



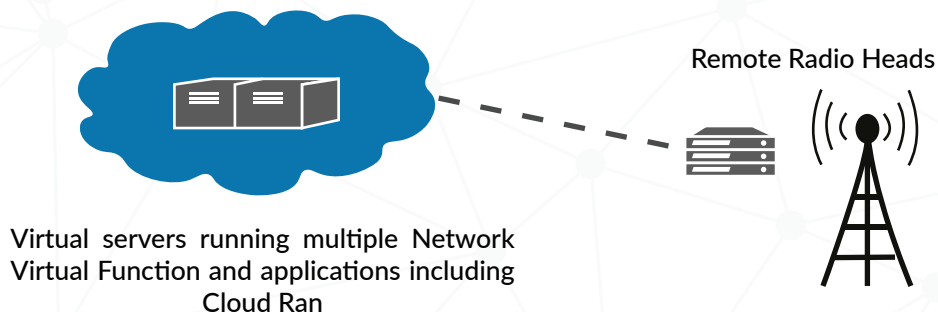
Bwtech performance monitoring 5G

The world of mobile telecommunication has recently taken yet another **quantum leap** and initiated a massive implementation of the already fifth generation of radio access technology.

This new global wireless standard has been designed to provide connectivity of virtually everyone and everything together. Not only humans but also machines and devices of any kind shall be able to communicate with each other.

The **new standard** is supposed to deliver true multi-Gbps peak data rates, extremely low latency, huge network capacity, increased availability, more reliability, and finally more uniform experience to many more users.

Challenges are the inherent part of any new development. This certainly remains true for the new 5G networks. The architecture of the 5G network is highly advanced, making the system not only more effective but also more efficient. In order to achieve the **promised scales** network operators must deploy tens of thousands of new 5G base stations, upgrading simultaneously their existing LTE infrastructure and core networks, migrating eventually to virtualized cloud environment.



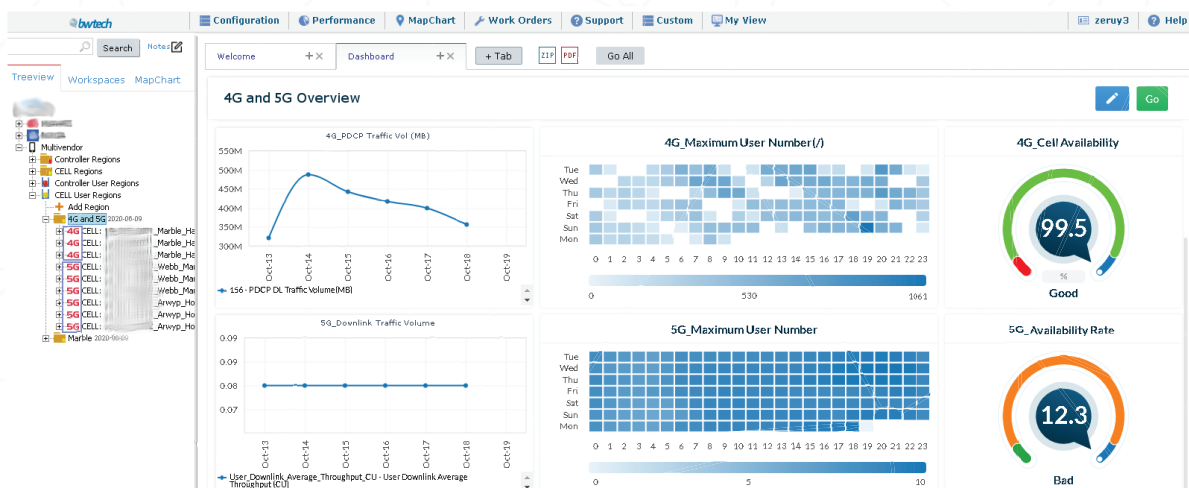
To enable smooth and cost-effective **transition** towards the 5G only networks the 3GPP has standardized a few possible 5G deployment models. Before the true 5G standalone model (5G NR SA) becomes reality it is expected, and actually observed, that the operators deploy the non-standalone model (5G NR NSA) first. The NSA model allows operators to launch the 5G NR **quickly** by leveraging their existing LTE footprint. The NSA mode of operation refers to an option that depends on an existing 4G LTE network for control functions, while 5G NR is exclusively focused on the user plane. This mode assumes that two radio network standards do work side by side.

