ARCHITECTURE MATTERS

DILBERT BY
SCOTT ADAMS

TELECOMMUNICATIONS MEET IT

3/1/2018, T-Mobile, Josef Trčka and Ondřej Macháček

LIFE IS FOR SHARING.

AGENDA

01 Telecommunication standardization

02 Generations of mobile systems

03 Current 3GPP Release 14 architecture

04 Upcoming 3GPP Releases heading to 5G

05 Deutsche Telekom steps

06 Live demo of PCRF system.

Telecommunication Overview

TELECOMMUNICATION STANDARDIZATION

ITU (http://www.etsi.org/)

The European Telecommunications Standards Institute, produces globally-applicable standards for Information and Communications Technologies (ICT), including **fixed, mobile, radio, broadcast** and Internet technologies.

3GPP (http://www.3gpp.org/)

The project covers cellular telecommunications network technologies, including **radio access**, the **core transport network**, and **service capabilities** – including work on codecs, security, quality of service – and thus provides complete system specifications. The specifications also provide hooks for non-radio access to the core network, and for interworking with Wi-Fi networks. There are 3 working groups:

- Radio Access Networks (RAN)
- Services & Systems Aspects (SA)
- Core Network & Terminals (CT)

GENERATIONS OF MOBILE SYSTEMS

From 80’ 1

- Analog
- AMPS, TACS, NMT
- Voice only

From 1991 2

- Digital
- GSM, GPRS, EDGE
- Voice, SMS and data services
- < 100 Kbit/s

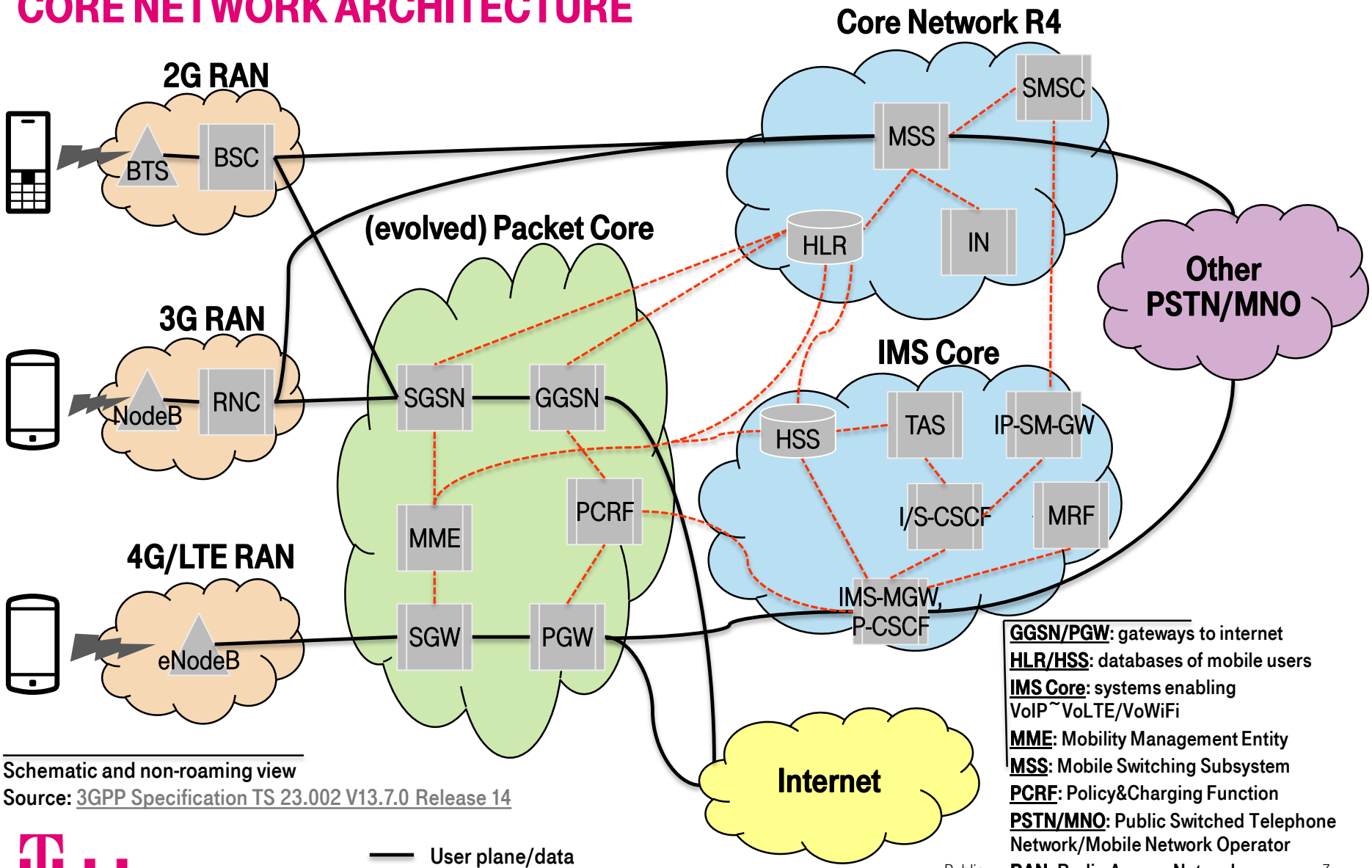
From 2001 3

- Digital
- UMTS/HSPA
- Evolution of 2G, decoupling of core components
- Up to 2 Mbit/s

From 2010 4

- Digital
- LTE, LTE Advanced
- Evolution of Data Core, full IP voice
- Up to 100 – 1000 Mbit/s
- 3GPP Rel.8÷14

