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Improving Customer Experience and ROI with Mobile Planning, Design, and Optimization

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Contents

Executive summary

Mobile operators set coverage and capacity targets to meet the expectations of their customers and ensure they are competitive with their peers. But overbuilding the network is a waste of precious capital. Finding the right balance is the challenge of network planners, designers, and optimization engineers. This challenge is particularly acute with the advent of 5G, which brings heightened consumer expectations and increased complexity because of the use of high-frequency spectrum bands, and technologies such as massive MIMO (multiple input, multiple output) and beamforming.

Operators need to be efficient in their use of capital as well as in their operations. Within the area of network planning, design, and optimization, operators are looking to increase the level of automation, for example, minimizing the use of drive tests. Operators are already sitting on a wealth of highly granular insights about network quality and user experience. They can leverage these insights through big data analysis and the application of artificial intelligence (AI) techniques such as machine learning (ML).

AI can also help communications service providers (CSPs) to automate the complex process of data collection, forecasting, and scenario analysis. Historical data analysis can be performed on a cell-by-cell basis. Sophisticated models for traffic growth and KPI performance can be developed. By performing cell-level modeling, operators can make their capacity expansions more targeted, improving the customer experience where needed and avoiding investment where not.

To increase efficiency, operations teams involved in the network lifecycle of planning, design, and optimization will need to work more closely than they have in the past, leveraging common systems and tools that provide a common workspace. This workspace should allow them to work across different radio access technologies and with equipment from different suppliers, unifying what is today a fragmented and siloed process.

Network lifecycle automation solutions can help lower the cost of operating existing networks and reduce time to market for new technologies such as 5G. However, it is critical that the different teams involved in planning, design, and optimization collaborate closely. Omdia’s research indicates that some operators are transitioning from siloed network plan, design, and optimization teams to a more collaborative DevOps approach. For these operators, the responsibility for network performance and user experience is shared across the entire team. This has increased efficiency and eliminated duplication of effort.

Network planning, design, and optimization are key to achieving CSPs’ goals of improving customer experience, boosting ROI, and accelerating time to market. Operators must ensure their tools and practices are up to date, leveraging new capabilities such as AI and IT best practices such as cloud-native software. Traditional methods and solutions will not allow them to make the most of their networks as they transition to 5G.

Introduction

Mobile networks have experienced tremendous growth in traffic since the advent of smartphones and 4G. This has placed ever greater demands on the network, forcing operators to purchase extra bandwidth, densify networks with small cells, and improve spectral efficiency via new technologies and network optimization techniques.

The traffic profile of mobile networks has also transformed from the initial use cases of circuit-switched voice and text messages to streaming video, web browsing, and gaming. The encryption of traffic by application providers reduces the visibility into the traffic types crossing operators' networks, making network optimization an even greater challenge for them. For example, streaming video requires high bandwidth but can tolerate high latency thanks to buffering. In contrast, a gaming application might not require as much bandwidth but is intolerant of high latency. A smart grid meter will not need much bandwidth and is latency agnostic. The ability to optimize network resource allocation across these different applications is a major challenge.

The evolution of the mobile network adds even more complexity. Multiple radio access technologies must coexist in noncontiguous spectrum and various cell sizes. And 5G adds to this, bringing new spectrum bands and new service types such as network slicing.

Operators face a constant struggle to balance the needs and desires of the customer for coverage and capacity with the requirement to earn a decent return on investment. Overbuilding the network is not an economically viable option. Therefore, operators must take great care during the planning phase that future network congestion is predicted with corrective measures taken ahead of time and also that unnecessary capex is avoided where a cheaper alternative such as network optimization is possible.

The design phase of the network is key to ensuring the right assets and level of experience are deployed in the right locations. Once the network is built it is important that its parameters (power levels, carrier frequencies, etc.) are optimized on an ongoing basis. There will be plenty of scope to improve both capacity and coverage from existing infrastructure, postponing as much as possible investment in new network gear.

AI technologies and automation can benefit the lifecycle of network planning, design, and optimization. AI promises more efficient utilization of network capacity and spectrum and improvements in the user experience.

This report explores the market context in which operators find themselves today, their challenges, and their strategic priorities. It then explores the mobile network planning, design, and optimization lifecycle in more detail, looking at the use of AI and modern IT practices.

