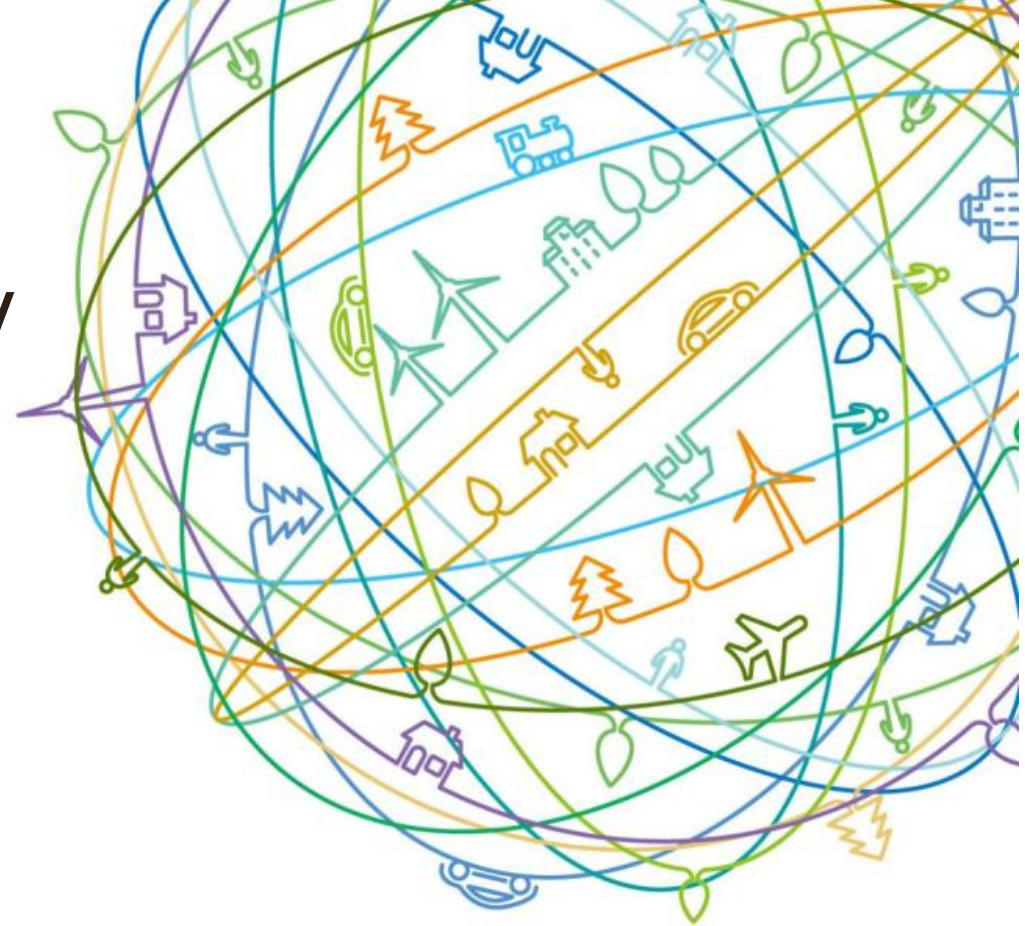


# 5G Wireline - Technology Challenges / Standards and Relationship to Open Source

*May 25<sup>th</sup> 2016*

*Peter Ashwood-Smith*

[peter.ashwoodsmith@huawei.com](mailto:peter.ashwoodsmith@huawei.com)



*Disclaimer: This presentation represents the author's personal opinions,  
no official position is implied by the contents of this presentation.*

