# Best Practices and Lessons Learned from Open and Intelligent RAN Commercial Deployment by NTT DOCOMO, Japan

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## Introduction

This paper shares the best practices and lessons learned from NTT DOCOMO's Open RAN commercial deployment. It aims to present realistic challenges and solutions in Open RAN adoption, contributing to the development of the entire ecosystem.

## 1. Motivation and Strategic Background of Open RAN Deployment

- Why Open RAN?
  - Based on our experience with multi-vendor operations since the 4G era, we have been promoting the activities of the O-RAN ALLIANCE since its inception. Our main motivation is to achieve "Best of Breed," combining the optimal products for each component, such as Radio Units (RUs), Distributed Unites (DUs), and Central Units (CUs). This flexibility provides the foundation for responding quickly to diverse customer needs and creating new value.
- Deployment Environments and Business Cases
  - While coexisting with our existing 4G network, we have built a nationwide Open RAN network from the outset for 5G. The knowledge gained from such a large-scale, multi-vendor integration is also beneficial for brownfield operators with existing networks. The business case anticipates significant reductions in TCO (Total Cost of Ownership) and power consumption, as well as strengthening supply chain resilience. Specifically, CAPEX is optimized through increased competition among vendors, while OPEX is reduced via operational automation driven by Service Management and Orchestration (SMO)/RAN Intelligent Controller (RIC). This approach allows us to improve network Quality and accelerate service Delivery (QCD) in a sustainable manner. This is achieved through the disaggregation of software and hardware (SW/HW) via openness and virtualization, enabling flexible function swaps, and advancing the network through E2E control, including the use of Artificial Intelligence (AI)/Machine Learning (ML) via SMO implementation.

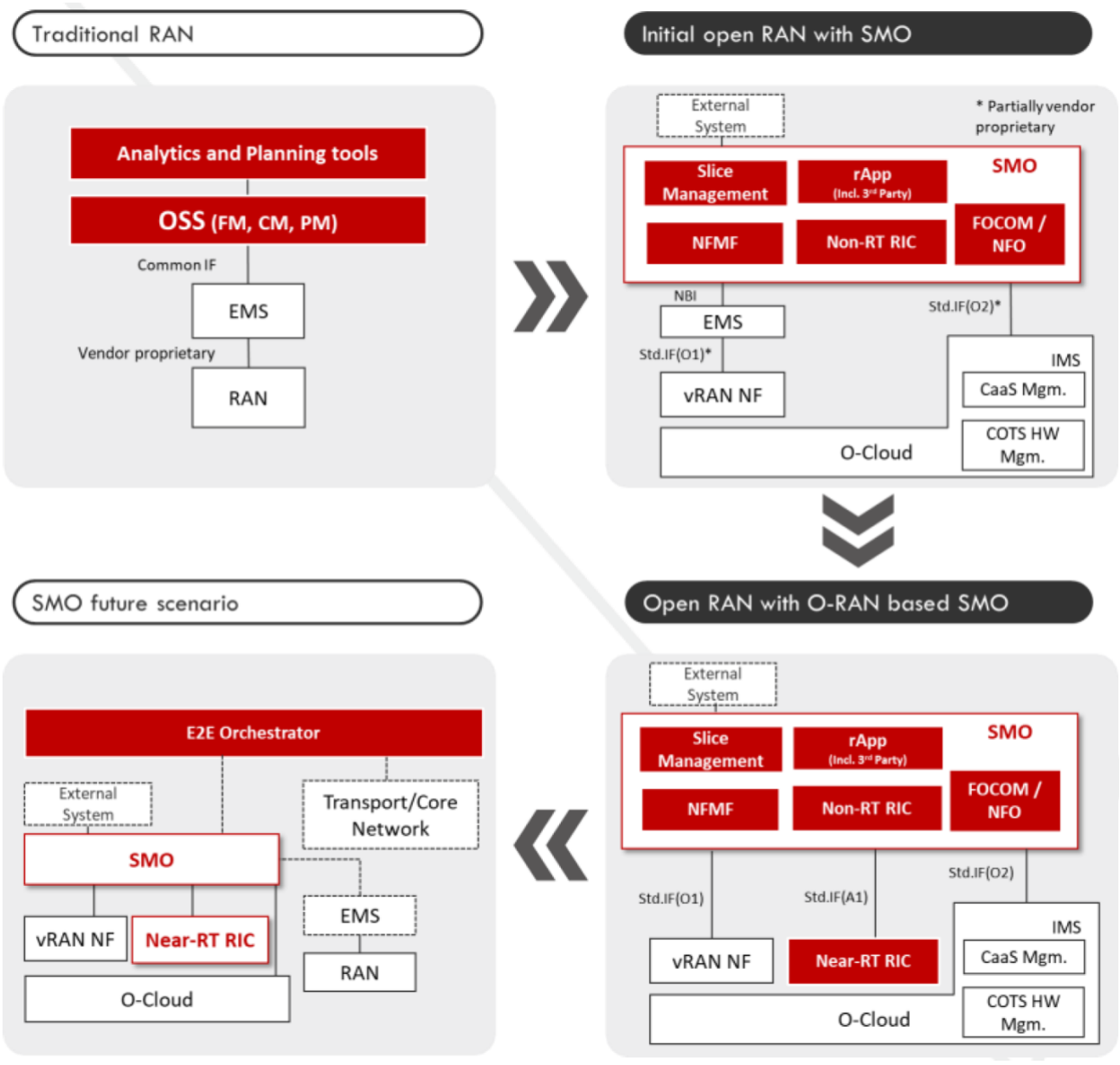
## 2. Roadmap and Practical Approach to Deployment

