VMS Clusters on the Cloud and Hybrid VMS Clusters

Jonathan Bergdahl & Martin Schneider
Date: 14/5 2025

VMS Software

Part 1: VMS Clusters on the Cloud

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Agenda Part 1

01 Introduction

02 System Topology

03 Clusters in one OCI region

04 Local VCN Peering

05 Clusters across OCI regions

06 Failure Scenarios

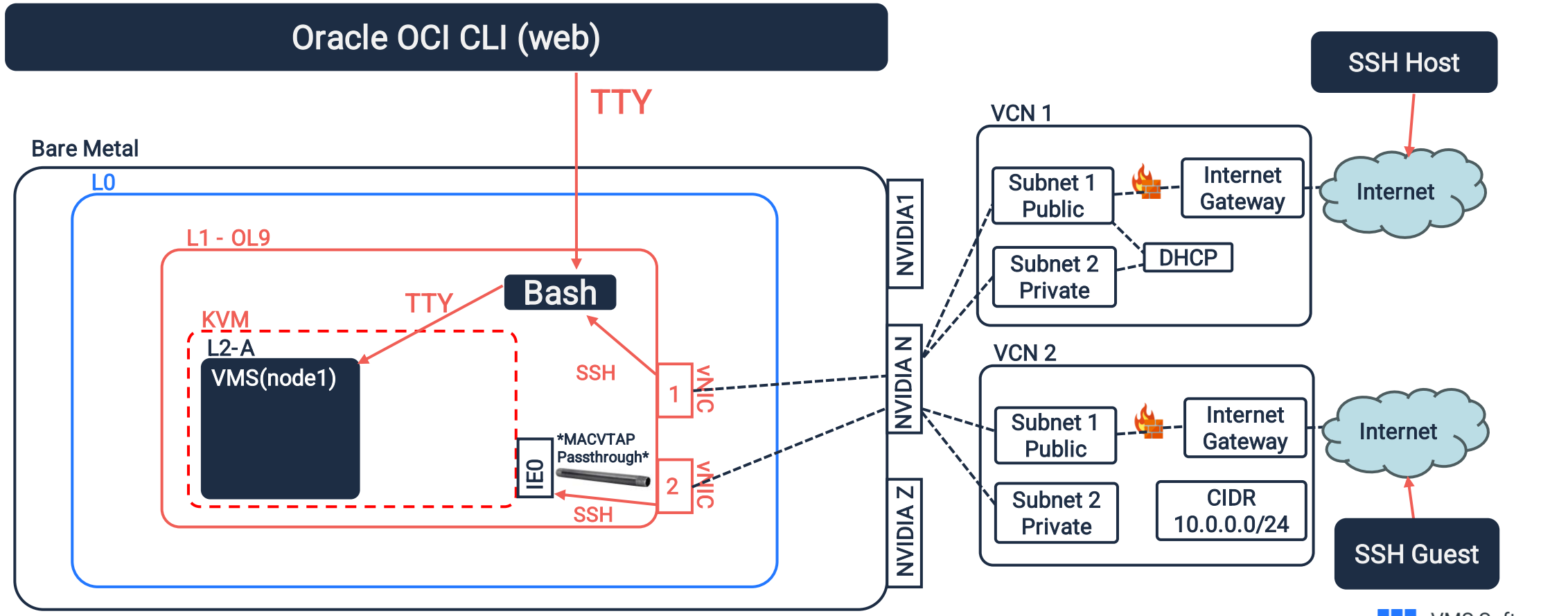
07 Summary

Presentation Objectives

- This presentation will:
  - Show the process of setting up a VMS cluster on the cloud.
  - OCI Networking and tunnelling
  - Share our learned lessons and roadblocks
  - Motivate you to try it out yourself!

- This presentation assumes you have:
  - Watched the previous webinar:
    - How to set up and configure your OCI instance
    - Details about KVM configuration
    - VMS guest in KVM
- Let’s get started!

System Topology – a quick recap from last webinar



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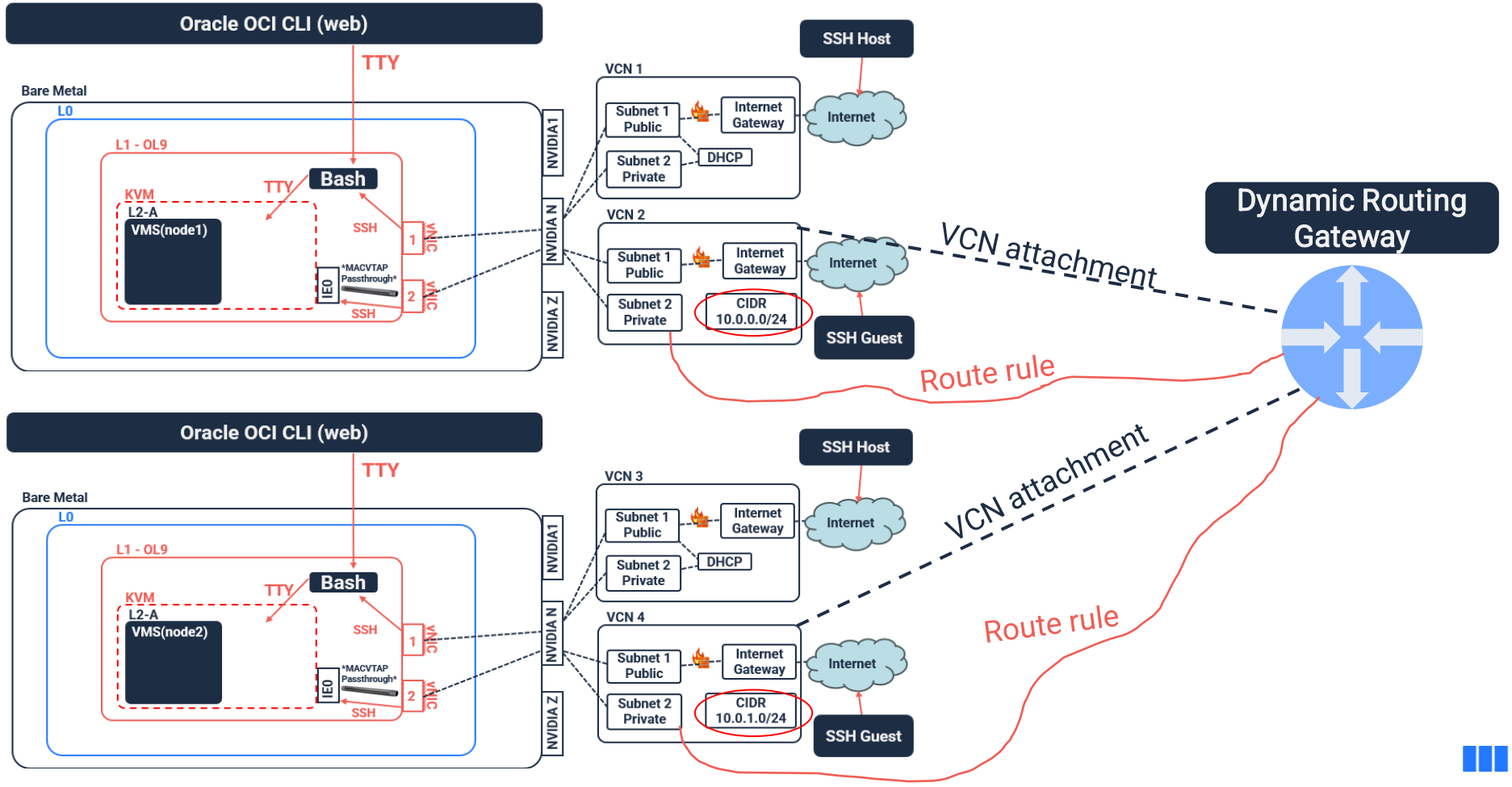
Cloud Cluster in the same OCI Region



