5 management-data work:

- Streaming-first telemetry collection. Network elements, NWDAF/MDAF instances, OSS/BSS systems, customer-experience probes and digital twins publish events to a unified, time-series streaming fabric. Latency-sensitive closed loops (sub-second) consume directly from the stream; longer-horizon learning loops consume curated, persisted views
- Domain-segmented but federated storage. Each network domain (RAN, IP, Core, Transport, Access) maintains its own primary data store under domain ownership, while a federated catalogue and standardised semantic schema enable cross-domain agents to query without centralising raw data—preserving data sovereignty and minimising movement of sensitive payloads
- Quality, lineage and governance built in. Every data product carries lineage metadata, freshness guarantees and quality indicators. Data products consumed by autonomous closed loops are gated by quality SLAs, so AI agents never act on data outside its valid envelope.
- Cross-vendor, cross-partner exposure via Open APIs. TM Forum Open APIs and Open Gateway expose curated data products to authorised partner agents, enabling federated learning and cross-operator scenarios while applying e& UAE's data-residency and privacy controls at the boundary
- This data foundation is what allows the AI Plane to operate with the precision telecom decisions require: timely, traceable, governed and consistent across domains



5.5 AI Plane: Internals, lifecycle and model operations

The AI Plane is more than a logical layer; it is a production system with a defined operating model. Within e&UAE's architecture, AI Plane internals are organised around three concrete elements:

- **Heterogeneous Agent Construction:** Agents are not uniformly LLM-based. Domain agents combine three model classes: (1) fine-tuned Telco LLMs for natural-language understanding, intent decomposition and reasoning over network corpora; (2) classical and deep-learning predictive models (gradient-boosted trees, recurrent networks, graph neural networks) for KPI forecasting, anomaly detection and root-cause inference where determinism and latency matter; and (3) reinforcement-learning policies for closed-loop control, where trial-and-error in digital twins can yield superior policies. The choice is scenario-driven, not technology-driven
- **Production Model Lifecycle (MLOps):** Every model in production passes through a defined lifecycle: data acquisition, offline training, digital-twin validation, shadow-mode deployment, guarded production and continuous monitoring. Concept drift, distribution shift and KPI regression are monitored continuously; degradation triggers automated rollback to the previous stable version while a retraining cycle is initiated. No model reaches production without a defined rollback path.
- **Inference placement and latency budgets:** AI inference is placed where decisions are executed: on the DU/RU for sub-millisecond decisions (e.g., beamforming policies); and in the central AI Plane for cross-domain reasoning and longer-horizon optimisation. This tiered placement ensures that latency-critical control is never gated by central infrastructure availability.

This explicit operating model is what distinguishes a production AI Plane from an experimental one.





5.6 AI governance, safety and human oversight

Autonomous Networks make decisions that affect customer service, national infrastructure and regulatory compliance. e& UAE's AN architecture therefore embeds governance as a first-class design pillar, not an afterthought. Five governance mechanisms run alongside every closed loop:

- **Policy guardrails and action classification:** Every AI-initiated action is classified by potential impact (low, medium, high, critical). Low-impact actions execute autonomously; medium-impact actions execute with post-hoc audit; high-impact actions require human approval before execution; critical-impact actions require dual approval and trigger a formal change-management workflow. This classification is the foundation of the human-in-the-loop boundary
- **Production Model Lifecycle (MLOps):** Every model in production passes through a defined lifecycle: data acquisition, offline training, digital-twin validation, shadow-mode deployment, guarded production and continuous monitoring. Concept drift, distribution shift and KPI regression are monitored continuously; degradation triggers automated rollback to the previous stable version while a retraining cycle is initiated. No model reaches production without a defined rollback path.
- **Safe-mode rollback and kill-switch:** The architecture includes a hierarchical rollback capability: per-action rollback (undo a single AI decision), per-loop suspension (pause a specific closed loop and revert to manual operation), and network-wide safe-mode (suspend all autonomous actions and revert to last-known-good configuration). The network-wide kill-switch is exercised regularly as a drill, not merely as a contingency.

- **Multi-agent accountability:** When multiple agents from different vendors jointly contribute to a decision, the A2A-T extended task-history mechanism preserves a complete chain of evidence: which agent contributed which observation, which decision used which evidence, and which vendor is accountable for which outcome. This supports both root-cause analysis and contractual SLA management.
- **Adversarial robustness and AI security:** Models are evaluated against telecom-relevant adversarial scenarios: data-poisoning of telemetry feeds, prompt-injection attempts via natural-language interfaces, agent-impersonation attacks across A2A-T boundaries, and confidentiality leakage through model outputs. Production agents include input validation, anomaly detection on their own input streams and signed Agent Cards (per A2A v1.0) to authenticate cross-vendor calls.

Together, these mechanisms ensure that the autonomy gained at L4 and beyond does not come at the cost of accountability, safety or regulatory standing.



5.7 AN architecture in action

In summary, the comprehensive blueprint of e& UAE’s AN L4/L5 architecture has been clearly delineated. Its core logic centres on the evolution of agentic AI, establishing a robust architectural foundation through Distributed and Hierarchical AI Agents and Multi-Agent Collaboration. Supported by cutting-edge technologies such as Intent-driven Workflow Orchestration, A2A-T and Digital Twin, this architecture fully empowers the intelligent transformation of both networks and business operations. The complete blueprint, integrating the three-layer/four closed-loop foundation with intent-driven orchestration, distributed and hierarchical AI agents, Multi-Agent Collaboration, A2A-T, and site intelligence, is summarised in Figure 8.

