M-CORD

C3PO / NGIC Update

December
2018

Current State

In the process of releasing

Cleaning code

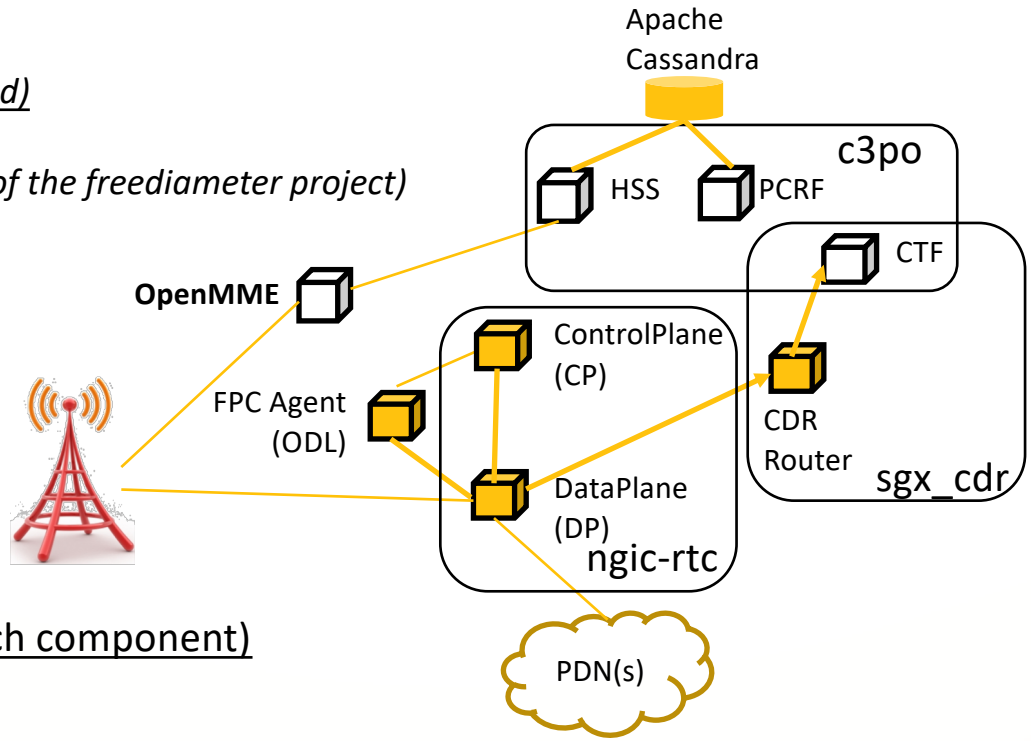
- Found code that can appear as duplicates with other projects under different license
- c3po (not ngic) contained code from another project that contained GPL code
- Current work undertaken by Intel / GS Labs (Thanks!)

- You will see new repos!

Projects

Infrastructure repos (*Not Pictured)*

- *oss-utils*
- *freediameter (modified branch of the freediameter project)*



Single Frame (1 instance of each component)

40K Users
1K Control Plane TPS
42-80 CPU Cores

Yes, there is no connection from the PCRF to anything yet
SCEF (S6t) supported on HSS
OpenMME (new project) replaces c3po's mme

Functional Improvements

- ngic-rtc
- sgx_cdr

- More feature compliance
- OAM

Future and in-progress (presented time permitting)

