M-CORD Connectivity: Deep Technical Dive

Open Networking Foundation (ONF)

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- Let’s Connect a New Service
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- Summary
EPC Connectivity

SGW + PGW → SPGW-C + SPGW-U + SDN Controller
M-CORD CORD Build Scenario

Operator specification (TOSCA) + GUI

Controller
- vBBU
- vMME (HSS)
- vENB
- vSPGW-C
- vSPGW-U
- SDN cont.
- OpenStack
- ONOS

UE
RRH

Emulator (Spirent)

PDN/Internet

UE
RRH
M-CORD CORD Build Scenario

(Simple version)

- Operator specification (TOSCA) + GUI
- Controller
  - vBBU
  - vMME (HSS)
  - vENB
  - vSPGW-C
  - vSPGW-U

UE, RRH, Emulator (Spirent), PDN/Internet, vBBU, vMME (HSS)
Network Connectivity in M-CORD

LTE scenario → CORD Build scenario
List of Interfaces into XOS

LTE Interfaces

S1-U
S11
SGi
S5
S11-MME

XOS Networks

s1u_net
s11_net
sgi_net
spgw_net
n(s)bi_net

CP/UP Interfaces

SPGW
NBI/SBI

#M-CORD
Network Connectivity in M-CORD

Simple Version

Controller

- **s11_net**
- **s1u_net**
- **spgw_net**

**Controller**
- vENB
- vSPGW-C
- vSPGW-U

New interface between vSPGW-C & vSPGW-U
Code-Level Analysis

Deep-dive in Simple Version
Where Can We Get Some Codes of CORD?

• Two repositories
  • Gerrit: https://gerrit.opencord.org
  • GitHub: https://github.com/opencord

• In this talk,
  • We use “platform-install” and “cord” repositories in cord-4.1 branch
    • platform-install: https://github.com/opencord/platform-install
    • cord: https://github.com/opencord/cord
Target: Network Connectivity in M-CORD

Controller

Management 172.27.0.0/24

vENB

sgi_net

115.0.0.0/24

s1u_net

111.0.0.0/24

Controller

vSPGW-C

spgw_net

117.0.0.0/24

Controller

vSPGW-U

112.0.0.0/24

117.0.0.0/24

s11_net

111.0.0.0/24

156.0.0.0/24

Management 172.27.0.0/24

#M-CORD
Scenario – Network Definition

platform_install/roles/cord_profile/templates/s1u-net.yaml.j2

(1)

s1u_template:
  type: tosca.nodes.NetworkTemplate
  properties:
    name: s1u_template

s1u_network:
  type: tosca.nodes.Network
  properties:
    name: s1u_network
    subnet: 111.0.0.0/24
    permit_all_slices: true
  requirements:
    - template:
      node: s1u_template
    - owner:
      node: {{ site_name }}_s1u

(2)

{{ site_name }}_s1u:
  description: This slice exists solely to own the private network
  type: tosca.nodes.Slice
  properties:
    name: {{ site_name }}_s1u
    default_isolation: vm
    network: noauto
  requirements:
    - site:
      node: {{ site_name }}
      relationship: tosca.relationships.BelongsToOne

#M-CORD
Scenario – Network Definition

platform_install/roles/cord_profile/templates/s11-net.yaml.j2

(1)

s11_template:
  type: tosca.nodes.NetworkTemplate
  properties:
    name: s11_template

s11_network:
  type: tosca.nodes.Network
  properties:
    name: s11_network
    subnet: 112.0.0.0/24
    permit_all_slices: true
  requirements:
    - template:
      node: s11_template
    - owner:
      node: {{ site_name }}_s11

(2)

{{ site_name }}_s11:
  description: This slice exists solely to own the private network
  type: tosca.nodes.Slice
  properties:
    name: {{ site_name }}_s11
    default_isolation: vm
    network: noauto
  requirements:
    - site:
      node: {{ site_name }}

relationship: tosca.relationships.BelongsToOne
Scenario – Network Definition

platform_install/roles/cord_profile.templates/sgi-net.yaml.j2

(1)

sgi_template:
  type: tosca.nodes.NetworkTemplate
  properties:
    name: sgi_template
    ...

