Solution Profile

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Amdocs

Open RAN

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EXECUTIVE SUMMARY

Amdocs needs no introduction to readers of Appledore's research: it is the pre-eminent provider of OSS and BSS to the world's telcos, fixed and mobile.

In the context of Open RAN, however, some of its less well-known assets gain a much greater significance and relevance for CSPs.

Open RAN, the opening up of the proprietary functionality of a mobile radio access network, is arguably the most significant initiative in the mobile telecom industry today. As a movement, its ambition is far-reaching. It specifically intends to impact the entire mobile telecom supply chain from chipset manufacturers to OEM/network equipment providers, all the way through to communications service providers (CSPs) and *their* end customers.

Amdocs already has a strong and relevant footprint – and perhaps more importantly in-depth technical knowledge and field experience – in RAN thanks to its Actix acquisition in 2013. This comes in the form of ActixONE, a conventional RAN planning tool (90+ deployments) and Smart RAN, its AI-enabled radio optimization product.

Through its engagement in SDOs and working groups (**ONF, O-RAN Alliance**), key partnerships (**Intel**), Amdocs has already established a powerful ecosystem of partners and standards, that gives it both influence (in shaping definitions, specifications, and capability statements) and reach (in ability to deliver them).

Appledore believes that Amdocs is particularly well positioned to benefit from the Open RAN movement and the new opportunities that it creates for CSPs. This will particularly be where Open RAN begins to enable the disaggregation of the RAN control and management plane functions. Its combination of systems integration expertise, but moreover its product capabilities and newer AI and ML competencies distinguish it in the marketplace.

ABOUT OPEN RAN

Open RAN seeks to break open the "black box" of the RAN – the software, hardware and systems integration (plus R&D, test, assurance, support and other adjacent services) – in such a way as to:

1. Allow greater choice for operators for each component (in order to meet distinct customer needs better, create more competition between vendors).
2. Enable faster introduction of new network (RAN) capabilities into the network (by making swap-out/swap-in easier).

By and large, smaller companies involved in Open RAN welcome the potential to win a piece of the overall RAN cake and establish a position as a strong provider of a niche component. However, for those larger companies already with well-established relationships with mobile CSPs, the question is how to create *new value* from Open RAN?

The answer is that the architecture for a RAN based on open (that is, standardized and public) interfaces exposes operational data, management and control capabilities that were previously proprietary and internal to a given vendor's RAN solution.

So, while the primary driver for Open RAN is (ostensibly) cost reduction, the speed/ease of innovation is probably more important in the longer term, along with the potential to provide new insights and analysis, new efficiencies, and new customer experiences for CSPs who embrace it, and the vendors that support it.

Amdocs is one of those well-established vendors with strong relationships with mobile CSPs. This profile analyzes Amdocs' value proposition in Open RAN. First, some context.

Traditional (i.e., proprietary) RAN solutions are typically provided by a single vendor, as a vertically integrated solution nationally or regionally, integrated via 3GPP backhaul interface standards with a core network management solution.

