

Machine Learning-based 5G RAN Planning



European Telecom Leader Pilots Subex Capacity Management, Achieves Superior customer experience with 5G RAN planning

Case Study

Client overview

The communication service provider (CSP) is a market leader in the European region, providing a range of services around mobility, television, home security, to name a few. They initiated their 5G journey in 2020, and have a clear agenda to cover more than 70% of the network with upgraded 5G RAN by 2022. Towards this, the CSP wanted to apply a superior capacity planning process, specific to 5G, to deliver enhanced customer experience by leveraging methods providing high accuracy towards service-driven capacity planning. At the same time, they wanted a capability that would enable them to make the right investment decisions to bring cost efficiencies and faster ROI as they upgrade their RAN for 5G. Well-aware of the complexity, the operator wanted to leverage AI/ML-based capacity planning tools that would facilitate network and budget plans based on accurate decisions.

Need for accurate analytics in 5G Planning

Today's digital ecosystem and a CSP's vision to 5G evolution demands accurate decision-making to ensure investments are made in the right areas and at the right time. 5G RAN, which accounts for 70% of the total network Capex investments, requires higher accuracy than any other domain. The three key areas where CSPs need to bring accuracy are:



Forecasting the existing services growth in the network and the capacity need to meet the demand



To accurately analyze the capacity demand of new service launch in the market



Understand and analyze the impact of new feature implementation on customer experience

Challenges

The objective of the evaluation program was to run different simulations and iterations and compare the results before finalizing the plan. Some immediate challenges were:



Traditional planning methods cannot ensure a high degree of accuracy, which would lead to Capex inefficiencies.



Complexities due to the challenges associated with demographics, bands, services, and technologies.



Ability to balance network investments, customer experience, and profitability.

Subex solution and implementation

Considering the scale and future impact of the program, Subex delivered value to the operator leveraging its proprietary AI/ML-based solution, Capacity Management. Subex applied its Network Investment Planning feature set to provide actionable insights to the capacity-related budgeting to meet future demands. The solution, built on a big data platform, leveraging microservices and cloud-native elements and applying advanced analytics on various datasets, ranging from network, financial, and customer experience metrics. This helped the CSP to make accurate and efficient decisions to plan for new services for 5G.

Solution highlights

With Subex's Capacity Management solution, a large set of historical data was fed into its advanced analytics engine, HyperlogIQ, the output of which was used to run multiple iterations and scenarios. The primary solution stages were:

01

Accurately forecasting the growth of existing services by leveraging Subex's proprietary machine learning model "CapMan4C®."

The operator was also able to apply Subex Capacity Management solutions to forecast the demand traffic for different types of services (data, video, and voice) at different bands/frequencies using Subex's proprietary Machine Learning-based models.

Data Service:

Actual
Forecasted

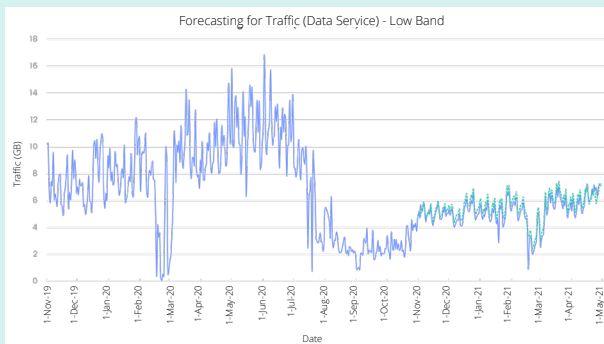


Figure 1 - Forecasting for Traffic (Data Service) - Low Band

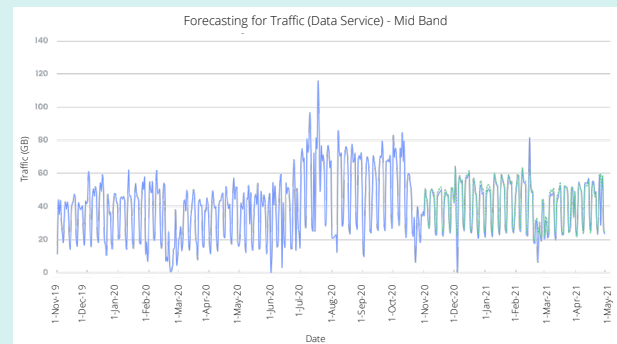


Figure 2 - Forecasting for Traffic (Data Service) - Mid Band

Video Service:

Actual
Forecasted

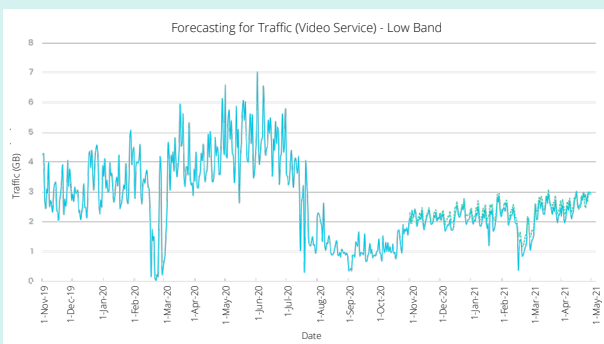


Figure 3 - Forecasting for Traffic (Video Service) - Low Band

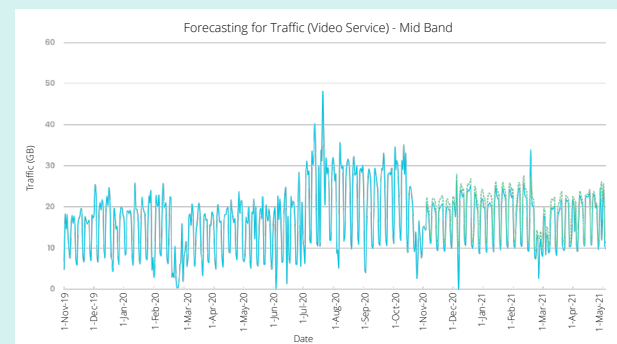


Figure 4 - Forecasting for Traffic (Video Service) - Mid Band

Voice Service:

Actual
Forecasted

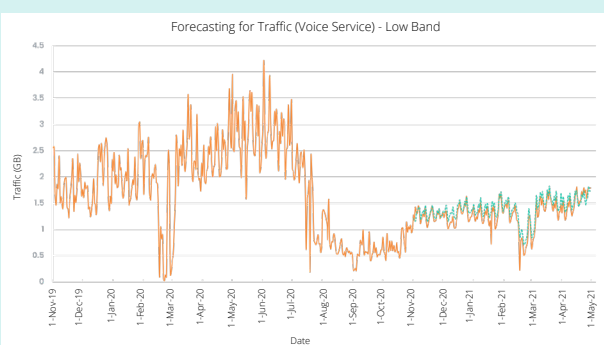


Figure 5 - Forecasting for Traffic (Voice Service) - Low Band

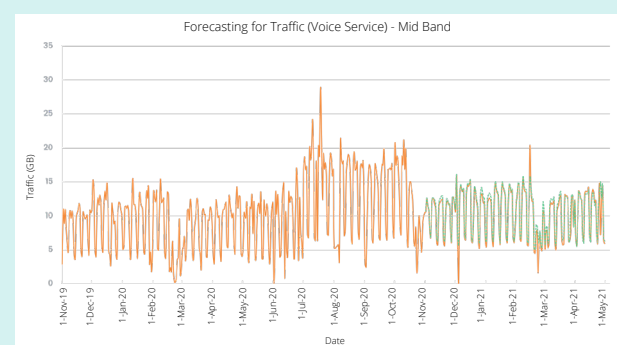


Figure 6 - Forecasting for Traffic (Voice Service) - Mid Band

Validating the accuracy of output –

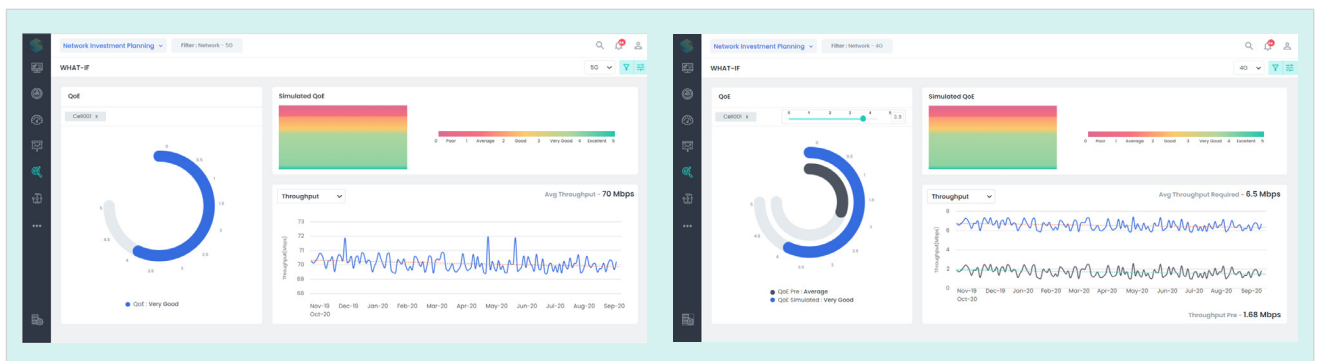
The operator compared Subex's forecasts with internal data holding the actual values of the chosen KPIs. Symmetric Mean Absolute Percentage Error (sMAPE) was used to validate the accuracy whereby a lower sMAPE indicates a superior forecast. The main results are:



02

What-if simulations to simulate planning scenarios for the launch of new services built on 5G

Subex leveraged Machine Learning-based multivariate what-if simulations to help the CSP predict the capacity demand required for launching new services on 5G. This, in turn, helped the CSP improve the Quality of Experience for different services in the network and gain competitive advantage. Subex was also able to help the CSP in their current 5G planning and capacity management by providing them recommendations on the optimal user throughput requirements for superior Quality of Experience, in this case, 4K (Ultra-HD) video content, in their network using 5G.



03

Intelligent Impact analysis for new feature roll-out on 4G and 5G

With the application of Subex's ML algorithms to derive accurate impact analysis of a series of new feature implementation for 5G, the CSP facilitated smart decision-making and understood the impact on QoS and QoE. Massive MIMO is a broad-scale antenna technology and a fundamental building block of 5G communications technology. The intelligent impact analysis was applied to practically understand the advantages in the CSPs network and impact on customer experience. It helped the operator to analyze the remarkable gain in performance and data capacity. The analysis and subsequent implementation of Massive MIMO in the selected trial cluster enabled the CSP to exploit the 5G spectrum optimally to maximize their return over investments (ROI).

To evaluate the capacity, a traditional way is to utilize Shannon's Capacity formula. The achieved capacity is a logarithmic curve, which is linear at low signal-to-interference-plus-noise ratio (SINR) and deflates at high SINR.

$$C = BW * \log_2(1 + \text{SINR})$$

where C is the achievable channel capacity, BW is the bandwidth, SINR is the signal-to-interference-plus-noise ratio and usually expressed in decibels (dB).

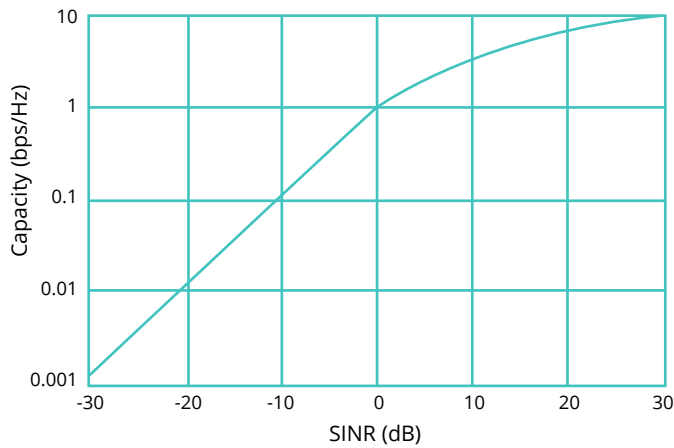


Figure 1

As seen from the above figure, the relation between SINR and capacity remains linear in the low SINR region. As mentioned earlier, Beamforming is a key technique used in Massive MIMO. In the low SINR range, Beamforming helps to have an elevated SINR due to directional nature and antenna gain. The high SINR region can take advantage of other Massive MIMO attributes such as spatial multiplexing with multiple users.