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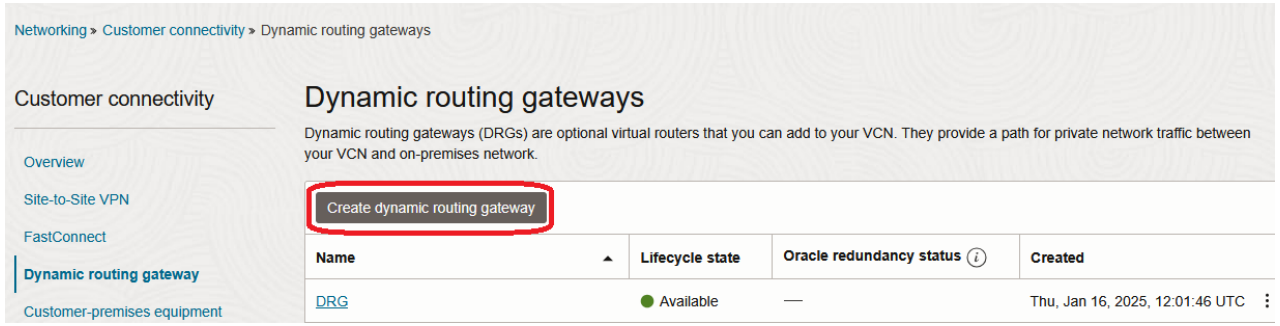
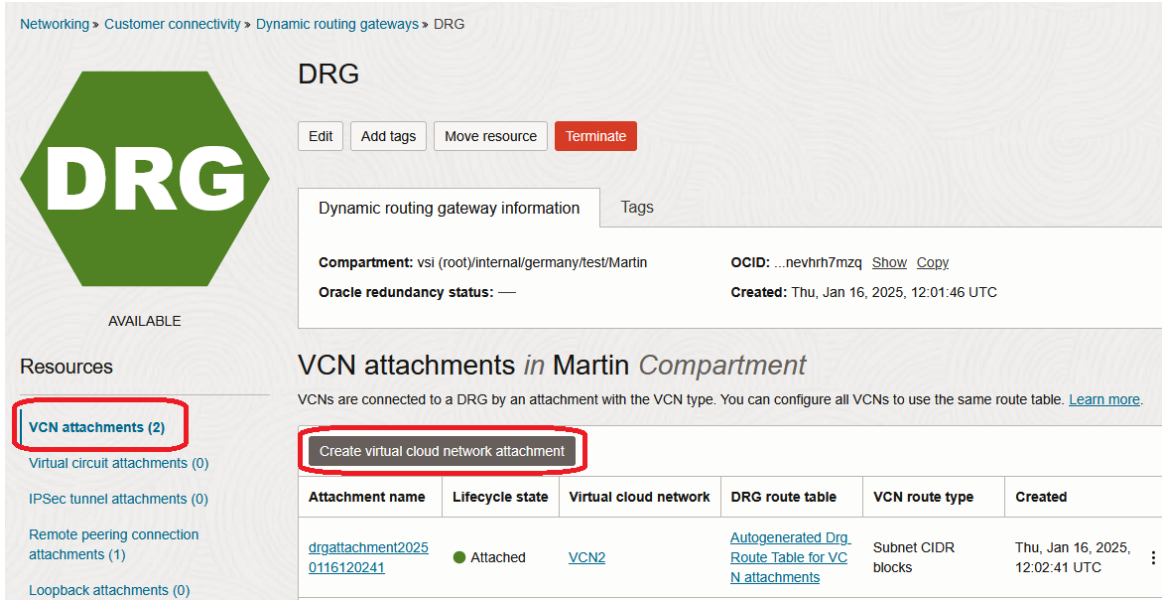
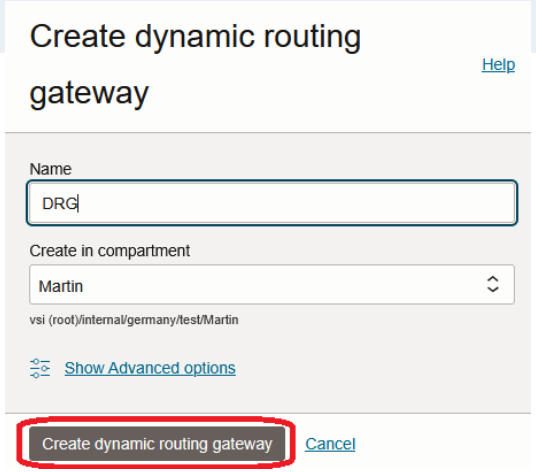
DRG creation (local peering)



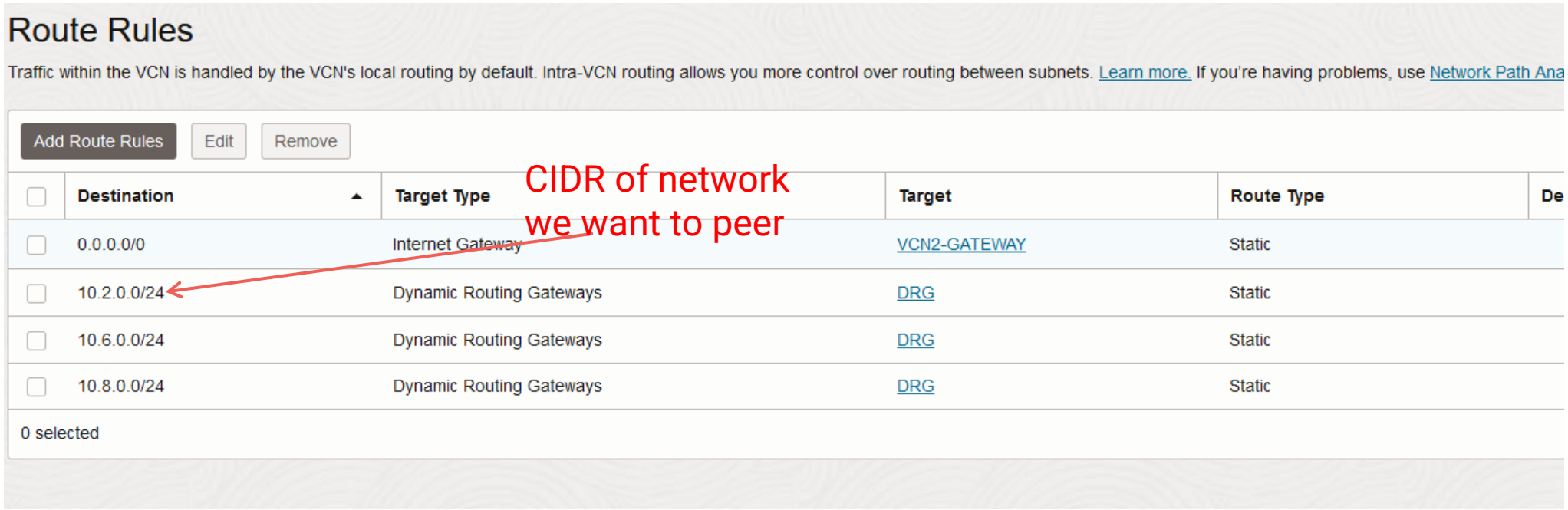




VMS Software

DRG creation (local peering)

- Define each subnet in the route rules



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Moving it up a notch: stretched cluster

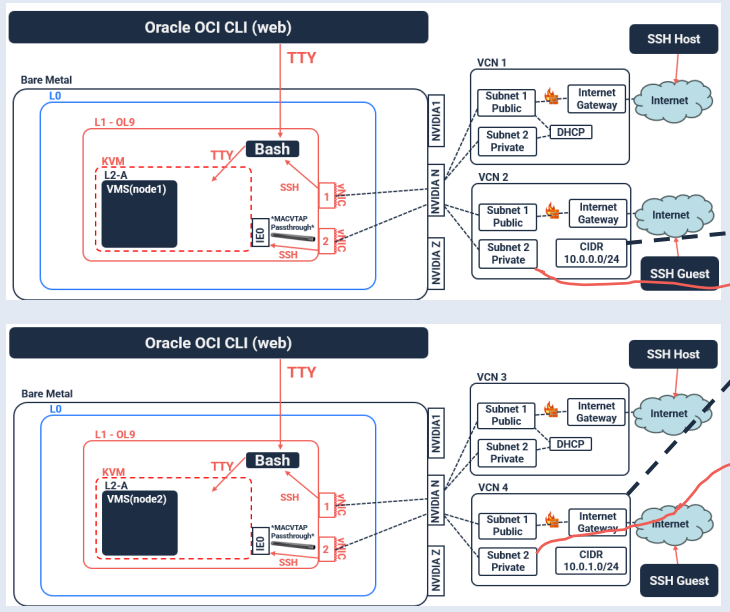
- From 2 nodes in the same Region

To

- 2 nodes in one region, 2 nodes in another region

Cloud Cluster across OCI Regions

OCI Region: Frankfurt-1

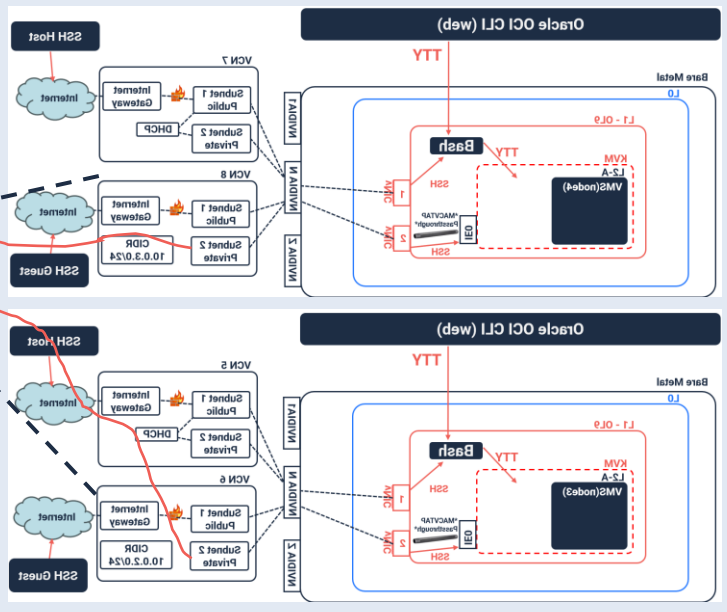


Dynamic Routing Gateway 1

Remote Peering Connection (RPC)