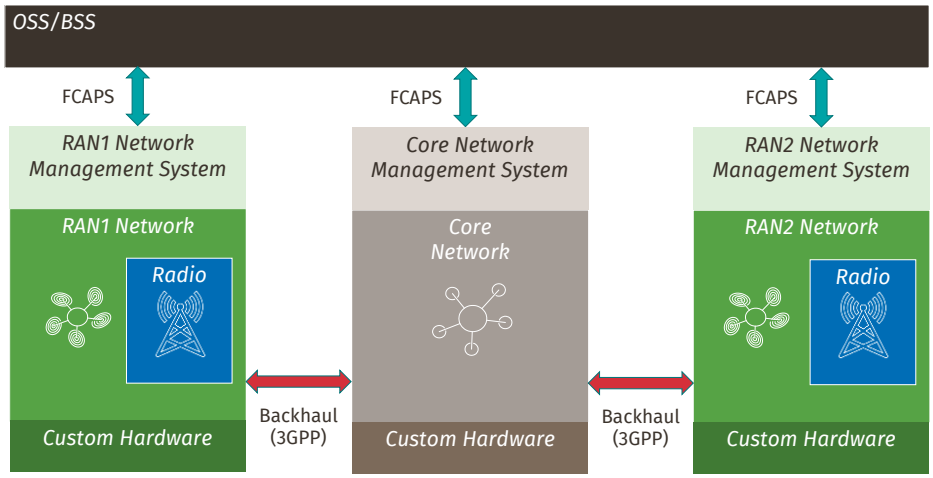


Figure 1: Traditional Proprietary RAN Architecture

Source: Appledore Research

By contrast, Open RAN dis-aggregates these proprietary stacks of equipment and software, standardizing and making public the interfaces between component parts, making it possible for more vendors to participate in the market. With increased competition and innovation, CSPs hope to see reduced costs. In an open RAN, components from multiple vendors can (it is hoped) be mixed-and-matched more easily.

The key disaggregated components of an Open RAN are illustrated in the following figure. (Red arrows indicate existing 3GPP standards. Blue arrows indicate new O-RAN alliance interface standards. Orange arrows indicate telemetry interfaces.)

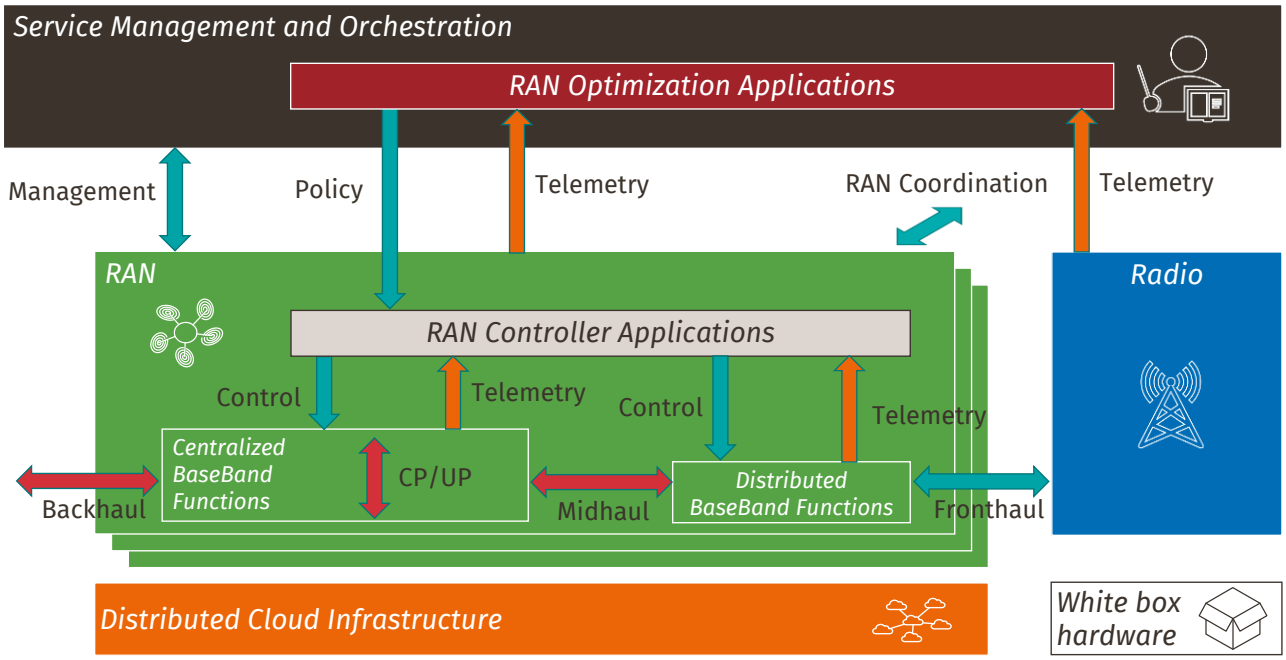


Figure 2: Simplified view of Open RAN network

Source: Appledore Research

All of the capabilities of a traditional RAN are still there in an open RAN. But in addition to potential cost savings, an open RAN creates new opportunities.

To understand the value of Amdocs' Open RAN offering, it is necessary to understand the proposed architectures for Open RAN, focusing on the business opportunity enabled by each open RAN disaggregation point (interfaces and functions). Each of these opens up distinct opportunities for introducing multi-vendor solutions, technical innovation, service innovation, lower CAPEX cost and lower operational cost.