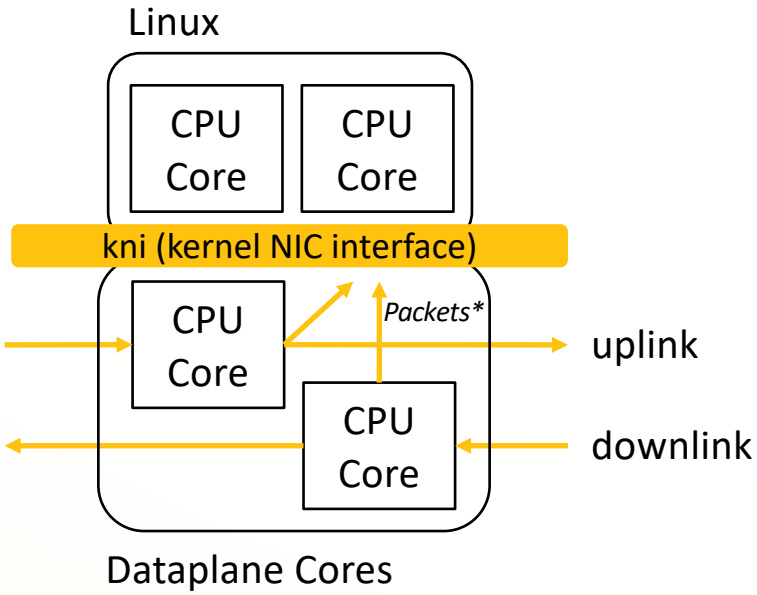
- Sx (with modifications)
- Multiple Role Support
- User level packet copying
- UPF selection via DNS (no slides presented here)
- Option 3x
- Gx

Basic Tests

- E-UTRAN initial attach with IMSI
- Initial attach with default and dedicated bearer
- Network initiated service request (paging)
- Downlink Data Notification (DDN)
- Session creation for PDN
- UE-initiated PDN disconnection
- 4 performance tests
- Ping
- Statistics and counters

ngic-rtc

4 CPU Core solution



Modes Supported

- SAE-GW
- SGW
- PGW

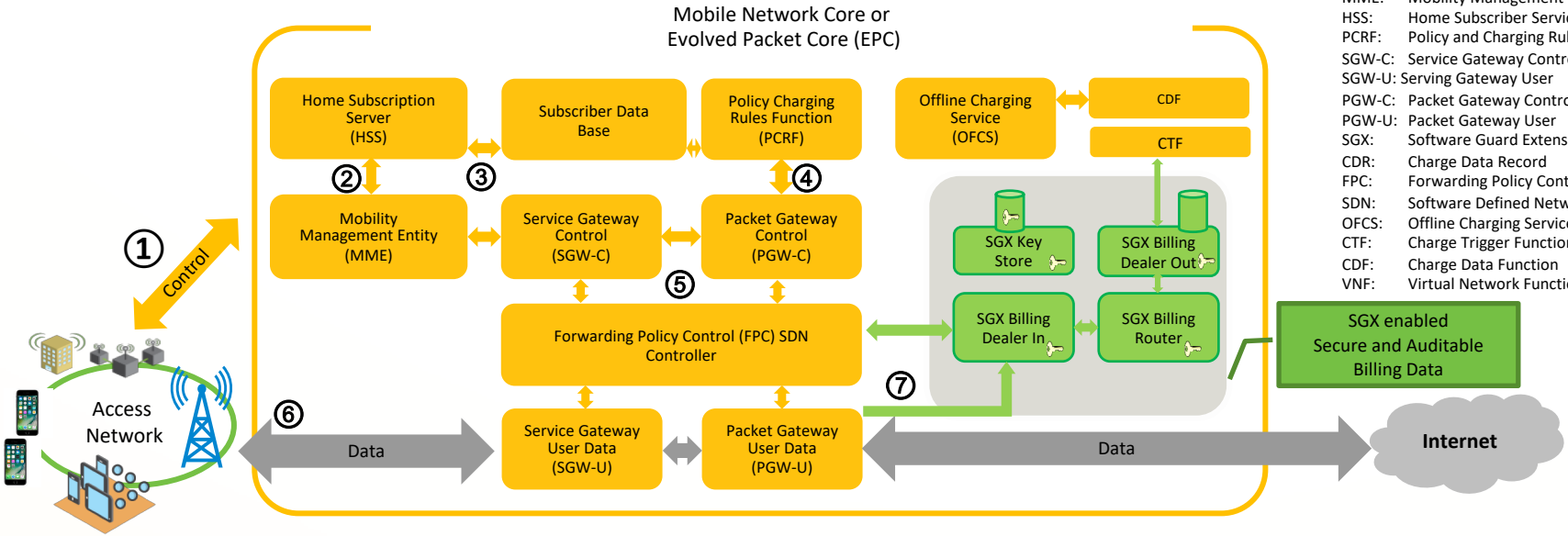
Use Linux & packages for ARP, signaling, etc.
Linux commands for your gateway!

