

M-CORD (Connectionless Massive IOT Architecture)

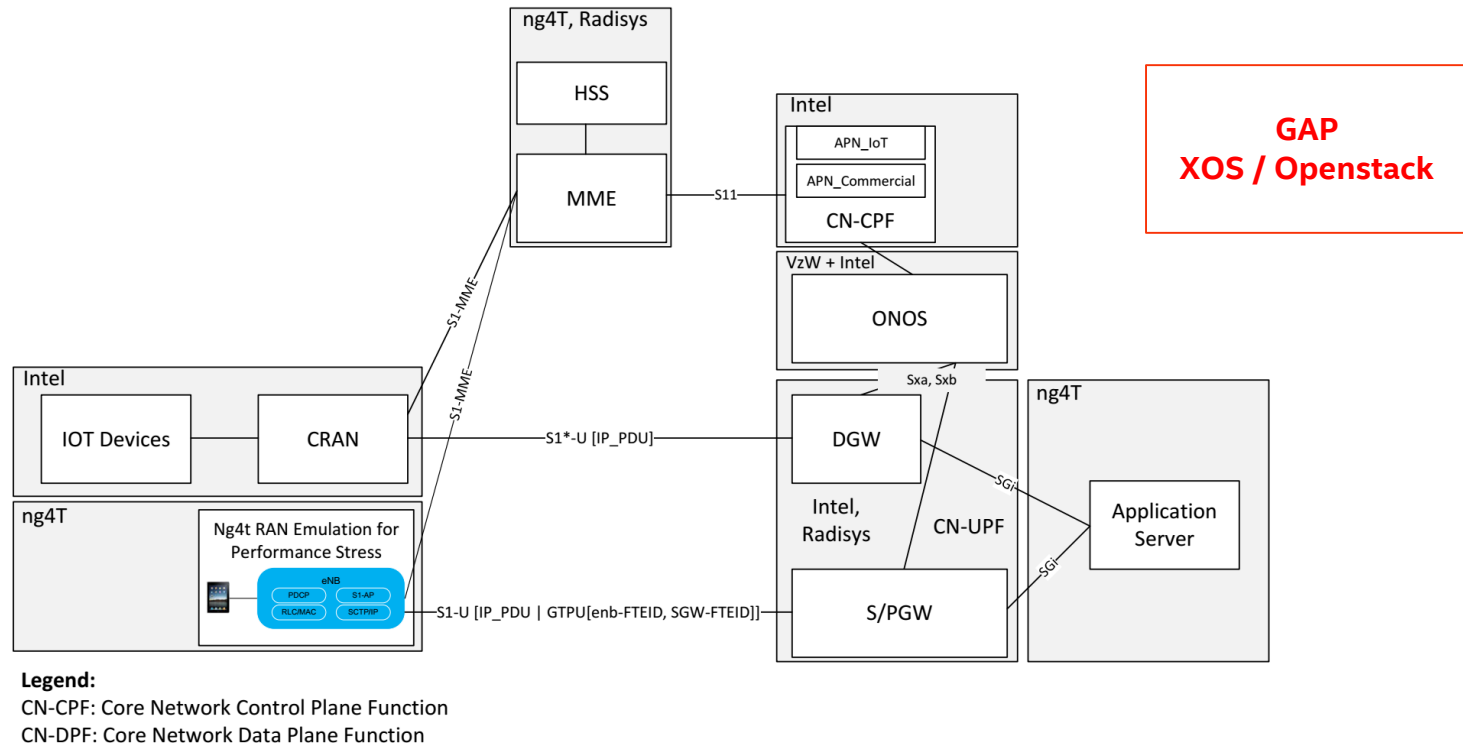
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Outlines

- Requirements for Stage 1 M-Cord Project
- Demo Scenario Proposal
- System Architecture with Connectionless Transmission features
 - Impacted Nodes
 - Benefits
 - Example Message Flows
- M-CORD Network / Rack
- Open Questions

Requirements for Stage 1 M-Cord Project



Key Functionality:

- 1 default bearer/session (no dedicate bearers)
- Rel. 11/12 compliant S1-MME, S11
- NB <> SB transformations
- SB transport to support tps requirements

Performance goals:

1x Data Paths: Highest Mpps/CPU CORE

~Signaling Path: 1000 tps

Lookup Table: ~250K users

1 Node= ~1x functional EPC w/ 250K users

Demo Scenario

The Commercial UEs' traffic stressing vEPC performance envelope will not be interfered by signaling storm generated by massive IOT devices.