*It's still a long way to 2020!*



# Some Major Drivers for the 5G wireline architecture

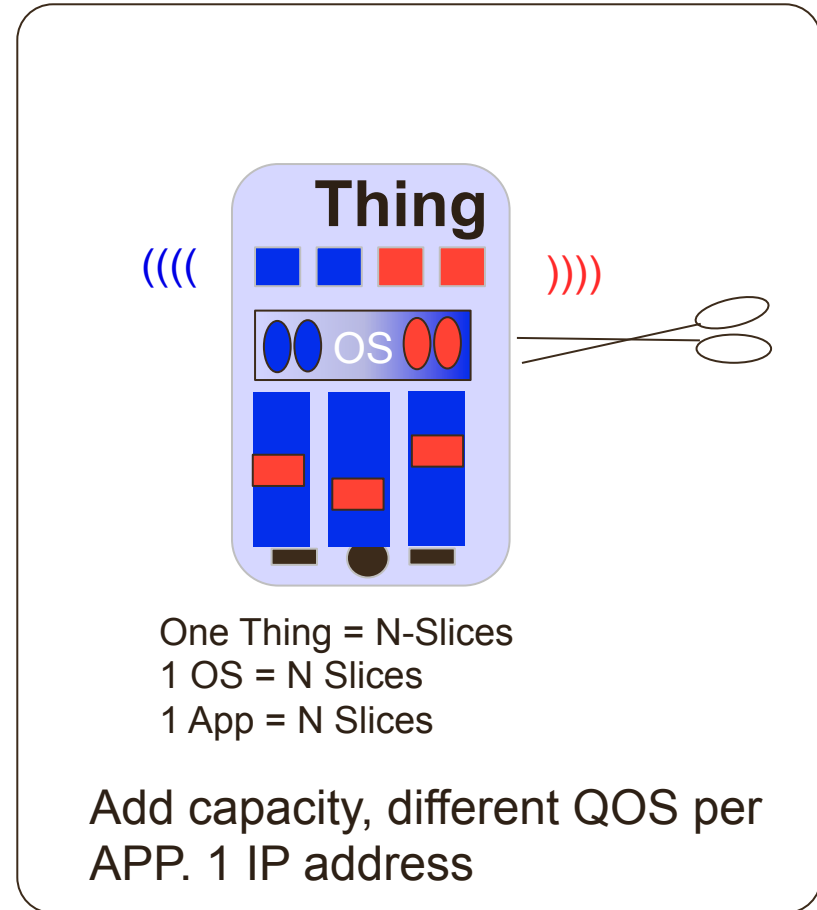
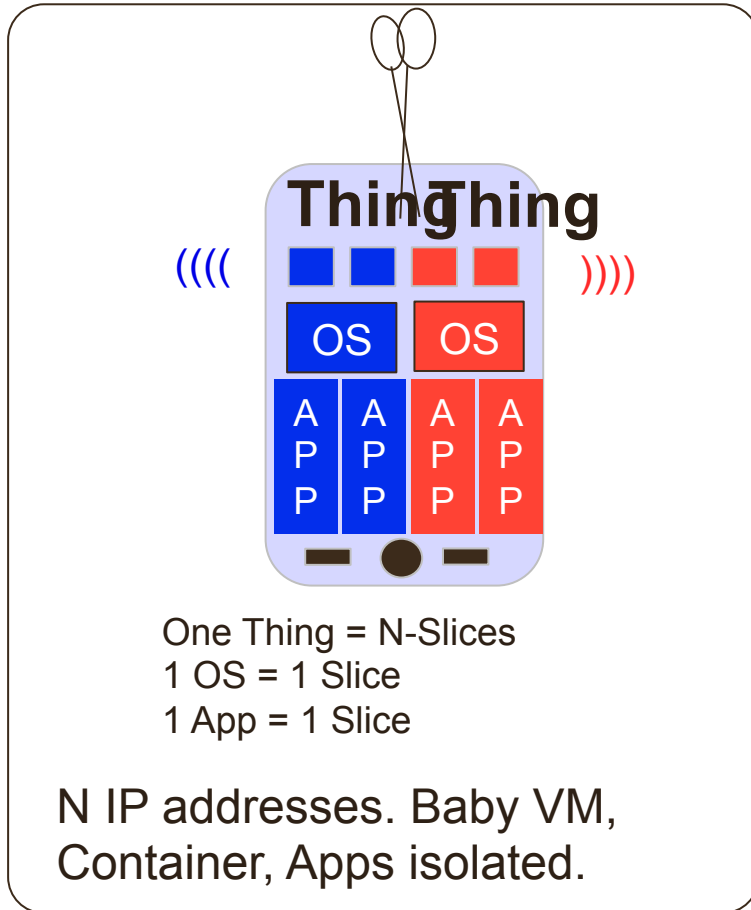
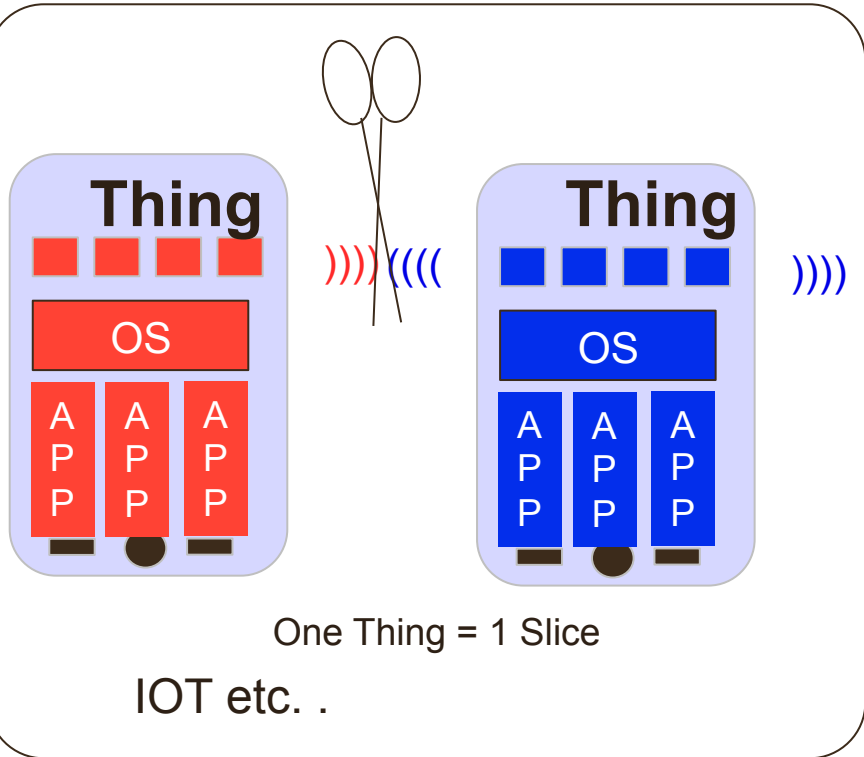
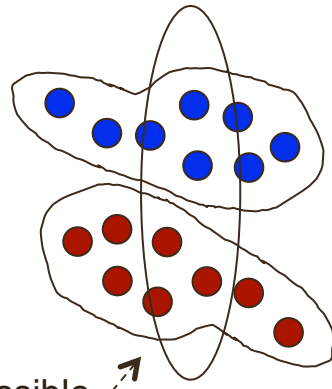
- **End to end virtualization** – obvious operational savings for “tidal” effects
- **Cloud RAN** – opex/capex savings, CoMP, CA, cell edge interference, migration, performance.
- **Mobile Edge Computing** – operators low delay advantage over the OTTs.
- **Fixed Mobile Convergence** – access side also looking for virtualization savings too... can they be combined?
- **Slicing** – differences between RAT's/CORES etc rather than a one size fits all allows ultra low delay etc. RATS.
- **SDN and Orchestration** – hard to implement all of above with distributed protocols and too complex for manual operation.
- **NFV** – use of general purpose compute as much as possible (but not everywhere) 4G vEPC, 5G-PacketCore<sub>[slice]</sub>, ... MEC + some of RAT
- **Better operations/mgmt**, more Cloud-Style, auto problem detect/fix etc.

