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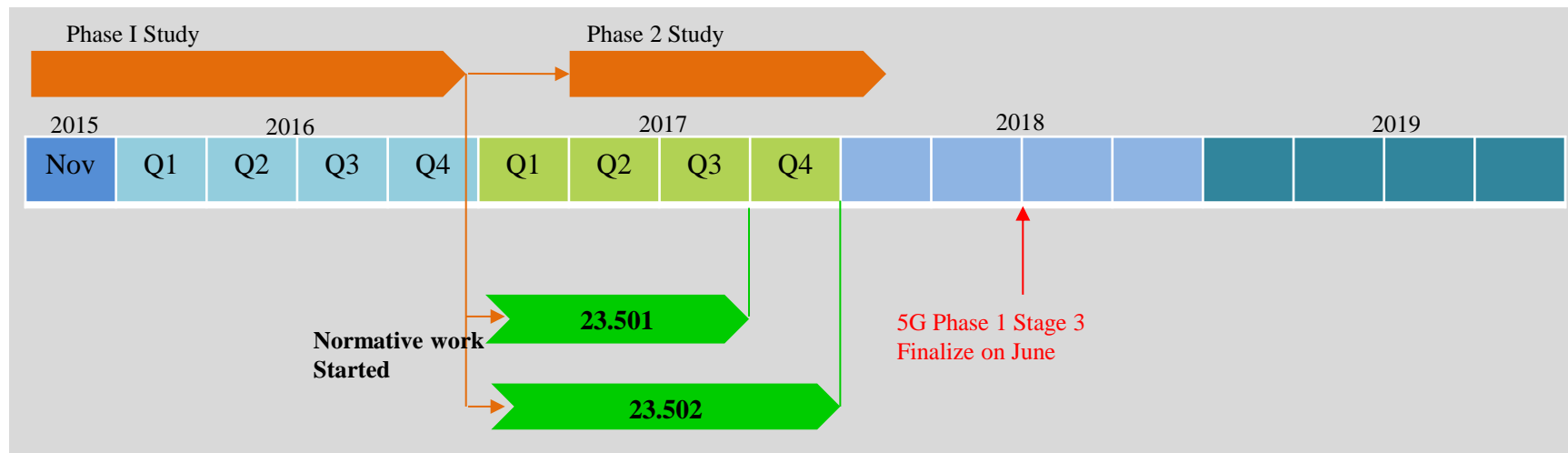# 5G Network Architecture:
Standard Progress, and Tranfromation to SBA and Network Slicing

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☐ **5G Network Architecture Standard Progress**

☐ **5G Network funtional archiitecture transformation: SBA**

☐ **5G Network funtional archiitecture transformation: Network slicing**

☐ **Activities on SBA and network slicing**

☐ **Summary**

- 3GPP SA1 already finished 5G requirement(SMARTER) specification TS 22.261 in March, 2017
- 3GPP SA2 Started "**Study on Architecture for Next Generation System"** (NextGen) from Nov. 2015.
- After one year study, NextGen is completed in Nov. 2016, with output 3GPP TR 23.799 v14.0.0
- Phase 2 study is expected to be started in Q2 2017

Phase I Study

Phase 2 Study

2015	2016				2017				2018				2019			
Nov	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4								

