This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 643964.

This work was supported (in part) by the Swiss State Secretariat for Education, Research and Innovation (SERI) under contract number 15.0091.

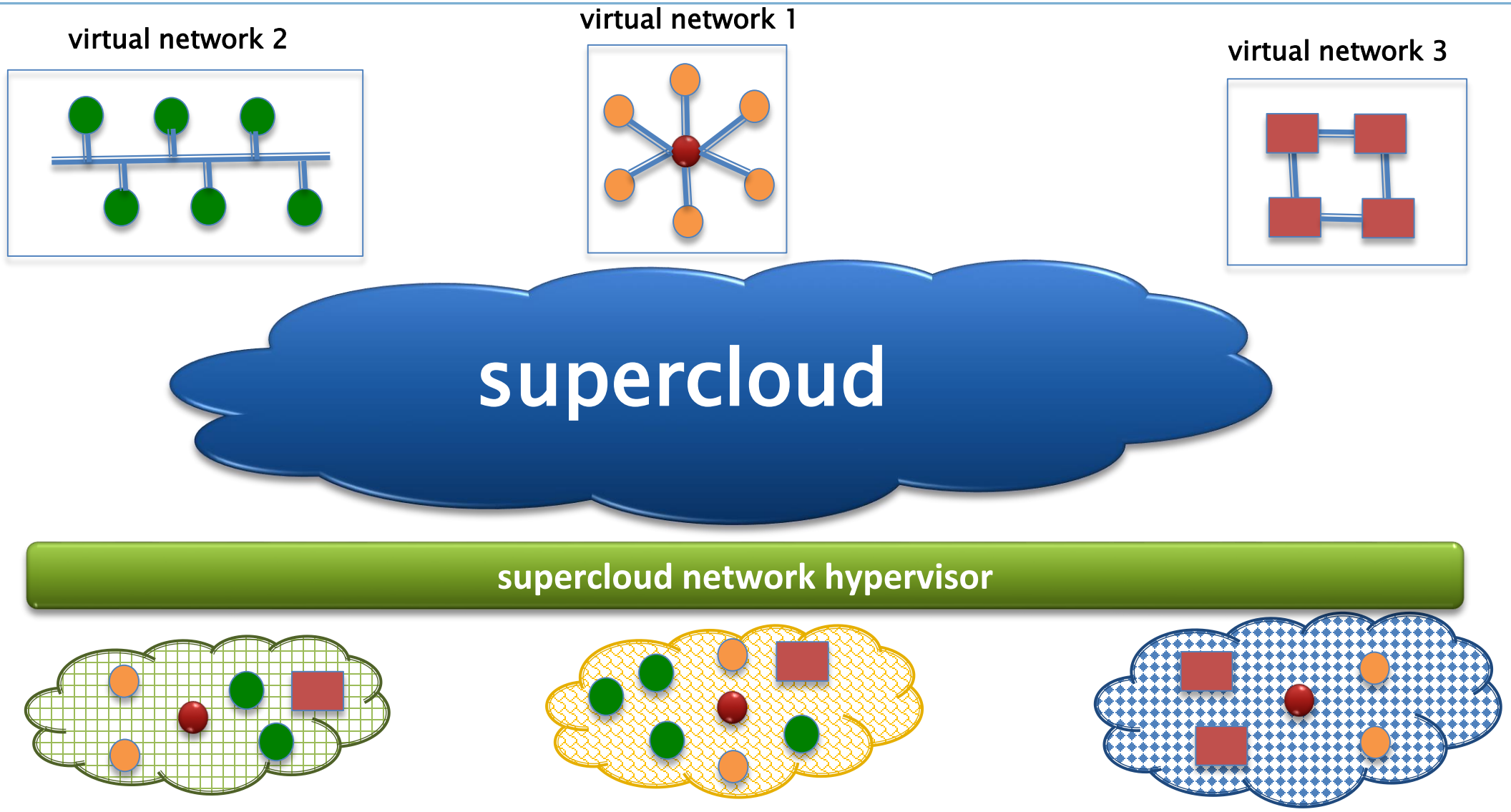
SUPERCLOUD H2020 PROJECT:

SuperCloud: The first demo is the hardest

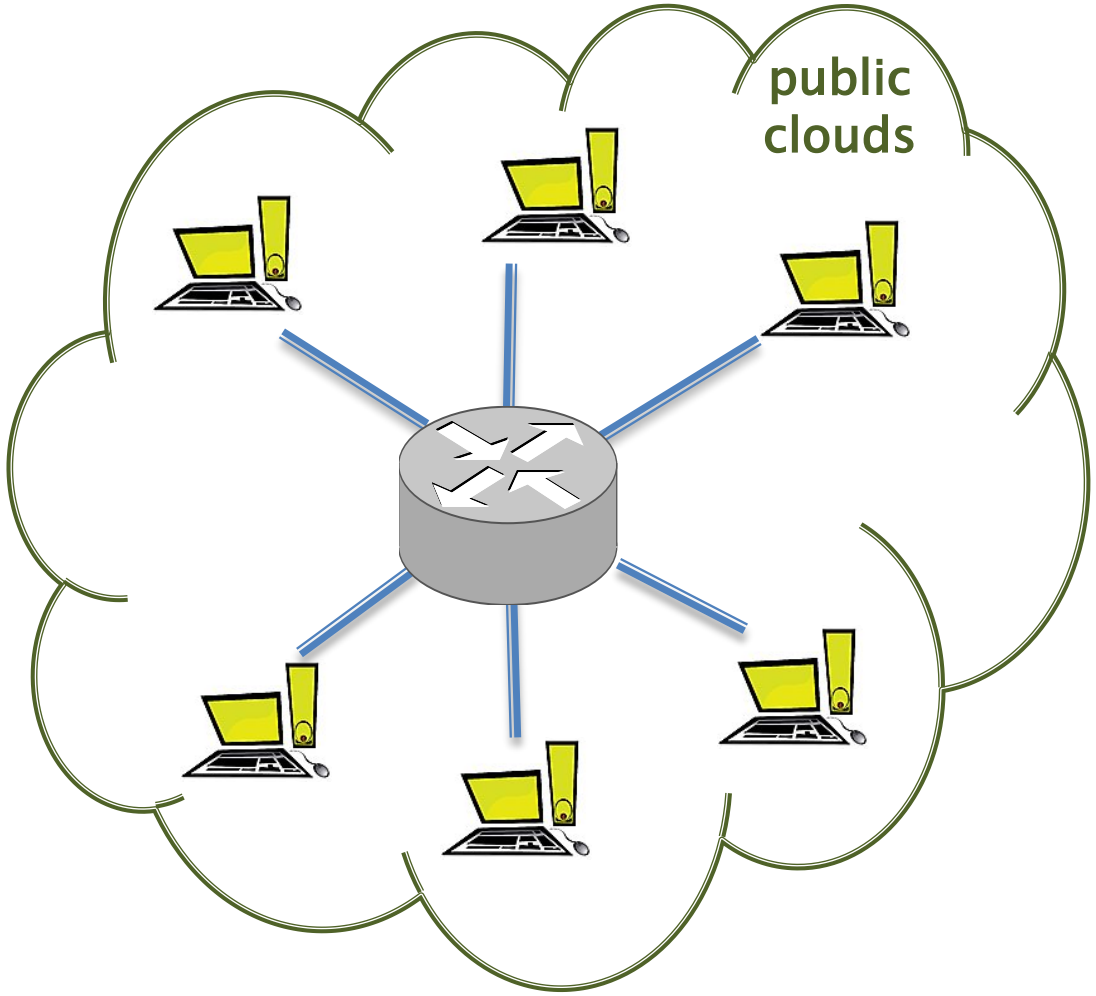
Max Alaluna

User-centric management of security and dependability in clouds of clouds

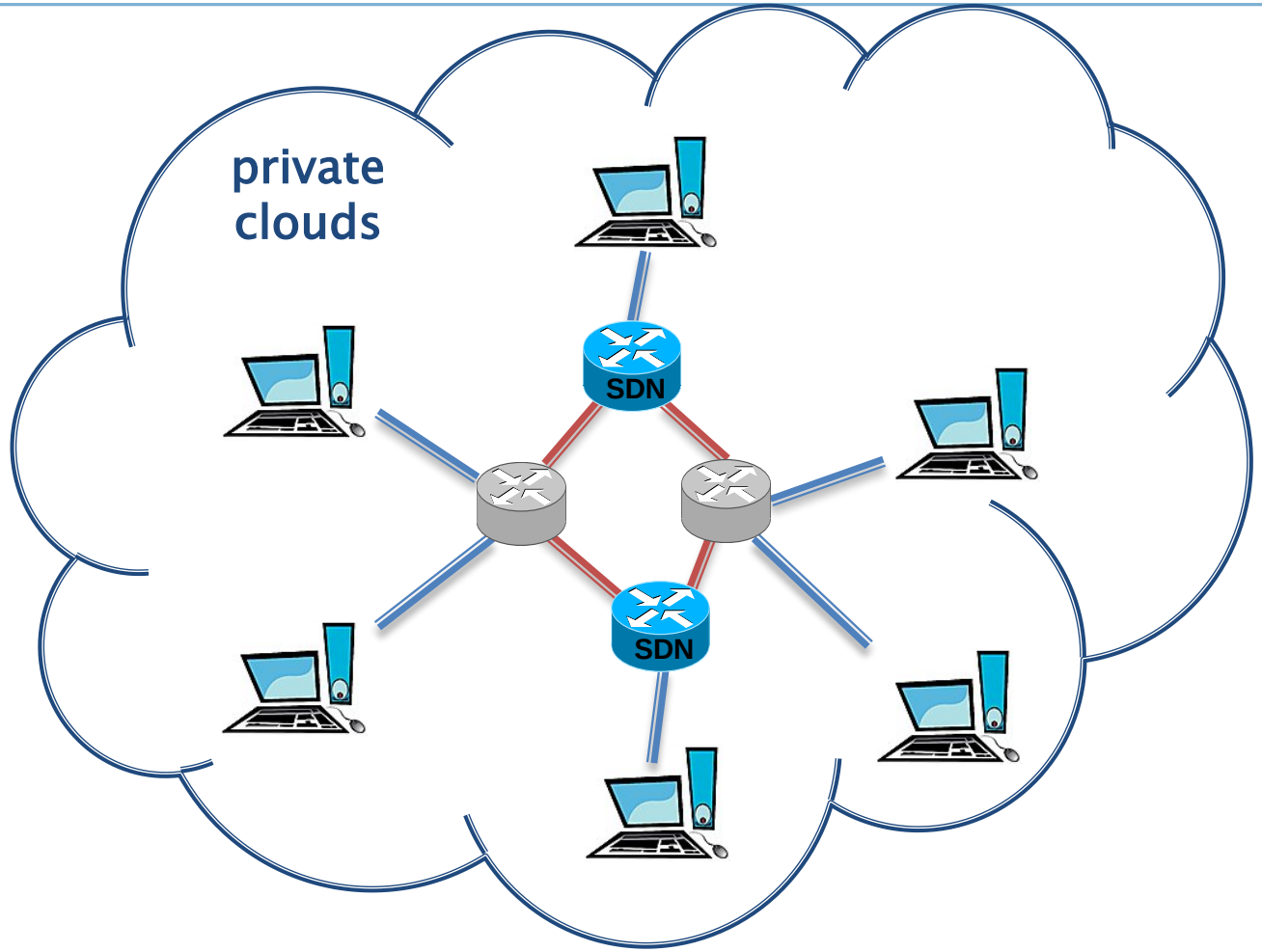
the concept


virtual network 2
virtual network 1
virtual network 3
supercloud
supercloud network hypervisor

infrastructure to leverage on



"big switch" abstraction; software switching



flexible topology; (partially) sdn-enabled;
software and hardware switching

Design requirements

Fulfilling the design requirements

Preliminary architecture

Demo: SUPERCLOUD network virtualization platform v0.1

Design requirements

Fulfilling the design requirements

Preliminary architecture

Demo: SUPERCLOUD network virtualization platform v0.1

design requirements

- Remote, flexible control of network elements
  - the enabler
- Full network virtualization
  - topology abstraction; addressing abstraction; isolation
- Security and dependability
  - resilient data plane; resilient controller
- Autonomic security management
  - Data plane monitoring and proactive attack detection
- Resource snapshot and migration
- Scalability and performance
- Compatibility and interoperability
  - Heterogeneous clouds -> Common view

