Comba

WHITEPAPER

MACRO RADIO SITE CONSIDERATIONS

INTRODUCTION

Since the introduction of the Global System for Mobile Communications (GSM), mobile networks and technology have evolved to unlock new levels of productivity and innovation on a global scale. At the same time, there are many challenges along the way, including health and safety concerns, as well as security and environmental issues of wireless networks.

Adding new macro radio sites effectively adds capacity and boosting network performance to meet the explosive growth of wireless data consumption, and the increasing demand for secure real-time access to location-based mobile wireless services. However, scaling up macro radio sites is a constant challenge for mobile operators in many cases.

The industry has adjusted the strategy to address the problem, without necessarily creating more sites. Let's take a look into the three factors affecting the development of the mobile networks and the kit for modern RAN sites:

- SPECTRUM
- SERVICE | COVERAGE REQUIREMENTS
- CAPACITY

Spectrum is a natural resource as it is nothing but a range of electromagnetic waves used as a communication carrier, while the end-user controls Service/Coverage Requirements and Capacity. We'll explore them one by one, knowing what they mean and what requirements they put on the equipment for the macro radio sites.

1. SPECTRUM

With the ever-growing needs for capacity and speed, spectrum is mobile operators' golden asset in mobile communication. More and more spectrum has been released and allocated by governments and regulators to meet today's mobile demands.

However, it also comes with complexity on how to build the sites and effectively manage and use the spectrum to realize the full potential of mobile broadband. While the industry constantly demands more spectrum, it would be fair to acknowledge that a fair amount of the spectrum has been released for public mobile networks. Some countries or territories are allocated spectrum of around 1GHz and below 6GHz for licensed public mobile networks.

The question arises for the network equipment vendors over how they manage spectrum partitioned across 10 different bands. Let's look at a European country for an example:

European
BANDS

- 700 MHz
- 800 MHz
- 900 MHz
- 1400 MHz
- 1800 MHz
- 2100 MHz
- 2600 MHz | 2600 MHz TDD
- 3500 MHz TDD

If a tri-sector site was built band by band, antenna by antenna and radio by radio, 27 antennas and 27 RRUs on each site resulted. Practicality aside, it is impossible to get planning permission for the construction, and it would be an eyesore for most people.

Photo 1: Antenna Jungle Example

1.1 ANTENNAS

To avoid the "Antenna Jungle/Forest" issue, the industry has spent time and effort in research and development to offer integrated antenna products. For example, **FDD+TDD Antenna (FDD 2L4H + TDD 2.6G&3.5G)** can host all of the bands mentioned in the example above, in one single antenna supporting the deployment of **FDD/TDD hybrid networks**.

There are regulatory limits on the number of antennas that could be mounted on a tower or a rooftop. Restrictions also limit the tower loading, including wind load, and the weight of the kit on the tower and mast. Exceeding the limit, fairly costly tower strengthening actions have to be taken. Hence the option of using one antenna with all bands avoids extra costs.

1.2 RADIOS

Open RAN radios have been developed to meet this challenge with a slightly different approach.

To balance the weight and size and network resilience, an Open RAN radio unit (O-RU) constituting up to three bands is the ideal solution. Imagine if there was a fault of fronthaul or power supply, instead of taking out all nine bands in one unit providing coverage in a sector, two or three bands meet different requirements.

2. SERVICE | COVERAGE

Building sites become more challenging for MNOs to provide network coverage catering for several different technologies when they operate **GSM, UMTS, LTE, 5G NR and NB-IoT** networks concurrently. Decommissioning legacy technologies have proven more difficult than adding new ones to the network. There are three underlying reasons:

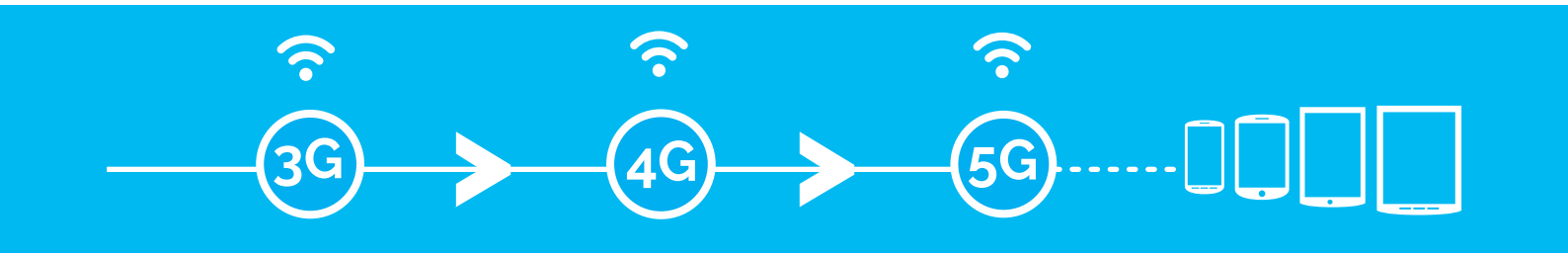
REGULATORY — BUSINESS — CUSTOMER SATISFACTION

GSM and UMTS are digital cellular technologies. Arguably, the 2nd and the 3rd generation mobile network should be replaced by the 4th and 5th generations. However, it is not that easy. Regulatory requirements in many countries keep them in place, such as emergency calls coverage needs to be always available. Since not all handsets manufactured are VoLTE enabled, circuit switch falls back to GSM or UMTS is required to initiate voice calls. In addition, MNOs recommend GSM and UMTS networks instead of LTE for the automotive industry to comply with the regulation as manufacturers are required to deploy eCall in the cars, giving automatic calls to emergency centres in the case of an accident to save lives. eCall data uses in-band modem signalling, and thus GSM and UMTS continue to stay, and even till 2024 when we expect a change in the standard since all cars produced up to date only support CS call.

2. SERVICE | COVERAGE

Many MNOs have also signed multiple M2M contracts with large customers in various industries based on GSM/UMTS coverage, and solutions have been rolled out accordingly. Some projects are capital intensive, such as smart meter charging solutions. Deployment of a few 10s of millions of meters is not done overnight. It does not only require very high CAPEX, but also generates massive electronic waste. As the lifetime of a smart meter is around 15 years, if the solution justifies the investment and environmental impact is questionable.

After looking into the reasons why GSM and UMTS networks continue playing a role, would they be phased out in the near future? It is very likely that UMTS will be phased out, while GSM may remain until the latter part of the next decade. Today, when most MNOs have to support at least four technologies GSM/LTE/5G NR/NB-IoT, they need to plan ahead for the new technologies and continue the support of the legacy networks simultaneously to meet customers' demand.



WHY DON'T WE JUST KEEP THE OLD KIT TO SERVE THE PREVIOUS GENERATIONS OF TECHNOLOGIES?

The answer lies in which strategy to adopt. Domain strategy and geographical strategy were used to be the options in the process of procuring and building networks. The geographical strategy was more or less synonymous with Single RAN as it was regarded as the best implementation. Today, RAN disaggregation, also known as Open RAN, is gaining attention.

Both Open RAN and the domain strategy disaggregate Single RAN, but they are orthogonal to each other. One disaggregates stack, and the other disaggregates technologies.

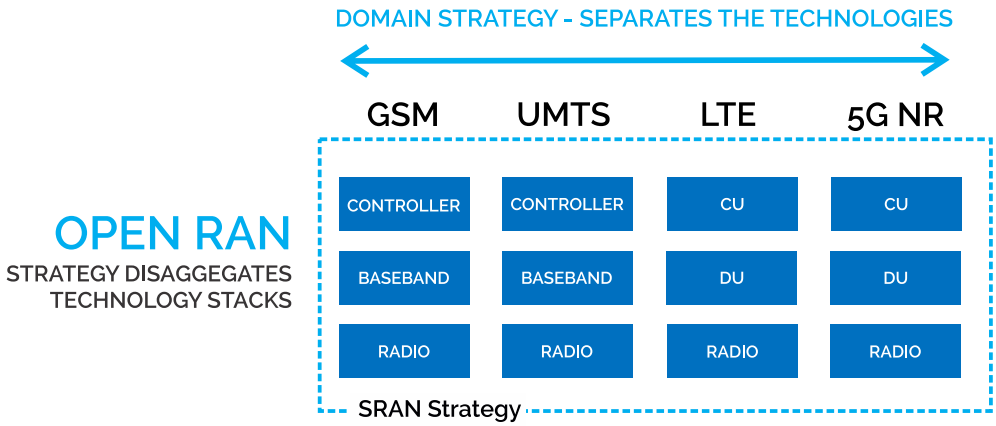


Figure 1: Open RAN and Domain Strategy

2. SERVICE | COVERAGE

As illustrated in the diagram, the combination of Domain Strategy and Open RAN strategy increases the complexity of selecting individual functions.

