



Intro and Dive with free5GC

Yi Chen


About me

- Project Coordinator of free5GC
- Research Assistant [at] NYCU
 - B5G Solution
 - Cloud/Container integration

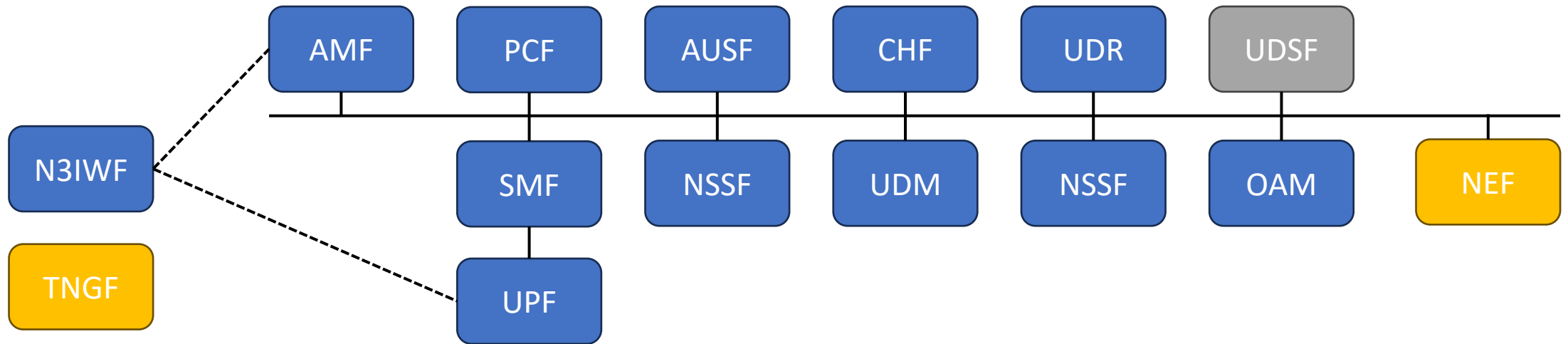
Outline

1. What is free5GC
2. Architecture of free5GC
3. New features released in v3.4.x
4. Future works
5. Roadmap

What is free5GC

- Open Source 5G Core Network Project
- Implement the functionalities defined in 3GPP release 15 ~ 17
- Most of developers are from NYCU 

Architecture of free5GC



■ released

■ public but need to be integrated

■ being developed

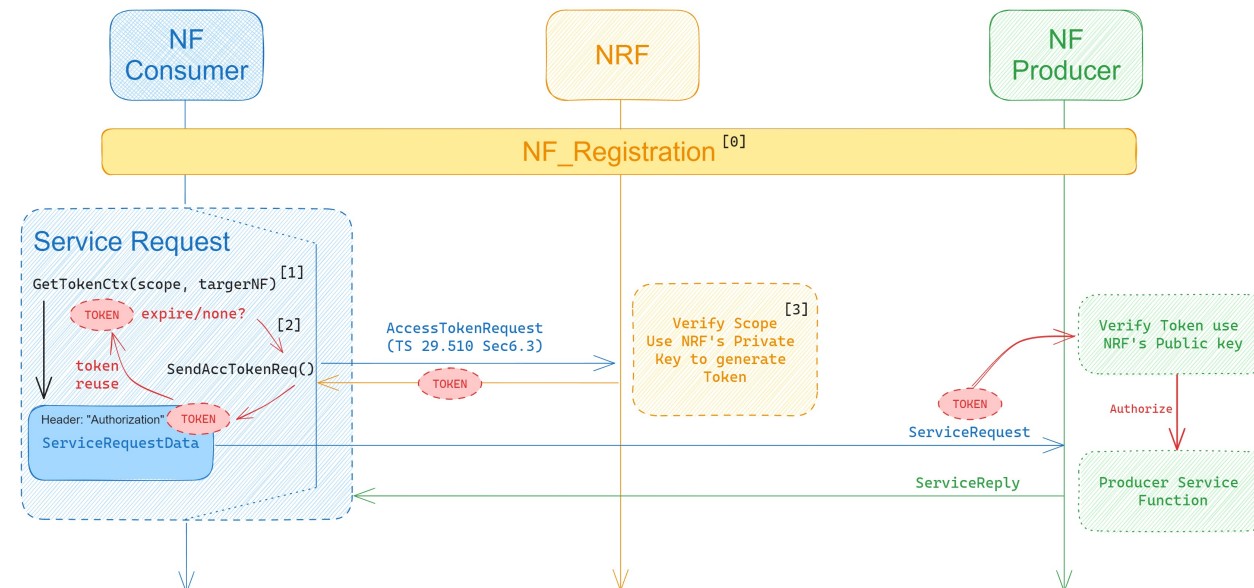
New features released in v3.4.x


- OAuth (v3.4.0)
- Convergent Charging (v3.4.1)
- free5GC helm (will be released soon)

