# TOSCA

*Topology and Orchestration Specification for Cloud Applications (TOSCA) Standard*

## OASIS TOSCA presentation to ETSI NFV Information Modelling Workshop

# Agenda

- **Overview**
  - **What is TOSCA**
  - **Main Features**
    - containers, policies，network modeling
  - **Some Open Source Implementations**
    - Openstack, Tacker, Parser, Senlin, alien4cloud, Cloudify
- **Way forward**
  - **How TOSCA can be used in NFV**
    - Many problems can be solved with TOSCA
  - **Sample templates**

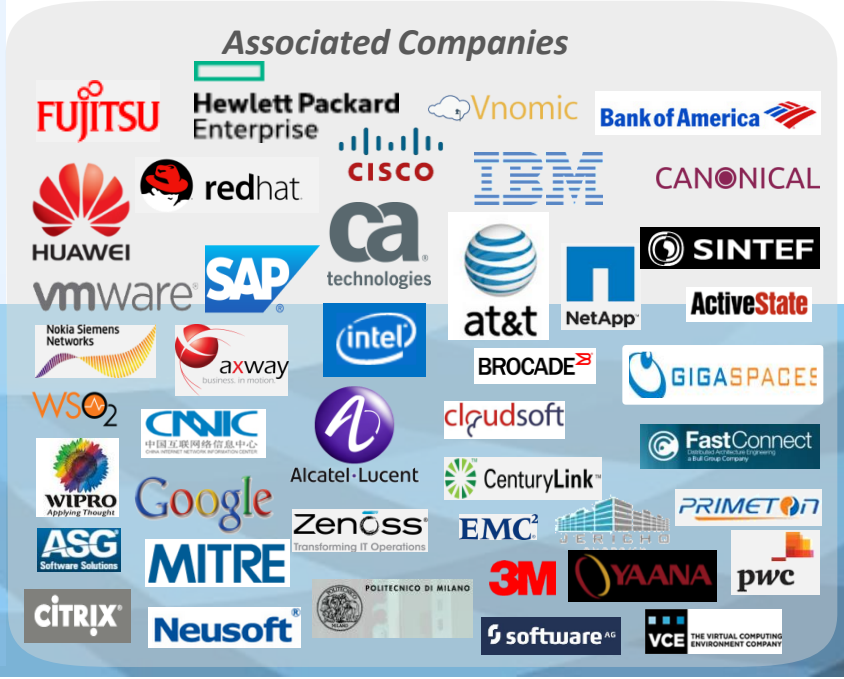

2

# I. Overview Part

# What is TOSCA?

- **TOSCA** is an important **new open cloud standard,** that is enabling a unique eco-system, supported by a large and growing number of international industry leaders…

- **TOSCA Version 1.0 Specification approved as an OASIS Standard** *(Nov 2013)*
- **Government and Corporate Awareness**:
  - **OASIS**: 600+ participant organizations. 5000+ participants spanning 65+ countries
  - **TOSCA Committee**: 170+ people 45+ companies/orgs
  - **International Standards & Research**: ETSI NFV liaison, EU FP7, etc.
  - **Industry Analysts**: Forrester names TOSCA as a top four cloud open standard *(Mar 2014)*
- **Multi-company Interoperability Demonstrated**:
  - **EuroCloud 2013** *(Oct 2013)*: IBM, SAP, Fujitsu, Huawei, HP, Vnomic, Zenoss and others
  - **Open Data Center Alliance**: TOSCA Application Portability in the Enterprise Cloud PoC *(Jan 2014)*



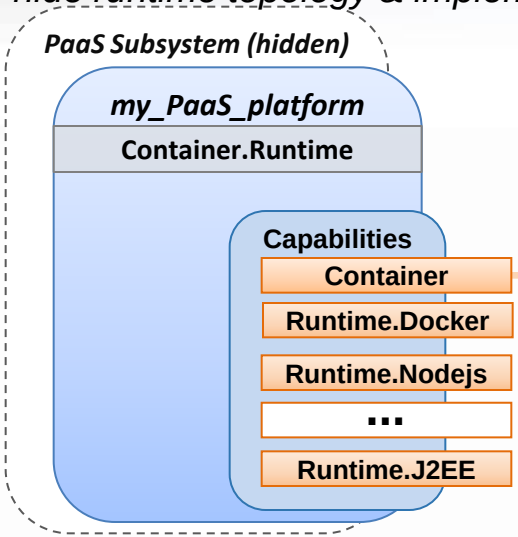
# Main features

- Container
- Policies
- Network modeling

# TOSCA Model for Containers leveraging Repositories

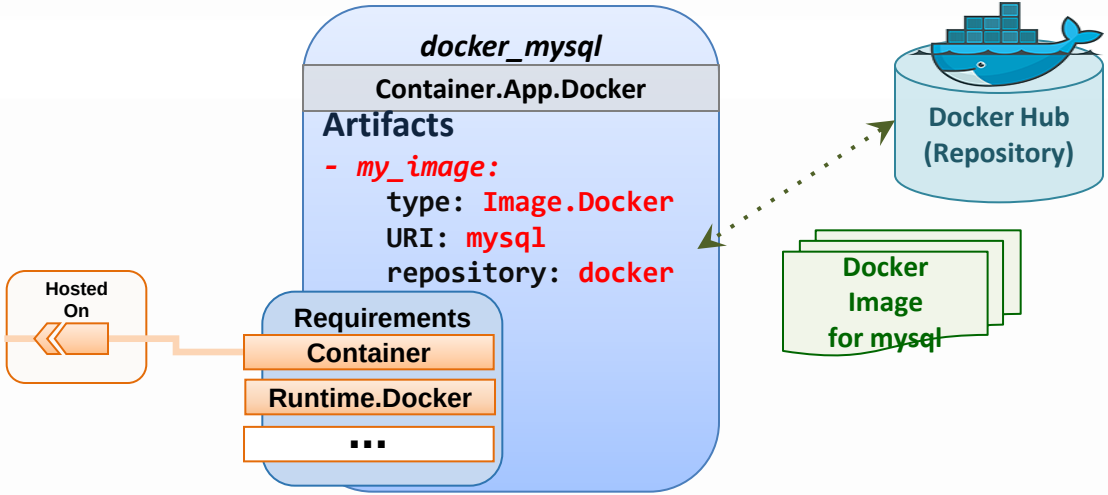
## PaaS Modeling

- *Template author chooses to expose or hide runtime topology & implementation*




## Container Application Modeling

- ***Agnostic of PaaS Cloud Provider***
  - *PaaS on OpenStack, Cloud Foundry, Azure, etc.*