Market context

The telecoms industry is still in the early phase of 5G rollout with many countries still issuing spectrum. Operators are typically adding 5G radios to existing sites rather than densifying their networks. To date there has been little deployment of 5G core. Some operators have managed to leverage a leadership position in 5G deployment to boost ARPU and reduce churn but only where network quality has delivered a noticeable improvement in user experience over 4G.

5G brings new capabilities but greater complexity

While 5G brings better performance in terms of faster data speeds, it also brings more complexity in network design and operation. A lot of the additional capacity associated with 5G comes from using high-frequency spectrum bands above 30GHz, commonly referred to as millimeter wave (mmWave). While there is plenty of spectrum available at these frequencies, the radio waves do not propagate as easily as at low frequencies. This restricts the coverage area for a 5G cell. Reaching inside buildings, where most cellular communication takes place, is particularly challenging at high frequency. This drives the need for careful radio planning to ensure 5G signals can reach subscribers.

Network slicing is expected to be a key component of operators' 5G strategy, enabling them to move away from simply charging by the megabyte. Instead, they will be able to charge for highly differentiated "slices" of network capacity, moving their value propositions beyond connectivity to supporting a wide range of digital services for enterprises and consumers. One such slice could be for fixed wireless access services. To meet the service level commitments associated with network slices, particularly for enterprise customers, operators need to ensure they have planned for sufficient capacity or are able to dynamically add it as required.

Many operators are considering open RAN as an opportunity to disaggregate radio access networks, opening them to niche suppliers. This will undoubtedly complicate network design and optimization. In conventional networks, there is usually a main vendor that takes responsibility for resolving problems; with open RAN it might not be clear which supplier is at fault. Robust planning, design, and optimization (including system integration testing for system-level performance) processes will be required if operators are to make a success of open RAN.

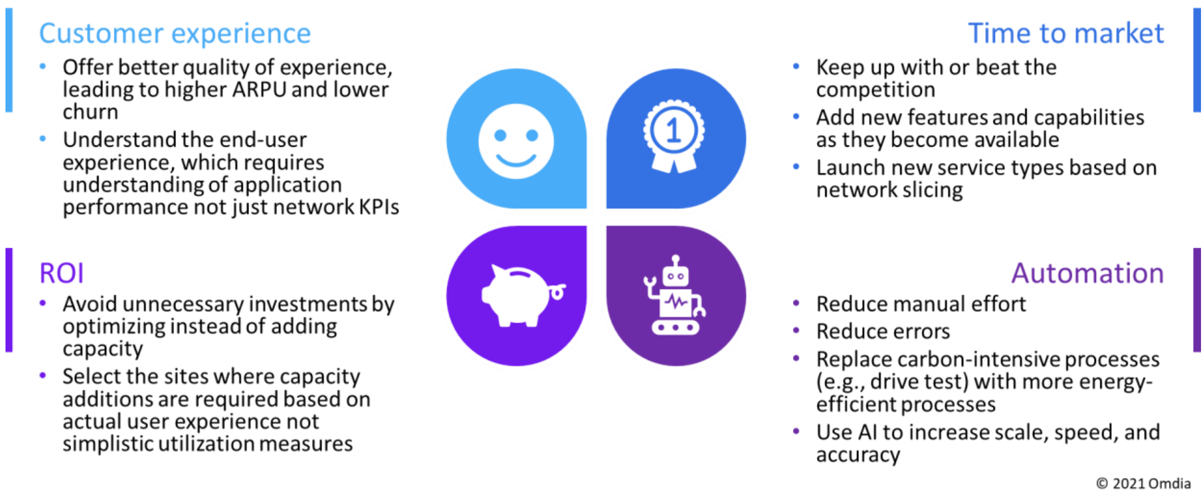
Planning, design, and optimization strategic priorities

As operators deploy 5G, they are aiming to accelerate their time to market through better planning. They are also aiming to maximize their ROI through careful design and optimization. To be efficient operators need to increase the level of automation in their operations, for example, minimizing the use of drive tests to understand their network quality. Operators are already sitting on a wealth of highly granular insights about the network quality and their users' experience. They need to leverage these insights through big data analysis and the application of AI techniques such as ML. The transformation enabled through AI represents a step change in the accuracy of understanding network performance.