Dynamic Routing Gateway 2

OCI Region: Chicago-1



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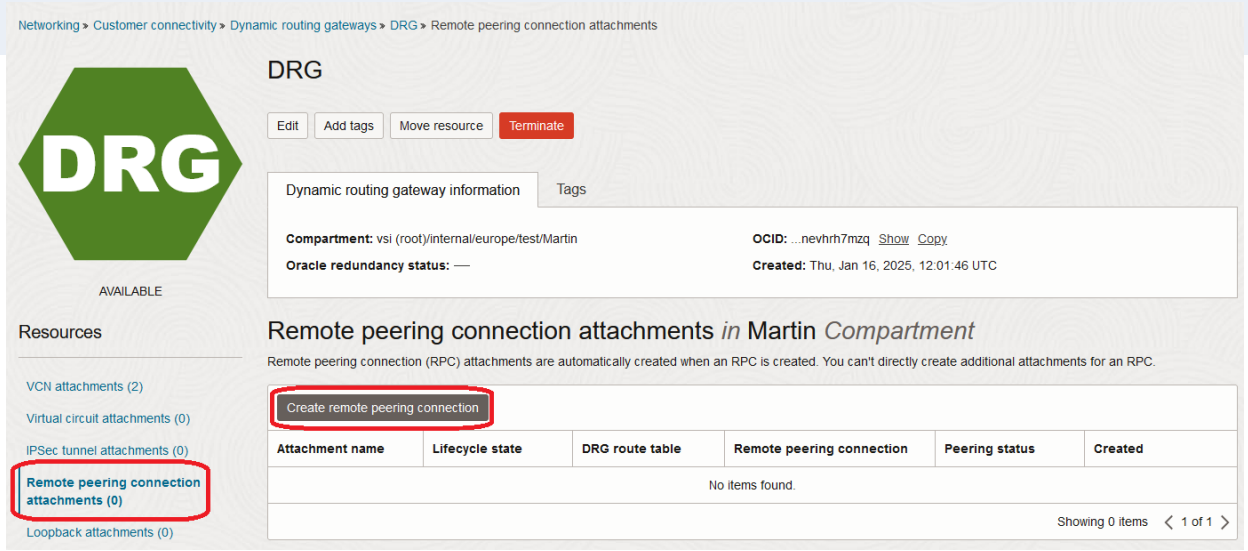
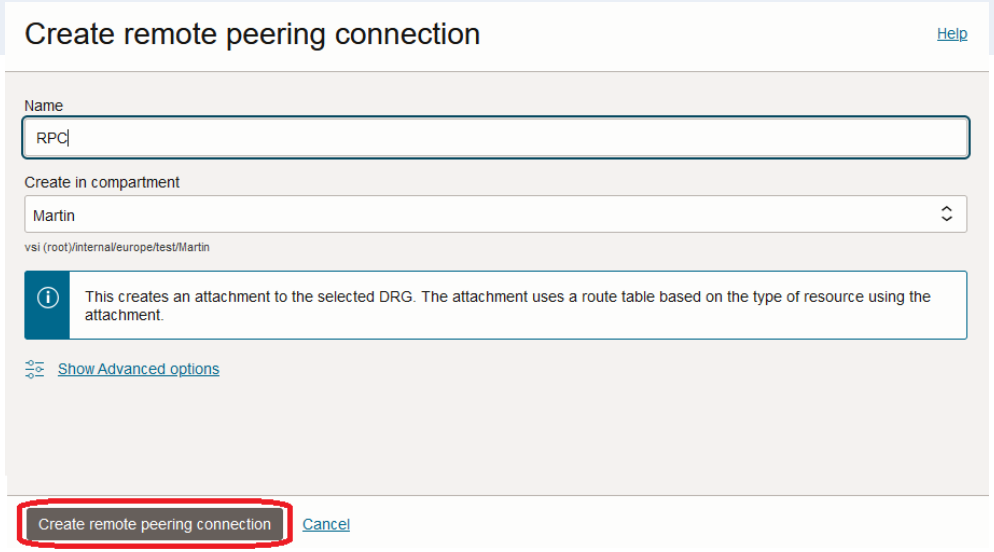
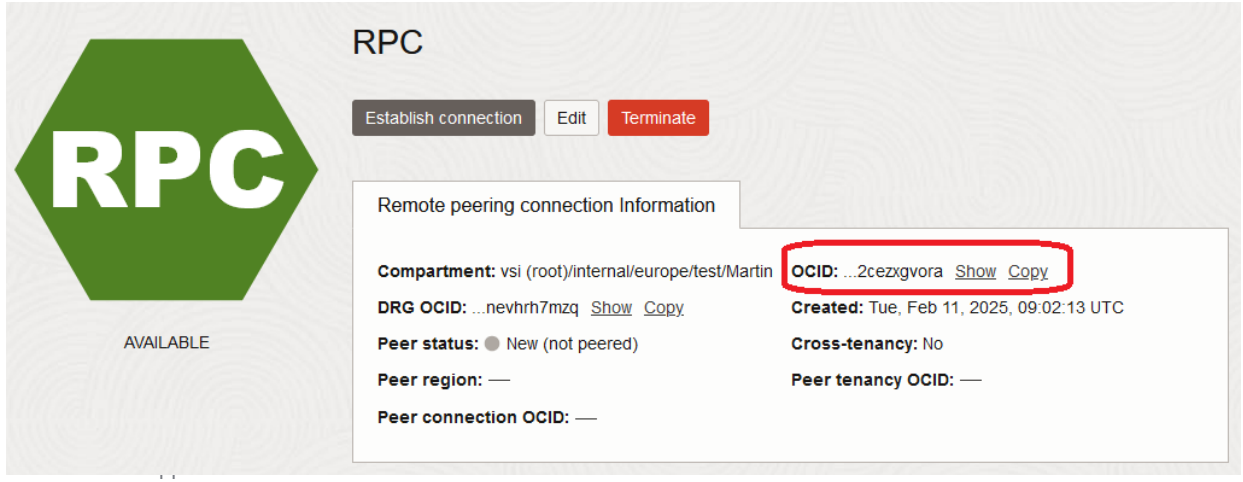
RPC creation (global peering)







