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Tutorial - A softwarized perspective of the 5G networks - 5G and beyond

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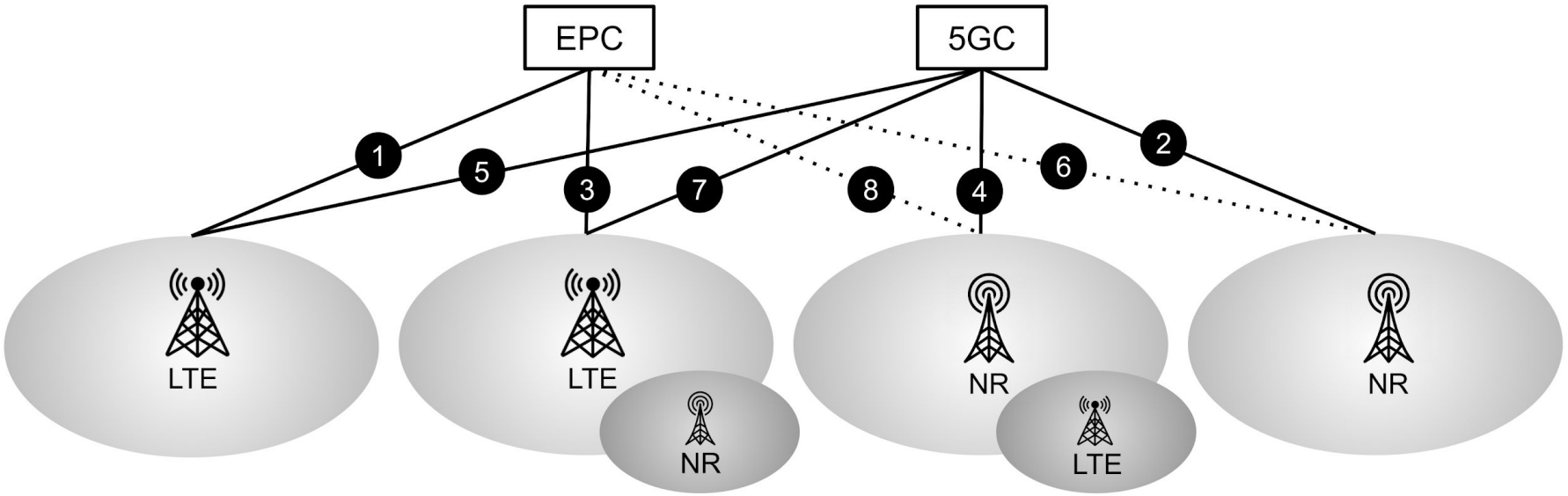
TRiBE inTeRnet BEyond the usual