Design requirements

Fulfilling the design requirements

Preliminary architecture

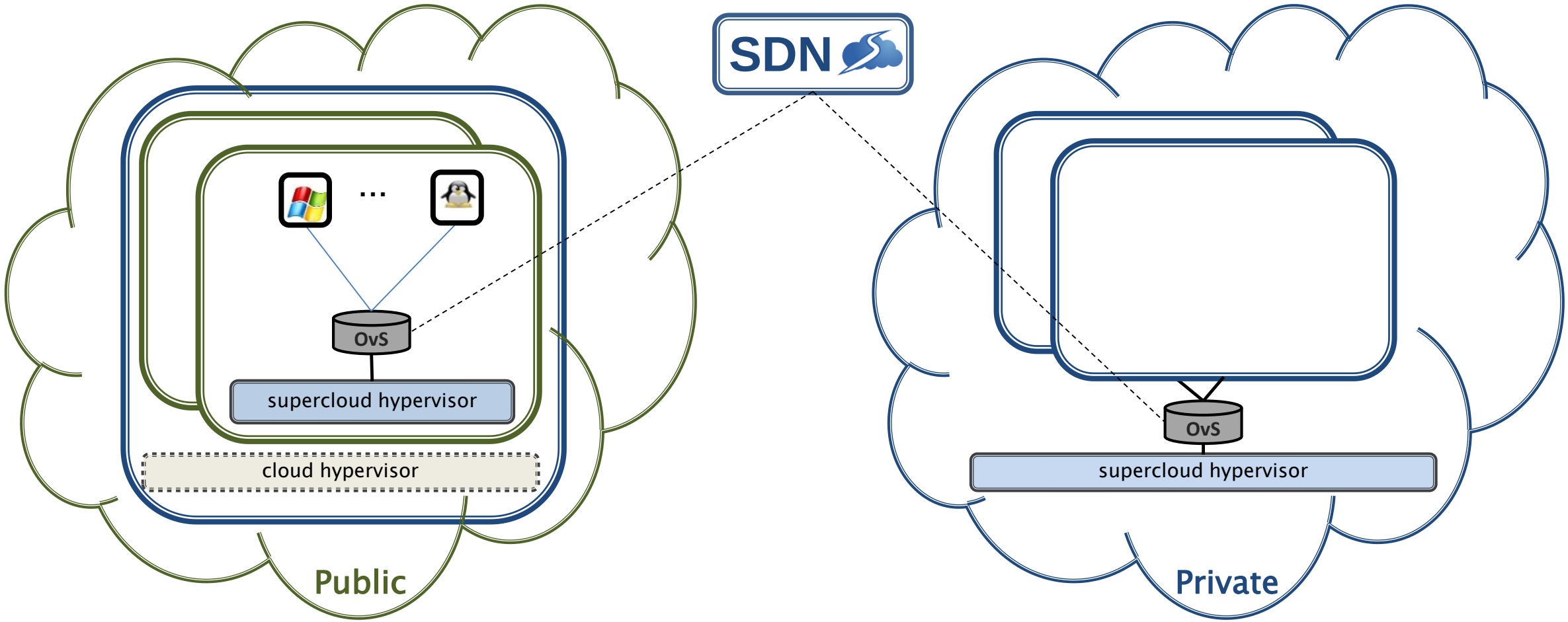
Demo: SUPERCLOUD network virtualization platform v0.1

Fulfilling design requirement #1: remote, flexible control

- Remote, flexible control of network elements: Open vSwitch
  - A software switch for virtualized environments
    - resides within the hypervisor or management domain
    - exports interface for fine grained control of the forwarding (via OpenFlow) and of configuration (via OVSDB: to configure queues, add/remove ports, etc.)

- Open vSwitch support:
  - Linux, FreeBSD, NetBSD, Windows, ESX
  - KVM, Xen, Docker, VirtualBox, Hyper-V, …
  - OpenStack, CloudStack, OpenNebula, …
- Widely used:
  - Most popular OpenStack networking backend
  - Default network stack in XenServer

Fulfilling design requirement #1: OvS



Fulfilling design requirement #2: full network virtualization

- Full network virtualization
  - isolation: logically-centralized control allows mapping of virtual/physical events
  - topology abstraction: intercept topology-related messages
  - addressing abstraction: tagging packets (MPLS, VLAN) and/or rewriting L2/L3 headers, tunneling

Fulfilling design requirement #3: security and dependability

- Resilient data plane
  - resilient routing
  - multipath
  - network coding
  - (secure) path monitoring

- Resilient controller
  - Fault tolerant controller
  - With a focus on correctness
    - consistency of both data and control planes (and their interaction) to avoid network anomalies (loops, security breaches)

Fulfilling other design requirements

- Resource snapshot and migration
  - Migrate the VM and the network
  - VM state + network state (OvS forwarding rules)
    - Do it live if possible
- Scalability and performance
  - Distributed SDN controller
  - fast algorithms for virtual/physical mapping, for network embedding
  - storage+networking solutions (e.g., deduplication techniques in SDN)
- Compatibility and interoperability
  - OASIS TOSCA: https://www.oasis-open.org/committees/tc_home.php?wg_abbrev=tosca
    - Open standard that defines the interoperable description of services and applications hosted on the cloud
    - Allows expressing application requirements independently from cloud provider capabilities
    - Flexible movement between different clouds
  - A facilitator for network migration

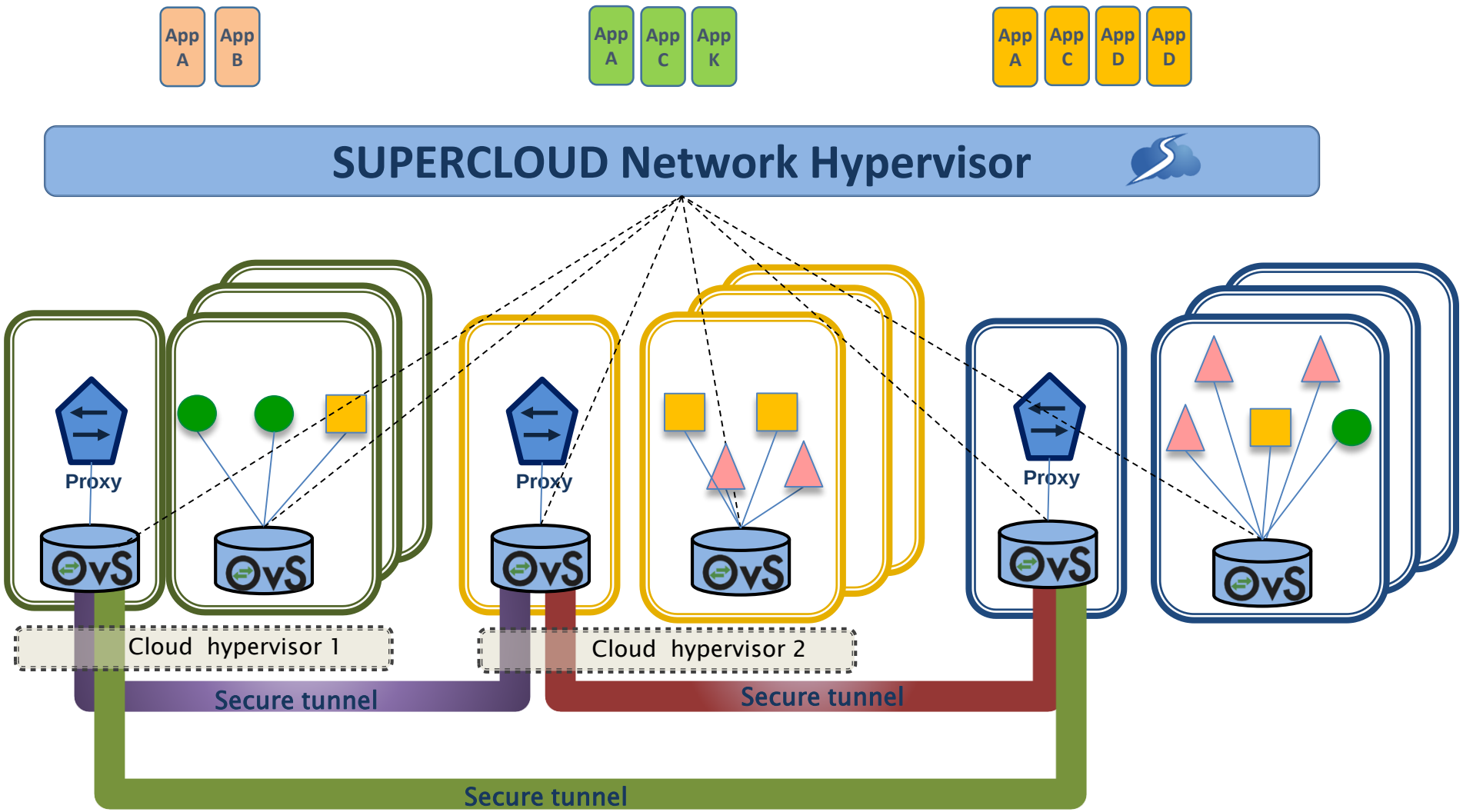
Design requirements

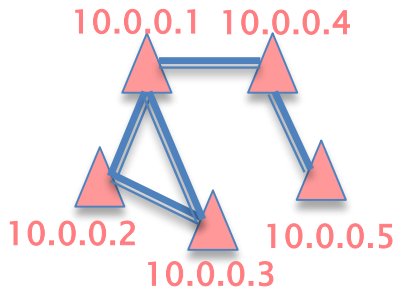
Fulfilling the design requirements

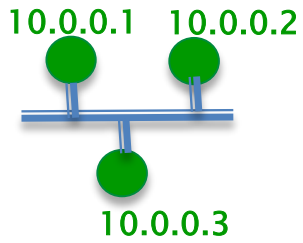
Preliminary architecture

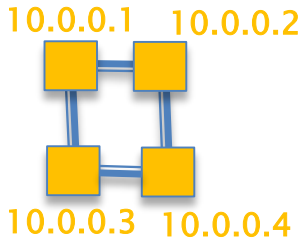
Demo: SUPERCLOUD network virtualization platform v0.1

