IPLOOK IMS PRODUCT DESCRIPTION

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IPLOOK IMS Product Information

IPLOOK Technologies / IPLOOK Technologies Co., Limited

Date (2022-01-24)

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Revision history

Version	Usage State	Modification Summary	Reviser	Reviewer	Revision date
1.1	Initiation Version		William Li		18-09-18
1.2	Done	Multi-PLMN support	William Li		03-11-19
1.3	Done	Support for ipv6	William Li		12-07-20
1.4	Done	Support for resource reservation control	William Li		13-12-20
1.5	Done	Support IMS to third party AS for IMPU conversion	Gavin	James	16-05-21
1.6	Done	Support for calling local numbers starting with 0	Gavin	James	28-10-21

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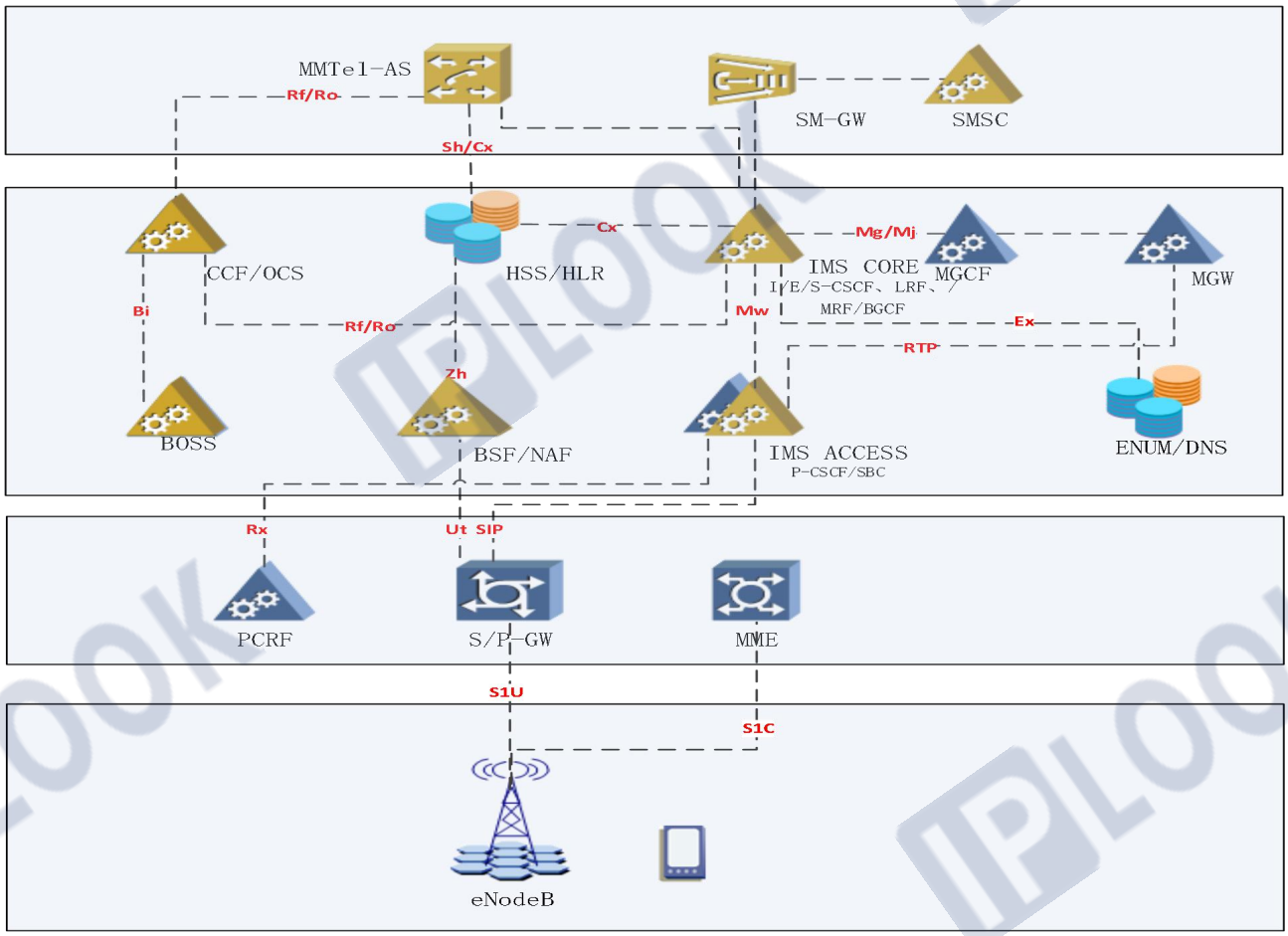
1 Introduction

1.1 IMS overview

IMS (IP Multimedia Subsystem) is a new mobile network infrastructure, a new way to deliver multimedia (voice, video, data, etc.) which can meet the requirements of multimedia services under the LTE system, especially VoLTE service.IPLOOK's IMS system is based on the 3GPP protocol and RFC standard, and using OpenStack for development. The product meets the VoLTE service function of the operator's LTE network and can also cooperate with the dedicated EPC as a multimedia service function under the dedicated network. IMS products has multiple functions, such as user authentication, session control and routing, service triggering, and network interworking.



1.2 Highlight features

1.2.1 Virtualization

Software and hardware are decoupled through virtualization. The IPLOOK IMS software can be deployed quickly and operate on universal hardware devices of the X86 COTS server or VM/container based virtual platform.

1.2.2 Carrier-grade High Availability

The IPLOOK IMS hardware resources are virtualized to many VMs. When the IPLOOK IMS needs to increase its processing capability, more VMs can be installed.
The IPLOOK IMS supports redundancy and disaster recovery of components and NEs. NEs can be deployed in the entire resource pool through distributed deployment of VMs to enhance system reliability.
The IPLOOK IMS supports smooth evolution and system migration through online patches and application updates.

1.2.3 Multi-NE Deployment

IPLOOK provides ALL-IN-ONE design compact EPC solution, all NEs like MME, SGW, PGW, HSS, PCRF, IMS, DRA and web management functions are in a single server. It also supports Gy or Radius for external billing.
Compact EPC specification:
1U Server: 2000 UEs, 20 eNBs, up to 600Mbps
2U Server: 5000 UEs, 50 eNBs, up to 6Gbps

1.2.4 Open Interfaces and Flexible Network Architecture

The IMS system provides a series of products and open standard interfaces.
The IPLOOK IMS supports multiple types of VIM/CMS cloud management systems, multiple types of Hypervisors, and multiple types of orchestrators. It can be configured flexibly based the network requirements.

1.2.5 Sophisticated Operation and Maintenance System

The IPLOOK IMS performs daily maintenance and management through the unified EMS .
The IPLOOK IMS functions can be maintained on the local O&M and in the upper-layer EMS.
The features are as follows:

- The O&M uses the B/S structure, and the EMS uses the C/S structure, ensuring a desirable networking capability and expansion of the operation and maintenance system.
- Provides remote and local access to the system so that both local and remote operation and maintenance can be implemented. Maintenance operations can be performed on the entire system and each specified NE.
- Multi-level permission mechanism to ensure system security.
- The IPLOOK IMS has the dynamic management, preventive maintenance, MML navigation, tracing tool (including signaling tracing and failure observation), alarm management, and performance management functions. With these functions, the system provides multiple operation and maintenance methods precisely, reliably, practicably and conveniently. In addition, more functions can be added as needed.
- The EMS system provides friendly management interfaces, various functions and flexible networking. Multiple NEs can be managed in a centralized way.

