



OmniPCF 配置

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

```
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

項目名	項目型	必須	初期値	コメント
	項目			
prometheus_metrics_port	項目	○	9568	PROMETHEUSのメトリクスポート番号
policy_association_ttl_ms	項目 項目 項目	○	86400000	(項目)
presence_reporting_areas	項目	○	項目	(項目)
hss_api_base_url	項目 項目	○	"https://127.0.0.1:8443"	(項目)

```
nrf_uri http://127.0.0.10:7777 runtime.exs
http://127.0.0.1:7777 NRF_URI / runtime.exs
NRF_URI
```

--	--	--	--	--	--	--	--

00000000 PCC 000000000000000000000000 SMF 00000000 UDR 0000000000
00000000000000000000000000000000

□□-AMBR□□□ - □□□□

00-AMBR 00000000000000000000 SMF 00000 AMBR subsSessionAmbr /
 subsSessAmbr 000 UDM 00 UDR SM 00000 sessAmbr / sessionAmbr 00000000
 Npcf_SMPolicyControl 0000 00000 422 Unprocessable Entity 000
 ERROR_INITIAL_PARAMETERS 0000000000000000 SUPI/DNN 000 SMF 000 PDU 00000000
 00000000000000000000000000000000 UDM/HSS 00000-AMBR 00 DNN APN-
 AMBR 00000 UDR SM 0000000000

□□□□-GBR□QoS

□□□□□□□□ QoS □□□ DNN □□□□□□□□□□□□□□

00	0
5QI	900-GBR0000000000
ARP 00000	8
ARP 0000	NOT_PREEMPT
ARP 00000	PREEMPTABLE

□-DNN □□ QoS □□□□

□□□□□ QoS □□□□□ DNN □□□□□□□□□□□ QoS □□□□□

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

属性値

UDR 属性値 SmPolicyDecision 属性値 UDR 属性値 PLMN_CH RES_M0_RE AC_TY_CH UE_IP_CH UDR 属性値 DEF_QOS_CH SE_AMBR_CH

AF 属性値 QoS 値

属性値 AF 属性値/属性値 ARP 値 NOT_PREEMPT / PREEMPTABLE 属性値 1属性値2属性値 9属性値

属性値	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
GET	/api/status/nf	NF <code>nf_type</code> <code>PCF</code> <code>npcf-smpolicycontrol</code> / <code>npcf-am-policy-control</code> <code>sbi_addr</code> / <code>sbi_port</code>

