

# DISAGGREGATING THE CELLULAR RADIO ACCESS NETWORK

SACHIN KATTI

PROFESSOR, STANFORD UNIVERSITY & CO-CHAIR, O-RAN ALLIANCE

# WAY BACK IN 2016 ...

- I WAS ACTIVELY INVOLVED IN CROSS LAYER WIRELESS RESEARCH
  - FULL DUPLEX, NETWORK CODING, COEXISTENCE, INTERFERENCE CANCELLATION, ETC
  - IMPACT ON PRACTICE WAS LIMITED BEYOND FULL DUPLEX
  - MOST ACADEMIC RESEARCH WAS ON WIFI WHILE THE DOMINANT MODE OF MOBILE CONNECTIVITY IS CELLULAR WIRELESS
- WHAT WE SET OUT TO DO: HOW CAN WE TRANSFORM THE CELLULAR NETWORK ARCHITECTURE TO BE MORE OPEN TO INNOVATION?
  - SELFISHLY, HOW DO WE FIND A WAY TO TRANSFER OUR RESEARCH TO PRACTICE?
- FOUNDED X-RAN FORUM IN 2016 WITH AT&T, T-MOBILE AND SK TELECOM
- X-RAN → O-RAN ALLIANCE IN 2018, A GLOBAL BODY TO DEFINE DISAGGREGATED CELLULAR RAN



# OPEN RAN IS ALREADY TRANSFORMING 5G ROLLOUTS

5G

## DISH commits to Open RAN for US 5G rollout, enters retail mobile market

By Ray La Maistre  
Jul 3, 2020

[in](#) [tw](#) [f](#) [m](#) [+](#)

### OPEN RAN

## Rakuten Mobile claims 5G open RAN breakthrough

[in](#) [f](#) [tw](#) [wh](#) [m](#) [+](#)



Tareq Amin, CTO of Japan's disruptive [Rakuten Mobile](#), appeared to let slip an announcement he was holding back for next month (but perhaps it wasn't too much of a surprise for seasoned watchers of the open RAN space).

In a conference call with European journalists, Amin flagged an upcoming unveiling of what he called the "world's first" massive 5G MIMO remote radio head (RRH), using a 32T/32R configuration, and which is "fully compliant" with open interface specifications laid out by the O-RAN Alliance.

The new RRH can support a wideband channel of 100MHz, deliver up to 1.7 Gbit/s throughput, and allows digital beamforming. Oh, and it weighs less than 22Kg.

News Analysis  
KEN WIELAND,  
contributing editor  
8/26/2020

telecoms.com

We know how to build a better 5G network.

news

## US hints at state support for domestic ORAN push

[tw](#) [in](#) [f](#)

