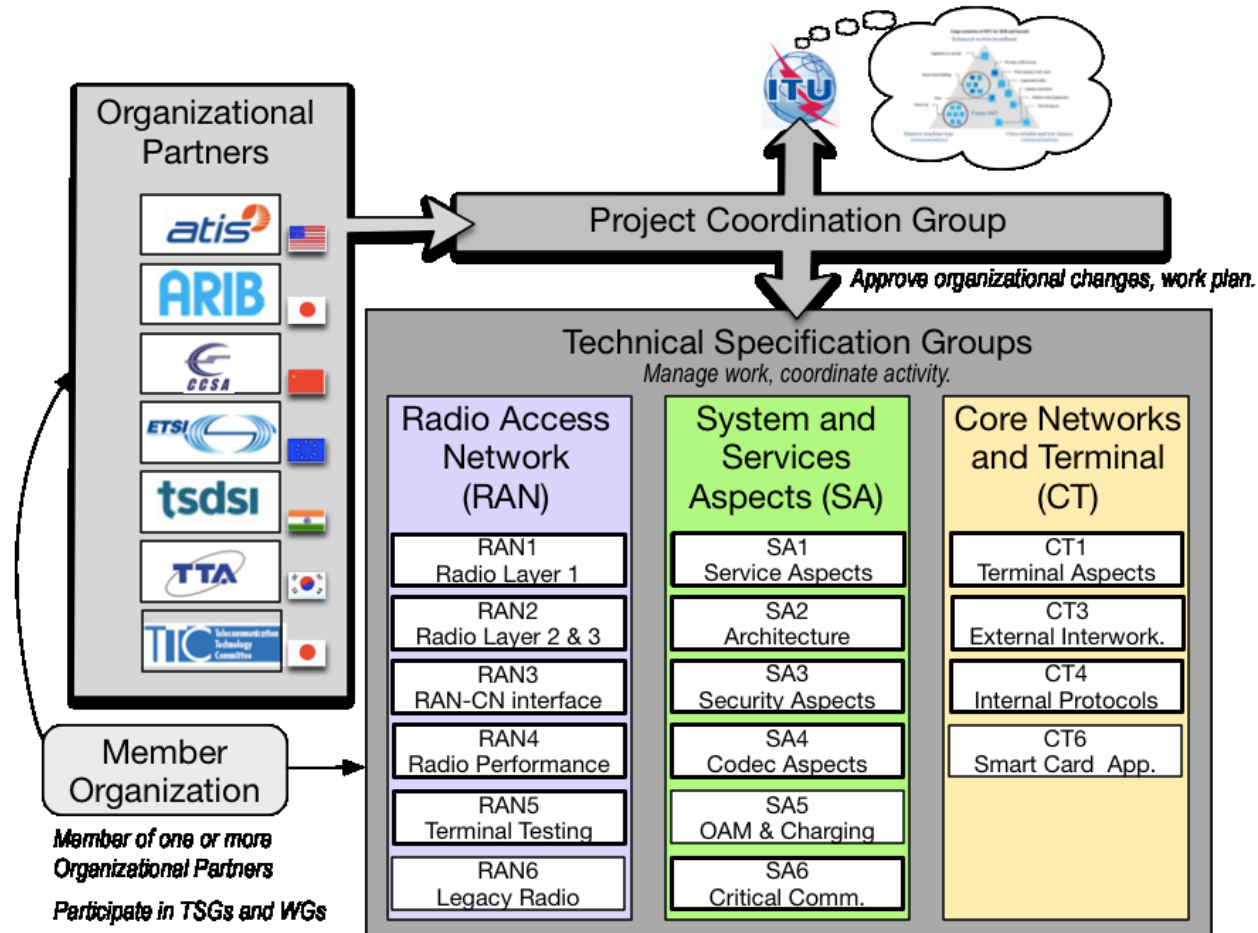# 5G New Radio and System Standardization in 3GPP

