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Open RAN Overview

USERI Regulatory Best Practices, 5G Emerging Technologies and Network Security Training 24 April 2023 | Bangkok, Thailand Jaydee Griffith jgriffith@ntia.gov www.ntia.gov

What is NTIA?

NTIA is part of the U.S. Department of Commerce and serves as the President's principal advisor on telecoms and information policy issues.

- Specific NTIA activities include:
 - Managing Federal use of spectrum and identifying additional spectrum for commercial use;
 - Administering over \$48 billion in grant programs that further Americans' access to broadband;
 - Addressing 5G supply chain and competition issues through the administration of the \$1.5B
 Public Wireless Supply Chain Innovation Fund
 - Leading Internet policy, including online privacy, copyright protection, cybersecurity, and the global free flow of information online;
 - Performing cutting-edge research and engineering; and
 - Leading 5G supplier diversity through the 5G Supplier Diversity Working Group.



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Evolution to 5G





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5G Today

- 5G development focused more on revolution than evolution
 - Enhanced Mobile Broadband (eMBB)
 - Ultra-reliable low-latency communication (URLLC)
 - Massive Machine-Type Communication (mMTC)
- ► In reality:
 - eMBB is the primary use case
 - URLLC and mMTC are not yet as widespread
- ► 5G Varieties
 - Non-standalone 5G
 - Standalone 5G





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5G Non-standalone (NSA)

- ► 3GPP Release 14
- New 5G Radio Access Network (RAN) features
- Leverages existing 4G core network
- Stop-gap effort:
 - 5G core network features were not yet ready
 - Allows MNOs to leverage 5G features while waiting for 5G device availability and adoption



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5G Standalone

- ► 3GPP Release 15+
- "True 5G"
- Uses new 5G Core Network (5GCN), separated from existing 4G network
- New features:
 - Service-Based Architecture
 - Network Slicing
 - Multi-access Edge Compute (MEC)



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Breakdown of the 5G Stack





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What is your experience thus far with 5G?



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Market Consolidation & Competition



Source: NetManias



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Market Barriers to Competition

- Business Practices
 - Regional Exclusivity Agreements
 - Intellectual Property Restrictions
 - Price Dumping

Preventing Competition



The focus of today's training



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5G Stack, Part Two





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RAN Spend





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Definitions

Open RAN

The movement to create a market of open, interoperable, standards-based 5G RAN solutions

O-RAN

 Technology/specifications developed by the O-RAN Alliance

OpenRAN

 Project group in the Telecom Infra Project (TIP), focused on testing and validation of Open RAN solutions

Virtualized RAN (vRAN)

 Virtualized RAN, becoming less dependent on custom-designed and built hardware and using more commercial-off-the-shelf (COTS) computing products

Cloud RAN (C-RAN)

Cloud-based RAN, leveraging containerized network functions to scale resources asneeded on public or private cloud services

Open vRAN/C-RAN

Application of vRAN or C-RAN in an Open RAN environment



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What exposure have you had to Open RAN?



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Virtualization vs Openness





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vRAN & C-RAN Architecture

Virtualized RAN

Cloud RAN





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Virtualization Advantages

- Disaggregate software and hardware
- Leverage commercial off the shelf hardware
 - Economies of scale
- Leverage software development cycle
 - Continuous Integration/Continuous Development (CI/CD)
 - Faster time-to-market
- "Build-to-suit"
 - Purchase the resources you need, can always incrementally add more



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Cloud Advantages

- Same as virtualization plus:
- More network flexibility
 - Only uses the resources you need
 - Multi-use infrastructure private cloud can be offered as MEC for customers
- Network centralization in dense deployment environments



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Cloud and Virtualization Concerns

- Energy Consumption vs Application Specific Hardware
- COTS hardware requiring accelerator cards
 - Open RAN specific accelerators
 - GPU/FPGA acceleration
- Security
 - More touchpoints, more risk
- Knowledge gap
 - Telecom world vs IT world
- Public cloud
 - Cost
 - Control
 - Availability