In the diagram above, the most important newly visible interfaces are identified:

- **Control** interfaces – between the RAN controller applications and (disaggregated) baseband functions.
- **Telemetry** interfaces – providing a rich new set of data from the network up into higher-order control, analysis or orchestration applications.
- **Policy** interfaces – defining and applying policies at different layers of the network.
- **Management interfaces** – providing co-ordination and orchestration between centralized OSS, NMS functions and the RAN.

Control Interface

This interface enables the centralized management of RAN by a single RAN controller, termed the **Near Real Time RIC** (RAN Intelligent Controller) in O-RAN Alliance.

The intent and benefits of this are similar to that for SDN network controllers. It provides:

- Extensibility by enabling new applications for the management of the RAN, potentially enabling innovation in areas such as mobility management and energy usage.
- Overhead reduction by providing a single point of RAN configuration.

The O-RAN Alliance refers to the interface between the RAN Intelligent Controller and the CU-User Plane, the CU-Control Plane and the DU as the **E2 interface**.

Policy Interface

This interface splits the near real time control functions of a RAN controller, from the slower RAN optimization processes. The interface opens up RAN to new forms of optimization, based on big data analytics and AI/ML. Using network, subscriber and third-party data, offline optimization processes can determine optimized RAN configuration policy that can be implemented by the near real time RAN controller. Example optimized policy could include optimal spectrum utilization patterns, optimal network traffic patterns, optimized user mobility and handover patterns tied to service type.

The O-RAN Alliance refers to the interface between the near real-time RAN Intelligent Controller and the non-real time RAN Intelligent Controller refers the **A1 interface**.

Management Interfaces

RAN management has traditionally been bound up in proprietary EMS and NMS systems, with higher OSS systems having limited visibility into the network and limited configuration capability.

By opening up the management interfaces to all RAN components it enables flexible orchestration of the individual components of the RAN by third party service management tools and orchestrators. Orchestration can potentially be common and coordinated across other network technologies, like core and transport enabling orchestrated scaling of all the network together, rather than individually. This can enable increasingly automated and autonomous mobile networks.

The O-RAN Alliance refers to the interface between service management and orchestration and the components of the Open RAN as the **O1 interface**.

Telemetry Interfaces

A large amount of network and subscriber statistics are available from the RAN components, such as the CU, DU and Radio Units. These are collected and used for optimization and policy models in Non-Real time RIC. In addition, they are consumed by the near real-time RIC to support near real-time control decisions using streamed data from the RAN components. Supporting open telemetry interfaces opens the opportunity for innovation in both the near real-time and non-real-time RAN control.

The A1, O1 and E2 interfaces contain telemetry interfaces and are O-RAN alliance standards.

The following diagram shows the main components, annotated with the O-RAN Alliance official references for key interfaces O1, A1 and E2:

