CORD – Technical Overview

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Open Networking Lab

#OpenCORD

CORD
Central Office Re-architected as a Datacenter

What is CORD?

CORD is a Vision

A goal the open source community is working towards

Start with Business Case → Reduce to Design Requirements

CORD is an Architecture

A collection of abstractions and interfaces

Start with an Organizing Principle → Iterate-and-Refine

CORD is a Reference Implementation

An integrated system built from concrete components

Make Technology Choices → Be More Inclusive with Time

CORD Vision – Business Case

- Large number of complex facilities
  - AT&T alone operates 4-5k Central Offices
  - Each serves 10-100k residential, enterprise & mobile customers
- Evolved piecemeal over the past 40-50 years
  - Source of huge CAPEX/OPEX costs
  - Difficult to introduce new services
  - Especially when compared to OTT cloud providers!

CORD Vision – Business Case

Economies of a datacenter

Infrastructure built with a few commodity building blocks using open source software and white-box switches

Agility of a cloud provider

Software platforms that enable rapid creation of new services

↓

From Access-as-a-Service to Software-as-a-Service

Both Bundled Legacy and Disaggregated Greenfield

CORD Vision – Requirements

Economies of Commodity Hardware

Architect to achieve the performance and reliability of purpose-built hardware on commodity servers and white-box.

Enable Innovative Services

Architect to support the full range of services

- *Access-as-a-Service and Software-as-a-Service*
- *Data Plane (NFV) and Control Plane (SDN)*
- *Bundled Legacy and Disaggregated Greenfield*
- *Trusted Operator-Defined and Untrusted 3rd Party*

CORD Vision – Requirements

Extensible and Controllable

Architect a Northbound Interface that allows operators to configure, control, and extend a deployment.

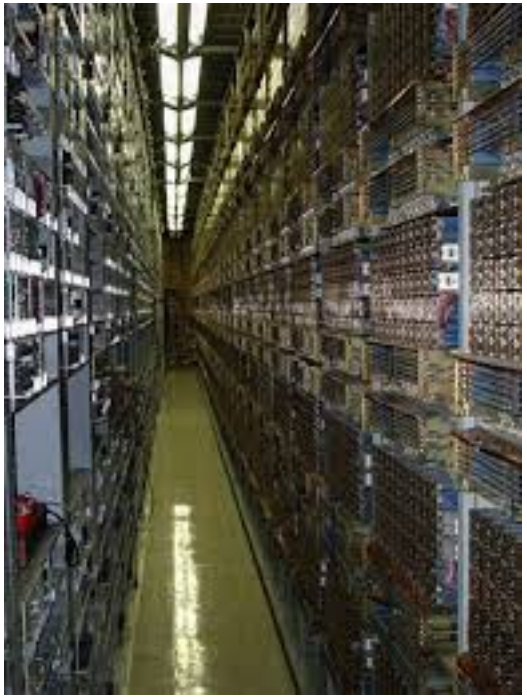
Multi-Domain Security

Architect to minimize trusted code base, mediate trust, and support the principle of least privilege.

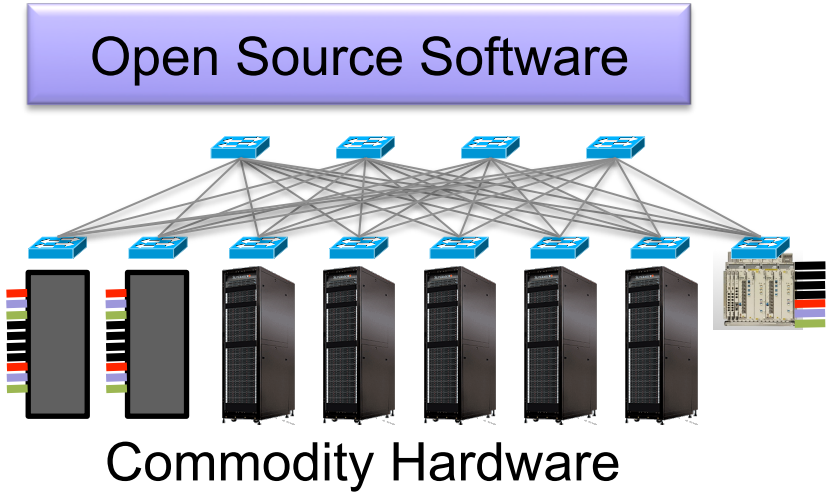
Operational Robustness

Architect to minimize service disruption in the face of transient and partial failures.