# A few key wireline standardization issues

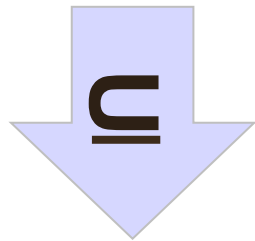
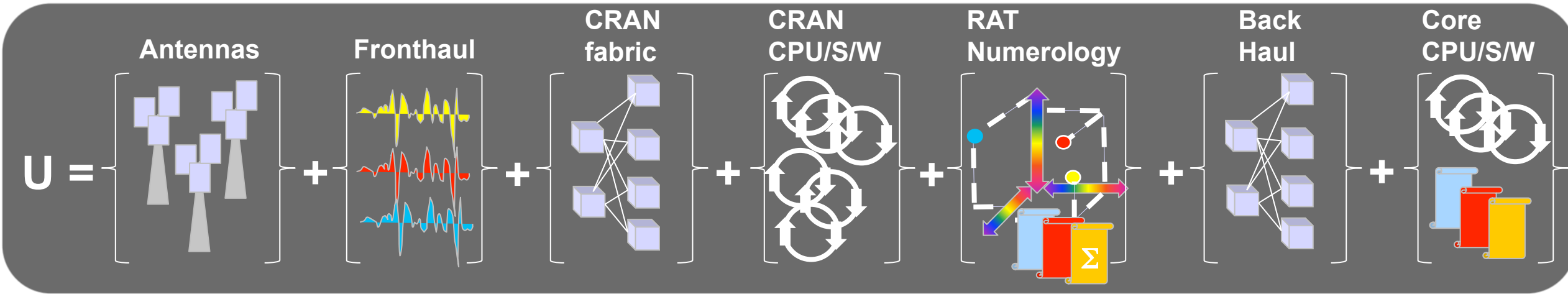
- **Fronthaul** – Fronthaul ties CRAN to Antennas, major downstream effects.
  - Is it sliced, where, how..
- **Backhaul/IDC** – latency, jitter, loss at packet layer, flexible data paths
- **NFV** – concept needs to be made broader. Cover some of DSP and all of MEC
- **MEC** – ETSI approach ridged. Any F any CPU + RAT (merge into NFV?)
- **Orchestration** – does not exist yet .. Understand AT&T to build in-house
  - Danger of orchestration/mgmt duplication (virtual/physical)
- **Softwarization** – high level programming model, profiles, scripts, end to end
- **OA&M** – need “cloud like” approach. Continuous test/repair not just report.

# Slicing from UE perspective

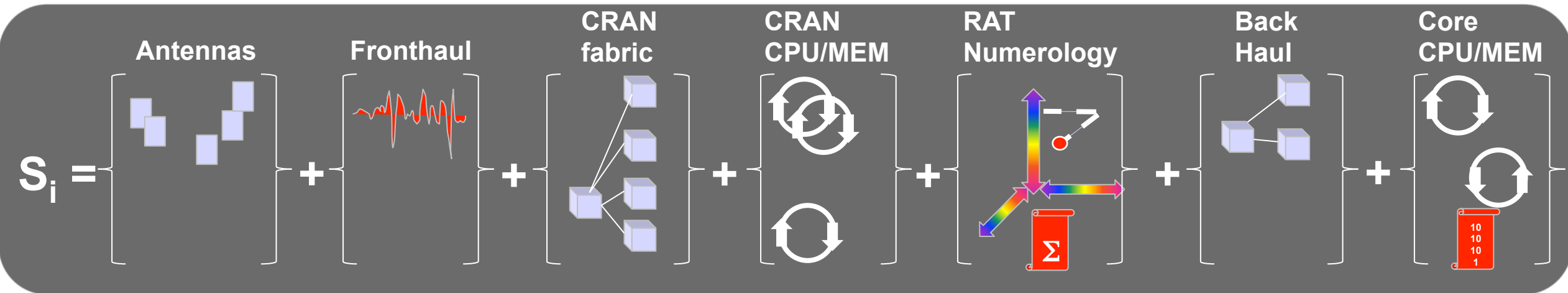
- Interesting options for slicing with respect to the UE's / "Things"
- Android and IOS will need to be extended to support



