Altran — Part of Capgemini

5G RADIO ACCESS NETWORK PLANNING AND OPTIMIZATION

A SINGLE WINDOW SOLUTION FOR 5G RADIO

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Fifth Generation (5G) mobile networks are designed to meet various customer requirements and demands. Mobile traffic is expected to grow to 49 exabytes per month by 2021. The number of connected devices is projected to grow by 50% from 8 to 12 billion. As per the Next Generation Mobile Network (NGMN) alliances, below are some of the key expectations or demands from 5G. And hence it is identified and designed as sustainable and scalable next-generation technology.

- 1 Gigabit per second data rate
- Simultaneous million connections of wireless sensors or users
- Enhanced spectral efficiency
- Improved coverage and signaling efficiency
- Low latency of less than 1ms

Due to these customer demands, the telecom industry will rapidly transition to meet demand and usage growth. To achieve the requirements related to 5G, technologies like mmWave, flexible numerology, hardware optimization, and Massive MIMO, along with automation of the process play a significant role.

Massive MIMO will be a crucial driver in spectral efficiency by serving both vertically and horizontally distributed users making sites more impactful. Here is the role of accurate network planning to effectively utilize the resources and meet customer requirements and deploy the network cost-efficiently. 5G RF planning should consider the challenges in planning and address them effectively. Also, the need to strategically use the massive MIMO, 3D beamforming technology and other enabling technologies to address all kinds of customer requirements and use cases.

5G Network optimization is more complex compared to existing technologies because of its composite design and surge in the number of parameters to be tuned. Also, it should ensure interworking with legacy technologies and HetNet. So Artificial intelligence (AI) has a key role to play in helping operators to increase network performance and shorten time to market new features. In the longer term, the integration of AI into current and future generations of cellular access will be critical to achieving the vision of creating a cellular network that continually adapts itself both to customer requirements and the static and dynamic characteristics of different scenarios. It maximizes the Quality of Services (QoS)/Quality of Experience (QoE) while minimizing investments.

This whitepaper is intended to identify multiple challenges and the Altran's solution approach and value proposition for the 5G RAN planning and optimization. And to be present as Altran's Vision document for the transition towards the 5G, which attributes the knowledge and capability of the team in the sphere of Radio Access Network (RAN) planning and optimization.

INTRODUCTION

The introduction of 5G mobile networks opens a wide range of business opportunities and use cases. It provides the operators the opportunity to tap into the revenue streams emerging from the digitization of industries. On the other hand, 5G is designed to address the wide range of needs of vertical industries (e.g., energy, e-health, smart city, connected cars, industrial manufacturing, etc.). Below is the high-level list of 5G major use cases along with service categorization.

- Enhanced mobile broadband services (eMBB services)
- Massive machine-type communications (mMTC services)
- Ultra-reliable low latency communications (uRLLC services)

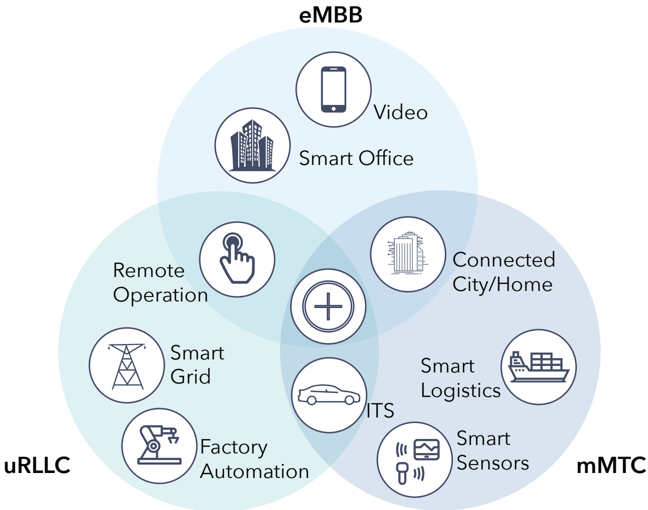

Figure 1: 5G Use Cases

The detailed KPI's and Specifications related to eMBB, URLLC and mMTC services are given below.[1]

Use Cases	Key Performance Indicator	Specifications
Enhanced Mobile Broadband (eMBB)	Data Rate	10-20 Gbps Peak
	Mobility Speed	500 km/h
	Use Scenario	Macro and Small Cells
	Network Efficiency	Network Energy saving by 100x
Massive Machine Type Communication (mMTC)	Connection Density	2 x 10^5 - 10^6/km^2
	Coverage	Long Range
	Data Rate	1-100 kbps
	Battery Life	10 Years
	Cost	M2M ulta low cost
	Access method	Asynchronous Access
Ultra Reliable Low Latency Communications (URLLC)	Latency	<1ms Air Interface Latency
		5 ms E2E Latency
	Reliable and Available	99.9999%
	Data Rate	50 kbps - 10 Mbps
	Mobility	High Speed Mobility

Table 1: 5G Requirements and Specifications

To deliver the above defined use cases and meet customer demands, 5G New Radio (NR) needs to have greater flexibility and scalability. Hence the planning and optimization of the 5G radio device system become more important when compared to the previous generation network.

With every change in technology, the complication related to planning and optimization also increases along with demands to meet the requirements and form the right balance between the cost-efficiency and interworking with legacy networks.

5G Introduced the concept of Network Slicing that addresses the deployment of multiple logical networks as an independent business operations on a common physical infrastructure to provide network slices "as-a-service." These address a wide range of use cases for the different industries that add more complexities to network planning and optimization.