One of the many challenges that operators face while deploying the new radio standard is **network monitoring**. Not only tens, or possibly hundreds of thousands of new network elements must be monitored, but also the **operational** relations and interactions between these elements are now much more complex. Thus a **new** approach for **service assurance** is needed in order to successfully build and scale 5G networks. An approach that provides excellent visibility and **insights** at all aspects of the 5G infrastructure, at all its phases of rollout and operations.

Network operators should rely on already **proven** network monitoring and service assurance solutions that are capable of addressing the new challenges. The modern tool shall offer an evolutionary path from reactive monitoring to automated root cause identification and **proactive** detection of failures before they actually happen. The tool shall offer enough scalability to support all scenarios, from a single site post launch verification, health check and build integrity, to cluster analysis, and ultimately the automated performance tuning and optimization of a large network, from parameter trials to software upgrade monitoring and feature testing and optimization.



Bwtech **NetChart** has been a network monitoring tool of **choice** for many network operators and equipment vendors. It effectively handles data collection from all network elements and turns them into multiple KPIs presented from various perspectives to address different optimization needs. It delivers countless visualizations and functions – from simple **reporting** to counter analysis and dashboard creation.



Performance monitoring of LTE networks has created **complexities** related to carrier aggregation where user plane data is carried by many cells at the same time. Final user experience can be evaluated only from simultaneous analysis of all involved cells together. 5G NR extends this complexity even further. User equipment can connect now to an LTE eNodeB that acts as a master node and a 5G gNodeB that acts as a secondary node.

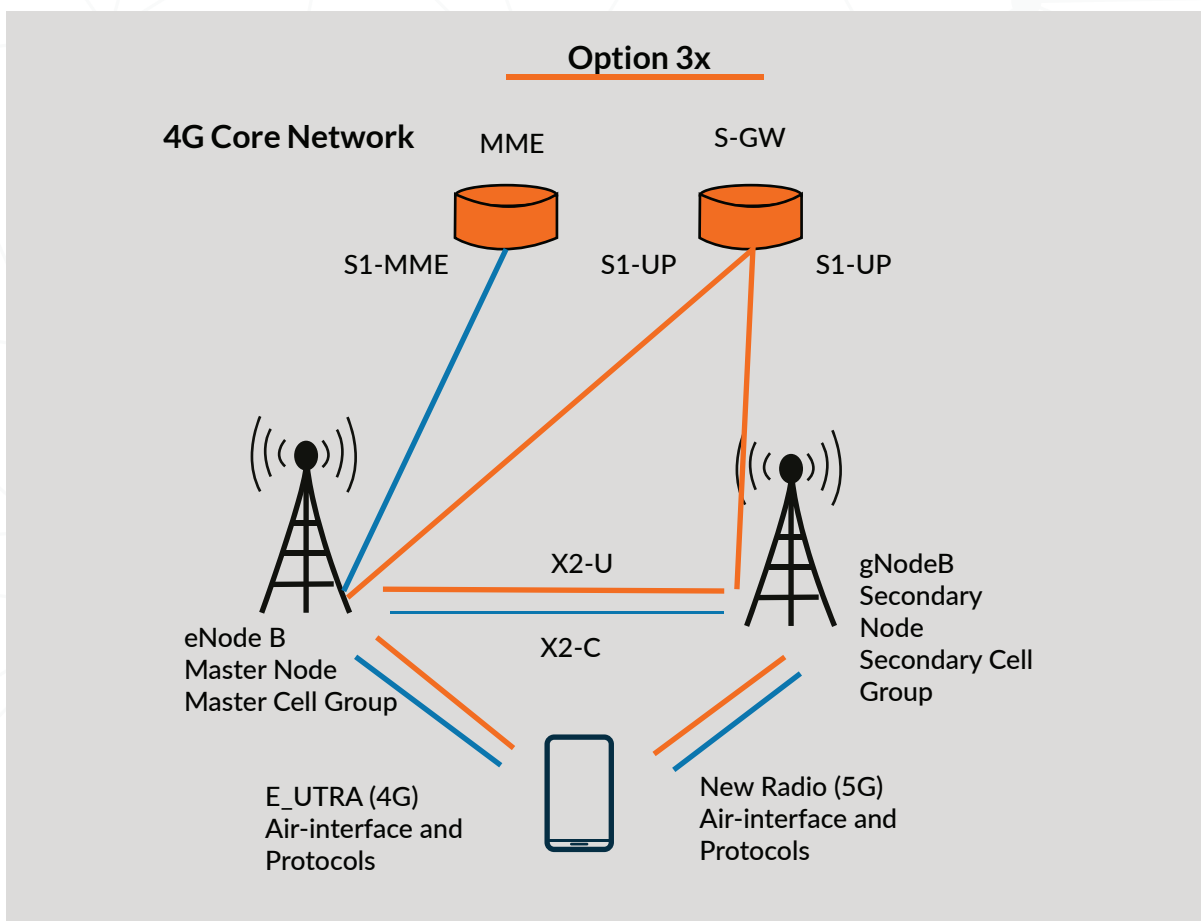
In this scenario, called **EN-DC**, or E-UTRAN New Radio – Dual Connectivity, user traffic is carried by multiple cells located at two different nodes at possibly two different geographical locations. **Performance** analysis of such a complex situation requires a new and **creative** approach to data visualization and presentation.