CORD Architecture

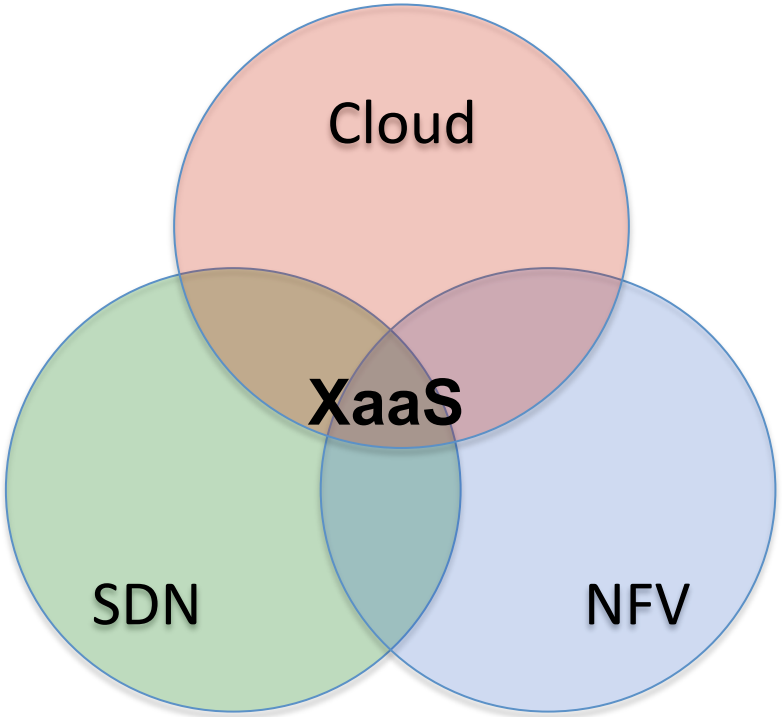


XaaS

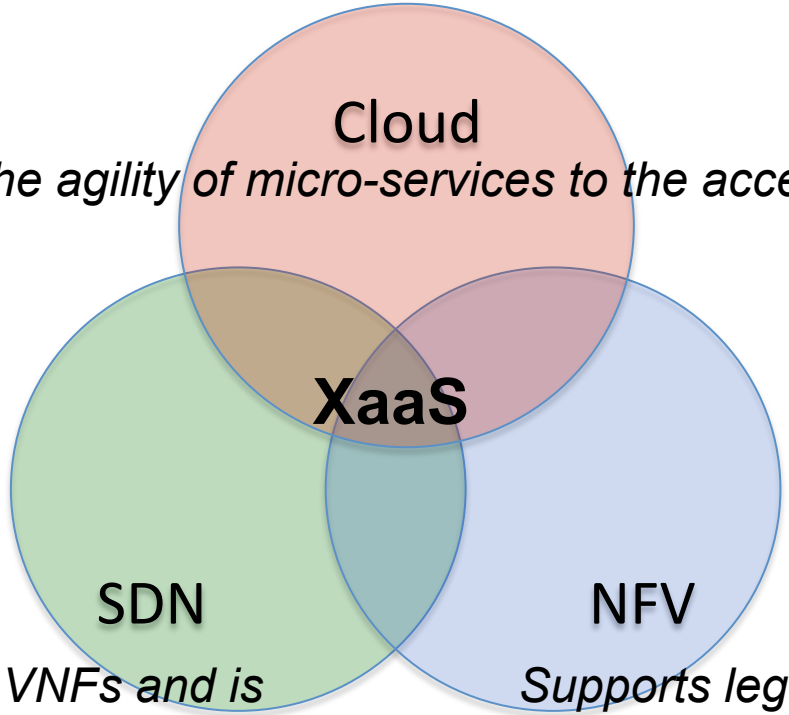


Everything-as-a-Service

CORD Architecture – Organizing Principle



CORD Architecture – Organizing Principle

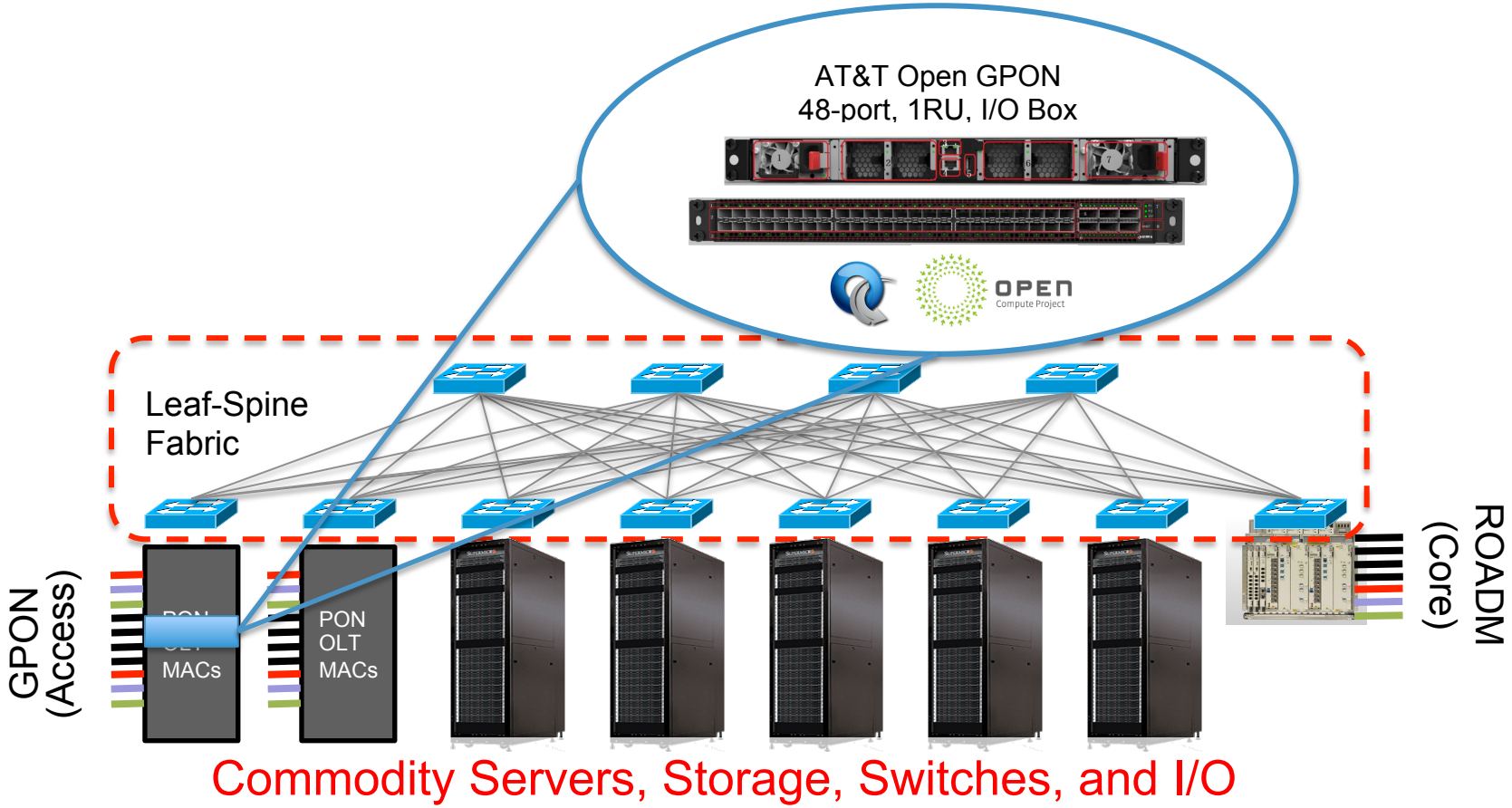


Extends the agility of micro-services to the access network

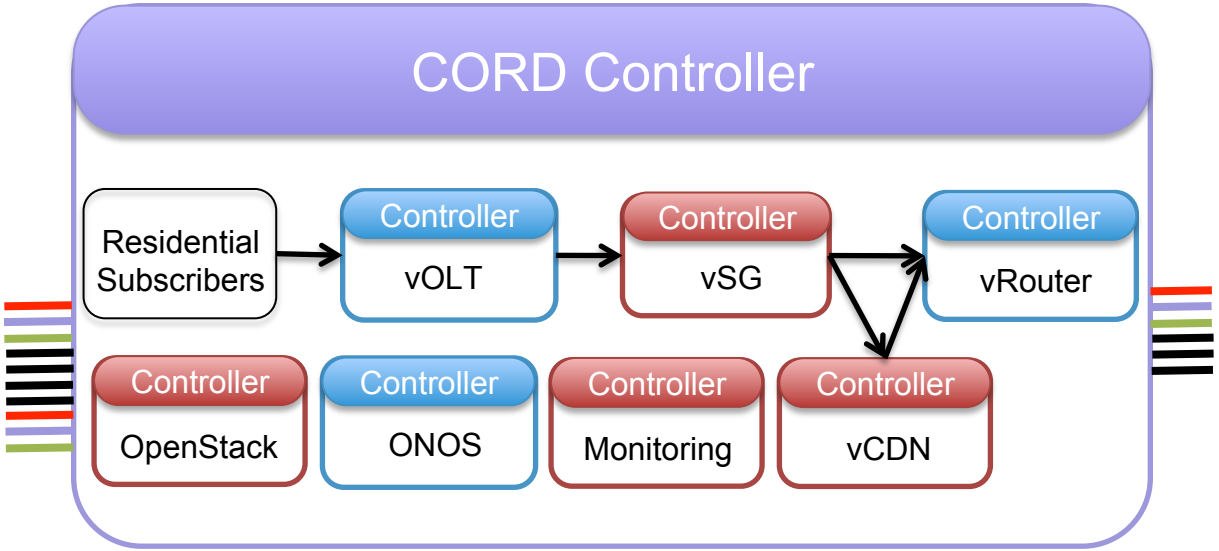
Interconnects VNFs and is a source of innovative new VNFs