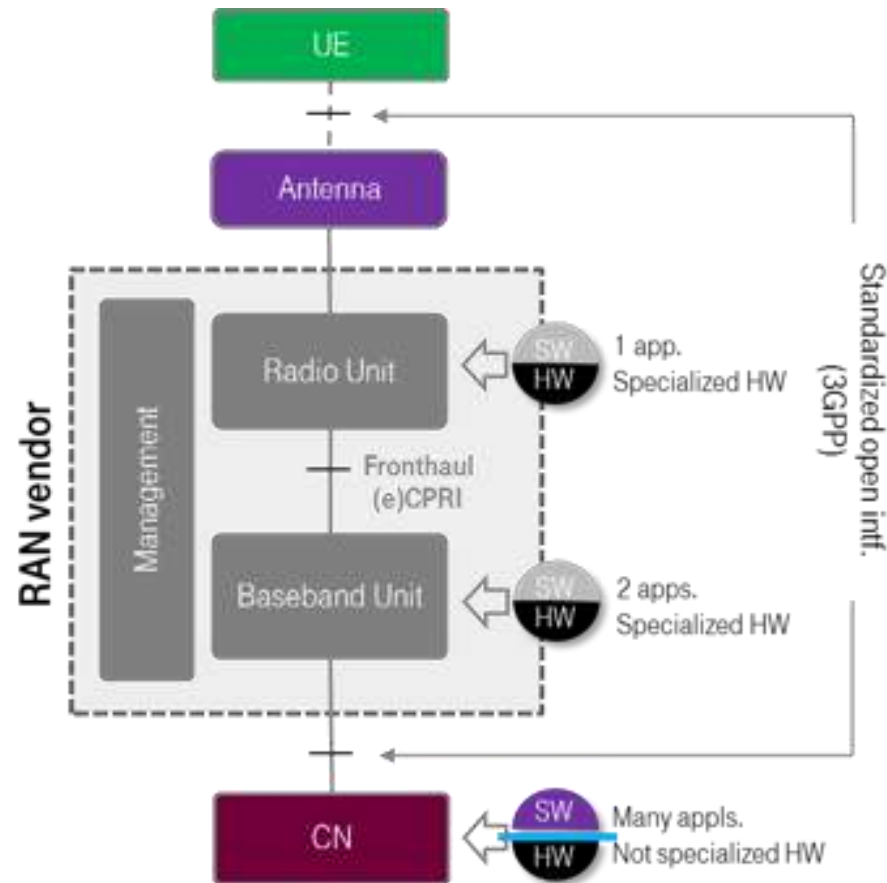


Written by [Scott Bichen](#) | 05 February 2020 @ 17:44

## Telefonica targets industrialised Open RAN "this year"

By Keith Dyer // 18 March 2020

[tw](#) [in](#) [g+](#) [f](#)