Common Features:

- HSS stores different subscriptions for commercial UEs and the IOT devices
- DNS allocates IP address based on service subscription at HSS

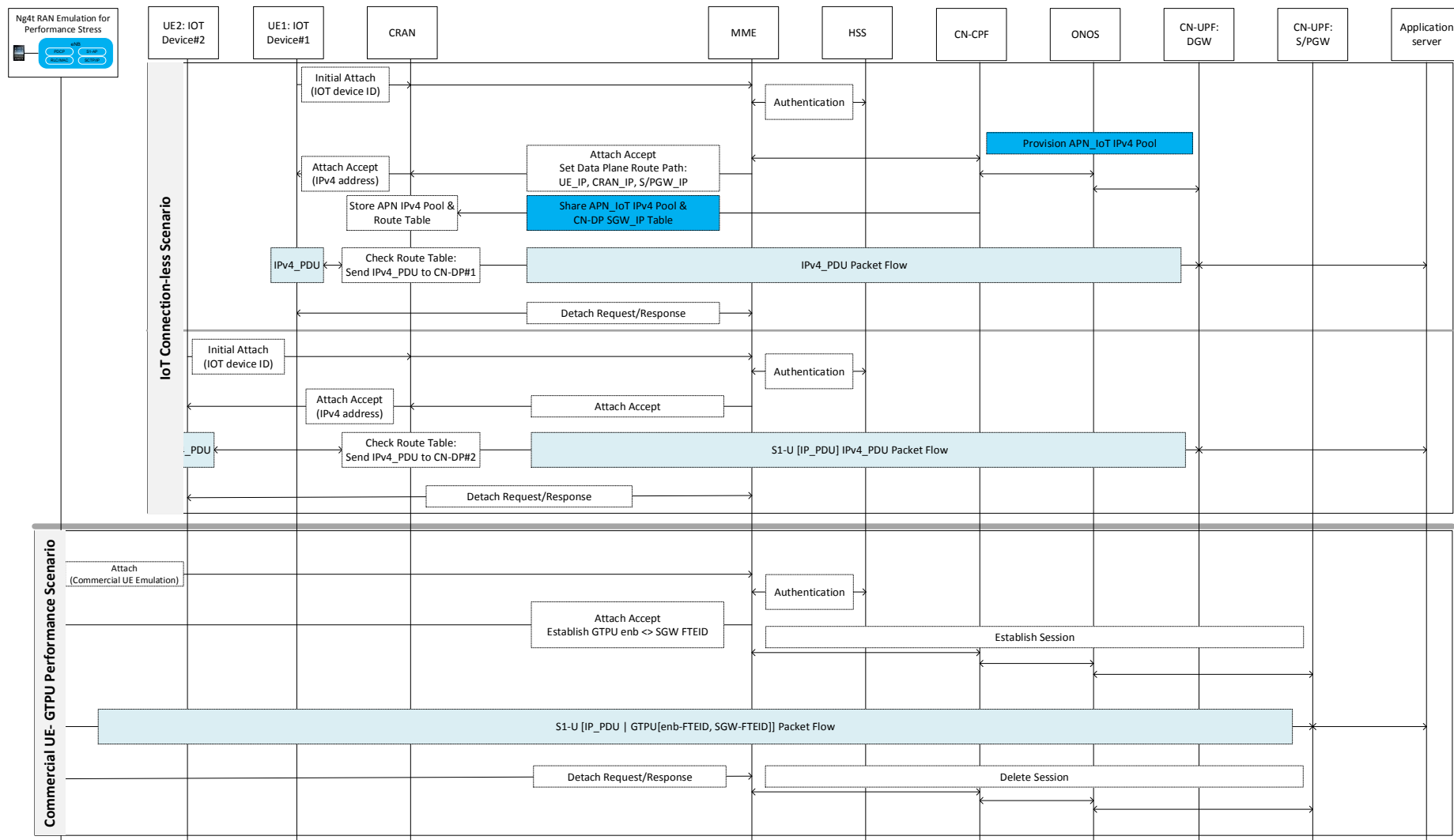
Commercial UEs

- CN slice: MME signals CN-CP/ONOS over S11 to establish GTP-U tunnel at S/PGW
- RAN slice: forward the GTP-U encapsulated IP packets over S1-U towards S/PGW.
- UE: attach→downlink TX

Massive IOT devices

- CN slice: MME signal to CN-CP/ONOS over S11 to configure routing policies at Data GW (DGW) by OF
- RAN slice: forward the IP packets toward the DGW.
- IOT device: attach→Uplink TX→detach
 - ❑ follow a scheduled traffic pattern (TBD)

IoT + Commercial MsgFlow



Impacted Nodes

HSS:

- Stores different service subscriptions for commercial UEs and the IOT devices

CN-CP/ONOS:

- CN-CP performs IPv4 address allocation based on service subscription
 - Makes IPv4 pool information available to CRAN
- ONOS establishes a routing policy for the requested IP service and configures it on the DGWs, in which the routing policy is associated to an IPv4 addresses pool for massive IOT devices.

CRAN:

- Stores a service context including at least one routing policy for forwarding IP packets within a IPv4 addresses pool.

IOT devices:

- Transmits IP packets using allocated IPv4 addresses within an allocated pool of the IPv4 addresses without marking the IP packets with additional information for packet forwarding.

Benefits

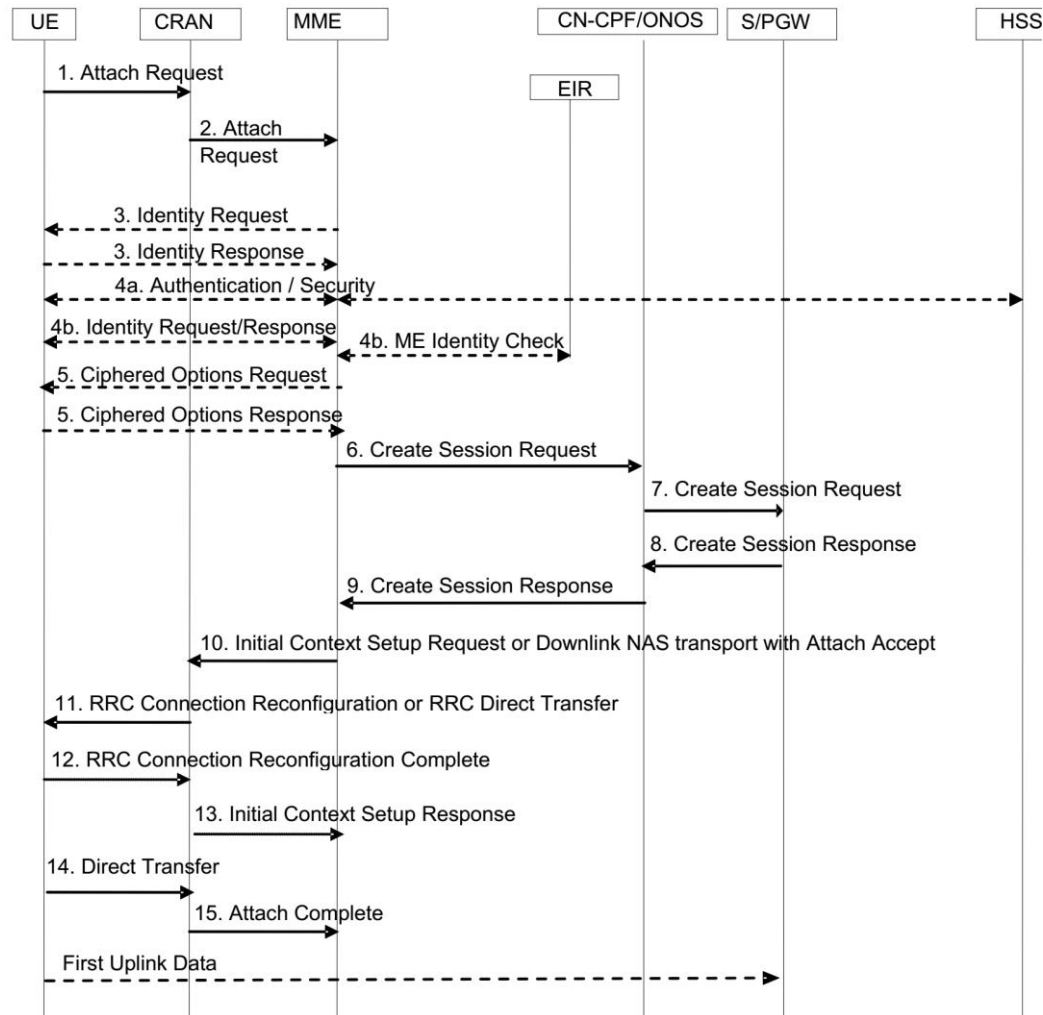
- The network, CN-CPF/ONOS, can configure a routing policy in a scalable manner by controlling the pool size of the IPv4 addresses to be allocated to the IOT devices.
- The network ,CN-CPF/ONOS, can easily perform load balance among DGWs by configuring different routing policy associated to another pool of the IPv4 addresses for different IOT devices
- The network entities including MME, CRAN node, and one or more DGWs does not need to maintain individual device context for storing routing policy of infrequent IP service session.
- The IOT device does not need to mark the IP packets for packet forwarding at the CRAN node and one or more DGWs, which greatly avoid packets transmission complexity and potential power consumption at the IOT device.