Network traffic and complexity will increase significantly with the advent of 5G. Operations teams must meet these demands with tight budget and head-count restrictions, all while managing a growing portfolio of services. To do so operations teams involved in planning, design, and optimization will need to work more closely than they have in the past, leveraging common systems and tools that provide a common workspace. This workspace should allow them to work across multiple different radio access technologies and with equipment from different suppliers, unifying what is today a fragmented and siloed process.

Figure 1 summarizes the network planning, design, and optimization priorities that mobile operators share.

Figure 1: Network planning, design, and optimization priorities



Source: Omdia

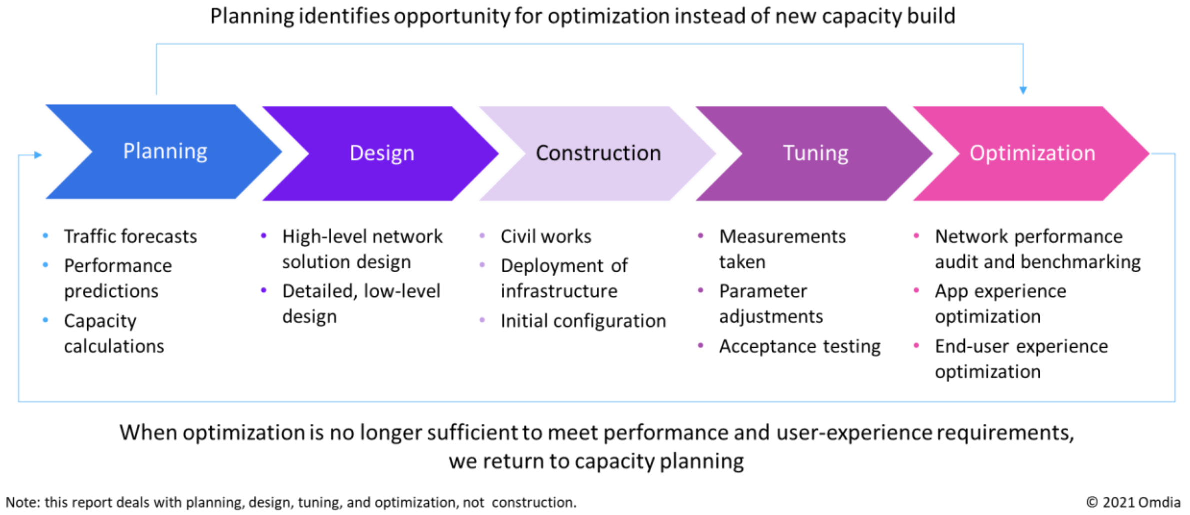
Mobile network lifecycle

Lifecycle overview

The network lifecycle starts with planning. Traffic levels are forecast, and calculations are made regarding how much capacity must be added to the network to keep performance within acceptable boundaries. How that capacity is added is decided in the design phase. The design includes the RAN, backhaul, and mobile core. Initially a high-level solution design is made; once it is approved, a more detailed design is undertaken. The design may be carried out by the operator, outsourced to consultants, or included with the provision of the network by an equipment supplier.

Once the network has been constructed, an initial tuning takes place. Measurements are taken and adjustments made before final acceptance of the infrastructure. Once the network is in operation there is an ongoing requirement for optimization. Periodically the network performance is audited and benchmarked internally (between regions) and externally (with competitors). Based on these audits, certain changes are made to improve network performance. Optimization is not just about measuring network KPIs; operators also need to ensure they can optimize the end-user experience by understanding how particular applications (e.g., VoLTE, video streaming) behave. While optimization enables operators to maximize the return on their network investment, eventually they will run out of scope for improvement (or the law of diminishing returns on incremental optimization effort will apply). The cycle then must start again with planning for additional capacity or new features to be added. The cycle is summarized in **Figure 2**.

Figure 2: Mobile network design and optimization lifecycle



Source: Omdia

Planning

The planning phase starts with the establishment of user experience targets. Network traffic levels are forecast using years of historical data. Based on these forecasts, predictions are made of network performance KPIs and user experience KPIs. Traditionally such planning was based on spreadsheets and was very time consuming, particularly data collection and processing. Only a few scenarios could be forecast given the manual nature of the work. And only a small number of KPIs were taken into consideration. A modern approach that leverages ML can automate the complex process of data collection, forecasting, and scenario analysis.

