Independent market research and competitive analysis of next-generation business and technology solutions for service providers and vendors

HEAVY READING
WHITE PAPER

Intelligent Data-Driven Operations with AIOps

A Heavy Reading white paper produced for Ciena

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AUTHOR: JENNIFER CLARK, PRINCIPAL ANALYST, HEAVY READING

Introduction: We (still) need a new way to manage networks

Last fall, Heavy Reading published a white paper, *Simplifying Operations with Multi-Layer Network Control,* that examines how communications service providers (CSPs) can simplify network management by automating multi-layer operations. In this new white paper, Heavy Reading revisits the subject with a special focus on artificial intelligence for IT operations (AIOps) and the emerging role of AI in multiple telco operational use cases. CSPs are looking to use AIOps to broaden the scope of network management and its value in all stages of the network lifecycle by combining big data with AI/machine learning (ML).

What is AIOps?

Heavy Reading defines AIOps as an overarching technology that uses AI to manage data and information across IT management practices such as observability, rapid mitigation, augmented decision-making, self-healing, and auto-scaling. This definition assumes that data is collected and analyzed across all available sources. For CSPs, applying AIOps to network management benefits them with improved operational efficiency at each stage in the network lifecycle.

AIOps pulls more data from more sources into an ever expanding data lake. This means that data management and big data solution implementation are fundamental to AIOps. In addition to big data, AIOps solution components include some or all of the following:

- **Data collection**
  - **AIOps platforms take in data** from multiple sources, such as logs, metrics, events, and traces generated by IT systems, applications, and network infrastructure components.
- **Data processing and storage**
  - **Data normalization:** Taking raw data from diverse sources and different formats and converting the data to a standardized format for analysis.
  - **Data aggregation:** Aggregating raw data to create meaningful summaries and reduce the volume of data for processing.
  - **Data storage:** Storing processed/aggregated data in centralized databases or storage solutions.
- **AI and ML algorithms**
  - **Anomaly detection:** Finding anomalies or unusual patterns in the data that can flag performance issues and outages.
  - **Predictive analytics:** Using historical data and ML to predict trends, capacity requirements, and likely maintenance issues.
  - **Root cause analysis:** Identifying underlying causes of incidents or problems.

- **Alerting and notification**
    - **Generating alerts** based on predefined thresholds, anomalies, or other specified criteria.
    - **Integrating with communication channels,** such as email or SMS (text messages), or with collaboration tools to notify network operations teams about incidents or potential problems.
- **Remediation**
    - **Automating routine tasks** and prescribing actions to resolve common issues without human intervention.
    - **Coordinating multiple automated responses** across different systems and components.
- **Visualization and reporting**
    - **Using dashboards** to visualize the current state of operations, leveraging metrics, event logs, and performance indicators.
    - **Generating detailed reports** on historical performance, incidents, and trends.
- **Feedback loop and continuous improvement**
    - **Collecting feedback** from network operations teams and using it to refine and improve the accuracy of alerts, automation, and analysis.
- **Security and compliance**
    - **Incorporating security-related data and alerts** to help identify and respond to security incidents.
    - **Configuring AIOps to monitor** for compliance with regulatory and organizational policies.

Although lengthy, this list is far from comprehensive. AIOps can also extend to documentation integration, customer experience, IT service management (ITSM) integration, configuration management database (CMDB) integration, and more. By combining these components, AIOps aims to optimize performance, reduce downtime, and enhance the overall reliability and availability of an IT organization. Ultimately, AIOps will extend its reach across the operational landscape.