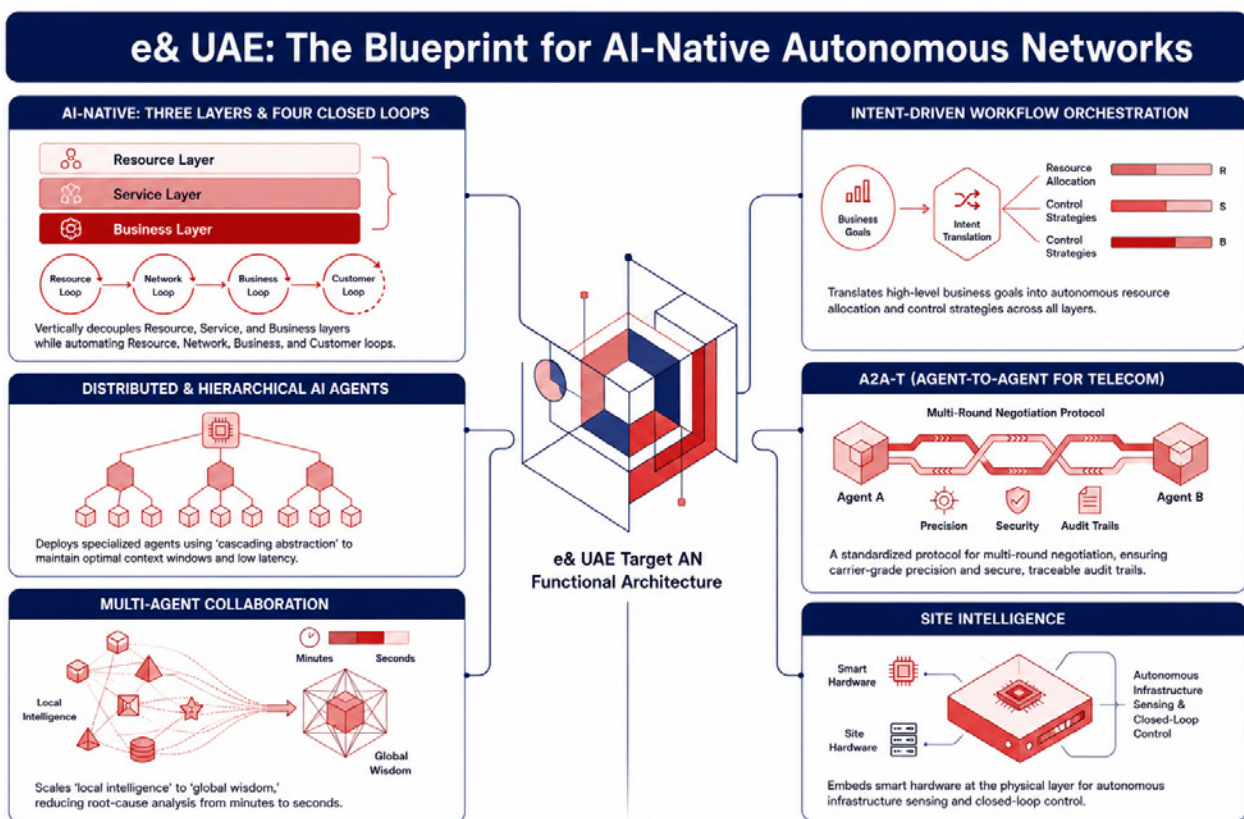


Figure 8: e& UAE Target AN functional architecture evolution map

A visionary blueprint is only the beginning; the real imperative is implementation – driving network and service empowerment to unlock genuine commercial value. To achieve the transition of architecture from blueprint to reality, the core lies in deeply coupling architectural evolution with tangible business gains, supporting e& UAE in its progress toward AN L4/L5 high autonomy through a “layered construction and collaborative synergy” model.

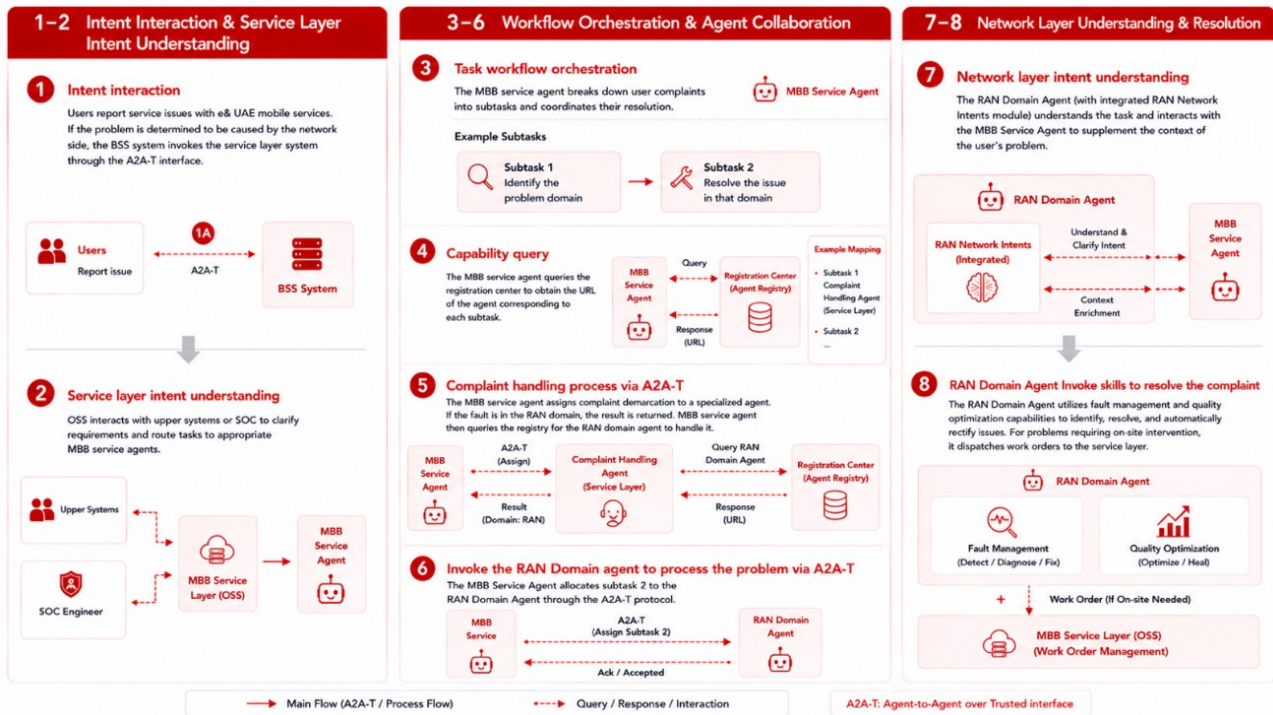


Figure 9: End-to-end working process for a user's mobile service complaint, illustrating multi-agent collaboration via A2A-T across the Business, Service and Network Layers

To illustrate the interplay of these components, consider the concrete mobile-service complaint scenario shown in Figure 9. The end-to-end resolution flow proceeds as follows:

1. **Intent interaction:** When a user reports a service issue with e& UAE mobile services and the issue is determined to originate from the network side, the BSS system invokes the Service Layer system through the A2A-T interface. Alternatively, the SOC engineer describes the problem on the service-layer through the language user interface.
2. **Service Layer intent understanding:** OSS interacts with upper systems or SOC engineers to clarify requirements and route tasks to the appropriate MBB Service Agents
3. **Task workflow orchestration:** The MBB Service Agent breaks down user complaints into subtasks and coordinates their resolution.
4. **Capability query:** The MBB Service Agent queries the Registration Centre to obtain the URL of the agent corresponding to each subtask. For example, subtask 1 can be handled by the Complaint Handling Agent at the service layer.
5. **Complaint handling process via A2A-T:** The MBB Service Agent assigns complaint demarcation to a specialised agent. If the fault is localised to the RAN domain, the result is returned, and the MBB Service Agent then queries the Registry for the RAN Domain Agent to handle it.