OAuth supported

- NRF is in charge of token generation
- To consume dedicated NF service, the Service consumer must request the token (signed by NRF's public key) from NRF
- Once the service producer receives the access token, it will verify the token by using NRF's private key.
- Support client credentials type

free5GC OAuth2.0 Procedure



-  Note:
- All design document(s) are available on free5gc.org/guide
 - We're welcome any form of the contributions

Convergent Charging

- Support online/offline charging on data usage (PDU Session)
 - User can configure charging rules of the subscription data via Webconsole

UE CHARGING

admin

A

\$

REFRESH

FOLD

LAST UPDATE: 2024-03-06 04:25:05

Offline Charging

SUPI	S-NSSAI	DNN	IP Filter	Usage	Data Total Volume	Data Volume UL	Data Volume DL
imsi- 2089300000000001	01010203			-	-	-	-
	01010203	internet	0.0.0.0/0	-	-	-	-

Online Charging

SUPI	S-NSSAI	DNN	IP Filter	Quota	Data Total Volume	Data Volume UL	Data Volume DL
imsi- 2089300000000001	01112233			97400	1600	800	800
	01112233	internet	0.0.0.0/0	2400	1600	800	800

```
[2024-03-06 04:24:49.871] [rrc] [info] RRC Setup for UE[1]
[2024-03-06 04:24:49.871] [ngap] [debug] Initial NAS message received from UE[1]
rval.code=0
rval.code=0
rval.code=0
[2024-03-06 04:24:49.997] [ngap] [debug] Initial Context Setup Request received
rval.code=0
rval.code=0
rval.code=0
[2024-03-06 04:24:50.362] [ngap] [info] PDU session resource(s) setup for UE[1] count[1]
rval.code=0
rval.code=0
[2024-03-06 04:24:50.376] [ngap] [info] PDU session resource(s) setup for UE[1] count[1]
rval.code=0
[2024-03-06 04:24:50.376] [nas] [debug] Configuration Update Command received
[2024-03-06 04:24:50.362] [nas] [debug] PDU Session Establishment Accept received
[2024-03-06 04:24:50.362] [nas] [info] PDU Session establishment is successful PSI[1]
[2024-03-06 04:24:50.376] [nas] [debug] PDU Session Establishment Accept received
[2024-03-06 04:24:50.376] [nas] [info] PDU Session establishment is successful PSI[2]
[2024-03-06 04:24:50.384] [app] [info] Connection setup for PDU session[1] is successful, TUN interf ace[uiesimtun0, 10.61.0.1] is up.
[2024-03-06 04:24:50.404] [app] [info] Connection setup for PDU session[1] is successful, TUN interf ace[uiesimtun1, 10.61.0.1] is up.
[2024-03-06 04:24:50.404] [app] [info] Connection setup for PDU session[1] is successful, TUN interf ace[uiesimtun1, 10.61.0.1] is up.
```

Offline

PING 9.9.9.9 (9.9.9.9) from 10.61.0.1 uesimtun1: 92(120) bytes of data.
PING 9.9.9.9: icmp_seq=2 ttl=53 time=8.24 ms
100 bytes from 9.9.9.9: icmp_seq=3 ttl=53 time=4.88 ms
100 bytes from 9.9.9.9: icmp_seq=4 ttl=53 time=4.13 ms
100 bytes from 9.9.9.9: icmp_seq=5 ttl=53 time=4.19 ms
100 bytes from 9.9.9.9: icmp_seq=6 ttl=53 time=4.30 ms
100 bytes from 9.9.9.9: icmp_seq=7 ttl=53 time=4.20 ms
100 bytes from 9.9.9.9: icmp_seq=8 ttl=53 time=4.20 ms
100 bytes from 9.9.9.9: icmp_seq=9 ttl=53 time=4.20 ms
100 bytes from 9.9.9.9: icmp_seq=10 ttl=53 time=4.20 ms
100 bytes from 9.9.9.9: icmp_seq=11 ttl=53 time=4.20 ms
100 bytes from 9.9.9.9: icmp_seq=12 ttl=53 time=4.20 ms