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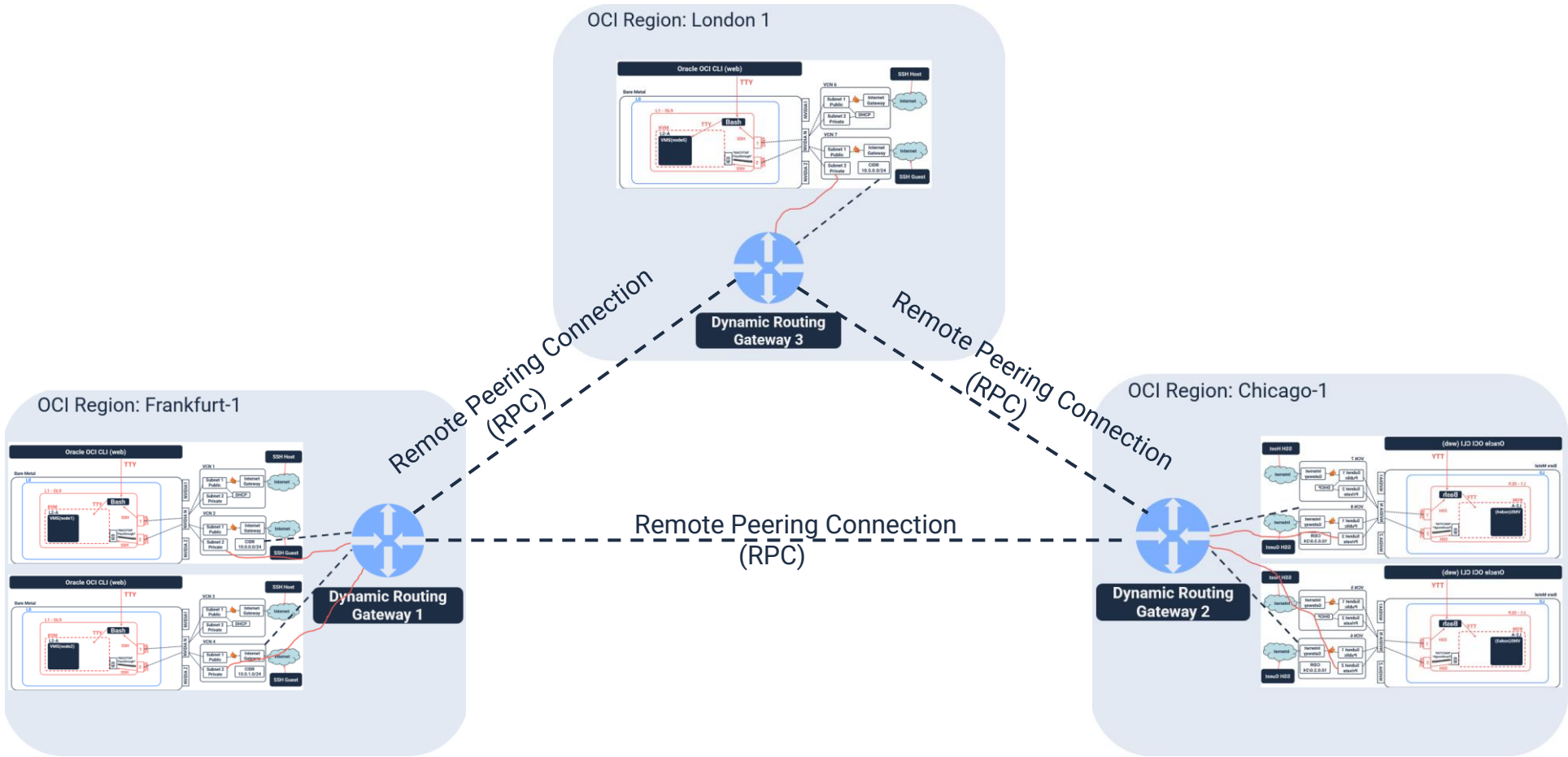
Improving the cluster

Issues:

- 2 + 2 cluster
  - Even number total
  - Even number in both sites
  - No quorum disk
- Single point of failure between 2 sites (peering going down)

Third Region, for Cluster improvement



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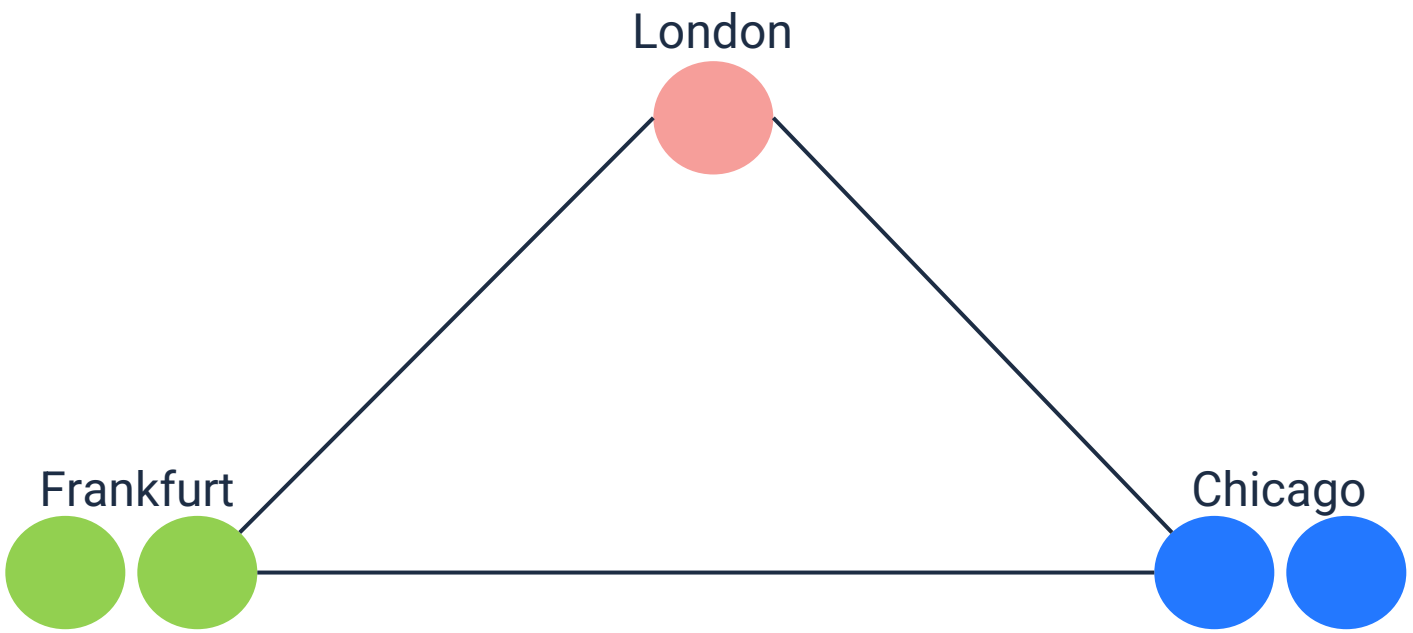
Cluster config in VMS

- EXPECTED_VOTES is set to 5 (Minimum votes to meet quorum will be 3)
  - Each node contributes with one vote
- UDP/IP communication is used for clustering (IPCI) – No bare SCS
- Use Unicast, not Multicast

Simplified Topology



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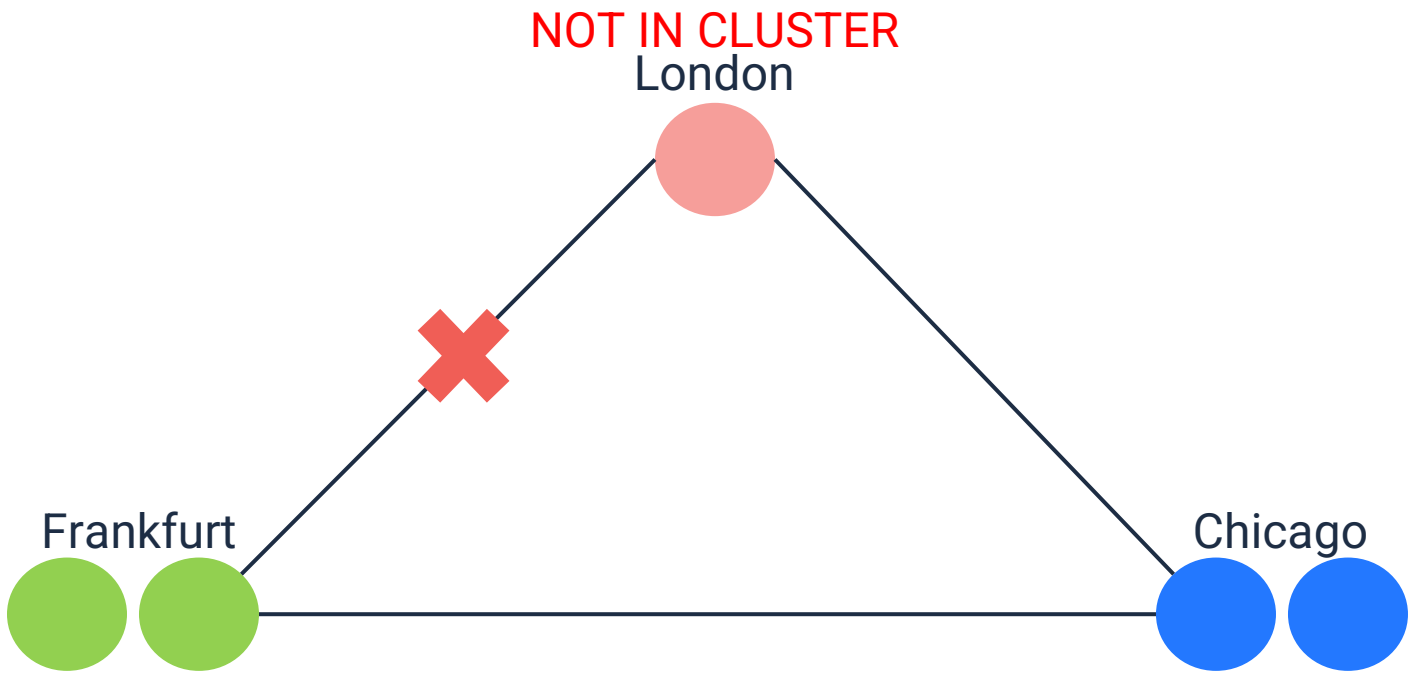
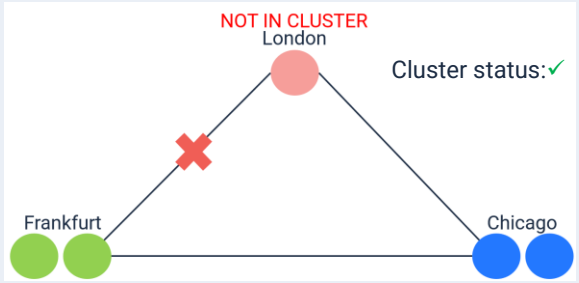
RPC Failure Scenarios

