



**5G and OpenAirInterface**  
**Communication Systems Dept.**  
**EURECOM, Sophia Antipolis**  
**FRANCE**

*Unleashing the potential of open-source in the 5G arena*



5G and OpenAirInterface - R2Lab Inauguration - 9/11/2016, INRIA Sophia Antipolis

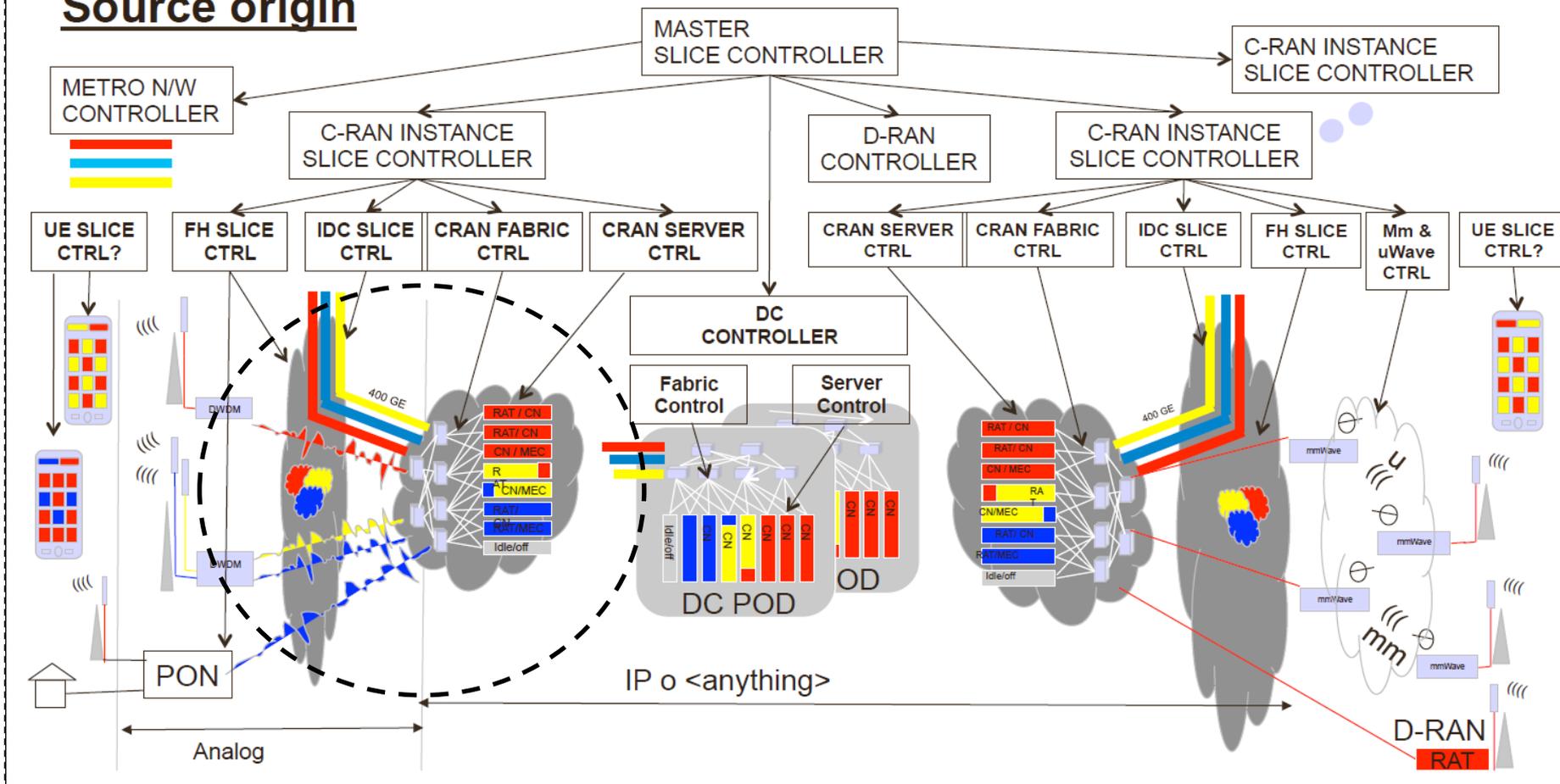


# Some visions of 5G and beyond

- **5G and beyond is not only New Radio and verticals**
- **It is also evolution in computing for wireless networks**
  - Central offices becoming data-centers (see CORD / M-CORD projects in USA as an example)
  - High-performance fronthaul networks for distributed computing
