

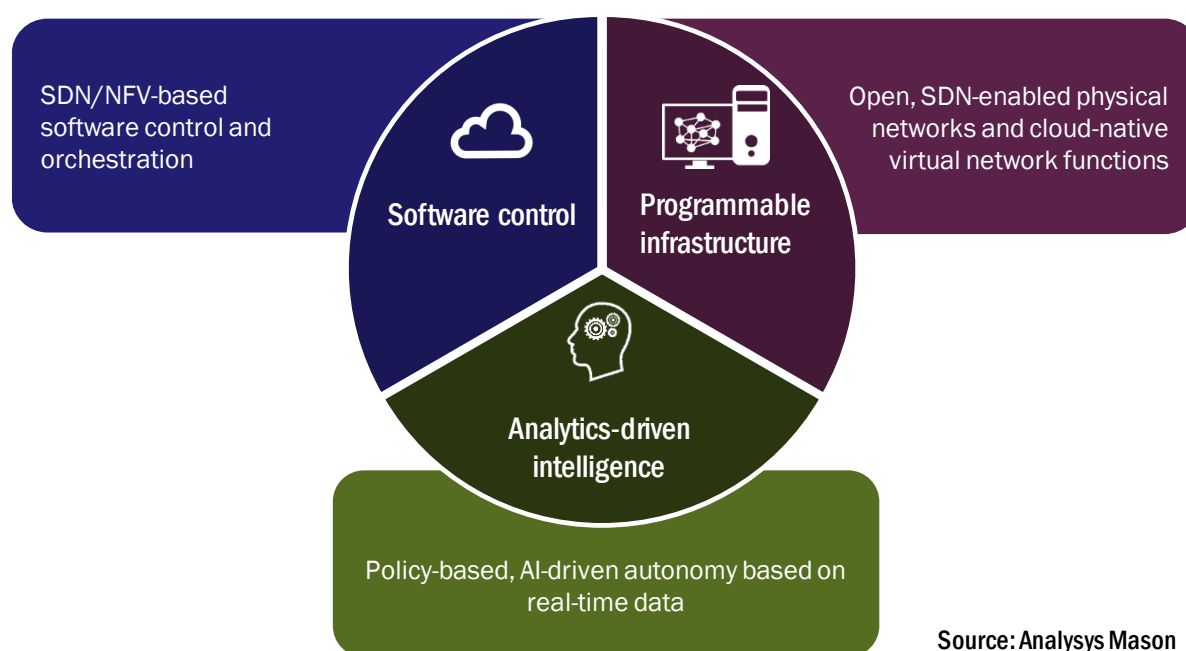
From autonomous to adaptive: the next evolution in networking

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There have been many discussions about how to eliminate manual, labor-intensive network operations and the industry is using a wide set of terminology to describe the future lean and automated network operations, such as ‘intelligent’, ‘cognitive’ or ‘self-driving’. Network providers are now able to rethink their operations with artificial intelligence (AI) and advanced analytics to achieve their long-desired goal of end-to-end automation, but most of them don’t want to cede control to networks that decide their own direction and remove humans from the equation altogether. They want their networks and operations to become more ‘adaptive’ to thrive in an ever-changing competitive landscape and consumer demands, which requires a coherent combination of human-controlled and -supervised analytics-driven intelligence, software controlled and automated operational processes and an underlying programmable infrastructure (see Figure 1).

Figure 1: The three key components of provider adaptive networks



This executive brief aims to set a clear vision for future ‘adaptive’ wide area networks and their operations. It provides a definition of adaptive networks and discusses the key market and operational forces driving network providers towards more adaptive networks. It then analyses the potential migration paths that providers can take to adaptive networks and recommends a stepwise approach to building adaptive networks without the need for a major transformation. This brief serves as an introduction to the complete report¹ that also discusses several use cases for adaptive networks and provides a real-world implementation case example from a provider

¹ Available at www.analysysmason.com/autonomous-to-adaptive-networks-white-paper

(Windstream). Finally, it provides best practices for network providers to overcome the technological, operational and organizational challenges for building an adaptive network.