Therefore, accurate and cost-efficient network planning plays a major role in network deployment along with the right optimization channels. In this whitepaper, we aim to address the challenges and solutions for better radio access network planning and optimization.

[1.] https://ranplanwireless.com/wp-content/uploads/5G-NR-Planning-White-Paper-by-Ranplan-Wireless.pdf

5G NR KEY ENABLING TECHNOLOGIES

Before providing our point of view on various challenges and solutions around planning and optimization. In this section, we shall discuss more on various key enabling technologies that are available within 5G radio services to meet the customer demands and support the above listed challenges that arise from use cases like eMBB, mMTC, and uRLLC.

Millimetre-Wave Communications

Traditional cellular networks use frequencies from 300MHz to 3GHz. Due to a higher wavelength, signals can be transmitted to several kilometers without significant loss. The penetration loss also is less and it is suitable for better indoor coverage in a sub-mmWave band. However, with the higher data demands, relying only on the spectrum below, 3GHz is not feasible to deliver eMBB services, which requires up to 10Gbps. 5G, with its potential to provide higher capacity, is exploring the opportunity to use the spectrum above 3GHz, mainly the mmWave range (30GHz to 300Ghz).

Massive MIMO

Massive Multiple Input – Multiple Output (mMIMO) is a key component in 5G new radio deployment. Each base station is equipped with multiple numbers of antennas transmitting concurrently using the same time-frequency resources. 5G is using the higher frequency bands with a shorter wavelength. Based on the below formula, when the wavelength reduces, the received signal power also reduces significantly. The transmitter and receiver antenna gain should be increased to overcome this issue. Increasing the number of transmitters and receiver antennas is the practical solution to increase the gain. So mMIMO is playing a major role in 5G to improve received signal power. [2]

[2.] https://www.youtube.com/watch?v=BQ45FuGpFQ0

$$P_{rx} = \frac{P_{tx}}{4\pi R^2} \frac{\lambda^2}{4\pi} G_{rx} G_{tx}$$

P_{rx} = Received Power
P_{tx} = Transmitted Power
R = Distance Between Tx and Rx Antenna
λ = Wavelength
G_{rx} = Transmitter Antenna Gain
G_{tx} = Receiver Antenna Gain

3D Beamforming

Beamforming is a spatial signal processing technique with antenna array for directional signal transmission and reception by intentionally controlling the phase and relative amplitude on the same signal at each antenna. Contemporary multi-antenna base stations for cellular communications are equipped with 2-8 antennas which are deployed horizontally and are capable of steering beams in 2D. If we instead deploy multiple uniform liner arrays on top of each other, it is possible to control both the azimuth and elevation angle of a beam. This is called 3D beamforming.

With a massive number of antennas, beamforming creates beams both vertically and horizontally towards the user. The major advantages of 3D beamforming is increased data rate and capacity, less intercell and inter-sector interference, higher energy efficiency, improved coverage and increased spectral efficiency.

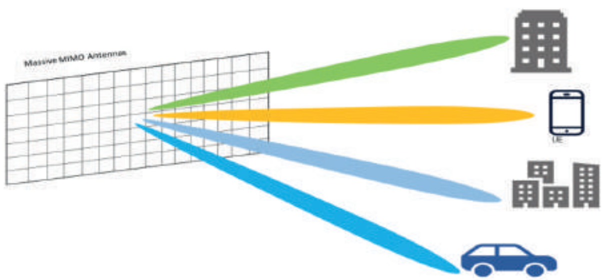

Figure 2: 3D Beamforming

Frame Structure

Different subcarrier spacing is introduced in the 5G NR system to accommodate large bandwidths in mmWave. The postulate introduces scalable Orthogonal Frequency Division Multiplexing (OFDM) subcarrier spacing and cyclic prefix durations based on carrier frequency and bandwidth. The increase in subcarrier spacing shortens the subframe duration.

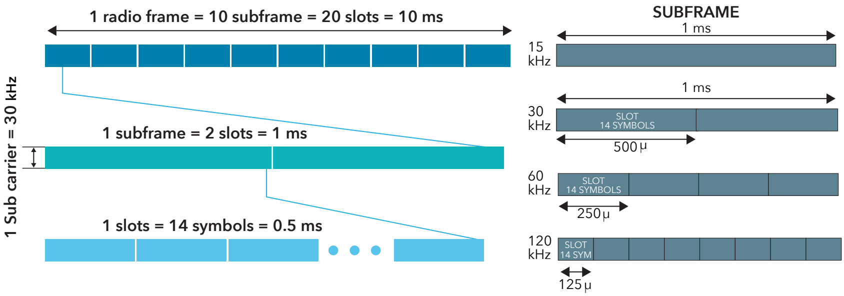

Figure 3: Frame Structure

RADIO NETWORK PLANNING CHALLENGES

Some of the significant challenges for 5G radio network planning are listed below:

Spectrum Challenges

5G NR planning in low (e.g., 600MHz, 700MHz, 2.6GHz, 3.5GHz) and high (e.g., mmW: 15GHz, 24GHz, 28GHz, 39GHz) frequencies had various scopes and challenges. With a higher wavelength, the sub-6GHz spectrum required fewer sites to ensure continuous mobile connectivity. However, the availability of bandwidth is less in low bands and require multiple carrier aggregation needed to meet the desired throughput.

