



Network Slicing: 3GPP, SDO, Carriers, Communities

Navid Nikaein

Professor@Eurecom

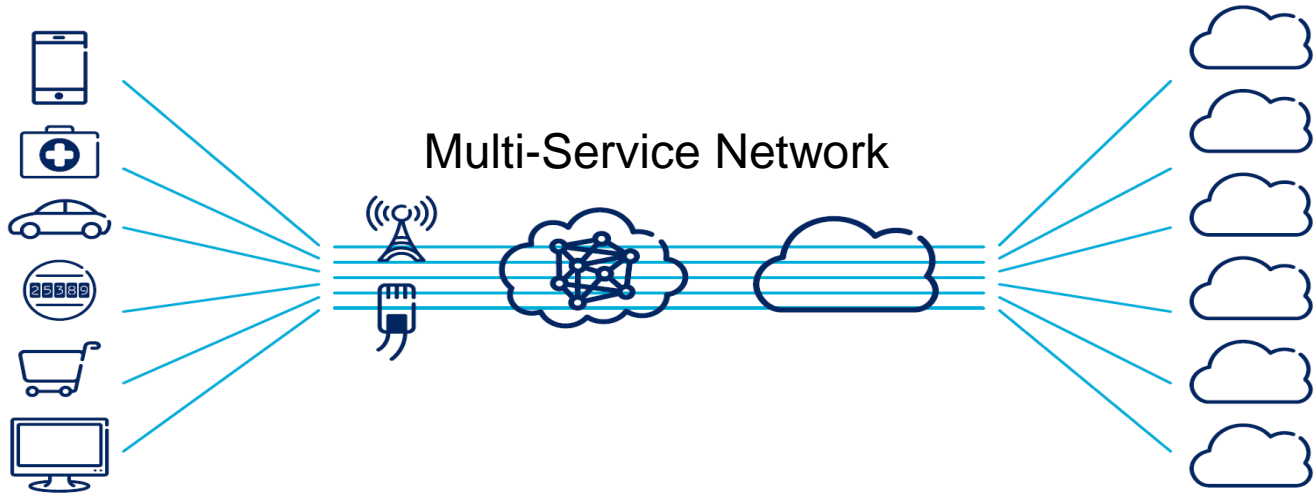
Coordinator of Mosaic-5G Initiative

Network Slicing Panel at EUCNC

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Turn physical infrastructure into multiple logical networks,
one per service instance

NOT a one-size fits all architecture **NOT** a
Dedicated Network



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One-Network, Many-Service

Different aspects of network slicing have been already prototyped both Opensource and commercials platforms

Industry is currently providing network slicing by means of

(a) Local/dedicated services enabled by MEC platform

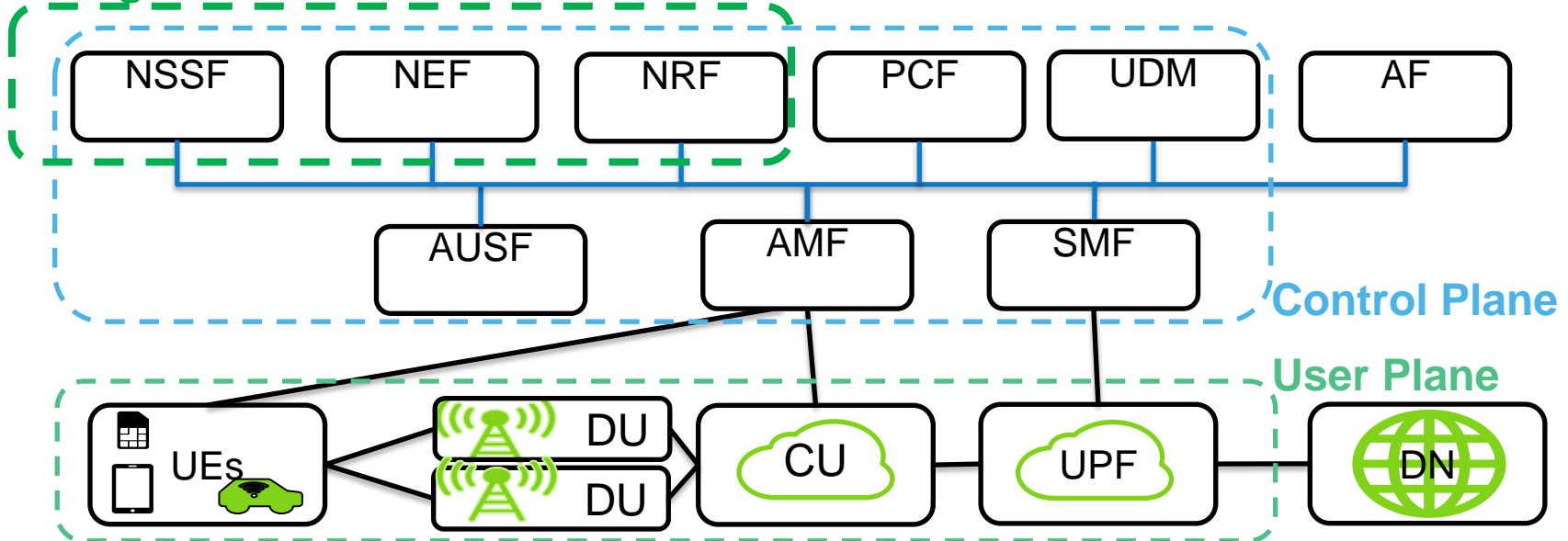
(b) Dedicated core networks and RAN sharing

