NTT DATA

5G PLANNING FOR SUCCESS

Rise of 5G

Commentators routinely describe the roll-out of 5G as an event of unique importance, not just for the telecom and media industry but for the world economy as a whole. Is this true? And if so, why?

NTT DATA is part of the NTT Group, alongside DoCoMO, one of the largest mobile network operators (MNOs) in the world. Telecom, and especially mobile telephony, is a key part of our history and helps explain our commitment to ensuring rapid roll-out of 5G and our determination to unlocking the full potential benefits this vital new technology can offer to telecom providers and their customers alike.

5G business services: a new opportunity

Previous connectivity advances have driven the massive growth in media on smart devices that has transformed our lives. They have also led to big profits for media owners, while leaving MNO margins under pressure. 5G gives telecom providers the chance to occupy a more strategically important position in the wider networking and communications market, potentially leading to improved margins and bottom-line profit growth. At the same time, the rapid rise in 5G private networks potentially offers a vital new growth opportunity.

That's because the low latency, high bandwidth characteristics of 5G make it possible to offer "cloud-like" services very fast and at low cost via secure network slices. This should enable MNOs in particular to gain a larger share in high value business services, which are set to grow exponentially as more enterprises move to a distributed cloud model.

Distributed cloud will see the traditional cloud model, based on virtual datacenters owned and operated by specialist providers, evolve into a programmable and extremely flexible network, with intelligence and decision-making capability held on remote edge devices. Assets and components of every kind are logically disaggregated and physically distributed, enabling fast low or no code development on hybrid platforms.

This approach marks a step change in cloud capability and 5G plays a strategically vital role in delivering it, because of its high bandwidth and low latency. Once 5G is in place, it becomes possible to roll-out new use cases at high speed, leading to added value for providers, customers and end users. Before MNOs can start to benefit, however, there are challenges to overcome, which we will cover in the next part of this paper.

5G plays a strategically role because of its high bandwidth and low latency

The RAN context and 5G challenges

Existing Radio Access Networks across Europe, North America and beyond are extremely complex, comprising different technologies, of different ages and generations, with interconnections that may be impacted in unpredictable ways by the installation of 5G. To maximize the potential of 5G will therefore require detailed mapping and careful planning.

Additionally, the many benefits introduced by 5G comes with a set of challenges that must be addressed. Some of the major challenges are described below:

- **New frequency bands**, as signals of this kind (for example 26GHz) can be heavily affected by environmental issues, such as vegetation and rain.
- **Massive Multiple Input, Multiple Output (mMIMO)**, which enables operators to deliver spatial diversity, multiplexing, beamforming and other communication benefits. This requires a much larger number of antennae than at present, and that complicates coverage, data rate, capacity estimates and all aspects of planning.
- **New 5G scenarios** (as defined by the ITU), which include enhanced mobile broadband (eMBB), massive machine type communication (mMTC) and ultra-reliability & low latency communication (URLLC), all bring with them new demands in terms of latency, reliability, numbers of connected devices and power consumption. All of these need to be accounted for by RAN Planning.
- **Network slicing**, as noted earlier, is key to providing “cloud-like” services at high speed and with high reliability.
- **Private Networks** are not new but are becoming more important, as enterprises and other organizations seek to use dedicated bandwidth to ensure quality of service across defined geographical and business areas. Planning teams need to understand how to use available radio frequencies to deliver service requirements to private users without affecting public networks in the locality.

As this networking landscape continues to evolve, and inevitably become even more complex, so every participant in this market needs to understand how every existing component fits with and relates to all the others. Before considering a new use case, a potentially profitable and innovative new business service, you need to ensure that it is technically possible to deliver this in the real-world context of the market as it is.

Operational Efficiency

One other point we need to remember is simply this: up until now, processes related to RAN planning and optimization have typically been carried out through manual work by teams of highly skilled engineers. This activity is time-consuming, which means that engineers are not free to work on other essential requirements, and it can also be unreliable.