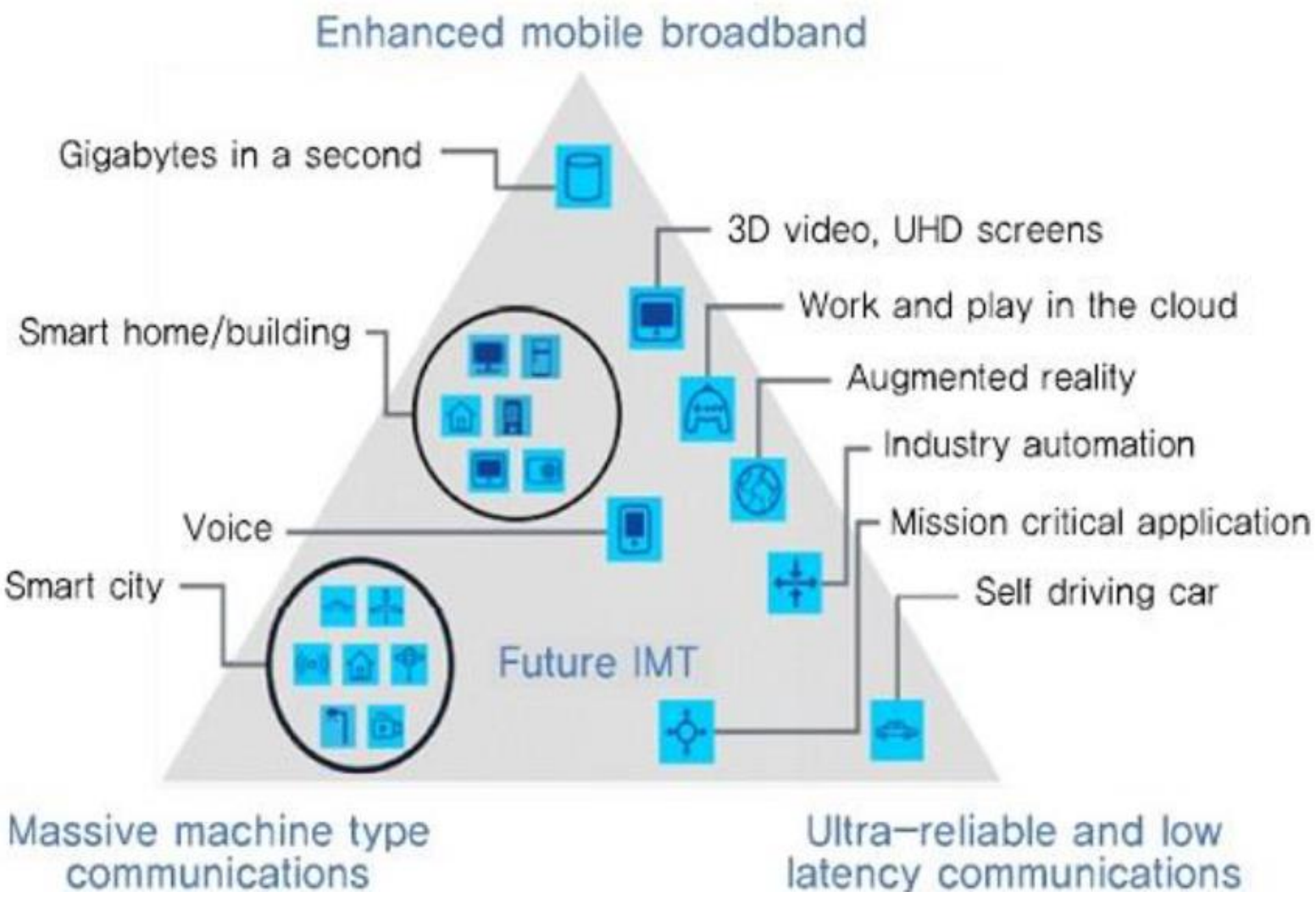
CURRENT 3GPP RELEASE 14
CORE NETWORK ARCHITECTURE



Schematic and non-roaming view
Source: 3GPP Specification TS 23.002 V13.7.0 Release 14

GGSN/PGW: gateways to internet
HLR/HSS: databases of mobile users
IMS Core: systems enabling VoIP~VoLTE/VoWiFi
MME: Mobility Management Entity
MSS: Mobile Switching Subsystem
PCRF: Policy&Charging Function
PSTN/MNO: Public Switched Telephone Network/Mobile Network Operator
RAN: Radio Access Network
SGSN/SGW: access control systems

UPCOMING 3GPP RELEASES 15 & 16 AKA 5G
EXPECTATIONS



UPCOMING 3GPP RELEASES 15 & 16 AKA 5G REQUIREMENTS

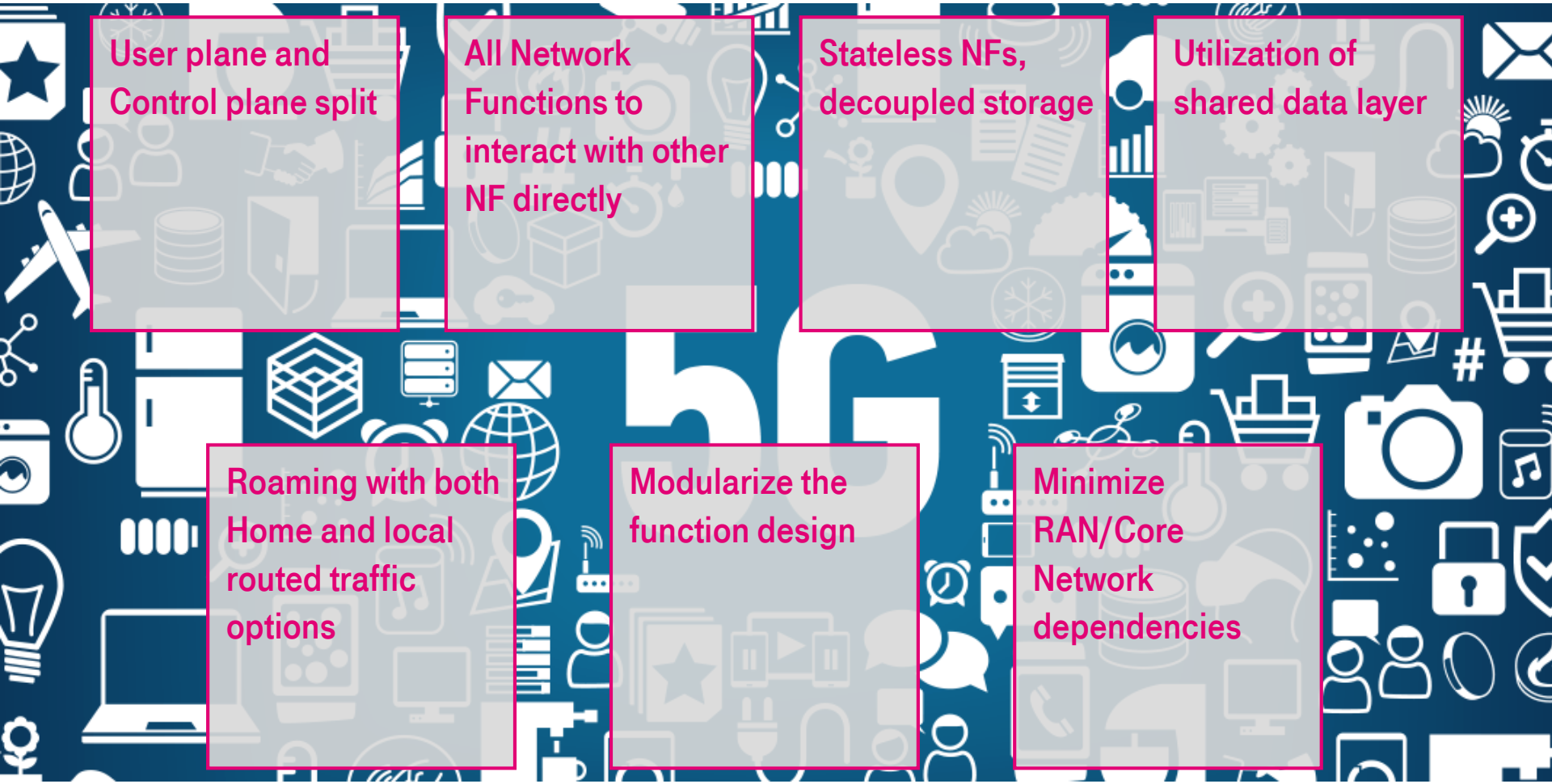
Enhanced mobile broadband (eMBB)	Massive machine type communications (mMTC), AKA Massive IoT	Ultra-reliable and low latency communications (UR-LLC), AKA Critical IoT
▪ Voice and **video** calls ▪ Access to **heavy throughput-intensive** applications, e.g. 4K video, cloud storage	▪ Demand for a lot of connected machine units satisfied with **long latency**, **limited throughput**, e.g. sensors sending small amount of data	▪ Use cases likely to require a high level of security, high level of mobility, **extreme reliability**, demand for high throughput and **extremely low latency**, e.g. **V2X** (Vehicle-to-Everything), Virtual Reality, Ultra High Definition (**UHD**) applications

These objectives contradict each other and show that today's one-size-fits-all approach is not viable in 5G.