    - Fixed network to support advanced radio
  - Centralized compute and storage using
    - More general-purpose equipment (Intel servers)
    - More and more software technologies from cloud-computing (NFV, SDN, MEC, etc.) jointly with radio signal processing
  - Applicable to lesser extent for existing and evolving 4G radio
- Fusion of Information and Cellular technologies

# ITU IMT2020 FG Vision

## Controller/Orchestrator Hierarchy likely most control is of Open Source origin

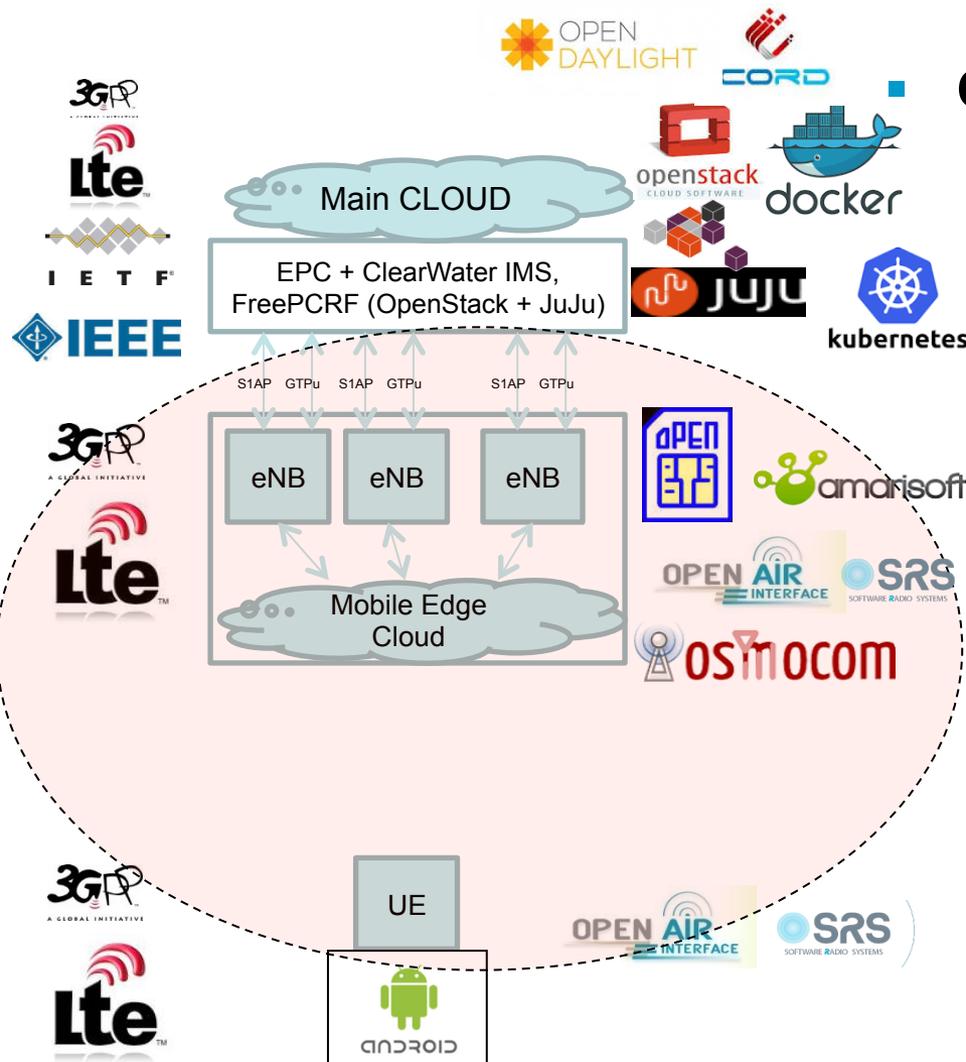


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# Federating the OAI Community - OSA