1.2.6 NFV Performance Optimization Techniques

Network Function Virtualization (NFV) is a core structural change in the way telecommunication infrastructure gets deployed. This in turn will bring significant changes in the way that applications are delivered to service providers. NFV will bring cost efficiencies, time-to-market improvements and innovation to the telecommunication industry infrastructure and applications. NFV will achieve this through disaggregation of the traditional roles and technology involved in telecommunications applications.

Performance, especially the user plane performance using COTS has always been a concern for service providers and equipment vendors alike. IPLOOK's vEPC address the issue by applying the following performance optimization techniques to the user plane software processing module.

Combine the Single Root I/O Virtualization (SR-IOV) with Intel's Data Plane Development Kit (DPDK) techniques to enhance the performance.

Apply Open vSwitch (OVS) on enhanced Intel's DPDK (By IPLOOK) to further enhance the data processing performance.

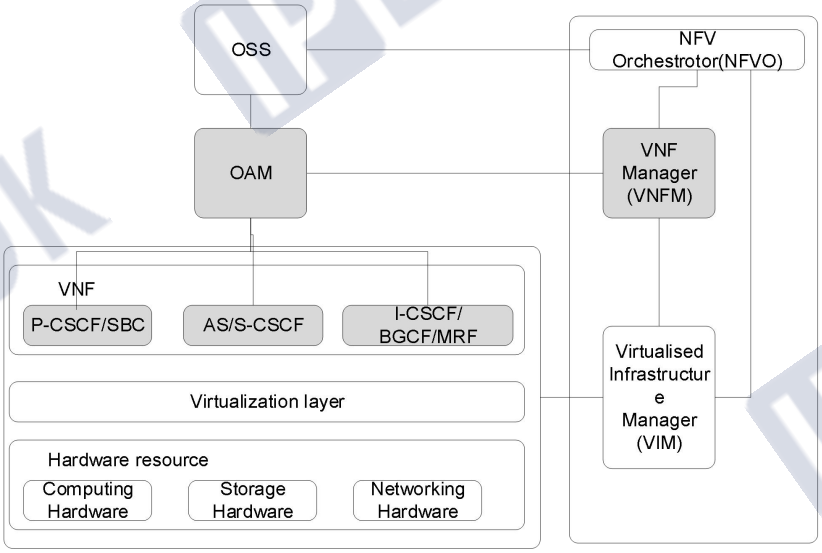
In addition, by using specific 10G, 40G or 100G NIC from Intel, the performance can be further enhanced.

2 System architecture

2.1 IPLOOK IMS in the NFVI

IPLOOK IMS is divided into three levels: HW level, virtualization level (cloud management platform and virtualization technology) and service level.

Figure 2 IPLOOK IMS System Architecture



IPLOOK IMS is able to be installed on VMs or containers. According the scale of the network, IMS could be separated into different parts. P-CSCF and A-SBC could be deployed in the same instance, while AS and S-CSCF could be deployed in another instance. Others like I-CSCF, BGCF and MRF will be together.

For a description of the architecture of the IPLOOK IMS, refer to Table 2.

Table 2 IPLOOK IMS System Architecture Descriptions

Node	**Description**
OAM	Comprehensive service operation and management platform, which provides various functions such as network management , system management and daily maintenance and management for MME.
NFVI	Network functions virtualization infrastructure, which refers to physical resources. The NFVI is provided and managed by the cloud platform.
Hypervisor	Arranges and manages NFV resources (infrastructure and applications) in the

Node	Description
	network, and deploys the NFV service on the NFVI.
Hardware	Includes computer hardware, storage hardware, and network hardware.
NFVO	Arranges and manages network services, virtualization resources, and physical resources in the network.
VNFM	Manages the IMS parts lifecycle.
VIM/CMS	Management module of the NFVI, which is the VIM in the ETSI NFV and the CMS in the CCSA. • The VIM/CMS is a system managing virtual infrastructure, managing and monitoring infrastructure-layer hardware resources and virtualization resources, monitoring and reporting alarms, and providing virtual resource pools for upper-layer applications. • The VIM/CMS are operation interfaces providing virtual resources related to the VNF for the NFVO and VNFM. • The VIM/CMS is a cloud platform management function provided by the cloud platform. General applications include TECS, VmWare, and Openstack.

3 Functionality

3.1 Basic function

3.1.1 Call session control

3.1.1.1 Definition

The IP Multimedia Subsystem provides multimedia services based on the session control capability defined by IETF, together with multimedia transmission capability based on IP-CAN. IP Multimedia Subsystem implements session control based on the Session Initiation Protocol (SIP) defined by IETF RFC 3261.

Based on 3GPP 23.228 protocol standard, IP multimedia subsystem session control is realized by Call Session Control Function (CSCF), which can play various roles used in IP multimedia subsystem and can be divided into Proxy-CSCF, Interrogating-CSCF, Serving-CSCF, Emergency-CSCF and other network entities according to different functions. CSCF, Serving-CSCF, Emergency-CSCF, and other network entities.

3.1.1.2 Dependency

P/I/S/E-CSCF	BGCF	AS
√	√	√

3.1.1.3 Principle description

3.1.1.3.1 Proxy CSCF

P-CSCF is the access point of an IMS network and behaves like an agent defined by IETF RFC 3261, that is, it accepts requests and internally services user agents or forwards messages.P-CSCF should not modify the request URI,P-CSCF in SIP messages can act as a user agent, that is, in exceptional cases, it can terminate and independently generate SIP transactions.

P-CSCF performs the following functions.

- Forward the SIP registration request received from the UE to the entry point determined using the attributed domain name provided by the UE.
- Forward the SIP messages received from the UE to the SIP server (e.g. S-CSCF) in the registration result.
- When information is available from the access network, the P-CSCF can insert the type of access network currently used by the UE in the SIP message (request or response.) The P-CSCF ensures that the SIP message from the UE to the SIP server (e.g. S-CSCF) contains the correct information about the type of access network currently used by the UE.
- Forward the SIP request or response to the UE.
- Detects and processes urgent session establishment requests.
- Generate a CDR.
- Maintain a security alliance between itself and each UE, as defined in TS33.203 [19].
- Control the creation of bearer resources.

3.1.1.3.2 Interrogating CSCF

The I-CSCF is the entry point for all connections to the IMS network for all roaming users destined to or located within this network.The I-CSCF performs the following functions:

Registration:

Assign S-CSCF to users performing SIP registration.

Session-related or session-independent processes:

- Routes SIP requests received from another network to the S-CSCF.
- Convert the E.164 address included in the request URI to the SIPURI and user=phone parameter format in Tel:URI format as defined in IETF RFC 3966 before performing the location query.
- Obtain the S-CSCF address from HSS.
- Forward the SIP request or response to the S-CSCF identified in the above step.
- If the I-CSCF determines that the destination of the session is not within the IMS based on the query, it may forward the request to another IMS network or return a failure response, depending on the operational policy.

3.1.1.3.3 Service CSCF

The S-CSCF performs session control services for the UE, which maintains the session state to support the service according to the needs of the network operator.The functions performed by the S-CSCF during a session are:

Registration:

- It can act as a registrar as defined in IETF RFC 3261, i.e. it accepts registration requests and provides its information through a location server (e.g. HSS).
- Notify subscribers about registration changes.
- During the registration process, the policy information obtained from the HSS is provided to the P-CSCF or the UE.
- Session-related or session-independent processes.

