CORE TRAINING

UNC 23.1 Product Introduction

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Objectives

- After completing this course, you will be able to:
  - Describe the 5G network architecture.
  - Describe UNC functions.
  - Have a good command of UNC key features.

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NF Introduction (1)

NF	Full Name	Function
AMF	Access and Mobility Management Function	Performs access control and mobility management on UEs in the 5G network and ensures service continuity during UE mobility.
SMF	Session Management Function	Enables UEs to access the data network (DN) through the 5G network to establish and manage PDU sessions. In addition, the SMF performs QoS control and charging management during sessions.
NRF	Network Repository Function	Provides highly reliable service registration and discovery functions for each NF on the 5GC. The NRF can be flexibly deployed based on networking requirements, helping carriers quickly construct highly autonomous 5G networks.
NSSF	Network Slice Selection Function	Manages slices on the 5G network and provides flexible and reliable slice selection functions, helping carriers build network slices in an agile manner.
SMSF	Short Message Service Function	Provides SMSs on 5G networks. It connects 5G Core and SMSC and implements protocol conversion over service-based interfaces (SBIs) and MAP interfaces.
NCG	Next-Generation Charging Gateway	Provides offline charging, online charging, and converged charging on 5G networks. It receives charging data from the SMF, generates and stores call detail records (CDRs), and provides the CDRs for the billing system (BS) in real-time.

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NF Introduction (2)

NF	Full Name	Function
SGSN	Serving GPRS Support Node	Performs mobility management and session management for 2G/3G terminals. Sends and receives mobile packet data between UEs and the GGSN.
MME	Mobility Management Entity	Serves as a 3GPP-defined key control node on the LTE access network. It provides access control, mobility management, and session management functions for subscribers.
SGW-C	Serving Gateway for Control Plane	Serves as an anchor point for the mobility signaling plane during inter-eNodeB handovers. It also manages user session bearers and inter-operator roaming charging.
PGW-C/GGSN-C	PDN Gateway for Control Plane	Assigns IP addresses to 2G/3G/4G user sessions and manages user session bearers. In terms of charging, the PGW-C/GGSN-C generates offline charging CDRs, manages online charging quotas, and manages QoS policies and SDF policies.

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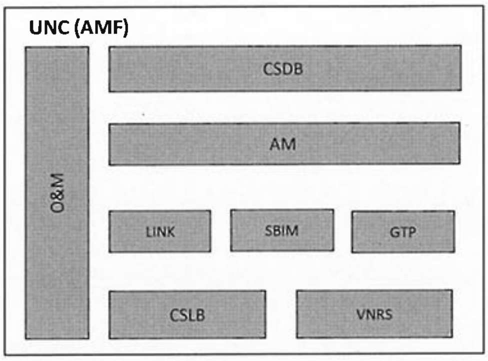
UNC System Architecture - AMF



Key microservices:

- AM: 5G access management, registration, handover, other procedures as well as 5GC security management. 5GC AM policy and UE policy management.
- LINK: (R)AN interface management.
- SBIM: Service-based interface management.
- GTP: GTP-C path management over the N26 interface. Network topology management, NGAP paging table management, and DNS query.

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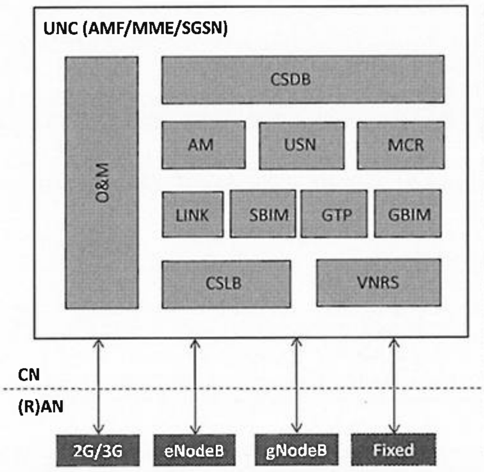
UNC System Architecture – Convergent AMF/MME/SGSN



Overall architecture

- 2G/3G/4G/5G/non-3GPP access (to be planned)/Fixed access (to be planned).
- OM/CSDB/CSLB/LINK microservice sharing by different access types.
- Service logic decoupling by separating 5G service logic from 2G/3G/4G service logic
- Co-deployment of 5G service logic and 2G/3G/4G service logic for POD-level resource sharing.

Benefits

- Unified O&M experience for various access types.
- Data services shared by different access types.
- Decoupling of the interface processing layer and service logic processing layer, independent upgrades and scaling of these layers.
- Decoupling of 5G service logic and 2G/3G/4G service logic, co-deployment of 5G service logic and 2G/3G/4G service logic on PODs for RAT resource adaptation and independent upgrades.
- On-demand orchestration according to service requirements, on-demand deployments of services in different access types. For example, if service processing over the Gb interface is not required, the GBIM microservice is optional.

All access types share resources to the maximum extent, while maintaining the flexibility of service orchestration, implementing on-demand microservice orchestration, upgrade, and scaling.

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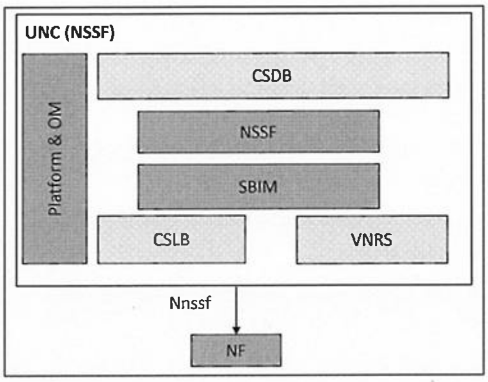
UNC System Architecture - NSSF



Functions

- **Network slice availability service:**
  - The AMF reports a list of supported TAs and the available/restricted network slice information of each TA to the NSSF. The NSSF then stores the information for subsequent network slice selection.
  - The NSSF supports local configuration of slice policies. The NSSF generates the final network slice availability data based on the locally configured policies and the information reported by the AMF.
  - The NSSF allows an NF to subscribe to slice availability service information.
- **Network slice selection: The NSSF supports the slice selection process initiated by an NF. Generally, the AMF can select a slice based on local information. If the initial AMF selected by the NG-RAN cannot serve the UE, the initial AMF needs to obtain the target AMF through the NSSF.**
- **NSSF interconnection: In the roaming scenario, the NSSF in the visited network interacts with the NSSF in the home network through the N31 interface.**

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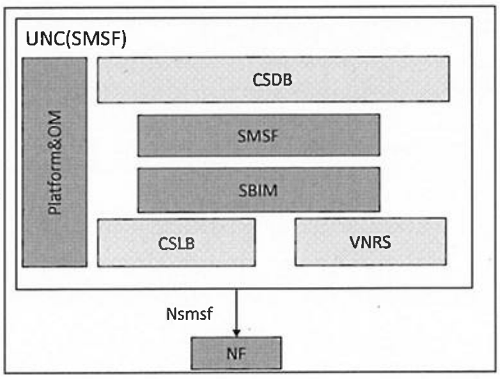
UNC System Architecture - SMSF



Functions

- **5G SMS**
  - The SMSF connects 5G Core and SMSC, and implements protocol conversion over SBIs and MAP interfaces.
  - When a UE accesses the network, the AMF selects an SMSF, registers with the SMSF, and records the UE context for subsequent SMS transmission.
  - The SMSF forwards messages from the SMSC to the AMF during MT SMS. In mobile originated (MO) scenarios, it forwards short messages sent by UEs to the SMSC.

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UNC Deployment Principles – Microservice Mapping Principles

VM Type	Full Name	Backup Mode	CPU	Memory	Storage	Function
OMU	Operation and Maintenance Unit	1+1 active/standby	4	32	470	Used to deploy microservices related to OM functions, such as log management, tracing management, upgrade, and configuration.
PBU_I	Public Business Unit for Interface	N-way	4	24	52	Used to process public interfaces of links and interface microservices, such as GTP and SBIM. Used to process public interfaces of basic microservices, such as CSLB and VNRS.
PBU-C	Public Business Unit for Computation	N-way	4	32	62	Used to deploy interface and link microservices and service-specific microservices with a large number of instances, such as LINK, GBIM, and USN.
PBU-M	Public Business Unit for Memory	N-way	2	32	54	Used to deploy microservices that have high memory requirements, such as CSDB.

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UNC Deployment Principles – Deployment Relationship Between Service Microservices and VMs

Microservice Abbreviation	Microservice Full Name	Home NF	VM Where Microservices Are Deployed	Function
USN	Unified Service Node	MME and SGSN	PBU-C	2G/3G/4G mobility management, access management
MCR	MME Chain Redundancy	MME	PBU-C	Backs up and restores subscriber data
SM	Session Management	SMF, GW-C, and GGSN	PBU-C	Session management and charging management
NRF	Network Repository Function	NRF	PBU-C	All functions of the NRF
NSSF	Network Slice Selection Function	NSSF	PBU-C	All functions of the NSSF

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Q&A

1. Which NFs are integrated into the UNC?
2. What types of VMs are available on which the UNC can run?

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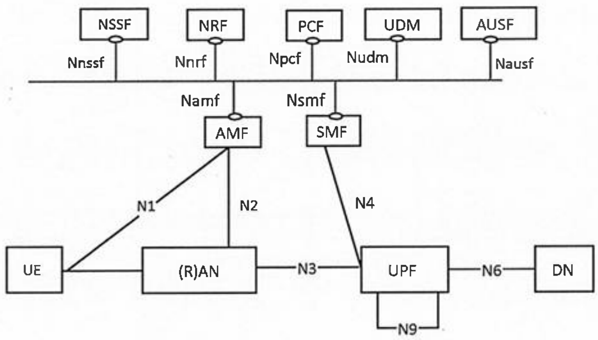
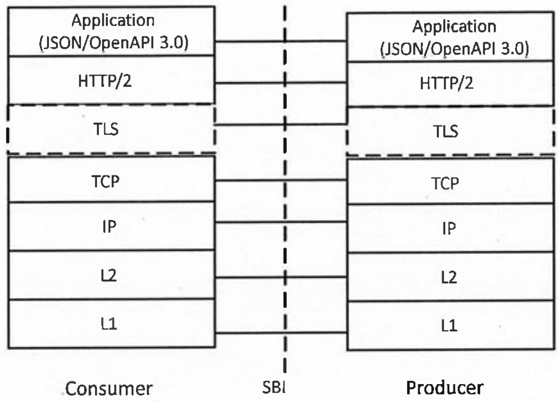
5G Network Interfaces – SBIs





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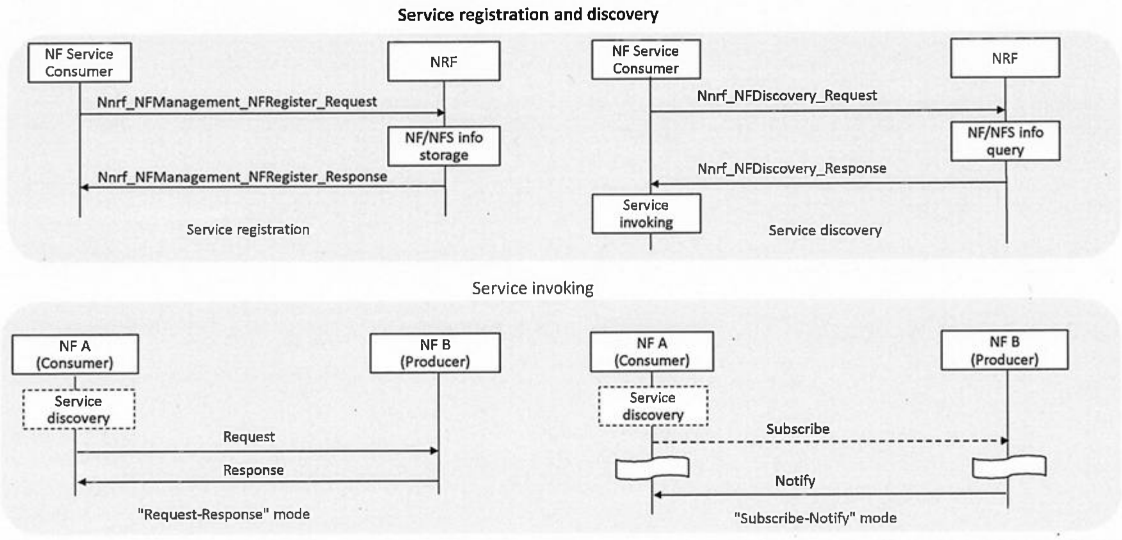
5G Network Interfaces – SBI Usage



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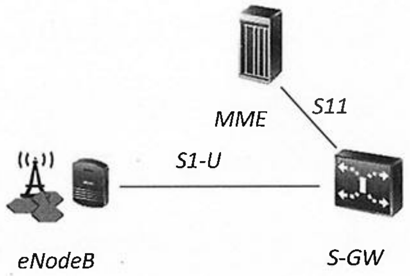
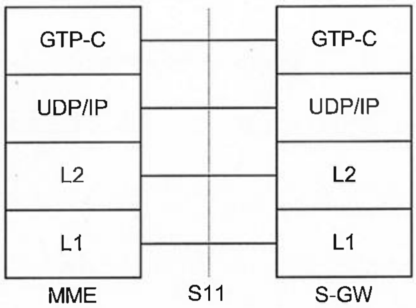
4G Network Interfaces – S11





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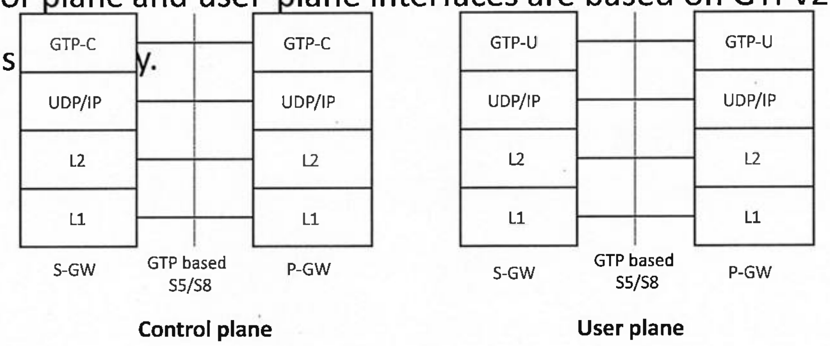
4G Network Interfaces – S5/S8

3GPP TS 23.401 (3GPP access): An S5/S8 interface complies with GTP.

The control-plane and user-plane interfaces are based on GTPv2 and GTPv1, res y.



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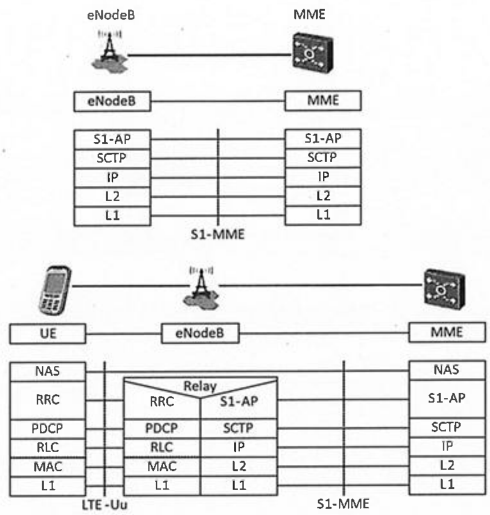
4GNetwork Interfaces – S1-MME (2)



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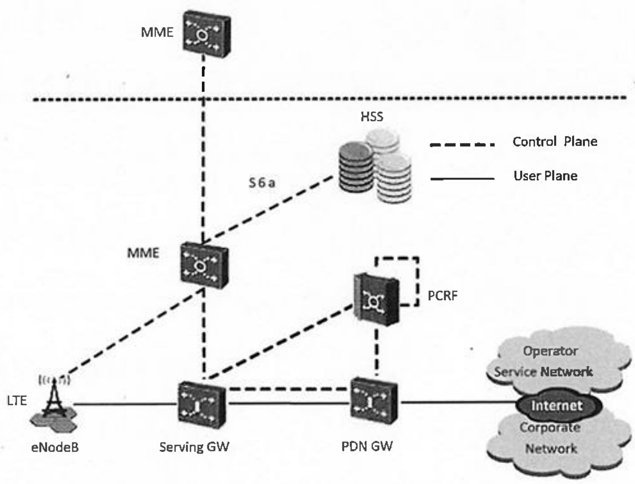
4GNetwork Interfaces – S6a (1)



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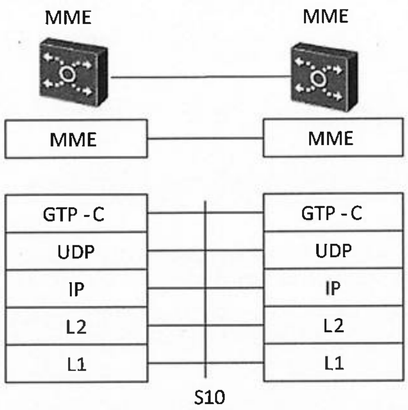
4GNetwork Interfaces – S10 (2)



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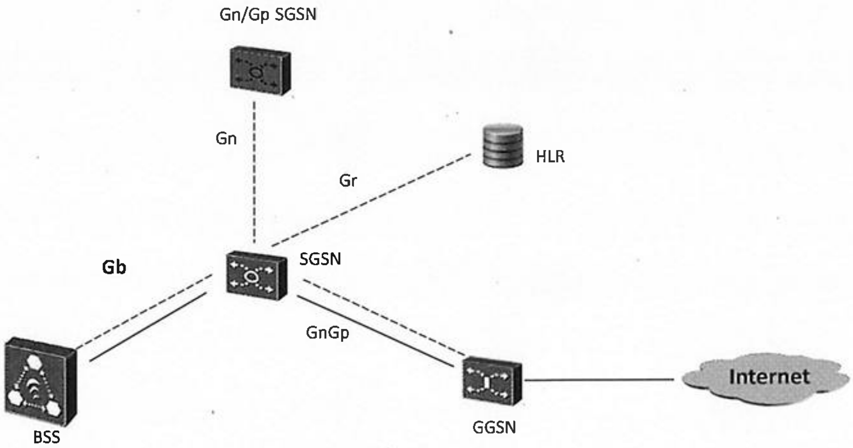
2G Network Interfaces – Gb (1)



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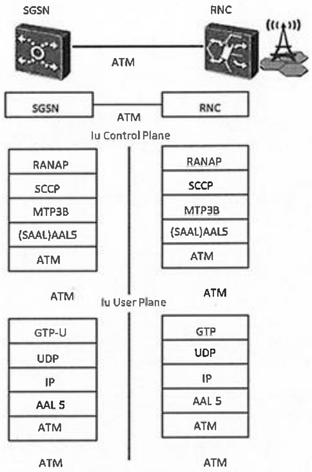
3G Network Interfaces – Iu (2)



Iu over IP interface protocol stack

The Iu interface supports only IP bearers, and no longer supports ATM bearers.

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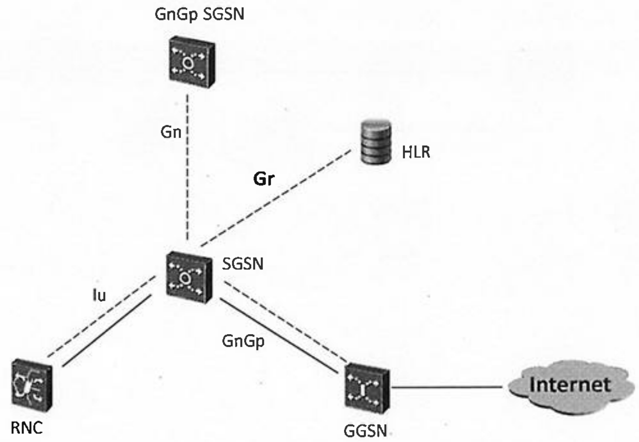
2G/3G Network Interfaces – Gr (1)



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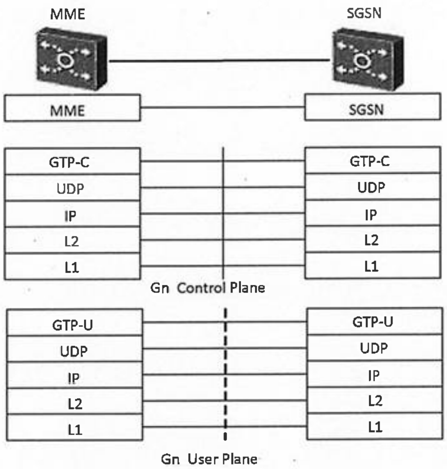
2G/3G/4G Network Interfaces – Gn/Gp (2)



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3. Functions

3.1 3GPP-defined Interfaces

3.2 Data Flow

3.3 Key Features

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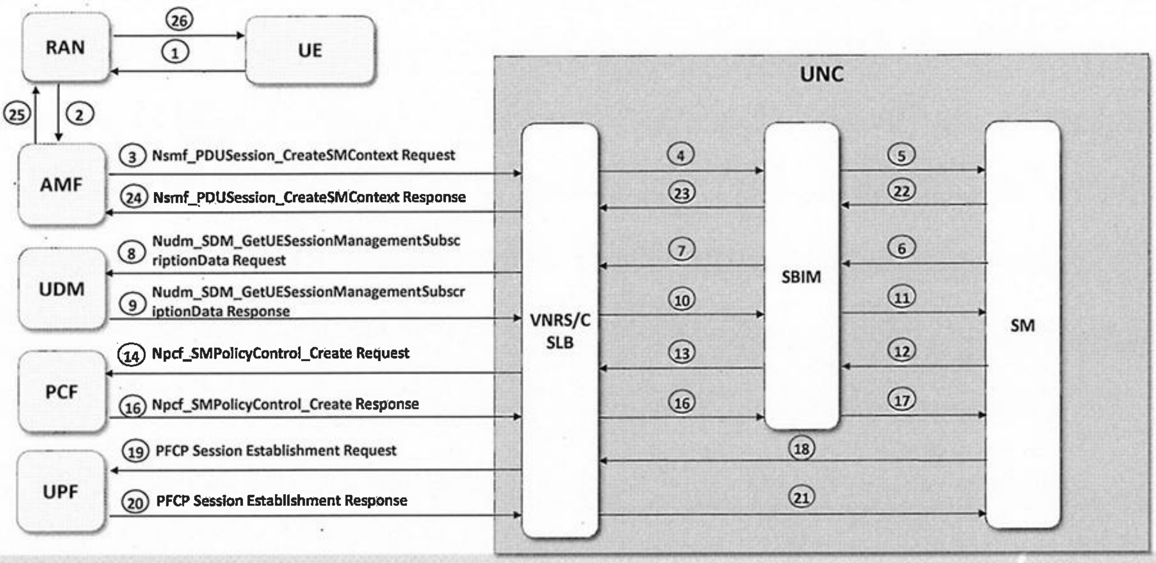
Signaling Flow of the PDU Session Establishment Procedure



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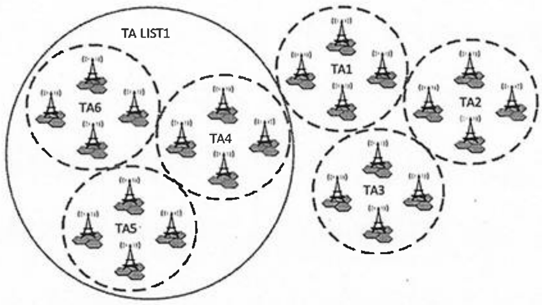
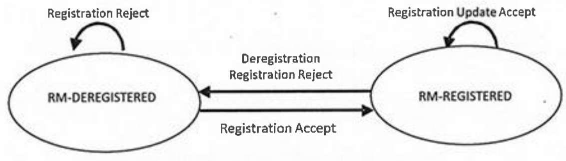
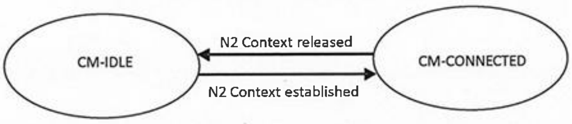
Mobility Management

Mobility management controls UE access to the network, traces the current UE location, and coordinates network devices such as the UE, (R)AN, and HSS/UDM to ensure that the UE remains registered on the network after it moves.





UE registration status on the 5G network



UE connection status on the 5G network

TA list: a list of TAs.

- When a UE moves in all TAs in the TA list, it no longer initiates a TAU.
- When the network pages a UE, all UEs in all TAs in the TA list are paged.

The basic mobility management principles of the 5G network are similar to those of the 4G network.

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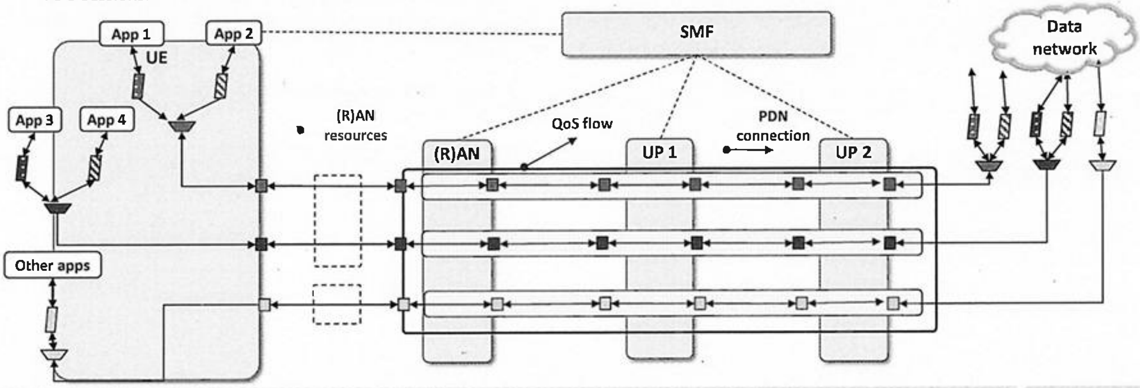
Session Management

- Session management is used to manage the connections, that is, PDU sessions, between UEs and external PDNs. PDU sessions are the basis of data services.
- The differences between 5G session management and 4G session management are as follows:
  - In the 5G-native architecture, the control plane is separated from the user plane. The control plane functions are provided by the SMF, while the user plane functions are provided by the UPF.
  - QoS flows on the 5G network replace EPS bearers on a 4G network, and control-plane management objects are changed from EPS bearers to PDU sessions.



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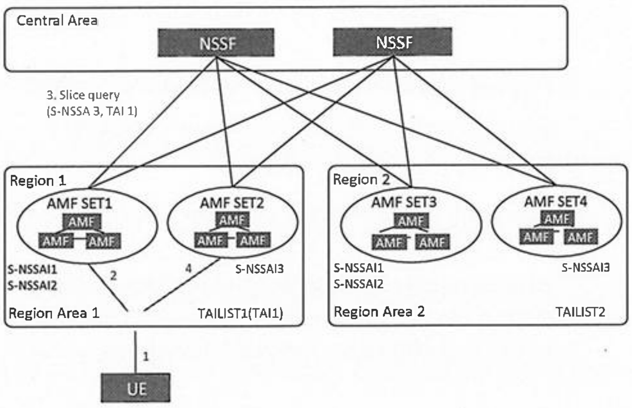
NSSAI-based Slice Selection

- The UE initially accesses the network from region area 1. The UE does not provide the NSSAI information in the NAS message. The default slice in the UE subscription data is S-NSSAI 3.
- Since no NSSAI information is requested, the (R)AN determines an AMF in the AMF set 1 as the initial AMF based on factors such as load.
- The initial AMF uses the negotiated NSSAI (NSSAI 3 in this example) to query the NSSF for the serving AMF.
- The NSSF is responsible for both region 1 and region 2, and both region areas have their respective AMF sets to provide corresponding slice services. In this case, ensure that region 1 can provide AMF set 2 for the slice service based on the UE TAI.



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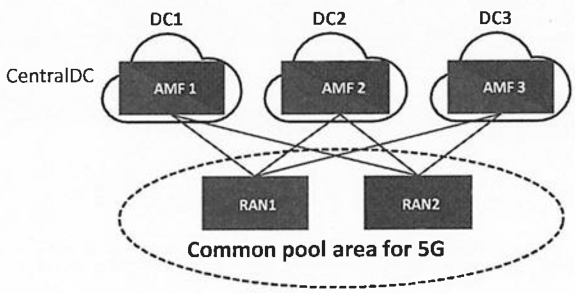
AMF Pool

- 3GPP defines a 5G pool as an AMF set.
- For new subscribers, the AMFs in a pool share resources and service loads. The (R)AN implements the load sharing function.
- The (R)AN distributes subscriber messages to the AMF with which the UE is registered based on the AMF region ID and AMF set ID in the 5G-GUTI.
- All AMFs in a pool support the same slice type.
- Pool network O&M (U2020)
- Subscriber migration between AMFs in a pool



MCC	MNC	AMF Region ID	AMF Set ID	AMF Pointer
12 bits	8 or 12 bits	8 bits	10 bits	6 bits
		AMF set ID		
		GUAMI		

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4G/5G Interworking – SMF/PGW-C Selection

- SMF/PGW-C characteristics:
  - 5G access: pgwFQDN contained in the registration information attribute on the SMF/PGW-C
  - 4G access: nc-smf contained in the DNS record interface capability on the SMF/PGW-C.
- SMF/PGW-C selection algorithm:
  - 5G access: The AMF selects an SMF/PGW-C based on the S1 capability and subscription data of 5G UEs.
  - S1 mode support
  - coreNetworkTypeRestrictions
  - iwkEpsInd
- 4G access: The MME selects an SMF/PGW-C based on UE capabilities and subscription data.
  - N1 mode support
  - Core Network Restriction
  - Interworking-5GS-Indicator

Table 6.1.6.2.12-1: Definition of type SmfInfo

Attribute name	Data type	P	Cardinality	Description
sNssaiSmfInfoList	array(sNssaiSmfInfoItem)	M	1..N	List of parameters supported by the SMF per S-NSSAI.
taiList	array(Tai)	O	1..N	The list of TAIs the SMF can serve. It may contain the non-3GPP access TAI. The absence of this attribute and the taiRangeList attribute indicate that the SMF can be selected for any TAI in the serving network.
taiRangeList	array(TaiRange)	O	1..N	The range of TAIs the SMF can serve. It may contain the non-3GPP access' TAI. The absence of this attribute and the taiList attribute indicate that the SMF can be selected for any TAI in the serving network.
pgwFqdn	Fqdn	O	0..1	The FQDN of the PGW if the SMF is a combined SMF/PGW-C.
accessType	array(AccessType)	C	1..2	If included, this IE shall contain the access type (3GPP_ACCESS and/or NON_3GPP_ACCESS) supported by the SMF. If not included, it shall be assumed the both access types are supported.

29.510 SMF registration information in the NRF

5.12.3.2 PGW-C/SMF selection

An MME and an ePDG shall select a combined PGW-C/SMF for PDN connections that may be subject to mobility to 5GS, e.g. for UEs supporting N1 mode and not restricted to interworking with 5GS by user subscription (see "5GC" bit within Core-Network-Restrictions AVP and Interworking-5GS-Indicator AVP specified in 3GPP TS 29.272 [27] and 3GPP TS 29.273 [30]). A UE signals its support for 5GC NAS to the MME in NAS signalling and to the ePDG in IKEv2 signalling.

A PDN connection of a subscription restricted from accessing the 5GC or without 5GS interworking subscribed for the APN is not subject to mobility to 5GS and may be connected to a PGW, a PGW-C or a combined PGW-C/SMF; when PGW-C (or PGW) and combined PGW-C/SMF are available for election, the preference order may be based on operator's policy in the MME or ePDG.

DNS procedures to select a combined PGW-C/SMF shall be supported as specified in subclause 5.12.1, with the following additions:

- the network-capability shall be set to "smf".

For example, the MME shall discover all GTP based S5/S8 interfaces using "Service Parameters" of "x-3gpp-pgw:x-s5-gtp+nc-smf", "x-3gpp-pgw:x-s8-gtp+nc-smf" and the ePDG shall discover all GTP based S2b interfaces using "Service Parameters" of "x-3gpp-pgw:x-s2b-gtp+nc-smf".

29.303 DNS characteristics information of the SMF/PGW-C

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4G/5G Interworking – Key Points

Networks

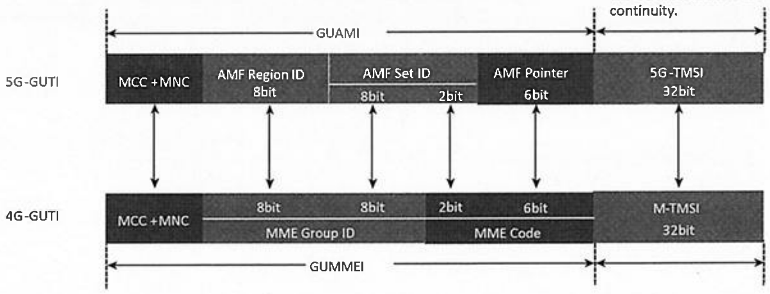
- Networks with N26: A UE can work only in single-registration mode.
- Network without the N26 interface: A UE can work in single-registration or dual-registration mode. (To be planned)

UEs

- Single registration: A UE can register with the 4G or 5G network at a time.
- Dual registration: A UE can register with the 4G and 5G networks at the same time and separately perform 4G and 5G services.

Continuity

- As defined in 3GPP specifications, a UE on the 5G network can fall back to the 4G network through the handover or reselection procedure to ensure service continuity.
- If a UE on the 5G network falls back to the 2G/3G network or falls backs to the 4G network before a fallback to the 2G/3G network, the UE must initiate an attach procedure, affecting service continuity.



- The preceding figure shows the mapping of temporary identifiers of 4G and 5G UEs. Since the combination of region ID and set ID has two more bits than MMEGI. Therefore, the least significant two bits of the set ID maps to the most significant two bits of the MME code.
- GUMMEIs and GUAMIs must be unique.