Online

Convergent Charging

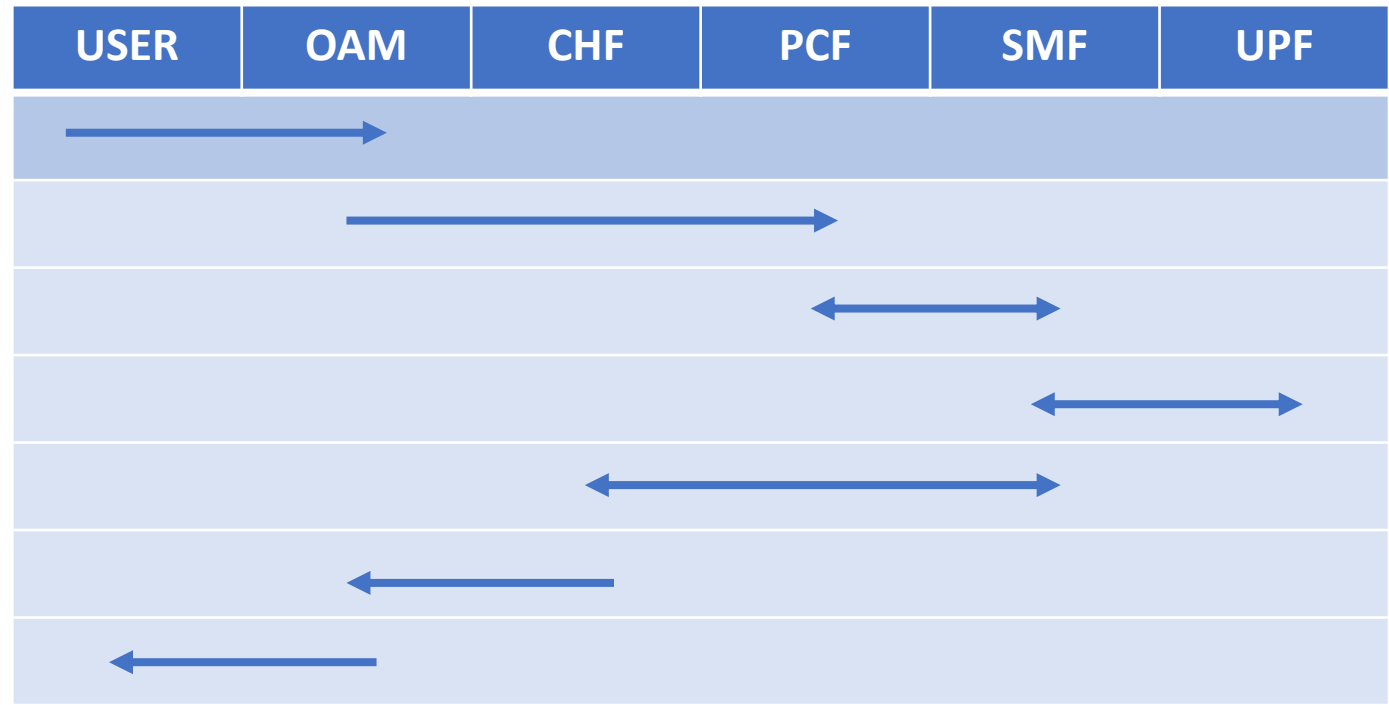
- PCF
 - Apply charging rule(s), from Billing Domain, to PCC Rule
- SMF
 - Send/Handle charging data request
 - Apply usage quota to UPF
 - Handle usage report(s) from UPF
- UPF
 - Perform the usage calculation
 - Send usage report to SMF basing on the triggering condition(s)

Convergent Charging

- CHF
 - Online/Offline/Convergent charging
 - RF + ABMF + CGF
- Webconsole
 - Read charging data record, is sent from CHF
 - Billing Domain

