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Solving the data challenge of telecom AIOps

Why relevant, sanitized, and verified data curation is the foundation of network AIOps

TANTRA ANALYST

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INTELLIGENCE ON ALL THINGS WIRELESS

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EXECUTIVE SUMMARY

Artificial intelligence (AI) is set to transform almost every industry on Earth. Its effect can be even more profound on a critical, diverse, and complex industry such as telecom. In fact, it can improve efficiency and performance as well as reduce cost in almost every aspect of the telecom business, from customer management to network operations to wireless technology itself. AI is not new to telecom; it has already been used for Self Organizing Networks (SON). However, the current market emphasis on AI, especially Generative AI (GenAI), will take its role to a new level. It is even more important for wireless operators when revenues are flattening, and the return on their significant investments in 5G is not yet realized.

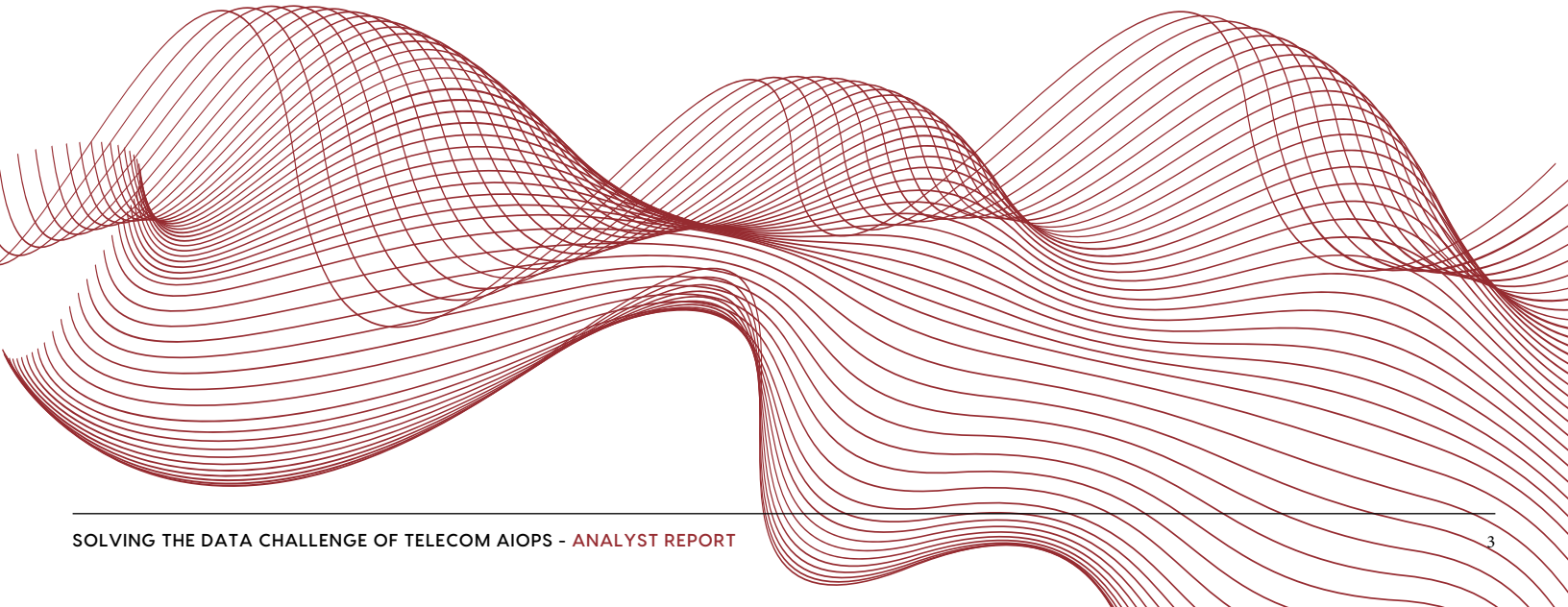
Telecom networks are usually built for peak load, and resources remain idle most of the time. Any solution that manages this peak better will substantially improve efficiency and cost. AI can help in better demand forecasting, which enables the right-sized build at the right time, better load management for higher resource utilization, and many other aspects of network deployment.

Managing customer operations is a complex task for telecom operators, involving innumerable variables regarding pricing plans, offers, analytics, etc... AI will be extremely useful in better analyzing data, understanding trends, identifying challenges early, and focusing on opportunities. This will allow operators to always be aware of their customer satisfaction level.

Optimizing network operations is one of AI's biggest, if not the biggest, uses, as it involves managing mission-critical and real-time data and use cases. AI can automate operations to minimize cost, better deliver and monitor service assurance and service level agreements (SLAs), reduce energy consumption to achieve corporate environmental goals, and identify opportunities to monetize while offering the best user experience to customers. Many forward-looking operators are already utilizing AI for their operations, and there are many "shovel-ready" use cases to take it further.

The activities around AI are often referred to as AI operations or AIOps. Throughout this report, we will use AI and AIOps as synonyms. One of the biggest challenges for AIOps in utilizing AI in network operations is the access to reliable and valid data. AI models are only as good as the data they are fed. Operators are sitting on a gold mine of data. However, not all of that is an easily ingestible form for AI. Some of it might be stale, not in the correct format, encrypted, incomplete, etc… A comprehensive approach is needed to not only to collect but also analyze and curate that data to the AI models for the best outcomes.

This report will discuss the role of AI for cellular/5G operators, especially for network operations, examine the challenges in acquiring and curating relevant, sanitized, and verified data, and suggest a comprehensive AIOps data management approach to achieve it. Additionally, it will illustrate the use of AI through a few case studies that utilize NETSCOUT products and services, highlighting how the company is helping operators in this journey.



ROLE OF AI IN TELECOM NETWORKS

AI can potentially transform almost every aspect of human life, transcending many industries and economies. Its ability to analyze complex, multidimensional data and not only create meaningful actions but also autonomously execute in a closed-loop fashion is vital for diverse, complex, and critical industries like telecom. Many analyst forecasts illustrate the outsized role AI will play in this industry. Precedence Research estimates the global telecom AI market to reach $42 billion in 2033, growing at a CAGR of 41.4% from 2024 to 2033, as shown in Fig. 1. The North American region will have a significant share of that market, followed by Europe and Asia Pacific.

The role of AI in telecom can be divided into three specific areas: 1) Network Planning and Dimensioning, 2) Radio Link Management, and 3) Customer and Network Operations.

