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RAN Automation, SON, RIC, xApps & rApps in the 5G Era: 2024 - 2030 – Opportunities, Challenges, Strategies & Forecasts

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Abstracts

Automation of the RAN (Radio Access Network) – the most expensive, technically complex and power-intensive part of cellular infrastructure – is a key aspect of mobile operators' digital transformation strategies aimed at reducing their TCO (Total Cost of Ownership), improving network quality and achieving revenue generation targets. In conjunction with AI (Artificial Intelligence) and ML (Machine Learning), RAN automation has the potential to significantly transform mobile network economics by reducing the OpEx (Operating Expenditure)-to-revenue ratio, minimizing energy consumption, lowering CO2 (Carbon Dioxide) emissions, deferring avoidable CapEx (Captial Expenditure), optimizing performance, improving user experience and enabling new services.

The RAN automation market traces its origins to the beginning of the LTE era when SON (Self-Organizing Network) technology was introduced to reduce cellular network complexity through self-configuration, self-optimization and self-healing. While embedded D-SON (Distributed SON) capabilities such as ANR (Automatic Neighbor Relations) have become a standard feature in RAN products, C-SON (Centralized SON) solutions that abstract control from edge nodes for network-wide actions have been adopted by less than a third of world's approximately 800 national mobile operators due to constraints associated with multi-vendor interoperability, scalability and latency. These shortcomings, together with the cellular industry's shift towards open interfaces, common information models, virtualization and software-driven networking, are driving a transition from the traditional D-SON and C-SON approach to Open RAN automation with standards-based components – specifically the Near-RT (Real-Time) and Non-RT RICs (RAN Intelligent Controllers), SMO (Service Management & Orchestration) framework, xApps (Extended Applications) and rApps (RAN Applications) – that enable greater levels of RAN programmability and automation.

Along with the ongoing SON to RIC transition, RAN automation use cases have also evolved over the last decade. For example, relatively basic MLB (Mobility Load Balancing) capabilities have metamorphosed into more sophisticated policy-guided traffic steering applications that utilize AI/ML-driven optimization algorithms to efficiently adapt to peaks and troughs in network load and service usage by dynamically managing and redistributing traffic across radio resources and frequency layers.

Due to the much higher density of radios and cell sites in the 5G era, energy efficiency has emerged as one of the most prioritized use cases of RAN automation as forward-thinking mobile operators push ahead with sustainability initiatives to reduce energy consumption, carbon emissions and operating costs without degrading network quality. Some of the other use cases that have garnered considerable interest from the operator community include network slicing enablement, application-aware optimization and anomaly detection.

While the benefits of SON-based RAN automation in live networks are well-known, expectations are even higher with the RIC, SMO and x/rApps approach. For example, Japanese brownfield operator NTT DoCoMo expects to lower its TCO by up to 30% and decrease power consumption at base stations by as much as 50% using Open RAN automation. It is worth highlighting that domestic rival Rakuten Mobile has already achieved approximately 17% energy savings per cell in its live network using RIC-hosted RAN automation applications. Following successful lab trials, the greenfield operator aims to increase savings to 25% with more sophisticated AI/ML models.

Although Open RAN automation efforts seemingly lost momentum beyond the field trial phase for the past couple of years, several commercial engagements have emerged since then, with much of the initial focus on the SMO, Non-RT RIC and rApps for automated management and optimization across Open RAN, purpose-built and hybrid RAN environments. Within the framework of its five-year $14 Billion Open RAN infrastructure contract with Ericsson, AT&T is adopting the Swedish telecommunications giant's SMO and Non-RT RIC solution to replace two legacy C-SON systems. In neighboring Canada, Telus has also initiated the implementation of an SMO and RIC platform along with its multi-vendor Open RAN deployment to transform up to 50% of its RAN footprint and swap out Huawei equipment from its 4G/5G network.

Similar efforts are also underway in other regions. For example, in Europe, Swisscom is deploying an SMO and Non-RT RIC platform to provide multi-technology network management and automation capabilities as part of a wider effort to future-proof its brownfield mobile network, while Deutsche Telekom is progressing with plans to develop its own vendor-independent SMO framework. Open RAN automation is also expected to be introduced as part of Vodafone Group's global tender for refreshing 170,000 cell sites.

Deployments of newer generations of proprietary SON-based RAN automation solutions have not stalled either. In its pursuit of achieving L4 (Highly Autonomous Network) operations, China Mobile has recently initiated the implementation of a hierarchical RAN automation platform and an associated digital twin system, starting with China's Henan province. Among other interesting examples, SoftBank is implementing a closed loop automation solution for cluster-wide RAN optimization in stadiums, event venues, and other strategic locations across Japan, which supports data collection and parameter tuning in 1-5 minute intervals as opposed to the 15-minute control cycle of traditional C-SON systems. It should be noted that the Japanese operator eventually plans to adopt RIC-hosted centralized RAN optimization applications in the future.

In addition, with the support of several mobile operators, including SoftBank, Vodafone, Bell Canada and Viettel, the idea of hosting third party applications for real-time intelligent control and optimization – also referred to as dApps (Distributed Applications) – directly within RAN baseband platforms is beginning to gain traction. As a counterbalance to this approach, Ericsson, Nokia, Huawei and other established RAN vendors are making considerable progress with a stepwise approach towards embedding AI and ML functionalities deeper into their DU (Distributed Unit) and CU (Centralized Unit) products in line with the 3GPP's long-term vision of an AI/ML-based air interface in the 6G era.

SNS Telecom & IT estimates that global spending on RIC, SMO and x/rApps will grow at a CAGR of more than 125% between 2024 and 2027 alongside the second wave of Open RAN infrastructure rollouts by brownfield operators. The Open RAN automation market will eventually account for nearly $700 Million in annual investments by the end of 2027 as standardization gaps and technical challenges in terms of the SMO-to-Non-RT RIC interface, application portability across RIC platforms and conflict mitigation between x/rApps are ironed out. The wider RAN automation software and services market – which includes Open RAN automation, RAN vendor SON solutions, third party C-SON platforms, baseband-integrated intelligent RAN applications, RAN planning and optimization software, and test/measurement solutions – is expected to grow at a CAGR of approximately 8% during the same period.

The “RAN Automation, SON, RIC, xApps & rApps in the 5G Era: 2024 – 2030 – Opportunities, Challenges, Strategies & Forecasts” report presents an in-depth assessment of the RAN automation market, including the value chain, market drivers, barriers to uptake, enabling technologies, functional areas, use cases, key trends, future roadmap, standardization, case studies, ecosystem player profiles and strategies. The report also provides global and regional market size forecasts for RAN and end-to-end mobile network automation from 2024 to 2030. The forecasts cover three network domains, nine functional areas, three access technologies and five regional markets. The report comes with an associated Excel datasheet suite covering quantitative data from all numeric forecasts presented in the report.

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