



OmniPCF 配置

配置文件中 `config/runtime.exs` 中的 `:omnipcf` 配置项用于配置 OmniPCF 服务。

```
config :omnipcf,
  sbi_scheme: System.get_env("SBI_SCHEME", "http"),
  sbi_addr:   System.get_env("SBI_ADDR", "127.0.0.13"),
  sbi_port:   String.to_integer(System.get_env("SBI_PORT",
"7777")),
  nrf_uri:    System.get_env("NRF_URI", "http://127.0.0.1:7777"),
  udr_uri:    System.get_env("UDR_URI", "http://127.0.0.12:7777"),
  bsf_uri:    System.get_env("BSF_URI", "http://127.0.0.15:7777"),
  mcc:        System.get_env("MCC", "999"),
  mnc:        System.get_env("MNC", "70"),
  heartbeat_interval:
String.to_integer(System.get_env("HEARTBEAT_INTERVAL", "10000")),
  prometheus_metrics_port:
String.to_integer(System.get_env("PROMETHEUS_PORT", "9568"))

config :logger, :default_formatter,
  format: {OmniLogger.JsonFormatter, :format},
  metadata: :all
```

□□□□

□□	□□	□ □	□□□	
sbi_scheme	□□ □	□	"http"	SBI_□
sbi_certfile	□□ □	□ □ □	□	(□)
sbi_keyfile	□□ □	□ □ □	□	(□)

변수명	타입	기본값	설명
sbi_addr	문자열	"127.0.0.13"	SBI 서버 주소
sbi_port	정수	7777	SBI 서버 포트
nrf_uri	문자열	"http://127.0.0.1:7777"	NRF 서버 URI
udr_uri	문자열	"http://127.0.0.12:7777"	UDR 서버 URI
bsf_uri	문자열	"http://127.0.0.15:7777"	BSF 서버 URI
mcc	정수	999	MCC 코드
mnc	정수	70	MNC 코드
heartbeat_interval	정수	10000	하트비트 간격

5G Core Network

Network Architecture: PCC (Policy Control) and UDR (Unified Data Repository) are managed by SMF (Session Management Function).

5G Core Network - AMBR

5G Core Network AMBR (Average Bit Rate) is managed by SMF. It includes parameters like `subsSessionAmbr` / `subsSessAmbr` and `UDM` / `UDR SM` / `sessAmbr` / `sessionAmbr`. The `Npcf_SMPolicyControl` interface is used for `422 Unprocessable Entity` and `ERROR_INITIAL_PARAMETERS` errors. The `SUPI/DNN` is managed by SMF. The `PDU` is managed by UDM/HSS. The `AMBR` is managed by UDR SM.

5G Core Network - GBR QoS

5G Core Network QoS (Quality of Service) is managed by DNN (Data Network Name).

QoS	QoS
5QI	9 5G-GBR
ARP	8
ARP	NOT_PREEMPT
ARP	PREEMPTABLE

5G Core Network - DNN QoS

5G Core Network QoS (Quality of Service) is managed by DNN (Data Network Name).

DNN	5QI	ARP 値	属性	属性
ims	5	1	MAY_PREEMPT	NOT_PREEMPTABLE
sos	5	1	MAY_PREEMPT	NOT_PREEMPTABLE
mcs	65	1	MAY_PREEMPT	NOT_PREEMPTABLE

ネットワークポリシー

UDR によって SmPolicyDecision によって UDR によって PLMN_CH RES_M0_RE AC_TY_CH UE_IP_CH UDR によって DEF_QOS_CH SE_AMBR_CH

AF によって QoS

AF によって ARP によって NOT_PREEMPT / PREEMPTABLE によって 1 によって 2 によって 9

属性	5QI	GBR 値/値	MBR 値/値
AUDIO0	1	64 Kbps / 64 Kbps	96 Kbps / 96 Kbps
VIDEO0	2	512 Kbps / 512 Kbps	2 Mbps / 2 Mbps
値	9	値	値

PCC

DNN	255
UDR	200
AF	100resPrio

/ OAM API

5G SBI OmniPCF REST OAM API HTTPS JSON
success / error /api
LiveView HTTPS 7443 REST API

	HTTPS (TLS)
	8443
	0.0.0.0
	/api

API

Method	URI	Description
GET	/api/status/api	API Status
GET	/api/status/license	License
GET	/api/status/nrf	NRF Status
GET	/api/status/nf	NF Status nf_type PCF npcfsmpolicycontrol / npcf-am-policy-control sbi_addr/sbi_port

