SAMSUNG

Technical Report

5G Core Vision

Samsung 5G Core Vol.1

Contents

Introduction

Until now, mobile communication technologies evolved with the primary goal of focusing on accelerating radio data throughput, while mobile communication networks provided the pipes to deliver user data securely and quickly. The 5G networks are changing this paradigm, as 5G provides radio connections and end-to-end network connectivity that enables not only ultra-high speed but also lower latency, higher reliability and massive connectivity. This network transformation delivers a platform integrating various services beyond a transport pipe by connecting devices, applications, and data to improve the lives of people and increase the efficiency of business. As of February 2019, Korea reached an LTE subscriber penetration rate of over 80% with total traffic volume moving 373.PB, or 7.6 GB per user per month. The growth of data on LTE indicates that the timing for 5G deployments is right. With 5G having a cell capacity ten times greater than LTE, and the acceleration of the Internet of Things, the 5G architecture is set to efficiently manage the total volume of data traffic that continues to increase exponentially.

With the need for 5G networks to process an ever-increasing volume of data more cost-effectively, and at the same time provide various services on a single infrastructure with high reliability at a faster speed, 5G needs new technologies. As such, IT technologies such as Network Function Virtualization (NFV) and cloud have been introduced into 5G Core, which completely overhauled the planning, deployment, operation and management of network services. Cloud native architecture, which is based on micro-services and containers, is considered the best suited technology as it enables faster service launch and network operation automation. Korea commenced the 5G era with the launch of the world's first mobile 5G network in December 2018, and commercialization of the world's first smartphone-based mobile 5G service in April 2019. Samsung introduced 5G ready core to KT, providing 5G Non-Standalone (NSA) Core with Control and User Plane Separation (CUPS)-based vEPC, and is concentrating on the development of cloud-native 5G Core for 5G Standalone (SA) commercialization. The 5G SA architecture provides the foundation for new technical capabilities, including services like network slicing and Multi-access Edge Computing (MEC). With network slicing being able to provide dedicated networks with specific service quality characteristics and Multi-access Edge Computing (MEC) being enable to create ultra-low latency experiences by processing application traffic at the edge of a network, the new 5G network capabilities are creating opportunities for new revenue streams for network operators.

This white paper reviews the vision and strategy of the Samsung 5G Core, describes how Samsung is incorporating the cloud native architecture in the Samsung 5G Core, and highlights how the Samsung Network Automation Platform automatically creates, deploys, operates and manages network services. This paper also discusses Samsung's network slicing and MEC solutions.

Samsung 5G Core Vision

The 5G core network, with its implementation of network services being software-based as opposed to using purpose-built hardware, needs to be optimized for NFV and cloud. The cloud-native design of the Samsung 5G Core takes full advantage of the cloud, acting as the key enabler for the rapid realization of 5G innovation. Figure 1-1 illustrates the vision of Samsung 5G Core. Defined as 'FAST', the vision of Samsung 5G Core aims to create a Flexible, Agile, Scalable and Tunable network.

Flexible

Samsung 5G Core flexibly adds new services and configures the network on a shared infrastructure. It also allows an elastic scalability of network functions in the control plane (CP), user plane (UP), and micro-service levels enabling a variety of 5G service profiles.

Agile

Samsung 5G Core shortens the service implementation time from hours to minutes and delivers faster time-to-market (TTM) by reducing the deployment interval for new services from months to days.

Scalable

Samsung 5G Core scales rapidly and highly with telco-grade reliability. This scalability further improves the performance of the distributed user plane and provides telco-grade cloud-native control plane performance.

Tunable

Samsung 5G Core not only provides both customized and optimized networks for various 5G services but also quickly adapts and optimizes the network according to operating conditions. It also supports cost-efficient migration from 4G to 5G based on an access agnostic common core.

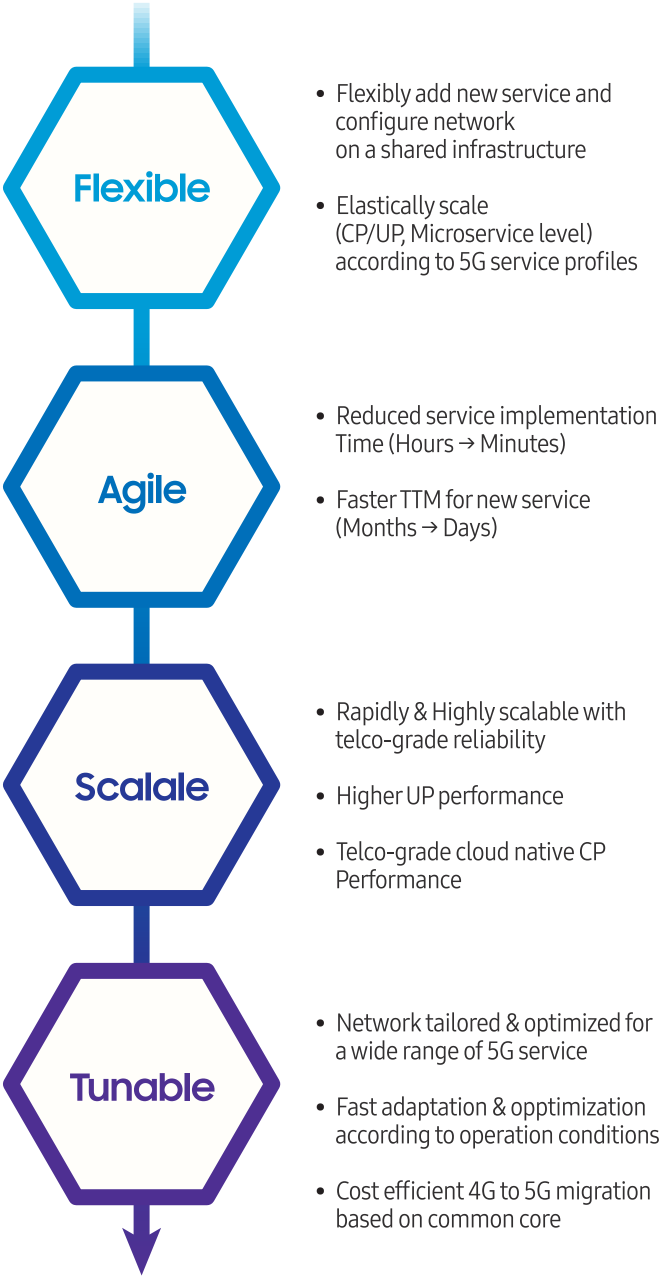


Figure 1. Samsung 5G Core Vision : FAST

A 3GPP-Defined 5G Core

5G Core Network Design Principles

The emergence of cloud forced the architecture of 5G Core to undergo revolutionary changes. The underlying drivers behind 5G Core innovation are Service-Based Architecture (SBA), Stateless, Network Slicing and Common Core.

Service-based Architecture (SBA)

The control plane of 5G Core adopts the SBA, which is fundamental in 5G's move towards the cloudification. A network function (NF) is comprised of small service units called NF services (micro-services). This approach allows the addition of a new service without any impact to existing ones, making scalability simple and seamless.

The interaction between two NFs depends on how a service operates. Unlike the traditional architecture where different point-to-point (P2P) interfaces connect network entities, NFs in the SBA can request and provide a service using a Service-Based Interface (SBI), which is a uniform interface based on HTTP/2 protocol. Services can be reused among NFs, and new features can be introduced easily using the uniform interface. The Network Repository Function (NRF) maintains the list of active NFs, based on their service registration and service discovery. The interactions between the control plane and user plane continue using traditional P2P interfaces.