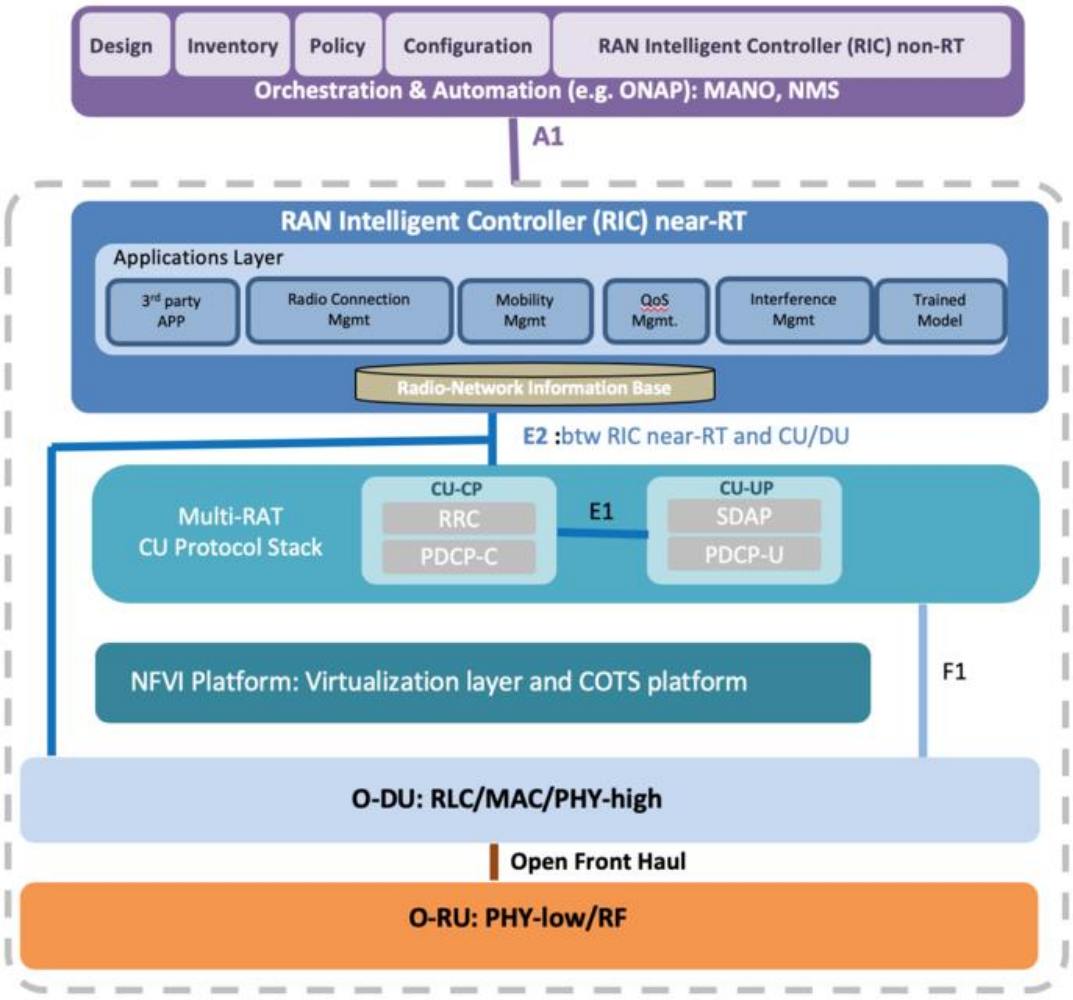
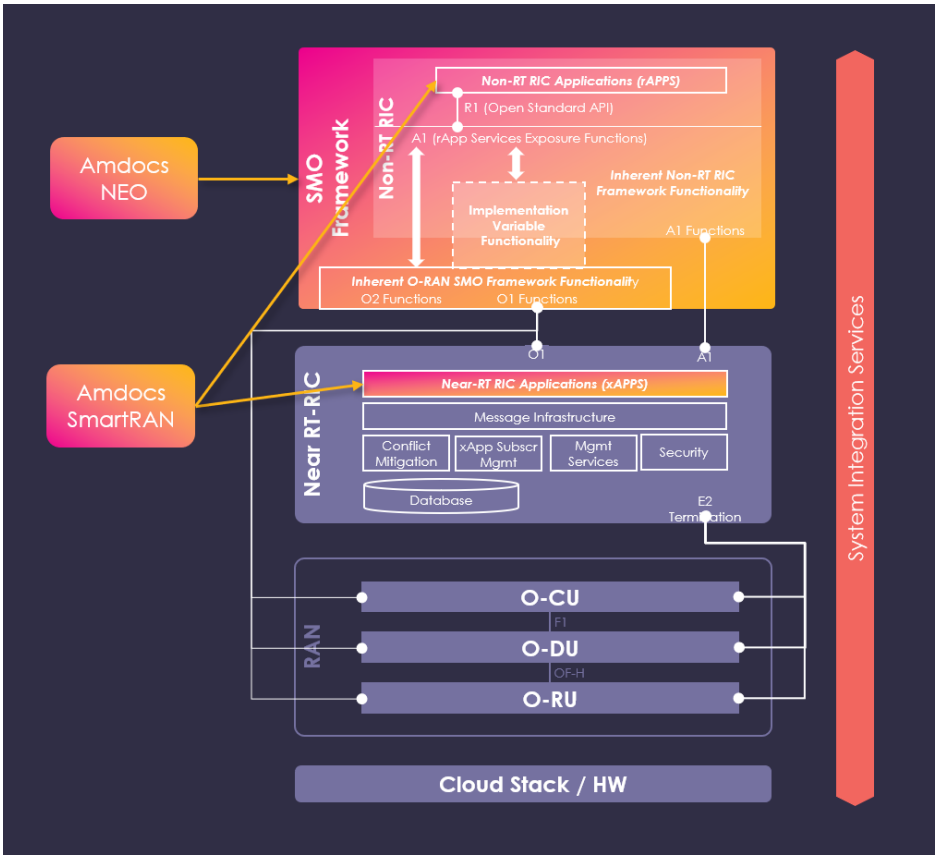