Inria

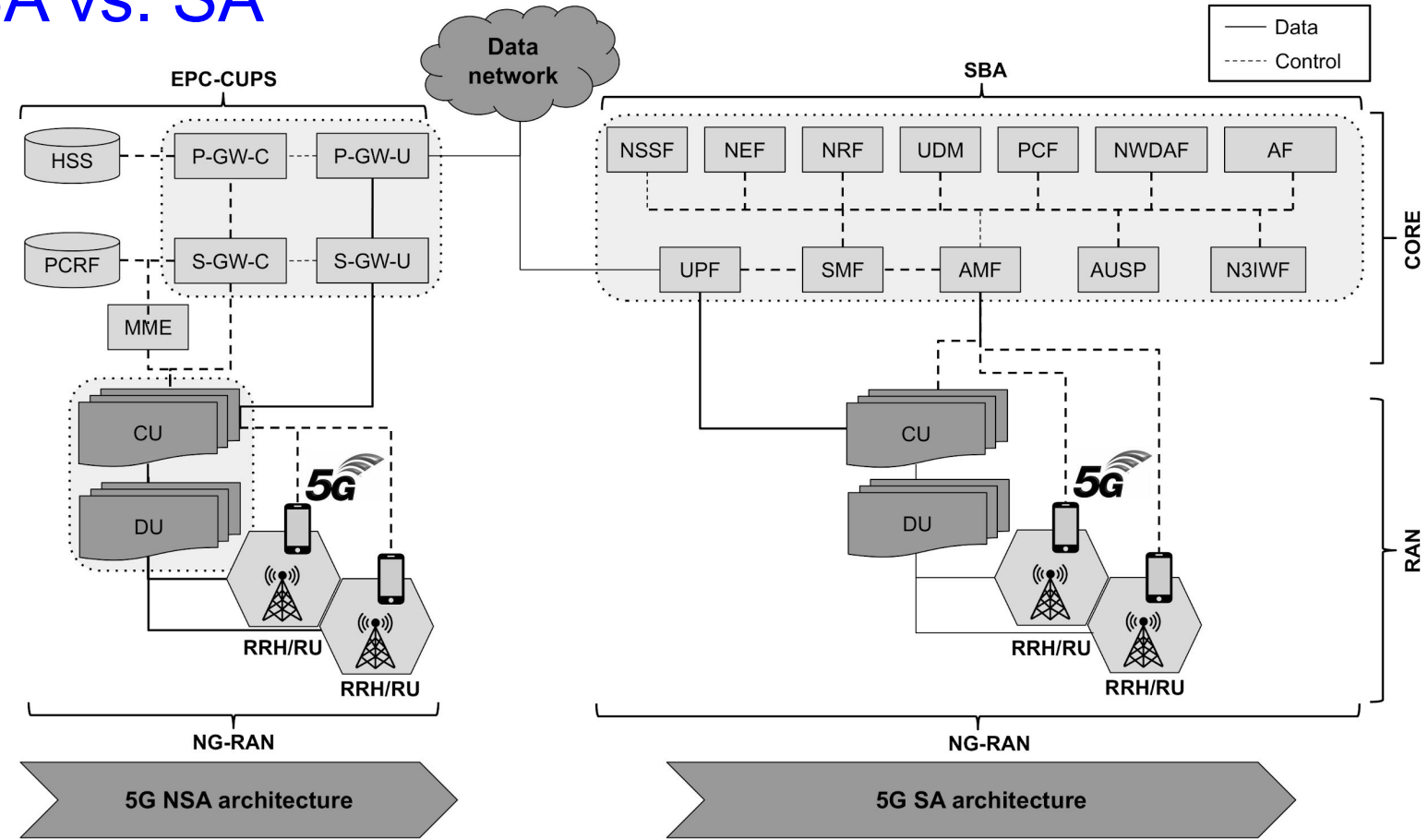
UNISINOS

5G architectures



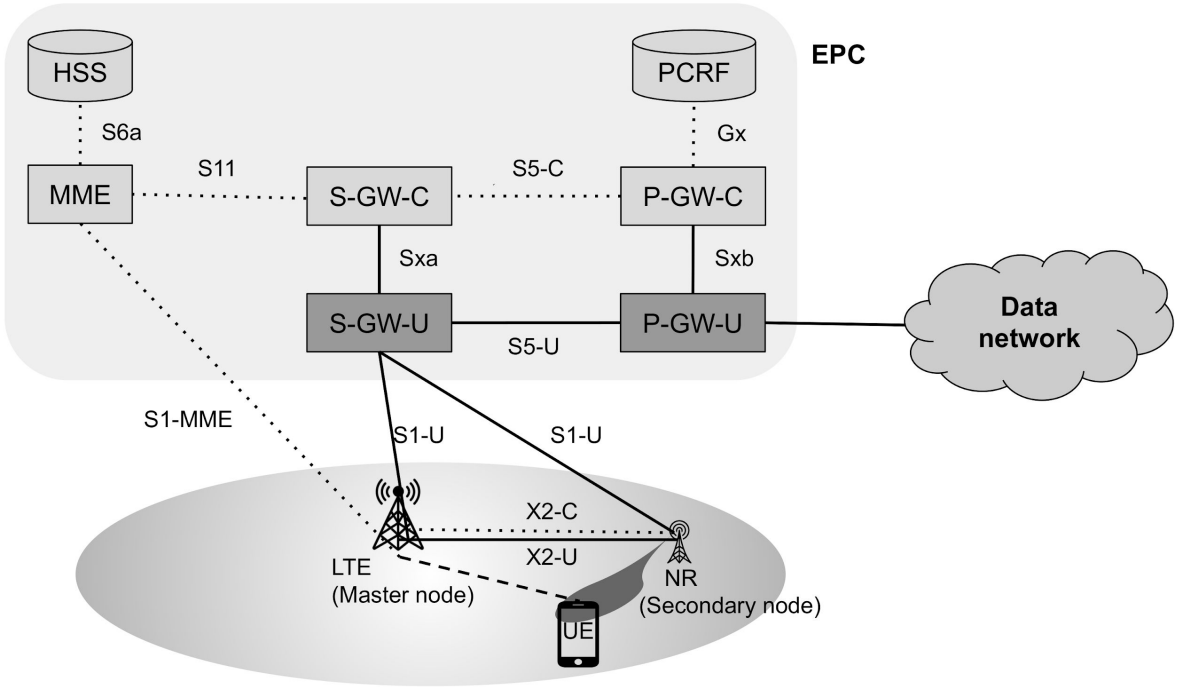
Core \ RAN	LTE only	NR only	LTE with NR for data only	NR with LTE for data only
EPC	Option 1 (4G)	Option 6 (disregarded)	Option 3	Option 8 (disregarded)
5GC	Option 5	Option 2	Option 7	Option 4