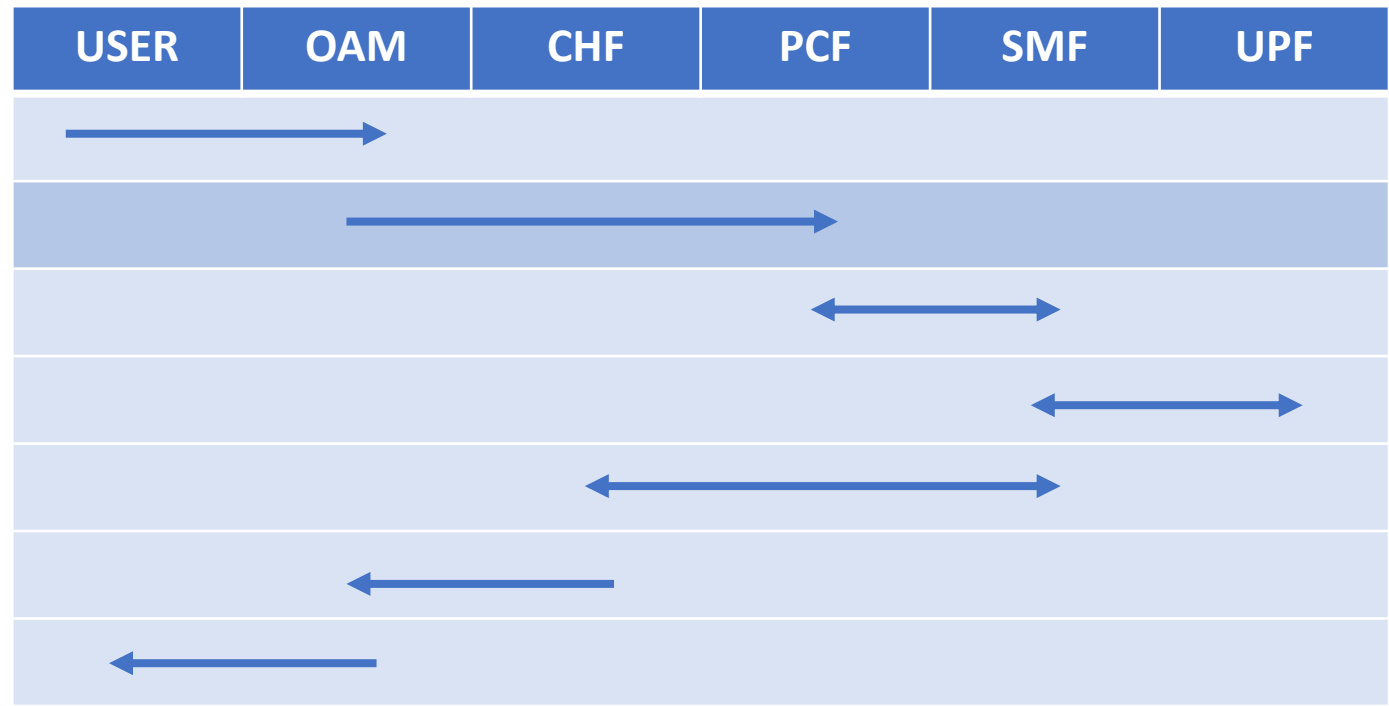
Convergent Charging

- Charging Config
 - SNSSAI
 - Charging method
 - Quota and Unit Cost
 - Flow rule



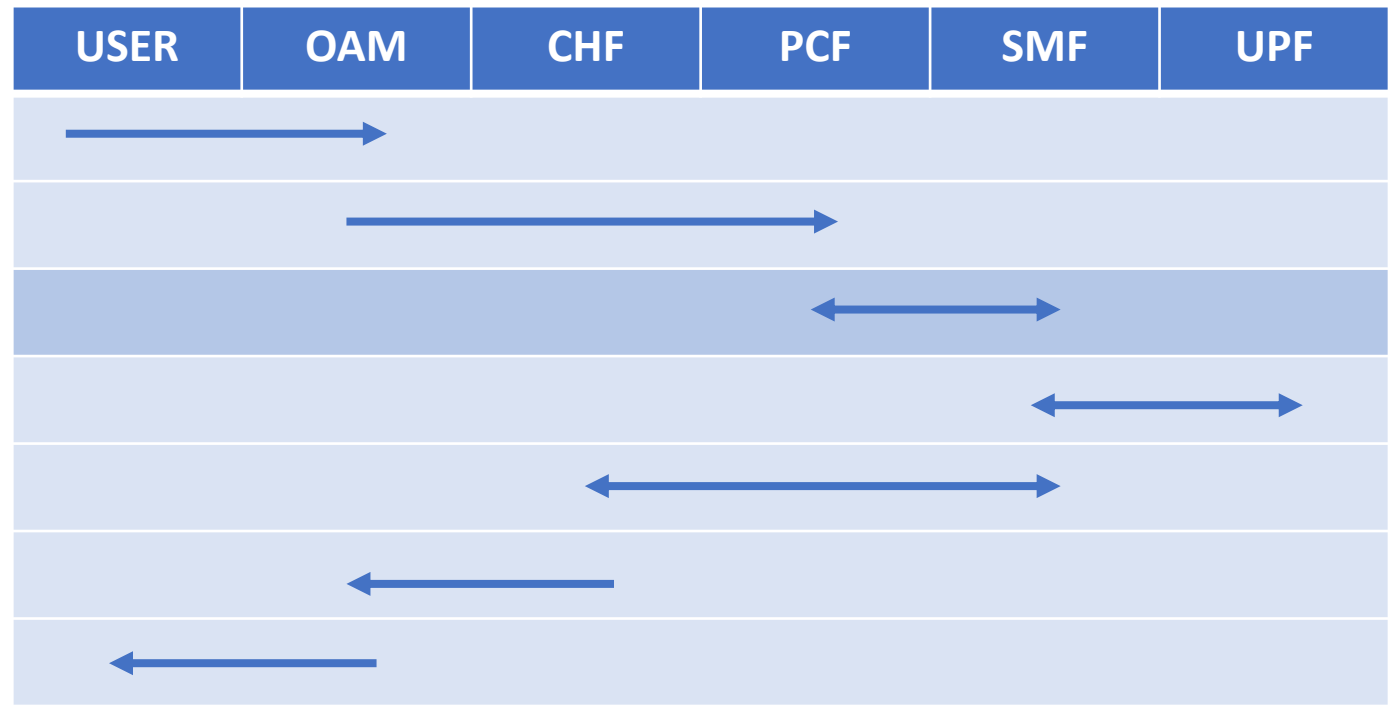
Convergent Charging

- PCF apply charging config to the PCC rule
- PCC Rule will be attached into SM Policy Decision and sent to SMF