Normative work Started

23.501
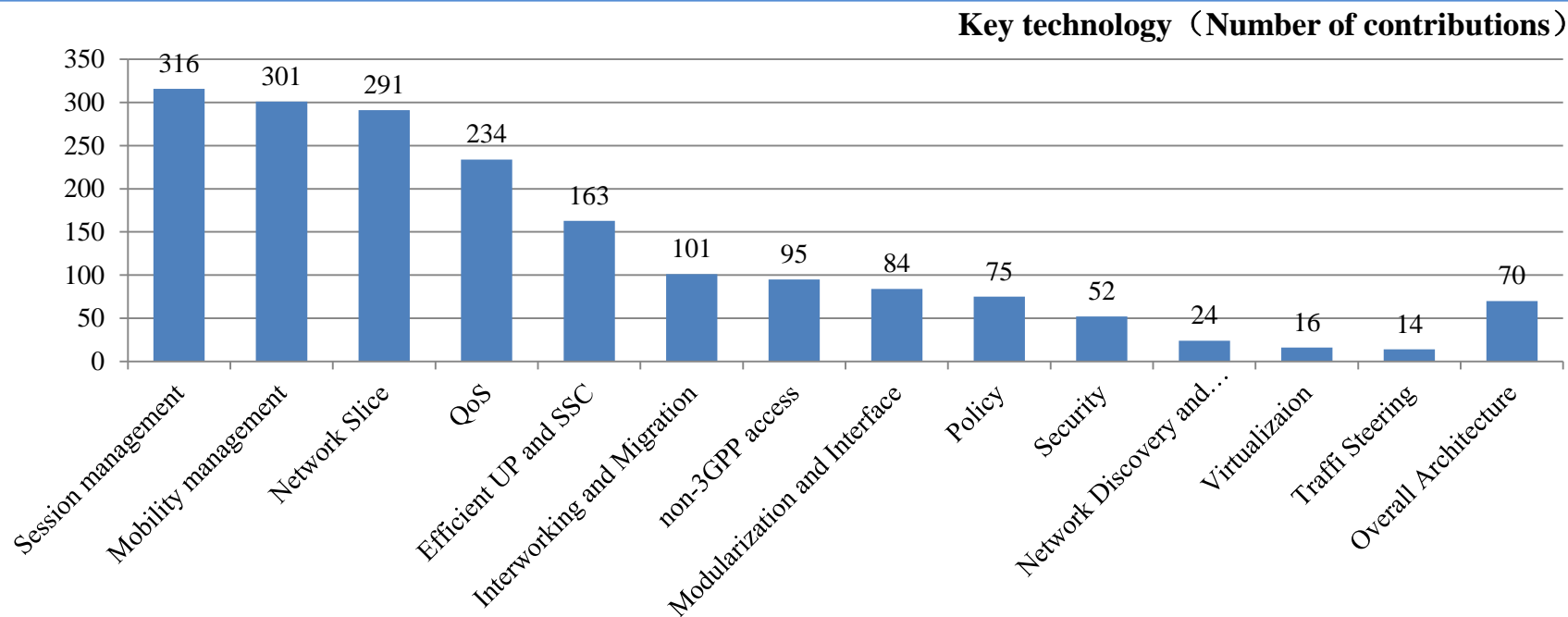
23.502

5G Phase 1 Stage 3
Finalize on June

- Based on the study, the "5G System-Phase 1" is started. Two Specifications will be generated
  - TS 23.501: System Architecture for the 5G System
  - TS 23.502: Procedures for the 5G System

Some key Principles and Concepts

- **Separate User Plane (UP) functions from the Control Plane (CP) function**, allowing independent scalability, evolution and a flexible deployment e.g. centralised location or distributed (remote) location.

- **Modularize the function design**, e.g. to enable flexible and efficient network slicing.

- Wherever applicable, procedures (i.e. the set of interactions between network functions) are **defined as services**.

- **Minimizes dependencies between Access Network (AN) and Core Network (CN),** the architecture is defined with a converged access-agnostic core network with a common AN - CN interface which integrates different 3GPP and non-3GPP access types.

- Support a **unified authentication framework**.

- Support "**stateless**" NFs, where the "compute" resource is decoupled from the "storage" resource.

- Support capability exposure.

- **Concurrent access to local and centralized services is supported**. To support low latency services and access to local data networks, UP functions can be deployed close to the radio network.

Hot Topics in 5G Phase 1 Study

NextGen Study Item identified 22 key issues, 14 of them are foundermental for 5G

Key technology（Number of contributions）

| Key technology	Number of contributions
Session management	316
Mobility management	301
Network Slice	291
QoS	234
Efficient UP and SSC	163
Interworking and Migration	101
non-3GPP access	95
Modularization and Interface	84
Policy	75
Security	52
Network Discovery and…	24
Virtualizaion	16
Traffi Steering	14
Overall Architecture	70

- Eight key issues: network slicing, QoS, mobility management, session management, migration and interworking, non-3GPP access, modularization and interface (service based interface)