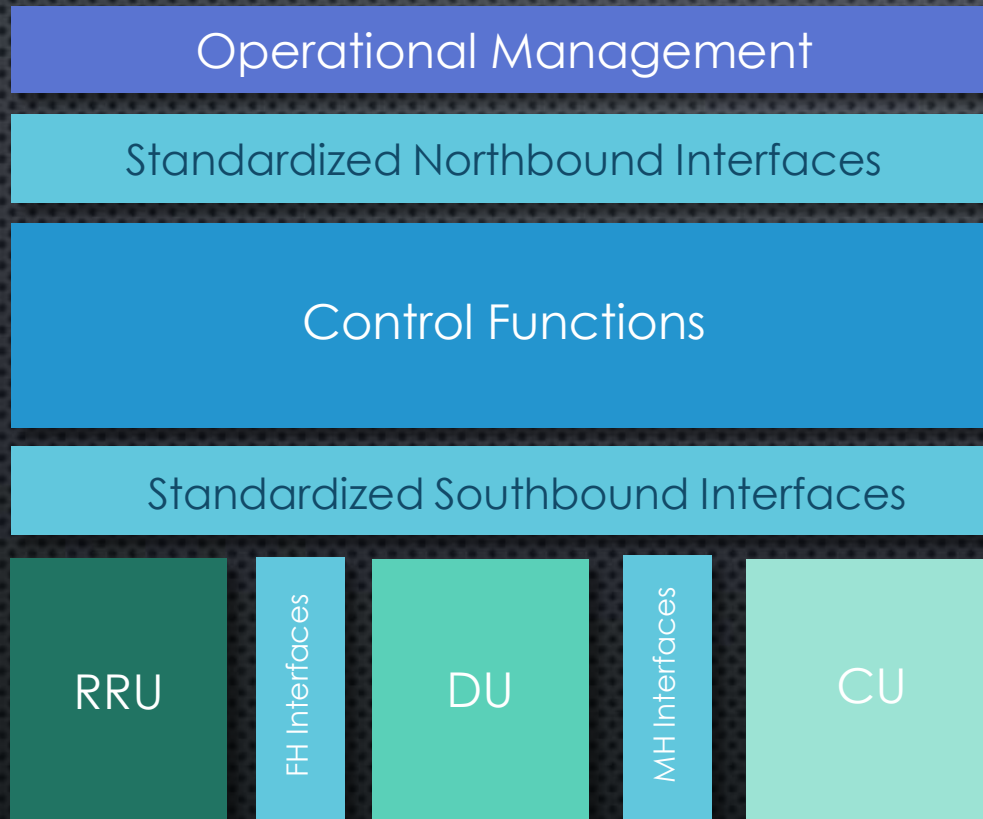


# CURRENTLY RADIO ACCESS NETWORKS ARE CLOSED, INNOVATION IS SLOW

- CHALLENGING TRANSFORMATION OF RAN TOWARDS CLOUDIFIED AND SOFTWARE-DRIVEN DEPLOYMENT AND OPERATIONS
- LIMITED PROGRAMMABILITY ⇒ LOW FLEXIBILITY FOR 5G NEW SERVICES INTRODUCTION
- VENDOR MARKET RELATIVELY CLOSED (3 MAIN VENDORS), EVEN WITH RAN DOMINATING OVERALL NETWORK CAPEX
- LIMITED INNOVATION