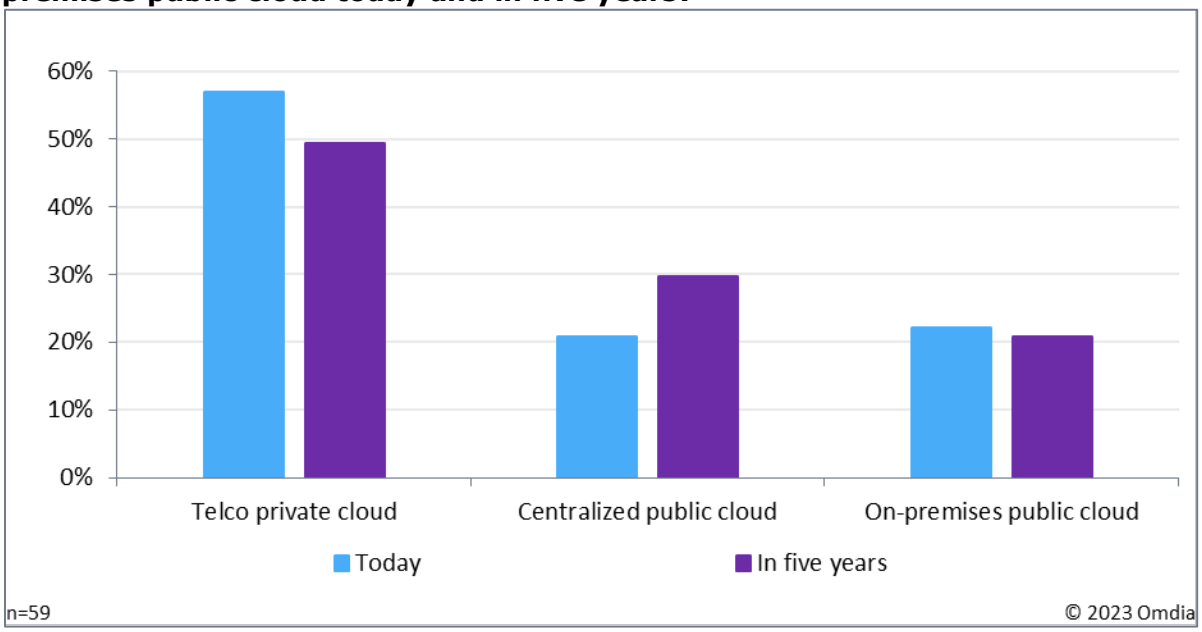
CSPs continue to move workloads to the cloud

AIOps is enabled with the elastic compute and memory resources that are available in a cloud or multicloud environment.

The migration of telco workloads to the public cloud is accelerating (see **Figure 1**). CSPs are looking to extend their reach into new services, new vertical industries, and expanded geographies—and to do all cost-effectively. Partnering with hyperscalers allows CSPs to achieve these goals and develop their technology and service capabilities with greater ease and agility.

Figure 1: Telco workloads continue to migrate to public cloud

Q: What percentage of your organization's virtualized/containerized network functions are hosted in telco private cloud, centralized public cloud, and on-premises public cloud today and in five years?

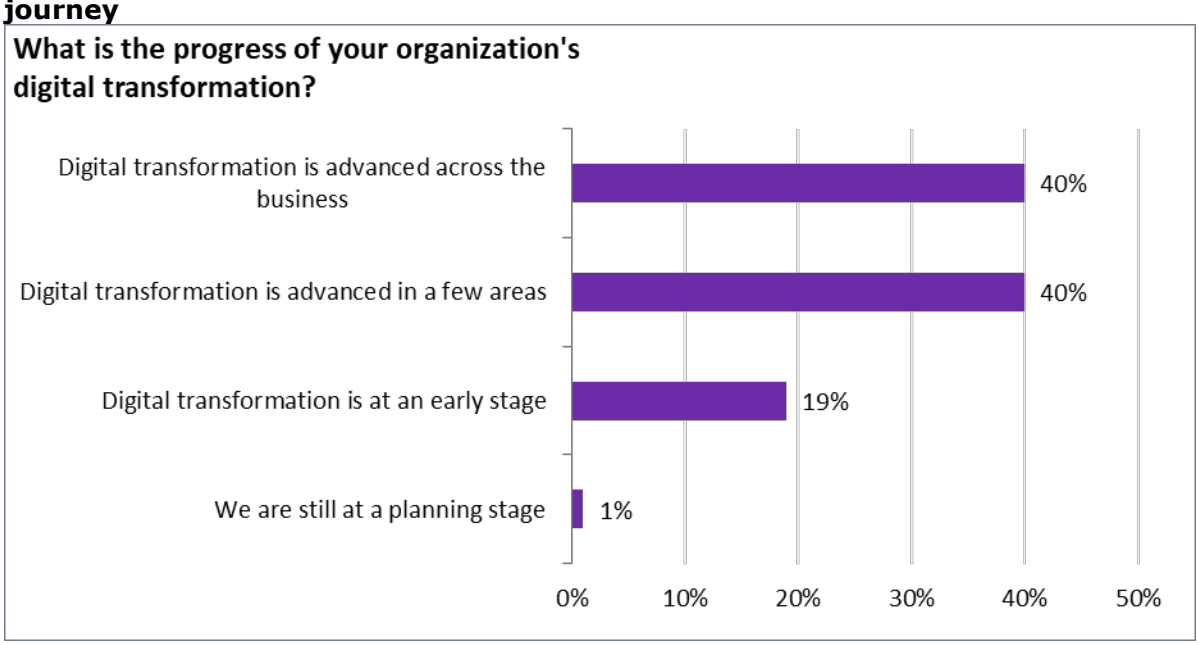


Note: Numbers in figures throughout this report may not total 100 due to rounding.
Source: Omdia, Telco Cloud Adoption and Vendor Perception Survey – 2023