UPCOMING 3GPP RELEASES 15 & 16 AKA 5G
FEATURES

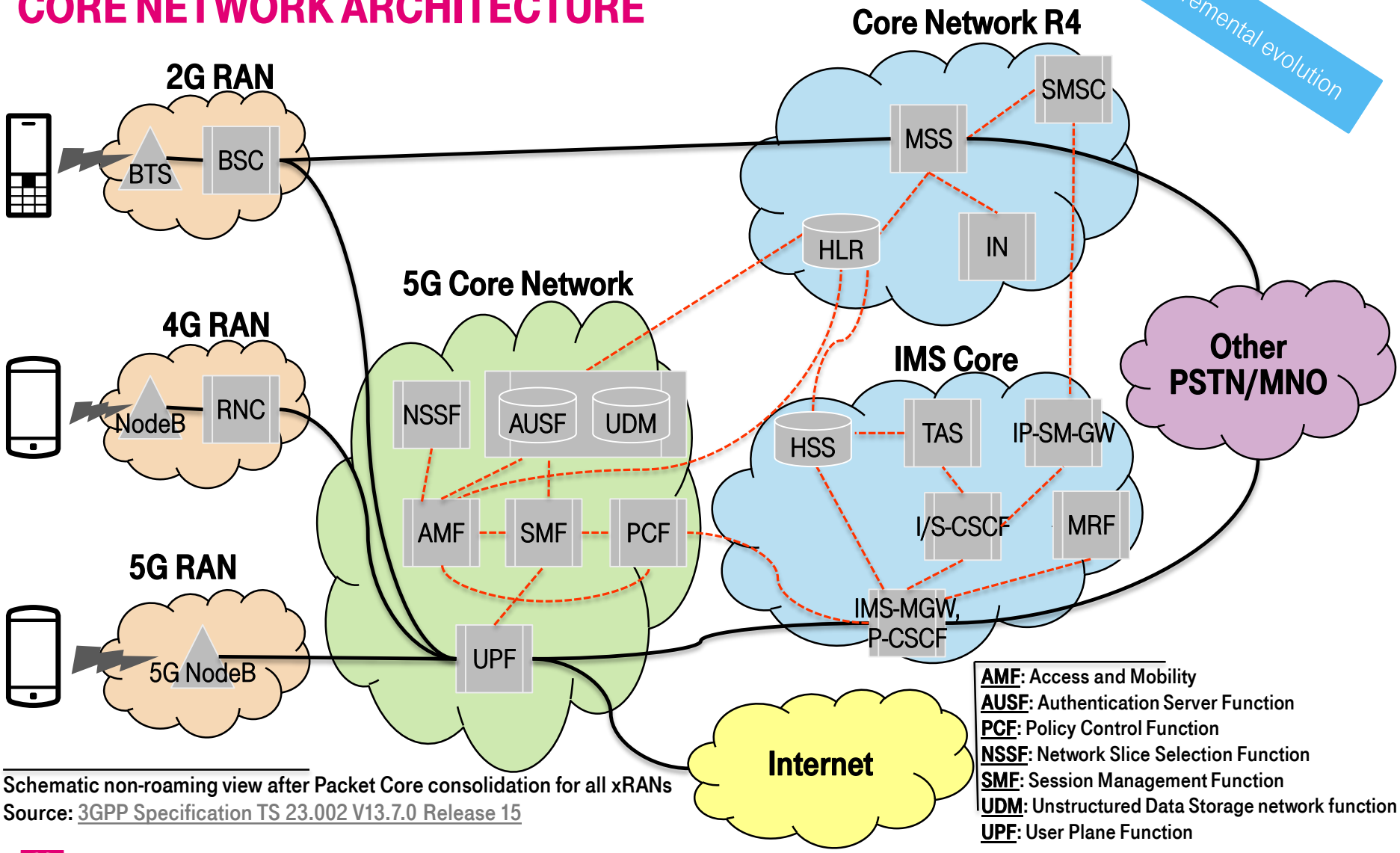
Network Slicing	▪ Permits offering within the same mobile networks complete different services ▪ Provides **traffic isolation** and **security** ▪ End to end service separation within **radio access**, **transport** and **core**
Mobile Edge Computing (MEC)	▪ Deployment paradigm enabling better services for content caching, gaming, AR/VR, etc. ▪ MEC is necessary for **achieving the latency reduction** that 5G aims for ▪ In principle, it brings the service nearer to the edge of the network ▪ Several approaches considered: deploying just SGW or complete EPC at the edge (except HSS) for instance for industrial IoT
Cloud RAN (C-RAN)	▪ Aim is to reduce costs of operating the network ▪ Basically eNodeB consists of **HW** (antenna, radio chips) and **Base Band Unit** (BBU) which is just SW ▪ **BBU** can be deployed **virtualized at a central location**