Preliminary network virtualization architecture



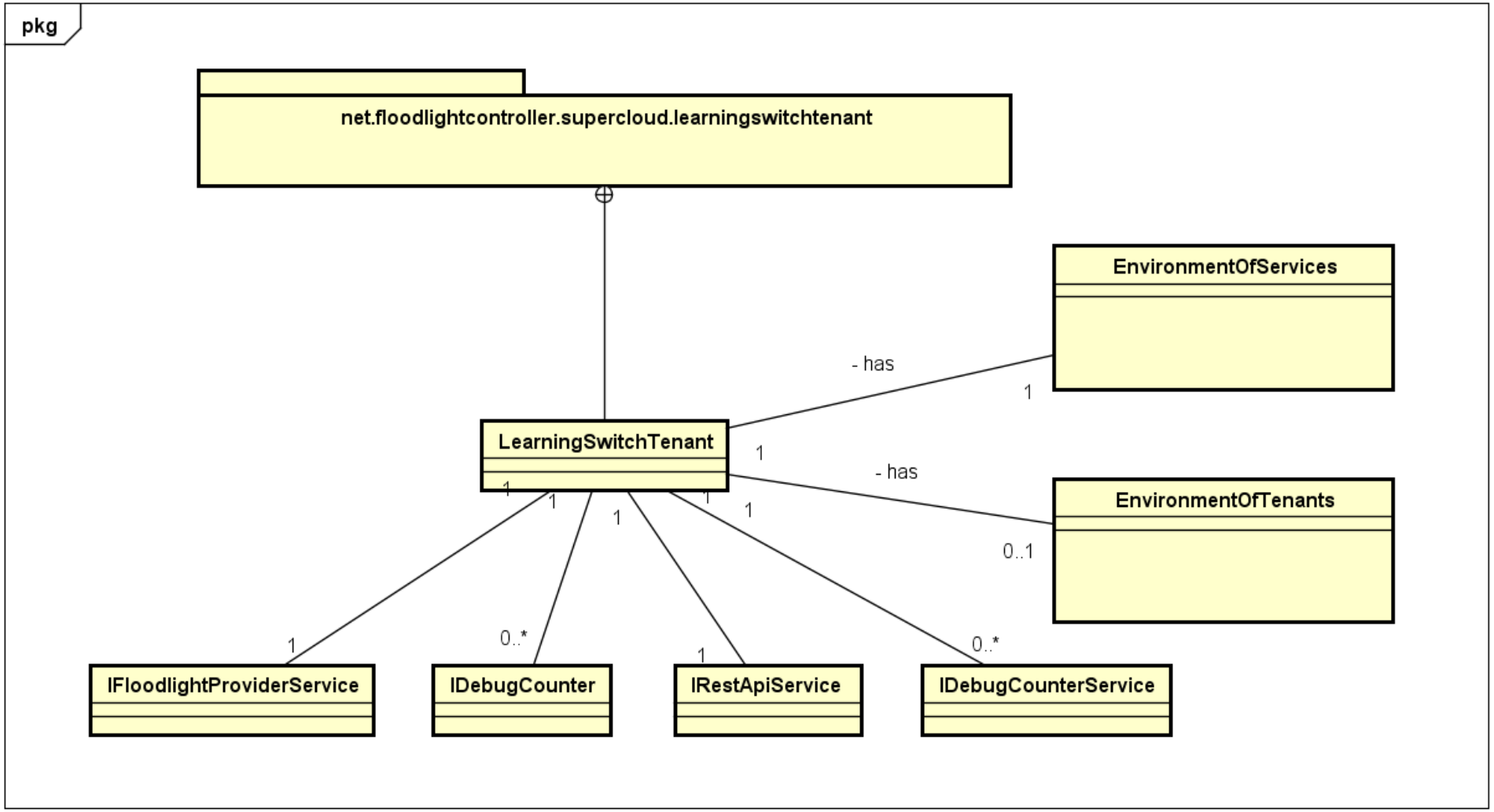






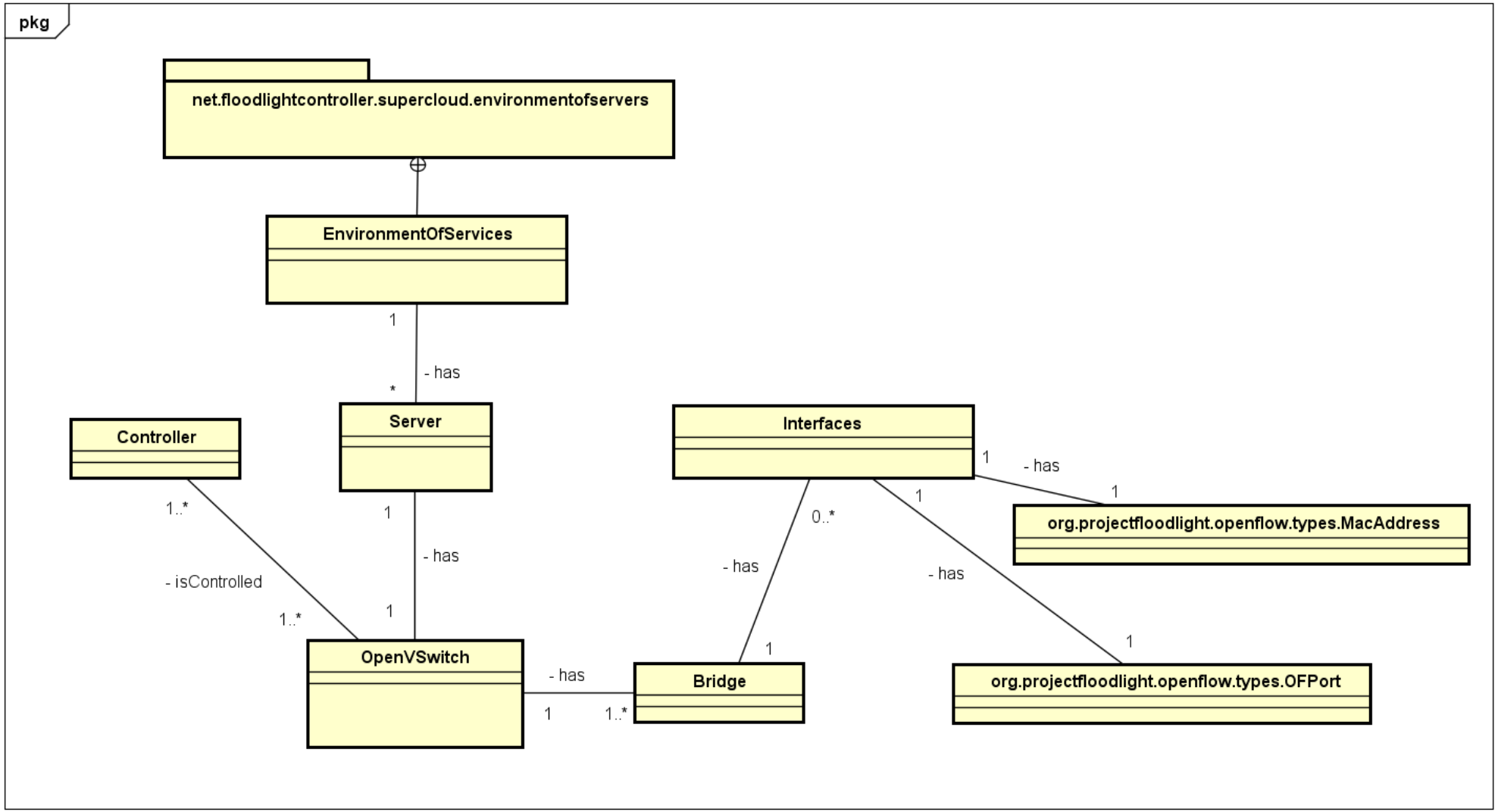
Tenant 1
Tenant 2
⋮
Tenant N

Preliminary network virtualization architecture



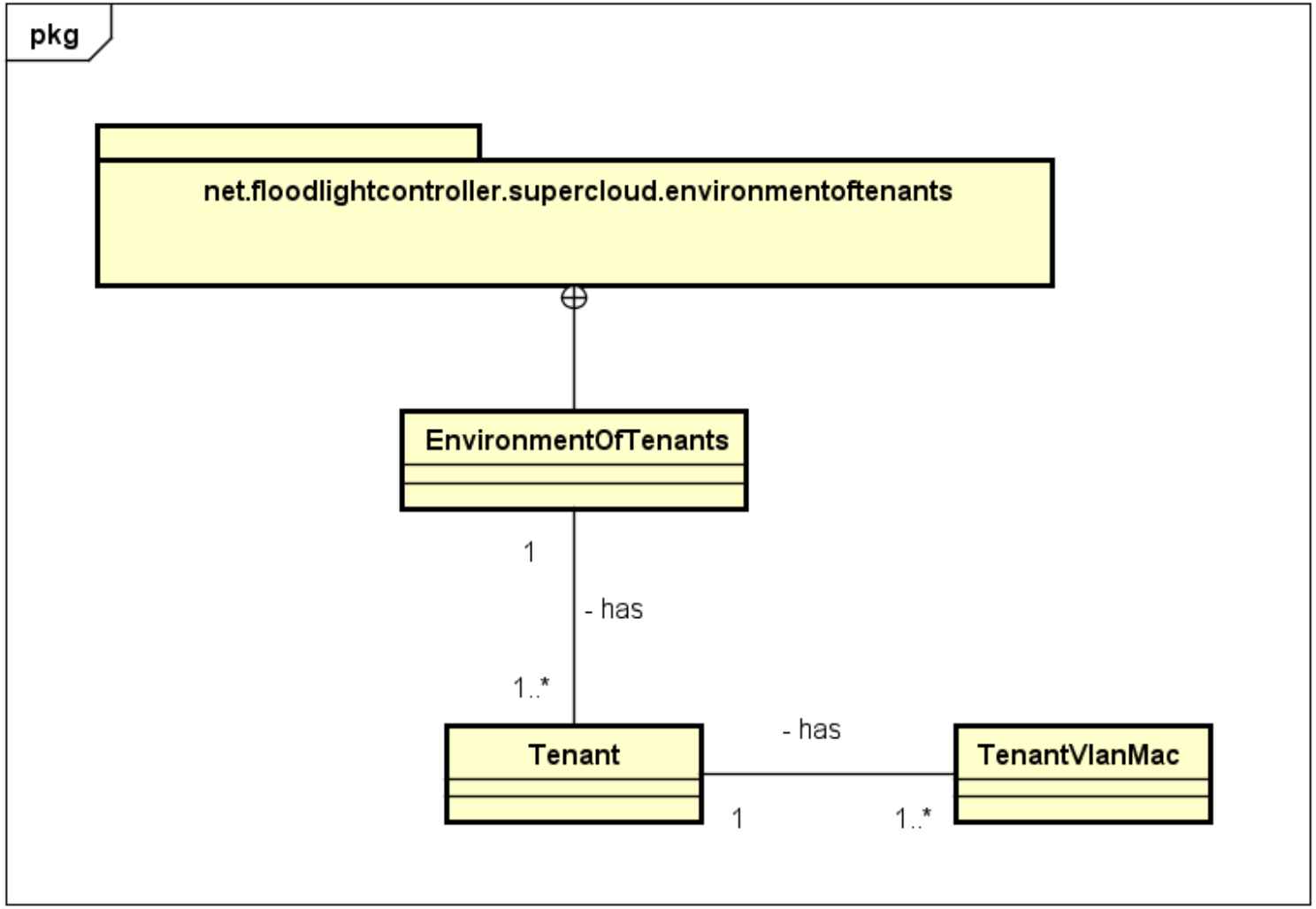
powered by Astah

Preliminary network virtualization architecture



powered by Astah

Preliminary network virtualization architecture



powered by Astah

Design requirements

Fulfilling the design requirements

Preliminary architecture

Demo: SUPERCLOUD network virtualization platform v0.1

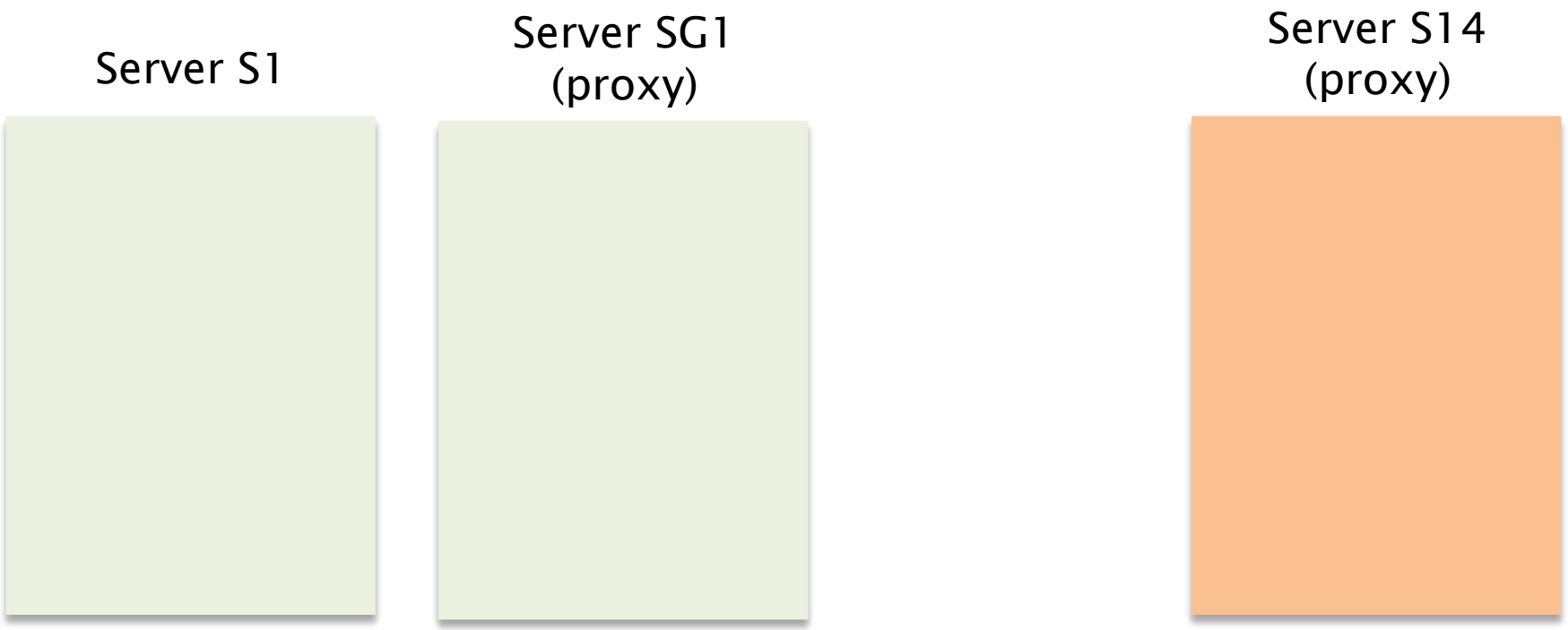
Windows

A fatal exception 0E has occurred at 0028:C0011E36 in VXD VMM(01) + 00010E36. The current application will be terminated.

