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Are You Overlooking RAN Configuration Management?

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When the management of a mobile network operator looks at how to improve customer experience, the focus almost always falls on the network processes of fault management and operational health. And indeed, no one would argue that when a fault occurs and services become unavailable, user experience will be impacted—hence the focus is justified. However, fault management is not the biggest factor in the formation of long-term customer perception of what constitutes a great experience. Customers easily forget short and infrequent events when their service is down, but what sticks in their minds are trivial yet persistent issues related to the service underperforming—for example, high latency in loading web pages or lengthy buffering when streaming video and music services.

To truly provide a great customer experience, eyes need to be firmly cast on best-in-class configuration management, specifically on the radio access network (RAN). This is an area of mobile network management that is typically overlooked due to its complexity and demand for high expertise. To assure the performance of a radio link is inherently risky—unlike in fixed communications, the wireless link cannot be fully guaranteed, and it is in its nature to be random. To mitigate this, it is important to ensure that the configuration, for example, the parameters and settings which govern the operation of the RAN, are set in the most optimum way. Why? Because it is this very configuration that will assure mobile services are performing at their best.

The complexity of managing RAN configuration

Thirty years ago, at the dawn of 2G cellular communications, RAN configuration management (RAN CM) was a straightforward operation, performed well and with a full reach to adequately assure customer experience. But things were simple. Mobile networks would use only one radio access technology, have a smaller number of base stations and network RAN controllers, use common radio equipment for all nodes, and provide a couple of main services (voice and text). Additionally, usually

only one vendor was chosen to provide both software and hardware for the RAN, or if there were to be two, they would be geographically split and segregated. The complexity of the RAN configuration was low, and the possibilities for design variations were limited. It was easy to appoint and train a small number of engineers to do RAN CM manually.

An example below illustrates the volume of unique parameters in a typical network for the three biggest RAN vendors on the market.

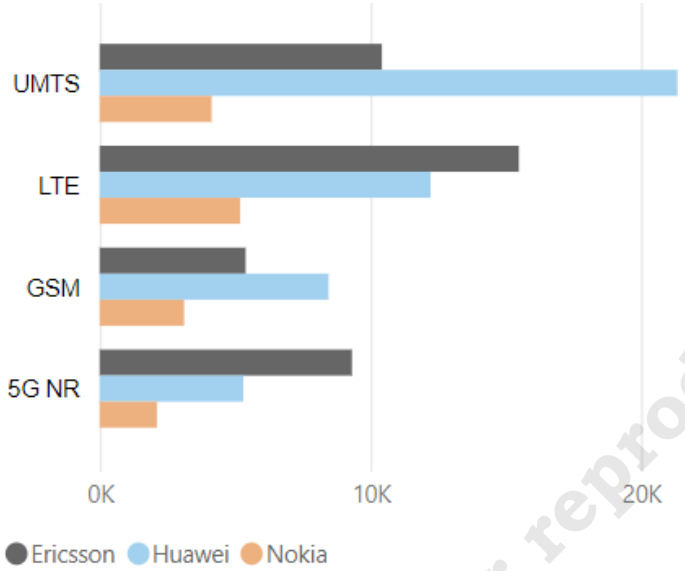

Figure 1: Volume of unique parameters per RAN vendor for a typical network. Source: WIM Technologies

Fast forward to the present, and things look different. Mobile networks operate a mix of up to four different radio access technologies (2G to 5G). The number of services has increased, with data access at the forefront. New base stations are built frequently, and a variety of different node solutions and radio products are installed—small cells, massive MIMO, dynamic spectrum sharing, and more. New verticals are introduced into the RAN mix, like private networks. The level of complexity has now increased so significantly that teams, pressed by tight budgets and increased knowledge gaps, have had to cut corners and focus on just the basic aspects of configuration management.