sgi_network:
  type: tosca.nodes.Network
  properties:
    name: sgi_network
    subnet: 115.0.0.0/24
    permit_all_slices: true
  requirements:
    - template:
      node: sgi_template
    - owner:
      node: {{ site_name }}_sgi

(2)

{{ site_name }}_sgi:
  description: This slice exists solely to own the private network
  type: tosca.nodes.Slice
  properties:
    name: {{ site_name }}_sgi
    default_isolation: vm
    network: noauto
  requirements:
    - site:
      node: {{ site_name }}
      relationship: tosca.relationships.BelongsToOne
Scenario – Network Definition

platform_install/roles/cord_profile/templates/spgw-net.yaml.j2

(1)

spgw_template:
  type: tosca.nodes.NetworkTemplate
  properties:
    name: spgw_template
    ...

spgw_network:
  type: tosca.nodes.Network
  properties:
    name: spgw_network
    subnet: 117.0.0.0/24
    permit_all_slices: true
  requirements:
    - template:
      node: spgw_template
    - owner:
      node: {{ site_name }}_spgw

(2)

{{ site_name }}_spgw:
  description: This slice exists solely to own the private network
  type: tosca.nodes.Slice
  properties:
    name: {{ site_name }}_spgw
    default_isolation: vm
    network: noauto
  requirements:
    - site:
      node: {{ site_name }}
      relationship: tosca.relationships.BelongsToOne
Scenario – Network Definition

platform_install/roles/cord_profile/templates/mcord-x-service.yml.j2

(1)

s1u_network:
  type: tosca.nodes.Network
  properties:
    must-exist: true
    name: s1u_network

s11_network:
  type: tosca.nodes.Network
  properties:
    must-exist: true
    name: s11_network

(2)

sgi_network:
  type: tosca.nodes.Network
  properties:
    must-exist: true
    name: sgi_network

spgw_network:
  type: tosca.nodes.Network
  properties:
    must-exist: true
    name: spgw_network
Define vENB Service and Networks
vENB Definition

platform_install/roles/cord_profile/templates/mcord-x-service.yml.j2

```yaml
service#venb:
  type: tosca.nodes.VENBService
  properties:
    ...  

{{ site_name }}_venb:
  description: vENB Service Slice
  type: tosca.nodes.Slice
  properties:
    name: {{ site_name }}_venb
    default_isolation: vm
    network: noauto
  requirements:
    - service:
      node: service#venb
      relationship: tosca.relationships.BelongsToOne
      ...  
venb_instance1:
  type: tosca.nodes.VENBServiceInstance
  ...  
venb_slice_management_network:
  type: tosca.nodes.NetworkSlice
  requirements:
    - network:
      node: management
    - slice:
      node: {{ site_name }}_venb
      ...  
venb_slice_s11_network:
  ...  
venb_slice_s1u_network:
  ...  
venb_slice_sgi_network:
  ...  
```
Define vSPGW-C Service and Networks
vSPGW-C Definition
platform_install/roles/cord_profile/templates/mcord-x-service.yml.j2

service#vspgwc:
  type: tosca.nodes.VSPGWCServices
  properties:
    ... {{ site_name }}_vspgwc:
    description: vspgwc slice
  type: tosca.nodes.Slice
  properties:
    name: {{ site_name }}_vspgwc
    default_isolation: vm
    network: noauto
  requirements:
    - service:
      node: service#vspgwc
      relationship: tosca.relationships.BelongsToOne
      ... intel_vspgwc:
        type: tosca.nodes.VSPGWCVendor
        ... serviceinstance#vpgw_instance:
        type: tosca.nodes.VSPGWCTenant
        ... vspgwc_slice_management_network:
        type: tosca.nodes.NetworkSlice
        requirements:
          - network:
            node: management
          - slice:
            node: {{ site_name }}_vspgwc
          ... vspgwc_slice_s11_network:
          ... vspgwc_slice_spgw_network:
Define vSPGW-U Service and Networks
vSPGW-U Definition

platform_install/roles/cord_profile/templates/mcord-x-service.yml.j2

service#vspgwu:
  type: tosca.nodes.VSPGWUService
  properties:
    ...