**PaaS Layer exposes "runtimes" as TOSCA Capabilities**

- *Docker, Nodejs, JSP, J2EE, etc.*

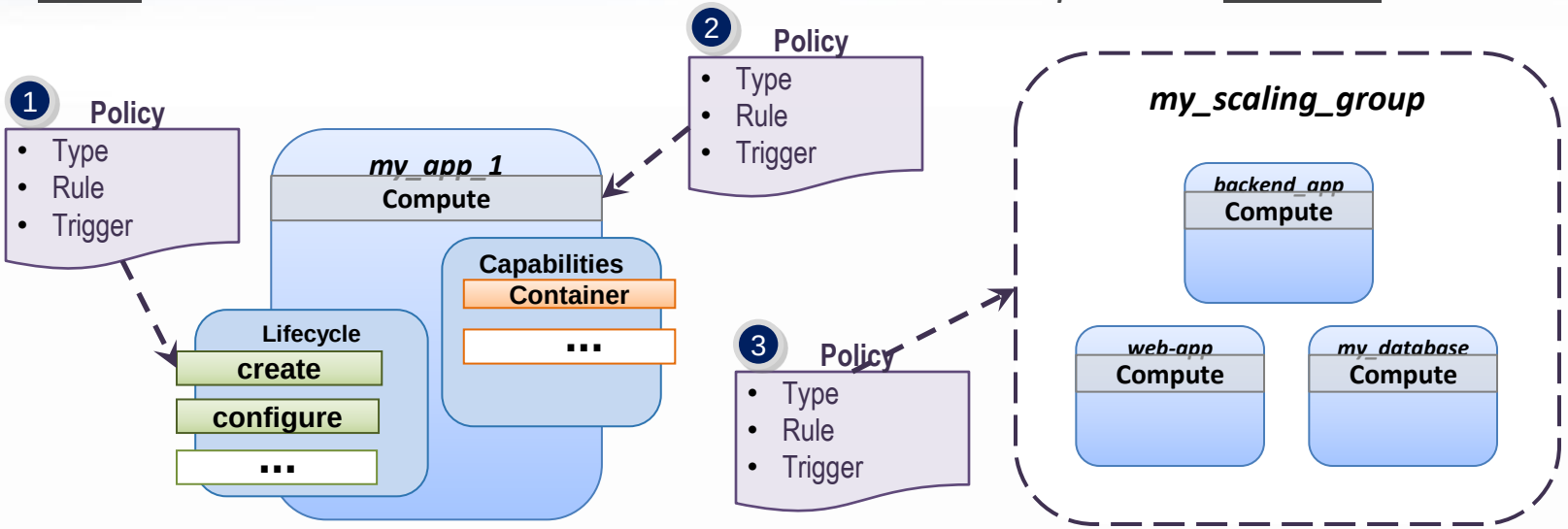
**Orchestrators could automatically retrieve and deploy a Docker image from a declared Repository**

- *TOSCA Templates can model repositories*
- *Orchestrators could dynamically "pull" from multiple repositories*

# TOSCA Direction to model Policies

Supported areas: **Placement** (Affinity), **Scaling** and **Performance**

- *with **Rules** that are evaluated to execute Automatic and Imperative **Triggers***