6. Invoke the RAN Domain Agent to process the problem through A2A-T: The MBB Service Agent allocates subtask 2 to the RAN Domain Agent through A2A-T protocol.
7. Network layer intent understanding: The RAN Network Intents module in the RAN domain understands the task and interacts with the MBB Service Agent to supplement the context of the user's problem.
8. RAN Domain Agent invoke skills to resolve the complaint: The RAN Domain Agent utilises fault management and quality optimisation capabilities to identify, resolve and automatically rectify issues. For problems requiring on-site intervention, it dispatches work orders to the service layer. With the target architecture and end-to-end agent collaboration mechanism in place, the next section translates this technical foundation into a phased deployment plan, prioritising the high-value scenarios where AN can deliver the greatest near-term business impact.



6. High value scenario evolution roadmap

6.1 Identification of high-value scenarios

In order to quickly realise service or operational improvements, the L4/L5 target state design needs to be scoped, and high-value scenarios should be prioritised. Taking reference from the 4-quadrant method for priority selection of value scenarios from TM Forum IG1339 and the identification method and reference in the TM Forum AN Industry Blueprint of AN high-value scenarios, e& UAE has developed our methodology for high-value scenario selection.

e& UAE considers the prioritisation of value scenarios in terms of both operational value and technical feasibility.

Operational value is assessed by evaluating the benefits of AN in terms of enhanced customer experience, optimised network monetisation and improved O&M efficiency. When selecting a scenario, it is crucial to consider its operational value, as scenarios with high business value often have a higher Return on Investment (ROI).

Technology feasibility refers to the ability to support and realise a solution within the existing technical infrastructure and resources. It is assessed by examining the superiority and maturity of the new technology, the effectiveness in problem-solving, the efficiency of development and the compatibility with existing systems, processes and organisations. Technology feasibility is a key factor in the selection of a solution, as only a technically feasible solution can be implemented and bring tangible benefits. The four-quadrant prioritisation map shown in Figure 10 plots candidate scenarios along these two axes, with the upper-right quadrant identifying the highest-priority opportunities for L4 deployment.

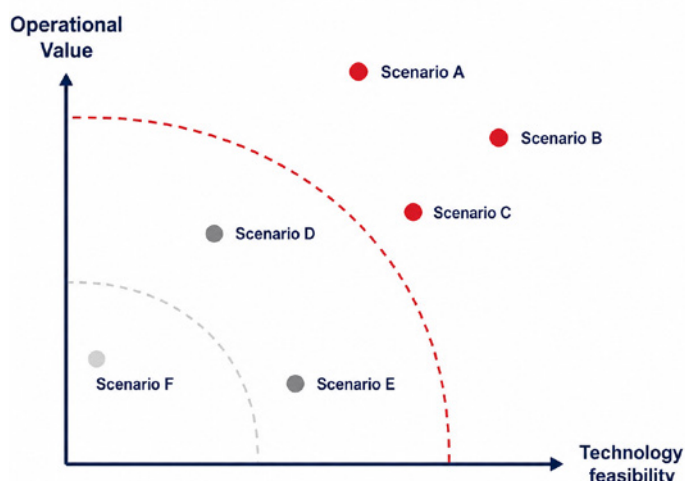


Figure 10: High-Value Scenario Selection, TMF IG1339 Autonomous Networks L4 High Value Scenarios

6.2 Overview of e& UAE high value scenario

Against the backdrop of the strategy to “integrate AI into every aspect of operations,” e&UAE’s core value orientation—“Extreme O&M Efficiency”, “Extreme Customer Experience”, “Extreme Energy Efficiency” and “Extreme Service Delivery Efficiency”—aligns closely with the high-value scenarios (HVS) of Autonomous Networks (AN) defined by TM Forum (TMF).

TMF emphasises that the key to evolving to higher levels of AN is to capture tangible business value and drive architecture transformation through the implementation of high-value scenarios. Based on this industry consensus and methodology, e& UAE has focused its strategic implementation on four core scenarios. Figure 11 maps these high-value scenarios across the service-oriented and network-oriented dimensions defined by TM Forum IG1339, highlighting where e& UAE is concentrating its initial L4 investments.

Based on strategic deployment and top-level design, e& UAE fully implements the Autonomous Network system to build long-term value, upgrading blueprint and anchor future development goals around four ultimate development dimensions.

- In terms of Extreme O&M Efficiency, it will establish a proactive and predictive network operation and maintenance system to identify potential hidden dangers in advance and avoid operational risks beforehand. This will fundamentally reduce network failure risks, shorten service downtime, steadily improve service reliability and lay a solid foundation for sustained customer satisfaction growth
- In terms of Extreme Energy Efficiency, supported by dynamic intelligent optimisation mechanisms, network resources will be flexibly allocated in response to real-time service demands. It will continuously expand network capacity and realise refined management as well as low-carbon and efficient utilisation of computing power, bandwidth, energy consumption and other resources
- In terms of Extreme Service Delivery, full-process automation will replace repetitive and routine network management tasks to gradually release high-quality human resources
- In terms of Extreme Customer Experience, the liberated manpower will be focused on core initiatives including strategic planning, business innovation and value-added development. Through long-term and high-quality operational upgrading, service quality will be continuously polished to fully unleash new potential for future user experience improvement

In summary, by selecting scenarios such as experience assurance, complaint handling, fault management and wireless energy saving, e& UAE essentially focuses on areas that can most directly drive business growth and cost reduction, steadily advancing its transition to a “Self-Evolution” network.