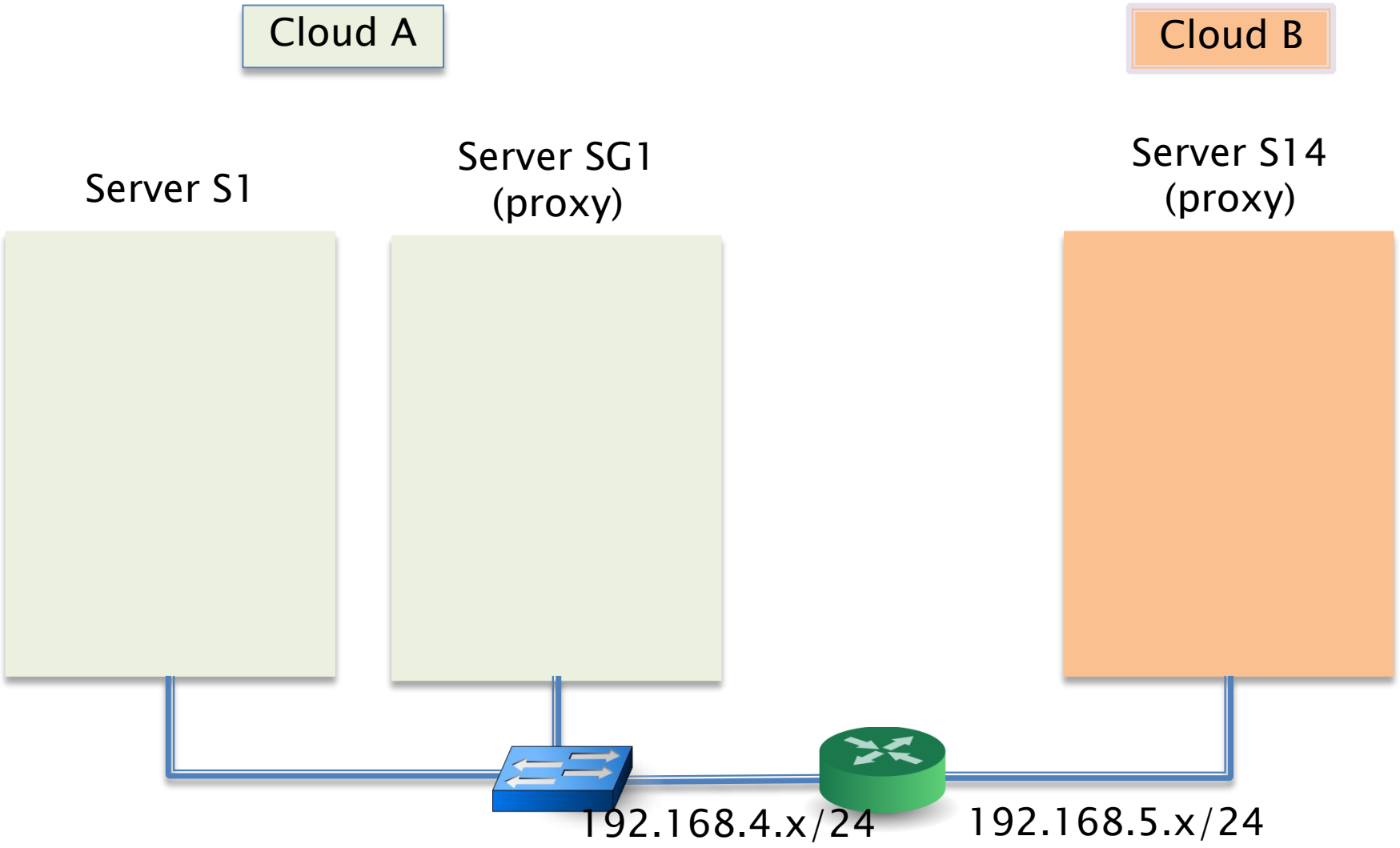
* Press any key to terminate the current application.
* Press CTRL+ALT+DEL again to restart your computer. You will lose any unsaved information in all your applications.

Press any key to continue _

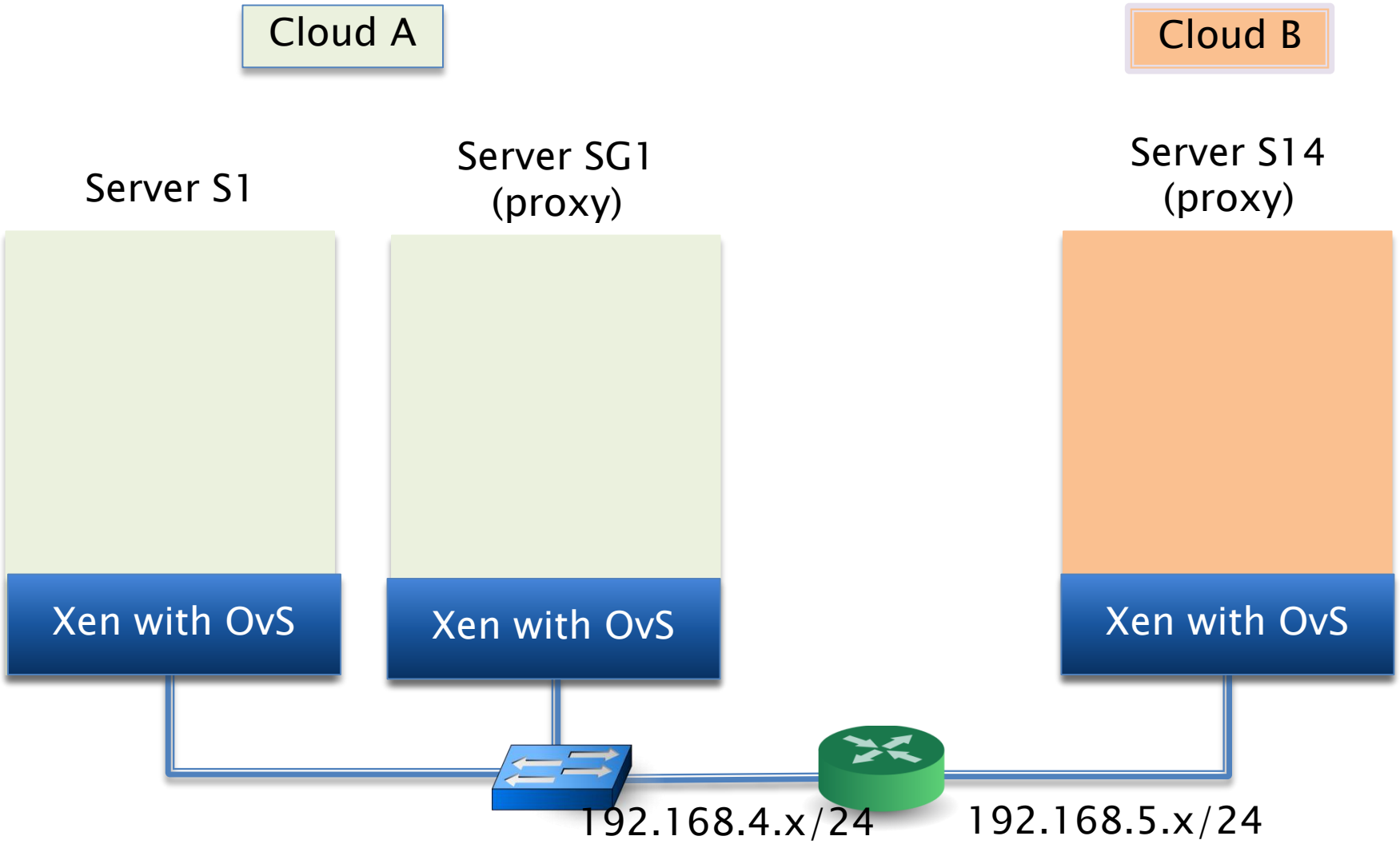
Instantiating the SUPERCLOUD provider network: 3 servers



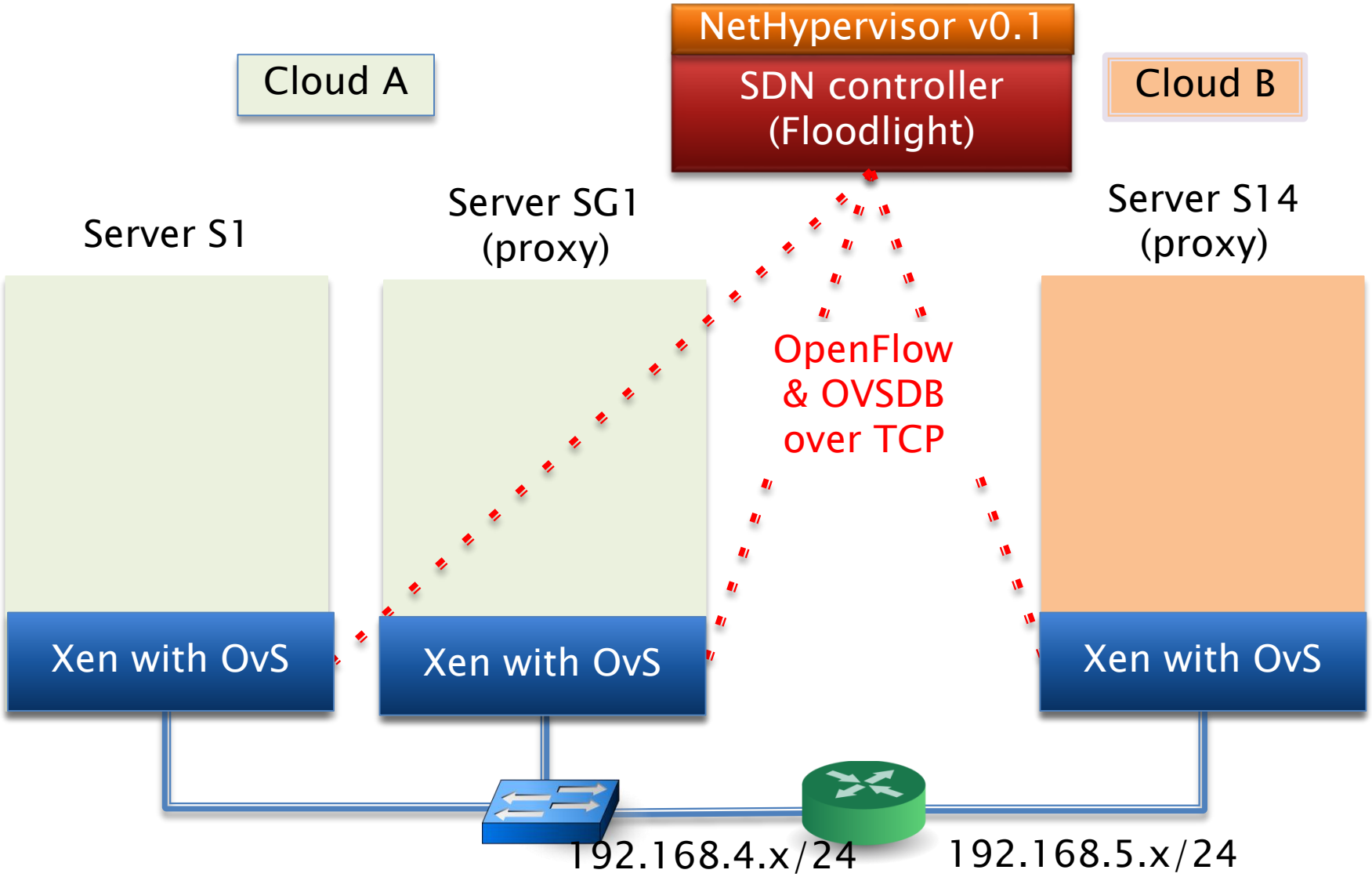
Instantiating the SUPERCLOUD provider network: emulating 2 clouds