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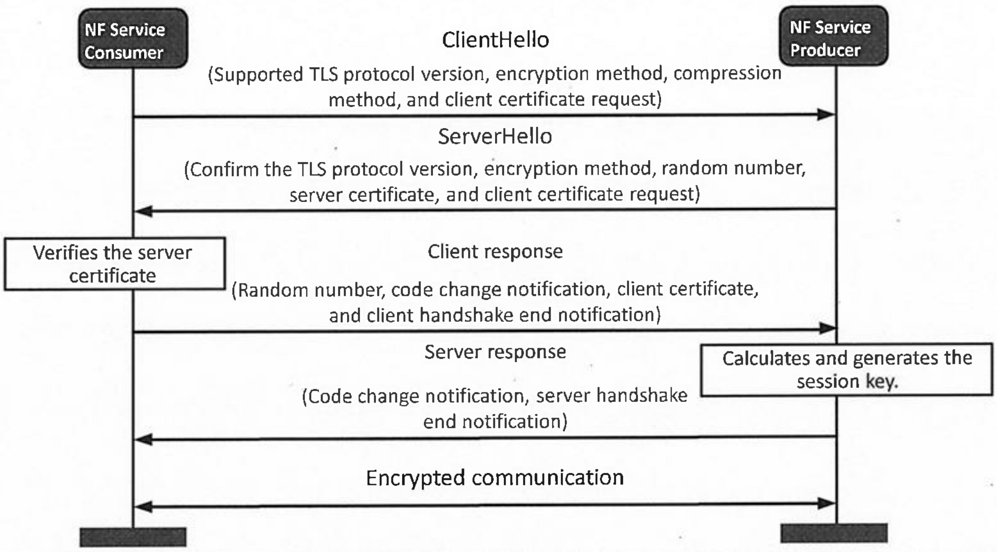
SBI Encryption



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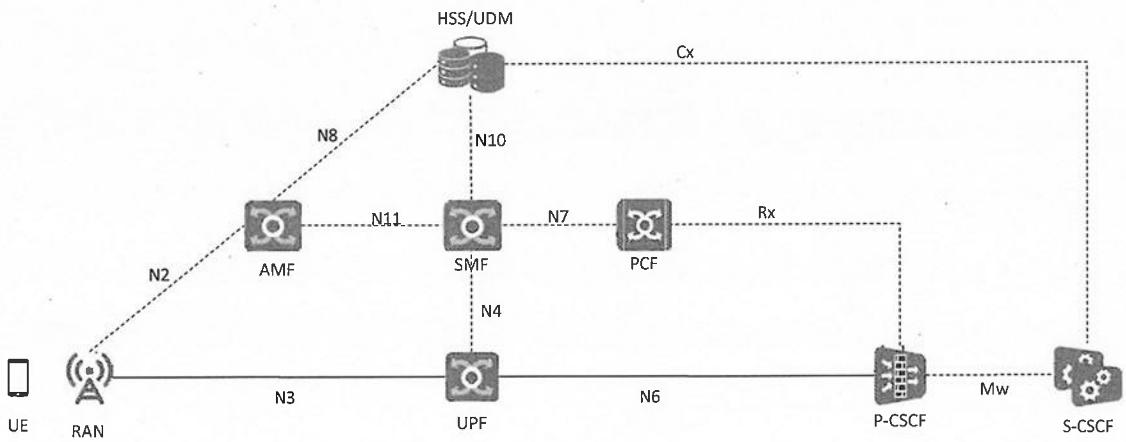
IMS VoPS Networking



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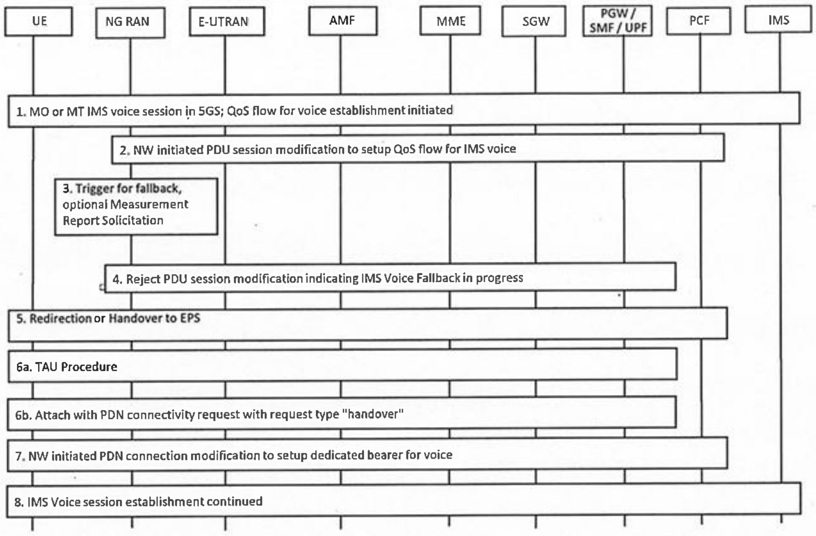
EPS Fallback

- When VoNR is not deployed on the (R)AN, if a UE accesses the 5G network, it can register with the IMS domain. However, if the UE needs to make a call, it must fall back to the 4G network to make a call through VoLTE.



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IMS Restoration for P-CSCF Failure

- The IMS Restoration for P-CSCF Failure feature enables the PGW-U/UPF to regularly detect the proxy-call session control function (P-CSCF) status using the Internet Control Message Protocol (ICMP). When detecting that a link between the PGW-U/UPF and P-CSCF is faulty, the PGW-U/UPF reports the fault to the PGW-C/SMF and pushes the IP addresses of a pair of P-CSCFs that are working properly to a UE. The UE selects either P-CSCF IP address and reinitiates IMS services so that IMS services are automatically restored.

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HSS/UDM-based P-CSCF Restoration

- When the S-CSCF detects an Mw interface fault or a P-CSCF fault (including the restart and congestion), the HSS/UDM-based P-CSCF Restoration feature enables the AMF to work with the HSS/UDM to quickly restore VoLTE MT services. This reduces voice service interruption duration and improves subscriber experience.

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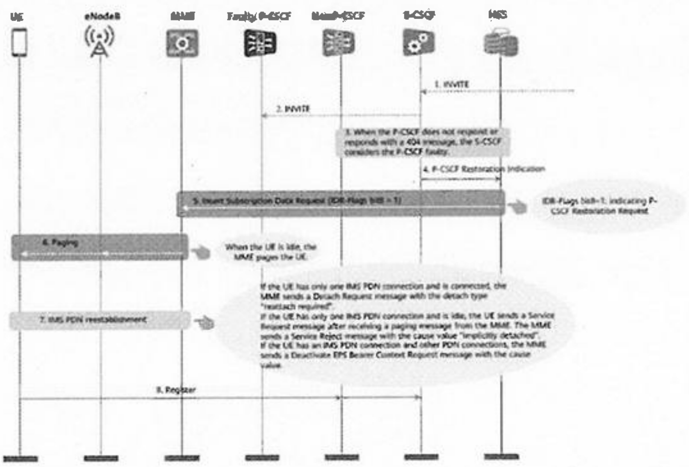
HSS/UDM-based P-CSCF Restoration

- MT VoLTE service restoration procedure when only the P-CSCF is faulty is shown in the figure.

Figure 1 MT VoLTE service restoration procedure when only the P-CSCF is faulty



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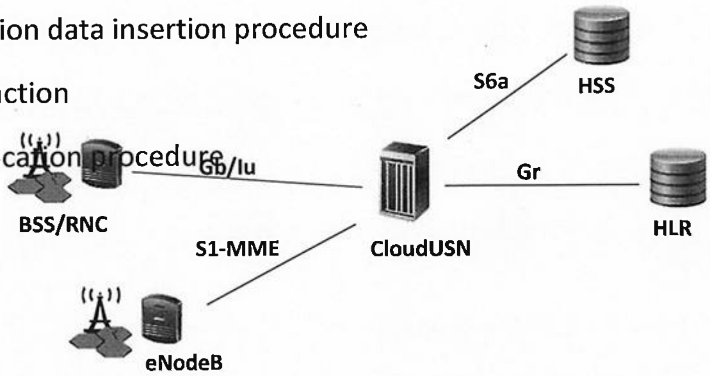
Subscriber Data Management (SGSN/MME)

- The subscriber data management function is implemented in the following procedures:
  - Subscription data insertion procedure
  - Purge function
  - Cancel Location procedure



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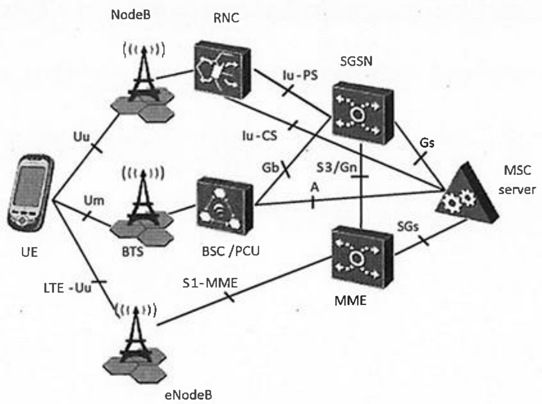
Voice Service (MME)

- The UNC provides voice services using the CSFB and the SRVCC solution.



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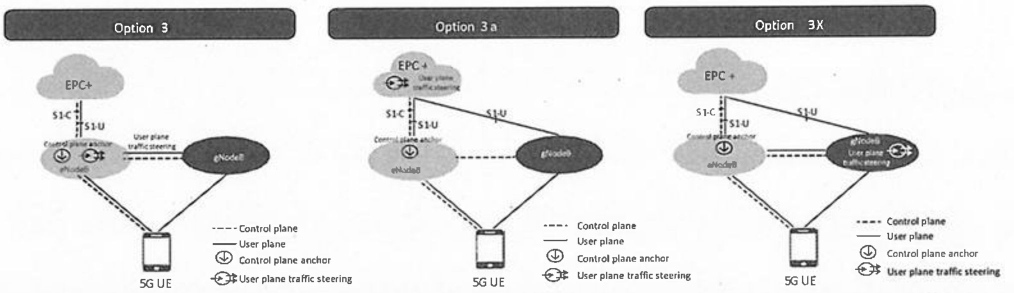
5G NSA(Opt.3) Networking

Note: In the three networking architectures, the control plane is always anchored to the eNodeB.



Function	Option3	Option3a	Option3x
Traffic distribution point	The eNodeB determines whether to steer traffic based on the service type and air interface status.	Same as option 3.	Same as option 3.
Traffic distribution mode	PDCP-level	Dual S1-U connections	PDCP traffic distribution and dual S1-U channels
Traffic distribution procedure	No communication with the network side	E-RAB Modification Indication procedure added	E-RAB Modification Indication procedure added
Networking selection reference	The peak data rate is limited. Otherwise, the capacity of the eNodeB must be expanded for user-plane data traffic steering.	The EPC implements static data traffic steering and does not dynamically adjust the data traffic based on the RAN status.	The impact of user-plane traffic distribution on the live network is avoided. User plane data distribution at the IP packet level can be performed with better performance

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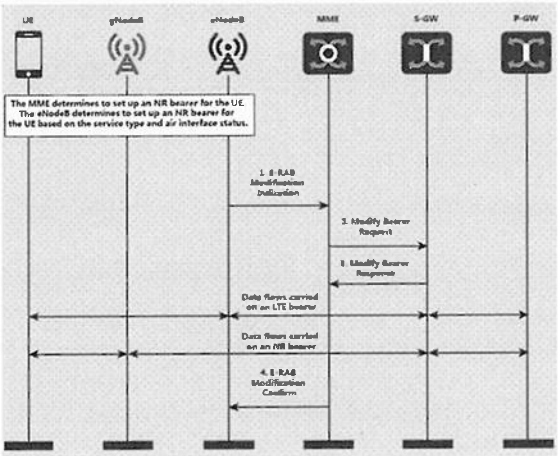
5G NSA (Opt.3) Dual Connectivity Management

E-RAB Modification Indication



1. When the eNodeB determines to set up an NR bearer for a UE based on the current service type of the UE, air interface status, and other information, it sends an E-RAB Modification Indication message, containing the IP address of the new bearer, to the gNodeB.
2. The MME sends the S-GW a Modify Bearer Request message containing the gNodeB IP address and notifies the S-GW of switching over the user-plane transmission path from the eNodeB to the gNodeB.
3. The S-GW updates the bearer IP address and sends the updated address to the MME through a Modify Bearer Response message.
4. The MME notifies the eNodeB of the update result through an E-RAB Modification Confirm message.

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Service Continuity Assurance for 5G NSA Subscribers

- The Service Continuity Assurance for 5G Users feature enables a UNC to preferentially select a high-speed GGSN that supports DCNR for a 5G UE during the GSM/UMTS PDP context activation procedure. This ensures that a 5G UE always anchors on a high-speed gateway when it moves from a GSM or UMTS network coverage area to an NR network coverage area.
- When a 5G UE moves to an area with poor 5G signal coverage, if the UNC identifies that it is a DCNR-capable UE and DCNR is not restricted in the subscription data, the UNC queries NAPTR resolution records in the DNS host file by running **ADD DNSN** and preferentially selects a high-speed GGSN that supports DCNR for the UE during the PDP context activation procedure. This ensures that the 5G UE always anchors on a high-speed gateway when it hands over from a GSM/UMTS network to an LTE network. If there is no high-speed GGSN that supports DCNR, the UNC attempts to identify a common GGSN and selects it for the UE.
- The USN9810 identifies a high-speed GGSN that supports DCNR using either of the following items:
  - Identifies a high-speed GGSN based on " +nc-nr" service field (for example, "x-3gpp-ggsn:x-gn+nc-nr") returned by a DNS server. If this field exists, the GGSN supports DCNR.
  - Identifies a high-speed GGSN based on " +nc-nr" service field (for example, "x-3gpp-ggsn:x-gn+nc-nr") returned by a DNS server. If this field exists, the GGSN supports DCNR.

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Network Interworking (SGSN/MME)

- The CloudUSN supports the interworking between LTE and GSM and between LTE and GSM. The main processes are as follows:
  - Network reselection between LTE and UMTS
  - Network reselection between LTE and GSM
  - PS handover between LTE and UMTS

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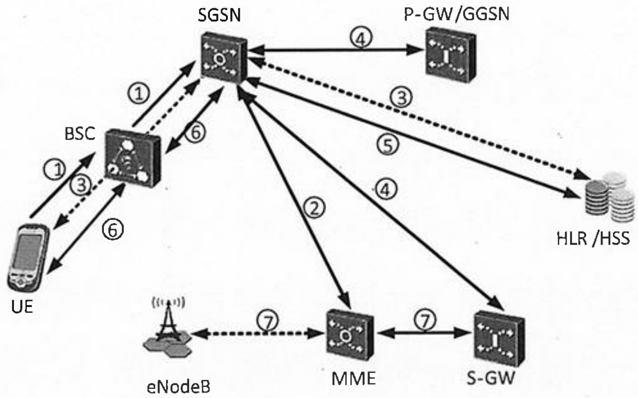
Network Interworking – Network Reselections Between LTE and GSM Networks (1)



Working principle of the cell reselection from an LTE network to a GSM network

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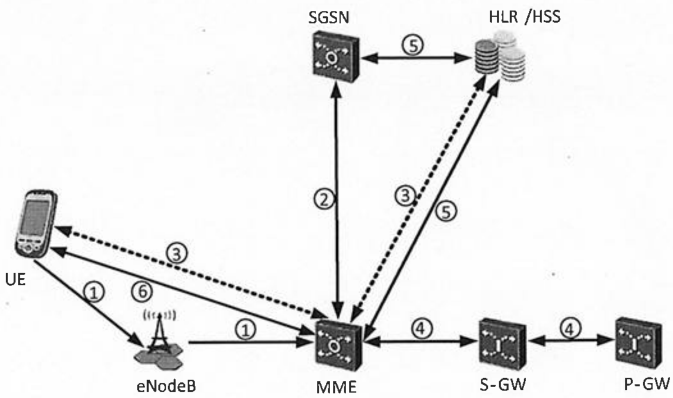
Network Interworking – Network Reselections Between LTE and GSM Networks (2)



Working principle of the cell reselection from a GSM network to an LTE network

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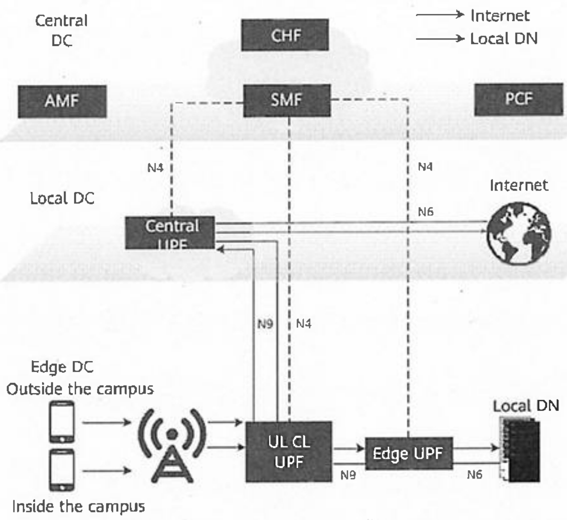
Traffic Steering Policy Control Based on Predefined or Dynamic Rules

- 3GPP defines an uplink classifier (UL CL) function for distributing 5G user plane data. The UL CL identifies data flows destined for the local data network (DN) based on service characteristics, and distributes them to the local DN close to subscribers and other service flows bound for the Internet.
- When a UE session is activated or its location is changed, the SMF determines whether UE traffic is destined for the local DN based on the UE data network name (DNN), location, and data network access identifier (DNAI). If it is, the SMF selects a UL CL UPF+secondary PDU session anchor (PSA) UPF, inserts the UL CL UPF+secondary PSA UPF into the current session, and delivers a data traffic steering rule to the UL CL UPF.



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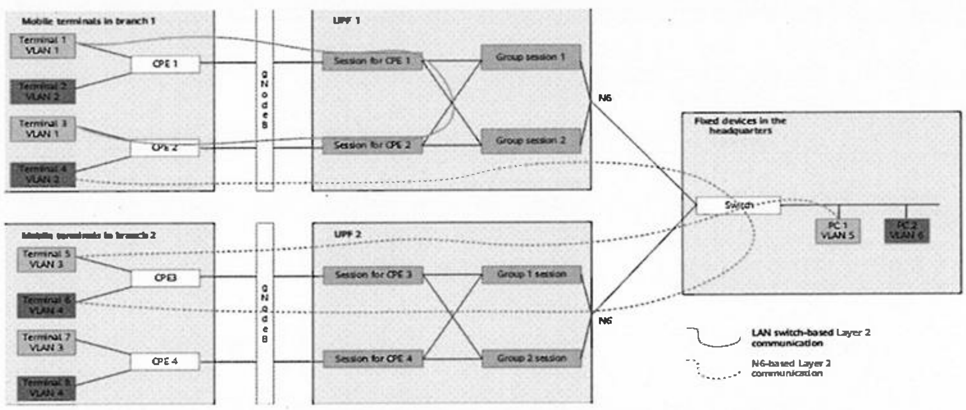
5G LAN

- The 5G Local Area Network (LAN) provides Ethernet communication services for specific groups of industry user terminals. It is a native virtual Ethernet LAN on 5G networks and is as widely used as wired LANs. 5G LAN enables buildout of LANs through 5G technologies. It provides high bandwidth, low latency, and high reliability of 5G with simple networking, full-mesh communication, and easy maintenance and reconstruction of LANs.



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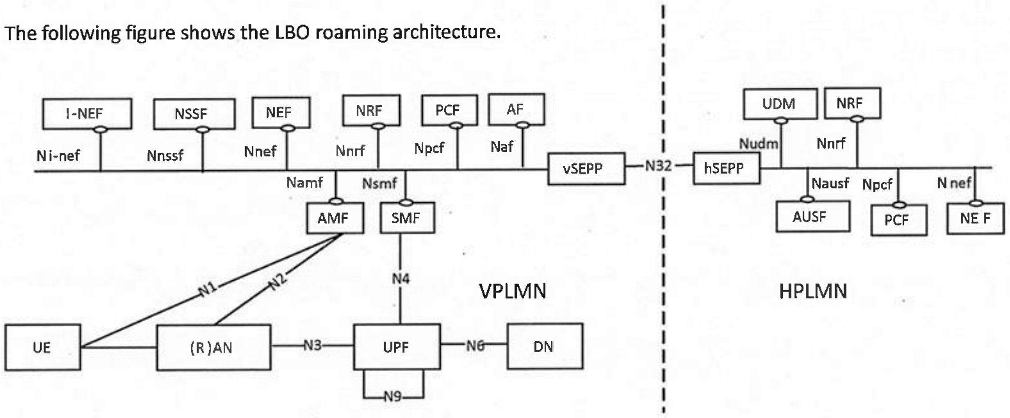
Supporting SA International Roaming Access (3)

- There are two 5G roaming architectures: LBO and HR.
- The following figure shows the LBO roaming architecture.



3GPP 5G SA LBO roaming architecture

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Supporting SA International Roaming Access (4)

- Table 1 describes the differences between HR roaming and LBO roaming.

Item	HR	LBO
Solution overview	The VPLMN allows the access of roaming subscribers and provides access policies, whereas the HPLMN provides subscription data, policies, and the session anchor. The home SMF (H-SMF) establishes connections to external data networks (DNs).	The VPLMN allows the access of roaming subscribers and provides access policies, as well as the session anchor, whereas the HPLMN provides subscription data and policies. The VPLMN forwards all user plane traffic of these subscribers.
Charging capability	Subscribers can be charged in either the HPLMN or VPLMN.	Subscribers can be charged only in the VPLMN. Charging reconciliation between the visited and home networks is not supported.
Transmission path	Data travels far, requiring large inter-PLMN user bandwidth.	The user transmission path is short. Inter-PLMN transmission requires only signaling bandwidth and does not require data bandwidth.
User experience	Common	Better

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Summary

1. Background
   - 5GC introduces SBA. NFs are deployed using microservices and containers for agile software capabilities to accelerate network deployment cost-effectively and efficiently, meeting different service requirements.
2. Product highlights
   - Fully converged product that provides various NF functions and their combinations through orchestration, such as AMF, SMF, MME, SMSF, and NCG.
   - Agile architecture: SBA enables different NF instances to share microservices to support microservice-level upgrade and release.
   - Network autonomy: The NRF enables automatic NF on-boarding, registration, and discovery.
3. Functions
   - Unified management and O&M of NFs, improving the O&M efficiency
   - Sharing of computing, memory, and storage resources of each NF, improving the resource utilization efficiency

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Acronyms and Abbreviations

- AMF: Access and Mobility Management Function
- SMF: Session Management Function
- NRF: Network Repository Function
- NSSF: Network Slice Selection Function
- SMSF: Short Message Service Function
- NCG: Next-Generation Charging Gateway
- NF: Network Function

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UNC (MME/SGSN) Basic Data Configuration

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Objectives

- Upon completion of this course, you will be able to:
  - Configure the OM interface for the UNC.
  - Configure local office data for the UNC.
  - Configure IP data for the UNC.
  - Configure DNS data for the UNC.

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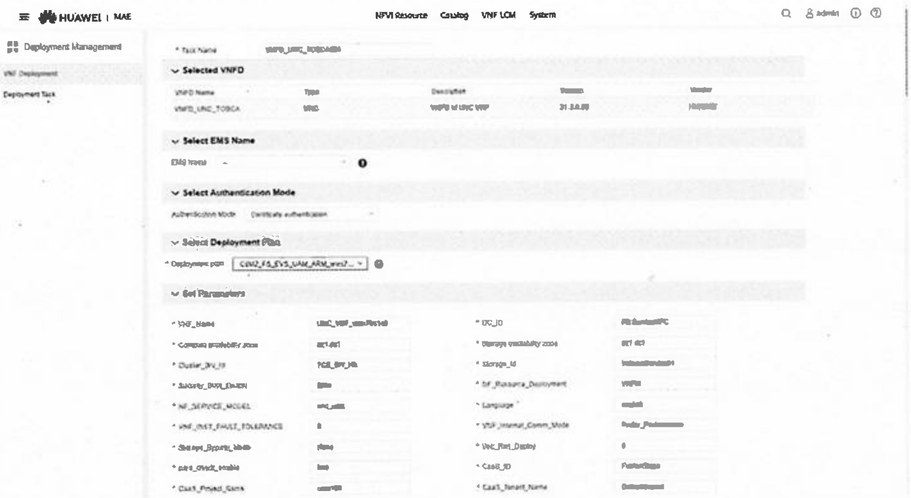
Configuring the OM Interface

- Use Internet Explorer to log in to the MAE. Choose **VNF LCM**.



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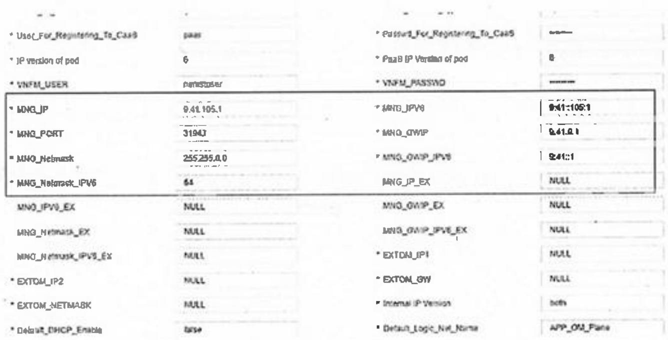
Configuring the OM Interface (Cont.)

MNG_IP MNG_Netmask MNG_GWIP

- For a pre-intergration solution, the OM interface is configured using a VNFD file according to the network plan.



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Local Office Data

- Before configuring service data, configure the local office data, that is, the attributes of the local MME.
- The basic data of the local office includes the system description, HPLMN, MME ID, and protocol version.

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Contents

3. Local Office Data Configuration

3.1 Concepts

3.2 Configuring Basic Data of the Local Office

3.3 Commissioning

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Configuring the MME ID

- Run **ADD MMEID** to configure an MME ID on the UNC.

  To add an MME node whose MCC is 460, MNC is 01, MMEGI is 8001, and MMEC is 01, run the following command:

  ADD MMEID: MCC="460", MNC="01", MMEGI="8001", MMEC="01";

Contents

2. Local Office Data Configuration

2.1 Concepts

2.2 Configuring Basic Data of the Local Office

2.3 Commissioning

MME ID

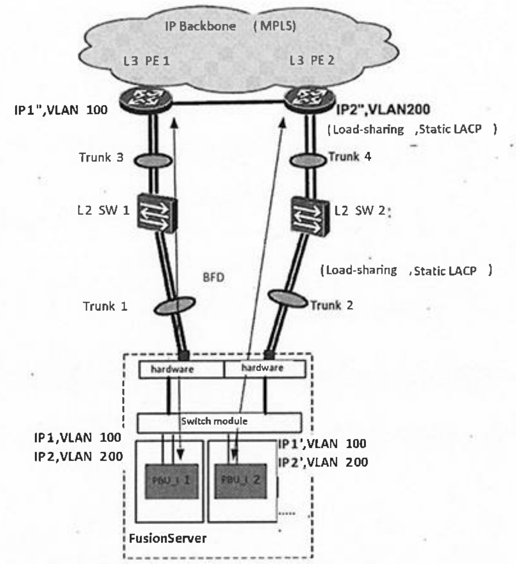
- List the MME ID configuration.
  - LST MMEID
- Modify the MME ID configuration (excluding the MCC, MNC, MMEGI, and MMEC).
  - MOD MMEID
- Remove the MME ID configuration.
  - RMV MMEID

Summary

- Local office data includes:
  - System data
  - HPLMN data
  - MME ID data

Dual Planes and Static Routes

- Physical interfaces are configured on PBU_I VMs.
- Logical interfaces are configured on PBU_C VMs.
- Service data is forwarded to external networks through switch modules.



Configuration Procedure

1. Query for the ID of the non-main-control VM (PBU_I).
   - DSP NODE:;
2. Configure a VPN instance.
   - ADD L3VPNINST:VRFNAME="VRF_CN";
   - ADD VPNINSTAF:VRFNAME="VRF_CN",AFTYPE=ipv4uni;

Example Configuration

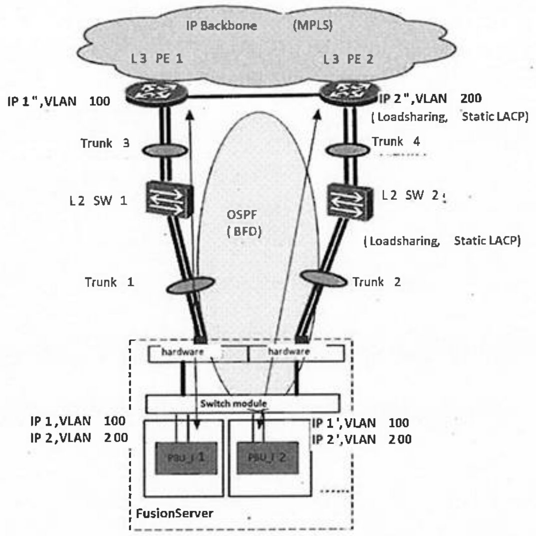
- Add a VPN instance.
  - ADD L3VPNINST:VRFNAME="VRF_CN";
  - ADD VPNINSTAF:VRFNAME="VRF_CN",AFTYPE=ipv4uni;
- Set the management status of the main interfaces to **up**.
  - MOD INTERFACE:IFNAME="Ethernet64/0/3",IFADMINSTATUS=up;
  - MOD INTERFACE:IFNAME="Ethernet65/0/3",IFADMINSTATUS=up;
- Add Ethernet sub-interfaces.
  - ADD INTERFACE:IFNAME="Ethernet64/0/3.4";
  - ADD INTERFACE:IFNAME="Ethernet64/0/3.5";
  - ADD INTERFACE:IFNAME="Ethernet65/0/3.4";
  - ADD INTERFACE:IFNAME="Ethernet65/0/3.5";

Example Configuration

- Bind the Ethernet sub-interfaces to the VPN instance.
  - ADD IPBINDVPN:IFNAME="Ethernet64/0/3.4",VRFNAME="VRF_CN";
  - ADD IPBINDVPN:IFNAME="Ethernet64/0/3.5",VRFNAME="VRF_CN";
  - ADD IPBINDVPN:IFNAME="Ethernet65/0/3.4",VRFNAME="VRF_CN";
  - ADD IPBINDVPN:IFNAME="Ethernet65/0/3.5",VRFNAME="VRF_CN";
- Associate each Ethernet sub-interface with a VLAN ID.
  - ADD ETHSUBIF:IFNAME="Ethernet64/0/3.4",VLANTYPEVID=100;
  - ADD ETHSUBIF:IFNAME="Ethernet64/0/3.5",VLANTYPEVID=200;
  - ADD ETHSUBIF:IFNAME="Ethernet65/0/3.4",VLANTYPEVID=100;
  - ADD ETHSUBIF:IFNAME="Ethernet65/0/3.5",VLANTYPEVID=200;
- VLAN configurations need to be manually adjusted on the switch modules and switches so that trunks allow packets of different VLANs to pass through under single-plane and dual-plane configurations.

Dual Planes and Dynamic OSPF

- Physical interfaces are configured on PBU_I VMs.
- Logical interfaces are configured on PBU_C VMs.
- Service data is forwarded to external networks through 1E/4E switch modules.



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Configuration Procedure

1. Query for the ID of the non-main-control VM (PBU_I).
   - DSP NODE:;
2. Configure a VPN instance.
   - ADD L3VPNINST:VRFNAME="VRF_CN";
   - ADD VPNINSTAF:VRFNAME="VRF_CN",AFTYPE=ipv4uni;

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Configuration Procedure

3. Configure OSPF.
   - Add an OSPF process.
     - ADD OSPF:PROCID=7,VRFNAME="VRF_CN ",SCHEMAROUID="18.3.30.210";
   - Add an OSPF area.
     - ADD OSPFAREA:PROCID=7,AREAID="0.0.0.0";
   - Specify the authentication mode.
     - ADD OSPFAREAAUTH:PROCID=1,AREAID="0.0.0.0",AUTHENMODE=keychain,KEYCHAINNAME="KcName1";
   - Add an interface that runs OSPF.
     - ADD OSPFNETWORK:PROCID=7,AREAID="0.0.0.0",IPADDRESS="192.168.115.81",WILDCARDMASK="0.0.0.3";

Example Configuration

- Add a VPN instance.
  - ADD L3VPNINST:VRFNAME="VRF_CN";
  - ADD VPNINSTAF:VRFNAME="VRF_CN",AFTYPE=ipv4uni;
- Set the management status of the main interfaces to **up**.
  - MOD INTERFACE:IFNAME="Ethernet64/0/3",IFADMINSTATUS=up;
  - MOD INTERFACE:IFNAME="Ethernet65/0/3",IFADMINSTATUS=up;
- Add Ethernet sub-interfaces.
  - ADD INTERFACE:IFNAME="Ethernet64/0/3.4";
  - ADD INTERFACE:IFNAME="Ethernet64/0/3.5";
  - ADD INTERFACE:IFNAME="Ethernet65/0/3.4";
  - ADD INTERFACE:IFNAME="Ethernet65/0/3.5";

Example Configuration

ADD OSPFAREA:PROCID=7,AREAID="0.0.0.0";

MOD OSPFINTERFACE:PROCID=7,AREAID="0.0.0.0",IFNAME="Ethernet64/0/3.4",DRPRI=0, VIRTUALSYSFLAG=TRUE;

MOD OSPFINTERFACE:PROCID=7,AREAID="0.0.0.0",IFNAME="Ethernet64/0/3.5",DRPRI=0, VIRTUALSYSFLAG=TRUE;

MOD OSPFINTERFACE:PROCID=7,AREAID="0.0.0.0",IFNAME="Ethernet65/0/3.4",DRPRI=0, VIRTUALSYSFLAG=TRUE;

MOD OSPFINTERFACE:PROCID=7,AREAID="0.0.0.0",IFNAME="Ethernet65/0/3.5",DRPRI=0, VIRTUALSYSFLAG=TRUE;

ADD OSPFNETWORK:PROCID=7,AREAID="0.0.0.0",IPADDRESS="192.168.115.81", WILDCARDMASK="0.0.0.3";

ADD OSPFNETWORK:PROCID=7,AREAID="0.0.0.0",IPADDRESS="192.168.115.97", WILDCARDMASK="0.0.0.3";

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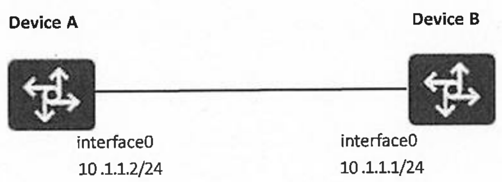
BFD Configuration

- Bidirectional Forwarding Detection (BFD) provides low overhead and rapid detection of failures in the paths between two network devices.