- New architecture is mostly interested

5

A single 5G architecture but the interaction between network functions is represented in two ways
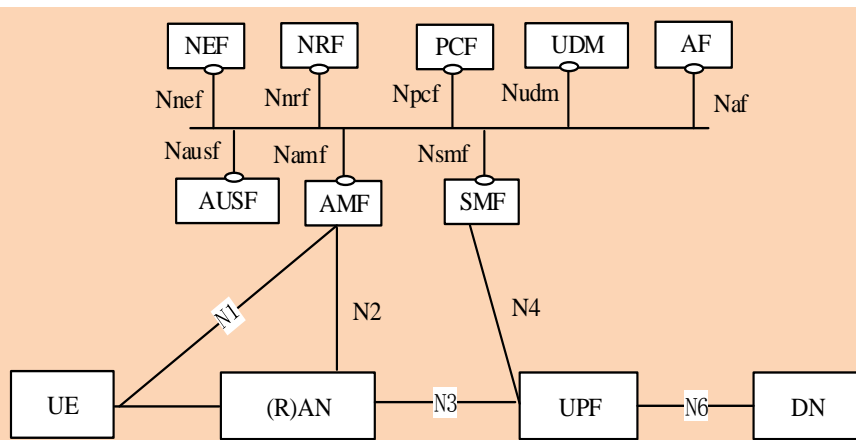
Representation 1: 5G System architecture Service-based interface
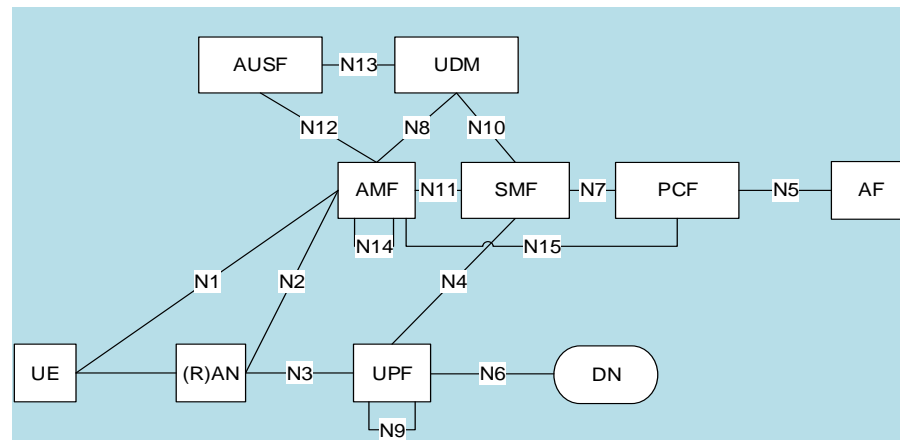
Representation 2: 5G System Architecture in reference point representation

It is intended that 5G Control Plane Network Functions (NF) exhibit their functionality via service-based interfaces, so that the NF services can be flexibly used by other authorized NFs.

Transition from "network function" to "network function service"

Key Features of 5G Architecture

1. Network slicing: a logical network that provides specific network capabilities and network characteristics
2. QoS: remove bearer concept, use flow based QoS mechanism
3. Mobility management: new MM state RRC_inactive to reduce the assess time and power consumption; On-demand Mobility
4. Session management: SM separated with UP, SM separated with MM,
5. Flexible user plane: support edge computing, On-demand session continuity
6. Policy control: introduce Network Data Analytics (NWDA)
7. Fix Mobile convergence: natively support unified authentication and non-3GPP access

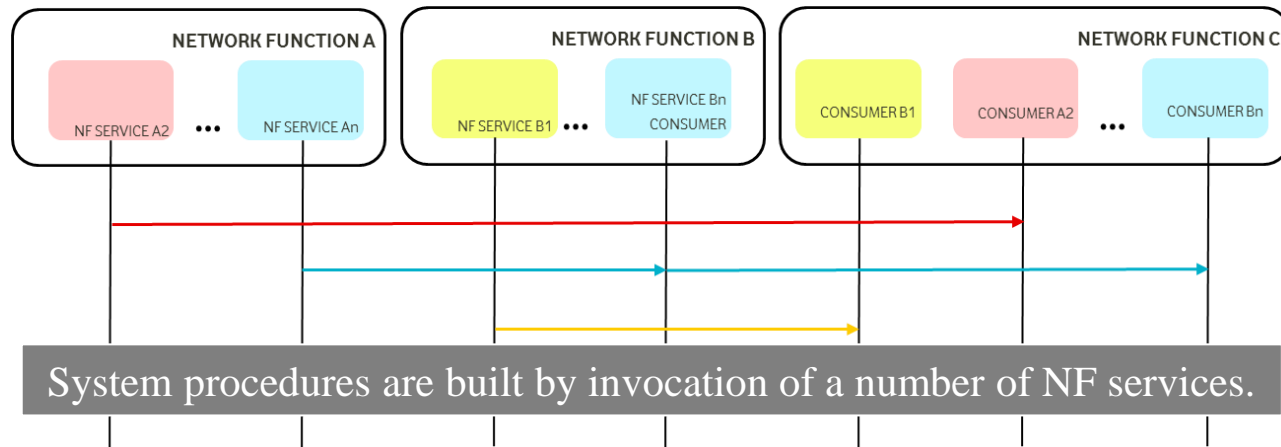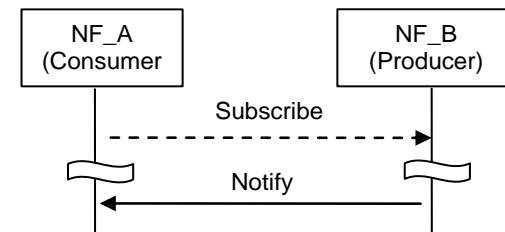Service-based Architecture

Network Slicing

What is Service-based Architecture of 5G?