* - packet headers for ARP or packets for traffic capture

Charge Data Record Handling

- **Security of charge and billing data is critical for NGIC deployment**
  - Operators are subject to rigorous security audit e.g. Sarbanes Oxley
  - Telecom billing data has critical information used for inter-operator roaming settlements
- **With move to open platforms with NGIC**
  - Billing and Charging records are typically stored in clear on shared storage
  - Auditing is a fairly complex tedious manual process
  - Auditors are concerned about validity and integrity of records
- **SGX protected charging and billing data handling provides:**
  - Privacy of records
  - Tamper resistance
  - Ease of Audit
  - Scalability to data plane traffic

SGX Protected CDR transfer to billing system



MME: Mobility Management Engine (Control)
HSS: Home Subscriber Services (Authentication)
PCRF: Policy and Charging Rules Function
SGW-C: Service Gateway Control
SGW-U: Serving Gateway User
PGW-C: Packet Gateway Control
PGW-U: Packet Gateway User
SGX: Software Guard Extensions
CDR: Charge Data Record
FPC: Forwarding Policy Control (IETF)
SDN: Software Defined Network Controller
OFCS: Offline Charging Service
CTF: Charge Trigger Function
CDF: Charge Data Function
VNF: Virtual Network Function

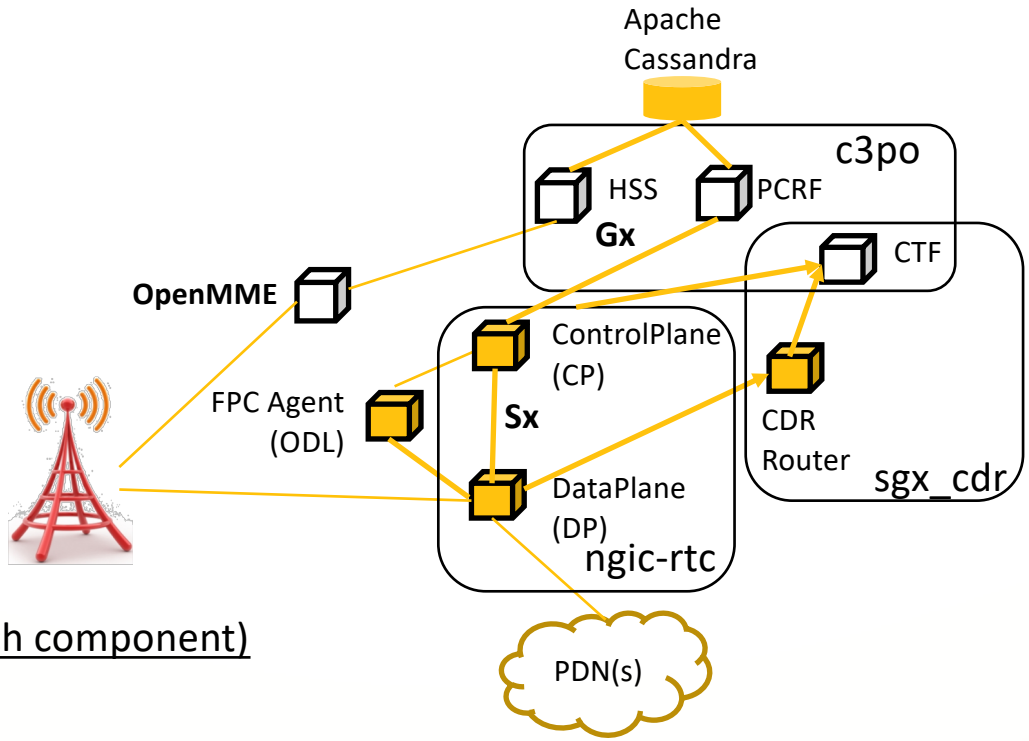
Fully secured and distributed Intel® Xeon based SGX protected CDR handling system