Supports legacy VNFs and pushes the limits of disaggregation

CORD Architecture – Hardware

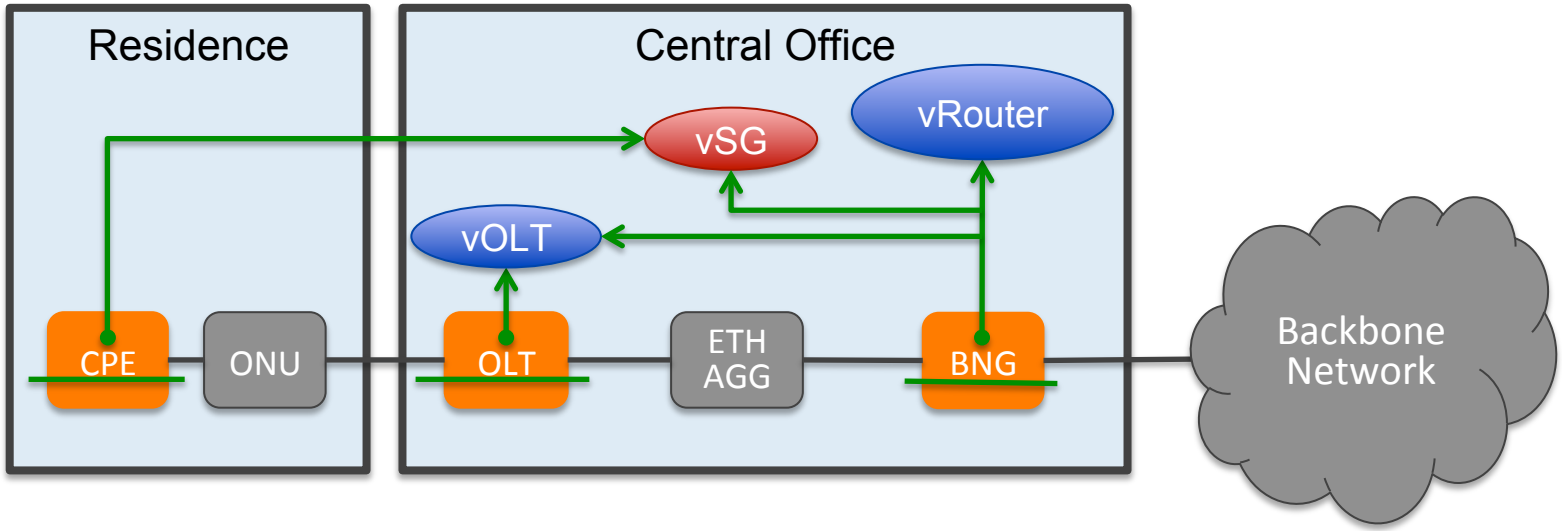


CORD Architecture – Software



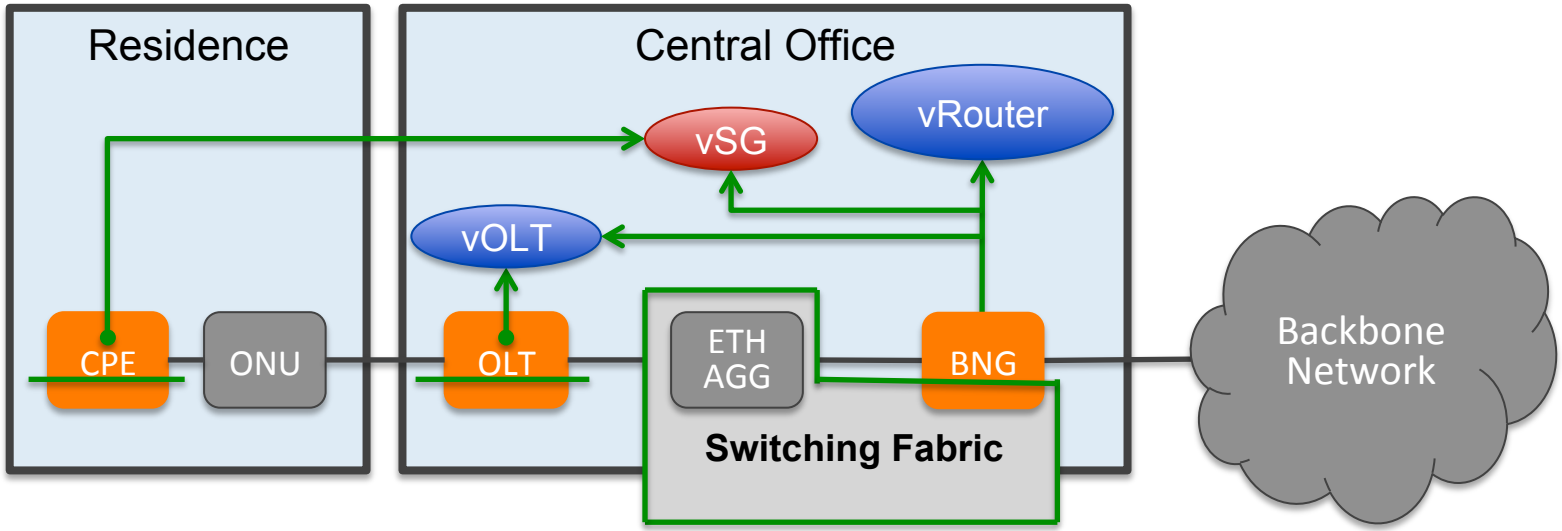
Everything-as-a-Service (XaaS)

Disaggregating the C.O.



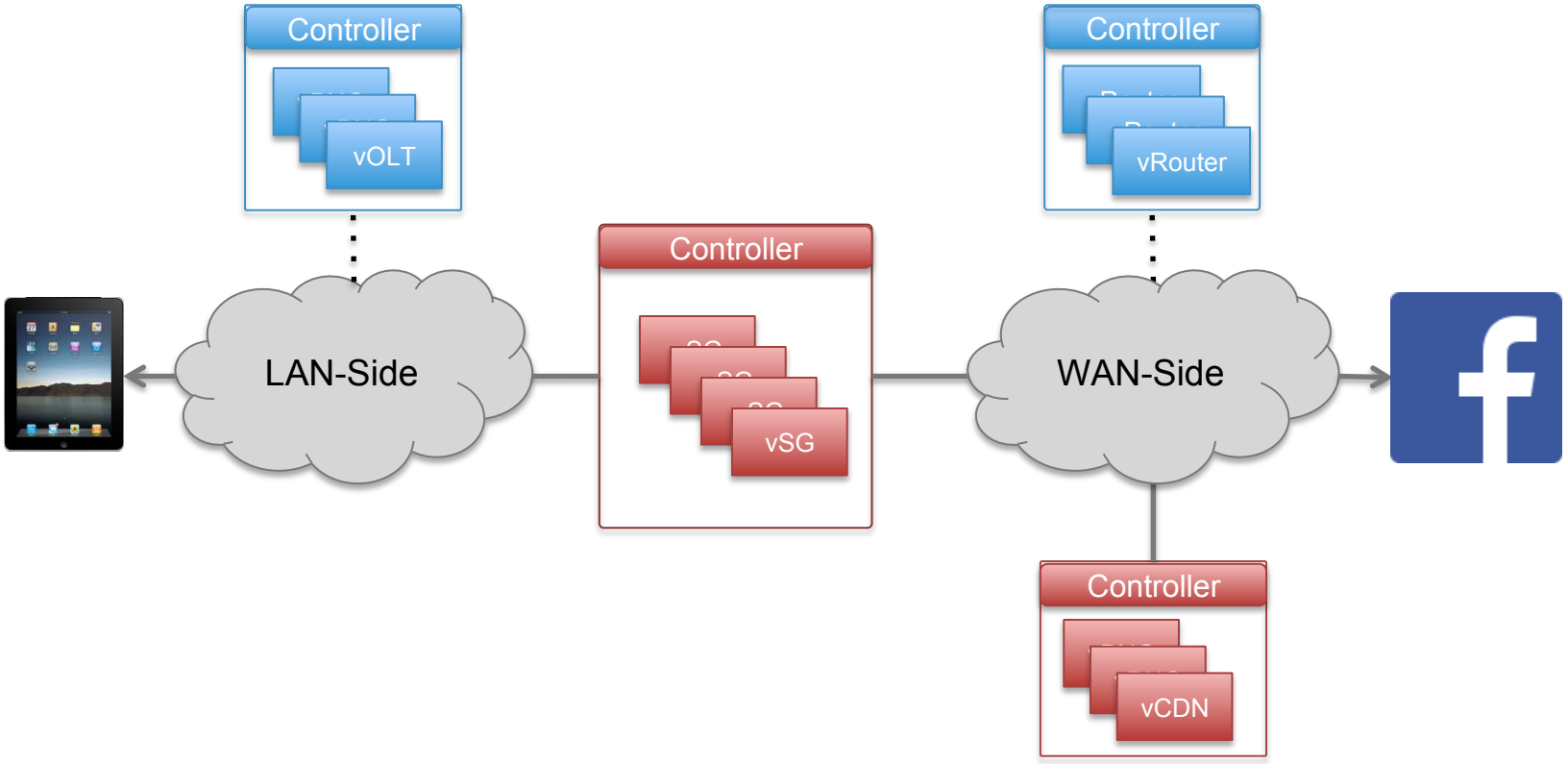
CPE – Customer Premises Equipment
OLT – Optical Line Termination
BNG – Broadband Network Gateway

Disaggregation

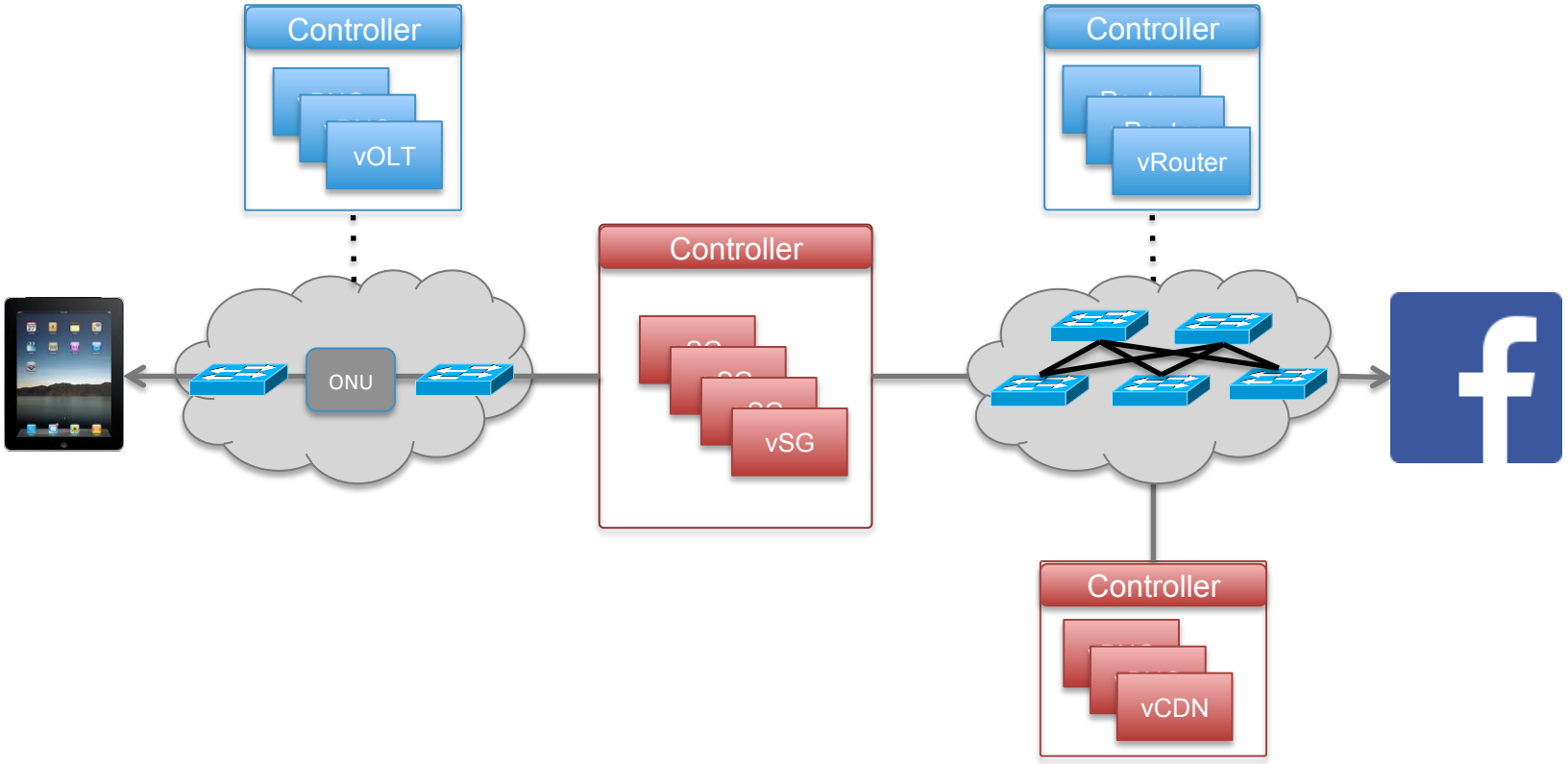


CPE – Customer Premises Equipment
OLT – Optical Line Termination
BNG – Broadband Network Gateway