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Service-based Architecture is defined with "Network function service" + "Service-based interface"
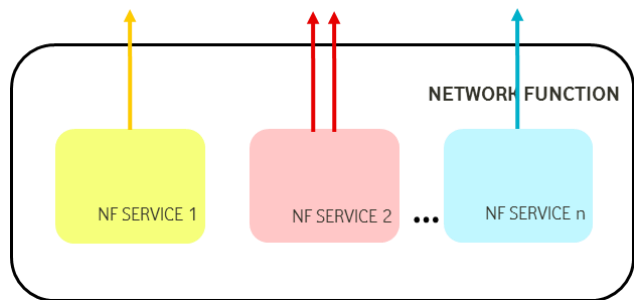
An NF service is one type of capability exposed by an NF (NF Service Producer) to other NF (NF Service Consumer).
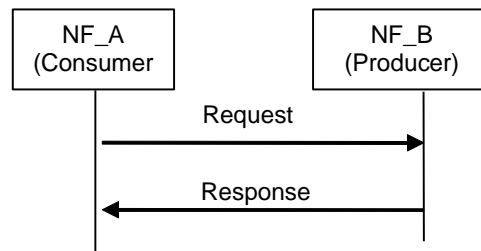
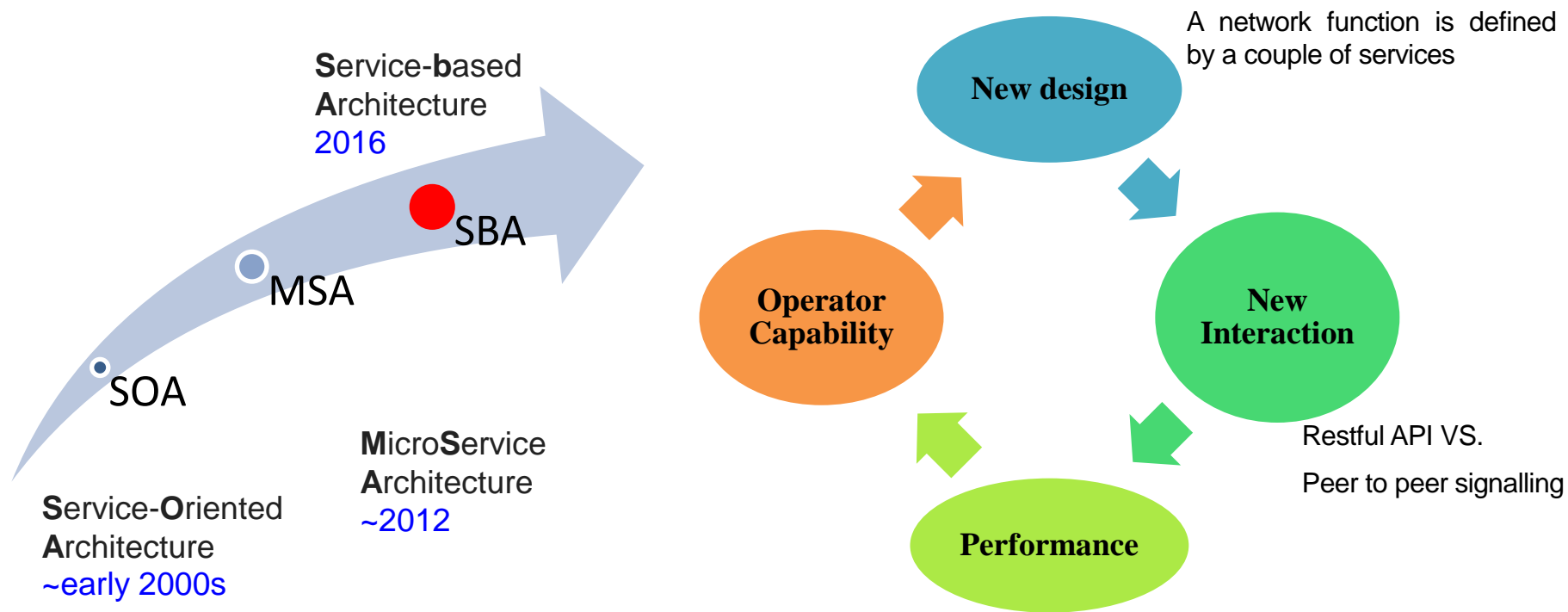Two type of primitive operations: "Request-response" and "Subscribe-Notify"

NF service is expected to be self-contained, reusable and use management schemes independently of other NF services offered by the same Network Function (e.g. for scaling, healing, etc).

System procedures are built by invocation of a number of NF services.

Benefits of 5G Service-based Architecture

- ### Updating Production Network

  - Services operate with finer granularity than in legacy networks and are loosely-coupled with each other allowing individual services to be upgraded/extended with minimal impact to other services.