Provides confidentiality and integrity of Charge Data Records (CDRs)

1Q19 State

New Functions:

- Gx
- User level packet copying
- Sx
- UPF Selection via DNS
- Multi UPF per CP support
- Option 3x



Single Frame (1 instance of each component)

40K Users
1K Control Plane TPS
42-80 CPU Cores
These numbers MAY be revised as testing permits

SCEF (S6t) supported on HSS

Common Questions (1/2)

5G NGC?

- We are focused on Option 3x
- NGIC DPN is being migrated to a UPF (first step) but are waiting for NGC specs, e.g. N4, to support more than eMBB and spec stability

Scale?

- Right now we recommend 40K although you can go higher if you do more than use out of box design/configuration
- Based upon current engineering design the system can support ~1 billion devices
- A design option is on the books allows for modifications to support ~ 1*10^18 devices
  - A test using 1.2 billion entries should prove this out

Field Trials / Productions?

- We are running out of reasons not to be in field trials / production in 1Q19
- Fixed wireless, 4G mobility seem viable
- MME feature set will be the largest limitations for products

NOTE - free code is NOT free to use in production. One still owes licensing for use of Intellectual Property (IP) for use of 3GPP standards.

Common Questions (2/2)

What happened to FPC (why Sx now)?

- Parties felt that an Sx implementation is best way to have an open discussion with others to finish the Sx spec. Sx is almost complete but not there.
- FPC is still there but not a focus (if you want advance features such as active session mirroring use FPC...)

When exactly will the code be ready in 1Q19?

- We hope to finish early in the quarter but it depends on the security reviews. We need to take our time

Repo access has been limited this year!

- We are going through the initial license checks and a security review so that the code is suitable for production
- ONF will pick this up and we will only look at delta's going forward so we do not anticipate periods of unavailability going forward
- *This is also why the project did not look active in 2018!*