The adoption of SRAN strategy has proliferated in the industry during the last ten years for its clear advantages such as lower TCO, better site solutions, better performance, and flexibility for re-farming. Most operators have gone down this path as opposed to the domain strategy.

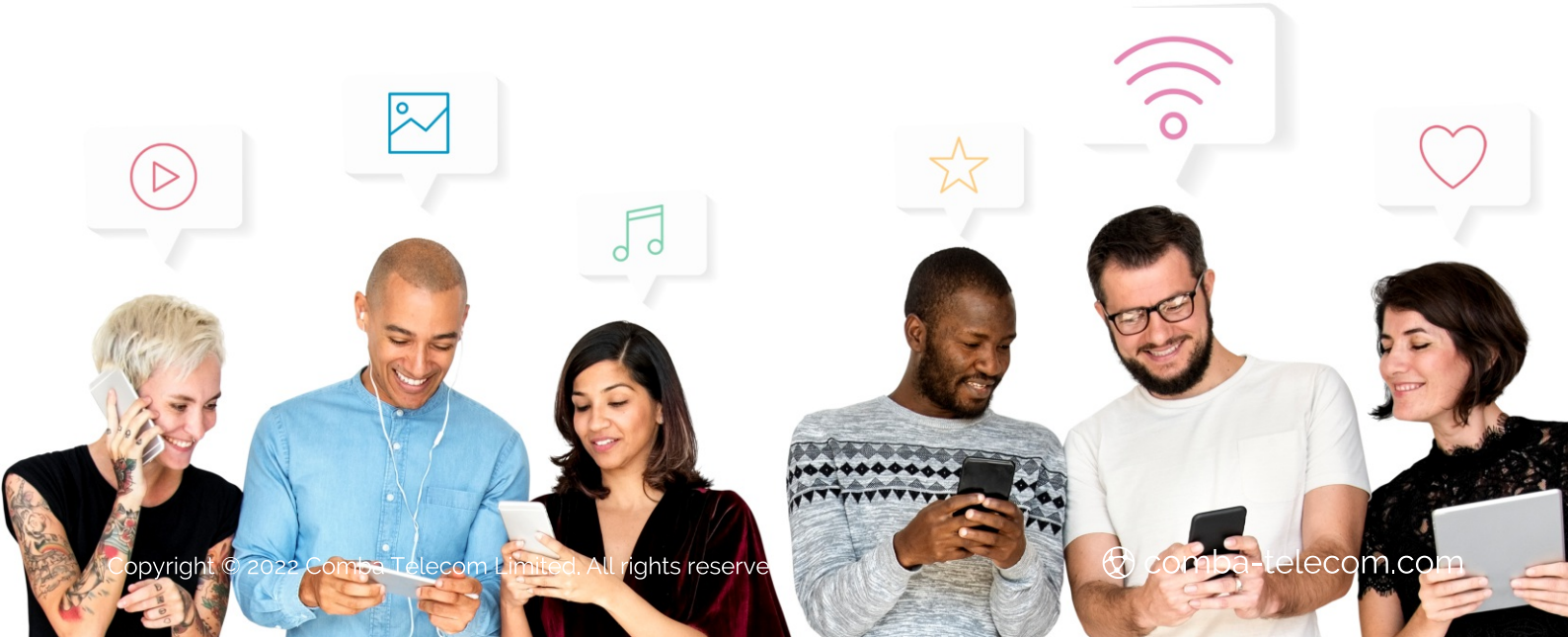
The benefits of Open RAN strategy are incomparable with SRAN, but it offers vertical disaggregation of technology stacks and supply diversity. This fundamentally means a ground-breaking step towards leveraging the best of both.

