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Perspective

Autonomous, intent-driven networks cannot be achieved without open network data

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RESEARCH

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1. Executive summary

The ability to rapidly change and improve processes based on business needs and use cases will be crucial to operating networks in the 5G era. Traditional network data collection systems predominantly use proprietary, non-standard data formats and models to capture and process data. This restricts the agility and operations of communications service providers (CSPs) because they have to pre- and post-process network data and data scientists have to produce customised models for different use cases to derive insights and support operational processes. Openness must be embraced in the network to empower higher-level applications and enable automation.

Standardised access to network data enables CSPs to perform in-depth analytics and to generate insights in order to create efficiencies and accelerate their journeys towards autonomous networks. To achieve this, CSPs must support the following three distinct capabilities.

- **Network data openness** enables CSPs to democratise FCAPS data that comes from the network using standard content and encoding formats, so that it can be turned into actionable insights.
- **Use case-based APIs** enable CSPs to use the curated data for higher-layer network automation, including the automation of network planning, engineering and roll-out processes, thereby significantly reducing network opex and time to market.
- **Intent-driven applications** powered by the underlying network intelligence enable industry digital transformation by exposing the network services to enterprises via open APIs.

Standard northbound open APIs are the key to fully exploiting open network data. The industry is coalescing around the open APIs NETCONF and RESTCONF, as well as the YANG models for network automation use cases. The open APIs can abstract the complexity of the underlying network from the management functions, thereby resulting in lean operations using a standardised, intent-driven approach, thereby enabling autonomous networks.

2. Higher-layer network automation initiatives are constrained by poor access to standardised and curated network layer data

CSPs' use of data for network and service operations is continuously improving. Operational processes such as network planning, design and roll-out benefit greatly from the increased use of data to drive optimisation and automation. However, the functions and interfaces that gather the data and translate it into actionable outputs are largely closed and siloed, so are difficult and expensive to integrate.

Traditional network data collection systems predominantly use proprietary, non-standard data formats and models to capture data from the network and send it northbound. Higher-level OSSs must then perform extensive pre- and post-processing on the network data to derive insights that support operational processes. This is resource-intensive and limits the amount of usable network data due to incompatible formats and information loss.

These issues are compounded when new data sources are introduced into the network. 5G and cloud-native networks will require additional new and varied data sources (such as streaming telemetry and trace data) and data from these sources will be key to gaining visibility and control over the network. Additionally, external, non-network data sources will be pivotal to the support of network development and operations. The increased amount of data inflow combined with the variability in data formats and interfaces will increase the strain on data processing systems, which in turn will affect operational and service agility.

The ability to rapidly change and improve processes based on business needs and use cases will be crucial to operating networks in the 5G era. Development of custom models that curate the necessary network data so that it can be used in higher-level network applications is an operational pain point. It is a slow and highly manual process that relies heavily on data scientists to produce customised models for different use cases. The costs of these processes and operations will not be sustainable as network complexity increases with the introduction of NFV/SDN and cloud-native architecture to support new 5G services.