- Session control for registered users.
- It can act as a proxy server as defined in IETF RFC 3261, i.e. it accepts requests and provides services internally or forwards messages.
- It can act as a user agent, i.e., it can terminate and generate SIP transactions independently in case of exceptions.
- Forward SIP requests or responses to the AS, and handle the interaction with the application service platform based on the user's application service information.
- Provide the UE with information related to the service event, such as playback.
- Forward SIP requests or responses to I-CSCFs within the IMS network or to ICSCFs in other IMS domains.
- Forward SIP requests or responses to the BGCF to route the call to the PSTN or CS domain.
- Forward SIP requests or responses to the P-CSCF.
- Attempt to convert the E. 164 address in the SIPURI to a globally routable SIPURI, if the conversion fails, the request can be forwarded to the BGCF for routing to the PSTN, if the conversion is successful, the request URI is updated.
- Generate a CDR.

3.1.2 Message Routing

3.1.2.1Definition

The IP Multimedia subsystem implements SIP message routing based on RFC3261. IMS network entities have the same basic message routing functionality and different message

routing functionality based on different network element functions, each playing the role of a SIP proxy.

3.1.2.2 Dependency

P/I/S/E-CSCF	BGCF	AS
√	√	√

3.1.2.3 Principle overview

According to RFC 3261, SIP proxies are the network elements that route SIP requests to user agent servers and SIP responses to user agent clients. A request arriving at the IMS can traverse multiple SIP proxies in its path, each of which can make routing decisions and modify the request before forwarding it to the next proxy. The response will be returned in reverse order through the proxy route.

When a request arrives, the SIP proxy determines whether it needs to respond to the request before making a routing decision. For example, before acting as a proxy, the request may carry unintelligible information or be unauthorized, and the SIP proxy responds with an appropriate error code and terminates the proxy for the request.

For each new request, the proxy can operate in stateful or stateless mode. When stateless mode is used, the agent acts as a simple forwarder, forwarding each request to some

next-hop address determined based on the request destination and route. Once the request is forwarded, the stateless proxy discards all state information associated with the request.

The stateful proxy keeps information about each incoming request, especially the transaction status. And any requests it sends are stored as the result of processing the received request. Stateful agents can choose to distribute requests, routing them to multiple destinations. Requests forwarded to multiple locations must have stateful processing.

If the first value in the Route header field of the received request is this agent, the agent must remove this value from the request. Next, the agent computes the target of the request. If the domain of the Request-URI indicates that this domain is not a domain that this agent is responsible for, then the Request-URI must be placed in the target set as the only target URI while continuing to forward the request. If the Request-URI does not provide enough information for the proxy to determine the target collection, then it should return a 485 response. The agent may modify the Request-URI's URI during forwarding only if the agent is responsible for this Request-URI.

For each target, the agent follows the following steps to send the request:

1. Replicate the received request
2. Update Request-URI
3. Update the Max-Forwards header field
4. Add Record-Route header field value (optional)
5. Add other header fields (optional)
6. Post-processing routing information
7. Determine the address, port and transport protocol of the next hop
8. Add a Via header field value
9. Add a Content-Length header field if needed

10. Forwarding new requests

11. Set Timer

3.1.3 Security Management

3.1.3.1 Definition

IMS security architecture defines the UE and P-CSCF to achieve signaling and media integrity and security protection mechanisms through IPsec, adding security mechanisms directly to the IP layer to provide security services based on network node identification; IPsec provides ESP protocols for providing confidentiality and anti-replay services for IP, providing reliability, integrity and confidentiality support for messages.

3.1.3.2 Dependency

UE	P-CSCF
√	√

3.1.3.3 Principle description

The four components of the IMS security architecture are:

- User terminal equipment, supporting all types of mobile or fixed terminal equipment, including those with IMS security capabilities or supporting earlier user terminal equipment that does not have such capabilities
- Signaling layer security system, to support SIP signaling and Cx interface security between various IMS communication entities
- User layer security system, providing communication security between user terminal devices and each application server
- Media layer security systems, i.e. media security for different uses and different user groups in the IMS user plane

The main security services provided by the security system include the following:

- Authentication (entity authentication): guarantees the correct identity of the communicating entity
- Integrity: data is exchanged in clear code, but it is possible to verify that the data and its characteristics have not been changed
- Anti-Replay: Prevents break-ins by replaying data, which is a special case of integrity protection
- Confidentiality: Data is exchanged in the form of a secret code to prevent leakage of content, which is an optional feature
- Access control: prevent unauthorized use of network resources

Business simple process:

- When the terminal initiates registration, the parameters of the Security-Client header field in the message carried by SIP signaling are combined with the contents of the parameters to carry out the corresponding encryption process, and the Security-Server header field with

IPsec encryption information is added to the SIP 401 reply message, and the IPsec channel is established at the same time.

- When the terminal registers for the second time, the link is established through the encrypted port provided by IPsec, the content of the second registration is completed using the encrypted channel, and the session establishment between the terminal and IMS is completed.

3.1.4 Business Agent

3.1.4.1 Definition

The service agent is a way to provide a way to handle NAT for IP and port when implementing SIP and RTP processing. With reliable, reasonable performance and real-time processing service processing capability, the service agent can also act as an RTP gateway to provide IPv4 and IPv6 session processing, and can support multi-instance distributed processing and collaborate with IMS network elements for high-capacity concurrent processing and load balancing.

3.1.4.2 Dependency

UE	P-GW	P-CSCF
√	√	√

3.1.4.3 Principle description

- After the P-CSCF receives the contents in the SIP message, it extracts the relevant IP and port contents, negotiates the assignment of new IPs and ports through the service agent function for use as primary agent layer processing, and replaces the original relevant IP and port contents in the source SIP message, and forwards the message to complete the current processing.
- Session session binding by the service agent by recording the IP and port in the source SIP message, after binding to the negotiated assigned port, and according to specific conditions or parameters.
- When the service agent receives a packet, it looks up the stored Session session record for matching and forwards it to the corresponding counterpart port after comparing the contents of the Session session, and then completes the message forwarding process.

3.1.5 User registration authentication

3.1.5.1 Definition

Registration and authentication refers to the registration request initiated by the terminal UE to IMS to complete the authentication and authorization of the subscriber and to save the subscriber data for subsequent provision of various network services of IMS. At the same time, when IMS authenticates the user's information, it judges the legitimacy of the access user according to the type of algorithm requested.

3.1.5.2Dependency

UE	eNodeB	MME	S-GW	P-GW	PCRF	HSS	P-CSCF	I-CSCF	S-CSCF
√	√	√	√	√	√	√	√	√	√

3.1.5.3 Principle description

- The terminal initiates a SIP registration request to the IMS access side, and the IMS extracts the relevant Realm and user's IMPI and other information based on the SIP message content, and then the I-CSCF initiates a UAR message to the HSS to request the appropriate S-CSCF based on the visiting domain.
- The CSCF forwards the SIP message to the appropriate S-CSCF, then the S-CSCF extracts the information carried by the terminal in the "Authorization" header field in the SIP message, and the S-CSCF initiates a MAR message to the HSS, which calculates the relevant values and sends them to the S-CSCF for Security authentication calculates the NONCE value, writes the NONCE value into the SIP message, and returns it to the terminal via the SIP 401 reply message along the original routing information.
- The terminal calculates the Response value once more based on the 401 response message and then initiates the REGSITER request to IMS again. IMS calculates and compares the Response it carries, and if the judgment is the same, the current security authentication is satisfied, the registration is successful, and 200OK is returned successfully; if not, the NONCE value is calculated again for authentication and sent to the terminal to continue to complete the Authentication process.