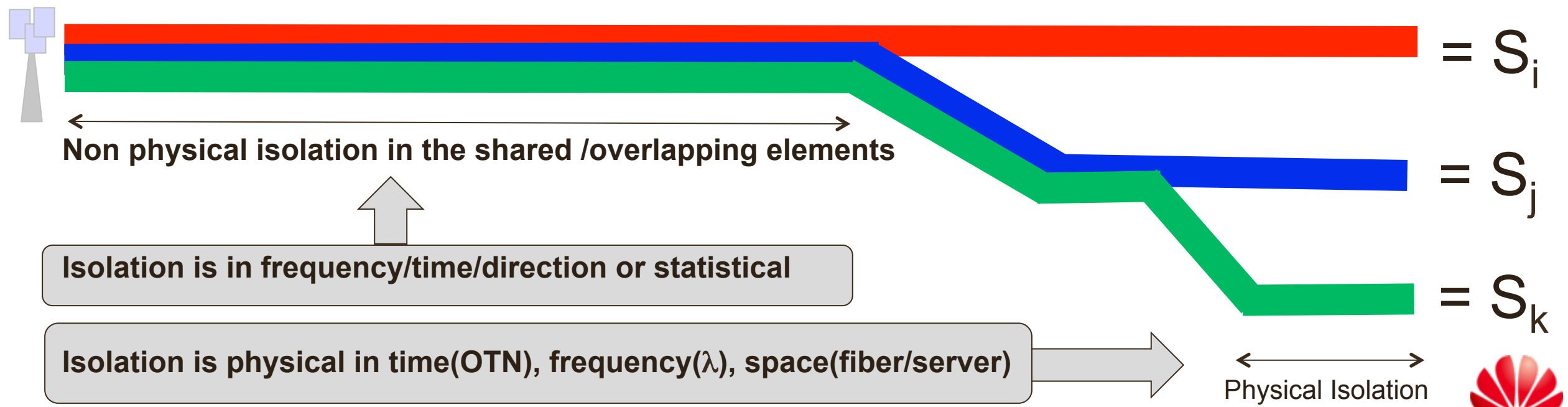
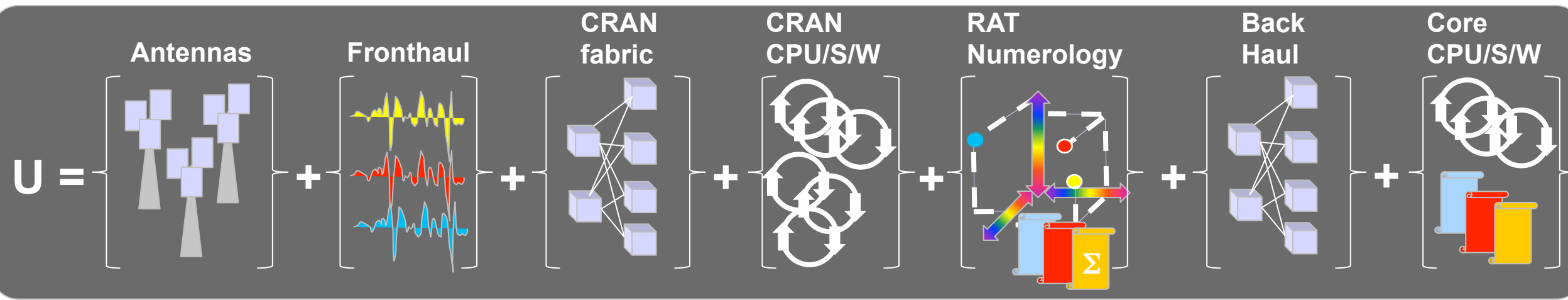
# 5G concept of an end to end “Slice” Network Perspective



