IPLOOK PCRF PRODUCT DESCRIPTION

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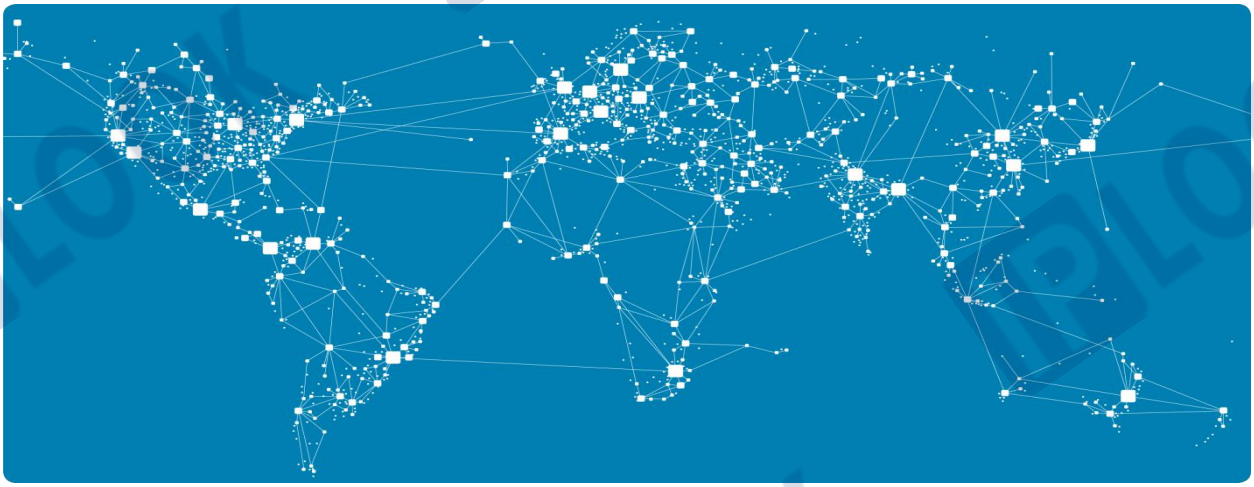
IPLOOK PCRF Product Information



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Revision history

Version	Usage State	Modification Summary	Reviser	Reviewer	Revision date
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1.2	Done	Add VoLTE Function	Johnson	Li	23-06-20
1.3	Done	Support User level control function	George	James	15-02-21
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1 Introduction

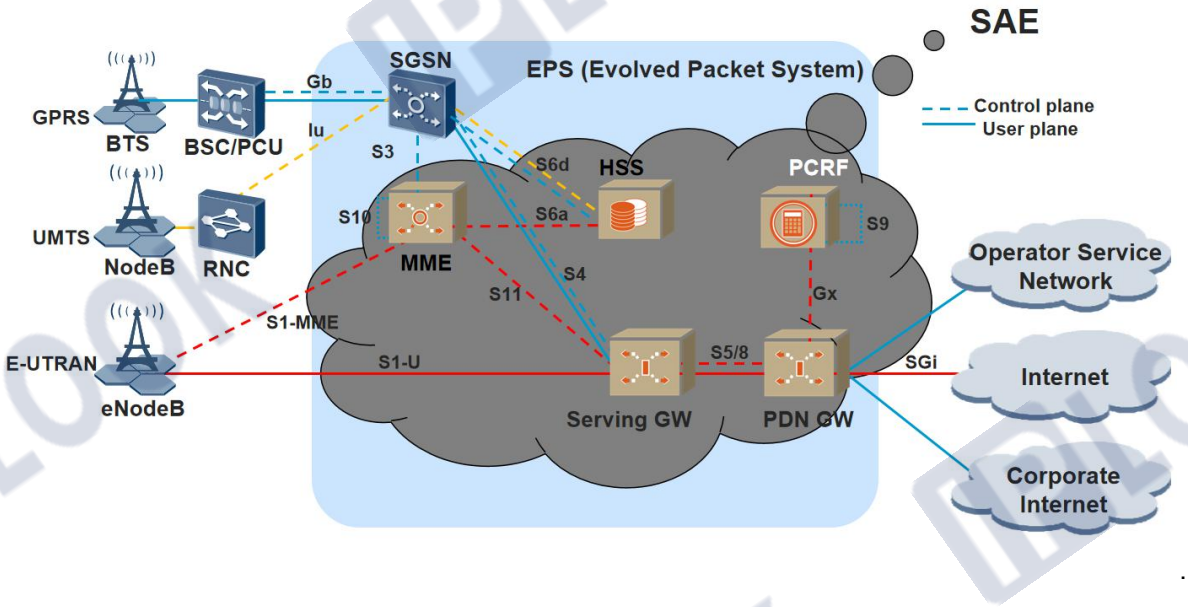
1.1 PCRF overview

EPC refers to a core network architecture that supports LTE access networks. IPLOOK provides Long Term Evolution/Evolved Packet Core (LTC/EPC). IPLOOK PCRF bring the functionality of the PCRF into the SAE domain. It features distributed structure, modular design and supports many reliability functions, including flexible strategy control ability, good integration of fixed and mobile services, large capacity and high degree of integration, open data access interface. Moreover, in-memory data management, multi-level data backup and seamless geographic redundancy solution.

IPLOOK's PCRF manages the access control. During the process of user activation / update, PGW obtains the relevant information about the user's policy and billing control from PCRF or local configuration according to the user information. When a user uses packet data service, PGW passes the user message, matches the corresponding rules, obtains the billing control, QoS control and other policies, and executes the strategy.

The location of PCRF in the EPC network is shown in Figure 1

Figure 1 Schematic Diagram



IPLOOK's PCRF adopts module structure and executes different functions through different modules. It is able to interconnect with different nodes in 4G, 2G or 3G network.

Table 1 Core network node description

Name	Function
E-UTRAN	Evolved UMTS Terrestrial Radio Access Network.
MME	The Mobility Management Entity (MME) represents the control plane for the User Equipments(UEs) to access the 4G LTE, or EPS network. From a UE's perspective, signaling for access control, location tracking, and bearer set up is performed via the MME.
HLR/HSS	Home Location Register, which stores the subscription data and location information of subscribers and provides route information for calls from the network to subscribers. Home Subscriber Server, which stores the subscription data and location information of subscribers and implements subscriber authentication and authorization.
MSC	Mobile Switching Center, which provides the call conversion service and call control between the telephony and data systems.
CG	Charging Gateway, which lies between the Gn/Gp SGSN/GGSN and the Charging Center to send CDR files to the Charging Center.
SGW	The service gateway that implements user-plane data routing in the EPC network.
PGW/GGSN	Gateway GPRS Support Node, which provides routing and encapsulation of data packets between the 3G core-network and external data network. In EPC network, the GGSN is evolved into a PGW(the packet data network gateway) function node, that implements subscriber access to the PDN in the EPC network.
PCRF	Implements policies and charging rules.

Name	Function
PDN	Provides the data transmission service for subscribers.