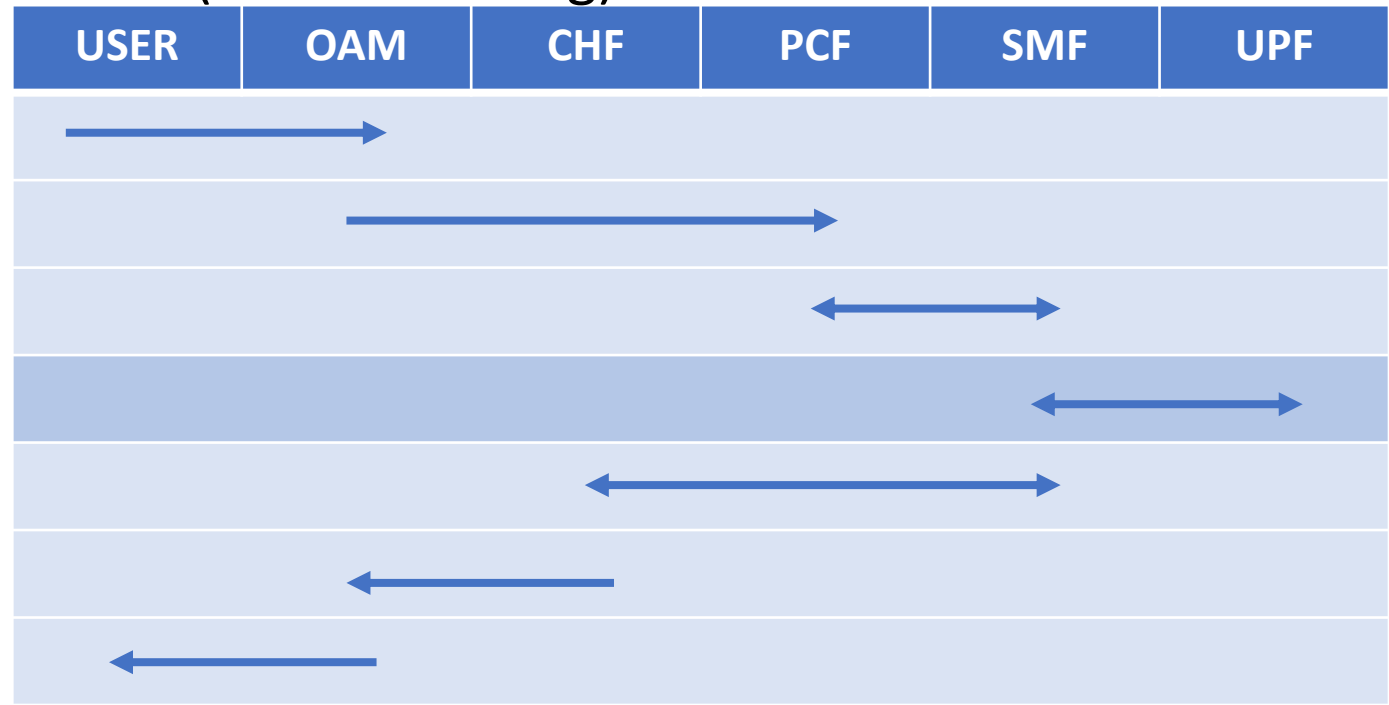
Convergent Charging

- SMF initiates SM Policy Association once it received PDU Sess Est req
 - PCF responds the decision to SMF
 - SMF apply the decision to packet rules (PDR, QER, FAR, URR...)



