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Principles for 6G Infrastructure

1st OAI Foundation U.S. Workshop

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What we'll discuss today

- 6G Architectural Demands
- 6G Infrastructure Principles
- Open-Source and Standards Collaboration
- Prototyping and Data

6G Architectural Demands

Architectural demands for 6G's infrastructure

Use cases like holographic communication, cooperative robots, integrated sensing, and pervasive intelligence demands a departure from current network designs

Agility and Dynamic Elasticity

The network must be highly adaptable and capable of rapid reconfiguration, scaling in near real-time based on intent.

Rapid Deployment and Service Creation

Services and functions must be instantiated instantaneously, tested and rolled out continuously.

Self-Managing Network Operations

To manage the massive complexity and scale of 6G, the network must be largely autonomous and self-aware.

Shortcomings of current infrastructure for 6G

The Challenge of Determinism

From best-effort scheduling to guarantee latency or deterministic timing.

The Lack of AI-Native Design

To train models that truly manage the network, every layer must expose data in an AI-ready format.

The Compute Continuum

Orchestrate workloads across siloed domain clouds which includes non-standard hardware features.

Sources:
Fumadzhiev, R. (2025). An Experimental Evaluation of Latency-Aware Scheduling for Distributed Kubernetes Clusters
Shiwen, H., Haolei, D., Liangpeng, W., & Zhenyu, A. (2025). A Real-time Data Collection Approach for 6G AI-native Networks

6G Infrastructure Principles

6G Infrastructure Principles

Cloud-Native infrastructure

Leverage cloud technologies to deliver the agility, dynamic elasticity, essential for resilient networks.

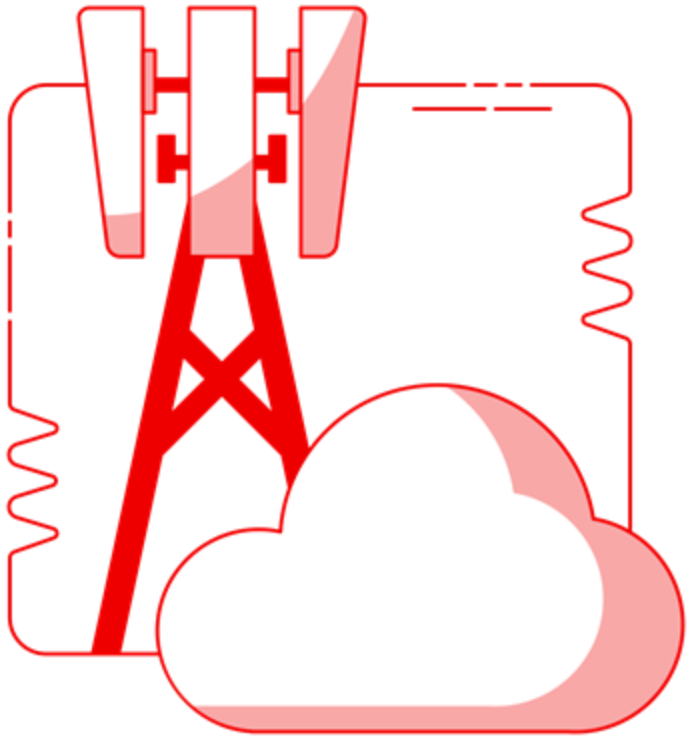
AI-Native infrastructure

Embed pervasive intelligence at all layers to unlock cognitive, real-time services.

Sustainable Infrastructure

Maximize power efficiency across the network lifecycle through efficient hardware-software co-design.

Cloud-Native infrastructure



- Achieve intent-driven resource scaling, and enable rapid reconfiguration.
- Leverage cloud principles to ensure fault tolerance and self-healing capabilities.
- Virtualize and manage all forms of heterogeneous compute hardware.

Building the 6G Cloud-Native infrastructure with OAI

Prototype service-based architecture for RAN

Introduction of service discovery and exposure to allow network functions to communicate across control-plane and user-plane for RAN and CORE.

