3GPP Network Slicing

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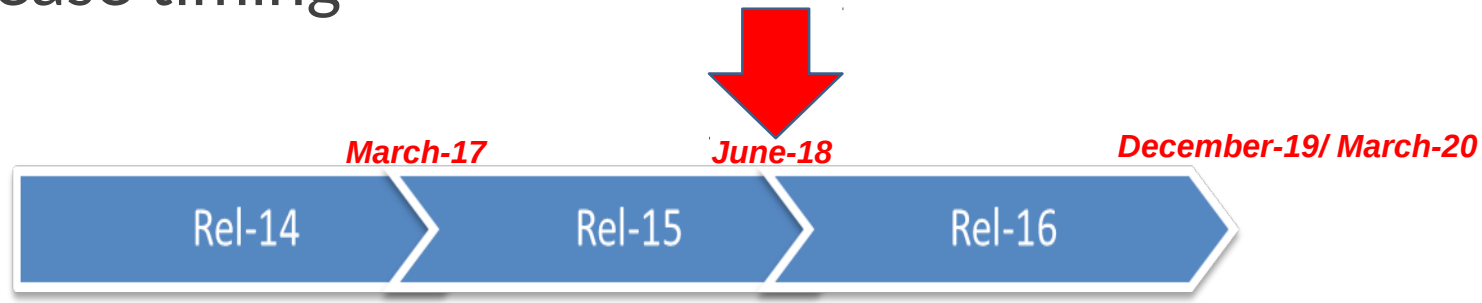
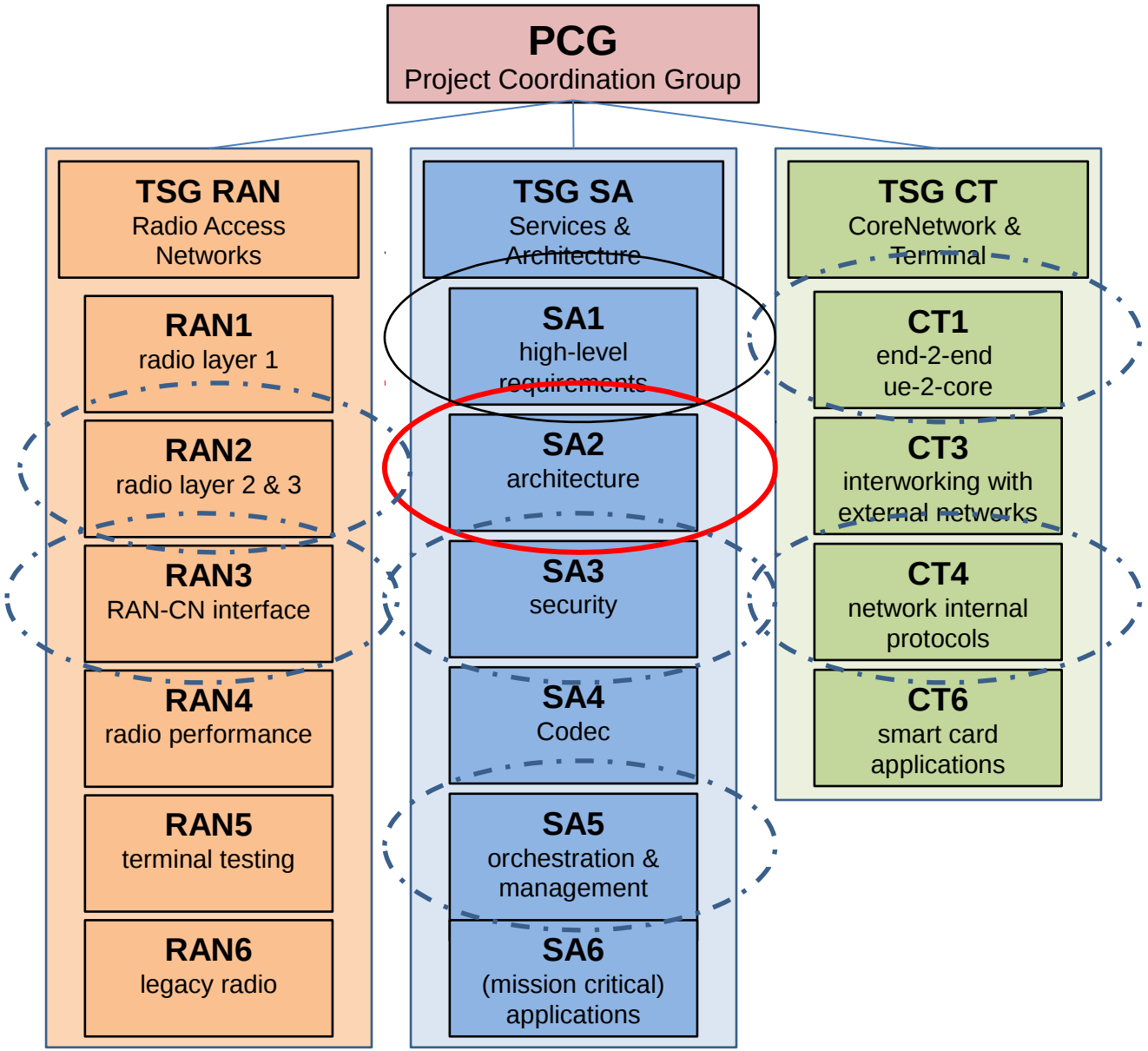
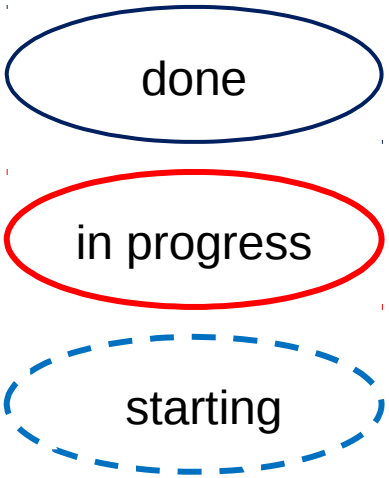
5G Timeline & Phasing