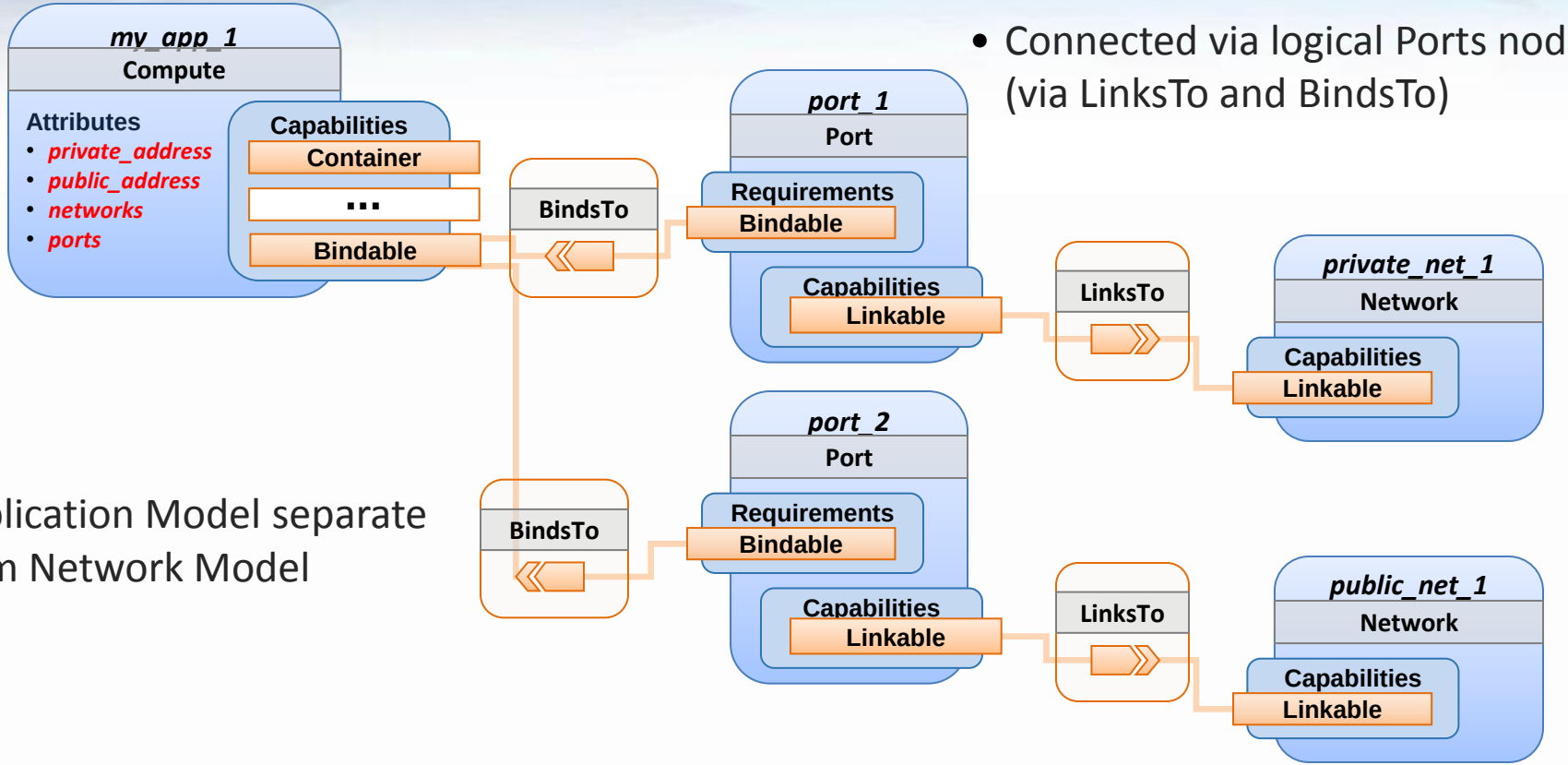



Policies modeled as *Requirements* using *Capability Types that can be attached to*

- *Interfaces or specific Operations*
- *Nodes and*
- *Groups of Nodes*

***TOSCA defines policies using an Event-Condition-Action model***

# TOSCA Model for Logical Public & Private Cloud Networks




- Connected via logical Ports nodes (via LinksTo and BindsTo)

- Application Model separate from Network Model

*Allows developers to model JUST the application bind to existing tenant networks*

# Some Open Source Implementations

- Senlin
- Tacker
- Parser
- Alien4cloud
- Cloudify

# TOSCA in OpenSource

## Openstack

**Heat-translator**

Deployment TemplateTranslation

**Senlin**

Policy (Placement&scaling)