  - Operational benefits such as shrinking testing and integration timescales (moving towards continuous integration) which reduces the time to market for installing bug fixes, and rolling out new network features and operator applications

- ### Extensibility

  - Comparing to the legacy hop-by-hop model, service based interfaces can be easily extended without introducing new reference points

  - Each service can interact directly with other services with light-weighted service based interface (SBI)

- ### Modularity & Reusability

  - The network is composed of modularized services, which reflects the network capabilities, and can be leveraged by 5G features such as network slicing;

  - A service can be easily invoked by other services (with certain authorization), enabling each service to be reused as much as possible;

- ### Openness

  - Together with some control functions (i.e. authentication, authentication), service based interface can be easily exposed to external users such as 3rd-party application provider

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Service-based architecture is a big thing for 5G……

Transforming functional architecture

Service-**b**ased **A**rchitecture 2016

● SBA

○ MSA

SOA

Micro**S**ervice **A**rchitecture ~2012

Service-**O**riented **A**rchitecture ~early 2000s

New design

A network function is defined by a couple of services

Operator Capability

New Interaction

Restful API VS.

Peer to peer signalling

Performance

Network slicing: customized network provision

- Network slicing enables flexibly building logical and E2E 5G mobile network with differentiated network capabilities, including RAN, CN , transport, and even including UE , Gi service deployed and third party application
  - **Guaranteed performance to vertical industry**
  - **Network slice as a service, opened to vertical customers**

Slice 1: eMBB

BBU	UPF(Complicated)	AMF
		AMF Service 1 / AMF service 2 / AMF service 3 ...

Slice 2: mIoT

| BBU	UPF(simplified)	AMF
		AMF service 1 / AMF service 3 ...
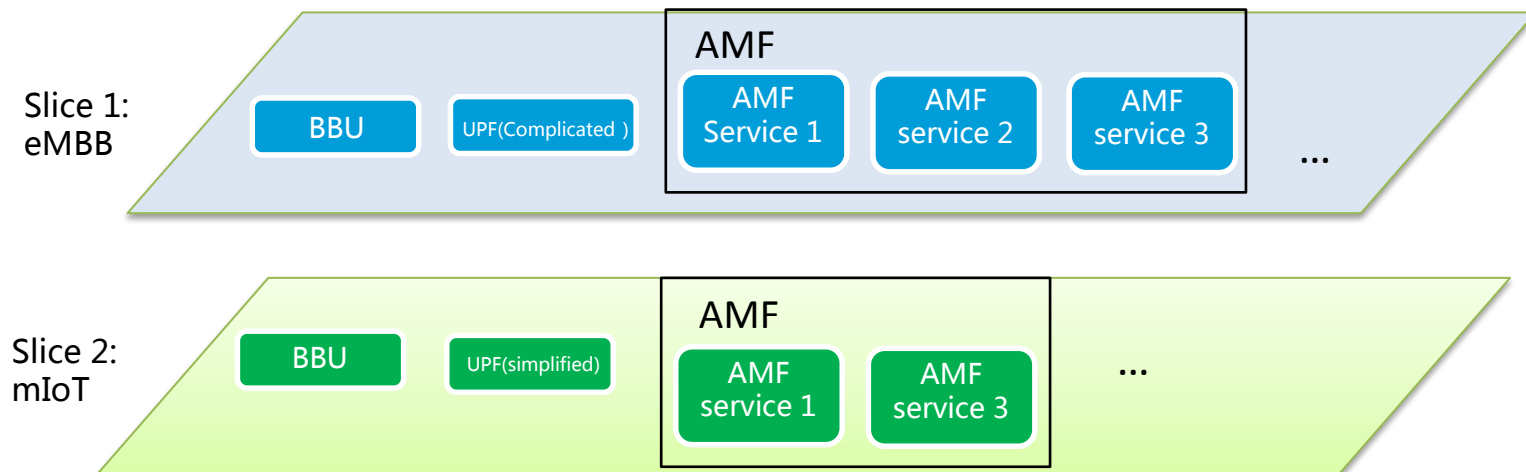
Service Based Architecture enables NF service level network customization and operation for network slicing, compared with NF level

Note: take AMF as a example

Common infrastructure(radio, computing, storage, and networking)

- Network Slice M&O enables openness, **automatic lifecycle management and intelligent operation of network slice**
- Need collaboration of multi-domains (Access network ,Core network, Transport network, IP network, Data Center etc.)