Stateless

Existing network elements maintain information about the user equipment (UE) context – its operating state – for the duration of the user session, which is called stateful . The 5G Core breaks this combination of context and network element. The 5G NFs operate stateless, which is a cloud concept where "process" and "storage" are information in a separate database (DB) defined as a standard NF. Any NF can store unstructured data in an unstructured data storage function (UDSF) and can store structured data from unified data management (UDM), policy control function (PCF) and network exposure function (NEF) in unified data repository (UDR.) These 5G stateless systems simplify the tasks performed by an NF and boosts its scalability.

Network Slicing

Network slicing is a technology that separates physical network infrastructure into multiple logical networks with different service characteristics, where each logical network is known as a slice. Each slice groups the necessary NFs for a particular service to offer a dedicated network. This grouping allows fast buildup of a network for a new service without impacting the existing services, which reduces time-to-market and improves operational efficiency. Network Slice Selection Function (NSSF) provides the network slicing capabilities in 5G Core.

Common Core

In the 5G Core, 3GPP-defined accesses, such as LTE and 5G NR, and non-3GPP accesses, including Wi-Fi and fixed broadband, can be integrated via a common interface. A unified authentication process supports multi-RAT (radio access technology) access.

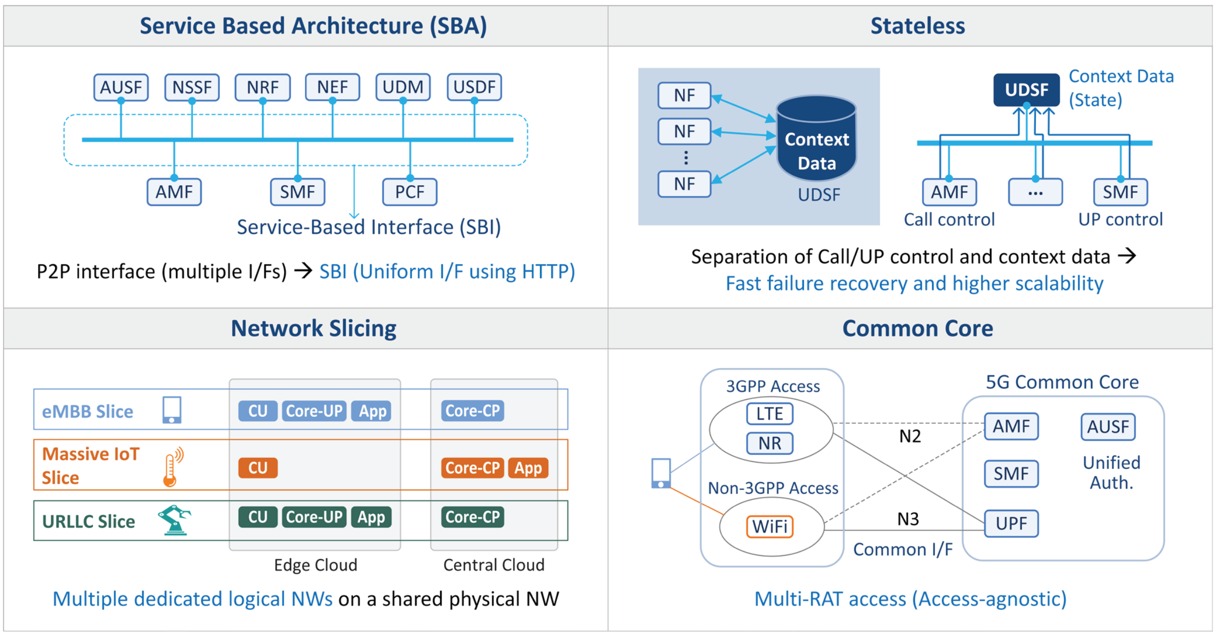


Figure 2-1. 5G Core Network Design Principle

3GPP Compliant 5G Deployment Options

The evolution from LTE to 5G can vary depending on the mobile operator's network status and strategy, with the different deployment options depicted below in Figure 2-2. Most network operators are deploying 5G today using the 5G NSA architecture, where the LTE eNB processes the UE signaling, with a plan to move to the 5G SA architecture, where the 5G NR base station performs the UE signaling. Effectively, existing LTE networks will evolve into 5G SA networks. 5G NSA has Option 3 that leverages the existing EPC, and Option 7, offers an option that introduces the 5G Core. Option 3 allows for quick commercialization of 5G NR. With the EPC and LTE being used to anchor services and signaling in Option 3, the 5G NR characteristics are limited, resulting in a single use case that increases cell throughput, but is not capable of supporting use cases that need low latency or massive device connectivity. This NSA architecture greatly improves user throughput for near term and is the driver for today's 5G deployments. Option 7 introduces the 5G Core and supports legacy 4G with eLTE. The 5G NR characteristics remain limited in Option 7, but the 5G SA architecture can support network slicing and deploy hot spots above 6 GHz (A6G) using 5G NR. Option 4 will be possible as the coverage of below 6 GHz (B6G) NR expands nationwide, allowing the full feature set of 5G NR capabilities and services such as low latency connectivity. Samsung 5G Networks support NSA Option 3 family and Option 4/7 family co-existence in order to support optimal 5G deployment for mobile operators.

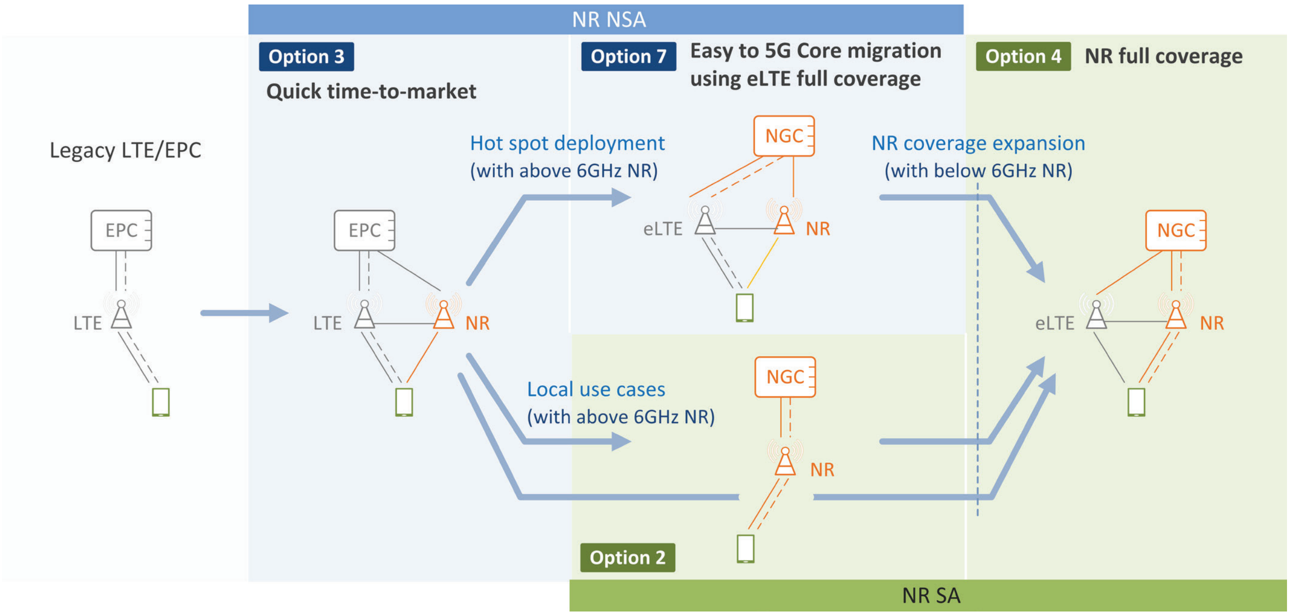


Figure 2-2. 4G to 5G Deployment Options

Samsung 5G Core Overview

Samsung 5G Core Strategy

The key strategy for achieving the vision of Samsung 5G Core incorporates leveraging cloud native principles on a Common Core platform that supports Network Slicing and utilizes Automation, as illustrated in Figure 3-1.