**Tacker**

Opensource MANO

Cloudify

Service Orchestration & Management

**OPNFV**
Parser

Deployment TemplateTranslation

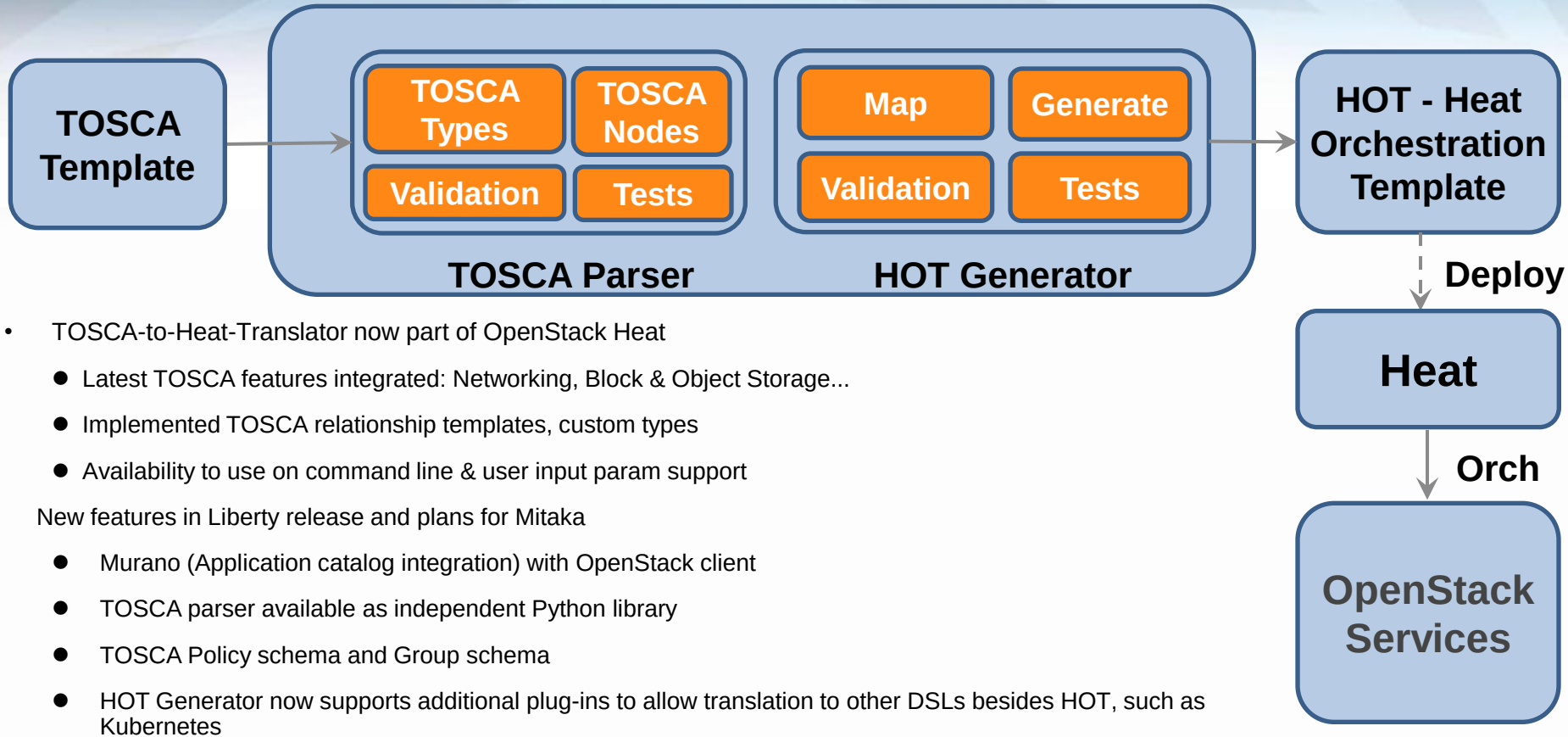
seaclouds

www.seaclouds-project.eu/media.html

alien4cloud

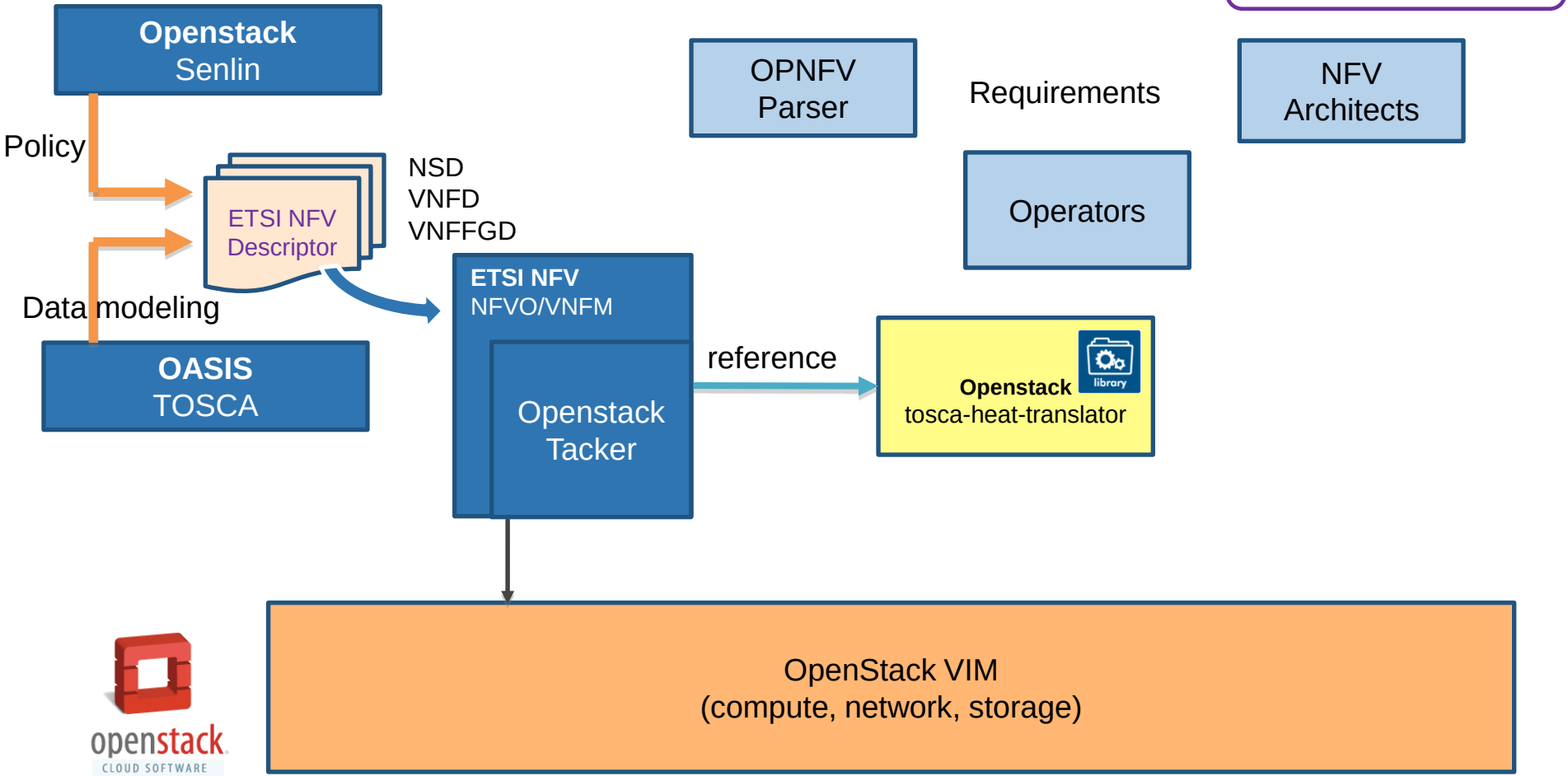
Topology & LCM Design
http://alien4cloud.github.io/

# Automated TOSCA-based Orchestration Now Part of OpenStack




- TOSCA-to-Heat-Translator now part of OpenStack Heat
  - Latest TOSCA features integrated: Networking, Block & Object Storage...
  - Implemented TOSCA relationship templates, custom types
  - Availability to use on command line & user input param support
- New features in Liberty release and plans for Mitaka
  - Murano (Application catalog integration) with OpenStack client
  - TOSCA parser available as independent Python library
  - TOSCA Policy schema and Group schema
  - HOT Generator now supports additional plug-ins to allow translation to other DSLs besides HOT, such as Kubernetes