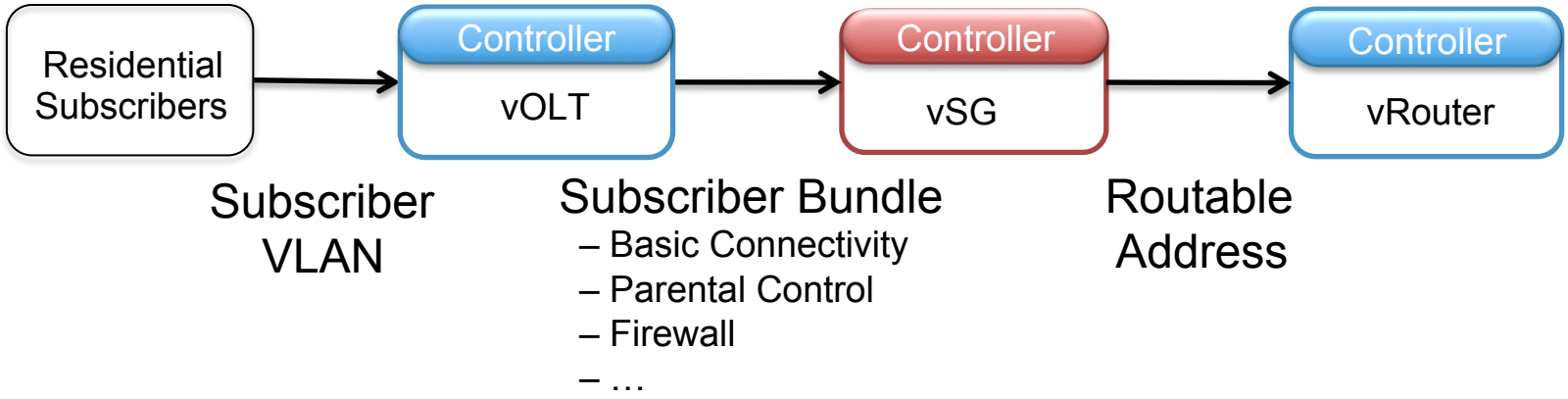
End-to-End Path



End-to-End Path



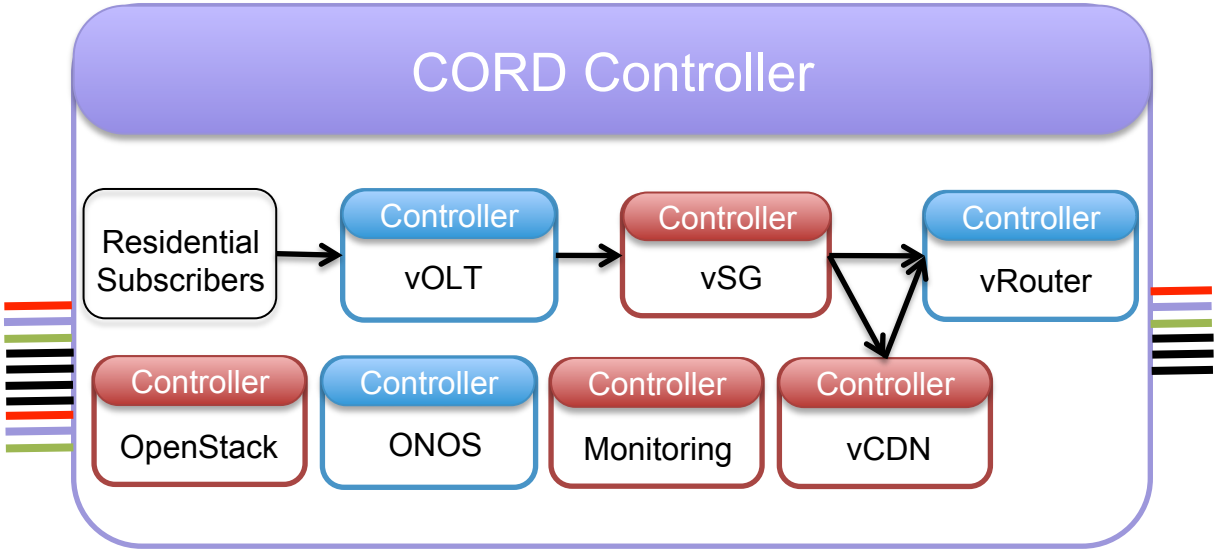
Services are Multi-Tenant



Service is an over-loaded term
- Consumer Service
- Multi-Tenant Cloud Service

Tenant is an over-loaded term
- Business Unit – tenant of infrastructure
- User – tenant of cloud service
- Service *A* – tenant of Service *B*

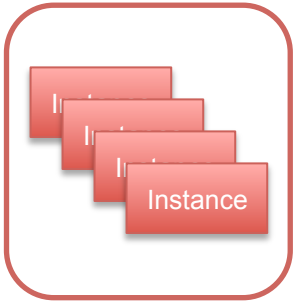
CORD Architecture – Software



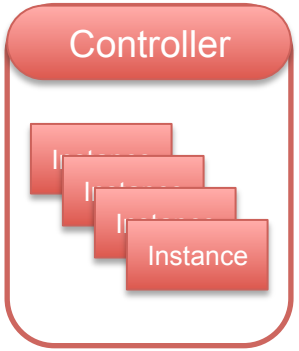
Everything-as-a-Service (XaaS)

CORD Architecture – Models

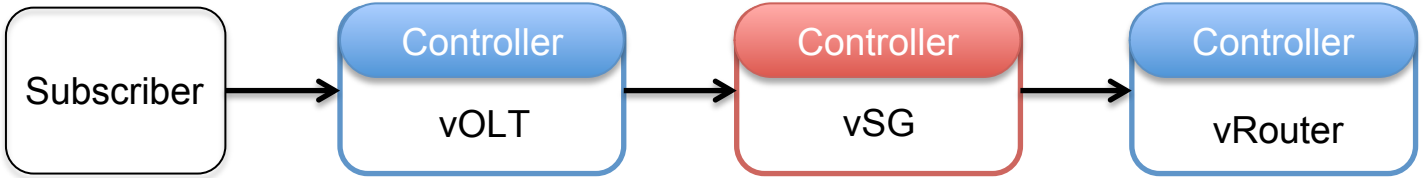
Instance =
(VM | Container |
Container-in-VM)



Slice =
(Instances[ ] + Networks[ ])

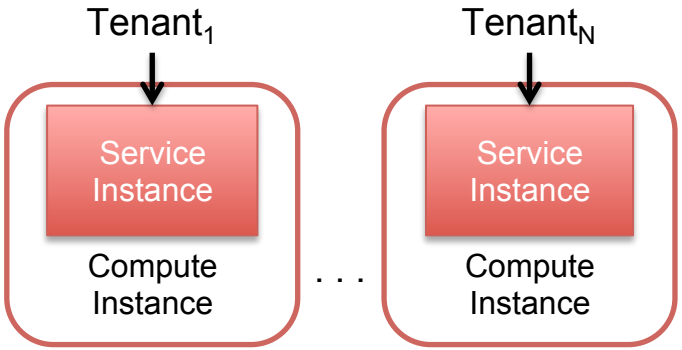


Service =
(Controller + Slices[ ])

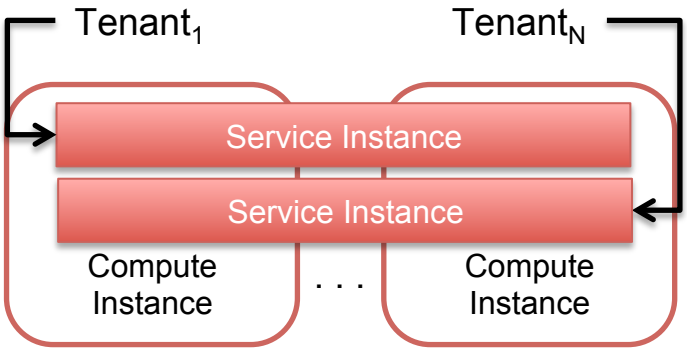


Service Graph =
(Tenants[ ]+ Services[ ] + Dependencies[ ])