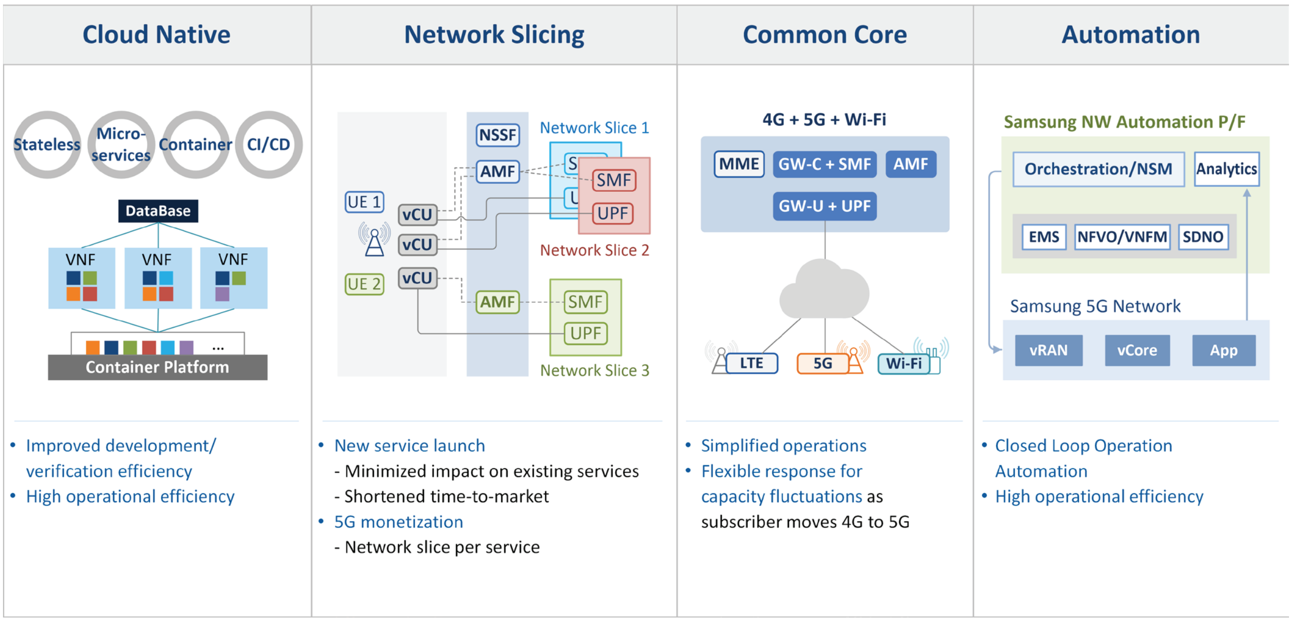


Figure 3-1. Samsung 5G Core Strategy

Cloud Native

Samsung 5G Core is developed and verified in a cloud-native environment. The cloud-native environment, based on micro-services, containers and stateless architectures, will boost the efficiency of development and verification of 5G Core NFs and will automate service upgrades and deployments for better operational efficiency.

Network Slicing

Network slicing feature can allocate and dedicate network resources for specific services, which will minimize the impact on the existing services while enabling the launch of a new service. The use of network slicing allows the creation of dedicated resources to support service creation for specific vertical industries, thus opening new revenue streams and customer opportunities for operators.

Common Core

Samsung 5G Core enables the integration of various types of access networks, ranging from 5G NR and LTE to Wi-Fi and fixed broadband, on a shared core network that provides access to user services.

Automation

Samsung 5G Core incorporates a Network Automation Platform, which boosts operational efficiency by instinctively responding to any network capacity changes. The Platform is also able to create 5G network services and network slices that deliver and maintain end-to-end service level agreements.

4G to 5G Migration Plan

An LTE network operator has various migration options from which to choose to support 5G network operations. The deployment option choices depend on the current network configuration of the operator, 5G network construction plan, and the 5G subscriber penetration rate, among other characteristics. Figure 3-2 summarizes the Samsung 5G Core's smooth migration plan from 4G to 5G.

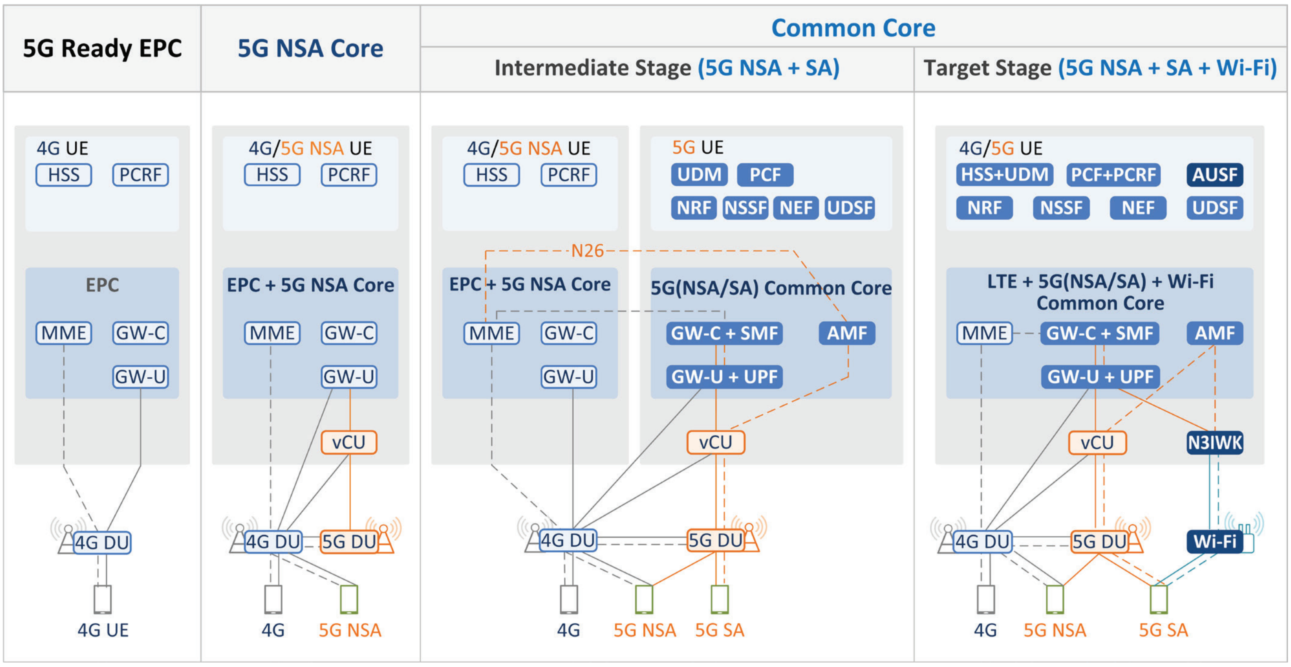


Figure 3-2. 4G to 5G Migration Plan

5G Ready EPC

Samsung LTE Core is already virtualized and provides a CUPS architecture that separates CP and UP, a basic feature of 5G, for quick and easy support of the introduction of 5G network.