Cluster status: ✓



RPC Failure Scenarios



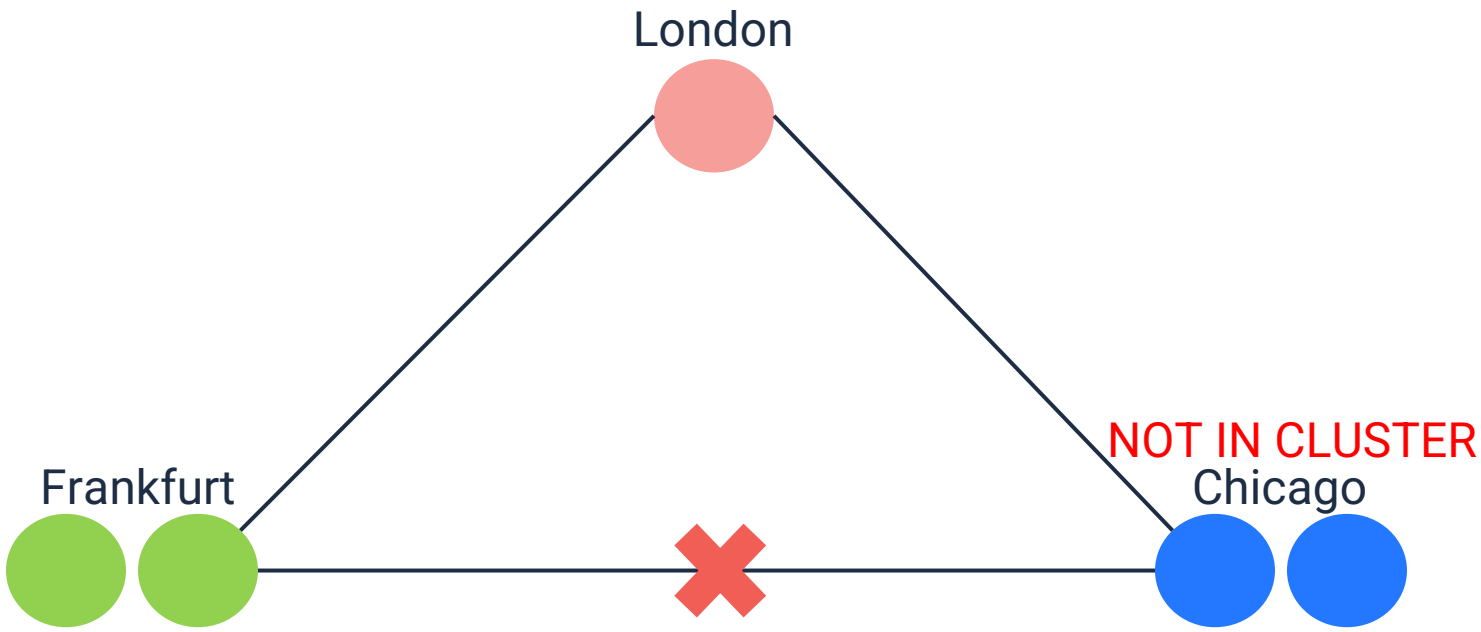
- What happens when one of the RPCs goes down?
- The node(s) in one region will crash
- Cluster will reform, and stay up
  - Frankfurt contributes with more votes
- Behaviour if RPC between Frankfurt and Chicago goes down?

```
View of Cluster from system ID 1025  node: FRANK1          17-FEB-2025 15:40:37

                SYSTEMS                          MEMBERS
NODE            SOFTWARE                         STATUS
FRANK1          VMS V9.2-3                       MEMBER
FRANK2          VMS V9.2-3                       MEMBER
UK1             VMS V9.2-3                       BRK_NON
CHIC1           VMS V9.2-3                       MEMBER
CHIC2           VMS V9.2-3                       MEMBER

%%%%%%%%%%%  OPCOM  17-FEB-2025 15:40:36.85  %%%%%%%%%%%
15:40:36.85 Node FRANK1 (csid 00010001) timed-out lost connection to node UK1
```

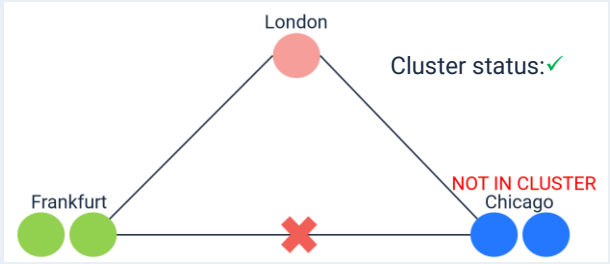

VMS Software

RPC Failure Scenarios

Cluster status: ✓



RPC Failure Scenarios



- What happens when the RPC between Frankfurt and Chicago goes down?
- Frankfurt and London stay
  - 3/5
  - 3/5
- Bringing the RPC up again results in Chicago (re)joining

```
View of Cluster from system ID 1025  node: FRANK1

                SYSTEMS                 MEMBERS
NODE            SOFTWARE                STATUS
FRANK1          VMS V9.2-3              MEMBER
FRANK2          VMS V9.2-3              MEMBER
UK1             VMS V9.2-3              MEMBER
CHIC1           VMS V9.2-3              BRK_NON
CHIC2           VMS V9.2-3              BRK_NON
```

```
View of Cluster from system ID 1029  node: UK1

                SYSTEMS                 MEMBERS
NODE            SOFTWARE                STATUS
UK1             VMS V9.2-3              MEMBER
CHIC2           VMS V9.2-3              NEW
CHIC1           VMS V9.2-3              NEW
FRANK1          VMS V9.2-3              MEMBER
FRANK2          VMS V9.2-3              MEMBER
```

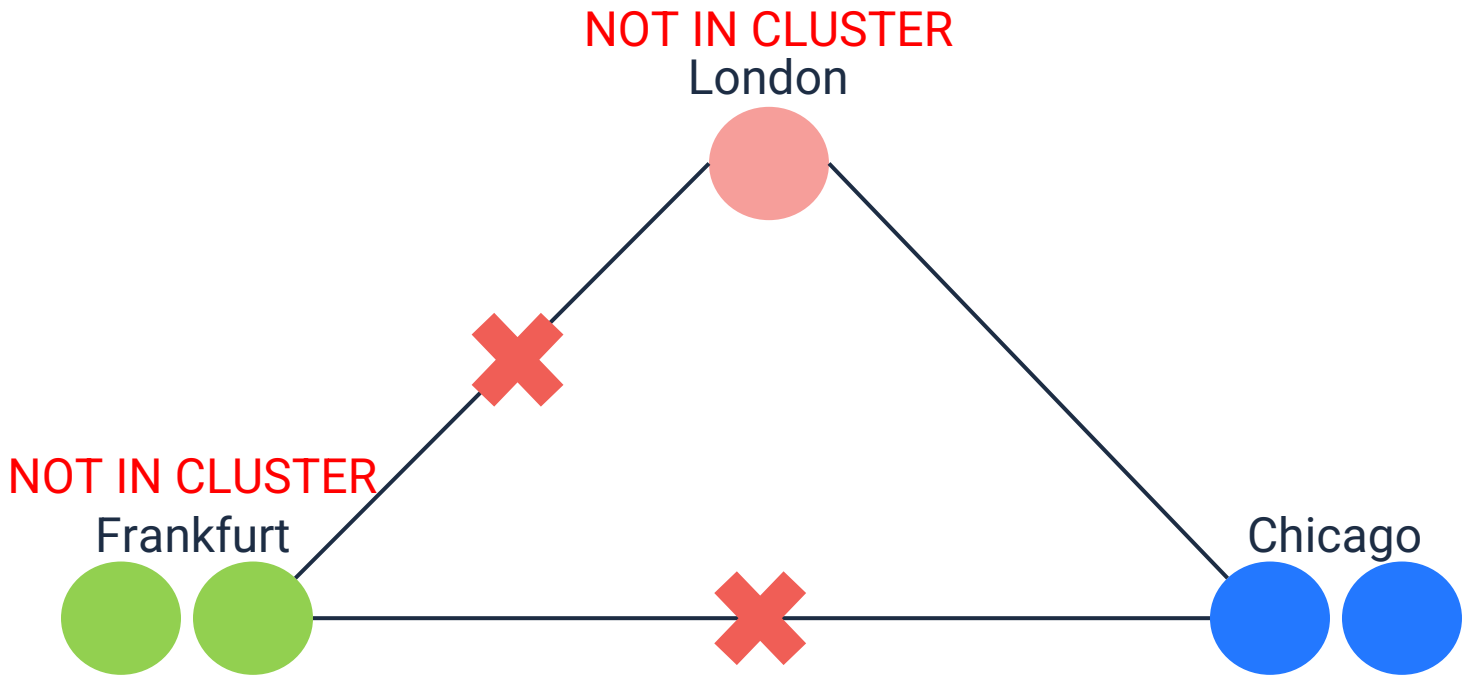
When RPC is down (Frankfurt – Chicago)

