



M-CORD Connectivity: Deep Technical Dive

Open Networking Foundation (ONF)

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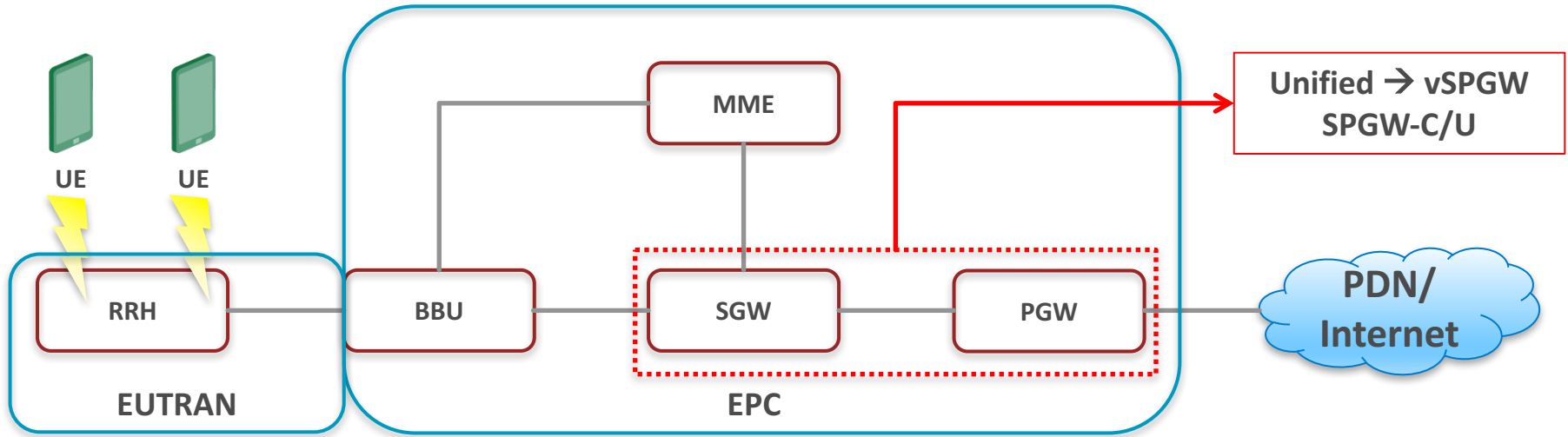
Contents



CORDTM
Central Office Re-architected as a Datacenter

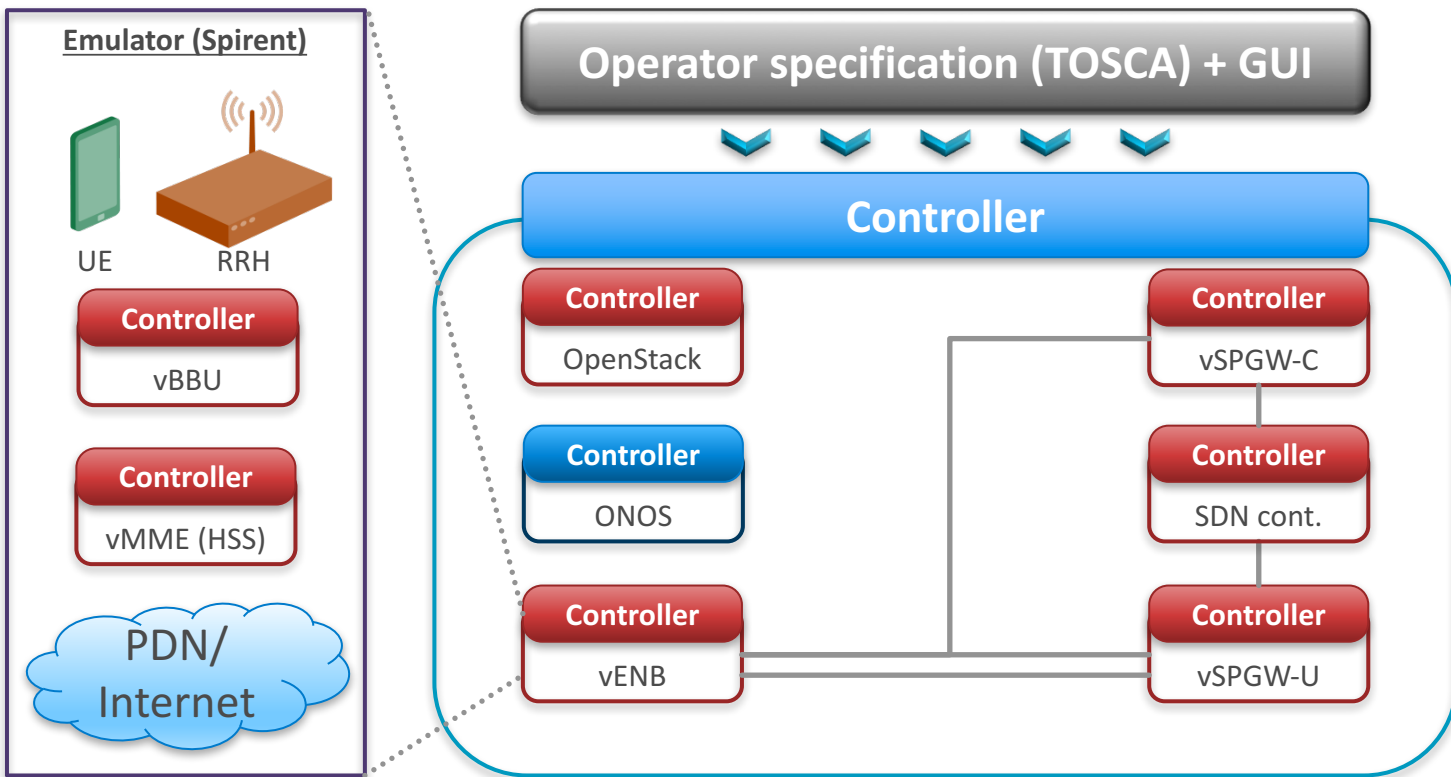
- EPC Connectivity
- Code-Level Analysis
- Let's Connect a New Service
- How to Build?
- Summary