Introduction of 5G NSA Core

The initial stage of 5G network will be 5G NSA, which introduces 5G base stations to the existing LTE network. To support a 5G NSA Core with LTE-NR dual connectivity for 5G base stations and to support new charging policies, the existing EPC simply uses software upgrades to the appropriate elements.

In NSA mode, LTE base stations operate as the signaling anchors, and 5G base stations provide the user data paths. Therefore, although 5G use cases are limited, the introduction of 5G base stations can achieve significant user throughput enhancement. The existing support of the CUPS architecture in Samsung EPC allows for an easy migration to 5G SA Core.

Introduction of 5G SA Core

Samsung's 5G SA will adopt 5G SA Core, which consists of new 5G Core NFs that operate on the cloud-based SBA. The existing EPC network elements GW-C, GW-U, HSS and PCRP receive software upgrades to become 5G Core NFs Session Management Function (SMF), User Plane Function (UPF), Unified Data Management (UDM) function, and Policy Control Function (PCF), respectively. In addition, the 5G SA Core introduces the following new elements: Access and Mobility management function (AMF), Network Repository Function (NRF), Network Slice Selection Function (NSSF), and Network Exposure Function (NEF) and Unstructured Data Storage Function (UDSF) . With the introduction of 5G SA Core, the 5G base stations become the signaling anchors, which allows the network to fully support 5G's use cases that enable low latency high bandwidth connectivity.
Factors like 5G subscriber growth, service proliferation and operator policies can affect the integration with and interworking between the 5G Core and existing EPC. Samsung 5G Core provides a comprehensive migration plan that includes:

i. separate operation of 5G Core from the existing EPC
ii. interworking via N26 interface, and
iii. Common core that integrates 4G, 5G (NSA and SA), Wi-Fi, and fixed broadband access technologies.

Samsung 5G Common Core Portfolio

Samsung 5G common core portfolio constitutes four solutions, as shown in Figure 3-3 below. Each solution supports tightly coupled feature set and telco-grade reliability.

5G Business Enablement Solution

supports NFs for charging, policing and network slicing

5G Service Support Solution

supports NFs for network information and exposure

Mobility & Connection Control Solution

supports NFs for authentication, database and signaling processing

Session & Data Processing Solution

supports NFs for session control and data traffic processing with embedded deep packet inspection (DPI) functions

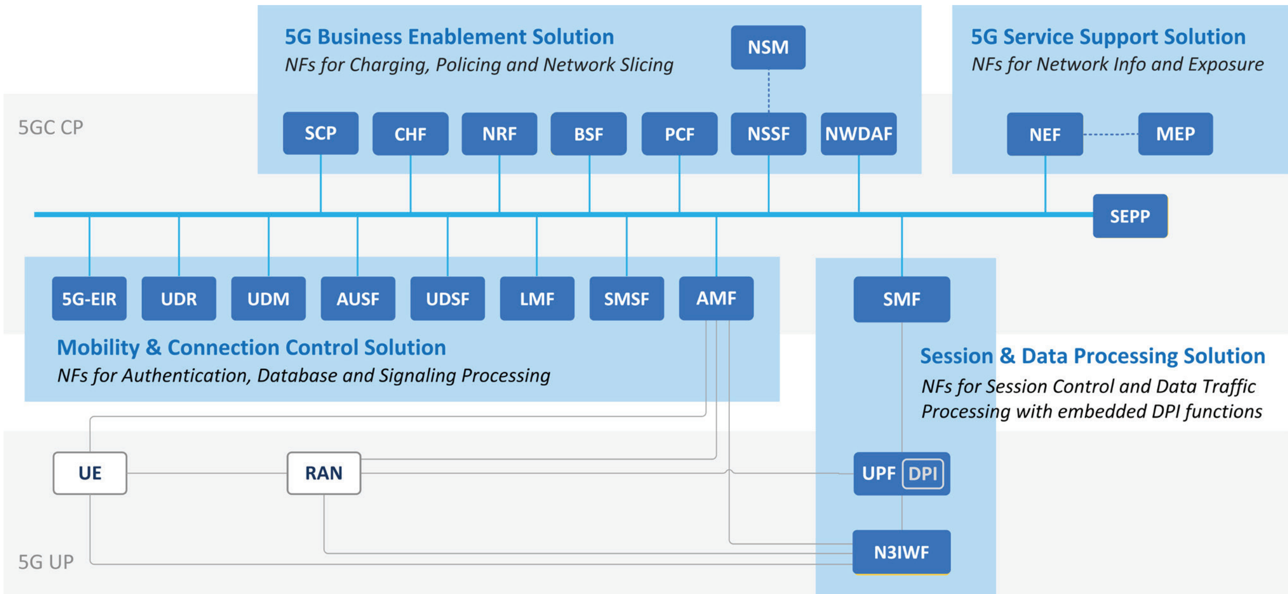


Figure 3-3. Samsung 5G Common Core Portfolio

Samsung Cloud Native 5G Core

Samsung 5G Network Automation Architecture

Telco's infrastructure currently consists of embedded HW, that supports individual network elements (NE). With the adoption of NFV and cloud, the architecture is shifting to virtualized cloud infrastructure that creates network services automatically on low-cost general-purpose server hardware. Furthermore, the infrastructure is evolving into a cloud native architecture as virtualization technology moves away from heavyweight virtual machine (VM) to lightweight containers. In a cloud native architecture, automatic creation and deployment of network services will warrant more efficient network operation and management.

Figure 4-1 illustrates Samsung 5G Network Automation architecture that is based on the Samsung Network Automation Platform and Samsung 5G Network. Samsung Network Automation Platform consists of four key components: Centralized Orchestration for end-to-end (E2E) orchestration, a Network Slice Manager (NSM) for creating and managing 5G network slices, a Centralized Operation for managing network elements (EMS), and Centralized Analytics for data collection and analysis and reporting.

Samsung 5G Network supports hybrid virtualization using both VM and containers and can provide network slices that deliver specific service characteristics. Samsung 5G Network Automation architecture integrates RAN, Core and MEC on Samsung Network Automation Platform for automated 5G network service management. The architecture also simplifies and automates the operation of Samsung 5G Network by minimizing operator intervention through its closed-loop control that constantly repeats data collection from the 5G network, followed by analysis, optimization, control, and monitoring.