When RPC is brought back up

```
%PEA0, Cluster communication successfully initialized on IP bus IE0 10.3.0.92
%CNXMAN,  Have connection to system CHIC2
%CNXMAN,  Have connection to system UK1
%CNXMAN,  Discovered system FRANK1
%CNXMAN,  Established connection to system FRANK1
%CNXMAN,  Discovered system FRANK2
%CNXMAN,  Established connection to system FRANK2
%CNXMAN,  Sending VMScluster membership request to system UK1
%CNXMAN,  Sending VMScluster membership request to system UK1
%CNXMAN,  Now a VMScluster member -- system CHIC1
%STDRV-I-STARTUP, OpenVMS startup begun at 18-FEB-2025 08:24:22.41
```

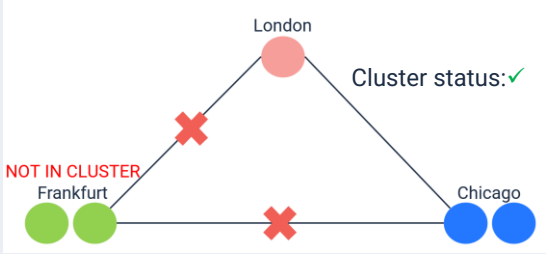
RPC Failure Scenarios

Cluster status: ✓



VMS Software

RPC Failure Scenarios



- What happens when 2 RPCs go down?

- Previous cluster: Frankfurt – Chicago
- When their RPC goes down: Chicago - London

- Chicago nodes have connection to each other + UK
  - 3/5
  - 2/5

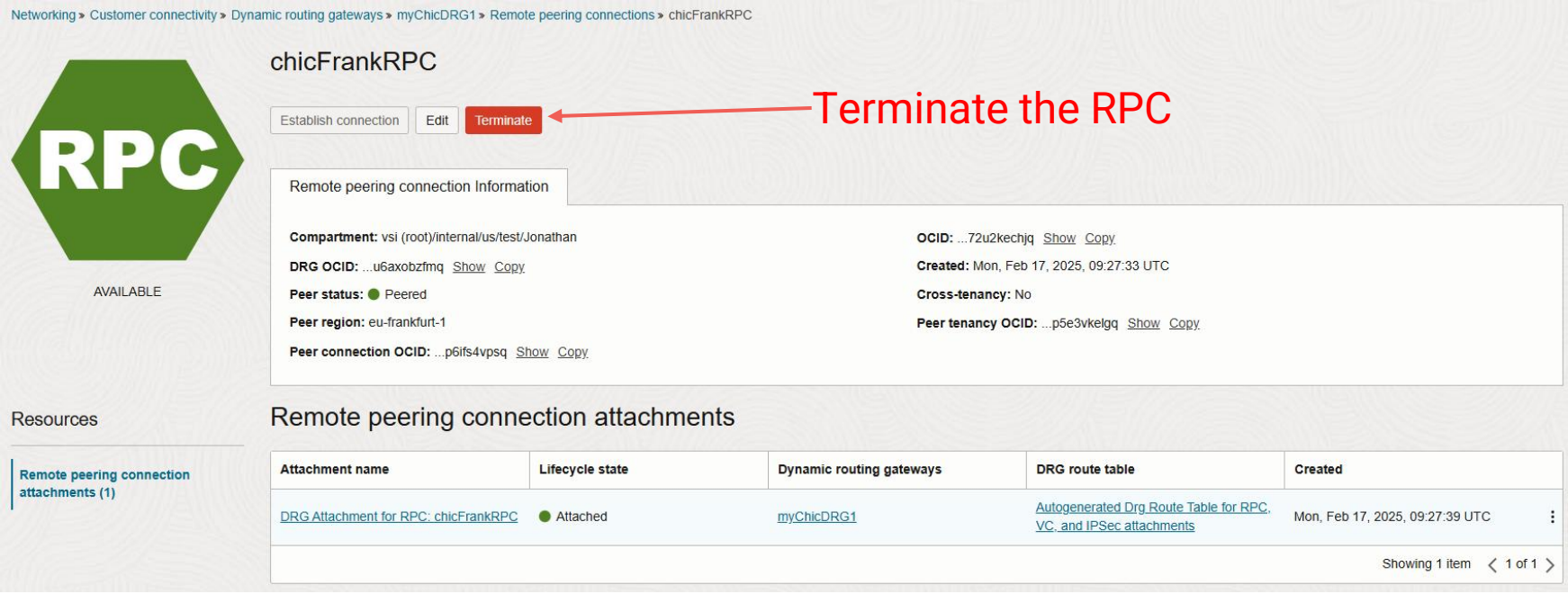
```
                    Copyright 2024 VMS Software, Inc.

%DECnet-I-LOADED, network base image loaded, version = 05.92.07
%VMScluster-I-LOADIPCICFG, loading IP cluster configuration files
%VMScluster-S-LOADEDIPCICFG, Successfully loaded IP cluster configuration files

%SMP-I-CPUTRN, CPU #1 has joined the active set.
%SMP-I-CPUTRN, CPU #2 has joined the active set.
%VMScluster-I-LOADSECDB, loading the cluster security database
%EIA0, Link up: 1000 mbit, 02-00-17-0C-26-A6
%MSCPLOAD-I-CONFIGSCAN, enabled automatic disk serving
%SYSINIT-I- waiting to form or join an OpenVMS Cluster
%PEA0, Configuration data for IP cluster found
%PEA0, Successfully allocated IP vector
%PEA0, Cluster communication enabled on IP bus, IE0, 10.5.0.44
%PEA0, Successfully initialized with TCP/IP Services
%PEA0, Unicast list for IP bus IE0, added remote node address 10.4.0.92
%PEA0, Unicast list for IP bus IE0, added remote node address 10.3.0.92
%PEA0, Unicast list for IP bus IE0, added remote node address 20.0.0.210
%PEA0, Unicast list for IP bus IE0, added remote node address 10.1.0.61
%PEA0, Hello message sent on IP bus IE0
%PEA0, Cluster communication successfully initialized on IP bus IE0 10.5.0.44
%CNXMAN,  Have connection to system CHIC1
%CNXMAN,  Have connection to system CHIC2
```

Cluster will reform when Frankfurt leaves

VMS Software

Recreating these tests

- Go to OCI web console
- Navigate to Dynamic Routing Gateways -> DRG_name -> Remote Peering Connections -> RPC_name



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Node Failure Scenarios

- How many individual nodes can go down?
- Which nodes are allowed to go down?
- It does not matter which region the node(s) reside in
- Recreate? Just shut down or crash your nodes!

View of Cluster from system ID 1026 node: FRANK2

SYSTEMS		MEMBERS
NODE	SOFTWARE	STATUS
FRANK2	VMS V9.2-3	MEMBER
FRANK1	VMS V9.2-3	BRK_NON
UK1	VMS V9.2-3	MEMBER
CHIC1	VMS V9.2-3	MEMBER
CHIC2	VMS V9.2-3	BRK_NON

Example: nodes in different regions going down

Things to consider

- Boot times
- Inter-region latency
- DRG creation can be scripted!

