AI-Native Open RAN for 6G

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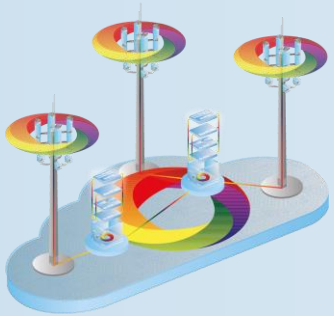
Open RAN Principles

Open disaggregation	Open RAN breaks from the idea that a single vendor must provide the entire RAN. Instead, it divides the RAN into functional elements provided by different vendors, connected via open interfaces.
Standards-based compliance	Open RAN solutions should adopt industry-driven standards for all interfaces to ensure RAN disaggregation is sustainable.
Demonstrated interoperability	Standardized interfaces and protocols between RAN parts are necessary but not sufficient. The equipment must be demonstrably interoperable in realistic environments.
Implementation neutrality	Open RAN should be neutral to the technologies used for implementation and allows for vendor differentiation and flexible approaches to implementing networks in the right mix of hardware and software.

Open RAN principles - GOV.UK (www.gov.uk)

O-RAN core principles are intelligence and openness

O-RAN ALLIANCE is committed to evolving Radio Access Networks with its core principles being intelligence and openness. It aims to drive the mobile industry towards an ecosystem of innovative, multi-vendor, interoperable, and autonomous RAN, with reduced cost, improved performance and greater agility

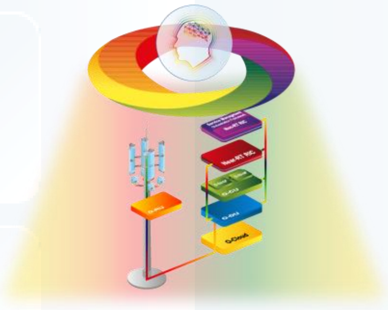


OPEN

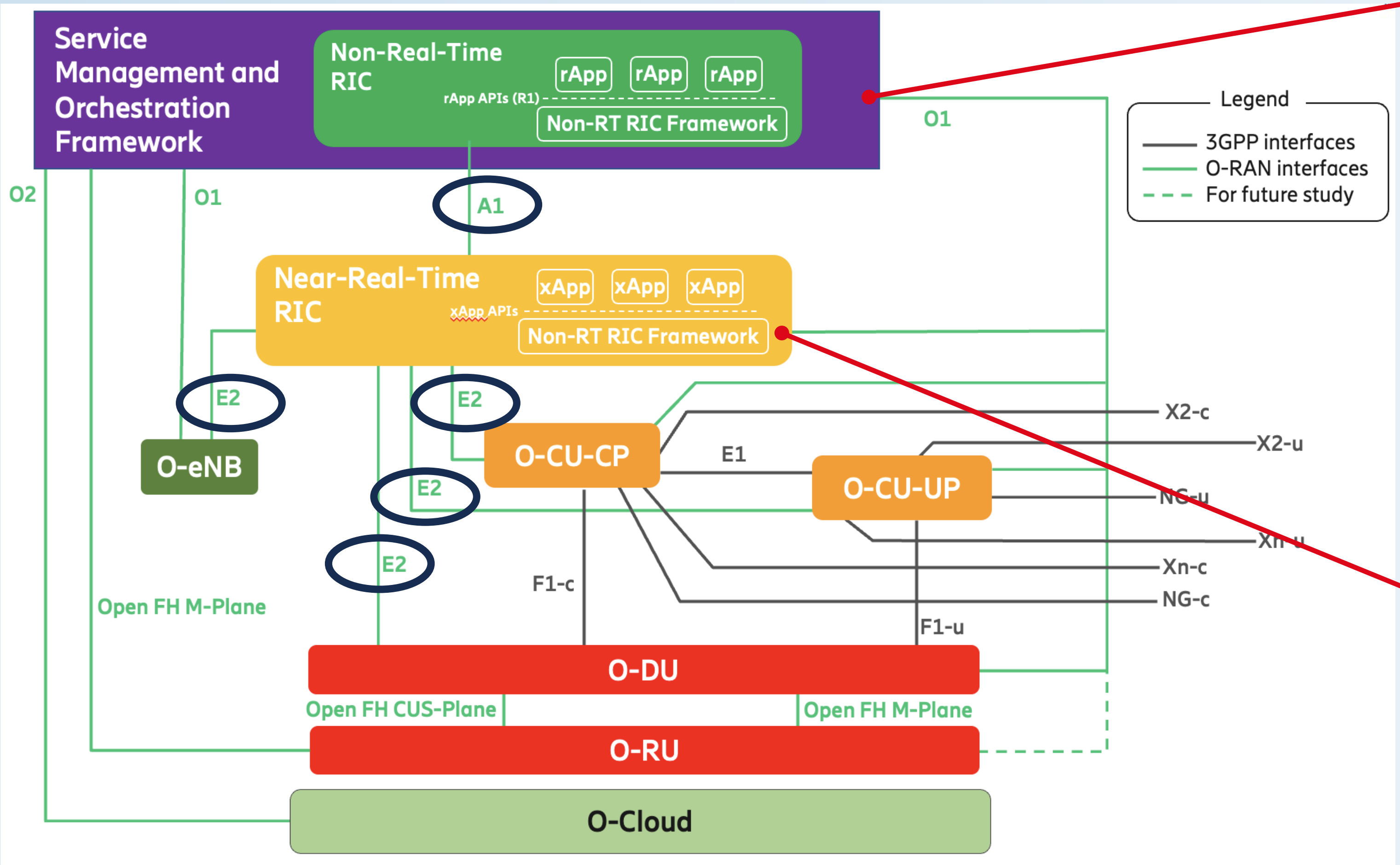
- Open interfaces and functions
- Interoperable RAN ecosystem
- Faster innovation
- Running on white box HW and supporting virtualization
- Leveraging Open Source SW