The high frequency mmWave spectrum, characterized by shorter wavelength, causes smaller transmitting length and hence required a high number of sites to ensure blanket mobile connectivity. For outdoor, it creates more coverage holes compared to the low band spectrum. So this spectrum is suitable for hotspots, such as high traffic and dense population and enterprises with high bandwidth demanding use cases. For instance, use cases such as high definition video streaming (UHD, 4K, 8K, 3D), remote diagnosis for healthcare (it can also be used for URLLC), low latency demanding applications (such as augmented reality, virtual reality, remote surgery mentoring) and industrial IoT applications.

5G deployments have significant challenges from propagation characteristics and dependencies, like vegetation, building, materials, and weather which will jeopardize the delivery of consistent coverage. It will highly impact the indoor coverage due to lower penetration capacity. So, it is suitable for high capacity and shorter distances.

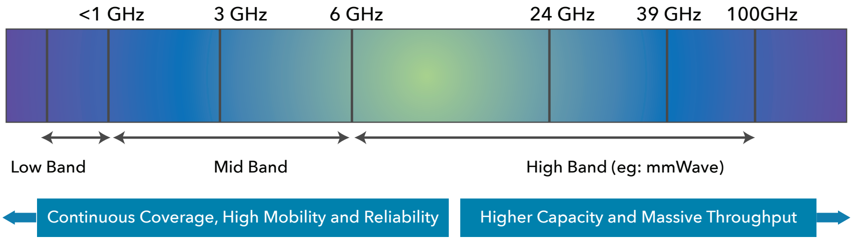

Figure 4: Spectrum Challenges

3D Beamforming Challenges

As described in 'Key enabling technologies,' 3D beamforming has multiple advantages. However, the initial 5G deployment is expecting many challenges because of the dependency of channel estimation, multi-user multi-stream optimization algorithms, and proprietary beam management solutions.

There are two major requirements in beamforming which are enormous Digital Signal Processing (DSP) and a high degree of interconnectivity to enable a combination of data from many beams. The struggle continues to come up with an improved solution. But a well-crafted precious in parameter tuning will enable effective 3D beamforming.

Hybrid Network Mobility Challenges

5G radio planning should consider all the collocated legacy networks like LTE, 3G, 2G, Wi-Fi, etc. The mobility between 5G and all these networks is essential and is a major challenge that needs to be considered while planning 5G. Some challenges arise due to the dual connectivity mode because of that required precise synchronization between eNB and gNB for signaling and data transfer to NR.

RADIO NETWORK OPTIMIZATION CHALLENGES

The 5G NR physical layer has a flexible and scalable design to converge multiple requirements of customer use cases. Some of the requirements are extreme and contradictory. So, the selected NR solution has a significant impact on the performance that is achieved. There may be a compromise between many competing requirements and constraints that are a part of NR solutions.

Here are some of the challenges in NR deployment that has a major impact on performance.

Non-Standalone vs. Standalone

The first phase of 5G deployment is covered in Non-Standalone (NSA) mode, where the 5G coexists and interworks with 4G. NSA deployment reduces the time and cost for deployment and ensures adequate coverage and mobility. From the network verification perspective, the performance of the 5G devices from accessibility, retainability, and mobility perspective will be dependent on the performance of the underlying LTE network.

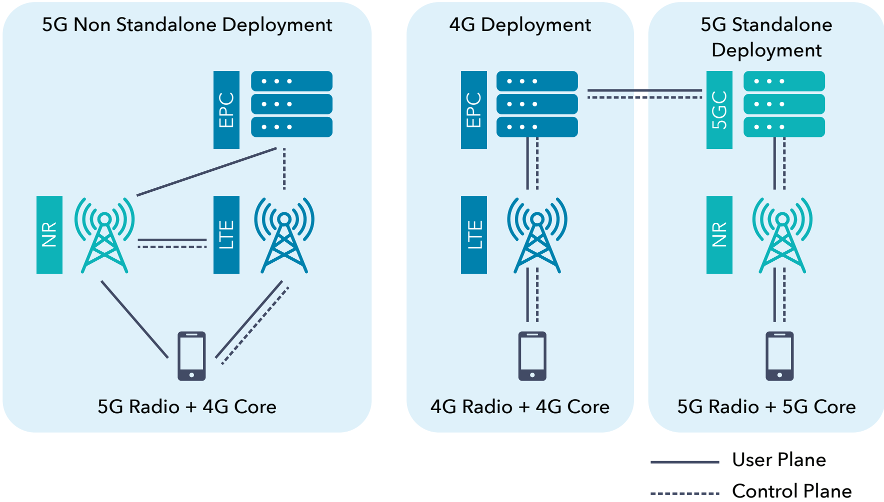

Figure 5: Non-Standalone vs. Standalone

Duplex Method

The 5G NR frame structure supports Frequency Division Duplex (FDD) and Time Division Duplex (TDD). The duplex method selected for the 5G deployment has an impact on network performance and integrity. The TDD network shares the same radio spectrum for Downlink (DL) and Uplink (UL). When the higher bandwidth is in use, the TDD duplex method is used because it enables the dynamic allocation of DL and UL resources to support asymmetric DL/UL traffic efficiently.

Spectrum Sharing and Interworking

In the initial stages of NSA deployment, NR is doing spectrum sharing and interworking with LTE and other networks like 2G,3G, etc. So, this Spectrum sharing and interworking raises constraints in the network performance, such as throughput. The achievable NR throughputs will be impacted by the load and utilization of the LTE network.