API

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

OAM

Method	URI	Details
GET	/api/oam/config	Retrieve OAM configuration parameters: sbi_addr, sbi_port, nrf_uri, udr_uri, mcc, mnc, and NF version.
PATCH	/api/oam/config/{id}	Update OAM configuration parameters: udr_uri, nrf_uri, nf_capacity, nf_priority, log_level, and log_level_max (max 400).
PATCH / DELETE	/api/oam/sm_policy/{id}	Update or delete SM policy parameters: pcc_rules and SMF version.
PATCH / DELETE	/api/oam/am_policy/{id}	Update or delete AM policy parameters: ue_ambr, triggers, pras, and AMF version.
POST	/api/oam/log_level	Set log level for OAM components: {"level": "<level>"}
GET	/api/oam/resources	Retrieve BEAM VM resources.
GET	/api/oam/diagnostics	Retrieve BEAM VM diagnostics.
POST	/api/oam/nrf/reregister	Reregister NF with NRF.
GET	/api/oam/peers	Retrieve NF peers and their URIs.
GET	/api/oam/nrf_discovery	Discover NF instances and NRF details.

配置 OAM

属性	単位	説明
udr_uri	文字列	UDR の URI
nrf_uri	文字列	NRF の URI
nf_capacity	整数	NRF の NF の能力
nf_priority	整数	NRF の NF の優先度
log_level	文字列	ログレベル: emergency, alert, critical, error, warning, warn, notice, info, debug

実装

OmniPCF は JSON の OmniLogger.JsonFormatter を使用して、[SM Policy]、[AM Policy]、[PolicyAuth]、[PccRules]、[UDR Client]、[BSF Client]、[Policy Notification]、SM/AM の ID、SUPI、PDU の ID、DNN の ID を /api/oam/log_level OAM の runtime.exs に logger を追加してログを出力します。



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 IMS/AF に関連する AM に関する情報を提供します。

項目	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	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 5G Core