Evaluate cloud-friendly transport protocols

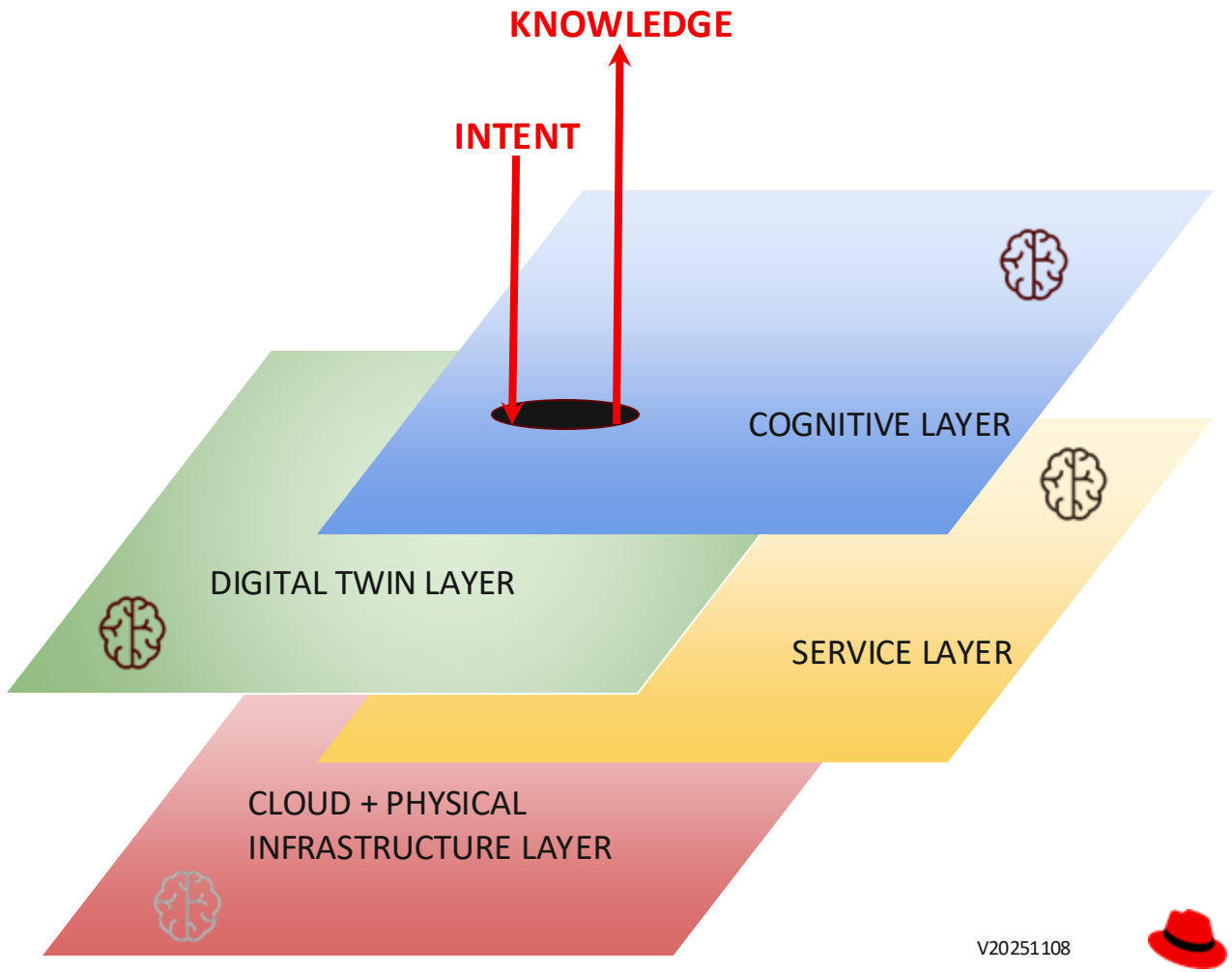
Introduction of QUIC, L4S, SRv6 as signalling and transport protocols across RAN and CORE compared to traditional protocols: SCTP, PFCP and GTP.

Investigate cloud-native acceleration offload

Moving demanding tasks from the host CPU to specialized hardware accelerators such DPUs, GPUs, FPGAs, to improve performance and efficiency.

AI-Native infrastructure

- Shift from complex, low-level configurations to objective-based intent.
- Continuously maintain system intent and build knowledge from all layers.