Figure 3: O-RAN Alliance's Open RAN Architecture

AMDOCS AND OPEN RAN



Overview

For CSPs, choosing to pursue an Open RAN strategy is not as simple a decision as choosing vendor A over vendor B. In addition to the normal processes for RAN planning and engineering, rollout program management, new activities and responsibilities must be accepted. For example:

- Selection of individual software components.
- Systems integration of new software components into overall network management.
- Analysis of new data and implications for new policies.
- Change from manual to automated processes (in particular, much faster cycles of network adjustment).
- Participation in an industry work-in-progress, in exchange for the first-mover advantages it will confer.

This combination delineates a critical new partnership for CSPs to make in their Open RAN programs: something more than traditional systems integration, but less than (and quite distinct from) turn-key RAN delivery.

Amdocs is aspiring to have a role in three key areas for Open RAN success:

1. Building on its systems integration skills, it wants to compete in enabling CSPs and enterprises to leverage Open RAN disaggregated solutions.
2. Building on its software assets and expertise (largely but not only via its Actix subsidiary), with its radio planning, SON and radio site management expertise, it wants to play a leading role in the analytics and control for both the non-real-time and near real-time RIC (RAN intelligent controller).
3. Working with standards organizations and open-source development communities it is looking to leverage and package these open-source solutions. Ultimately potentially leading to a role in wider support of open-source Open RAN, akin to RedHat with Linux.

Systems Integration

In Open RAN, systems integration is widely understood to be the most important new activity for CSPs to manage. The success of open RAN, somewhat ironically, depends on the choice of SI more than the choice of RAN vendor.

Systems integration of complex and demanding telecom software systems is a core strength of Amdocs, and it is applying its expertise to Open RAN. Amdocs aims to be the SI of choice across open RAN, an ambition it is progressing with its support of the **Telecom Infra Project's** interoperability testing labs in Indonesia, for example.

Today, Amdocs is selling the SI services to deliver virtualized RAN (vRAN) components. This is extending into lab test and interoperability testing services, potentially encroaching on the territory of out-and-out test and assurance vendors such as **Spirent**, **Keysight**, or test-focused SIs such as **World Wide Technologies**. (Amdocs also offers microservices CI/CD leadership with MS360 as an enabler/differentiator for the future (largely software-driven) Open RAN.)

However, they acknowledge the need of CSPs for a complete solution with delivery management and service guarantees, similar to that available from network equipment providers (NEPs). Amdocs expect that their SI approach will evolve as Open RAN matures and they are able to offer a full stack.

In Open RAN, CSPs are still learning what they *can* do, and which parts of a RAN rollout can now go to a cloud provider, which parts to a RAN integrator and so on. To some extent, Amdocs is competing with a desire from CSPs to attempt to do their own systems integration. However, this is likely to have limits and CSPs will gradually draw clearer lines around what they can do for themselves and where they need greater experience. Amdocs is prioritizing CSPs with an interest in Open RAN who already recognize they cannot do it all themselves. Given the breadth and depth of their experience, Amdocs looks in a good position to help CSPs map out the Open RAN journey and its multiple (disaggregated) responsibilities.

In addition, one growing feature of the Open RAN market is the potential for its application to private 4G and 5G networks. Even large enterprise customers are much less likely to have competing in-house development or integration teams than a typical CSP.

However, the assets and expertise from its 2013 Actix acquisition, with more of a focus on near-real-time RIC and non-real-time RIC and related RAN optimization functions, may prove a significant differentiator against other SI firms.

Software

Amdocs is looking to build its Open RAN position based on its strong experience in RAN planning with the ActixONE RAN analytics platform. They understand traditional RAN and have good visibility on both NEP and CSP need.