UPCOMING 3GPP RELEASES 15 & 16 AKA 5G
APPROACH



UPCOMING 3GPP RELEASES 15 & 16 AKA 5G
CORE NETWORK ARCHITECTURE

An incremental evolution

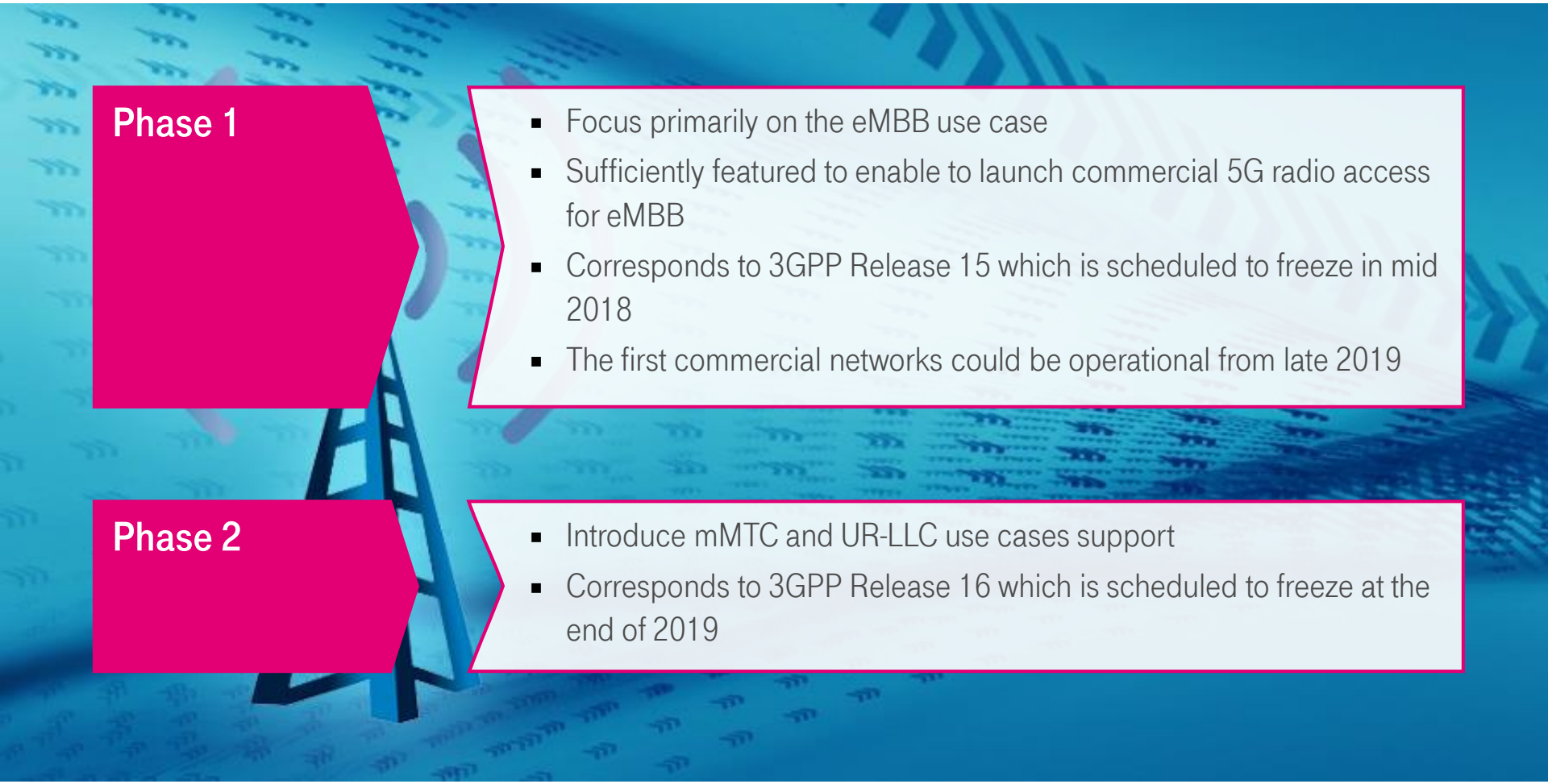


AMF: Access and Mobility
AUSF: Authentication Server Function
PCF: Policy Control Function
NSSF: Network Slice Selection Function
SMF: Session Management Function
UDM: Unstructured Data Storage network function
UPF: User Plane Function

Schematic non-roaming view after Packet Core consolidation for all xRANs
Source: 3GPP Specification TS 23.002 V13.7.0 Release 15

User plane/data
Control plane/signalization

UPCOMING 3GPP RELEASES 15 & 16 AKA 5G
TIMING



Phase 1

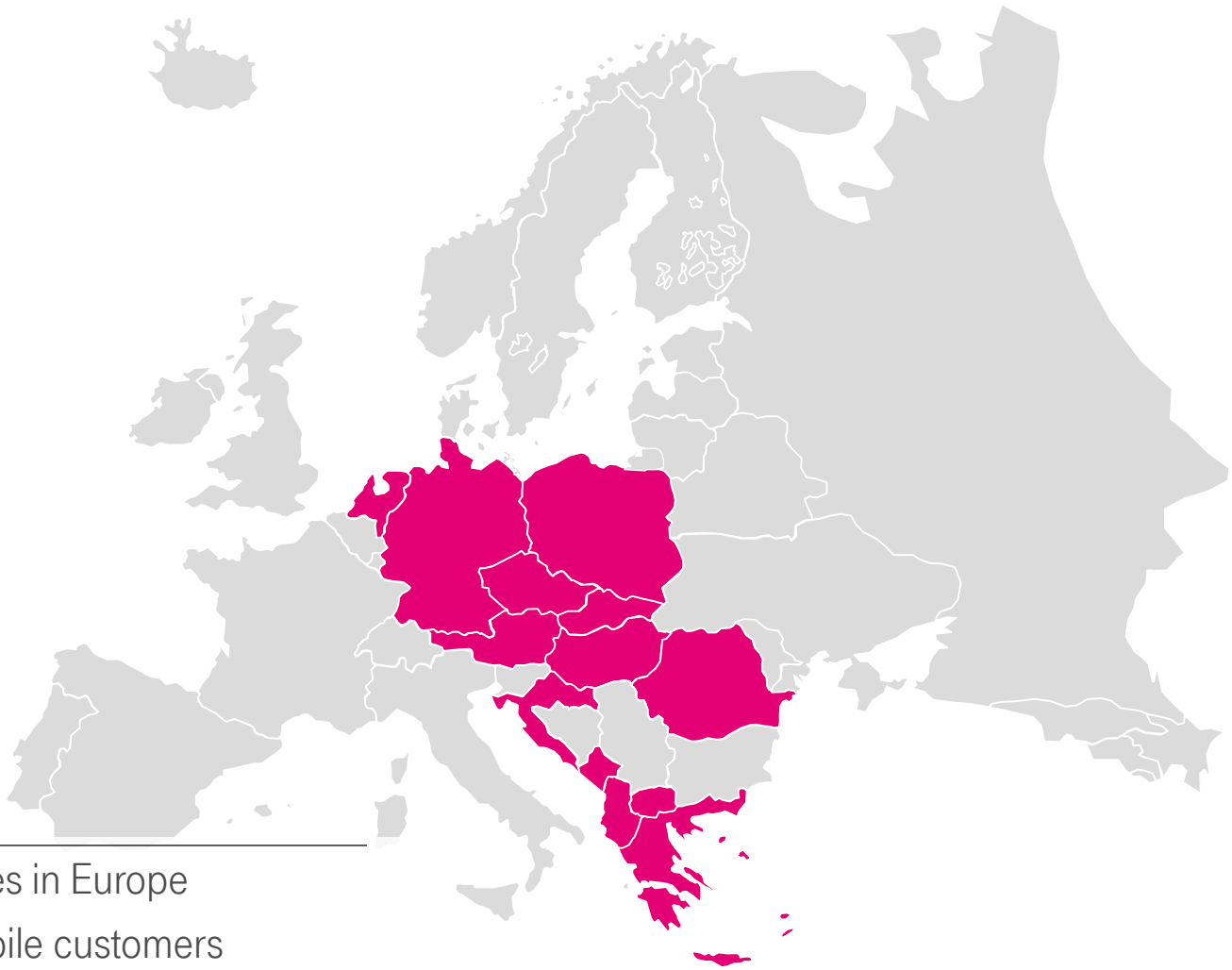
- Focus primarily on the eMBB use case
- Sufficiently featured to enable to launch commercial 5G radio access for eMBB
- Corresponds to 3GPP Release 15 which is scheduled to freeze in mid 2018
- The first commercial networks could be operational from late 2019