Software transformation is needed

Heavy Reading has been tracking the network transformation of the carriers. As shown in **Figure 2**, in Omdia's *Carrier Survey 2023*, 80% of CSP respondents claim that digital transformation is "advanced" across all or some areas of the business, a percentage like that reported last year. However, the shift to implementation continues, with only 1% of respondents still in the planning stage and less than 20% at an "early" stage of digital transformation. Nevertheless, these numbers are similar to those of last year. This is the first year Heavy Reading has not seen a clear increase, which suggests that a degree of maturity is creeping into the digital transformation market. Large operators (>$5bn in annual revenue) claim to be more advanced in their digital transformations. Fixed line operators are still lagging the other categories of operators.

Figure 2: Service providers continue to progress in their digital transformation journey



n=86 global network operators

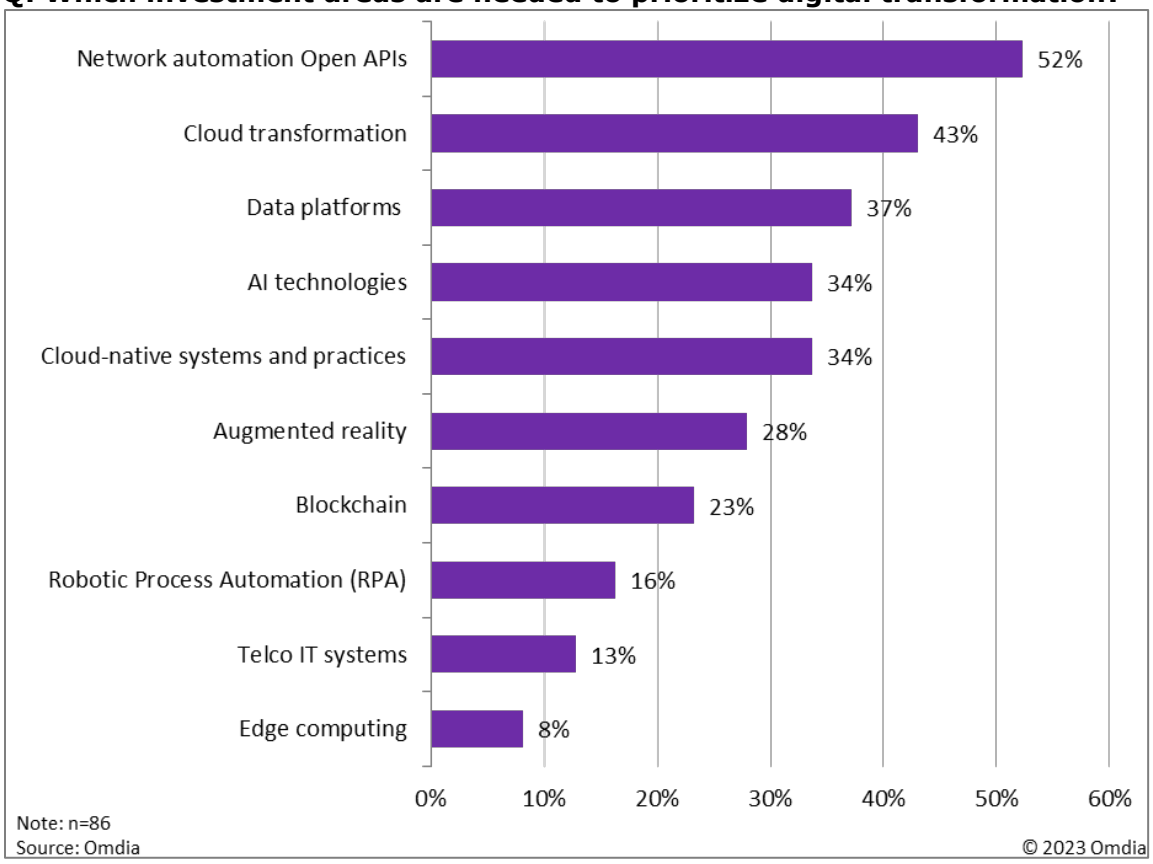
Source: Heavy Reading, Omdia, Service Provider Digital Transformation & Cloud Strategies Survey Report – 2023