- **OAI is open-source software for soft radio-access**
- **Today it is feasible to put a fully-compliant 4G eNodeB and EPC in a commodity x86 or ARM-based computer (or data center for a pool of eNodeBs)**
  - Emergence of “radio”-hackers in addition to commercial vendors
  - OAI Alliance
    - launched in 2014 as a “Fond de dotation”
    - 3GPP strategic members in 2016 (Orange, TCL-Alcatel, Ercom)
- **Coupling this with an open-source community makes for a very disruptive technology for the onset of 5G**
  - What we’re building
    - Community of individual developers, academics and major industrials embracing open-source for 5G
  - What we hope to become
    - A strong voice and maybe a game-changer in the 3GPP world
      - ☞ Real impact from “the little guys” on 3GPP systems

# Bringing open-source into the RAN

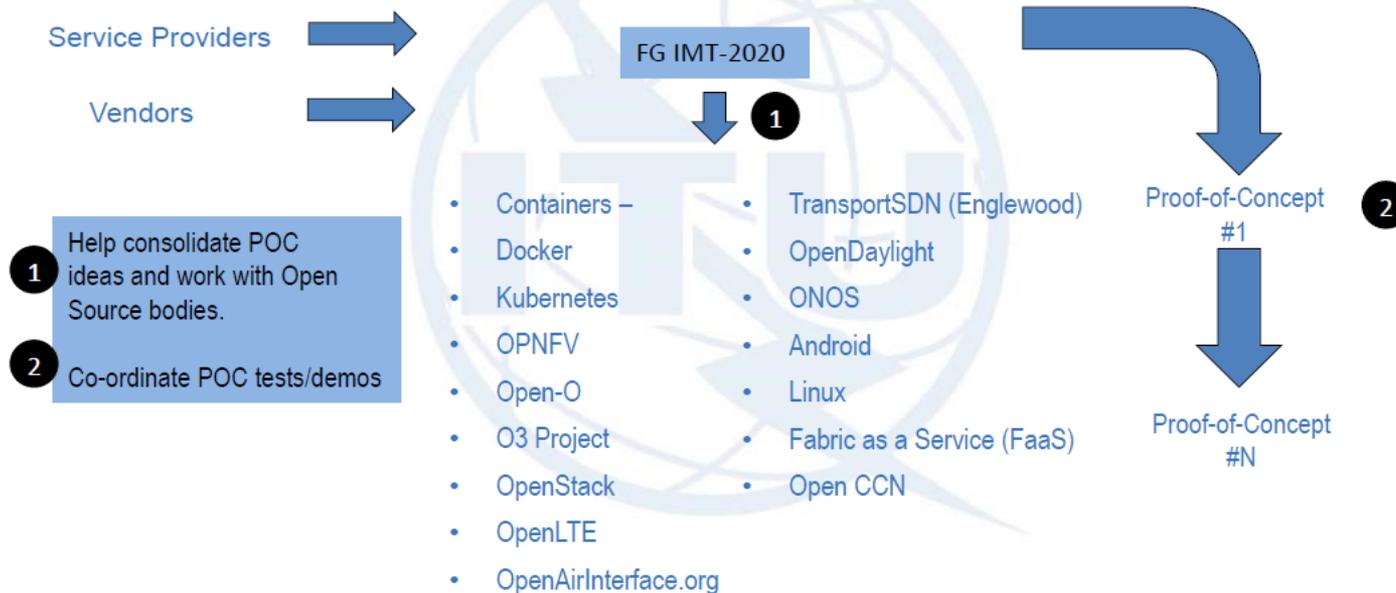


## Challenges for 4.5G/5G

- FRAND License for open-source
  - Allow 3GPP members to contribute to open-source and still perceive royalties
  - Compatible with
    - ☞ academic/research/prototyping use
    - ☞ commercial use in devices, data centers and testing equipment
  - Approval by Nokia, Orange, TCL and Ericsson (observer)
- Community coexistence/synergy with standardization process
  - Use of open-source in prototyping phase of 5G
  - Open-source community following 3GPP process
  - Community representation in 3GPP via OSA