Data Plane Services

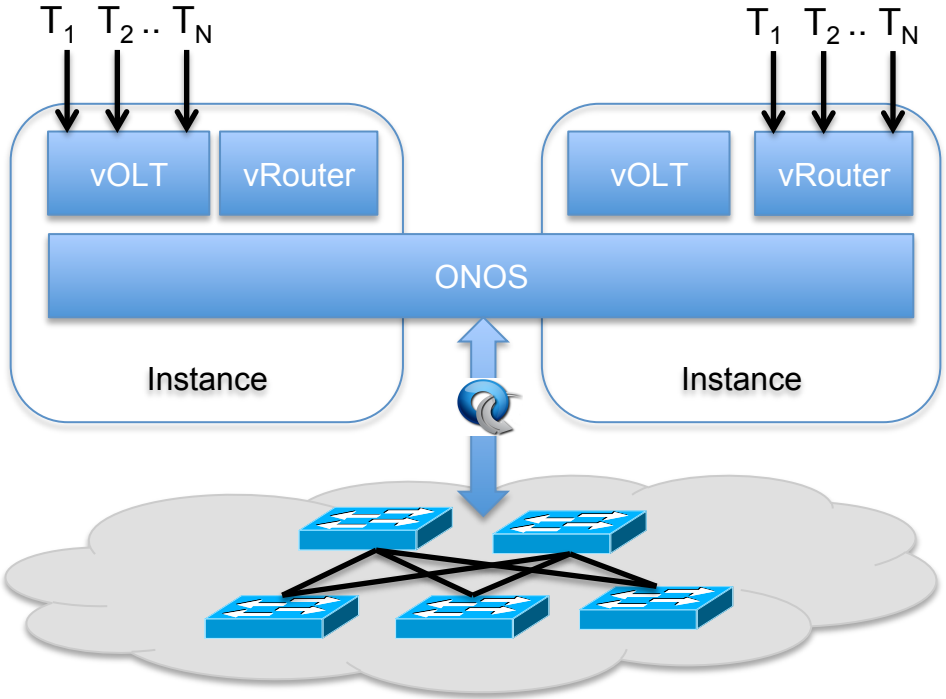


vSG
(Compute Instance = Container)

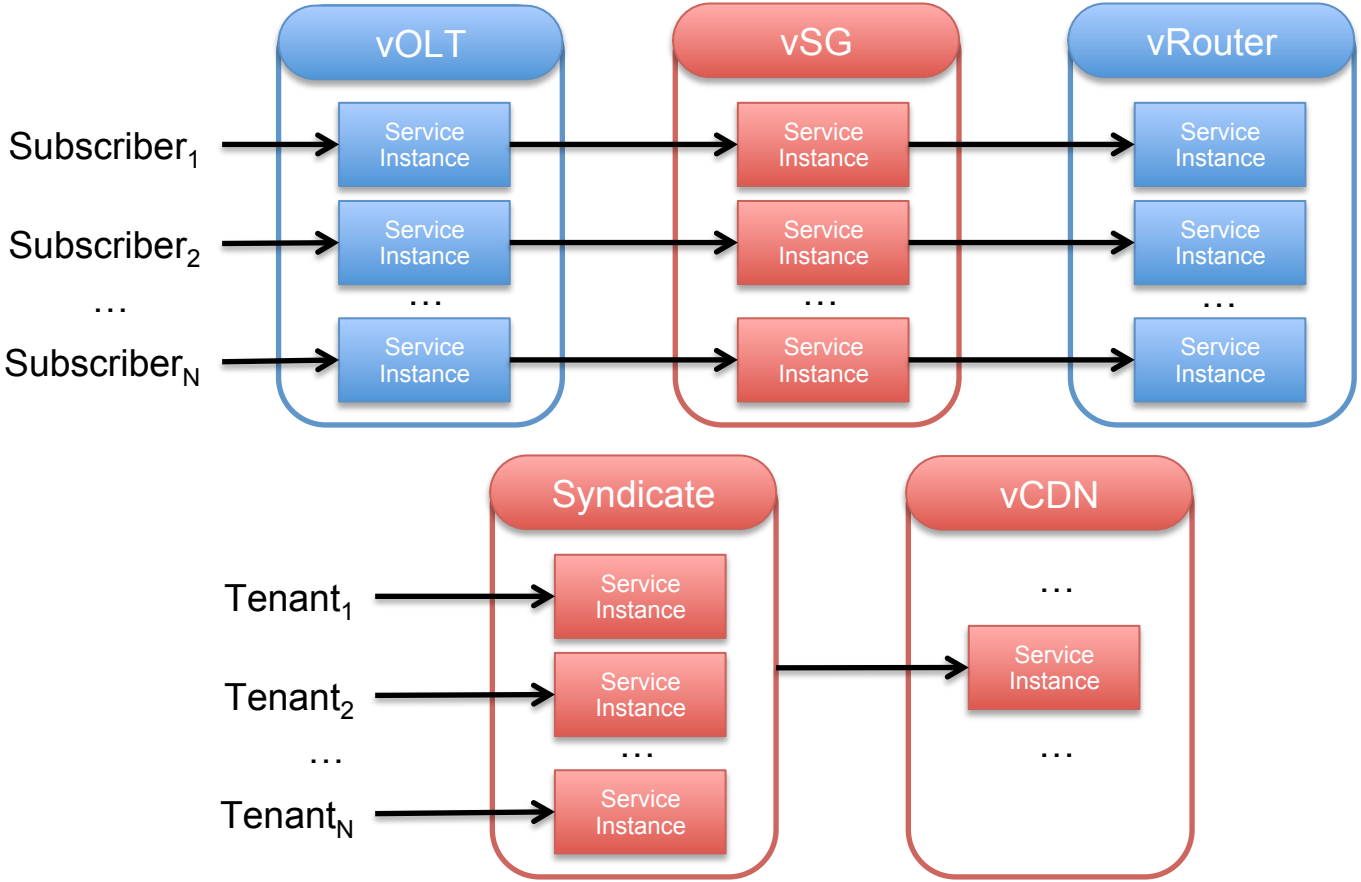


vCDN
(Compute Instance = VM)