EPC Connectivity



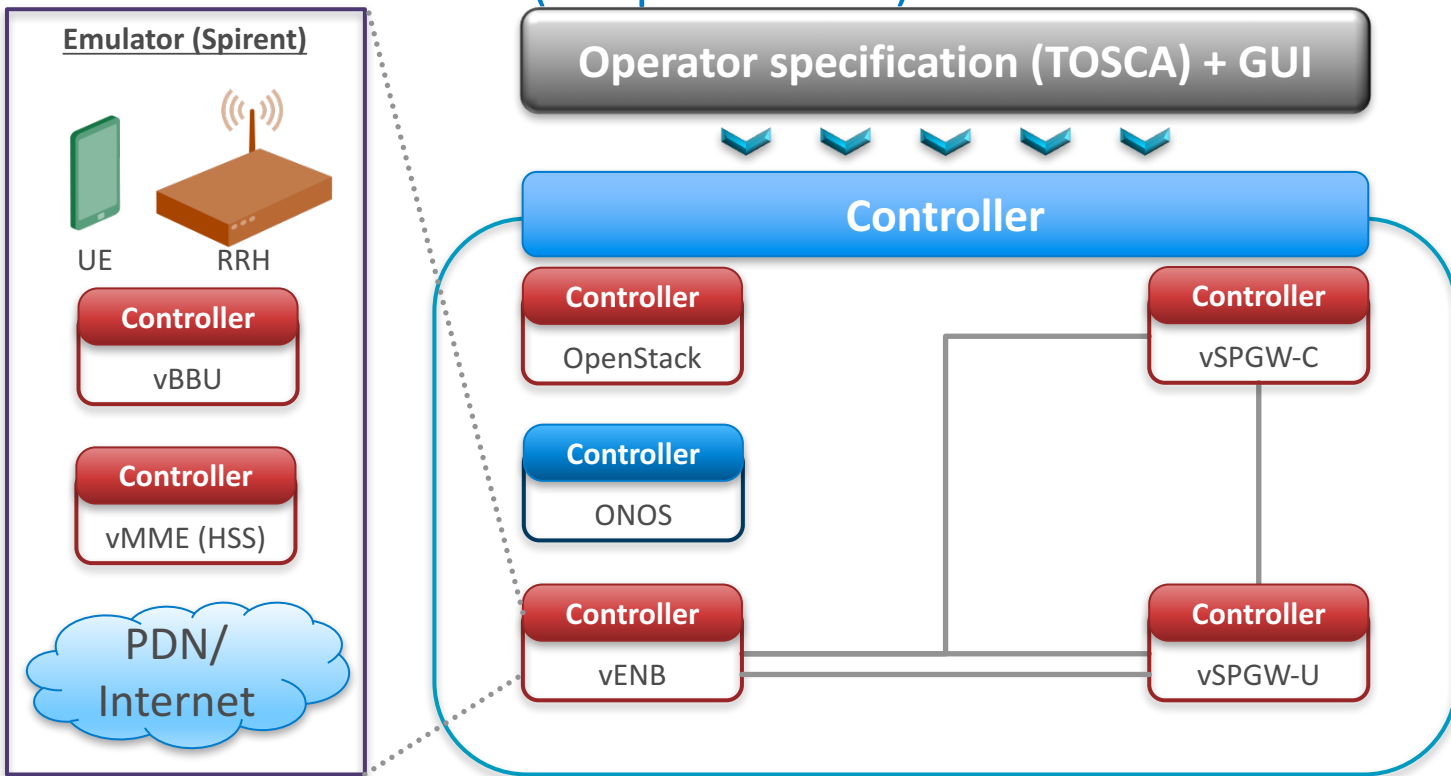
SGW + PGW → SPGW-C + SPGW-U + SDN Controller

M-CORD CORD Build Scenario

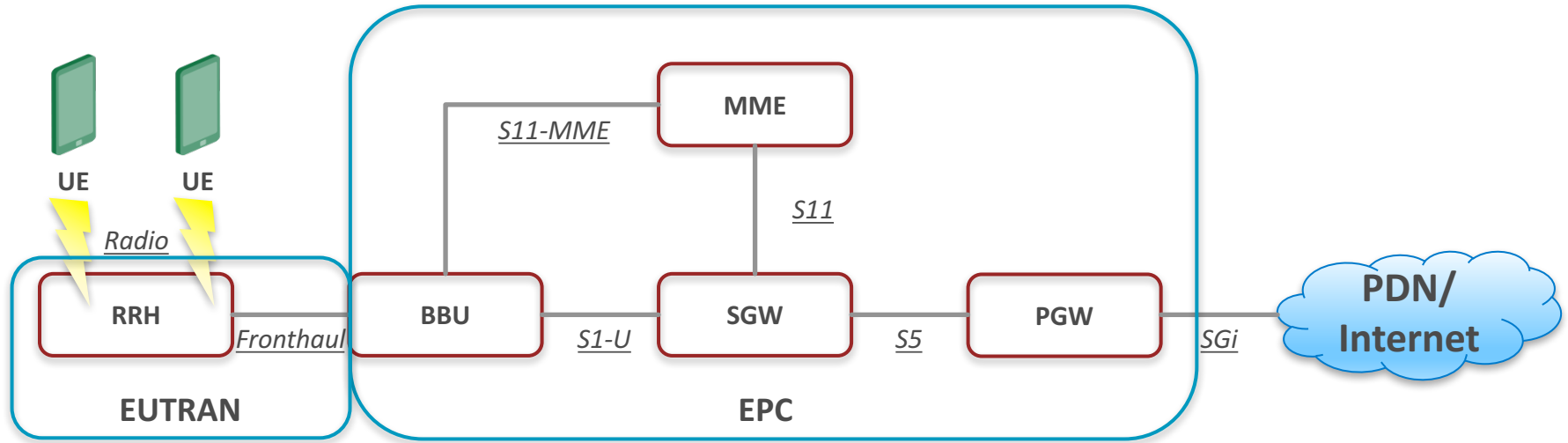


M-CORD CORD Build Scenario

(Simple version)