{{ site_name }}_vspgwu:
  description: vspgwu slice
  type: tosca.nodes.Slice
  properties:
    name: {{ site_name }}_vspgwu
    default_isolation: vm
    network: noauto
    ...

intel_vspgwu:
  type: tosca.nodes.VSPGWUVendor

  ...

serviceinstance#vspgwu_instance:
  type: tosca.nodes.VSPGWUTenant
  ...

vspgwu_slice_management_network:
  type: tosca.nodes.NetworkSlice
  requirements:
    - network:
      node: management
    - slice:
      node: {{ site_name }}_vspgwu
      ...

vspgwu_slice_sgi_network:
  ...

vspgwu_slice_spgw_network:
  ...

vspgwu_slice_s1u_network:
Add All Components in Profile
platform_install/profile_manifests/mcord-x.yml

```
# add configurations
xos_new_tosca_config_templates:
- s11-net.yaml
- s1u-net.yaml
- spgw-net.yaml
- sgi-net.yaml
- flat-net.yaml
- mcord-x-services.yml

xos_services:

- name: venb
  path: orchestration/xos_services/venb
  keypair: mcord_rsa

- name: vspgwc
  path: orchestration/xos_services/vspgwc
  keypair: mcord_rsa

- name: vspgwu
  path: orchestration/xos_services/vspgwu
  keypair: mcord_rsa
  profile_library: "mcord"
```
Result: Network Connectivity in M-CORD

<table>
<thead>
<tr>
<th>Name</th>
<th>Status</th>
<th>Task State</th>
<th>Power State</th>
<th>Networks</th>
</tr>
</thead>
<tbody>
<tr>
<td>mysite_venb-2</td>
<td>ACTIVE</td>
<td>-</td>
<td>Running</td>
<td>s1u_network=111.0.0.3; sgi_network=115.0.0.3; management=172.27.0.4; s11_network=112.0.0.3; fl</td>
</tr>
<tr>
<td>mysite_vspgcw-8</td>
<td>ACTIVE</td>
<td>-</td>
<td>Running</td>
<td>management=172.27.0.9; spgw_network=117.0.0.8; s11_network=112.0.0.5</td>
</tr>
<tr>
<td>mysite_vspgwc-11</td>
<td>ACTIVE</td>
<td>-</td>
<td>Running</td>
<td>s1u_network=111.0.0.9; sgi_network=115.0.0.9; management=172.27.0.12; spgw_network=117.0.0.11</td>
</tr>
</tbody>
</table>

![Diagram](image_url)
Let’s Connect a New Service

An Example of SDN Controller Service
Overview

Controller

- s11_net
- s1u_net
- spgw_net
- nbi_net
- sbi_net

Assumption: Define SDN controller Service

Define nbi_net

Define sbi_net

Remove spgw_net
Scenario – Network Definition
platform_install/roles/cord_profile/templates/nbi-net.yaml.j2

(1) nbi_template:
type: tosca.nodes.NetworkTemplate
properties:
  name: nbi_template
...

nbi_network:
type: tosca.nodes.Network
properties:
  name: nbi_network
  subnet: 113.0.0.0/24
  permit_all_slices: true
requirements:
  - template:
    node: nbi_template
  - owner:
    node: {{ site_name }}_nbi