Sprint

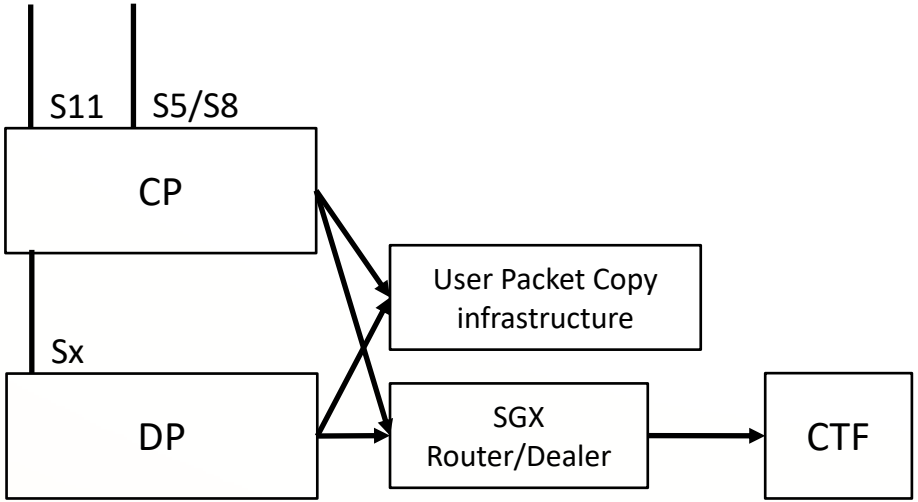
Brighter Future For All

Future Work

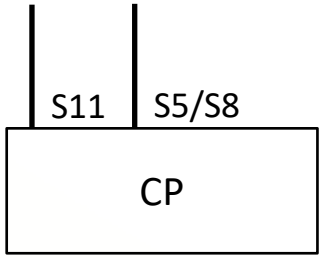
2Q19 Objectives

Sx Support

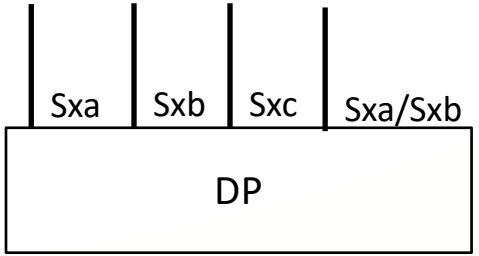
Sx is not a complete specification (as of November 2019)
We will not change our billing path (sgx_cdr)



Multiple Role Support

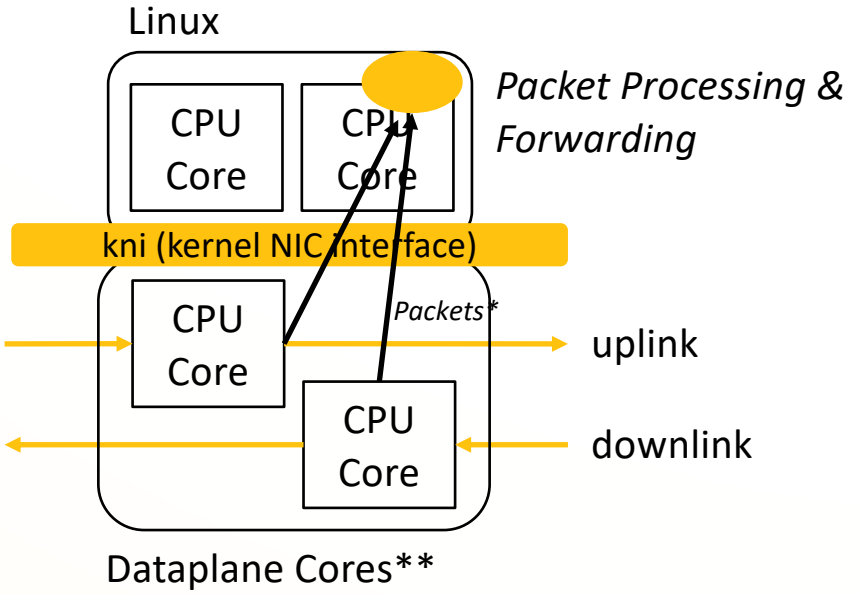


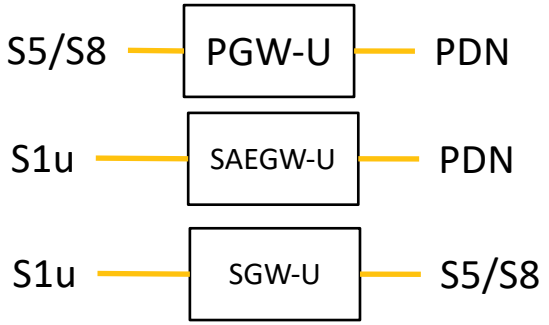
- Interface Configuration requires each role applicable to be specified
  - Helps Ops
  - Makes it clear what is going on



We do NOT permit support for S5/S8 & S11 roles on same config entry

Feature – User Level packet copying (1/4)