1.2 Highlight features

1.2.1 Virtualization

Software and hardware are decoupled through virtualization. The IPLOOK PCRF 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 PCRF hardware resources are virtualized to many VMs. When the IPLOOK PCRF needs to increase its processing capability, more VMs can be installed.
The IPLOOK PCRF 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 PCRF 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 PCRF system provides a series of products and open standard interfaces.

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

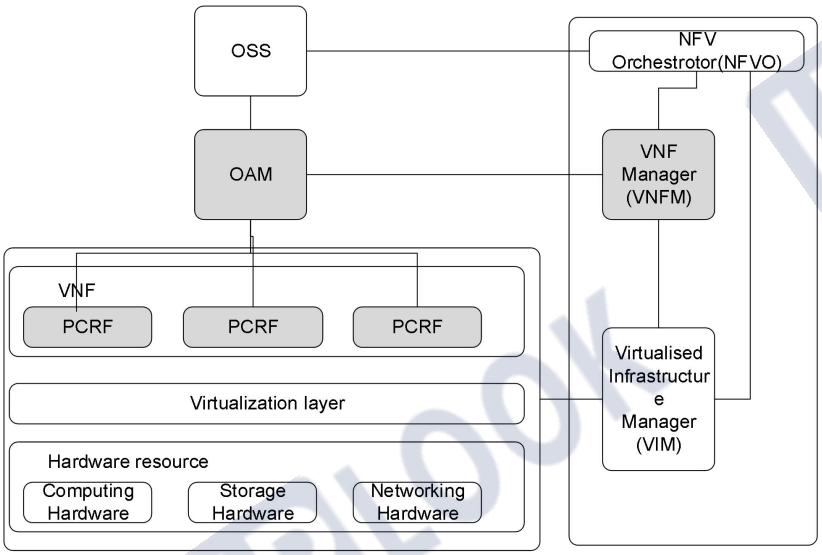
- The O&M uses the B/S structure, and the EMS uses the C/S structure, ensuring a desirable networking capability and expansion of the operation and maintenance system.
- Provides remote and local access to the system so that both local and remote operation and maintenance can be implemented. Maintenance operations can be performed on the entire system and each specified NE.
- Multi-level permission mechanism to ensure system security.
- The IPLOOK PCRF 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.

2 System architecture

2.1 IPLOOK PCRF in the NFVI

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

Figure 2 IPLOOK PCRF System Architecture



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

Table 2 IPLOOK PCRF 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 PCRF.
NFVI	Network functions virtualization infrastructure, which refers to physical resources. The NFVI is provided and managed by the cloud platform.

Node	Description
Hypervisor	Arranges and manages NFV resources (infrastructure and applications) in the 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 PCRF 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 Definition

The main realization of policy control function, policy is that operators according to their own operational needs, purposefully and selectively impose some control means on users, networks and services. For example, users' use of P2P services is limited during busy hours, so as to reduce or eliminate the overload of packet network resources. Policy control and billing control together constitute the two basic functions of PCC.

During the process of user activation / update, PGW obtains the relevant information about the user's policy and billing control from PCRF or local configuration according to the user information. When a user uses packet data service, PGW passes the user message, matches the corresponding rules, obtains the billing control, QoS control and other policies, and executes the strategy.

There are two sources of policy：

- Issued by PCRF

PGWIn the PCC architecture, policies are defined by PCRF and enforced by PCEF. In the process of activation, the user interacts with PCRF, obtains the authorization information related to policy and billing control through Gx interface, and provides it to each business module in PGW to realize policy and billing control. PCRF can issue dynamic rules, predefined rules or predefined rule groups to PGW.

- PGW Local Policy

If PCRF is not deployed in the network, policy matching and enforcement are performed using rules configured locally by PGW.

The priority of policy selection from high to low is issued by PCRF and local static configuration.

Rule Name	PGW	PCRF	Description
Predefined Rules	Define the rule name and the specific content of the rule.	Define the same rule name as on PGW.	PGW looks for matching specific rules according to the rule name issued by PCRF, and processes the user data.
Predefined Rule Group	Define a set of rule names and specific rule contents, which are bound in a user-profile.	Defines a predefined rule group name that is consistent with the user-profile name on PGW.	PGW looks for matching specific rules according to the rule group name issued by PCRF, and processes the user data.
Dynamic Rule	Not responsible for specific rule definitions.	The rule name and specific rule content are defined on PCRF.	PGW processes user data according to the rule name and specific rule content issued by PCRF.

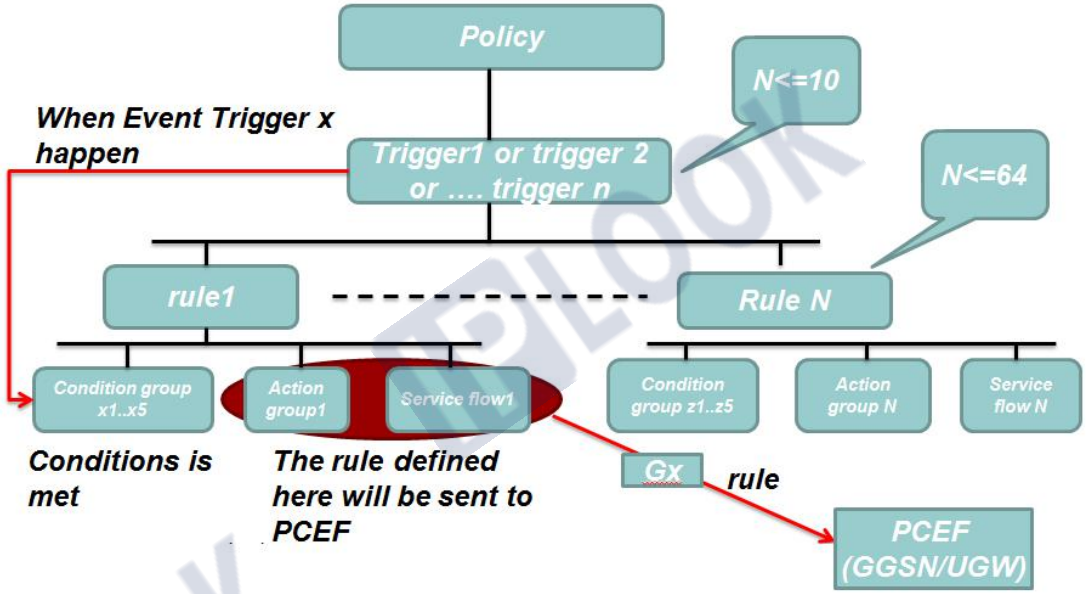
The priority of the rules issued by PCRF adopts global planning. In the case of the same priority, the priority of dynamic rules is higher than that of predefined rules.

3.1.2 Dependencies

UE	eNodeB	MME	S-GW	PDN-GW	PCRF	HSS
			√	√	√	

3.1.3 Principle Explanation

3.1.3.1 Policy



3.1.3.2 Trigger

Triggers are events that trigger policy enforcement.