- Release timing



- Two phases for the normative 5G work
  - Phase 1 (Rel-15) to be completed by June 2018
    addresses the more urgent subset for commercial deployments
  - Phase 2 (Rel-16) to be completed by March 2020
    IMT 2020 submission, addresses all identified use cases & requirements


PCG
Project Coordination Group
TSG RAN
Radio Access Networks
RAN1
radio layer 1
RAN2
radio layer 2 & 3
RAN3
RAN-CN interface
RAN4
radio performance
RAN5
terminal testing
RAN6
legacy radio
TSG SA
Services & Architecture
SA1
high-level requirements
SA2
architecture
SA3
security
SA4
Codec
SA5
orchestration & management
SA6
(mission critical) applications
TSG CT
CoreNetwork & Terminal
CT1
end-2-end ue-2-core
CT3
interworking with external networks
CT4
network internal protocols
CT6
smart card applications


done
in progress
starting

3GPP Requirements For IETF netslicing

- *Does 3GPP currently have dedicated requirements for any kind of IETF protocol or activity related to nw-slicing?*
  - At the moment: No
- *Why?*
  - Normative work so far only on high-level requirements and architecture
  - Protocol, security, orchestration related studies ongoing, but no definite results yet – don't speculate!
- *What's foreseeable?*
  - UE-to-Core / Core-internal (CT1/CT4) – can be done by existing mechanisms (NAS/SBA), i.e. most likely no requirements to IETF
  - RAN – most likely nothing
  - Orchestration – too early to say
  - Collaboration with BBF (Broadband Forum)

5G Network Slicing in SA2

- Network Slice
  - A logical end-to-end network
  - Dynamically created
- Different slices for different services types
  - Committed services – slice types
  - Dedicated customers
- May comprise
  - 5G CoreNetwork (CP & UP)
  - 5G Radio Access Network
  - Interworking Functions to non-3GPP Access Networks
- UE connects
  - Max 8 slices in parallel
  - Common AMF for one UE in all slices

3GPP SA5 on Network Slicing

Network slicing is about

- transforming the system from a static “one size fits all” paradigm,
- to a new paradigm where logical networks/partitions are created, with
  - appropriate isolation,
  - resources and
  - optimized topology
- to serve a particular purpose or service category
- or individual customers

- Specs (just some):
  - TR 28.801 Study on Network Slicing http://www.3gpp.org/DynaReport/28801.htm
  - TS 28.531 Provisioning of network slicing for 5G networks and services (starting) http://www.3gpp.org/DynaReport/28531.htm

3GPP SA5 on Network Slicing

- SA5 has studied management aspects of network slicing in TR 28.801

- SA5 identified related use cases, potential requirements and potential solutions for
  - lifecycle management,
  - fault management,
  - configuration management,
  - performance management,
  - policy management.