TS	Feature
TS 23.501	5G Core Network Architecture, 5QI, QoS
TS 23.503	Network Slice Selection Function (NSSF)
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	Flow Information, S-NSSAI, Ambr

5G 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	Npcf SM 4.2.2	TS 29.512 4.2.2
GET	/npcf-smpolicycontrol/v1/sm-policies/{smPolicyId}	Npcf SM 4.2.5	TS 29.512 4.2.5
POST	/npcf-smpolicycontrol/v1/sm-policies/{smPolicyId}/update	Npcf SM 4.2.3	TS 29.512 4.2.3
POST	/npcf-smpolicycontrol/v1/sm-policies/{smPolicyId}/delete	Npcf SM 4.2.4	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

Request Body (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

Request Body (SmPolicyUpdateContextData):

- PCF
- ipv4Address
- ipv6AddressPrefix
- ratType
- ruleReports
- repPolicyCtrlReqTriggers
- UDR
- SmPolicyDecision
- PCC
- SMF
- notificationUri

Request Body (SmPolicyDeleteData):

- BSF
- 204 No Content

Request Body (PolicyAssociationRequest):

- supi
- notificationUri
- suppFeat
- guami
- gpsi
- pei
- accessType
- ratType
- allowedSnssais
- ueAmbr
- servingPlmn
- 201 Created
- PolicyAssociation
- ueAmbr
- triggers
- suppFeat
- Location
- IE
- 400
- MANDATORY_IE_MISSING

Request Body (PolicyAssociationUpdateRequest):

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

Request Body (TS 29.507):

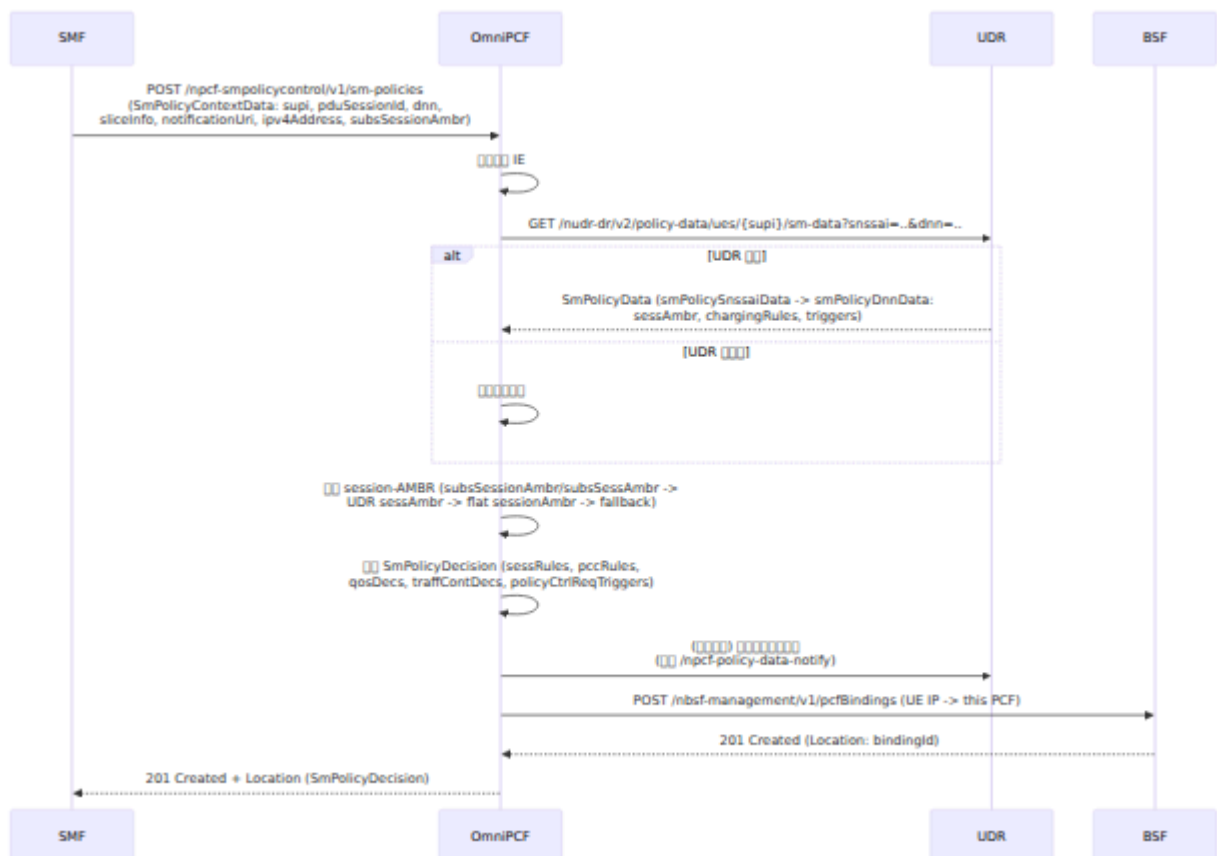
- PCF
- AM
- UDR
- AM
- (praInfos)
- presence_reporting_areas

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

SM 000000 (TS 29.512 4.2.3)

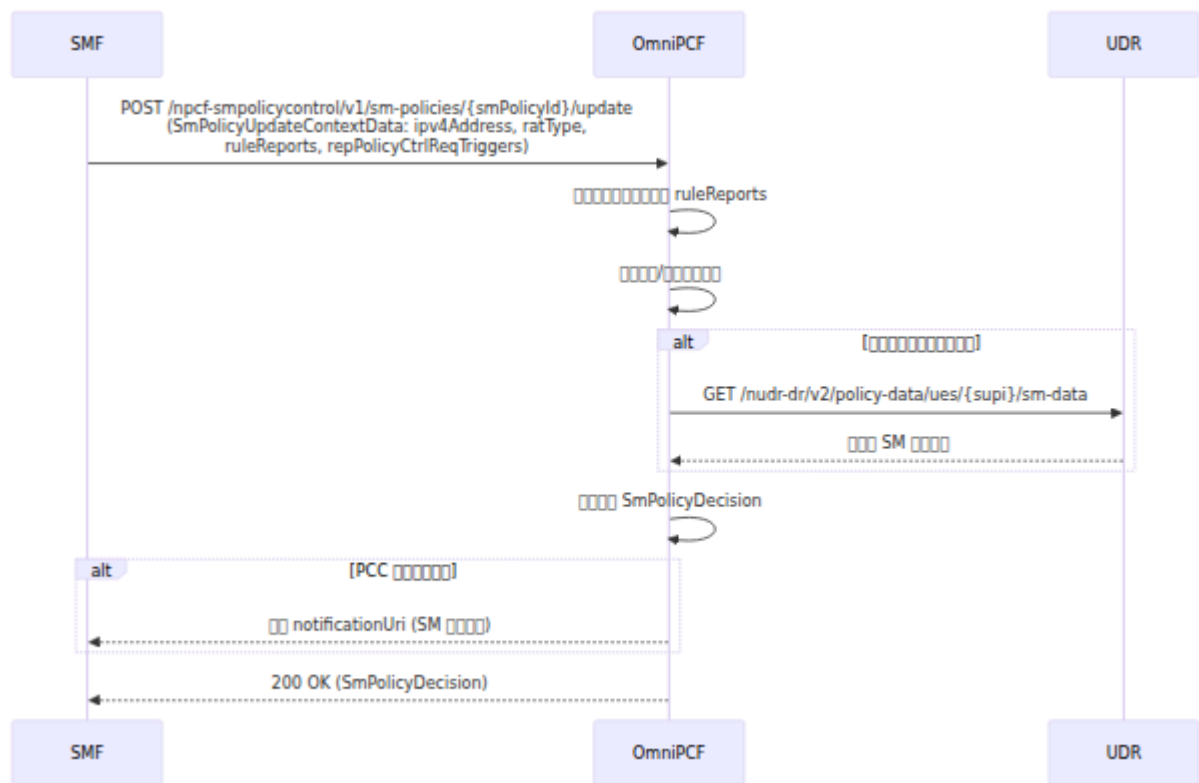