INTELLIGENT

- Radio Intelligent Controllers featuring Artificial Intelligence and Machine Learning
- AI/ML based Service Management and Orchestration
- Automated RAN deployments and operations to drive efficiency



O-RAN Radio Intelligent Controllers (RIC)



Service Management and Orchestration (SMO) framework contains the **Non-Real-Time RIC** and **rApps** for intelligent RAN optimization in non-real-time (>1 s) using data analytics and AI/ML

Near-Real-Time RIC and **xApps** enable control and optimization of O-CU and O-DU with near-real-time control loops (10ms - 1s)

O-RAN RIC is one of the most demanding features

Which are the most important areas of focus for the Open RAN community during the next 12 months?

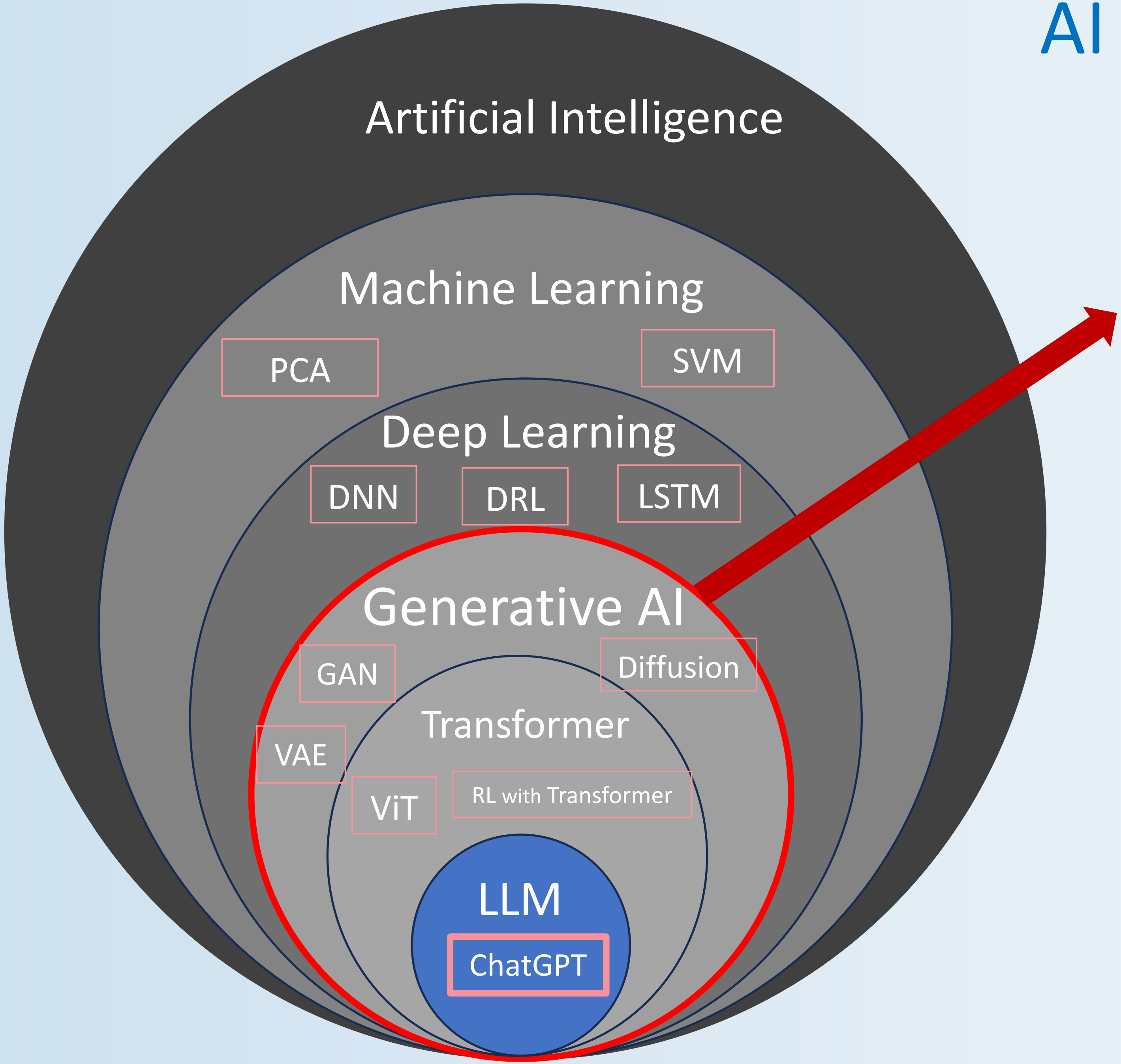
Total cost of ownership (TCO) models for commercial deployments	62%
Development of a reliable RAN Intelligent Controller (RIC) platform	46%
Creation of an expanded developer ecosystem for xApps and rApps	32%
Systems integration models and blueprints	50%
Open RAN-compliant Remote Radio Head pricing and functionality	35%
Security measures in Open RAN architectures	46%
Acceleration of specification activity and alignment with standards	40%