Erik Guttman
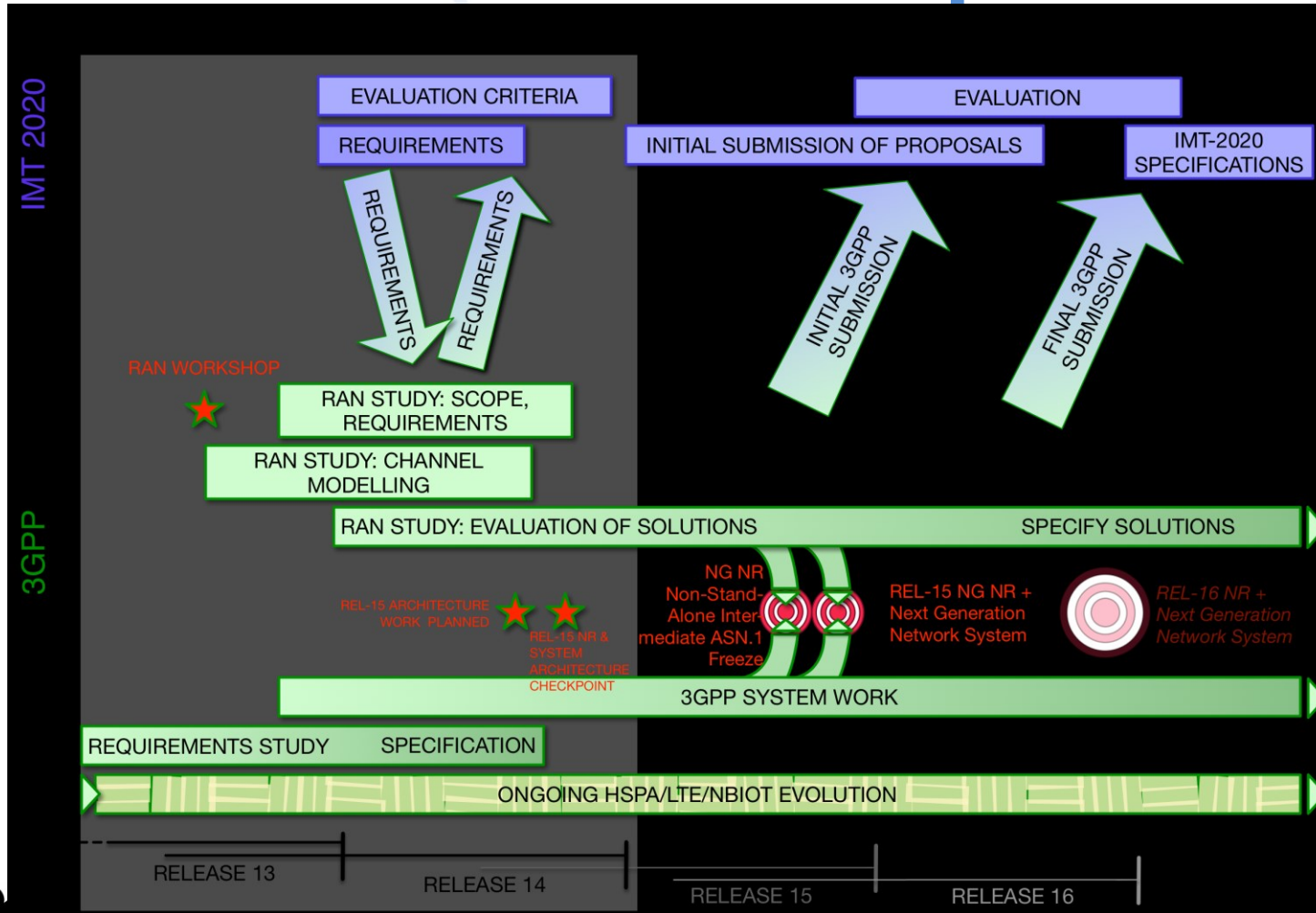
3GPP TSG SA Chairman
Samsung Electronics R&D Institute, UK