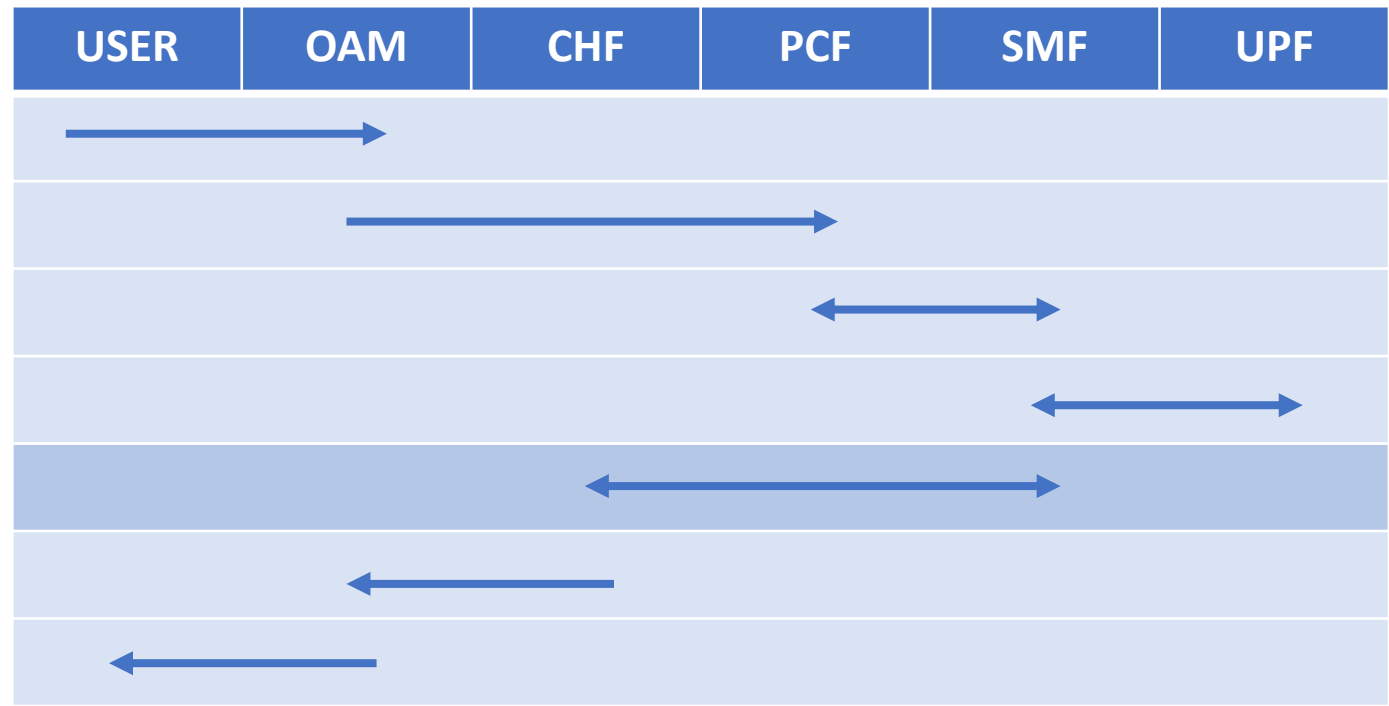
Convergent Charging

- UPF performs the packet processing based on the provided rules
- And send usage report to SMF
 - Periodically (Offline Charging)
 - Data usage is going meet the threshold (Online Charging)