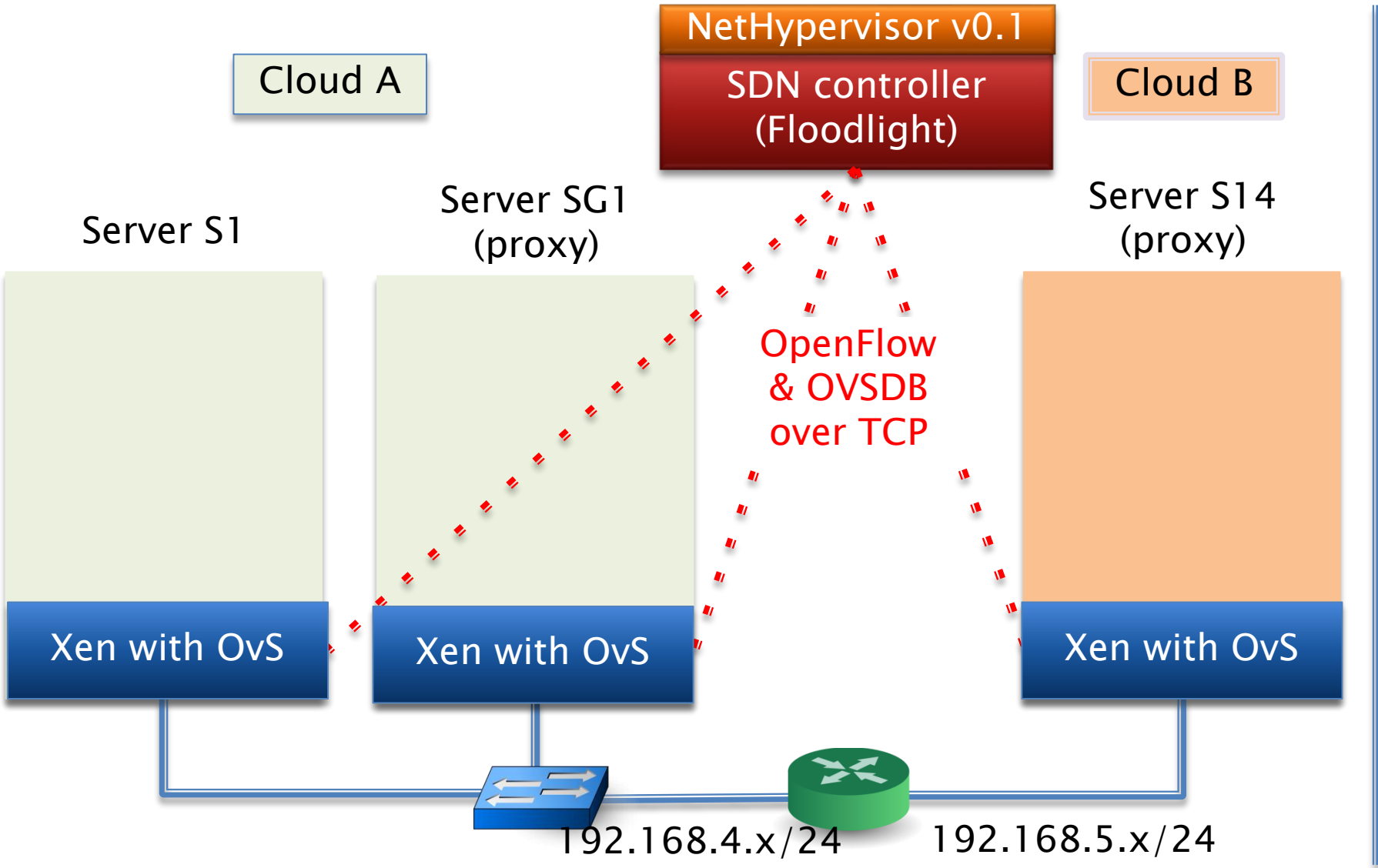
Instantiating the SUPERCLOUD provider network: virtualized



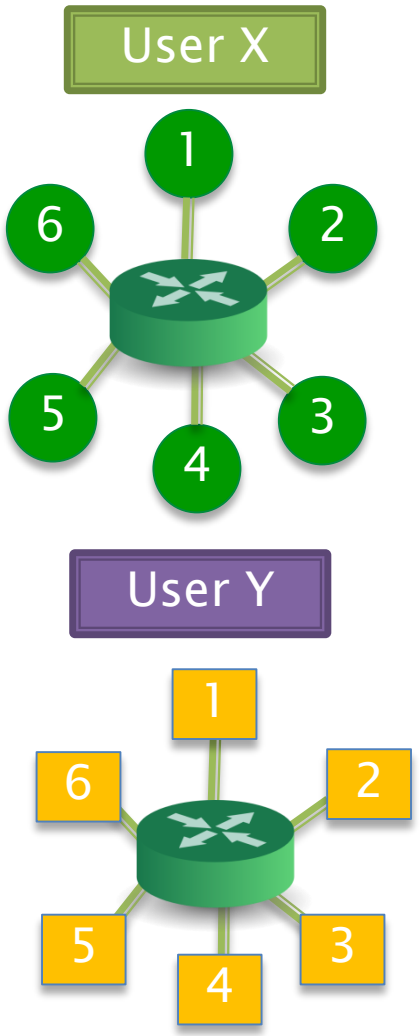
Instantiating the SUPERCLOUD provider network: with SDN control



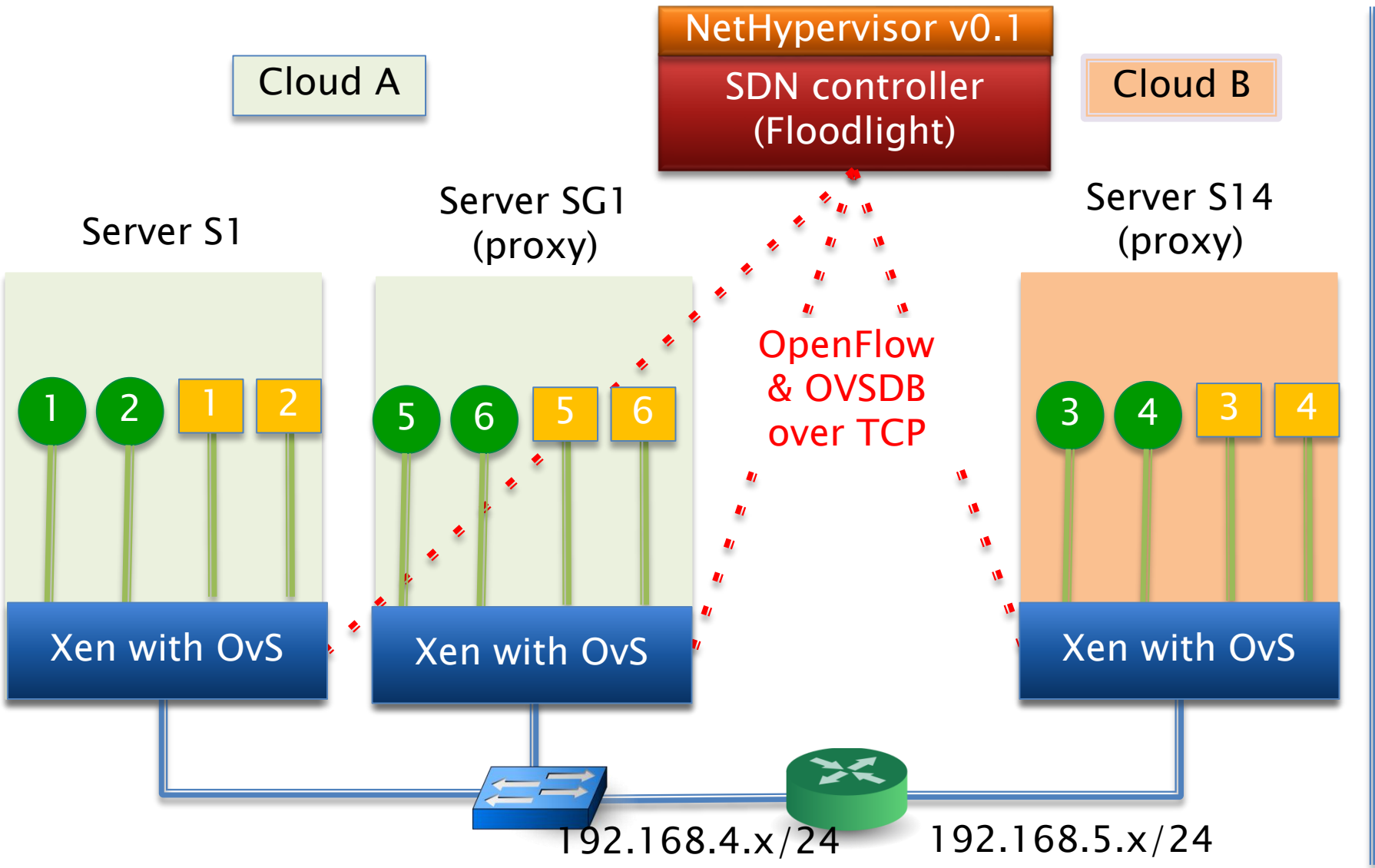
Instantiating the SUPERCLOUD user virtual network