```

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)

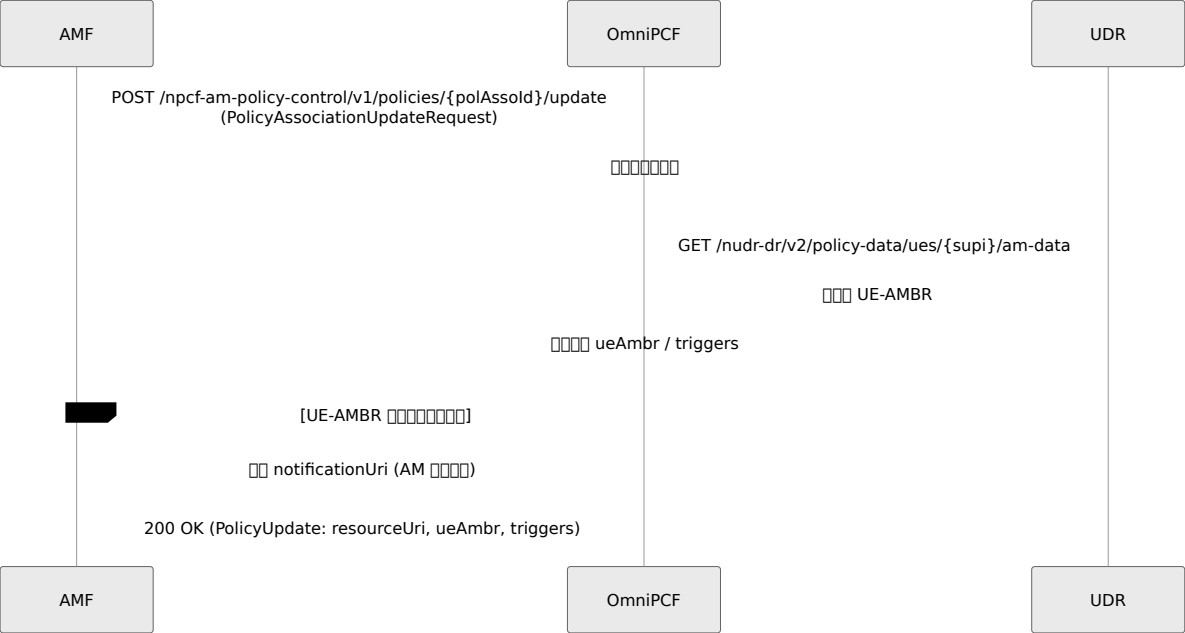


AM 機能 (TS 29.507 4.2.2)



