

Case Study

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Agility Meets Autonomy

stc goes end-to-end with Nokia service orchestration

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EXECUTIVE SUMMARY

Keeping up with the demands of customers no longer means only providing more bandwidth and faster speeds. It means delivering quickly and efficiently, and responding rapidly with new services as their needs evolve.

In the case of mass market consumer services, most telcos have well automated (if not entirely flexible) processes. But in meeting the needs of enterprises, multi-national entities and governments, the technical and operational complexity is significantly higher, making automation much more challenging. Much as telcos want to offer advanced services and capabilities to their largest and most important customers, the need to coordinate across a complex mix of on- and off-net infrastructure, 4G/5G resources and cloud-based services presents an obstacle to fast, efficient service delivery.

As part of a strategic national digital transformation program, **stc** has worked with **Nokia** to overcome this obstacle. Its solution is a new, end-to-end service orchestration and closed-loop automation for all services (B2B and B2C) that implements the key principles of autonomous networks: intent, abstraction, unified and dynamic orchestration, closed-loop automation, a common intelligence layer and the use of industry-standard APIs.

Key results from the stc deployment of Nokia Digital Operations Center include:

- Significant automation of the activation and lifecycle management of sophisticated B2B services, meaning more services delivered much more quickly, with virtually no errors.
- Significant proportion of in-service faults identified and resolved autonomously.
- Faster Level 1 handling times for tickets that cannot be resolved automatically.

Ultimately, this gives stc a significant competitive edge in getting new services and features to market more quickly, and in providing its most important customers with rapid turnaround on their requirements. Once deployed, even complex services can be assured in a highly responsive, highly automated fashion.

stc is looking to the future with its transformation, and especially for growth in revenues by providing emerging technology services such as 5G slicing, private Edge Computing, private networks, cyber security services, Internet of Things services, and Next Generation SD-WAN. With its focus on automation and autonomy, stc is both addressing its business goals and further reinforcing its reputation as an industry pioneer.

The success of the solution reflects Nokia's broad telecom domain knowledge and capabilities as one of the few vendors working across all domains (radio, fixed, IP optical, data center, cloud core), allowing services of all kinds to be stitched together through its Digital Operations Center.

stc: MARKET CONTEXT

Saudi Telecom Company (**stc**) serves around 30 million customers in the Kingdom of Saudi Arabia, with interests in operators in Bahrain and Kuwait, tower companies in Europe and Pakistan. It is the largest shareholder in **Telefonica** and has a strategic partnership with satellite operator **AST SpaceMobile**. It also serves B2B, wholesale and government customers in Saudi Arabia and internationally, with fixed line and wireless services as well as datacenter, IT and fintech services.

Over the last decade, stc has been working to an ambitious program of strategic transformation, under the acronym DARE – Digitize, Accelerate, Reinvent, and Expand. DARE was initiated in 2017 and refreshed in 2020. The goal is a generational shift in stc’s business from a traditional telco to a diversified digital services provider operating on a global stage. DARE is closely aligned to the Saudi Arabian government’s *Vision 2030*: a plan to reset the country’s economic and workforce foundations with a digital and technology focus - with stc as a key national technology enabler.

DARE has driven significant investment and modernization in network infrastructure as well as supporting systems and operations, including a major rollout of fiber and 5G (one of the fastest globally), regional telco cloud and data centers.

A key focus of DARE is increasing digitization and automation of processes and systems in pursuit of industry-leading efficiency and exceptional customer service. Improving levels of intelligence and automation are integral to those goals. stc is continuing its DARE program with a focus on achieving a high level of **autonomous networks**.

Nokia has been a key supplier partner of stc’s, supporting each step of the company’s visionary journey towards digital leadership. This case study examines the achievements of Nokia and stc to date in progressing towards more autonomous networks.

AUTOMATION AND AUTONOMY STRATEGY

Meeting the needs of enterprise customers has become increasingly complex and competitive. Traditional telcos must now compete for enterprise business with enterprise market players, such as systems integrators and hyperscalers. As a result, in areas such as speed of delivery, responsiveness and customer experience, the bar is continuously being raised.