# *OpenSource related to ETSI NFV and OASIS TOSCA*



# II. Way Forward Part

# How TOSCA can be used in NFV

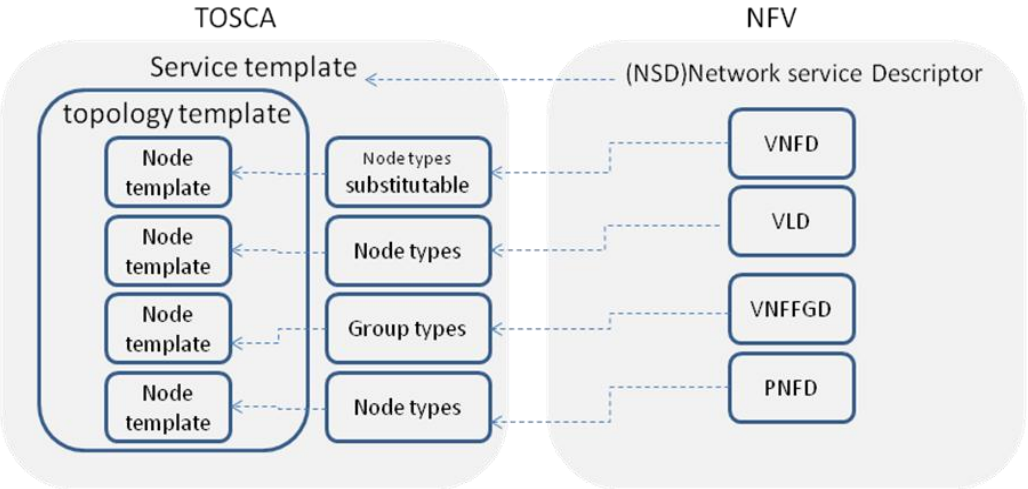
Many problems can be solved with TOSCA

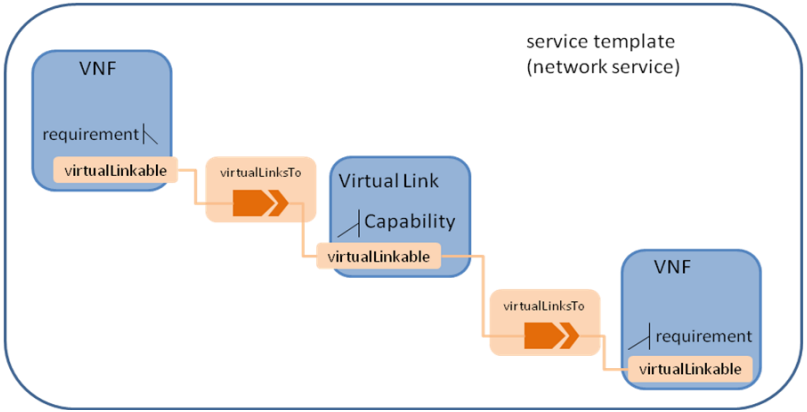
- ***Topology***
- ***Composition***
- ***Lifecycle***
- ***Portability***

# Topology

***As the Topology and Orchestration Specification for Cloud Applications, TOSCA is mainly used to describe the topology of the deployment view for cloud applications.***

- ***Defining node templates to describe components in the topology structure***
- ***Defining relationship templates to describe connecting, dependency, deployment ordering***



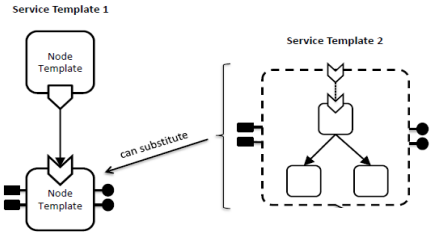




***TOSCA can be used to describe the topology of a Network service or VNF as defined by ETSI NFV.***

***VNF, VL can be defined as node templates in TOSCA. A new virtualLinksTo relationship type can be defined to connect VNF and VL.***

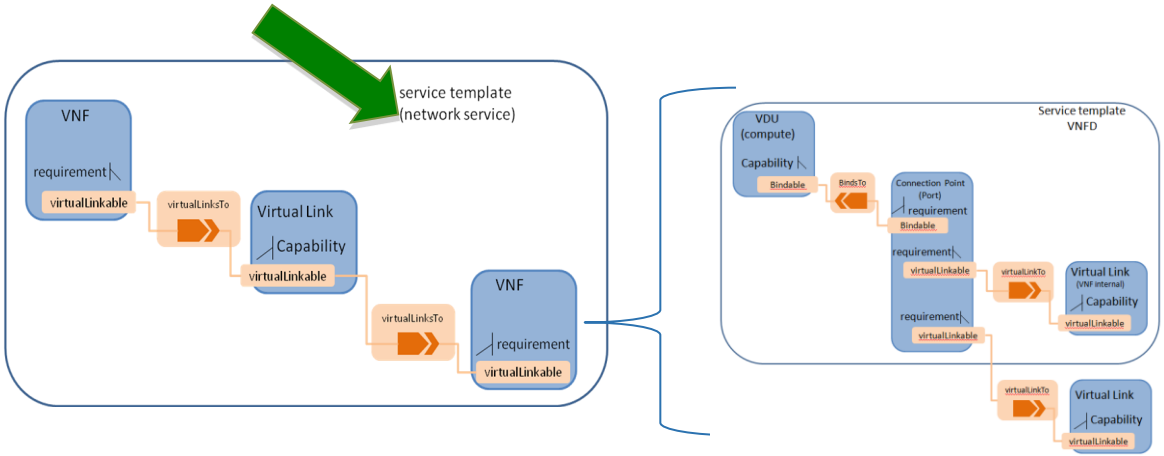
# Composition

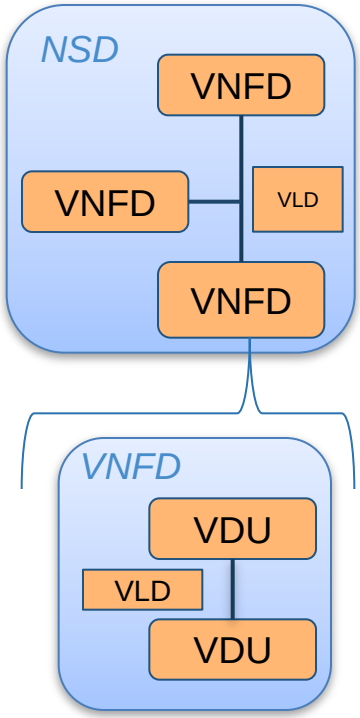
***Any node in a TOSCA topology can be an abstraction of another layer or subtopology***




***NFV information model has the layered structure.***

- ***NSD are composed of VNFD, VLD, PNFD and etc.***
- ***VNFD are composed of VDU, VLD and etc.***



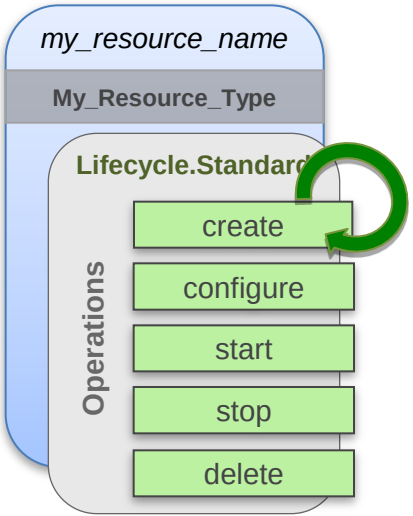

***Using the TOSCA substitution feature, NFV information model can be described by using multiple TOSCA service templates***