3.1.6 Business Trigger

3.1.6.1Definition

In addition to the Cx interface, S-CSCF supports the standardized Service Control Protocol interface, ISC, which delegates service execution to an Application Server, located at a third-party location on the network, which can be either a network or just a standalone ApplicationServer (AS).

3.1.6.2 Dependency

P/I/S/E-CSCF	BGCF	AS
√	√	√

3.1.6.3 Principle description

IFC: Initial Filtering Criteria, the IFC is stored in the HSS as part of the user's ServiceProfile and downloaded to the S-CSCF when the user is registered or when an unregistered user is called as a called.

When the registration of a terminal with the S-CSCF is complete, the S-CSCF decides whether to initiate a registration request to the application server or to forward additional terminal requests to the application server based on the IFC initial filtering criteria information received from the HSS. the IFC stores per-application server information for that user and contains service indications in the IFC to identify the service and the SIP transaction in a single order of

execution on the application server. The name and address information of the application server is received from the HSS.

For incoming SIP requests, the S-CSCF performs IFC filtering on ISC interactions before performing other routing processes. When obtaining the names and addresses of multiple application servers from the HSS, the S-CSCF shall contact the application servers in the order provided by the HSS, and the response from the first application server will be used as input for the second application server. The result of the response from the first application server will affect the subsequent IFC filtering process, continuing the execution or terminating it.

S-CSCF does not provide authentication and security features for third parties.

3.1.7 Voice calls

3.1.7.1 Definition

Voice call is one of the most basic functions of IMS, IMS provides a service rich, high quality call, more diversified etc. voice function; it can provide the maximum quality call quality, while meeting the interconnection with fixed network users.

3.1.7.2 Dependency

UE	eNodeB	MME	S-GW	P-GW	PCRF	HSS	P-CSCF	I-CSCF	S-CSCF
√	√	√	√	√	√	√	√	√	√

3.1.7.3 Principle description

- When the terminal makes a dialing call, IMS will compare the user information based on the SIP signaling content, and IMS will query whether the current calling user belongs under this IMS domain, and if it meets, it will forward from the stored information to the S-CSCF domain where the record has been saved.
- The calling S-CSCF domain is then forwarded to the IMS domain on the called end side depending on the routing situation
- The called S-CSCF domain will extract the called information from SIP messages, verify the called information, and forward the corresponding content to the called side according to the verification, and complete the voice call paging process through SIP signaling interaction.
- After the SIP interaction is completed, the RTP service is started and the voice call is completed.

3.1.8 Support multiple PDN / PDU functions

3.1.8.1 Video call

Video call is one of the services of IMS, the terminal carries the relevant VIDEO information content when registering and also carries the relevant VIDEO information in SIP-SDP during the call, IMS will use the proprietary communication bearer to provide high quality video call according to the signaling situation.

3.1.8.2 Dependency

UE	eNodeB	MME	S-GW	P-GW	PCRF	HSS	P-CSCF	I-CSCF	S-CSCF	MMTEL-AS
√	√	√	√	√	√	√	√	√	√	√

3.1.8.3 Principle description

- The terminal carries VIDEO-related parameters when initiating SIP registration according to the bearing bandwidth provided by the core network.
- SIP signaling for video-voice calls initiated by the terminal, and the IMS receives the SIP signaling and verifies the VIDEO content carried in the signaling.
- The IMS forwards SIP signaling to the called IMS domain, which verifies the called status and forwards SIP messages to the called
- After the SIP signaling interaction is completed, the RTP service for video calls begins

3.1.9 Billing Strategy

3.1.9.1Definition

The billing policy refers to IMS's billing function under different policies for user's information during user's audio and video calls, supporting multiple billing policies and billing methods. IMS can support online billing to connect to OCS network elements and offline billing to connect to CCF network elements.

3.1.9.2 Dependency

P-CSCF	S-CSCF	MMTEL-AS	OCS	CCF
√	√	√	√	√

3.1.9.3 Principle description

- IMS connects to OCS network element for online billing through Diameter-Ro interface, triggers the billing process by initiating CCR message, and AVP carries specified parameters in the CCR message, which is handed over to OCS network element for user billing operation according to the parameter content in the message; at the same time, it can meet multiple billing policy modes
- IMS docks to CCF network element for offline billing through Diameter-Rf interface, and notifies CCF network element for offline billing operation by initiating ACR message carrying relevant AVP content, which can also meet multiple billing policy modes.

3.1.10 Supplementary Operations

3.1.10.1Definition

Multimedia Telephony Application Server MMTEL-AS provides multimedia telephony-related supplementary services other than basic multimedia telephony services.

3.1.10.2 Dependency

HSS	MMTEL-AS
√	√

3.1.10.3 Principle description

IMS multimedia telephony services include supplementary services, which behave almost identically to CS voice and PSTN/ISDN supplementary services. The behavior of IMS supplementary services perceived by users is consistent with the behavior they perceive when using equivalent supplementary services on a traditional telephony network.

IMS supports the following complementary operations:

- Calling number identification display OIP.
- Calling number identification restriction OIR.
- Called number identification display TIP.
- Called Number Identification Restriction TIR.
- Call forward CDIV, including:
  - Unconditional call forward to CFU.
  - Forwarding CFBs before a user is busy calling.
  - No-answer call forward to CFNR.
  - Forwarding CFNL before the user is not logged into the call.
  - User unreachable call forwarding CFNRc.
- Call Waiting CW
- Call hold HOLD

- Call Restriction CB
- Prompt tone

3.1.11 Exit Gateway Control

3.1.11.1Definition

Egress gateway control is an important part of IMS, generally controlling calls transmitted to or receiving sessions from the PSTN network for session management.

3.1.11.2 Dependency

I-CSCF	S-CSCF	BGCF
√	√	√

3.1.11.3 Principle description

- The egress gateway control mainly implements the call routing function, which is used to select the network connected to the PSTN/CS domain entry point, receive I-CSCF/S-CSCF requests, and select the appropriate PSTN interface point for the call.
- The egress gateway control is able to receive SIP messages from the PSTN domain, forward them under the locally available IMS domain depending on the message, and then complete the message processing of SIP messages in the IMS domain based on the SIP message content.

3.1.12 Media Resource Control

3.1.12.1Definition

MRF: Multimedia Resource Function

Multimedia Resource Function Controller (MRFC): controls the media streaming resources in MRFP.

Multimedia Resource Function Processor (MRFP): provides multimedia resources controlled by MRFC.

Multimedia resources to enable functions such as beep playback in IMS networks.

3.1.12.2 Dependency

MRFC	MRFS	AS	S-CSCF
√	√	√	√

3.1.12.3 Principle description

The MRF network topology is as follows.