In common with many operators, stc’s business services were organized by product line with service-specific systems, processes and organizations. Delivering services that spanned multiple domains involved manual piecing-together of individual service components (each with their own Business Requirements document), which required human effort and manual configuration by designers and operations teams. This added days to the design and delivery cycle - and was not compatible with a strategy of increasing automation and faster time-to-market.

As part of its wider strategic transformation journey, stc set out to transform delivery of business services to meet rising customer expectations, specifically to:

- **Shorten time to market**, to meet new customer demands more quickly as they emerged.

- **Expose sophisticated network capabilities (such as 5G slicing) as usable services**, to give customers compelling new offerings and features.
- **Reduce human intervention** in provisioning and assurance of services, to meet customer needs rapidly and reduce human error.
- **Achieve real-time identification and resolution of service outages**, to provide market-leading service availability levels.
- **Ensure overall reliability and performance** of business services across a complex and new generation of virtualized network infrastructure.

stc has pursued a layered architecture featuring an orchestrator, service catalog, inventory, service decomposer, and design hub, all compliant with TM Forum standards and designed to be future-proof for emerging technologies:

- **Unified Data and Integration Layers:** a unified data layer and a unified OSS integration layer, enabling efficient fault and performance management and supporting agile, secure service delivery through standardized APIs.
- **Intent-Based Orchestration:** customer intents expressed via APIs and managed by domain orchestrators, facilitating closed loop automation and rapid customization.
- **Industry Collaboration and Standards:** use of industry standards bodies and initiatives such as ZSM, ONAP, 3GPP, TM Forum and GSMA, ensuring alignment with emerging technologies and best practices.

Advanced *domain orchestration* is already a central aspect of stc's business and operational support system transformation vision. Working with Nokia, it has now implemented an end-to-end service orchestration solution that provides service delivery assurance for enterprise services.

Initially, 5G slicing automation was the primary focus of the deployment. However, market context led the stc team to prioritize B2B services for automation, such as IPVPN and SD-WAN – a perfect example of the need for agility.

stc and TM Forum

stc has long used the TM Forum's Autonomous Networks framework as a reference guide for its transformation strategy, mapping achievement of higher autonomy levels to a five-year timeframe (*Figure 1: stc's autonomous networks journey roadmap*).

In BSS and OSS, stc has also been a major contributor to industry collaboration efforts notably through the TM Forum. In 2025, stc became the first operator in the Middle East to achieve the TM Forum's "running on ODA" accreditation, acknowledging its comprehensive adoption of the Forum's Open Digital Architecture.

Figure 1: stc's autonomous networks journey roadmap

2025~2026	2026 ~2027	2028 - 2030
KBI 1: Grow revenue	KB 2: Enhance customer experience	KB3: Improve operation efficiency
Automation	Conditional Autonomous	High Autonomous
<p>Process</p> <ul style="list-style-type: none"> Standardized processes that integrate the service and resource operations across stc KSA, Kuwait and Bahrain. Introduce rules and policy to automate the decision and execution stage 	<p>Process</p> <ul style="list-style-type: none"> Inter-domain process flow that supports NOC-SOC related value streams without breakpoint. Cross-domain (Business, Service and Resource Operations) with orchestratable process automation 	<p>Process</p> <ul style="list-style-type: none"> Hyperautomation involvement process API to expose intelligent operation service and network service for application consumption
<p>Platform / Information</p> <ul style="list-style-type: none"> Common and consolidated operation platforms for the service and resource operations across the stc group. Improve high accuracy in demarcation and RCA for cross-domain cross relation to eliminate human intervention. 	<p>Platform / Information</p> <ul style="list-style-type: none"> Common data model allows functions collaboration and ML training. AI- personal assistant and digital twin network capability to provide autonomous customer service and problem resolution support. 	<p>Platform / Information</p> <ul style="list-style-type: none"> LLM based co-pilot Generative AI interworking with DTN (decisions based on learned data distribution and synthetic data to generate new data samples.)
<p>People Skillset</p> <ul style="list-style-type: none"> Talent equipped with application development, CI/CD capabilities to support in-house application development for automation requirement. 	<p>People Skillset</p> <ul style="list-style-type: none"> Data modeling and data architecture capabilities AI/ML and LLM development capabilities 	<p>People Skillset</p> <ul style="list-style-type: none"> Talents equipped with AI and ML application development skillset