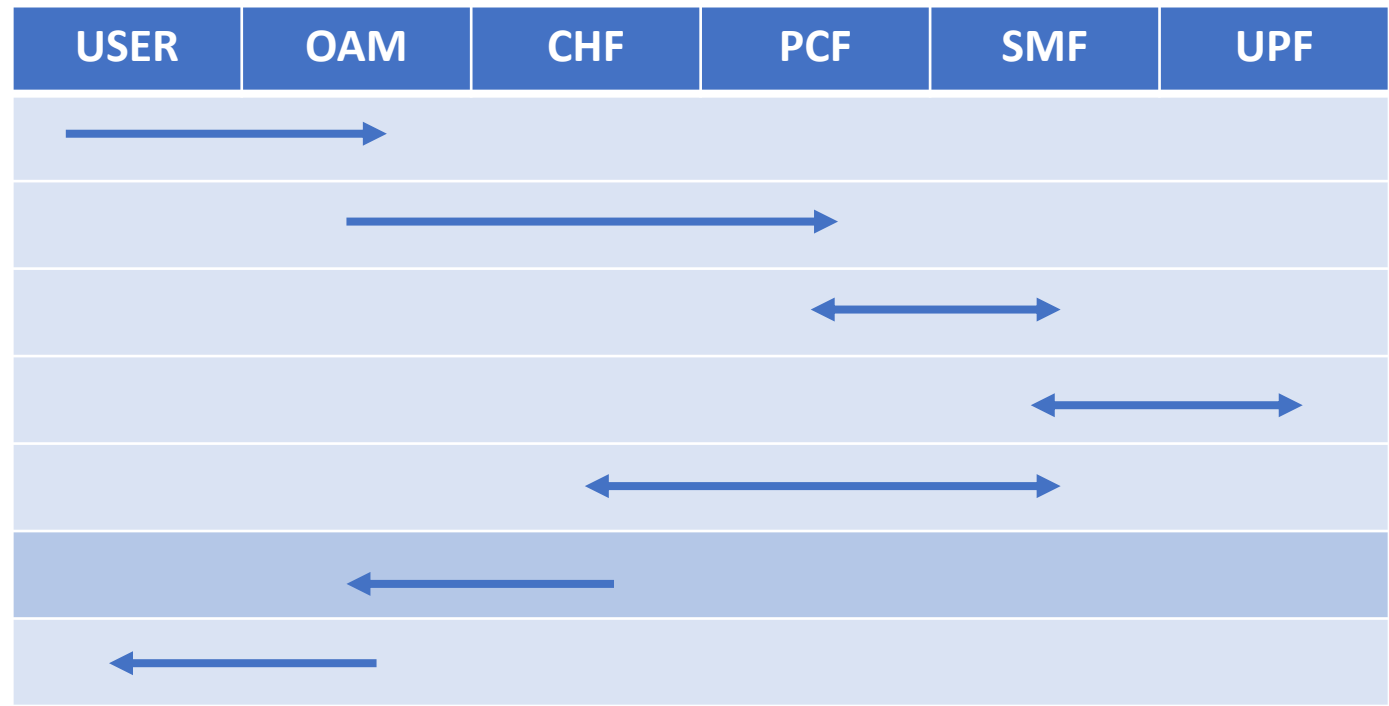
Convergent Charging

- SMF will tries to grant the quota if the quota used up
- SMF sends the data usage records to CHF



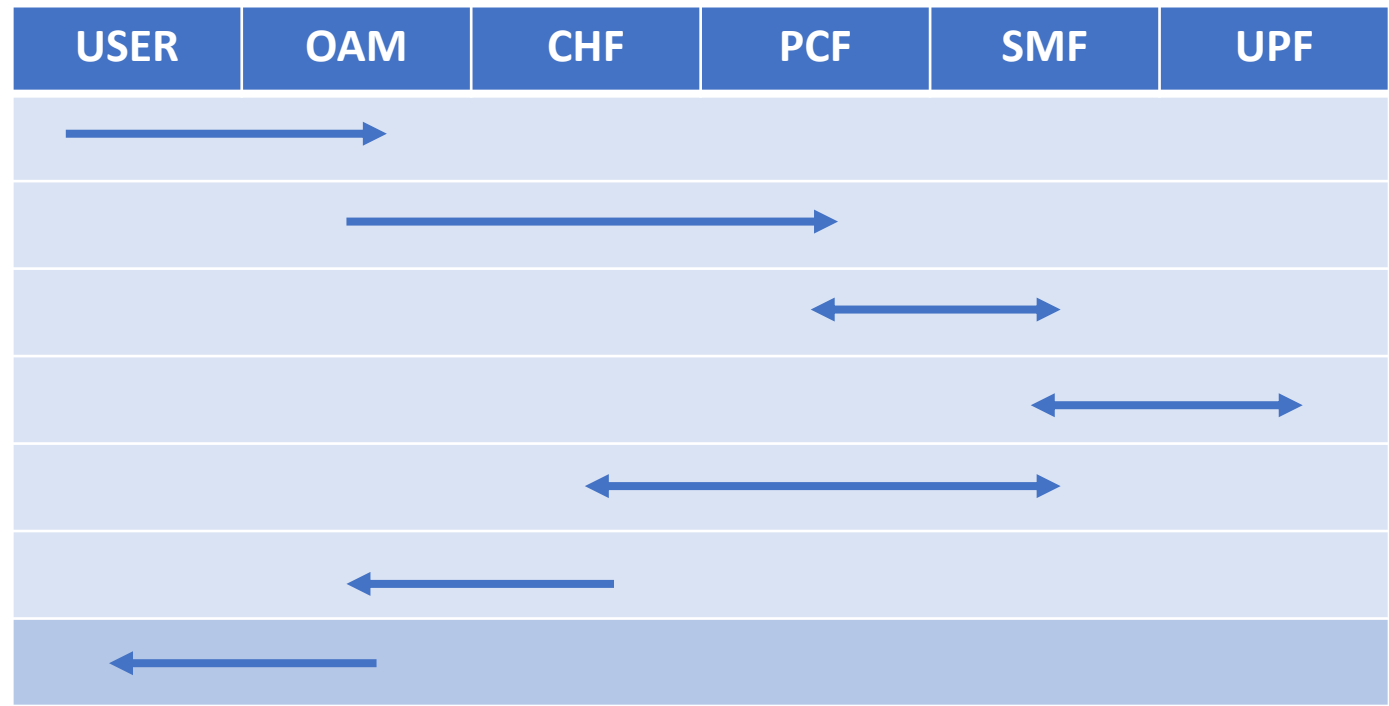
Convergent Charging

- CHF sends the CDR file to the Billing Domain (OAM)
- OAM embeds with the FTP server for receiving CDR files