Figure 2 highlights a comparison of the average channel capacity for various use cases at specific SINR values. It is evident that by increasing the configuration from SISO towards MIMO 2x2 and MIMO 4x4, there is good capacity gain (~1.5x, 2x). At the same time, when compared with Massive MIMO, the gain is exceptional; it reaches beyond 5x.

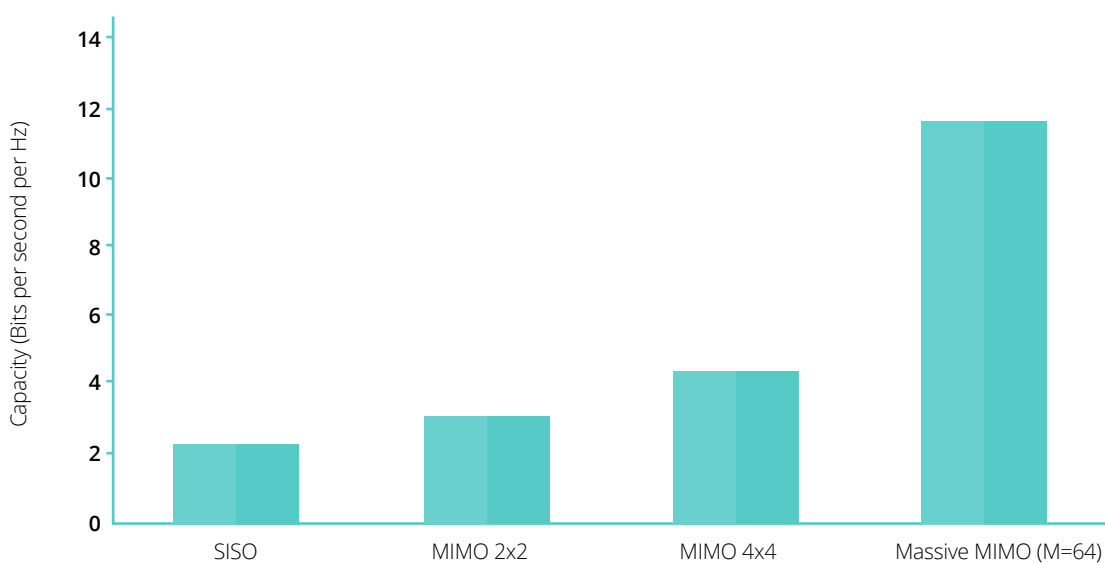


Figure 2

A practical comparison in the scenario of how different forms of MIMO impacts the network performance can be seen in figure 3, which indicates throughput gain when the site is enabled with 8x8 when compared to 4x4 MIMO. The performance gain also gets translated into a better user experience. Figure 4 shows post 8x8 MIMO enablement at the site, user QoE (Quality of experience) performs much better.