Amdocs acquired Actix in 2013 for $120m. Since its foundation in 1991, it had developed considerable footprint in RAN engineering and optimization (including SON) software. Amdocs understood that customer experience was becoming an overriding concern for mobile operators, and it made sense to combine Actix' access to low-level network data (and related intelligence) with Amdocs' BSS and OSS data. At the time of its acquisition, Actix reported over 350 deployments at mobile operators. Unusually for Amdocs, Actix retains a direct identity (listed as "an Amdocs company") – perhaps reflecting the strong brand value that Actix had already established with its customer base.

Under the Actix sub-brand, the portfolio consists of:

- **Smart RAN**: vRAN compatible analytics and optimization x/rApps delivered on top of a RIC platform
- **ActixONE**: a unified analytics and optimization platform for multi-G networks
- **Actix Analyzer**: a desktop-based drive test survey analytics tool

The Smart RAN components from Actix, will ultimately lead to a series of new xApps that can run in the near real time RIC.

In addition, it has leveraged AI and Machine Learning technology to provide insights into vertical specific mobile network application experiences ("Smart Mobility") and network investment planning ("Smart Capacity").

Amdocs also has extensive capabilities in the OSS domain, Amdocs NEO for orchestration and management of the RAN. This will be increasingly important as open RANs will operate alongside conventional RAN for many years to come, so having higher level systems and processes that can manage across both open and traditional RANs will be an inevitable requirement for CSPs.

STANDARDS INVOLVEMENT

Amdocs has a significant involvement in all the major Open RAN standards development organizations (SDOs) and initiatives:

O-RAN Alliance

Amdocs has voting rights in O-RAN Alliance Working Groups 1 ("Use Cases and Overall Architecture") and 2 ("Non-Real-Time RIC and A1 Interface"). (The O-RAN Alliance has nine Working Groups and a Test & Integration Focus Group.)

Within O-RAN Alliance, there is a program to develop an open-source RAN Intelligent Controller (RIC). There is a somewhat competing effort to develop an opensource RT RIC from ONF (SD-RAN) however there is an agreement to align SDKs. Facebook is a significant driver of both O-RAN Alliance and ONF efforts.

Amdocs is extremely experienced with industry open-sourcing initiatives and their pros and cons thanks to its earlier work on AT&T-led ONAP initiative. So far in Open RAN, though active, open-source code does not seem to be a top priority for the driving CSPs.

Telecom Infra Project (TIP)

TIP RIA is TIP's New Radio RAN Intelligence and Automation (subgroup within 5G SD-RAN) which "aims to deploy AI/ML-based applications (xApps) for a variety of RAN use cases (incl SON, MIMO)."

Under TIP's New Radio RAN Intelligent Automation (RIA) subgroup, operators were polled for the top priority use cases for Open RAN proving. The top cases were then matched against vendors preferences, and the result is the collaborative lab activities (such as in Indonesia, for which Amdocs is providing supporting systems integration services). Massive MIMO is regarded by CSPs as a critical use case (and proof point) for Open RAN.

THE RAN INTELLIGENT CONTROLLER (RIC)

The RAN Intelligent Controller is a major new function identified by the O-RAN Alliance. This is where greater intelligence and automation can be applied, fed with data from the edge of the network. While still at an early stage, the RIC (particularly in its near-real-time form), is the most important potential for differentiation and customer experience for CSPs using Open RAN. Amdocs is already well-advanced in its development of a RIC, and the sorts of analytics and optimization applications (xApps) that it enables.

Amdocs is working closely with the ONF open-source initiatives for the RIC controllers leveraging from their μONOS SD-RAN RIC controller as Amdocs-powered RIC platform, with a possible role similar to ONAP in providing a RedHat-like support package for these components. xApps and rApps are the areas where Amdocs and its Actix sub-brand can differentiate RIC solutions.