Control Plane Services



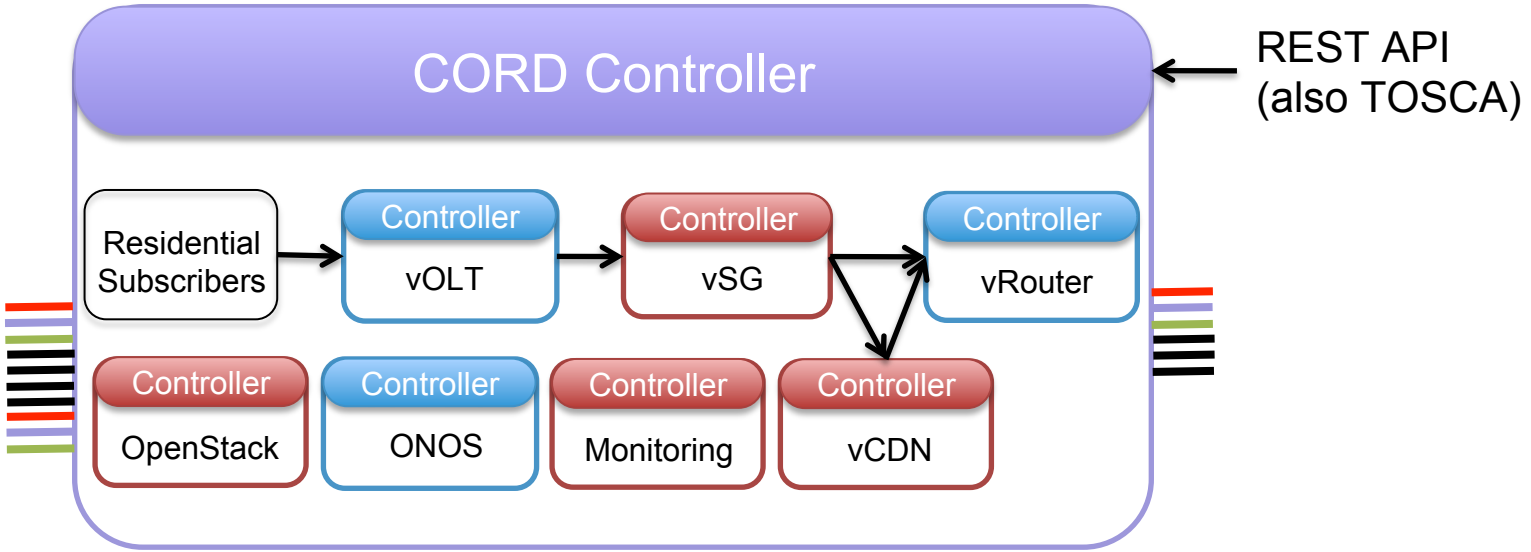
Services as Tenants



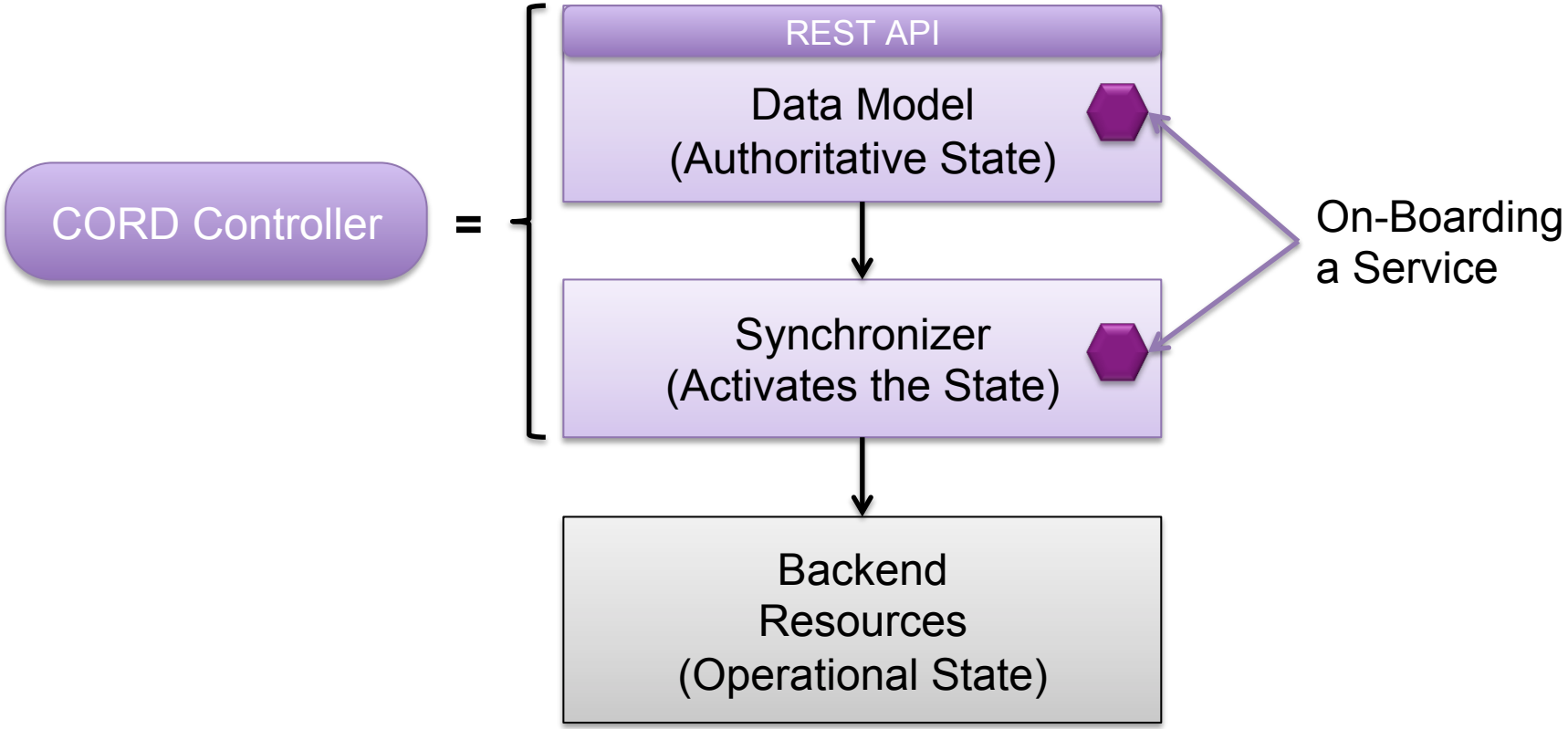
CORD Architecture – Interfaces

- Design Time Configuration Interface
  - On-Board Services and Configure Service Graph
- Runtime Control Interface
  - Provision and Scale Services
  - Instantiate and Manage Service Instances
  - Monitor Service Performance and Behavior

CORD Architecture – Interfaces



On-Boarding Services



Runtime Control – Subscriber API

GET http://portal.cord.net:9999/api/tenant/cord/subscriber/1/

Response:


```
{
    "humanReadableName": ”John Doe"
    "id": 1
    "features": {
        "cdn": true
        "uplink_speed": 4000000000
        "downlink_speed": 1000000000
        "uverse": true
        "status": "enabled"
    }
    "identity": {
        "account_num": "123"
    }
    "related": {
        "instance_name": "mysite_vcpe"
        "vsg_id": 4
        "c_tag": "432"
        "instance_id": 1
        "wan_container_ip": null
        "volt_id": 3
        "s_tag": "222"
    }
-
}
```

Runtime Control – API Endpoints

../api/tenant/cord/subscriber
../api/tenant/cord/enterprise
…

../api/core/slices
../api/core/nodes
../api/core/instances
../api/core/services
…

../api/services/hpc
../api/services/vsg
../api/services/onos
…

Also a TOSCA-based interface
– Primarily used at design time

A Yang-based interface is in progress

CORD Reference Implementation

Hardware Blueprint ← **CORD POD** → **Open Source Software**

Bill of Materials
- OCP Servers
- OCP Switches
- OCP Access Blades

Assembly Instructions
- …

Testing Infrastructure
- …

Ciena and Radisys to provide turnkey CORD PODS

*An open virtualized **service delivery platform** that provides cloud economies and agility.*

From Access-as-a-Service to Software-as-a-Service.

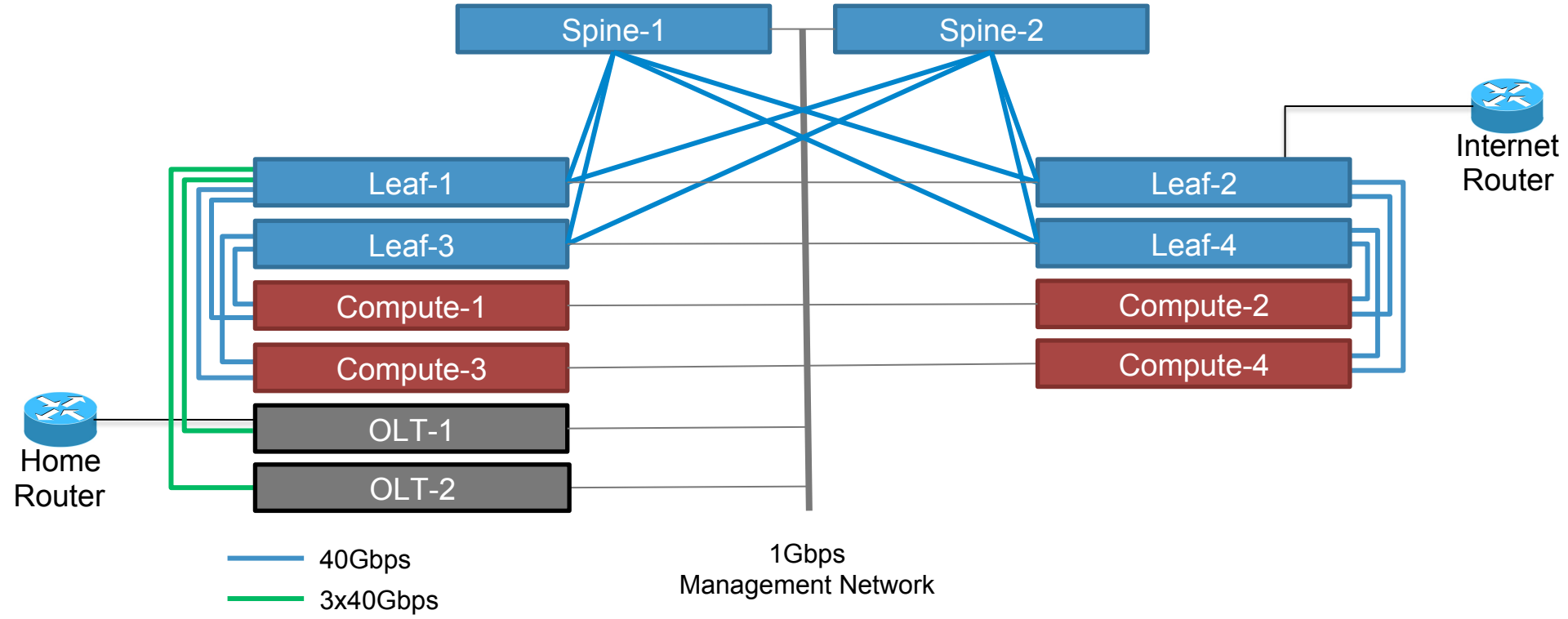
Configured for Different Domains: Residential, Enterprise, Mobile