Example Message Flow

– Network Slice for GTP tunnel based Transmission

4 Messages (step 6-9) for Create Session Request/Response

No Modify Bearer Request/Response messages are required for providing the Presence Reporting Area Information of the IOT devices

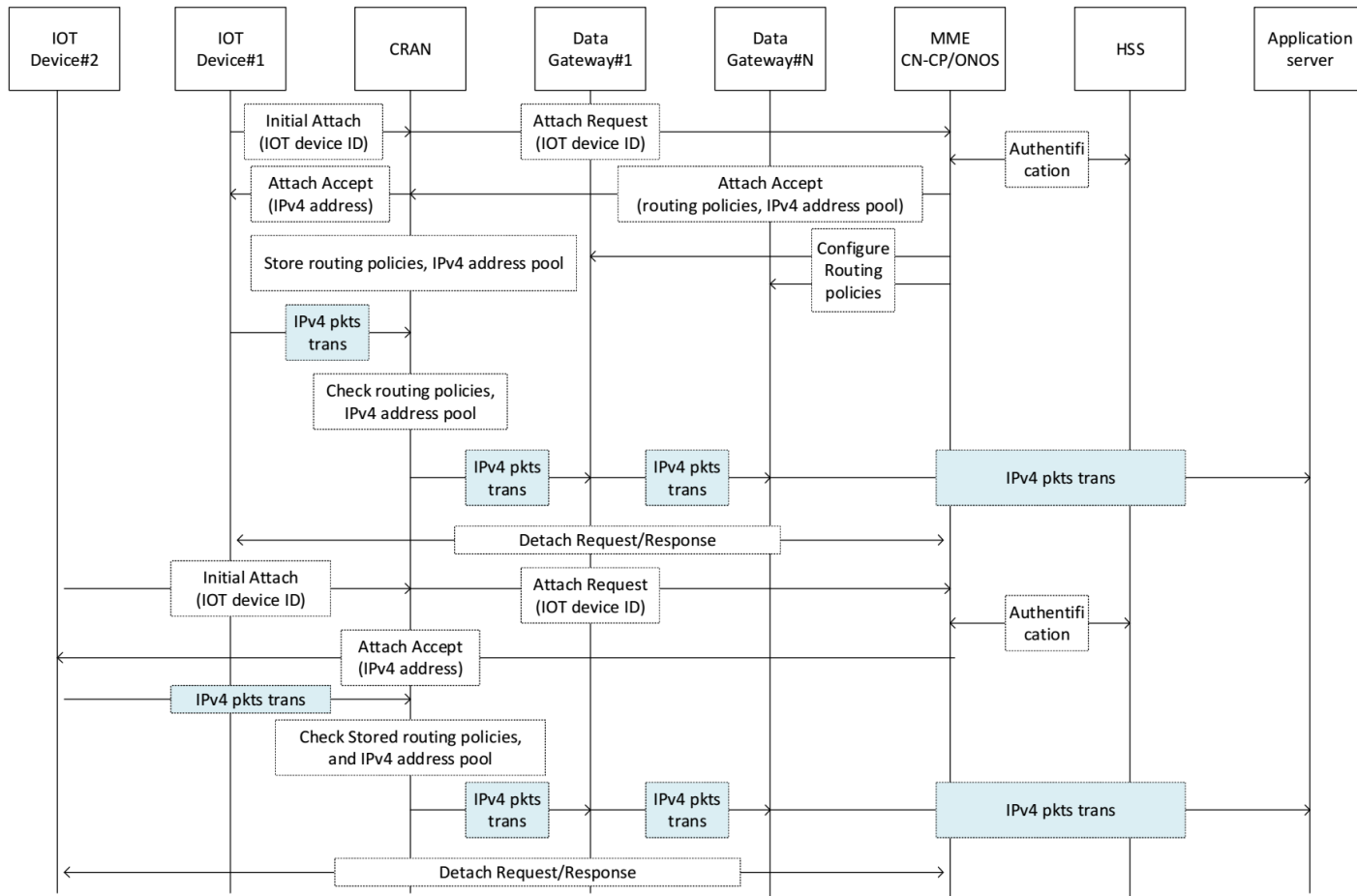


Example Message Flow

– Network Slice for Connectionless Transmission

2 Messages for Create Session Request/Response between MME and CN-CPF/ONOS

2 Messages for Routing Policy Configuration Request/Response



Signaling Overheads and Device Contexts Saving

Network Slice for GTP tunnel based Transmission

- Create Session request/response message for each Device
- Create Device context by Initial UE Context Setup Message

Network Slice for Connectionless Transmission

- Configure one routing policy for accommodating all Device
- The routing policy may be changed from time to time in reflect to real-time network conditions
- A Service Context is created and shared for all Devices

Signaling Overheads Saving for Connectionless Transmission:

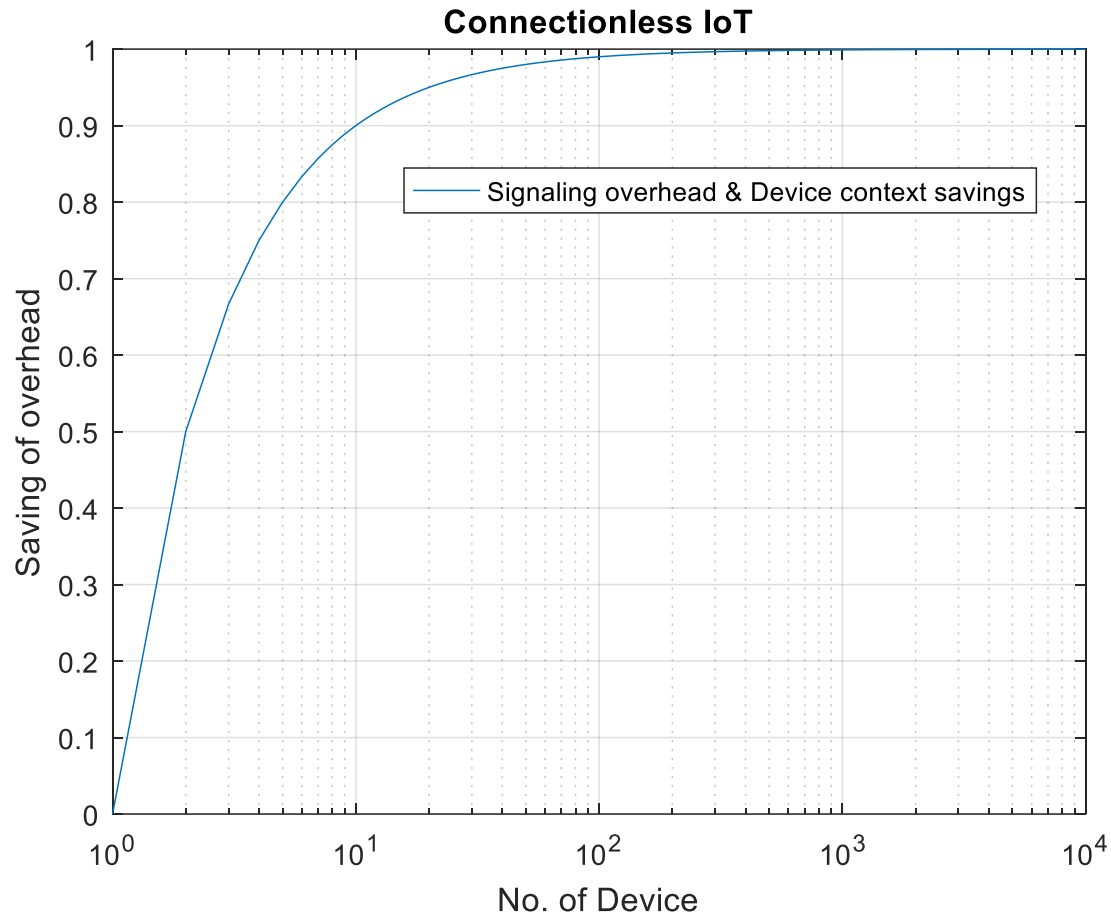
Assume N is the number of Devices.

- The saving is $1 - 4/(4*N)$

Device Context Saving for Connectionless Transmission:

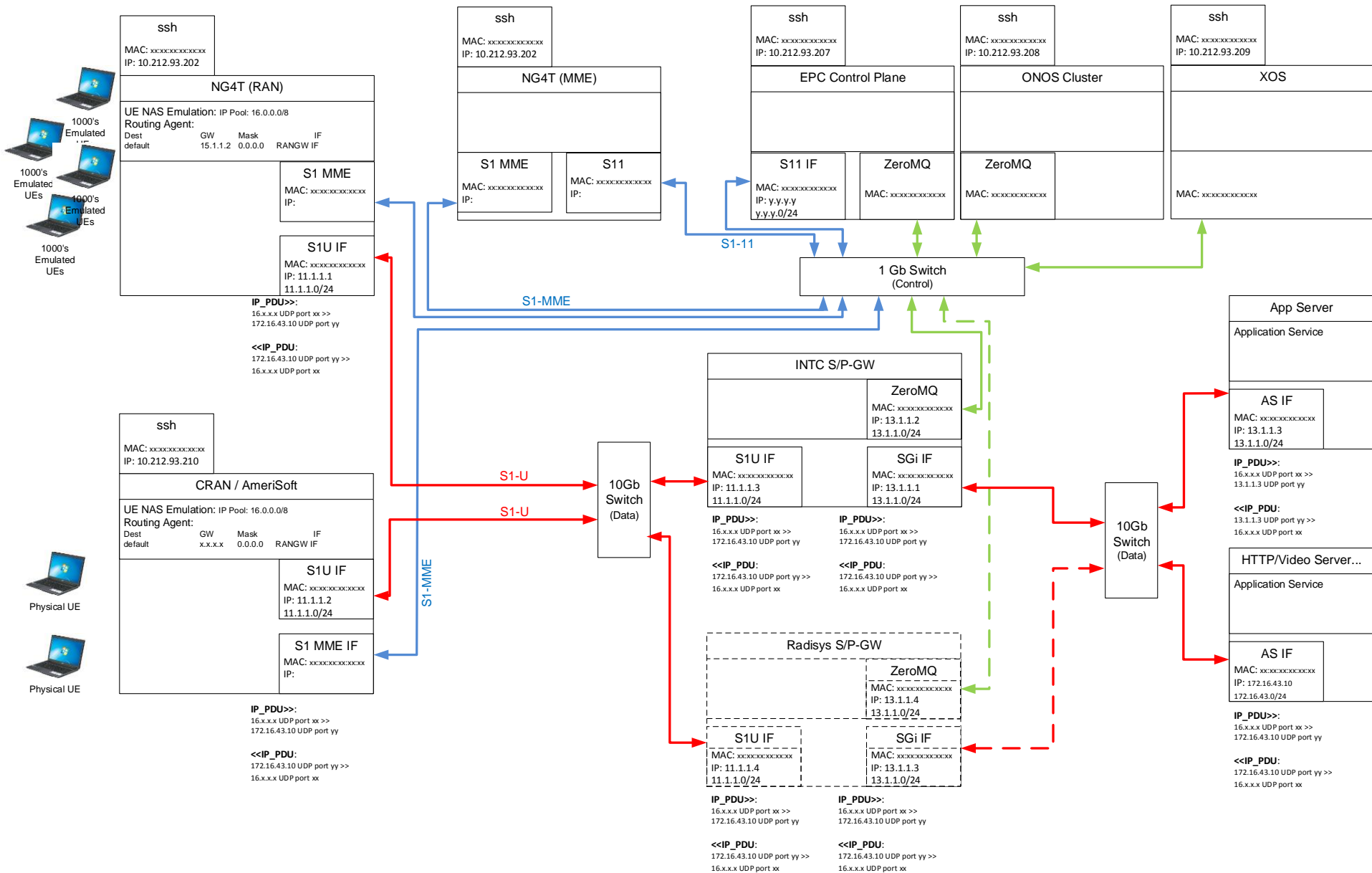
- The saving is $1 - 1/N$

Signaling and Device Context Saving with Connectionless Core Network