2.1 Recommendations for phased deployment steps

A phased approach is effective, especially for brownfield operators, to manage risks while reaping the benefits.

1. Step 1: Starting with Open Fronthaul (FH)
   - The most realistic first step is to open the fronthaul interface between the RU and DU. By taking opportunities such as new frequency assignments or capacity expansion in specific areas with surging traffic, operators can introduce O-RAN compliant RUs from other vendors with minimal impact on the existing network. This allows operators to gain operational experience with multi-vendor environments at low risk.
2. Step 2: Phased Introduction of virtualized RAN (vRAN) and SMO (Initial Architecture)
   - The next step is to introduce DU/CU virtualization (vRAN) and the Service Management and Orchestration (SMO), which governs operations. In this "Initial Architecture," recognizing that interface standardization for O1/O2 interfaces is still in progress, we use existing operational assets like EMS and some vendor-proprietary APIs for connecting the SMO to each network function. This pragmatic approach allows operators to enjoy currently available benefits like Zero Touch Provisioning and resource virtualization early on, without waiting for full standardization, enabling a smooth transition even for operators with existing networks.
3. Step 3: Maturation of RIC and SMO (Mature Architecture)

- The ultimate goal is to replace the vendor-proprietary parts tolerated in Step 2 with fully standardized, open interfaces (e.g., O1, O2, A1, R1) in a "Mature Architecture." This will enable a true plug-and-play multi-vendor environment, allowing for the free deployment of third-party rApps/xApps on the Non-Real-Time (Non-RT)/Near-Real-Time (Near-RT) RIC. As a result, advanced autonomous network optimization using AI/ML (such as traffic management and power saving) becomes truly possible.




https://ssw.web.docomo.ne.jp/orex/technical/pdf/VF-Docomo%20whitepaper_SMO.pdf

2.2 Key to Multi-Vendor Integration: Testing and Information Sharing

We propose the following best practices to overcome integration challenges. Success hinges not only on the efforts of a single MNO but also on collaboration among operators and the utilization of neutral organizations.