5G – the 3GPP Perspective

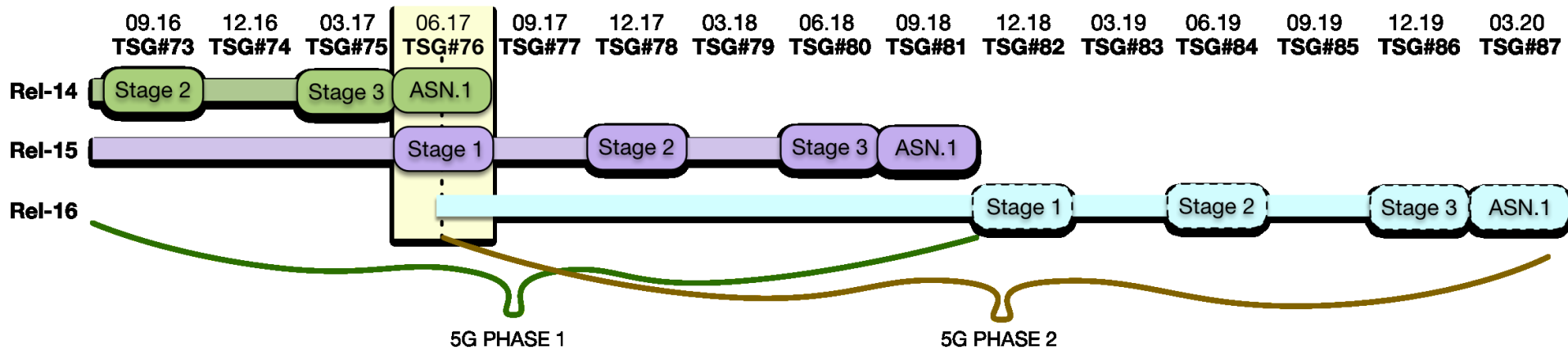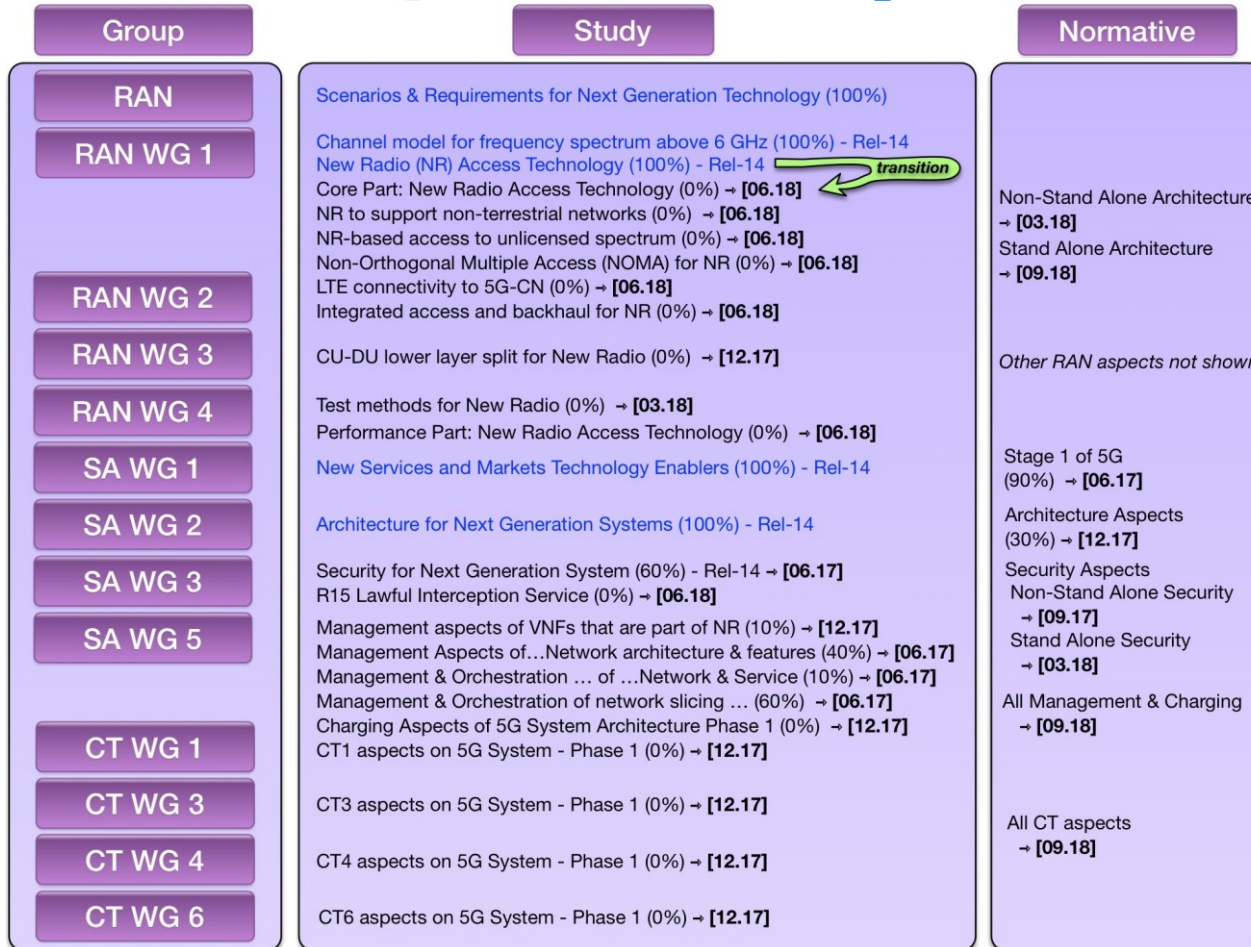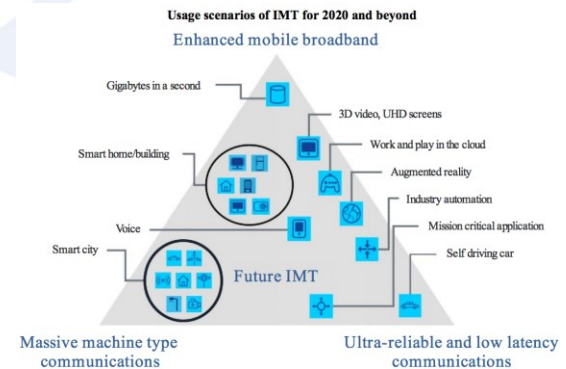# 5G Roadmap