# Lifecycle

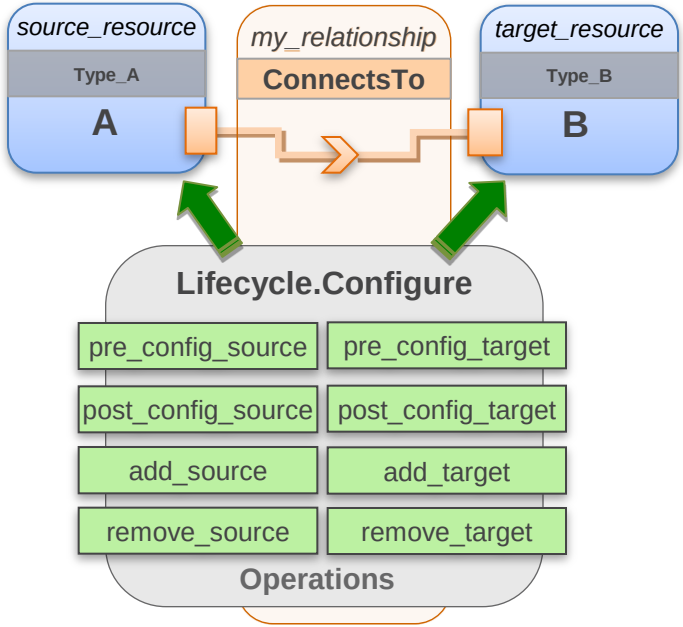
***TOSCA models have a consistent view of state-based lifecycle***

- ✓ have **Operations** (implementations) that can be sequenced against state of any dependent resources
- ✓ *fits into any* ***Management Framework*** *or* ***Access Control System***

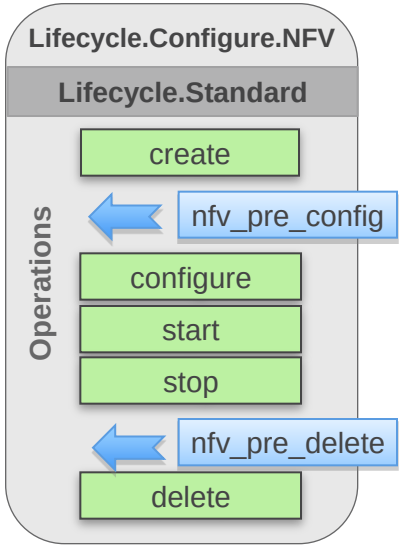
## Standardize Resource Lifecycle




## Standardize Relationship Lifecycle




## Lifecycle Customization

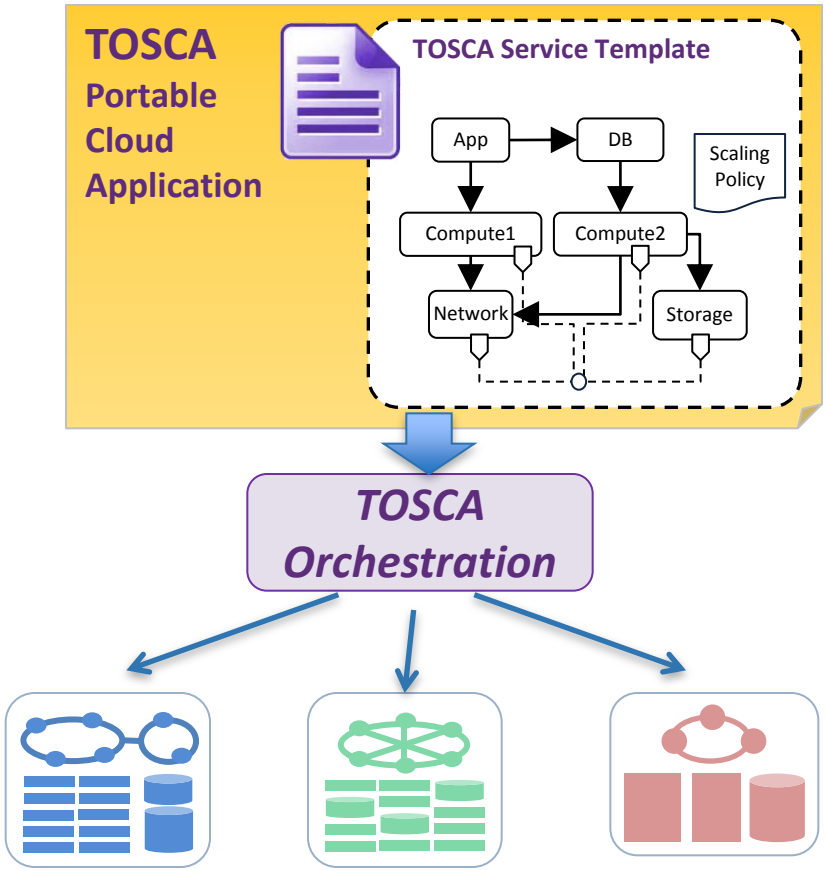



*Create new NFV Lifecycles or Augment existing (via subclassing)*

- ✓ **Parameters** and **Policies** can be supplied to operations to affect resource behavior (state)
- ✓ **Workflow** - TOSCA is developing workflow to allow handling complex state changes, configurations, etc.

***TOSCA Lifecycle can be customized for NFV Resources and Relationships***

# Portability



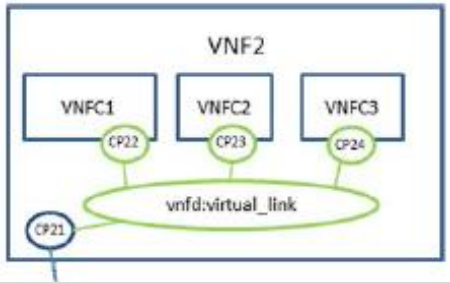

*By expressing application requirements independently from cloud capabilities and implementation,*
*TOSCA provides:*

- *Multi VIM Support*
- *Portability of services across clouds*
- *Declarative model spanning infrastructure and service*
- *Manipulate the orchestration declaratively instead of dealing with disparate cloud APIs (leave that to the TOSCA Orchestrator)*