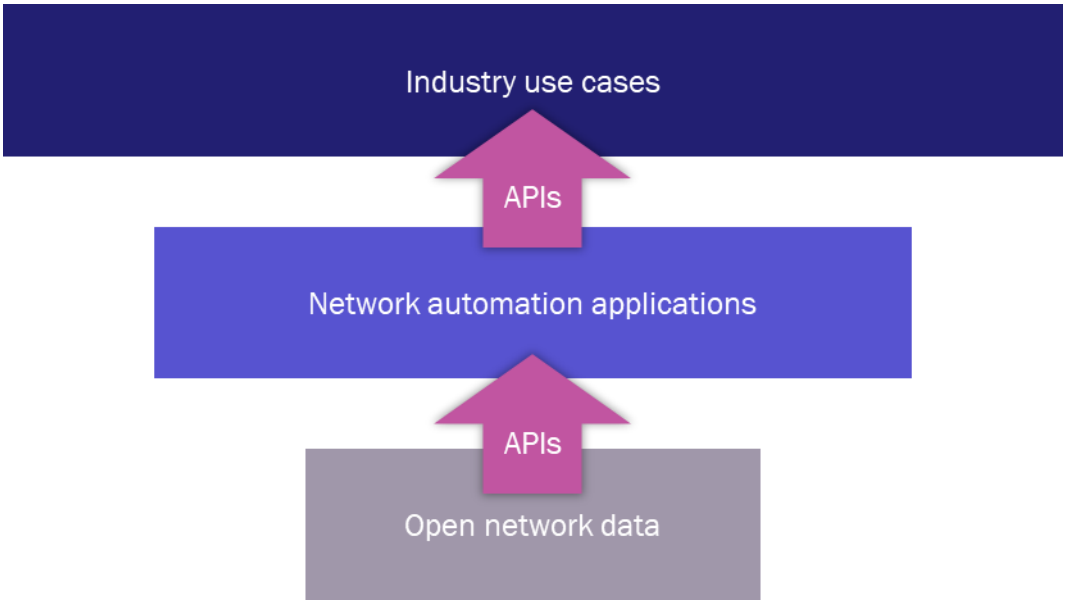
Extreme automation is required to achieve the service agility and opex efficiency goals of the 5G era. Achieving these goals will help CSPs to support industries' digital transformation. CSPs' 5G networks will enable new URLLC and mMTC services thanks to technologies such network slicing. These services will allow enterprises to develop their own applications and streamline their own operations. URLLC and mMTC will also enable use cases such as long-distance drones, self-driving cars, emergency response services and Industry 4.0 initiatives. Many of these new use cases will be critical to enterprise business functions and will rely on CSPs' service agility to succeed.

3. Network data openness provides the basis for the automation of higher-layer operational processes

Network data has been under-utilised in the past, but better access to data enables CSPs to pursue automation initiatives. End-to-end visibility of the network through comprehensive monitoring and data acquisition from all layers and functions supports many types of processes, from network roll-out to orchestration. Data enables CSPs to perform in-depth analytics and to generate insights in order to create efficiencies and accelerate network automation.

Opening up network data enables the automation of CSPs' higher-level operations processes. It also allows CSPs to expose network capabilities to enterprise customers and enables intent-based network automation driven by the network resource demands of those enterprises. These capabilities build upon each other to link the end customer's intentions and experience on the network back to the data produced by the network. Figure 3.1 illustrates the hierarchy of network data openness that is enabled by open APIs.

Figure 3.1: Hierarchy of openness



Source: Analysys Mason, 2021

3.1 Data openness enables CSPs to harness and reuse network data for a variety of applications

Data openness enables the democratisation of FCAPS data coming from the network so that it can be turned into actionable insights. Data sources must use standardised content and encoding formats at both the data acquisition and data aggregation layers.

Telemetry and trace data are new types of data sources that are a crucial part of cloud-native networks. They are enabled by the observability framework, and they provide the granularity that is needed in real time to gain full visibility of highly dynamic network clouds. These new sources need support from more-traditional sources (such as wire data and syslogs) in order to capture all of the necessary FCAPS data.

The acquisition layer provides the necessary abstraction to acquire data from dynamic network infrastructure. It must be able to ingest a variety of data sources, which are then curated to be consumed by the aggregation layer. The aggregation layer correlates the data to generate reusable data structures and metadata in standardised models. These models output historical KPI trends, anomalies and other insights that can be consumed by a variety of higher-layer applications.