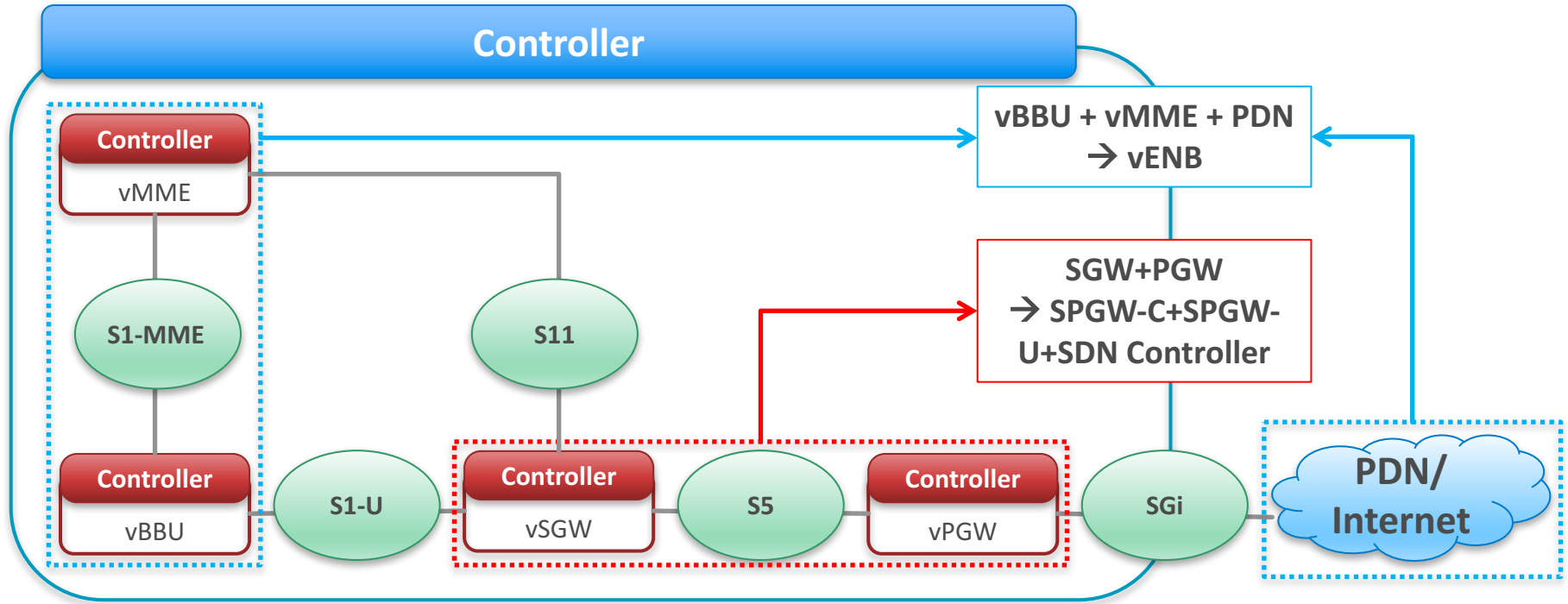
LTE Interfaces



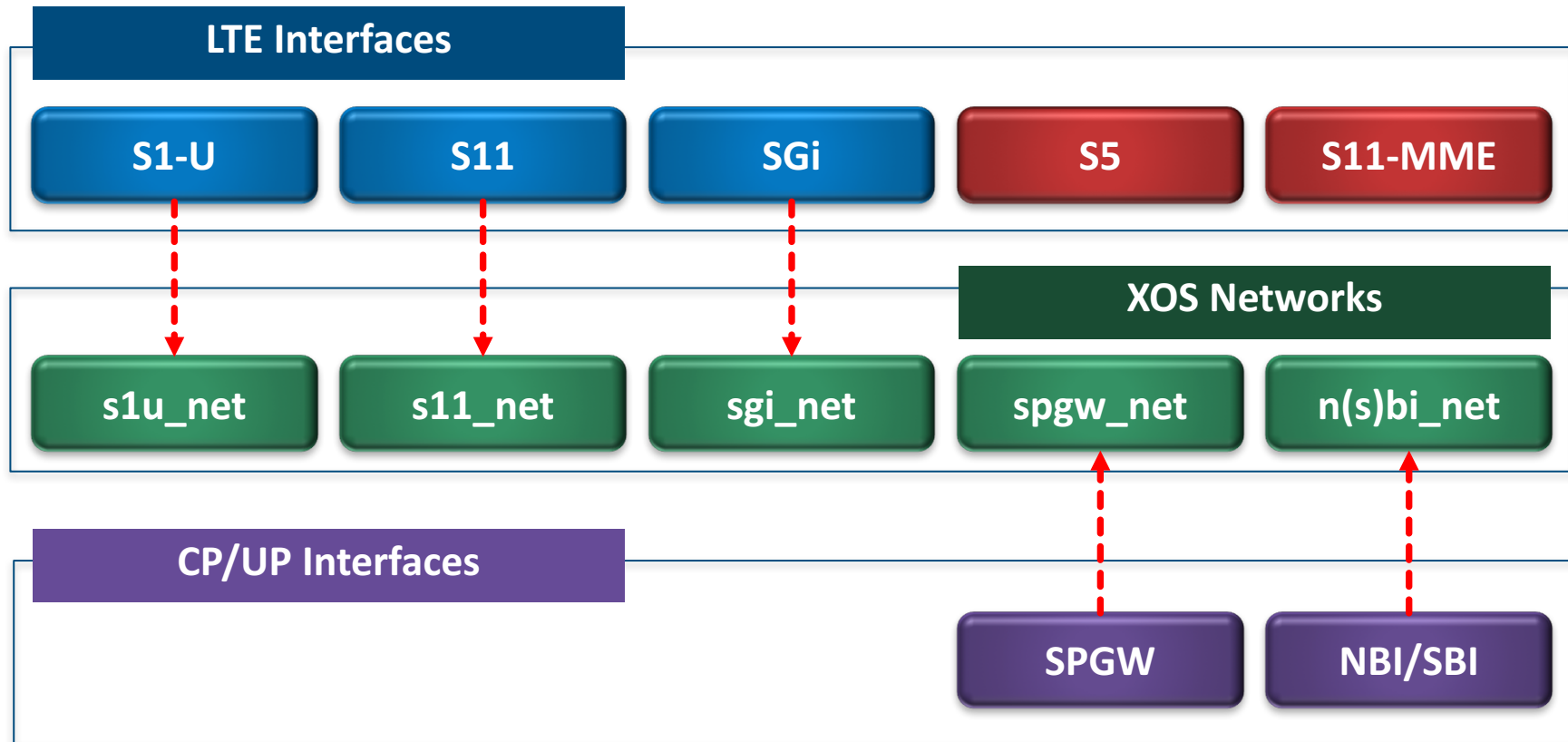
LTE Interface → XOS Network

Network Connectivity in M-CORD

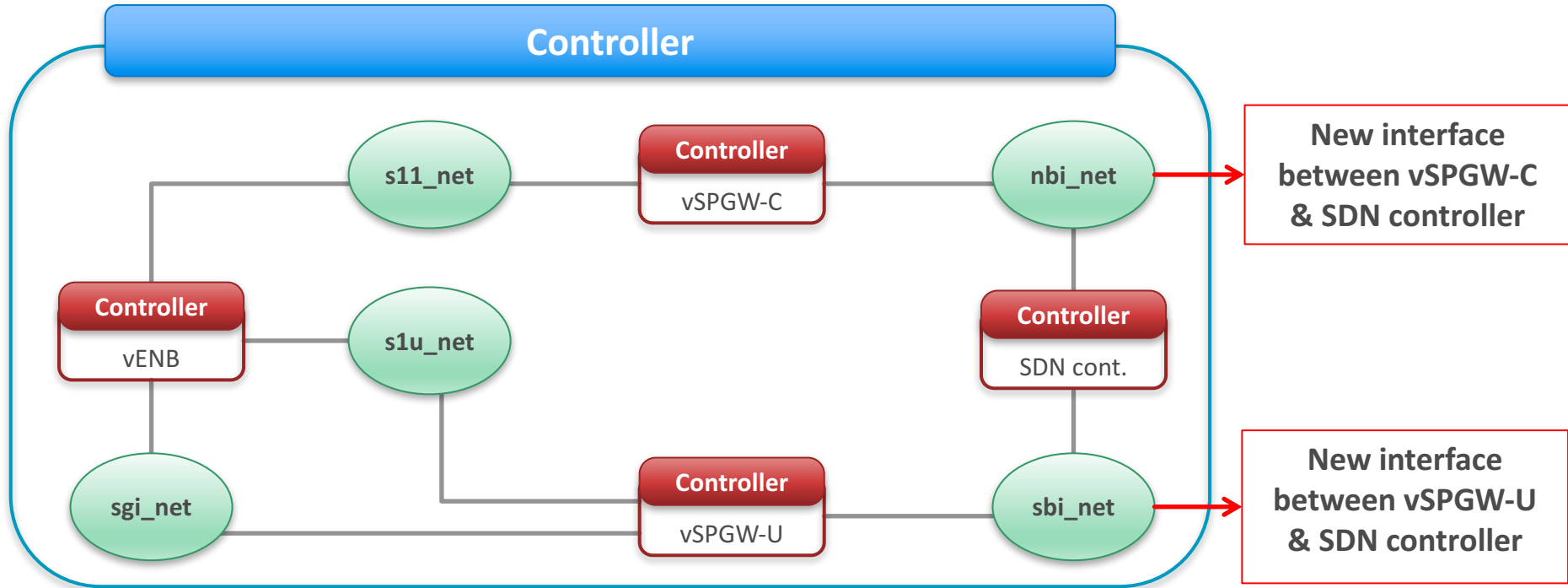
LTE scenario → CORD Build scenario



List of Interfaces into XOS

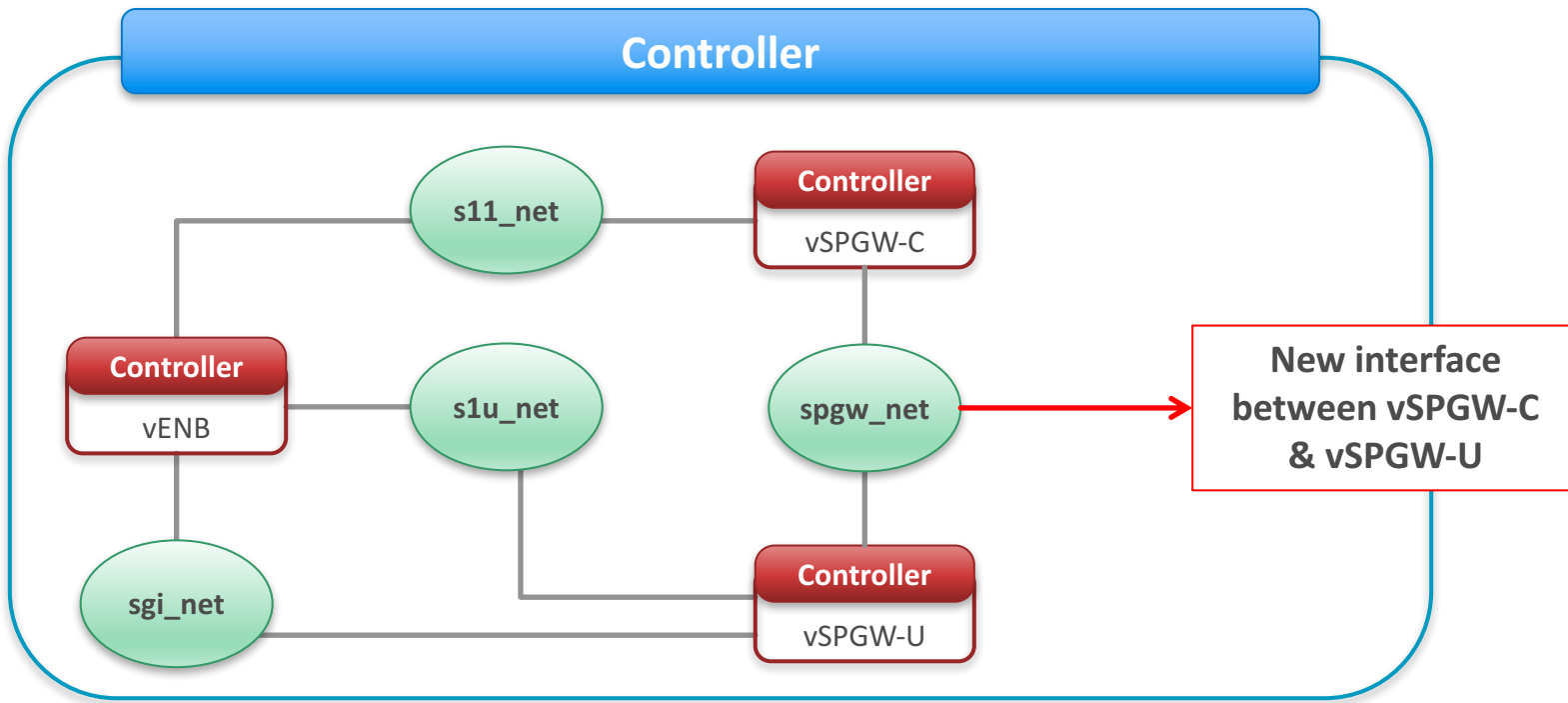


Network Connectivity in M-CORD



Network Connectivity in M-CORD

Simple Version





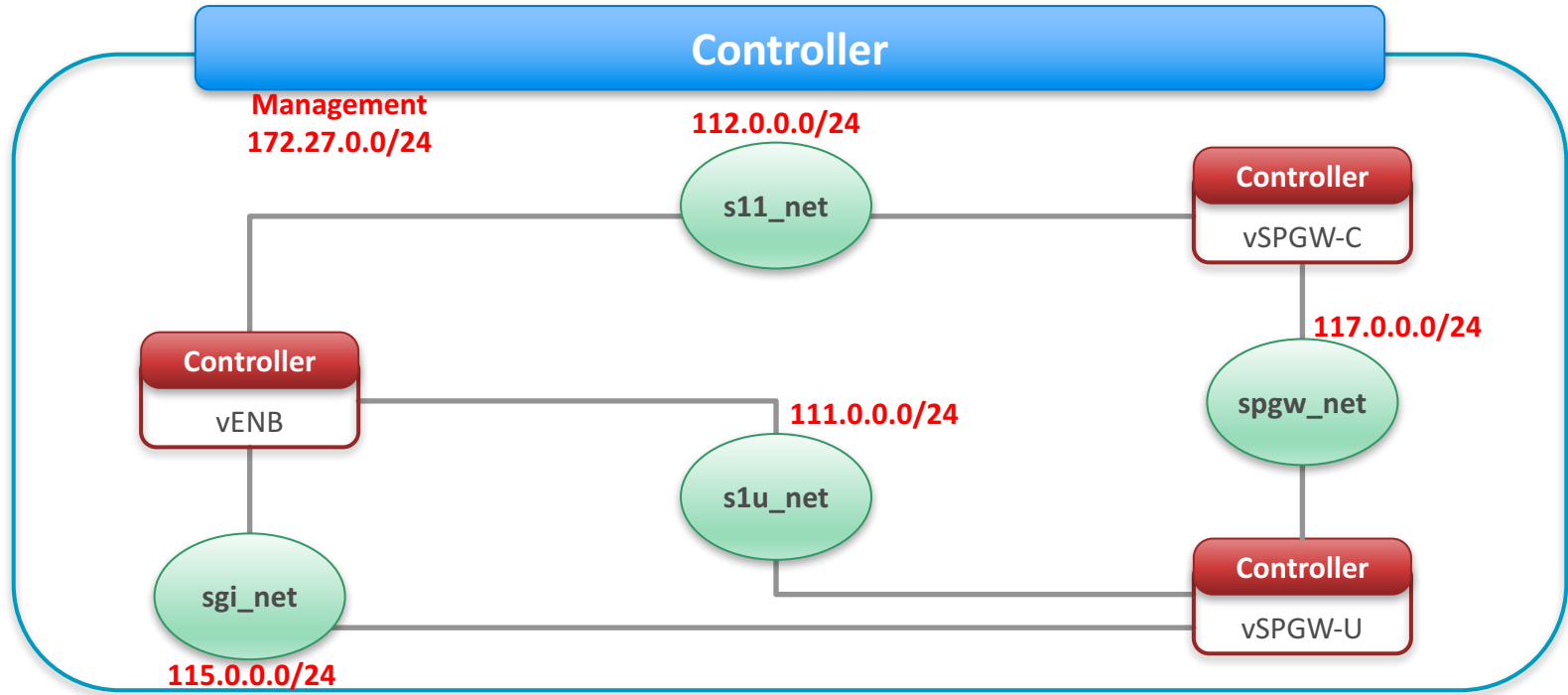
Code-Level Analysis

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



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: toska.relationships.BelongsToOne
```

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: toska.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: toska.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: toska.relationships.BelongsToOne
```

Scenario – Network Definition

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

(1)

s1u_network:

type: tosa.nodes.Network

properties:

must-exist: true

name: s1u_network

s11_network:

type: tosa.nodes.Network

properties:

must-exist: true

name: s11_network

(2)

sgi_network:

type: tosa.nodes.Network

properties:

must-exist: true

name: sgi_network

spgw_network:

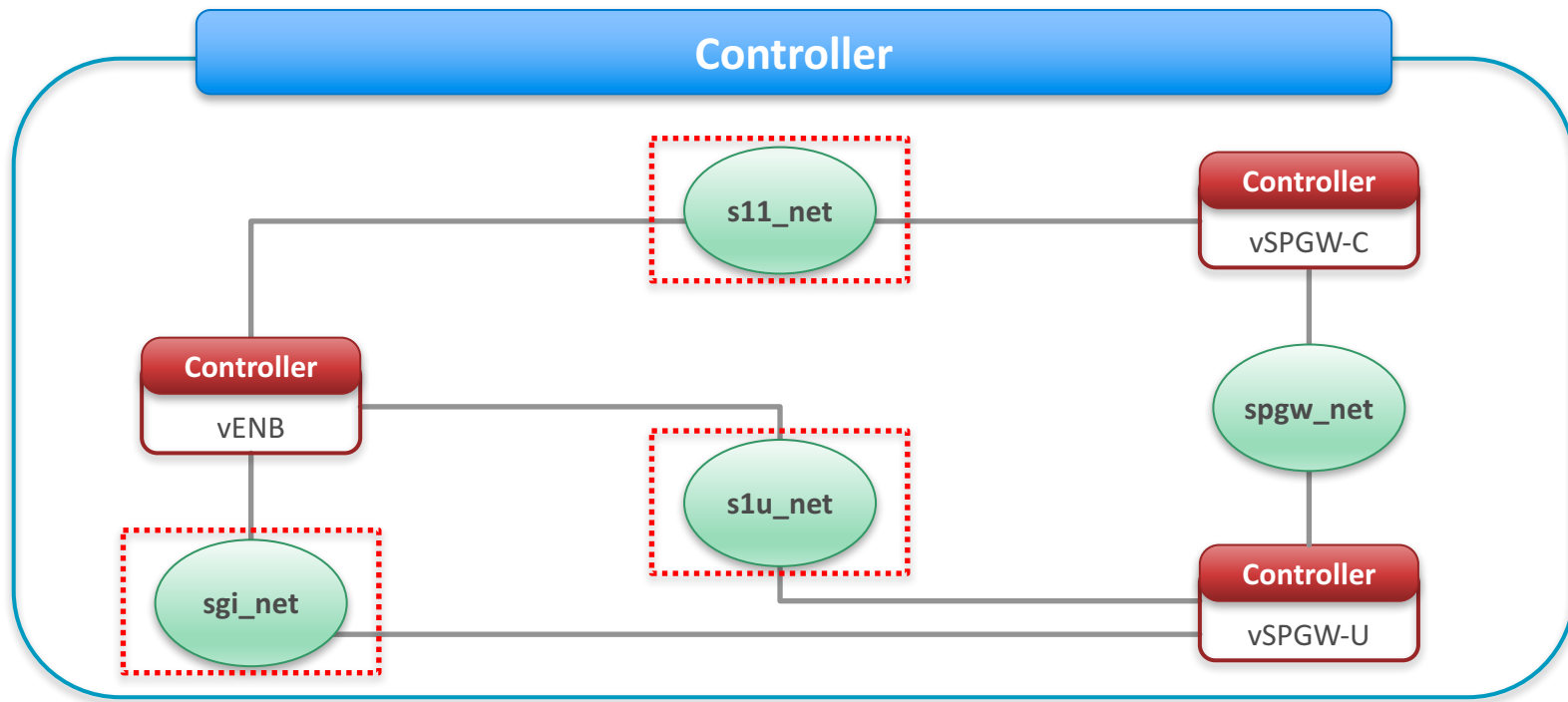
type: tosa.nodes.Network

properties:

must-exist: true

name: spgw_network

Define vENB Service and Networks



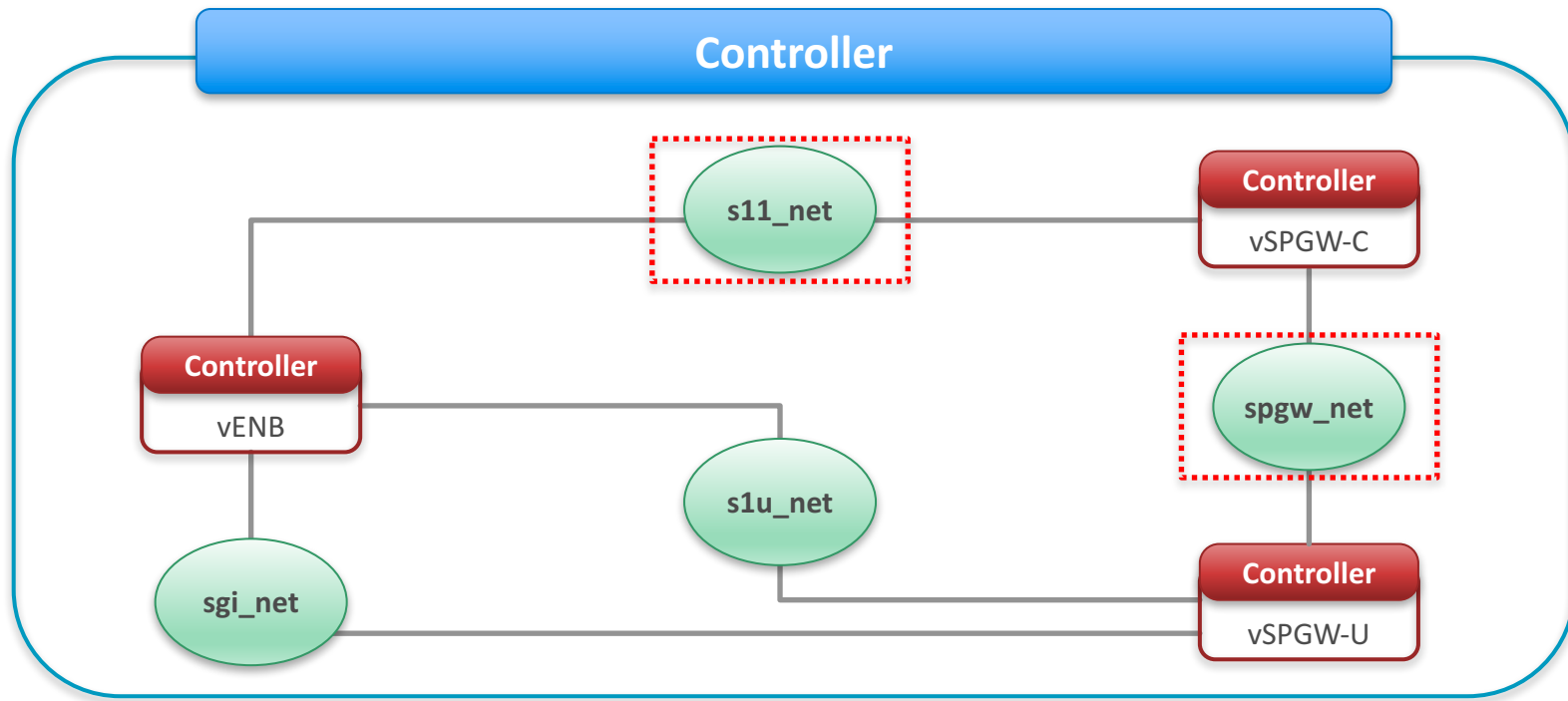
vENB Definition

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

```
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



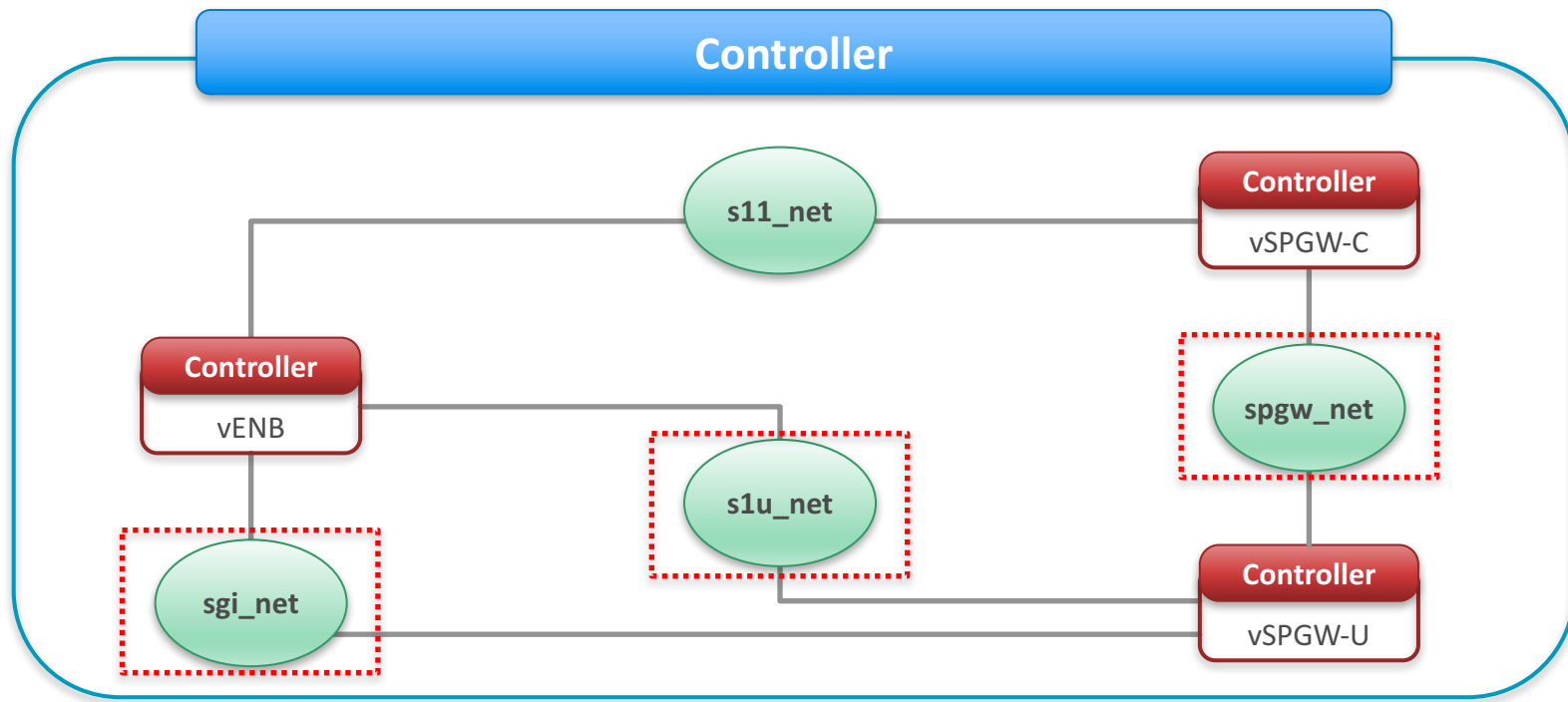
vSPGW-C Definition

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

```
service#vspgwc:
  type: tosca.nodes.VSPGWCSERVICE
  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#vspgwc_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: toska.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.yaml**

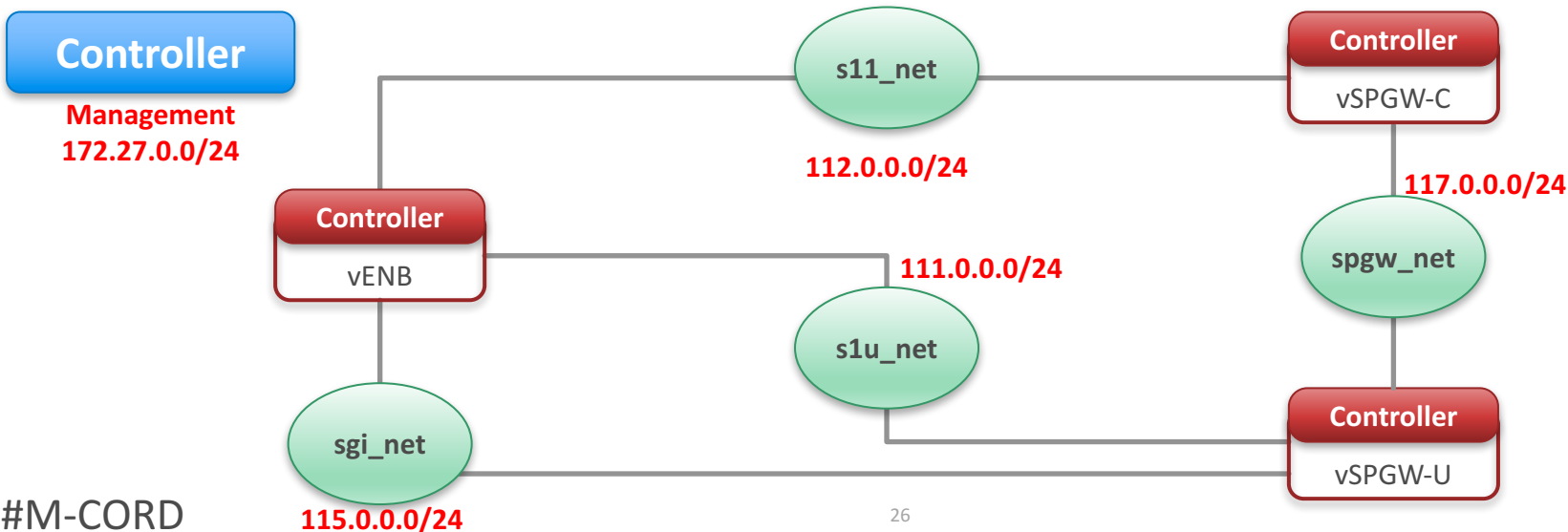
xos_services:

...