Adaptive networks go beyond AI-led autonomy by putting network providers in the driver's seat

An adaptive network can self-configure, self-monitor, self-heal and self-optimize, but is bound by the rules and policies set by the network provider and is under constant human supervision. It is a step beyond an automated/autonomous network. The adaptive network will enable providers to progress from today's reactive operations to a new operational model based on a 'automate – learn – predict – adapt' cycle which involves tight interworking of SDN/NFV-based software control and automation; enhanced analytics-driven intelligence with AI and machine learning; and a programmable network infrastructure that is open, secure and scalable. This requires providers to adopt a more strategic, embedded automation approach compared to their tactical and disjointed automation initiatives of the past.

Automating networks and their operations is not a new idea; providers have been pursuing the autonomous network vision for years. Many providers have already adopted various tools and technologies to apply software-controlled, automated processes in various operational scenarios to certain degrees, such as for fault/alarm management, traffic management and RAN optimization, and more recently for layer 1-3 service provisioning with SDN. However, these have typically been tactical solutions that have been implemented as disjointed, fragmented 'automation islands' for specific domains and services. Therefore, the overall level of automation in operations remains low, a long way from the desired goal of end-to-end automation and simplification across multiple networks and services.

Network providers are now presented with the opportunity to change this. The main building blocks of adaptive networks, such as SDN/NFV-based software control and automation, enhanced analytics-driven intelligence with AI and machine learning and more programmable network infrastructure are now available. They will enable providers to adopt a more strategic, embedded automation approach to make the network truly adaptive.

Network providers should start now to build their adaptive networks using a stepwise approach

Providers should take a step-by-step approach to building their adaptive networks, as illustrated in Figure 2 below, with an end goal of bringing separate automated domains/services under end-to-end, cross-domain orchestration and closed-loop automated operations. Then they can achieve analytics-driven, more intelligent and autonomous networks bound by providers' business policies and rules.

Figure 2: Evolution to adaptive network operations

Network operations	Reactive	Proactive	Adaptive
Level of automation	Low/single task	Partially automated services	Policy-based autonomous processes
Analytics	Descriptive/diagnostic	Predictive	Prescriptive
Infrastructure	Static	More dynamic with external/overlay software control	Programmable with embedded software control
Description	■ Begins automating repetitive, day-to-day processes – mostly using static ‘if this then that’ scripts, simple policy and rules, but operations remain largely manual ■ High level of manual handover between disjointed processes	■ Domain/service-based automation and orchestration ■ Processes assisted by predictive analytics – that is, proactive/pre-emptive maintenance ■ Introduce machine learning to analyze, predict and learn; use AI decision making in non-critical processes	■ Re-engineer, coalesce and orchestrate complex, cross-domain processes with business-based policies, such as closed-loop assurance and fulfilment ■ Use AI to interpret, recommend and act based on real-time data enriched by ML within the pre-defined policies and under constant monitoring

Source: Analysys Mason

The main building block technologies and tools of adaptive networks are now available and providers can bring them together without going through disruptive and costly transformation projects. Providers can minimize operational disruption and risks by following a ‘bottom-up’ domain-specific automation approach starting from the SDN-based automation of individual domains and moving to end-to-end orchestration over time by bringing SDN, NFV and programmable physical infrastructure together. An example of this is Windstream’s SDN-based network automation project to radically reform its B2B service processes and reshape customer experience.² To achieve this, Windstream needed an open, extensible, model-based (e.g. TOSCA) network automation platform around which it could build new SDN-based automated services with a phased approach. As such, it has deployed Ciena’s Blue Planet Intelligent Automation Platform to simplify operations and move to DevOps-centric processes. Other providers may prefer to take an infrastructure-based approach that incorporates programmable hardware coupled with analytics and software tools to make their network more adaptable and provide a stepping stone to this bottom up approach.

Moving to adaptive network operations will involve significant technological, operational and organizational/cultural change, and providers will be faced with many challenges. The following recommendations and best practices can help providers overcome perceived barriers and get on the path to building adaptive networks.

² For more details on this implementation, see *Windstream: intelligent multi-layer/multi-domain network automation with SDN*. Available at www.analysismason.com/windstream-ciena-sdn-rma16.

