IEEE NETSOFT 2020

Tutorial - A softwarized perspective of the 5G networks - Introduction

Presenters: Kleber, Cristiano, Lucio, Ciro, and Victor

Computer Networks & Distributed Systems LABORAtory

INSTITUTO DE INFORMÁTICA UFG

TRiBE inTeRnet BEyond the usual

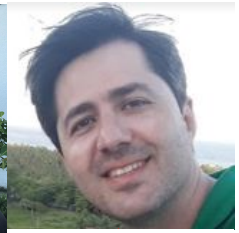
Inria

UNISINOS

Who we are


Professor


PhD student


PhD student

Professor

Professor

International projects: FIBRE (1st BR-EU call), FUTEBOL (3rd BR-EU call), NECOS (4th BR-EU call), EMBRACE (BR FAPs - FR CNRS/Inria)

> 10 R&D Brazilian projects

Experience: wireless networks, software development, testbed deployment, virtualization, software-defined networking, network slicing, resource allocation, performance evaluation, and related topics

Agenda

Duration	Subject	Presenter(s)
15 min	Introduction, Mobile networks until 4G	Kleber
15 min	5G and beyond	Kleber
15 min	RAN	Victor
45 min	Demo 1 (3 experiments)	Victor, Ciro, Cristiano
Break		
25 min	Core	Kleber, Cristiano
30 min	Demo 2 (2 experiments)	Ciro, Cristiano
15 min	Non-3GPP RANs	Cristiano, Lucio
15 min	Demo 3 (1 experiment)	Lucio
5 min	Conclusion	Kleber

Softwarization

Wiktionary: The use of a software solution, rather than traditional hardware, to solve a problem.

1st NetSoft (2015): Software-Defined Networks (SDN), Network Function Virtualization (NFV), and Software-Defined Clouds could be seen as different expressions of an overall transformation trend, which is deeply impacting and bridging Telecom and IT industries. This trend is also transforming several other Industries, in using “softwarization” to optimize costs and processes and in bringing new values in infrastructures.

This tutorial: The use of a software solution based on concepts, technologies, and best practices widely adopted in IT and recognized by their benefits. This software must follow standards, seeking interoperability, and should run preferably over standardized hardware.

Expectations for 5G

As the previous generations:

- Increase capacity
- Increase coverage

But also:

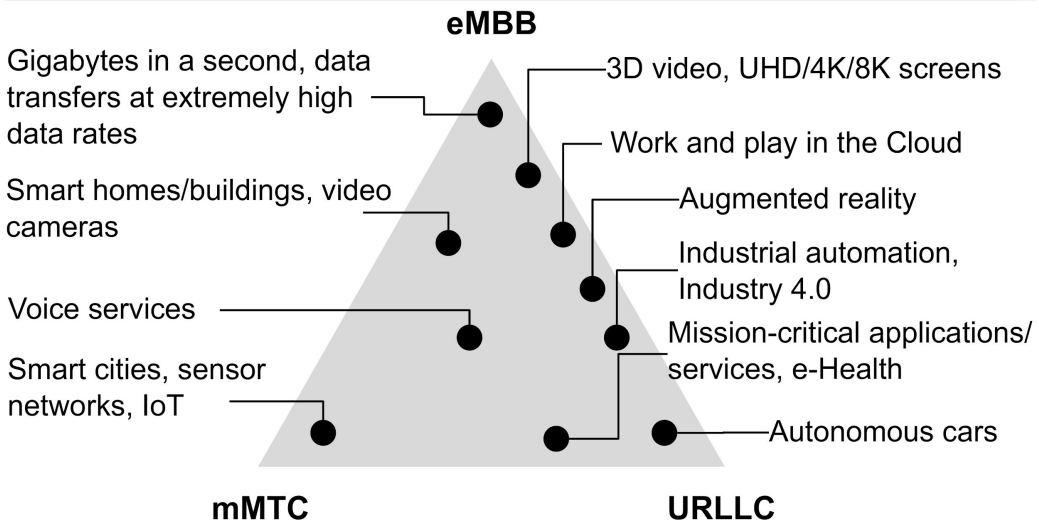
- Support for new applications: autonomous cars, Industry 4.0, AR/VR/MR, ...
- Network slicing
- Edge computing
- SDN, NFV, ...