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3GPP — A GLOBAL INITIATIVE

ngmn — the engine of broadband wireless innovation
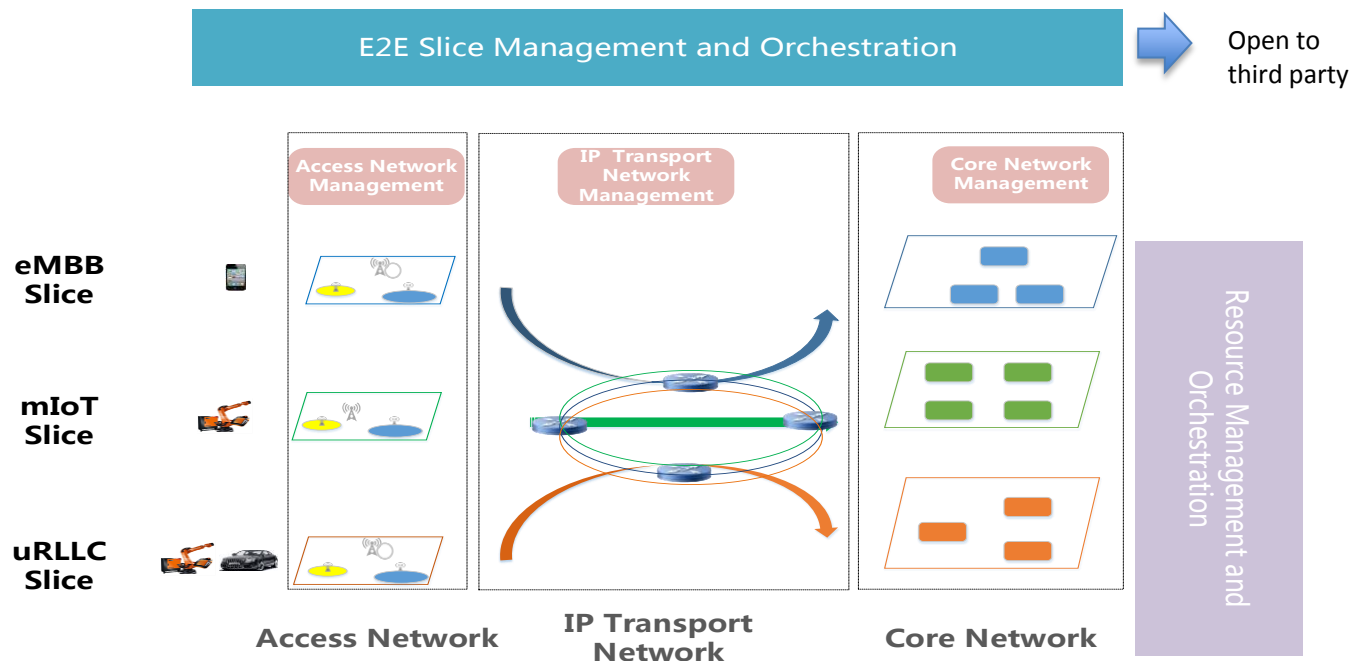
- SBA is recommended in the White Paper
- Companies are joint work on phase 2 testing

- More and more operators interested with SBA and is working together
- China Mobile, AT&T, Deutsche Telekom, Sprint, Telecom Italia, Vodafone, China Unicom, Orange, BT, SK Telecom, KDDI…

China Mobile initiated the "SBA in 5G" project in March 2017

- Supported by many operators
- Investigate the how to best leverage SBA in network deployment and operation
- Look at future work, e.g., may beyond 5G

- Supported by key partners
  - Good corporation with Huawei, supported by ZTE
  - Start to get support from more key partners such as Nokia, Ericsson…

- Develop the prototype of SDN-based EPC with separation of control and user plane based on OAI in joint project with BUPT sponsored by china mobile (2015-2016)
  - **Very limited open source projects of mobile core network**
  - **Tight coupled network functions and functionalities**
  - **Very limited researchers**
- SBA-based 5G core prototype and verification project has launched this year