Convergent Charging

- OAM shows the result on the web page
- User can observe the status of the quota consumption



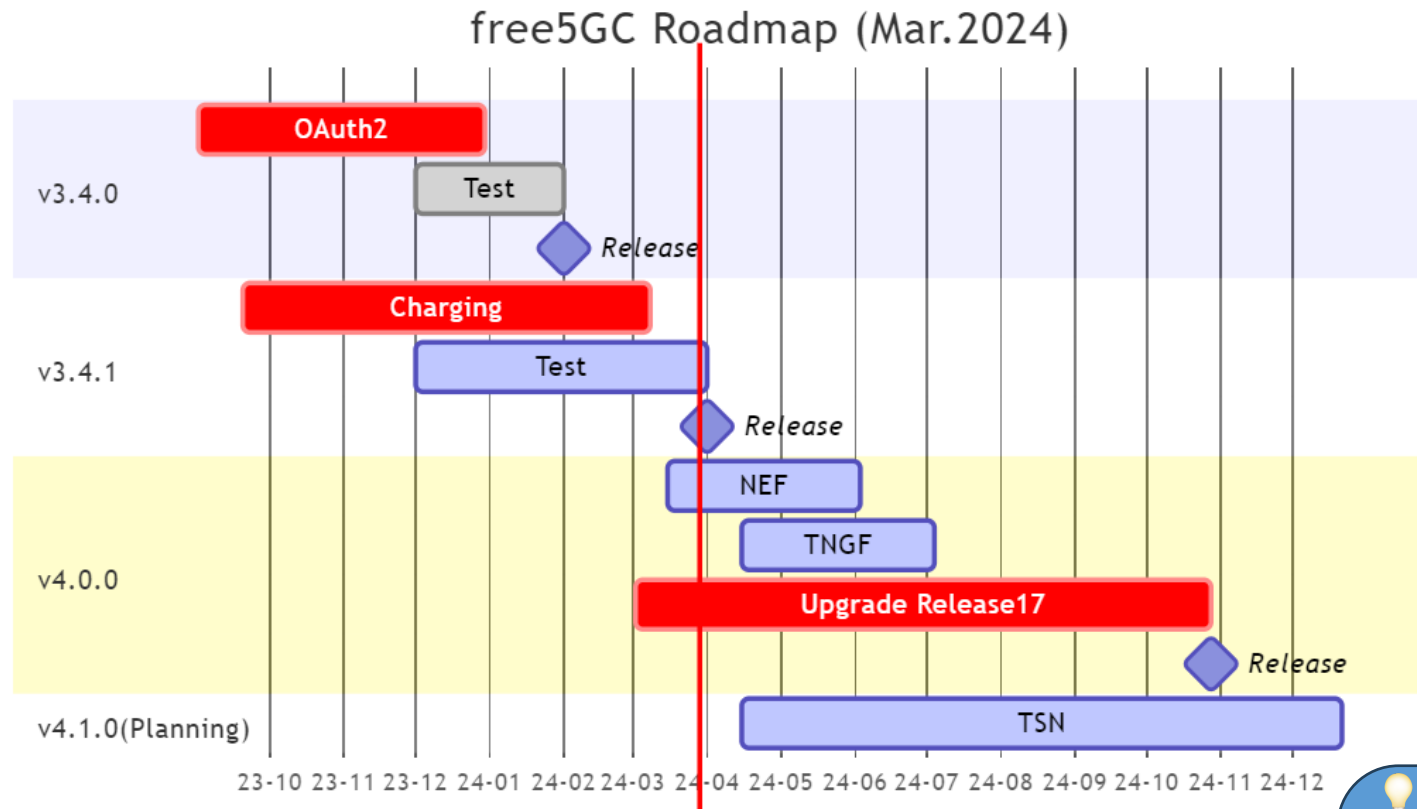
Kubernetes Deployment & CI

- CI Enhancement
 - Integrate the Packet Rusher project, released by HPE (Hewlett Packard Enterprise).
- Officially support Kubernetes deployment
 - We're planning to provide a quick installation package
 - Launch VM
 - Setup k8s environment
 - Install free5GC
 - It's based on the towards5gs project, developed by Orange.

Next Step(s)

- Network Exposure Function
- R17 Upgrade
 - The progress of R17 Upgrade can be found at [free5GC Dashboard](#).
 - We have designed the software architecture, and now we working on the implementation works.

Roadmap



Note:

- All of tasks are managed by using GitHub dashboard
- The dashboard is visible for anyone:
<https://github.com/users/ianchen0119/projects/4>