***TOSCA enables NFV applications flexible movement between different cloud infrastructures.***

# Sample Examples

# VNFD example

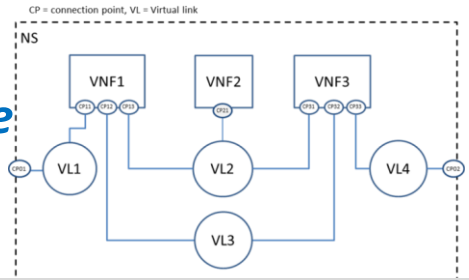



```
tosca_definitions _version:      tosca_simple_profile_for_nfv_1_0_0
tosca_default_namespace :    # Optional. default namespace (schema, types version)
template_name:                    # Optional name of this service template
template_author:                  # Optional author of this service template
template_version:                 # Optional version of this service template
description: example for VNF2
service_properties:
    ID:                                  # ID of this VNF Descriptor
    vendor:                              # Provider or vendor of the VNF
    version:                             # Version of VNF software, described by the
descriptor under consideration
imports:
    - tosca_base_type_definition.yaml
  # list of import statements for importing other definitions files
topology_template:

inputs:

subsititution_mappings:
     node_type: tosca.nodes.nfv.VNF.VNF2
     requirements:
       virtualLinkable: [CP21, virtualLinkable]
```

```
node_templates:
    VDU1:
       type: tosca.nodes.nfv.VDU
       properties:
          # omitted here for brivity
       requirements:
          - host:
            node_filter:
              capabilities:
                # Constraints for selecting “host” (Container Capability)
                - host
                   properties:
                     - num_cpus: { in_range: [ 1, 4 ] }
                     - mem_size: { greater_or_equal: 2 GB }
                # Constraints for selecting “os” (OperatingSystem Capability)
                - os:
                   properties:
                     - architecture: { equal: x86_64 }
                     - type: linux
                     - distribution: ubuntu       Interfaces:
                      # omitted here for brevity
       artifacts:
          VM_image:vdu1.image  #the VM image of VDU1
       Interface:
         Standard:
         create:vdu1_install.sh
         configure:
           implementation: vdu1_configure.sh
VDU2:
   type: tosca.nodes.nfv.VDU
   properties:
     # omitted here for brivity

VDU3:
   type: tosca.nodes.nfv.VDU
   properties:
     # omitted here for brivity
```

```
CP21:
   typ
   pro
     type:
   requirements:
     virtualbinding: VDU1

CP22:
   type: tosca.nodes.nfv.CP
   properties:
     type:
   requirements:
     virtualbinding: VDU1
     virtualLink: internal_VL
CP23
   type: tosca.nodes.nfv.CP
   properties:
     type:
   requirements:
     virtualbinding: VDU2
     virtualLink: internal_VL

CP24
   type: tosca.nodes.nfv.CP
   properties:
     type:
   requirements:
     virtualbinding: VDU3
     virtualLink: internal_VL
internal_VL
  type: tosca.nodes.nfv.VL.ELAN
  properties:
    # omitted here for brivity
  capabilities:
    -virtual_linkable
       occurrences: 5
```

# NSD example




```
tosca_definitions_version:      tosca_simple_profile_for_nfv_1_0_0
tosca_default_namespace:    # Optional. default namespace (schema, types version)
template_name:                  # Optional name of this service template
template_author:                # Optional author of this service template
template_version:               # Optional version of this service template
description: example for a NSD.
service_properties:
    ID:                                 # ID of this Network Service Descriptor
    vendor:                             # Provider or vendor of the Network Service
    version:                            # Version of the Network Service Descriptor
imports:
    - tosca_base_type_definition.yaml
    # list of import statements for importing other definitions files
```

```
topology_template:
    inputs:
        flavor ID:
    VNF1:
        type: tosca.nodes.nfv.VNF.VNF1
        properties:
            Scaling methodology:
            Flavour ID:
            Threshold:
            Auto-scale policy value:
            Constraints:
        requirements:
            virtualLink: VL1
            virtualLink: VL2
            virtualLink: VL3
```

```
VNF2:
    type: tosca.nodes.nfv.VNF.VNF2
    properties:
        Scaling methodology:
        Flavour ID:
        Threshold:
        Auto-scale policy value:
        Constraints:
    requirements:
        virtualLink: VL2
VNF3:
    type: tosca.nodes.nfv.VNF.VNF3
    properties:
        Scaling methodology:
        Flavour ID:
        Threshold:
        Auto-scale policy value:
        Constraints:
    requirements:
        virtualLink: VL2
        virtualLink: VL3
        virtualLink: VL4
CP01
        #endpoints of NS
    type: tosca.nodes.nfv.CP
```

```
    properties:
        type:
    requirements:
        virtualLink: VL1
CP02
        #endpoints of NS
    type: tosca.nodes.nfv.CP
    properties:
        type:
    requirements:
        virtualLink: VL4
```

```
VL1
    type: to
    properti
        # omitted here for brevity
    capabilities:
        -virtual_linkable
            occurrences: 2
VL2
    type: tosca.nodes.nfv.VL.ELAN
    properties:
        # omitted here for brevity
    capabilities:
        -virtual_linkable
            occurrences: 5
VL3
    type: tosca.nodes.nfv.VL.Eline
    properties:
        # omitted here for brevity
    capabilities:
        -virtual_linkable
            occurrences: 2
```

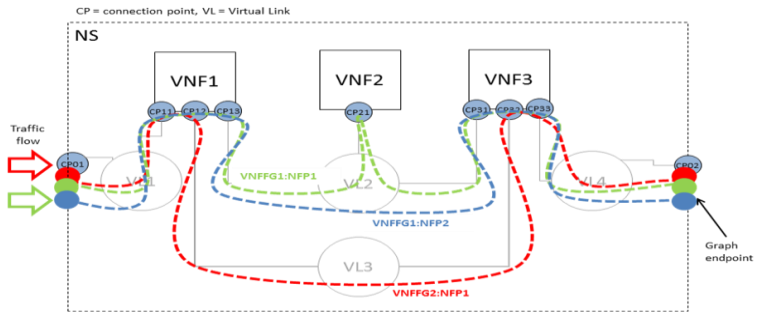
```
VL4
    type: tosca.nodes.nfv.VL.Eline
    properties:
        # omitted here for brevity
    capabilities:
```

```
        -virtual_linkable
            occurrences: 2
```