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1. OM Interface Configuration
2. Local Office Data Configuration
3. IP Data Configuration
4. **DNS Data Configuration**

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Contents

5. DNS Data Configuration
   5.1 Basic Concepts
   5.2 Configuring Interconnection with the DNS Server
   5.3 Local DNS Data Configuration

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DNS Server Functions (4G)

- The domain name resolution service is required in the following scenarios:
  - Resolve the P-GW IP address during the attach and PDN connectivity procedures.
  - Resolve the old MME address in the inter-MME TAU or GUTI attach procedure.
  - Resolve the old MME address in the inter-MME handover procedure.
  - Resolve the S-GW address in the attach, TAU, and handover procedures.
- The domain name can be resolved using:
  - The local host information table HOSTFILE.
  - Local DNS cache.
  - DNS server

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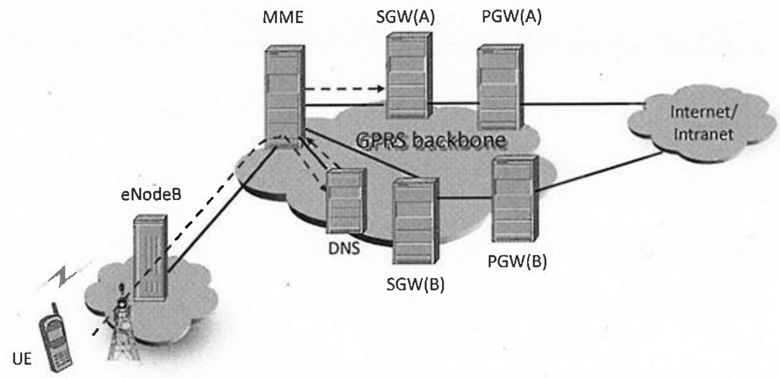
DNS Server Functions (4G)



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DNS Resolution Procedure (4G)

1. FQDN is used and query type is obtained.
2. The MME queries the hostfile on the UNC for related records.
3. If no record is available, the SGSN searches for the record in the DNS cache.
4. If no record is available, the SGSN sends a DNS resolution request to the DNS server.

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Contents

5. DNS Data Configuration

 5.1 Basic Concepts

 5.2 Configuring Data for Interconnection with the DNS Server

 5.3 Local DNS Data Configuration

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Example Configuration

Category	Parameter Name	Value
Service IP parameters	IP Version (IPVERSION)	IPv4
	Service IPv4 Address (SERVICEIPV4)	193.254.140.17 and 10.10.1.3
	VPN Instance Name (VPNINSTNAME)	VPN_CN
DNS data	IP Address (IP)	212.176.152.1 and 212.176.153.1
	DNS Server Priority (PRI)	PRI1 and PRI2

Example Configuration

1. Ensure that route configurations for the S10 interface are completed on the MME,
2. Add service IP addresses.
   - On the UNC, configure service IP addresses.
   - ADD SERVICEIP: IPVERSION=IPv4, SERVICEIPV4="193.254.140.17", VPNINSTNAME="VPN_CN";
   - ADD SERVICEIP: IPVERSION=IPv4, SERVICEIPV4="10.10.1.3", VPNINSTNAME="VPN_CN";
3. Configure DNS data.
   - Configure the DNS client.
     - ADD DNSLE:IPT=IPV4,IPV4="193.254.140.17",LOCPORT=15001, VPNNAME="VPN_CN", LENAME="Dnsle";
     - ADD DNSLE:IPT=IPV4,IPV4="10.10.1.3",LOCPORT=15001,VPNNAME="VPN_CN", LENAME="Dnsle";
   - Configure two DNS servers. The IP addresses are 212.176.152.1 and 212.176.153.1 and the priorities are PRI1 and PRI2.
     - ADD DNSS: IP="212.176.152.1", PRI=PRI1;
     - ADD DNSS: IP="212.176.153.1", PRI=PRI2;
4. Set DNS running parameters.
   - SET DNS: DDS=ON, DDI=10, SFT=5, FAILTM=0, RCUPDTM=0;

Step 1: Configure the DNSQ.

- ADD DNSQ
  - Add a domain name suffix.
    - ADD DNSQ: SUBRANGE=All, DNSUF="gprs", DNSQUERYMODE=AAAA/A, GROUPID=0;
  - Add an IMSI prefix and a domain name suffix.
    - ADD DNSQ: SUBRANGE=SPECIFY, IMSIPRE="46000", DNSUF="org", DNSQUERYMODE=NAPTR, GROUPID=0;

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Step 2: Configure Host File (2G/3G)

- ADD IPV4DNSH
  - ADD IPV4DNSH: HSINDEX=1, HOSTNAME ="mobile.MNC000.MCC460.GPRS", ADDRSECTION=SECTION1, ADDR1="211.13.1.1";
    - The domain name configuration in the Hostfile includes:
      - APN
        - ~ **Mobile.MNCYYY.MCCZZZ.GPRS**
      - Neighboring cell RA
        - ~ **RACAAAA.LACBBBB. MNCYYY.MCCZZZ.GPRS**
      - Neighboring RNC ID
        - ~ **RNCXXX. MNCYYY.MCCZZZ.GPRS**

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Summary

- DNS data configuration includes:
  - Data for interworking with the DNS server
  - Local DNS resolution data

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1. OM Interface Configuration
2. Local Office Data Configuration
3. IP Data Configuration
4. DNS Data Configuration

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UNC
MME Service Data Configuration

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Objectives

- Upon completion of this course, you will be able to:
  - Understand the basic concept of S1-MME/S6a/S10/S11/ESM/EMM.
  - Understand the protocol stack of S1-MME/S6a/S10/S11.
  - Finish the configuration and commissioning of S1-MME/S6a/S10/S11/ESM/EMM.

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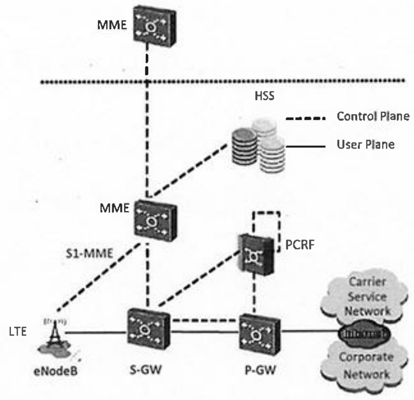
S1-MME Interface



The S1-MME interface is a control plane interface between an eNodeB and an MME. It is used to control E-UTRAN radio access bearer (E-RAB) information and signaling links between UEs and the network and to transparently transmit non-access stratum (NAS) messages, ensuring reliable transmission over the wireless network.

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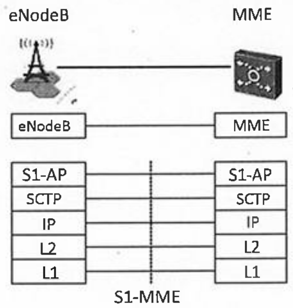
S1-MME Protocol Stack



- The S1-MME protocol stack shown in the figure above is based on an IP network. It uses Stream Control Transmission Protocol (SCTP) as a transport-layer protocol and S1-AP as an application-layer protocol.

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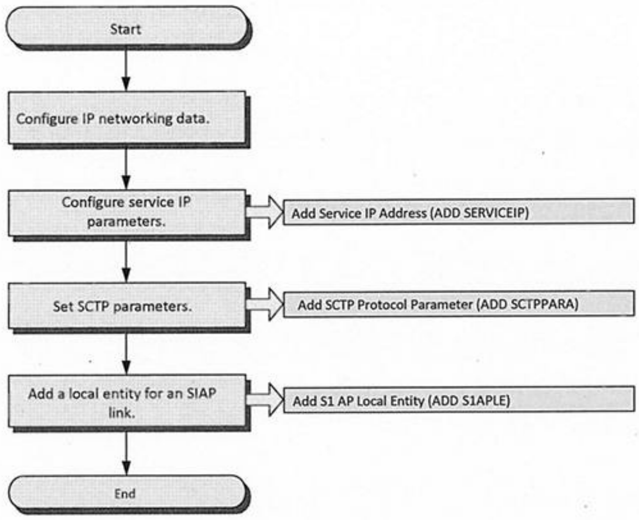
S1-MME Interface Configuring Procedure



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S1 Interface Data Planning

Category	Parameter	Example Value
S1AP local entity data	VPN Name (VPNNAME)	s1mme
	Local IPv4 Address 1 (LOCALIPV4_1)	193.254.140.17
	Local IPv4 Address 2 (LOCALIPV4_2)	193.254.140.18
	Local Port No. (LOCALPORT)	36412

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Configure Local Entity for S1AP Link

- Add a local entity for the S1AP link.
  - ADD S1APLE: LLEINDEX=1, IPTYPE=TPTADDR_TYPE_IPV4, LOCALIPV4_1="193.254.140.17", LOCALIPV4_2="193.254.140.18", LOCALPORT=36412, CROSSIPFLAG=NO, SCTPINDEX=1, LLNAME="To-eNodeB", VPNNAME="s1mme";

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Contents

1. **S1-MME Interface Data Configuration**

   1.1 Background

   1.2 Data Configuration

   1.3 Commissioning

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Checking the Paging Table

- Check the paging table.
  - For example, run the following command to check the paging table with the base station ID of 69665:
  - LST S1PAGING: MCCMNC="46003",ENODEBTYPE=MACRO_ENB, ENODEBID=69665, SERVICETYPE="USN_VNFC";

```
%%LST S1PAGING: MCCMNC="46003", ENODEBTYPE=MACRO_ENB, ENODEBID=69665, SERVICETYPE="USN_VNFC";%%
RETCODE = 0  Operation Success.

The result is as follows
------------------------
               RU Name  =  USN_SP_RU_0065
           Process No.  =  3
               MCC_MNC  =  46003
       eNodeB ID type  =  MACRO_ENB
            eNodeB ID  =  69665
     Tracking area ID  =  460031102
             RAT-Type  =  NB-EUTRAN
NB-IoT Default Paging DRX = 1.28s
(Number of results = 1)
---    END
```


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Summary

- S1-MME interface data configuration includes:
  - IP configuration: service IP addresses and IP routes
  - SCTP configuration: SCTP parameter setting
  - S1-AP configuration: S1-AP local entity

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2.1.2 Diameter Protocol

2.1.3 SCTP Protocol

2.1.4 S6a Interface Operating Principle

2.1.5 Distributed HSS Networking

2.2 Data Configuration

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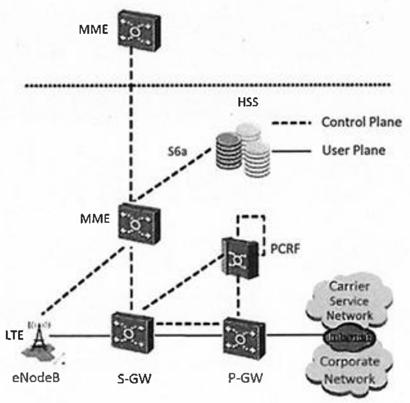
S6a Interface



- The S6a interface is a standard interface between the MME and the HSS on an EPC network.
- In compliance with the Diameter protocol, the S6a interface transfers subscription and authentication data between the HSS and the MME over the IP network.

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S6a Interface Function Description

- Location management: allows updating location, deleting subscription data, and clearing UE information.
- User data processing: allows inserting or deleting user subscription data.
- User authentication: allows retrieving authentication information.
- Fault rectification: allows resetting the S6a interface.
- Notification: allows the MME to report the updated UE and location information to the HSS.

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S6a Interface Networking - SCTP Multi-Homing + Dual Active Ports

Category	Parameter	Value
VPN instance	VPN Instance Name (VPNINSTNAME)	sigvrf
External interface	Interface Name (IFNAME)	Ethernet 65/0/2, Ethernet 66/0/2
	IPv4 Address (IFIPADDR)	10.65.39.77, 10.65.39.78
	IPv4 Address Mask (SUBNETMASK)	255.255.255.240
Static route	Address (IPADDRESS)	200.80.47.4, 200.80.47.5
	Next Hop (NEXTHOP)	10.65.39.66
	Route Mask Length (MASKLENGTH)	24
BFD	Session Name (SESSNAME)	bfdsig
	IPv4 Destination Address (DESTADDR4)	200.80.47.4, 200.80.47.5
	VPN Name (VPNNAME)	sigvrf
	Outbound Interface Name (IFNAME)	Ethernet 65/0/2, Ethernet 66/0/2
	IPv4 Source Address (SRCADDR4)	10.65.39.77, 10.65.39.78
	Minimum Transmit Interval (ms) (MINTXINT)	300
	Minimum Receive Interval (ms) (MINRXINT)	300
SCTP parameters	SCTP protocol parameter Index (SCTPPARAINDEX)	2
	IPv4 MTU size (IPV4MTU)	1500
	IPv6 MTU size (IPV6MTU)	1280

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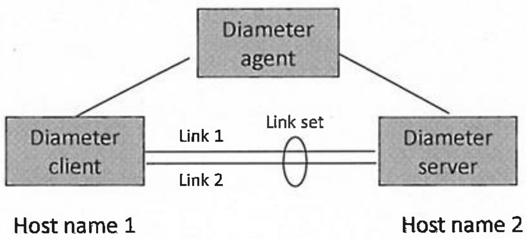
Introduction to the Diameter Protocol

- As an E2E protocol, the Diameter protocol transports and manages data including user location information, subscription data, and authentication data between the MME and the HSS using the SCTP protocol over an IP network.
- The Diameter protocol consists of the base protocol and the application.

Diameter Entity

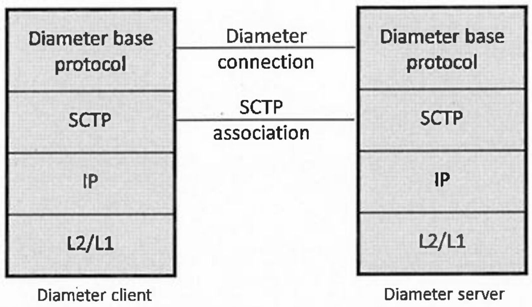
- Diameter client: sends request messages.
- Diameter server: receives and processes request messages.
- Diameter proxy: forwards Diameter messages.



The Diameter protocol entity is identified by the host name.

Diameter Connection Management

- The Diameter connection refers to the protocol links between two Diameter entities. The connection management consists of the following functions:
  - Diameter connection setup
  - Diameter connection detection
  - Diameter connection release



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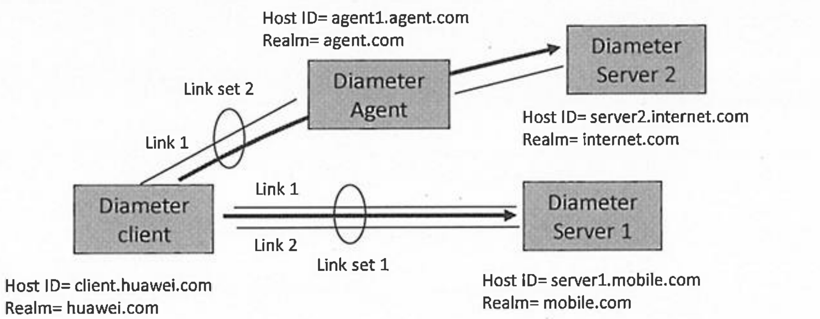
Diameter Routing Management



Route 1:
Destination host: server1.mobile.com
Destination realm: mobile.com
Peer entity: server1.mobile.com
Link set number: 1
Link number: 1 or 2

Route 2:
Destination host: server2.internet.com
Destination realm: internet.com
Peer entity: agent1.agent.com
Link set number: 2
Link number: 1

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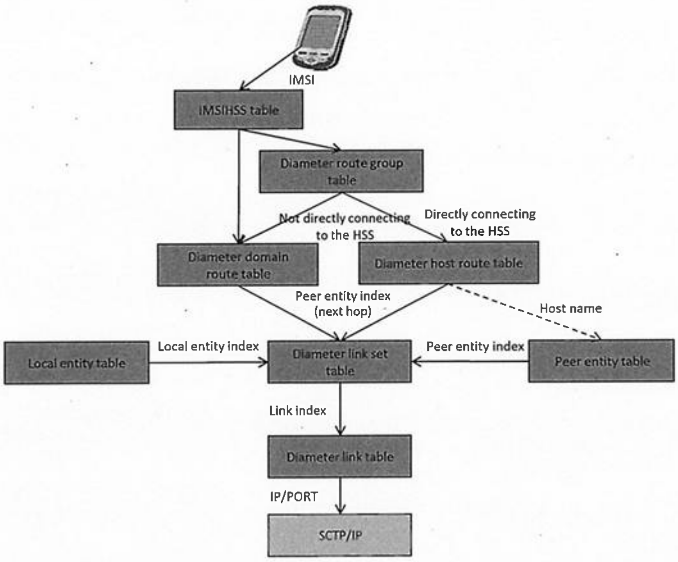
Operating Principles of the Diameter Protocol

1. If no record is found in the IMSIHSS mapping table, the MME automatically assembles a domain name.
2. If no Diameter route group index is found in the IMSIHSS table, the MME automatically queries the Diameter domain route table based on the domain name.



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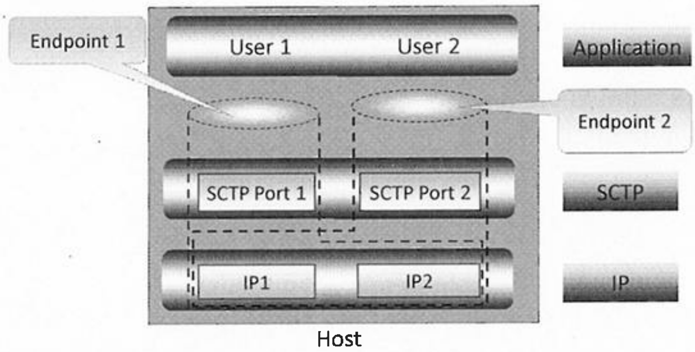
Host and Endpoint

Host: A host is configured with one or more IP addresses. It is a typical physical entity.

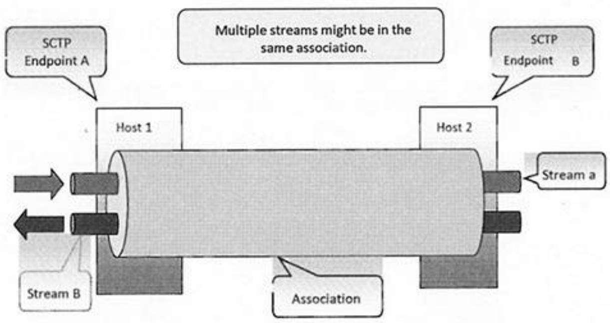
SCTP endpoint: Endpoint is one of basic concepts of SCTP. An endpoint is the logical sender/receiver of SCTP packets. It is a typical logical entity.



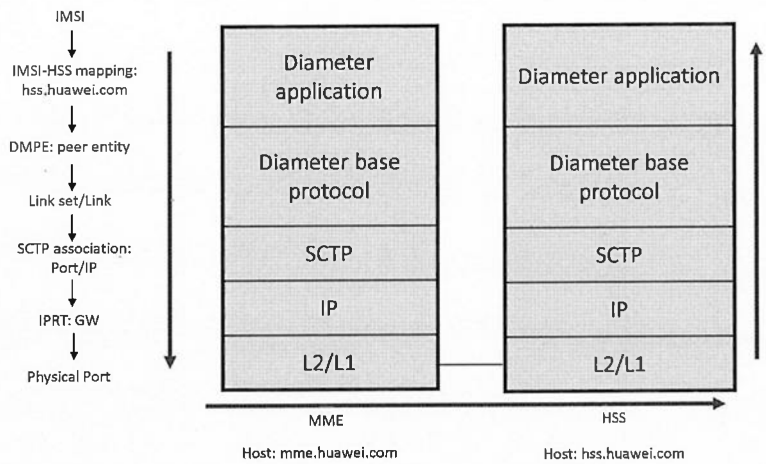
Association and Stream

Association:
An association is the logic relationship, or channel, established between two SCTP endpoints for data transmission, through the four-way handshake mechanism prescribed in SCTP.

Stream:
In an SCTP association, stream is a uni-directional logical channel established from one endpoint to the other associated endpoint.
The data to be delivered in sequence must be conveyed within a single stream.



Direct Connection



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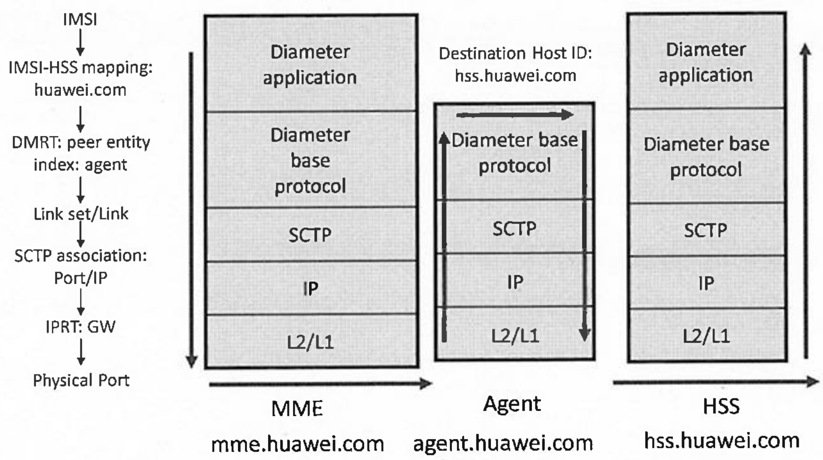
Indirect Connection with the Configured Mapping Between the IMSI and the HSS



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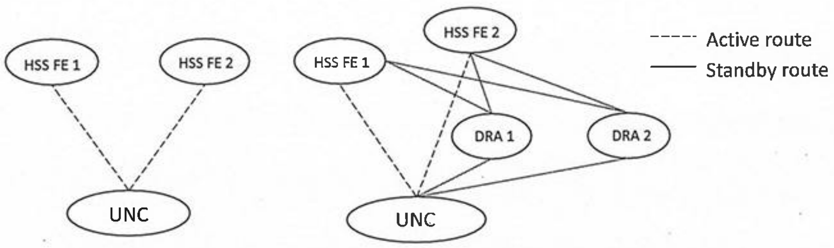
Background



- A distributed HSS is equipped with multiple FEs. The UNC can connect to multiple FEs of the HSS.
- Large carriers plan the same domain name for their HSSs. FEs can be distinguished by host name.
- The UNC connects to the HSS in direct or DRA quasi-direct mode.

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Description

- The UNC can connect to multiple HSS FEs. The FEs share loads in active/standby, load sharing, N+1 backup, or priority/weight-based mode.
- When multiple distributed HSSs share the same domain name, the HSS FEs need to be grouped and the load sharing mode can vary with the FE group.
- The UNC connects to the HSS in direct or DRA quasi-direct mode.

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Data Planning (Cont.)

Category	Parameter	Value
HSS IP	HSS IP address	20.1.1.5/32
IP route	Gateway	10.1.1.1

Data Configuration Process

- The interface data can be hierarchically configured based on the interface protocol stack. The configuration process is as follows.

Configure SCTP parameters.

↓

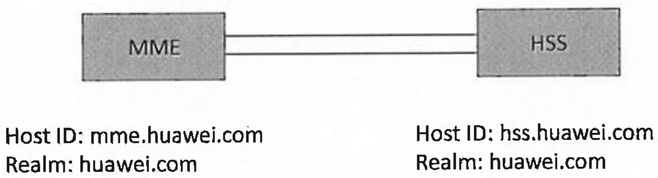
Configure Diameter parameters.

Step 2: Set SCTP Parameters

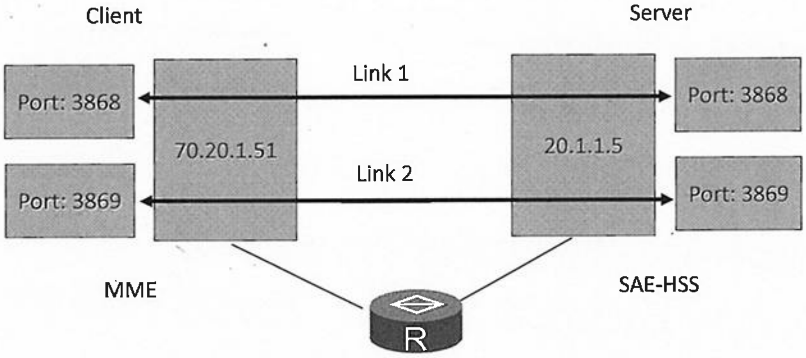
- Run **ADD SCTPPARA** to add protocol parameters for IP-based broadband signaling SCTP association.
- The default value **0** of **SCTPPARAINDEX** is already defined, which can be used without modification.
  - ADD SCTPPARA: SCTPPARAINDEX=1, SCTPPARANAME="For_S6a";

Step 3: Add a Diameter Local Entity

- Run **ADD DMLE** to add the Diameter local entity information.
  - ADD DMLE: LOINDEX=0, LOHSTNAME="mme.huawei.com", LORLMNAME="huawei.com", PDTNAME="MME", LOINFONAME="DMLE";



Step 6: Add a Diameter Link



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Step 6: Add a Diameter Link (Cont.)

- Run **ADD DMLNK** to add a Diameter link. The Diameter link is between the MME and the HSS.
  - **ADD DMLNK**: LINKIDX=1, IPTYPE=TPTADDR_TYPE_IPV4, PROTOTYPE=CONN_PROTOCOL_SCTP, LOCALIPV4_1="70.20.1.51", LOCALPORT=3868, PEERIPV4_1="20.1.1.5", PEERPORT=3868, CLIORSER=DIAM_CONN_CLIENT, LINKSIDX=1, SCTPINDX=1, LINKNAM="LINK1", CROSSIPFLAG=NO;
  - **ADD DMLNK**: LINKIDX=2, IPTYPE=TPTADDR_TYPE_IPV4, PROTOTYPE=CONN_PROTOCOL_SCTP, LOCALIPV4_1="70.20.1.51", LOCALPORT=3869, PEERIPV4_1="20.1.1.5", PEERPORT=3869, CLIORSER=DIAM_CONN_CLIENT, LINKSIDX=1, SCTPINDX=1, LINKNAM="LINK2", CROSSIPFLAG=NO;

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Step 8: Add IMSI-HSS Mapping

- Run **ADD IMSIHSS** to add the mapping between the IMSI and HSS.
  - **ADD IMSIHSS**: IMSIPRE="46001", HSSRLM="huawei.com", GRPIDX=0, MNNAME="mnn1";

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2. S6a Interface Data Configuration

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2.2 Data Configuration

2.2.1 Direct Connection to a Non-distributed HSS

2.2.2 Direct Connection to a Distributed HSS

2.2.3 Connection to an HSS Through a DRA

2.3 Commissioning

Configuration Example

1. Configure Diameter links.

//Only peer entity configurations are listed here.

ADD DMPE: PEERIDX=0, PEERHTNAM="hss1.epc.mnc015.mcc234.3gppnetwork.org", PEERNAM="HSS FE1";

ADD DMPE: PEERIDX=1, PEERHTNAM="hss2.epc.mnc015.mcc234.3gppnetwork.org", PEERNAM="HSS FE2";

2. Configure a Diameter host route.

ADD DMHOSTRT: ROUTEIDX=0, RSELMODE=SELMODE_MASTER_SLAVE, PEERSEL=PEER_INDEX, PEERIDX=0, ROUTENAM="HSS FE1", PRIORITY=1;

ADD DMHOSTRT: ROUTEIDX=1, RSELMODE=SELMODE_MASTER_SLAVE, PEERSEL=PEER_INDEX, PEERIDX=1, ROUTENAM="HSS FE2", PRIORITY=2;

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Configuration Example

3. Configure a Diameter route group.

ADD DMRTGRP: GRPIDX=0, RTMODE=HOST_NAME_ROUTE, RTPRIMODE=HOST_NAME_ROUTE_PREFER, ROUTEIDX=0, ROUTEGRPNAM="To_HSS FE1";

ADD DMRTGRP: GRPIDX=0, RTMODE=HOST_NAME_ROUTE, RTPRIMODE=HOST_NAME_ROUTE_PREFER, ROUTEIDX=1, ROUTEGRPNAM="To_HSS FE2";

4. Configure the IMSI-HSS mapping.

ADD IMSIHSS: IMSIPRE="30800", HSSRLM="epc.mnc015.mcc234.3gppnetwork.org", GRPIDX=0;

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Configuration Example

1. Configure Diameter links.

//Only peer entity configurations are listed here.

ADD DMPE: PEERIDX=0, PEERHTNAM="dra1.epc.mnc015.mcc234.3gppnetwork.org", PEERNAM="DRA1";

ADD DMPE: PEERIDX=1, PEERHTNAM="dra2.epc.mnc015.mcc234.3gppnetwork.org", PEERNAM="DRA2";

2. Configure a Diameter domain route.

ADD DMRT: ROUTEIDX=0, RSELMODE=SELMODE_ROUND_ROBIN, REALMNAME="epc.mnc015.mcc234.3gppnetwork.org", PEERIDX=0, ROUTENAM="rt to dra1";

ADD DMRT: ROUTEIDX=0, RSELMODE=SELMODE_ROUND_ROBIN, REALMNAME="epc.mnc015.mcc234.3gppnetwork.org", PEERIDX=1, ROUTENAM="rt to dra2";

3. Configure the IMSI-HSS mapping.

ADD IMSIHSS: IMSIPRE="46000", HSSRLM="epc.mnc015.mcc234.3gppnetwork.org";

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Contents

2. S6a Interface Data Configuration

2.1 Background

2.2 Data Configuration

2.3 Commissioning

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Commissioning (Cont.)

Item	Command	Expected Result
Check the Diameter link set.	DSP DMLKS	The link set is normal.
Check the Diameter link status.	DSP DMLNK	The link is normal.
Check the Diameter route.	DSP DMRT	The route is normal.

```
%%DSP DMLKS:;%%
RETCODE = 0  Operate success

The result is as follows
------------------------
 Diameter links index  Linkset name  Linkset status

 0                     To-HSS0       UP
 1                     To-HSS1       DOWN
(Number of results = 2)
```

```
%%DSP DMLNK:;%%
RETCODE = 0  Operate success

The result is as follows
------------------------
Link No.   Link name   ND Name           Process No.   Link status

2          normal      USN_SP_BU_0066    1             UP
1          normal      USN_SP_BU_0066    3             DOWN
0          normal      USN_SP_BU_0066    4             DOWN
6          normal      USN_SP_BU_0066    2             DOWN
(Number of results = 4)
---    END
```

```
%%DSP DMRT:;%%
RETCODE = 0  Operate success

The result is as follows
----------------
Route index  Route name  Route status

0            TO-HSS0     UP
1            TO-HSS1     DOWN
(Number of results = 2)
---    END
```


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Summary

- S6a interface data configuration includes:
  - IP configuration: service IP and IP route
  - SCTP configuration: SCTP parameter setting
  - Diameter configuration: local entity, peer entity, link set, link, route, mapping of IMSIs and HSSs

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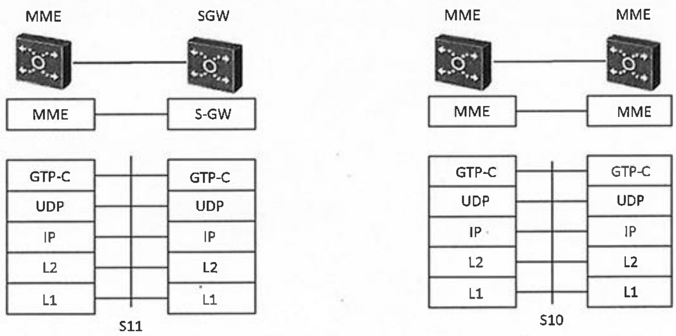
Introduction to S11/S10 Interface

- The S11 interface is a control plane interface between the mobility management entity (MME) and serving gateway (S-GW) in the EPC system. This interface is used to transmit and carry creation, update, and deletion requests and response messages between the MME and S-GW. In addition, when the UE is in the ECM-IDLE status, the S-GW uses this interface to instruct the MME to page the UE and restore the S1 bearer.
- The S10 interface is an interface between the MMEs in the EPC system. In the case of subscriber location handover, the interface is used to forward subscriber context information and handover signaling between MMEs.

S11/S10 Interface Protocol Stack



Introduction to the GTP-C Protocol

- GTP-C: stands for the GPRS tunneling protocol-control plane. This protocol is an S10/S11 interface protocol. The GTP-C protocol is used to transmit signaling messages such as mobility management and session management messages not only between MMEs but also between the MME and S-GW.
- At present, GTP-C protocol versions include GTP-Cv0, GTP-Cv1, and GTP-Cv2. The S10 and S11 interfaces support only GTP-Cv2.