Next steps : **SO-CN** and **SO-RAN**

From R&D to Reality

5G 3GPP re-architects mobile networks ⁴

Slicing Functions



AMF	Access & Mobility Management Function	SMF	Session Management Function
AUSF	Authentication Server Function	UPF	User Plane Function
NRF	Network Repository Function	AF	Application Function
UDM	Unified Data Management	PCF	Policy Control Function
NSSF	Network slice selection function	NEF	Network Exposure Function

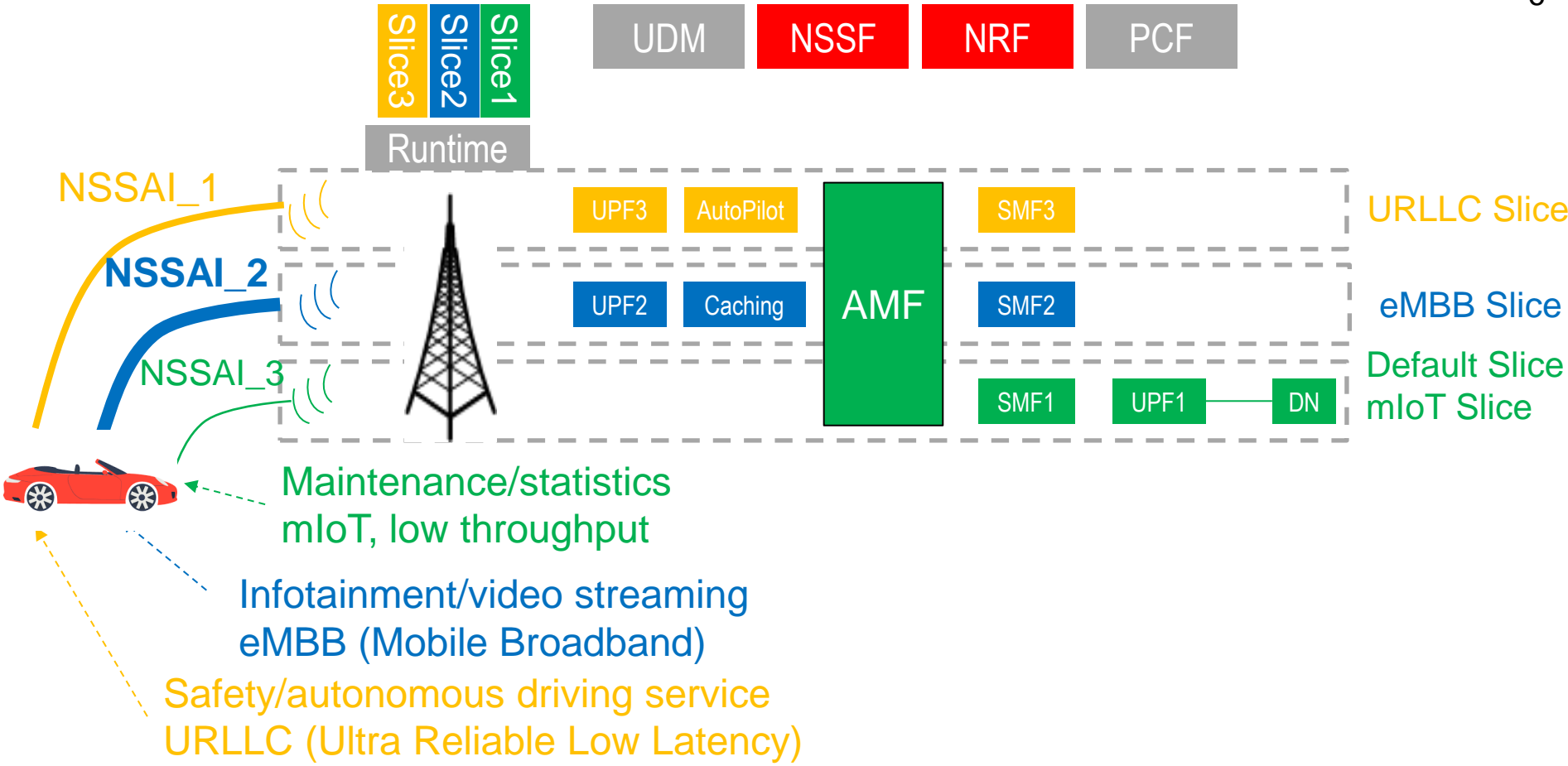
3GPP Mobile Network



3GPP re-architects mobile networks

	3G	4G	5G
Downlink waveform	CDMA	OFDM	OFDM, SCFDMA
Uplink waveform	CDMA	SCFDMA	OFDMA, SCFDMA
Channel coding	Turbo	Turbo	LDPC (data) / Polar (L1 contr.)
Beamforming	No	Only data	Full support
Spectrum	0.8 – 2.1 GHz	0.4 – 6 GHz	0.4 – 90 GHz
Bandwidth	5 MHz	1.4 – 20 MHz	Up to 100 MHz (400MHz for >6GHz)
Network slicing	No	No	Yes
QoS	Bearer based	Bearer based	Flow based
Small packet support	No	No	Connectionless
In-built cloud support	No	No	Yes

3GPP Mobile Network



3GPP Mobile Network

**SDO,
Carriers,
OpenSource,
Communities**

Can opensource without standard?

YES

Can standard without opensource?

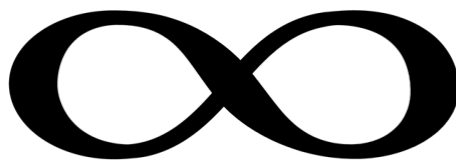
YES

Standard and OpenSource

Today standardization and open-source are becoming complementary



Fast innovation & development phase of new technologies



Retain long-term stability & interoperability