Same IP range:
10.200.0.x/24



Instantiating the SUPERCLOUD user virtual network



Same IP range:
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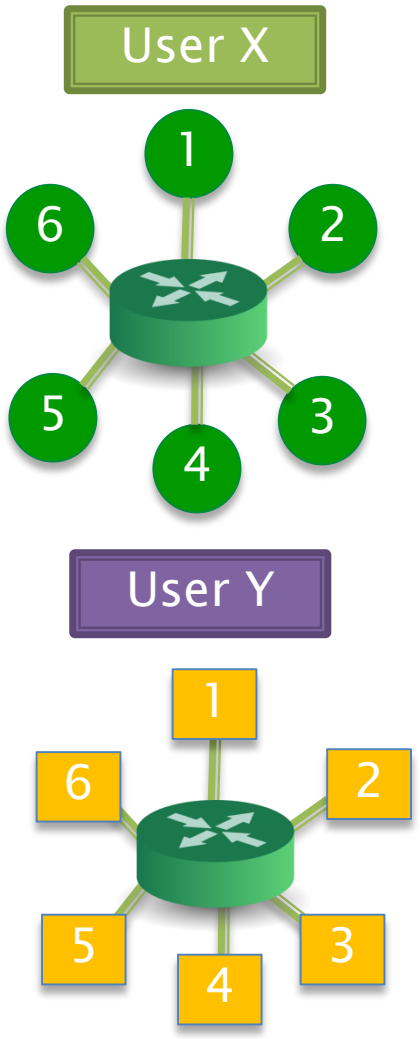
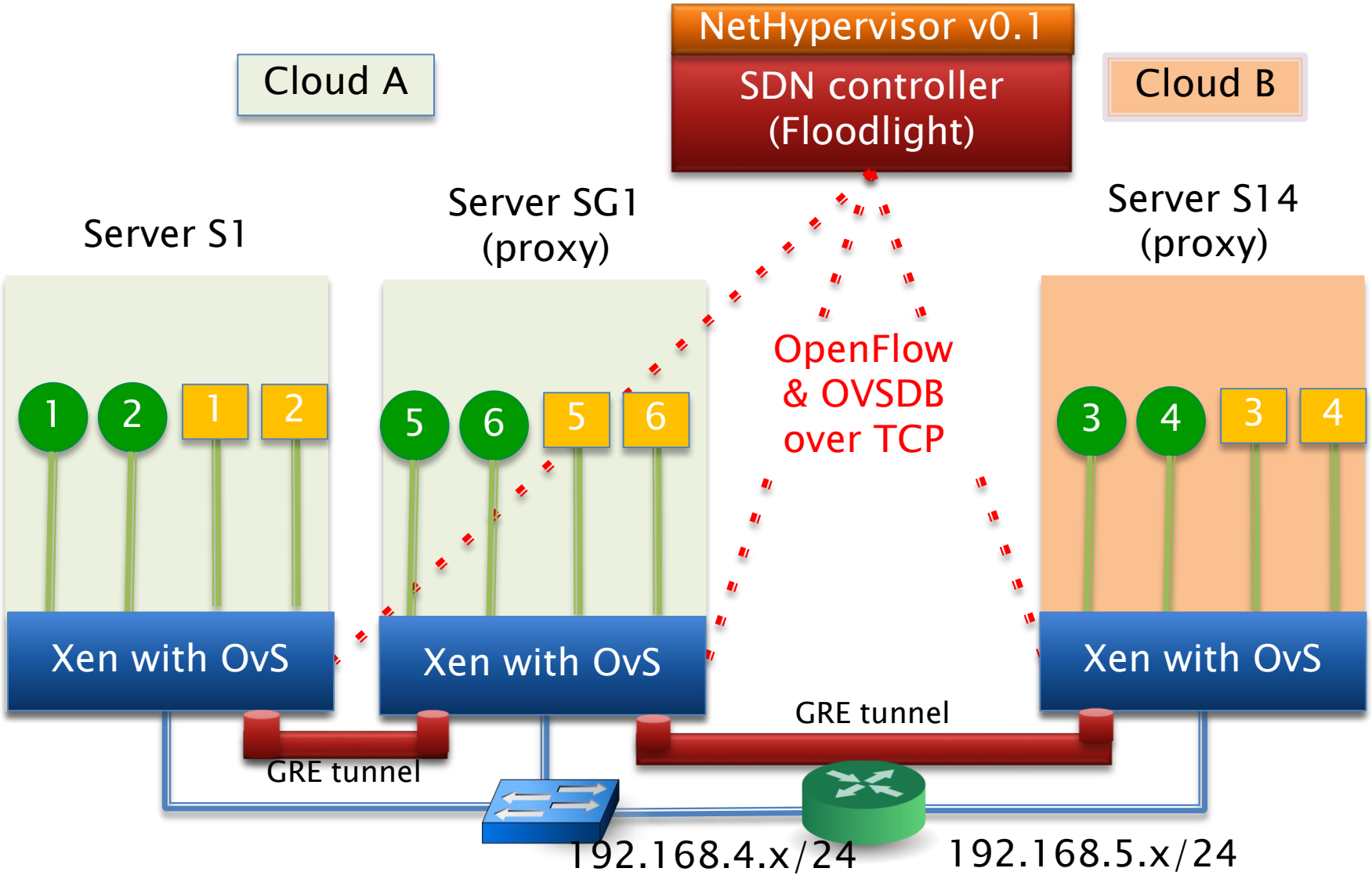
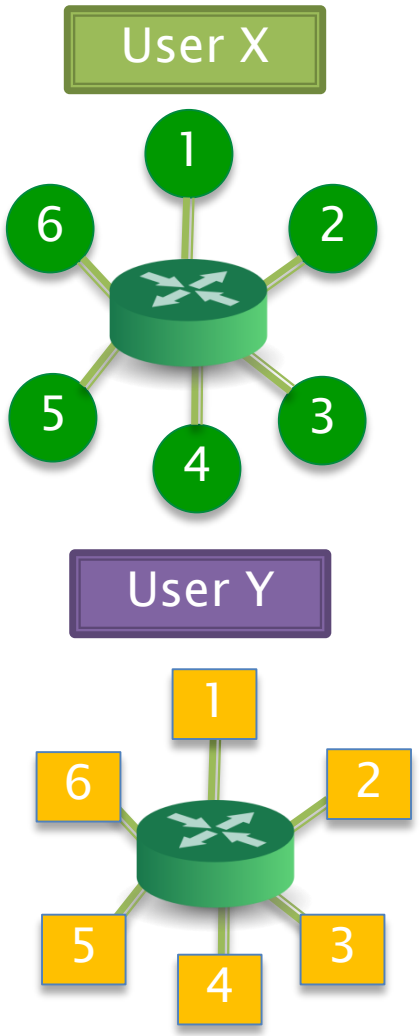