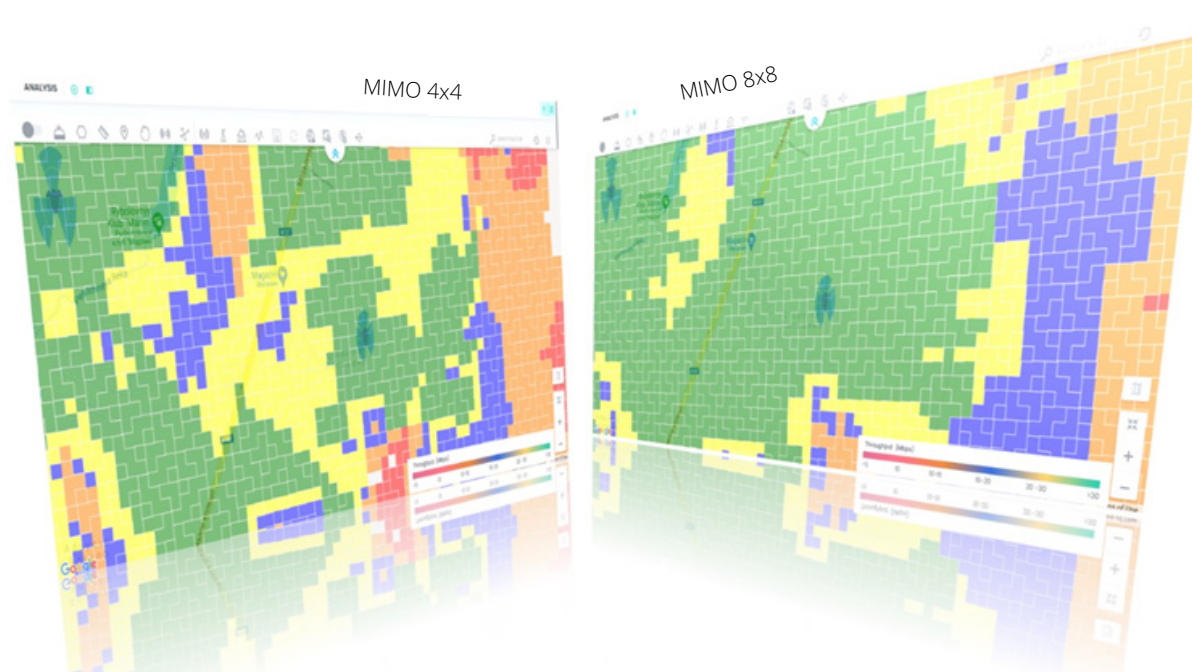


Figure 3: MIMO 4x4 vs. MIMO 8x8 Performance

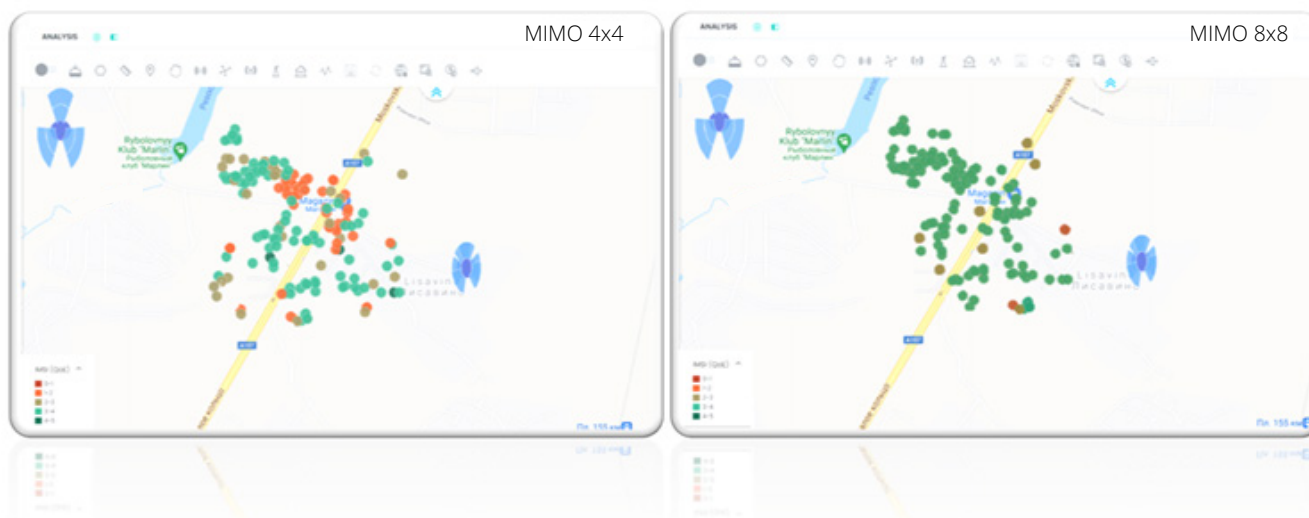


Figure 4: QoE comparison

The intelligent impact analysis also considered cost modeling, which emerged as a crucial capability that clearly distinguished the most profitable method to achieve desired capacity gains. On the same lines, Figure 5 summarizes the capacity and cost comparison of various solutions. Inputs depend on research done in a specific geography, which may vary based on a plurality of factors. Though cost and capacity have a linear relationship, massive MIMO has a steep rise in cost because Massive MIMO solutions require a significant investment in infrastructure.