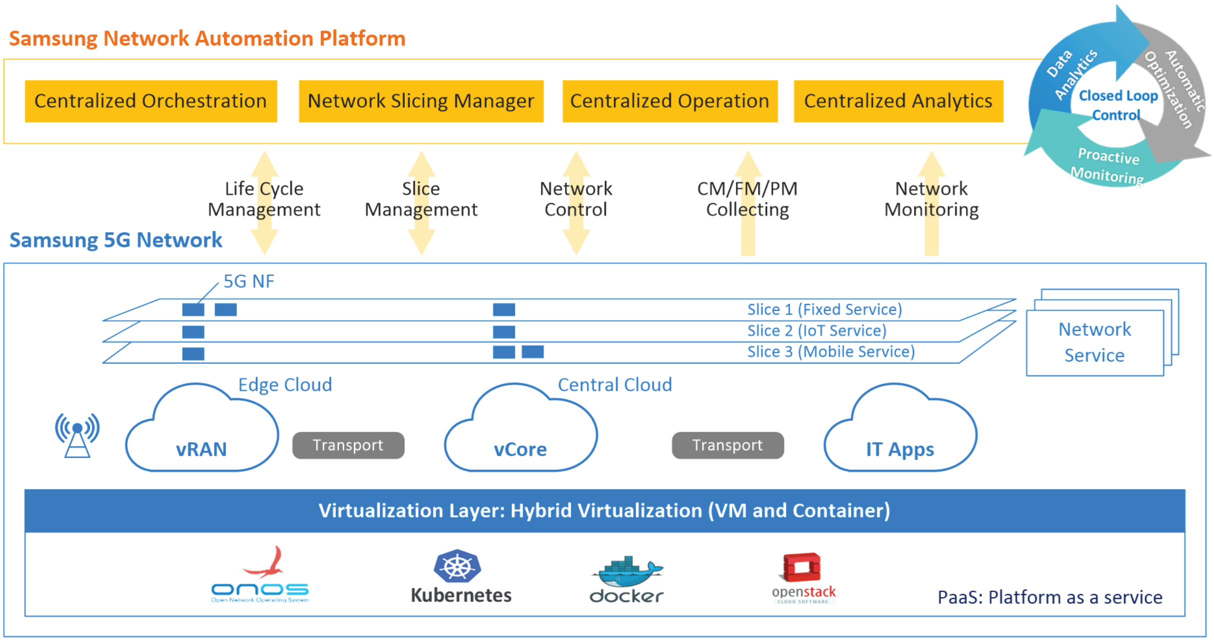


Figure 4-1. Samsung 5G Network Automation Architecture

Figure 4-2 illustrates the automatic service creation process in Samsung 5G Network Automation architecture. For every request for network service creation, the E2E orchestrator instantiates VNFs, the EMS configures VNFs and PNFs with provisioning data, and the software-defined networking orchestrator (SDN-O) or SDN controller (SDN-C) establishes and manages the network connectivity for NFs. The Centralized Analytics function of the Samsung Network Automation platform collects and derives metrics from Samsung 5G Network to help establish rules for auto-scaling of the network services.

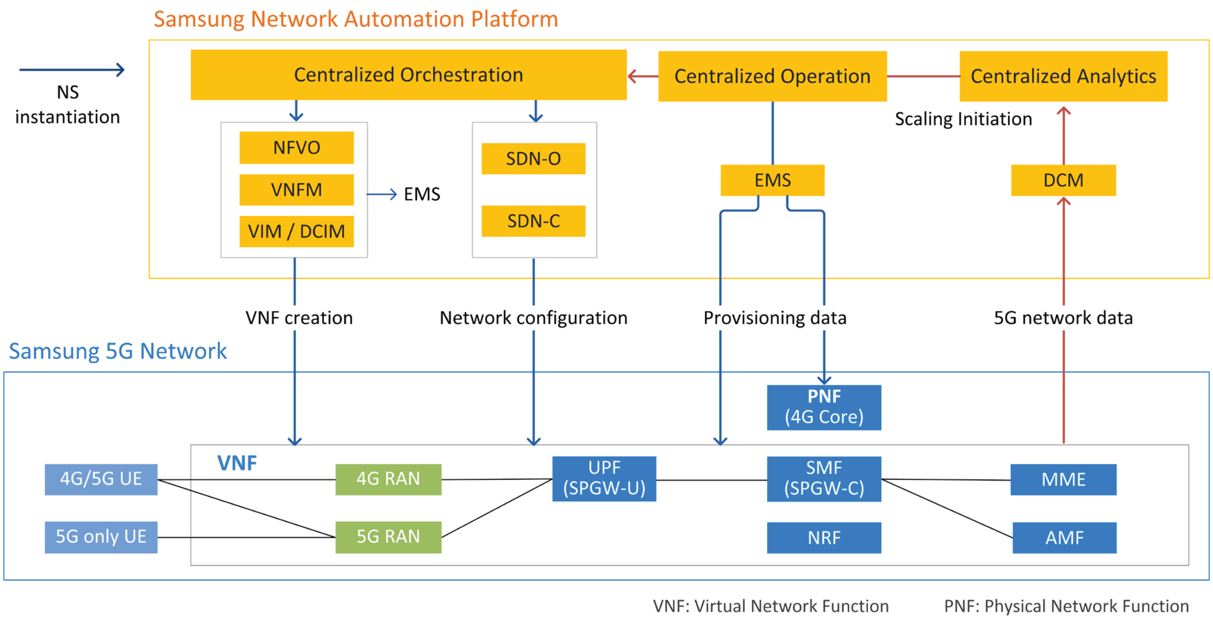


Figure 4-2. Zero-Touch Service Creation

Samsung Cloud Native 5G Core

Samsung 5G Core NFs are cloud native NFs, which consist of container-based micro-services that enable flexible scaling and upgrade to meet telecom operators' requirements. Figure 4-4 outlines the cloud-native architecture of Samsung 5G Core. The fundamental concepts of the cloud-native 5G Core are defined as Stateless Micro-services deployed in a container-based architecture.

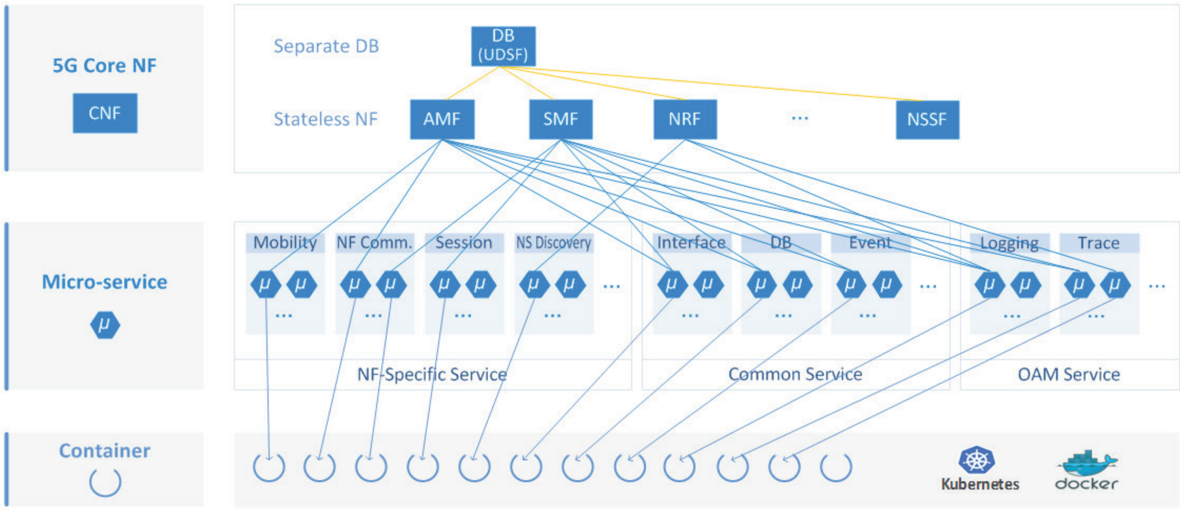


Figure 4-3. Samsung 5G Core: Cloud Native Architecture

Stateless

State information is stored centrally in UDSF by separating NF's operation and data. Stateless NFs can be scaled separately from the application, and a specific NF can be isolated in case of the NF failover, enabling service continuity.

Micro-services architecture

5G Core NFs consist of micro- services. The types of micro- services constituting an NF are classified as follows:

- **NF-specific micro-services:** services specific to a particular NF, e.g., AMF-specific micro-services, like N1/N2 communication, mobile termination, N1/N2 interface, etc.
- **Common micro-services:** services commonly used by all NFs; e.g., interface, DB, event, etc.
- **OAM micro-services:** services for operations, administration and management, like logging, tracing, etc.