- SA5 has identified and describes the following management functions,
  - the Communication Service Management Function,
  - the Network Slice Management Function, and
  - the Network Subnet Slice Management Function.

5G Phase 1 (Rel-15) – SA5 upcoming work

SA5 upcoming work

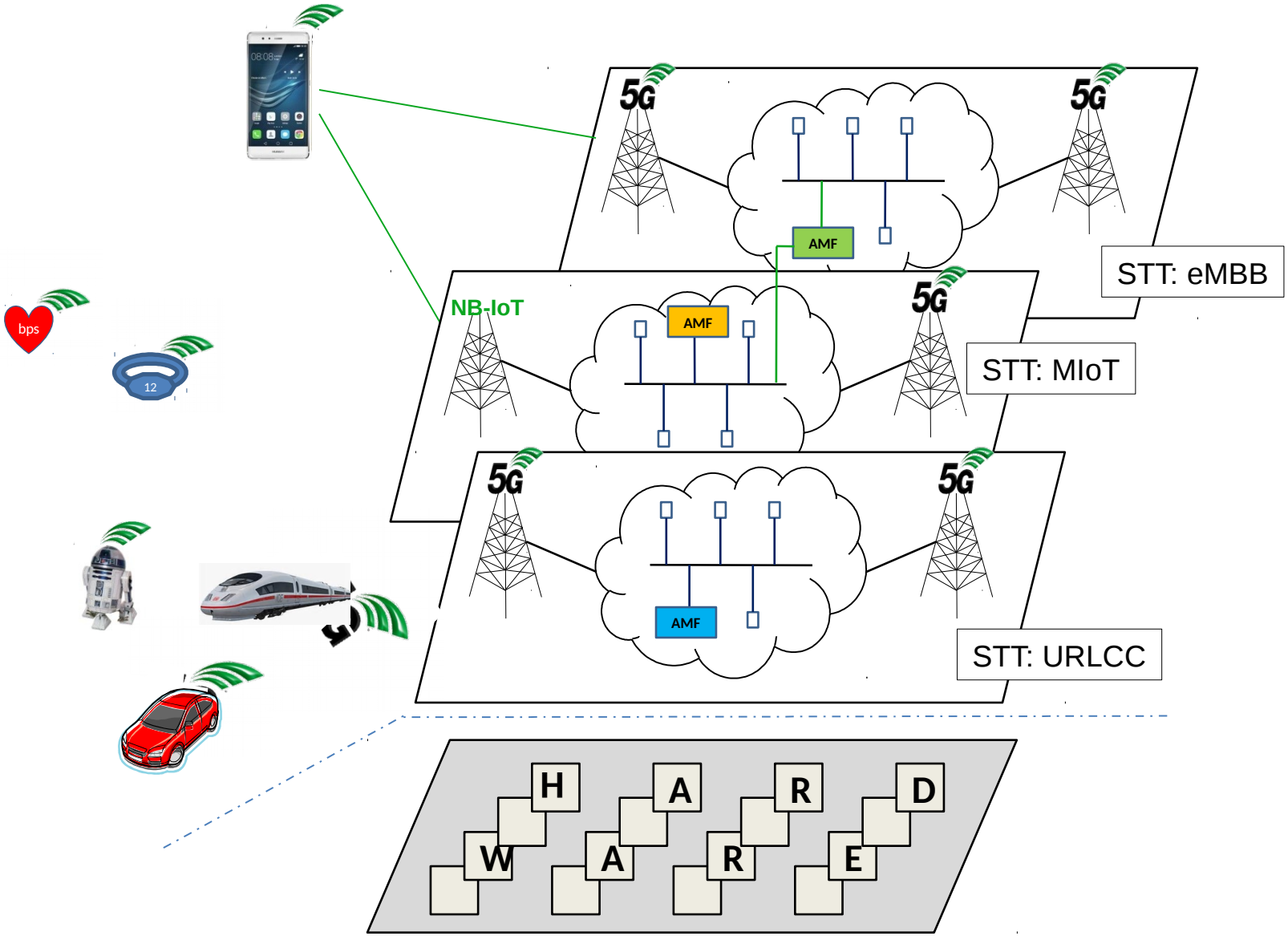
- enable the provisioning of network slices for 5G networks and services:
- information model to support different Slice/Service type;
- information model and interfaces to handle service requirements (e.g. SLAs) associated to the network slice;
- network slice template and define the relation of network slice template and network slice instance;
- procedures for provisioning of network slices instance;
- protocol-independent information model of network slice and slice subnet;
- corresponding solution set.
- requirements for transport and virtualization
- trigger the cooperation with relevant standard groups and industry fora when needed.