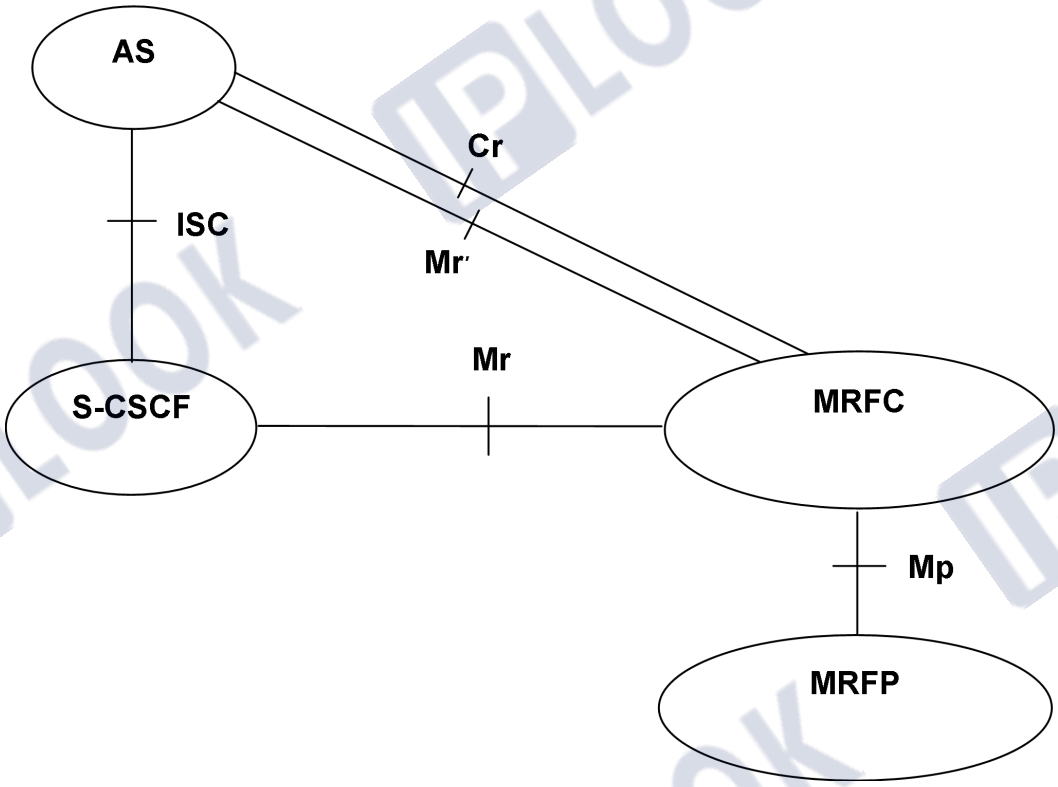


Figure : Architecture of MRF

MRF is divided into Multimedia Resource Function Controller (MRFC) and Multimedia Resource Function Processor (MRFP).

The tasks of MRFC are as follows:

Control of media streaming resources in the MRFP.

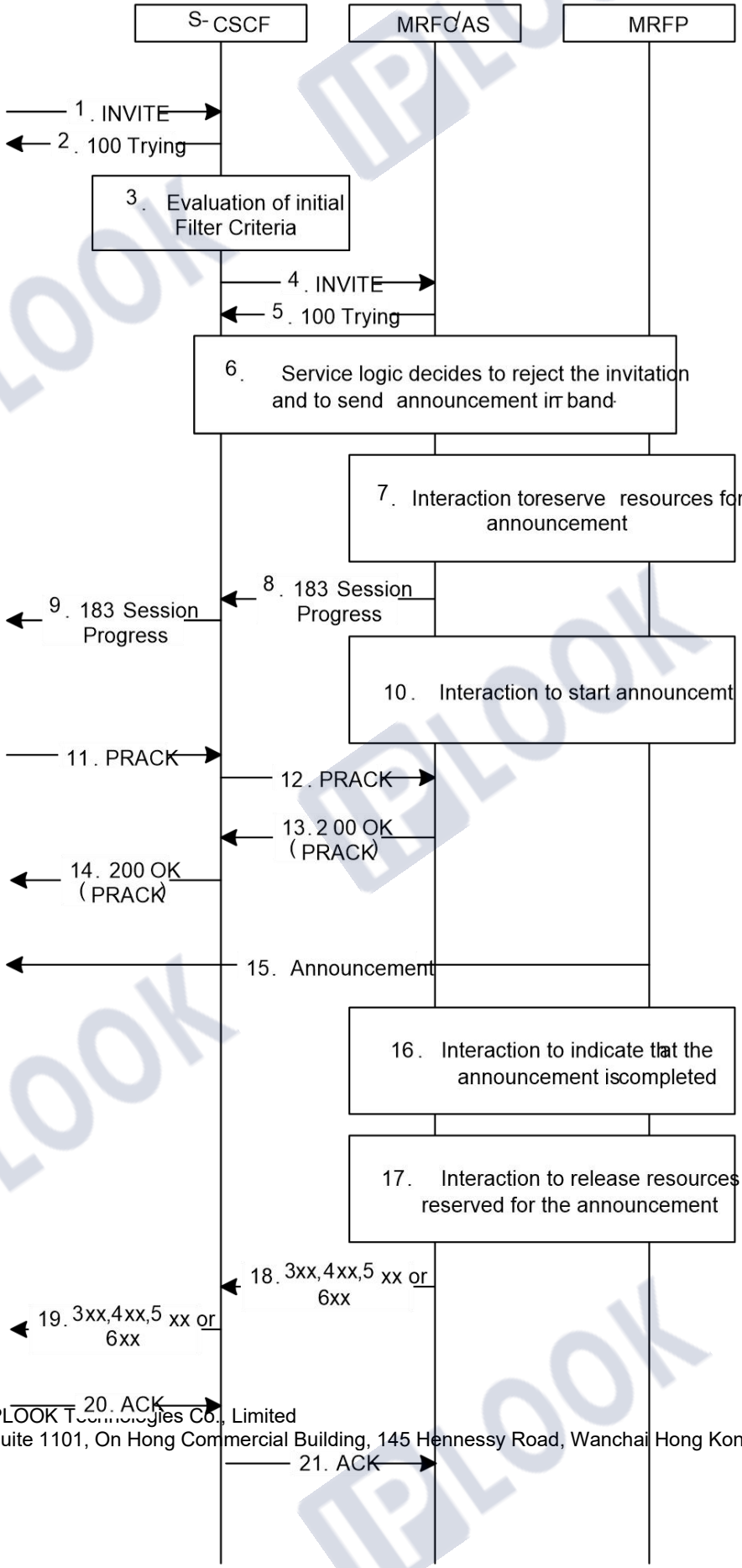
Parsing SIP requests from the AS and S-CSCF and controlling the MRFP accordingly.

The tasks of MRFP are as follows.

Provision of resources controlled by MRFC.

Playback of media streams.

The tone release process for a failed or rejected call is as follows:


S-CSCF
MRFC/AS
MRFP
1. INVITE
2. 100 Trying
3. Evaluation of initial Filter Criteria
4. INVITE
5. 100 Trying
6. Service logic decides to reject the invitation and to send announcement in-band
7. Interaction toreserve resources for announcement
8. 183 Session Progress
9. 183 Session Progress
10. Interaction to start announcemt
11. PRACK
12. PRACK
13. 200 OK (PRACK)
14. 200 OK (PRACK)
15. Announcement
16. Interaction to indicate that the announcement iscompleted
17. Interaction to release resources reserved for the announcement
18. 3xx,4xx,5xx or 6xx
19. 3xx,4xx,5xx or 6xx
20. ACK
21. ACK

Shows how AS uses early media sessions to send in-band notifications and when to send them and reject communication requests using the appropriate response code.

3.1.13 Emergency Call

3.1.13.1 Definition

Emergency CSCF (E-CSCF): A call session control feature that handles emergency call sessions. For example, routing emergency call requests to the correct emergency call center or PSAP.