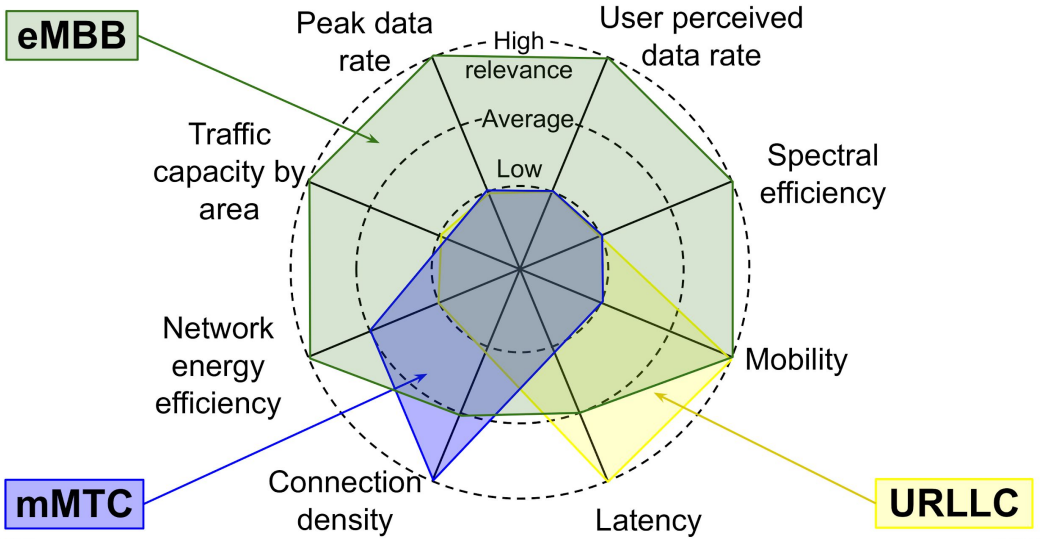
5G scenarios

New ‘users’: those who have users,

i.e., industries, verticals,

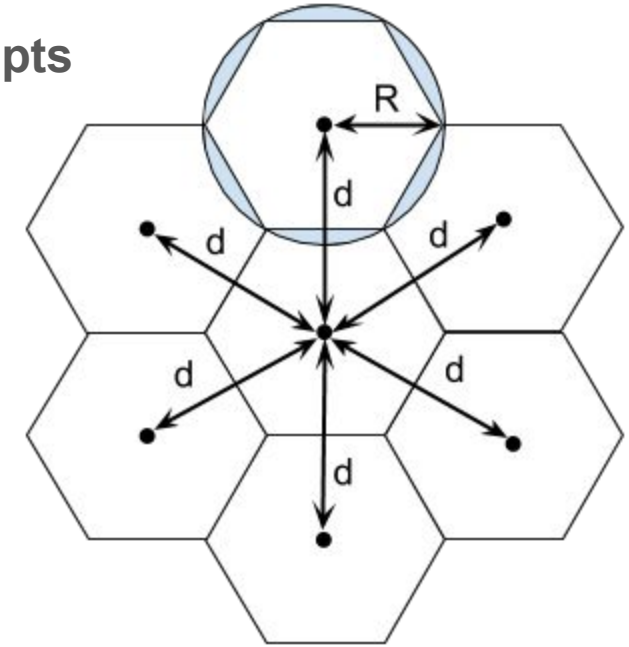
service providers

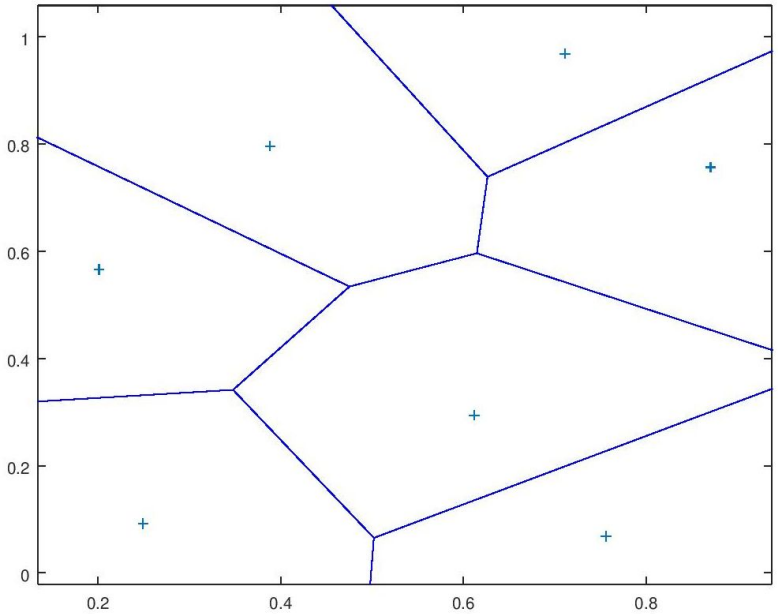




Mobile cellular networks until 4G

Basic concepts





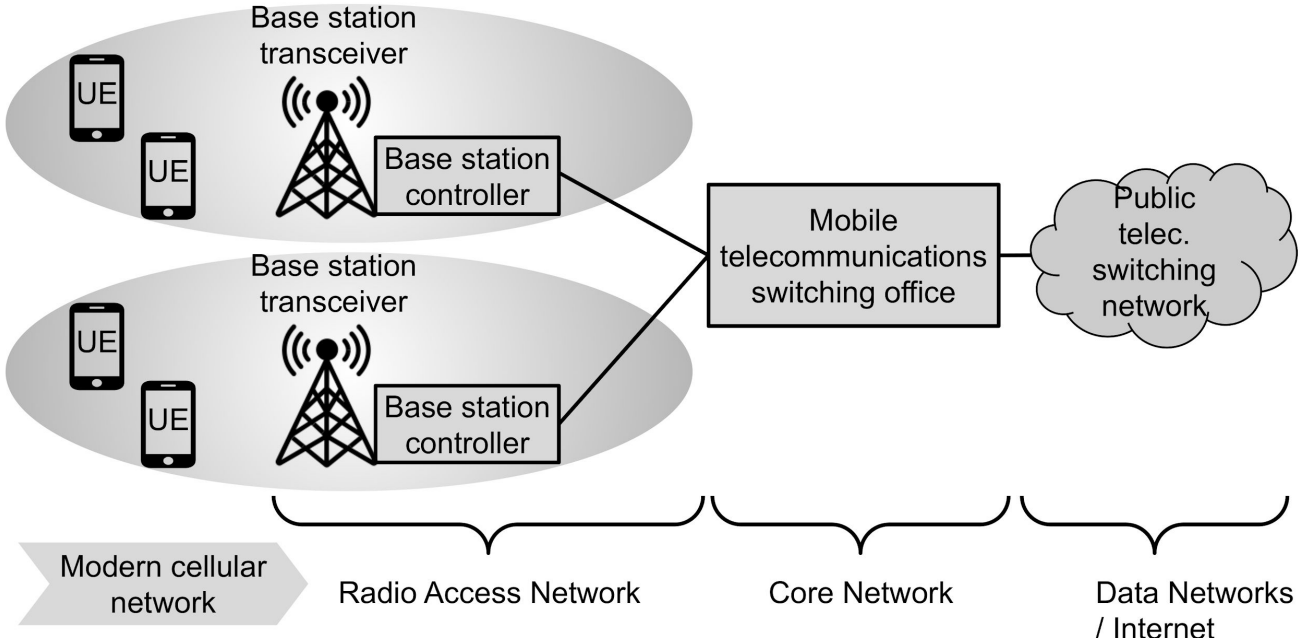
Soon: cell-less, i.e., multiple associations and coordinate and dynamic coverage

Mobile cellular networks until 4G (2)

Basic operation of a cellular system

Telecom approach: network is complex and “host” is simple; control and user traffic are separated

- Authentication
- Channel (de)allocation
- Handoff/handover
- Paging
- Monitoring
- ...



Mobile cellular networks until 4G (3)

Evolution of the mobile cellular networks

	1G	2G	3G	4G
Deployment	≈ 1980	≈ 1991	≈ 1999	≈ 2009
Main services	Analog voice	Digital voice, SMS	Digital voice, data packets	IP packets
Data rate	1.9 kbps	14.4 kbps	384 kbps	200 Mbps
RAN	AMPS, TACS, NMT, C-450, TMA, RTM	GSM, GPRS, EDGE, PDC, IS-95, IS-136	UMTS (W-CDMA), CDMA2000, TD-SCDMA	LTE, WiMAX
Core	PSTN (SS7)	PSTN (SS7, ISDN)	PSTN, ATM, IP	IP network (EPC)
3GPP initial standard	-	-	Release 99	Release 8
Global market share (by 2019)[1]	0%	23%	25%	52%

[1] https://www.statista.com/statistics/740442/worldwide-share-of-mobile-telecommunication-technology/

Mobile cellular networks until 4G (4)

Evolution of the mobile cellular networks: 1G and 2G

- 1G: proprietary software, low-level, and embedded in specific hardware
- 2G:
  - 2G today: IoT
  - Software has important role, e.g., monitoring and billing
  - However, proprietary technologies and specialized appliances are dominant
