SD-Core 1.2 Release

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Agenda

- Release 1.2 Overview
- SD-Core Introduction
- SD-Core 1.2 Features
- Q & A

SD-Core 1.2 Release Overview

- SD-Core 1.2 Released on Oct 11, 2022
- Highlight - Move towards cloud native 5G network functions
- SD-Core 1.2 Release blog
- SD-Core 1.2 Release Notes
- Helm Charts can be found on Charts Repository . Helm Charts code is tagged & branch created
- SD-Core Document Website has SDCore-1.2 branch
- SD-Core NF Code repository code is not tagged but image versions has git commit id included in them, so if required we can create branch/tag from commit hash
- Thank You all Community Members !
    - Intel, Infosys, CPQD, Purdue University, GS Lab
    - There are more individuals contributing with individual Contributor Licencse Agreement (CLA)

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SD-Core Support Recap

- 4G/5G/5G-NSA Core Network Support
    - 4G supports - Release 13
    - 5G supports – Release 15.3
- SD-Core is fully containerized, and helm charts provided to deploy SD-Core on K8s
- CUPS compliant Control Plane, User Plane
- 2 UPF implementations available – BESS-UPF, P4-UPF
    - You can connect any other UPF to control Plane
    - BESS UPF is available in AF_PACKET mode , DPDK mode
- Configuration APIs to create/update/delete Network Slice
- Subscribers can be provisioned through simapp APIs or through configmap updates
- 3 Level QoS support – Slice level, UE level and application level
    - In progress - QoS scheduling support
- Application Filtering support
- Access control support

SD-Core Cloud Native

- Goal is to have Multiple Instances of all Network Functions
  - Currently we achieved multiple instances of AMF, SMF

- 3gpp NRF features
  - Keep alive
  - Caching NRF results. Could not make to release, code review in progress

- 3gpp SET features
  - Multiple Network Functions of same type share the User Context and User state is not lost if some members of the SET are removed/restarted

- MongoDB started in cluster mode
  - MongoDb streaming feature is used
  - Timeout on the documents is used
  - Multiple keys are added in hash table

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NRF Keep Alive Support
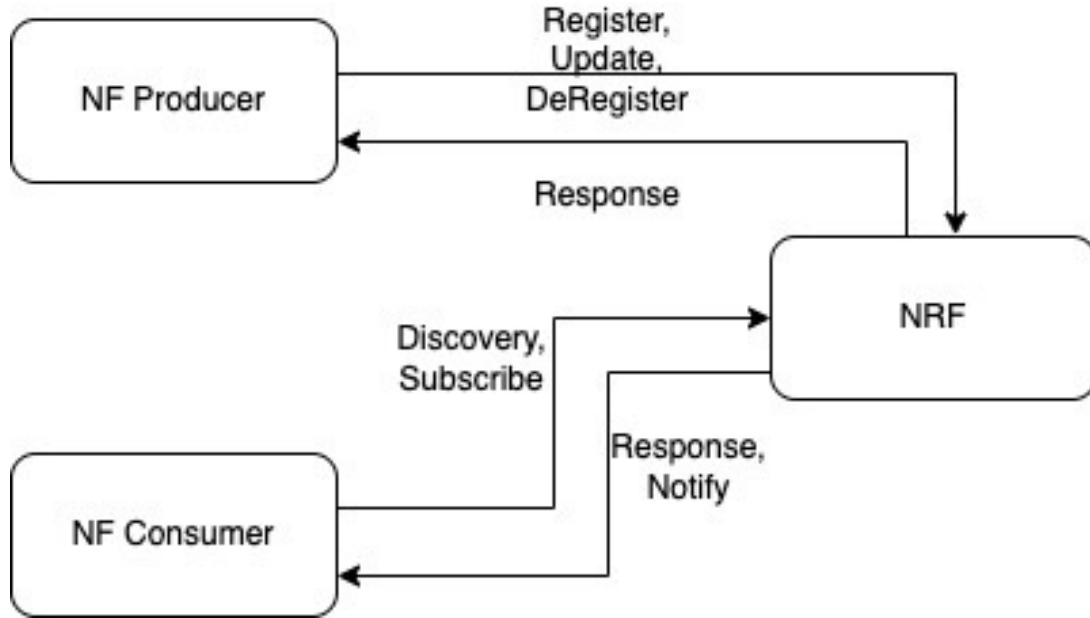
- Feature is default disabled. Enabled by changing override values for NRF
- Keep Alive Support in NRF
    - Configuring Heartbeat Timer Value
    - Handling Heartbeat Messages from the NFs
    - Deletion of NFProfile from DB on Heartbeat timer expire
    - Discover returns multiple profiles
- Keep Alive Support in other NFs
    - Sending NFProfile update message to NRF on Heartbeat Timer expire
    - Send Deregistration message to NRF (graceful exit)
- *Future Release*
    - *NRF cache and NRF notification support shall come in upcoming release*