3GPP Status Overview

- Rel-14 freezing (completion of all items) at TSG#76
  - Some aspects continue (e.g. testing, legal intercept) but expected to conclude by 12.17.
- Rel-15
  - Stage 1 freeze at TSG#76.
  - Under way: Stage 2 5G Work on Architecture, Security, Charging, Management in SA, studies on 5G aspects of protocols, end-to-end aspects in CT, studies on RAN aspects.

5G Work and Study Summary

Group	Study	Normative
RAN	Scenarios & Requirements for Next Generation Technology (100%)	
RAN WG 1	Channel model for frequency spectrum above 6 GHz (100%) - Rel-14	
	New Radio (NR) Access Technology (100%) - Rel-14 *transition*	Non-Stand Alone Architecture → **[03.18]**
	Core Part: New Radio Access Technology (0%) → **[06.18]**	
	NR to support non-terrestrial networks (0%) → **[06.18]**	Stand Alone Architecture → **[09.18]**
	NR-based access to unlicensed spectrum (0%) → **[06.18]**	
	Non-Orthogonal Multiple Access (NOMA) for NR (0%) → **[06.18]**	
RAN WG 2	LTE connectivity to 5G-CN (0%) → **[06.18]**	
	Integrated access and backhaul for NR (0%) → **[06.18]**	
RAN WG 3	CU-DU lower layer split for New Radio (0%) → **[12.17]**	*Other RAN aspects not shown.*
RAN WG 4	Test methods for New Radio (0%) → **[03.18]**	
	Performance Part: New Radio Access Technology (0%) → **[06.18]**	
SA WG 1	New Services and Markets Technology Enablers (100%) - Rel-14	Stage 1 of 5G (90%) → **[06.17]**
SA WG 2	Architecture for Next Generation Systems (100%) - Rel-14	Architecture Aspects (30%) → **[12.17]**
SA WG 3	Security for Next Generation System (60%) - Rel-14 → **[06.17]**	Security Aspects
	R15 Lawful Interception Service (0%) → **[06.18]**	Non-Stand Alone Security → **[09.17]**
SA WG 5	Management aspects of VNFs that are part of NR (10%) → **[12.17]**	Stand Alone Security → **[03.18]**
	Management Aspects of…Network architecture & features (40%) → **[06.17]**	
	Management & Orchestration … of …Network & Service (10%) → **[06.17]**	All Management & Charging → **[09.18]**
	Management & Orchestration of network slicing … (60%) → **[06.17]**	
	Charging Aspects of 5G System Architecture Phase 1 (0%) → **[12.17]**	
CT WG 1	CT1 aspects on 5G System - Phase 1 (0%) → **[12.17]**	
CT WG 3	CT3 aspects on 5G System - Phase 1 (0%) → **[12.17]**	All CT aspects → **[09.18]**
CT WG 4	CT4 aspects on 5G System - Phase 1 (0%) → **[12.17]**	
CT WG 6	CT6 aspects on 5G System - Phase 1 (0%) → **[12.17]**	