Phase 2

- Introduce mMTC and UR-LLC use cases support
- Corresponds to 3GPP Release 16 which is scheduled to freeze at the end of 2019

Deutsche Telekom Approach

DEUTSCHE TELEKOM OVERVIEW



- 13 countries in Europe
- ~93M mobile customers
- ~18.5M fix customers

DEUTSCHE TELEKOM INTERNALS
PAN-NET COMPANY OVERVIEW

BACK-END DATA CENTER

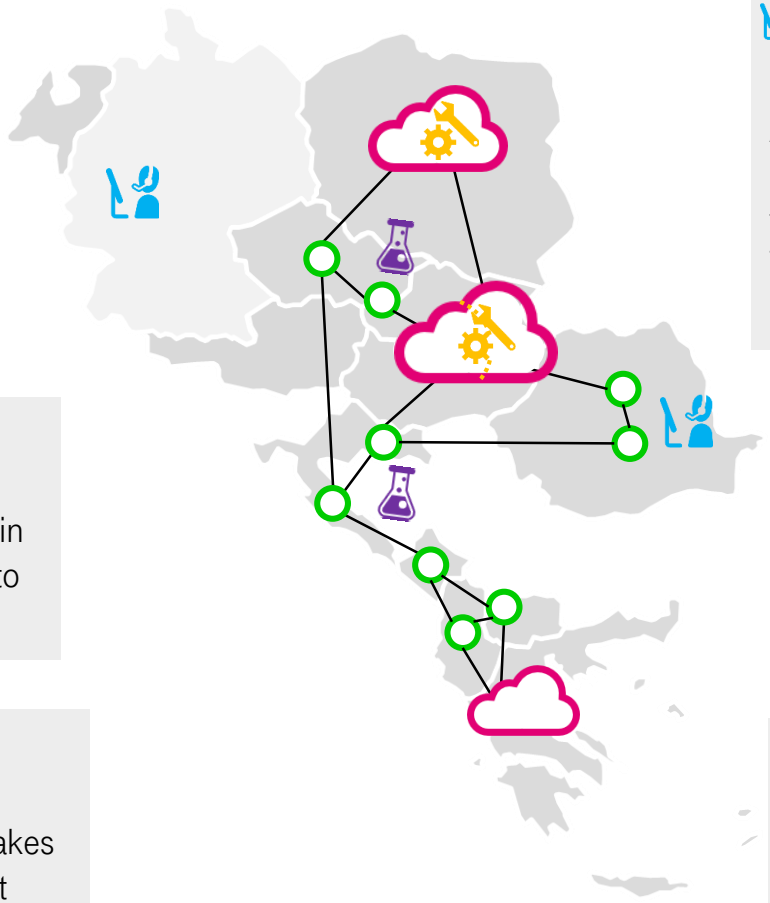
Three geo-redundant BEDCs provide the core of the infrastructure cloud.

FRONT-END DATA CENTER

At least two redundant FEDCs in each NatCo provide the basis to connect and serve the NatCo.

INTL. OPERATIONS SUPPORT SYSTEM

A common operating system takes care of all central management functions and provides a common IT integration point for the NatCos.



SERVICE OPERATION CENTER

At least 2 SOCs monitor the production factory and provide first level support for NatCos. They are connected to all local SOCs.

BACKBONE NETWORK

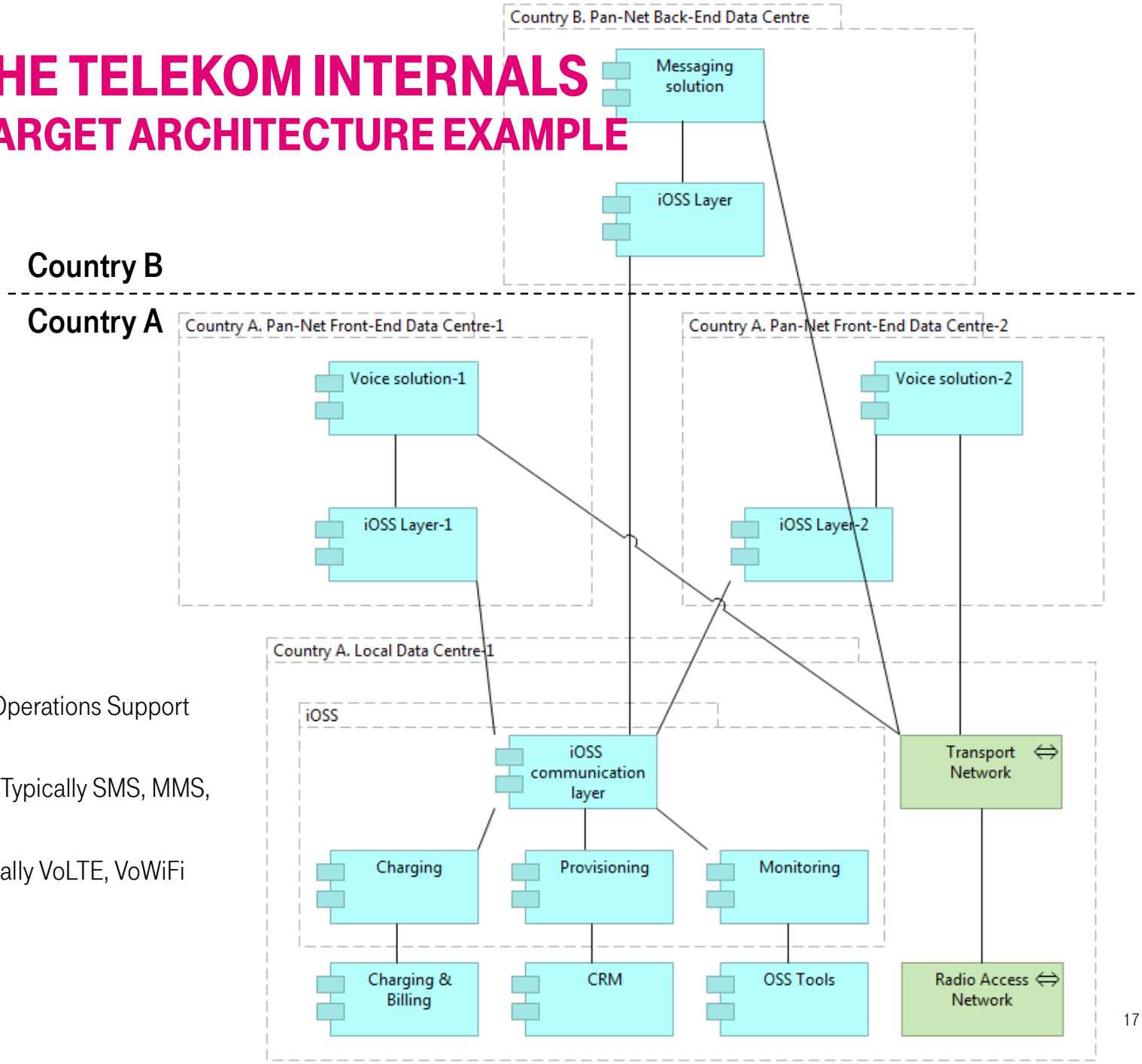
A multi-national network connects all Pan-Net locations.