Source: TM Forum whitepaper – New-generation Intelligent Operations, Agentic AI-driven transformation

NOKIA’S ROLE

Like stc, Nokia has also been a pioneer in supporting the journey towards more autonomous networks, developing new, enabling solutions that embrace key principles such as:

- intent-based rather than per-technology implementation
- a common orchestration layer for both fulfilment and assurance
- cloud-native, scalable software
- enabling autonomous domains with an overarching (end-to-end) orchestration layer above.
- multi-vendor support
- use of industry-standard APIs between layers

Nokia’s collaboration with stc is in two key areas:

- **End-to-End (E2E) Service Orchestrator:** An abstracted, cross-domain layer for services (not just slicing, but B2B services lifecycle and orchestration).
- **Intelligent Layer/NGOSS:** focusing on assurance, utilizing AI/AIOps for closed-loop automation by analyzing triggers and policy-based actions across and within domains.

In December 2023, stc selected Nokia’s Digital Operations Center to support B2B service delivery and operations modernization.

Nokia Digital Operations Center envisages and enables a new future mode of operations for telcos; cloud-native and dynamic, leaving the legacy conventions of operations support processes and

systems behind. Digital Operations Center is built on three pillars: fulfillment automation, assurance automation, with both supported by a common unified inventory.

Nokia is also supporting later stages of stc's autonomous networks journey with its work on GenAI. A separate proof of concept using Nokia Bell Labs' AI/ML models and Large Language Models (LLMs) automates the creation of provisioning artifacts and design, resulting in a 40-50% measured improvement in productivity.

Nokia views both AI and GenAI as key to achieving Level 5 Autonomous Networks. Level 5 Automation represents the ideal state of network operation: a fully autonomous network operating completely independently with closed-loop automation across all services, domains, and lifecycle stages, requiring minimal to no human intervention. Nokia sees a particularly significant role for GenAI in enabling higher levels of closed loop automation and autonomy:

- dynamically creating workflows direct from initial requirements
- automatically troubleshooting and resolving failed orders, using GenAI to propose workflows based on identified issues

Building on this, by integrating agentic AI into the core orchestration and assurance processes, complex procedures can be simplified, and self-sufficient network ecosystems can be established.

DISTINGUISHING CAPABILITIES

stc leverages the **Orchestration Center** and **Unified Inventory** components of the Nokia Digital Operations Center and integrates them into stc's multi-vendor environment.

Cross-domain (end-to-end) service Orchestration

The solution functions as a multi-vendor orchestrator, integrating with the underlying core cloud and multi-vendor transport controllers. Northbound integrations from Digital Operations Center include IT inventory, IT Service Order Management, and BSS. Southbound interfaces are to domain controllers (for example, Cisco provides the IP domain controller). These are responsible for actively monitoring their respective domains (IP, optical, RAN...), handling both intra-domain assurance and fulfillment, and communicating status and changes to higher-level systems, effectively replacing the need for separate intent probes.

Orchestration is where innovation and service creation take place, linking together applications, transport and other assets into end-to-end services. More specifically, "cross-domain", or "service" orchestration creates end-to-end services out of (generally) pre-existing service components, typically from multiple domains (thus "cross-domain"), resulting in low-code innovation, feasibility of more complex services, and allowing self-management within domains and service components. These components are both internal (RAN, Access, IP transport, optical transport, Security, CNFs...) and third-party (public cloud, SaaS functionality, wholesale bandwidth partners, customer's LAN ...).

Cross-Domain service orchestration has some powerful properties:

- It is the point at which end-to-end services – as simple as connections or as complex as 5G slices – are created.
- It is the point at which CSPs may innovate internally, creating product variants, and even custom or semi-custom services, easily (via the assembly of building blocks).
- It is the point of integration with third parties (such as public clouds, out-of-region access partners, factory LANs...) so that innovation may occur beyond the borders of the telco.
- It is the point at which CSP's may expose network services to third parties, driving innovation from myriad segments from gaming to manufacturing to health.
- Designed properly (loosely coupled to domains, intent based, ...) cross-domain service orchestration also yields significant software cost and complexity reductions, such as reduced integration and maintenance costs.