NSA vs. SA


Data
Control
Data network
EPC-CUPS
SBA
HSS
P-GW-C
P-GW-U
PCRF
S-GW-C
S-GW-U
MME
NSSF
NEF
NRF
UDM
PCF
NWDAF
AF
UPF
SMF
AMF
AUSP
N3IWF
CORE
CU
DU
5G
RRH/RU
RRH/RU
RAN
NG-RAN
NG-RAN
5G NSA architecture
5G SA architecture

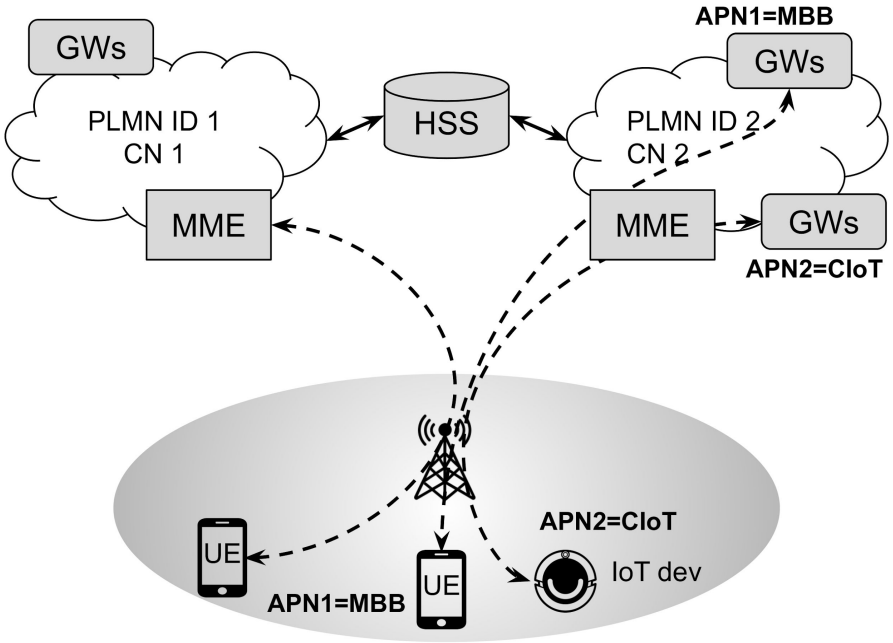
5G Non-Stand Alone - NSA

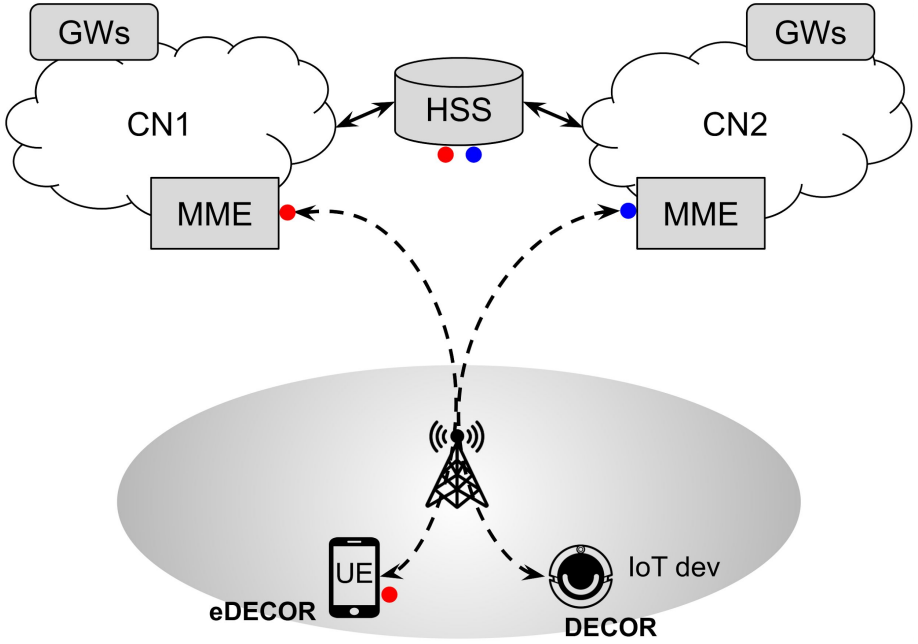
- Some drawbacks
- Key technologies:
  - Dedicated Core networks (DECOR) and enhanced DECOR
  - Control and User Plane Separation (or CUPS)
  - NR (New Radio) as secondary Radio Access Technology



5G Non-Stand Alone - NSA (2)