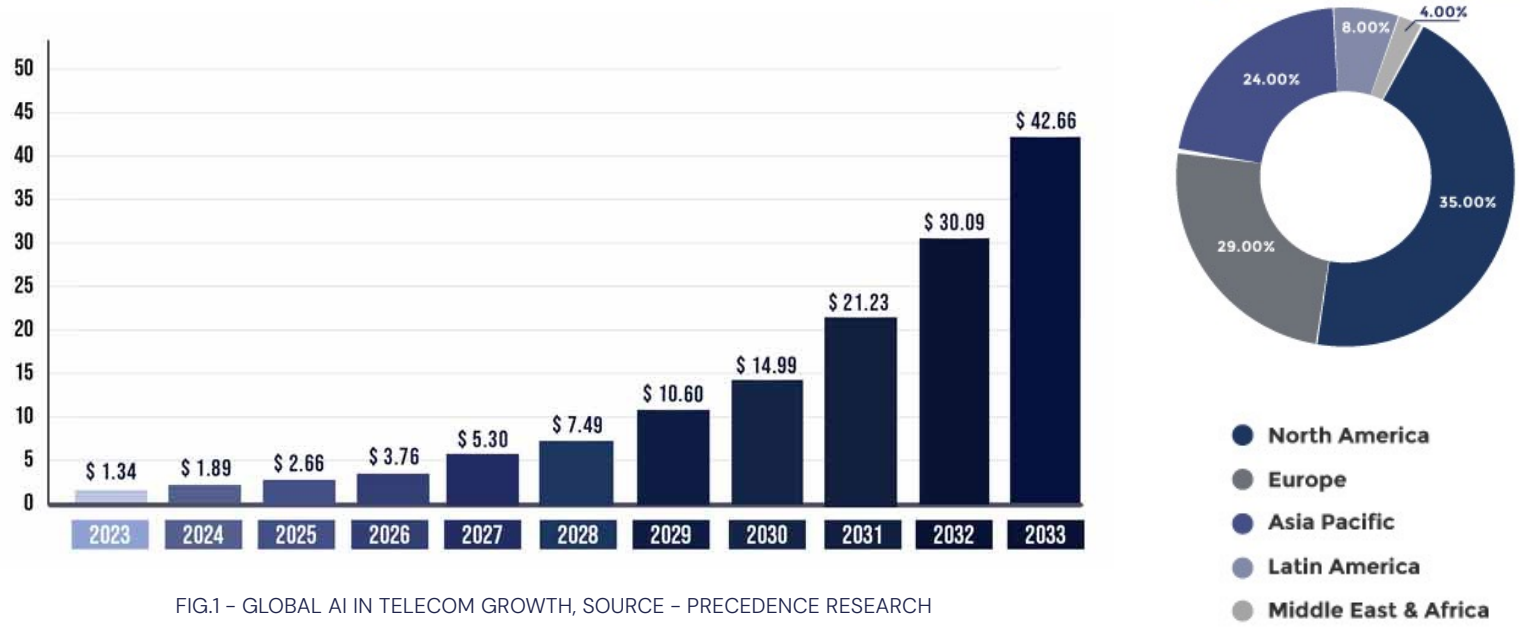


FIG.1 – GLOBAL AI IN TELECOM GROWTH, SOURCE – PRECEDENCE RESEARCH

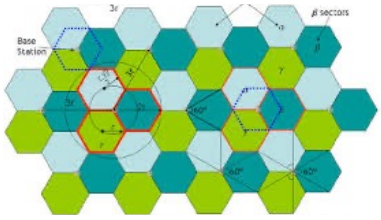
NETWORK PLANNING AND DIMENSIONING

Network Planning and Dimensioning are crucial steps in building and maintaining the network. They ensure the network is built to the projected capacity and always has the just-right amount of coverage and capacity. This requires a good deal of foresight and forecasting.

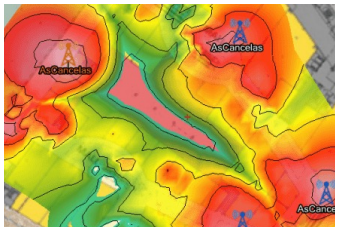
Networks are usually built for peak demand, which only exists for a short amount of time. So, any effort to correctly predict the location and timing of that peak demand and build the network to match that, minimizes the build-out cost.

AI can play a pivotal role in ensuring a right-sized build. Building an accurate digital twin of the network using AI will help to plan and dimension the network accurately.

Site/Coverage Planning



Capacity Planning



Traffic Growth Forecasting

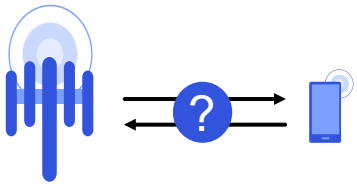
FIG.2 – USE OF AI IN NETWORK PLANNING AND DIMENSIONING

RADIO LINK MANAGEMENT

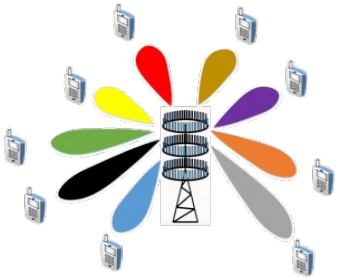
RF (Radio Frequency) conditions change rapidly, and everything in a radio link happens virtually in real-time. Additionally, because of the need for instant conversion of calculations done in the digital realm into analog, it is one of the most complex challenges to solve. For example, link parameters like link transmit power, modulation, coding, etc... are reconfigured every few milliseconds based on the quality of the link. The receiver constantly measures the link condition (aka channel estimation) and feeds that back to the transmitter for adaption. However, when this information reaches the transmitter, it might already be stale, making the configuration suboptimal. AI can help accurately predict the link rather than constantly measuring it, and help it configure optimally. Building an accurate digital twin of the network using AI will help to plan and dimension the network accurately.

All modern cellular systems have higher-order MIMO and beamforming. Selecting the right beam for the right user is a complex and ongoing process that also relies on channel estimation. AI can make this beam management much more accurate with less signaling overhead. Similarly, AI can help in precise indoor location where GPS coverage may not be present. These and many other AI features are being studied as part of 5G Advanced in the cellular standards-developing organization 3GPP.

Channel Estimation



Beam Management



Traffic Growth Forecasting

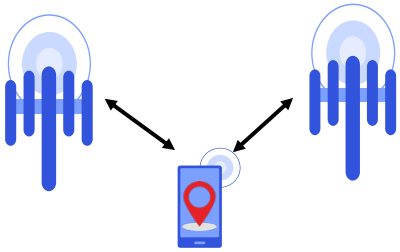


FIG.3 – USE OF AI IN RADIO LINK MANAGEMENT

CUSTOMER AND NETWORK OPERATIONS

Operations is a multi-dimensional challenge for operators. Often, their customer friendliness is measured by Net Promoter Score (NPS) and financial performance by left column, operational expense (opex). There are more opportunities for AI to improve through better operations than anywhere else. Also, long before it was called that, operators were using AI for operations. For example, SON, a staple for most networks today, is an early incarnation of AI. The network planning and simulation tools also used an early version of AI, which mainly used statistical modeling and analysis to predict the coverage and capacity of networks. Now, the latest transformer models and Generative AI will take the utility of AI to even higher levels.

There are a large number of use cases for the use of AI in operations; suffice it to say that there is an opportunity for AI in almost every system and function used for operations. They can be divided into two parts: 1) Customer Operations and 2) Network Operations, with ample overlap between the two.