API

Method	URI	Description
GET	/api/policy_context	Policy Context
GET	/api/sm_policy	SM Policy
GET	/api/sm_policy/{id}	SM Policy {id}
DELETE	/api/sm_policy/{id}	SM Policy {id}
GET	/api/am_policy	AM Policy
DELETE	/api/am_policy/{id}	AM Policy {id}
GET	/api/statistics	SM/AM Statistics PCC

OAM

Method	URI	Details
GET	/api/oam/config	Retrieve OAM configuration parameters including sbi_addr, sbi_port, nrf_uri, udr_uri, mcc, mnc, and NF type.
PATCH	/api/oam/config/{id}	Update OAM configuration parameters including udr_uri, nrf_uri, nf_capacity, nf_priority, log_level, and log_interval.
PATCH / DELETE	/api/oam/sm_policy/{id}	Update or delete SM policy rules including pcc_rules and SMF ID.
PATCH / DELETE	/api/oam/am_policy/{id}	Update or delete AM policy rules including ue_ambr, triggers, and pras.
POST	/api/oam/log_level	Set the log level for the OAM component.
GET	/api/oam/resources	Retrieve BEAM VM resources.
GET	/api/oam/diagnostics	Retrieve BEAM VM diagnostic information.
POST	/api/oam/nrf/reregister	Reregister the NF with the NRF.
GET	/api/oam/peers	Retrieve the list of NF peers and their URIs.
GET	/api/oam/nrf_discovery	Discover the NF instances in the NRF.

配置参数 OAM

参数	类型	描述
udr_uri	字符串	UDR 的 URI 地址
nrf_uri	字符串	NRF 的 URI 地址
nf_capacity	整数	NF 的容量
nf_priority	整数	NF 的优先级
log_level	字符串	日志级别: emergency, alert, critical, error, warning, warn, notice, info, debug

配置

OmniPCF 使用 JSON 格式输出日志，使用 OmniLogger.JsonFormatter 格式化日志。配置参数包括：[SM Policy]、[AM Policy]、[PolicyAuth]、[PccRules]、[UDR Client]、[BSF Client]、[Policy Notification]、SM/AM 的 ID、SUPI、PDU、ID、DNN、ID。配置路径为 /api/oam/log_level。OAM 配置文件为 runtime.exs，日志文件为 logger。



OmniPCF 配置

配置 Prometheus 监听 `prometheus_metrics_port` 为 `9568` 的 `/metrics` 接口

配置 Prometheus 监听 `omni_pcf.sm_policy.create.count` 接口
配置 Prometheus 监听 `/metrics` 接口

SM 配置

名称	类型	参数	描述
<code>omni_pcf_sm_policy_create_count</code>	counter	<code>supi</code> , <code>dnn</code> , <code>result</code>	SM 创建策略 SUPI/DNN 结果
<code>omni_pcf_sm_policy_delete_count</code>	counter	<code>supi</code> , <code>dnn</code>	SM 删除策略
<code>omni_pcf_sm_policy_expire_count</code>	counter	(none)	SM 过期策略 数量/策略数量
<code>omni_pcf_sm_policy_creates_total</code>	counter	<code>result</code>	策略 成功 / 失败 SM 策略
<code>omni_pcf_active_sm_policies_count</code>	gauge	(none)	SM 策略 数量

AM

名前	タイプ	パラメータ	説明
omni_pcf_am_policy_create_count	counter	supi, result	AM 作成 回数
omni_pcf_am_policy_update_count	counter	result	AM 更新 回数
omni_pcf_am_policy_delete_count	counter	supi	AM 削除 回数
omni_pcf_am_policy_expire_count	counter	(none)	AM 有効期限 満了/無効 回数
omni_pcf_am_policy_creates_total	counter	result	作成 AM 総回数
omni_pcf_active_am_policies_count	gauge	(none)	現在 AM 数

概要

このメトリクスは Npcf_PolicyAuthorization AF/VoNR 間で IMS/AF 間で交換される
メトリクス

項目名	単位	初期値
omni_pcf_policy_authorization_create_count	counter	resource
omni_pcf_policy_authorization_update_count	counter	resource
omni_pcf_policy_authorization_delete_count	counter	(none)
omni_pcf_policy_authorization_pcscf_restoration_count	counter	(none)