Traditionally, simple heuristics have been used to compare the utilization of a carrier to the user experience. For example, we might say that carriers experiencing a downlink physical resource block utilization level of over 80% deliver a user throughput of less than 5Mbps. If we decide to upgrade all carriers with utilization over 80%, there will be unnecessary upgrades and some poor-performing carriers that we have missed because we have not considered other factors such as the radio channel quality. We can still have well-performing cells despite their having high utilization as long as the load (number of active users) is sufficiently low and the network quality (channel quality indicator) is high. By applying ML, we can model each cell individually and consider multiple KPIs to predict the cell's performance.

The planning process should also lead to specific recommendations for individual cells down to the sector and carrier level. For example, one carrier in a sector might be overloaded while another is underloaded. Through modeling, the planning system should be able to determine whether shifting traffic from one carrier to another will reduce the load below the carrier's limit or whether an additional carrier will be required. The system should produce a list of cells where carrier load balancing is recommended with the necessary metrics for engineers to carry out an optimization.

If the planning process determines that new cell site locations are required, the system should recommend an approximate site location using clustering techniques. For example, if multiple sectors in an area are predicted to reach congestion, the planning algorithms will propose a new site between them that will alleviate the congestion.

Design

The network design phase aims to determine the best RF configuration and infrastructure layout to meet the operator's business needs regarding coverage, capacity, cost, and quality of service. The quality of the design will affect the performance of the network, its reliability, and potential for future expansion. A good design requires user-centric data that is based on highly granular live traffic. It also needs accurate modeling of the radio products. Logically, the design system should be seamlessly integrated with the planning system, importing load forecasts and other metrics.

The design process encompasses trace-based RF design (footprint optimization), RF planning, and site selection for densification and consolidation (removal of carriers). If new sites are being constructed, the designers will use raster data for site selection. Raster data is a field-based data model that represents real-world geography using grid cells. The cells store location information (latitude, longitude) as well as discrete thematic rasters (e.g., elevation, land-use, soil type). This geographic information system is combined with an RF propagation model to determine suitable locations for new cell sites and appropriate initial RF settings.

Ideally, the system should provide an automated ranking of potential site locations considering both their cost and their contribution to network performance. For example, when designing a brand-new network such as 5G New Radio, the designers might initially aim to reach a defined user-coverage metric by installing 5G radios at a minimum number of existing cell sites that support the 4G network. Consideration should also be given to the site location of competitor networks and their network quality as measured by crowdsourced data.

For indoor designs, where the cost of deployment will be borne by an enterprise customer (e.g., a shopping mall owner), it is critical that the design process be fast so as not to impede the sales process. Experience of prior real-world deployments is critical to making accurate, timely budgets for indoor planning.

Tuning

Network tuning is the initial adjustment of the network after construction but before final product acceptance. When a new network is installed, or new features are activated, the radio network functionality and operation are measured and adjusted.

The systems to support tuning must extract OSS-level data about the network (performance counters, etc.). In addition, they might import crowdsourced data on mobile user experience.

Drive tests are often used to perform these functions. However, because of limitations of scale and speed, CSPs require more effective approaches to network tuning to deliver better user experiences. An alternative to drive tests is the use of call-trace data (RAN telemetry) from real users. With these data sources, operators can perform virtual drive tests, replacing manual logs from a vehicle traveling along fixed routes. Operators can also perform drive tests at any time given the user data is readily available. Traffic and coverage maps can be built both indoors and outdoors. This is advantageous because a large proportion of mobile data traffic occurs indoors. Performance can also be analyzed anytime across the entire network based on the different handsets that customers are using or based on a subset of customers, for example, VIPs.

Although not available and activated in many handsets yet, an important complement to call-trace data is minimization of drive tests (MDT), a standardized mechanism introduced in 3GPP Release 10 to provide operators with network performance data from the user equipment perspective, including accurate latitude, longitude, velocity, and even altitude from the GPS in the device.

CSP example of network tuning

XL Axiata, the Indonesia-based mobile operator, was looking to accelerate its network rollout in the congested capital Jakarta, where average road traffic speed is just 5kph. Instead of further contributing to congestion and carbon emissions with traditional drive tests, it adopted the virtual drive test approach in 2018. XL Axiata industrialized crowdsourced call-trace data collection, processing, and analysis, giving it real-time visibility into the experience of all of its subscribers. The company reduced the amount of drive tests by 90%, saving 18 tons of carbon dioxide each year. It was also able to get much faster site-level performance reporting and increased its deployment project capacity by 20%.