- IP-CAN session establishment
  IPCANSessionEstablish (PDP context activation of GPRS; Attach procedure of EPC)
- Status change
  TimeRangeChange (triggered by PCRF system time changing)
  UsageStatusChange(Quota level changed)
- Location change
  SGSNChange (SGSN IP address changed)

RATChange: (Radio access type change: GERAN(2G),UTRAN (3G), HSPA_EVOLUTION, EUTRAN(4G))
RAIChange (RAI changed)
Concept introduction-rules

A typical specification contains the following information:

- Service data flow filter: How to detect business flow. For example, business flow can be defined by IP, port, protocol type, etc.
- Qos information: How to control the bandwidth and filter the traffic flow
- Charging information: How to charge the business flow, including the billing rate

3.1.3.3 Predefined Rules

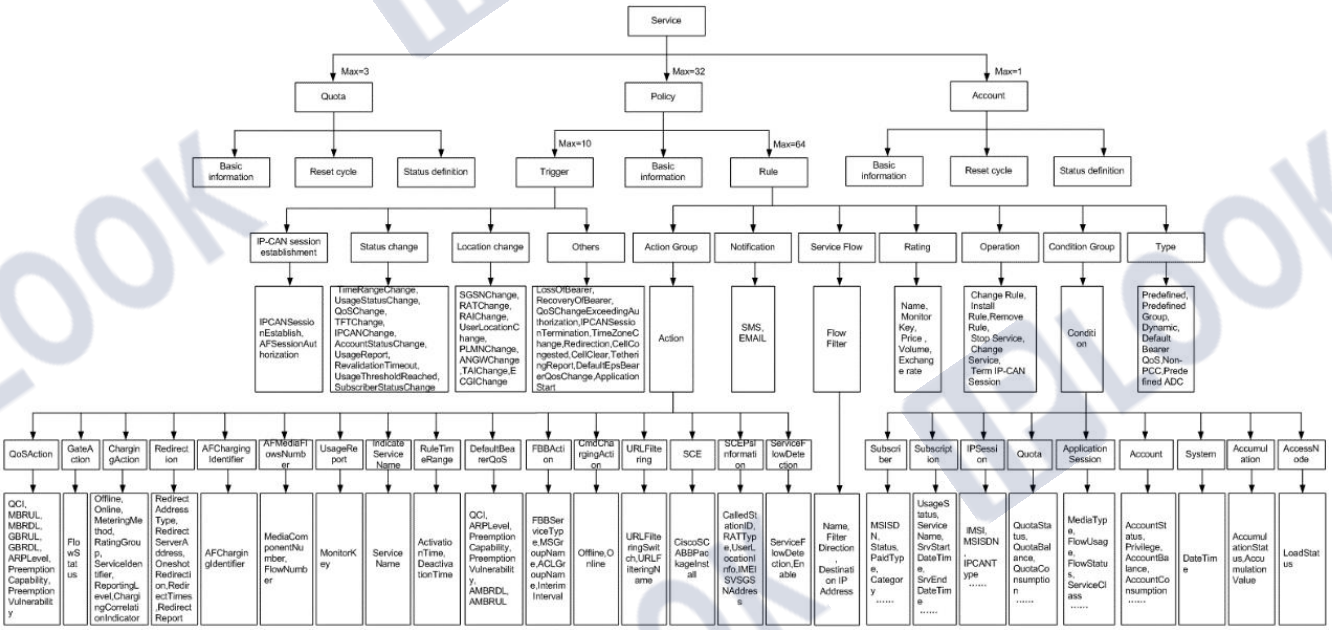
- Predefined rules and predefined rule groups.
- Detailed rules are defined on PCEF.
- Configure the rule name or rule group name on UPCC, which must be consistent with the one defined on PCEF.

3.1.3.4 Concept introduction-dynamic rules

The dynamic rules defined on the UPCC side define the details of the rules, and the names of the issued rules are randomly generated by UPCC.

- Qos information is defined by Action group
- Service flow information is defined by Service flow
- Billing information is defined by Action group

3.1.3.5 Configuration Logic



- After UPCC detects that an event has occurred, it looks for matching rules according to ConditionGroup in multiple Rule associated with Policy, sends the corresponding ServiceFlow,ActionGroup to PCEF in the matching rules, and UPCC sends a notification to the corresponding notification server if there is any Notification.
- Logic can be reduced to:
  When (Trigger)
  - if (ConditionGroup)
    - then (ServiceFlow & ActionGroup & Notification)

3.2 Consumption Statistics

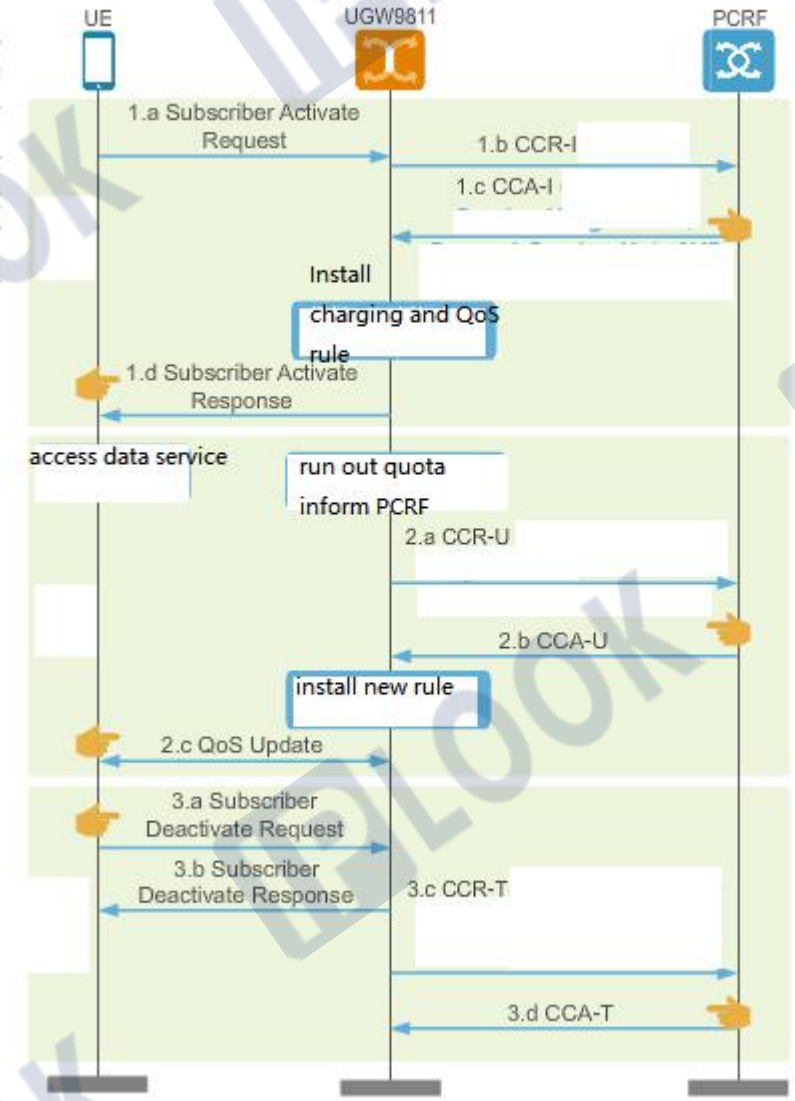
3.2.1 Definition

According to the amount reported by the user, PCRF will count it down, calculate that the user is currently in one of the states (normal, level1, exhaust) according to the subscribed amount service, and send the rules to the user according to the status control, which has reached the speed limit control.