PCC 項目

項目名	単位	初期値	説明
omni_pcf_pcc_rule_installs_total	counter	(none)	PCC ルールインストール数

NRF 表

項目	単位	項目	項目
omni_pcf_nrf_registration_status	gauge	nf_type	NRF 項目 1 = 項目 0 = 項目

BEAM VM 指标

指标	类型	描述
beam_memory_total	gauge	BEAM 总内存
beam_memory_processes	gauge	Erlang 进程内存
beam_memory_processes_used	gauge	进程内存使用量
beam_memory_system	gauge	系统内存
beam_memory_atom	gauge	原子内存
beam_memory_atom_used	gauge	原子内存使用量
beam_memory_binary	gauge	二进制内存
beam_memory_code	gauge	代码内存
beam_memory_ets	gauge	ETS 内存
beam_processes_count	gauge	Erlang 进程数
beam_ports_count	gauge	Erlang 端口数
beam_atom_count	gauge	原子数
beam_vm_uptime	gauge	VM 运行时间

📄 PromQL

```
# SM 创建成功率 5 分钟
sum(rate(omni_pcf_sm_policy_creates_total{result="success"}[5m]))
  / sum(rate(omni_pcf_sm_policy_creates_total[5m]))

# DNN 中 SM 创建成功率
sum by (dnn) (rate(omni_pcf_sm_policy_create_count{result="error"}
[5m]))

# 统计 SM + AM 数量
omni_pcf_active_sm_policies_count +
omni_pcf_active_am_policies_count

# PCF 中 NRF 注册成功率
omni_pcf_nrf_registration_status < 1

# PCC 安装率
rate(omni_pcf_pcc_rule_installs_total[5m])
```

GenServer SM AM
PCC QoS-AMBR UE-AMBR BSF
ETS UDR
PDU SMF AMF

3GPP

TS 23.501, 23.503, 29.507, 29.512, 29.514, 29.519, 29.521, 29.571

TS	Feature
TS 23.501	5G QoS, PCF, PCC, 5QI, QoS
TS 23.503	PCC, PCF
TS 29.507	Npcf_AMPolicyControl API
TS 29.512	Npcf_SMPolicyControl API, SmPolicyDecision
TS 29.514	Npcf_PolicyAuthorization API, AF
TS 29.519	Nudr_DataRepository, PCF
TS 29.521	Nbsf_Management, PCF (BSF)
TS 29.571	FlowInformation, S-NSSAI, Ambr

SBI

5G SBI URL {sbi_scheme}://{sbi_addr}:{sbi_port}

Npcf_SMPolicyControl (TS 29.512)

Method	URI	Interface	Reference
POST	/npcf-smpolicycontrol/v1/sm-policies	SM Interface	TS 29.512 4.2.2
GET	/npcf-smpolicycontrol/v1/sm-policies/{smPolicyId}	SM Interface	TS 29.512 4.2.5
POST	/npcf-smpolicycontrol/v1/sm-policies/{smPolicyId}/update	SM Interface	TS 29.512 4.2.3
POST	/npcf-smpolicycontrol/v1/sm-policies/{smPolicyId}/delete	SM Interface	TS 29.512 4.2.4

Npcf_AMPolicyControl (TS 29.507)

Method	URI	Media Type	Reference
POST	/npcf-am-policy-control/v1/policies	application/javascript	TS 29.507 4.2.2
GET	/npcf-am-policy-control/v1/policies/{polAssoId}	application/javascript	TS 29.507 4.2.5
POST	/npcf-am-policy-control/v1/policies/{polAssoId}/update	application/javascript	TS 29.507 4.2.3
DELETE	/npcf-am-policy-control/v1/policies/{polAssoId}	application/javascript	TS 29.507 4.2.4

Npcf_PolicyAuthorization (TS 29.514)

Method	URI	Media Type	Reference
POST	/npcf-policyauthorization/v1/app-sessions	application/json	TS 29.514 4.2.2
GET	/npcf-policyauthorization/v1/app-sessions/{appSessionId}	application/json	TS 29.514 4.2.5
PATCH	/npcf-policyauthorization/v1/app-sessions/{appSessionId}	application/json	TS 29.514 4.2.3
POST	/npcf-policyauthorization/v1/app-sessions/{appSessionId}/delete	application/json	TS 29.514 4.2.4
PUT	/npcf-policyauthorization/v1/app-sessions/{appSessionId}/events-subscription	application/json	TS 29.514
DELETE	/npcf-policyauthorization/v1/app-sessions/{appSessionId}/events-subscription	application/json	TS 29.514
POST	/npcf-policyauthorization/v1/app-sessions/pcscf-restoration	P-CSCF	TS 29.514

TS 29.514 defines the following HTTP methods and URIs:

- DELETE /app-sessions/{appSessionId}
- POST .../delete
- POST pcscf-restoration
- POST {appSessionId}

PCF

Method	URI	Request	Response
POST	/npcf-policy-data-notify	UDR 201 Created	TS 29.519