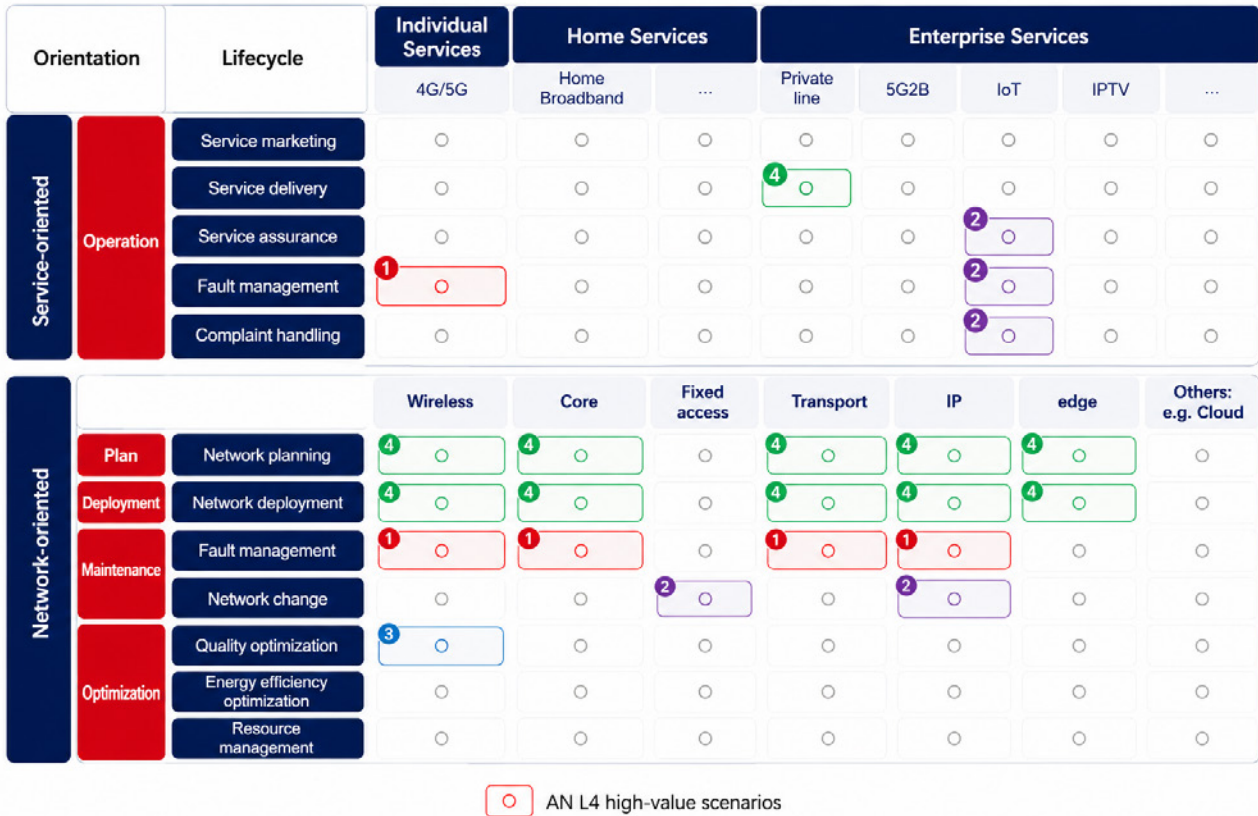


Figure 11: High-Value Scenarios Selection Map, Source: TMF IG1339 Autonomous Networks L4 High Value Scenarios

6.3 Roadmap towards L4/L5 evolution

To realise its strategic vision of becoming a “Leading AI-Native Telco,” e& UAE has closely aligned with TM Forum’s Autonomous Networks framework, focusing on “Extreme O&M Efficiency”, “Extreme Customer Experience”, “Extreme Energy Efficiency” and “Extreme Service Delivery Efficiency” as its core value drivers. It has formulated a robust and forward-looking roadmap for evolving to L4/L5 high-level autonomy. By adopting a strategy of “single-domain breakthroughs, prioritising core scenarios and cross-domain collaboration”, e& UAE is steadily advancing toward the ultimate network vision of “Self-Configuration, Self-Optimisation, Self-Healing and Self-Evolution”. The phased timeline, milestones and value scenarios are summarised in Figure 12.

L4 Phase 1 (2026–2028): Single-scenario autonomy and value realisation

In 2026, e& UAE will prioritise achieving L4-level closed-loop autonomy in single-domain core scenarios that can significantly drive business value and cost savings, while simultaneously initiating intelligent upgrades for complex fault scenarios.

Achieving L4 in wireless energy efficiency optimisation: e& UAE will fully implement AI and machine learning (ML)-based radio access optimisation capabilities across its wireless access network. The network will be able to dynamically and adaptively manage intelligent sleep modes and achieve globally optimal energy efficiency scheduling based on real-time traffic models and digital twin technology, without impacting customer core network experience (KPIs).

L5 Phase (2030+): Self-Evolution Network

The AN L5 pilot exploration is carried out. The network realises cognitive auto-adaptation and self-evolution, and has the closed-loop automation capability across multiple services, multiple domains and the entire lifecycle. It can be managed and decided independently through cognitive AI and adaptive technologies, with human oversight retained for strategic policy direction and exception governance. It is important to note that L5 is positioned as a multi-year research and controlled-pilot horizon, not a network-wide commercial commitment for 2030. Reaching genuine self-evolution will depend on maturity in several enabling technologies that e&UAE is actively tracking and selectively contributing to: causal AI to move beyond correlation-based optimisation; world-model approaches that let agents simulate consequences before acting; continual learning at scale to avoid catastrophic forgetting in long-running production agents; and cross-operator federated learning to share model improvements without sharing sensitive data. The L5 timeline will be shaped by the maturity of these foundations, not by calendar pressure. The following section grounds this roadmap in concrete practice, presenting six representative use cases across the four “Extreme” dimensions where e&UAE has already deployed AI-driven, closed-loop autonomy.