The main contributing factor to the increase of complexity is, however, the introduction of multiple RAN vendors. This has resulted in the need for a bigger pool of experts to handle the configuration, each individual specializing only on a single vendor. Why is this? In theory, products designed to operate the same radio access technology, for example LTE, should work similarly, as they need to conform to the specification. And they do, however, this only applies to the basic aspect of the operation of LTE. As so many things can go wrong in a radio access channel, a lot of different parameters and settings can be made available to challenge this. Every RAN vendor has a different approach on what to make available as part of their offering. In fact, many use this as an opportunity to differentiate their product from the rest, resulting in a tremendous number of parameters that are available for engineers to set and modify. For a contemporary multi-vendor radio access network with four radio technologies and three vendors, one is looking at over 100,000 parameters that need to be managed. The complexity is not only in the sheer number of settings to consider, but also in the need for bespoke design policies that apply to specific network elements, carriers, and specific scenarios such as rural, fast-mobility, or high- capacity urban. Because of the previously mentioned high mix of different radio solutions and services, combined with the nuances of land topology, geography, and location of customers, one configuration design across the whole network simply will not do. Configuration management needs to factor in unique policies that apply to only targeted elements and ensure that those policies are constantly reviewed and adapted to the fast-paced evolution of a mobile network.

The advent of Open RAN

One might be misled to assume that further evolution in the RAN architecture will bring simplicity—the truth is different. It provides new business and consumer opportunities at the expense of increased technical complexity. This is the case with Open RAN when it comes to configuration management and its impact on customer experience. Open RAN will bring much-needed liberalization to the RAN market—creating open architecture standards and strictly defined interoperability between RAN components. Mobile operators will have the opportunity to shop around for products from a variety of vendors and replace them with new ones when deemed fit to do so. This will bring costs down and enable innovation, which in turn will allow for new mobile services to be offered to customers. A comparison can be made to the release of the IBM personal computer using open architecture and the subsequent impact this had in the PC industry in the 1980s.

What are the implications of Open RAN on configuration management? Inadvertently, the opportunity to use a variety of new and numerous vendors for RAN components will increase the architectural complexity of those networks that bring Open RAN into their mix. And this means more parameters and more settings that need to be considered when establishing RAN design policies. Open RAN will govern how different components in the architecture talk to each other; it does not enforce vendors to use standardized configuration schemas beyond the need for interoperability. In fact, vendors will use this to differentiate their products from the rest of the market and enable innovative solutions. When we consider that most networks will be of a Hybrid-RAN nature, that is containing both Open RAN and proprietary RAN, the task of configuration management becomes enormous.

The configuration management solution is already available

Conscious of the exponential increase in complexity of RAN configuration management, most mobile operators have not been able to adapt. A lot of work remains manual and, as argued earlier in this article, the result is that the RAN is not configured to its maximum potential. The outcome is subpar customer experience. Configuration management is easy to overlook, too. It is often a dry and boring matter, too complicated to grasp its gravity and lacking the panache to create a natural excitement for it. It need not be so—the challenges can be tackled should a zero-touch approach be undertaken. Relying on manual effort is no longer practical or affordable. RAN configuration management can only be fully assured using software that provides closed-loop automation (CLA) for all vendors on a network.

The challenge for a network design team is in both the creation of the design policies and their application on the network. Design policies themselves must be adapted on the go and constantly modified as the network itself evolves and customer behavior changes. The application of those policies needs to factor the differences and specifics that each vendor has in the method the respective parameters are defined and modified. Closed-loop automation along with unified policy definition help in managing the RAN configuration efficiently—application of new design policies, audit against live configuration, correction on a repeated cycle, analysis of impact on network performance, and feedback loop to modify the design when it is no longer fit for purpose. It is important to note that effectiveness of the automation itself is directly dependent on the quality of the solution and particularly how the concept of design policies is implemented. A RAN network is constantly changing with network elements integrated and removed frequently. For configuration management automation to work in practice, design policies need to be flexible and dynamic to automatically

adapt to those changes.

This is hardly a revelation, of course. The topic of network automation has frequently been raised in a multitude of platforms and events. And yet, the focus mostly falls on automation of reactive problem identification rather than on automation for proactive network performance, the latter being what the core aspect of configuration management is. Mobile operators who understand the importance and growing complexity of configuration management are those that usually end up winning benchmark awards and customers' satisfaction.