Frequency Band

Each Frequency band has different physical properties and some levels of trade-off required between each frequency bands in terms of coverage, capacity, latency, and spectrum efficiency. When NR uses high and mid bands, the coverage will have a significant negative impact. So this factor needs to be considered during network verification and optimization.

Bandwidth

The initial stages of NR deployment are with limited spectrum availability due to various reasons. So bandwidth has a significant impact on the peak, average, and cell edge throughputs. Thus, the bandwidth factor needs to be considered when determining appropriate targets for network verification and optimization.

RADIO NETWORK PLANNING SOLUTIONS

5G planning and optimization need to overcome the above-mentioned challenges and we will discuss some of the planning requirements, solutions and value propositions to address the planning challenges.

5G NR Access Network Planning Requirements

Here we discuss some of the requirements to do network planning such as environment modeling, radio propagation modeling, and 5G NR system modeling.

5G NR Operating Environment Modeling

5G NR mmWave signals are highly affected by small objects such as trees, vegetation, buildings, vehicles, etc. So 5G deployment modeling should be created precisely to reduce the cost of implementation. Geographic Modelling System (GIS) with high-resolution 3D vector data for urban outdoor, 3D building models, and the seamless integration of outdoor GIS and indoor 3D building models are essential for accurate modeling.

Geographic Modelling System (GIS)

GIS provides multiple layers of information for radio network planning, including terrain, vegetation, clutter and vector data. High-resolution vector data is required for 5G planning which is about 1m or higher than what is required to do 5G NR planning efficiently.

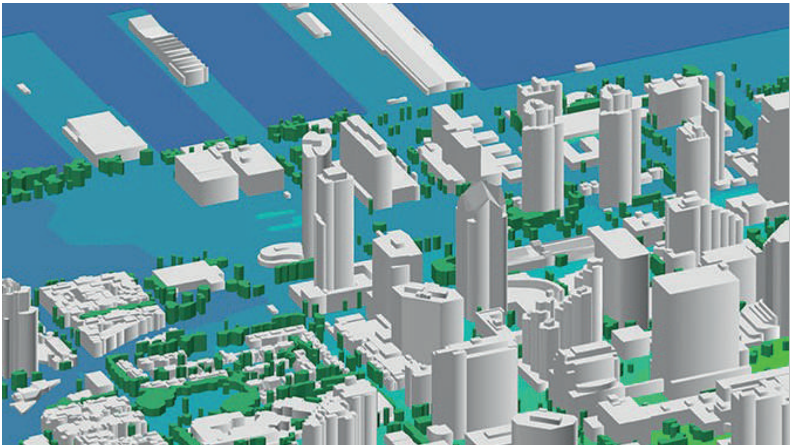

Figure 6: 3D Model of San Diego

3D Building Models

There is an exponential growth in indoor mobile data traffic and 80% of the traffic is from indoors. So, it's important to plan the indoor coverage to make the network more economically viable. In higher bands, the penetration power is much lesser. Planning of small cell and indoor Distributed Antenna System (DAS) cells play a major role. Detailed 3D building models with building structures and elements of walls, doors, windows, columns are required for accurate indoor planning.

Radio Propagation Modelling

With the emergence of massive MIMO and beamforming, the 5G NR system is more complicated than traditional 2G/3G/4G technologies. Hence the traditional propagation models like Hata & COST231-Hata are not accurate enough to plan for the 5G NR system. Therefore ray-tracing propagation model established upon high-precision electronic maps and multipath modeling plays a significant role in 5G planning.

Ray tracing models are much accurate than the older model, but it comes with a cost of time consumption to do the complex calculation.

Image Source: https://visicomdata.com/news/3d_model_of_san_diego?lang=en)

To overcome this bottleneck, most commercial ray-tracing models simplify the calculation by the number of rays considered. The ray-tracing propagation model includes features such as direct radiation, reflection, diffraction, signal transmission and combined paths.

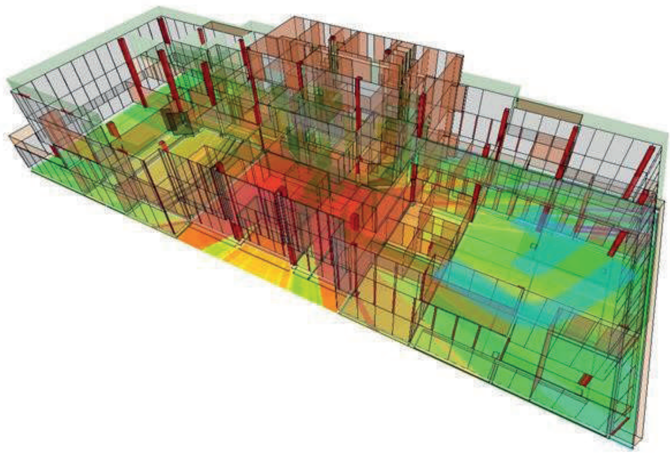

Figure 7: 3D Building Model

Image Source: http://vietvuong-telecom.vn/san-pham/en/d3034/iBwave-inbuilding-design-solution

5G RADIO NETWORK PLANNING: ALTRAN'S VALUE PROPOSITION

Here we present Altran's key capabilities in radio network planning and the value proposition. These case studies demonstrate Altran's leading 5G NR network planning capabilities for scenarios such as joint indoor-outdoor, urban outdoor and large venues.