3.2.2 Dependencies

UE	eNodeB	MME	S-GW	PDN-GW	PCRF	HSS
√	√	√	√	√	√	√

3.2.3 Principle Explanation



3.3 Dedicated Bearer QoS Control

3.3.1 Definition

PCRF can support the activation / update / deletion of dedicated bearer initiated by the network side.

3.3.2 Dependencies

UE	eNodeB	MME	S-GW	PDN-GW	PCRF	HSS	IMS
√	√	√	√	√	√	√	√

3.3.3 Principle Explanation

3.3.3.1 Dedicated bearer activation

GGSN does not support the activation of dedicated bearer initiated by the network side, and P-GW supports the activation of dedicated bearer initiated by UE and the network side. If the QCI/ARP defined in the rules carried in the CCA/RAR message sent by PCRF is different from the QCI/ARP of the existing bearer, the establishment of dedicated bearer is triggered.

If the dynamic rule does not contain QoS information, no dedicated bearer will be established, and the rule will be installed on the default bearer.

3.3.3.2 Dedicated bearer update

When PCRF sends a RAR or CCA-U message to PGW with updated dynamic PCC rules, a dedicated bearer update process is initiated.

The main update processes of dedicated bearer are as follows：

- QoS updates initiated by UE/SGSN

  PGW receives the Update PDP Context Request message sent by SGSN, which contains the TFT and QoS information of the UE request. If the message contains QoS information that is different from the original dedicated bearer, it initiates the QoS update process, and PGW sends a CCR-U message to PCRF to request an update.

- QoS updates initiated by UE/MME

PGW receives the Bearer Resource Command message sent by MME/S-GW, which contains the TFT and QoS information of the UE request. If the message contains QoS information that is different from the original dedicated bearer, it initiates the QoS update process, and PGW sends a CCR-U message to PCRF to request an update.

- QoS updates initiated by HSS

When the signing QoS on HSS changes, an Insert Subscriber Data message is sent to MME,MME and then the Modify Bearer Command message is used to transmit the changed QoS information to P-GW through S-GW. P-GW notifies PCRF through QoS-Information AVP and Default-EPS-Bearer-QoS AVP on the Gx interface of the changed QoS information (mainly including APN-AMBR and default bearer QCI and ARP).

- TFT modification initiated by the network side

When the PCC rule sent by PCRF through RAR message contains updated flow information (filter), and the PCC rule has been installed in the original dedicated bearer, the TFT modification process will be initiated, and the TFT filter in the original dedicated bearer will be modified according to the updated filter.

- Add dynamic rules to an existing bearer

When PGW receives a new dynamic PCC rule that contains the same QCI and ARP as in the activated dedicated bearer, the dedicated bearer modification process is initiated. The bandwidth value in the newly received QoS will be accumulated in the corresponding activated dedicated bearer bandwidth. In this case, the dedicated bearer update is initiated based on the new QoS, and the updated TFT filter is installed into the dedicated bearer.

- Delete dynamic rules in an existing host

When a dynamic PCC rule needs to be removed from an activated dedicated bearer, a modification process for the dedicated bearer is initiated. The bandwidth of the dedicated bearer will be subtracted from the bandwidth value of the PCC rule that

needs to be deleted, and the corresponding TFT filter in the PCC rule that needs to be deleted will be deleted.

3.3.3.3 dedicated bearer termination

The termination process of dedicated bearer can be initiated by SGSN, MME, GGSN, P-GW, or PCRF. PGW and PCRF use CCR-U/CCA-U or RAR/RAA messages to activate a dedicated bearer and delete all PCC rules on that dedicated bearer.

3.4 VoLTE Function

3.4.1 Definition

- Connect user terminals to the IMS network to provide voice and video services
- VoLTE (Voice over LTE) is a LTE voice solution defined by 3GPP standard and based on IMS (IP Multimedia Subsystem) network. GW500 can provide voice call and video services to IMS network.

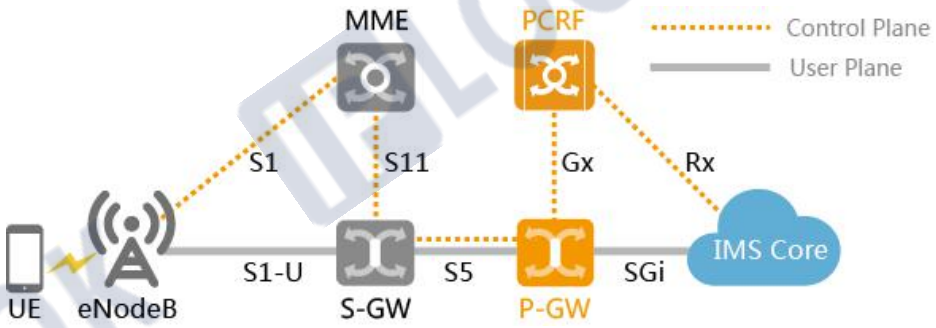
3.4.2 Dependencies

UE	eNodeB	MME	S-GW	PDN-GW	PCRF	HSS	IMS
√	√	√	√	√	√	√	√

3.4.3 Principle Explanation

3.4.3.1IMS network structure

The structure diagram of IMS network in EPC network is as follows：



3.4.3.2 IMS Business process

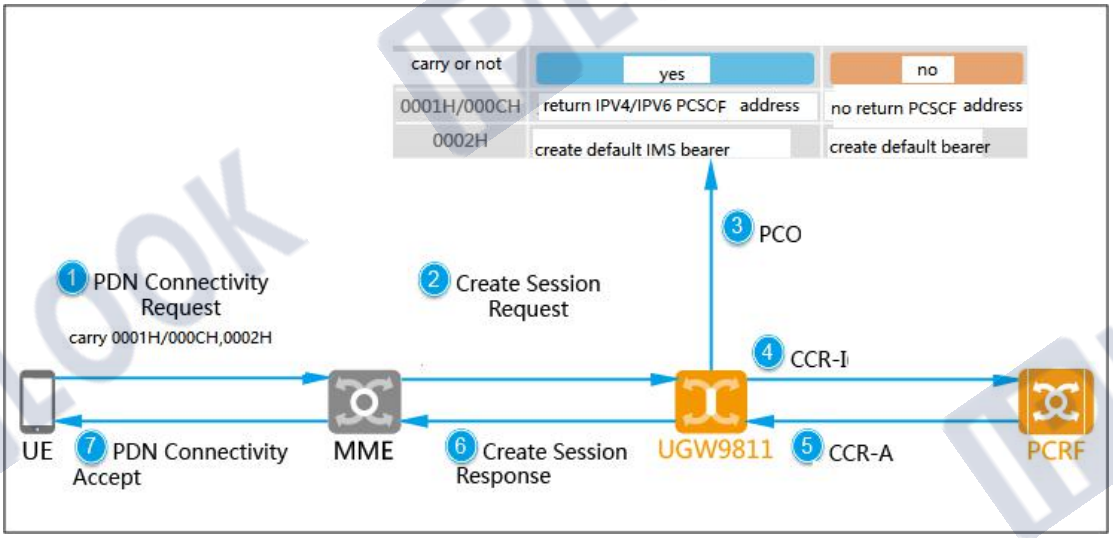
Currently, voice services can be carried on independent APN or data APN. Huawei recommends independent APN. The following process description takes independent APN as an example.