Network Slicing – Slice Identification

TS 23.501, section 5.15.2

- S-NSSAI – single network slice selection assistance information
  - SST – slice type, describes expected network behavior
  - SD – slice differentiator, optional, further differentiation
- S-NSSAI can have standard or network-specific values
  - Standard SST values: *eMBB*, *URLCC*, *MIoT* (see next slides)
- NSSAI is a collection of max 8 S-NSSAI
- UE sends NSSAI – based on which related slice(s) are selected

3GPP Network Slicing - Simplified



Standard Slice Type (STT) Values

TS 23.501, section 5.15.2.2-1

Slice/Service type	SST value	Characteristics.
eMBB (enhanced Mobile Broadband)	1	Slice suitable for the handling of 5G enhanced Mobile broadband, useful, but not limited to the **general consumer space** mobile broadband applications including - streaming of High Quality Video, -Fast large file transfers etc. It is expected this SST to aim at supporting High data rates and high traffic densities
URLLC (ultra- reliable low latency communications)	2	Supporting ultra-reliable low latency communications for applications including, - industrial automation, - (remote) control systems.
MIoT (massive IoT)	3	Allowing the support of a large number and high density of IoT devices efficiently and cost effectively.

e.g. MIoT Performance Requirements TS 22.261, table 7.1-1

	Scenario	Experienced data rate (DL)	Experienced data rate (UL)	Area traffic capacity (DL)	Area traffic capacity (UL)	Overall user density	Activity factor	UE speed	Coverage
1	**Urban macro**	50 Mbps	25 Mbps	100 Gbps/km² (note 4)	50 Gbps/km² (note 4)	10 000/km²	20%	Pedestrians and users in vehicles (up to 120 km/h	Full network (note 1)
2	**Rural macro**	50 Mbps	25 Mbps	1 Gbps/km² (note 4)	500 Mbps/km² (note 4)	100/km²	20%	Pedestrians and users in vehicles (up to 120 km/h	Full network (note 1)
3	**Indoor hotspot**	1 Gbps	500 Mbps	15 Tbps/km²	2 Tbps/km²	250 000/km²	note 2	Pedestrians	Office and residential (note 2) (note 3)
4	**Broadband access in a crowd**	25 Mbps	50 Mbps	[3,75] Tbps/km²	[7,5] Tbps/km²	[500 000]/km²	30%	Pedestrians	Confined area
5	**Dense urban**	300 Mbps	50 Mbps	750 Gbps/km² (note 4)	125 Gbps/km² (note 4)	25 000/km²	10%	Pedestrians and users in vehicles (up to 60 km/h)	Downtown (note 1)
6	**Broadcast-like services**	Maximum 200 Mbps (per TV channel)	N/A or modest (e.g., 500 kbps per user)	N/A	N/A	[15] TV channels of [20 Mbps] on one carrier	N/A	Stationary users, pedestrians and users in vehicles (up to 500 km/h)	Full network (note 1)
7	**High-speed train**	50 Mbps	25 Mbps	15 Gbps/train	7,5 Gbps/train	1 000/train	30%	Users in trains (up to 500 km/h)	Along railways (note 1)
8	**High-speed vehicle**	50 Mbps	25 Mbps	[100] Gbps/km²	[50] Gbps/km²	4 000/km²	50%	Users in vehicles (up to 250 km/h)	Along roads (note 1)
9	**Airplanes connectivity**	15 Mbps	7,5 Mbps	1,2 Gbps/plane	600 Mbps/plane	400/plane	20%	Users in airplanes (up to 1 000 km/h)	(note 1)

NOTE 1: For users in vehicles, the UE can be connected to the network directly, or via an on-board moving base station.
NOTE 2: A certain traffic mix is assumed; only some users use services that require the highest data rates [2].
NOTE 3: For interactive audio and video services, for example, virtual meetings, the required two-way end-to-end latency (UL and DL) is 2-4 ms while the corresponding experienced data rate needs to be up to 8K 3D video [300 Mbps] in uplink and downlink.
NOTE 4: These values are derived based on overall user density. Detailed information can be found in [10].
NOTE 5: All the values in this table are targeted values and not strict requirements.

Thank You!

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