End to End Consultancy Services

Altran's world class consultancy services provide a comprehensive set of capabilities to deliver end to end solutions for telecom operators and enterprises without vendor help in all technologies like 3G/4G and 5G to optimize operators costs and deliver unmatched customer experience. Our expert consultants do market research, feasibility study and data forecasting to develop cost effective deployment models for you. We work with you through all steps from design to vendor selection, capacity study, lab testing, live trials, optimization and commercial go live and the type of feasible services to be provided.

We provide flexible support to your business needs optimizing the implementation for your commercial and technical success and delivering excellent customer experience. Also, our team helps to introduce the right service and technology at the right time like 5G, Edge Computing, VoLTE, NFV, IoT, Open RAN, or any other new technologies.

Multi RAT Network Planning

Multi-RAT network planning combines the planning of several radio access technologies to deliver the service to users (e.g., 5G NR, UMTS, LTE, Wi-Fi). The heterogeneous cellular network contains more than one layer of cells with different cell sizes aimed to meet specific targets such as an increase in coverage, capacity, etc. 5G NR services provide an option to add a layered network: we add Small cells to the Macro cells to provide an additional layer of capacity and new services.

Multi-RAT planning is the planning of those multiple layers as a single network, considering multi-technology coverage targets, traffic sharing, and offloading between layers and installation and implementation constraints (e.g., shared antennas). Multi-RAT planning and optimization, including small cell deployment, site selection, automatic configuration, interference coordination, capacity analysis and backhaul planning. Also, we provide expert consultancy services to modernize the legacy networks to 5G and other new services which enable the customer to stand out in the market.

Small Cell Network Planning

Small cell deployment mainly targets the high traffic and dense urban areas to provide network capacity and the coverage holes where macrocells are not feasible to provide extended coverage. 5G small cell planning proposes new small cell locations that improve capacity deficits in the macrocell layer based on the low capacity zone generated from the macro cell service area predictions.

Propose a new small cell location that recovers capacity losses in the macro layer based on traffic saturation statistics calculated from the macro cell Monte Carlo simulation results. Also, effective small cell planning includes selecting a suitable small cell location from a list of potential options.

3D Coverage Prediction

3D coverage prediction and simulation are crucial for 5G indoor coverage prediction that can indicate multiple coverage layers on different floors being displayed.

3D building database has z-axis height data and with the help of various propagation models like the Ray-trace propagation model, floor wise coverage can be generated. This will be very helpful to plan dense cities with several high rise buildings. Based on floor wise coverage prediction, In-Building Solutions (IBS) can be installed to cover the coverage gaps.

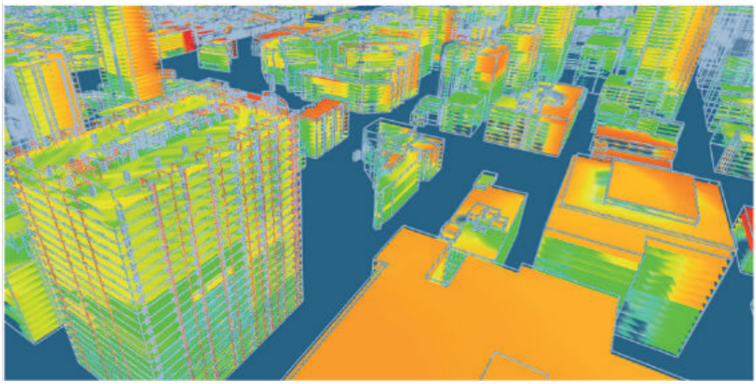

Figure 8: 3D Coverage Prediction

Automatic Cell Planning

Automatic cell planning allows the operator to automatically find the best option to add a new cell or add additional capacity in the existing network. The most demanded use case for this feature is to select a small location from a list of candidates to achieve coverage or capacity objectives. The Automatic Cell Planning (ACP) option is working based on sophisticated mathematical optimization algorithms that find an optimal solution.

The automatic cell planning module combines prediction based inputs and live network data to support both RAN planning and optimization activities within the operator's organizations. Predictions, Key Performance Indicators (KPIs) and geolocated mobile traces are used as inputs to generate ACP results. Site selection, small cell planning, capacity planning, and optimization are the general use cases for the ACP module.[3]

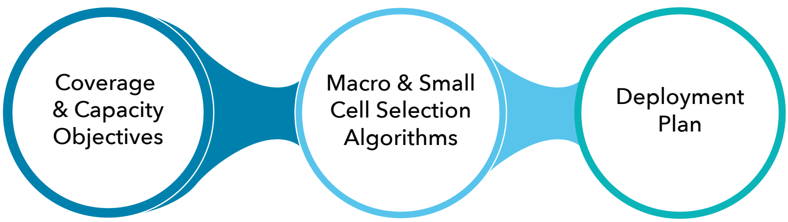

Figure 9: Automatic Cell Planning

[3.] https://www-file.huawei.com/-/media/corporate/pdf/white%20paper/2018/5g_wireless_network_planing_solution_en.pdf

RADIO NETWORK OPTIMIZATION SOLUTIONS

Radio network optimization is a set of processes and activities based on the analysis of the system, followed by elaboration and execution of recommended actions to assure that the system is operating most efficiently and is at its best performance. Optimization is done in two phases, as pre-launch and post-launch optimization which is considered during the network deployment. The optimization solution can be divided into the function's performance statistics, performance recording, and performance data analysis. The end goal of optimization is to maximize the operator's return on investment, efficiently utilize the resources and end user satisfaction.