TEST LAB

Testing and development environment for new components, functions and their integration.

DEUTSCHE TELEKOM INTERNALS

PAN-NET TARGET ARCHITECTURE EXAMPLE

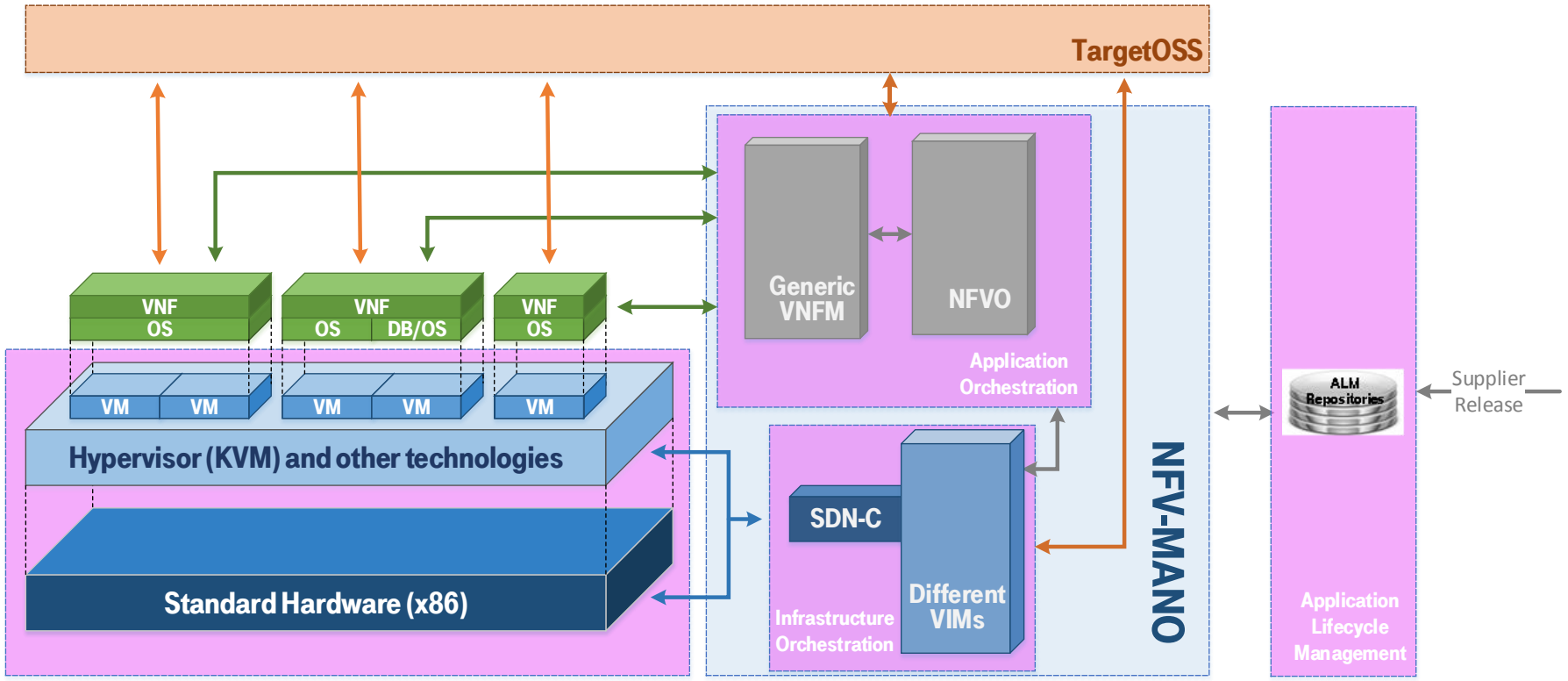


iOSS: International Operations Support Systems

Messaging solution: Typically SMS, MMS, VoiceMail services

Voice solution: Typically VoLTE, VoWiFi

DEUTSCHE TELEKOM INTERNALS
PAN-NET INFRASTRUCTURE



- Architecture is based on **ETSI NFV** principles.
- Pan-Net production will support additional virtualization technologies, e.g. **containers**.
- Pan-Net production will provide **central generic VNFM** functionality (in Application Orchestration) and **central NFVO** (partly in TargetOSS and partly in Application Orchestration), as well as generic repositories for VNF artefacts for the lifecycle management of VNFs and their components.
- **TargetOSS** will manage the lifecycle of services and interacts with the VNFs via application specific models and ensure end-to-end service quality
- The VNF shall contain the needed internal management functionality so that it can be managed by external management systems (TargetOSS and Application Orchestration)

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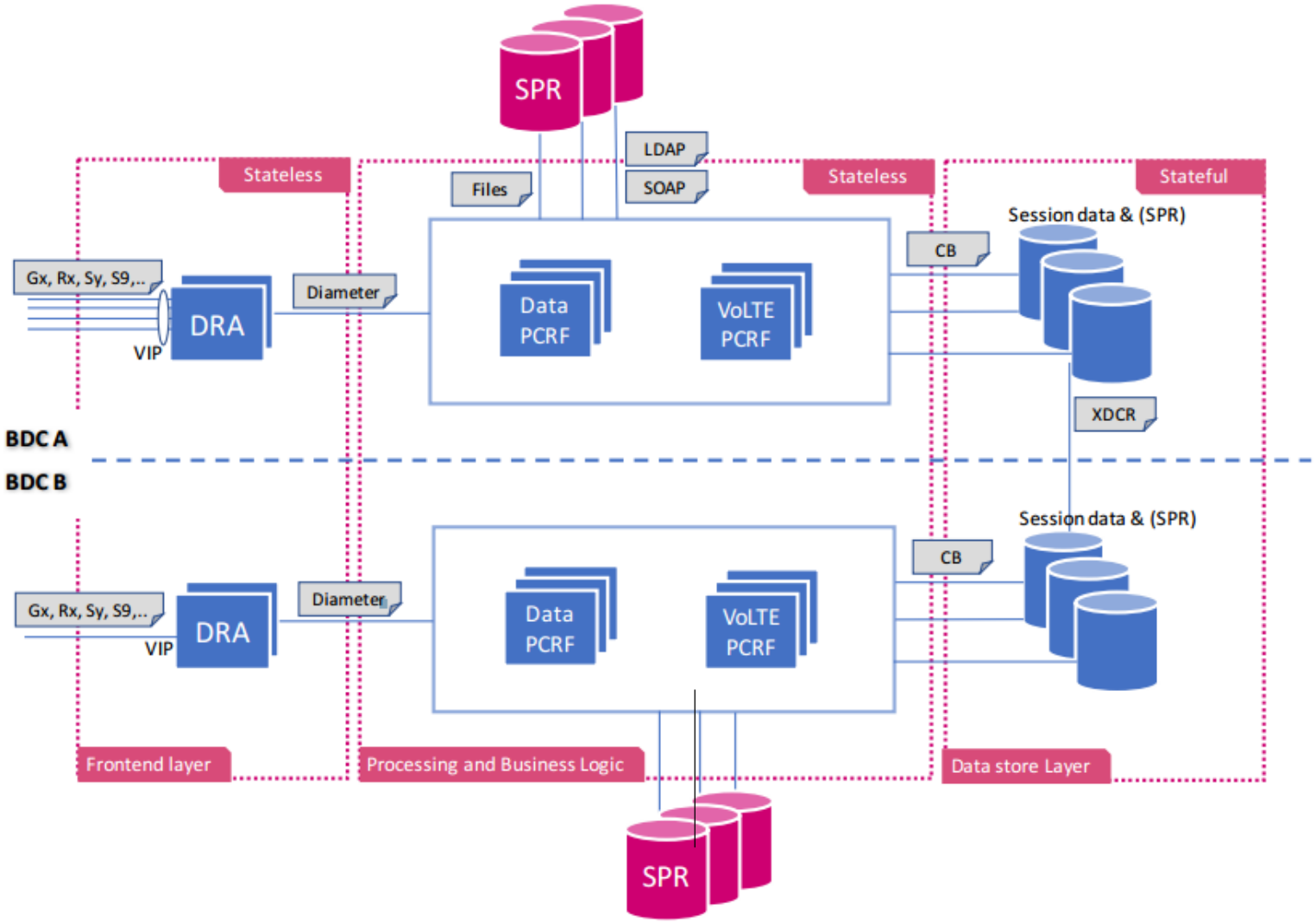
2nd Part
Live demo