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GTP-C Path and Tunnel

- GTP-C path: an internal logical concept in a GTP-C entity. The GTP-C entity determines a GTP-C path for channel status detection between GTP-C entities according to the local IP address, local UDP port number, peer IP address, peer UDP port number, and GTP-C version number.
- GTP-C tunnel: a session-level connection channel created when subscriber services are activated. As a tunnel identifier, the "IP address + TEID" is used to carry signaling transmission of designated sessions.
- A GTP-C path can carry multiple GTP-C tunnels.

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GTP-C Path Aging

- The GTP-C aging mechanism is used to delete a GTP-C path.
- A GTP-C path can record the tags for received and sent messages. If GTP-C signaling messages are not received or sent on a GTP-C path in the configured aging duration, aging occurs in the path.

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3. S10/S11 Interface Data Configuration

3.1 Background

3.2 S11 Interface Data Configuration

3.3 S10 Interface Data Configuration

Data Configuration Procedure

Step	Operation	Command
Configure IP parameters.		
1	Open the **MML Command - UNC** window.	N/A
2	Add a logical IP address.	ADD GTPCLE
3	Open the **VNRS_VNFC CLI** window.	N/A
4	Add an interface IP address.	For details, see *UNC (MME+SGSN) Basic Data Configuration.ppt*.
5	Add an OSPF route.	For details, see *UNC (MME+SGSN) Basic Data Configuration.ppt*.

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Data Configuration Procedure (Cont.)

Step	Operation	Command
(Optional) Configure GTP parameters.		
6	Set aging parameters of GTP-C path.	SET UGTP
7	Set GTP-C protocol parameters.	SET GTPPUB
8	Set GTP-C T3/N3 parameters.	SET T3N3
(Optional) Configure DNS resolution data.		
9	Add a DNS hostfile record.	ADD IPV4DNSH
10	Add a DNS NAPTR record.	ADD DNSN

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Steps 3, 4, and 5: Configure IP Interfaces and Routes

- For details, see "IP Data Configuration" *in UNC (MME+SGSN) Basic Data Configuration.ppt*.

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Step 6: Set Aging Parameters of GTP-C Path

- Run **SET UGTP** to configure GTP-C path aging parameters.
  - SET UGTP: ICI=180, SSI=60, MSI=60, GMSI=60;
- The system has already been configured with the default values the GTP-C path aging parameters. The default values can be used without modification.

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Step 9: Add a Hostfile Record

- Run **ADD IPV4DNSH** to add a hostfile record.
- **ADD IPV4DNSH**: HSINDEX=1, HOSTNAME="topon.s11.sgw.nodes ", ADDRSECTION=SECTION1, IPV4ADDR1="20.2.2.5";

Step 10: Add a DNS NAPTR Record

- Run **ADD DNSN** to add a NAPTR record.
- **ADD DNSN:** FQDN="tac-lb01.tac-hb11.tac.epc.mnc460.mcc003.3gppnetwork.org ", HSINDEX=7, ENTITY=MME, INTYPE=S10;

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3. S10/S11 Interface Data Configuration

3.1 Background

3.2 S11 Interface Data Configuration

3.3 S10 Interface Data Configuration

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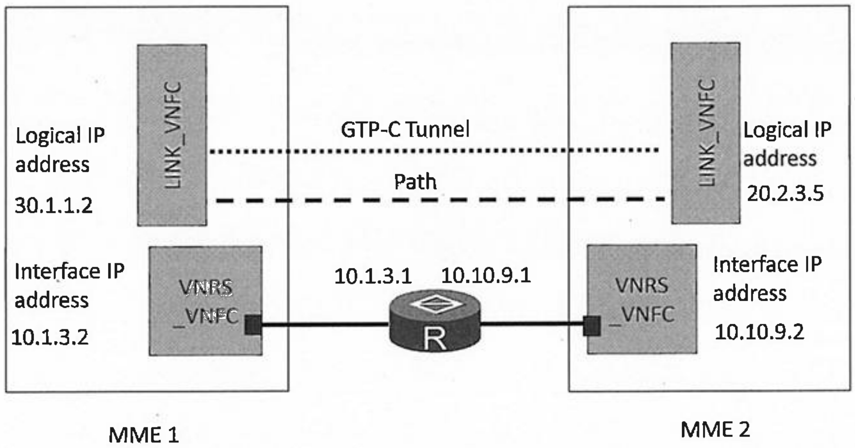
Networking



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Data Configuration Procedure

Step	Operation	Command
Configure IP parameters.		
1	Open the **MML Command - UNC** window.	N/A
2	Add a logical IP address.	ADD GTPCLE
3	Open the **VNRS_VNFC CLI** window.	N/A
4	Add an interface IP address.	For details, see *IP Data Configuration.ppt*.
5	Add an OSPF route.	For details, see *IP Data Configuration.ppt*.

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Data Configuration Procedure (Cont.)

Step	Operation	Command
(Optional) Configure GTP parameters.		
6	Set GTP-C parameters.	SET UGTP
7	Set GTP-C protocol parameters.	SET GTPPUB
8	Set GTP-C T3/N3 parameters.	SET T3N3
Configure DNS resolution data.		
9	Add a hostfile record.	ADD IPV4DNSH
10	Add a NAPTR record.	ADD DNSN

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Commissioning

Action	Command	Expected Result
Query the GTP-C path.	DSP GTPCPATH	The GTP-C path status is normal.

```
%%DSP GTPCPATH: RUNAME="LINK_SP_RU_0064", QRYTP=MEMORY, GTPVER=GTPv2, IPTYPE=IPV4, PATHST=ALL, PEERINTF=Gn-0&Gp-0&S10-1&S11-1&S16-0&S3-0&S4-0&Sm-0&Sv-0, SERVICETYPE="LINK_VNFC";%%
RETCODE = 0  Operation succeeded

The result is as follows
------------------------
                 RU Name  =  LINK_SP_RU_0064
            Process Type  =  UPP
             Process No.  =  0
(Number of results = 1)

The result is as follows
------------------------
            GTP Path Num  =  20
(Number of results = 1)

The result is as follows
------------------------
GTP Version  Local IP Address  Peer IP Address  Path Interface Type           Interface Between the PLMN Ne  GTP Path Status  GTP Path Attribute    Peer Recovery  Send Echo Request

GTPv2        102.3.41.12       182.100.206.109  Evolved Packet Core Network   S11 interface                  Normal           GTPC Path Management  NULL           Yes
GTPv2        102.3.41.12       182.100.206.106  Evolved Packet Core Network   S11 interface                  Normal           GTPC Path Management  NULL           Yes
GTPv2        102.3.41.12       182.100.206.103  Evolved Packet Core Network   S11 interface                  Normal           GTPC Path Management  NULL           Yes
GTPv2        102.3.41.12       182.100.206.102  Evolved Packet Core Network   S11 interface                  Normal           GTPC Path Management  NULL           Yes
```


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Summary

- S10/S11 interface data configuration includes:
  - Service IP configuration
  - IP route configuration
  - GTP parameter configuration: GTP-C path aging parameters, GTP-C public list, and T3/N3 parameters
  - DNS resolution data: hostfile record and NAPTR query record

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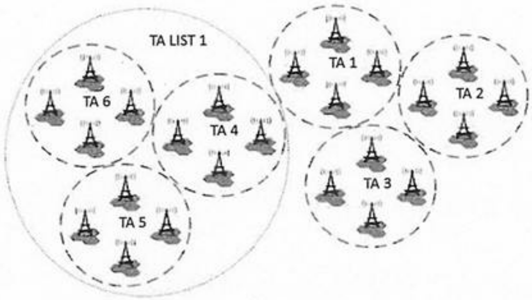
New Identifiers of the EMM

- Globally Unique Temporary UE Identity (GUTI)
  - Globally unique identifier that an MME provides for a UE
- Tracking Area Identity (TAI)
  - Identifier of a TA where a UE is located
- TA list



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Adding an MME Identifier

- Add a unique MME identifier (MMEID) on the public land mobile network (PLMN).
  - Add an MME identifier where MCC is set to 460, MNC is set to 01, MMEGI is set to 8001, and MMEC is set to 01.
  - ADD MMEID: MCC="460", MNC="01", MMEGI="8001", MMEC="01";

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Adding a TA List

- Add a TA list.
  - Add TA list 1 where TAI is set to 4600100010.
  - ADD TALST: TALISTID=1, TAI="4600100010"
- Appropriately set the TAs on the TA list to ensure proper paging scope.

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Configuring UE Security in S1 Mode

- ADD S1USRSECPARA
  - This command is used to configure UE security, such as the security policy, encryption algorithm, authentication events, and pre-retrieval of authentication vectors in S1 mode.
    - Configure security for all UEs.
      - MOD S1USRSECPARA: USRRANGE=DEFAULT, SECPLC=AUTHANDPROTECTED, SUPTINTAGTH=EIA0-1&EIA1-1&EIA2-1, OPTIONAL=NO;
    - (Optional) Configure security for UEs of a number segment.
      - ADD S1USRSECPARA: IMSIPRE="46000110", SECPLC=AUTHANDPROTECTED, SUPTINTAGTH=EIA0-1;

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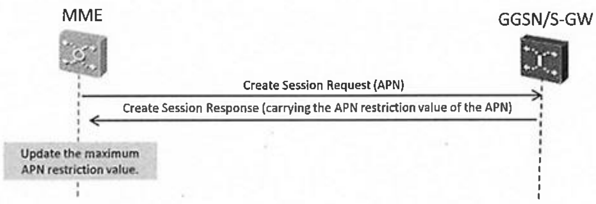
APN Restriction

- Function enabling
  - Run **SET SMFUNC: APNRES=YES** to enable this function.
  - The GGSN/S-GW must be configured.
- Function description
  - This function prevents a UE from concurrently using PDP contexts of public and private APNs to ensure network security.



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Summary

- EMM/ESM data configuration includes:
  - MMEI
  - EMM protocol parameters
  - TA List
  - UE security parameters
  - Access restriction
  - ESM parameters
  - APN restriction

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4.1

UNC
SGSN Service Data Configuration

www.huawei.com

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Objectives

- Upon completion of this course, you will be able to:
  - Understand the configuration of the local office data
  - Understand the basic concepts of the Gb/Iu/Gr/Gn/Ga interfaces
  - Understand the networking and protocol stacks of the Gb/Iu/Gr/Gn/Ga interfaces
  - Configure and commission the Gb/Iu/Gr/Gn/Ga interfaces

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Local Office Data

Before configuring service data, configure the local office data, that is, the attributes of the local SGSN, including basic data and SS7 data.

The basic data of the local office includes system description, time zone, HPLMN, MMEID, system time, and protocol version.

The SS7 data of the local office includes office type, signaling point code (SPC) of the local office, signaling network where the ME locates, signaling transfer point or not, and SCCP function supported or not.

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SS7 Network Identification

- There are four types of SS7 networks: International, International Reserve, National, National Reserve.
- The SGSN can be deployed in the four types of SS7 networks, but it is generally in at least two types of the networks.
- Different networks can be interworked by using a network element in these networks to transfer signaling.
- Before interworking an SS7 network, specify the type of the SS7 network.

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Contents

1. **Local office data configuration**

1.1 Concepts

1.2 SS7 Data Configuration of the Local Office

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Configuring SS7 Data of Local Office

Step	Action	Command
	SS7 data configuration of the local office	
1	Set the attributes of the signaling network	SET SIGATTR
2	Add the local entity of the M3UA (optional, configure the entity required only for SS7 over IP)	ADD M3LE
3	Add the SCCP signaling point of the local office	ADD SCCPOPC
4	Add the SCCP subsystem of the local office	ADD SCCPSSN
5	Add the GT translation data of the local office	ADD SCCPGT
6	Configure the MAP (optional, configure the parameter required when changing the MAP version and MAP function process option)	SET MAPFUNC

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Adding the SCCP Signaling Point of Local Office

- ADD SCCPOPC
  - The local office SGSN communicates with the HLR/RNC using the SCCP. Therefore, the SCCP signaling point of the local office must be configured.
  - The SCCP signaling point of the local office must be the configured signaling point: local office signaling point of the MTP3, local office signaling point of the MTP3B, or signaling point in the M3UA local entity.
  - Example
    - ADD SCCPOPC: OPX=1, NI=NAT, OPC="A00", SPN=COREONLY, SGSNN="8613900477", OPN="SGSN9810";
      - OPX
      - SGSNN
      - OPC
      - SPN

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Adding the SCCP Subsystem of Local Office

- ADD SCCPSSN
  - The subsystem is used to address upper-layer subscribers of the SCCP.
  - The local office must be configured with the following subsystems: SCMG, SGSN, RANAP (the RANAP is required when connected to the RNC), BSSAP+ (the BSSAP+ is required when connected to the MSC/VLR), and CAP (the CAP is required when connected to the SCP).
  - Example
    - ADD SCCPSSN: SSNX=0, SSN=SCMG, NI=NAT, DPC="A00", OPC="A00", SSNNAME="LOCAL SCMG";
      - SSN
      - NI
      - DPC
      - OPC

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Summary

- Local office data configuration includes:
  - Signaling network attributes
  - SCCP local signaling point and SCCP local subsystem
  - Local GT translation data

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1. Local office data configuration
2. **Gb interface data configuration**
3. Iu interface data configuration
4. Gr interface data configuration
5. Gn interface data configuration
6. Ga interface data configuration

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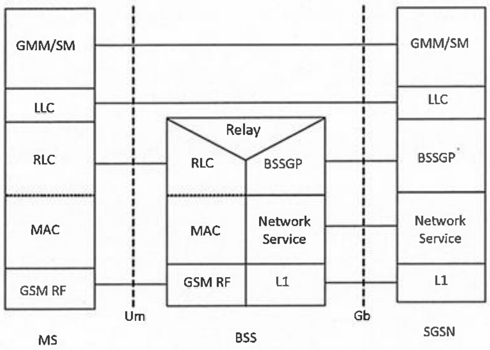
Protocol Stack of the Gb Interface in the Signaling Plane

- The protocol stack of the Gb interface in the signaling plane consists of GMM/SM, LLC, BSSGP, NS, and L1bis.



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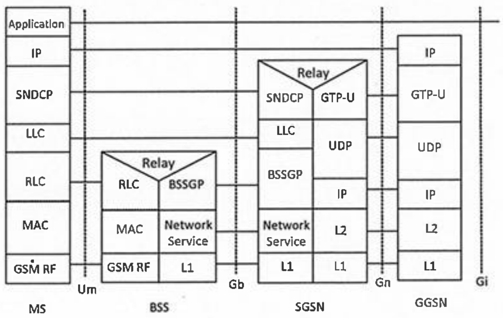
Protocol Stack of the Gb Interface in the User Plane

- The protocol stack of the Gb interface in the user plane consists of SNDCP, LLC, BSSGP, NS, and L1bis.



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2. Gb interface data configuration

2.1 Basic Concepts

2.2 Data Configuration

2.3 Commissioning

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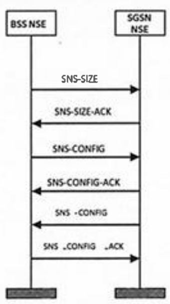
Gb over IP Configuration Mode

Configuration modes specified in 3GPP TS 48.016:

Administrative configuration

Auto-configuration



Configuration modes provided by the UNC:

Static configuration:
NSE: manual configuration
Local endpoint: manual configuration
Peer endpoint: manual configuration

Dynamic automatic configuration:
NSE: automatic configuration based on load sharing
Local endpoint: automatic configuration
Peer endpoint: automatic configuration

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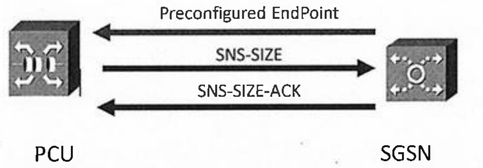
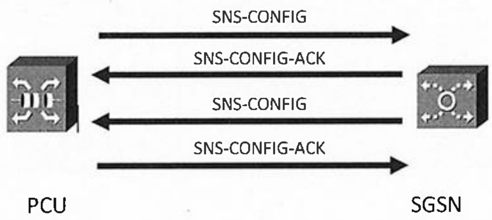
SIZE and Configuration Procedures





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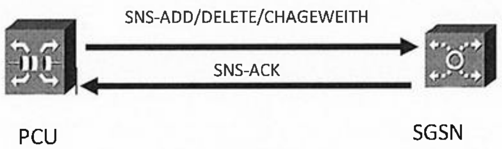
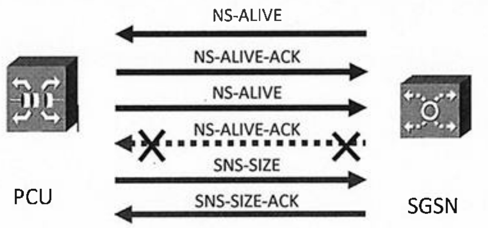
Modification and Test Procedures





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Add Service IP

- Configure and check the IP route or BFD on VNRS_NSVC.
- Configure service IP parameters.
  - Configure service IP parameters for the Gb interface.
  - ADD SERVICEIP: IPVERSION=IPv4, SERVICEIPV4="10.10.80.130", VPNINSTNAME="VRF_Access";
  - ADD SERVICEIP: IPVERSION=IPv4, SERVICEIPV4="10.10.80.131", VPNINSTNAME="VRF_Access";
  - ADD SERVICEIP: IPVERSION=IPv4, SERVICEIPV4="10.10.80.140", VPNINSTNAME="VRF_Access";
  - ADD SERVICEIP: IPVERSION=IPv4, SERVICEIPV4="10.10.80.141", VPNINSTNAME="VRF_Access";

Add the NSE Link Data (Static Configuration)

- Configure the NSE for interworking with each PCU. The bearer type of the NSE is IP; the configuration type is static configuration.
  - ADD NSE: OTHERNODE="PCU1", SGSNINDEX=0, NSEI=2740, BSSID=2740, PFC=YES, SPID=NO;
  - ADD NSE: OTHERNODE="PCU2", SGSNINDEX=0, NSEI=2740, BSSID=2740, PFC=YES, SPID=NO;

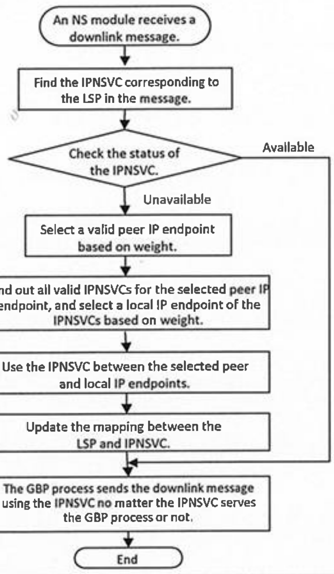
Add the NSE Link Data (Dynamic Automatic Configuration)

- Enable the automatic configuration function.
  - SET GB: AUTO=YES;
- Configure the IP address pool for the Gb interface
  - ADD GBEPPOOL: IPTYPE=IPV4, IPV4="10.10.80.130";
  - ADD GBEPPOOL: IPTYPE=IPV4, IPV4="10.10.80.131";
  - ADD GBEPPOOL: IPTYPE=IPV4, IPV4="10.10.80.140";
  - ADD GBEPPOOL: IPTYPE=IPV4, IPV4="10.10.80.141";
- Configure the port number range of the local endpoint to ensure that all ports in the range can be used.
  - SET GBLOCPORTRGE: PORTBGN=1024, PORTEND=10000, BEGINPRECFGPORT=2000, DESC="DEFAULT";

Add the NSE Link Data (Dynamic Automatic Configuration)

- Configure the mapping between BSSIDs and NSEIs related to the NSEs that are automatically reported.
  - SET BSSGP: BSSIDRULE=NSEI;
- Configure an NSE attribute template.
  - ADD GBNSECFGPARA: PARAINDEX=1, EPNUM=ONE;
  - ADD GBNSECFGPARA: PARAINDEX=2, EPNUM=TWO;

Gb over IP Traffic Sharing for GBP Processes



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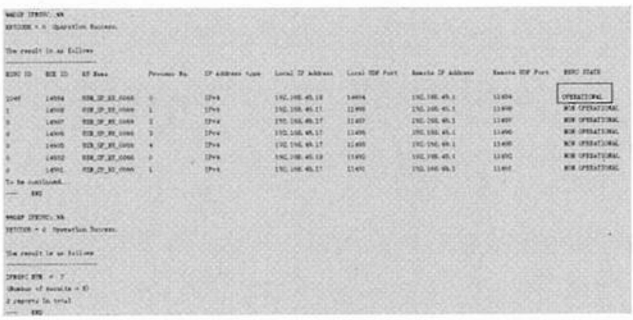
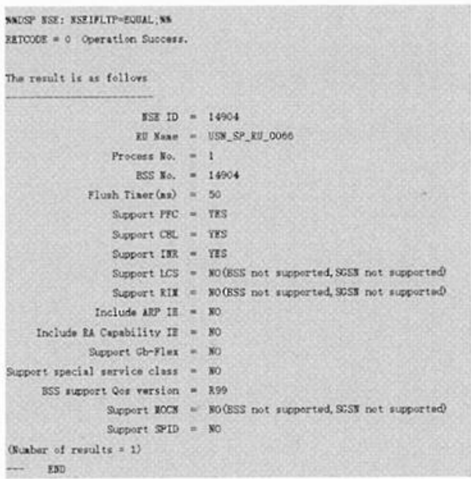
Gb over IP Interface Status Check

- Check whether the NSE is successfully negotiated (for dynamic automatic configuration only).
  - DSP NSE
- Check whether the IPNSVC is available.
  - DSP IPNSVC





```
%%DSP NSE: NSEIFLTP=EQUAL;%%
RETCODE = 0  Operation Success.

The result is as follows
------------------------
                       NSE ID  =  14904
                      RU Name  =  USN_SP_RU_0066
                  Process No.  =  1
                      BSS No.  =  14904
               Flush Timer(ms) =  50
                  Support PFC  =  YES
                  Support CBL  =  YES
                  Support INR  =  YES
                  Support LCS  =  NO(BSS not supported,SGSN not supported)
                  Support RIM  =  NO(BSS not supported,SGSN not supported)
               Include ARP IE  =  NO
     Include RA Capability IE  =  NO
              Support Gb-Flex  =  NO
Support special service class  =  NO
      BSS support Qos version  =  R99
                 Support MOCN  =  NO(BSS not supported,SGSN not supported)
                 Support SPID  =  NO
(Number of results = 1)
---    END
```

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Cell Information Check

Cell information check

- You can run the LST CELL command to obtain detailed information about cells of an NSE.
- LST CELL: OUTPUTTYPE=SCREEN, NSEI=1600;

Cell loss check

- On a 2.5G network, the PCU reports cells automatically. If a cell is lost, check whether it is reported using the following method:

(1) Use an LMT of the SGSN to trace the Gb interface and run the RST PTPBVC command to specify a cell identifier.

(2) If the cell identifier is recorded in a BVC_RESET_ACK message, the PCU reports the cell.

(3) If a cell is not recorded in the message, the PCU does not report the cell.

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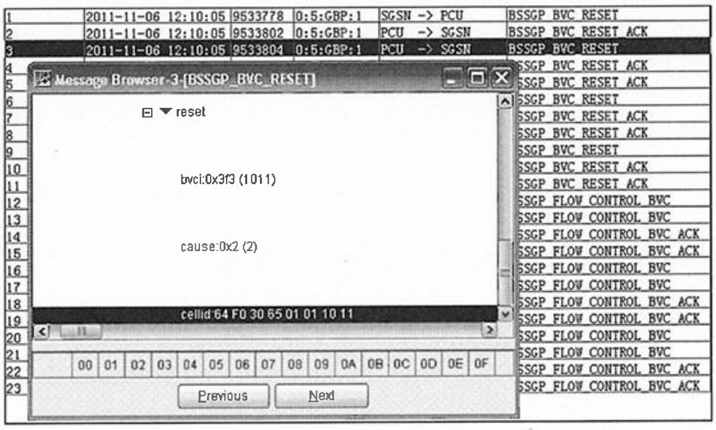
Cell Information Check

- Cell loss



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Summary

- Gb interface data configuration includes:
  - IP configuration: service IP addresses and IP routes
  - Local data configuration: local endpoint information of the Gb interface
  - Peer data configuration (static configuration involved): peer IP addresses and endpoints, and peer NSE

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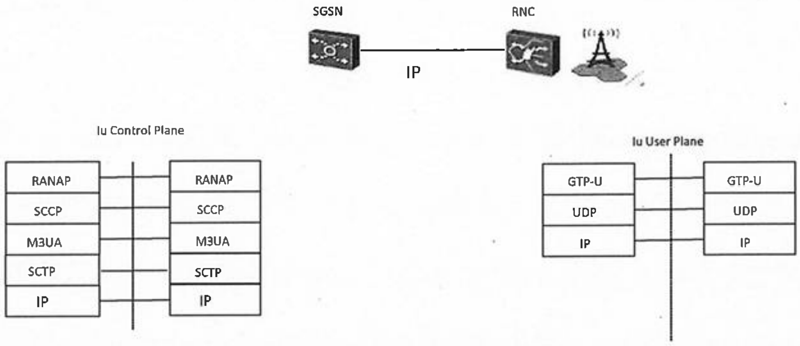
Iu Interface Protocol Stack



Protocols over the Iu Interface

- **RANAP**

  The RANAP protocol is used to process signaling message between the SGSN and the UTRAN and manage the GTP connection over the Iu interface.

- **Broadband MTP**

  The broadband Message Transfer Part (MTP) is implemented by the MTP3 User Adaptation (M3UA). The signaling messages of the upper layer are routed and forwarded through broadband MTP.

- **GTP-U**

  The GTP-U protocol uses the tunnel to transmit signaling or user data.

Configuration Procedure

Step	Operation	Command
Configure the SCCP layer.		
8	Add the SCCP OPC. (Refer to Local office data configuration.)	ADD SCCPOPC
9	Add the SCCP DPC.	ADD SCCPDPC
10	Add the SCCP subsystem.	ADD SCCPSSN
Configure the RNC.		
11	Add the RNC information.	ADD RNC
12	Add the 3G paging table.	ADD IUPAGING
Configure the user plane.		
13	Configure the GTPU Local Entity	ADD GTPULE

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Step 1: Configure the SCTP Parameter

- ADD SCTPPARA
  - Configure an SCTP parameter.
    - ADD SCTPPARA: SCTPPARAINDEX=0;

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Step 5 and 6: Configure the Link Set and Route

- ADD M3LKS
  - Configure the M3UA link set.
    - ADD M3LKS: LSX=0, DEX=0, SLSM=B0000, WM=IPSP, TM=LOADSHARE, LSN="LINKSET1";
- ADD M3RT
  - Configure the M3UA route.
    - ADD M3RT: RTX=0, DEX=0, LSX=0, PRI=0, RTN="TO rnc";

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Step 7: Configure the M3UA Link

- ADD M3LNK
  - Configure the M3UA link.
    - ADD M3LNK: LNK=0, IPT=IPV4, LOCIPV41="10.10.12.14", LOCPORT=2906, PEERIPV41="10.11.12.12", PEERPORT=2907, CS=C, LSX=0, SCTPINDX=0;

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Step 10: Configure the Subsystem Number of the SCCP

- ADD SCCPSSN
  - Configure the subsystem number related to the Iu interface for the SGSN.
    - ADD SCCPSSN: SSNX=1, SSN=SCMG, NI=NATB, DPC="401", OPC="A00", SSNNAME="scmg";
    - ADD SCCPSSN: SSNX=2, SSN=RANAP, NI=NATB, DPC="401", OPC="A00", SSNNAME="RANAP";

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Step 11: Configure RNC Information

- ADD RNC
  - Configure the RNC information.
    - ADD RNC: RNCX=1, RNCMCC="460", RNCMNC="00", RNCID=1234, NI=NATB, SPC="401";

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Check on Iu over IP Interface Status

- Check the control plane status.
  - DSP M3DE: DEX=1;
  - DSP M3RT: RTX=1;
  - DSP M3LNK: SRT=LINK, SRN=0, SN=13, LNK=0;
  - DSP SCCPDPC: DPX=1;
  - DSP SCCPSSN: SSNX=2, NI=NATB, DPC="401", SSN=RANAP;

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Summary

- This section introduced the basic concept, protocol stack, and data configuration of the Iu interface.
  - IP configuration: service IP address and IP routes
  - Local and peer data configuration: M3UA, SCCP, and GTP-U data
  - Base station configuration: RNC and IUPAGING data

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4. Gr interface data configuration

4.1 Background Knowledge

4.1.1 Gr Interface Overview

4.1.2 Gr Interface Addressing

4.2 Data Configuration for the Gr over IP Interface

4.3 Commissioning

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Gr Interface

- The Gr interface is mandatory between the SGSN and the HLR on a GSM or UMTS network. It is used to transfer data such as authentication information, subscription data, and user location information between the SGSN and the HLR.
- On the entire network, the Gd/Gs/Ge/Gf/Lg interface is the same as the Gr interface and based on the SS7 signaling network.

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MAP Version Negotiation Process

- The MAP version negotiation process is as follows:
- The example provided assumes that Party A uses MAP Phase N while Party B uses MAP Phase M.
- Party B sends a dialog request to Party A:
  - If M is equal to N, MAP version negotiation is not required.
  - If M is less than N (Party B's MAP version is earlier), Party A accepts the request and this service is processed in compliance with MAP Phase M.
  - If M is greater than N (Party B's MAP version is later), Party A sends the TC_U_ABORT communication primitive notifying that the request is rejected. TC_U_ABORT carries the latest version N that Party A supports. Upon receiving the TC_U_ABORT primitive, Party B sends another dialog request using MAP Phase N. The service and later will be processed in compliance with MAP Phase N.

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SCCP Configuration Table

- The SCCP protocol supports message exchange over the Gr interface at the MAP layer. The involved SCCP configuration tables are as follows:

Name	Description	Command
SCCP OSP table	A list of SCCP originating signaling points. It identifies the protocol address of the local SCCP entity.	ADD SCCPOPC
SCCP DSP table	A list of SCCP destination signaling points. It needs to include data related to any signaling point that exchanges SCCP messages with the originating signaling point.	ADD SCCPDPC
SCCP subsystem table	Local addressing information used by SCCP. It identifies each SCCP user on a node.	ADD SCCPSSN
SCCP GT table	A list of SCCP global translation codes. It is used to translate GT into an address consisting of DPC, SSN, or GT.	ADD SCCPGT

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Addressing Mode of the Gr Interface

- According to the address numbering plan of the SS7 signaling network, there are two addressing modes for the Gr interface:
  - DPC or DPC+SSN
  - DPC+GT
- The HLR needs to be set with two different global title (GT) numbers:
  - HLR number: The numbering plan is ISDN. It is used to address the HLR when the HLR message is replied.
  - IMSI number: The numbering plan is MSISDN. It is used for the HLR initial addressing after the routing area is updated.

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Comparison Between DPC and DPC+SSN

- When the DPC+SSN addressing mode is used, the subsystem number (SSN) in the SCCP message is the SSN that configured in the SCCPGT.
- When the DPC addressing mode is used, the SSN in the SCCP message is the SSN that sent from the user layer to the SCCP.