IMS signaling is used for the default bearer of voice signaling. Voice is divided into signaling and voice packets. Signaling is carried by default in IMS signaling, and voice data is carried exclusively.

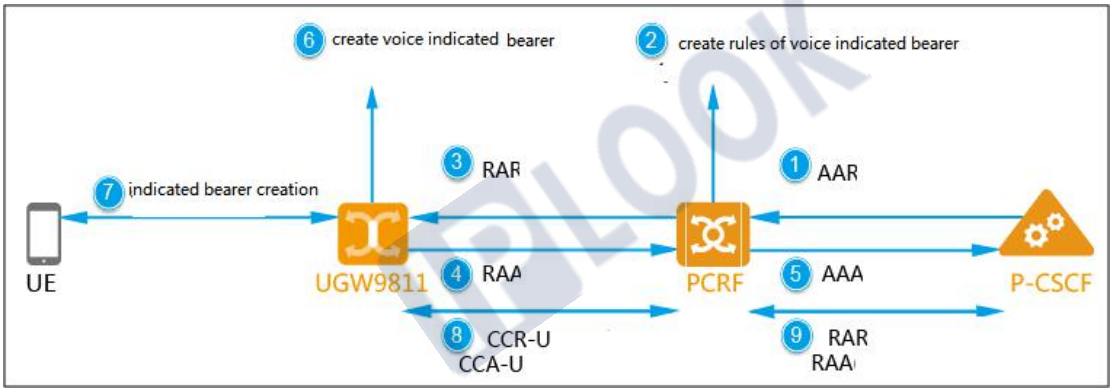
The whole voice establishment process is divided into three steps.

- IMS voice default bearer creation process
- IMS Voice SIP signaling call flow
- IMS voice dedicated bearer process

IMS voice default bearer creation flowchart



IMS voice dedicated bearer creation flowchart



3.5 User level control

3.5.1 Definition

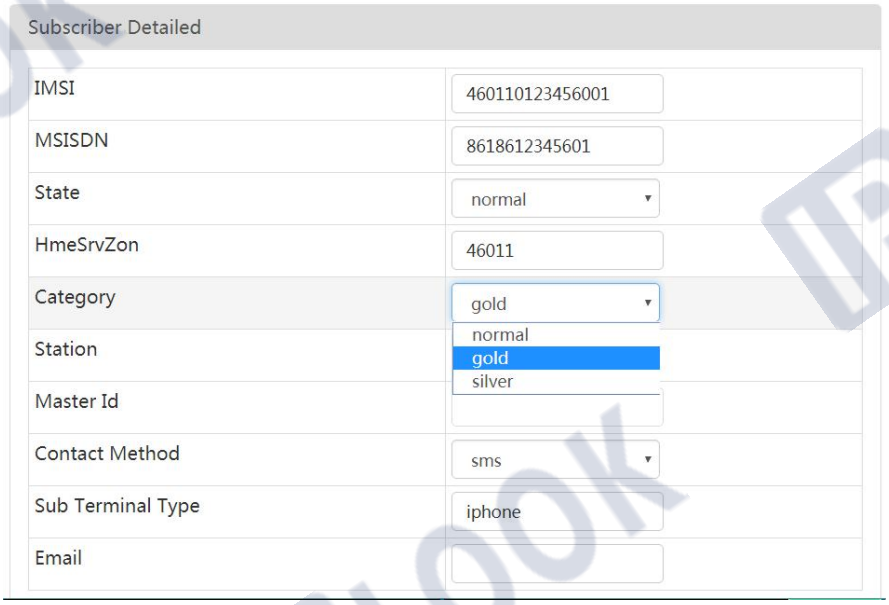
PCRF can control the bearer rate through user attributes through the rules of the user attribute process when opening an account.