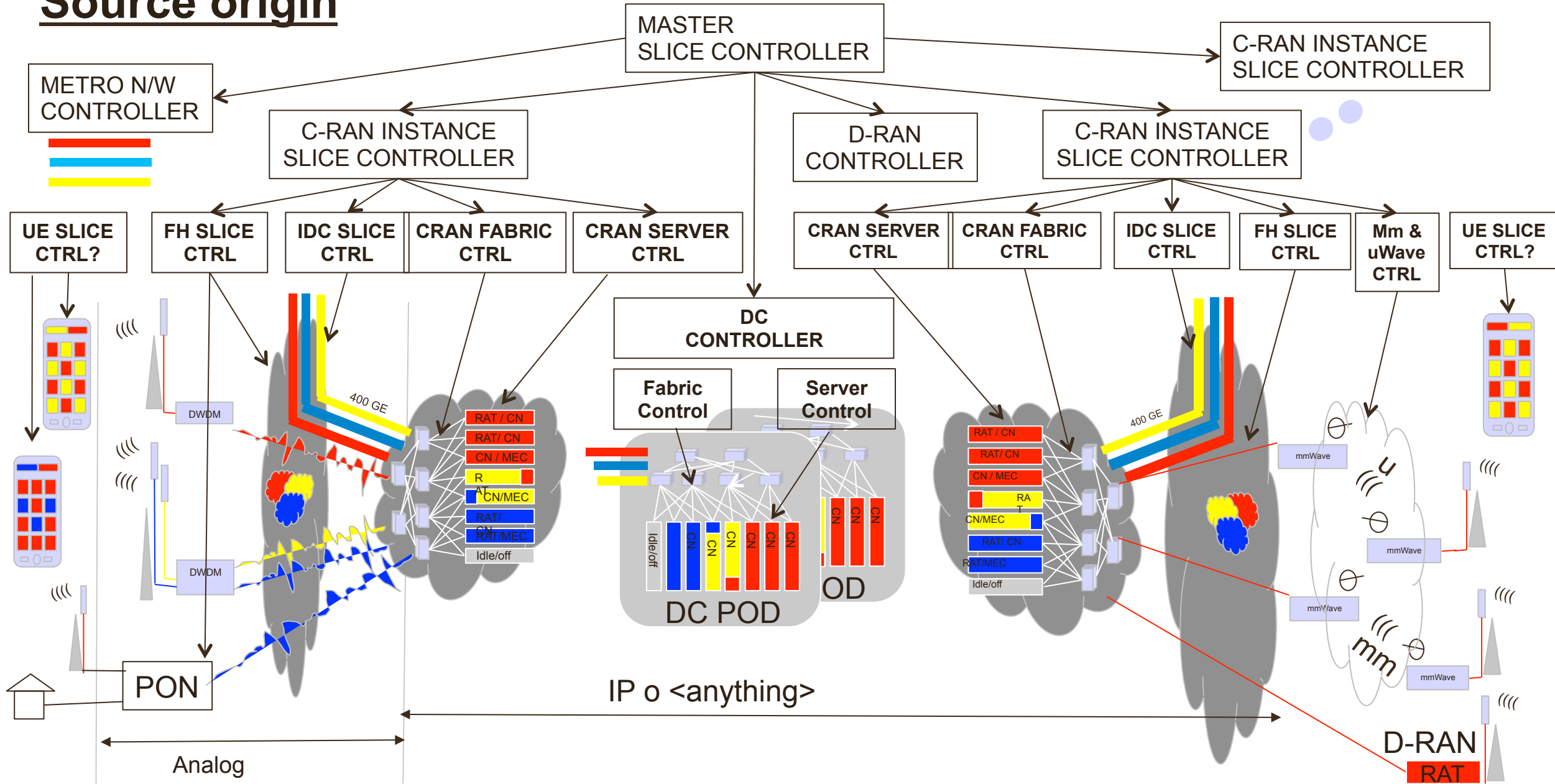
If  $U$  is the set of all resource sets { Antennas, Fronthaul , ..} then  
 Slice  $S_i$  is a set of resource subsets  $\subseteq$  taken from resource sets { Antenna, Fronthaul }  
 There are a nearly infinite number of possible slices  $| S_* |$