This is because manual work of this kind always includes a certain level of human error, due to a lack of advanced visualization techniques, leading to a certain amount of trial and error rather than real precision. The information used in this kind of manual calculation is also likely to be incomplete, static, inconsistent and historic, instead of always current, real-time data. The result is a long process that may need to be reworked and repeated in some areas before reliable results can be delivered.

There are likely to be a lot of negative outcomes from this way of working. We see less accurate results, lower customer satisfaction, the need for repeated reworking, involving workflows that are not streamlined and, as a result of all this, higher operational costs.

Existing planning solutions, therefore, have been stretched almost to breaking point in dealing with growing complexity in the current RAN landscape. The arrival of 5G makes the problems far worse, as 5G network deployments require many more sites, leading to a level of complexity that simply cannot be dealt with by manual processes.

Newly available frequency bands (such as mmWaves), together with enhanced capacity and the extremely demanding low-latency requirements for new services, including eMBB, URLLC and mMTC, make it essential to find new and better ways to deliver effective, rapid planning.

Finally, we need to be clear that 5G technology is an amplifier for mobile private networks, encouraging industry users to apply for frequency spectrum and deploy their own infrastructures. In addition, new features such as network slicing and zero-touch automation will accelerate development and roll-out of cloud-like new services, which need even more careful and meticulous planning, raising the pressure still further on engineering teams.

Even the most experienced professionals will struggle to get their strategies right, given the fast-growing complexities of the evolving RAN landscape. So what is the best approach to take? How can MNOs and other telcos turn 5G into the kind of growth opportunity they need and deserve, in this challenging context?

Scenarios and simulations

NTT DATA has already developed a series of services designed to accelerate and derisk 5G roll-out, including Network as a Service and Campus Development Platform. The portfolio also enables rapid monetization through a 5G Framework that provides network integration and infrastructure services, IT system integration and a 5G platform for rapid deployment and management of use cases. Now, in addition, we are focusing on the essential first step for designing and introducing any new service: 5G Planning.

To carry out fast and efficient planning, the goal is to map the entire RAN network in a specific location or region, and then use advanced simulation techniques to test the impact and viability of 5G related services in this context. Use cases can be defined in great detail and then introduced to the virtualized network model that has been built within the test and development platform. It is then possible to model different usage patterns, traffic models and potential developments, building up a detailed view of how the network is likely to respond under a range of scenarios.

Once this process has been completed, it should be possible to launch a new service with a high probability that it will behave in a predictable way, and a low risk of adverse effects on the rest of the communication and networking environment in the area. So how does this work in practice?

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Building the picture

As with all simulation-related solutions, the quality of the planning carried out depends very much on the quality of data that we can input. This needs to be always current (reflecting real world- and real time-usage as far as possible). It also needs to be very detailed, with all relevant parameters covered so that the scenario context is accurate and comprehensive.

To build this picture, NTT DATA's Planning vision inputs data from multiple sources, including network information supplied by operators of every kind and also, most importantly, through crowdsourcing.

This enables the system to collect usage data (no identifiable personal data can be accessed at any point) simply to understand the number of devices connected at any moment, where they are, how much data they receive and transmit, in which forms, with what kind of variations and with which mobility patterns.

Additionally, NTT DATA vision relies on machine learning, so the patterns input on day one are enriched continuously from that point on, making the network picture as detailed as possible, while becoming more accurate with every new piece of data input.

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Use cases

In the majority of cases, we expect to see a requirement for secure environments that enable discrete services to be built, delivered and consumed within a private space (which may be physical but is more likely to be virtual).

Examples might include a major event, such as the Olympic Games or some equivalent, which requires a month-long ultra-high capacity, highly secure environment to be created fast, operated flawlessly and taken down again without disruption to services provided in the surrounding area to what may be millions of individuals and many thousands of businesses.

We might also consider a development Campus, in which a safe meeting space is created, with a physical hosting location but accessible by authorized partners who could be based around the world. The Campus in this case will be used as a rapid development, test and go to market environment that is completely secure but supports extremely fluid and high-capacity interactions once inside.

Other options might be physical and permanent: a large university campus, a major commercial park or industrial zone, a huge manufacturing plant or a port.

These last two have some especially interesting characteristics because here you will need high bandwidth to support fleets of complex production assets, each of which uses and generates vast amounts of data every minute, together with secure connectivity to supply chain and core business applications.