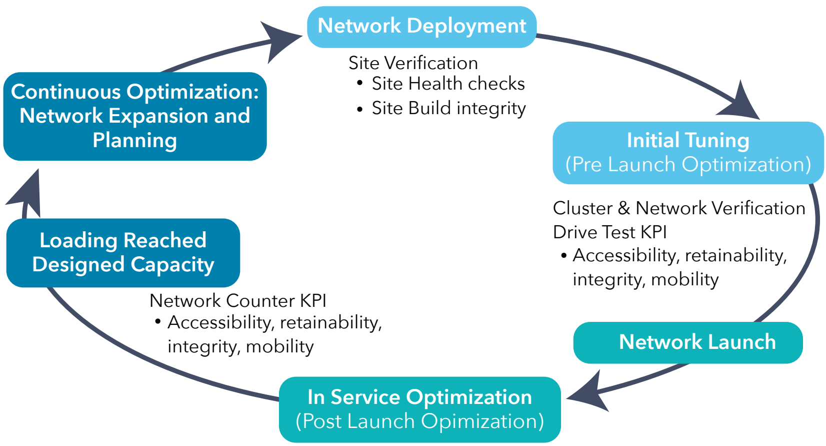

Figure 10: Optimization Workflow

The pre-launch optimization refers to the initial tuning that has been done before the launch of the network and after the network is deployed. The pre-launch optimization mainly includes physical changes (e.g., Antenna Height, Tilt, and Azimuth), although some level of parameter tuning also included optimizing the coverage and quality of the network. During the pre-launch optimization, no traffic data is available on the network. So, drive and walk testing is the main optimization method for pre-launch optimization to achieve specific field KPIs.

In post-launch network optimization, it is a continuous daily task and is necessary, so that network performance satisfies certain thresholds or targets for KPIs agreed by the operator. It is done by using the network counters and KPI statistics to optimize the use of network resources and provide a better user experience to the end customer.

Some of the major KPI's are listed below.

Types of 5G NR RAN KPI's

The service experienced by end users is measured by using several Performance Indicators (PIs) that are aggregated to form a KPI. According to the third generation partnership project (3GPP TS 28.554) standard, there are six main KPIs that directly influence network performance and end user experience: accessibility, retainability, integrity, mobility, utilization and energy efficiency.[4]

Accessibility KPI

Accessibility KPI describes the probability for the user to register and obtain a requested service to a network slice within specified tolerances and other given conditions. This KPI is calculated as the ratio of the number of successfully performed registration procedures to the number of attempted registration procedures for the AMF set. This is related to one single network slice instance and is used to evaluate accessibility provided by the end to end network slice instance and network performance.

[4.] https://www.3gpp.org/ftp/Specs/archive/28_series/28.554/28554-g30.zip

Integrity KPI

Integrity is the property that data have not been altered in an unauthorized manner and Service integrity is the degree to which a service is provided without excessive impairments. The categories under latency are end to end latency, integrated downlink delay in RAN, uplink/downlink throughput for network and network slice instance, uplink/downlink throughput at N3 interface, etc.

Utilization KPI

Utilization KPI refers to the simultaneous usage of network resources without affecting the end user experience. The categories under utilization KPI are Mean a number of Protocol Data Unit (PDU) sessions of network and network slice instance, virtualized resource utilization of network slice instance, PDU session establishment time of network slice, etc.

Retainability KPI

Retainability KPI refers to the ability of the network to continuously provide the requested service under given conditions for the desired period. The two types of retainability KPI's are QoS flow retainability and Data Radio Bearers (DRB) retainability.

Mobility KPI

Mobility KPI refers to the handover performance of a user within the NR network and between NR and other networks. The three mobility cases are NG-RAN handover success rate, mean time of inter-gNB handover execution of network slice and successful rate of mobility registration updates of single network slice.

Energy Efficiency (EE) KPI

Energy efficiency KPI shows the mobile network data energy efficiency in operational NG-RAN. This KPI is calculated as Data Volume (DV) divided by Energy Consumption (EC) of the considered network elements.

RADIO NETWORK OPTIMIZATION: ALTRAN SOLUTIONS AND VALUE PROPOSITION

Here we present Altran's 5G NR Network optimization value proposition, which demonstrates the capabilities to analyze, optimize and improve the network performance and reduce the Capex for the operators and efficiently utilize the resources.

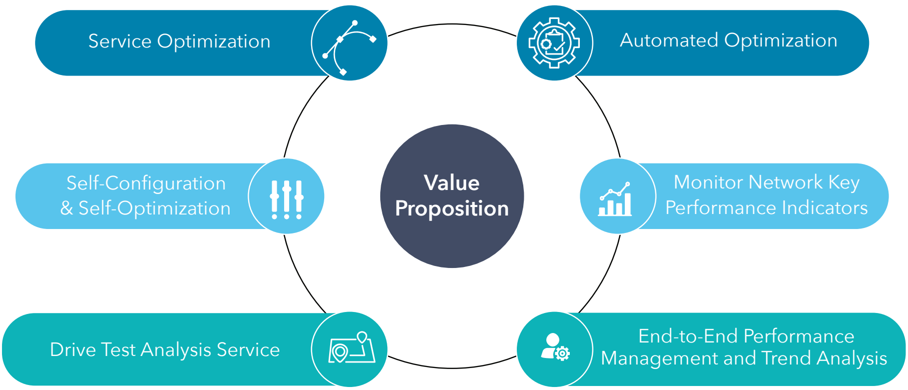

Figure 11: Value Proposition

5G Automated Optimization

New methods of optimization take the focus from the network centric optimization to customer-centric optimization. It considers where subscribers are located, how they use the network and what their current QoE is at any given time. This can collect, locate, store and analyze data from mobile connection events, creating a repository of location intelligence from all subscribers throughout a network to deliver a customer centric optimization solution.