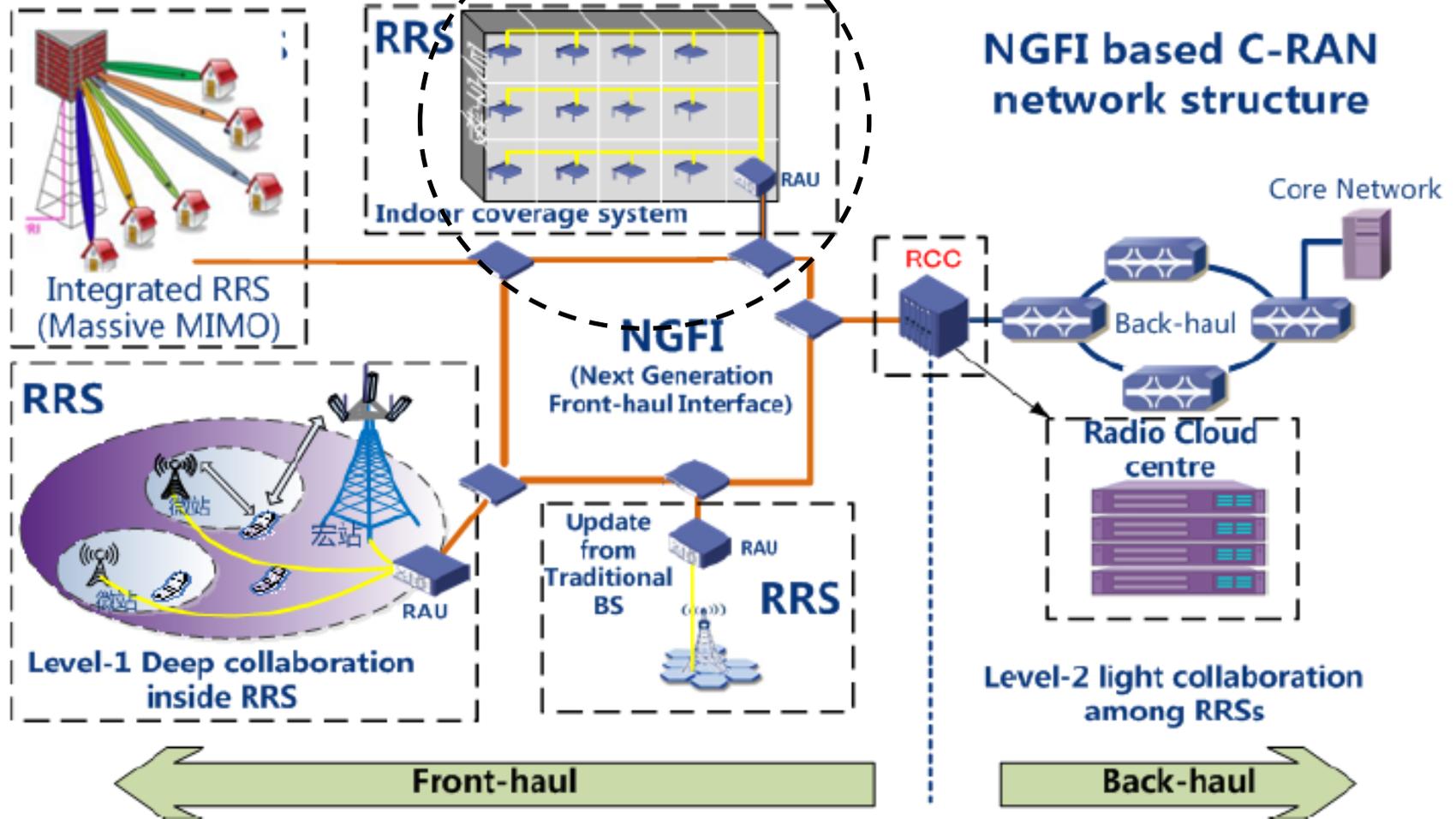
# ITU-Vision for Open-source and 5G

## 2016: Collaboration with Open Source initiatives



# NGFI (IEEE 1914) – Fronthaul Vision

Main target of OAI Playground  
@ Campus SophiaTech

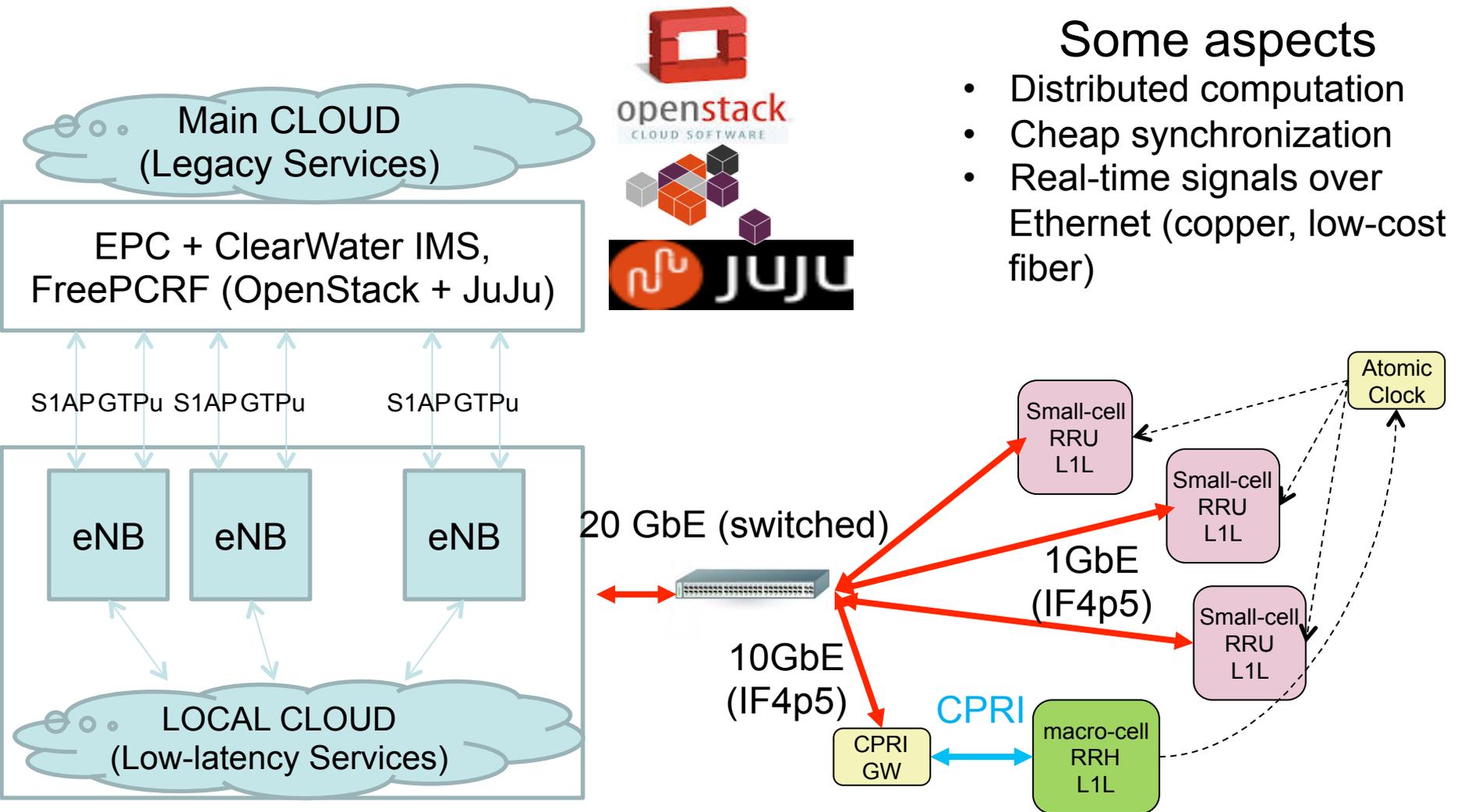


# OpenAirInterface Software Alliance Project 4

- **Short-term goal: “Manual” for up to 50 RRUs and BBU pool**
  - align with ITU/NGFI/3GPP architectures for fixed network and data center RAN/CORE
- **Replication of this test network globally to carry out PoCs / Research in the following areas:**
  - Network Slicing
  - Study split of PHY – Data Center / RRU (IEEE/NGMN specs + guidelines)