POST /npcf-policy-data-notify

SM (SmPolicyContextData) supi pduSessionId pduSessionType dnn notificationUri sliceInfo ipv4Address / ipv6AddressPrefix 201 Created SmPolicyDecision Location IE 400 MANDATORY_IE_MISSING 400 ERROR_INITIAL_PARAMETERS 403 POLICY_CONTEXT_DENIED session-AMBR subsSessionAmbr subsSessAmbr QoS subsDefQos

SM SMF SmPolicyUpdateContextData PCF ipv4Address ipv6AddressPrefix ratType ruleReports repPolicyCtrlReqTriggers UDR SmPolicyDecision PCC SMF notificationUri

SM SmPolicyDeleteData BSF 204 No Content

AM (PolicyAssociationRequest) supi notificationUri suppFeat guami gpsi pei accessType ratType allowedSnsais ueAmbr servingPlmn 201 Created PolicyAssociation ueAmbr triggers suppFeat Location IE 400 MANDATORY_IE_MISSING

AM AMF PolicyAssociationUpdateRequest PCF UDR UE-AMBR resourceUri ueAmbr / triggers PolicyUpdate AMF notificationUri

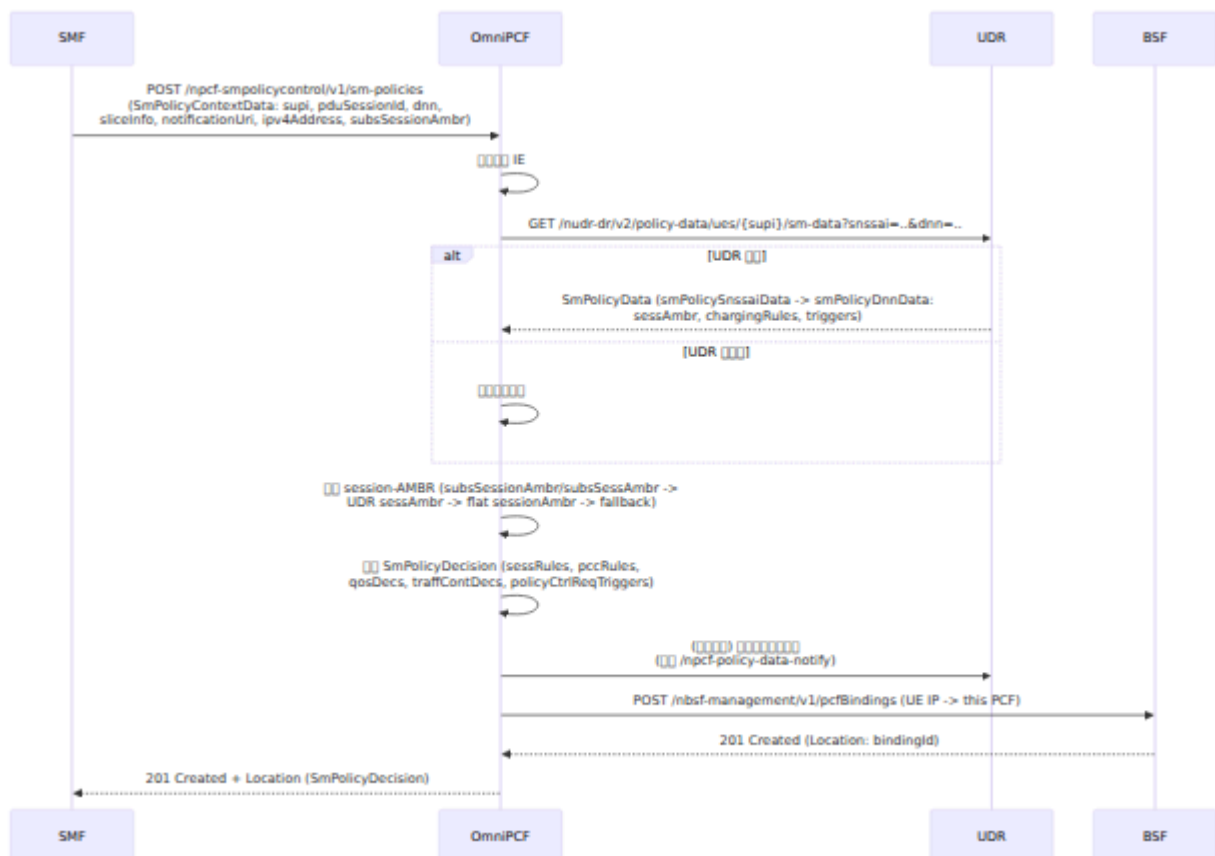
(TS 29.507) PCF AM UDR AM (praInfos) UDR presence_reporting_areas