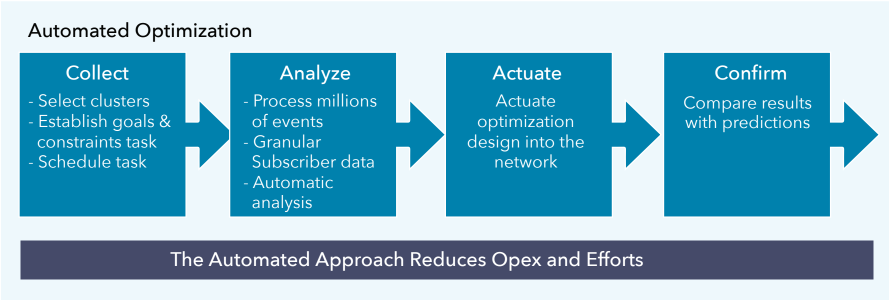

Figure 12: Automated Optimization Workflow

5G Networks become more complex and customer centric optimization and automated optimization become more important. Any optimization solution must be able to consider the holistic impact of configuration changes and their ability to deliver the variety of QoE required by the different devices. Doing this effectively in the complex and configurable network will require advanced modeling of radio/ RAN, transport and core along with mature configuration optimization capability to optimize the infrastructure and spectrum assets. The only way for this to happen is to automate optimization using subscriber centric methods in the beginning and then add more automated features as they become available.

End to end Performance Management and Trend Analysis

Network optimization is a continuous process that includes collecting KPI, analysis and troubleshooting the issues at the cell level, cluster level and network level. Also, the multidimensional, multivendor and customer centric RAN and core analytics. For getting unbiased visibility on network performance, optimization has to be done through independent KPIs. And issues must be drilled down and analyzed on a deeper level to understand the root cause and take necessary action.

Figure 13: Performance Management and Trend Analysis

Monitor Network Key Performance Indicators

Performance monitoring service targets to create expressions using KPIs that store the information from a data source and this information is used in the measurement of a service target when assessing compliance and non-compliance for defined goals. The selected KPIs are defined in the service target using an interface that lists the discovered KPIs of each collection node. These collection nodes are configured in the application administration console.

Network monitoring includes the KPI trend analysis, alarms and reports allowing you to create a high quality and reliable network for the subscribers and manage network assets from RAN to the core. It also ensures that resources are optimized to serve subscribers best while minimizing OPEX and CAPEX. This Identify unusual performance behavior and allocates resources more efficiently in near real time.

Image Source: Screenshot from Astellia tool (https://www.exfo.com/en/products/service-assurance/real-time-analytics/network-performance-optimization/)

Drive Test Analysis Services

5G testing has become critical for analyzing network performance in the early stages of NR deployment. Test solutions have quickly adapted to complex use cases and architectural advancements encompassing core, transport, RAN and fiber network elements simultaneously. Drive testing tools to enable us to measure QoE metrics for the services and applications your customers are using, including advanced YouTube video testing, Facebook, Twitter, Dropbox, Viber, BiP and Instagram testing. The smartphone measurement results reflect the real end user experience. This provides customers the capability to understand wireless network quality from the end consumer perspective, troubleshoot and optimize the network based on the results, ultimately improving customer satisfaction and reducing churn.

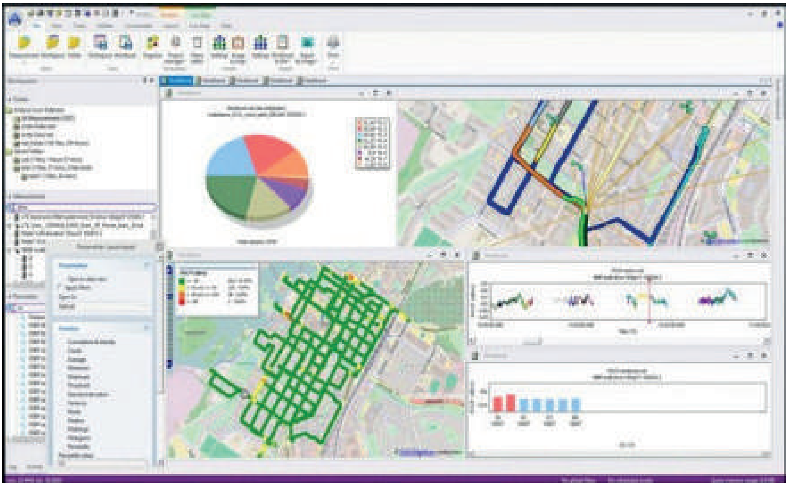

Figure 14: Screenshot from Nemo Drive Test Tool

Self-configuration & Self-optimization

Self-Organizing Network (SON) technology minimizes the lifecycle cost of running a mobile network by eliminating manual configuration at the time of deployment and throughout the dynamic optimization process and improves network performance and customer experience.