Among the CSPs, "increasing business agility" and "increasing end-to-end business transparency" are the top two drivers of Digital Transformation by a margin of 8 percentage points. To generate new revenue, CSPs need to increase business agility to develop and deliver products and services more quickly; transparency is required to manage operations and processes more efficiently and gain an end-to-end view of customers, complex operations, and the business overall. These drivers help explain the increasingly rapid adoption of cloud native tools and practices highlighted in the survey. Respondents claim to be making strong progress in several areas, including DevOps and agile practices; continuous integration, delivery, and testing (CI/CD/CT); and open APIs. Almost two-thirds of service providers are expecting to see a broad swathe of cloud native tools and practices adopted on a widescale basis over the next two years.

This suggests a high degree of confidence about the pace of cloud native adoption. However, the timescales are like those obtained in the last two surveys, suggesting that the cloud native end state is not as close as CSPs want or need. The challenge for CSPs in 2023 has been the necessity to implement this transformation in a multicloud environment. CSPs require a *software* transformation with a generational upgrade in network management visibility and automation, and that is where they are putting their money (see **Figure 3**). Investments in open APIs, cloud transformation, data platforms, and AI are needed to support a move to AIOps and the many computationally intensive AIOps apps (such as proactive maintenance) that will need to reside in the cloud.

Figure 3: CSPs' top investment priorities in digital transformation are a recipe for AIOps

Q: Which investment areas are needed to prioritize digital transformation?



Source: Omdia, Service Provider Digital Transformation & Cloud Strategies Survey Report – 2023

Converged IP/optical infrastructure

Cloud and 5G services will run over a converged IP/optical infrastructure. As discussed in last year's Heavy Reading report, Layers 1–3 of the network were once crowded with a mass of technologies and protocols. Today, they are comparatively thin layers that have been simplified by protocol attrition and streamlined by decades of industry-standard practices. There is de facto standardization on fiber and dense wavelength division multiplexing (DWDM) at Layers 0 and 1, Ethernet at Layer 2 (the data link layer), and IP at Layer 3, the network layer.

From the perspective of logic and efficiency, there is no need to manage these technologies separately. From an implementation perspective, it is a different story. CSPs must be able to collect traffic and performance data from all Layer 0–3 devices and then act on that information in an informed, coherent, and intelligent fashion. This requires the tight integration of analytics engines that collect telemetry data from a variety of devices from multiple vendors with different data formats. The CSP must then be able to analyze the multi-layer data intelligently, apply AI/ML algorithms to the data collected in real-time, and then generate network insights and actions with minimal operator intervention—long before an issue can affect the customer experience.

By managing Layers 0−3 as one unit and acting automatically on the resulting data, operators are taking a giant step toward AIOps and digital transformation.

An examination of telecom AI contracts shows, in **Figure 4**, CSP priorities for network operations and management.

Figure 4: CSP investment in AI is robust, growing, and favoring network operations and management

Source: Omdia, Telecoms AI Contracts Tracker – 4Q22

Bringing the cloud into focus with AIOps

The scope and scale of networks are evolving, increasingly relying on cloud and multicloud environments, as is evident in Heavy Reading data. The expanding mix of network resources makes performance goals increasingly more difficult to establish, measure, report on, and, ultimately, act on.

The planning, design, and management of current networks already require the capture and analysis of perpetually growing telemetry data within the context of a multi-layer information model. In the future, big data acted on by AI/ML will enable even greater insights and the optimization of multi-layer networks to reach a variety of objectives: best performance (highest throughput with lowest latency), lowest absolute cost, lowest energy consumption, and more.

Through the use of AI/ML, AIOps can automate the often separate manual tasks of network management, including monitoring, troubleshooting, and incident response. This multi-layer analysis of gigaquads of data from the network/cloud will deliver a more accurate snapshot of the network and offer integrated problem resolution that considers performance data from all layers in the network. Such massive data-crunching analysis will save time, money, and network resources while at the same time improving efficiency and customer experience.