- 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_rsaprofile_library: "mcord"

Result: Network Connectivity in M-CORD

Name	Status	Task State	Power State	Networks
mysite_venb-2	ACTIVE	-	Running	s1u_network=111.0.0.3; sgi_network=115.0.0.3; management=172.27.0.4; s11_network=112.0.0.3; fl
mysite_vspgwc-8	ACTIVE	-	Running	management=172.27.0.9; spgw_network=117.0.0.8; s11_network=112.0.0.5
mysite_vspgwu-11	ACTIVE	-	Running	s1u_network=111.0.0.9; sgi_network=115.0.0.9; management=172.27.0.12; spgw_network=117.0.0.11

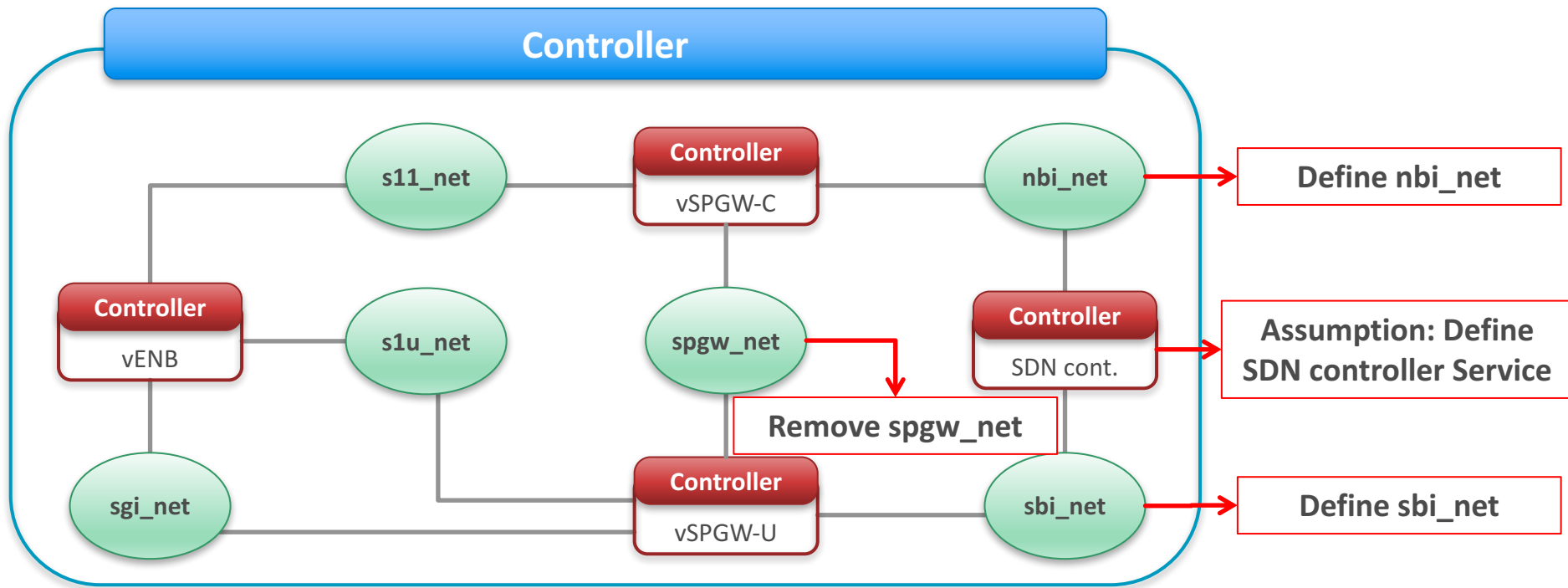




Let's Connect a New Service

An Example of SDN Controller Service

Overview



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: toska.relationships.BelongsToOne
```

Scenario – Network Definition

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

(1)

```
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
    ...
```

(2)

```
{{ 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

(1)

```
s1u_network:
  type: toasca.nodes.Network
  properties:
    must-exist: true
    name: s1u_network
s11_network:
  type: toasca.nodes.Network
  properties:
    must-exist: true
    name: s11_network
```

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

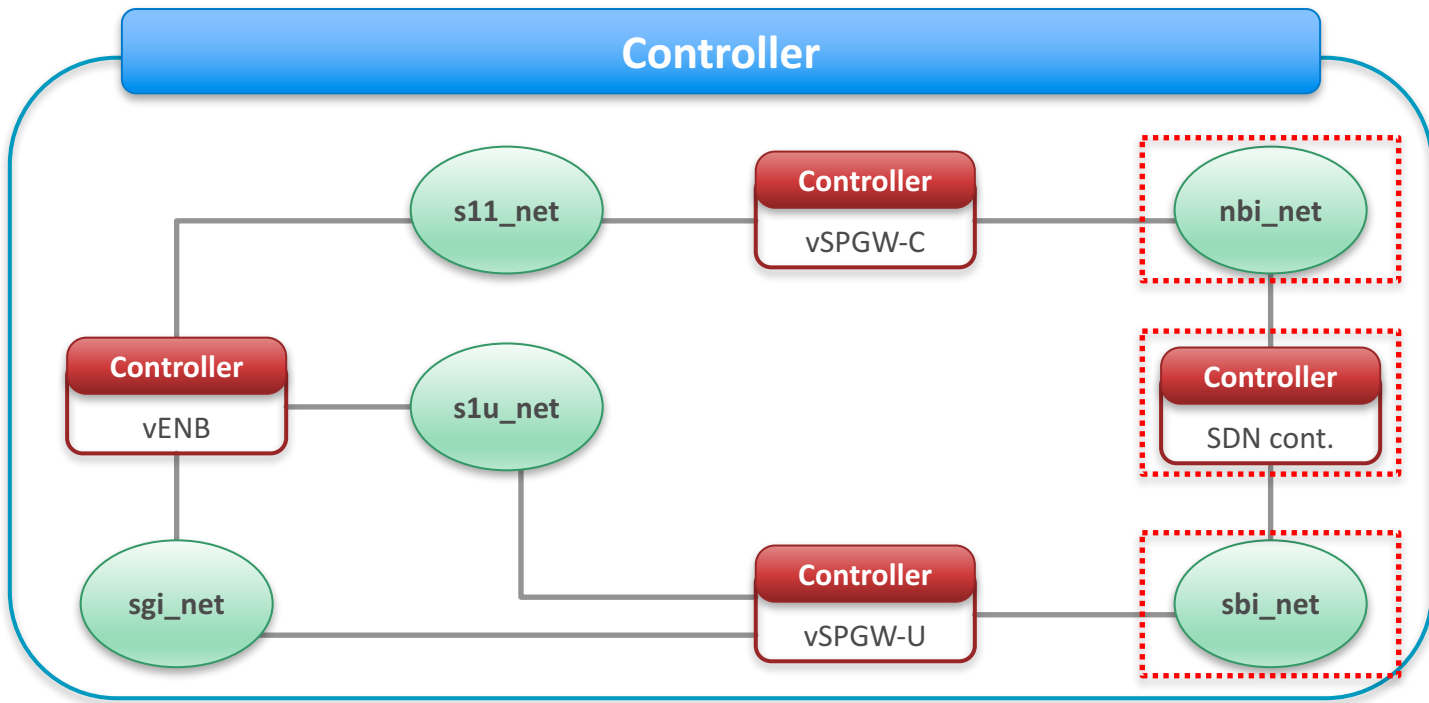
(2)

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

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

```
spgw_network:
type: toasca.nodes.Network
properties:
  must-exist: true
  name: spgw_network
```

Define SDN Controller Service and Networks



SDN Controller Model

Orchestration/xos_services/sdn-controller/xos/sdncontroller.xproto

```
option name = "SDNController";  
option app_label = "sdncontroller";  
option kind = "vEPC";
```