In some cases, these sorts of services may be classed as “service chains”, in other cases “network slices”. Many in the industry refer to digital services and how IoT will drive new digital services. The traditional web term is “mashup”. Without these new service categories, a massive new market opportunity that Appledore estimates to be more than \$100bn is not economically nor practically feasible.

Regardless of the service type, service orchestration enables rapid, efficient innovation. It also allows others to innovate, incorporating telco services as part of their innovations.

Success in service orchestration depends on several factors:

1. The pre-existence of self-managing automated domains
2. Loose coupling to those domains, treating them “aaS”
3. A cross-domain environment that allows for agile, intent-based innovation and management

Orchestration determines the “best” way to achieve a given outcome (expressed as intent), taking into account the resources and capabilities available, and any constraints (cost, routing, maximum latency) placed on the solution. Importantly, orchestration *also* continuously checks that the service intent is being met and, if it is not (or if it is at risk of breaching an SLA), autonomously initiates corrective action.

stc's cloud-based network is sophisticated and complex. For an advanced service such as a 5G slice, there are many individual elements (both VNFs and CNFs) to be orchestrated across the diverse, multi-vendor infrastructure to make a complete, reliable service. “Orchestration” is not just fulfilment: all those elements must also be continuously monitored to ensure the service meets its SLA, and action taken (by the orchestrator) to rectify any deviation.

In this way, orchestration merges the previously separate functions of fulfilment and assurance, and so allows for more dynamic, on-demand services and higher value SLAs.

Key business goals have shaped this innovation in architectural approach: the need for faster, more automated service delivery; greater efficiency; and improving customer experience and, ultimately,

satisfaction levels. But there is another aspect too. If high-value services can be delivered more quickly, reliably and cost-effectively, then many more of them can be provided to customers. Advanced orchestration is thus critical for delivering on revenue growth targets.

Unified Inventory

Unified Inventory is Nokia's graph database-based inventory offering, including discovery, reconciliation and sync of network/service Assets ("in near real time"). Unified Inventory underpins both Fulfilment and Assurance flows (now just different forms of orchestration). This is aligned with Appledore's view about the need for more closed-loop thinking, which allows fulfilment, healing and scaling to use essentially the same methods, just with differently constrained solutions. A unified inventory also supports an understanding of root-cause across resource and service layers, which is especially useful in dealing with complex, layered services and mashups.

RESULTS AND NEXT STEPS

Results

stc now has in place:

- **End-to-End Service Orchestration:** Full automation of service provisioning for critical offerings like SD-WAN connectivity, enterprise data services (Layer 2 and Layer 3), and Corporate APN.
- **E2E 5G Slicing Enablement:** Integration of 3GPP-defined Control and Management Plane functions (CSMF/NSMF) to support end-to-end 5G slicing.
- **Multi-Vendor Integration:** Unified orchestration across a diverse ecosystem of vendors, blending Network Function Virtualization Orchestrators (NFVOs), domain controllers, and orchestrators into a cohesive, agile platform.
- **Closed loop automation** for specific use cases such as SD WAN, working toward multi-domain closed loop automation, with plans to operationalize these capabilities by 2026.

Given its original goals, the impact on customer-facing service experience is the critical measure of success. stc has reported:

- **Significant reduction in time to fulfil** new service requests – from 6 days to 7 minutes. This reduction is a potential game-changer in stc's market competitiveness.
- **Significant reduction in fulfilment and configuration errors**, with 99% of service requests now delivered right first time.
- **Improved resource utilization** through optimized allocation and management of network assets.
- **Increased Agility and Innovation:** Using a library of pre-defined use cases enables stc to rapidly design, customize, and launch services, effectively responding to market demands with speed and innovation.

This degree of automation means that stc can expect to generate higher revenues from enterprise customers: more orders fulfilled in less time. The improvements in detecting and resolving network issues should also help retain customers. The ability to create new offers more quickly will also enable stc to respond to emerging customer needs more quickly.

stc has indicated that the transition from manual to automated operations will be gradual, noting that while the system manages technical functions such as IP and VLAN assignments, human intervention remains necessary for decisions with significant business or financial impact. Appledore notes that this is a statement of policy rather than a limitation in system capability.

In parallel, reflecting the new level of visibility and control that the end-to-end orchestration solution provides, stc has adopted a more horizontal, service-centric organizational structure. Multiple teams, each responsible for different architectural layers (BSS, OSS, infrastructure), collaborate to deliver services, with the overall operational team comprising tens of people rather than hundreds.