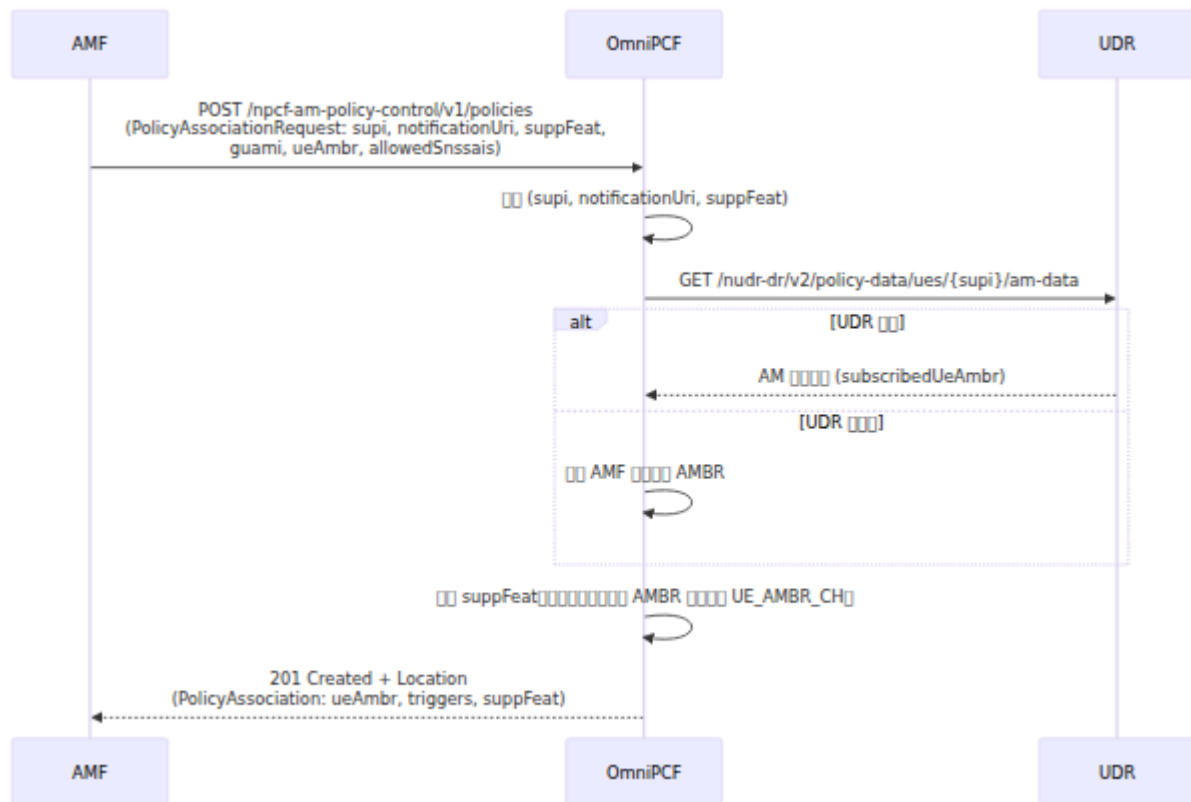
AMF UE-AMBR UDR subscribedUeAmbr AMF AMF UE-AMBR UE-AMBR UE_AMBR_CH

AM (TS 29.507 4.2.3)



VoNR (TS 29.514)