# VNFFG

## –Using TOSCA group concept

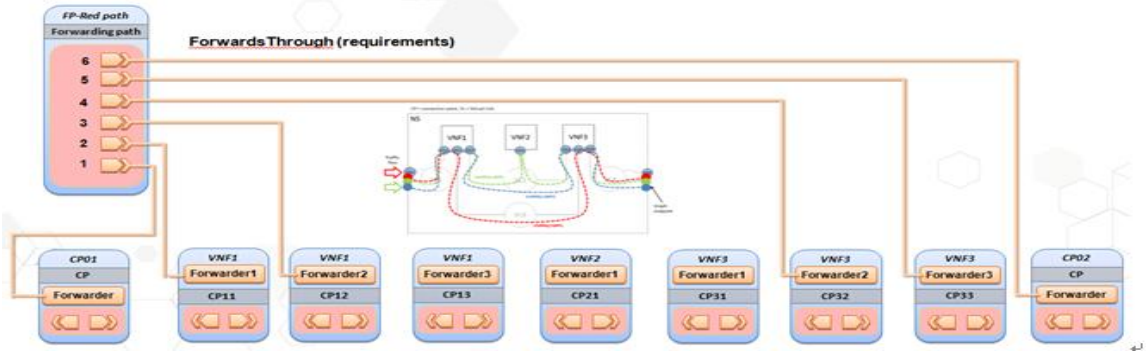
```
Groups:
      VNFFG1:
        type: tosca.groups.nfv.vnffg
        description: forwarding graph 1
        properties:
          vendor:
          version:
          vl: [VL1,VL2,VL4]
          vnf: [VNF1,VNF2,VNF3]
        targets: [Forwarding path1, Forwarding path2]

      VNFFG2:
        type: tosca.groups.nfv.vnffg
        description: forwarding graph 2
        properties:
          vendor:
          version:
          vl: [VL1,VL3,VL4]
          vnf: [VNF1,VNF2]
        targets: [Forwarding path3]
```




Source: xxx

## NFP

Network forwarding path as defined by **ETSI NFV** is an order list of connection points forming a chain of network functions (VNFs or PNFs). A new “Forwarder” requirement is defined in this specification to model the network forwarding path by using ordered list of multiple “Forwarder” requirements. Each “Forwarder” requirement points to a single connection point.




```
Forwarding path1:
      type: tosca.nodes.nfv.FP
      description: the path (CP01→CP11→CP13→CP21→CP31→CP33→CP02)
      properties:
         policy:
      requirements:
         -forwarder: CP01
         -forwarder: VNF1
           capability: forwarder1          #CP11
         -forwarder: VNF1
           capability: forwarder3          #CP13
         -forwarder: VNF2
           capability: forwarder1          #CP21
         -forwarder: VNF3
           capability: forwarder1          #CP31
         -forwarder: VNF3
           capability: forwarder3          #CP33
         -forwarder: CP02
```

# TOSCA Resources – Learn More

- TOSCA Technical Committee Public Page (latest documents, updates, and more)
  - https://www.oasis-open.org/committees/tc_home.php?wg_abbrev=tosca
- OASIS Channel (all standards) **or** TOSCA YouTube Playlist
  - https://www.youtube.com/user/OASISopen **or** http://bit.ly/1BQGGHm
- TOSCA Simple Profile in YAML v1.0 (latest committee approved draft)
  - http://docs.oasis-open.org/tosca/TOSCA-Simple-Profile-YAML/v1.0/TOSCA-Simple-Profile-YAML-v1.0.pdf
- TOSCA Simple Profile for NFV v1.0 (latest committee approved draft)
  - http://docs.oasis-open.org/tosca/tosca-nfv/v1.0/csd02/tosca-nfv-v1.0-csd02.pdf
- Contact the Technical Committee Co-Chairs:
  - **Paul Lipton, paul.lipton@ca.com**
  - **Simon Moser, smoser@de.ibm.com**
- Today's Presenters from the TOSCA TC:
  - **Shitao Li, lishitao@huawei.com**
  - **Matt Rutkowski, mrutkows@us.ibm.com**
  - **Chris Lauwers, lauwers@ubicity.com**
  - **Sridhar Ramaswamy , sramasw@Brocade.com**
  - **Sivan Barzily, sivan@gigaspaces.com**

# TOSCA

***An Open Standard for Business Application Agility and Portability in the Cloud***

# Q&A

***Start Blueprinting Your Cloud Apps in TOSCA now!***


25

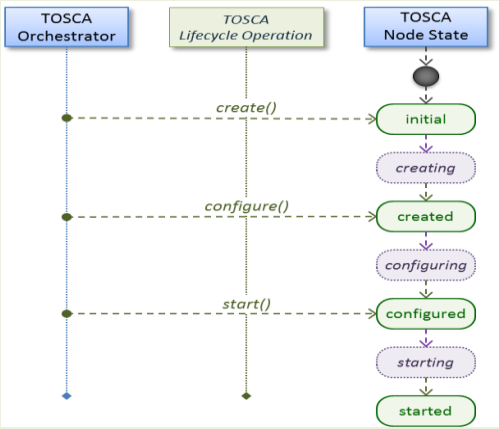
# Backup Slides

- Lifecycle Sequencing

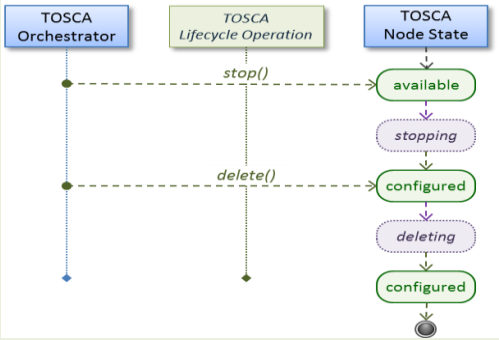
# TOSCA Orchestrators - Standardized Lifecycle Sequencing

## Lifecycle.Standard

### Deploy Sequencing

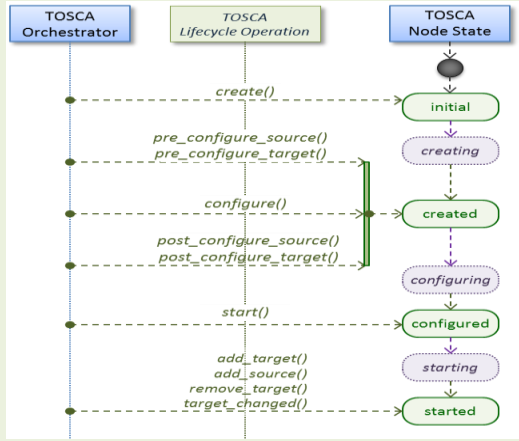



### Undeploy Sequencing




## Lifecycle.Configure

### Source-Target Sequencing




### Combined Sequencing