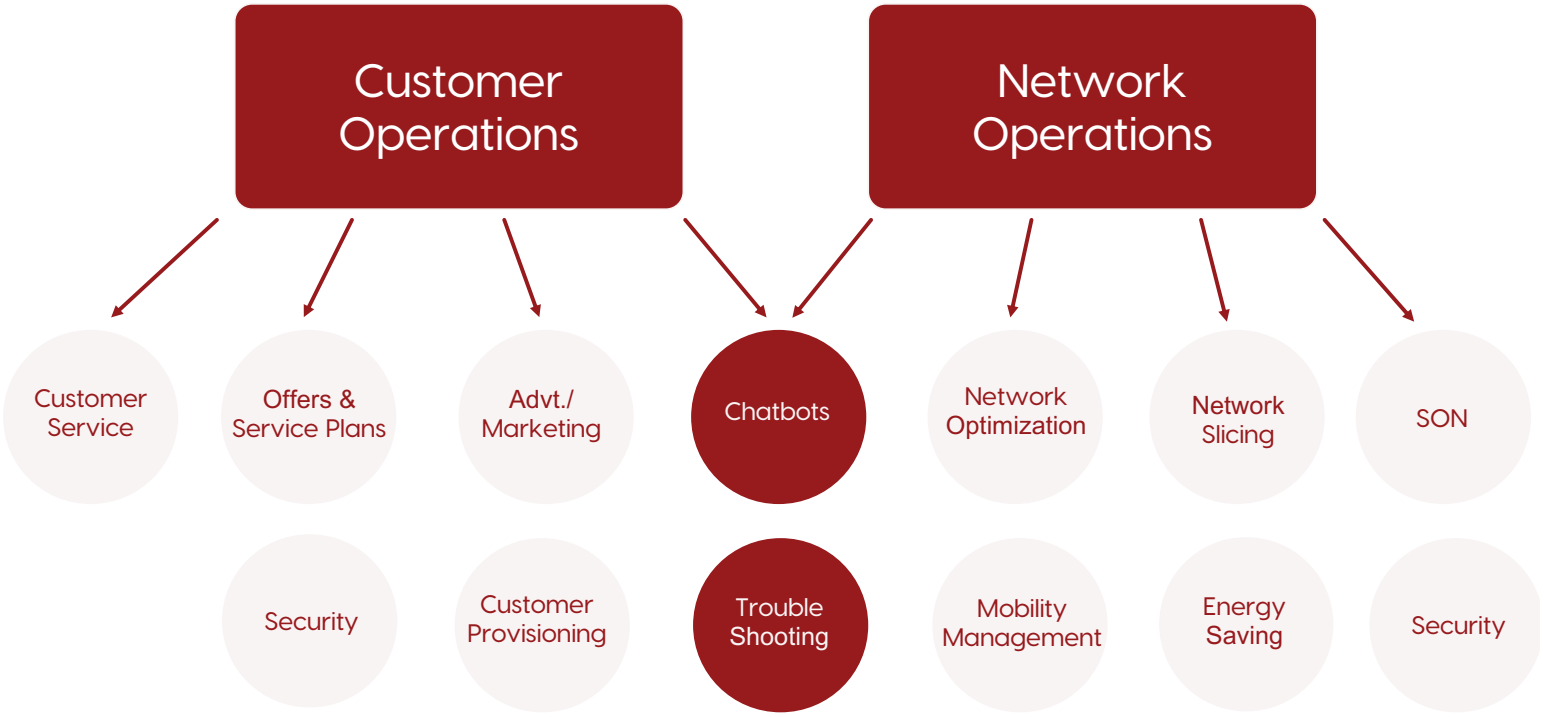


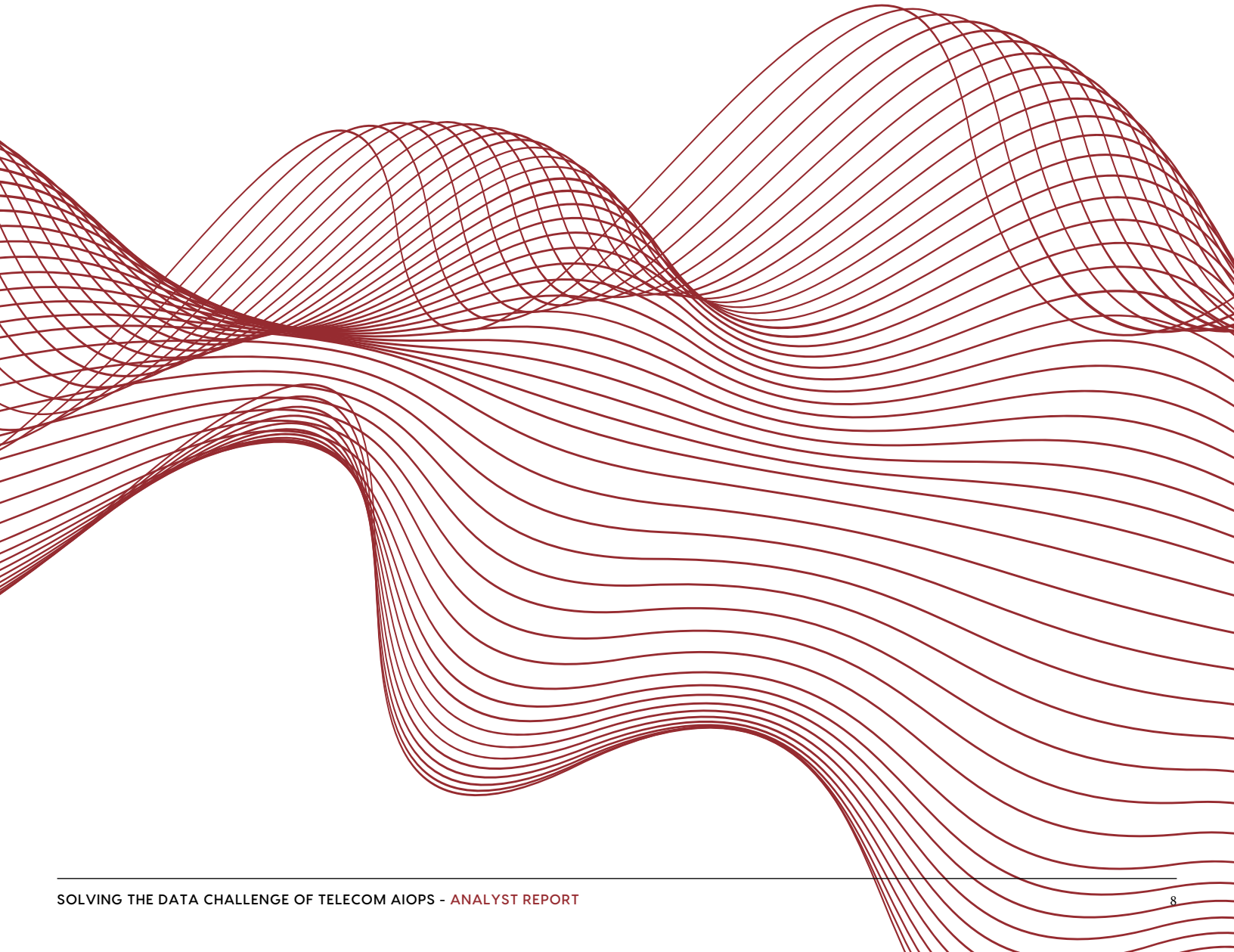
FIG.4 – USE OF AI IN RADIO LINK MANAGEMENT

There are a plethora of applications and AI use cases for customer operations, including chatbots for customer service, analyzing which service plans and marketing promotions work, simple customer provisioning, forecasting the chance of customers discontinuing / downgrading service, and more.

For example, the chatbot experience, whether answering customer queries or troubleshooting, can be fundamentally improved using Gen AI. Operators could train their chatbots with the entire library of their self-help guides and customer service training material and can fully eliminate the need for human customer service, except for level-2 and level-3 service issues.

Network operation is a major expense item in every operator's balance sheet. Today, it requires an army of highly trained and skilled engineers and technicians to keep the network at an extremely high availability and reliability that we have grown accustomed to. The workforce spans central offices to regional and field offices to service a large number of server gateways, and hundreds of thousands of base stations, typical operators have. Continuousy training them with the latest and greatest tools, features, and options the network introduces is a considerable expense. So, any efficiencies that AI brings in making this workforce more efficient and leaner will significantly reduce operating expenses.

AI can help improve efficiency in many ways. Loading balancing during peak load periods, smart management rather than over-provisioning to ensure SLAs, using AI instead of physical drive testing for network optimization, and putting sites/ carriers to sleep when not needed to reduce energy consumption are some of the many use cases for AI deployment in network operations.



OPTIMIZING NETWORK OPERATIONS WITH AI

Network optimization is one of the biggest, if not the biggest, use cases for AI. The remainder of this report explores the various aspects of this in terms of the challenges, opportunities, and approaches needed to maximize the utilization of AI in network operations and other systems.

Automation is Key to Optimizing Operations

Increasing efficiency and lowering operational expenses are the focus of any operator during any time of its business cycle. However, it has become even more crucial for cellular operators who have invested billions of dollars in 5G deployment. As the new capabilities enabled by 5G are taking time to bring new revenue, and the ARPU (Average Revenue Per User) is flattening, the focus is even more intense now on reducing costs. Apart from financial needs, societal needs in terms of corporate pledges for environmental and carbon footprint reduction are also necessitating improvements in efficiency to reduce energy consumption.