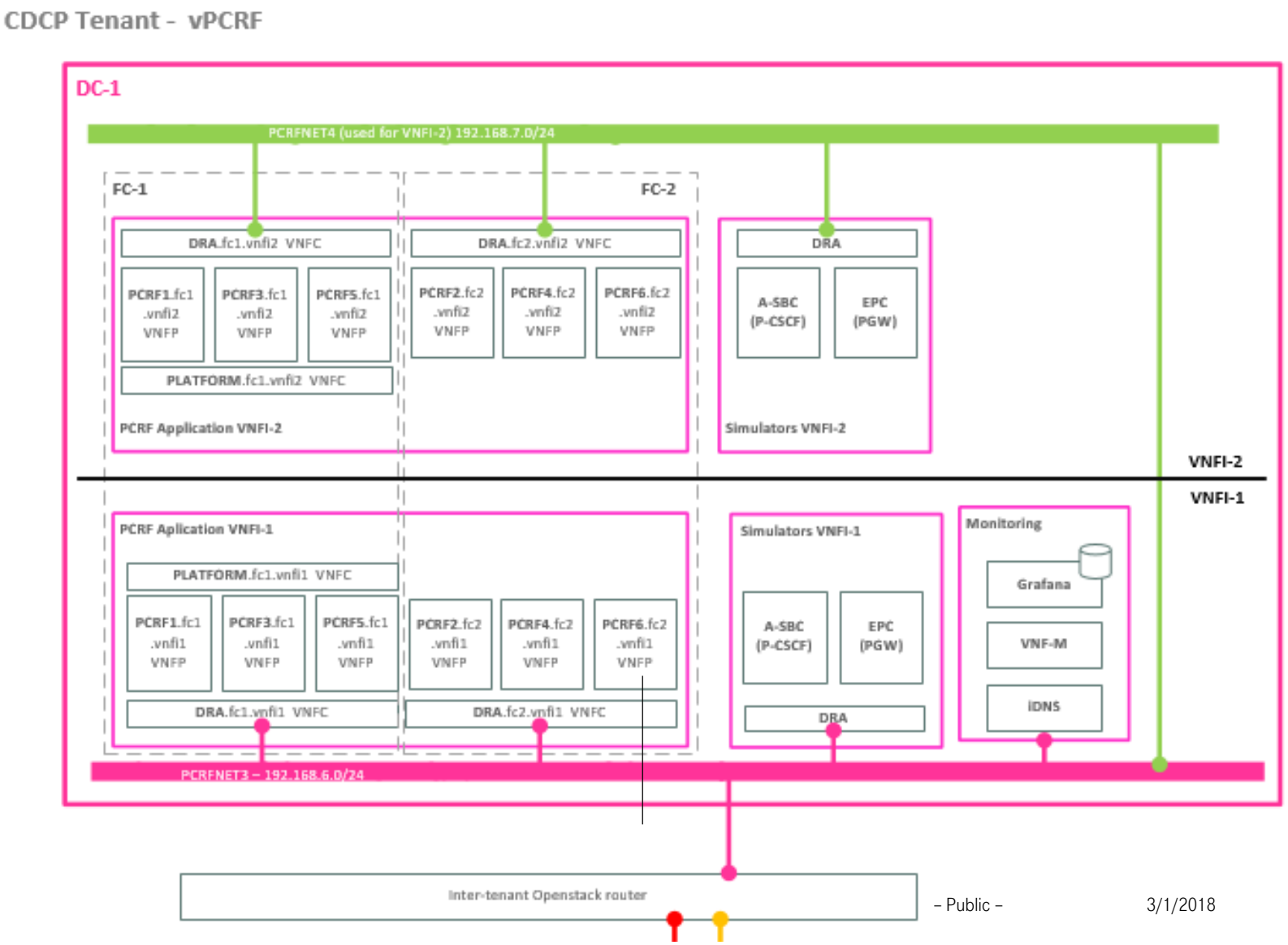
AGILE PCRF DEPLOYMENT

OpenStack multi-VM deployment



AGILE PCRF DEPLOYMENT

OpenStack multi-VM deployment



AGILE PCRF
Big Data Integration

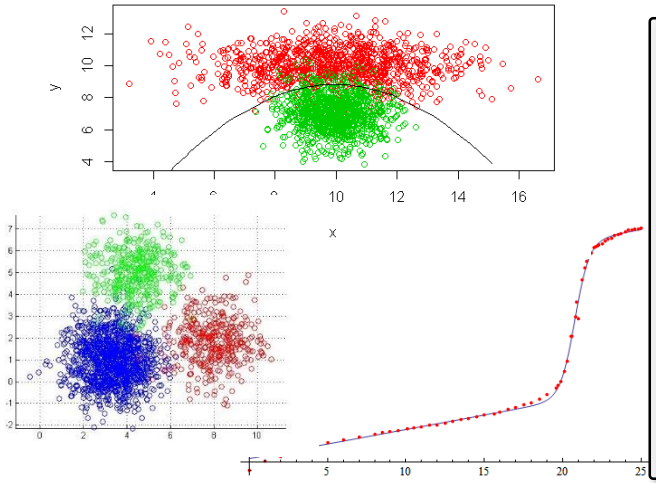
AGILE PCRF – MACHINE LEARNING

Lets make telco clever

Telco network is becoming more and more complex due to

- Virtualization
- Handful telco generations running simultaneously
- Exponential grow on data services related traffic

Exact/static measures and statistics are obsolete



What about **Machine learning** & **probability**?