Four technical advantages lead to SRAN's success:

1) Better RF by avoiding combiners, and using Multi-RAT/ Multi-Band radios
2) Improved spectrum efficiency by allowing re-farming without site visits through software-defined radio
3) Better energy efficiency by reducing the number units
4) Better use of RF resources by coordinating all layers with functions such as Mobility Load Balancing (MLB)

Figure 2: Technical Advantages Lead to SRAN's Success

Open RAN's challenge is to replicate SRAN's advantages. Nothing architecturally hinders the advancement of open RAN, but it is just a matter of time to catch up with the "essential" legacy features. Though vendors have developed a hundred features over the years, in reality, only a fraction of them are used, and incremental advances are insignificant.



2. SERVICE | COVERAGE

Open RAN industry has already enabled Multi-RAT radios compliant to accommodate the four basic radio access technologies going forward. Points 1-3 have already been addressed.

For point 4 "Better use of RF resources by coordinating all layers with functions such as **Mobility Load Balancing (MLB)**, it refers to the function of the DU and upwards in the stack. The CU/DU vendors are making steady progress in realizing this SRAN advantage.

3. CAPACITY

There are, in principle, four factors affecting network capacity:

As power is regulated by spectrum licenses, health and safety standards and device battery limits, it is not so easy to explore when building a network.

BREAKING DOWN THE CHALLENGES

Spectrum and site density are the hardest for the MNOs to improve upon. Spectrum licenses are costly, a burden of network investment, but they are fundamental for MNOs to secure the businesses. The license offers competitive edge by blocking others from taking the business. To get more spectrum when one needs it is not an option, as the licenses only come around roughly every decade. The reality is that, when the auction comes, the MNO will need to buy spectrum prorated to its market share.

Sites would have been a great way to expand the capacity, and some MNOs have been able to do so by acquiring large amounts of sites like Softbank's acquisition of Willcom that rendered Softbank 160k sites. For a typical MNO's site, the acquisition is tedious with long lead times and resistance from the public. Everyone wants excellent mobile coverage, but no one wants the towers.

3. CAPACITY

The promise of densification though small cells, once pitched as the solution to the capacity problem, has to a large extent not been able to live up to its initial hype. Everything from the site cost to the availability of transmission and power has come in its way.

Remains is the part where RAN vendors can make a difference and is in the hands of the MNO to control, MIMO solutions and sectorization. This has propelled macro sites to new heights of spectrum efficiency, with the OPEX part of the network relatively untouched. MIMO explores multipath, which used to be a problem in the past, but now delivers capacity gains in the network.

This has allowed the equipment vendors to produce radio equipment with different MIMO configurations to match the need and practicality of network rollout and capacity. oday, we benefit from a multitude of solutions from **2T2R, 2T4R, 4T4R**, all the way to **64T64R**. Each of them fits different settings from rural to dense urban deployment and is almost spanning a magnitude of capacity difference between the common 2T2R to the most advanced **Massive MIMO** under specific conditions.

Sectorization does a similar job by breaking down the coverage area for each RF path. The choice between higher-order MIMO and higher-order sectorization is based on the UE base. For 5G, the choice leans towards MIMO, but for hard-hit city centers with many LTE UE (1T2R), sectorization may be a better solution. Either way, the MNOs have so many choices to build network capacity without adding spectrum or sites.

4. CONCLUSION

We identified four controlling technical factors to provide mobile service – Spectrum licenses, Service/Coverage Requirements, Site density and technology.

We identify that adding new macro radio sites or upgrading existing macro radio sites are still the key strategies for adding capacity and boosting network performance.

OpenRAN is well suited to fit these strategies as it provides an open foundation with supply chain choices while still being efficient with across all radio technology domains.

LEADER IN COVERAGE SOLUTIONS

Comba

Comba is a **market leader** and offers a complete portfolio of products and solutions for **mobile coverage** in different kind of scenarios and applications.

Antennas & Subsystems

DAS Systems

OpenRAN

Small Cells

www.comba-telecom.com/en/openran-solutions

FOLLOW US ON LINKEDIN

marketing.europe@comba-telecom.com

comba-telecom.com