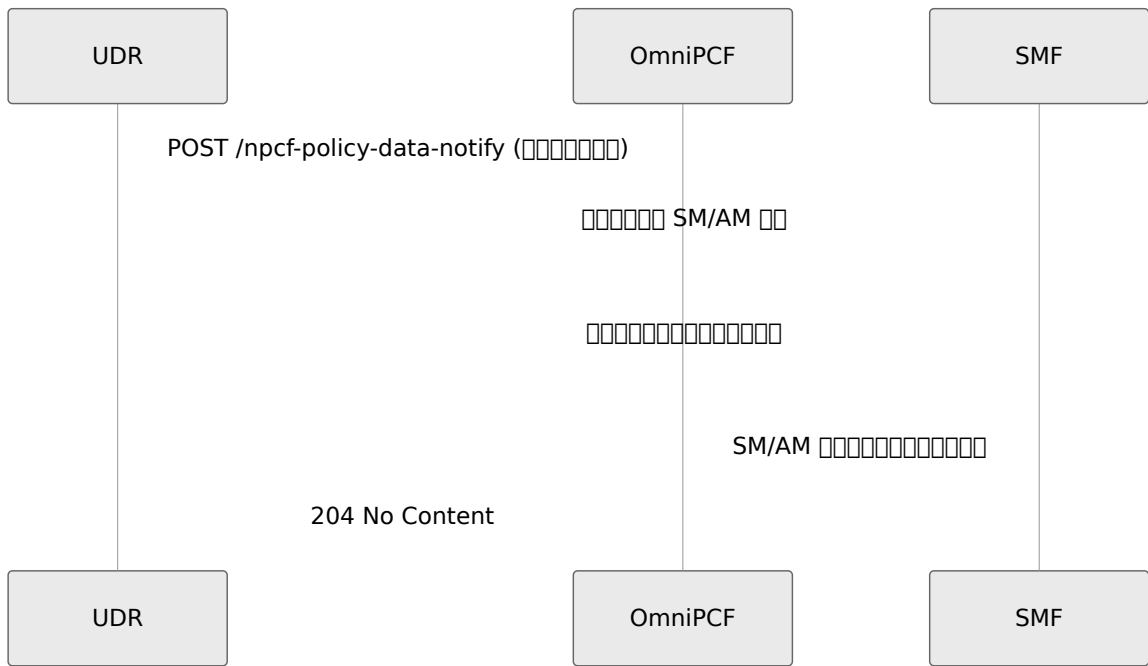
VoNR PCF IMS P-CSCF AF PCF GBR PCC 5QI 1 UE SM SMF BYE AF PCF



AF 는 IP 를 UE 에 PCF 는 UE IPv4 를 SM 에 UE IPv6 를 IP 를 SUPI ueIpv6 는 IPv6 VoNR 를 IP6 를 UE IP 를 SM 에 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 □□)

```
00000-AMBR   SMF   SM      subsSessionAmbr    000000  
subsSessAmbr000000000PCF 0000000 sessRules.*.authSessAmbr0000000  
00000 maxbrUl / maxbrDl 00UDR 000000000000  
smPolicySnssaiData[snssai].smPolicyDnnData[dnn].sessAmbr 0000  
sessionAmbr PCF 00000-AMBR   SMF   PDU 00000000000000000000 PCF  
0000000000000-AMBR   0 000000000000000000000000000000000000 422 000  
ERROR_INITIAL_PARAMETERS 000000000000000000000000000000 #3400000 SMF 0  
PCF 00000000000 sessionAmbr   subsSessAmbrOmniPCF 0000000000000000  
0000000 AMBR
```

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)は	pcc-dedicated-{n}
precedence	優先度 = 0 から 255 の範囲の値	200
flowInfos	FlowInformation オブジェクトのリスト SMF (TS 29.571)は	[]
5qi	QoS 5QI	DNN の QoS 5QI
arp	ARP priorityLevel preemptCap preemptVuln	null
gbrUl / gbrDl	アップリンク/ダウンリンク GBR "64 Kbps" は	GBR
mbrUl / mbrDl	アップリンク/ダウンリンク GBR	gbrUl / gbrDl

DNN .mnc... dnn UDR S-NSSAI DNN PCF sst S-NSSAI DNN flowInfos

5QI GBR ARP

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

(suppFeat)

PCF 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 00000 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_PARAMETERS00SMF 00 PDU 0000000000000000 [SM Policy]
No Session-AMBR available for SUPI=... DNN=...0000000000000000 PCF 0000
0 1000 Kbps 00000000000000000000000000000000 5G 00000000 #340000000 UDM/HSS 000
000 session-AMBR000 SMF 00000000 subsSessAmbr000 UDR 0 SM 00000000
sessAmbr 00000000OmniPCF 00 SMF 0000 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