We may also need rich data access points to enable centrally located controllers to manage remotely based assets, potentially using immersive technologies as the user interface. We will also see data flows from sensor arrays (IoT devices), with data collated on site in Edge devices, which can include algorithms for hyper-automated decisions where necessary.

5G will support these and many other use cases, which include low latency, high bandwidth operations onsite but typically will also require interactions with remote locations, in which rich data flows will be important.

What we can assume is that all such use cases are likely to have real strategic significance. They will help manufacturers reduce their carbon footprint and manage supply chains more effectively; manage energy flows on campuses; enable faster time to market with advanced new solutions and concepts and a host of other uses, as well.

The cloud-like, fast response characteristics of 5G make these and other options rapidly available to users of many different kinds. Yet they all depend on carrying out the upfront analysis and planning quickly and with great accuracy. So how is NTT DATA 5G Planning vision designed and structured to make this possible?

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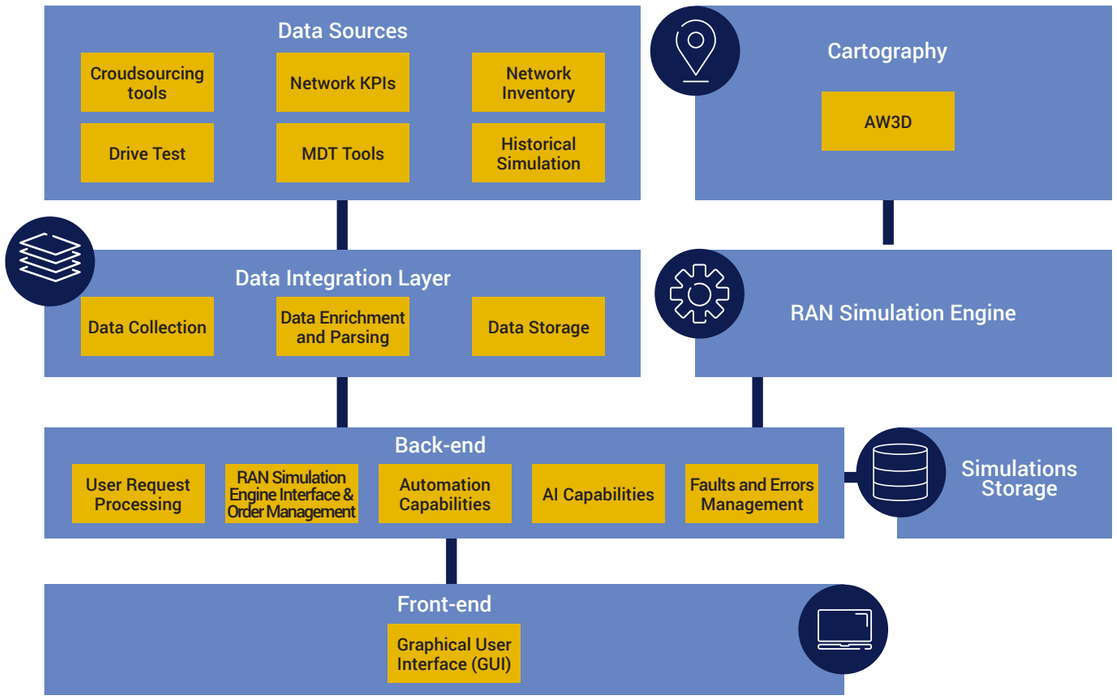
Key building blocks

The NTT DATA RAN Planning vision is built from seven main functional modules:

- Data sources.
- Cartography.
- Data Integration layer.
- RAN Simulation engine.
- Back-end.
- Simulation Storage.
- Front-end.

Let's take a look at them all and see how they connect and work together. A simplified view of the Planning vision is shown below:



This diagram shows the range of different data sources, the ways in which these sources are integrated and enriched for presentation to the simulation engine, the cartography and RAN simulation engine, the core back-end functionality aggregating other modules and containing automation capabilities and the Graphical User Interface.