3.5.2 Dependency Relationship

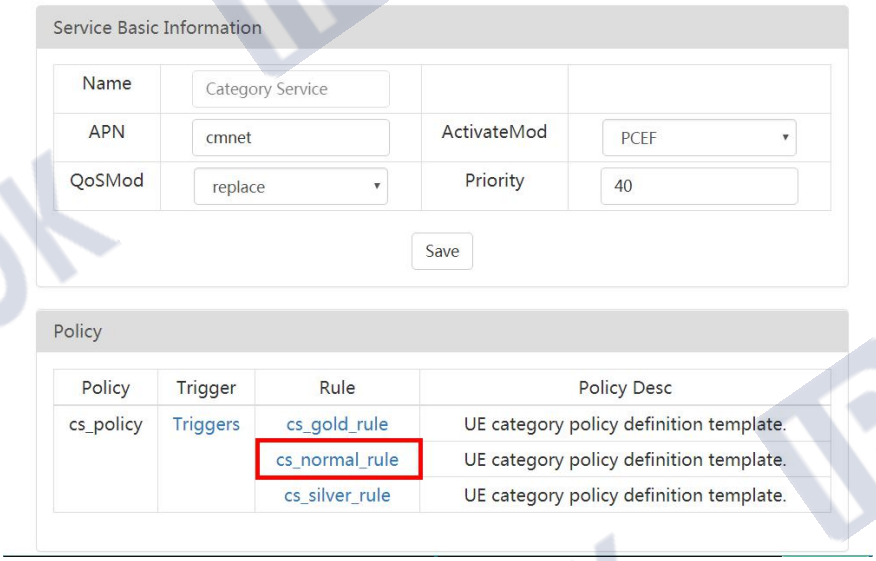
UE	eNodeB	MME	S-GW	PDN-GW	PCRF	HSS

√	√	√	√	√	√	√

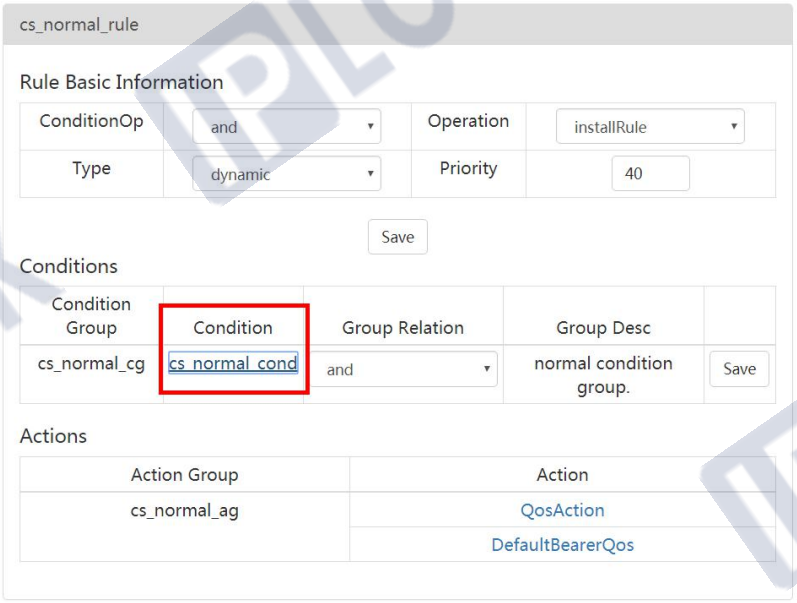
3.5.3 Principle Explanation



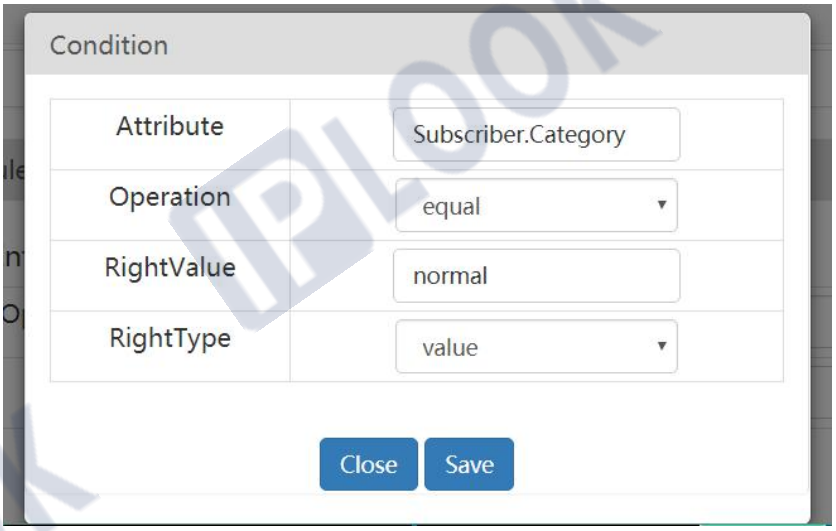
Figure（3.5.3.1）



Figure（3.5.3.2）



Figure（3.5.3.3）



Figure（3.5.3.4）

The PCRF user information page can set the user level (Figure 3.5.3.1), and PCRF will select the corresponding level service rule and distribute it through the judgment option set in the rule (Figure 3.5.3.4).

3.6 Time interval control

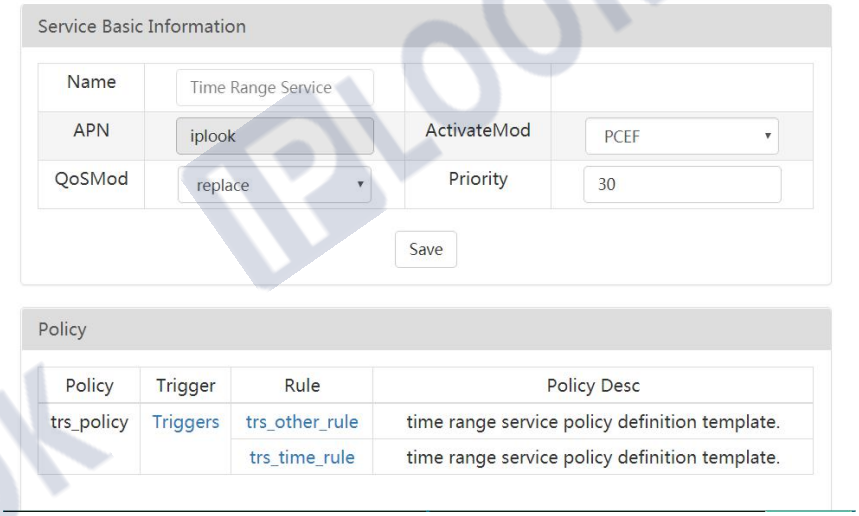
3.6.1 Definition

PCRF can enable registered users to implement different rates in different time periods by setting time intervals.

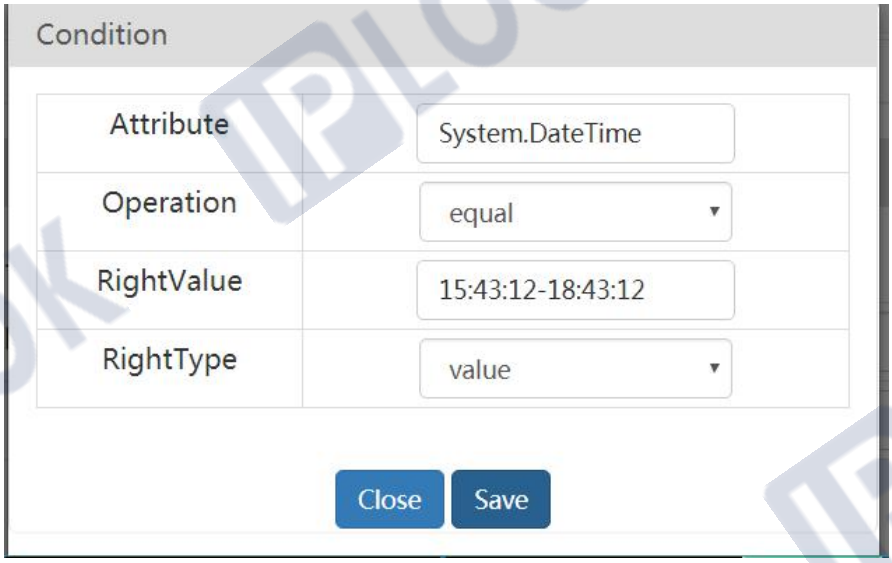
3.6.2 Dependencies

UE	eNodeB	MME	S-GW	PDN-GW	PCRF	HSS
√	√	√	√	√	√	√

3.6.3 Principle Explanation



Figure（3.6.3.1）



Figure（3.6.3.2）

The PCRF user information page can set a time period in the condition in trs_time_rule, in which the trs_time_rule will be sent when the user goes online. When outside the time range, PCRF will trigger RAR-U to actively send the rule trs_other_rule to PCEF.

4 Operation and Maintenance

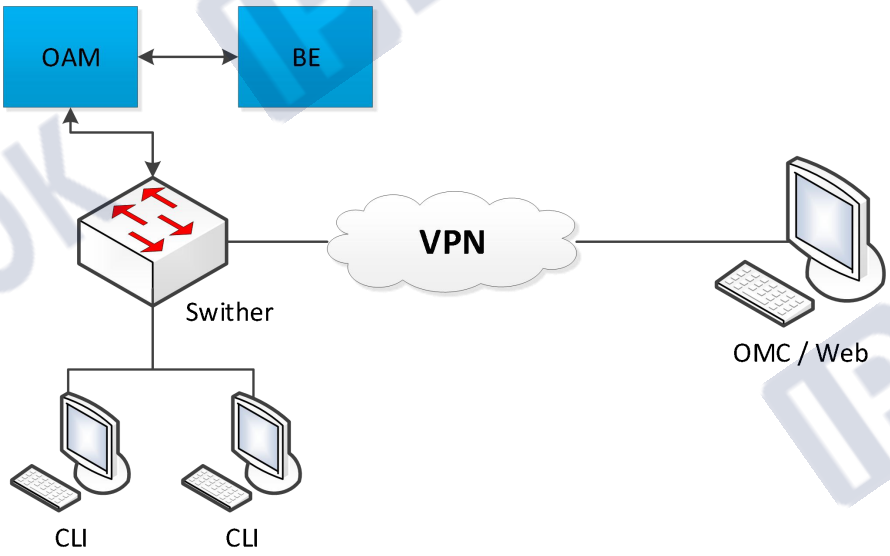
The IPLOOK provides a perfect operation and maintenance function and supports the unified EMS to implement daily maintenance and management.