SDN-based EPC Prototype

Practice: Architecture transformation towards 5G Network Slicing
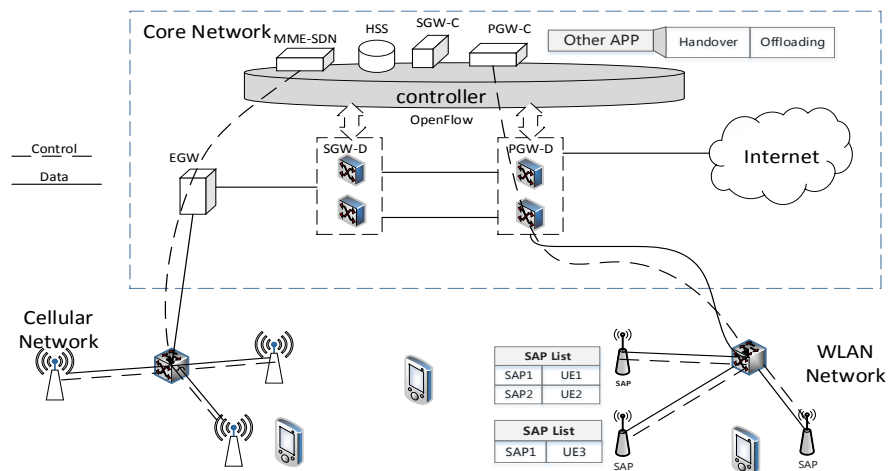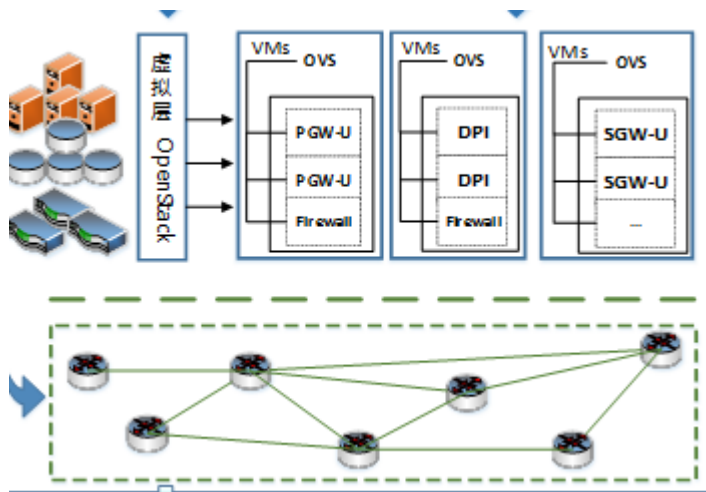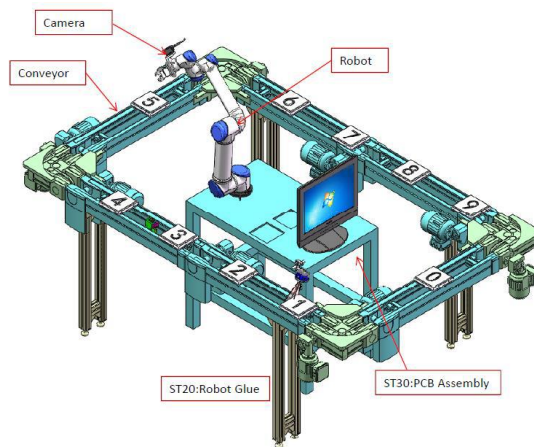
- In Feb. 2017, China Mobile has released 5G Service-Guaranteed network slicing white paper with Huawei, Deutsche Telekom and Volkswagen
- China mobile work with Huawei, Ericsson and ZTE to demonstrate the Vision of network slicing in 2016 and 2017 MWC

5G Smart factory
- multiple network slice
- low latency and high reliability slice support remote control

Far less than infrastructure part

5G UE

5G RAN

5G CORE

Slice M&O

Resource Management

Network infrastructure(Transport, DC, computing, storage, and networking)
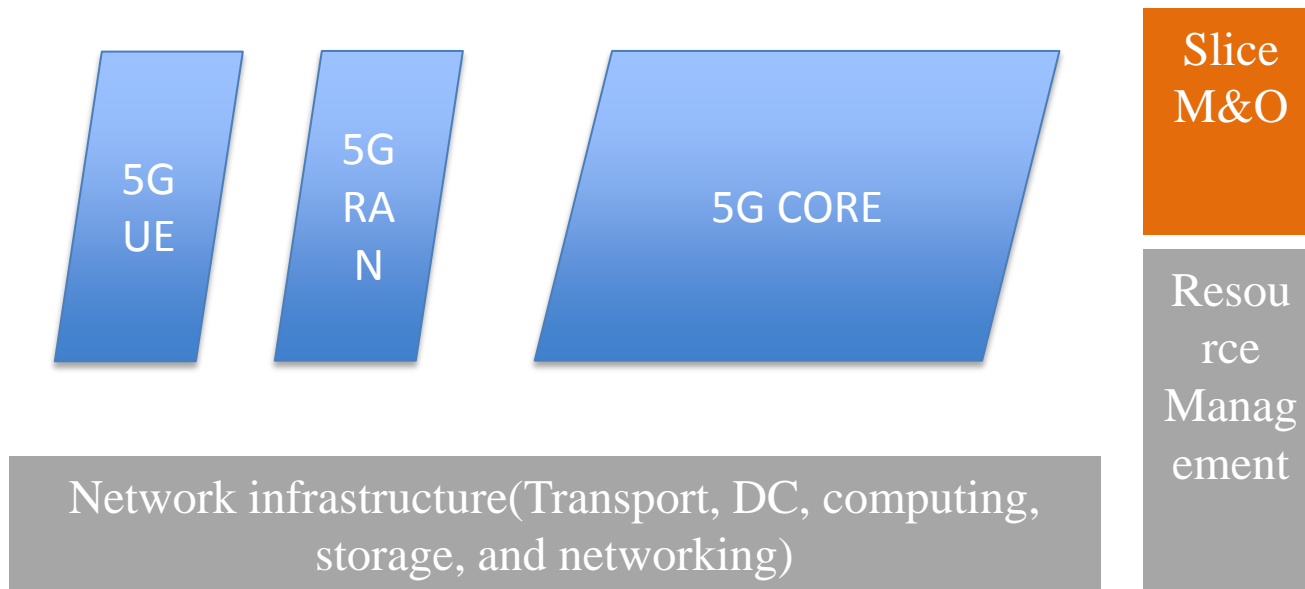
Many infrastructure: ONAP, ODL, OSM, TIP……