Optimization

Mobile network optimization is about getting the best combination of capacity, coverage, and quality from existing infrastructure. Consideration is also given to reliability, energy consumption, and location-specific requirements. Optimization can be achieved in many ways, such as the reassignment of specific carrier frequencies to cells or the adjustment of power levels. Other aspects include

- Managing interference between cells
- Maintaining appropriate neighbor lists to ensure robust handover between cells
- Optimizing beam configurations (transmit power, direction), physical cell identity distribution, handover parameters, and physical layer parameters

Manual optimization includes the identification of problems and their root causes. Engineers perform manual interventions to reconfigure and tune parameters in the network. Automation takes the same processes and encodes them in software, with AI providing insights to drive automated workflows. This frees the engineer to focus on problem solving instead of workflow processing.

Increasingly the focus of optimization is shifting from network performance to end-user experience based on the performance of popular applications such as streaming video. End-to-end network optimization considers service KPIs that are tailored to the specific apps and services used in each local market. Correlating these service KPIs with network KPIs enables performance optimization opportunities to be identified.

CSP example of optimization

China Unicom has a huge subscription base (about 400 million) and a correspondingly large network (about 2 million nodes). For an experienced engineer to analyze the performance of the worst-performing cells in a target cluster might be a week’s work. With an automated cell issue classification tool, China Unicom was able to exhaustively analyze 100,000 cells and reduce the time to just 15 minutes. Following a successful trial, China Unicom has now deployed the automated solution across three provinces covered by more than 1 million cells in a multi-vendor network. Overall, the solution has saved the network optimization team around 20% of its time and improved troubleshooting accuracy by nearly 90%. As a result, China Unicom has been able to reduce the number of poor-quality cells in its network by around 40%.

Leverage modern IT practices in network planning, design, and optimization

CSPs need to transform current network planning, design, and optimization to address the new challenges they face and to achieve business objectives. Leveraging multi-vendor expertise and modern IT practices such as DevOps, cloud, big data, and AI will play a key role in enabling this transformation.

The importance of multi-vendor support

Networks comprise multiple vendors, technologies, and domains. Working with planning, design, and optimization tools that only support one vendor's technology is inefficient. It is important that tools understand data from different network equipment and cater to the needs of heterogenous network environments. With open RAN the complexities of multi-vendor support will only increase.

Multi-vendor planning, design, and optimization solutions use several different data sources such as network performance and configuration data, geolocation data from call traces, and crowdsourced data to ensure that the challenges presented by working with proprietary vendor tools are addressed. What is most critical is that CSPs can correlate these datasets to gain a complete view of their network and leverage this insight to improve network performance and focus efforts on areas that will deliver business value.

Take a DevOps approach to team collaboration

Network lifecycle automation solutions can help lower the cost of operating existing networks and reduce time to market for new technologies such as 5G. However, the different teams involved in planning, design, and optimization need to collaborate and not work as independent silos.

Omdia's research indicates that some operators are transitioning from siloed network plan, design, and optimization teams to being more collaborative using the DevOps approach. For these operators, this change ensures that the responsibility for network performance and user experience is shared by the entire team. It has also increased efficiency (with less need for external resources) and eliminated duplication of effort.

With a centralized platform, hosting data and tools from each phase of the network lifecycle can facilitate this transition to DevOps. Automated workflows between the various phases of the network lifecycle can be developed, leveraging common tools. Functions such as capacity planning and network optimization can then be executed using common datasets and tools to identify how best to maximize network resources and generate ROI before spending on new resources.

Leverage open solutions

Having an open platform that is flexible and that integrates with third-party systems is a key requirement. Network planning, design, and optimization requirements vary across operators, and no single commercial solution can address all of them. For example, some CSPs have their own propagation and optimization models, which the platform will need to support. The platform insights should also be accessible to other parts of the organization such as financial planning or marketing.

Therefore, it is important that the platforms used for network planning, design, and optimization provide software development kits (SDKs) for a CSP's development team to create custom applications. They should also provide APIs to make data and insights available to third-party systems such as self-organizing network (SON) tools, RAN Intelligent Controllers, and the CSP's big data lake.