Core Components
- OpenStack
- Docker
- ONOS
- XOS

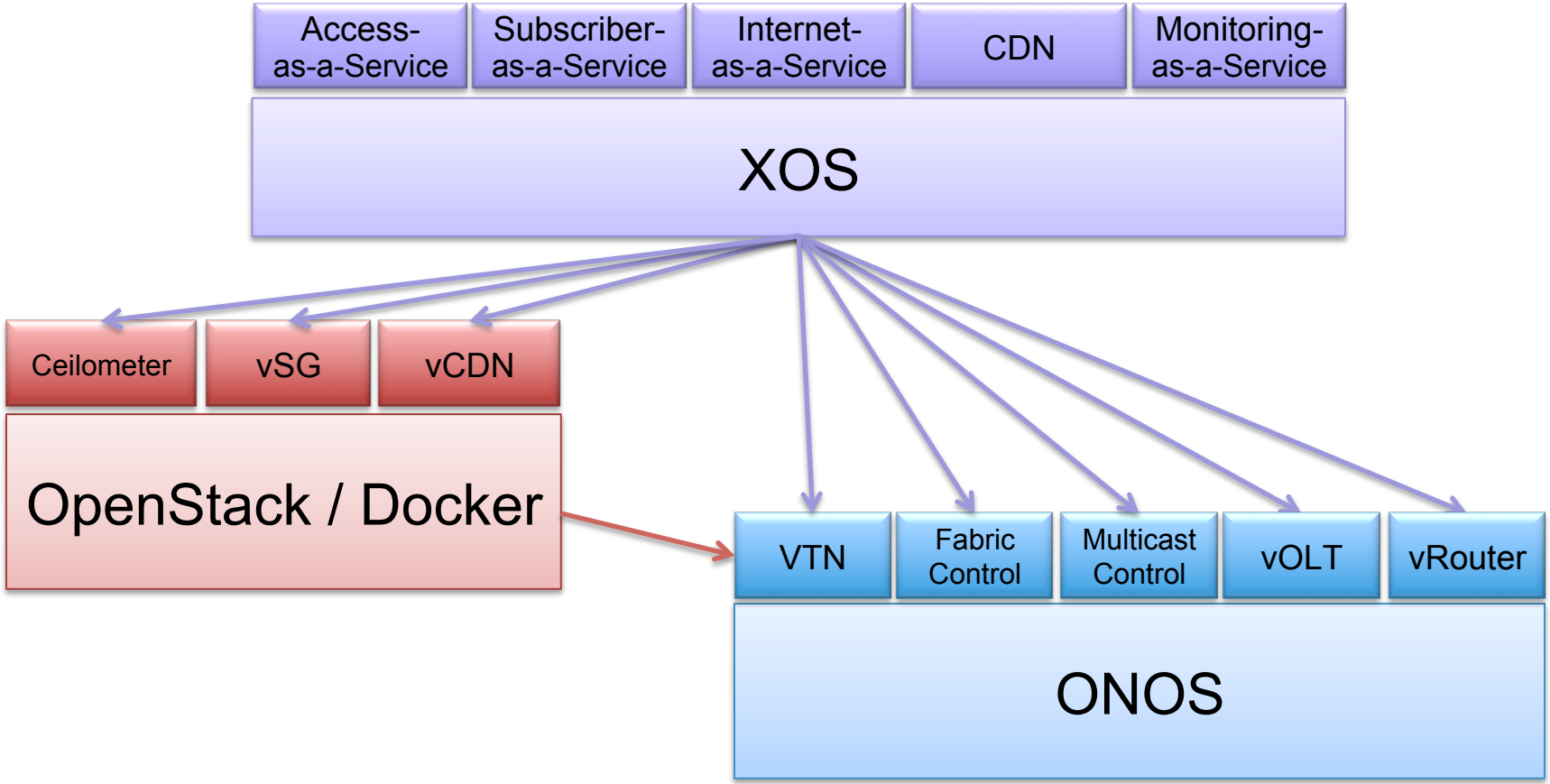
Access Services
- R: vOLT, vSG, vRouter
- E: vOAM, vCE,…
- M: vBBU, vPGW,…
- …