2016   **2017**   **2018**   **2019**   **2020**

3GPP
A GLOBAL INITIATIVE

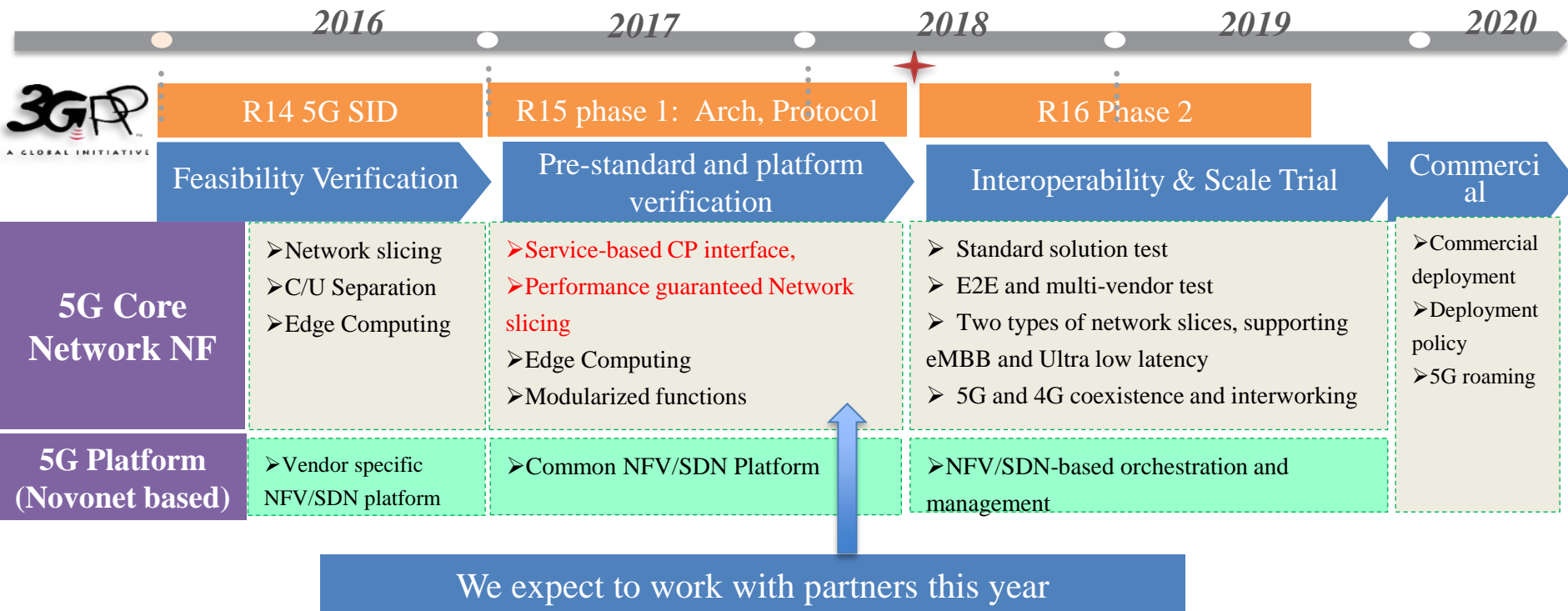|	R14 5G SID	R15 phase 1: Arch, Protocol	R16 Phase 2	
	Feasibility Verification	Pre-standard and platform verification	Interoperability & Scale Trial	Commercial

5G Core Network NF	➢Network slicing ➢C/U Separation ➢Edge Computing	➢Service-based CP interface, ➢Performance guaranteed Network slicing ➢Edge Computing ➢Modularized functions	➢ Standard solution test ➢ E2E and multi-vendor test ➢ Two types of network slices, supporting eMBB and Ultra low latency ➢ 5G and 4G coexistence and interworking	➢Commercial deployment ➢Deployment policy ➢5G roaming
5G Platform (Novonet based)	➢Vendor specific NFV/SDN platform	➢Common NFV/SDN Platform	➢NFV/SDN-based orchestration and management	

We expect to work with partners this year

- 5G network standardization and development is in full speed

- China Mobile is promoting 5G network architecture transformation

  - SBA

  - Network slicing

- Open source community will play the more and more role in 5G era, like IT open community.

We expect more partners to join in the research, design, verification and open source community towards 5G!!

Thanks!