Region	N	MAD	MEL	MRS	MTY	MTZ	NRT	ORD	PHX	QRO
AMS	6	28.13	258.67	23.78	123.77	69.84	233.43	92.37	134.03	136.37
ARN	1	52.03	282.47	43.78	147.37	96.10	257.25	116.13	157.66	159.39
AUH	6	88.88	160.34	74.60	202.39	151.47	146.73	177.42	210.91	213.98
BOG	8	181.01	280.79	170.24	82.99	230.80	224.14	106.95	104.46	73.35
BOM	2	109.75	139.57	94.83	231.31	172.55	126.25	206.40	242.51	242.84
CDG	4	21.18	251.81	10.43	118.59	70.33	238.51	93.88	127.12	130.21
CWL	9	30.70	261.05	22.11	120.37	75.81	231.36	89.75	131.41	132.93
DXB	6	92.45	158.47	78.13	205.93	154.99	144.96	180.96	214.42	218.25
FRA	2	31.44	250.96	17.36	129.11	63.78	238.65	97.58	139.10	141.73
GRU	2	205.12	323.85	194.63	157.58	253.65	266.68	125.31	166.51	170.06

Summary

- Cross-region VMS clusters on OCI achieved through DRGs
- Scalability potential!
- Cluster behaviour on the cloud

Part 2: Hybrid VMS Clusters

Jonathan Bergdahl & Martin Schneider
Date: 14/5 2025

Agenda Part 2

01 Introduction

02 System Topology

03 OCI Networking setup

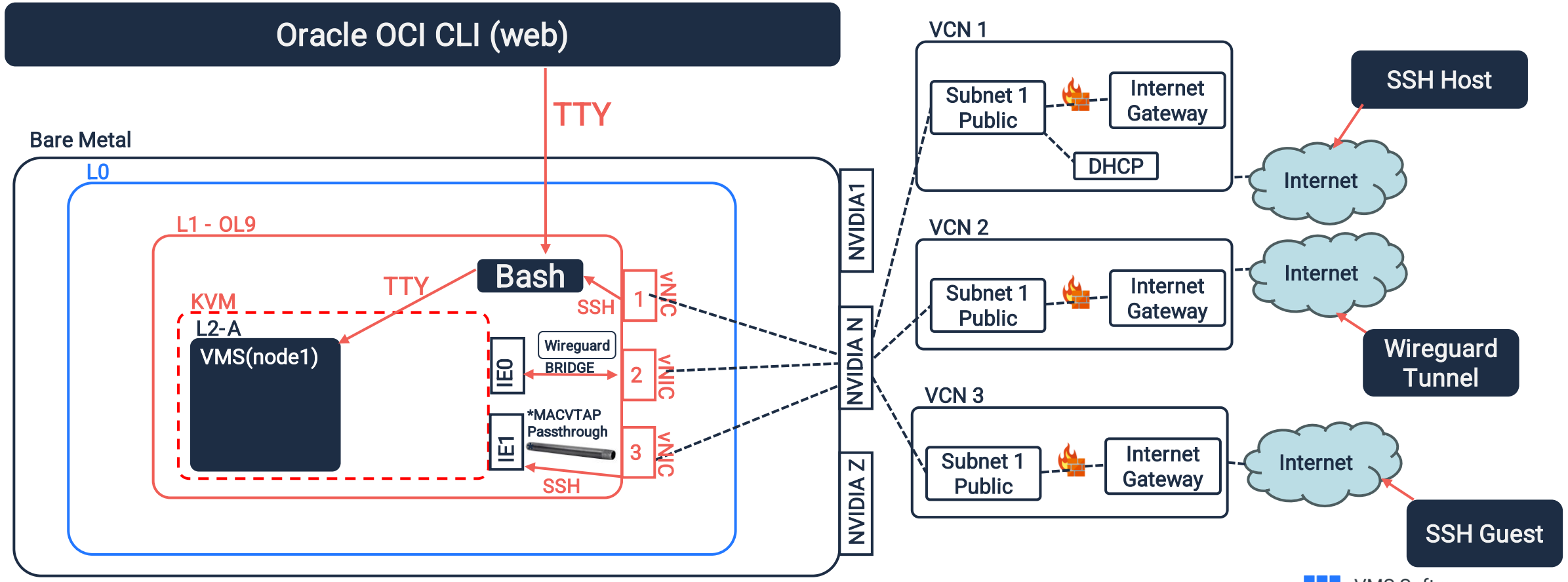
04 Wireguard Configuration

05 Cluster and TCPIP configuration

06 Challenges and Pitfalls

07 Q&A

System Topology



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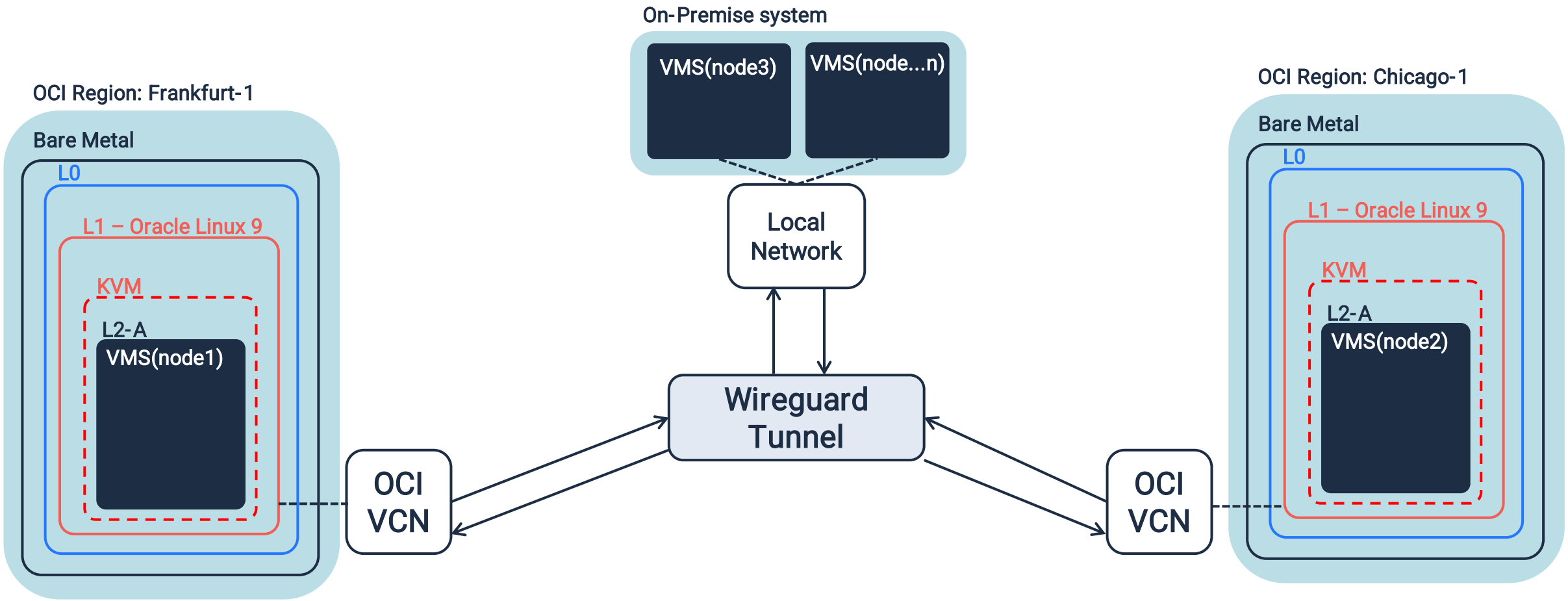
Hybrid Cluster Topology



VMS Software

Configuring a Bridge Interface in the Cloud

- Secondary VNIC
- OCI networking under the hood
- Primary VNIC routes must always have a lower metric
- Can be done with a script!

```
[opc@myprimvnic ~]$ sudo brctl show
bridge name     bridge id               STP enabled     interfaces
br0             8000.0200170599cb       no              enp2s0
```

OCI Networking Challenges

- Under the hood port forwarding
- Firewall
- Route rules and metrics
- Unmanaged network interfaces

```
[opc@cluster-frank-1 ~]$ cat fix_net.sh
#!/bin/sh
#
################################################
#            MAGIC SECOND vNIC SCRIPT          #
################################################
#                                              #
# Quick and dirty script to get the secondary vNIC#
# working on OCI. Might take several tries to  #
# ping with both cards.                        #
# Keep in mind that ping can be unreliable, and #
# that you need to have ICMP allowed on your   #
# firewall.                                    #
#                                              #
# If it fails to unconfigure, make sure you have #
# all network connected virtual machines stopped #
# and have tools like WireGuard turned off.    #
#                                              #
################################################
```