(2) {{ site_name }}_nbi:
description: This slice exists solely to own the private network
type: tosca.nodes.Slice
properties:
  name: {{ site_name }}_nbi
  default_isolation: vm
  network: noauto
requirements:
  - site:
    node: {{ site_name }}
    relationship: tosca.relationships.BelongsToOne
Scenario – Network Definition
platform_install/roles/cord_profile/templates/sbi-net.yaml.j2

sbi_template:
  type: tosca.nodes.NetworkTemplate
  properties:
    name: sbi_template

sbi_network:
  type: tosca.nodes.Network
  properties:
    name: sbi_network
    subnet: 114.0.0.0/24
    permit_all_slices: true
  requirements:
    - template:
      node: sbi_template
    - owner:
      node: {{ site_name }}_sbi

{{ site_name }}_sbi:
  description: This slice exists solely to own the private network
  type: tosca.nodes.Slice
  properties:
    name: {{ site_name }}_sbi
    default_isolation: vm
    network: noauto
  requirements:
    - site:
      node: {{ site_name }}
      relationship: tosca.relationships.BelongsToOne
Network Definition for SDN Controller

platform_install/roles/cord_profile/templates/mcord-x-service.yml.j2

s1u_network:
  type: tosca.nodes.Network
  properties:
    must-exist: true
    name: s1u_network

s11_network:
  type: tosca.nodes.Network
  properties:
    must-exist: true
    name: s11_network

nbi_network:
  type: tosca.nodes.Network
  properties:
    must-exist: true
    name: nbi_network

sbi_network:
  type: tosca.nodes.Network
  properties:
    must-exist: true
    name: sbi_network

sgi_network:
  type: tosca.nodes.Network
  properties:
    must-exist: true
    name: sgi_network

spgw_network:
  type: tosca.nodes.Network
  properties:
    must-exist: true
    name: spgw_network
Define SDN Controller Service and Networks
option name = "SDNController";
option app_label = "sdncontroller";
option kind = "vEPC";

message SDNControllerService (Service){
  option verbose_name = "SDN Controller Service for vSPGW";
}

message SDNControllerVendor (XOSBase){
  option verbose_name = "SDN Controller Vendor for vSPGW";
    ...
}

message SDNControllerServiceInstance (TenantWithContainer){
  option verbose_name = "SDN Controller Service Instance for vSPGW";
    ...
}

#M-CORD
SDN Controller Definition
platform_install/roles/cord_profile/templates/mcord-x-service.yml.j2

service#sdncontroller:
type: tosca.nodes.SDNControllerService
properties:

{{ site_name }}_sdncontroller:
description: sdn controller slice
type: tosca.nodes.Slice
properties:
  name: {{ site_name }}_sdncontroller
default_isolation: vm
network: noauto
requirements:
- service:
  node: service#sdncontroller
  relationship: tosca.relationships.BelongsToOne

intel_sdncontroller:
type: tosca.nodes.SDNControllerVendor

serviceinstance#sdncontroller_instance:
type: tosca.nodes.SDNControllerServiceInstance

sdncontroller_slice_management_network:
type: tosca.nodes.NetworkSlice
  requirements:
    - network:
      node: management
    - slice:
      node: {{ site_name }}_sdncontroller

sdncontroller_slice_sbi_network:

sdncontroller_slice_nbi_network:
Change vSPGW-C Networks

Controller

s11_net
Controller
vSPGW-C

Controller
vENB

s1u_net
Controller
vSPGW-U

Controller
SDN cont.
nbi_net

sgi_net

sbi_net
Scenario – vSPGW-C Definition

platform_install/roles/cord_profile/templates/mcord-x-service.yml.j2

```yaml
service#vspgwc:
  type: tosca.nodes.VSPGWCSlice
  properties:
    ...%
    \{ site_name \}_vspgwc:
      description: vspgwc slice
    \{ site_name \}_vspgwc:
      type: tosca.nodes.Slice
      properties:
        name: \{ site_name \}_vspgwc
        default_isolation: vm
        network: noauto
      requirements:
        - service:
          node: service#vspgwc
          relationship: tosca.relationships.BelongsToOne
          ...%
  intel_vspgwc:
    type: tosca.nodes.VSPGWCVendor
    ...%
  serviceinstance#vspgwc_instance:
    type: tosca.nodes.VSPGWCTenant
    ...%
  vspgwc_slice_management_network:
    ...%
  vspgwc_slice_s11_network:
    ...%
  vspgwc_slice_s11_network: # before: spgw_network
    type: tosca.nodes.NetworkSlice
    requirements:
      - network:
        node: nbi_network # before: spgw_network
        ...%
      - slice:
        ...%
        node: \{ site_name \}_vspgwc
        ...%```

#M-CORD
Change vSPGW-U Networks
Scenario – vSPGW-U Definition

platform_install/roles/cord_profile/templates/mcord-x-service.yml.j2

```
service#vspgwu:
  type: tosca.nodes.VSPGWUService
  properties:
    ...

  {{ site_name }}_vspgwu:
    description: vspgwu slice
    type: tosca.nodes.Slice
    properties:
      name: {{ site_name }}_vspgwu
      default_isolation: vm
      network: noauto
    requirements:
      - service:
        node: service#vspgwu
        relationship: tosca.relationships.BelongsToOne
        ...

intel_vspgwu:
  type: tosca.nodes.VSPGWUVendor
  ...

serviceinstance#vspgwu_instance:
  type: tosca.nodes.VSPGWUTenant
  ...

  vspgwu_slice_management_network:
    ...

  vspgwu_slice_sgi_network:
    ...

  vspgwu_slice_sbi_network: # before: spgw_network
    type: tosca.nodes.NetworkSlice
    ...

  vspgwu_slice_s1u_network:
  ...
```
Add All Components in Profile
platform_install/profile_manifests/mcord-x.yml

# add configurations
xos_new_tosca_config_templates:
- s11-net.yaml
- s1u-net.yaml
- sgi-net.yaml
- spgw-net.yaml
- nbi-net.yaml
- sbi-net.yaml
- flat-net.yaml
- mcord-x-services.yml

xos_services:
- name: venb
- name: vspgwc
- name: vspgwu
- name: sdncontroller

# VTN network
configurationmanagement_network_cidr: 172.27.0.0/24
management_network_ip: 172.27.0.1/24
data_plane_ip: 10.168.0.253/24
How To Build in CiaB?

• First build
  • $ make PODCONFIG=mcord-spirent-virtual.yml config
  • $ make -j4 build

• Second build
  • $ make xos-teardown
  • $ make clean-openstack
  • $ make clean-profile
  • $ make -j4 build
  • $ make compute-node-refresh
Let’s See the Result
Summary

• M-CORD
  • Promising technology to manage EPC/RAN nodes
  • Easy to define services/networks with TOSCA engine

• In this talk
  • Services and networks in M-CORD POD
  • Current scenario of M-CORD
  • Definition of M-CORD services/networks
  • How to make a new service in terms of networks
Future Work and Collaboration Opportunities

• Preparing M-CORD Release 1
• Think about new services
  • Need to make new services/synchronizers in XOS
  • Connect each VNF with the new services
  • …
• Test/Deploy/Evaluation…
• Anything you propose: discuss ➔ discuss again ➔ … ➔ just do it
How to Get Involved?

- **Mailing list**
  - https://groups.google.com/a/opencord.org/forum/#!forum/mobile

- **Slack channel**
  - #m-cord channel in CORD slack (opencord.slack.com)

- **Guide-book**
  - https://guide.opencord.org/profiles/mcord/

- **Code repository**
  - https://gerrit.opencord.org

- **Regular meeting**
  - M-CORD meeting: Monday 9:30 AM PST
Useful Links

• CORD website:
  • http://opencord.org

• Tutorials, documents, and others
  • https://wiki.opencord.org and https://guide.opencord.org

• CORD github/gerrit
  • https://github.com/opencord and https://gerrit.opencord.org

• By email:
  • {woojoong, pingping}@opennetworking.org
Thank you for Listening