Building the 6G AI-Native infrastructure with OAI

Prototype AI-driven RAN management

Introduction of Artificial Intelligence (AI) and Machine Learning (ML) infrastructure blocks to automate, optimize, and enhance RAN network functions.

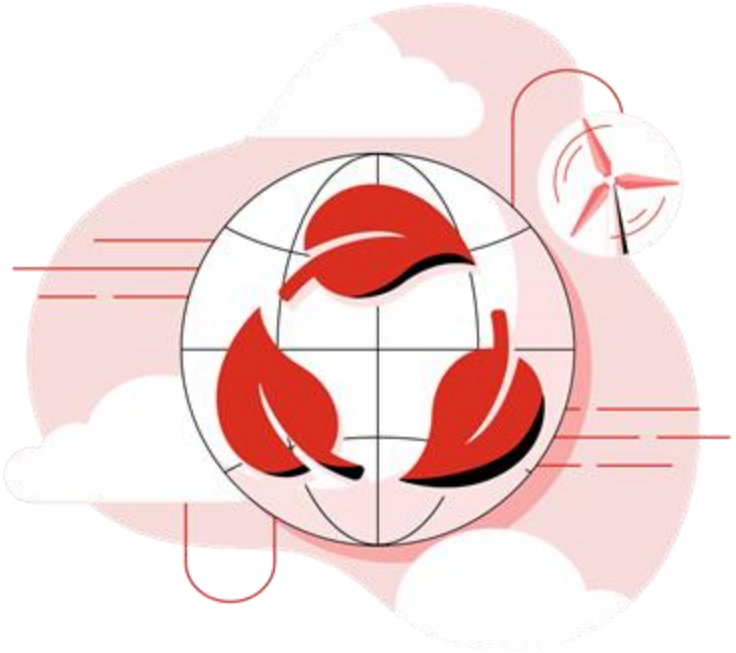
Evaluate distributed-AI in the RAN infrastructure

Introduction of LLM-D to address key challenges in deploying resource-intensive AI models at in the RAN infrastructure.

Investigate AI-native RAN architecture

Redesigning the RAN architecture with an "AI-first" mindset, introducing technologies such as agentic AI and federative learning.