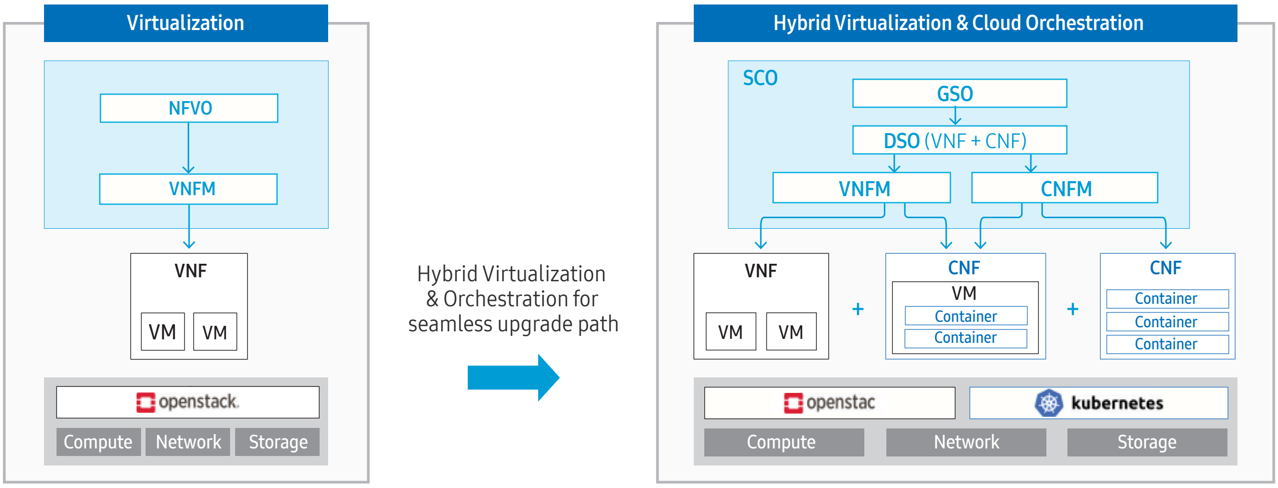
The cloud native 5G Core creates 5G Core NFs by combining the necessary NF-specific micro-services, common micro-services, and OAM micro-services that create the required service. Each micro-service runs in a container and is independently scalable and re-usable, which enables the flexible launch of new services. This independence also enables faster time-to-market of new services and offers enhanced scalability.

Container-based architecture

Containers have low overheads, which allows quick and easy installation of micro-services, enabling rapid service deployment.

Hybrid virtualization and hybrid cloud orchestration

Current 5G network virtualization environment moved away from existing VMs to more lightweight containers. Sometimes, however, telco environments require VMs due to performance or I/O bandwidth issues. Thus, a hybrid virtualization environment where micro-services can run in VMs and/or containers is required. Hybrid cloud orchestration creates and manages the services that use hybrid virtualization. Samsung Cloud Management System (CMS) offers comprehensive management of physical, virtual and containerized resources, and automatically manages the lifecycle of VNFs and cloud native network functions (CNFs) to support seamless migration from VNFs to CNFs. Figure 4-5 highlights the hybrid virtualization environment and hybrid cloud orchestration in Samsung 5G Core.



- Consolidated management of physical, virtualized and containerized resources
- Automated life cycle management of VNF and CNF
- Seamless migration form VNF to CNF

Figure 4-4. Hybrid Virtualization and Hybrid Cloud Orchestration

Samsung 5G Core Evolution

Lastly, Figure 4-6 summarizes the evolutionary path of Samsung 5G Core.

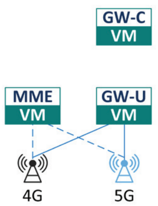
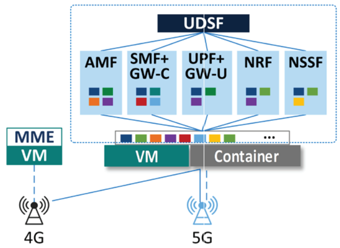
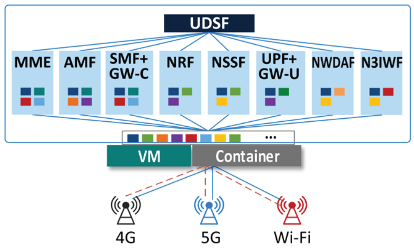
	Phase 1 ('18)	Phase 2 ('19)	Phase 3 ('20~)
Portfolio & Architecture	5G NSA (CUPS) 	Cloud Native 5GC 	Cloud Native 5GC Enhancement 
Common Core		- 4G/5G Common Core	- 4G/5G/Wi-Fi Common Core
Cloud Platform	- MANO NFVO/VNFM - OpenStack VIM	- Hybrid Virtualization & Orchestration (VM+Container) - CNP (k8s based CaaS, PaaS)	- SDN - E2E-O/NSM - ONAP Compliant
Automation	- VNF LCM Automation	- Micro-service LCM Automation - S/W LCM Automation (CI/CD, In-service SW upgrade)	- E2E Service LCM Automation - AI-based Closed Loop Operation - Automated Healing/Optimization
Network Slicing	- 4G/NSA Network Slicing based on eDECOR/CUPS	- 5G Network Slicing based on NSSAI/NSSF - Dynamic Charging per slice	- E2E Rollout (NSM-Core-RAN) - Zero-Touch Network slice Creation - AI-based Closed Loop Slice with NWDAF - RAN Slicing
MEC	- Distributed UP, MEP - Local Breakout by samsung specific method	- Local Breakout using 5G Features * ULCL, IPv6 Multi-homing, LADN, SSC Mode2/ Mode3	- 5G NEF - MEAO/MEPM

Figure 4-5. Samsung 5G Core Evolution

Key Features Supporting Various 5G Use Cases

As telco business shifts to be more service-focused, the paradigm of 5G network infrastructure is also moving away from phone-centered services to business-focused services. Samsung's cloud-native 5G Core provides two new capabilities, network slicing and multi-access edge computing, that allow mobile operators to develop new revenue streams and acquire innovative business opportunities.

Network Slicing

Samsung 5G Network Slicing solution creates independent end-to-end mini-networks, or network slices, that provide specific service characteristics (throughput, voice, low latency). These slices enforce E2E service level agreements by delivering and maintaining the specified quality of service across the RAN, Core, and Transport networks.