Automation is one of the key tools in achieving higher efficiency and lowering costs. It can be employed for not only mundane tasks like bringing up sites, configuring them, etc... but also sophisticated tasks like predictive maintenance, anomaly detection, fast network and consumer problem resolution, and more. Much of these are done manually or in a semi-automated way, requiring highly skilled technicians and engineers. For example, to solve customer complaints, technicians must now gather call data from radio and core networks, IMS, and other systems, correlate and analyze hundreds of variables such as location, link status, and signaling to understand the situation and solve it. Automating such things can improve efficiency by leaps and bounds.

Another immediate use case for automation is service assurance and SLA compliance. This setup is very complex as the network situation can change abruptly; operators address that by overprovisioning and wasting resources. Also, much of this is done manually. Automation can significantly simplify the set-up and dynamically allocate resources as and when needed, improving efficiency.

AI is the best tool for automation. Gen AI enables even more highly complex tasks to be automated. Many times, it can consider far more variables than humans can comprehend and deliver even better solutions. A simple use case that some forward-looking operators have employed is digitizing all the network equipment manuals and resources and putting that knowledge base behind a Gen AI-enabled chatbot. So, technicians can type the questions into the chatbot and instantly get the answers to any diagnostics or details instead of searching through manuals. An operator indicated that this alone improved their efficiency by more than 20%.

Apart from increasing efficiency, AI can be used for enabling new use cases, such as automated 5G network slicing. This slicing sets up dedicated network resources for a user's specific requirements, such as guaranteed bandwidth, latency, etc... Since this complicated process involves multiple systems, skilled engineers/technicians are required to set it up and tear it down. Because of the overhead involved, it is now done statically and is very expensive. However, with AI, this can be fully automated, reducing costs and complexity. That means operators can offer easy options to get their own slices at attractive pricing points when needed and how long they need. If done correctly, Network Slicing can create a new longterm revenue stream for 5G operators.

These are mere early examples, but there is no question that automation will be an even more important lifeline for operators than it already is, and AI will be a major tool for achieving that automation.

VALID DATA IS CRITICAL FOR AIOPS

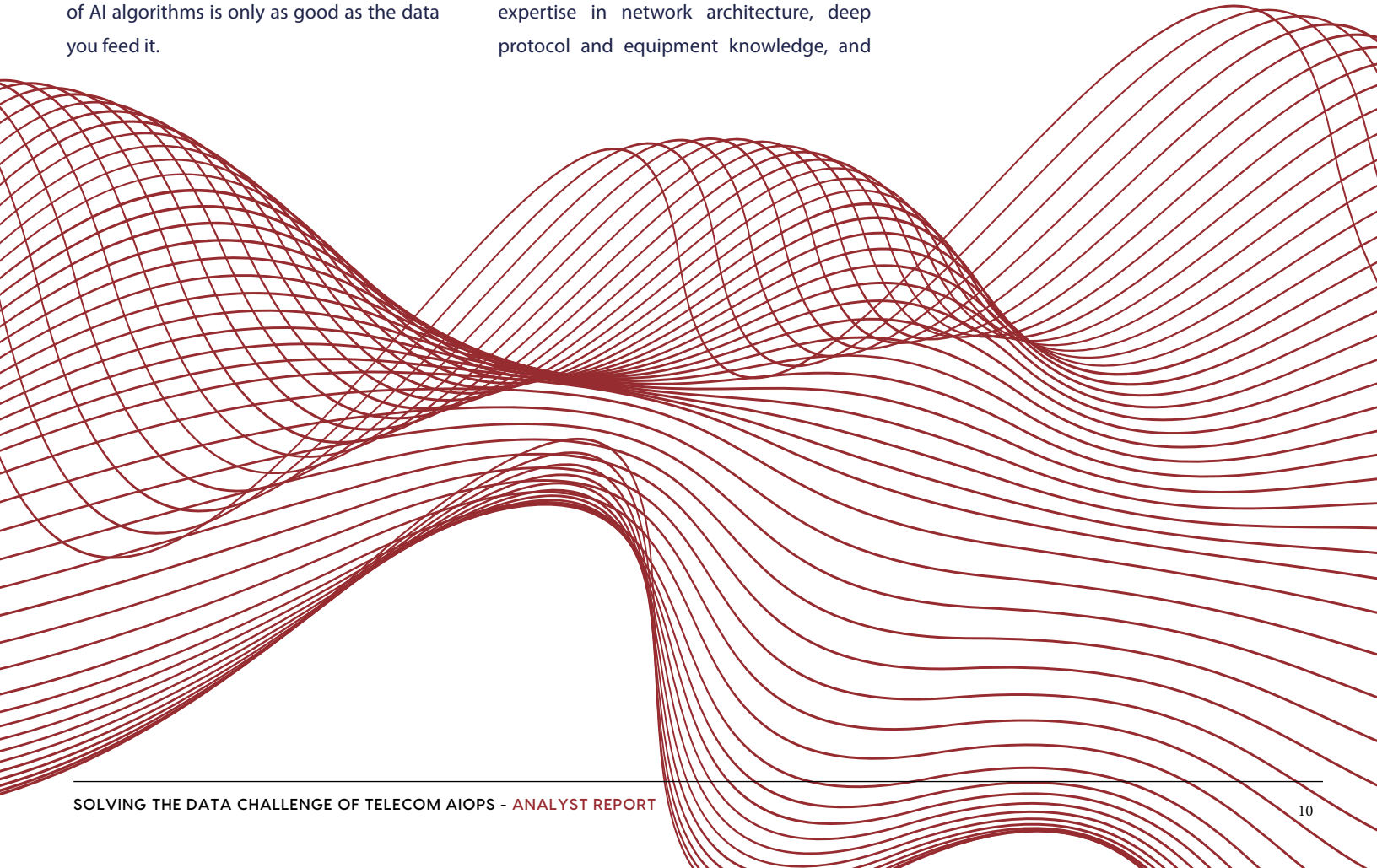
It wouldn't be wrong to say that operators are sitting on a data gold mine. If done properly, they can monetize it in many ways, securely without impinging on the privacy and security of users. That in itself is a major topic of discussion. However, that is not the scope of this report. In this, we are looking at using that data for AIOps.

Every call, text or data session creates a significant amount of data, and not just the data consumers generate or use; user plane data contains details on how the connection is set up, maintained, and concluded. All of this data is useful for all the AI use cases we have been discussing here. AI is the classic case of "garbage in, garbage out." The output of AI algorithms is only as good as the data you feed it.

Data is used for inferencing, i.e. applying models to solve specific problems. Since telecom is a highly specialized field, training on generic data will result in hallucinations and severe errors in results. Also, telecom AI workflows are unique and require the right data from actual networks, not synthetic or generic data.

Many different aspects of AIOps use cases require different domain knowledge and expertise. For example, analyzing and creating models for coverage and capacity forecasting might require RF knowledge and statistical data engineering expertise. However, network problem resolution and predictive maintenance will require expertise in network architecture, deep protocol and equipment knowledge, and more. Moreover, every network is different in terms of configuration, technology, spectrum, customer behavior, topography, demography, usage patterns, etc... That means AI models have to be tuned and optimized for specific use cases and operators.

The detailed discussion about AI models for telecom is out of scope of this report. Bottomline, AIOps requires relevant, valid and verified data.



CHALLENGES IN ACQUIRING AND PROCESSING NETWORK DATA

While the operator network is a gold mine for data, there are a lot of challenges in gathering, processing, and curating that data. To begin with, there is usually too much data. Every user device continuously generates data, both when being used or idle, or running diagnostics in almost all network nodes at different layers of the stack. Multiplying that by millions of subscribers, one can imagine the magnitude of the volume. Processing all of this data requires insane amounts of computing power and massive storage infrastructure, which is highly investment-intensive.

Since data is coming from different sources, it is usually not available in a standardized format. Different vendors generate data in different formats. Even when from the same vendor, the core and radio networks, OAM, different functions, analytics tools, cloud platforms, etc…will all have different data formats. Moreover, a lot of the data could be encrypted, making it hard to decipher without proper decryption keys and tools. Since AIOps needs formatted data, collecting and curating all this data from different sources, in different formats, into something that is digestible by AI models becomes a major challenge.