5G Serves New Verticals

- Since 3GPP was founded (1998), member companies have sought to offer new applications and services via data services of mobile telecommunications.

- 5G expands offerings by specializing radio and network capabilities, exposing them.
  - Enhanced Mobile Broadband
  - Massive Internet of Things
 - Ultra-Reliable & Low Latency

Usage scenarios of IMT for 2020 and beyond

Enhanced mobile broadband

Gigabytes in a second

3D video, UHD screens

Smart home/building

Work and play in the cloud

Augmented reality

Industry automation

Voice

Mission critical application

Smart city

Self driving car

Future IMT

Massive machine type communications

Ultra-reliable and low latency communications

Stage 1 Requirements Frozen

- 5G Requirements approved **March 2016** include
  - **Specialization** via **Network Slicing, Diverse Mobility Management, expanded QoS and Policy control, Exposure of capabilities**
  - **Efficiency** via **a common core for multiple accesses (fixed, mobile/terrestrial [LTE, NG NR and more], satellite), optimized signalling, traffic steering, content delivery features, energy use optimization,**
  - **Radio related improvements** via **Self Backhauling, Flexible Multicast/Broadcast service, Long Range in Rural Areas,** and support for service improvements
  - **Service improvements** via **Higher Data Rates, Supporting Higher Speeds, Low Latency, High Reliability, High Accuracy Positioning, Security Features**
- Specific targeted services
  - Vehicle to Everything, Industrial Automation, Tactile Internet, UHD Video, …

Supported Scenarios

- 5G Deployments
  - Support 5G CN; or
  - Support NG NR; or
  - Support both

- Migration
  - Devices operate in all scenarios to avoid incompatibility / market fragmentation.

- Early freeze of Rel-15 NSA architecture (Mar 2019)
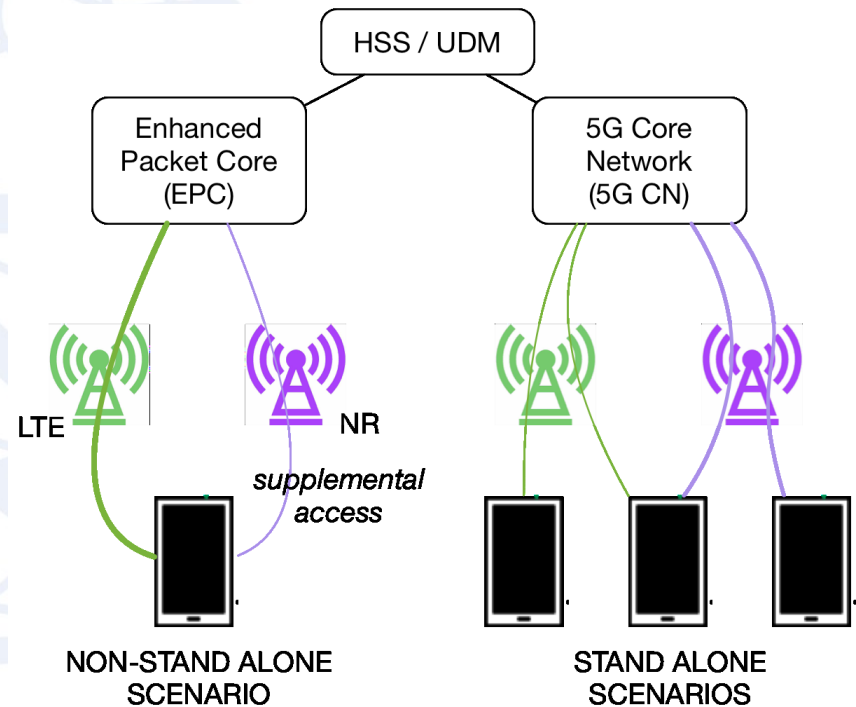
NR Radio Progress