Sustainable Infrastructure

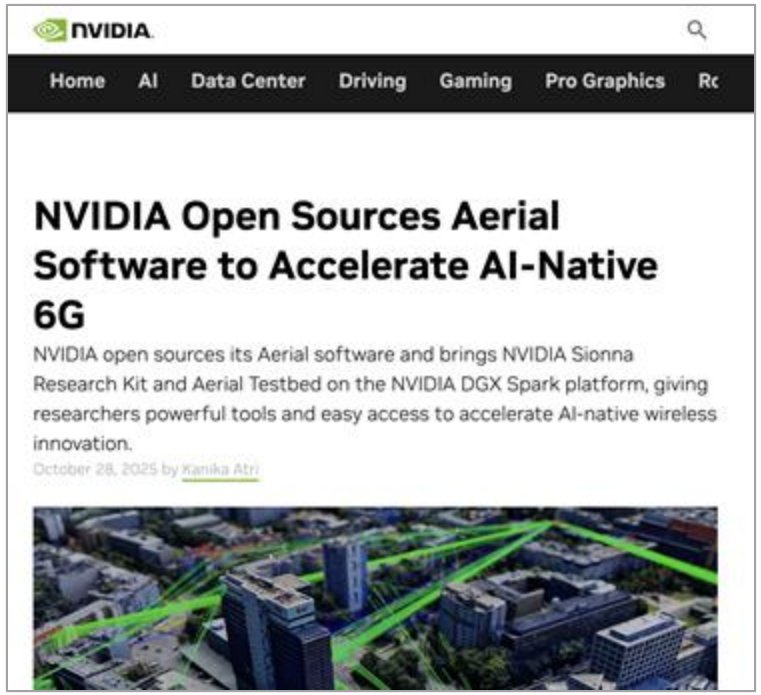


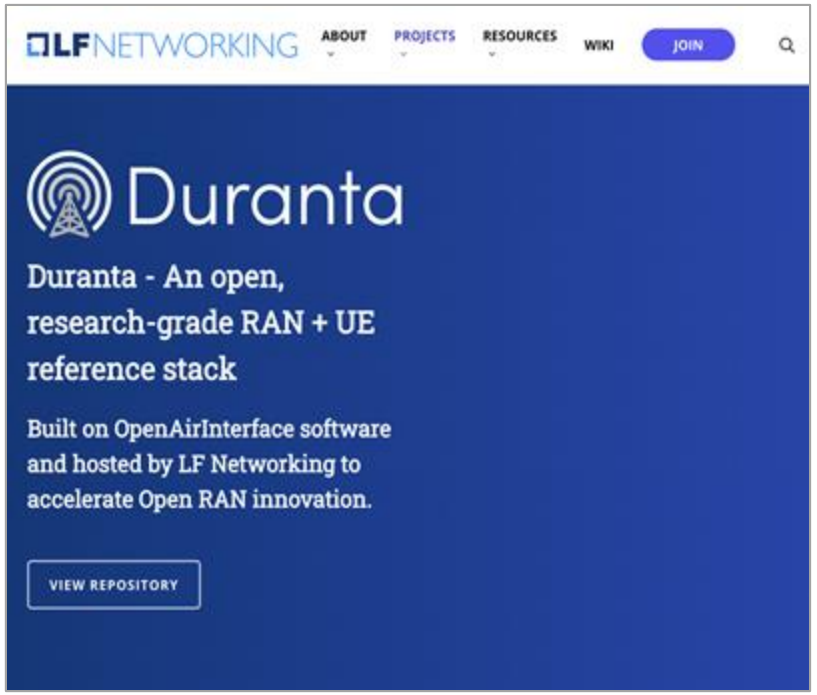
- Address energy and resource efficiency.
- Prioritize maximizing hardware and software lifecycles.
- Embed sustainability from design to operations.

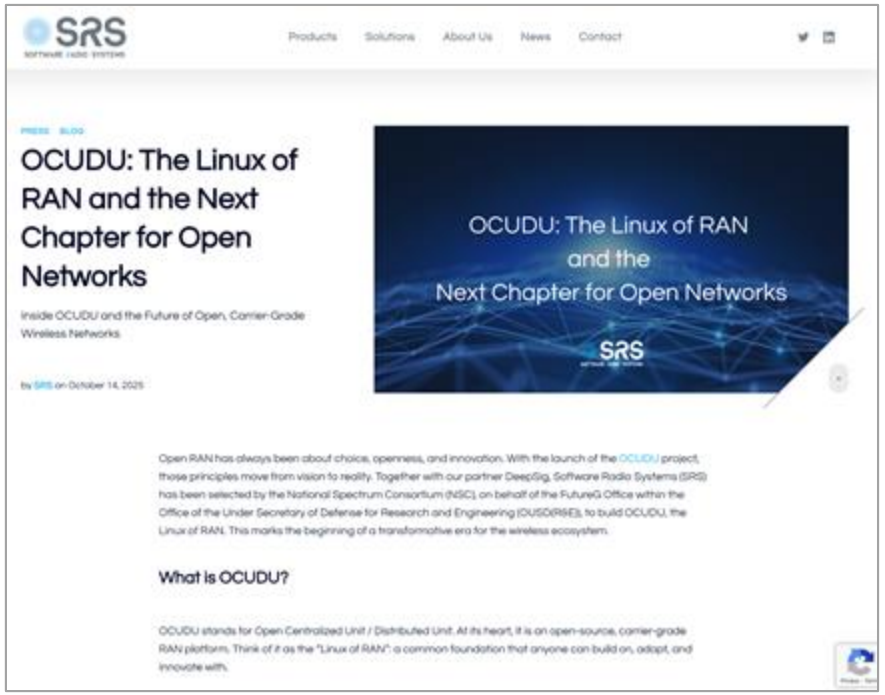
Open-Source and Standards Collaboration

Open Collaboration to Innovate

Open source the catalyst for innovation







Sources:
NVIDIA Open Sources Aerial Software to Accelerate AI-Native 6G, https://blogs.nvidia.com/blog/open-source-aerial-ai-native-6g/
Duranta - An open, research-grade RAN + UE reference stack, https://lfnetworking.org/projects/duranta/
OCUDU: The Linux of RAN and the Next Chapter for Open Networks, https://srs.io/building-ocudu-the-linux-of-ran/