With these capabilities, CSPs can enjoy the flexibility to innovate network operations and other business operations that can benefit from network insights.

Big data and AI to drive intelligent network planning, design, and optimization practices

To maximize ROI, CSPs should increase their use of big data analytics in planning, design, and optimization of their networks. Current practices take time and are limited in terms of the datasets used to perform tasks because they are reliant on humans to collect and analyze the data. Results can be inaccurate because a broader set of datasets and the unique requirements of each cell in the network cannot be considered. Consequently, only few network scenarios can be modeled.

Investment in big data lakes and AI technologies will play a crucial role in enhancing how networks are planned, designed, and optimized. The robust data-storage capabilities of open source big data platforms will enable CSPs to capture and store historical and near-real-time datasets from a broader set of KPIs with cell-level granularity. Analysis of these datasets can be achieved using AI technologies, enabling CSPs to adjust quickly to changing network conditions and maximize performance.

Leverage cloud practices to scale deployments

Deploying cloud-native network infrastructure allows CSPs to flexibly adjust provisioning of network resources in line with their customers' needs. Tools supporting such scalable and agile environments need to also transform to being cloud native to align with the new network capabilities. In addition, as the number of services and the amount of equipment supporting them increases, large volumes of data will be generated. These datasets need to be ingested, stored, and processed. Standard on-premises network design, planning, and optimization software is challenged because of a lack of scalability.

With cloud-native tools, CSPs can benefit from the simpler upgrade cycles associated with a microservices architecture. These microservices can be deployed within Docker containers and orchestrated using a common orchestrator, such as Kubernetes, within any cloud environment. The cloud-native software approach brings with it the possibility of a software-as-a-service delivery model (in addition to purchasing a tool), allowing operators to turn an upfront capex item into a smaller operational expense.

Use of AI in network planning, design, and optimization

Why AI is important

AI is a key enabler for automation. With network complexity expected to increase, planning, design, and optimization functions will increasingly leverage AI-driven automation. For example, 5G network planning will need to consider additional factors in the environment that can influence radio propagation. For CSPs to modernize their networks and achieve business objectives—improved revenue performance and customer experience at reduced cost—they must look beyond current manual processes.

AI can also help analyze broader datasets (common datasets mentioned earlier and new ones such as charging and billing data). AI fields such as machine and deep learning can further harness these datasets using supervised, unsupervised, or reinforced learning. Through automation and powerful computing resources, AI-based systems can perform complex analysis much faster than traditional methods. Several operators are already implementing AI to plan, design, and optimize their networks. Some of the use cases deployed are shown in **Table 1**.

Table 1: Use cases for AI across the network lifecycle

Planning	Design	Tuning	Optimization
Traffic forecasting Cell-level performance and experience prediction Automated dimensioning Digital twin	Automating site design and resource allocation Enhanced propagation models Indoor 5G site design Elastic RAN design	Virtualized drive testing Identifying swapped sectors Increased geolocation accuracy Subscriber- and device-level analytics	Improve SON capabilities Network performance monitoring and analysis Network issue classification, for example, uplink interference Root-cause analysis Parameter optimization

Source: Omdia and Ericsson

AI in network planning

Operators need to accurately predict the coverage and capacity requirements of the network. These predictions should be for each individual cell. A broader set of service-specific KPIs should be analyzed. All this analysis should be done quickly so that network planning can be proactive rather than in reaction to customer complaints when network issues occur.

Using ML techniques, CSPs can automate the complex process of data collection, forecasting, scenario analysis, and network slicing. Historical data analysis for each cell can be performed and models for traffic growth and KPI performance developed. Modeling techniques can consider multiple KPIs for each cell. Through individual cell KPI modeling using ML, operators can make their capacity expansions more targeted, improving the customer experience where needed and avoiding overinvesting where additional capacity is not needed. They can also identify whether performance problems are related to radio quality rather than a lack of resources and hence identify cells that need optimization instead of expansion.