3.2 Use case-based applications consume highly curated data, thereby providing better control for higher-level applications

Operational use cases consume network data from the data aggregation layer to support network operations. These use cases require highly curated data to inform and optimise changes to applications in order to support intent-based operations and service requirements. Use case-based APIs enable CSPs to use the curated data for network planning, engineering and roll-out, thereby significantly reducing network opex and time to market. For example:

- network engineering tools can be bolstered by traffic, capacity, geolocation and site visualisation data that helps CSPs to optimise cell coverage, capacity and site parameters, thereby greatly reducing network planning time and cost
- the SON and real-time network optimisation with advanced routing capabilities and resource allocation will be enabled by real-time topology, inventory and service quality data.

CSP operations and maintenance processes differ greatly. Open, standardised network data with granular access will enable simplified interfaces between higher-layer applications, regardless of the particular O&M process. It will remove rigid integrations and will enable rapid automation in the upper-layer applications. Furthermore, network engineers will be able to use standard APIs to rapidly develop, reuse and adapt data models for specific use case applications, thereby greatly reducing adaptation and implementation times.

3.3 Intent-driven applications expose the network to industries, thereby enabling digital transformation

Intent-driven applications, powered by the underlying network intelligence, enable industry digital transformation by exposing the network services to enterprises via open APIs. On-demand service ordering and provisioning through self-service portals provides enterprises with rapid service exposure to power transformation. The business intent is defined by customers' requirements. For example, a uRLLC service could be provided through network slicing or the NaaS could be supplied through API-driven service exposure in order to support cloud services, security and content delivery services.

Business intent is translated to service intent through service and order orchestration functions, which determine the network resource requirements to optimally fulfil the customer's conditions. Service intent is defined by the use case-based APIs; it is translated into network intent by the network orchestration functions, which map service requirements to the network resources. The loop is closed by monitoring and assurance applications, which ensure that network intent remains aligned with business intent. The system is underpinned by standard and open data, which enables seamless integration and transfer of data across all interfaces.

4. Open APIs and collaborative development will be critical to fully exploit the power of open data and enable autonomous networks

Standard northbound open APIs are the key to fully exploiting open network data. The industry is coalescing around open APIs such as NETCONF and RESTCONF and data models such as YANG for network automation use cases. NETCONF and RESTCONF are standardised interfaces that were designed with programmability in mind. These APIs provide a simple and robust interface to apply, read and modify network configurations and importantly, to facilitate automation.

YANG is the default data model that is used in conjunction with NETCONF and RESTCONF to curate data in the aggregation layer. OpenConfig, a consortium of large CSPs and digital-native companies, has lobbied for it to be used as the standard data schema, not just for NETCONF and RESTCONF interfaces, but also for network monitoring techniques (such as streaming telemetry) and Wi-Fi use cases. The NETCONF and RESTCONF open APIs are being used extensively by large multi-territory CSPs as part of their abstraction, standardisation and automation initiatives.

Open and programmable standards are the foundations of autonomous networks. Open APIs assist in derisking network cloudification and SDN transformations. Multiple domain orchestrators with standard northbound interfaces can be integrated into an end-to-end cross-domain orchestrator, which stitches the traditionally siloed domains together. The open APIs then abstract the complexity of the underlying network from the management functions and lead to lean operations using a standardised, intent-driven approach, thereby turning the network into a platform. Unifying the network in this way enables true end-to-end automation.

5. About the author

Anil Rao (Research Director) is the lead analyst on network and service automation research that includes the Network Automation and Orchestration, Automated Assurance and Service Design and Orchestration research programmes, covering a broad range of topics on the existing and new-age operational systems that will power operators' digital transformations. His main areas of focus include service creation, provisioning and service operations in NFV/SDN-based networks, 5G, IoT and edge clouds; the use of analytics, ML and AI to increase operations efficiency and agility; and the broader imperatives around operations automation and zero touch networks. In addition to producing both quantitative and qualitative research for both programmes, Anil also works with clients on a range of consulting engagements such as strategy assessment and advisory, market sizing, competitive analysis and market positioning, and marketing support through thought leadership collateral. Anil is also a frequent speaker and chair at industry events, and holds a BEng in Computer Science from the University of Mysore and an MBA from Lancaster University Management School, UK.

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