Instantiating the SUPERCLOUD user virtual network

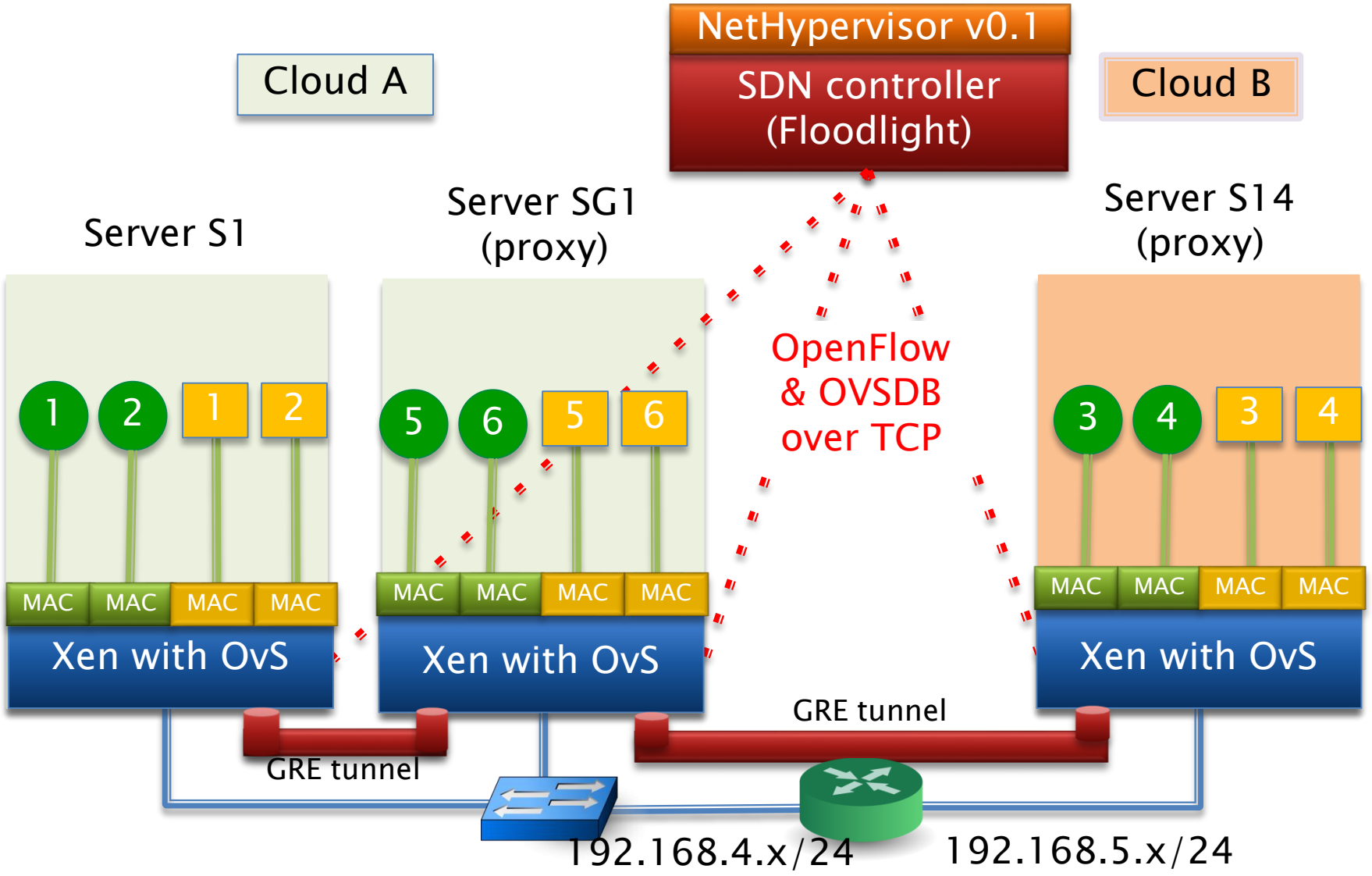
Same IP range:
10.200.0.x/24

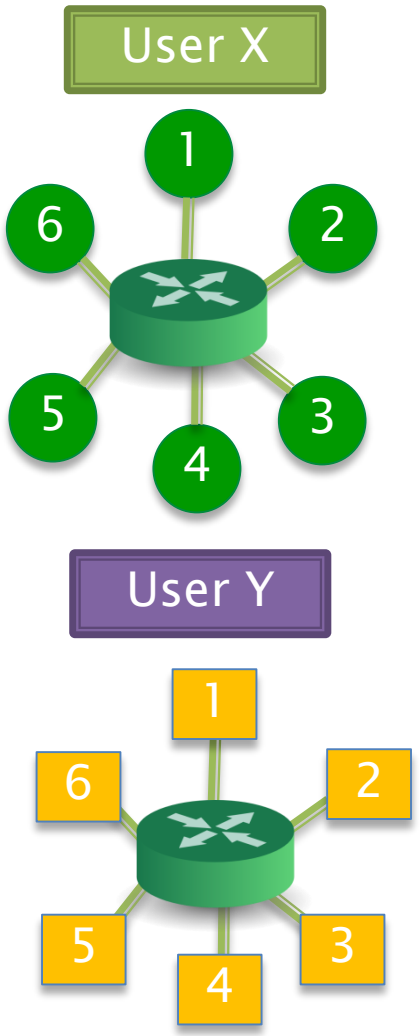




Instantiating the SUPERCLOUD provider network

Same IP range:
10.200.0.x/24

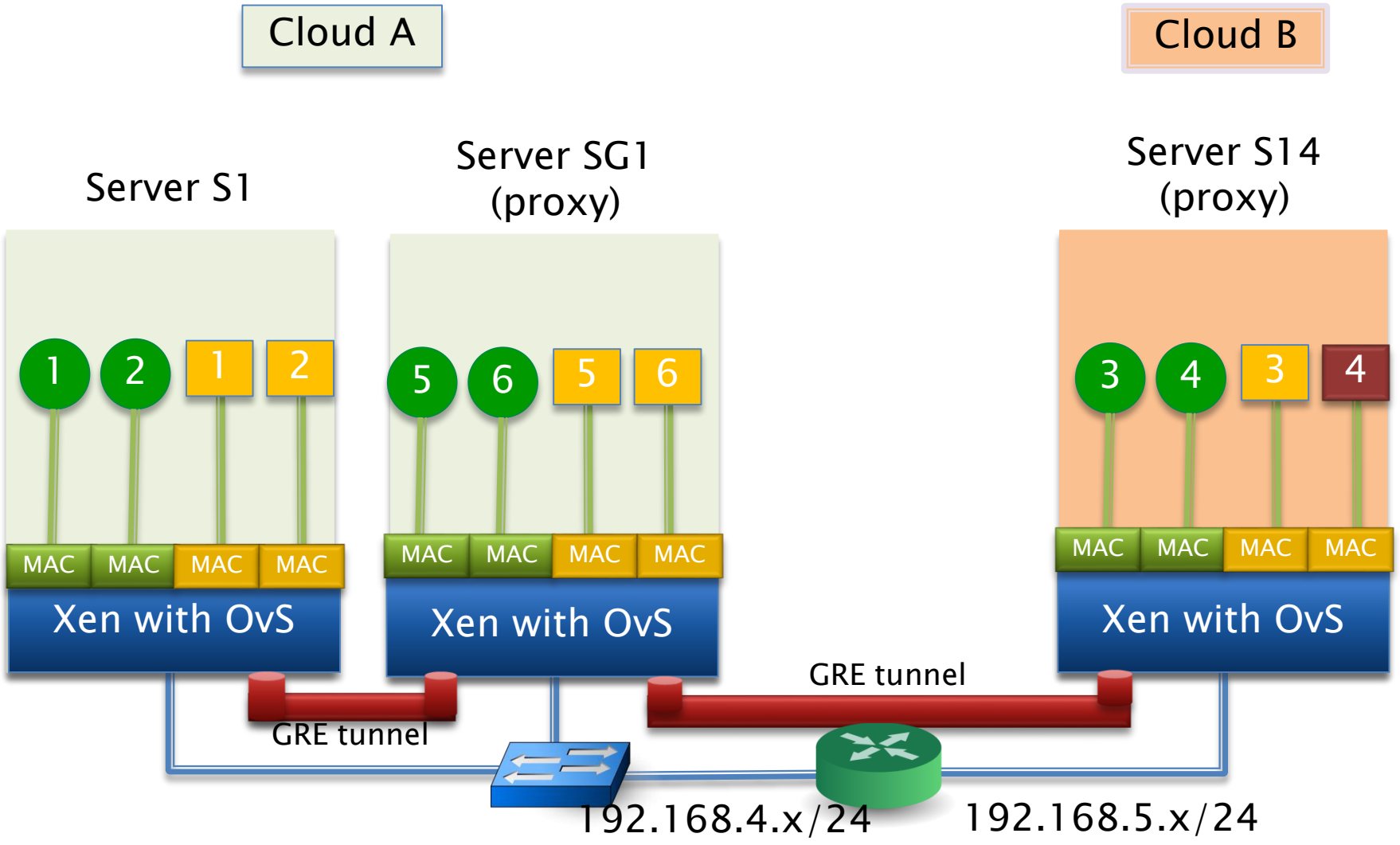


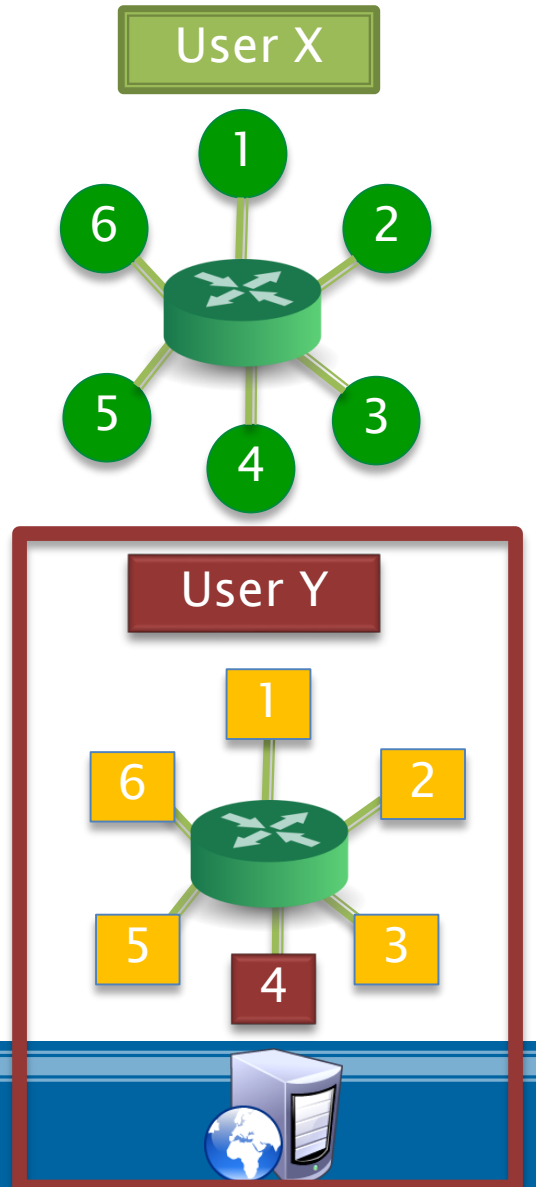


MAC 00:01:00:00:00:x
MAC 00:02:00:00:00:x

User Y: Web server in host 10.200.0.4

Same IP range:
10.200.0.x/24





MAC 00:01:00:00:00:x

MAC 00:02:00:00:00:x

User X: ping 1 -> 4

Same IP range:
10.200.0.x/24

Cloud A

Cloud B

Server S1

Server SG1
(proxy)

Server S14
(proxy)

1 2 1 2

5 6 5 6

3 4 3 4

MAC MAC MAC MAC

Xen with OvS

GRE tunnel

GRE tunnel

192.168.4.x/24

192.168.5.x/24

User X

1 2 3 4 5 6

User Y

1 2 3 4 5 6

MAC 00:01:00:00:00:x

MAC 00:02:00:00:00:x

User X: ssh 1 -> 4

Same IP range:
10.200.0.x/24

Cloud A

Cloud B

Server S1

Server SG1
(proxy)

Server S14
(proxy)