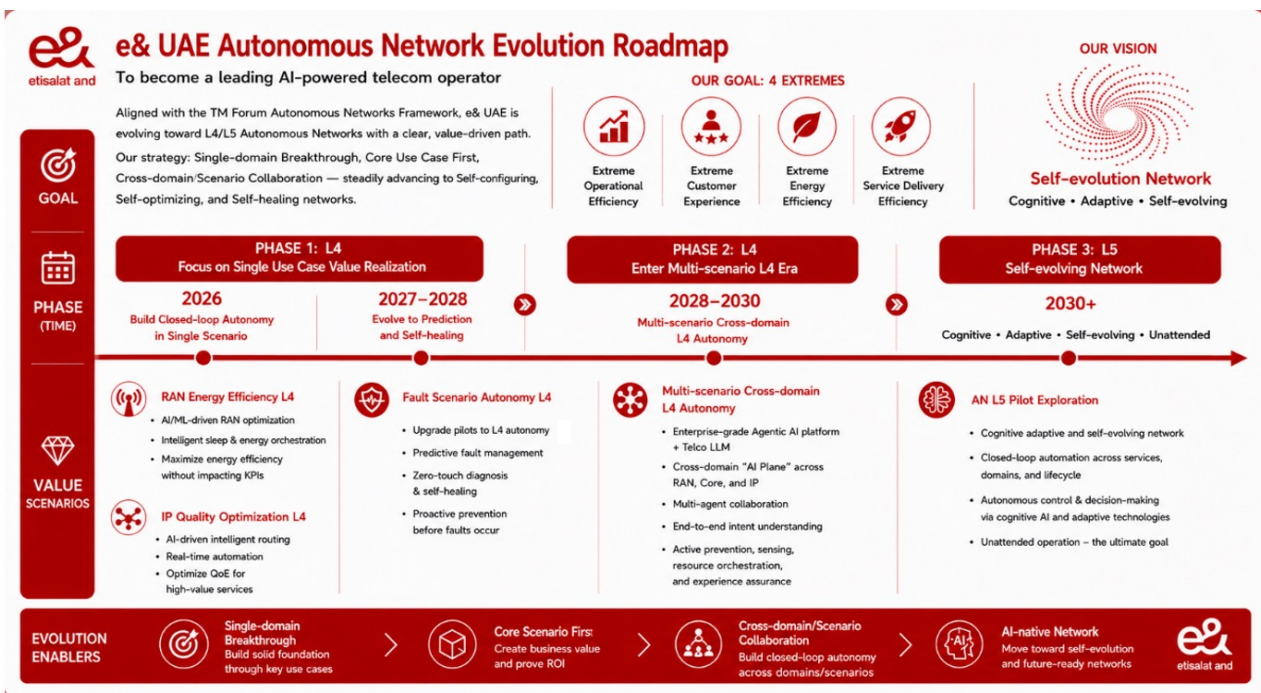


Figure 12: e&UAE AN L4/L5 evolution roadmap

5.1. Security best practices: How to secure GenAI applications

7. e& UAE AN practices

The following six use cases, across O&M efficiency (Tables 5–6), customer experience (Tables 7–8), energy efficiency (Table 9) and service delivery (Table 10), illustrate how e& UAE is operationalising the strategy, architecture, and roadmap presented above. Each case follows the same problem/solution/value template to facilitate side-by-side comparison.

Throughout this section, value figures combine three categories: (1) measured outcomes from internal pilots and limited live-network deployments completed in 2025–2026; (2) target capabilities defined for the L4 Phase 1 rollout window (2026–2028); and (3) industry benchmarks drawn from TM Forum and peer-operator references. Each table caption identifies the predominant measurement basis, and percentages and time reductions should be read as design-stage commitments unless explicitly labelled as measured. Baselines are e& UAE's 2024–2025 operational averages for the corresponding KPI.

7.1 Extreme O&M Efficiency: Intelligent O&M & Fault Self-Healing

Based on TM Forum I-AADE, e& UAE built an intent-driven intelligent O&M and fault management system with layered AI-agent capabilities, millisecond-level network monitoring and fast link fault localisation to enable autonomous healing and higher operational efficiency.

7.1.1 AI-driven individual service assurance for VoNR & VoLTE

Problem:




VoNR (5G) and VoLTE (4G) are highly sensitive to performance and congestion, requiring $\geq 99.9\%$ accessibility for an acceptable customer experience. Limited visibility across RAN, Core and Transport hinders early issue detection. Manual monitoring and reactive RCA delay MTTD and MTTR, making consistent voice quality difficult to maintain under growing traffic.

Solution:

Deploy an AI-driven, closed-loop service assurance system specifically optimised for VoNR and VoLTE services. Agentic AI monitors cell-level real-time traffic, accessibility KPIs and user capacity to identify abnormal deviations, conducts cross-domain correlation across RAN, Core and Transport for root cause isolation and noise suppression, leverages machine learning to detect congestion risks, and adopts LLMs and digital twin simulation to automatically validate and implement optimisation measures via closed-loop self-healing to minimise service disruption. The measured impact is summarised in Table 6.

Value:

Table 6: AI-driven service assurance for VoNR & VoLTE – pilot results and L4 Phase 1 targets

No.	Value point
1	 <p>Reduced MTTD by 60–75% (from ~2 hours to near real-time detection), reduced MTTR by ~75% (from ~2 hours to ~30 minutes per incident).</p>
2	 <p>Reduced voice service disruptions and dropouts significantly, increased VoNR/VoLTE accessibility maintained at ≥99.9%.</p>
3	 <p>Reduced manual intervention by 70–85%.</p>

7.1.2 AI-driven core network fault management for self-healing

Problem:



As core networks evolve from 2G to 5G, scale and complexity surge, exposing the limits of traditional operations. Cloudification and IP transformation expand fault impact and signalling storms, making single-point fault avoidance insufficient and increasing pressure on network stability.

Solution:

Built on 3GPP MDAF, digital twins and AI large models jointly form an intelligent fault management agent with natural language-enabled one-stop O&M. It adopts the AADE closed-loop framework to automate full fault handling and complete root cause localisation and service recovery within 15 minutes and applies resilience principles including single-point fault avoidance, multi-failure resilience and blast radius containment to realise network-level disaster recovery, fast convergence and steady service continuity. The measured impact is summarised in Table 7.

Value:

Table 7: Core network intelligent O&M & fault self-healing – pilot results and L4 Phase 1 targets.

No.	Value point
1	 <ul style="list-style-type: none"> • Mean Time to Recovery reduced to within 15 minutes (Core Network Faults) • O&M efficiency improved by 80% • Target of zero major incidents during steady-state operation.
2	 <ul style="list-style-type: none"> • Enables service continuity during partial outage scenarios – prioritises VIP service recovery. • Around 70% of services unaffected. • Remaining ~30% restored within 30 minutes (target).

7.2 Extreme Customer Experience: Ultimate experience and business monetisation

Focused on Extreme Customer Experience, this solution empowers ToB/ToC/ToH services via five core capabilities, layered service assurance and Autonomous Network architecture for intelligent O&M and reliable service delivery.

7.2.1 AI-driven IPTV service complaint handling for experience optimisation

Problem:

IPTV (DTV & Satellite) issues like buffering and signal degradation trigger complaints, but analysis is manual and fragmented, limiting pattern detection. Lack of cross-channel visibility leads to reactive operations, delayed resolution, recurring issues and no predictive insights to prevent widespread service degradation.

Solution:

An AI-powered complaint intelligence platform built on agentic AI and LLMs analyses structured and unstructured complaint data to mine hidden patterns and anomaly clusters across users and services. It correlates complaints with network and service data for cross-domain root cause locating, predicts complaint trends for proactive remediation, and realises closed-loop automated fixes with continuous self-optimisation via data learning. The measured impact is summarised in Table 8.

Value:

Table 8: AI-driven complaint intelligence for IPTV experience optimisation – pilot results and L4 Phase 1 targets

No.	Value point	
1		<ul style="list-style-type: none"> Reduced MTTR by ~90% (from ~6 hours to ~30 minutes per incident). Repeated incidents significantly reduced (pattern-based prevention). Reduced manual analysis effort by 70–85%. Increased operational efficiency (monthly effort reduced from ~24h to ~12h).
2		<ul style="list-style-type: none"> Reduced customer complaints by 30–50% through proactive detection. Increased customer experience and satisfaction (NPS improvement).