On one side, exceptional capacity gains were achieved from Massive MIMO, but on the other, an exponential increase in costs was also triggered. Subex's solution helped the operator make a real trade-off between cost and capacity gains towards 5G network capacity expansions not just on Massive MIMO, but on other expensive 5G features as well.

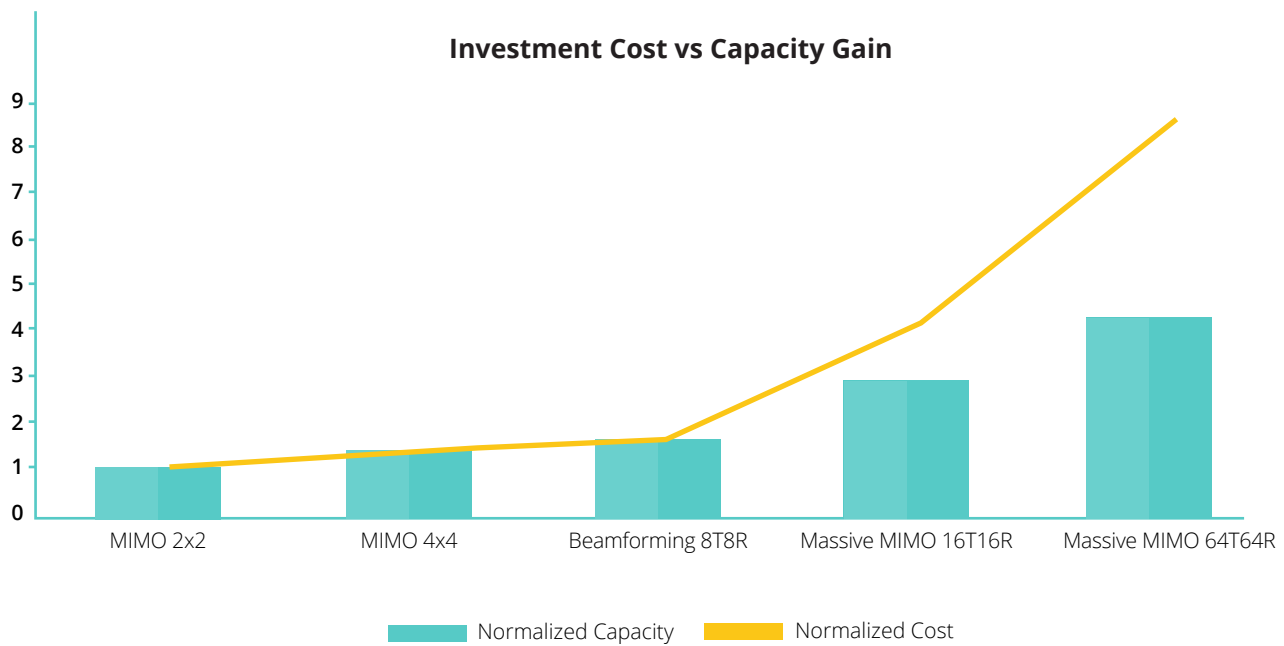
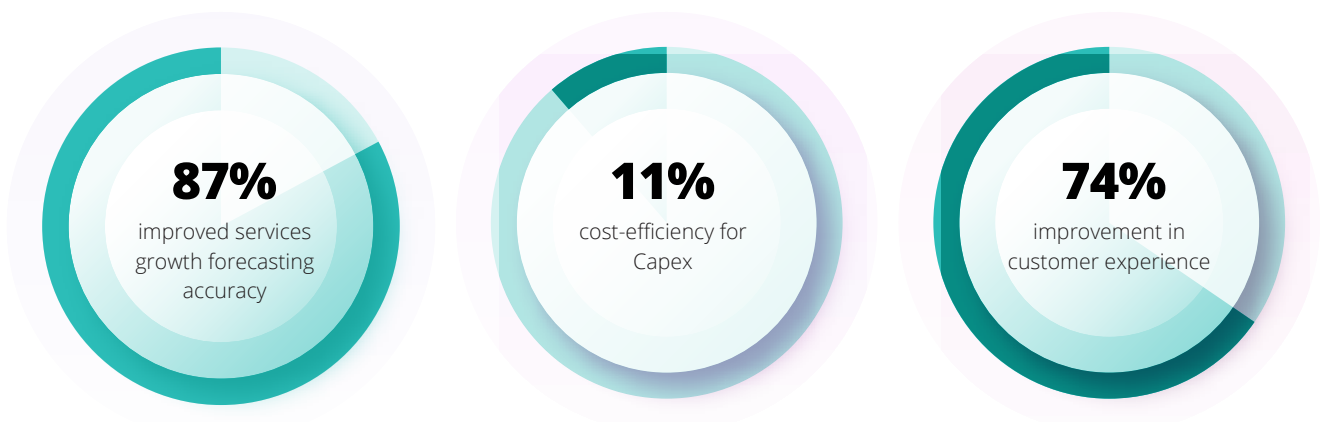