The EN-DC mode brings more new challenges. Not one, but possibly three different user plane bearers need to be monitored:

- Master Cell Group (MCG) Bearer – a bearer terminating at MN node – in case of EN-DC at eNB
- Secondary Cell Group (SCG) Bearer – a bearer terminating at SN node – in case of EN-DC at gNB
- Split Bearer – a bearer for which traffic is routed via LTE and/or NR bearer

For each of these **bearers** one need to monitor bearer setup and release process, bearer additions, and failures. Smoothless performance of all these bearers is required in order to provide 5G NR functionality.



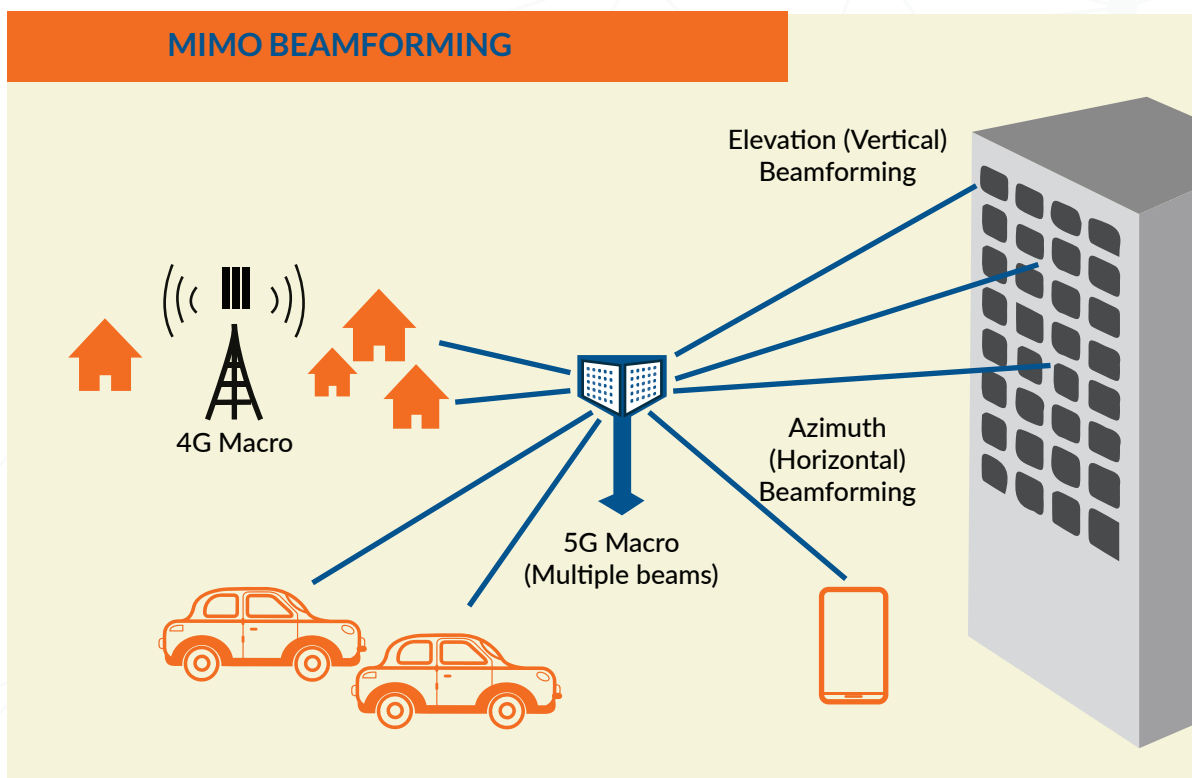
5G NR has finally paved the way for the extensive implementation of Massive Multiple Input Multiple Output (**mMIMO**) solutions. Massive MIMO and **beamforming** are buzzwords that have been widely used in the telecom industry. Adoption of millimeter wave spectrum in 5G NR makes it possible to deploy active antenna arrays with large number of logical antenna ports while still keeping a compact and lightweight form factor.