AMF Changes
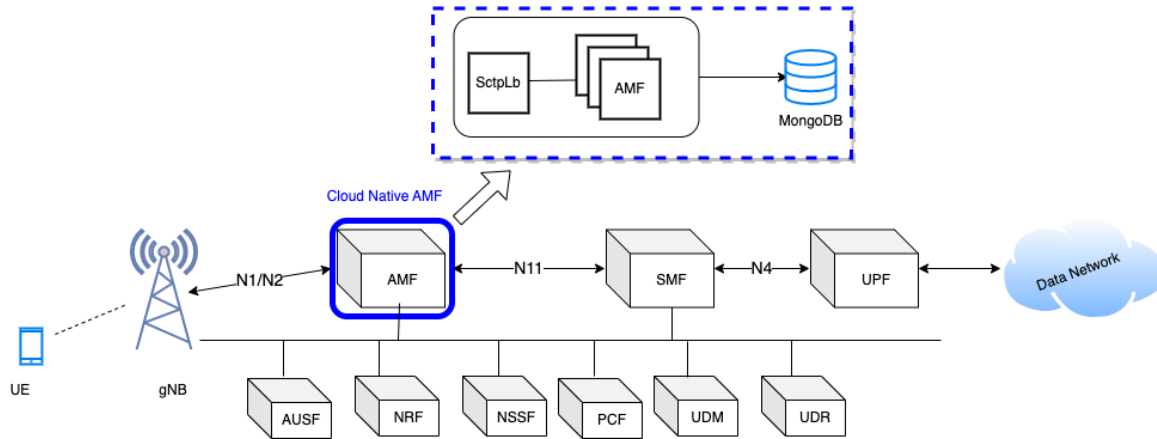
- New K8s Pod SctpLb
- Accept and manage gNodeB connections
- GRPC communication between SctpLb and Amf Service
- Handles Amf Instance Down/Up Notifications
- Distributed Resource Sharing Module (DRSM) used to share resource IDs among AMFs
- Sctplb is disabled by Default and can be enabled through helm chart override values

SCTP Load Balancer

- Tracks AMF instances in the deployment
- SCTPLb just reads SCTP socket message. No ngap message decoded.
- Round-Robin Distribution of Sctp Messages over grpc channel to AMF
- Redirect Support for forwarding Sctp Messages to a particular Amf Instance
- If instance is detected to be down, then remove the AMF from Pool
- Future release
  - *Decode NGAP message and forward message to correct AMF instance*
  - *Multiple SctpLb support*
    - *Will help in scaling number of gNBs connected to core.*
  - *NRF api integration in SctpLb to discover as custom NF*

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AMF DB support

- DB Read when context is not found in memory
- DB create/update on success of following procedures
  - ✓ Registration Procedure
  - ✓ Deregistration Procedure
  - ✓ Service Request Procedure
  - ✓ PDU Session Setup Procedure
  - ✓ PDU Session Release Procedure
  - ✓ AN Release Procedure
  - ✓ GUTI Registration Procedure
  - ✓ Network Initiated Deregistration Procedure
  - ✓ Context Replacement: Registration on Registration
- DB Delete on Completion of following procedures
  - ✓ Deregistration Procedure
  - ✓ Network Initiated Deregistration Procedure
- REST API support to fetch Active UEs Context from DB.
- REST API to purge Subscriber from AMF