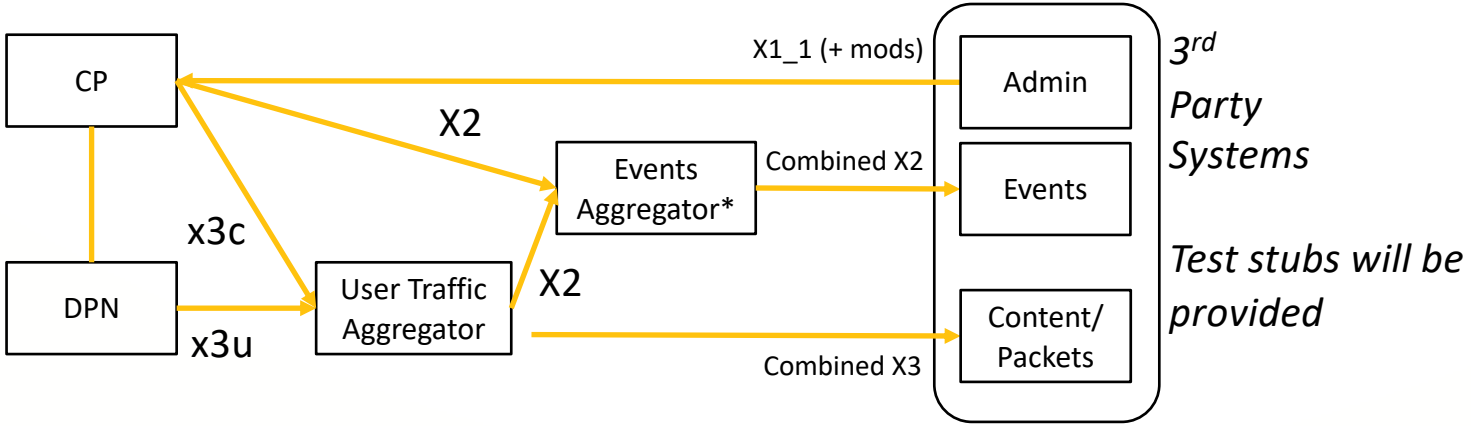


S1u can comprise 8 GTP tunnels
2 for current eNB (LTE)
2 for current gNB (NR for EN-DC)
2 for next eNB (handover)
2 for next gNB (handover)

* - packets for traffic capture

** - 3rd core may be required to complete this feature

Feature – User Level packet copying (2/4)



Purpose

X1_1 - Control

X2 – Events

X3 – User Traffic / Content

* - The Events Aggregator is required for operations use or adaptation to legacy DF2

Feature – User Level packet copying (3/4)

Feature follows design similar to 3GPP Lawful Intercept (LI) but designed for user trouble management

- The LI design is helpful reference for how to administer, send control events & capture user traffic

What is different is you can

- capture whole GTP packet (except on PDN connections where there isn't a GTP tunnel)
- Multiple tap points per UE (e.g. capture all links on the S1u)
- Turn off content capture (user data) so that only headers are sent (it is not always necessary)
- Multiple ADMFs, DF2s, DF3s etc.

Capture options per packet

- GTP header (on GTP interfaces only)
- T-PDU (user datagram) header
- T-PDU (user datagram) content

Optional Data added per packet

- Correlation #
- Timestamp

Data available per stream (or packet)

- Target ID
- Target location IA information (if available)
- Element Type (PGW, SGW, SAEGW)
- Interface (S5, S8, S1U)
- Protocol Type
- Direction - Mobile Originated / Mobile Terminated
- S1U interface subtype (if applicable)
  - gNB (old/new), eNB (old/new)

Feature – User Level packet copying (4/4)

Limitations

- Up to 3 targets of each type (ADMF, DF2, DF3) per UE for X1,X2,X3
- Auto aging of taps (if you don't spec a time endpoint we set one for you)
  - Default value via Configuration
- X2 aggregation (Split X3_LI IWF) for Operations and legacy X2 DF2s
- There is a max limit of the targets one can monitor
  - A limitation advisory will occur after testing

- There is no LI compliance claim here but the functionality is close.
  - Each region has specific requirements the code does not support
  - LI infrastructure is not standard in how the X3 or other packets are transported. Some default transports will be supported for operations support.