Not all data generated and stored is of equal value. Some tasks, like user-level troubleshooting, require almost real-time data. Other tasks like predictive maintenance, network-level troubleshooting, trend analysis, etc... need historical data. Many times, data becomes stale very quickly, such as analytics for older network configurations. Additionally, there are increasingly more regulations regarding data privacy and sovereignty. Operators must be cognizant of what kind of user data can be stored, for how long, where it can reside, what it can be used for, who has access to it, etc... Not complying with regulations might have very dire consequences. All of this data only provides performance and visibility from one dimension, i.e. from the perspective of each function/system. But for trouble shooting, performance assessment and improvement and many other needs, operators require a full 360-degree view of the network. That requires combining all this data in a meaningful way.

Even with the 360-degree view of the network, it is hard to ascertain the user experience perspective. For example, the network might show an impressive less than 1% call failure rate. However, if all those failures are coming from a single neighborhood, the user experience in those areas might really be awful requiring attention, but never reflected in the overall network view. When churn is a major concern, operators can't afford to miss such cases.

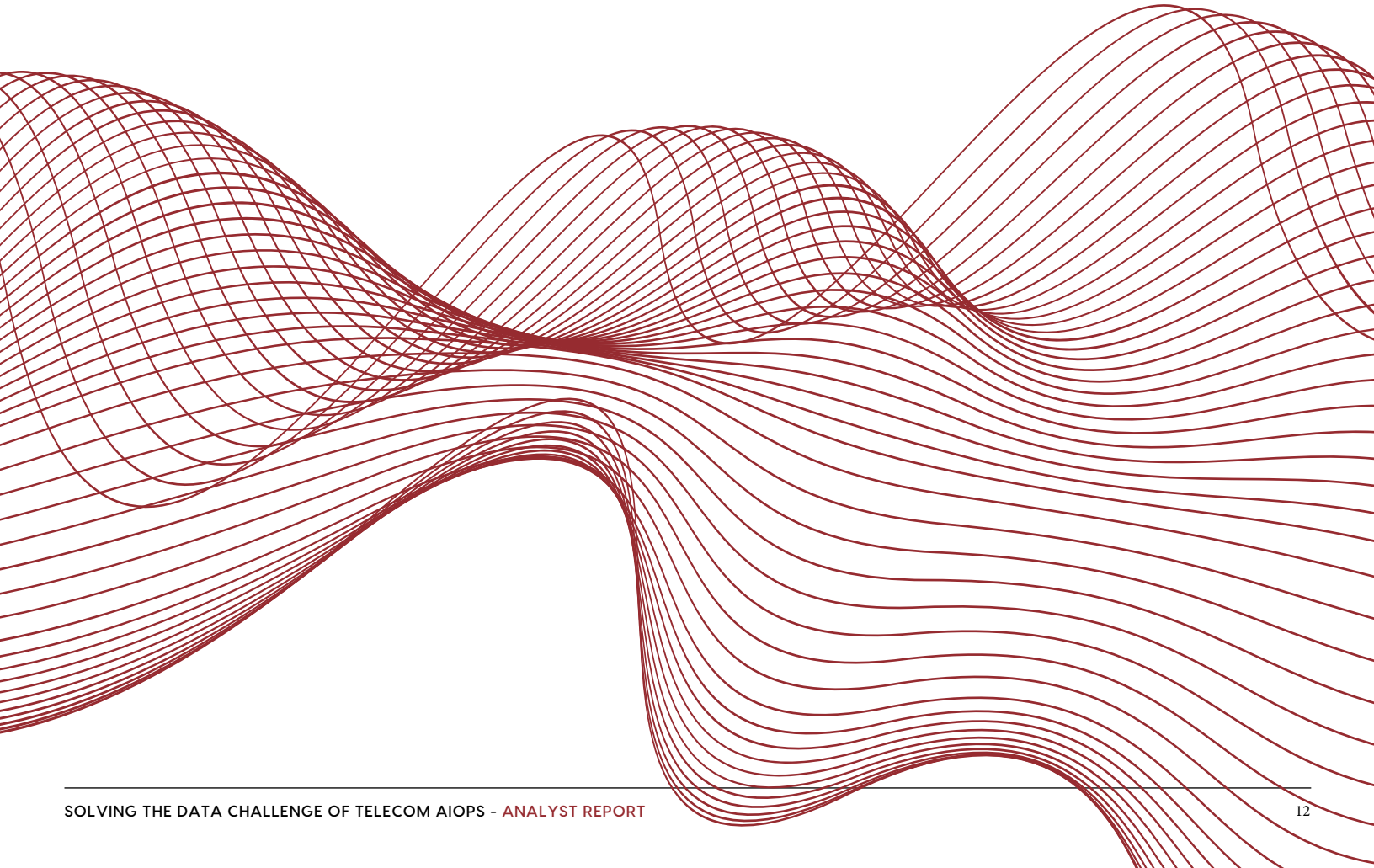
These are only a few of the challenges. Because of the vastness of the data volume, diversity of the systems involved, and variance of the operator environments and conditions, one can image the myriad challenges faced in collecting and curating data for AIOps.

SOLVING THE AI DATA CHALLENGE—FOUR STEPS TO HOLISTIC DATA MANAGEMENT

To embark on the AI journey, solving this data challenge should be the first order of importance for operators. They need a comprehensive, end-to-end, holistic data management approach to solve the challenge. The approach consists of two parts. The first is collecting and analyzing the relevant data from all the possible sources, and the second is to curate it in the right format and context so that AI models ingest and make the right decisions. Let's look at each of these in detail.

There are some basic tenets to the data collection needed for AIOps. First is, go broad, utilize data from all sources, end-to-end, from all the interfaces, sensors and functions. This allows AI models to grasp the complete context. The ability of AI to analyze large and complex data sets with many dimensions and characteristics is a major differentiator compared to today's rudimentary "smart" tools or manual analysis.

Second, go deep and inspect at a packet level, be it a signaling or data packet. Utilize Deep Pocket Inspection (DPI). It's the actual information in the packet that matters and provides the ultimate truth, whether trying to provide the right priority for the content (e.g; higher priority for latency-sensitive packets) or ensuring performance for service assurance and SLA compliance.



Third, analyze full data, not samples, based on the use case. This one is subjective. When analyzing and troubleshooting specific network problems, you need to analyze all the data for a specific group of users or functions. Those groups or network functions could be samples of the overall network. But the data should be whole, not sampled.

And the fourth key capability is the ability to collect real-time data. Many use cases will need real-time data, be it turning off and on carriers/sites to save power, or complex trouble shooting. Hence easy way to collect real-time data is essential.

The biggest characteristic of this comprehensive approach is to have levers so that you can dynamically adjust the scope of the data collection. Obviously, collecting all the kinds of data mentioned above all the time for all the users in the network is practically impossible because of the cost and complexity of processing, transport, storage, and management of such a large quantity of data. The levers should provide operators the complete control but also the ability to pick and choose what data to collect, for how long, and on what subset, based on the use cases. For example, the extent and granularity of compliance with SLAs or regulations can be more relaxed, whereas it is much higher for troubleshooting or predictive maintenance purposes.