SMF Changes
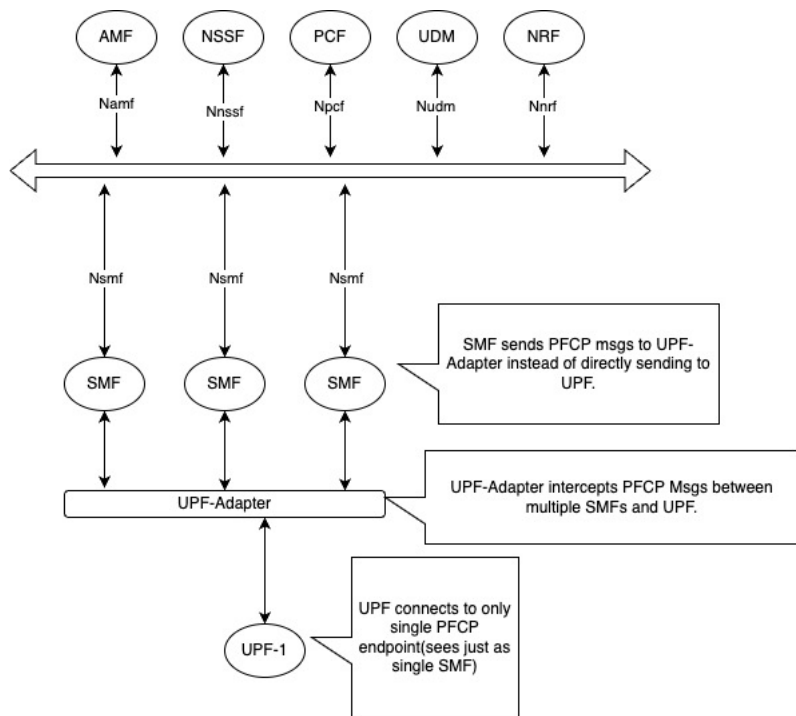
- Introduced UPF adapter as PFCP endpoint from SMF side
- UPF adapter talks to one or more UPF
- UPF-Adapter acts like Mux-Demux for PFCP messages between multiple SMF instances and UPF.
- The UPF-Adapter intercepts and modifies certain fields before sending PFCP msg to actual UPF.
- Similar handling is done for the response from UPF towards SMF.
- PDU Session preservation in Database
- Two or more SMF instance supported. Scale up/down of SMF instance supported

SMF Changes

- PDU Session preservation in Database
  - SMF shall preserve PDU Session in Database after every procedure to maintain latest updates. This shall ensure stateless support to operate on PDU session at any SMF instance.
- UPF support for handling multiple SMF instances association
  - UPF-Adapter introduced to handle multiple SMF PFCP associations with same Node-Id towards UPF.
- NRF Keep-Alive support. Send periodic NRF profile update
- Unique ID/IP-Address Management across all the Instances
  - Distributed Resource Assignment handling using DRSM
  - UPF supported UE address allocation
  - With support of DRSM module, during the recovery of any SMF instance, other NFs shall claim resources of that instance and shall become new owner of the resources(e.g., SEID/TEID Pools)
- AMF shall forward ongoing procedure to alternate SMF if procedures times out/fails with current SMF instance
  - Retransmission of message to alternate SMF
  - NRF notification will reduce the signalling delays during pod restart

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gNBSim Changes

- Support for Custom Profile
  - Iterate over procedures as per configured steps
  - Delay between procedures possible
  - StepTrigger to execute procedures one by one. Step profile can be enabled. Step trigger can be given through API. Example here.
  - Execute subscribers in parallel to simulate 100+ calls

```yaml
customProfiles:
  customProfiles1:
    profileType: custom # profile type
    profileName: custom1 # uniqely identifies a profile within application
    enable: false # Set true to execute the profile, false otherwise.
    execInParallel: false #run all subscribers in parallel
    stepTrigger: true #wait for trigger to move to next step
    gnbName: gnb1 # gNB to be used for this profile
    startImsi: 208930100007487
    ueCount: 5
    defaultAs: "192.168.250.1" #default icmp pkt destination
    opc: "981d464c7c52eb6e5036234984ad0bcf"
    key: "5122250214c33e723a5dd523fc145fc0"
    sequenceNumber: "16f3b3f70fc2"
    plmnId: # Public Land Mobile Network ID, <PLMN ID> = <MCC><MNC>
      mcc: 208 # Mobile Country Code (3 digits string, digit: 0~9)
      mnc: 93 # Mobile Network Code (2 or 3 digits string, digit: 0~9)
    startiteration: iteration1
    iterations:
      #at max 7 actions
      - "name": "iteration1"
        "1": "REGISTRATION-PROCEDURE 5"
        "2": "PDU-SESSION-ESTABLISHMENT-PROCEDURE 5"
        "3": "USER-DATA-PACKET-GENERATION-PROCEDURE 10"
        "next":  "iteration2"
      - "name": "iteration2"
        "1": "AN-RELEASE-PROCEDURE 100"
        "2": "UE-TRIGGERED-SERVICE-REQUEST-PROCEDURE 10"
        "repeat": 5
        "next":  "iteration3"
      - "name": "iteration3"
        "1": "UE-INITIATED-DEREGISTRATION-PROCEDURE 10"
        #"repeat": 0 #default value 0 . i.e execute once
        #"next":  "quit" #default value quit. i.e. no further iteration to run
```