Configuring Wireguard

- Various route rules
- Ensuring the correct VNIC is used
- Allowed IPs

Static route to endpoint(s)

```
[Interface]
Address = 192.168.2.10/24
SaveConfig = true
PostUp = iptables -A FORWARD -o wg0 -m conntrack --ctstate RELATED,ESTABLISHED -j ACCEPT
PostUp = ip route a[redacted]/32 via 10.0.2.1 dev br0
PostUp = iptables -A FORWARD -i br0 -o wg0 -j ACCEPT
PostUp = iptables -A FORWARD -i wg0 -o br0 -m conntrack --ctstate RELATED,ESTABLISHED -j ACCEPT
PostUp = iptables -t nat -A POSTROUTING -o br0 -j MASQUERADE
PostUp = iptables -t nat -A POSTROUTING -o wg0 -j MASQUERADE
PostDown = ip route da[redacted] via 10.0.2.1 dev br0
PostDown = iptables -t nat -D POSTROUTING -o br0 -j MASQUERADE
PostDown = iptables -t nat -D POSTROUTING -o wg0 -j MASQUERADE
PostDown = iptables -D FORWARD -o wg0 -m conntrack --ctstate RELATED,ESTABLISHED -j ACCEPT
PostDown = iptables -D FORWARD -i br0 -o wg0 -j ACCEPT
PostDown = iptables -D FORWARD -i wg0 -o br0 -m conntrack --ctstate RELATED,ESTABLISHED -j ACCEPT
ListenPort = 30300
PrivateKey = [redacted]

[Peer]
PublicKey = [redacted]
AllowedIPs = 192.168.2.1/32, 10.1.0.61/32, 10.1.0.62/32
Endpoint = [redacted]:51820
```

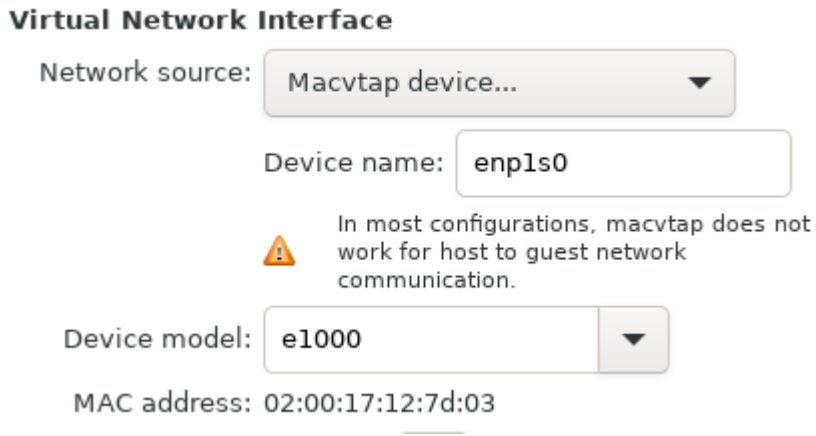
ALL IPs of peer

```
[opc@myprimvnic ~]$ sudo wg show
interface: wg0
  public key: [redacted]
  private key: (hidden)
  listening port: 30300

peer: [redacted]
  endpoint: [redacted]:51820
  allowed ips: 192.168.2.1/32, 10.1.0.61/32, 10.1.0.62/32
  latest handshake: 1 minute, 48 seconds ago
  transfer: 103.38 MiB received, 103.67 MiB sent
```

MacVTap

- Passthrough to the guest
- Disable Decnet Phase IV addressing!
  - @NET$CONFIGURE ADVANCED
- Used for all non-cluster communication



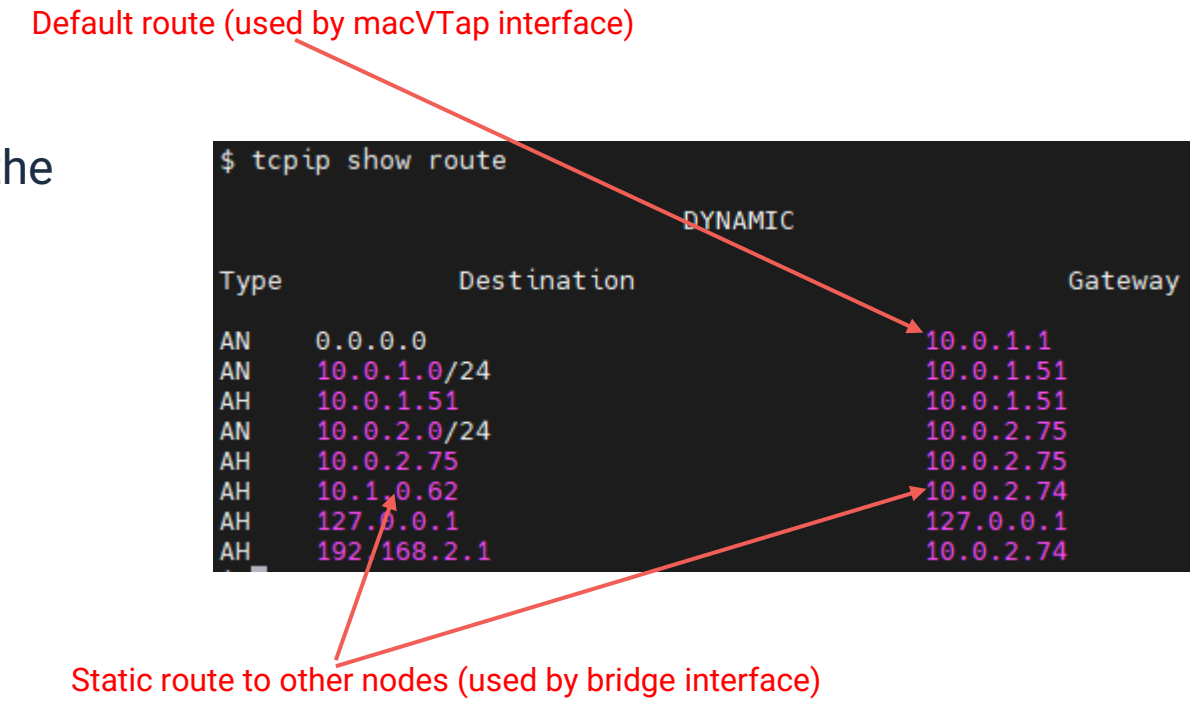

```
* Data Link name to use for EIB0 (EI/82558)?      [CSMACD-1] :
* Routing Circuit Name for Data Link 'CSMACD-1'?  [CSMACD-1] :
* Enable Phase-IV Addressing on Routing Circuit 'CSMACD-1'? [NO] :
```

Configuring TCPIP

- Configure 2 interfaces, macVTap + bridge
- Default route – IP address of bridge interface in the host
- Redefine default route + static routes
  - SYS$MANAGER:SYSTARTUP_VMS.COM
  - Have a better idea? Please let us know!

```
$ @SYS$STARTUP:TCPIP$STARTUP.COM
$ tcpip set route /default /gateway=10.0.1.1
$ tcpip set noroute /default /gateway=10.0.2.74
```

```
$ tcpip set route 192.168.122.102 /gateway=10.0.2.74 /permanent
```



Cluster Configuration

- Cluster over IP (IPCI)
- Choose the bridged interface for cluster communication
- Unicast addresses

Summary

- Cloud + On-Prem clusters, Possible!
- Networking on OCI is challenging, but not impossible
- On-prem Wireguard setup varies

One last thing... OpenVMS native on OCI

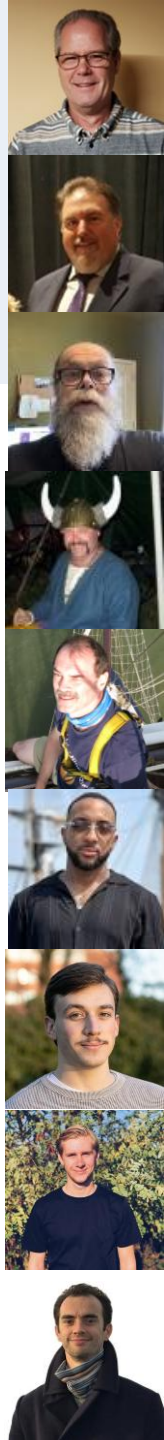
- Buckets, custom images
- Netboot
- Custom iPXE

Shape: VM.Standard.E5.Flex
Chipset: q35

Get in touch with Professional Services!

- We are a mixed team, with lots of years of VMS experience and well versed in many contemporary IT tools

- We are here to help, get in touch!
- Save your time! Tools, scripting, automation
- Learn from our mistakes! Processes, best practices
- Leverage our attention to details: Performance Testing, Fine Tuning
- Delegate your responsibilities: Full system migration, updates and upgrades, plus 24/7 managed services
- And much more! Contact your account manager for details.



Questions and Suggestions Please!

- OCI
- KVM
- VMS