# DISAGGREGATED O-RAN ARCHITECTURE

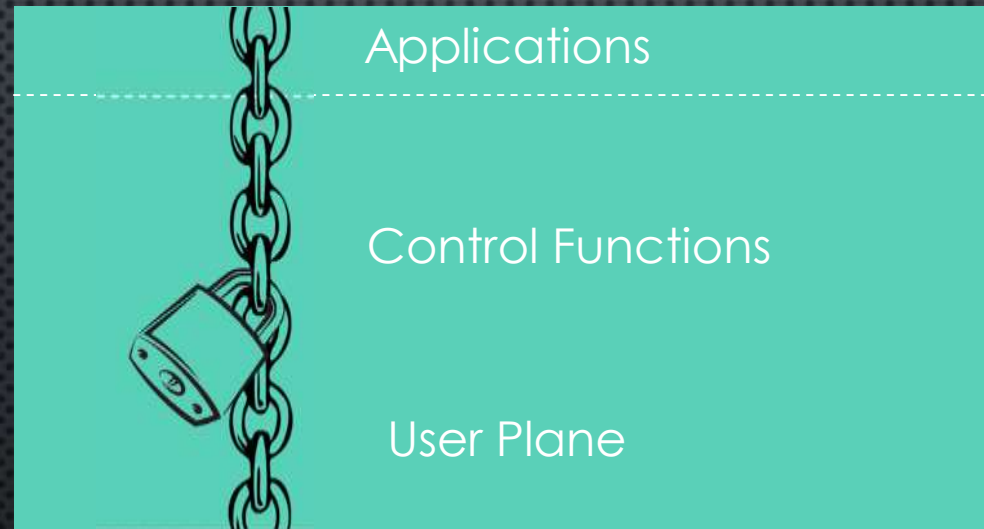


MODULAR RAN INFRASTRUCTURE WITH OPEN INTERFACES

# O-RAN'S SOFTWARE DEFINED RAN CONTROL PLANE

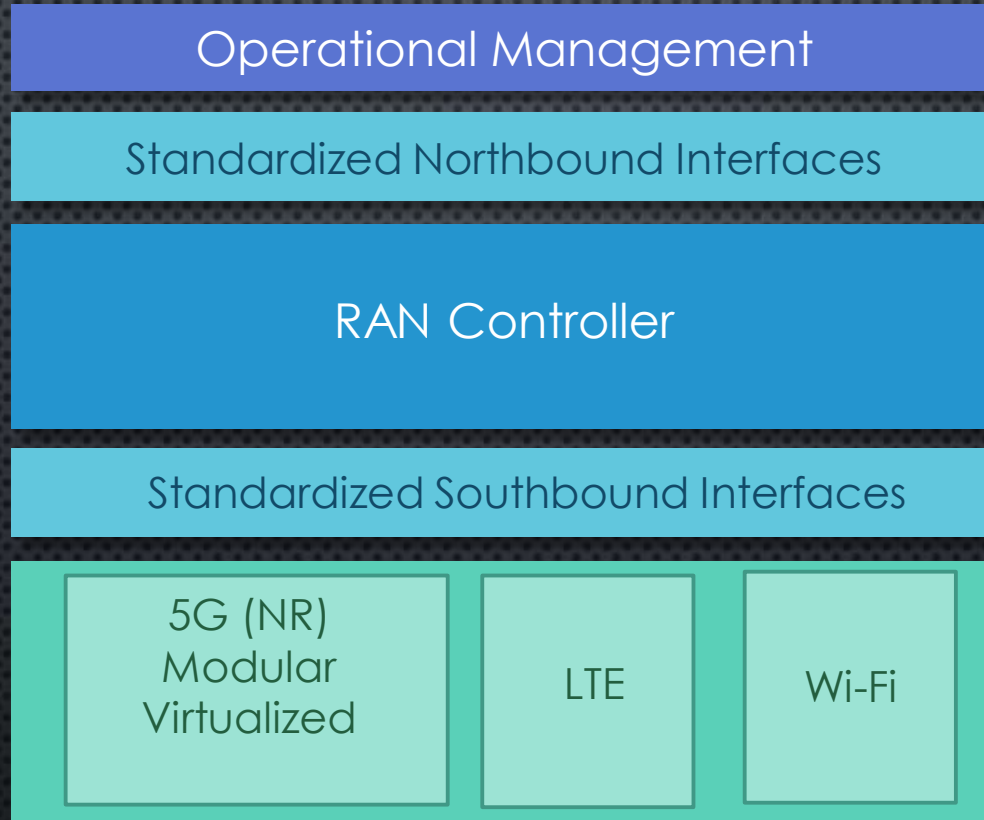


# EXISTING RAN CONTROL PLANE



VERTICALLY INTEGRATED, VENDOR SPECIFIC

# NEXT GENERATION RAN – DECOUPLED CONTROL





# RADIO ACCESS NETWORK CONTROLLER ARCHITECTURE

## Key Requirements

Ingest operator policies and application intents



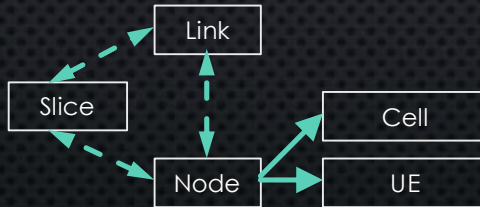
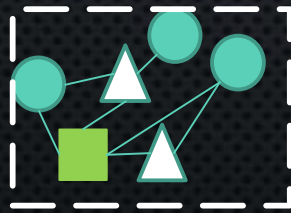
NBI