M-CORD Network / Rack (1/2)

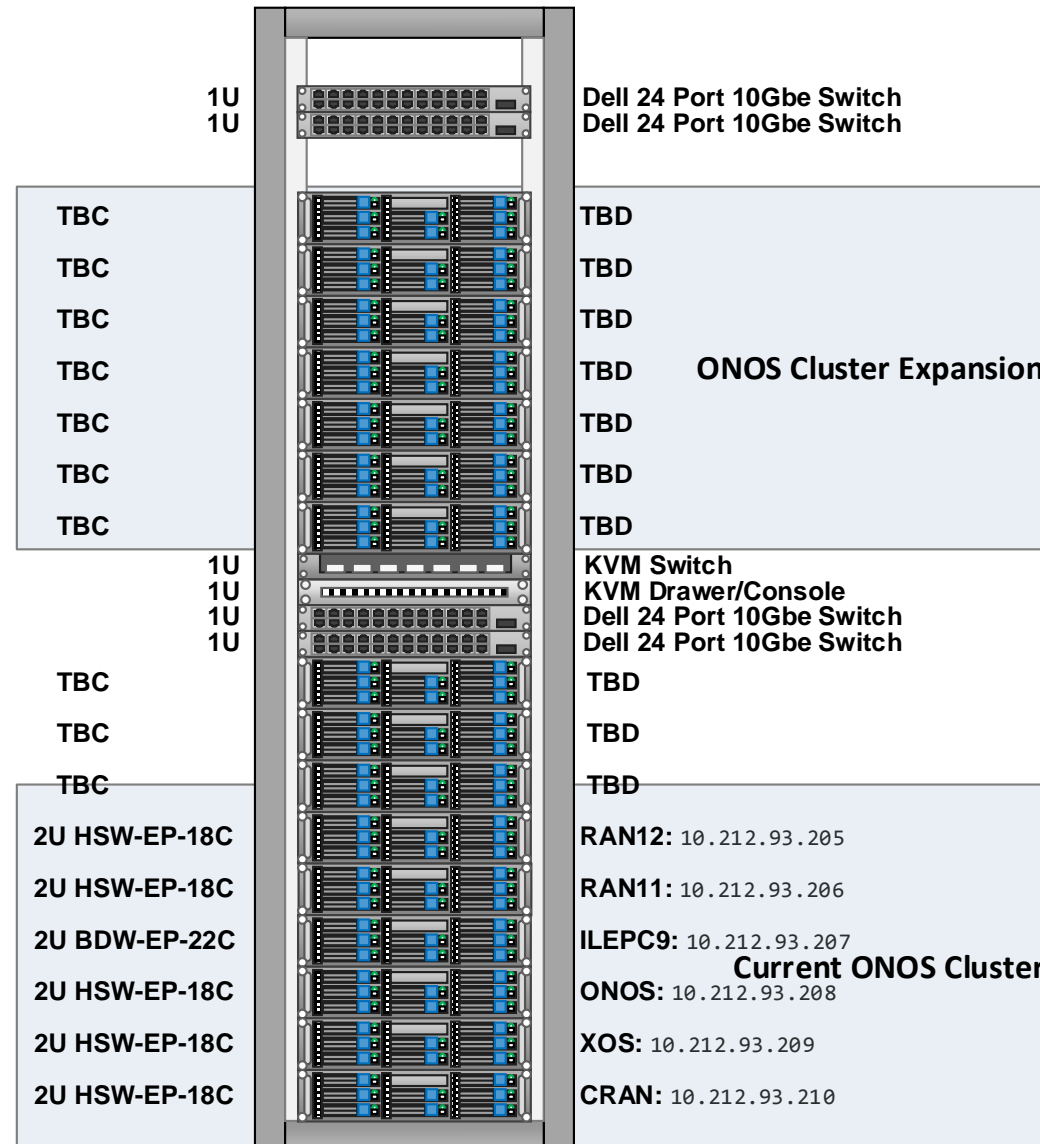
Needs to be updated w/
SSH addresses, names, etc