Location Retrieval Function (LRF): This functional entity handles the retrieval of location information for the UE, including temporary location information, initial location information and updated location information.

Public Safety Answering Point (PSAP): a physical location to receive emergency calls from the public.

3.1.13.2 Dependency

P-CSCF	E-CSCF	LRF	PSAP
√	√	√	√

3.1.13.4 Principle description

3.1.13.4.1 Emergency calls recognizable by the terminal.

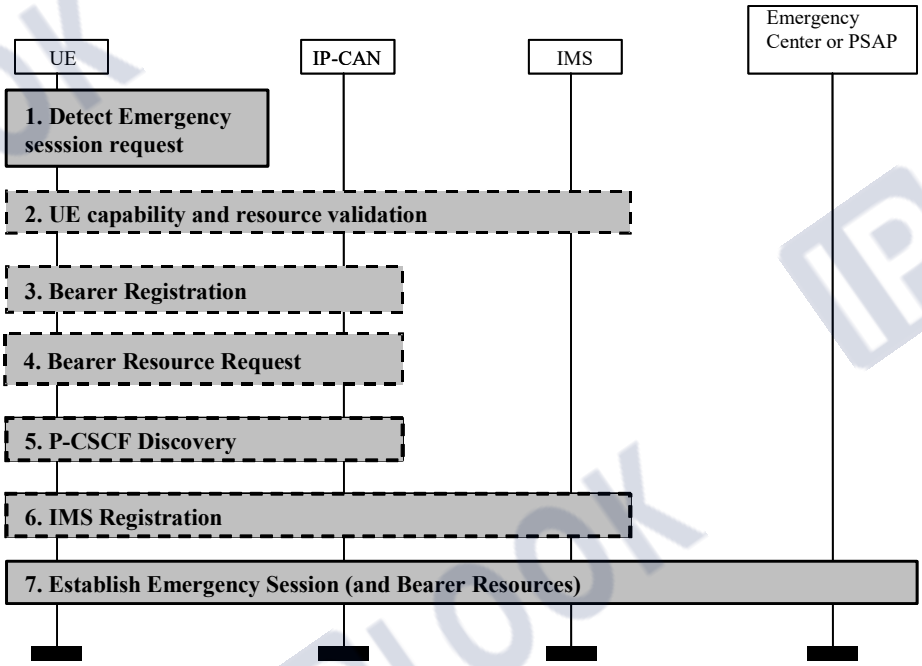


Figure: Terminal Detected Emergency Calls

Perform the following steps:

1. The UE recognizes the request to establish an emergency session.

2. In the case that the UE does not have sufficient resources or capacity to establish an emergency call due to other ongoing sessions, then the UE shall terminate the ongoing communication and release the reserved bearer resources.

3. In the case that bearer registration is required but not carried out, the UE needs to carry out bearer registration to IP-CAN. If the UE has already performed bearer registration, the bearer registration process does not need to be performed. Depending on the IP-CAN, an IP address may be assigned to the UE at this stage.

4. If a bearer resource for the transmission of IMS related signaling needs to be reserved in the IP-CAN, then the UE shall reserve the resource in the IP-CAN. the IP-CAN may support the UE indication that the request is for emergency services. If the IP-CAN does not provide an IP address to the UE in step 3, then the IP-CAN shall assign an IP address to the UE during the bearer resource request.

5. the UE performs a P-CSCF discovery process where the UE discovers the P-CSCF applicable to the emergency session in the local network. the exact method of P-CSCF discovery depends on the IP-CAN.

6. If the UE has sufficient credentials to authenticate to the IMS network, it shall initiate an IMS emergency registration by providing the IP address obtained in step 3 or step 4 to the P-CSCF selected in step 5. The IP address used for signalling purposes is associated with step 3 or step 4. the IMS registration request shall include an emergency indication. When the UE performs a non-emergency registration, the implicit registration set of the SIP URI used by the UE in the emergency registration request shall contain the associated TEL-URI for calling back to the UE. S-CSCF sets recommended registration expiration times based on local regulations or carrier policies. The follow-up registration process is similar to any other registration.

If the UE does not have sufficient credentials to authenticate to the IMS network, it shall not initiate an IMS emergency registration request, but immediately establish an emergency session to the P-CSCF.

7. The UE shall initiate an IMS emergency session establishment using the IMS session establishment procedure containing the emergency service indication and, if the UE has performed an emergency registration, the UE shall use the public user identifier of the emergency registration.

3.13.4.2 Non-terminal identifiable emergency calls

Since the UE cannot detect the emergency call, the call request is sent to the P-CSCF according to the normal session establishment process. The P-CSCF detects the call as an emergency call, adds the emergency call flag and forwards the request to the E-CSCF for processing.

3.13.4.3 Emergency call session establishment in IMS networks

Upon receipt of the initial request for an emergency call, the P-CSCF detects the call as an emergency call, detects whether the UE has provided a TEL-URI as its identity, and if the request does not provide a TEL-URI and the P-CSCF is aware of the TEL-URI associated with the emergency registration, it provides the TEL-URI to the E-CSCF in the session establishment request and adds the emergency call marker.

Upon receipt of the initial request for an emergency call, the E-CSCF shall perform the following actions.

If the location information is not included in the emergency request or if additional location information is required, the E-CSCF needs to retrieve the location information of the UE. If the UE contains location information, the E-CSCF requests the LRF to verify the location information.

If a route based on the UE location is required but the location is unknown, the default PSAP destination is used.

3.1.14 Carrier authorization

3.1.14.1 Definition

According to 3GPP TS 29.214 standard, P-CSCF shall initiate a service request to PCRF for each SIP message containing the payload of SDP, and apply for authorization to establish a bearer for audio and video communication after judging the conditions in the SIP message.

3.14.2 Dependency

UE	eNodeB	MME	S-GW	P-GW	PCRF	HSS	P-CSCF
√	√	√	√	√	√	√	√

3.1.14.3 Principle description

- After the P-CSCF receives the SIP message, it checks whether the SIP message carries precondition information and whether it meets the authorization to apply for the establishment of a proprietary bearer.
- When P-CSCF determines that the proprietary bearer can be established, the SIP message with SDP payload extracted content, and according to the SDP content, imported into the AAR message Flow-Description AVP at
- After the P-CSCF passes the service agent, the changed IP and port inside the SDP content and the terminal's own IP and port are filled into the IP field content in the AAR message

- The P-CSCF transmits the AAR message to the PCRF network element signed by the corresponding terminal and waits for the AAA message to reply
- According to the AAA message reply for verification processing, if the reply is successful, then complete the bearing authorization application process; otherwise, the application for bearing failure.