Figure 5

Business Benefits

Subex Capacity Management helped the operator to better plan its network upgrade and optimize Capex for its 5G RAN roll-out. Through the deployment, the below business values were realized:



With Subex proprietary ML models and their application to realize accurate forecasting, what-if simulations, and intelligent impact analysis, the solution helped the operator maximize ROI through the smart decision-making and effective budget planning.

Testimonial

"Subex Capacity Management tool has significantly helped us accurately plan RAN capacity for 4G/5G. The solution also helped us to generate ROI-driven network-wide plans by leveraging forecasted KPIs containing all the required capacity additions at cell/site/cluster/network level (spectrum addition or new feature implementation, etc.). We have found the solution to be very helpful and will ensure we can easily handle the traffic that we will have in our network by 2022."

About Subex

Subex is a pioneer in enabling Digital Trust for businesses across the globe. Founded in 1994, Subex helps its customers maximise their revenues and profitability. With a legacy of having served the market through world-class solutions for business optimisation and analytics, Subex is now leading the way by enabling all-round Digital Trust in the business ecosystems of its customers. Focusing on risk mitigation, security, predictability and intelligence, Subex helps businesses embrace disruptive changes and succeed with confidence in creating a secure digital world for their customers.

Through HyperSense, an end-to-end augmented analytics platform, Subex empowers communications service providers and enterprise customers to make faster, better decisions by leveraging Artificial Intelligence (AI) analytics across the data value chain. The solution allows users without a knowledge of coding to easily aggregate data from disparate sources, turn data into insights by building, interpreting and tuning AI models, and effortlessly share their findings across the organisation, all on a no-code platform.

Subex also offers scalable Managed Services and Business Consulting services. Subex has more than 300 installations across 90+ countries. For more information, visit www.subex.com

Subex Limited

Pritech Park SEZ, Block-09,
4th floor, B wing,
Survey No.51 to 64/4
Outer Ring road, Varthur Hobli,
Bengaluru 560103 India

Tel: +91 80 6659 8700
Fax: +91 80 6696 3333

Subex, Inc

12303 Airport Way,
Bldg. 1, Ste. 390,
Broomfield, CO 80021

Tel : +1 303 301 6200
Fax : +1 303 301 6201

Subex (UK) Ltd

1st Floor, Rama
17 St Ann's Road,
Harrow, Middlesex,
HA1 1JU

Tel: +44 0207 8265300
Fax: +44 0207 8265352

Subex (Asia Pacific) Pte. Limited

175A, Bencoolen Street,
#08-03 Burlington Square,
Singapore 189650

Tel: +65 6338 1218
Fax: +65 6338 1216