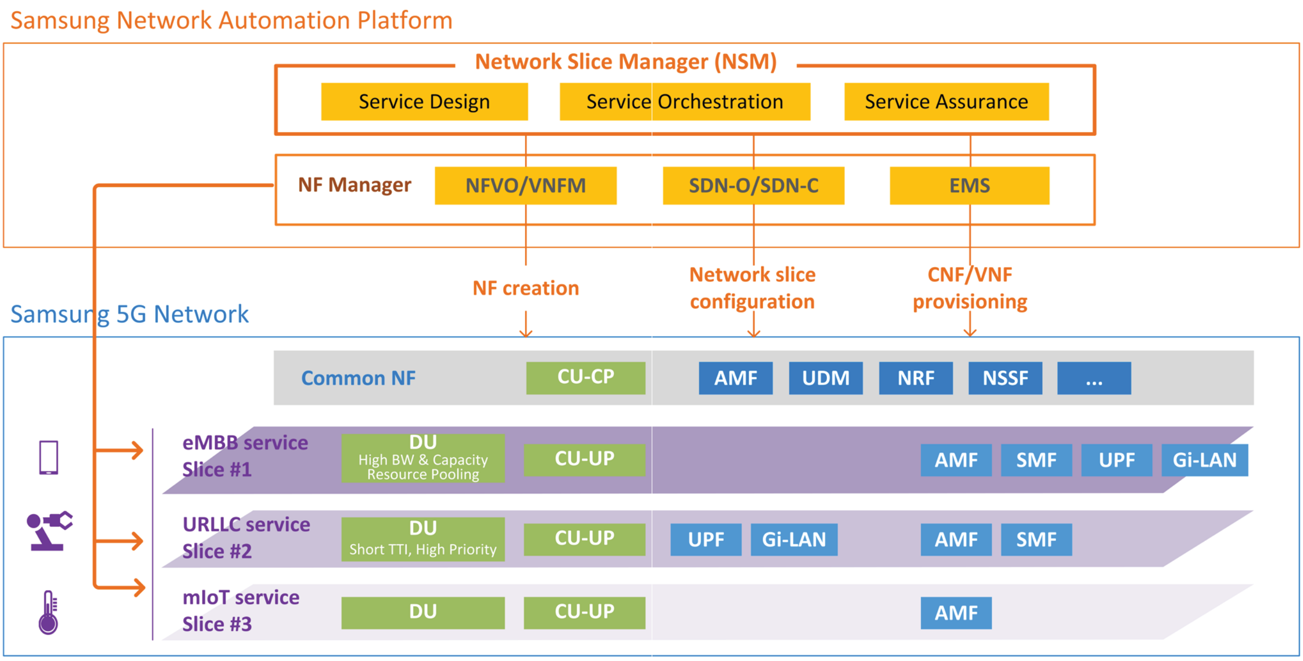


Figure 5-1. Network Slice Creation by Operator

Samsung Networks offer multiple network slicing solutions:

Solution 1: Slice Creation Across the Network

The Network Slice Manager (NSM) is an E2E network slice orchestrator that dynamically groups a set of NFs that meet the defined service characteristics. The characteristics can contain any blend of attributes, from latency and speed to location and priority. Creating a network slice entails

i. Identifying the required NFs, allocating the necessary resources, and creating the NFs
ii. Determining the proper locations for the NFs (core, edge, etc.) and connecting them
iii. Recording the details of the slice in order to map the appropriate users to the resources assigned for use by the slice.

Figure 5-1 illustrates the network functions in 3 E2E Network Slices in the Samsung 5G Core.

Once the NSM starts initiating a network slice instance (e.g., slice for eMBB), NFVO/VNFM determines which network function capabilities (e.g., DU, CU-UP, AMF, SM, PF, application server) are needed to establishes the virtual network resources (VMs/Containers) for the remaining NFs and instantiates the NFs. The EMS sends the provisioning data to the instantiated NFs, and SDN-O/SDN-C connects the NFs. The NSSF records the network slice instance information, so that when a UE requests the service, the NSSF can deliver the target AMF and Network Slice Selection Assistance Information (NSSAI) for the service. In addition, the NSM optimizes network resources by supporting auto-scaling, which increases or decreases the network slice resources according to the traffic demands being placed on the network slice.

Solution 2: Slice Allocation to UE

Figure 5-2 details the allocation of a slice to the requesting UE. Once the UE starts an application that needs a network slice, the UE receives an NSSAI that corresponds to the service needs. If necessary, the 5G network creates the network slice based on the NSSAI for use by the UE. For a user needing an eMBB network slice, the Central Unit Control Plane (CU-CP) that acquires the NSSAI from the UE, recognizes that it needs the eMBB network slice, selects the specific Central Unit User Plane (CU-UP) and AMF. Then the AMF selects an eMBB-specific SMF, and the SMF selects eMBB-specific UPF(s). The RAN's DU acquires the NSSAI from the CU-CP and allocates the dedicated resources to the slice, such as high BW and capacity resource pooling. This completes the establishment of a dedicated E2E eMBB slice for the UE across RAN and Core.

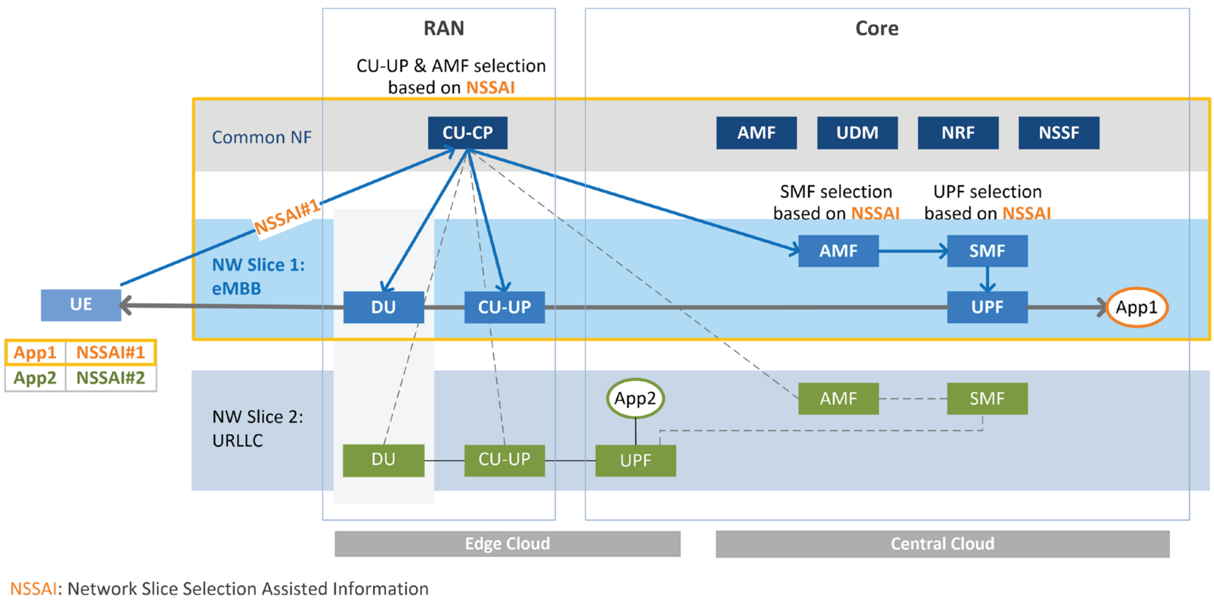


Figure 5-2. Network Slice Allocation to UE

MEC

Samsung MEC solution consists of a Multi-access Edge Platform (MEP), a Multi-Access Edge Platform Manager (MEPM) and Multi-Access Edge Orchestrator (MEAO). As the 5G standard for the interworking between MEC and 3GPP Core is not yet completed, Samsung-specific solutions provide the interworking between MEC and EPC in 5G NSA, while the interworking between MEC and the 5G Core on the 5G SA architecture will follow the 3GPP 5G standard. The interworking between Samsung's MEP and MEC App server is based on the ETSI standard. Figure 5-3 depicts the Samsung current MEC solutions based on 5G NSA architecture.