4 Operation and Maintenance

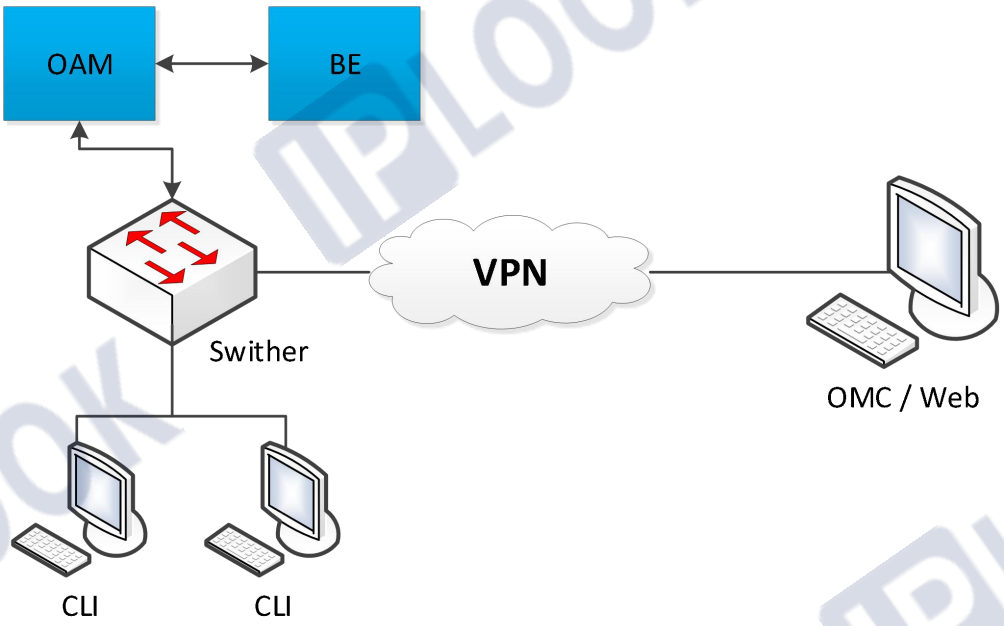
The IPLOOK provides a perfect operation and maintenance function and supports the unified EMS to implement daily maintenance and management.

Based on the Client/Server architecture, the operation and maintenance subsystem provides a GUI operation and maintenance subsystem and a Web UI performance measurement system to support customized human-machine interfaces.

The operation and maintenance subsystem supports three modes of operation:

- You can log in to the OAM server through a Web browser for management and operations
- Accessing to the OMC maintenance center for centralized management by the OMC.
- Remote operation and maintenance, accessing to the internal network through the dial-up server, and remote maintenance based on the Web.

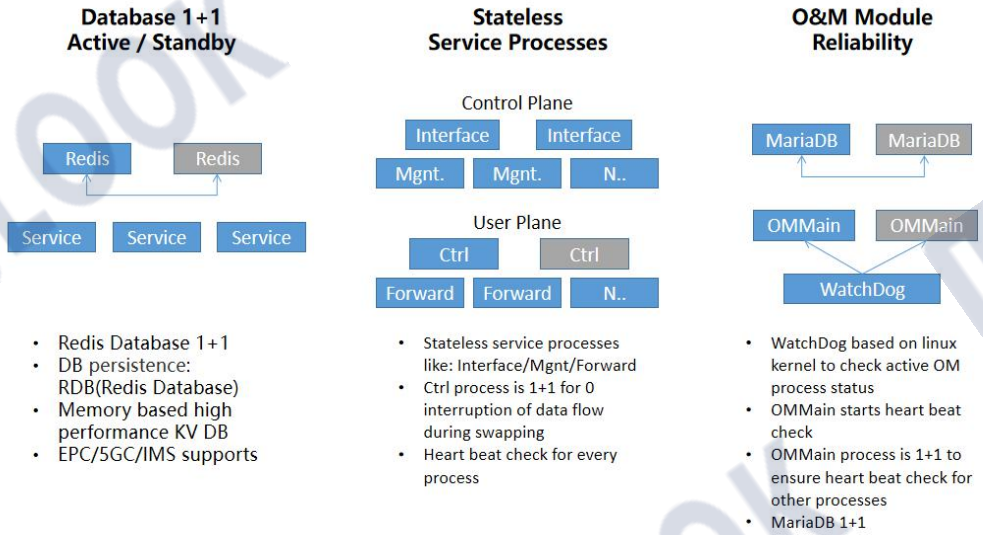
Figure 3 shows the network architecture



5 Reliability design

5.1 Software Reliability

Figure 4 software reliability



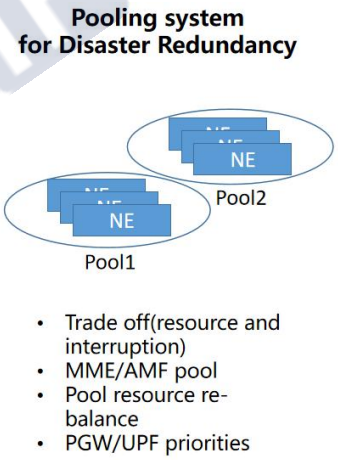
IPLOOK uses open-source database Redis in core network system, it is a memory-based Key-Value database, has great performance, and deployed as an active/standby redundancy mode. All stateful contexts of core network system are stored in this database. Other service processes are stateless such as interface message process, mobility management process, session management process and so on.

But for user plane, the session control process is deployed as active/standby mode to ensure ZERO interruption of the data flow during the service swapping procedure, for the backup forwarding table could be immediately in charge of dealing with packets.

And for O&M plane, the redundancy enforcements are deployed from the bottom at the Linux kernel, watchdog is here to check the active OM process status, this process is in charge of the heartbeat check with every other process.

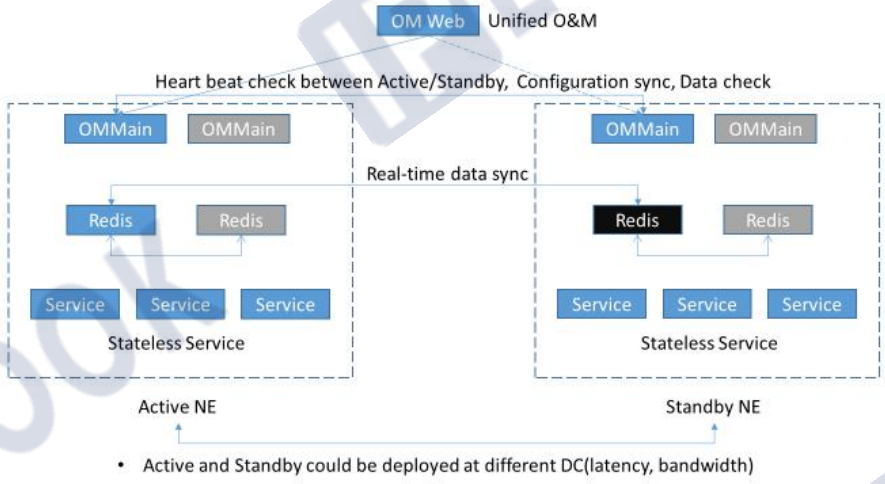
5.1 Network element Reliability

Figure 6 MME pool



At NE level, IPLOOK provides pooling redundancy solution for different scenario requirement. 3GPP standard pooling system like MME pool, AMF pool, PGW/UPF DNS priorities set is for disaster redundancy.

Figure 7 OAM redundancy



IPLOOK backup mechanism is hot backup, that means active node and standby node are synchronizing user data (context, state etc) in real-time, and they could be managed by a single

unified O&M, so when the active node fails, the standby could immediately handle current service without any service interruption.

6 Interfaces and Protocols

The related 3GPP interfaces, protocols and functions of IPLOOK IMS are listed in Table 4.