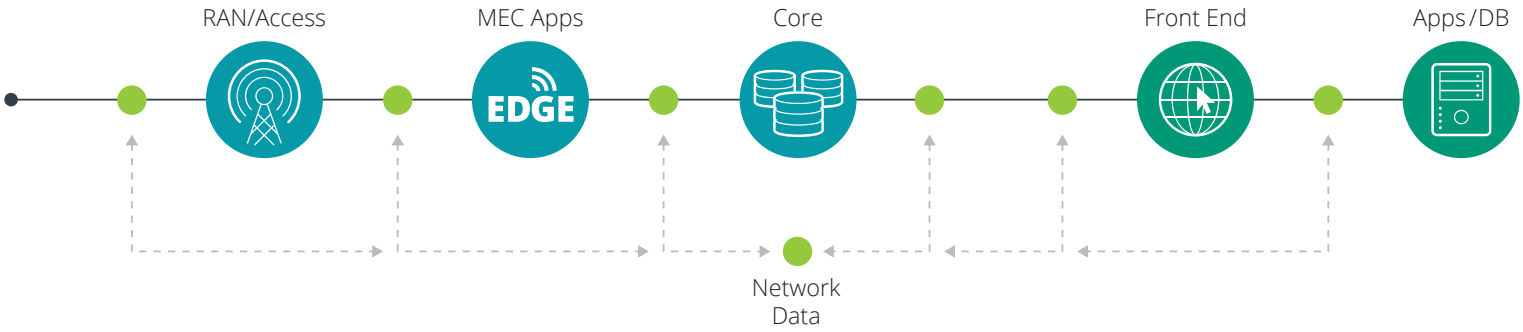


FIG.5 – COLLECT AND UTILIZE ALL DATA FROM ALL THE SOURCES FOR AIOPS

DATA CURATION FOR AI MODELS

Data curation is the equally important second half of this holistic data management approach. It involves a series of steps to take all the raw data collected and convert it into meaningful information to be processed by the AI models.

The first step is to use multi-protocol analysis and filter out all the noise. This step involves understanding the technologies and protocols used in the network, be it LTE, 5G, public or a private network, cloud or edge data. Next step is to contextualize the data through triangulation and correlating them, based on the user, device type, location, or other parameters, based on the use case. And finally presenting it to the AI models to ingest.

Such well-curated data with context and the holistic view is extremely useful in trouble shooting complex issues. It can localize the problem element, whether it is the radio network, core, IMS, other elements or the device itself. It will also be helpful in isolating the problem to a specific dimension, such as location, sites/group of sites, specific device types of models, applications, functions, etc...

This data can also help AI models in solving challenges or find patterns that are not even possible for technicians or the simple tools to comprehend. For example, failures that have a large number of variables and seem unrelated when only a small sample is examined. However, when AI can examine this huge volume of data from all parts of the network, it can correlate better and identify patterns. Similarly, AI can anticipate the need for correction or maintenance. For exmaple, finding a possible failure involving a large number of dependent variables that might occur during, say, an upcoming major event with lots of traffic.

As you can imagine, none of these diagnostics would be possible unless the full end-to-end data were provided to AI models.

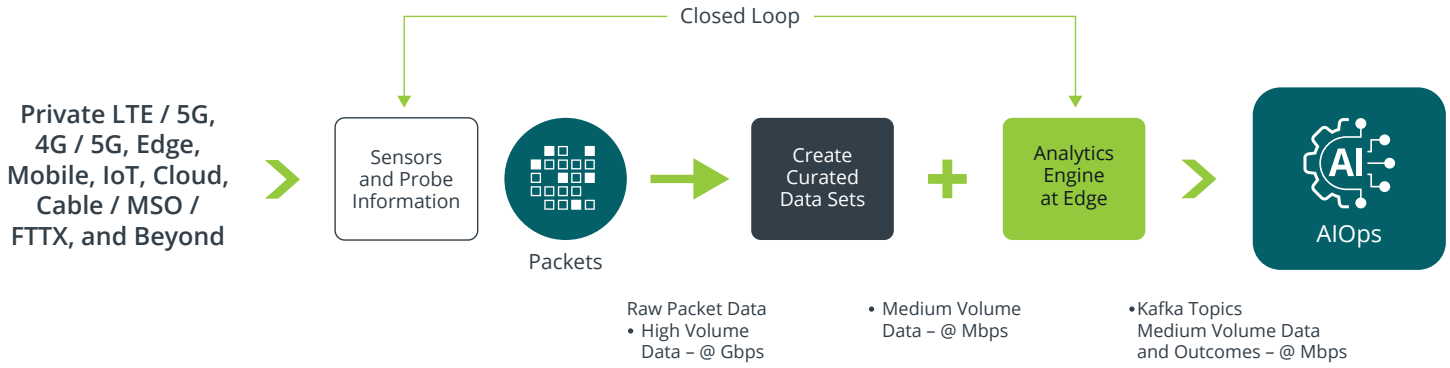


FIG.6 – DATA CURATION IS A CRITICAL STEP IN HOLISTIC DATA MANAGEMENT FOR AI

CONSIDERATIONS FOR THE HOLOSTIC DATA MANAGEMENT APPROACH

There are a couple of ways to implement this holistic AI data management approach. First is to have an integrated functional entity within the network infrastructure itself. The other one is an Over-The-Top service layer approach with tools coming from third-party software providers.

The 3GPP has introduced a dedicated function called Network Data Analytics Function (NWDAF) specifically for this task in Rel. 16 as part of 5G network architecture. It is being further enhanced in Rel.17.

NWDAF is responsible for collecting, analyzing, and processing network data to help improve network performance and user experience. It is evident that this is the manifestation of the holistic data management approach we espoused in the previous sections.

Many of the legacy cellular infrastructure players claim they now have NWDAF as part of their offerings. However, it is still in the early days, and so far, there haven't been any large-scale commercial deployments. There have also been some concerns about it, such as the massive amount of data processing needed might overburden the other network functions. As this function will most likely come from legacy providers, which might further increase the vendor lock in, etc., some vendors claim that their NWDAF is open and supports multivendor operation. We will have to see how this situation evolves.

The other third-party OTT solutions, which are already available today, have many merits over the integrated NWDAF approach. For starters, such data management is more of an IT function than a cellular function, which means that IT infrastructure companies, who have vast experience and are the front runners in the AI space, are better qualified and equipped to address this opportunity. The whole function might even be divided into different sub-functions, managing different network elements and creating opportunities for vendors who have expertise in those elements, be it core, radio, OAM, billing, etc... That also means these sub-functions have to be open and fully interoperable. The IT ecosystem has been managing such openness since its inception, and it is not a forte of the cellular ecosystem. But this also means a lot of integration challenges, interoperability testing, etc...

Both approaches have their pros and cons. Operators have to choose what suits them best, based on their needs and in-house skill set to manage integration, multiple vendors, cost, and other considerations.