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GT Structure

- SCCP Address Format
  - Format of global code in the SCCP address:

7	6	5	4	3	2	1	0
Translation type							
Number plan				Encoding scheme			
Reserve	Address indicator						
Address signal 2				Address signal 1			
...							
Pad number (if required)				Address signal N			

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GT Structure (Continued)

- Example SCCP GT:

	global-title4
00000000	translation-type:unknown (0)
0111----	numbering-plan:isdn-mobile-numbering-plan (7)
----0001	encoding-scheme:bcd-odd-number-of-digits (1)
0-------	spare:0x0 (0)
-0000100	nature-of-address-indicator:international-number (4)
********	global-title-address-information:861398600000002

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Data Planning

Category	Parameter	Example Value		
IP Configuration	Service IP	220.0.0.1, 220.0.0.2		
M3UA Link data configuration	M3UA LE IP	PORT	HLE IP ADD	PORT
	220.0.0.1	2000	230.0.0.1	2000
	220.0.0.2	2001	230.0.0.1	2001
Signaling configuration data	OPC	CC0001		
	Local entity index	8613900755		
	DPC	EE0001		
	Peer entity index	8613900756		
	Mobile country code	460		
	Mobile network code	07		
	Country code	86		
	NDC	139		
	Matched IMSI	46007755		
	Addressing mode	DPC+SSN		

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Procedure for Data Configuration

Step	Operation	Command
Set the attributes for the signaling network (For details, see local data configuration).		
1	Set the signaling network attributes for the local SGSN.	SET SIGATTR
Set the MTP3.		
2	Set SERVICE IP.	ADD SERVICEIP
3	Add M3UA LE.	ADD M3LE
4	Add the M3UA DE.	ADD M3DE
5	Add the M3UA link set	ADD M3LKS
6	Add the M3UA route.	ADD M3RT
7	Add the M3UA link.	ADD M3LNK

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Step 2: Add the Service IP

- //Configure service IP parameters for the HLR.
  - ADD SERVICEIP: IPVERSION=IPv4, SERVICEIPV4=" 10.40.40.2 ", VPNINSTNAME="VPN_SIG";
  - ADD SERVICEIP: IPVERSION=IPv4, SERVICEIPV4=" 10.40.40.2", VPNINSTNAME="VPN_SIG";

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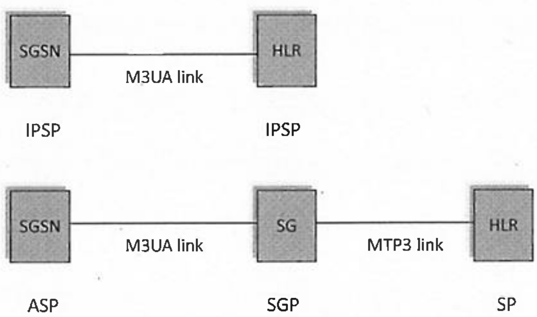
M3UA Entity Type

ASP	Application Server Process
SGP	Signaling Gateway Process
IPSP	IP Server Process



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Step 5: Configure the M3UA Link Set

- ADD M3LKS
  - This command is used to add the M3UA link set. Only one link set can be configured between two adjacent M3UA entities.
  - Example:
    - ADD M3LKS: LSX=1, DEX=1, SLSM=B0001, WM=IPSP, TM=LOADSHARE, LSN="TO HLR";

Step 6: Configure the Route

- ADD M3RT
  - This command is used to configure the M3UA route destined for the HLR.
  - Example:
    - ADD M3RT: RTX=1, DEX=1, LSX=1;

Step 9: Add an SCCP DPC

- ADD SCCPDPC
  - This command is used to add an SCCP DPC.
    - ADD SCCPDPC: DPX=3, OPX=1, DPC="EE0000", DPN="HLR1";

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Configuring the SSN

SSN	OPC	DPC
SGSN	SGSN's SPC	SGSN's SPC
SCMG (SGSN)	SGSN's SPC	SGSN's SPC
HLR	SGSN's SPC	HLR's SPC
SCMG (HLR)	SGSN's SPC	HLR's SPC

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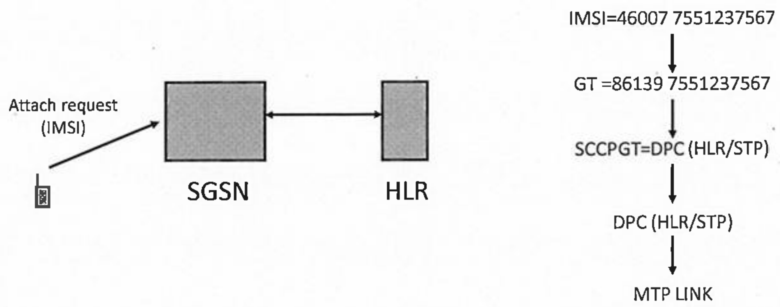
Step 12: Configure the IMSI-GT Translation Table

- Run **ADD IMSIGT**.
  - Configure the IMSI-GT translation table.
    - ADD IMSIGT: IMSI="46007", GT="86139";



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Step 13: Configure the SCCP GT Translation Table

- ADD SCCPGT
  - Configure the SCCP GT translation table for the local SGSN.
  - For the SGSN, you need to configure the SCCP GT according to the SGSN No.; otherwise, transmission of SCCP layer messages will fail.
  - ADD SCCPGT: GTX=0, NI=NAT, RT=DPC, NP=ISDNP, ADDR="8613900757", DPC="CC0001", NAME="SGSN";

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GT Configuration Specification

- In SCCP GT translation table, the GT translation of the following number/number segments are required:
  - National/International IMSI number segment
  - Number of local SGSN
  - National/International HLR number segment

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GT Configuration Specification

Number Type	Numbering Plan	Translation Type	Destination	Number Segment to Be Configured
IMSI number	E.214, ISDN/mobile numbering plan NP=ISDNMS	DPCGT (DPC+GT)	HSTP	1, 2, 3, 4, 5, 6, 7, 8, 9
Local SGSN number	E.164, ISDN/telephone numbering plan NP=ISDNP	DPC	SGSN	SGSN number
HLR number	E.164, ISDN/telephone numbering plan NP=ISDNP	DPCGT (DPC+GT)	HSTP	1, 2, 3, 4, 5, 6, 7, 8, 9

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Data Planning

Category	Parameter	Value	
Service IP parameter	IP Version (IPVERSION)	IPv4	
	Service IPv4 Address (SERVICEIPV4)	10.11.95.5 10.11.127.5 10.11.127.6 10.11.95.6	
	VPN Instance Name (VPNINSTNAME)	VPN_SIG	
M3UA signaling data	Network indicator (NI)	NAT	
	OPC (OPC)	0x1064	
	Local entity type (LET)	ASP	
	Route context (RC)	123456	
	Network Appearance (NA)	789456	
	DPC (DPC)	0x2880, 0x2881	
	Destination entity type (DET)	SGP, SP	
	Link selection mask (SLSM)	B0010	
	Work mode (WM)	ASP	
	Traffic mode (TM)	LOADSHARE	
	Local IP address 1 (LOCIPV41)	10.11.95.5, 10.11.127.5	10.11.127.6, 10.11.95.6
	Local port No. (LOCPORT)	2906	
	Peer IP address 1 (PEERIPV41)	10.11.75.107, 10.11.107.107, 10.11.107.109, 10.11.75.109	10.11.70.107, 10.11.102.107, 10.11.102.109, 10.11.70.109
	Peer port No. (PEERPORT)	2905	
	C/S mode (CS)	C	
	Active/Standby flag (ASF)	ACT	
	Cross Ip flag (CROSSIP)	NO	
	SCTP Parameter index (SCTPPARAINDEX)	1	

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Data Planning

Category	Parameter	Value	
SCCP signaling data	OPC (OPC)	0x1064	
	Signaling point purpose (SPN)	COREONLY	
	Original SGSN number (SGSNN)	8613912345	
	DPC (DPC)	0x2880, 0x2881	
	Loadshare type (LDP)	LOADSHARE	
	Subsystem No. (SSN)	SGSN, SCMG	
GT translation data	IMSI Prefix (IMSIPRE)	46000	
	CC_network access No. (GT)	86139	
	Translation result type (RT)	DPCGT	
	Numbering plan (NP)	ISDNMS	ISDNP
	Address information (ADDR)NOTE:The address information is obtained from the HLR.	86139	

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Configure M3UA Signaling Data

- //Add an M3UA local entity. The originating signaling point (OSP) code resides on the national network. The type of local entity is ASP.
  - ADD M3LE: LEX=0, NI=NAT, OPC="0x1064", LET=ASP, RC=123456, NA=789456, LEN="SGSN";

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Configure M3UA Signaling Data

- //Configure M3UA destination signaling points (DSPs). The two SGs are adjacent signaling points. The type of destination entity is SGP.
  - ADD M3DE: DEX=1, LEX=0, DPC="0x2880", SLSSM=B0001, DET=SGP, ADJF=TRUE, RC=123456, PVER=RFC3332, DEN="SG_A";
  - ADD M3DE: DEX=2, LEX=0, DPC="0x2881", SLSSM=B0001, DET=SGP, ADJF=TRUE, RC=123456, PVER=RFC3332, DEN="SG_B";

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Configure M3UA Signaling Data

- //Configure M3UA signaling links. Add two SCTP multi-homing signaling links to each SG. The signaling links are distributed on different SGPs. The SGSN works as the client.
  - ADD M3LNK:LNK=1,VPNNAME="VPN_SIG",IPT=IPV4,LOCIPV41="10.11.95.5", LOCIPV42="10.11.127.5",LOCPORT=2906,PEERIPV41="10.11.75.107",PEERIPV42="10.11.107.107",CS=C,LSX=1,SCTPINDX=1,LKN="Link1_to_SG_A";
  - ADD M3LNK:LNK=2,VPNNAME="VPN_SIG",IPT=IPV4, LOCIPV41="10.11.127.6", LOCIPV42="10.11.95.6",LOCPORT=2906,PEERIPV41="10.11.107.109",PEERIPV42="10.11.75.109",CS=C,LSX=1,SCTPINDX=1,LKN="Link2_to_SG_A";
  - ADD M3LNK:LNK=3,VPNNAME="VPN_SIG",IPT=IPV4, LOCIPV41="10.11.95.5", LOCIPV42="10.11.127.5",LOCPORT=2906,PEERIPV41="10.11.70.107",PEERIPV42="10.11.102.107",CS=C,LSX=2,SCTPINDX=1,LKN="Link1_to_SG_B";
  - ADD M3LNK:LNK=4,VPNNAME="VPN_SIG",IPT=IPV4, LOCIPV41="10.11.127.6", LOCIPV42="10.11.95.6",LOCPORT=2906,PEERIPV41="10.11.102.109",PEERIPV42="10.11.70.109",CS=C,LSX=2,SCTPINDX=1,LKN="Link2_to_SG_B";

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Configure SCCP Signaling Data

- //Add an SCCP OSP. The OSP resides on the national network. The SCCP OSP of Signaling System Number 7 (SS7) is provided for only the SS7 signaling network.
  - ADD SCCPOPC: OPX=1, NI=NAT, OPC="0x1064", SPN=COREONLY, SGSNN="8613912345",OPN="SGSN_BER1_GR";
- //Configure the SCCP DSPs. SG A and SG B are load-sharing signaling points.
  - ADD SCCPDPC: DPX=1, OPX=1, DPC="0x2880", LDP=LOADSHARE, SDPX=2, DPN="SG_A";
  - ADD SCCPDPC: DPX=2, OPX=1, DPC="0x2881", LDP=LOADSHARE, SDPX=1, DPN="SG_B";

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4. Gr interface data configuration

4.1 Background Knowledge

4.2 Data Configuration for the Gr over IP Interface

4.2.1 Data Configuration Procedure for the UNC to Directly Connect to the Local HLR

4.2.2 Data Configuration Procedure for the UNC to Connect to the Local HLR Using STPs

4.2.3 Data Configuration Procedure for the UNC to Connect to the HLR in the Same PLMN

4.2.4 Networking for the UNC to Connect to the HLR in a Different PLMN

4.3 Commissioning

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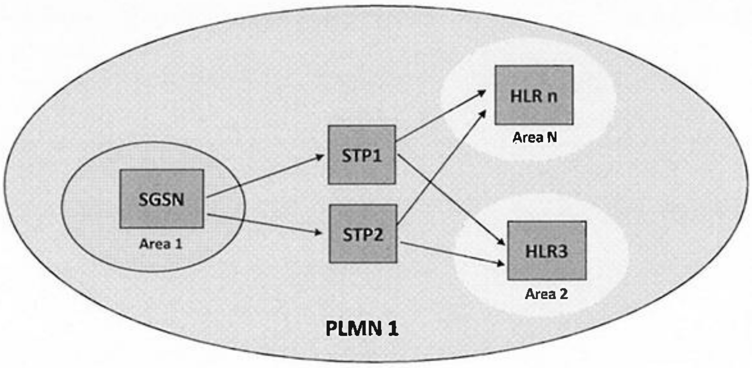
Networking Model

- Addressing mode: DPC+GT



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Step 1: Configure the roaming PLMN

- ADD CONNECTPLMN
  - Add 46007 PLMN:
    - ADD CONNECTPLMN: MCC="460", MNC="07", CC="86";

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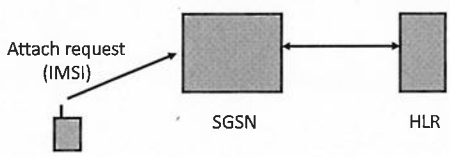
Step 2: Configure the IMSI-GT Translation Table

- ADD IMSIGT
  - Configure the IMSI-GT translation table.
    - ADD IMSIGT: IMSIPRE="46007", GT="86139";



IMSI=46007 XXXXXXXXXX

↓

GT =86139 XXXXXXXXXX

↓

SCCPGT=DPC (STP)

↓

DPC (STP)

↓

MTP LINK

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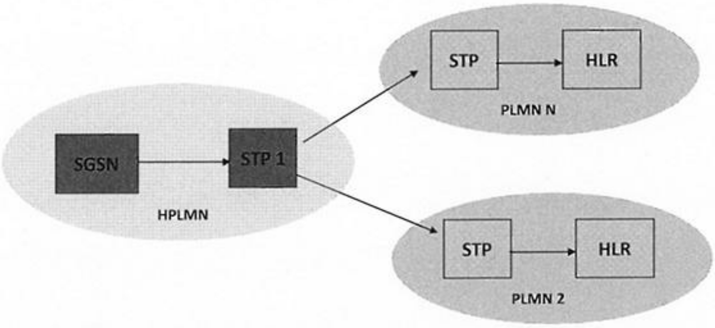
Networking Model



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IP Commissioning

Procedure	Operation	Remarks
1	Run the **PING** command to check whether the M3UA link from the source IP address to the destination IP address is properly connected. If the command output indicates that the link is disconnected, check the route configuration.	–

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SCCP Commissioning

- What should I do to determine that the Gr interface works properly during SCCP message tracing?
- The SCCP status can be queried using the DSP SCCPDPC or DSP SCCPSSN command. If the SCCP status is normal, messages received from the upper layer cannot be forwarded by the SCCP layer generally due to the GT code configuration error. You can capture a MAP message such as location update request, during the Gr interface tracing and check whether the corresponding message can be found during the SCCP tracing. If it is found, the SCCP is normal; otherwise, check the GT code configuration.

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Summary

This section introduced the following:

- Basic concept, protocol stack, and data configuration of the Gr interface
- Gr-interface addressing methods
- Configuration methods of the Gr interface in different networking modes, for example, direct connection or indirection connection (via an STP)

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4.2

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5. Gn interface data configuration

5.1 Background Knowledge

5.2 Configuration of Gn Interfaces

5.3 Configuration of the Optional GGSN Routing Function

5.4 APN OI-based DNS server selection

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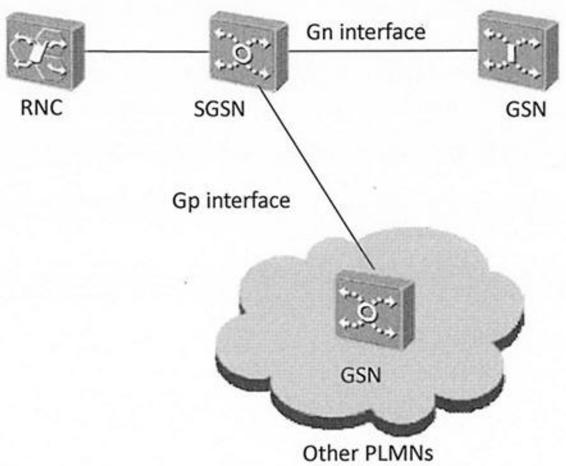
Gn Interface



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5. Gn interface data configuration

5.1 Background Knowledge

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5.2.1 Interworking Configuration Between SGSN and GGSN

5.2.2 Interworking Configuration Between SGSNs

5.2.3 Commissioning

5.3 Configuration of the Optional GGSN Routing Function

5.4 APN OI-based DNS Server Selection

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Data Planning

Category	Parameter	Value	
Service IP parameter	IP Version (IPVERSION)	IPv4	
	Service IPv4 Address (SERVICEIPV4)	212.10.0.1	
	VPN Instance Name (VPNINSTNAME)	VPN_CN	
GTP-C local entity data	IPv4 address	212.10.0.1	
	vpnName (vpnName)	VPN_CN	
GTP-U local entity data	IPv4 address	212.10.0.1	
	vpnName	VPN_CN	
GGSN resolution data	Host name index (HSINDEX)	3	4
	Host name (HOSTNAME)	APN.MNC0000.MCC0460.GPRS	APN.MNC0001.MCC0460.GPRS
	Host address section (ADDRSECTION)	SECTION2	SECTION2
	IPv4 address1 (IPV4ADDR1)	212.10.0.100	
	IPv4 address2 (IPV4ADDR2)	212.10.0.101	

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Configure GTP Data

- Set the GTP path management parameters.
  - SET UGTP: ICI=180, SSI=60, MSI=60, GMSI=60, PATHVERCHKINT=60;
  - SET GTPPUB: ECHOSIG=ALL, V2EI=239, OTSIE=DENY, POTHD=85, PNTHD=80, PCTHD=95, PRTHD=90, GTPEXT=10, GTPEXLEN=100, GTPVER=GTPv2;

Configure Domain Name Resolution Data to the GGSN

- Configure the domain name resolution data.
  - ADD IPV4DNSH: HSINDEX=3, HOSTNAME="APN.MNC0000.MCC0460.GPRS", ADDRSECTION=SECTION2, IPV4ADDR1="212.10.0.100", IPV4ADDR2="212.10.0.101";
  - ADD IPV4DNSH: HSINDEX=4, HOSTNAME="APN.MNC0001.MCC0460.GPRS", ADDRSECTION=SECTION2, IPV4ADDR1="212.10.0.100", IPV4ADDR2="212.10.0.101";
- Add characteristics information for the GGSN.
  - ADD GGSNCHARACT: RANGE=SPECIAL_GGSN, IPT=IPV4, GGSNIPV4="212.10.0.100", MASKV4="255.255.255.255", QOSVER=R5QOS;
  - ADD GGSNCHARACT: RANGE=SPECIAL_GGSN, IPT=IPV4, GGSNIPV4="212.10.0.101", MASKV4="255.255.255.255", QOSVER=R5QOS;

Configuration Procedure

Step	Action	Command
Configuring a Static Route		
1 (optional)	Configure the static route to the SGSN	ADD SRROUTE

For details, see "Interworking Configuration Between SGSN and GGSN."

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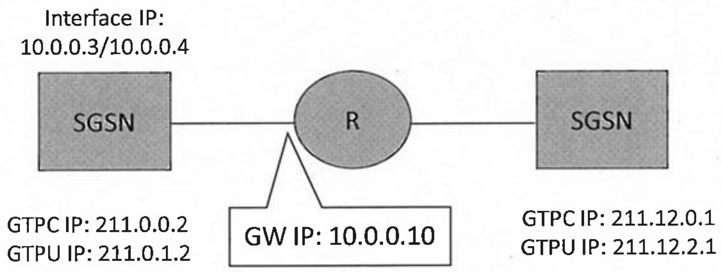
Step 1 Configure the Static Route to the SGSN.

- Configure IP routes.
  - ADD SRROUTE:VRFNAME="VRF_CN",AFTYPE=ipv4unicast, PREFIX=" 211.12.0.0",MASKLENGTH=16, DESTVRFNAME="_public_", NEXTHOP=" 10.0.0.10 ",IFNAME="Ethernet64/0/3.4";



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Test the GTPC/GTPU Route

- Run **TST GTPCPATH** and **TST GTPUPATH** to test GTP-C and GTP-U paths.
  - TST GTPCPATH: GTPVER=GTPv2, IPTYPE=IPV4, LOCIPV4ADDR=" 211.0.0.1,", PEERIPV4ADDR=" 211.1.1.1 ";
  - TST GTPUPATH: GTPVER=GTPv1, IPTYPE=IPV4, LOCIPV4ADDR=" 211.0.0.2", PEERIPV4ADDR=" 211.1.1.1 ";

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5. Gn interface data configuration

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GGSN Selection Based on the IMSI Number Segment

- Configure the GGSN IP address based on the IMSI number segment.
  - ADD GWSELPLCY: SUBRANGE=IMSI_RANGE, BEGIMSI="460001234560000", ENDIMSI="460001234569999", APNNI="*", SLCTM=GGSN/P-GW_IP, IPV4="211.1.1.1";
- Configure the GGSN APN OI based on the IMSI number segment.
  - ADD GWSELPLCY: SUBRANGE=IMSI_RANGE, BEGIMSI="460001234560000", ENDIMSI="460001234569999", APNNI="HUAWEI1.COM", SLCTM=CUSTOMIZE_APN-OI_REPLACEMENT, APNOI="MNC000.MCC460.GPRS", LABEL=NO_CUSTOMIZED_IDENTIFIER;

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5. Gn interface data configuration

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Summary

The Gn interface data configuration includes:

- Basic concept, protocol stack, and configuration
- GGSN selection and APN OI–based DNS server selection

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Q&A

1. How can some routes be configured so that subscribers can be routed to the specified GGSN?
2. If the mapping between the APN OI and DNS server is incorrectly configured, how can the SGSN resolve the domain names?

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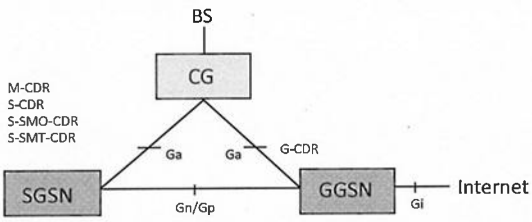
Functions of the Charging Subsystem

- Functions of the charging subsystem:
  - MM CDR: M-CDR
  - SM CDR: S-CDR
  - SMS CDR: S-SMO-CDR & S-SMT-CDR
  - Location service CDR: LCS-MT-CDR & LCS-MO-CDR & LCS-NI-CDR



S-CDR Generation Scenarios (1)

- Start and stop of S-CDR charging
  - When the PDP is successfully activated, the SGSN starts S-CDR charging for the PDP immediately.
  - When the PDP session is terminated, the SGSN stops the corresponding S-CDR charging.
- S-CDR generation scenarios
  - Partial CDR generation scenarios
    - The PDP service traffic reaches the traffic threshold configured by the SGSN.
    - The CDR duration reaches the time threshold configured by the SGSN.
    - The RAT changes (intra SGSN), such as handover between the 2G system and the 3G system.
    - Charging conditions change.
    - S-CDRs are generated during the operation and maintenance.

CDR Formats

CDR Type	CDR Format
R98 (GPRS)	CMCCV130, GSM1215V760, and USI1215V760
R99 (GPRS&UMTS)	3GPP32015V360, 3GPP32015V3a0, AIS32015V360
R4 (GPRS&UMTS)	3GPP32215V440, VOX32215V440
R5 (GPRS&UMTS)	GPP32215V560
R6 (GPRS&UMTS)	GPP32251V660
R7 (GPRS&UMTS)	GPP32251V740
R9 (GPRS&UMTS)	GPP32251V940

S-CDR Field

Field	Description	CMCC R98 V1.3.0	ETSI R98 V7.6.0	ETSI R99 V3.6.0	ETSI R99 V3.A.0	ETSI R4 V4.4.0	ETSI R5 V5.6.0	ETSI R6 V6.6.0	ETSI R7 V7.4.0	ETSI R9 V9.4.0
Record Type	Record type. The CDR is an S-CDR.	M	M	M	M	M	M	M	M	M
Network Initiated PDP Context	A flag that is present if this is a network initiated PDP context.	C	C	C	C	OC	OC	OC	OC	OC
Served MSISDN	MSISDN of a subscriber.	M	-	O	O	OM	OM	OM	OM	OM
System Type	The type of air interface used, such as UTRAN.	-	-	C	C	OC	OC	OC	OC	OC
Served IMSI	IMSI of a subscriber (non-anonymous access)	M	M	M	M	M	M	M	M	M

S-CDR Field

Field	Description	CMCC R98 V1.3.0	ETSI R98 V7.6.0	ETSI R99 V3.6.0	ETSI R99 V3.A.0	ETSI R4 V4.4.0	ETSI R5 V5.6.0	ETSI R6 V6.6.0	ETSI R7 V7.4.0	ETSI R9 V.4.0
List of Traffic Data Volumes	Data traffic list.	M	M	M	M	OM	OM	OM	OM	OM
Record Opening Time	Record opening time.	M	M	M	M	M	M	M	M	M
Duration	CDR duration.	M	M	M	M	M	M	M	M	M
Cause for Record Closing	Record closing cause	M	M	M	M	M	M	M	M	M

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Traffic Field

- List of Traffic Data Volumes
  - Uplink, downlink traffic
  - Change condition and time stamp

QoS Requested = QoS1 QoS Negotiated = QoS1 Data Volume Uplink = 1 Data Volume Downlink = 2 Change Condition = QoS change Time Stamp = TIME1	QoS Negotiated = QoS2 Data Volume Uplink = 5 Data Volume Downlink = 6 Change Condition = Tariff change Time Stamp = TIME2	Data Volume Uplink = 3 Data Volume Downlink = 4 Change Condition = Record closed Time Stamp = TIME3

		Index
QoS1+Tariff1	uplink = 1, downlink = 2	1
QoS2+Tariff1	uplink = 5, downlink = 6	2
QoS2+Tariff2	uplink = 3, downlink = 4	3
QoS1	uplink = 1, downlink = 2	1
QoS2	uplink = 8, downlink = 10	2+3
Tariff1	uplink = 6, downlink = 8	1+2
Tariff2	uplink = 3, downlink = 4	1

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Five Charging Type Selection Modes

Value	Description
Home default	The charging type is the default one configured in SGSN.
Visiting default	
Roaming default	
APN specific	The charging type is the APN charging type subscribed by the HLR. It is the charging type of the PDP context subscribed by the HLR.
Subscription specific	The charging type is the subscriber charging type subscribed by the HLR.

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Charging Behaviors

- Charging behaviors:

PLT(Idle context purge long timer)
PST(Idle context purge short timer)
NOROAMING(Inhibit visitor use local GGSN)
NOQOS(Inhibit QoS)
CGIP(CG address)
SMSC(SMSC of deactivate S-SMO-CDR)
SMSCMT(SMSC of deactivate S-SMT-CDR)
SMSCMOMT(SMSC of deactivate SMS-CDR)

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Configuration Procedure

Step	Description	Command
	Configure basic charging information.	
5	Set Ga interface attributes.	SET CHGGA
6	Configure information contained in a generated CDR.	SET CHGCDR
7	Set charging characteristic parameters.	SET CHGCDR/ ADD CHGAPN/
8	Set CDR generation policies.	SET CHGPLMNCHAR/ ADD CHGIMSICFG/ SET CHGCHAR
9	Configure the CG selection priority.	ADD CHGPLMNCG/ ADD CHGBEHA/

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Configuration Procedure

Step	Description	Command
	4. Set special tariffs.	
10	(Optional) Set charging holidays/festivals.	ADD CHGHOLI
11	Set charging weekdays.	SET CHGWKDY
12	(Optional) Set Tariff change points.	ADD CHGTARI/ SET CHGCHAR
13	Set call barring parameters.	SET CHGCHAR
14	(Optional) Configure charging behavior.	ADD CHGBEHA
15	(Optional) Configure forcibly generated CDRs	CRE CHGCDR SET CHGCDR

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Step 1: Set the CDPIP

- Run **ADD SERVICEIP**.
  - Set the IP address of SPU.
    - ADD SERVICEIP: IPVERSION=IPv4, SERVICEIPV4=" 10.161.70.2 ", VPNINSTNAME="VPN-Ga", DESC="for ga"
- Run **ADD CHGCDPIP**.
  - Set the IP address, bearer type, and port number of the CDP process.
  - If no SERVICEIP is available, configure **SERVICEIP**.

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Step 2: Add an Interface IP Address

- Run **ADD IFIPV4ADDRESS**.
  - Add an IP address for the network port connecting IPU and the CG.
  - ADD IFIPV4ADDRESS : IFNAME="Ga", IFIPADDR="10.161.70.2", SUBNETMASK="255.255.255.0", ADDRTYPE=main;

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Step 5: Set Ga Interface Attributes

- Run **SET CHGGA**.
- This command is used to set the related configuration parameters in the Charging Ga Interface Parameter table, such as GPRS CDR release and CDR resend interval(s).
  - Example:
    - To set charging Ga interface parameters, with GPRS CDR release being set to R4, UMTS CDR release to R4, and R4 CDR version to V32215V440, run the following command:
    - SET CHGGA: GCR=R4, UCR=R4, CHGVER4=GPP32215V440;

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Step 5: Set Ga Interface Attributes

- Run **SET CHGGA**.

Note:

(1) The setting of GPRS CDR release takes effect after the SPP and the GTP are restarted.

After the SPP or GTP is reset, run **DSP CHGGA** to check whether the CDR version of the processes is consistent with the CDR version configured by running SET CHGGA.

(2) If CDR resend interval(s) is specified, the configuration takes effect after the CDP is restarted.

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Step 7: Set Charging Characteristics.

- Run **ADD CHGAPN**.
  - This command is used to configure the charging configuration of the APN
- Example:
  - Set charging types of the subscribers whose APN as "huawei.com" to PREPAID.
  - **ADD CHGAPN: APNNI="huawei1.com", CC=PREPAID;**

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Step 8: Set CDR Generation Policy

- Run **SET CHGPLMNCHAR**.
  - This command is used to control whether CDRs are generated for local network subscribers and other network subscribers. If the specified CDR type is set to No generate, the subsequent configuration does not take effect. This is because the priority of CDR generation configured by running this command is the highest.
  - Example:
    - SET CHGPLMNCHAR: PLMN=HPLMN, MP=NO, SP=YES, SMOP=NO, SMTP=NO, LCSMOP=NO, LCSMTP=NO, LCSNIP=NO;

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Step 8: Set the S-CDR Generation Policy

- The following uses **ADD CHGIMSICFG** as an example to set the S-CDR generation policy.
  - Example:
    - To set the S-CDR generation policy for the subscriber whose IMSI prefix is 46003, with Generate S-CDR being set to Generate, Period trigger S-CDR to Period permit, S-CDR period(min) to 60, Volume trigger S-CDR to Generate, Volume threshold(KB) to 1000, Cond. Chg. trigger S-CDR to No generate, Location change trigger S-CDR to No generate, and Max num of Cond. Chg. to 3, run the following command:
    - ADD CHGIMSICFG: IMSIPRE="46003", SP=YES, SPP=PERMIT, SPL=60, SVP=YES, SVL=1000, SCCP=NO, SCCL=3, SLCP=NO;
  - The configuration method of the S-CDR generation policy configured by running SET CHGCHAR is similar to that configured by running ADD CHGIMSICFG.

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Step 9: Configure the CG Selection Priority

- There are different commands to set IP address of CG. Selection priority for CG is as the following:

• ADD CHGPLMNCG	High priority
• ADD CHGBEHA	↓
• SET CHGCHAR	↓
• ADD CHGCG	Low priority

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Steps 10 to 15: Set Special Tariffs

Option	Value
Holiday	October 1, 2005
Charging mode of holidays and festivals	Normal
Weekend	Weekends
Charging mode of weekends	Normal
Weekday	Weekdays (from Monday to Friday)
Charging mode of weekdays	Normal
Period for adopting a special tariff on holidays	10:00–20:00
Charging mode of a special tariff	Normal
Period for adopting a special tariff on weekends	10:00–20:00
Charging mode of a special tariff	Normal
Period for adopting a special tariff on weekdays	10:00–20:00
Charging mode of a special tariff	Normal

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Step 10: Set Holidays/Festivals

- Run **ADD CHGHOLI**.
  - This command is used to set parameters, such as date and charging mode, of holidays and festivals.
  - Example:
    - ADD CHGHOLI: YEAR=2005, MONTH=10, DAY=1, CC=NORMAL;

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Step 13: Set Call Barring Parameters

- The system can specify whether to continue the data service when the cache is insufficient (generally, the hard disk is full, and the Ga interface communication is interrupted).
- SET CHGCHAR
  - The values of Service restrict flag are as follows:
    - Unrestricted service
    - Prohibit active PDP and SMS
    - Interrupt service
- Example:
  - To set Service restrict flag of the subscriber whose Charging characteristic of Normal charging to Unrestricted service, run the following command:
  - SET CHGCHAR: CC=NORMAL, SR=UNRESTRICT;

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Step 14: Configure Charging Behavior

- The system provides multiple specific charging behaviors, such as deactivating the idle PDP and specifying CG. This configuration is optional. The operator can customize the configuration as required.
- Run **ADD CHGBEHA**.
  - This command is used to customize specific charging behavior.
  - Example:
    - To set PDP purger length(min) to 30, and Behavior attribute to Idle context purge short timer, run the following command:
    - ADD CHGBEHA: CB=B1, BA=PST, PURGELEN=30, ACC=NORMAL-1;

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Step 16: Commissioning

- Check the communications status of the Ga interface.
- On the UNC MML command page, run **DSP CHGCG:;**.

```
%%DSP CHGCG: SRN=0, SN=3;%%
RETCODE = 0  Operation succeeded

The result is as follows:
------------------------
 Process id  IP address of CG  CG status                  GTP bearing protocol  CG receiving port No.
 0           200.1.1.22        Communication normal       UDP                   4003
 0           200.1.1.3         Communication interruption UDP                   4003
(Number of results = 2)

---  END
```


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Step 17: Query the Number of CDRs on the Hard Disk

- Run **DSP CHGFILE**.
  - This command is used to query CDR file information on the hard disk of SPU.

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UNC (GW-C) System Configuration

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Objectives

- Upon completion of this course, you will be able to:
  - Learn basic concepts about UNC system data configuration.
  - Learn how to configure UNC system data.

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PLMN Data Configuration

- PLMN Configuration
  a. Add carrier information.
    By default, a record with **Network Operator ID** being **0** is configured on the UNC.
    MOD NGMNO: NOID=0, FULLNAME="Operator A", SHORTNAME="OA";
  b. Configure the HPLMN for the subscribers of the carrier.
    Set MCC to 460 and MNC to 00 for the UNC.
    ADD NGHPLMN: NOID=0, MCC="460", MNC="01";
    Add information of other HPLMNs (for example, set MCC to 460, and MNC to 02).
    ADD NGHPLMN: NOID=0, MCC="460", MNC="02";
  C. Configure the serving PLMN of the carrier.
    Configure the serving PLMN for the UNC (for example, set MCC to 460, and MNC to 03).
    ADD NGSRVPLMN: PLMNIDX=0, NOID=0, MCC="460", MNC="03";

PLMN Data Configuration

- PLMN Configuration
  d. Configure the MNC length of the MCCs.
    Set the MNC length to 2 for MCC 460.
    ADD MNCLEN:MCC="460",MNCLEN=2;
  e. Configure network slices supported by the carrier.
    Configure the serving PLMN whose **PLMN Index** is **0**, **Slice/Service Type** is **1**, and **Slice Differentiator** is **010101**.
    ADD PLMNNS: NSIDX=0, PLMNIDX=0, SST=1, SD="010101",

Contents

1. PLMN Configuration

2. Subscriber Attribute Management

3. Access Control Through the S-GW/SGSN

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PLMN and Subscriber Type

- Subscriber Type
  - Local subscribers
  - Roaming subscribers
  - Visiting subscribers

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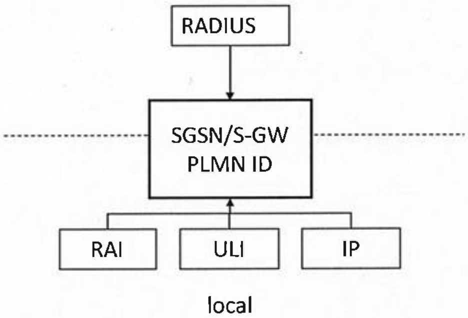
Configuration for Obtaining the PLMN ID (1)

- The UNC can determine whether a subscriber is a local subscriber or roaming subscriber only after it obtains the PLMN ID of the S-GW/SGSN.