1. MNO-led "IOT Profile" Creation

- To eliminate differences in specification interpretation, it is essential for the MNO to provide all vendors with a profile that defines requirements (features and parameters to be used). However, since not all operators possess this capability, collaboration with experienced partners or using frameworks that offer SI know-how as a service, such as our OREX initiative, are also effective options.

2. Promoting Information Sharing Among Vendors
    - By having the MNO mediate, vendors can exchange and conduct desktop checks of O-RAN YANG data models before integration, which significantly reduces rework.
3. Sufficient Pre-verification Between Equipment (Interoperability Testing)
    - Sufficient pre-verification between equipment is essential. Utilizing a neutral "hub" like the OTICs (Open Testing and Integration Centres) established in various countries and regions, including Japan, is extremely effective for facilitating pre-verification and information sharing, reducing the burden on the entire ecosystem, and ensuring interoperability.

## 3. Key Success Factors, Challenges, and Lessons Learned

3.1 Key Success Factors

- **Proactive System Integration (SI) coordination based on 4G experience:** Our key success factor was not just having multi-vendor experience, but learning from the "pain points" of 4G. We identified that siloed vendor communication and specification ambiguities were the root causes of integration failures. Based on these lessons, we adopted a proactive, MNO-led coordination model for 5G. This involved carefully managing the SI process, with a focus on ensuring interoperability by addressing subtle issues that are often not apparent in the specifications. This is the core reason why we were able to achieve a nationwide Open RAN rollout from Day 1.
- **Systematizing and sharing SI capabilities:** Instead of relying on the specialized skills of a few key experts, we systematized the complex integration know-how into frameworks, as represented by OREX. This approach transforms informal, experience-based knowledge into explicit, shareable assets, enabling our partners to achieve integration success efficiently. This framework for sharing SI capabilities ensures consistent quality and scalability across the ecosystem.

3.2 Challenges and lessons learned

- **Challenge**: The Fundamental Complexity of System Integration
    - Discrepancies in specification interpretation and incompatibility of optional features occur frequently.
- **Lesson Learned**: The success of Open RAN deployment depends not on technical prowess alone, but on the MNO's ability to lead the creation of a "framework." This is not something that can be accomplished alone; it means building strong partnerships across the entire ecosystem. It is essential to acquire and promote capabilities such as "IOT profile definition," "promoting information sharing among vendors," and "sufficient pre-verification between equipment" through collaboration among operators and with various partners.

## 4. Organization, Skills, and Future Outlook

- Organization and Skills:
    - On the organizational side, traditional siloed structures divided by area of expertise are inadequate. A cross-

functional structure is required where teams with different expertise—such as radio, cloud, and software development—collaborate closely. This is not just about an organizational chart, but about fostering a unified SI capability to proactively solve multi-vendor issues at their source. In terms of skills, in addition to conventional radio technology, expertise in cloud, software development, and, above all, project management skills — especially the ability to orchestrate a complex multi-vendor ecosystem— are essential. Participation in community activities like O-RAN ALLIANCE PlugFests is effective for acquiring these skills.

- The Role of AI/ML:
    - The true value of AI/ML is unleashed in a "Mature Architecture" where multi-vendor xApps/rApps operate on the SMO/RIC. Delays in interface standardization will hinder the future of AI utilization. To avoid ecosystem fragmentation, it is important to collaborate and align with 3GPP.
- Collaboration with Governments and Regulators:
    - Dialogue and coordination with regulatory bodies are effective for vitalizing the ecosystem.

## Conclusion

Open RAN adoption is not just a technological implementation but an ecosystem transformation process led by MNOs. Its success depends on the ability to build a "framework" that overcomes specification ambiguities. Our most important lesson learned is that MNOs must take the lead to (1) present clear requirements (IOT profiles), (2) provide a venue to facilitate collaboration among vendors, and (3) conduct sufficient pre-verification between equipment. We hope this paper will contribute to the promotion of Open RAN.