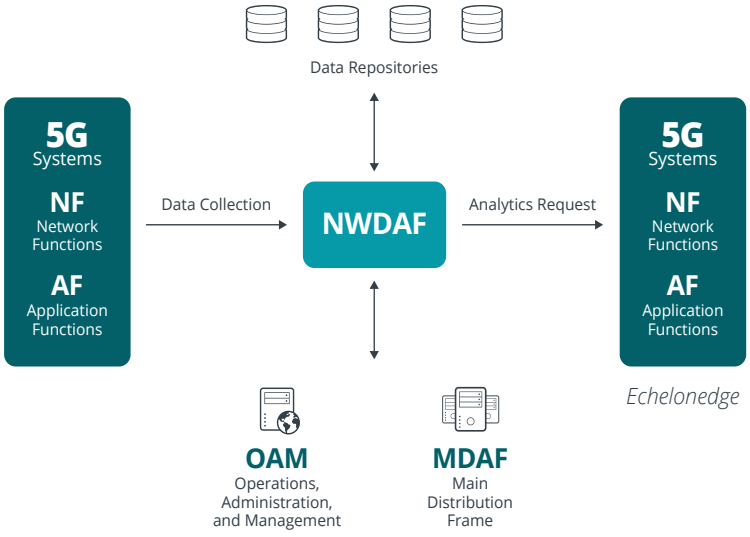


FIG.7 – NWDAF FOR HOLISTIC DATA MANAGEMENT

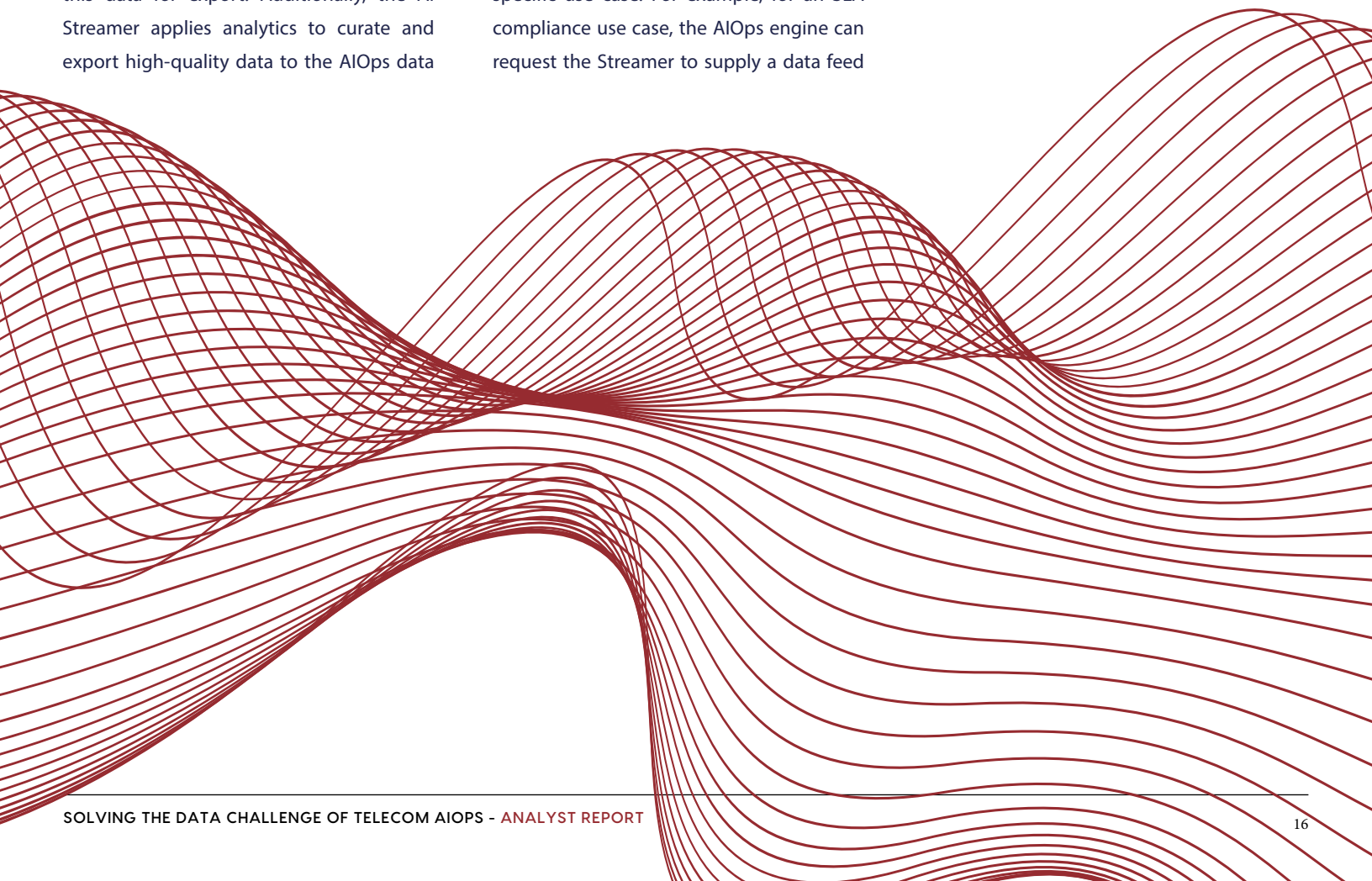
NETSCOUT HELPS SOLVE THE AI DATA CHALLENGE

NETSCOUT delivers this curated data via their Omnis CSP AIOps Insights solution, which includes Omnis CSP AI Sensor and Omnis® CSP AI Streamer. Together, these deliver contextual data in near realtime.

This capability allows cellular real time operators to effectively manage and leverage the complexities of the modern cellular network. The Omnis CSP AI Sensor performs data extraction and analytics through deep packet inspection at the source. The Omnis CSP AI Streamer then collects and enriches this data for export. Additionally, the AI Streamer applies analytics to curate and export high-quality data to the AIOps data pipeline. This data offers an end-to-end view, including RAN-MEC-CORE visibility, all packaged together and available for third-party AIOps consumption.

The comprehensive data curation process leads to data reduction, resulting in less data needing to be stored (reducing data bloat) and processed within the AIOps engine. This, in turn, reduces overall costs and achieves faster results from the AIOps engine. The AI Streamer can be programmed through an open API to provide tailored data for each specific use case. For example, for an SLA compliance use case, the AIOps engine can request the Streamer to supply a data feed where subscribers' WebEx sessions on a 5G SA Slice have RTP latency exceeding a certain threshold or to export only RADIUS failures and the affected MAC addresses on a fixed broadband network.

The high-fidelity curated data provided by the AI Streamer unlocks a myriad of potential use cases for the AIOps engine, including enhancing subscriber experience, network analytics and automation, threat detection, and enabling monetization and personalization, among others.