7.2.2 AI-Driven IP Network Quality Optimisation for Stable Service Experience

Problem:



Driven by cloudification and service diversification, IP networks face greater scale, traffic dynamics, and cross-domain complexity. Manual, offline optimisation cannot handle congestion and traffic fluctuations in real time, leading to increased latency, jitter, packet loss, and an unstable user experience.

Solution:

Built on the TM Forum AN Solution Package, the IP network optimisation agent framework integrates streaming telemetry, digital twins, and AI large models for real-time network perception and predictive optimisation with a unified intelligent O&M portal. Adopting the AADE closed-loop framework, it automates full-lifecycle traffic management to deliver minute-level cross-domain closed-loop optimisation. It also applies SR/TE, intelligent load balancing and dynamic path adjustment to evade congestion, reduce latency and maximise resource efficiency for stable network operation. The measured impact is summarised in Table 9.

Value:

Table 9: IP Network Quality Optimisation – pilot results and L4 Phase 1 targets

No.	Value point
1	 <p>SLA increased to 99%, and monthly DOU growth improved by 25% compared to scenarios where optimisation capabilities are not used.</p>
2	 <p>Network optimisation automation increased significantly, reducing manual intervention by 70%+ and shortening optimisation cycles from hours to minutes.</p>

7.3 Extreme Energy Efficiency: Green energy and resource optimisation

Focusing on Extreme Energy Efficiency, e& UAE built a QoS-guaranteed hardware-software collaborative system using digital twins and telecom large models for AI-driven energy optimisation and intelligent network performance improvement.

7.3.1 AI-driven energy efficiency optimisation for RAN energy saving

Problem:



RAN sites are major energy consumers, intensified by 5G densification. Manual analysis and static configurations lack real-time multi-vendor visibility and traffic-energy correlation, causing inefficiencies. Long optimisation cycles hinder dynamic response, increasing OPEX and carbon footprint.

Solution:

An AI closed-loop energy optimisation system empowered by agentic AI and predictive analytics dynamically adjusts RAN power consumption, analyses cross-vendor traffic, load and power KPIs, predicts optimal energy baselines, and adopts strategies like dynamic cell shutdown, carrier adaptation, and power scaling. It validates energy-saving actions via digital twin simulation, realises QoS-guaranteed energy optimisation through closed-loop automation and boosts long-term efficiency with continuous intelligent learning. The measured impact is summarised in Table 10.

Value:

Table 10: AI-driven autonomous RAN energy optimisation – pilot results and L4 Phase 1 targets.

No.	Value point
1	 <ul style="list-style-type: none"> Reduced energy consumption by 20–30% across RAN sites. Reduced energy-related OPEX by 15–25%.
2	 <ul style="list-style-type: none"> Reduced manual analysis time from ~48 hours to near real-time. Increased operational efficiency (automation >80%).

7.4 Extreme Service Delivery Efficiency: Agile delivery and network orchestration

This solution uses cross-domain orchestration and IP/MPLS automation to realise automated multi-network full-lifecycle management, with intent-driven slicing and telecom AI enabling fast deployment, SLA assurance and reduced O&M costs.

7.4.1 AI-driven private network and wholesale service delivery for zero-touch

Problem:




Enterprise private and wholesale services require multi-domain provisioning across RAN, Core, Transport and Edge. Manual workflows and fragmented systems cause long cycles and errors. Limited visibility and flexibility delay revenue, reduce efficiency and degrade customer experience.

Solution:

An AI-native intent-driven orchestration platform delivers zero-touch provisioning for enterprise private and wholesale services. It captures service intent via TMF-aligned Open APIs, leverages agentic AI and LLMs for intent translation and automatic workflow generation, and enables end-to-end lifecycle automation across all network domains. Digital twin simulation validates configurations pre-deployment, A2A multi-agent collaboration realises cross-domain and cross-partner coordination, and the I-AADE closed-loop mechanism monitors performance, guarantees SLAs and triggers automatic optimisation and remediation. The measured impact is summarised in Table 11.

Value:

Table 11: AI-driven zero-touch private network and service provisioning – design targets for L4 Phase 1

No.	Value point	
1		<ul style="list-style-type: none"> Reduced private network provisioning time by 70–90% (weeks → hours/minutes). Reduced wholesale partner onboarding time by 60–80%.
2		<ul style="list-style-type: none"> Reduced manual provisioning effort by 80–90%. Reduced configuration errors by 60–80%.
3		<ul style="list-style-type: none"> Increased time-to-revenue (faster enterprise and wholesale service activation). Increased Enterprise SLA compliance and service agility. Increased new revenue streams (private networks, Network-as-a-Service, API monetisation).

8. Ecosystem and collaboration

8.1 e& UAE's industry collaboration progress

Since the Group unveiled its “Infuse AI into every facet of e&” vision, e& UAE has been actively driving AI innovation and transformation. This includes collaborating with industry partners to pioneer telecom foundation models and AI capabilities that boost O&M efficiency, while advancing theory, practice, and ecosystem development. Figure 13 illustrates how e& UAE positions itself within the global telecom AI ecosystem, anchoring partnerships across global alliances and industry standards (GTAA, TM Forum standardisation), sovereign AI platform infrastructure, and infrastructure and ecosystem partners.



Figure 13: e& UAE: Architecting the Global Telecom AI Ecosystem

8.1.1 Leading the telecom-grade AI alliance and industry vision

e& UAE is actively promoting the large-scale application and collaboration of AI in the telecom industry within TM Forum.

Establishment of the Global Telecom AI Alliance (GTAA) Joint Venture: At the DTW24-Ignite conference hosted by TM Forum, e& officially signed a joint venture agreement with founding members such as SK Telecom and Deutsche Telekom to collaboratively develop a multilingual, telecom-specific large language model (Telco LLM).

Sharing the industry vision: At the same TMF conference, e& UAE participated in hosting the second Global Telecom AI Roundtable (GTAR), showcasing the latest progress of the GTAA and presenting the commercial vision for deploying telecom-specific LLMs to global industry partners.

8.1.2 Release of AI-native 6G network and AI application strategy white papers

e& UAE, in collaboration with Khalifa University, has jointly released the white paper titled “6G AI-Native Networks: Architecture, Intelligence, and the Path to Autonomous Connectivity”. The paper proposes integrating learning, reasoning, and autonomous decision-making capabilities as fundamental attributes into the network DNA to drive global standardisation.

In addition, e& UAE has also released the white paper “Unleashing the Power of AI”, showcasing over 400 AI use cases and more than 160 machine learning models [RJ1] deployed in its telecommunications operations. Furthermore, it has collaborated with Open Innovation to release a strategic blueprint white paper on the adoption of generative AI (GenAI).