RAN 73
Sep 16

RAN 74
Dec 16

RAN 75
Mar 17

RAN 76
Jun 17

Agreement: Put items *on hold* until RAN 75/Mar 1

Agreement: As RAN 73, however 'working groups must consider forward compatibility'.

Agreement: The scope of ongoing study and targets of NR work in Rel-15 / Phase 1.

Agreement:
(5G) IOT: pursue eMTC and NB-IoT, avoiding overlapping categories.

Waveforms above 40GHz
mMTC
[Flexible duplex of paired spectrum]
Interworking with non-3GPP systems
Wireless relay
Satellite communication
Air-to-ground & light air craft communications
Extreme long distance coverage
Sidelink (direct communications)
V2V and V2X
Multimedia Broadcast/Multicast Service
Shared spectrum and unlicensed spectrum
[Location/positioning functionality]
Public warning/emergency alert

Unlicensed Spectrum *
Non-orthogonal multiple access *
Non-terrestrial networks *
enhanced V2V evaluation method **
Integrated Access Backhaul (Relay) **
5G Self Evaluation
Architecture Evolution for E-UTRAN
CU-DU lower layer split for New Radio
Test Methods for New Radio

* start in Q3
** start in Q4

5G Phases

Phase 1
(Rel-15, 06.18 stage 3 freeze)

- Base features (with forward compatibility)
  - Roaming, Charging, Management, QoS &Policy Control, Service Continuity, Network Sharing…
- Enhanced Mobile Broadband
  - NSA and SA scenarios
  - LTE, NR and Untrusted Non-3GPP Access
  - Positioning, Public Warning System, Access Class Barring
- SMS, IMS, Emergency Services & Priority Services

Phase 2
(Rel-16, 12.19 stage 3 freeze)

- Goals still under study, may include:
  - MBMS
  - MDT, SON
  - CIoT / NBIoT / LPWA LTE / eDRX & MTC features
  - Device to Device
  - V2X
  - Satellite Support
  - Trusted Non-3GPP Access

5G Core Network

Explanation

Credentials, Authorization

Centralized Storage

Policy Control

Terminal & Access

Session Management

User Plane

Network Exposure

AMF AUSF

UDM

VPCF hPCF AF

UE AN

vSMF hSMF

UPF UPF Data Network

Visited | Home

NEF
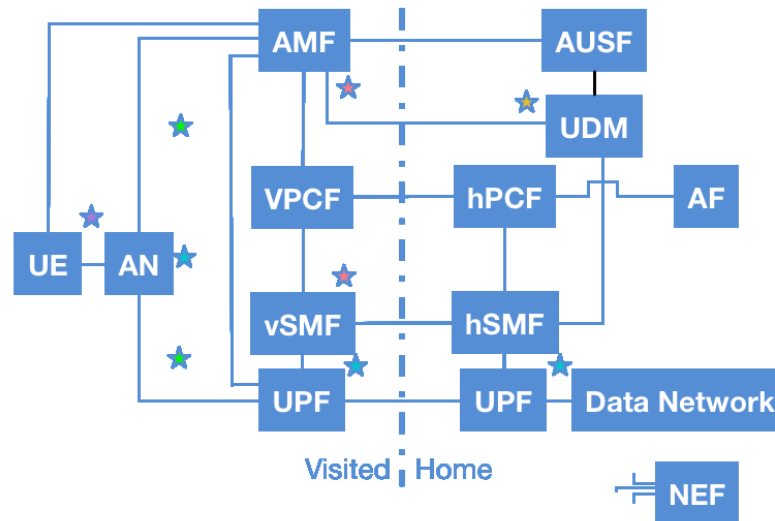
Advances

⭐ Separation of UP/CP

⭐ Increased Centralization of State

⭐ Articulation of Control

⭐ Access independent Architecture

⭐ QoS Flow (not bearers)