Source : TelecomTV

Comparison between SON, RIC and IBN

	Self-Organizing Network (SON)	RAN Intelligent Controller (RIC)	Intent-Based Networking (IBN)
Purpose	Automate network management, **configuration, and optimization**	Provide **centralized control and orchestration** for RAN components	Align network configurations and operations **with high-level business intentions**
Automation Level	Automation of specific network functions and tasks, such as **configuration and optimization**	Automation and orchestration of RAN components based on **non-real-time and near real-time data and policies by RIC**	**Autonomous network operations** based on high-level business intents and policies
Scope	Primarily focused on managing and optimizing **cells** in RAN	Manages the intelligent control and coordination between **RIC and RAN** in the O-RAN architecture	**Hierarchical network management** and automation in multi-domain networks, including RANs
Technologies Used	**Machine learning, data analytics**, and network intelligence for automation and optimization.	AI/ML, Open interfaces, protocols, and **APIs for interoperability** among RAN components	Automation, machine learning, analytics, and APIs for **intent translation and closed-loop operation**
Benefits	Improved **network efficiency**, enhanced user experience, reduced operational costs.	**Flexibility, scalability, and vendor neutrality, enabling multi-vendor deployments**	**Autonomous, zero touch** network management, agility, operational efficiency, and alignment with business objectives

AI Models



Capabilities of GenAI

1. Contents Generation
(Image,Text,Sound, etc.)

2. Translation
(between NLs, or NL and ML)

3. Code Generation

RIC Use Cases and ML models

Predictive Maintenance:

Regression models, **Support Vector Machines**, and Random Forest models can predict equipment failures based on historical data. Neural networks, especially Recurrent Neural Networks (RNNs), can also be effective due to their ability to understand sequences.

Dynamic Spectrum Allocation:

Reinforcement Learning (RL) algorithms, which learn by trial and error, can be used to adjust spectrum allocation dynamically based on real-time network conditions.

Automated Network Optimization:

Deep Learning (DL) models, like **Convolutional Neural Networks (CNNs)**, can process large volumes of data to identify efficient network configurations.

Energy Efficiency:

RL algorithms can be applied to dynamically adjust the power of network elements based on real-time network traffic.