The solution was awarded the Best Autonomous Network Operations Award at FutureNet MENA 2025, from a panel of independent judges.

Challenges and Future Vision

stc's complex brownfield environment presents ongoing challenges, while the collaboration looks toward advanced autonomy levels. Data quality, especially regarding topology and inventory data, remains a challenge due to the complexity of stc's large, multi-system ecosystem. Additionally, ensuring the readiness of domains (overarching service orchestration requires autonomous domains underneath) and adapting complex processes are ongoing difficulties.

The vision remains progress towards Level 5: fully autonomous networks with minimal human involvement. Nokia and stc have used a [TM Forum Catalyst](#) project to showcase capabilities on the journey to Level 4 autonomy. This includes piloting Intent Probing/Negotiation, as well as use of knowledge graphs and a service digital twin for simulating actions and performing "what if" analysis before deployment. This advanced capability, along with Agentic AI, is positioned on a two-to-three-year roadmap for full implementation.

AUTOMATION/AUTONOMY MARKET CONTEXT

stc is actively implementing autonomous network capabilities and benchmarking these against TM Forum's Level 3 and Level 4 scales, with explicit commitments to advanced automation, 5G network slicing, and differentiated enterprise services (*Figure 2: stc autonomy progress and TM Forum AN Levels*).

Other operators worldwide are accelerating autonomous network development, using TM Forum's maturity models for benchmarking and validation. Level 4 is rapidly becoming the baseline for leading-edge operators, often tied to the rollout of 5G network slicing and enterprise digital platform services. While not every operator starts from the same place, most are headed in the

same direction as regards the critical importance of a high-performing, resilient, efficient, secure national communications infrastructure.

Figure 2: stc autonomy progress and TM Forum AN Levels

Capability	TM Forum Level	Progress/Commitment	Enterprise/Slicing Focus
Fault Mgmt/Assurance	Level 3/4	TMF benchmarking with new questionnaires	SLA-driven enterprise services
Slice Orchestration	Level 3/4	Nokia/ODA-based multi-vendor orchestration	5G slicing, private 5G, AR/VR
Service Intelligence/Prediction	Level 3/4	AI-powered automation, predictive analytics	Real-time enterprise APIs
Commercial NaaS	Level 3/4	NaaS packages for enterprises	Multi-slice, rapid onboarding

Telstra

Telstra is moving toward Level 4 autonomy, leveraging knowledge graphs and TM Forum's definitions to transition from human-defined automation to autonomous network behavior. Its Connected Future 30 strategy prioritizes agentic AI, intent-based automation, and the adoption of TM Forum Open Digital Architecture (ODA) for network-layer orchestration. Telstra has received awards for knowledge-driven autonomous network approaches that enable digital twins and Network-as-a-Service capabilities, although deployment is ongoing and not yet at full Level 5 autonomy.

AT&T

AT&T is advancing multi-vendor, cloud-native autonomous networks aligned with TM Forum maturity models, aiming for truly programmable networks via reusable integration and safe AI. AT&T is the first US CSP to achieve "Running on ODA" status, setting a precedent for scalable autonomous networks and providing tools to benchmark against TM Forum's levels.

Orange

Orange is a founding member of TM Forum's autonomous networks initiative, formally pledging to reach Level 4 by 2025 and explicitly citing the need to enable APIs, network slicing, and differentiated enterprise services. Orange is progressing from Level 2 (alarm filtering, root cause analysis) toward Level 3 and then Level 4, focusing on integrating intent and closed-loop capacity management. Its rollout is country-specific, especially with 5G SA providing mobile private networks and network slicing for enterprises.

Verizon

Verizon has achieved TM Forum “Running on ODA” status and uses the TMF’s Autonomous Network Level Evaluation Tool (ANLET) and Autonomous Networks Level Assessment Validation (ANLAV) service to benchmark individual domain autonomy levels.

Deutsche Telekom

Deutsche Telekom is benchmarking Level 4 autonomy for specific scenarios such as energy efficiency and fault management and subscribes to TM Forum autonomous network evaluations for validation. DT, along with partners, is moving toward closed-loop automation and aims to leverage AI for zero-touch lifecycle management.