8.1.3 Deepening AI ecosystem collaboration with global tech giants

To promote AI technology sovereignty and innovation within the UAE, e& UAE has partnered with Open Innovation AI to establish an “AI Lab” tailored specifically for the UAE market. In terms of infrastructure, e& UAE has collaborated with Intel to establish an AI Excellence Centre. It has also deployed Oracle Cloud Infrastructure with integrated Nvidia GPU clusters (GPU Farm) locally. Additionally, in partnership with Dell and Intel, e& UAE has launched the region’s first sovereign AI inference platform to meet the highest standards of data security and residency requirements.

8.1.4 Developing a leading network AI capability system

In conjunction with industry partners, e& UAE has actively built automation and intelligent operation and maintenance capabilities throughout the network lifecycle. Facing 5G, computing force networks, and other new infrastructure, it has constructed one set of benchmark-class network AI platforms, incubated more than 400 AI capabilities, filling in technical blanks in the integration of networks and AI, and reached leading levels in technology. Based on existing research results on intelligent operation and maintenance technologies, comprehensive innovation is realised in “theory, technology, ability, product, service” through capability sharing and core technology breakthroughs.

8.2 Future Initiatives

e& UAE calls on industry partners to adhere to value-oriented and practical principles, jointly establishing a standardised system for measuring the effectiveness of Autonomous Networks. This will guide the construction and evolution of network automation and intelligence capabilities. The synergy between practices and industry collaboration is strengthened to enable application demands within operators to drive product testing and certification, thereby accelerating the promotion of applications and guiding the supply of advanced products/services from suppliers. Looking towards the vision of highly autonomous networks, focusing on major standardisation organisations like TMF, 3GPP, ITU-T and CCSA, collaboration should be enhanced in formulating core standards such as AI-native architecture, network large models, intent management, network orchestration and closed-loop methodologies, leading the innovation of industrial theories.

8.2.1 Enhancing International Standard Contribution

To play a leading role in the global Autonomous Network and intelligent ecosystem, e& UAE will fully and deeply integrate into the international standards development and industry collaboration system, covering the following three core dimensions:

First, in terms of international standards development and improvement, e& UAE will actively participate in collaborative efforts with top international standards organisations including TM Forum, 3GPP SA5 (network management and orchestration), ETSI ZSM (Zero-Touch Network and Service Management) and ITU-T (notably the ML5G and FG-AN work streams). Drawing on its practical experience in live networks, e& UAE will focus on promoting the definition of key specifications, including the overall architecture of network intelligence, hierarchical evaluation methods, intent-driven models and unified open APIs, to support the unification and evolution of the global autonomous network standards system.

Second, in contributing to industry white papers and best practices, e& UAE will take a leading role and either lead or deeply participate in research activities of key industry organisations like TM Forum, GTI and NGMN. For example, by contributing high-value business implementation scenarios, implementation path planning and best practice cases to TM Forum's series of white papers on Autonomous Networks, e& UAE will work together with other industry partners to enrich the value proposition of network intelligence and provide practical methodologies and experience references for global operators to accelerate their transition to advanced autonomous network levels (e.g., L4/L5).

Finally, in terms of cutting-edge joint innovation and proof of concept (PoC), e& UAE will actively engage in forward-looking joint innovation projects such as TMF Catalyst. By collaborating with a wide range of global ecosystem partners, e& UAE will conduct validation and demonstrations of cutting-edge technical solutions, such as intent-driven automation and AI closed-loop systems, in real-world or simulated network environments. This will drive the formulation of new industry standards through practical business scenario innovations, thereby comprehensively promoting the thriving development of the global network intelligence industry.

8.2.2 Enhancing international standard practice

To fully accelerate the evolution toward advanced Autonomous Networks, e& UAE has deeply benchmarked and integrated the TM Forum's Autonomous Networks (AN) standards framework, systematically advancing its innovation practices toward achieving Level 4/5 autonomy. The overall implementation path from baseline assessment and scenario deployment to performance evaluation:

First, in terms of network evaluation and gap identification, e& UAE strictly adhered to TMF's IG1252 (Autonomous Network Levels) and GB1059, among other core standards and specifications, to conduct a comprehensive ANL (Autonomous Network Level) assessment of its existing network infrastructure and operational support systems. This process clearly identified the core gaps between the current network capabilities and the high-level objectives, providing clear direction for subsequent evolution planning and investment.

Second, in terms of value scenario deployment, e& UAE primarily referenced the TMF GB105x series of standards and guidelines. Based on the gaps identified in the earlier evaluation, the team focused on commercial value and operational outcomes, selecting and planning a series of high-value O&M scenarios for targeted breakthroughs. By operating under the architecture of "single-domain autonomy and cross-domain collaboration", the team transformed standard use cases into actual productivity on the live network, propelling the network toward the Level 5 characteristics of "self-configuration, self-optimisation, self-healing and self-evolution".

Finally, in terms of summarising and evaluating the outcomes of these practices, e& UAE fully adopted the TMF IG1256 (Autonomous Network Effectiveness Indicators) standards framework. By establishing a scientific measurement framework, the team conducted a systematic quantitative assessment and summary of the implementation results in AN high-level scenarios from multiple dimensions, including business agility, customer experience, resource efficiency and O&M efficiency.

This not only achieved a complete closed-loop process from strategic planning to the realisation of business value but also provided solid data support and accumulated experience for the ongoing evolution toward higher levels of Autonomous Network capabilities. Building on this validated foundation, the closing section sets out the longer-term ambition and the contribution e& UAE intends to make to the broader industry.

8.3 Workforce and operating model transformation

The shift from human-led NOC and SOC operations to agent-mediated autonomy is as much an organisational transformation as a technical one. e& UAE’s workforce strategy treats this transition as a managed evolution of roles rather than a step-change in headcount:

- **Role redefinition:** Front-line NOC monitoring roles evolve into “AI supervisor” roles—engineers who set policies for autonomous agents, review high-impact decisions, manage exceptions and tune the boundary of autonomous authority. Domain SMEs evolve into “Knowledge Engineers” who curate the corpora and procedural knowledge that domain agents draw on
- **New competencies:** AN operations require a hybrid skillset—telecom domain depth combined with literacy in AI/ML lifecycle, prompt and intent engineering, agentic-system design, digital-twin operation and AI governance. The e& UAE AI Academy curriculum has been extended to cover these competencies through structured pathways for existing operations engineers
- **Cultural and organisational shift:** Operating models evolve from incident-response cultures to proactive, intent-driven cultures. KPIs for operations teams shift from “tickets closed” toward “policies validated” and “autonomy confidence”. Governance councils, combining operations, AI, security and customer-facing leadership, own the boundary between human decision and autonomous action

This workforce transformation is the human-side foundation that makes the technical transformation sustainable.