  - Interface with commercial RRHs over CPRI
  - Orchestration of BBU pool in Intel/ARM based cluster using automated virtualization tools
  - Address real-time, HW abstraction issues when running future RAN in containers and KVM.
  - Work closely with other open source initiatives (OSM, JuJu, OpenStack, OPNFV and ONOS)
  - make it replicable (open-access to technology) and based on current OAI RAN and EPC
    - Interoperable with
      - ☞ COTS UEs
      - ☞ Commercial EPC
  - Evolve towards 5G as 3GPP progresses (below 6 GHz access)
  - Generic cloud computing equipment and new architecture (XEON + FPGA)
  - 100% open-source

Reference Platform for 3GPP/IEEE/ETSI/NGMN Based on  
Open Source tools (OAI + others) + Proprietary HW/SW IP Blocks

# EURECOM RRH to Datacenter Architecture



## Some aspects

- Distributed computation
- Cheap synchronization
- Real-time signals over Ethernet (copper, low-cost fiber)

# OAI Playground Equipment

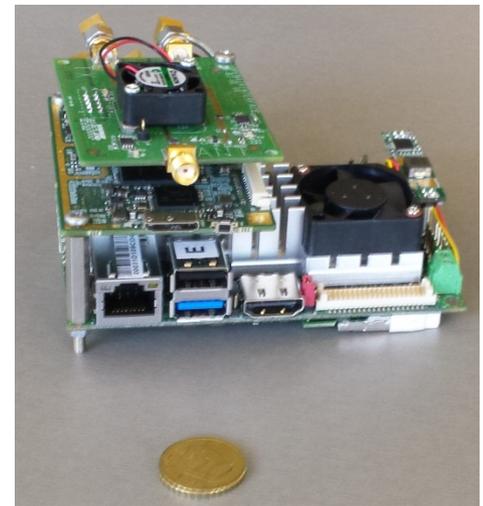
- **Deployment of OAI playground on SophiaTech Campus**
  - 50 Low cost RRU (Intel Atom E3845 or X7-8300, <10W TDP)
  - Dense servers x86-64 Xeon (today)
  - Optical (10/20/100 GbE) and copper (1 GbE) distribution

RCC/RAU (COTS Intel Server Technology)