AI in network design

Network design focuses on identifying ideal site locations and defining and improving the parameters for a cell and those of its neighbors for network deployment. It is critical that this stage is completed quickly and accurately, especially in pursuit of the 5G enterprise opportunity, which drives the need for enhanced indoor planning capabilities and a faster approach to generating budgetary requirements for private networks. Furthermore, given the seasonality in traffic conditions, limitations to budget, and growing pressure to deliver a high-quality customer experience, CSPs need to perform network design tasks more often. Therefore, they require a more precise but flexible approach to defining the cell parameters to accelerate time to market for new services and to remain competitive.

AI techniques provide opportunities for CSPs to predetermine cell parameters for a new site and for its neighbors. AI techniques such as ML can be applied to historical radio network data to model the complex radio network and its underlying structures such as the relations between cells and baseband unit (BBU) and across BBUs within the same cluster. Several factors can be considered, including distance between cells, signal-to-noise ratio between carriers in each cell, and the intra- and inter-frequency cell coverage. This model then forms the basis to predict network performance and required design specifications. It can also be updated regularly to ensure an accurate view and allocation of radio resources in line with customer expectations.

Deep learning can be used for 3D modeling of the network environment and its radio performance. These models can take into consideration small objects such as trees and building materials that traditional planning tools may omit. This level of granularity is particularly critical to mmWave spectrum because the propagation of these signals is affected by these objects.

The result of using AI to support the network design process is better predictions to prioritize sites for network upgrades. It also gives scalability and flexibility in resource allocation that is not provided by the static propagation models used in most networks today.

AI in network tuning

To accelerate time to market of newly deployed network infrastructure and reduce the number of customer complaints at new service launch, CSPs need to improve their site acceptance optimization processes. Most CSPs continue to see drive testing as a core practice. However, drive testing is time consuming with limited visibility into actual user experience, and the data is soon out of date. AI presents an alternative approach to drive testing with the benefits of speed, improved accuracy with geolocation, and reduced carbon dioxide emissions.

Virtual drive testing uses AI to correlate broad datasets including network performance and configuration data, geolocated data from call traces, and crowdsourced data. These AI-based solutions can cover wider areas and provide greater insights into the real experience of end users. Use cases such as detection of swapped sectors and areas with poor network performance data (e.g., high dropped-call rates and bad coverage) can be achieved by leveraging ML clustering performed on call-trace data. Root-cause analysis of these network issues can also be identified with suggested remedial actions provided from the AI-based systems. The result is faster time to market for high-quality services and reduced opex because less time is spent spotting and resolving issues after network deployment.

AI in network optimization

The objective of every network optimization task is to ensure the network delivers high-quality services. It also ensures that deployed network assets are utilized to their maximum potential before expansion is considered. As the number of subscribers and the amount of network equipment has increased, optimizing the network has become increasingly challenging. CSPs need to improve the accuracy and speed of their network quality improvement efforts. They also need to identify cell performance issues and recommend changes with high precision to ensure that customer experience and network costs are balanced.

By correlating and analyzing a broad set of data, AI techniques such as deep learning can cluster problematic cells based on parameters such as coverage, load, mobility, and uplink interference. These datasets might include performance, configuration, geolocation, and alarms. Using these datasets, AI techniques can identify common issues associated with problematic cells and suggest configuration changes.

Recommendations to resolve issues can also be provided, including retuning network parameters such as antenna tilt angles, cell handover parameters, hyperparameters for self-organizing networks algorithms, L3 algorithms (mobility and load balancing), and L1/L2 algorithms (uplink power control, link adaptation, scheduling, etc.).

CSPs and vendors can look to AI techniques such as reinforced learning to analyze network performance following implementation of recommended parameter changes. Further retuning can be also be performed and performance assessed until optimal performance is achieved.

Benefits of an AI-driven approach

Leveraging AI in mobile network planning, design, and optimization comes with several benefits including the following:

- CSPs gain from accelerated pace in completing analysis and forecasting tasks and doing so at high accuracy.

- Predictive capabilities of AI enable more proactive operations, with network issues resolved before they have an impact on customer experience.
- The scale of the number of cells, KPIs, and network issues addressed and resolved is greater than with manual processes.
- Operations such as drive testing are transformed to more efficient and real-time functions with reduced environmental impact.

Several CSPs have enjoyed these benefits as illustrated by the examples given in **Table 2**.