Table 4 Interfaces and description IPLOOK IMS

Interface	Description
Rx interface	Between PCRF and P-CSCF for QoS control.
ENUM interface	Between S-CSCF and ENUM-DNS server for Tel URI to SIP URI conversion.
Sh interface	Between AS and HSS – used for IMS user profile management
ISC interface	Between AS and CSCFs – standard IMS interfaces
Gm interface	Between SBC/P-CSCF and UE (via EPC/PGW)
Cx/Dx interface	Between CSCF and HSS
Mg/Mj interface	Between CSCF and MGCF for PSTN-IMS interconnect
SNMP interface	Towards Network Management System

Interface	Description
Ro interface	Between CSCFs and IN/OCS – used for pre-paid service charging

7 Dimension

User	Intervals					
NE	Resource Requirement：CPU Thread(T),Memory(GB)					

User	<10K	10K-50K	50K-100K	100K-200K	200K-500K	500K-1M	1M-2M
IMSCore	8T, 16GB	20T, 32GB	32T, 64GB	40T, 64GB	2*(40T, 128GB)	4*(40T, 128GB)	8*(40T, 128GB)
SBC	8T, 16GB	20T, 32GB	32T, 64GB	2*(32T, 64GB)	4*(32T, 64GB)	8*(32T, 64GB)	16*(32T, 64GB)

User	<200k	200k-500k	500k-1M	1M-2M
OMC	6T,16GB	12T,32GB	24T,64GB	48T,128GB

User means maximum user number to serve in specified hardware resource.

2*(40T, 64GB) means 2 sets of NEs or NFs to support required capacity.

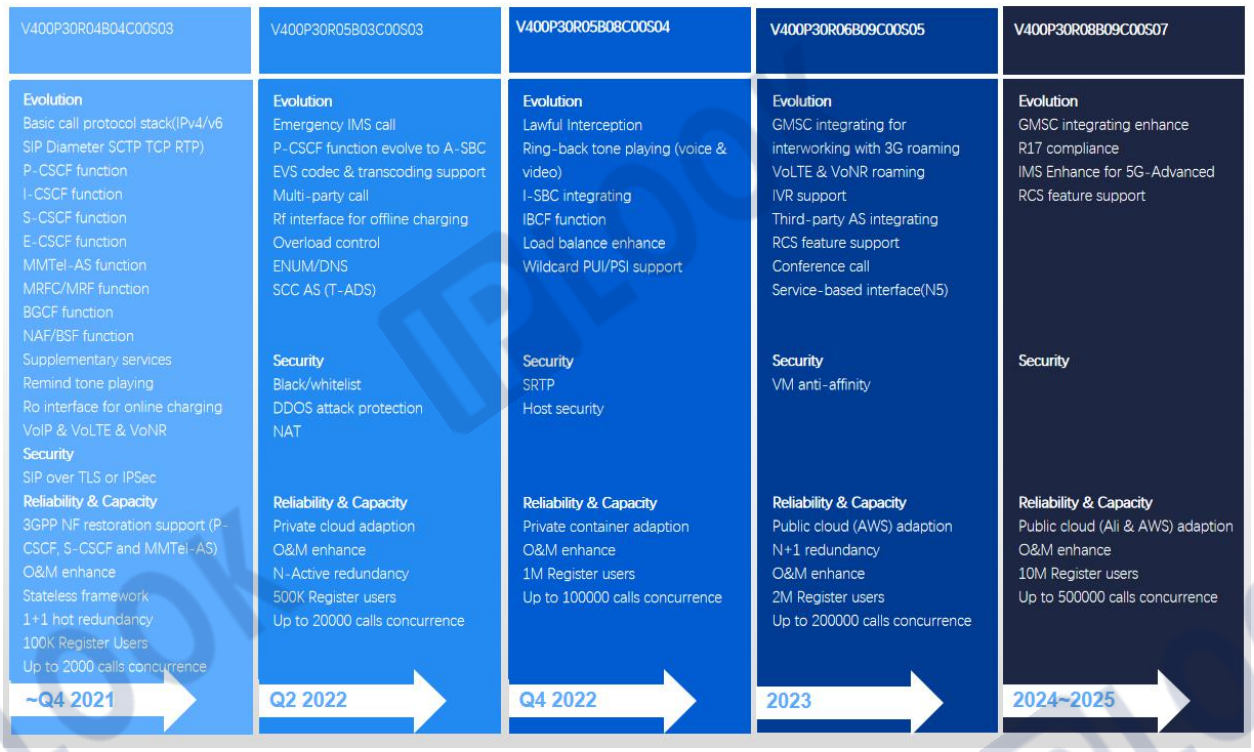
Each NE/NF should have 100GB free HD space for usage.

IMSCore includes other IMS NEs without SBC.

For default virtualization deployment, 1 vCPU = 1 CPU Thread. So resource requirement set (CPU Thread(T), Memory(GB)) is equal to (vCPU, Memory(GB)).

*GTP proxy dimension is calculated by session number, in previous table 1 user has 1 session, so <10k user range equals <10k session range.

8 Roadmap



9 Acronyms and Abbreviations

Table 6 Acronyms and Abbreviations

Name	Explanation
2G	Second Generation
3G	the third Generation mobile communications
3GPP	Third Generation Partnership Project
3GPP2	Third Generation Partnership Project 2
ATM	Asynchronous Transfer Mode
AUC	Authentication Center
AVP	Attribute Value Pair
BOSS	Business Operator and Supporting System
BSC	Base Station Controller
CAMEL	Customized Application for Mobile network Enhanced Logic
CAP	CAMEL Application Part
CAPEX	Capital Expenditure
CBC	Content Based Charging
CCG	Content based Charging Gateway
CG	Charge Gateway
CN	Core Network
COTS	Commercial Off The Shelf
CS	Circuit Service
CSCF	Call Session Control Function
EIR	Equipment Identity Register
EMS	Element Management System

EPS	Evolved Packet System
EUTRAN	Evolved Universal Terrestrial Radio Access Network
FCAPS	Fault, Configuration, Accounting , Performance, Security
FTP	File Transfer Protocol
GGSN	Gateway GPRS Support Node
GPRS	General Packet Radio Service
GSM	Global System for Mobile communications
HLR	Home Location Register
HSS	Home Subscriber Server
IM-SSF	IMS – Service Switch Function
IMS	IP Multimedia Subsystem
IMSI	International Mobile Subscriber Identity
IOT	Inter-Operation Test
ITU	International Telecom Union
LAI	Location Area Identity
MAP	Mobile Application Part
MME	Mobility Management Entity
MMS	Multimedia Message Services
MS	Mobile Station
MSC	Mobile Switching Center
MSISDN	MS ISDN
MTBF	Mean Time Between Failures
MTTR	Mean Time To Repair
NAT	Network Address Translation

NE	Network element
NFV	Network Function Virtualization
NM	Network Management
NRI	Network Resource Identifier
OMC	Operation and Maintenance Center
OCS	Online Charging System
OPEX	Operating Expense
PDP	Packet Data Protoco1
PLMN	Public Land Mobile Network
POS	Packet Over SONET/SDH
PS	Packet Service
QoS	Quality of Service
RADIUS	Remote Authentication Dial In User Service
RAN	Radio Access Network
RANAP	Radio Access Network Application Part
RNC	Radio Network Controller
RNS	Radio Network Subsystem
RRU	Remote Radio Unit
SCTP	Stream Control Transmission Protocol
SGW	Serving Gateway
SGSN	Serving GPRS Support Node
SIGTRAN	Signaling Transport
SMS	Short Message Service
SMSC	Short Message Service Center

SMTP	Simple Mail Transfer Protocol
SS7	Signaling System Number 7
TCP/IP	Transmission Control Protocol/Internet Protocol
TECS	Tulip Elastic Computing System
UMTS	Universal mobile telecommunication system