Other Services
- Monitoring
- …

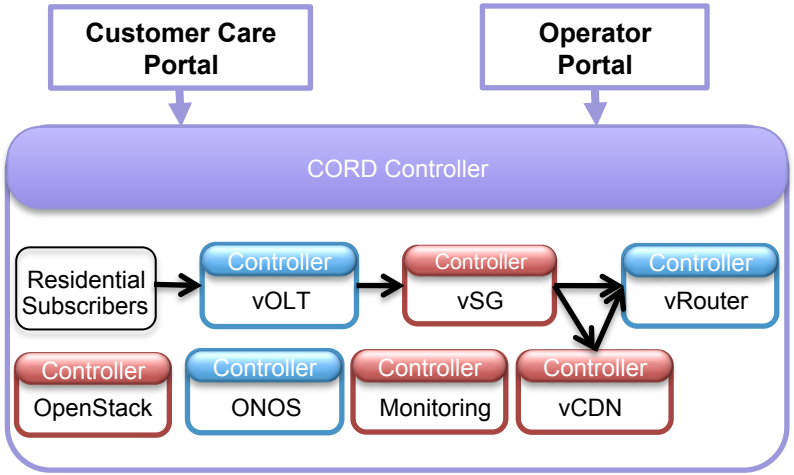
CORD POD – Hardware



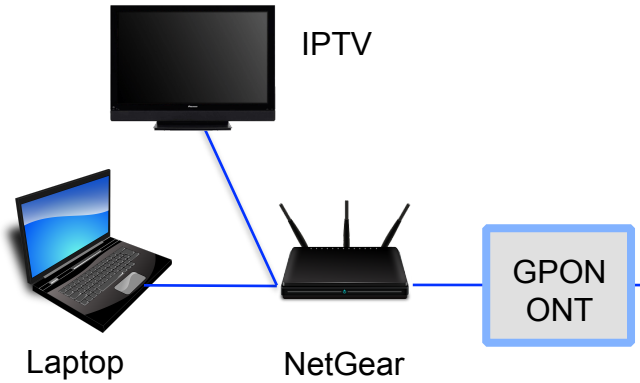
CORD POD – Software Stack

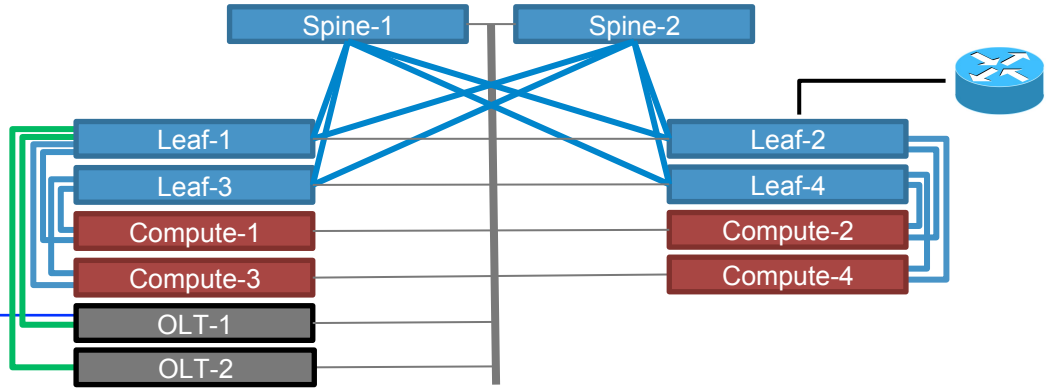


CORD – Field Trial

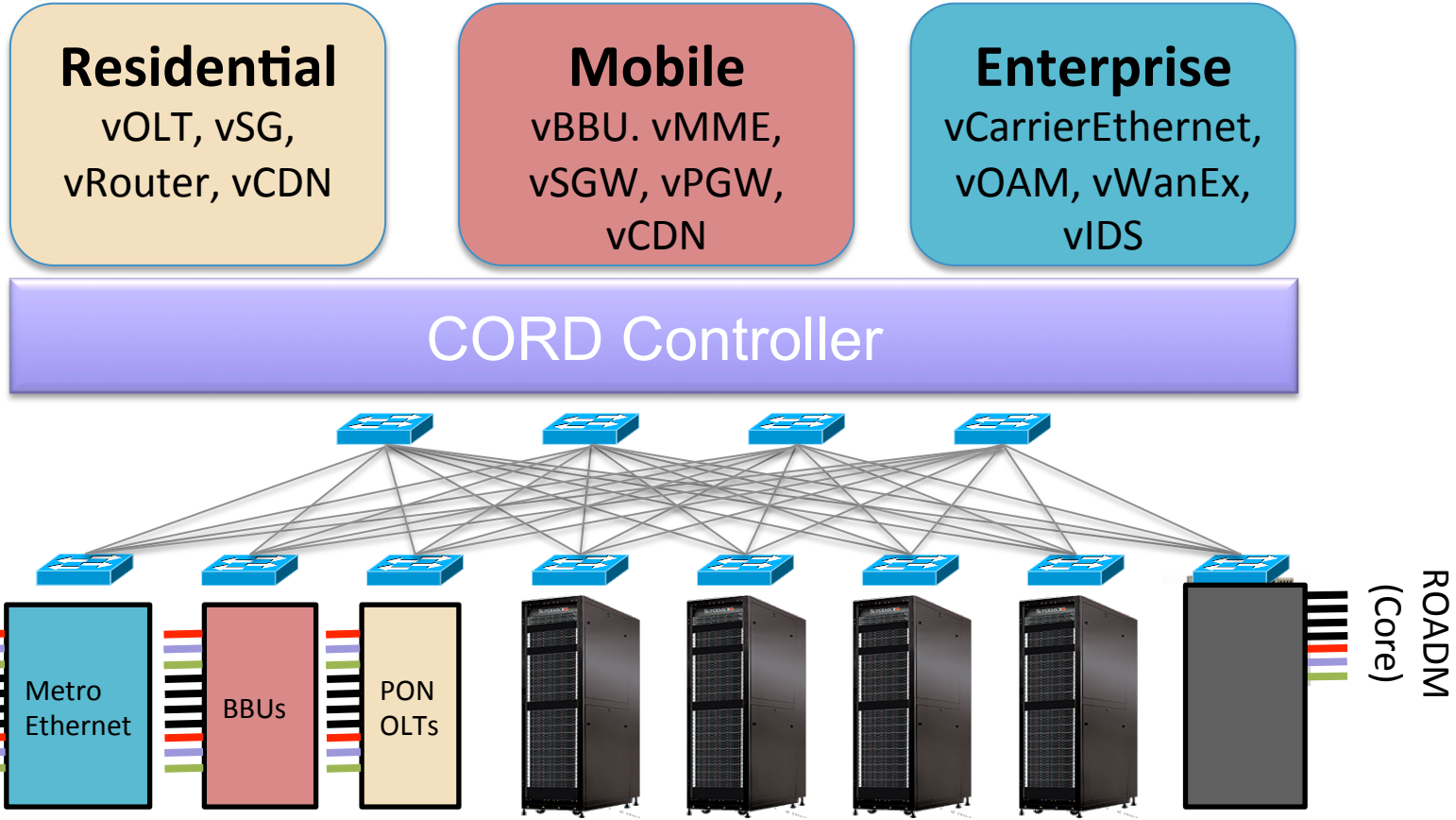


Access the Internet
Stream (Cached) Video
Watch TV

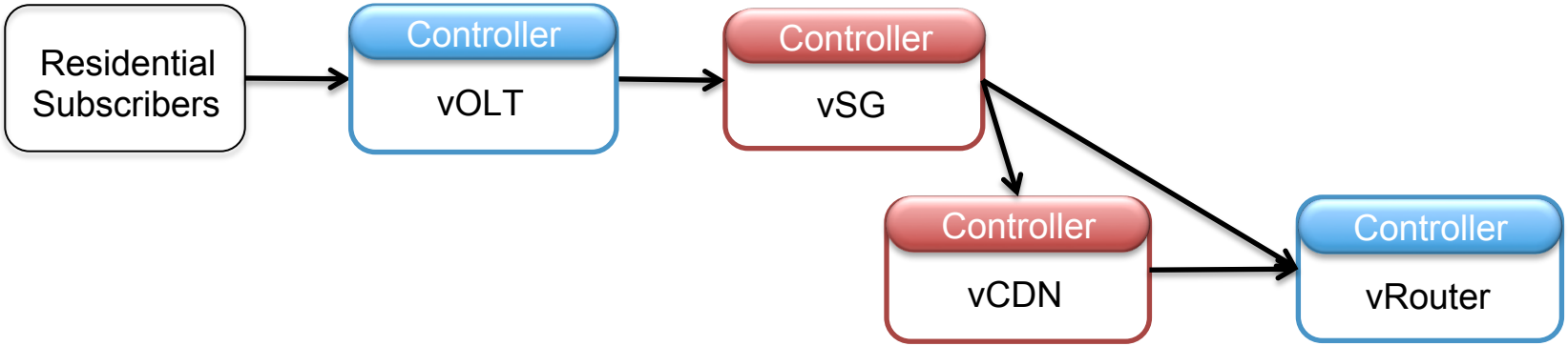




Domains of Use



CORD – Extensible Platform



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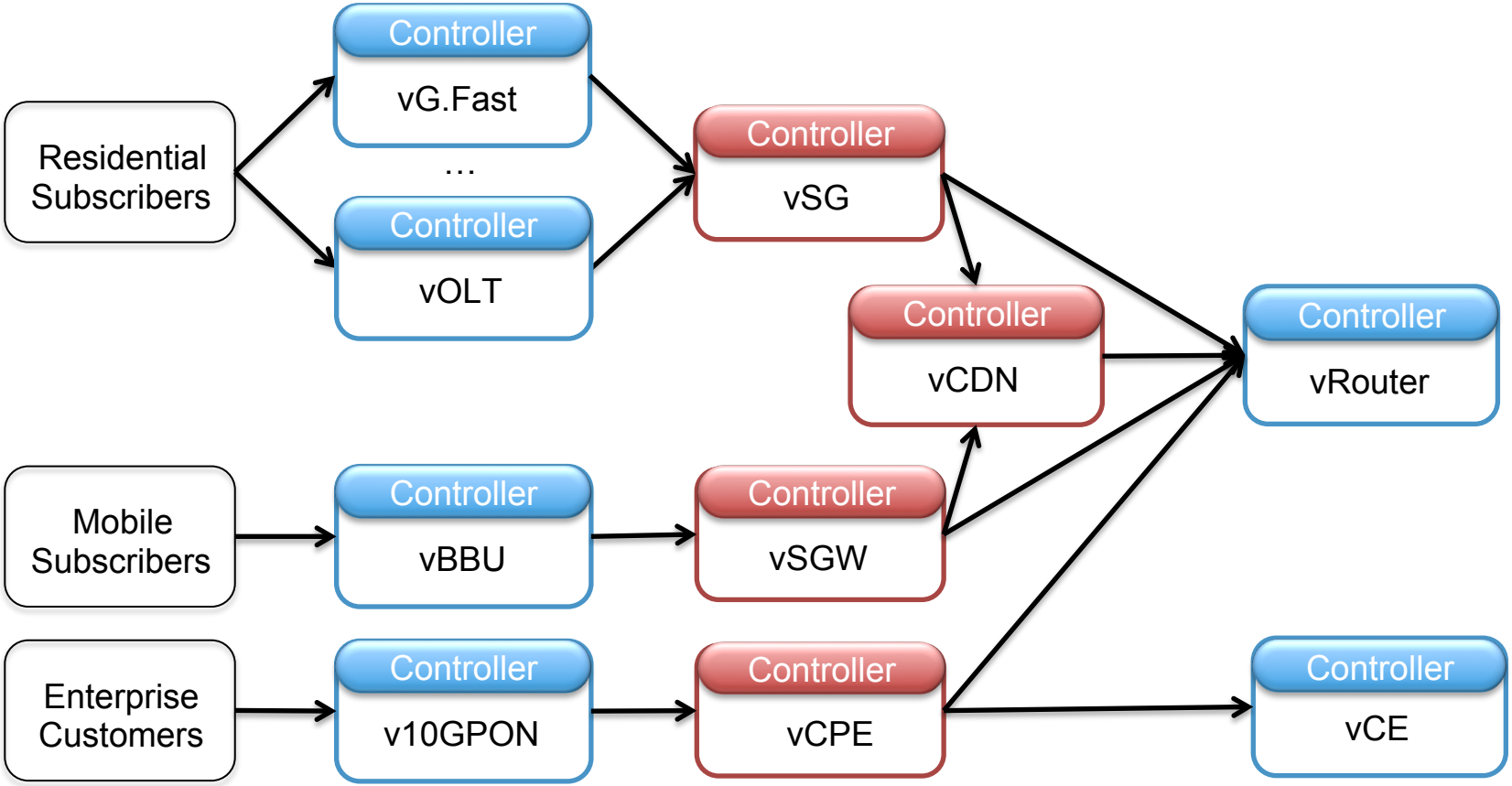


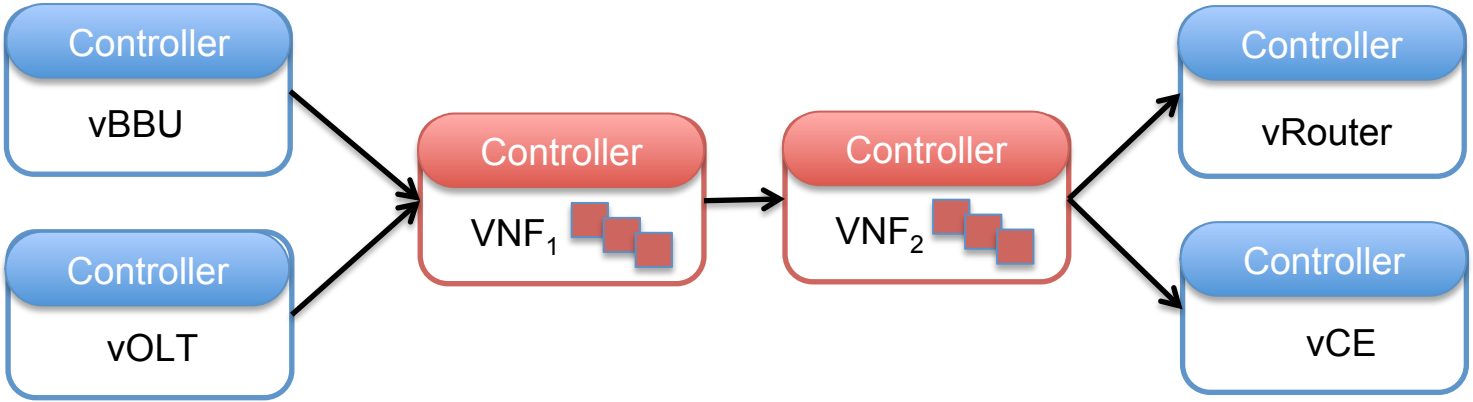
Summary

- CORD Provides Cloud Economies and Agility
  - Fully Exploits Micro-Services (Access-as-a-Service)
  - Fully Exploits Disaggregation (vOLT → vSG → vRouter)
  - Fully Exploits SDN (overlay, underlay, services)
- CORD Controller
  - Assembles services from building block components
  - Exports a unified interface to a collection of services
    - Operators specify service graph (configuration-time interface)
    - Operators and customers control services (runtime interface)

More Information

http://opencord.org

https://wiki.opencord.org

- Community Workspace for Domains-of-Use
- CORD POD Assembly Instructions (build your own POD)
- Links to Open Source Tools (help develop CORD)
- Project Governance (participate in Linux Foundation project)

VTN and Service Composition