- Intelligent Categorization & Aggregation
- Adaptive algorithms
- Better predictions
- Searching for common features
- Self learning

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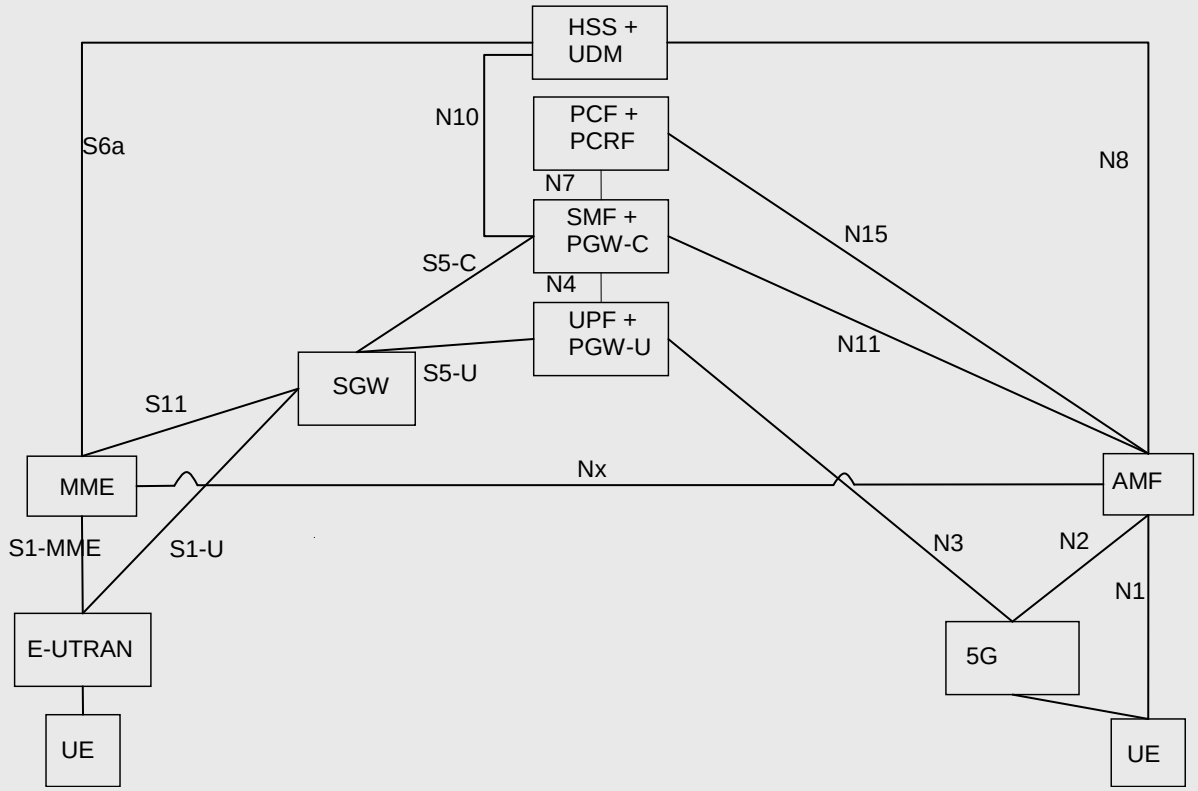
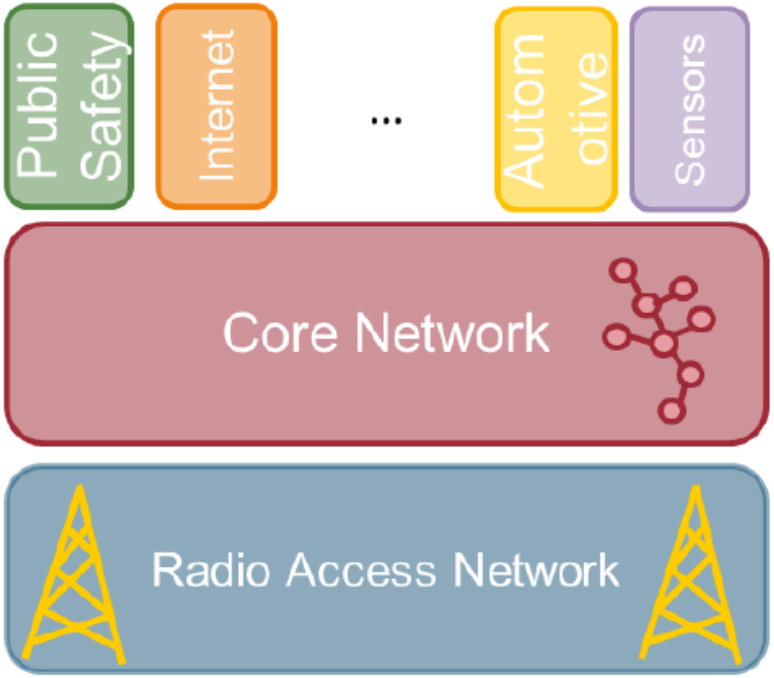
THANK YOU!

Back up slides

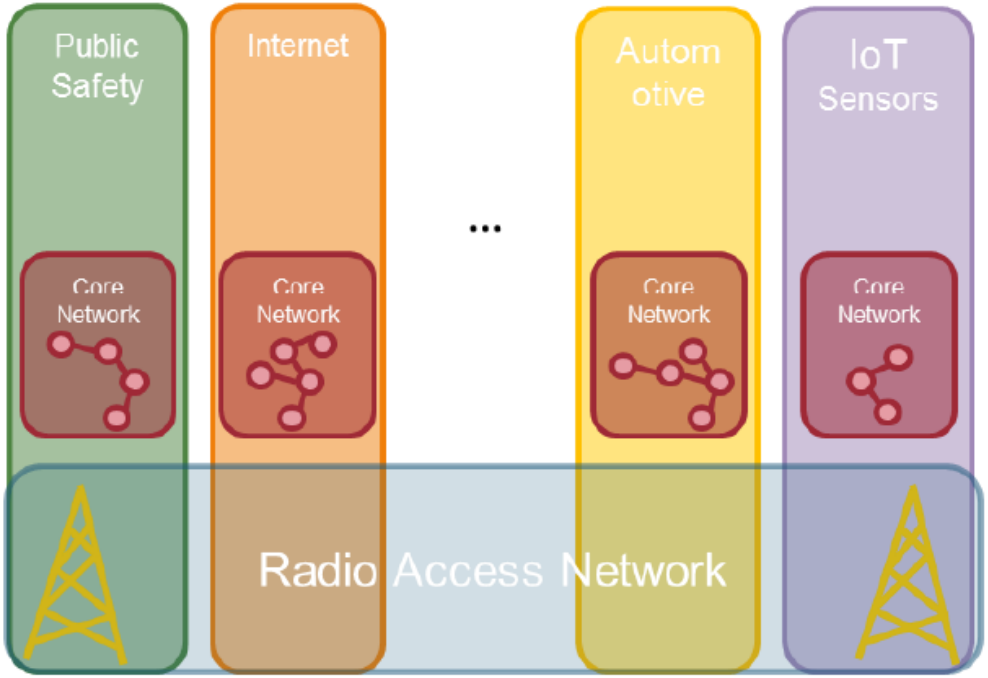
5G Core Network architecture
NON-ROAMING



NETWORK SLICING



Before slicing



After slicing