PRA PCF (PRA_CH) AMF UE PATCH /api/oam/am_policy/{id} pras

(AppSessionContextReqData ascReqData)notifUri
suppFeat ueIpv4 / ueIpv6 / ueMac (medComponents) PCC
201 Created AppSessionContext Location

SM (TS 29.512 4.2.2)

SMF PDU SM PCF UDR SM PCC
UDR BSF UE



session-AMBR SMF AMBR (subsSessionAmbr subsSessAmbr
UDM) UDR SM
(smPolicySnssaiData[snssai].smPolicyDnnData[dnn].sessAmbr) UDR
sessionAmbr PCF session-AMBR SMF

PDU ☐ **BSF** ☐ **AF** ☐ **QoS** ☐ **PCF** ☐

SM 000000 (TS 29.512 4.2.3)

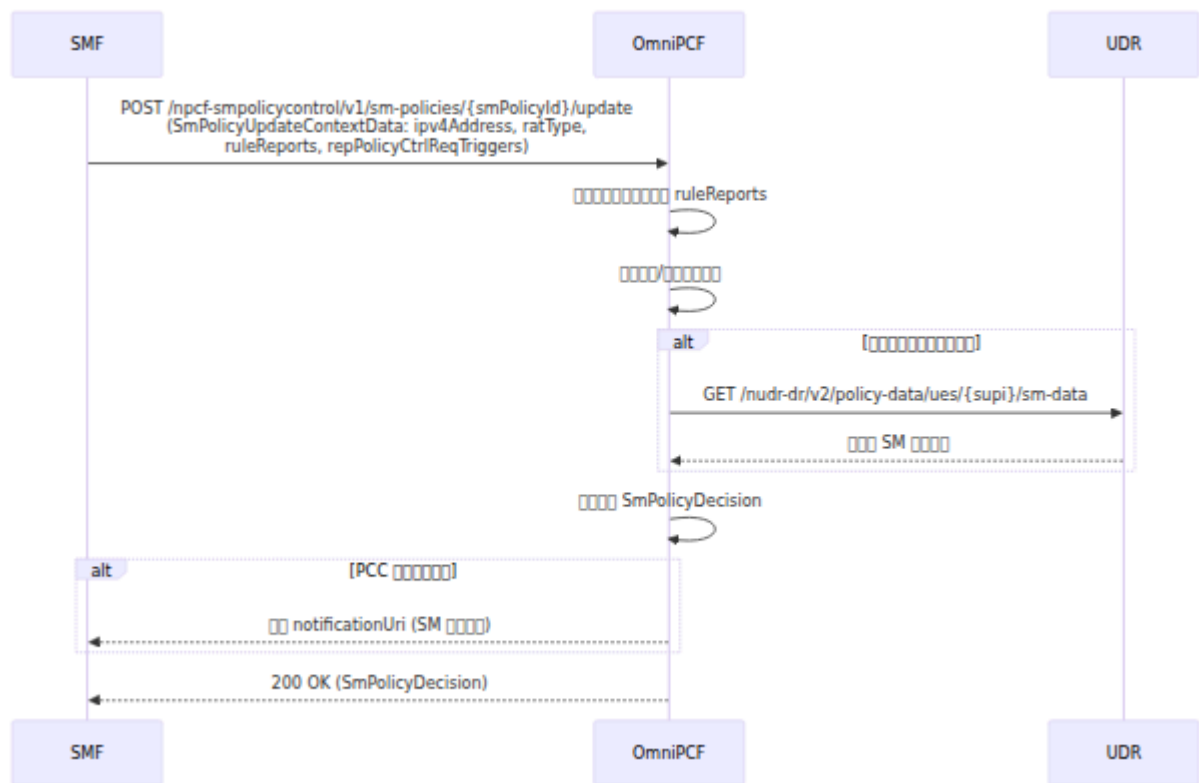


```

UDR
PCF
SMF
repPolicyCtrlReqTriggers
ipv4Address / ipv6AddressPrefix
UE_IP_CH
ratType
AC_TY_CH
servingNetwork
PLMN_CH
ruleReports
RES_MO_RE
UDR

```

SM 機能 (TS 29.512 4.2.4)