Rakuten

Rakuten Mobile reports network autonomy at Level 3.5 using TM Forum’s taxonomy, actively deploying AI use cases for conditional and AI-assisted automation. Rakuten’s vision extends to Level 5 (fully autonomous intent-aware), but this remains aspirational. Rakuten focuses on use cases that improve OSS automation, service assurance, and commercial business impact.

Telefónica O2

Telefónica is strongly committed to TM Forum’s model, reporting an average level near 3 and reaching Level 4 autonomy for specific use cases. In Brazil (Vivo), its “Fractal” system is designed to automate and accelerate planning for the 5G transport network, as well as to deliver Level 4 automation (focus on self-healing) for its 5G core. At Telefonica O2 Germany, NetOptimizer is a digital twin of 28,000 mobile sites and transport routes, enabling Level 4 autonomy for configuration tasks in IP and microwave transport domains. Telefónica’s ambition is Level 4 across domains over the next three to five years, explicitly referencing 5G as a driver for slicing and adaptive services supporting enterprise agility.

China Mobile

China Mobile has reached Level 4 autonomy in its network operations centers (“dark NOC”), leveraging TM Forum’s frameworks for process scope, ODA architecture, and generative AI. Its Level 4 automation enables zero-touch O&M, minimizing manual interventions, and is pivotal for 5G network slicing and complex enterprise service orchestration.

Telus

TELUS is focused on transforming network and IT operational support to enable “zero delays” and “zero-touch interactions.” Strategies include network and service disaggregation, open APIs, and fault self-healing, aiming to leverage TM Forum best practices and reach Level 4, with an emphasis on customer experience and rapid capacity scaling for enterprise services.

Autonomy, 5G Network Slicing and Enterprise Services

- **Orange** and **China Mobile** explicitly tie their Level 4+ ambitions to network slicing, enterprise services, and API exposure, aligning autonomous network frameworks with differentiated commercial offerings.
- **Telefónica** and **Deutsche Telekom** connect Level 4 progress with the ability to deliver zero-touch 5G, slicing, and on-demand enterprise services, validated by TM Forum assessments.
- **TELUS** and **Rakuten** discuss the operational impact, speed-to-market, and customer experience enhancements arising from higher autonomy, which are prerequisites for slicing and tailored enterprise solutions

CONCLUSION

End-to-end, or cross-domain, service delivery and assurance is a defining capability of a modern digital services provider. stc's approach and progress in establishing end-to-end service orchestration mark it out as a leader among operators on the journey towards more autonomous networks.

This project serves as a blueprint, with the approach and technology being replicable for other customers globally who follow industry standards in particular the TM Forum's.

Operators must be prepared to make the shifts that are necessary in the move to cloud-native and ultimately more autonomous networks:

- Layers in place of siloes – both for systems as well as organizations
- Use of intent as the basis for both fulfilment *and* assurance
- Autonomous domains and automated cross-domain orchestration
- Use of industry standards to simplify development and reduce integration cost
- Decommission legacy systems whose technical debt will only increase over time
- Challenge established conventions (in particular, COM/SOM) where more modern, flexible approaches align better with business transformation goals.

stc's example proves the benefits on offer:

- Dramatic reductions in service delivery cycles, even for complex services (days to minutes)
- Self-healing networks – reducing human effort and increasing customer satisfaction
- Platforms that will support the growth of flexible, on-demand service mashups across multiple clouds.

With Nokia's support, stc is continuing to affirm its position as a pioneer, and an enthusiastic early adopter of transformational concepts, technologies and solutions. The fact that this is a truly cross-domain orchestration – spanning both mobile and fixed – makes this even more notable.

In 2022, in a report on the [opportunity for telcos](#) in Enterprise, we wrote: *“Today's telecom operators can secure a unique position in supporting the growing needs of enterprises.... But the window of*

opportunity will not stay open forever. Enterprises operate more in internet timescales than telecom timescales. In this market, both traditional and untraditional rivals are acquiring new skills and capabilities rapidly. Simply waiting is too high-risk as a strategy.”

With its end-to-end service orchestration capability now in place, stc has proven its seriousness in driving a true transformation of the experience and relationship with its enterprise customers.

Insight and analysis for telecom transformation.

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