M-CORD Network / Rack (2/2)

Needs to be updated w/
SSH addresses, names, etc

JF2-2-H8 M-CORD Dev Rack



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Open Questions

Backup

Tasks List and Timeline

- M-CORD Rack connected, up and running for external access
 - Basic System Architecture Setup Ready with NG4T-RAN/MME, CN-CPF/ONOS
 - Tests with Emulator UEs; Tests with Amarisoft UEs (number?)
- Replacing NG4T-RAN with CRAN for S1-MME connection
 - Tests with Amarisoft UEs (number?); Tests with Commercial UEs
- NG4T-MME and CN-CP:
 - Configure Different Subscription at HSS for differentiating IOT device and commercial UE;
 - Configure IPv4 address pool at DNS for IPv4 addresses allocation based on UE types
 - Suspend GTP tunneling establishment at S/PGW for IOT device
 - Apply OF for configuring routing policies at DGW based on IPv4 addresses pool
- Cloud RAN:
 - Create Fixed Routing policies for fixed IPv4 addresses pool
 - Add a new IP connection with Radisys DGW (?)
 - Forward IP packets to S/PGW or DGW based on IPv4 addresses
 - Test with Amerisoft UEs configured as IOT devices (detailed configuration?)
- UI design for demo (TBD): show traffic activity at S/PGW, UE's video streaming, IOT-UE ??

Todo – Next Steps

- Tasks Coordination

- EPC provider:
 - Interface between CRAN and S/P-GW
 - Interface between Control Plane Function (CN-CPF) and SDN Controller
 - Interface between SDN Controller and Data Plane Function (CN-UPF)
 - Need to add Information Element to configure routing policies based on IPv4 pool
 - Transport between CP and SDN Controller and between SDN Controller and DP
 - Proposed ZeroMQ – Tried OF but significant IE limitations requiring Vendor's Extensions
- MME / EPC:
 - MME interfaces with HSS for subscription configuration – Static file ?
 - IP address allocation based on IPv4 address pool for IOT devices
- XOS / Service Chaining
 - **Gaps – Needs help & support**