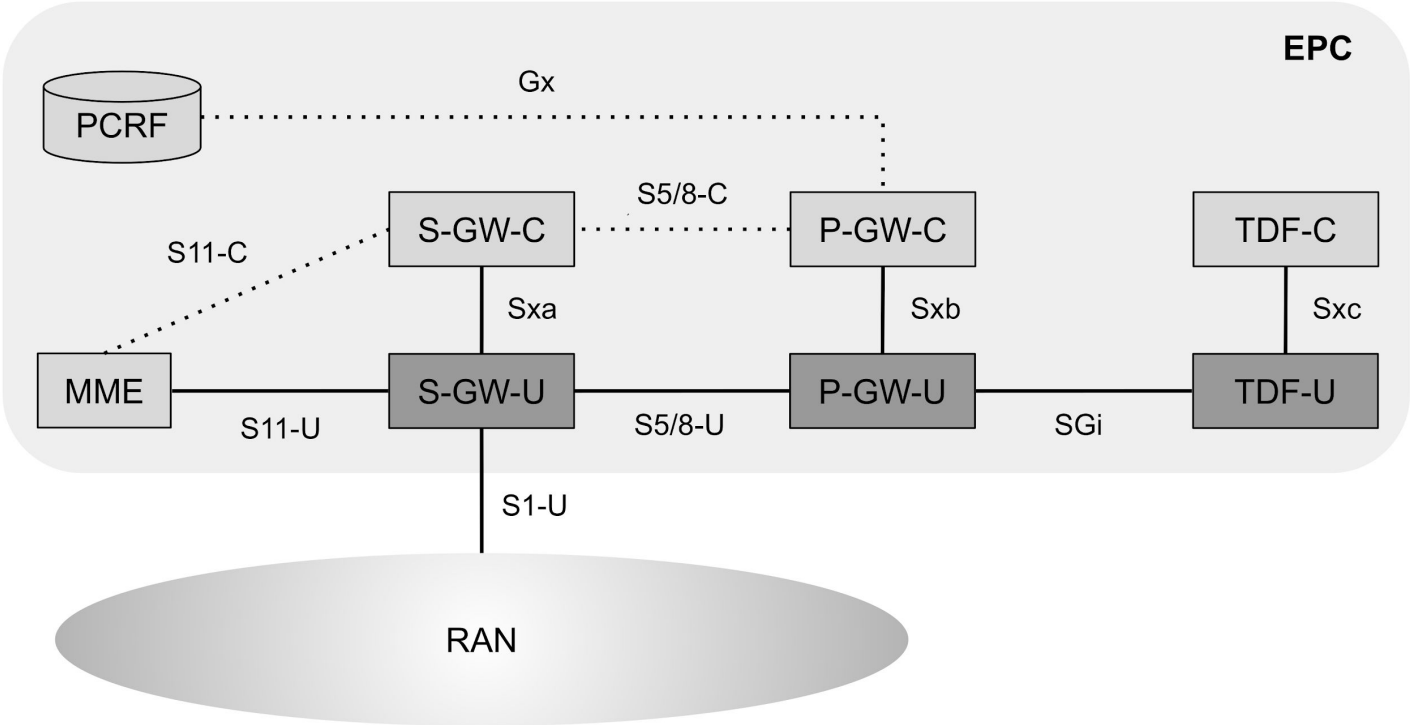
Dedicated Core networks (DECOR) and enhanced DECOR (eDECOR)





5G Non-Stand Alone - NSA (3)

Control and User Plane Separation (CUPS)



5G Non-Stand Alone - NSA (4)

NR as secondary access radio technology

Benefits:

- Increase user throughput
- Greater mobility robustness
- Support load balancing between RAN nodes

Frequency ranges:

- FR1 (410 MHz - 7125 MHz)
- FR2 (24250 MHz - 52600 MHz) - millimeter-wave communications: great potential, but still challenging, mainly under mobility

5G Stand Alone - SA

Main difference between NSA and SA: new 5G core built as a Service-Based Architecture (SBA)

- Helps to implement the 5G scenarios: eMBB, mMTC, and URLLC
- Simplifies updating and maintenance of 5G systems
- Reduces the operation cost
- Facilitates the introduction of new services

‘NSA vs. SA’ is actually ‘from NSA to SA’

Open-source 5G software

- OpenAirInterface Software Alliance: https://gitlab.eurecom.fr/oai/openairinterface5g
- free5GC: https://www.free5gc.org
- Open5GS: https://open5gs.org
- Open Core Network: https://telecominfraproject.com/open-core-network/ (nowadays, no software available)

Beyond 5G

- 6G? Nowadays, a lot of hype, mainly in the research area
- In practice, still unclear
- But, some topics appear more regularly
  1) Artificial Intelligence, Machine Learning
  2) New applications: telepresence, holographic communication, multisensory extended reality, wireless brain-computer interaction
  3) New wireless resources: THz communication, Visible Light Communication (VLC)

Interesting process to follow the steps, because after one decade it will look like a leap