Such antennas make beamforming possible so now, instead of blasting coverage out throughout a cell, a base station can transmit directly to a selected user. This solution increases cell capacity and coverage, while also improving energy **efficiency**. Implementation of beams and beamforming has huge impact on **performance** monitoring.

The coverage in 5G NR is beam-based, not cell based. There is no cell-level reference channel from where the coverage of the cell could be measured. Instead, each cell has one or multiple Synchronization Signal Block (SSB) beams. From perspective of network performance monitoring this creates new **NR specific** issues like beamforming analysis.

For example beamforming counters let us understand **angular** distribution of the UEs in the cell and detect parts of cells that have bad radio coverage. Also, with some help of triangulation we can locate areas of interference.

MIMO BEAMFORMING



Bwtech has been mastering collecting, managing, and analyzing location based data while developing its MapChart and NetGeo modules. **Geospatial** analysis of 5G NR beamforming L2 counters will be a next step in NetChart evolution.

Although 5G NR introduces a wide range of new exciting topics in network performance monitoring one cannot forget about the **classical** “old-fashioned” KPI categories. These include:

|Availability

- To verify if a service in a cell is available for end users

|Accessibility

- To check whether services requested by users can be accessed in given condition – this includes among others EN-DC call setup procedure from both 4G and 5G perspective, admission control and 4G and 5G RACH performance

|Retainability

- To verify if a network is able to maintain service to users – this includes for example analysis of UE releases due to abnormal causes, e.g. radio link failures

|Mobility

- To measure if a network can handle the movement of users and still retain the service – this includes for example Primary SCell change monitoring as well as intra gNB and inter gNB handovers

|Usage

- To measure the utilization of a network and keep control over its capacity – this includes such indicators like share of EN-DC connections, number of EN-DC capable users, data volume, monitoring SGC Split Bearer Data via X2 interface, data share for intra-site EN-DC and inter-site EN-DC, or PRB utilization

|Integrity

- To measure the character or “honesty” of a network to its user – with indicators such as PDCP SDU delay, round trip delay, cell level and user level throughput or packet loss

Performance data collection and monitoring is not only applicable to all network elements but also to all network **interfaces**. Traffic, capacity, availability, delays, etc. is monitored also over all interfaces such as S1, F1, X2 or eCPRI.





Want to know more about our solutions? Feel free to get in touch with us! You can send an e-mail to hello@bwvtech.com and we will talk soon.