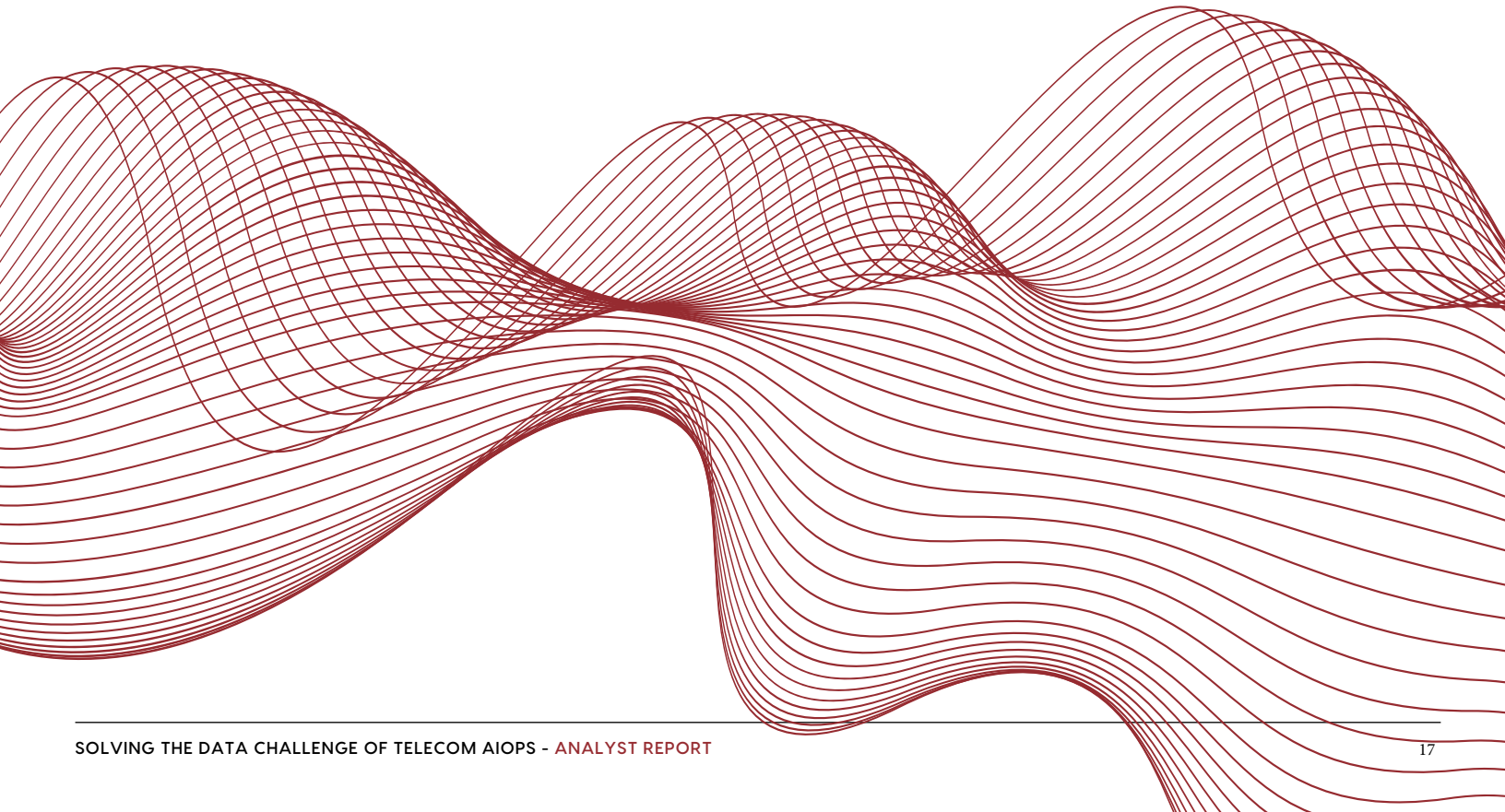
HOLISTIC DATA MANAGEMENT DELIVERING REAL LIFE AIOPS USE CASES

As mentioned, operators are already using AI for many use cases. NETSCOUT has helped its customers solve many challenges by utilizing its solutions that implement a holistic data management approach for AI. Here are two case studies that are typical for any operator.

An operator wanted to measure the user experience of their customers, score it and increase it tangibly. NETSCOUT collaborated with that operator for this project. Together with the operator, they defined a parameter called "Experience Score," which was given to each target user and reflected the perception of their experience. The score was based on accessibility, retainability, and quality of services received. Then, users with low scores were targeted for improvement. AI algorithms were used to analyze the vast amounts of network data to identify which phone types, locations, apps/services, etc... were causing the low score. Once identified, the network team worked on finding out the root cause and solving it to improve their score. NETSCOUT's CSP AI Sensor and Omnis CSP AI Streamer were used for this project.

Another operator decided to partner with retailers to provide just-in-time coupons and offers to their customers so that they can increase revenue together. NETSCOUT worked with the operator and used AI to identify where and when subscribers spend time. AI correlated the anonymized user location to determine the vicinity of popular stores, restaurants, bars, etc... Based on this information, the operator and the retailer were able to create just-in-time offers and campaigns to targeted customers. Further, they were able to correlate the usage of these offers to purchases and determine the campaign's effectiveness. NETSCOUT's RAN TrueCall® and Omnis CSP AI Streamer were used for this project.

These are just a few early examples. There are many successful, high-impact AI use cases that highlight the need for comprehensive network data collection, curation, and management approach.



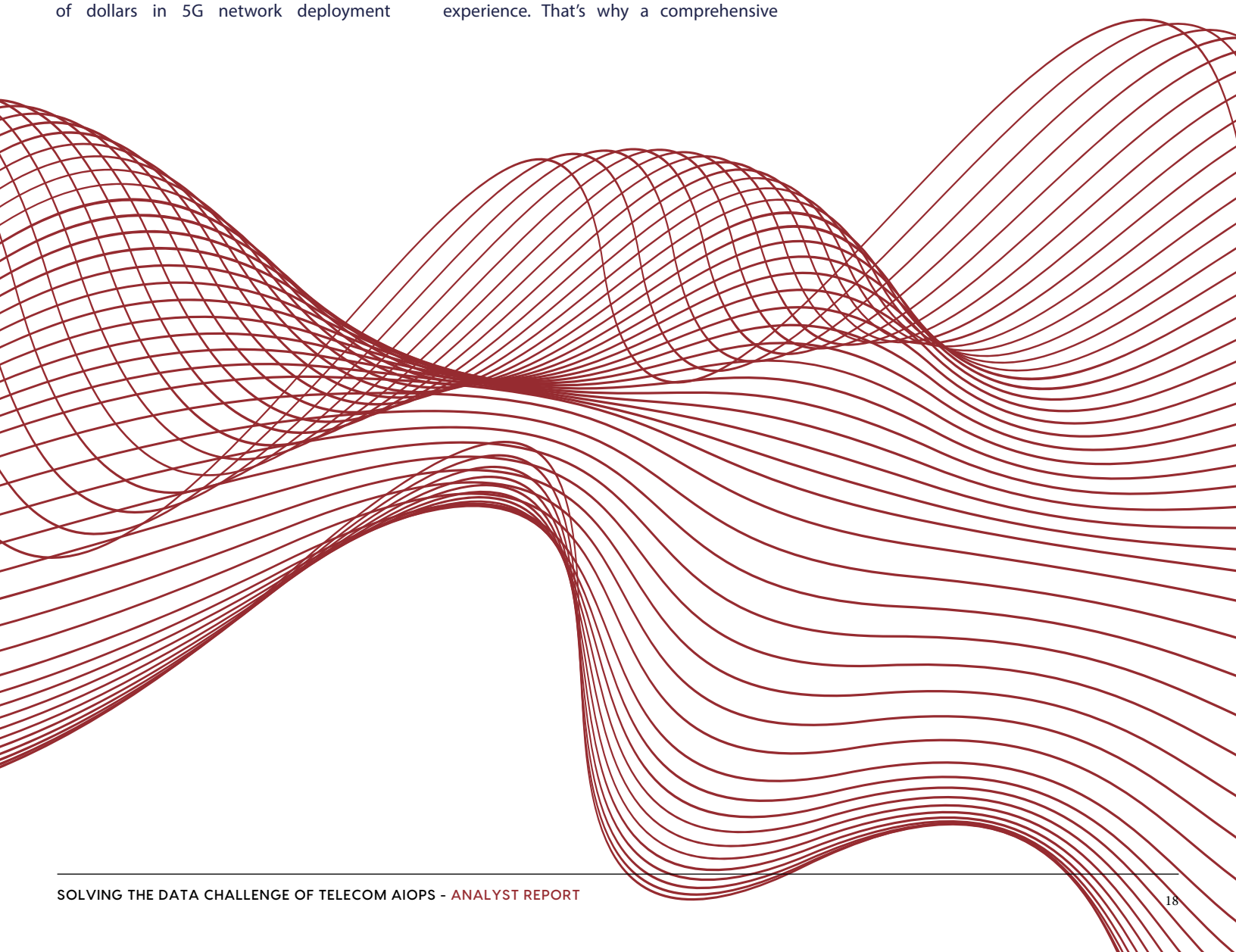
CONCLUSION

AI is not new to telecom, but the rise of Generative AI is set to transform telecom fundamentally and profoundly. There are a wide range of impactful AI use cases across Network Planning and Dimensioning, Radio Link Management, and Customer and Network Operations. They will improve performance, increase efficiency, and lower costs.

Increasing efficiency and lowering costs in network operations is an immediate need for operators, who have invested billions of dollars in 5G network deployment and have yet to see a return on that investment. Automation is key to achieving efficiency and cost improvements, and AI is a key technology in operators' arsenal to accomplish that.

AIOps run on data. The telecom workload is unique, and AI models need valid data to work, be it training or inferencing. But acquiring and curating that data is a major challenge, as there is too much data, not in the right format, and the tools often don't capture an end-to-end view and customer experience. That's why a comprehensive data management approach is absolutely necessary to acquire relevant, sanitized, and verified data and curate it to AIOps in an ingestible format.

NETSCOUT offers solutions that enable cellular operators to employ a comprehensive approach and solve this data challenge of AIOps. Forward-leaning operators are already utilizing these solutions for real-life use cases. A couple of such use cases have been discussed, and there is a huge scope for many more.



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