  - Open-source software:
    - OpenBTS: http://openbts.org/
    - YateBTS: https://yatebts.com/
    - GSM baseband software: https://osmocom.org/projects/baseband

Mobile cellular networks until 4G (5)

Evolution of the mobile cellular networks: 3G

- Software becomes very important
- However, proprietary software and vendor-specific appliances are dominant
  → vendor lock-in and innovation delay
- Open-source software:
  - OpenBTS-UMTS: https://github.com/RangeNetworks/OpenBTS-UMTS
  - Cellular network infrastructure components for GSM, GPRS, EDGE, UMTS, HSPA, LTE: https://projects.osmocom.org/projects/cellular-infrastructure/

Mobile cellular networks until 4G (6)

Evolution of the mobile cellular networks: 4G

- Software is already in the whole system
  - SDN, NFV initial adoption
- Interoperability is a reality, mainly for basic operation
  - eNB-eNB, RAN-Core
- However,
  - Vendor lock-in is still common, mainly for advanced features
  - Adoption of cloud technologies is still very limited
- Open-source software:
  - OpenAirInterface: https://www.openairinterface.org
  - srsLTE: https://github.com/srsLTE/srsLTE
  - Open5GS: https://open5gs.org

Mobile cellular networks until 4G (7)

Evolution of the mobile cellular networks: LTE-Advanced

- RAN (Evolved Universal Terrestrial Access Network - E-UTRAN): eNodeB and Relay Node (RN)
- Core (Evolved Packet Core - EPC):
  - Mobility Management Entity (MME)
  - Home Subscriber Server (HSS)
  - Policy and Charging Rules Function (PCRF)
  - Packet Data Network (PDN) Gateway (P-GW)
  - Serving Gateway (S-GW)