Clear need for open-source for 5G to

(a) Lower the entry barrier

(b) Reduce TCO and improve accessibility and reuse

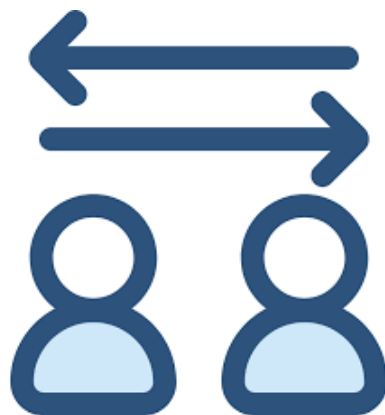
(c) Common R&D framework for innovation

Standard and OpenSource

Leverage **FRAND-type of License** for open-source in 5G

- (a) Allow 3GPP members to contribute to open-source and still perceive royalties (e.g. OSA License)
- (b) Compatible with both commercial and academic/research/prototyping use

- 1. Common R&D prototyping
- 2. Feasibility and Validation
- 3. Reproducibility



- 1. Reference implementation
- 2. Open-source community following 3GPP specs
- 2. Community representation in 3GPP

Standard and OpenSource

Towards RAN WhiteBOX

- (1) Specifying APIs and interfaces
- (2) Exploring open source NF and commodify hardware where appropriate
- (3) Enabling RAN virtualization and RAN intelligence

Operator-led Alliance

X-RAN + C-RAN → O-RAN

Consortium-led Alliance

OpenAirInterface

Standard and OpenSource

ORAN: xRAN+ CRAN

Carrier-led consortium: AT&T, China Mobile, Deutsche Telekom, NTT DOCOMO, Orange

Objective: push more openness into the radio access network with ORAN reference design

- (a) virtualized network elements with open, standardized interfaces
- (b) real-time analytics with machine learning systems and artificial intelligence

ORAN Spec.