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Configuration for Obtaining the PLMN ID (2)

- Configuring how the UNC obtains the PLMN ID of the S-GW/SGSN.
  - Run **SET PLMNPRIORITY** to configure the priority of the ways for the UNC to obtain the PLMN ID of the SGSN/S-GW.

For example:

Subscribers are activated on a 3G network and the UNC functions as the GGSN. Set the UNC to preferentially obtain the PLMN ID from the local configuration data, and set the priorities of the PLMN source in descending order as follows: the RAI in the message > the IP address of the SGSN that sends the message > the ULI in the message.

SET PLMNPRIORITY: NODETYPE=GGSN, PRIORITYMODE=LOCAL, GGSN1STPRIORITY=RAI, GGSN2NDPRIORITY=SGSN_IP, GGSN3RDPRIORITY=ULI;

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Q&A

1. What are the types of subscribers on the UNC?
2. Which of the following methods can be used by the UNC to obtain the PLMN ID of the S-GW/SGSN?

Summary

- A public land mobile network (PLMN) ID is a mobile network identifier of a carrier. It is composed of a mobile country code (MCC) and a mobile network code (MNC).
- MCCs identify countries or areas, and MNCs identify carriers.
- The UNC needs to identify the subscriber type (local, visiting, or roaming subscribers) and use different charging modes and service control policies.

Access Control Configuration

- Configure access control.
  - Enable or disable the access control function.

    SET AccessListFunc: ListSwitch=DISABLE/ENABLE
  - Configure the whitelist or blacklist.

    SET AccessListFunc: ListType=WHITE/BLACK

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Q&A

1. If the ACL for the S-GW/SGSN is a blacklist, when receiving access requests from subscribers, what will the UNC do?

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UNC 23.1 (GW-C) Interface Configurations

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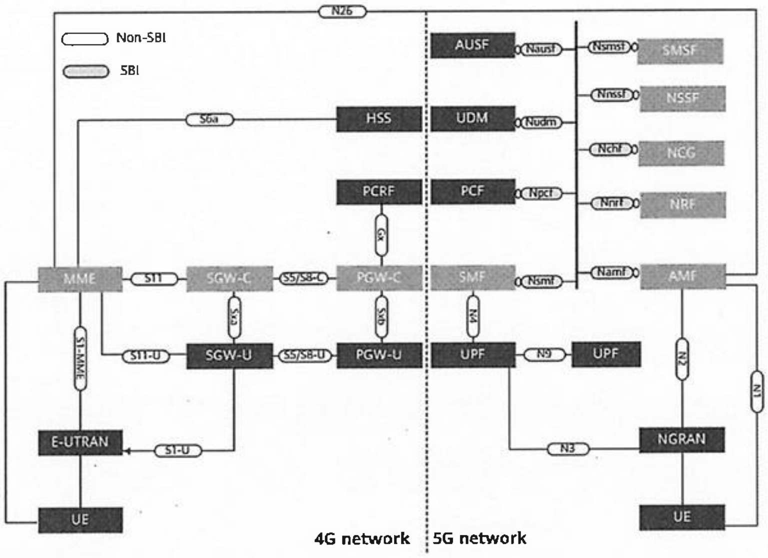
Recommendations

- UNC Product Documentation

Overview

When the UNC (SMF/GW-C) functions as a 5G VNF, it can be the SMF.

When the UNC (SMF/GW-C) functions as a 2G/3G/4G VNF, it can be the PGW-C/SGW-C/GGSN.



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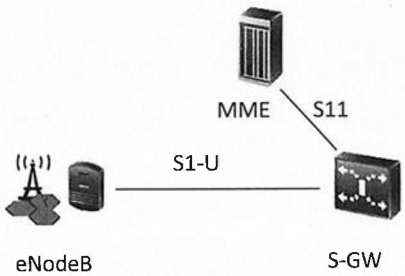
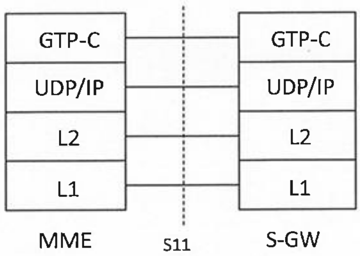
S11 Interface





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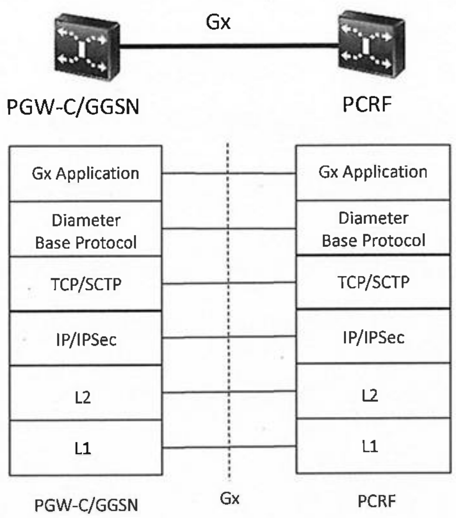
Gx Interface



The Gx interface allows the exchange of policy control data between the PCRF and the PCEF.

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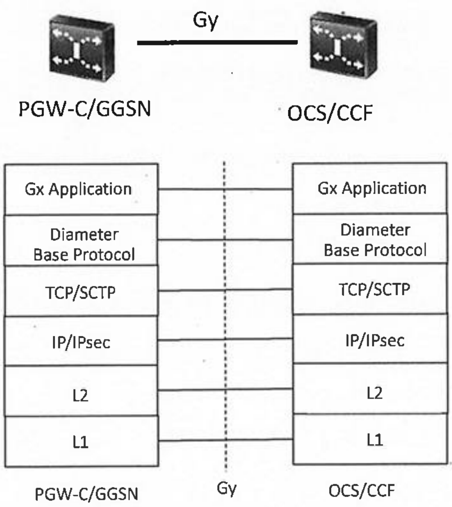
Gy Interface



The Gy interface is an interface between the GGSN/PGW-C and the online charging system (OCS). It is used for online charging control and uses the Diameter protocol for communication. It is used to provide credit control for both flow-based and non-flow-based charging subscribers.

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2. S11/S5/S8-C Interface Configuration Process

2.1 Data Planning

2.2 Logical Interface Configuration

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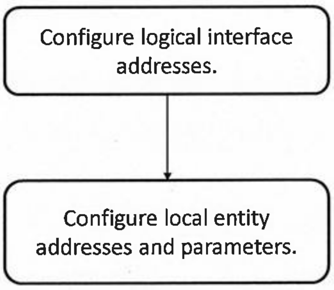
S11/S5/S8-C Interface Configuration Process



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Data Configuration

Step	Operation	Command
Configuring logical interfaces		
1	Configure IP addresses for logical interfaces.	ADD LOGICIP
Configuring local entities		
1	Configure a local entity group.	ADD GTPCLEGRP
2	Configure members for the local entity group.	ADD GTPCLEGRPMEM
3	Configure interface information.	ADD GTPCINTF

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Commissioning

Run **DSP GTPCSTATUSINFO** to check the GTP-C path status.

```
%%DSP GTPCSTATUSINFO: ;%%
RETCODE = 0  Operation succeeded

The result is as follows
------------------------
                  POD Name  =  uncpod-0
            Interface Type  =  S11
        Local IPv4 Address  =  10.2.215.26
        Local IPv6 Address  =  ::
         Peer IPv4 address  =  192.168.208.11
         Peer IPv6 address  =  ::
        Path Status Change  =  UP->DOWN
Path Status Change Timestamp  =  09:30:05 06/04/2021
(Number of results = 1)

—  END
```

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Summary

- S11/S5/S8-C interface data configuration includes:
  - Configure the IP address of the logical interface: **ADD LOGICIP**
  - Configure the GTP-C local entity: **ADD GTPCLEGRP**, **ADD GTPCINTF**, and **ADD GTPCLEGRPMEM**
- The S5-S and S8-S interfaces can use the same IP address, and the S5-P and S8-P interfaces can use the same IP address.

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Data Planning – UNC (GW-C)

VNF Configuration	Category	Parameter	Value
UNC (GW-C)	VPN	VPN instance	VPN_SG
	Local end of the N4 interface	IP address	10.72.214.7
	Peer end of the N4 interface	UPF name	GZUPF001BHW
		NF instance UUID (NFUUID)	5ea7f228-47cc-2032-0a06 -151313000001
		Peer service IP address	10.72.214.18
		Peer port No.	8805

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Contents

3. N4 Interface Configuration

3.1 Data Planning

3.2 Logical Interface Configuration

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Configuration Example (1)

- Configure a logical interface.

  ADD LOGICIP: IPVERSION=IPv4, LOGICIPV4="10.72.214.7", VPNINSTNAME="VPN_SG", DESC="N4Ip";

- Configure a local node.

  ADD CPNODE: CPNODEINDEX=0, NODEIDTYPE=CpFqdn, NODEIDFQDNVALUE="APP-HNGZgdGW-C001BHW-05AHW011.gz.gd.node.5gc.mnc000.mcc460.3gppnetwork.org", CPFUNCTION=0;

- Configure a local endpoint.

  ADD CPPOINT: CPPOINTINDEX=0, CPNODEINDEX=0, IPVERSION=IPv4, IPV4="10.72.214.7", VPNNAME="VPN_SG";

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Configuration Example (2)

- Configure a peer node.

  ADD UPNODE: NFINSTANCENAME="5ea7f228-47cc-2032-0a06-151313000001", LOCATION=Central, UPFUNCTION=None;

- Configure a peer NF instance.

  ADD PNFPROFILE: NFINSTANCEID="5ea7f228-47cc-2032-0a06-151313000001", NFTYPE=NfUPF, FQDN="EXUPF001BHW", IPADDRESSTYPE=IPTypeV4, IPV4ADDRESS1="10.72.214.18", PORT=8805, LOCALITY="HuaNan.SomeDC";

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4. Gx Interface Configuration Process

4.1 Data Planning

4.2 Logical Interface Configuration

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5. Gx Interface Configuration Process

5.1 Data Planning

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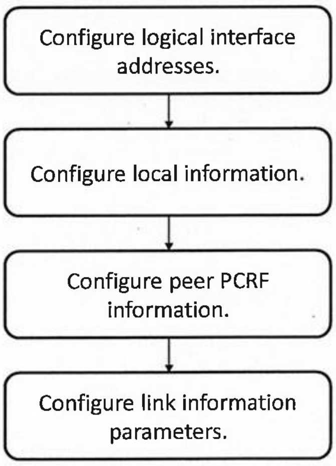
Gx Interface Configuration Process



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Configuration Example (2)

- Configure a PCRF.

  ADD PCRF: HOSTNAME="pcrf_1", REALMNAME="example.com", VPNINSTNAME="vpn_gxif", SUPFEANEGOSW=ENABLE, FEATURELIST=RELEASE8-1&RELEASE9-1&RELEASE10-1;

- Configure a PCRF IP address.

  ADD DIAMPEERADDR:HOSTNAME="pcrf_1",ADDRTYPE=IPv4,IPV4ADDRESS="10.11.21.59";

- Configure a Diameter link group.

  ADD DIAMCONNGRP: CONNGROUPNAME="dconn_pcrf1", LOCALHOSTNAME="pgw_1", APPLICATION=GX, PEERHOSTNAME="pcrf_1", SELECTMODE=SESSION_ID;

- Configure a Diameter link.

  ADD DIAMCONNECTION: DIAMCONNGRP="dconn_pcrf1", LOCINTERFACE="gxif1/0/0", PEERADDRTYPE=IPv4, PEERIPV4ADDR="10.11.21.59", LOCALPORT=16450;

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Commissioning

Run **DSP PCRFSTATUS** with **PCRF Host Name** specified to check the PCRF status.

```
DSP PCRFSTATUS: PCRFNAME="pcrf_1";
RETCODE = 0  Operation Success
PCRF Status
-----------
 PCRF Host Name  =  pcrf_1
       POD Name  =  uncpod-0
  Local Address  = 10.8.10.1
Local SubAddress  =  -
   Peer Address  = 10.11.21.59
      Gx Status  =  Normal
 Local Host Name  =  gpw_1
(Number of results = 1)
—   END
```


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5. Gy Interface Configuration Process

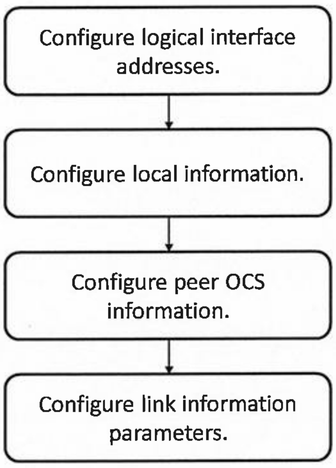
5.1 Data Planning

5.2 Logical Interface Configuration

Data Planning – UNC (GW-C) (1)

VNF Configuration	Category	Parameter	Value
UNC (GW-C)	VPN	VPN Instance	vpn_gy
	Gy logical interface	Logical interface name	Gyif1/0/0
		Logical interface address	10.8.20.1
	Local device identifier	Local host name	pgw_1
		Local realm name	huawei.com
		Product name	unc@huawei.com
	OCS server information	OCS host name	ocs1
		OCS realm name	huawei.com
	OCS IP address	Host name	ocs1
		OCS IP address	10.11.21.59

Gy Interface Configuration Process



Data Configuration (1)

Step	Operation	Command
Configuring logical interfaces		
1	Configure a logical IP address.	ADD LOGICIP
2	Configure a logical interface.	ADD LOGICINF
Configuring local information		
1	Configure UNC local information.	ADD DIAMLOCINFO
Configuring an OCS server		
1	Configure an OCS server.	ADD OCS
2	Configure the IP address of the OCS server.	ADD DIAMPEERADDR
Configuring link information		
1	Configure a Diameter link group.	ADD DIAMCONNGRP
2	Configure Diameter links.	ADD DIAMCONNECTION

Configuration Example (2)

- Configure an OCS server.

  ADD OCS: OCSHOSTNAME="ocs1", REALMNAME="huawei.com", VPNINSTANCE="vpn_gy";

- Configure the IP address of the OCS server.

  ADD DIAMPEERADDR: HOSTNAME="ocs1", ADDRTYPE=IPv4, IPV4ADDRESS="10.11.21.59", PORT=3868;

- Configure a Diameter link group.

  ADD DIAMCONNGRP: CONNGROUPNAME="dia1", LOCALHOSTNAME="pgw1", APPLICATION=GY, PEERHOSTNAME="ocs1", SELECTMODE=MASTER_SLAVE;

- Configure a Diameter link.

  ADD DIAMCONNECTION: DIAMCONNGRP="dia1", LOCINTERFACE="Gyif1/0/0", LOCALPORT=13201, PEERADDRTYPE=IPv4, PEERIPV4ADDR="10.11.21.59", PEERPORT=3868;

Configuration Example (3)

- Configure an OCS server group.

  ADD OCSGROUP: OCSGRPNAME="og-test1";

  ADD OCSBINDING: OCSGRPNAME="og-test1", OCSHOSTNAME="ocs1";

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6. Ga Interface Configuration Process

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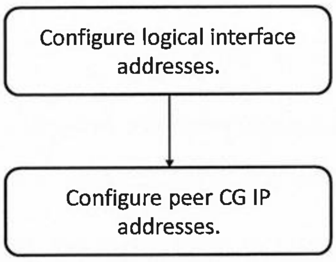
Ga Interface Configuration Process



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Data Configuration

Step	Operation	Command
Configuring logical interfaces		
1	Configure a logical IP address.	ADD LOGICIP
2	Configure a logical interface.	ADD LOGICINF
Configuring a CG		
1	Configure a CG.	ADD CG

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Summary

- Ga interface data configuration includes:
  - Configure the IP address of the logical interface: **ADD LOGICIP** and **ADD LOGICINF**
  - Configure CG information: ADD CG
  - Configure the CG selection mode: **SET CDRTRANSFER**
- The CG selection mode can be MSG_BASED_LB (message-based load balancing) or PDP_BASED_LB (PDP/bearer-based load balancing).

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7. **DHCP Interface Configuration Process**

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Data Planning – UNC (GW-C) (2)

VNF Configuration	Category	Parameter	Value
UNC (GW-C)	VPN	VPN instance	vpna
	DHCP address pool	Address pool name	citya
		IP version	IPV4
	Address range in the DHCP address pool	Address range number	0
		Proxy IPv4 address	10.0.1.1
		Start IPv4 address	10.0.1.0
		End IPv4 address	10.0.1.254

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7. DHCP Interface Configuration Process

7.1 Data Planning

7.2 Logical Interface Configuration

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Data Configuration (2)

Step	Operation	Command
Configuring a binding between the DHCP server group and the address pool group		
1	Configure a binding between the DHCP server group and the address pool group.	ADD DHCPBINDPOOLGRP

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Configuration Example (1)

- Add a VPN instance.

  ADD VPNINST:VPNINSTANCE="vpna";

- Add a DHCP server group.

  ADD DHCPSERVERGRP: GROUPNAME="dgrp", IPVERSION=IPV4, REQLEASETIME=25, HASVPN=ENABLE, VPNINSTANCE="vpna";

- Add DHCP servers.

  ADD DHCPSERVER: GROUPNAME="dgrp", ISPRIMARY=ENABLE, IPVERSION=IPV4, V4IPADDRESS="10.1.4.51";

  ADD DHCPSERVER: GROUPNAME="dgrp", ISPRIMARY=DISABLE, IPVERSION=IPV4, V4IPADDRESS="10.1.4.52";

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Summary

- UNC service interfaces
- Configuration process and example of each service interface

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UDG System Overview

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References

- Huawei UDG (23.1) product description

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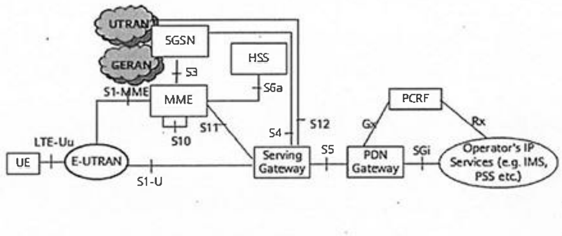
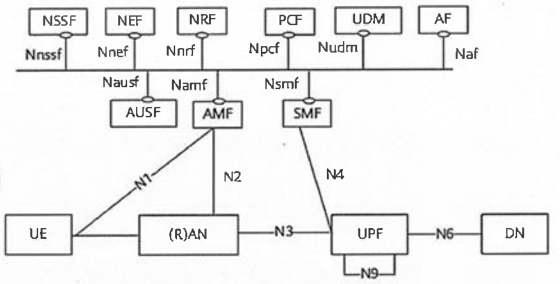
5G Architecture Overview



4G non-roaming architecture



5G non-roaming architecture (SBA)

5G key technologies and capabilities:

- **SBA:** The 5G control plane uses the SBA, where control-plane functions are decoupled and reconstructed into network functions (NFs), and network function services (NFSs) are defined for each NF.
- **Control plane modularization:** Control-plane functions are modularized. The AMF and SMF are used to separate the MM from the SM. The authentication function is performed by the AUSF.
- **User plane normalization:** The 5G architecture inherits the 4G control and user plane separation (CUPS) feature. The UPF functions as a normalized entity for the user plane, and the S-GW and P-GW are no longer used.
- **Network slicing:** This technology meets requirements of different application scenarios. Each resource slicing can be customized as required, and slice resources are mutually isolated.
- **Support for UL CL/BP:** 5G enhances traffic localization by enabling the UPF to function as an uplink classifier (UL CL) or branching point (BP) in the data path of a PDU session or a multi-homed PDU session (associated with multiple IPv6 prefixes).
- **Unified authentication:** 3GPP access and non-3GPP access use a unified authentication mechanism and unified NAS.

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3GPP Latest Progress

2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023

R15 **R16** **R17** **R18**

5G NR NSA

Phase 1.1

- Option 3/3x/3a
- eMBB QoS and rate
- DCNR
- NR access control

The 5G NSA (Option3) architecture was frozen in Phase 1.1 in December 2017.

5G NR SA

Phase 1.2

- Option 2
- Service based architecture (SBA) (AMF/SMF/UDM/UPF...)
- 4G-5G interworking
- New capabilities in R15: UL CL/LADN/QoS flow/Vo5G...

The 5GC (Option 2) architecture was frozen in Phase 1.2 in June 2018.

5G NR Late Drop

Phase 1.3

- Option 4 & Option 7

The 5GC (Option 4/7) architecture was frozen in Phase 1.3 in December 2018. –Delayed to March 2019

5GC/5G System Panorama

Phase 2

- NR IIoT
- NR V2X
- NR Voice
- NR URLLC
- MEC
- Non-3GPP
- Dynamic network slicing

R16 is to be frozen in Phase 2 in December 2019. --Delayed to March 2020

5G NR Enhancement

- NR light
- NR multicast and broadcast
- **NR coverage enhancement**
- Small data packet transmission enhancement
- IIoT and URLLC enhancement
- NR node enhancement
- NB-IoT and eMTC enhancement

R17 is to be frozen in March 2022.

5G Enhancement

- FS_5WWC_Ph2 /FS_ATSSS_Ph3/FS_MPS_WLAN
- FS_eEDGE_5GC_ph2
- FS_5MBS_Ph2
- FS_5G_ProSe_Ph2
- FS_GMEC
- FS_eNPN_ph2
- FS_DetNet
- FS_5GSAT_ARCH_Ph2/FS_5GSATB
- FS_5GAIML
- FS_eLCS_ph3
- FS_VMR_ARC

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2. UDG Functions

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2. UDG Functions

2.1 UDG Interfaces

2.2 UDG Features

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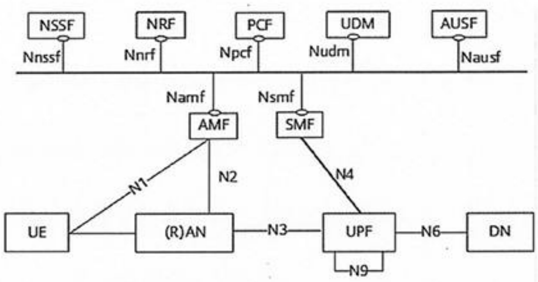
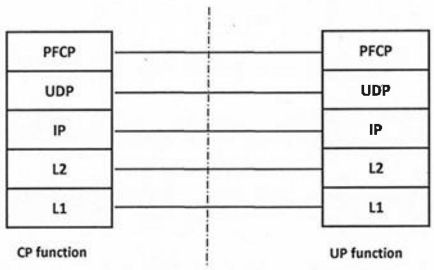
UDG Interface and Protocols: N4



Packet Forwarding Control Protocol (PFCP)



Sx and N4 reference point

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2. UDG Functions

2.1 UDG Interfaces

2.2 UDG Features

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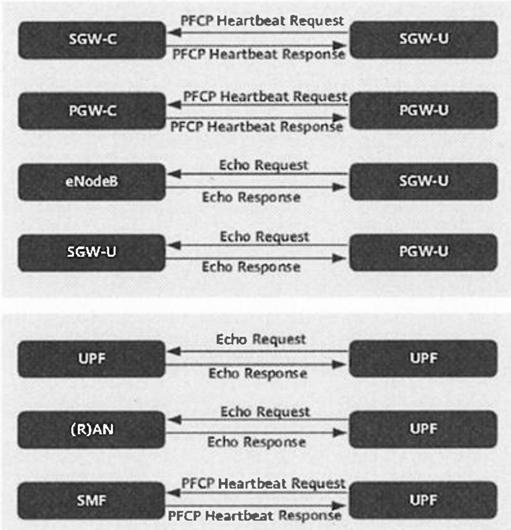
Access & QoS – Path Management

Path management is an effective fault detection function and ensures non-stop communication over networks. It can be used between any of the following NEs:

- SGW-C and SGW-U
- PGW-C and PGW-U
- eNodeB and SGW-U
- SGW-U and PGW-U
- UPFs
- (R)AN and UPF
- SMF and UPF



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Access & QoS – 4G-5G Interworking

The UDG supports interworking between 5G and 4G networks over the N26 interface. The interworking involves the following procedures:

- 5G-to-4G handover
- 5G-to-4G TAU
- 4G-to-5G handover
- 4G-to-5G registration update

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2.2 UDG Features

- Access & QoS
- **Charging**
- SA & Service
- Security & Routing
- UL CL/BP
- Single IP
- Full Meshing
- Others

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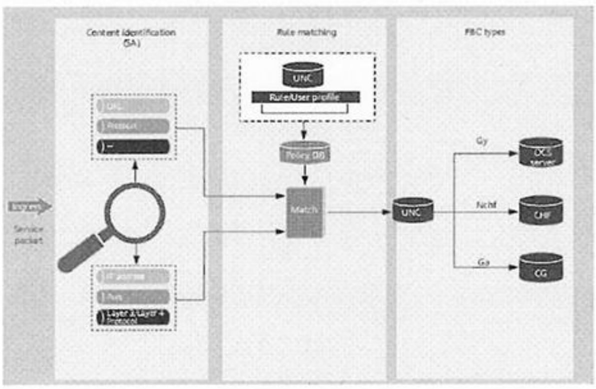
Charging

When a subscriber starts to access services, the UDG records the subscriber's uplink and downlink service data and reports the data to the UNC over the Sxa, Sxb, or N4 interface.

If flow-based charging (FBC) is used, carriers can identify the service types for uplink and downlink data based on packet filtering and analysis. This way, carriers can flexibly apply charging policies.

Based on configured rules, the UDG performs the following operations on subscriber packets:

- Layer 3 filtering: source and destination IP addresses
- Layer 4 filtering: Layer 4 protocol and source and destination port numbers
- Layer 7 filtering: application layer protocols, such as HTTP, WAP, FTP, RSTP based VOD, and more
- FBC is divided into offline charging and online charging.



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Service Redirection

- Captive Portal
  - When a subscriber initiates an HTTP service request, the UDG redirects the request to the URL of a captive portal based on the portal configuration.
- Web Proxy
  - To accelerate web browsing, the UDG can redirect web browsing requests to the IP address of a web proxy cache server, which caches the requested web pages.

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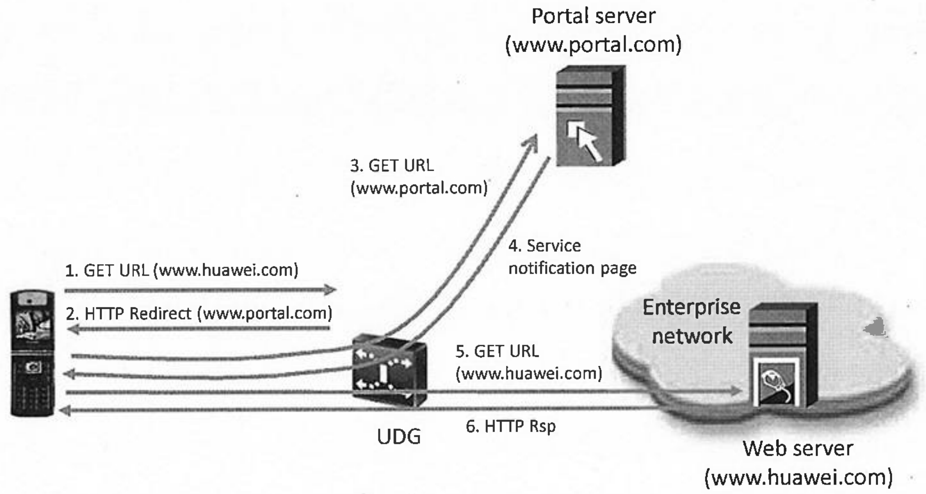
Captive Portal



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Security

- The UDG provides the following security features:
  - IP security (IPsec)
  - Packet filtering and ACL
  - SGi redirection
  - Anti-DDoS protection
  - Anti-spoofing

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Routing

- The UDG supports the following routing techniques:
  - Static route
  - OSPF
  - BGP-4
  - Routing policy

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2.2 UDG Features

- Access & QoS
- Charging
- SA & Service
- Security & Routing
- UL CL/BP
- **Single IP**
- Full Meshing
- Others

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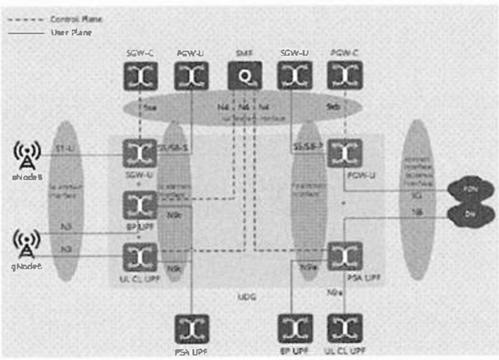
Single IP

With the Single IP feature, the UDG can:

- **Reuse IP addresses for different types of logical interfaces.**

  The UDG can function as a combined SGW-U/PGW-U/UPF, but multiple types of logical interfaces are required in this situation. Single IP introduced to the UDG reduces the number of IP addresses that must be configured for logical interfaces. For instance, the Saif/Paif interface only needs to be configured with one IP address, but can function as multiple types of logical interfaces.
  - The Sa abstract interface can function as S1-U and N3 logical interfaces, and the two types of logical interfaces can be independently configured on the UDG.
  - The Sc abstract interface can function as the S5-S/S8-S and N9c logical interfaces, and the two types of logical interfaces can be independently configured on the UDG.
  - The Pa abstract interface can function as Gn, S5-P/S8-P, and N9a logical interfaces, and the three types of logical interfaces cannot be independently configured on the UDG.
- **Configure just one interface for each logical interface type.**

  The Single IP feature allows a single interface to be configured for all logical interfaces of a given type. The interface occupies a single IP address, which simplifies network planning and network configuration.



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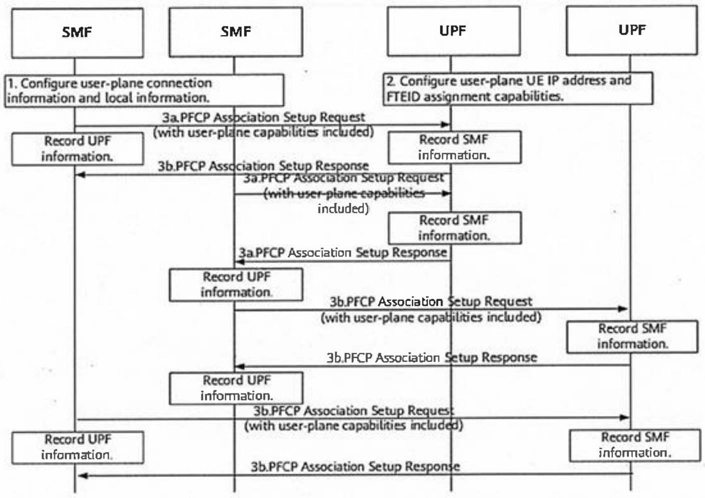
Full Meshing

Association establishment between the control plane and user plane

1. A UPF can establish associations with multiple SMFs and maintain information about the paths towards the SMFs at the same time.
2. Both the control plane and user plane can initiate association establishment, as specified in 3GPP specifications. By default, an SMF is selected to initiate an association establishment request.
3. During association establishment, the control plane and user plane negotiate about UE address and F-TEID assignment capabilities.



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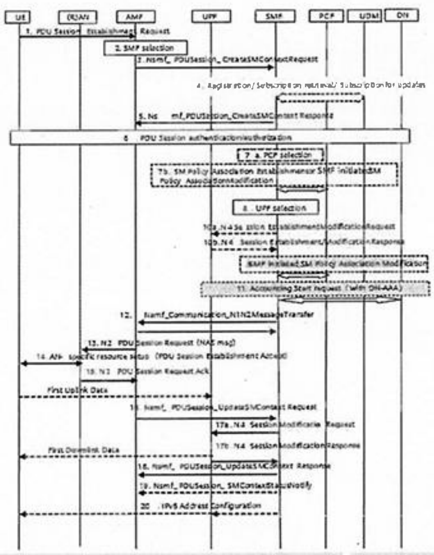
Full Meshing

PDU session establishment:

1. Standard procedures are adjusted. Specifically, the SMF needs to perform step 9 after step 10 is complete.
2. In step 10a, the SMF determines whether the user plane assigns F-TEIDs and UE IP addresses.
3. The content of the activation message transmitted over the N4 interface is extended. This message now also contains the indication of allocating F-TEIDs and UE IP addresses by the user plane and required information if the user plane has been selected for assignment.
4. The user plane responds with the assigned F-TEIDs and UE IP addresses in activation response messages if the user plane has been selected for assignment.



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Summary

- The UDG provides unified functions of the SGW-U, PGW-U, and UPF at the user plane based on the 5G architecture.
- The UDG uses the CUPS architecture to meet diverse network location requirements. It can also be deployed flexibly in different application scenarios based on network slices.
- The UDG is a high-performance, stateless, and programmable product.
- The UDG supports standard interfaces and protocol stacks.
- The UDG inherits 4G service functions and also introduces Reflective QoS and UL CL/BP features for 5G scenarios.