9. Future outlook

The ultimate ambition - fully autonomous networks: e& UAE's current AN blueprint is anchored around the pursuit of Level 5—achieving full autonomy and a self-evolving network. According to TMF's definition of a fully Autonomous Network, the system has closed-loop automation capabilities across multiple services, multiple domains (including partners' domains) and the entire lifecycle via cognitive self-adaptation.

Nevertheless, we recognise that a gap remains between the current status and this ambitious long-term goal. Accordingly, our core strategic focus at this stage is to consolidate the practical outcomes of L4-level automation. At present, we are in the critical L4 Phase 1 stage, with the top priority placed on ensuring the stability and large-scale verification of foundational capabilities. Upon consolidating the achievements of Phase 1, we will advance to L4 Phase 2, marking our evolution from single-scenario automation to multi-scenario, cross-domain closed-loop autonomy.

e& UAE's commitment to industry contribution: The 2025–2026 industry signals, including TM Forum's Level-4 progress certifications, 16+ ANLET-validated CSPs, the launch of ANLAV, the maturation of A2A v1.0 under Linux Foundation governance, and emerging telecom-specific AI patterns such as Model-as-a-Service (MoDaaS) and agentic AI blueprints, make clear that L4 has crossed the threshold from aspiration to validated, repeatable practice. e& UAE recognises that the path to Autonomous Networks cannot be navigated in isolation. It is a shared industry challenge that demands open collaboration across operators, technology partners, standards bodies and ecosystem innovators. As an active contributor to the TM Forum Autonomous Networks mission, e& UAE is committed to translating its architectural decisions, scenario implementations, maturity assessments and lessons learned into reusable industry assets that benefit the broader telecommunications community. By sharing its blueprint, ANLET evaluation results, and operational best practices through TMF working groups and industry forums, e& UAE aims to accelerate the collective progression toward L4 and beyond to L5, not only for its own competitive advantage, but as a meaningful contribution to the industry's shared transformation agenda.

Acknowledged risks and open challenges: A credible roadmap requires honest acknowledgement of what could slow the transition. Four risks are actively monitored:

- AI model confidence and concept drift: As networks evolve, models trained on historical patterns may degrade silently; ongoing investment in monitoring, retraining and drift detection is therefore non-optional

- Multi-agent coordination overhead at scale: As the number of collaborating agents grows into the thousands, coordination latency, conflict resolution and emergent behaviour become first-order engineering challenges that the industry has not fully solved
- Regulatory and governance evolution: AI in critical infrastructure is increasingly subject to national and supranational regulation; the AN architecture must be adaptable to evolving requirements on explainability, accountability and human oversight
- Openness in practice versus principle. While open standards (TM Forum Open APIs, A2A under Linux Foundation) avoid traditional vendor lock-in, multi-vendor agent ecosystems can create new forms of integration debt that need active management

e& UAE addresses these risks through technical investment, governance council oversight, active standards participation and a pragmatic, scenario-by-scenario rollout that does not over-commit to capabilities the technology cannot yet deliver.

10. Authors

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11. Abbreviations and acronyms

Abbreviation	Definition	Abbreviation	Definition	Abbreviation	Definition
3GPP	3rd Generation Partnership Project	I-AADE	Intent, Awareness, Analysis, Decision, Execution	NOC	Network Operations Centre
5G-A	5G-Advanced	ICT	Information and Communication Tech	NPS	Net Promoter Score
A2A	Agent-to-Agent (Linux Foundation protocol)	IoT	Internet of Things	NWDAF	Network Data Analytics Function
A2A-T	Agent-to-Agent for Telecom	IPTV	Internet Protocol Television	O&M	Operation and Maintenance
AADE	Awareness, Analysis, Decision, Execution	ISO/IEC 42001	International Standard for AI Management Systems	OAM	Operations, Administration and Maintenance
AI	Artificial Intelligence	KBI	Key Business Indicator	OLT	Optical Line Terminal
AN	Autonomous Network	KCI	Key Capability Indicator	OMC	Operation and Maintenance Centre
ANL	Autonomous Network Level	KEI	Key Effectiveness Indicator	OPEX	Operating Expense
ANLAV	Autonomous Network Level Assessment Validation (TM Forum)	KPI	Key Performance Indicator	O-RAN	Open Radio Access Network
ANLET	Autonomous Network Level Evaluation Tool (TM Forum)	LAN	Local Area Network	OSS	Operation-Support System
API	Application Programming Interface	LLM	Large Language Model	OTDR	Optical Time-Domain Reflectometer
BSS	Business Support System	MANO	Management and Orchestration	OTN	Optical Transport Network
BVM	Business Value Measurement	MBB	Mobile Broadband	PDPL	UAE Personal Data Protection Law (Federal Decree-Law 45/2021)
CapEx	Capital Expense	MCP	Model Context Protocol	PoC	Proof of Concept
CEI	Customer Experience Index	MDAF	Management Data Analytics Function	PON	Passive Optical Network
CEM	Customer Experience Management	MDAS	Management Data Analytics Service (3GPP)	RAN	Radio Access Network
DOU	Data Usage	MIMO	Multiple-Input Multiple-Output	rApps	Non-RT RIC applications (O-RAN)
DTV	Digital Television	ML	Machine Learning	RCA	Root Cause Analysis
E2E	End-to-end	MTTD	Mean Time to Detect	RIC	RAN Intelligent Controller (O-RAN)
FTTH	Fibre to the Home	MTTR	Mean Time to Repair	ROI	Return on Investment
FTTR	Fibre to the Room	MU-MIMO	Multi-User Multiple-Input Multiple-Output	SISO	Single-Input Single-Output
GenAI	Generative Artificial Intelligence	NaaS	Network as a Service	SLA	Service-Level Agreement
GHG	Greenhouse Gas	NDC	Nationally Determined Contribution	SOC	Service Operations Centre
GPT	Generative Pre-trained Transformer	NE	Network Element	SON	Self-Organised Network
GPU	Graphics Processing Unit	NESA / SIA	UAE National Electronic Security Authority/Signals Intelligence Agency	SR/TE	Segment Routing/Traffic Engineering
GTAA	Global Telecom AI Alliance	NIST AI RMF	US National Institute of Standards and Technology AI Risk Management Framework	TDRA	UAE Telecommunications and Digital Government Regulatory Authority
GTAR	Global Telecom AI Roundtable			TM Forum	Telecom Management Forum
HBB	Home Broadband			toB	To Business
HVS	High-Value Scenario			toC	To Customer

Abbreviation	Definition	Abbreviation	Definition
URLLC	Ultra-Reliable Low-Latency Communications	XAI	Explainable AI
VoLTE	Voice over LTE	xApps	Near-RT RIC applications (O-RAN)
VoNR	Voice over New Radio	XR	Extended Reality

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