Data sources are based around primary information linked to:

- Network Inventory, which provides the true status of nodes as geographical coordinates and real antenna configuration.
- Network KPIs and Multicast Distribution Tree (MDT) tools, giving a real picture of network configuration and status, constantly updated.
- Drive Tests, which measure and analyze the coverage, capacity and quality of Service (QoS) status of a radio network.
- Historical data, providing useful information from previous RAN simulations.

The major new factor in the NTT DATA Planning vision is the use of Crowdsourcing. This ensure that the network picture built up through these disparate sources is always kept current by collecting data, often real time, by agreement with MNOs and other operators from nodes, antennae and multiple devices in the target area.

This is gathered and subject to analysis to identify the most relevant factors, including traffic volumes, types of traffic, location of access to services, fluctuations in demand and usage, together with other forms of technology that could potentially affect the use case under review.

Cartography, integrating the AW3D tridimensional map covering all global land spaces, which is especially important for 5G networks, which use millimeter spectrum that is highly sensitive to interference from natural and man-made objects. The AW3D cartography used in the NTT DATA Planning vision represents key Intellectual Property, developed in-house by our own innovation teams, and offering a major operational differentiator for clients.

Data Integration layer collects network data from all of the sources noted above, requesting data that is precisely aligned with the requirements of each new simulation being carried out. Simulations will specify a geographical area, period of time and other factors that are relevant to the requirement, and will present the information in a form suitable for the simulation engine. Data packages will cover location coordinates, sectors, antennae in the relevant geographical area, with frequency, carrier, capacity, types of traffic, numbers of devices and other relevant information.

Data is enriched and parsed, then presented to the interface of the simulation engine, so that it can be rapidly utilized and analysis and scenario testing.

RAN Simulation Engine for all the tasks involved in the RAN planning and optimization process, such as predictions and simulations, propagation model, etc.

Back-end, which is perhaps the core element, enabling integration and orchestration of the data integration layer, the RAN simulation engine and front-end. The back-end performs tasks such as processing user requests coming from the front-end GUI, management of orders towards the RAN simulation engine, following standard procedures, provision of automation and Artificial Intelligence capabilities and, finally, fault and error management to ensure proper platform operation.

Simulations Storage, for having a consistent space where storing all the results from the simulations and being accessible for enriching the data or applying any automation technique.

Front-end, providing a user-friendly **Visualization interface**. This operates within a collaborative working environment, in which NTT DATA project personnel work closely with the client team to review simulation outcomes and then dynamically alter parameters to test options and review potential consequences of each change. Joint development happens in real time in a secure development environment, and enables a rapid move into production, once testing is complete. Further details of the interface are given below.

Making the difference

Let's summarize the ways in which the NTT DATA Planning vision offers new options to the growing number of customers that are turning to 5G technology as a key enabler for their business goals.

The key factor here is that we base our approach on real data, real or near real-time. This is constantly updated and enhanced as the picture we can build up of a specific area, physical location or virtual environment is deepened and enriched.

Before this form of data analytics could be incorporated into a planning approach the only options were:

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First, to use a "worst case" approach, by preparing for extreme use cases, meaning that the finished design would likely include a lot of redundancy.

2

Second, use a good deal of "trial and error", as experienced engineers made their "best guess" about requirements and then tried to update and enhance their assumptions by using operational data, when this became available.

Both options lead to conservatism in planning, wasted resources, constant input of human effort to review and propose upgrades, and a service that is not likely to be optimal for end users.

5G has the potential to deliver unprecedented speed and agility to MNOs and other telcos, as they seek to unlock the value of intelligent networks, and distributed cloud, for themselves.

The NTT DATA Planning vision proposes digital native techniques and working practices. In other words, we conceive cloud-like methods to design cloud-like solutions in a cloud-like way. 5G has the potential to deliver unprecedented speed and agility to MNOs and other telcos, (and their customers) as they seek to unlock the value of intelligent networks, and distributed cloud, for themselves.

Now the combination of enriched, complete and consistent data, advanced analytics and machine learning, plus simulation and visualization combined, ensure that the value of 5G will become available faster than before, at much lower risk and cost. It is a major contribution to competitive advantage.

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