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.

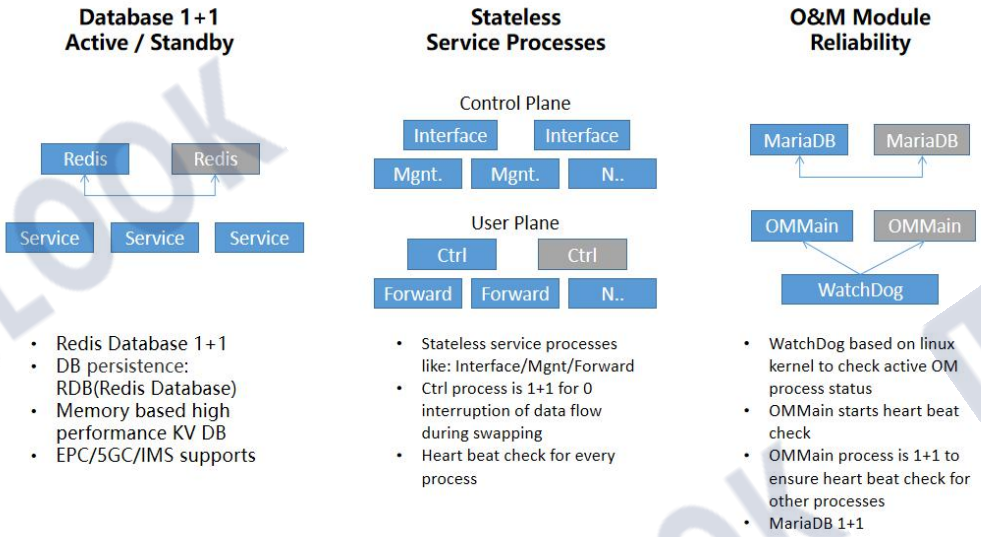
Figure 3 shows the network architecture



5 Reliability design

5.1 Software Reliability

Figure 4 software reliability



- Redis Database 1+1
- DB persistence: RDB(Redis Database)
- Memory based high performance KV DB
- EPC/5GC/IMS supports

- Stateless service processes like: Interface/Mgnt/Forward
- Ctrl process is 1+1 for 0 interruption of data flow during swapping
- Heart beat check for every process

- WatchDog based on linux kernel to check active OM process status
- OMMain starts heart beat check
- OMMain process is 1+1 to ensure heart beat check for other processes
- MariaDB 1+1

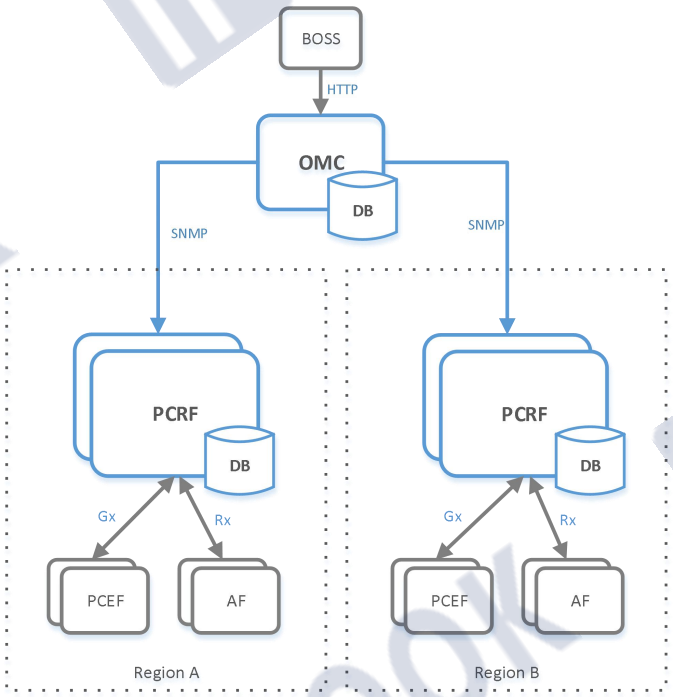
IPLOOK uses open-source database Redis in core network system, it is a memory-based Key-Value database, has great performance, and deployed as an active/standby redundancy mode. All stateful contexts of core network system are stored in this database. Other service processes are stateless such as interface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

5.2 Network element Reliability

Figure 5 PCRF pool



Distributed architecture is applied in PCRF, which has the following excellent quality:

- High Reliability
- Smoothly Expansion

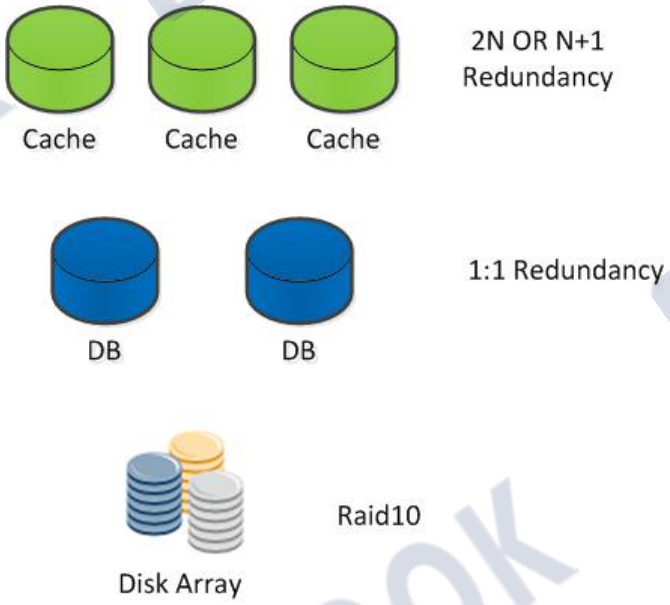


Figure 6 PCRF redundancy

- **Multi-level backup mechanism**

There are three level backup mechanisms.

Level 1

2N or N+1 redundancy solutions are applied in backup user data stored in cache. The user data from the main unit will be synchronized to the backup unit in real time.

Level 2

Database backup mode using 1+1 redundancy mode.

Level 3

The data is saved to a disk array in RAID10 mode.

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 MME are listed in Table 4.