Table 2: Use cases for AI spanning mobile network lifecycle

CSP	Problem	Solution	Results
NTT DoCoMo	Needed to increase accuracy and speed of network quality improvements	Implemented a containerized performance diagnostics solution based on AI	98% accuracy in troubleshooting network faults Increased scale for optimization tasks following trial in 12 cities and expanded nationwide
China Unicom	Being able to accelerate data and KPI processing to mine insights for optimization tasks	Integrated an AI-based diagnostics module to in-house big data platform hosting data from more than 1 million cells across the network	Fast processing with millions of cells analyzed in 30 minutes 20% reduction in time per FTE working on optimization tasks
dtac Thailand	Needed to improve Net Promoter Score and contain opex for multi-vendor network environment Depart from congestion monitoring to predictive capacity planning	Collected and analyzed using AI techniques historical datasets across 150,000 cells. Generated a predictive model that provides network performance data three months in advance, enabling the CSP to take proactive steps to resolve issues before customer experience is affected	Increased speed in analyzing network scenarios: processed two years' worth of data for 150,000 cells in 30 minutes Greater than 75% accuracy in predicting capacity issues, three months in advance 80% operational efficiency in network planning tasks
XL Axiata	To depart from traditional, batch-based drive test-based approach to testing and optimizing the network to reduce carbon dioxide impact	Utilize AI to provide fast processing of crowdsourced data to provide better visibility of subscriber experience	60% increase in site-level report generation 90% reduction in the use of drive testing

Source: Omdia and Ericsson

Conclusions and recommendations

The complexity of CSPs' networks is a given and will demand a transformed approach to network planning, design, and optimization. Multi-vendor support, adopting a DevOps approach to team collaboration, and utilizing open and cloud-native solutions will be key to this transformation.

Automation driven by AI and big data will also enable CSPs to achieve their business objectives such as minimizing capex while meeting their customers' needs thanks to increased accuracy in determining network requirements. There are, however, challenges that must be addressed to successfully implement AI. These include dealing with skepticism about "black-box" solutions and data access and quality issues.

Some CSP radio specialists and executives Omdia has spoken with have suggested that AI does not possess enough local knowledge to effectively plan and optimize the network. Other CSP executives have noted difficulty convincing employees to use AI-based systems given their lack of confidence. For example, a director from a Europe-based CSP said, "It is hard to get the operations team confident about AI as the tools cannot explain their decisions."

CSPs and vendors have a role to play in addressing these concerns. CSPs need to take a stepwise approach to implementing AI-based systems. As employees' confidence in these systems grows, they are likely to allow them to act more autonomously. AI-based network plan, design, and optimization solutions should include explainable AI (with algorithmic accountability), providing documentation with guidance on how models work and how decisions are made. This guidance is necessary to build employee confidence in the AI-based solutions and help them make changes to the models when required. DevOps practices such as continuous integration, continuous development (CI/CD) are also required to enable fast adaptation to changing local network behavior.

The success of AI deployments depends on high-quality data being readily accessible. Therefore, CSPs should prioritize investment in big data lakes to house multiple datasets with well-established governance policies.

The decision to develop in-house AI tools or to purchase vendor solutions varies depending on CSPs' current AI expertise. Top-tier CSPs such as AT&T and Orange are developing AI-based tools but are open to working with vendors that they consider better positioned, from a quality and cost perspective, to address specific needs.

When selecting a vendor partner, CSPs should ensure that it possesses strong telco expertise and a roadmap to continuously evolve its AI capabilities. They also should consider the vendor's flexibility in supporting their needs when either outsourcing or insourcing network lifecycle functions. Most importantly, CSPs should take a collaborative approach when engaging with technology partners, because this will be critical to advancing their use of AI.

Appendix

Methodology

This report is based on research conducted in January and February 2021. Qualitative surveys were conducted with executives from CSPs and vendors with operations across the globe to understand trends and challenges faced in mobile network planning, design, and optimization.

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We hope that this analysis will help you make informed and imaginative business decisions. If you have further requirements, Omdia's consulting team may be able to help your company identify future trends and opportunities.

About Ericsson

Ericsson enables communications service providers to capture the full value of connectivity. The company's portfolio spans networks, digital services, managed services, and emerging business. It is designed to help our customers go digital, increase efficiency, and find new revenue streams. Ericsson's innovation investments have delivered the benefits of mobility and mobile broadband to billions of people around the world. Ericsson stock is listed on Nasdaq Stockholm and on Nasdaq New York. www.ericsson.com

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