OAI: Follow 3GPP Specification

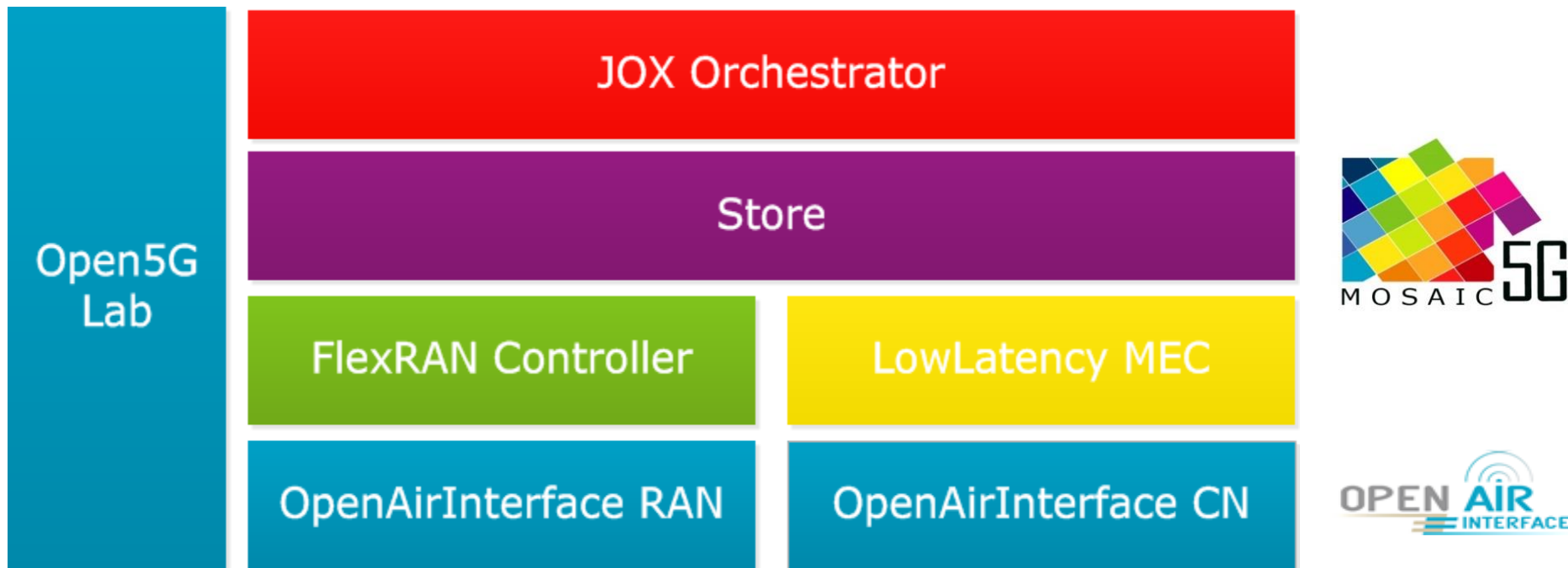
Consortium-led consortium: Orange, Nokia, TCL, Fujitsu, Samsung, Interdigital, ...

Objective: Reference implementation and development kit for common R&D prototyping

- (a) OpenSource RAN and CN code base
- (b) Open APIs, e.g. FlexRAN and FlexCRAN
- (c) Fully software solution (Intel and Arm-based)
- (d) User and developer community

OpenAirInterface Spec.

OpenSource Platforms for Agile network service delivery platforms (OpenAirInterface and Mosaic-5G.io)



Open5G Lab

Facebook and Google are quickly entering
the datacenter Telco space

Value-chain of Telecom is under siege and
may become very different because of this

Example: <https://telecominfraproject.com/>

- Low-cost equipment for rural areas
(openCellular)
- Federating open-source developers



TIP and OpenCellular

Fusion of Computing, Information and Cellular technologies

- (a) 5G and beyond is not only New Radio and verticals, it is also an **evolution in General-Purpose computing for wireless networks**
- (b) More and more software technologies (NFV,SDN,MEC) and Data (mining, analytics) jointly with radio signal processing

Conclusion

Personal Info:

Email: navid.nikaein@eurecom.fr

Website: <http://www.eurecom.fr/~nikaeinn/>

Linkedin: <https://www.linkedin.com/in/navidnikaein>

Tel: +33.(0)4.93.00.82.11

Mosaic-5G.io :

Mail : contact@mosaic-5g.io

Website : <http://mosaic-5g.io>

Linkedin: <https://www.linkedin.com/in/mosaic-5g>

Twitter: [@mosaic5g](https://twitter.com/mosaic5g)

Contact Information