Prototyping and Data

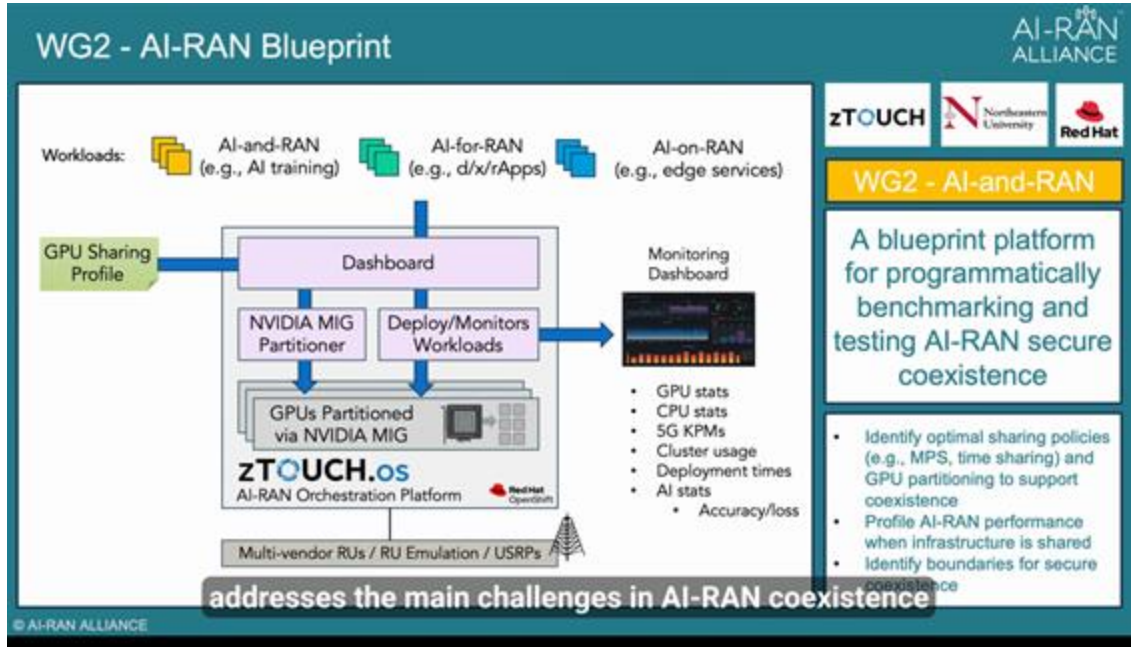
O-RAN Plugfest

OpenAirInterface & Red Hat

- Demonstrate the automatic deployment of an AI-RAN node via O-RAN O2 interface leveraging Red Hat O-Cloud Manager.
- Developed in collaboration with Red Hat and OAI, this demo lays the groundwork for scalable AI-RAN infrastructure aligned with O-RAN architecture.

AI-and-RAN Blueprint Platform

zTouch Networks & Northeastern University



- Introducing the first AI-and-RAN platform to evaluate and test AI-RAN coexistence with flexible GPU sharing and service orchestration.
- Developed in collaboration with Red Hat and Northeastern, this demo lays the groundwork for scalable, intelligent wireless infrastructure.

Source:
Advancing Spectrum Efficiency Through AI-Native Innovation, https://ai-ran.org/advancing-spectrum-efficiency-through-ai-native-innovation/
AI-and-RAN Blueprint Platform, https://www.youtube.com/watch?v=6SVEhtuVQN0&t=56s

Telco-AIX: Inspire AI To Be Relevant & Useful for Telco

- **Open-source repository for Telco AI use cases**
  - A collaborative platform for developing and sharing AI solutions for the telecom industry
- **Leverages data science and machine learning to address industry challenges**
  - Employs data-driven approaches to solve real-world problems in telecom
- **Provides practical solutions, not just theoretical concepts**
  - Focuses on delivering actionable solutions that can be readily implemented

Source: https://github.com/open-experiments/Telco-AIX

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