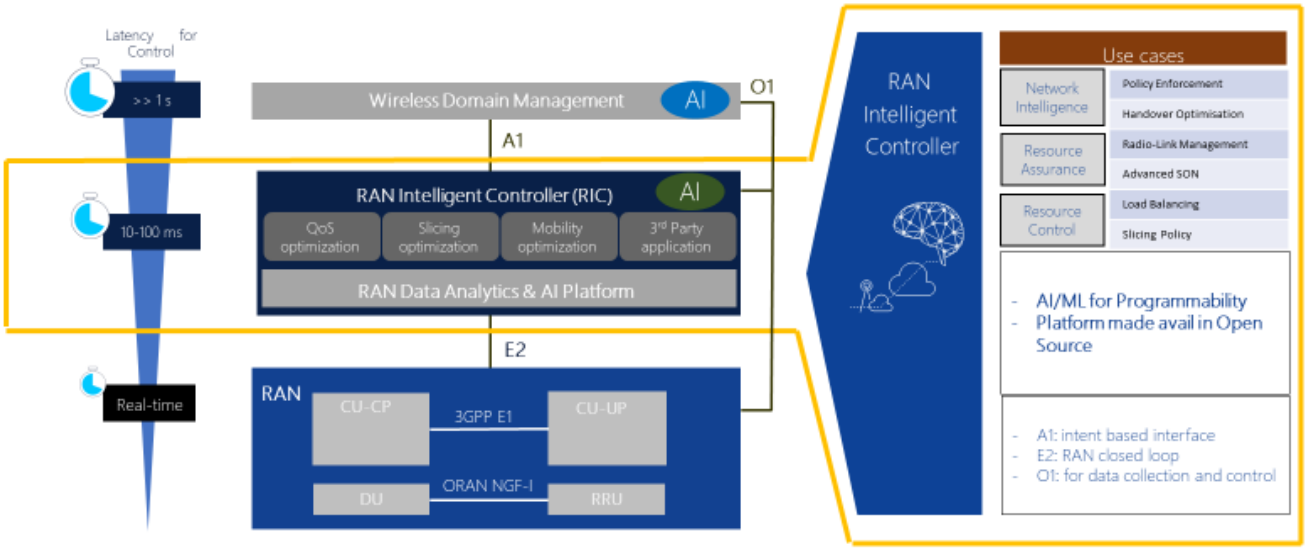


Figure 4: The RAN Intelligent Controller

Source: O-RAN alliance and Linux foundation, OLF networking

Amdocs is working on a real-world scale deployment, with a RIC providing AI control and coordination across hundreds of eNodes.

New Data = New Value

For a company such as Amdocs, the OpenRAN E2 interface (between CU/DU and Real-time RIC) is a goldmine of new, previously inaccessible, data that will make possible a smarter, more efficient RAN. The E2 interface presents data from a lower part of the protocol stack (Layers 1 and 2) that relates to key 5G and massive MIMO capabilities such as beam forming. This opens the possibility for new forms of optimization, and software-based control – especially over multi-vendor RANs.

As Amdocs puts it:

> ***"RAN optimization software now has direct access to all of the disaggregated component processes, including the non-real-time RAN intelligent controller (RIC) and the near-real-time RIC, both defined by the O-RAN Alliance, as well as the CU and DU processes that make up the baseband unit (BBU)."***

RF Planning traditionally involves a lot of "what if". Creating alternate network configurations, locations, placements, signal strengths, angles and other parameters to test network behaviour. Thanks to the data now becoming available via Open RAN, this sort of activity can now be done much more frequently and automatically within the RAN itself. This may be why massive MIMO holds such appeal for operators. It is the most complex RF access technology configuration to plan and