Not shown:

Service Based Architecture (CP)
Forward Compatibility
No 2G/3G Service Continuity
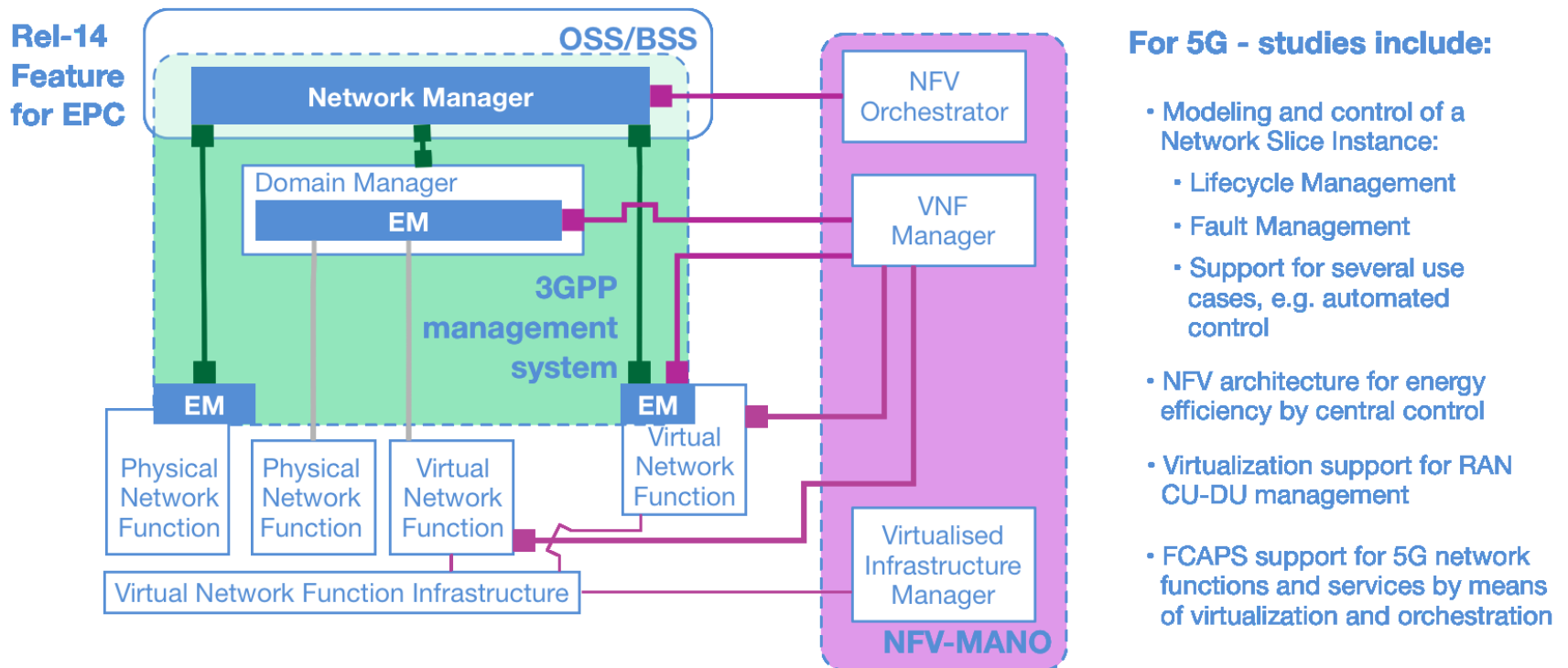Network Slicing