Admission Control

Mobility Management

QoS Manager

Slice Manager



Translate control apps intents into southbound RAN specific messages



SBI

Operational Management

Standardized Northbound Interfaces

Controller

Standardized Southbound Interfaces

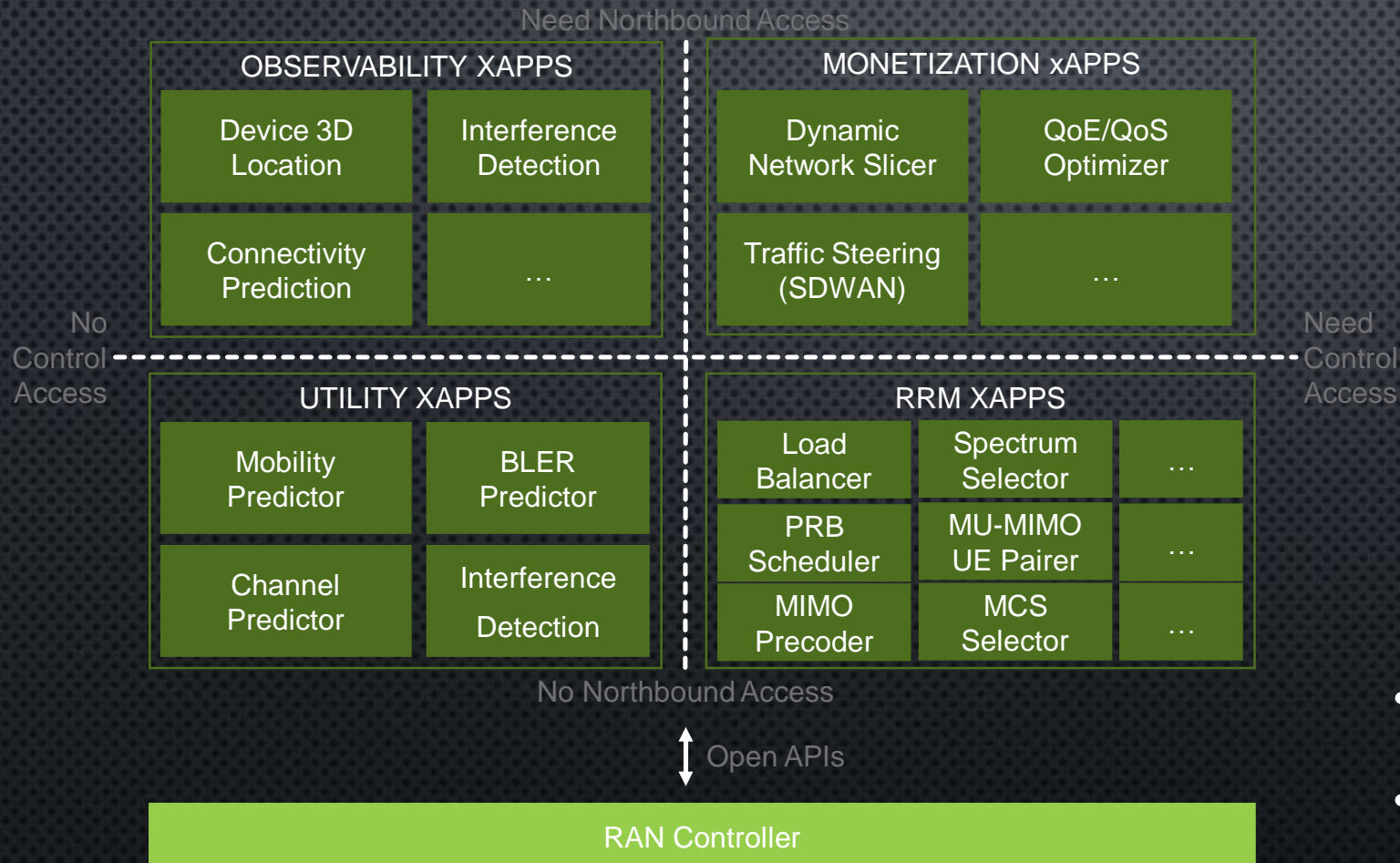
5G (NR)  
Modular  
Virtualized

LTE

Wi-Fi

# RAN PROGRAMMABILITY: CONTROLLER XAPPS

Smaller players can provide “xApps” for RAN to create new or improved service capabilities



## KEY XAPP CATEGORIES

xApp Category	Need control access?	Need northbound access?
Utility	No	No
RRM	Yes	No
Observability	No	Yes
Optimization	Yes	Yes

- **Better mobile user experience.**
- **New/more powerful service capabilities.**



# CONCLUSION: OPEN RAN & CALL TO ARMS

**DECOUPLED CONTROL PLANE IS MAKING THE RAN PROGRAMMABLE → OPPORTUNITY FOR WIRELESS SYSTEMS ACADEMIA & STARTUPS TO PUSH CROSS LAYER RESEARCH INTO PRACTICE**

## OPEN RAN BENEFITS:

- MODULARITY **REDUCES BARRIER TO ENTRY** FOR SMALLER VENDORS; CAN PROVIDE SMALLER SPECIALIZED FUNCTIONS INSTEAD OF A GIANT MONOLITHIC STACK
- MORE COMPETITION LEADS TO MORE AND FASTER **INNOVATION**; OPEN RAN IS EXPECTED TO INTRODUCE NEW SERVICE CAPABILITIES LIKE NETWORK SLICING, 4G/5G SPECTRUM SHARING, TACTILE INTERNET AND MASSIVE IOT
- DECOUPLING SOFTWARE AND HARDWARE ENABLES **SOFTWARE-DEFINED** AND **CLOUDIFIED** RAN
- CLOUD-RAN LEADS TO **BETTER UTILIZATION OF COMPUTE & SPECTRUM** RESOURCES; **LOWERS CAPEX**