1 2 1 2

5 6 5 6

3 4 3 4

MAC MAC MAC MAC

Xen with OvS

GRE tunnel

GRE tunnel

192.168.4.x/24

192.168.5.x/24

User X

1 2 3 4 5 6

User Y

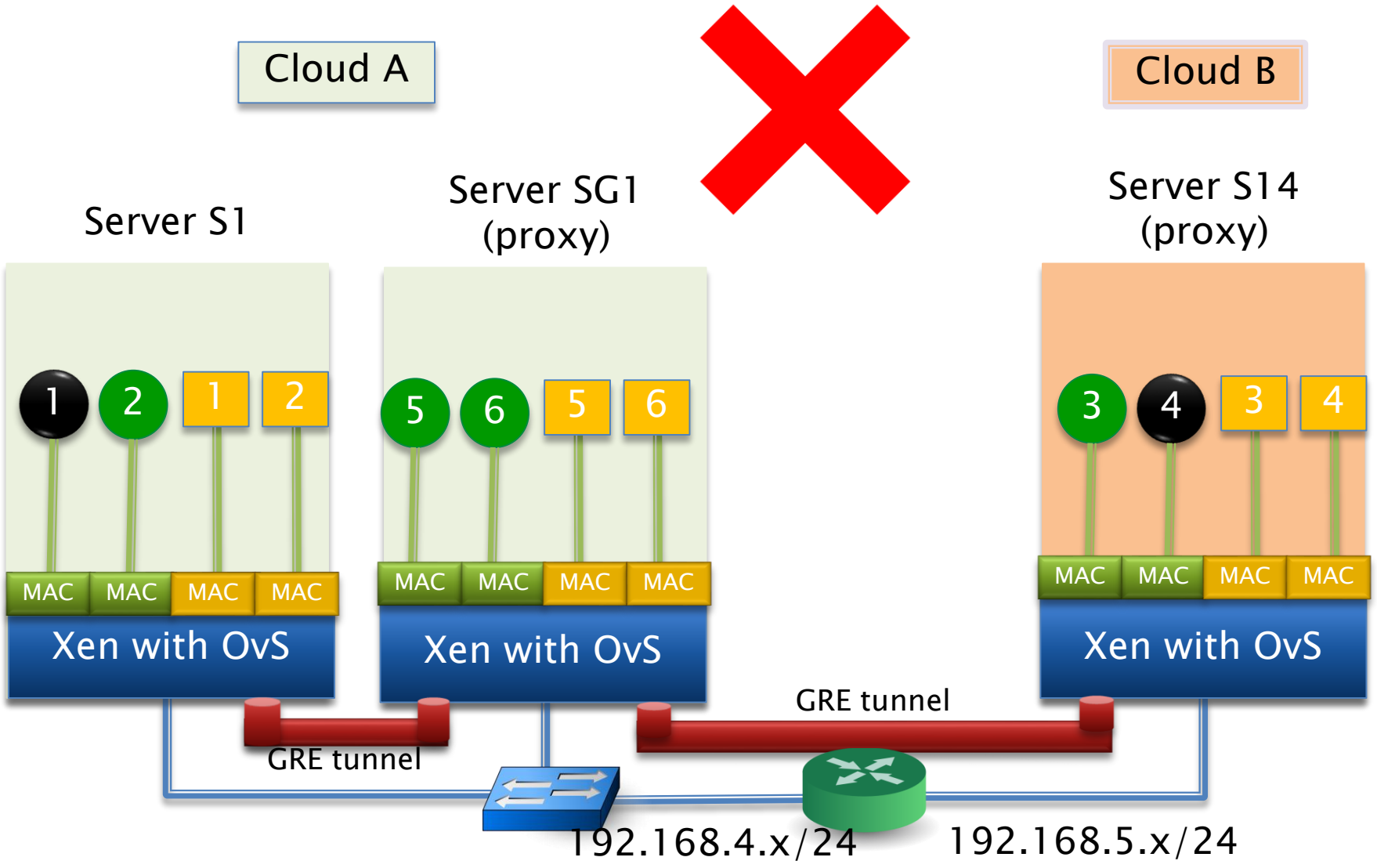
1 2 3 4 5 6

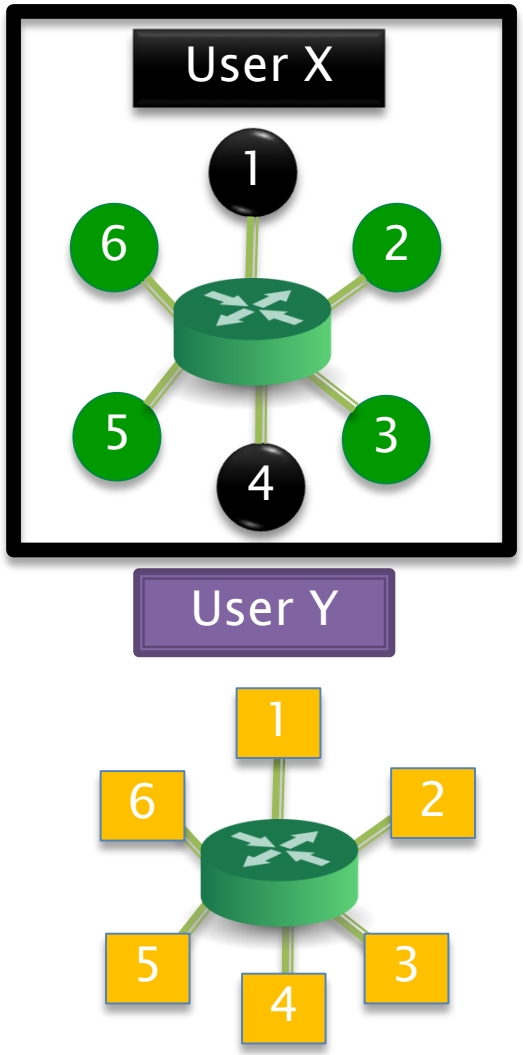
MAC 00:01:00:00:00:x

MAC 00:02:00:00:00:x

User X: wget 1 -> 4

Same IP range:
10.200.0.x/24

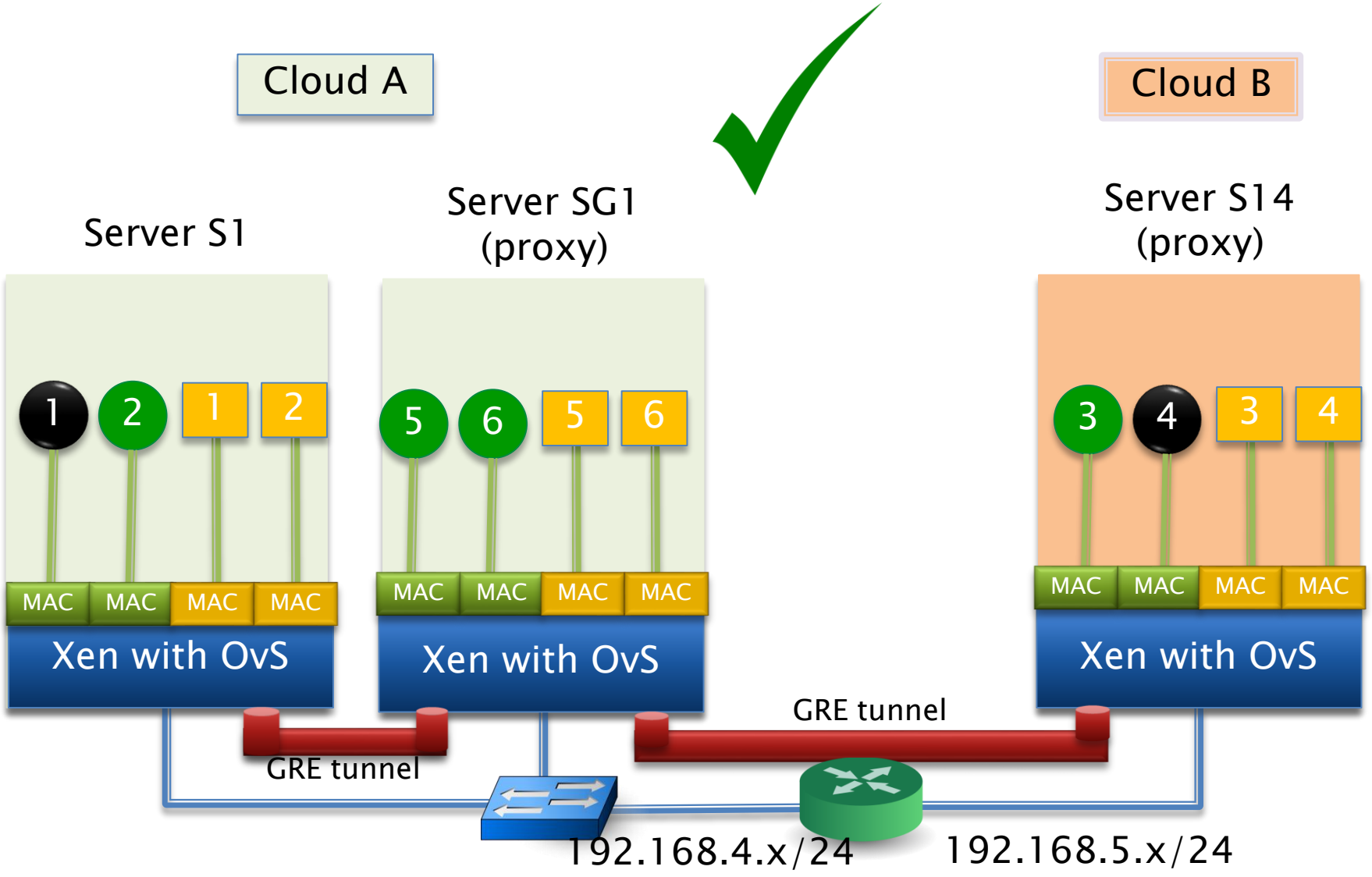


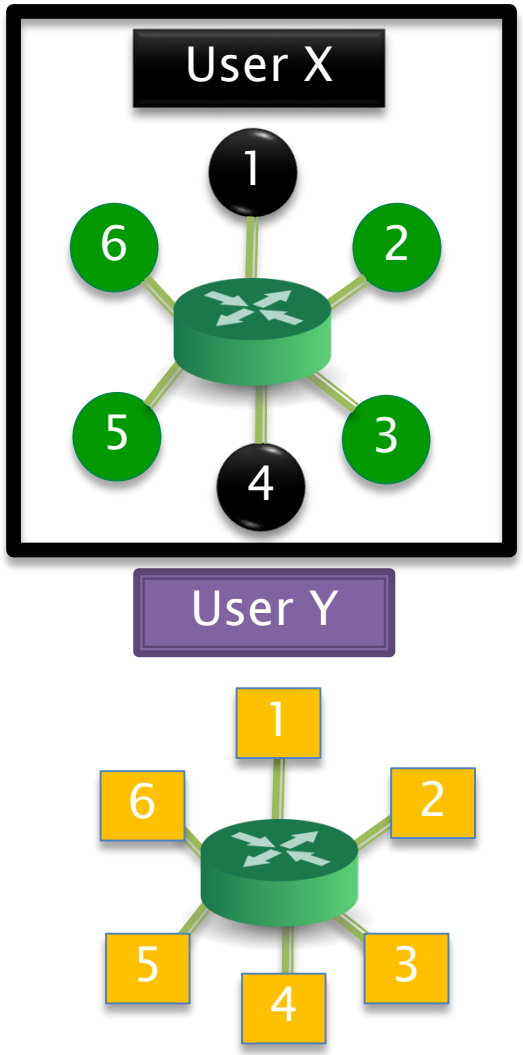


MAC 00:01:00:00:00:x
MAC 00:02:00:00:00:x

User X: wget 1 -> 4 (FAILURE == ISOLATION)

Same IP range:
10.200.0.x/24





MAC 00:01:00:00:00:x
MAC 00:02:00:00:00:x

User Y: ping 1->4

Same IP range:
10.200.0.x/24

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Cloud B

Server S1

Server SG1
(proxy)

Server S14
(proxy)

1 2 1 2

5 6 5 6

3 4 3 4

MAC MAC MAC MAC

Xen with OvS

GRE tunnel

GRE tunnel

192.168.4.x/24

192.168.5.x/24

User X

1 2 3 4 5 6

User Y

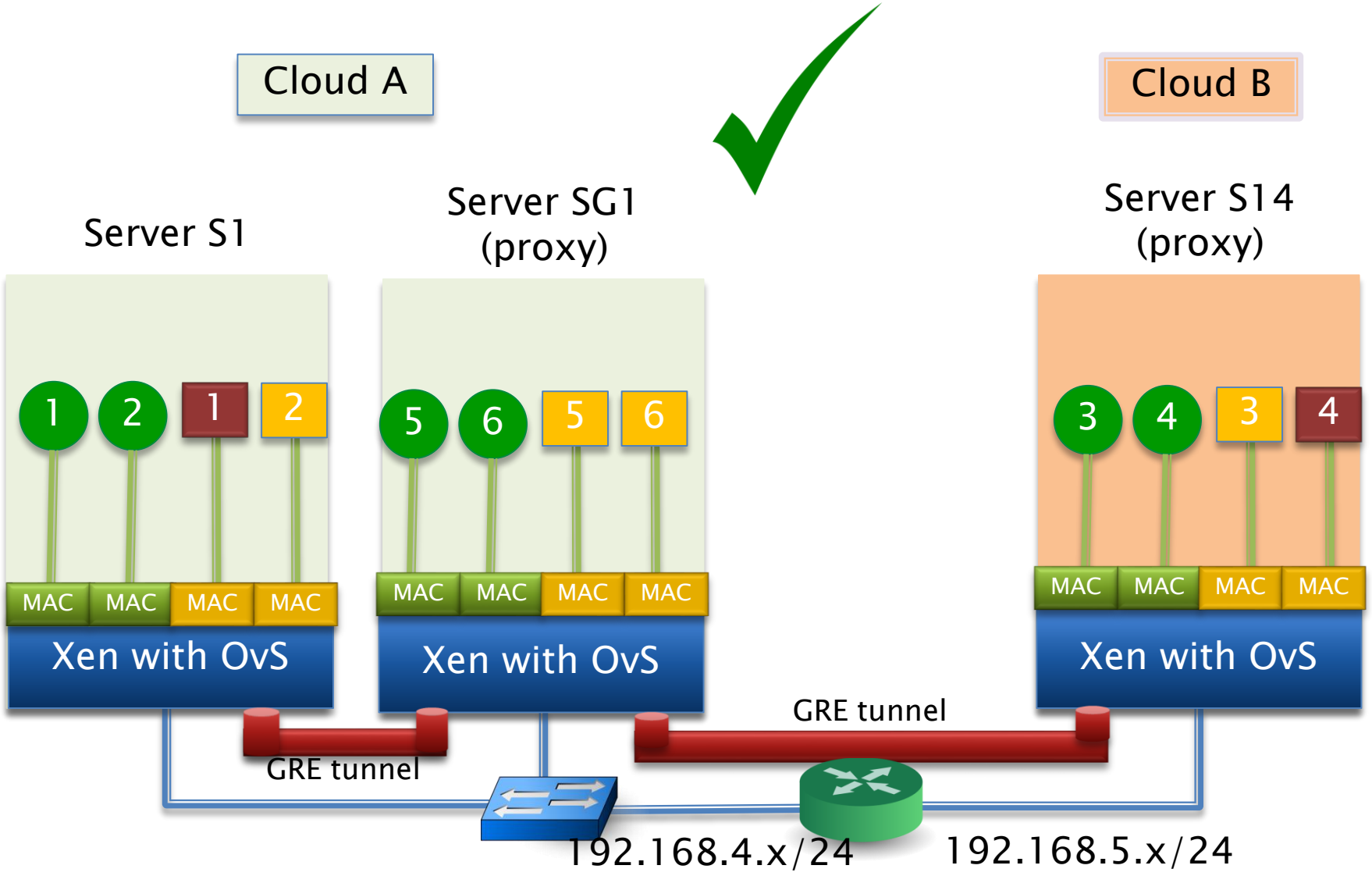
1 2 3 4 5 6

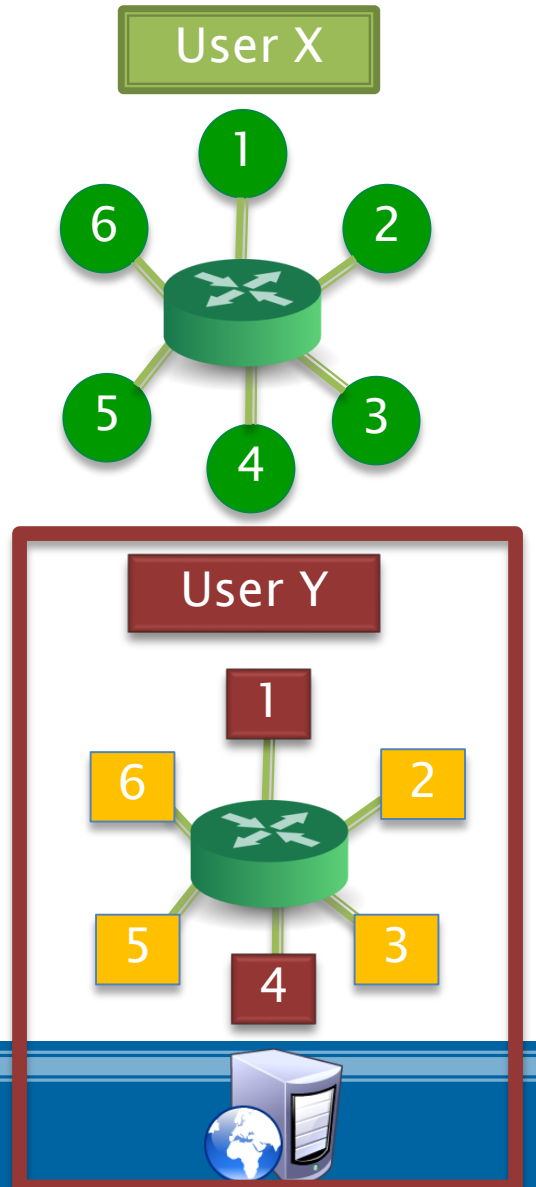
MAC 00:01:00:00:00:x

MAC 00:02:00:00:00:x

User Y: ssh 1->4

Same IP range:
10.200.0.x/24





MAC 00:01:00:00:00:x

MAC 00:02:00:00:00:x

User Y: wget 1 -> 4

Same IP range:
10.200.0.x/24

Cloud A

Cloud B

Server S1

Server SG1
(proxy)

Server S14
(proxy)

1 2 1 2

MAC MAC MAC MAC

Xen with OvS

5 6 5 6

MAC MAC MAC MAC

Xen with OvS

3 4 3 4

MAC MAC MAC MAC

Xen with OvS

GRE tunnel

GRE tunnel

192.168.4.x/24

192.168.5.x/24

User X

1 2 3 4 5 6

User Y

1 2 3 4 5 6

MAC 00:01:00:00:00:x

MAC 00:02:00:00:00:x

SUPERCLOUD Grant Agreement No. 643964

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If you need further information, please contact the coordinator:
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