There are multiple challenges tied to AIOps, notably:

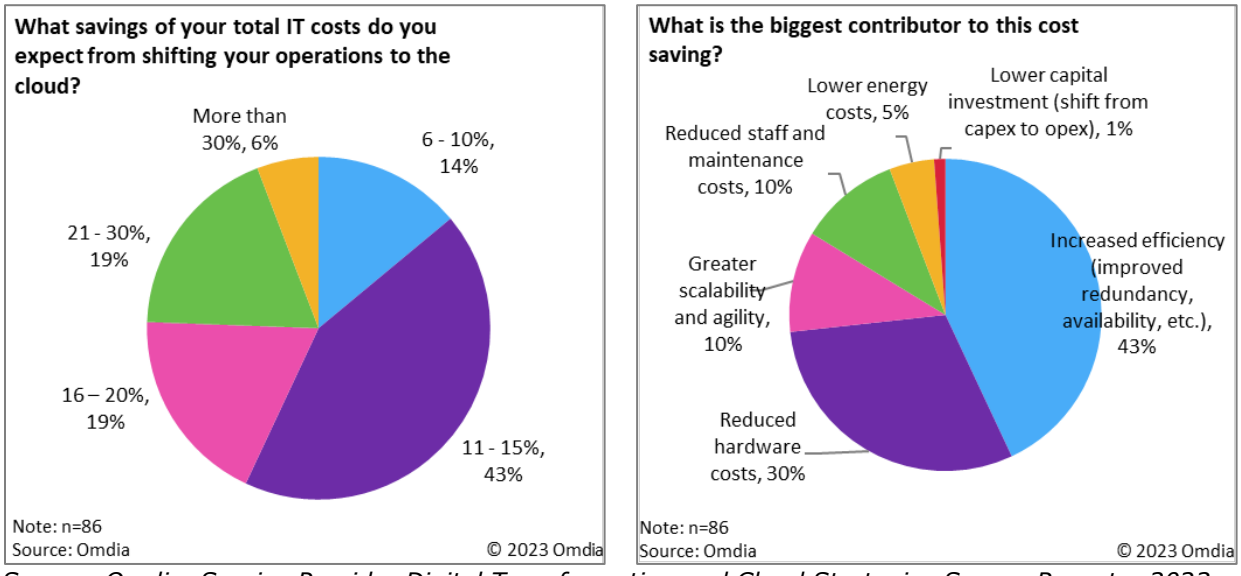
- Understanding implementation costs, including hardware, software, and personnel
- Providing data management, including identifying the necessary data sources, rationalizing the data among data sources, and ensuring the ongoing integrity of the data
- Integrating the AIOps applications with existing IT systems
- Building AI training models on trending data over time

Most CSPs will focus first on AIOps use cases with a well-established ROI. Rather than attempt to manipulate a huge data lake of information, they will start by identifying, gathering, and analyzing raw historical machine and metric data to establish a base understanding. They will use clustering algorithms and analytics to identify trends and patterns. Then, they will apply AI and ML to automate management and enable predictive analytics.

Use cases for AI/ML in networking

CSPs are leveraging a combination of AI/ML, multi-layer management, and the cloud to underpin AIOps strategy (see **Figure 5**). Heavy Reading believes that specific current use cases will benefit most from AIOps, providing the best ROI for the telcos. These use cases are in the network operations and management space, as suggested by the survey results shown above in **Figure 4**. More specifically, most are performance optimization use cases, which optimize routes, channels, and bandwidth or spectrum while meeting SLA parameters and route diversity requirements. Multi-layer management capability is essential to *all* these use cases for merged Layer 0–3 visibility and control across optical and IP layers.

Figure 5: CSPs are looking to improve efficiency and cut hardware costs with a shift to cloud



Source: Omdia, Service Provider Digital Transformation and Cloud Strategies Survey Report – 2023

Consider the following use cases in more detail:

- **Proactive maintenance:** This uses AI/ML to predict maintenance issues, identify the root cause, and ultimately resolve the issue without operator intervention. Verifying fiber health is an example of proactive maintenance. It usually relies on an optical time domain reflectometer (OTDR), a device that tests the integrity of a fiber cable and is used for the building, certifying, maintaining, and troubleshooting of fiber optic systems. Current OTDR capability is embedded into photonic line cards, making frequent measurement possible. Historical and current OTDR data can feed AI/ML modules to enable proactive maintenance apps.
- **Multi-layer capacity forecasting:** This means analyzing historical and trend data from Layers 0–3 to predict future demand. In delivering a prediction of future capacity, such forecasting also considers the impact of changes to the individual layers (IP, Ethernet, or optical) and the cost impact of the capacity recommendations.
- **Congestion alleviation:** This uses ML to identify patterns and relationships in traffic data to move traffic to avoid congestion or to identify distributed denial-of-service (DDoS) attack traffic and drop it.
- **Signal-to-noise ratio optimization:** This uses analytics to monitor and control the signal-to-noise ratio (SNR) margin. Today's coherent modems generate a massive amount of data, but without AI/ML, it is difficult to leverage the data in a timely and holistic manner. If CSPs can increase the SNR ratio on their optical infrastructure, they can optimize costly fiber transport and significantly lower their overall cost per bit.
- **Spectrum defragmentation:** Spectrum becomes fragmented when isolated, non-aligned, and non-contiguous frequency slots accumulate, and spectrum cannot be allocated to new connections. Defragmentation of the spectrum results in better use of the fiber and the freeing up of stranded capacity. This use case is computationally intensive and relies on AI/ML to determine the optimal channel assignments to free up the most spectrum.