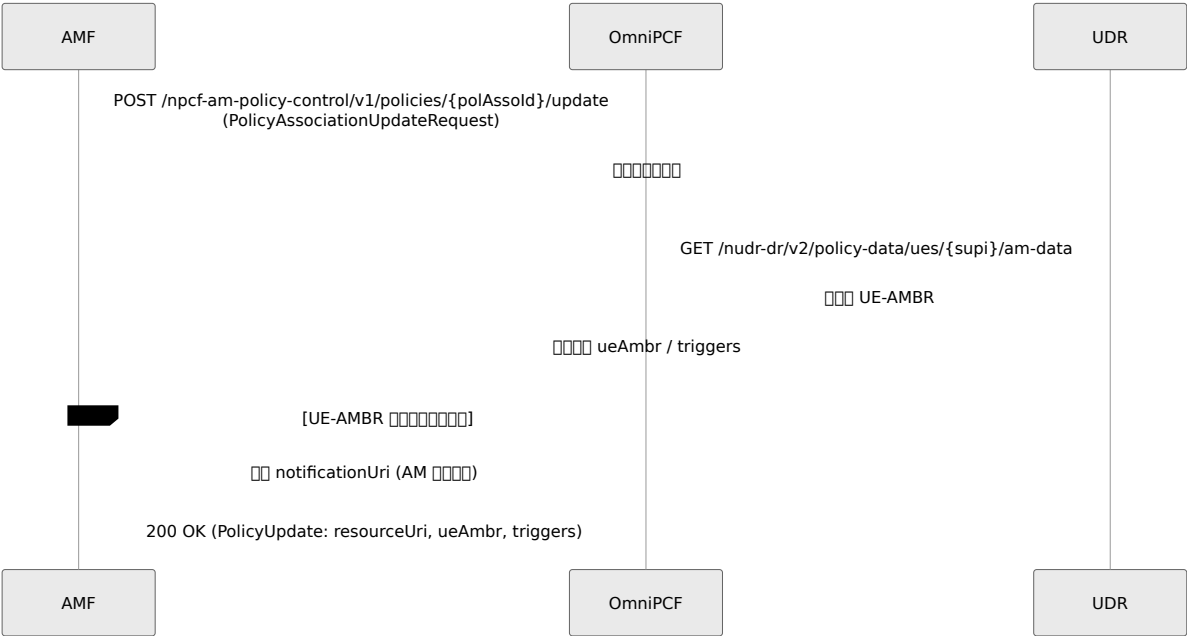


AM 機能 (TS 29.507 4.2.2)



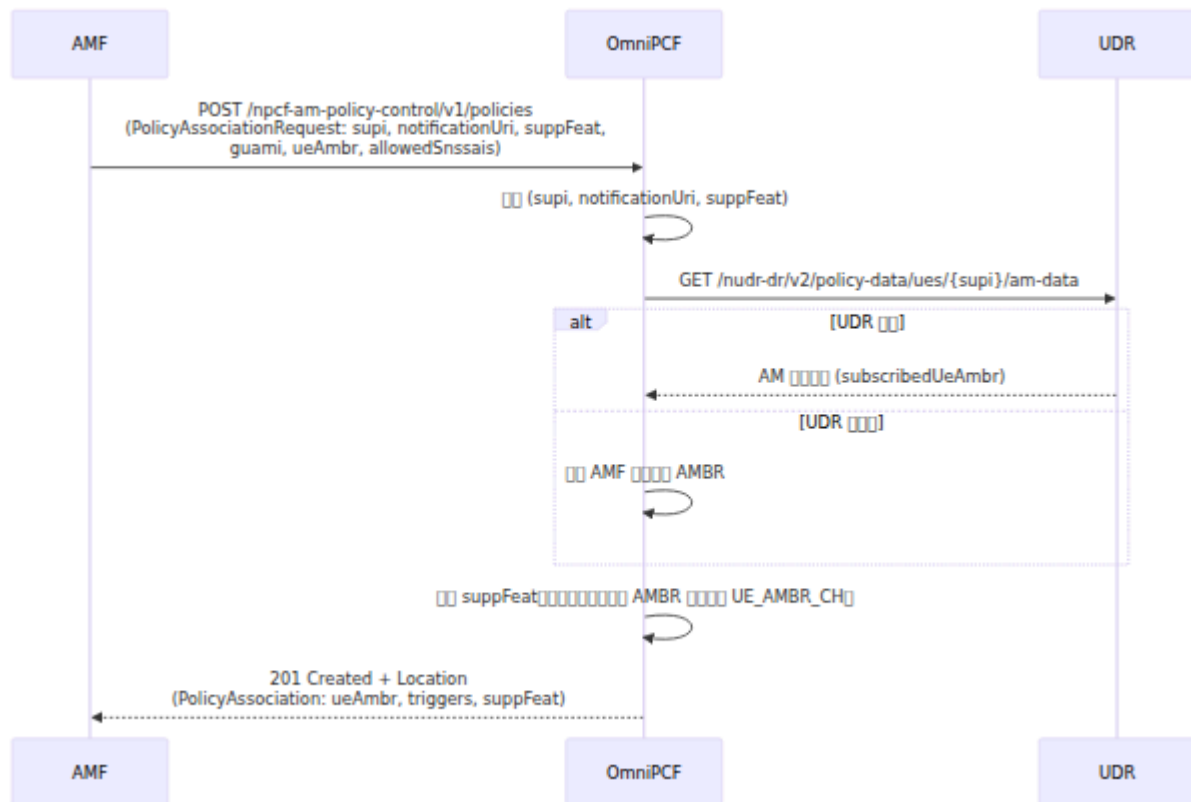
UE-AMBR UDR subscribedUeAmbr AMF AMF UE-AMBR UE-AMBR UE_AMBR_CH