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

Service

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

Vendor

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

ServiceInstance

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

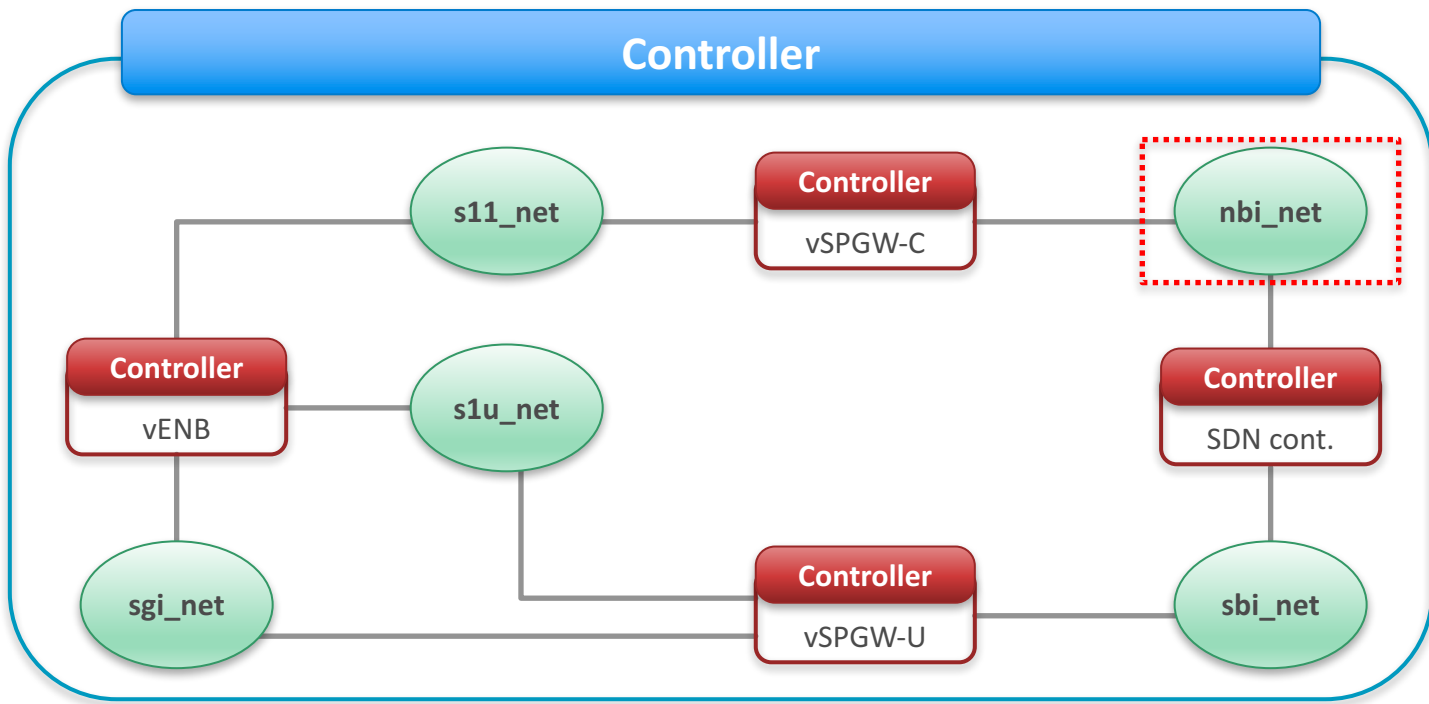
...

sdncontroller_slice_sbi_network:

...

sdncontroller_slice_nbi_network:

Change vSPGW-C Networks



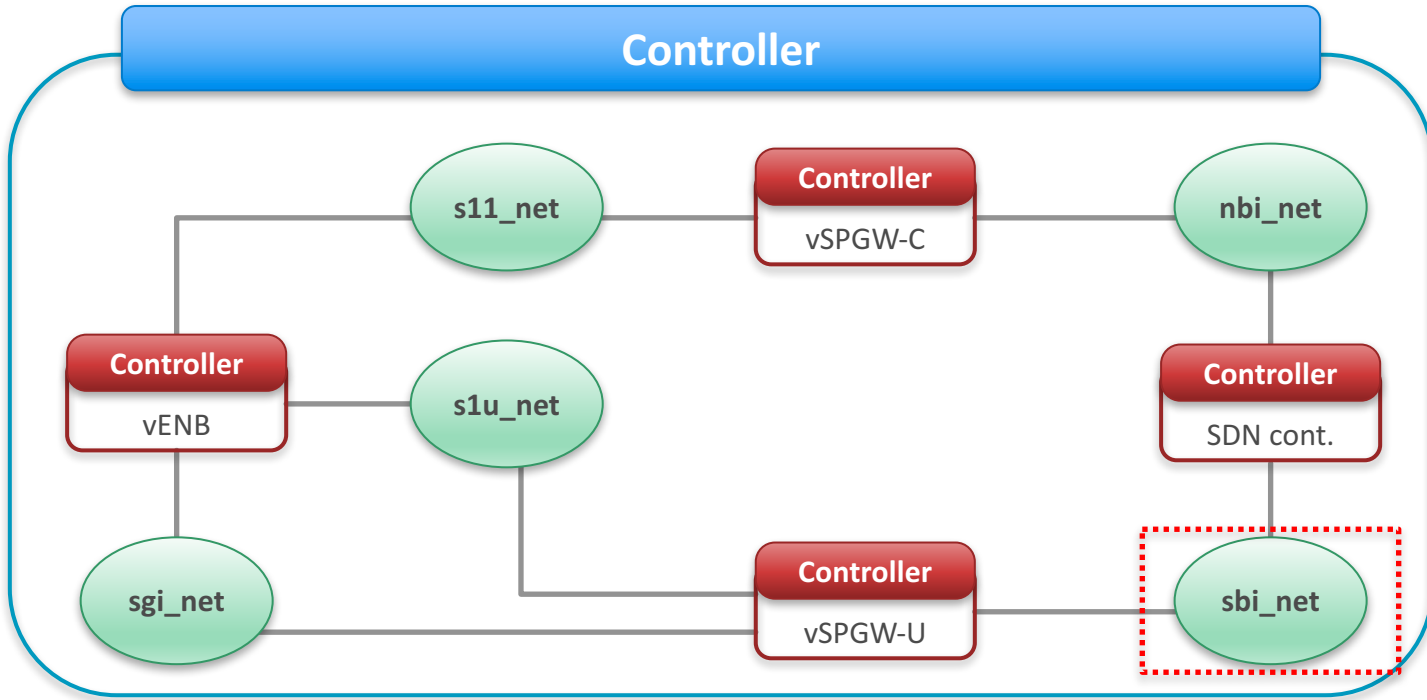
Scenario – vSPGW-C Definition

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

```
service#vspgwc:
  type: tosa.nodes.VSPGWCSERVICE
  properties:
    ...
  {{ site_name }}_vspgwc:
    description: vspgwc slice
    type: tosa.nodes.Slice
    properties:
      name: {{ site_name }}_vspgwc
      default_isolation: vm
      network: noauto
    requirements:
      - service:
          node: service#vspgwc
          relationship: tosa.relationships.BelongsToOne
    ...
```

```
intel_vspgwc:
  type: tosa.nodes.VSPGWCVendor
  ...
serviceinstance#vspgwc_instance:
  type: tosa.nodes.VSPGWCTenant
  ...
vspgwc_slice_management_network:
  ...
vspgwc_slice_s11_network:
  ...
vspgwc_slice_nbi_network: # before: spgw_network
type: tosa.nodes.NetworkSlice
requirements:
  - network:
      node: nbi_network # before: spgw_network
  - slice:
      node: {{ site_name }}_vspgwc
```

Change vSPGW-U Networks



Scenario – vSPGW-U Definition

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

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

```
intel_vspgwu:
  type: tosa.nodes.VSPGWUVendor
  ...
serviceinstance#vspgwu_instance:
  type: tosa.nodes.VSPGWUTenant
  ...
vspgwu_slice_management_network:
  ...
vspgwu_slice_sgi_network:
  ...
vspgwu_slice_sbi_network: # before: spgw_network
type: tosa.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.yaml

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