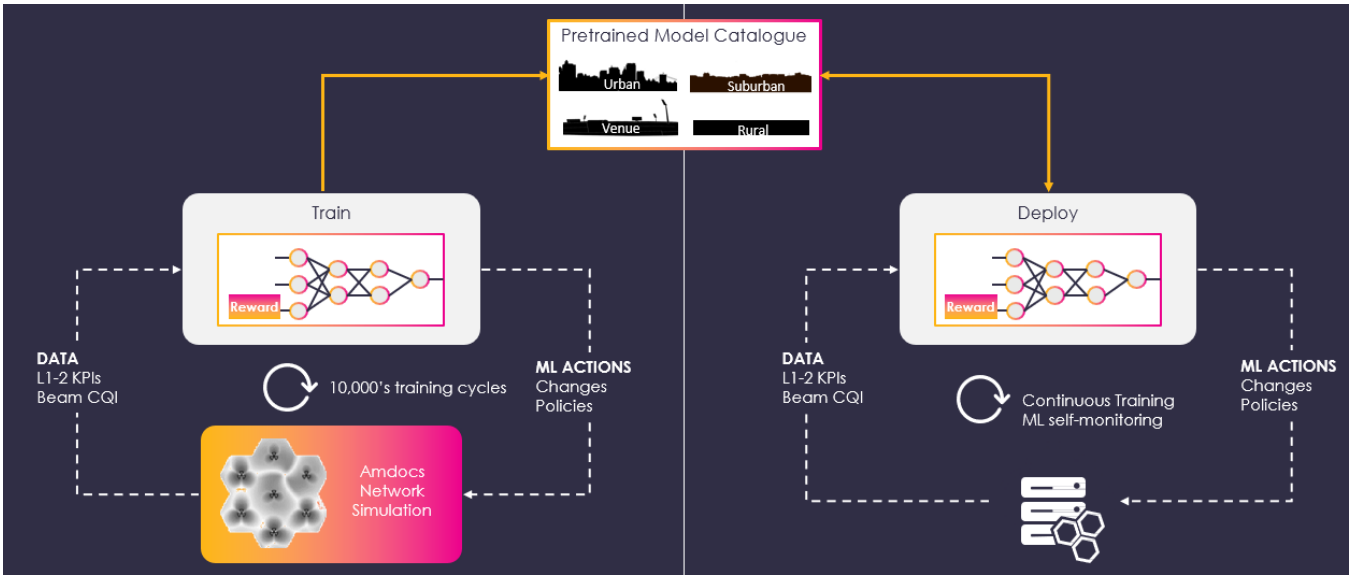
manage, so the potential to automate that process, and continuously optimize it, is powerful. Here particularly, Amdocs' acquired knowledge from Actix and TTI is a potential trump card against other more general SIs. Knowledge is power!

While Open RAN spec is open, it is not inextensible. That is, there is room for expansion and innovation – the Open RAN specs do not mandate a specific service model, for example. This would permit creation of proprietary applications within the CU or DU operating on the service layer data - applications that may be tuned to different RAN contexts such as a private network for a hospital versus an oil refinery. Amdocs' involvement in the Open RAN standards working groups has allowed them to build up considerable knowledge of how to develop and leverage the E2 interface.

Machine Learning

One of the principal ideas in Open RAN is greater intelligence within the formerly closed, black box of the RAN. rApps in the non-real-time RIC can bring machine learning to bear on the problems of coordinating hundreds of network nodes. Machine learning relies on data. Lots of data. This learning can then be deployed, with ongoing optimization, as policy to be implemented in xApps in the near real time RIC.

Amdocs is leveraging its knowledge from radio planning simulation in its work on the near real-time RIC. They are using simulation to reinforce machine learning models (an interesting use of a "digital twin"). RF simulation that was used to support planning is now used to pre-train RIC models. Among SIs, this seems a unique differentiator in our discussions to date.



PARTNERSHIPS

One characteristic feature of the Open RAN landscape is that no single vendor provides a complete Open RAN solution. The proof of openness is precisely the existence of meaningful partnerships with other vendors who provide complementary pieces of the Open RAN.

Amdocs has partnerships with **Intel,** through its Netbuilders initiative. Their relationship with Intel is enabling them to leverage data from the physical layer for better analytics, as well as using their optimized SDK and compilers.

(Amdocs' relationship with Intel helps explain one of the finer points of Intel's positioning in Open RAN. Intel's *FlexRAN* is a reference implementation of a chipset optimized to process the new data available via the E2 interface. Intel has created source-code-compatible libraries and a customized compiler that makes ML application code run more efficiently on its chips. Effectively providing application-specific acceleration, but not through hardware.)

SUMMARY

Amdocs has a strong set of products and capabilities to offer to operators (or private network customers) pursuing an open RAN rollout. This portfolio includes:

- Actix SmartRAN.
- A Non-Real-time RIC (RAN intelligent controller).
- New xApps (near RT RIC apps).
- New rApps (non-RT RIC apps at the Orchestration/service management level).
- Deployment of opensource RIC (along the ONAP model) where a customer chooses this.
- Systems integration (including some test and simulation functions).
- Custom software development.

Amdocs is investing in Open RAN for its long-term potential. While the Open RAN movement is travelling fast, real business will arrive only gradually. While Open RAN undoubtedly offers opportunities for new and smaller vendors, those with deeper pockets, committed to invest over the long-term, are likeliest to be the big winners – whatever shape the market takes.

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