AM (TS 29.507 4.2.3)



VoNR (TS 29.514)

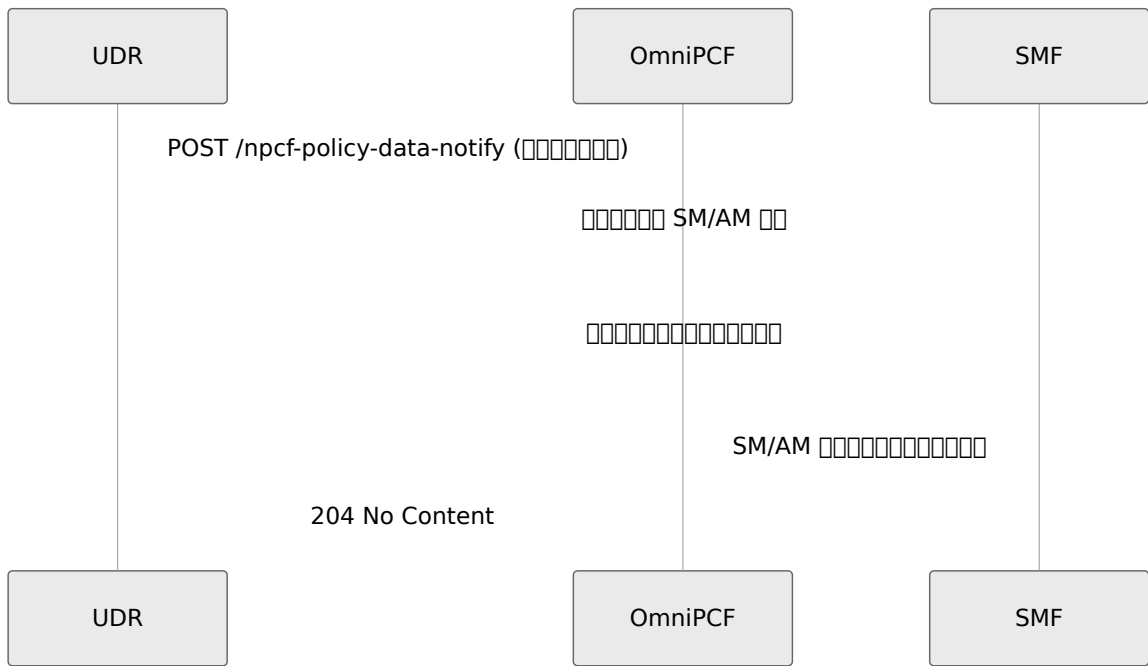
VoNR PCF IMS P-CSCF AF PCF GBR PCC 5QI 1 UE SM SMF BYE AF PCF



AF 는 IP 를 UE 에 PCF 는 UE IPv4 를 SM 에 UE IPv6 를 IP 를 SUPI ueIpv6 는 IPv6 VoNR 를 IPv6 를 UE IP 를 SM 를 IPv4 를 IP 를

UDR (TS 29.519)

는 SM 는 PCF 는 UDR 는 UDR 는 /npcf-policy-data-notify 는 UDR 는 PCF 는



PCC

SmPolicyDecision

SM PCF SmPolicyDecision (TS 29.512 5.6.2.3-1) UDR

```
SmPolicyDecision
  sessRules:
    SessRule-{dnn}:
      sessRuleId: "SessRule-{dnn}"
      authSessAmbr: {uplink, downlink}      <- subsSessionAmbr /
subsSessAmbr / UDR sessAmbr ({} 422)
      authDefQos: {5qi, arp}                <- {} / DNN {} / 5QI 9

  pccRules:
    PccRule-{dnn}-default:                  <- {} 255
      flowInfos: [permit out ip from any to {ueIp},
                  permit out ip from {ueIp} to any]
      refQosData: ["QosData-{dnn}"]
      refTcData: ["TcData-{dnn}"]
      {udr-charging-rule}:                  <- 0..n {} UDR
chargingRules {}

  qosDecs:
    QosData-{dnn}: {5qi, arp, maxbrUl, maxbrDl}    maxbr =
session-AMBR

  traffContDecs:
    TcData-{dnn}: {flowStatus: ENABLED}

  policyCtrlReqTriggers: [ ... ]              <- {} UDR {}
  suppFeat: {}
```