Three Pillars in AI-Native RAN

DevOps

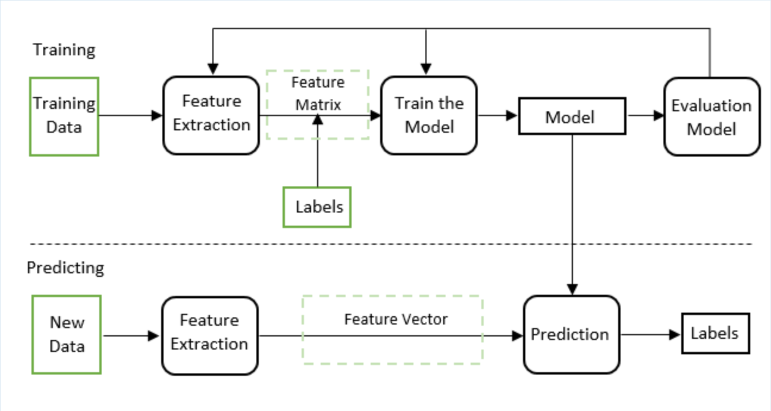
MLOPs

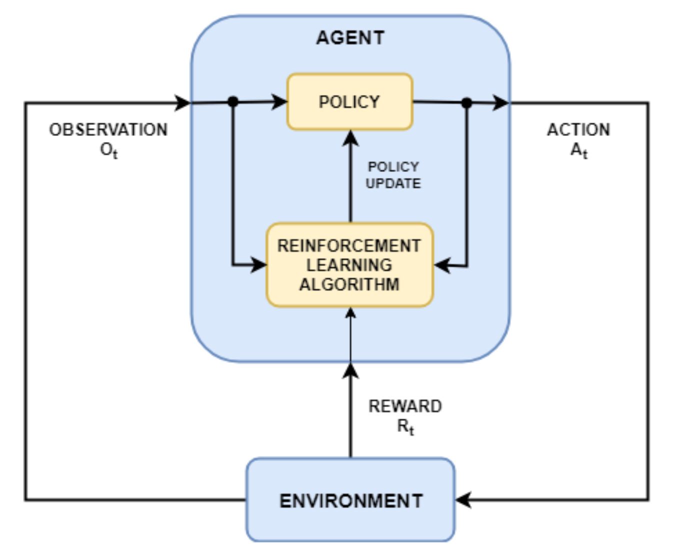
Use Case

Training Dataset

Model Development

Orchestrator
Control-Loop
Open Interfaces
Common Data Models
Network Knowledge
Measurement





O-RAN RIC as The Most Practical Enabler for AI-Native RAN

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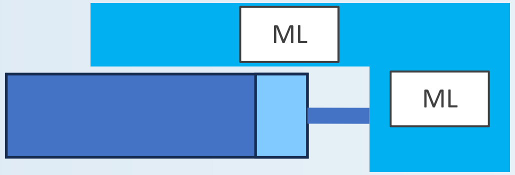
Evolutionary approach

3GPP Rel 19, 20, 21,…

Opportunistic ML addition

Realistic approach

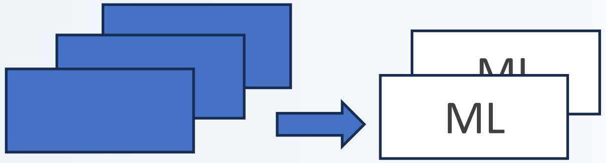
O-RAN RIC



RIC/ML addition
with open interfaces

Revolutionary approach

Fully AI based Radio System from the ground up



reinventing

Delayed Innovation: The process of developing and deploying standardized upgrades in 3GPP could delay the adoption of innovative new technologies.
Legacy Constraints: Backward compatibility requirements might limit the scope of changes that can be made in a 3GPP upgrade.

O-RAN with its RIC would be the best.
It's an approach to integrating AI into the open RAN that's cloud be compatible with existing 3GPP evolution path,
while providing most of the benefits that a fully AI-native system offer.

The key challenge of implementing AI-native air interface is the lack of standardization.
There is no clear definition of what an AI-native air interface is and how it should be implemented.

AI-Native vs. Autonomous Network

Autonomous networks and AI-native networks are both types of networks that use artificial intelligence (AI) to improve their performance.

- Autonomous networks are being used to improve the performance of 5G networks. They are also being used to optimize the performance of cloud networks.
- AI-native networks are being used to develop new applications for 6G networks. They are also being used to develop new security solutions for networks.

As AI technology continues to evolve, we can expect to see even more applications for autonomous networks and AI-native networks. These networks have the potential to revolutionize the way we use and manage networks.

Feature	Autonomous Network →	AI-Native Network
Level of automation	Minimal human intervention → Zero Touch	Built from the ground up with AI in mind
AI applications	Monitoring and optimization	Machine learning and deep learning
Performance	Improved performance and reliability	Potential for even greater performance improvements
Adaptability	Adaptable to new and emerging applications	More adaptable to new and emerging applications

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