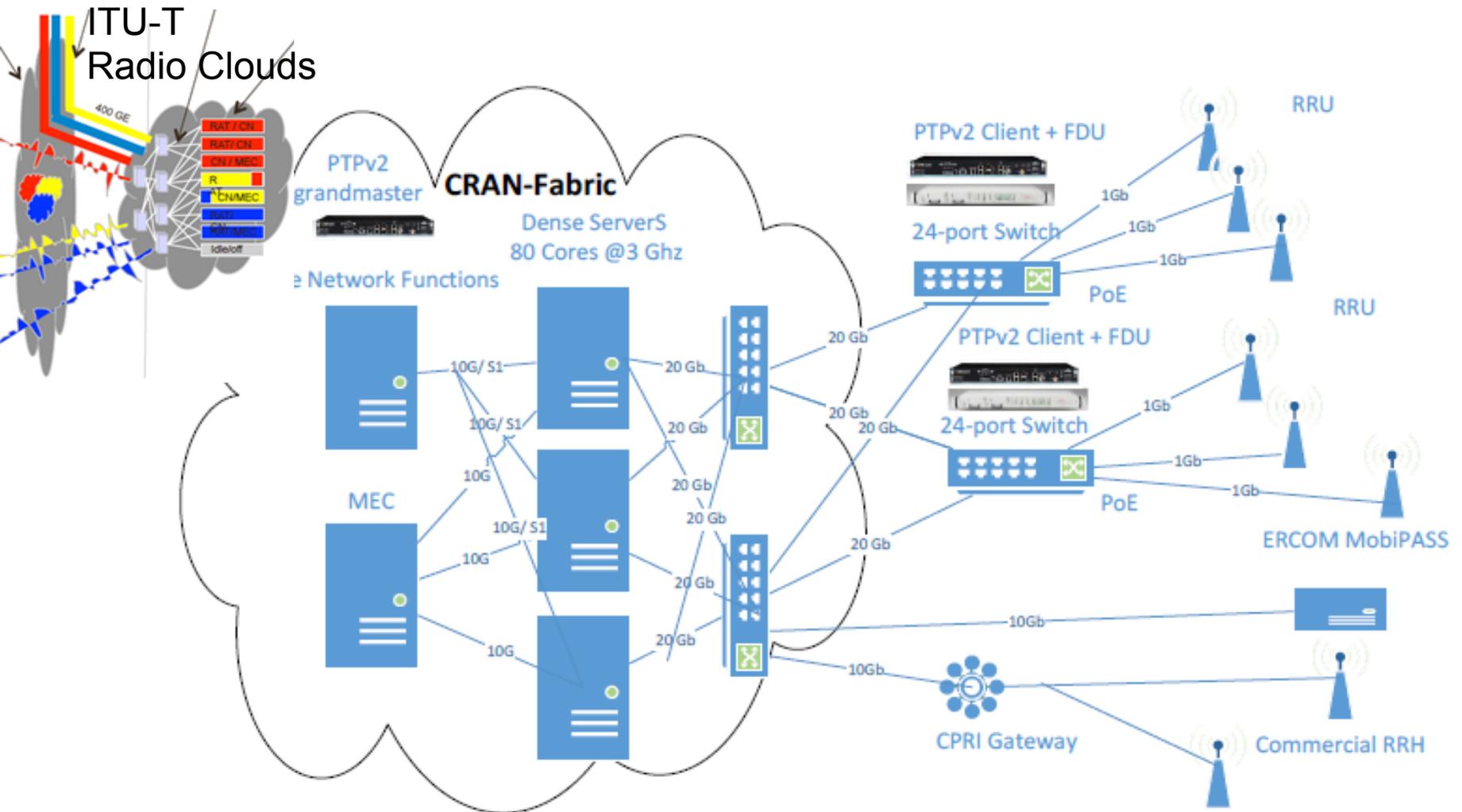


Example  
Radio Cloud  
Processing units

RRU



# Targeted Indoor/Outdoor deployment (SophiaTech Campus)



# Concluding Message

- **We want people to take this, experiment and enrich in a community-driven effort**
  - Contribute to the software
  - Replicate the hardware
  - Integrate with other hardware
  - Push to standards bodies (e.g. ITU, ETSI, 3GPP) and upstream in other communities (e.g. OPNFV)
  - Use for PoC demonstrators (5GPPP and other project programs)