□□-AMBR □□□□ (N7 / Npcf SM □□)

[illegible]

PCC

SM DNN PCC 255

- UDR UDR SM chargingRules DNN 200 PCC QoS SMF 5G QoS VoNR 5QI 1 GBR
- AF pcc-af-{component} PCC 100 5QI AUDIO→1 VIDEO→2 →9 SM SMF TS 29.512

UDR

AF UDR SM chargingRules
smPolicySnssaiData[snssai].smPolicyDnnData[dnn].chargingRules
PCC PCF QoS

項目	説明	デフォルト値
name	PCC ルール名 (pccRuleId) 参照	pcc-dedicated-{n}
precedence	優先度 = 0 から 255 の範囲の整数	200
flowInfos	FlowInformation 参照のリスト SMF (TS 29.571) 参照	[]
5qi	QoS 5QI	DNN 参照の QoS 5QI
arp	ARP priorityLevel 参照 preemptCap 参照 preemptVuln 参照	null
gbrUl / gbrDl	アップリンク/ダウンリンク GBR (例: "64 Kbps")	なし
mbrUl / mbrDl	アップリンク/ダウンリンク GBR	gbrUl / gbrDl

DNN 参照 (例: .mnc...) dnn 参照 UDR 参照 S-NSSAI 参照
DNN 参照 PCF 参照 sst 参照 S-NSSAI 参照 DNN 参照
flowInfos 参照

5QI、GBR、ARP

QoS 5QI (ARP 参照) GBR (gbrUl/gbrDl/maxbrUl/maxbrDl) TS 23.501 5.7.4-1 PCF AF 5QI 1/2 UDR GBR GBR 5QI 9

サポート (suppFeat)

PCF 参照 SM 参照
0x3F 0x3F AM 0x1F 0

OmniPCF 0000

SM 000000 400 (MANDATORY_IE_MISSING / ERROR_INITIAL_PARAMETERS)

SmPolicyContextData 00000000 IE00000000 supi pduSessionId
pduSessionType dnn notificationUri sliceInfo00000000
MANDATORY_IE_MISSING000000000000 UE 000 ipv4Address /
ipv6AddressPrefix0000000000000000 ERROR_INITIAL_PARAMETERS00000000 UE IP
000SMF 0 UPF 0000000000000000 IP 000000 PFCP 0000000000000000 SMF 00000000

SM 000000 403 (POLICY_CONTEXT_DENIED)

00000000000000000000000000000000 PCF 000000000000

SM 000000 422 (00 session-AMBR)

000 SMF 000 subsSessionAmbr / subsSessAmbr000 UDM000 UDR (sessAmbr / 0
0 sessionAmbr) 00 session-AMBR0000000000000000 422 Unprocessable Entity
000 ERROR_INITIAL_PARAMETERS000SMF 00 PDU 0000000000000000 [SM Policy]
No Session-AMBR available for SUPI=... DNN=...0000000000000000 PCF 0000
0 1000 Kbps 00000000000000000000000000000000 5G 00000000 #34000000 UDM/HSS 000
000 session-AMBR000 SMF 000000 subsSessAmbr000 UDR 0 SM 00000000
sessAmbr 00000000OmniPCF 00 SMF 000 subsSessionAmbr 0 subsSessAmbr 00
00000000000000000000000000000000

UDR /

UDR PCF [UDR Client] SM policy query failed for {supi} AM DNN 5QI 9 QoS session-AMBR SMF (subsSessAmbr) UDR sessAmbr udr_uri UDR TS 29.519 v2 /nudr-dr/v2/policy-data/ues/{ueId}/sm-data /am-data

AF (VoNR)

SM AF UE SM IPv6 ueIpv6 UE IP SM BSF [PolicyAuth] Notifying N SM policy assoc(s) No SM policy association found IP/SUPI IPv6 ueIpv6 5QI 1

BSF

BSF NRF BSF bsf_uri [SM Policy] BSF binding registration failed SM AF QoS PCF UE BSF NRF bsf_uri 403 UE

AM

AM UE SM PDU AMF SMF DELETE DELETE AMF SMF AM SM policy_association_ttl_ms TTL 86400000 24 omni_pcf_active_am_policies_count SM AMF SMF PDU