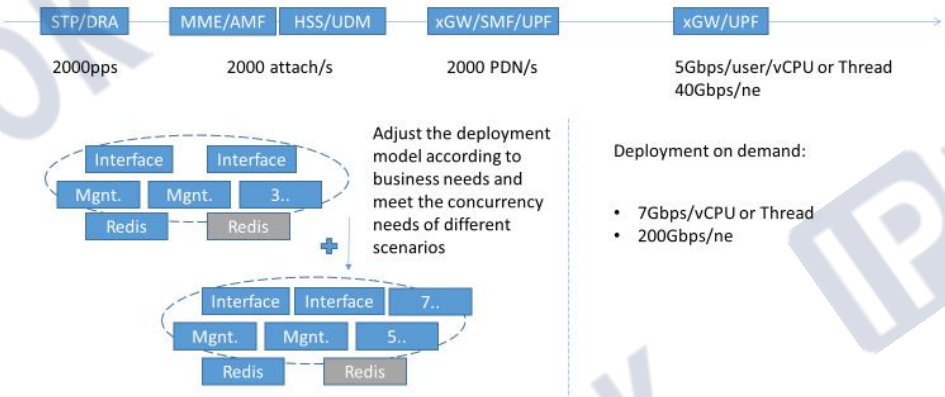
Table 4 3GPP Related Interfaces and Protocols of IPLOOK PCRF

Interface	Description	Protocol	Standard
Gx(S7)	Interface between PCRF and PGW.	Diameter	3GPP TS 29.272
Rx	Interface between PCRF and IP Bearer Network.	Diameter	3GPP TS 29.272

7 Dimension

7.1 Performance

Figure 8 Performance



One MME instance could support around 2000 attach/s at most, we can adjust the process deployment model according to the business needs and meet different concurrency requirements of different scenarios.

7.2 Dimension sheet

Table 5 Dimension

User/Site, Throughput	Intervals						
NE	Resource Requirement: CPU Thread(T),Memory(GB)						
User/Site	<10K/40	10K-50K/100	50K-100K/400	100K-200K/400	200K-500K/800	500K-1M/1600	1M-2M/3200
AMF/MME/SMF	8T, 16GB	20T, 32GB	40T, 64GB	40T, 64GB	2*(40T, 64GB)	4*(40T, 64GB)	8*(40T, 64GB)
User	<200k		200k-500k		500k-1M		1M-2M
OMC	6T,16GB		12T,32GB		24T,64GB		48T,128GB

User/Site means maximum user number and eNB or gNB number to serve in specified hardware resource.

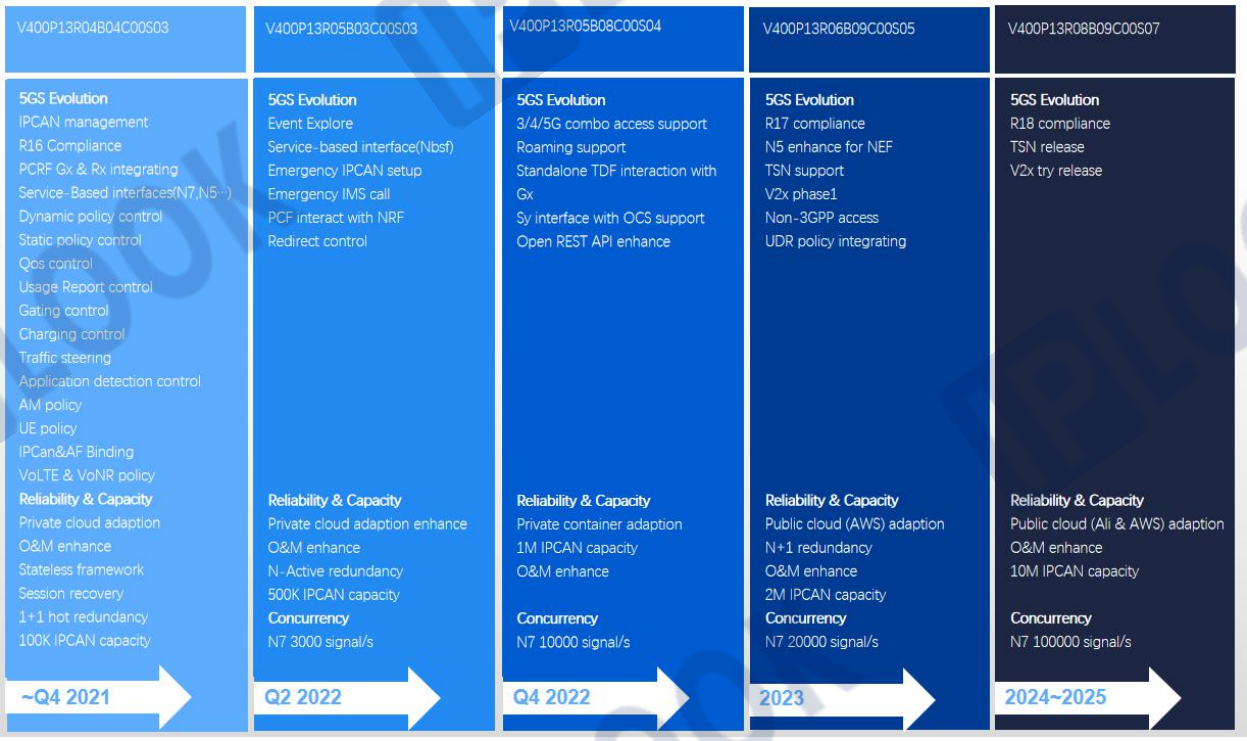
AMF/MME/SMF means they have same dimension methodologies, share same hardware resource requirements.

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.

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

8 Roadmap


V400P13R04B04C00S03
5GS Evolution
IPCAN management
R16 Compliance
PCRF Gx & Rx integrating
Service-Based interfaces(N7,N5…)
Dynamic policy control
Static policy control
Qos control
Usage Report control
Gating control
Charging control
Traffic steering
Application detection control
AM policy
UE policy
IPCan&AF Binding
VoLTE & VoNR policy
Reliability & Capacity
Private cloud adaption
O&M enhance
Stateless framework
Session recovery
1+1 hot redundancy
100K IPCAN capacity
~Q4 2021
V400P13R05B03C00S03
5GS Evolution
Event Explore
Service-based interface(Nbsf)
Emergency IPCAN setup
Emergency IMS call
PCF interact with NRF
Redirect control
Reliability & Capacity
Private cloud adaption enhance
O&M enhance
N-Active redundancy
500K IPCAN capacity
Concurrency
N7 3000 signal/s
Q2 2022
V400P13R05B08C00S04
5GS Evolution
3/4/5G combo access support
Roaming support
Standalone TDF interaction with Gx
Sy interface with OCS support
Open REST API enhance
Reliability & Capacity
Private container adaption
1M IPCAN capacity
O&M enhance
Concurrency
N7 10000 signal/s
Q4 2022
V400P13R06B09C00S05
5GS Evolution
R17 compliance
N5 enhance for NEF
TSN support
V2x phase1
Non-3GPP access
UDR policy integrating
Reliability & Capacity
Public cloud (AWS) adaption
N+1 redundancy
O&M enhance
2M IPCAN capacity
Concurrency
N7 20000 signal/s
2023
V400P13R08B09C00S07
5GS Evolution
R18 compliance
TSN release
V2x try release
Reliability & Capacity
Public cloud (Ali & AWS) adaption
O&M enhance
10M IPCAN capacity
Concurrency
N7 100000 signal/s
2024~2025

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