# Slices can overlap in some elements (some subsets are full)

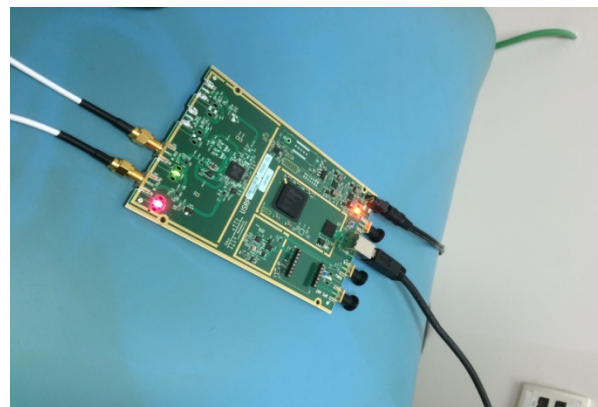
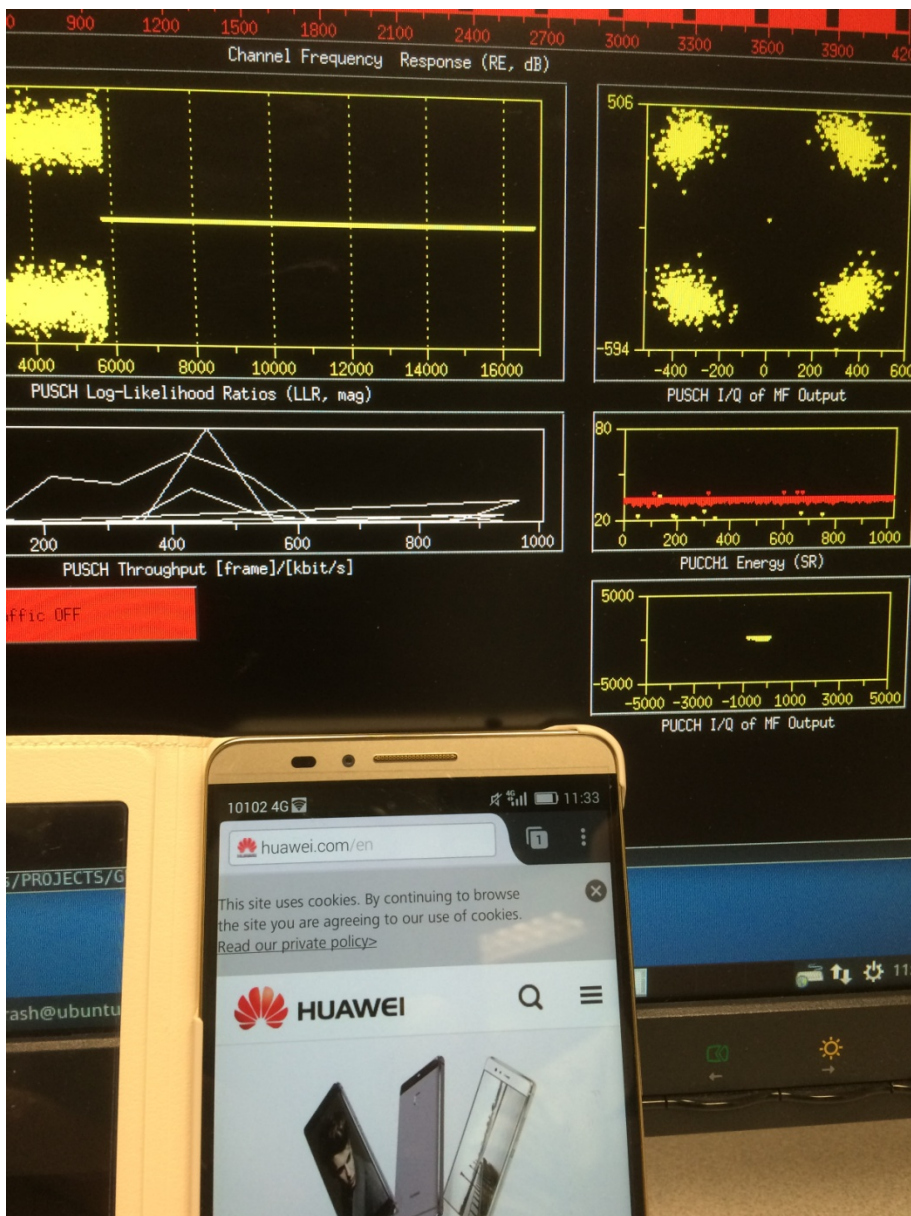


# Controller/Orchestrator Hierarchy likely most control is of Open Source origin





# Complete Open Source 4G – end to end for FG-IMT-2020 POC experiments.



- Android based phone.
- Linux based eNodeB
- Linux based EPC
- Linux based HSS
- Docker/Containers/VM/OpenStack
- Open source eNodeB
- Gnu Radio
- Open source EPC
- Open source HSS
- Soon to include Open NFV, Open Daylight, ONOS (TSDN)
- And Likely Open-O

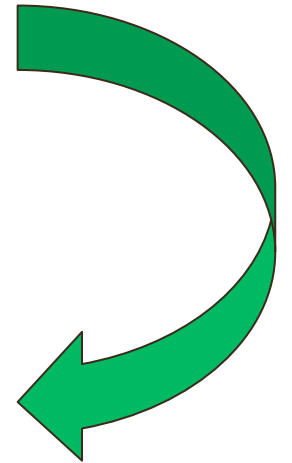
= 100's of millions of lines of code!!!

Could 5G be > 90% code from open source origins?



# ITU-T 5G wireline FG-IMT-2020 Phase II (2016)

- Renewed end of 2015 for all of 2016
- New Terms of Reference as follows:
  - Demonstrations or prototyping with other groups (e.g., with open source community);
  - Network softwarization and ICN;
  - Network architecture refinement;
  - Fixed mobile convergence;
  - Network slicing for front haul/back haul;
  - New traffic models and associated QoS and OAM aspects applicable to IMT-2020 architecture.
- Four meetings in 2016 – Seoul and Beijing completed.
- Outputs A: Draft recommendations to accelerate process in SG13 in 2017.
- Outputs B: Proof of concept of softwarization, working with open source orchestrator (three teams currently planning this Japan, Ottawa and California (ICN))



# Thank You