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UDG 23.1 Interface Configuration

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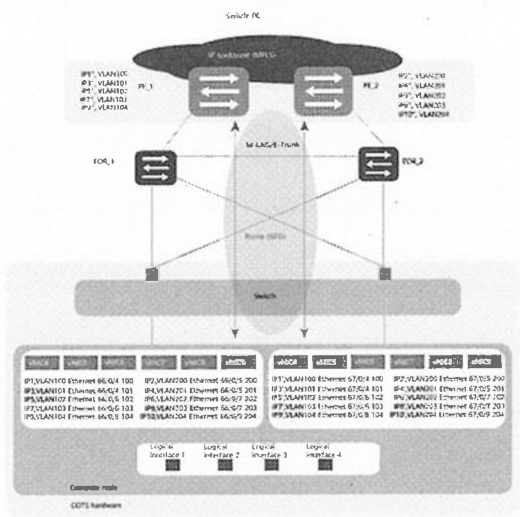
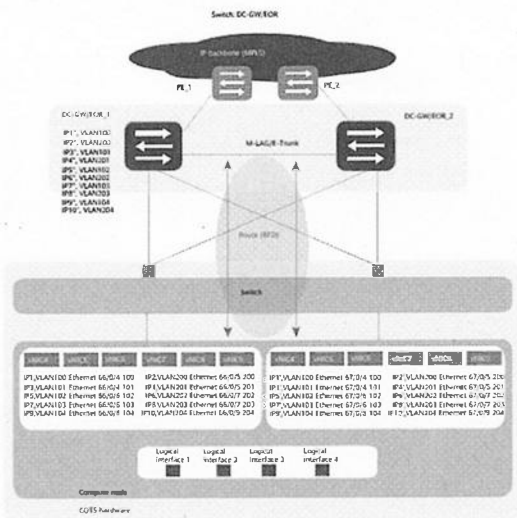
References

- Huawei UDG 23.1 Product Documentation

Networking Architecture





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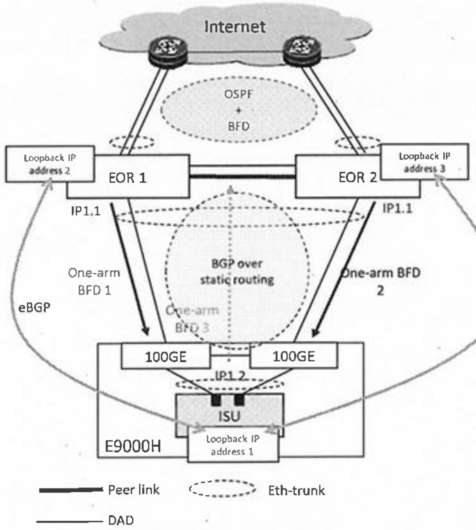
Configuration Example for UPF Interface Networking (Internal BGP and External OSPF)



- EOR switches use M-LAG networking, and peer links and DAD ports are configured for interworking between EOR switches. A peer-link port transmits both Layer 2 and Layer 3 service traffic.
- Static LACP is enabled for the Eth-Trunk between the server NIC and the gateway, and the Fast mode is used to detect link faults and converge paths.
- EOR switches connect to PTN devices through Eth-Trunk interfaces, forming a square-shaped network.
- EOR switches 1 and 2 are configured with the gateway IP address of the vNIC interface on the ISU and both are configured with the same MAC address. They interwork with each other over a VLANIF interface.
- Layer 3 interworking must be enabled between EOR switches. VLANs different from those used for interworking with vNICs must be planned, VLANIF interfaces must be configured for interworking at Layer 3, and the switches are not configured with the same MAC address. In addition, OSPF routes are configured for interworking between EOR switches.
- The vNIC interfaces of a VRF instance belong to one network segment and one VLAN.
- The VRF instance created on a VNF must be the same as that on the transport network.
- BGP over static routing+one-arm BFD networking is used between the UDG and an EOR switch. The BGP peer addresses on the VNF and EOR switches must be configured as loopback addresses. Moreover, static routes for communicating with the peer loopback address must be configured.
- Configure a one-arm BFD session from the EOR switch to the VNF, with the source and destination IP addresses being the VLANIF IP addresses for one-arm BFD, and set the BFD interval to 500 ms x 4. In addition, enable BFD between OSPF routes, and set the BFD interval to 500 ms x 4.

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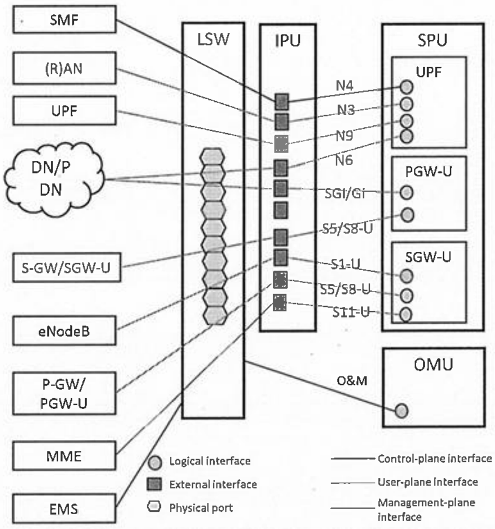
UDG Interface Overview (PBU_P-N+SPU Deployment Mode, That Is, Using NP Forwarding Modules)



- Interface types:
  - Logical interfaces
    - N4if
    - N3if
    - N9if
  - External interfaces
    - 10GE
  - Physical ports
    - 10GE
    - 40GE

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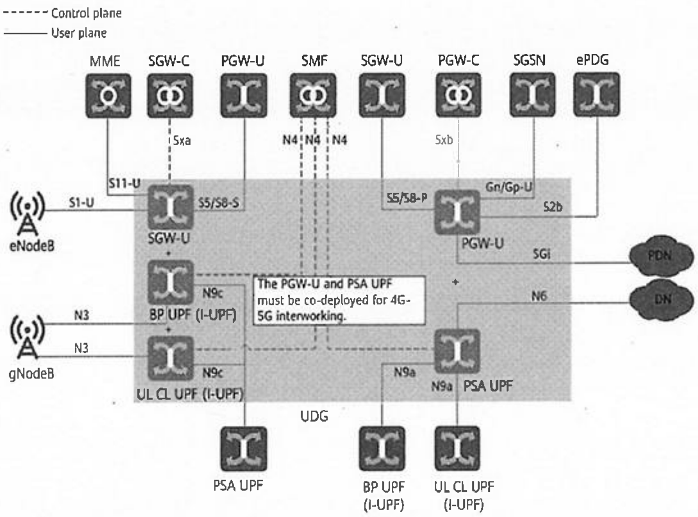
Abstract Interface



- The UDG categorizes GTP interfaces on 3G, 4G, and 5G networks and uses Saif, Paif, and Scif as abstract interfaces to replace their logical interfaces.
- Abstract interfaces can meet flexible networking requirements and conserve IP address resources.
- The S1-U and N3 interfaces can be configured independently, but the combined Sa and S1-U/N3 interfaces are mutually exclusive.
- The S5-S/S8-S and N9c interfaces can be configured independently, but the combined Sc and S5-S/S8-S/N9c interfaces are mutually exclusive.
- IP addresses of the S5-P/S8-P and N9a interfaces must be the same. Therefore, you can configure only the Pa interface, eliminating the need to configure the S5-P/S8-P and N9a interfaces.
- When being used for interworking with the MME, the S11-U interface can be configured independently. In other situations, the combined Sa and S11-U interfaces can be jointly configured.

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3GPP-Defined Logical Interfaces That Can Be Configured on the UDG (3)

Deployment Mode	Logical Interface	Name of an Independent Interface on the UDG	Name of an Abstract Interface on the UDG
Co-located UPF+PGW-U	S5/S8-P	- (independent interface configuration not supported)	Paif
	S2b	- (independent interface configuration not supported)	Paif
	Sxb	- (independent interface configuration not supported)	N4if
	SGi	- (not required because its function is provided by the physical port of an external interface)	-
	N3	N3if	Saif
	N9c	N9cif	Scif
	N9a	- (independent interface configuration not supported)	Paif
	N4	- (independent interface configuration not supported)	N4if
	N6	- (not required because its function is provided by the physical port of an external interface)	-

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3GPP-Defined Logical Interfaces That Can Be Configured on the UDG (4)

Deployment Mode	Logical Interface	Name of an Independent Interface on the UDG	Name of an Abstract Interface on the UDG
Co-located UPF+PGW-U	Gn-U	- (independent interface configuration not supported)	Paif
	Gp-U	- (independent interface configuration not supported)	Paif
	S11-U	S11-uif	-
	Gi	- (not required because its function is provided by the physical port of an external interface)	-
Independently deployed UPF	N3	N3if	Saif
	N9c	N9cif	Scif
	N9a	- (independent interface configuration not supported)	Paif
	N4	- (independent interface configuration not supported)	N4if
	N6	- (not required because its function is provided by the physical port of an external interface)	-

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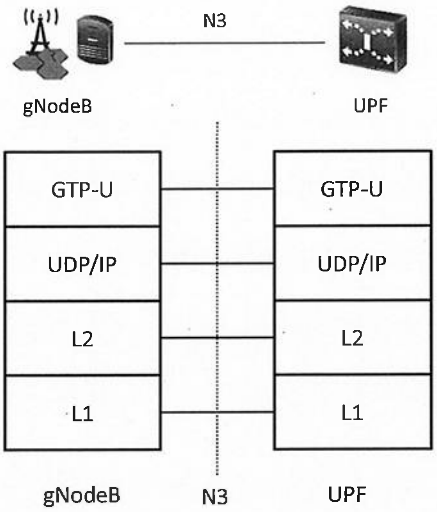
N3 Interface



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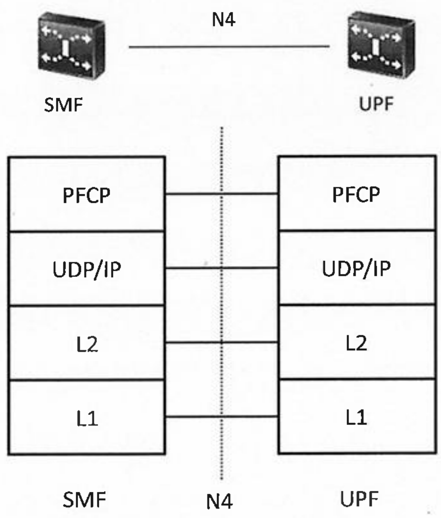
N4 Interface



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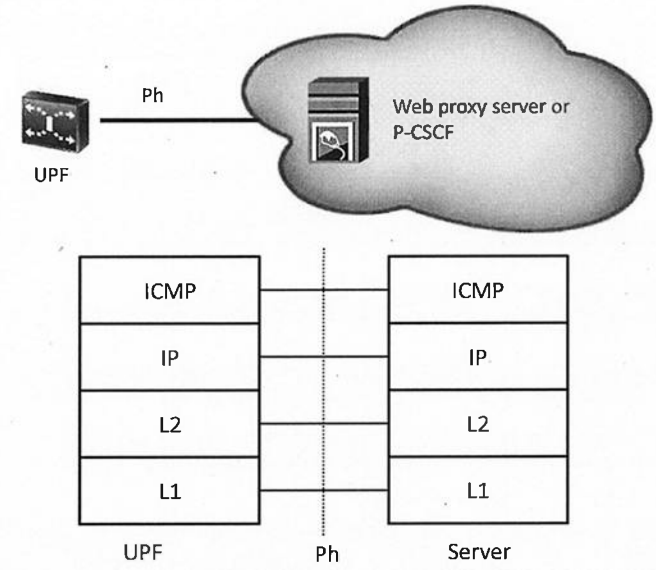
Ph Interface



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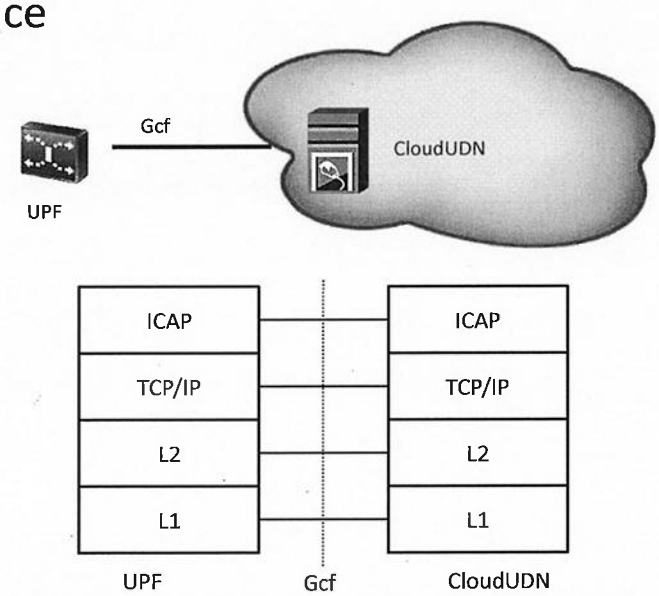
Gcf Interface



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2. O&M Interface Configuration

2.1 Data Planning

2.2 O&M Interface Configuration

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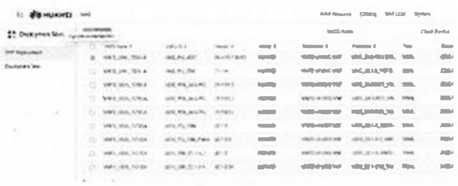
O&M Interface Configuration



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Data Plan on the UDG

<table>
<tr><th>Category</th><th>Parameter</th><th>Example Value</th><th>Data Source</th></tr>
<tr><td>ADD L3VPNINST</td><td>VPN Name (VRFNAME)</td><td>VRF_CN</td><td>5G Core IP Addresses > VRF in 5G Core LLD for Vertical Integration</td></tr>
<tr><td rowspan="2">ADD VPNINSTAF</td><td>Address Family Type (AFTYPE)</td><td>ipv4uni</td><td>Fixed value</td></tr>
<tr><td>Router Distinguisher (VRFRD)</td><td>10.10.10.78</td><td>Routing > VRF Design in 5G Core LLD</td></tr>
<tr><td rowspan="3">ADD AUTOSCALINGETHTRUNK</td><td>Ethernet Trunk Template ID (ETHTRUNKTMPID)</td><td>1</td><td>Local data plan (configurations on other NFs do not need to be considered)</td></tr>
<tr><td rowspan="2">Virtual Nic IDS (VNICLIST)</td><td>4</td><td rowspan="2">5G Core IP Addresses > Sub-Port in 5G Core LLD for Vertical Integration</td></tr>
<tr><td>5</td></tr>
</table>

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Data Plan on the UDG

<table>
<tr><th>Category</th><th>Parameter</th><th>Example Value</th><th>Data Source</th></tr>
<tr><td rowspan="12">ADD AUTOSCALINGSERVICE</td><td rowspan="2">Service Name (SERVICENAME)</td><td>ServName_CN_100_v4</td><td rowspan="2">Local data plan (configurations on other NFs do not need to be considered)</td></tr>
<tr><td>ServName_CN_200_v4</td></tr>
<tr><td>VPN Name (VPNNAME)</td><td>VRF_CN</td><td>Existing configuration</td></tr>
<tr><td>Address Family (AFTYPE)</td><td>IPv4</td><td>Existing configuration</td></tr>
<tr><td>IPv4 Address Assignment Mode (IPALLOCTYPE4)</td><td>DHCP</td><td>Fixed value</td></tr>
<tr><td rowspan="2">VNIC ID (VNICID)</td><td>4</td><td rowspan="2">5G Core IP Addresses > Sub-Port in 5G Core LLD for Vertical Integration</td></tr>
<tr><td>5</td></tr>
<tr><td>Ethernet Trunk Template ID (ETHTRUNKTMPID)</td><td>1</td><td>Existing configuration</td></tr>
<tr><td rowspan="2">VLAN ID (VLANID)</td><td>100</td><td rowspan="2">5G Core IP Addresses > VLAN (VM) and VLAN (NFVI) in 5G Core LLD for Vertical Integration</td></tr>
<tr><td>200</td></tr>
</table>

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Data Plan on the UDG

Category	Parameter	Example Value	Data Source
ADD AUTOSCALINGSRROUTE (used to add service routes)	Service Name (SERVICENAME)	ServName_CN_100_v4	Existing configuration
		ServName_CN_200_v4	
	VPN Name (VRFNAME)	VRF_CN	Existing configuration
	Address Family (IPVERSION)	IPv4	Local data plan (configurations on other NFs do not need to be considered)
	Route Prefix IPv4 (PREFIX4)	0.0.0.0	Fixed value
	Route Mask Length (MASKLENGTH)	0	Fixed value
	IPv4 Route Next Hop Assignment Mode (NEXTHOPALLOCTYPE4)	DHCP	Fixed value
	Is BFD Enabled (BFDENABLE)	TRUE	**Routing** > **BFD Design (One-arm)** in 5G Core LLD for Vertical Integration
	BFD Template Name (BFDTEMPLATENAME)	BFD_1	Existing configuration
		BFD_2	

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3. N4 Interface Configuration

3.1 Data Plan

3.2 External Interface Configuration

3.3 Logical Interface Configuration

3.4 IP Route Configuration

3.5 (Optional) PFCP Parameter Setting

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Step 2: Disable Automated Configuration

- Example

1. View the status of the automated configuration function.

   LST AUTOCONFIG:;

   If **Auto Configuration Switch** is **TRUE**, perform steps 2 and 3 to disable automated configuration.

   If **Auto Configuration Switch** is **FALSE**, automated configuration has been disabled. Then, go to step 4.

2. Verify that the value of **autoscaling_autoconfig.py** is **Ready** for the automated configuration maintenance assistant or that there is no such a script. This ensures that the current device is not under automated configuration. If there is an ongoing automatic configuration task, disabling automatic configuration will affect the system configuration result because it takes a period of time for the automatic configuration function to take effect.

   DSP OPSASSISTSTATE:;

3. Disable automated configuration. This is because commands for automated configuration can be executed only after automated configuration is disabled.

   SET AUTOCONFIG:SWITCHFLAG=FALSE;

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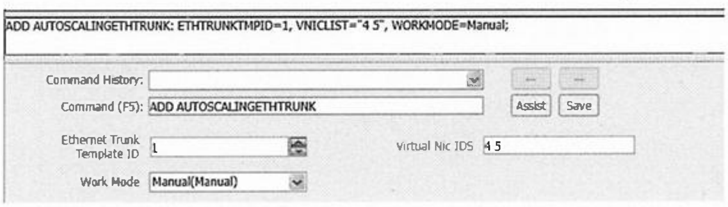
Step 3: Add an Automatic Configuration Template for Multi-vNIC Ethernet Trunks when the Interfaces Use SR-IOV Bonding Networking

- Example

ADD AUTOSCALINGETHTRUNK: ETHTRUNKTMPID=1, VNICLIST="4 5";

Note: This template must be configured if SR-IOV bonding networking is used. Skip this step in non-SR-IOV bonding networking.

On SR-IOV bonding networking, the two member interfaces of an Eth-trunk interface must have the same MAC address and consecutive IDs. That is, IDs specified using **VNICLIST** are the same as the two consecutive IDs of Ethernet interfaces with the same MAC address. You can run **LST INTERFACE** to obtain the MAC addresses and names of the Ethernet interfaces.



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Step 5: Add Automatic Configuration Templates for Static Routes

- Example

ADD AUTOSCALINGSRROUTE: SERVICENAME="ServName_CN_100_v4", VRFNAME="VRF_CN", IPVERSION=IPv4, PREFIX4="10.10.20.78", MASKLENGTH=32, NEXTHOPALLOCTYPE4=DHCP, PREFERENCE=60, BFDENABLE=TRUE, BFDTEMPLATENAME="BFD_1";

ADD AUTOSCALINGSRROUTE: SERVICENAME="ServName_CN_200_v4", VRFNAME="VRF_CN", IPVERSION=IPv4, PREFIX4="10.10.30.78", MASKLENGTH=32, NEXTHOPALLOCTYPE4=DHCP, PREFERENCE=60, BFDENABLE=TRUE, BFDTEMPLATENAME="BFD_2";

ADD AUTOSCALINGSRROUTE: SERVICENAME="ServName_CN_100_v4", VRFNAME="VRF_CN", IPVERSION=IPv4, PREFIX4="0.0.0.0", MASKLENGTH=0, NEXTHOPALLOCTYPE4=DHCP, PREFERENCE=60, BFDENABLE=TRUE, BFDTEMPLATENAME="BFD_1";

ADD AUTOSCALINGSRROUTE: SERVICENAME="ServName_CN_200_v4", VRFNAME="VRF_CN", IPVERSION=IPv4, PREFIX4="0.0.0.0", MASKLENGTH=0, NEXTHOPALLOCTYPE4=DHCP, PREFERENCE=60, BFDENABLE=TRUE, BFDTEMPLATENAME="BFD_2";

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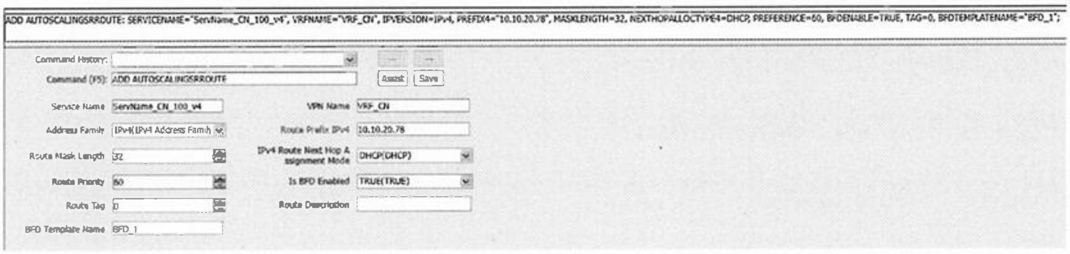
Command Execution Example



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Data Configuration Steps

Step	Operation	Command
VPN Configuration		
1	Configure a VPN instance.	ADD VPNINST
Logical Interface Configuration		
2	Configure a logical interface.	ADD LOGICINF

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Step 1: Configure a VPN

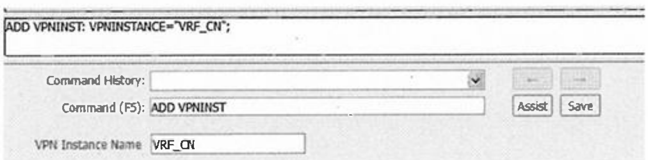
- Example

  Add a VPN instance named **VRF_CN**.

  ADD VPNINST: VPNINSTANCE=" VRF_CN";

Note:

- The VPN instance name must be the same as that configured for the external interface. Otherwise, services will fail.
- The VPN instance named **_public_** is reserved for public networks and cannot be created or deleted.



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BFD

- Bidirectional forwarding detection (BFD) is a unified detection mechanism for the entire network. It helps quickly detect network faults, reduce the impact of device faults on services, and improve network availability.
- When BFD is used, two systems establish a BFD session between each other and periodically send BFD packets along the path between them. If a system does not receive BFD packets within a specified period, the system considers that the path is faulty.
- BFD can be used in multiple modes.
  - BFD for IP
    - A BFD session is established on an IP link, and then the BFD detection mechanism is used to quickly detect faults.
  - BFD for static routing
    - BFD for static routing is introduced to bind a static route to a BFD session so that the BFD session monitors the status of the link related to the static route.
  - BFD for OSPF/BGP
    - BFD is associated with OSPF/BGP. After BFD for OSPF/BGP is configured, BFD quickly detects link faults and notifies OSPF/BGP of the faults. This accelerates the response of dynamic routing protocols to network topology changes.

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BFD Data Configuration Steps

Step	Operation	Command
BFD Configuration		
1	Enable or disable BFD globally.	SET BFD
2	Add a BFD session.	ADD BFDSESSION

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Command Execution Example

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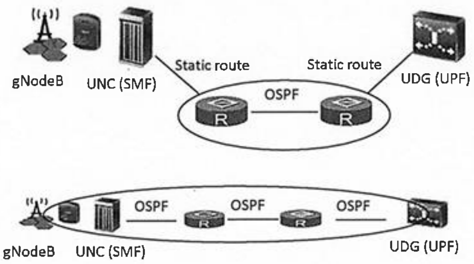
Routing Policy

The UDG supports both static and dynamic routes, and you can configure either of them according to the following principles:

- OSPF dynamic routes (bound to BFD sessions) are preferred for networking due to their good scalability, which ensures that internal routes are automatically advertised during VM addition or reduction.
- Static routes (bound to BFD sessions) can also be used for networking, which allows new routes to be added to external devices during VM addition.



- Static route
  - Static routes: global routes and VPN routes
  - Default routes: global routes and VPN routes
- Dynamic route
  - OSPF

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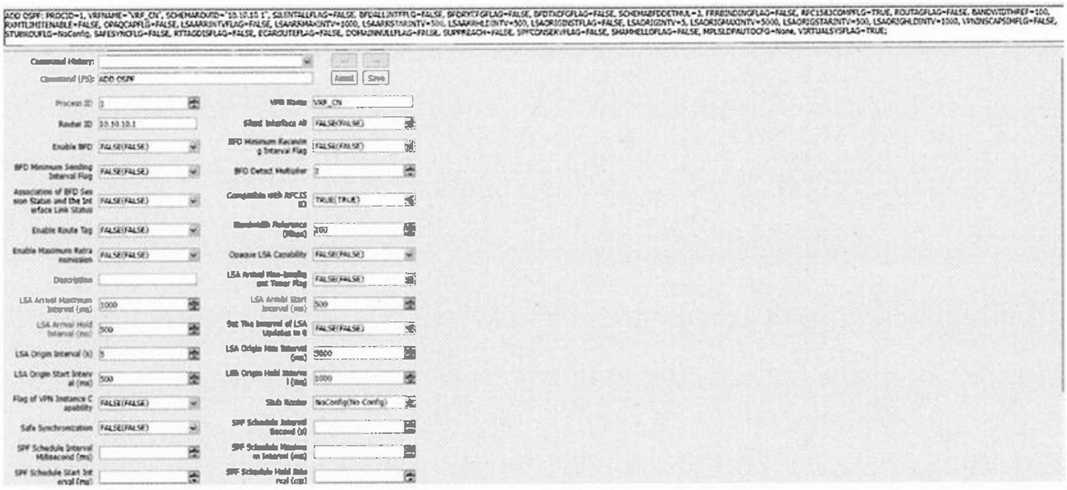
Step 3: Create an OSPF Process (Continued)



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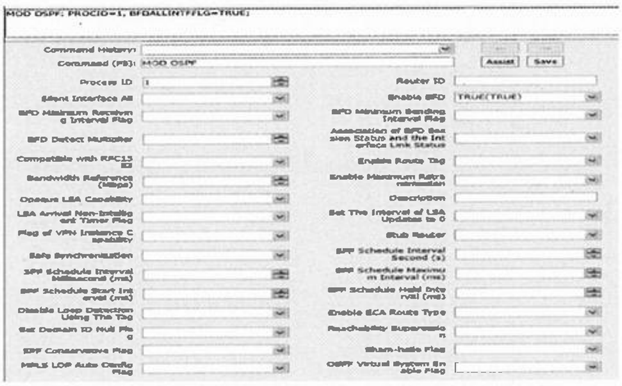
Step 4: Modify Configurations of an OSPF Process

- Example

  # Enable BFD on OSPF process 1.

  MOD OSPF: PROCID=1, BFDALLINTFFLG=TRUE;



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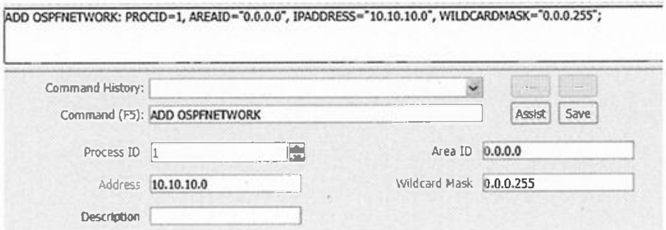
Step 7: Configure an OSPF Interface

- Example

Add network segment 10.10.10.0/24 to the area (with the ID **0.0.0.0**) for OSPF process 1.

ADD OSPFNETWORK: PROCID=1, AREAID="0.0.0.0", IPADDRESS="10.10.10.0", WILDCARDMASK="0.0.0.255";



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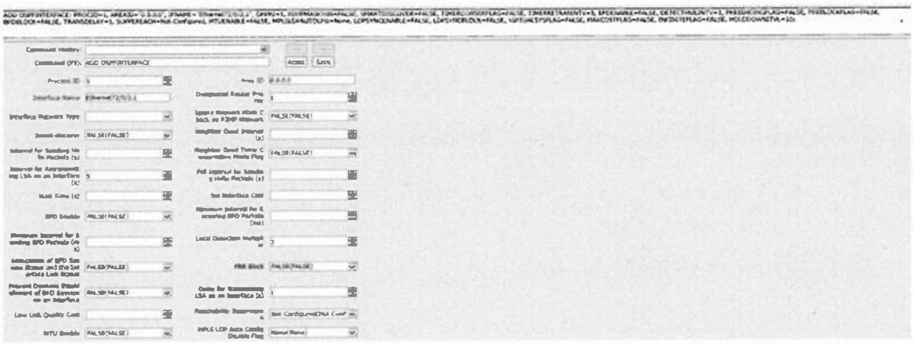
Step 8: Configure OSPF Interface Attributes

- Example

Add the Ethernet72/0/2.1 interface to the area (with the ID **0.0.0.0**) for OSPF process 1.

ADD OSPFINTERFACE: PROCID=1, AREAID="0.0.0.0", IFNAME ="Ethernet72/0/2.1";



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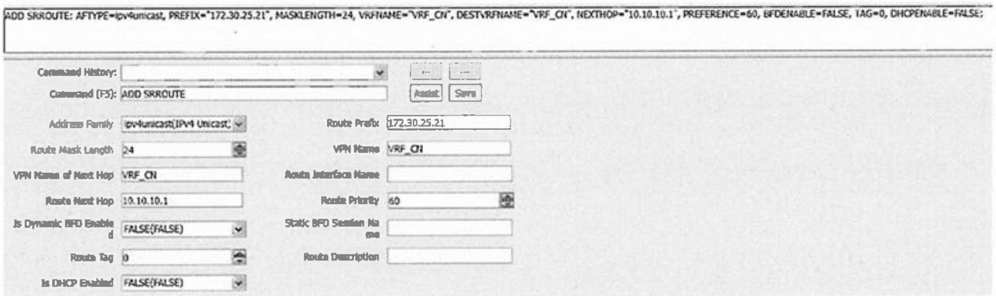
Step 3: Configure a Static Route

- Example

  # Add a static route, with the destination address **172.30.25.21**, subnet mask **24**, next-hop address **10.0.0.1**, VPN name **VPN_CN**, and without an outbound interface.

  ADD SRROUTE: VRFNAME="VRF_CN", AFTYPE=ipv4unicast, PREFIX="172.30.25.21", MASKLENGTH=24, DESTVRFNAME="VRF_CN", NEXTHOP="10.10.10.1", SESSIONNAME = "forCN";



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Step 4: Configure a Default Route

- Example

  # Add a default route for VPN **VRF_CN**.

  ADD SRROUTE: PREFIX="0.0.0.0", MASKLENGTH=0, NEXTHOP="10.10.10.1", VRFNAME="VRF_CN", SESSIONNAME="forCN";

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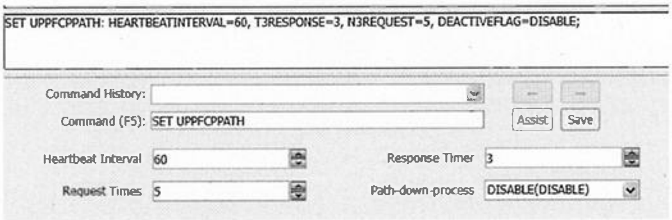
Step 1: Configure Information About the PFCP Protocol

- Example

  \# Set the interval for sending PFCP heartbeat messages to **60**, interval for retransmitting PFCP request messages to **1**, maximum number of PFCP request message retransmission attempts to **2**, and session activation flag of a path to **Disable**.

  SET UPPFCPPATH: HEARTBEATINTERVAL=60, T3RESPONSE=1, N3REQUEST=2, DEACTIVEFLAG=DISABLE;



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Data Configuration Process

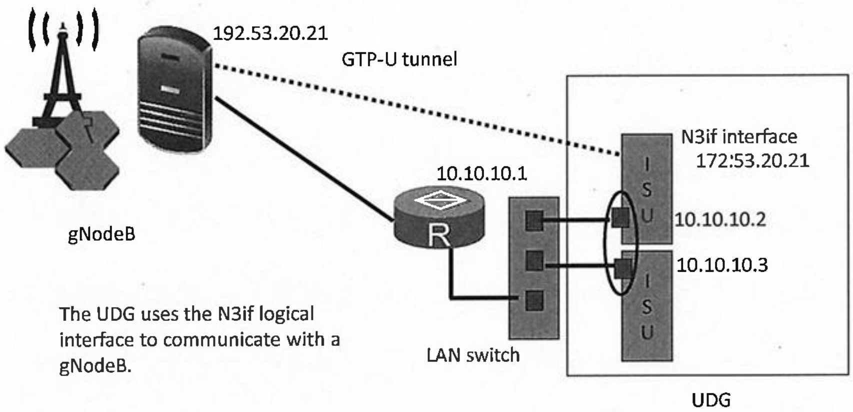
- The process of configuring an S11-U interface is similar to that of configuring an N4 interface.
- All configuration steps (except step 5) are the same as those for an N4 interface.

1. (Optional) Create a VPN instance.
2. Configure a physical port.
3. Configure a logical interface.
4. Configure an IP route.
5. (Optional) Set GTP parameters.