gNBSim Changes

- Regular/default profiles
  - Procedure list is fixed per profile
  - Execute Subscribers In Parallel to simulate 100+ calls
  - Step profile can be enabled. Step trigger can be given through API. Example here.
  - Custom Profile and Regular profile
  - Delay between procedures can not be provided
- Add new calls in exiting profile
  - Works when step profile is enabled
- REST Api to trigger new profile execution
- Dnn, slice Information can be configured
- Future release
  - gNB handovers, gNB deployment as container, error indication, gtpu echo handling, negative testing, external interface to send uplink traffic

```
profiles: # profile information
  - profileType: register # profile type
    profileName: profile1 # uniqely identifies a profile within application
    enable: false # Set true to execute the profile, false otherwise.
    gnbName: gnb1 # gNB to be used for this profile
    startImsi: 208930100007487
    ueCount: 5
    defaultAs: "192.168.250.1" #default icmp pkt destination
    opc: "981d464c7c52eb6e5036234984ad0bcf"
    key: "5122250214c33e723a5dd523fc145fc0"
    sequenceNumber: "16f3b3f70fc2"
    dnn: "internet"
    sNssai:
      sst: 1 # Slice/Service Type (uinteger, range: 0~255)
      sd: 010203 # Slice Differentiator (3 bytes hex string, range: 000000~FFFFFF)
    execInParallel: false #run all subscribers within profile in parallel
    plmnId: # Public Land Mobile Network ID, <PLMN ID> = <MCC><MNC>
      mcc: 208 # Mobile Country Code (3 digits string, digit: 0~9)
      mnc: 93 # Mobile Network Code (2 or 3 digits string, digit: 0~9)
```

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Documentation Improvements

- Updated Configuration Guide
- UPF deployment
- QoS configuration
- Release Notes for 1.2
- Application Filtering Rules
- Default Aether in a Box (AiaB) override file has newly added comments to explain configuration
- Design Section added to capture new design aspects
- Next Release features on doc website

Future Enhancements

- Details of next release targeted features available at [doc website](#)
- Documentation for UPF deployment
    - Standalone Control + edge
    - Distributed Edge
- Supporting metrics from multiple NFs and creating dashboard
    - Making dashboard available for AIAB for 5G
- Cloud Native UPF
- gNBSim feature extensions
- Spin up/down NF instances based on metrics such as CPU utilization, memory utilization, or custom metrics
- NRF cache and NRF notification support
- Multiple SctpLb Instance Support
    - NGAP Decode to forward messages to a particular Amf Instance
- Multiple UPF adapter support
    - UPF initiated message handling
- Most of the above Features will be address in SD-Core 1.3 Release, scheduled to be delivered in Jan 2023

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How to contribute

- Queries can be sent on slack channel
  - Workspace - https://onf-community.slack.com/
  - Channels #sdcore-dev #aether-dev
- Identifying value add features and send the proposal for review
- Aether Users
  - Let us know documentation issues
  - Raise pull request on code, document, helm charts
- Developer
  - Raise pull request for code changes
- Quality Assurance
  - Test our released code and let us know issues found
- Join our Aether Community calls. Next meeting October 27th | 8:00am Pacific
  https://opennetworking.org/events/aether-community-meeting-kajeet/
- Previous meeting recordings available here

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