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Organizations Involved



- Sets overall 5G NR Specifications
- Serves as overall baseline for O-RAN



- MNO-led organization
- Sets O-RAN Specifications, building upon 3GPP



- Originally setup by Facebook/Meta
- Develops testing and some specifications for open and interoperable connectivity solutions
- Focus on Open RAN testing



 Industry Organization set up to work with governments to inform policies around Open RAN and ways to incentivize innovation and deployment



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Source: O-RAN Software Community



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RAN Intelligent Controller

- Non-Real Time RIC
 - >1s response
 - Part of Service Management and Orchestration Function
 - rApps
 - Use case example: dynamic cell loading/optimziation
- Near Real Time RIC
 - 10ms-1s response
 - xApps
 - Use case example: efficient use of spectrum and interference mitigation



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Challenges to Adoption

- Legacy telecom approaches
 - Security
 - Deployment
 - "The race to 2nd place"
- Maturity of specifications/devices
- Adoption/R&D cycle
- Supply Chain Shortages
- Workforce



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Open RAN Adoption Categories

- Pilots & Trials
 - Most major international carriers
- Production Deployment
 - New greenfield networks
 - DISH Wireless
 - Rakuten Mobile
 - 1&1 Drillisch
 - Existing brownfield networks
 - Vodafone UK
 - NTT Docomo
 - Tigo Colombia
 - Inland Cellular



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Open RAN Pilots & Trials



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Source: Telecom Infra Project



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Adoption Case Study: DISH Wireless

Advantages:

- Fast deployment time & quick rollout
- Reduced physical footprint
- Better control of resources
- Equipment Source flexibility
- Concerns:
 - Network Performance
 - Unclear how much is Open RAN related vs using bleeding-edge core network features (VoNR)
 - "Early Adopter's Tax" & Integration Difficulty



Source: Light Reading



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Adoption Case Study: Rakuten Mobile

- Advantages
 - Fast deployment time
 - Reduced CAPEX and OPEX
 - 40% Savings per site on CAPEX
 - 30% Savings on OPEX
 - Reduced Staffing Footprint
 - Flexible network deployment model
- Concerns
 - "It's almost Open RAN"
 - Self-developed solutions -> Rakuten Symphony
 - Network Performance
 - Unclear if Open RAN related or due to spectrum availability



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Adoption Case Study: Tigo Colombia

- Advantages
 - Easier remote control and management
 - More flexibility
 - Performance comparable to traditional RAN
- Disadvantages
 - Some features not available (e.g. ICIC)
 - Lack of multi-vendor certification
- Netural
 - Cost on-par with traditional RAN
 - Power consumption similar to traditional RAN
- ► NOTE: The Tigo deployment is a 4G Open RAN system



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Barriers to Adoption

- ► Fear, Uncertainty, and Doubt
 - Interoperability
 - Performance
 - Security
- Potential "interference" being conduced by traditional suppliers preventing progress
- Lack of acceptance by traditional vendors -> difficult to interoperate



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Role of Governments in Open RAN



Key Roles of Government with Open RAN







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Regulatory Role

- Spectrum Assignments
 - International Harmonization (ITU)
 - Regional Harmonization (e.g. ATU, CITEL, etc.)
 - Allocation (Unlicensed, Assigned Licensed, Auction)
 - Flexibility in spectrum assignment
 - Does the spectrum model make sense for the use case?
- Device Type Acceptance
- Operator Requirements
 - Performance
 - Coverage
 - Facilities
- Important to consider impacts on financial stability/survivability and flexibility for innovation



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Policy

- Domestic assistance in innovation and new technology
 - FCC Innovation Zones
 - NTIA Public Wireless Supply Chain Innovation Fund
 - UK Future RAN Competition (UK FRANC)
 - Tax breaks for innovators and early adopters (Japan)
- International Cooperation; Examples:
 - 2021 Prague Proposals on Telecommunications Supplier Diversity
 - Czech Republic, Australia, Canada, Japan, United Kingdom, United States, and Taiwan
 - Quadrilateral Security Group (Quad; Australia, India, Japan, and U.S.)
 - Bilateral Cooperation



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