- **Establish priority and timing** for what parts of the network to make adaptive based on clear business strategies and goals. Network and network operations are complex. ‘Rip and replace’ is costly and disruptive, but a plan based purely on end-of-life replacements is likely to take too long and result in persistent islands of adaptability. A strategic whole WAN plan— worked through with the help of an able, trusted partner, as required— will help guide investment and quicken returns.
- **Bring the pieces together:** The plan should include a vision of how all the pieces of an adaptive network will come together. Adaptive network ingredients will likely continue to mature at different rates. Providers may need help integrating the pieces together and keeping them updated, but they should have a long-range vision that guides their construction of adaptive networks.
- **Start staff retraining/reorganization and process reengineering very early on:** Some processes will need to be re-designed specifically for automation and adaptive networking. Jobs will change from performing direct action on the network to programming effective policies and supervising decisions made by an adaptive network. For example, providers can re-allocate some of their operational staff, whose tasks are being automated, to newly-established policy management teams which will be responsible for the creation, testing, validation, monitoring and continuous adaptation and improvement of adaptive network policies. Expertise as well as trust will build over time. Focus on reengineering/retraining and reorganizing staff and processes in concert with the business priorities to maximize return.
- **Control the risks of autonomy:** providers are naturally averse to ceding the running of their networks to algorithms. First, poor automation/automated decision-making in workflows could have significant adverse impact on the network and services. Second, any network outage could have serious negative consequences to a provider’s reputation and finances. Providers will need to grow confidence in adaptive networking over time. Controlled adaptation (i.e. autonomous processes may seek approval from operations staff for the mission critical decisions before they act, or they can be designed ‘fail-safe’- no decisions can be taken autonomously if they cannot be undone) can help increase providers’ comfort level. Again, partnerships with system integrators or other trusted solution providers can help assess and mitigate concerns and remove risks. Increasing decision-making autonomy step by step (from supervised learning to reinforced learning to unsupervised learning, for example, or starting with conservative, fixed policy control then implementing dynamic, machine-learning based policies) is another way to grow comfortable with autonomous adaptability. Implementing autonomy with a minimal disruption strategy is also wise.
- **Select the right partners to support your journey:** The evolution of the adaptive network is a long journey with many challenges along the way and providers may benefit from engaging with external partners who can bring the expertise and professional services to effectively execute the architectural, operational and organizational shifts that an adaptive network will require.

The payoff: more agile and efficient operations

Investments in adaptive WANs can enable network providers to achieve the following key benefits.

- **Improve network service agility to innovate faster and increase revenue** by transforming the highly fragmented and static nature of networks and operations towards adaptive approaches and improving long and opex-intensive service creation and provisioning cycles.
- **Control opex by increasing productivity:** a human-supervised and -programmed adaptive network can deliver the following productivity gains to providers:
 - protect/grow margins while scaling up networks and services without adding significant headcount
 - minimizing human-error and reducing its associated operational risks

- re-allocating skilled workforce from more mundane, repetitive tasks to more strategic and value-added activities directly aligned to business goals
- **Defer capex or redirect it to new growth opportunities:** improved network and data center capacity allocation and increased utilization can allow providers to free up capex, which can be diverted to seek new market opportunities such as 5G, IoT/M2M, video etc.

These benefits collectively provide a significant competitive advantage to network providers. Investments can and should be paced to support a provider's financial and other business goals, and should not require massive 'rip and replace' or large scale 'transformation' projects.

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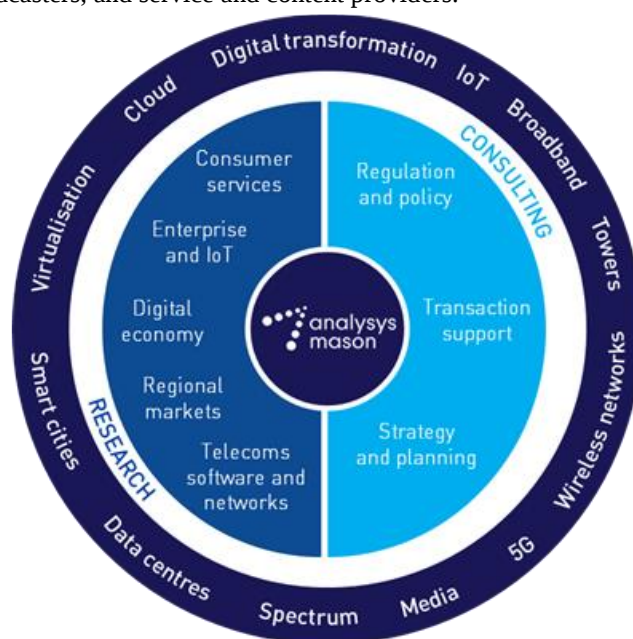
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