The digital twins use case

Heavy Reading defines digital twins as a virtual representation of a physical entity, operational process, or set of data. The purpose of digital twinning is to simulate, capture real-time performance data, and predict and optimize. It gives CSPs the tools they need to answer questions such as, "Can I complete this network modification in a maintenance window?" Digital twinning also enables them to test software upgrades (e.g., to routers) by first providing scripts that can be validated before installing the upgrade on the production network (see **Figure 6**).

Figure 6: Digital twinning can have a positive impact across the network lifecycle

Key advantages of digital twins	
Achieve operational efficiency and reduce costs	A digital twin can accurately detect anomalies and errors before they occur, minimizing downtime and extra costs.
Enhance remote collaboration	Cloud-based digital twins allow real-time (remote) collaboration across multiple users. For example, geographically dispersed teams can implement and visualize changes in the twin.
Drive sustainability efforts	Digital twins can incorporate and test elements/parameters that drive suitability efforts.
Accelerate time to market for new products with shorter design cycles	Digital twins allow service/product designers to experiment with prototyping virtually. For example, they can test different infrastructures or identify quality of service issues before designs are finalized and move to production.
Elevate customer experience	Digital twins allow customer support teams to develop a more personalized customer service approach as they provide real-time visibility on how the customer solution operates.
Ensure safety	Digital twins operate in a virtual environment that allows users to experiment in safe environments.
Build new business models	Digital twins are a way to create new business models and post-sale services.

Source: Heavy Reading, 2023

A digital twin is a digital representation that provides the elements and dynamics of how a device, product, or ecosystem operates and lives throughout its lifecycle. For carriers, this means a replica of the physical network, a replica that exists in the digital space. A digital twin continuously learns and updates itself from multiple sources to show its near real-time status and features, working conditions, or position. It also integrates historical data from past machine usage into its digital model.

Digital twins for CSPs combine a vast amount of data from network resources with ML and software analytics, which are then used to create spatial graphs. These graphs offer a digital simulation model that is updated in real-time in tandem with their physical counterparts.

Although digital twining has seen many implementations in the enterprise space, only a small number of organizations are running truly advanced digital twins. This is also the case with the CSPs. Carrier networks have multiple challenges when establishing digital twins, mostly related to vendor landscape complexity and digital twin interoperability. Many CSPs have limited or pilot projects, but digital twinning at scale is still part of future plans two to five years out. Providers will continue to take incremental steps.

An emulation cloud, offered by a hyperscaler partner, can be a viable option, adding the scope needed for CSPs to model and test their complex networks.

Conclusions and recommendations

In its 2022 white paper, Heavy Reading examined the challenge to CSPs of the relentless growth of networks in terms of traffic, endpoints, and connected devices. AIOps is not a solution only for dealing with network expansion; it is imperative for managing the network going forward.

Virtually all the CSPs that have responded to our network surveys over the past year have cited AIOps and the technologies that make up an AIOps solution—AL, ML, multicloud, cloud native migration, etc.—as critical parts of their digital transformation strategy. They have also underscored that the transition to AIOps cannot take place overnight. Here are Heavy Reading's recommendations to CSPs considering an AIOps solution:

- **Identify your AI evangelist or champion** to lock-in the top-down support that you will need.
- **Fill in skills gaps** through additional hires, retraining personnel, or pulling in third-party expertise.
- **Do not bite off too much at once,** but rather, identify and focus on limited, contained operational use cases.
- **Identify the databases and datasets** that will be needed to power ML learning and train AI algorithms.
- **Only then, verify the integrity of that data** … and verify it again.
- **Build the ecosystem you will need** in terms of vendors, integrators, hyperscalers, and third-party tools that you will need for the use cases you have identified and for your move to AIOps overall.