Image Source: https://www.emitec-industrial.ch/media/image/thumbnail/emitec-keysight-nemo-outdoor-drive-test-solution-for-5G-wireless-network-optimization-3_720x600.jpg

After enabling self-configuration, each RAN features can configure itself without any manual operation. For example, the feature sets up an IP connection with a site for information exchange or work with a site for joint transmission or reception. The self-optimization feature enables each RAN feature to monitor its performance and to evaluate if it is working correctly and if any adjustment is needed.

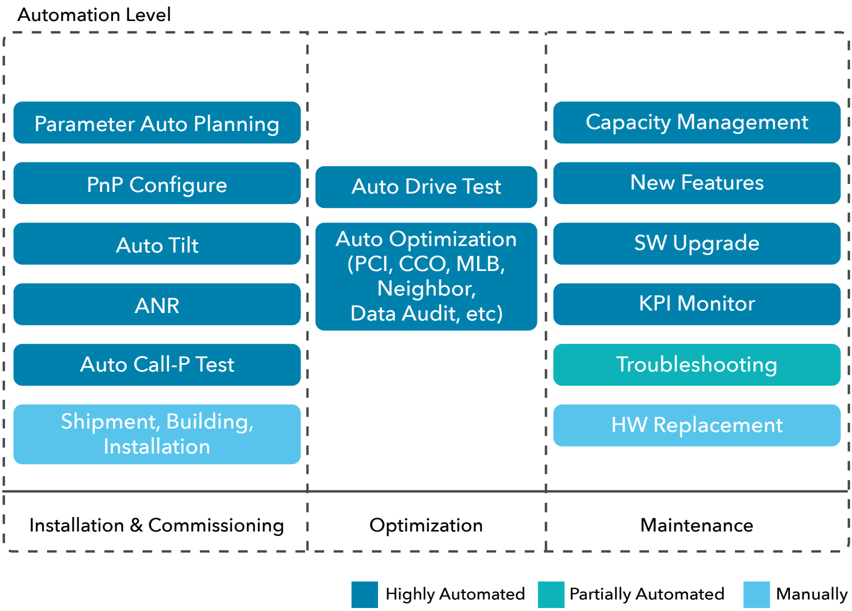

Figure 15: Wireless Network Tasks and SON Potentials

Service Optimization

5G is expected to introduce all kinds of new services and it is imperative to optimize each service separately to obtain a better user experience. This includes low latency services such as live Virtual Reality (VR) video streams or lives VR sports games. 5G networks are dedicated to experience modeling and network optimization based on low latency. Different 5G services will have different requirements in terms of data rates and delay stability. Hence other management solutions must be formulated for network optimization based on differentiated experiences. For example, optimizing VR video services requires studying multiple cases and scenarios and mapping different rates and delays to key network performance indicators such as Signal to Interference Noise Ratio (SINR) and Reference Signal Received Power (RSRP).

CONCLUSION

Altran is the global leader in innovation and high-tech engineering consulting. Altran has been working for more than 35 years with major players in telecommunication and has been at the forefront of transformation in the telecommunication and networking industry. Altran provides a single-window solution for all consulting, networking planning, and optimization needs. Our end to end planning capabilities includes consultancy services where we do the market research, feasibility study and data forecasting. We develop a cost effective deployment model and work with you through all steps from design to vendor selection, capacity study, lab testing, live trials, including commercial, go live and providing feasible service solutions.

The future network will be much complex in terms of multivendor, multi-technology usage. So the planning and optimization of such a network require a high level skill set with efficiency and competency to use multiple planning and optimization tools and techniques.

Altran has accumulated rich networking and planning experience by constructing experimental 5G networks and has been able to provide leading 5G wireless network planning and optimization solutions.

By using the methods described in the white paper for NR planning and optimization along with vendor tools like Atoll, iBwave, TEMS, etc, Altran can help the customer in the deployment of various use cases like high-speed data, HD, Ultra HD video streaming, AR/VR, IoT, Smart Cities, Industrial automation, etc. We can meet the multiple services and diversified customer requirements while modernizing and revolutionizing the process of network planning and optimization.

Altran's strong footprint in automation and data analysis collaborated with network planning and optimization, helps the customers to modernize the networks with the latest technology and reduce the time to market and optimize the cost and increase ROI.

Contact us

marketing@altran.com

About the Authors

Nithin P Joy
Client Support Representative and Network Specialist, Product Support & Services

Ashish Nagar
Global Practice Lead OSS/BSS & 5G, Product Support & Services

About Altran

Altran is the world leader in engineering and R&D services. Altran offers its clients a unique value proposition to meet their transformation and innovation challenges. Altran supports its clients, from concept through industrialization, to develop the products and services of tomorrow and has been working for more than 35 years with major players in many sectors: Automotive, Aeronautics, Space, Defense & Naval, Rail, Infrastructure & Transport, Energy, Industrial & Consumer, Life Sciences, Communications, Semiconductor & Electronics, Software & Internet, Finance & Public Sector. Altran has more than 50,000 employees operating in over 30 countries.

Altran is an integral part of Capgemini, a global leader in consulting, digital transformation, technology and engineering services. The Group is at the forefront of innovation to address the entire breadth of clients' opportunities in the evolving world of cloud, digital and platforms. Building on its strong 50-year + heritage and deep industry-specific expertise, Capgemini enables organizations to realize their business ambitions through an array of services from strategy to operations. Capgemini is driven by the conviction that the business value of technology comes from and through people. Today, it is a multicultural company of 270,000 team members in almost 50 countries. With Altran, the Group reported 2019 combined revenues of €17billion.

www.altran.com


altran
Part of Capgemini