Network Slicing
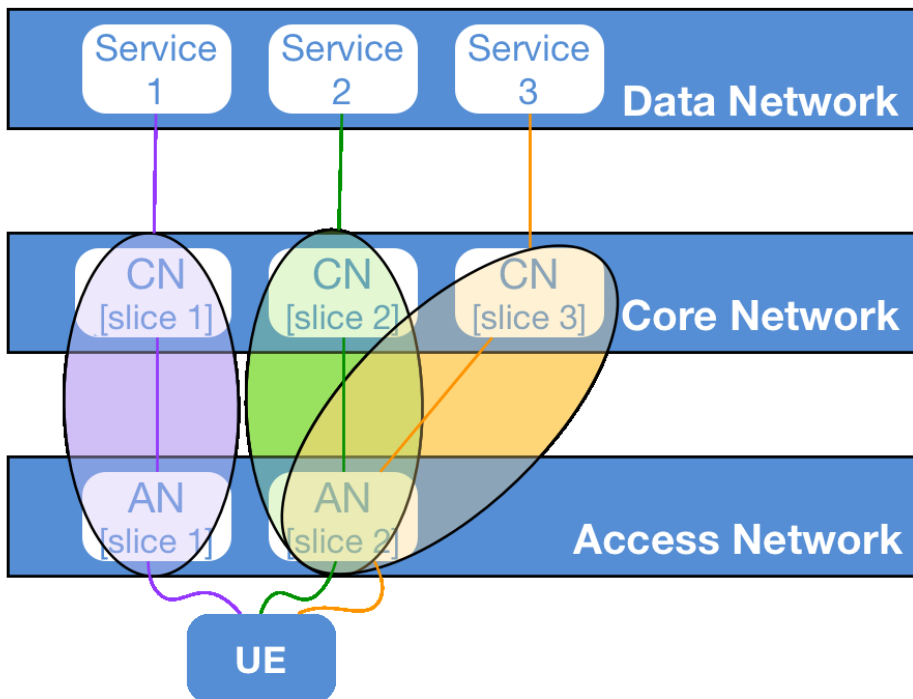
Properties

- Slice instances provide communication services.

- Policy determines which slices serve a UE.

- Slices isolate resource allocation to allow for purpose-suited infrastructure.

- 3 types at least: eMBB, URLLC and MIoT.

Advances

- Redesigns and removes limitations to Dedicated Core Network features in Rel-13 and Rel-14 EPC

Network Function Virtualization

Rel-14 Feature for EPC

OSS/BSS

Network Manager

Domain Manager

EM

3GPP management system

EM

Physical Network Function

Physical Network Function

Virtual Network Function

Virtual Network Function

EM

Virtual Network Function Infrastructure

NFV Orchestrator

VNF Manager

Virtualised Infrastructure Manager

NFV-MANO

For 5G - studies include:

- Modeling and control of a Network Slice Instance:
  - Lifecycle Management
  - Fault Management
  - Support for several use cases, e.g. automated control

- NFV architecture for energy efficiency by central control

- Virtualization support for RAN CU-DU management

- FCAPS support for 5G network functions and services by means of virtualization and orchestration

Fixed Mobile Convergence

02.17	06.17	12.17	06.18	12.18	06.19	12.19

To include: N1, N2, N3, etc. and untrusted Non-3GPP access.

3GPP Rel-15 St. 3 Freeze

Expected to include: Trusted Non-3GPP access, enhancements.

3GPP Rel-16 St. 3 Freeze

Workshop

SA2

FS_5WWC: Study on Wireless and Wireline Convergence for the 5G system architecture
FS_ATSSS: Study on Access Traffic Steering, Switch, Splitting support in the 5G system architecture

BBF

Study of architecture and functional impacts of 5G system architecture, migration aspects, interworking strategies. Definition of an Access Gateway Function (AGF), as an access node.

It was the common understanding that:
• 3GPP and BBF seek to find common interfaces for the AN and CN, to support convergence.
• BBF considers N1, N2, N3 and other aspects of the 5G standard, sending feedback ASAP.
• 3GPP evaluates how to proceed and fill gaps as quickly as possible.

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Other 5G Aspects (for Phase 2)

- 5G Media
  - Ongoing work on streaming enhancements, Studies already for Virtual Reality, '5G Media.'
- ULLRC
  - Studies prepare for reliability and low latency specific features for the CN and RAN.
- 5G CIoT aspects
  - Rel-16 will see CN and RAN IoT features.
- Non-Terrestrial Radio Aspects
  - Satellite access network support (high latency, etc.) CN and RAN.

Thank you for your attention.

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