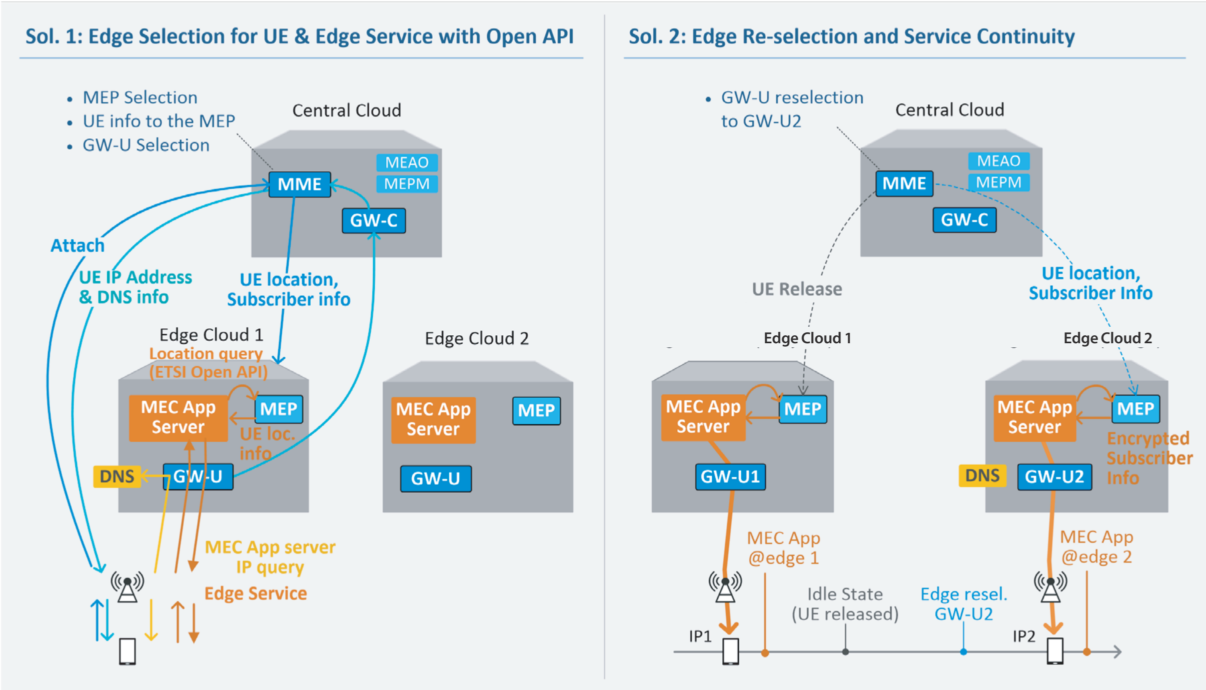


Figure 5-3. MEC Solutions

Solution 1: Edge Selection for UE and Edge Service

The left side of Figure 5-3 explains how Samsung 5G NSA Core connects a 5G UE to the closest edge to provide services.

- **Edge Selection –** When a 5G UE accesses a 5G network, the MME located in the central cloud selects the MEP that is geographically closest to the UE, delivers subscriber information to the MEP, and forwards the UE's IP address and DNS information to the UE. Through a DNS query, the UE acquires the IP address of the MEC App server at the edge, connects to the MEC App server and uses the service from the edge.

- **Edge Service with Open Application Programming Interface (API) –** MEP and MEC Application server interwork with ETSI Open API. According to the query of the MEC App, the MEP provides encrypted information on the UE's location and subscriber identification. Being encrypted, the information is delivered securely.

Solution 2:
Edge Re-selection and Samsung-Specific Service Continuity

The right side of Figure 5-3 depicts how the Samsung 5G NSA Core supports edge re-selection and local service continuity. Samsung MEC solution ensures that an idle state UE can execute edge reselection to use the MEC App from the geographically closest edge. For any changes in the UE IP address, the MEC App from the new edge will be able to utilize Subscriber ID to support local service continuity. In addition, each MEP interworks with operators' LBS platform to periodically update cell configuration information to reflect any cell configuration changes instantly.

Based on the 3GPP standard, 5G SA Core will interwork with MEP to provide local break functions such as Uplink Classifiers (UL-CL), IPv6 Multi-homing and Local Area Data Network (LADN). Session and Service Continuity (SSC) Mode 2 and Mode 3 will also be supported.

Samsung's 5G Innovation Continues

In April 2019, the era of 5G officially commenced with the launch of 5G smartphones in Korea. Although the 5G deployments currently focus on the LTE-based 5G NSA, 5G SA with full 5G Core features will soon trigger more innovative 5G services that encompass the attributes of high speed, ultra-low latency, and massive connectivity. The 5G network requires a high degree of agility to support the variety of services and highly dynamic capacity demands of these new services. The cloud-native 5G Core delivers the requisite flexibility and scalability to enable the support of the exponential increase in data traffic from new services that will emerge in the 5G era. Samsung cloud-native 5G Core leverages containers and hybrid cloud orchestration to support of VNFs and CNFs, as well as seamless migration from VNF to CNF when needed. In addition, its network slicing and MEC solutions will empower telecom operators with new business opportunities that can drive profitability. Samsung network slicing solution segments resources from the UE to the application to provide genuine E2E network slicing, and the MEC solution provides subscriber information to MEC applications, allowing the MEC applications to offer a higher degree of customization. With the abilities for 5G to support high capacity and low latency over network slices and edge computing, operators need intelligent systems that can both recognize the need for additional resources and allocate the resources to reserve system level agreements with customers. The Samsung 5G Network with cloud-native 5G Core and Samsung Network Automation Platform utilizes big data analysis to enable telecom operators to build and operate 5G service enabler platforms in the upcoming 5G era leveraging SW-based tools and architectures triggered by the introduction of NFV and cloud technologies. Samsung's innovation continues to provide solutions that support efficiencies, growth, and revenue for leading network operator worldwide.

Abbreviations

AMF	Access and Mobility Management Function
AUSF	Authentication Server Function
CIoT	Cellular IoT
CNF	Cloud Native Network Function
C-RAN	Centralized RAN
CO	Central Office
CU	Central Unit
CUPS	Control and User Plane Separation
DECOR	Dedicated Core
DN	Data Network
DPI	Deep Packet Inspection
DU	Digital Unit
DU	Distributed Unit
eNB	Evolved Node B
eMBB	Enhanced Mobile Brodaband
EMS	Element Management System
EPC	Evolved Packet Core
gNB	Next generation Node B
GW-C	Gateway Control Plane
GW-U	Gateway User Plane
HSS	Home Subscriber Server
LTE	Long Term Evolution
MEAO	Multi-access Edge Application Orchestrator
MEC	Multi-access Edge Computing
MEP	Multi-access Edge Platform
MEPM	MEP Manager
MME	Mobility Management Entity
NEF	Network Exposure Function
NF	Network Function
NFV	Network Functions Virtualization
NFVI	NFV Infrastructure
NFVO	NFV Orchestrator
NR	New Radio
NRF	Network Repository Function
NSA	Non-Standalone
NSM	Network Slice Manager
NSSAI	Network Slice Selection Assistance Information
NSSF	Network Slice Selection Function
PCF	Policy Control Function
PCRF	Policy and Charging Rules Function
PGW	PDN Gateway
PNF	Physical Network Function
RAN	Radio Access Network
RAT	Radio Access Technology
RRC	Radio Resource Control
RU	Radio Unit
SA	Standalone
SBA	Service Based Architecture
SBI	Service Based Interface
SDN	Software Defined Networking
SDNC	SDN Controller
SDNO	SDN Orchestrator
SGW	Serving Gateway
SMF	Session Management Function
UDM	Unified Data Management
UDR	Unified Data Repository
UDSF	Unstructured Data Storage Function
UE	User Equipment
UPF	User Plane Function
vCore	Virtualized Core
vEPC	Virtualized EPC
VM	Virtual Machine
VNF	Virtual Network Function
VNFM	VNF Manager
vRAN	Virtualized RAN

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Samsung inspires the world and shapes the future with transformative ideas and technologies. The company is redefining the worlds of TVs, smartphones, wearable devices, tablets, digital appliances, network systems, and memory, system LSI, foundry and LED solutions.

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