Setting GTP Parameters

Step	Operation	Command
(Optional) GTP Parameter Setting		
1	Set GTP path attributes.	SET UPGTPPATH

N3 Interface Networking



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Data Plan

Plan the VPN, address family, and routing data based on the N4 interface data plan.

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Step 1: Set GTP path parameters

- Example:

  # Enable the echo function for GTPv1 data paths, and set the maximum number of GTP request retransmissions to **5** and retransmission interval to **10**. Configure the UDG to allow it to deactivate UEs in the case of path disconnection, and set the number of heartbeat messages sent after path disconnection.

  SET UPGTPPATH: V1DATAECHOSW = ENABLE, T3RESPONSE = 10, N3REQUEST = 5, DEACTIVEFLAG = ENABLE, ECHOTIME = 40;

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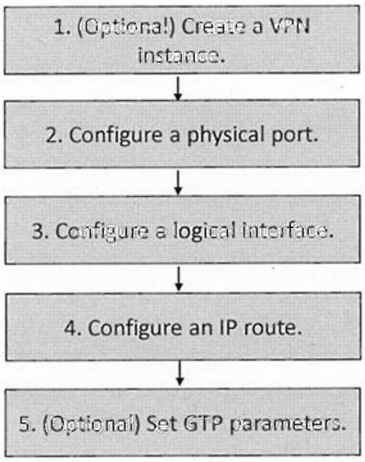
6. **Sc Interface Configuration**
7. Pa Interface Configuration
8. Ph Interface Configuration
9. Gcf Interface Configuration
10. Grp Interface Configuration
11. Commissioning

Data Configuration Process

- The process of configuring an Sc interface is similar to that of configuring an N3 interface.



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10. Grp Interface Configuration
11. Commissioning

Data Configuration Process

- The process of configuring a Pa interface is similar to that of configuring an N3 interface.

1. (Optional) Create a VPN instance.
2. Configure a physical port.
3. Configure a logical interface.
4. Configure an IP route.
5. (Optional) Set GTP parameters.

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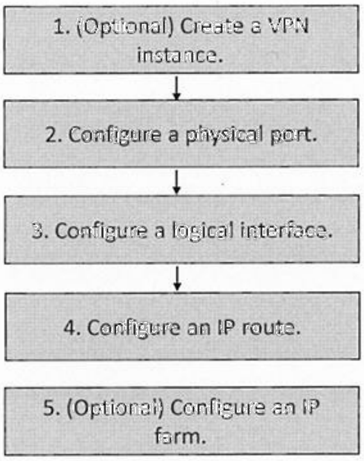
Data Configuration Process

- The process of configuring a Ph interface is similar to that of configuring an N3 interface. All configuration steps (except step 5) are the same as those for an N4 interface.
- In step 5, an IP farm needs to be configured to implement signaling detection and packet exchange of both the local Ph interface and the peer server address.



Configuring an IP Farm

Step	Operation	Command
(Optional) IP Farm Configuration		
1	Create an IP farm instance.	ADD IPFARM
2	Add IP farm server configurations.	ADD IPFARMSERVER

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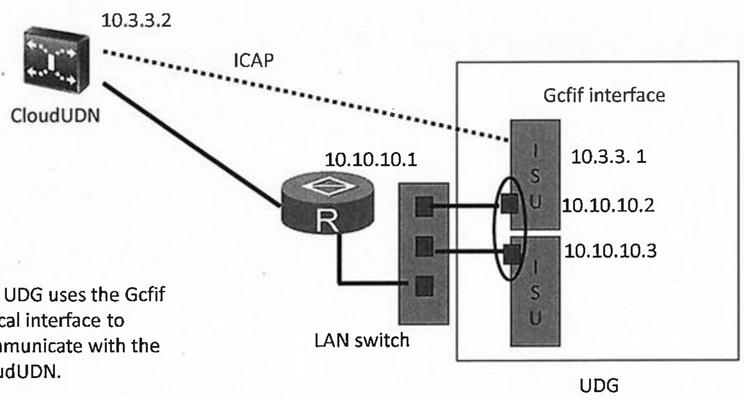
Gcf Interface Networking



The UDG uses the Gcfif logical interface to communicate with the CloudUDN.

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Setting ICAP Parameters

Step	Operation	Command
(Optional) ICAP Parameter Configuration		
1	Modify configurations of the ICAP server.	MOD ICAPSERVER

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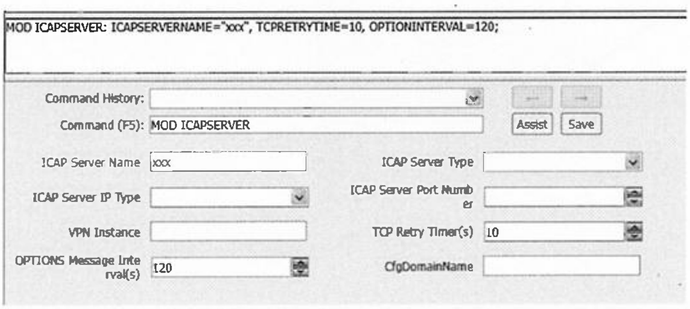
Step 1: Modify ICAP Parameters.

- Example:

  # Change the interval for TCP connection establishment attempts to 10 seconds and the interval for heartbeat OPTIONS message retransmissions to 120 seconds.

  MOD ICAPSERVER: ICAPSERVERNAME="XXX", TCPRETRYTIME=10, OPTIONINTERVAL=120;



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Data Plan

Plan the VPN, address family, and routing data based on the N4 interface data planning.

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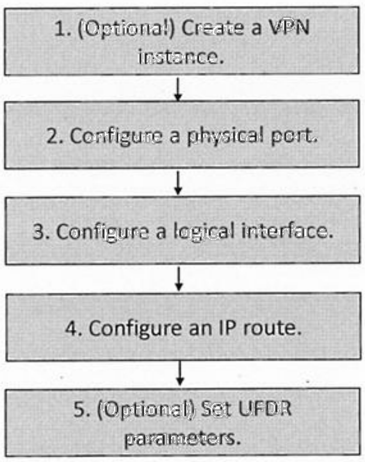
Data Configuration Process

- The process of configuring a Grp interface is similar to that of configuring an N4 interface.
- All configuration steps (except step 5) are the same as those for an N4 interface.



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Commissioning

Action	Command	Description
Run the **ping** command to check whether the connection to the peer end is normal.	PING	The peer end is reachable.
(Optional) Check data configurations.	LST xxxxxxx	Data configurations are correct.
(Optional) Delete incorrect configurations.	RMV xxxxxxx	--
Check whether the service IP addresses of VNFs can be pinged.	NGPING	The peer end is reachable.
Dynamically query for CP information.	DSP CPINFO	The path between the system and CP is normal.
Detect the GTP/PFCP path status.	TST PATH	Check whether the status is normal.

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Commissioning Procedure (Continued)

3. Run **DSP CPINFO** to query for real-time CP information.

```
+++    UDG/*MEID:0 MENAME:udg*/        2023-05-08 17:16:54+8:00
O&M    #7459
%%DSP CPINFO:;%%
RETCODE = 0  Operation succeeded

CP Information:
---------------
Result  =
CP IP Address                         CP State      CP Node ID
19.70.46.15                           UP            smf1
ALL CPInfo Number = 1
(Number of results = 1)

---    END
```

You can check whether the value of **CP State** is **UP**.

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Commissioning Procedure (Continued)

4. Run **TST PATH** to check whether the path status is normal.

#PFCP is used as an example.

```
+++    UDG/*MEID:0 MENAME:udg*/        2023-05-08 17:17:17+8:00
O&M    #7462
%%TST PATH: IPVERSION=IPV4, LOCALIPV4="84.2.46.131", PEERIPV4="19.70.46.15", PROTOCOLTYPE=PFCP;%%
RETCODE = 0  Operation succeeded

---    END
```

If the path status is normal, the command output indicates that the operation succeeds.

If the path status is abnormal, the command output indicates that the detection fails and no response is returned.

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Summary

- Data configuration of the N4/N3 interface involves:
  - VPN instance configuration
  - External interface configuration
  - Logical interface configuration
  - Route configuration: static route and dynamic route
  - PFCP or GTP parameter setting: time, protocol parameters, and path parameters
- For details about how to configure other interfaces, such as the N9 interface, see the above interface configuration procedure.

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UDG 20.3 User Plane Address Assignment

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Objectives

- After completing this course, you will be able to:
  - Understand the principles for user plane address assignment.
  - Master data configuration for user plane address assignment.

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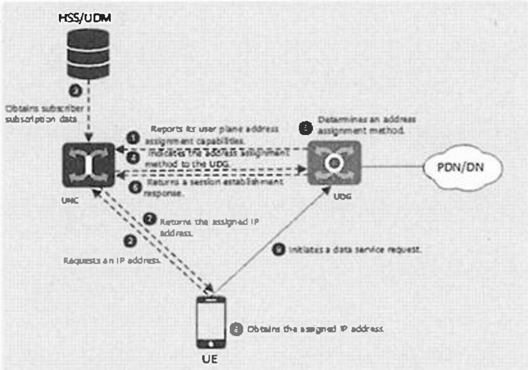
Address Assignment Overview

- The following figure shows how the UDG works with the UNC and UDM to assign IP addresses to UEs. A UE requests the UNC for an IP address. The UNC notifies the UDG of an address assignment method based on the UE's subscription data and the local policy. The UDG either assigns a user-plane IP address or forwards a received IP address to the UE through a session response message. After obtaining the IP address, the UE initiates a data service request.



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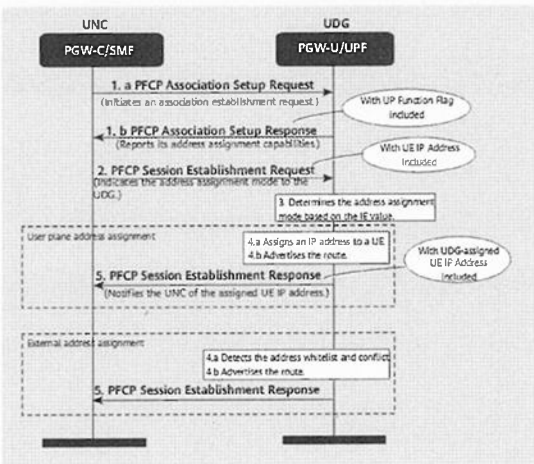
Overall Address Assignment Procedure

- The UNC proactively sends a PFCP Association Setup Request message to the UDG. The UDG responds to the UNC with a PFCP Association Setup Response message that contains user plane address assignment capabilities.
- During PDU session establishment, the UNC sends the UDG a session establishment request message to notify the UDG of a specific address assignment method. The UE IP Address IE in this message contains the address type and IP address required for a UE to access an external data network.
- The UDG determines to use external or user plane address assignment based on the parameters in the UE IP Address IE in the session establishment request message.
- The UDG then assigns an address or forwards a received address to the UE, advertises a route, and detects the address whitelist or conflict.
- If user plane address assignment is used, the UDG assigns an IP address to the UE and sends the assigned IP address to the UNC through a PDU session establishment response message.



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User Plane Address Assignment Overview

- The UDG uses a proprietary extension field in an association establishment request or response message over the N4 interface to inform the control plane of its local address assignment capabilities. The control plane then obtains the capabilities.
- A subscriber initiates a session establishment request to the control plane during the activation procedure, applying for an IP address. The control plane then determines whether the user plane or control plane assigns an IP address of the specified type (IPv4, IPv6, or IPv4v6). If the control plane determines that the user plane assigns an IP address, it uses a PFCP Session Establishment Request message over the N4 interface to instruct the UDG to assign an IP address. The UDG then assigns an IP address as instructed by the control plane, and sends a PFCP Session Establishment Response message with the assigned IP address to the UE. After the UE obtains the IP address, it can initiate an uplink or downlink data service request.

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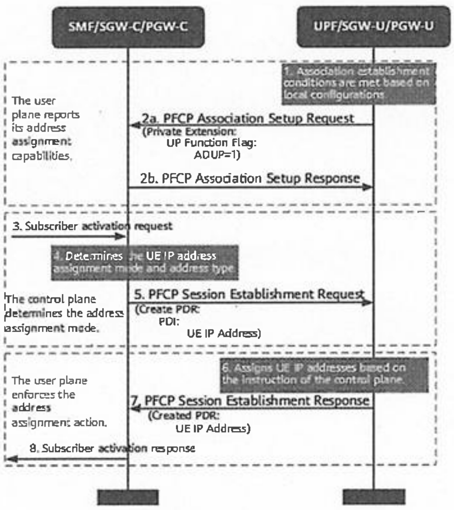
User Plane Address Assignment Procedure

1. After NFs are deployed and the data link layer is working properly, the user-plane NF (UPF/SGW-U/PGW-U) determines to initiate association establishment based on local configurations.
2. The user-plane NF (UPF/PGW-U) proactively reports its address assignment capabilities to the control-plane NF (SMF/PGW-C).
3. The user plane initiates a session establishment request message to the control plane for subscriber activation. The Requested PDU Session Type IE in this message indicates the PDU session type (IPv4, IPv6, or IPv4v6) requested by the UE.
4. The control plane determines whether the control plane or user plane assigns the requested IPv4, IPv6, or IPv4v6 address of the specified PDU type to the UE based on its locally configured address assignment capabilities.
5. The control plane sends a PFCP Session Establishment Request message to the user plane. This message contains the UE IP Address sub-IE, which is delivered with either the PDI or Create Traffic Endpoint IE in the Create PDR IE. In the UE IP Address sub-IE, the extension UPA bit, V4 bit, and V6 bit jointly indicate whether the UDG assigns IP addresses and what types of IP address it assigns.
6. The user plane assigns a specified type of IP addresses to UEs from its local address pool as instructed by the control plane.
7. The user plane returns a PFCP Session Establishment Response message to the control plane, with the assigned IP address included in the UE IP Address sub-IE in the Created PDR or Created Traffic Endpoint IE in this message. If address assignment fails due to insufficient IP addresses in the address pool, the UDG responds to the control plane with a cause value "75 (No resources available)".
8. After obtaining the UE IP address, the control plane responds with a subscriber activation response message to the (R)AN, and sends the assigned IP address to the UE.



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Data planning - 1

Category	Parameter	Example Value	Value Source	Description
ADD VPNINST	VPN Instance (VPNINSTANCE)	vpn1	Network data plan (configurations on other NFs need to be considered)	The VPN instance bound using this command must be the same as that bound to a service APN.
ADD POOL	Pool Name (POOLNAME)	testpool1	Local data plan (configurations on other NFs do not need to be considered)	-
	Pool Type (POOLTYPE)	LOCAL	Local data plan (configurations on other NFs do not need to be considered)	-
	IP Address Type (IPVERSION)	IPV4	Local data plan (configurations on other NFs do not need to be considered)	A local address pool can contain either IPv4 or IPv6 addresses. If both IPv4 and IPv6 addresses are planned, add an IPv4 address pool and an IPv6 address pool.
	Has VPN (HASVPN)	ENABLE	Local data plan (configurations on other NFs do not need to be considered)	VPN instances bound to the following items must be consistent: • APN used for subscriber activation • Address pool • External interface for the Gi/SGi/N6 interface of the PDN/DN
	VPN Instance Name (VPNINSTANCE)	vpn1	Existing configuration	You can run **LST VPNINST** to view the VPN instance name.
ADD SECTION	Pool Name (POOLNAME)	testpool1	Local data plan (configurations on other NFs do not need to be considered)	You can run **LST POOL** to view the address pool name.
	Segment Number (SECTIONNUM)	1	Local data plan (configurations on other NFs do not need to be considered)	-
	IP Address Type (IPVERSION)	IPV4	Local data plan (configurations on other NFs do not need to be considered)	-
	Start IPv4 Address (V4STARTIP)	10.10.1.1	Network data plan (configurations on other NFs need to be considered)	A local address pool can contain either IPv4 or IPv6 addresses. If both IPv4 and IPv6 addresses are planned, add an IPv4 address pool and an IPv6 address pool.
	End IPv4 Address (V4ENDIP)	10.10.1.10	Network data plan (configurations on other NFs need to be considered)	

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Data planning - 2

Category	Parameter	Example Value	Value Source	Description
ADD POOLGROUP	Pool Group Name (POOLGRPNAME)	poolgroup1	Local data plan (configurations on other NFs do not need to be considered)	-
	IPv4 Address Allocation Priority Algorithm (IPV4ALLOCPRIALG)	ENABLE	Local data plan (configurations on other NFs do not need to be considered)	This parameter must be set to **ENABLE** if an IPv4 address pool uses the address pool priority-based algorithm.
	IPv6 Address Allocation Priority Algorithm (IPV6ALLOCPRIALG)	ENABLE	Local data plan (configurations on other NFs do not need to be considered)	This parameter must be set to **ENABLE** if an IPv6 address pool uses the address pool priority–based algorithm.
ADD POOLBINDGROUP	Pool Group Name (POOLGRPNAME)	poolgroup1	Existing configuration	You can run **LST POOLGROUP** to view the pool group name.
	Pool Name (POOLNAME)	testpool1	Local data plan (configurations on other NFs do not need to be considered)	You can run **LST POOL** to view the address pool name.
	Priority of Pool (PRIORITY)	10	Local data plan (configurations on other NFs do not need to be considered)	If multiple address pools are bound to an address pool group, IP addresses are assigned based on the address pool priority. Priorities can be compared only for address pools of the same type. For example, the priorities of an IPv4 address pool and an IPv6 address pool cannot be compared.
ADD APN	APN (APN)	apn-test1	Local data plan (configurations on other NFs do not need to be considered)	An APN/DNN instance should be planned after considering all site entities. The APN/DNN instance configured on the UDG must be consistent with that configured on a control-plane NF (SMF/SGW-C/PGW-C).
	Has VPN (HASVPN)	ENABLE	Local data plan (configurations on other NFs do not need to be considered)	VPN instances bound to the following items must be consistent: • Address pool • APN used for subscriber activation • External interface for the Gi/SGi/N6 interface of the PDN/DN
	VPN Instance Name (VPNINSTANCE)	vpn1	Local data plan (configurations on other NFs do not need to be considered)	You can run **LST VPNINST** to view the VPN instance name.

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Data Configuration Process

Configure data for address assignment.

↓

Configure a downlink route for the UE.

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2. User Plane Address Assignment

2.1 Data Planning

2.2 Configuring Data for Address Assignment

2.3 Configuring a Downlink Route for a UE

2.4 Commissioning User Plane Address Assignment

Configuration Example

- //Run the following commands in the **MML Command - UDG** window:
- //Bind an address pool to an address pool group.
- ADD VPNINST:VPNINSTANCE="vpn1";
- ADD POOL:POOLNAME="testpool",POOLTYPE=LOCAL,HASVPN=ENABLE,VPNINSTANCE="vpn1";
- ADD SECTION:POOLNAME="testpool",SECTIONNUM=1,IPVERSION=IPV4,V4STARTIP="10.10.1.1",V4ENDIP="10.10.1.10";
- ADD POOLGROUP: POOLGRPNAME="poolgroup1", IPV4ALLOCPRIALG=ENABLE, IPV6ALLOCPRIALG=ENABLE;
- ADD POOLBINDGROUP: POOLGROUPNAME="poolgroup1", POOLNAME="testpool", PRIORITY=10;
- //Configure a mapping between the APN and address pool group.
- ADD APN:APN="apn-test1",HASVPN=ENABLE,VPNINSTANCE="vpn1";
- ADD POOLGRPMAP: MAPPINGNAME="mapping1", APN="apn-test1", POOLGROUPNAME="poolgroup1";

  //Configure an address assignment rule.
- SET IPALLOCRULE: FIRSTRULESW=ENABLE, FIRSTRULE=APN-1&LOCATION-0&SMF-0, SECONDRULESW=DISABLE, THIRDRULESW=DISABLE;

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2.4 Commissioning User Plane Address Assignment

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Commissioning User Plane Address Assignment

- After user plane address assignment is configured, commission the User Plane Address Assignment feature to ensure that it functions properly.
- Prerequisites
  - Data (see the following table.)
  - Tool
    - Test UE
    - WebLMT

Category	Parameter	Example Value	Value Source	Description
Subscriber information	IMSI (IMSI)	460000123456789	Test UE	-
APN used by the test UE	APN/DNN (APN)	apn-test	Existing configuration	-

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Summary

- About UE Address Assignment
  - A UE IP address uniquely identifies a UE on a network. Only UEs assigned IP addresses can be addressed or communicate with each other.
- User Plane Address Assignment Procedure
  - The UDG uses a proprietary extension field in an association establishment request or response message over the N4 interface to inform the control plane of its local address assignment capabilities. The control plane then obtains the capabilities.
  - A subscriber initiates a session establishment request to the control plane during the activation procedure, applying for an IP address. The control plane then determines whether the user plane or control plane assigns an IP address of the specified type (IPv4, IPv6, or IPv4v6). If the control plane determines that the user plane assigns an IP address, it uses a PFCP Session Establishment Request message over the N4 interface to instruct the UDG to assign an IP address. The UDG then assigns an IP address as instructed by the control plane, and sends a PFCP Session Establishment Response message with the assigned IP address to the UE. After the UE obtains the IP address, it can initiate an uplink or downlink data service request.

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Recommendations

- https://support.huawei.com/carrier/docview!docview?nid=DOC1100565051&path=PBI1-21262245/PBI1-7899527/PBI1-22892303/PBI1-23710417/PBI1-22609856/PBI1-23757606/PBI1-23757607/PBI1-23757609/PBI1-250755284

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UDG V100R001C10
5G NSA Features and Data Configuration

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Objectives

- Upon completion of this course, you will be able to:
  - Describes the functions and features of the UNC Option3 NSA networking.
  - Configuring Data for the UNC Option3 NSA Networking

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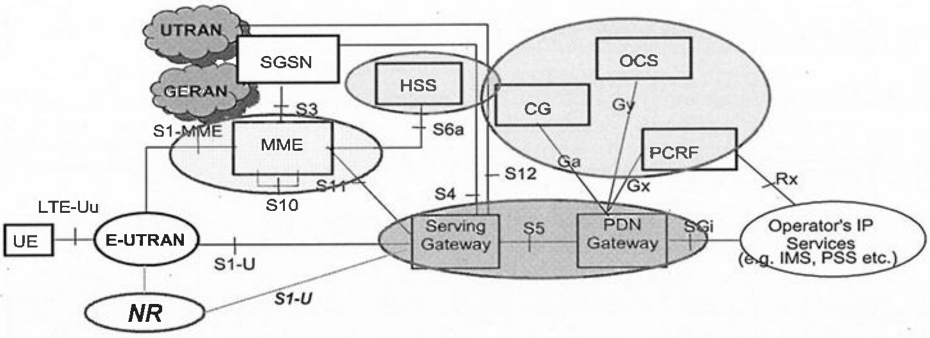
5G NSA Typical Networking of the UGW9811



UE access in the NSA architecture requires no new network functions (NFs) or networking changes. The UE access procedure is the enhancement of the original LTE UE access procedure.

The gNodeB is introduced on the radio access network and interworks with the S-GW over the S1-U interface.

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2. **5G NSA Features**
3. 5G NSA CDR Management
4. 5G NSA QoS Management
5. 5G NSA New Performance Statistics

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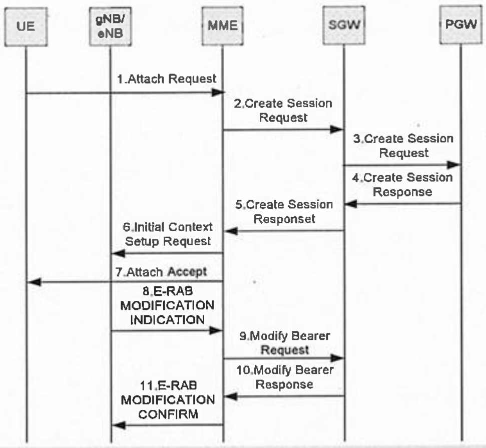
NSA UE Access Procedure

- The NSA UE access procedure is the same as the LTE UE access procedure. This slide provides only the key steps. For details about IE changes in messages, see the next slide.



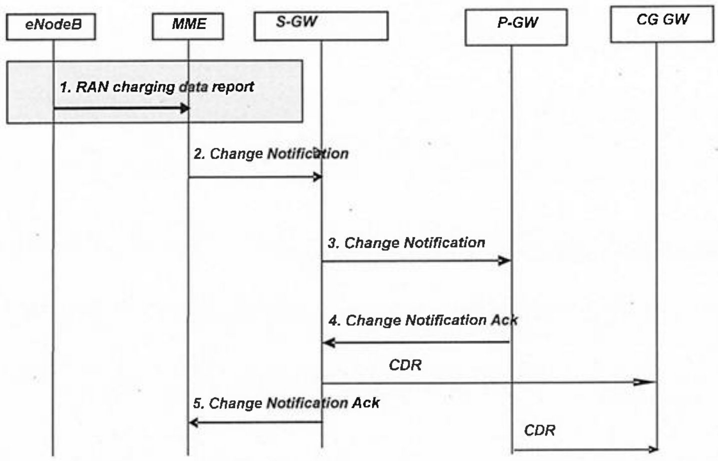
NSA UE Access Procedure - IE Changes

Message	IE Change	Function
Create Session Request	The UP Function Selection Indication Flags IE is added.	Indicates whether DCNR is supported.

IE format (3GPP TS29.274 "8.133 UP Function Selection Indication Flags")

	Bits							
Octets	8	7	6	5	4	3	2	1
1	Type = 202 (decimal)							
2 to 3	Length = n							
4	Spare				Instance			
5	Spare							DCNR
6 to (n+4)	These octet(s) is/are present only if explicitly is specified.							

RAT-based Charging Policy



- Key Message
- This feature is enabled on all gNodeBs at the same time.
- Reports 5G NR data usage based on the bearer granularity.
- In the handover procedure, the source gNodeB reports usage of 5G NR data traffic, excluding the forwarded traffic.
- The gNodeB has to report 5G NR data usage in the S1 Release and E-RAB Deactivation procedures.
- IEs are added to report 5G NR data usage in the detach and PDN deactivation procedures.
- To generate some CDRs, the gNodeB needs to periodically report 5G NR data usage.

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5G CDR Versions

- ***R8 (SGW-CDR/PGW-CDR)***
- ***R9 (SGW-CDR/PGW-CDR)***
- ***R10 (SGW-CDR/PGW-CDR)***

The CDR format must be consistent with that on the peer CG.

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Data Configuration

CDR field	MML Command	Parameter Name	Parameter Description
RAN-SecondaryRAT-Usage-Report	**ADD CDRFIELDTEMP**	SECRATUSAGE	This parameter specifies whether CDRs carry the RAN-SecondaryRAT-Usage-Report field.
	SET OFCTHRESHOLD	SECRUTHRESHOLD	This parameter specifies the RAN-SecondaryRAT-Usage-Report threshold for generating CDRs. It's an integer ranging from 1 to 10.
extendedMaxRequestedBWUL	**SET OFCCDRPARA**	**PGWLOTVQOSEXT**	This parameter specifies whether the EPC Qos in LOTV of PGW-CDRs carries the extended Qos parameters.
extendedMaxRequestedBWDL			
extendedGBRUL		**PGWLOSDQOSEXT**	This parameter specifies whether the EPC Qos in LOSD of PGW-CDRs carries the extended Qos parameters.
extendedGBRDL			
extendedAPNAMBRUL		SGWLOTVQOSEXT	This parameter specifies whether the EPC Qos in LOTV of PGW-CDRs carries the extended Qos parameters.
extendedAPNAMBRDL			

If the CDR contains the 5G NSA fields, the peer CG must support the corresponding field. Otherwise, the interworking fails.

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Questions

1. What are the differences between 5G CDRs and 4G CDRs?
2. When the UDG supports 5G CDRs, what functions does the CG need to support?

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5G NSA Gx Interface Function Comparison with 4G

- The bandwidth required by 5G is beyond the value range of the original bandwidth description field defined for the Gx interface. To address this issue, Extended-BW-NR is defined since 3GPP TS 29.212 R15. An extended field is added to each original bandwidth description field. All original bandwidth fields are in a unit of bit/s, and all extended fields are in a unit of kbit/s.

- The Gy interface involves the following new IEs:
  - - Extended-Max-Requested-BW-DL/UL (substitution for Max-Requested-Bandwidth-DL/UL)
  - - Extended-GBR-DL/UL (substitution for Guaranteed-Bitrate-DL/UL)
  - - Extended-APN AMBR DL/UL (substitution for APN-Aggregate-Max-Bitrate-UL/DL)

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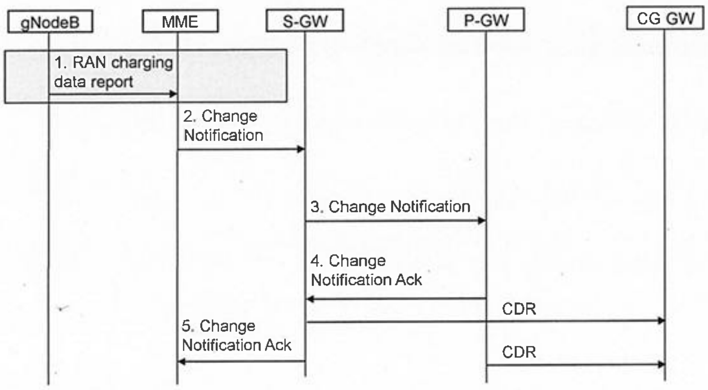
RAT-based Charging Policy

The Secondary RAT Usage Data Report IE is added to messages over the S11, S5, and S8 interfaces for reporting 5G NR charging traffic.



Notes:

- ✓ The RAT-based charging policy function must be enabled for all gNodeBs at the same time.
- ✓ Traffic must be reported at a bearer granularity.
- ✓ The source gNodeB during a handover procedure is responsible for reporting traffic (excluding traffic forwarding).
- ✓ The gNodeB during an S1 release or E-RAB deactivation procedure is responsible for reporting traffic.
- ✓ The processing sequence during a detach or PDN deactivation procedure needs to be concerned.
- ✓ The gNodeB must support periodic traffic reporting for the generation of partial CDRs.
- ✓ The MME includes the Secondary RAT Usage Data Report IE in messages, reports 5G subscriber traffic to the S-GW or P-GW, generates SGW-CDRs or PGW-CDRs, and supports R8, R9, and R10 CDRs.

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Activating the Function for 5G Ultra-High Bandwidth

- Enable the license switch for this feature in the **MML Command - OMO_VNFC** window of CGW.
  - SET LICENSESWITCH: ITEM="LKV3W95UHB01", SWITCH=ENABLE;
  - SET LICENSESWITCH: ITEM="LKV3W95UBA01", SWITCH=ENABLE;
  - SET LICENSESWITCH: ITEM="LKV3W95UHB02", SWITCH=ENABLE;
  - SET LICENSESWITCH: ITEM="LKV3W95UBA02", SWITCH=ENABLE;
- Enable the license switch for this feature in the **MML Command - OMO_VNFC** window of DGW.
  - SET LICENSESWITCH: ITEM="LKV3W95UHB01", SWITCH=ENABLE;
  - SET LICENSESWITCH: ITEM="LKV3W95UBA01", SWITCH=ENABLE;
  - SET LICENSESWITCH: ITEM="LKV3W95UHB02", SWITCH=ENABLE;
  - SET LICENSESWITCH: ITEM="LKV3W95UBA02", SWITCH=ENABLE;

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Questions

1. How to activate 5G QoS feature on UDG?

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New Counters in 5G CGW (2)

- PGW-C average active 5G sessions via GTP S5/S8
- PGW-C current active 5G bearers via GTP S5/S8
- PGW-C current active 5G sessions via GTP S5/S8
- PGW-C current active bearers with Secondary RAT Usage 5G traffic
- PGW-C current active sessions with Secondary RAT Usage 5G traffic
- SGW-C and PGW-C combined maximum simultaneously active 5G bearers
- SGW-C and PGW-C combined maximum simultaneously active 5G sessions
- SGW-C and PGW-C combined average active 5G bearers
- SGW-C and PGW-C combined average active 5G sessions
- SGW-C and PGW-C combined current active 5G bearers
- SGW-C and PGW-C combined current active 5G sessions
- SGW-C and PGW-C combined current active bearers with Secondary RAT Usage 5G traffic
- SGW-C and PGW-C combined current active sessions with Secondary RAT Usage 5G traffic

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New Counters in 5G DGW (1)

- SGW-U 5G S1-U uplink user traffic in packets
- SGW-U 5G S1-U uplink user traffic in KB
- SGW-U 5G S1-U downlink user traffic in packets
- SGW-U 5G S1-U downlink user traffic in KB
- SGW-U 5G GTP based S5/S8 downlink user traffic in packets
- SGW-U 5G GTP based S5/S8 downlink user traffic in KB
- SGW-U 5G GTP based S5/S8 uplink user traffic in packets
- SGW-U 5G GTP based S5/S8 uplink user traffic in KB
- SGW-U maximum simultaneously active 5G bearers via Sxa
- SGW-U maximum simultaneously active 5G sessions via Sxa
- SGW-U average active 5G bearers via Sxa
- SGW-U average active 5G sessions via Sxa
- SGW-U current active 5G bearers via Sxa
- SGW-U current active 5G sessions via Sxa

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Summary

This course introduces the following:

- UDG 5G NSA QoS management procedure, 5G QoS License control, and Gx QoS control feature and configuration
- New IEs in the UDG 5G NSA CDR, differences between the 5G NSA CDR and the 4G CDR, and the method of controlling the new IEs in the CDR.
- UDG 5G NSA New Traffic Statistics

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Acronyms and Abbreviations

- NR: new radio
- NSA: non-standalone
- DCNR: dual connectivity with NR

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