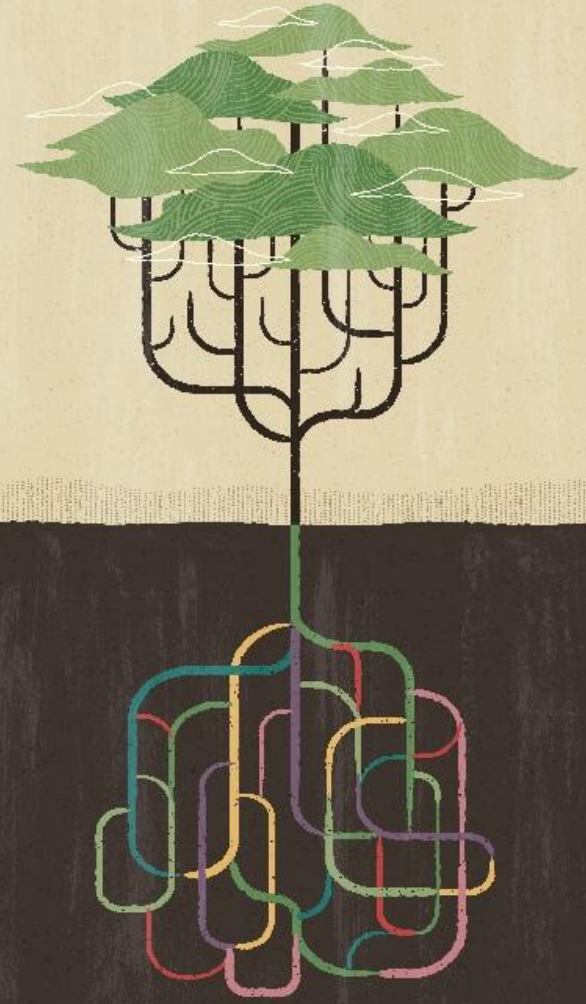
Oracle Cloud Infrastructure (OCI)

Networking Services



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Apr 25, 2025

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OCI Network Core Components

Overview on VCN

- *What is a **Virtual Cloud Network (VCN)** ?*

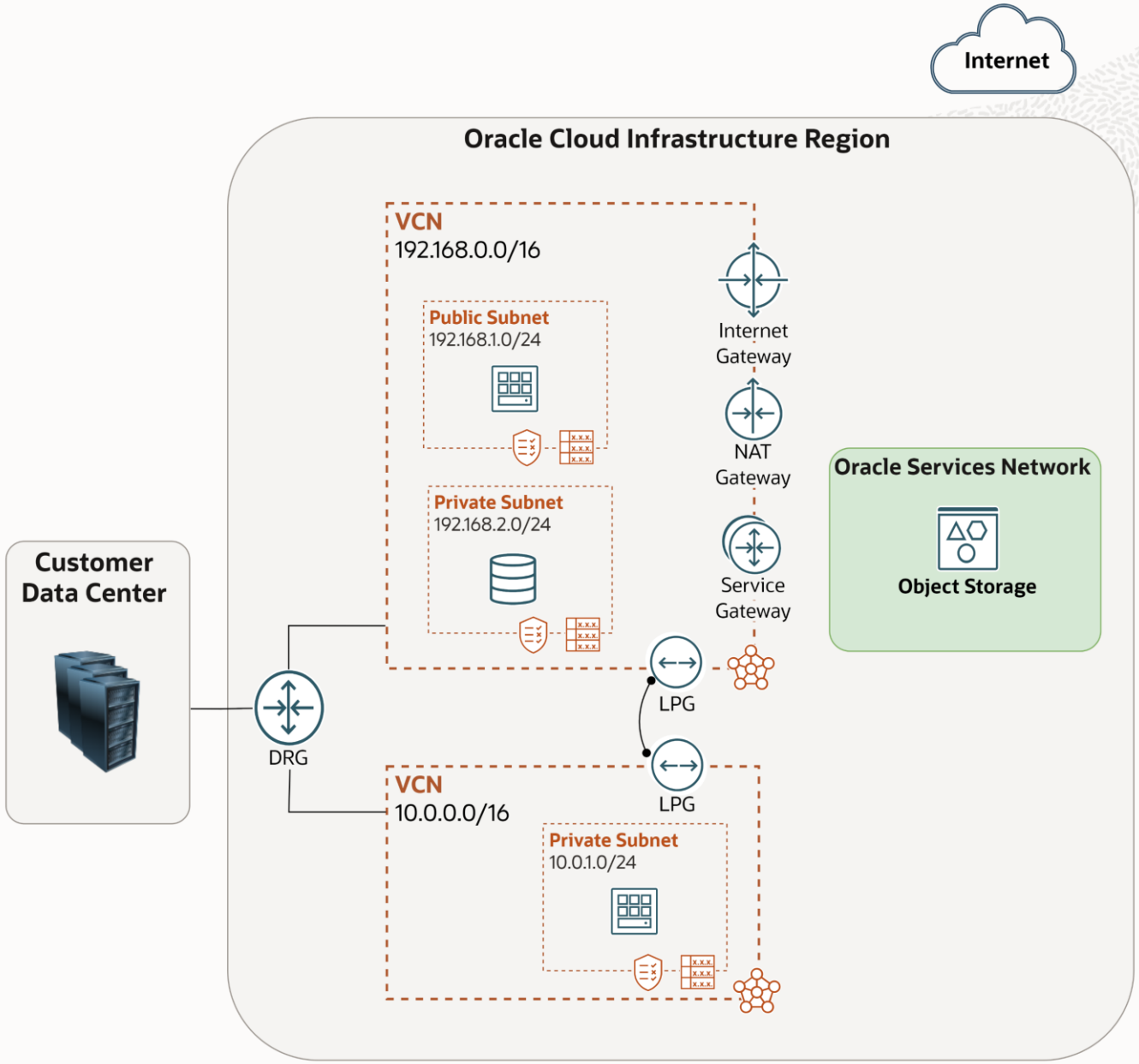
- *Each VCN is subdivided into **Subnets***

- *To **secure** your resources within the VCN, use security rules:*

e.g.
Allow inbound SSH traffic (port 22)
Allow inbound & outbound web traffic (port 80)
…

- *To route traffic out of the VCN, use **Route Tables***

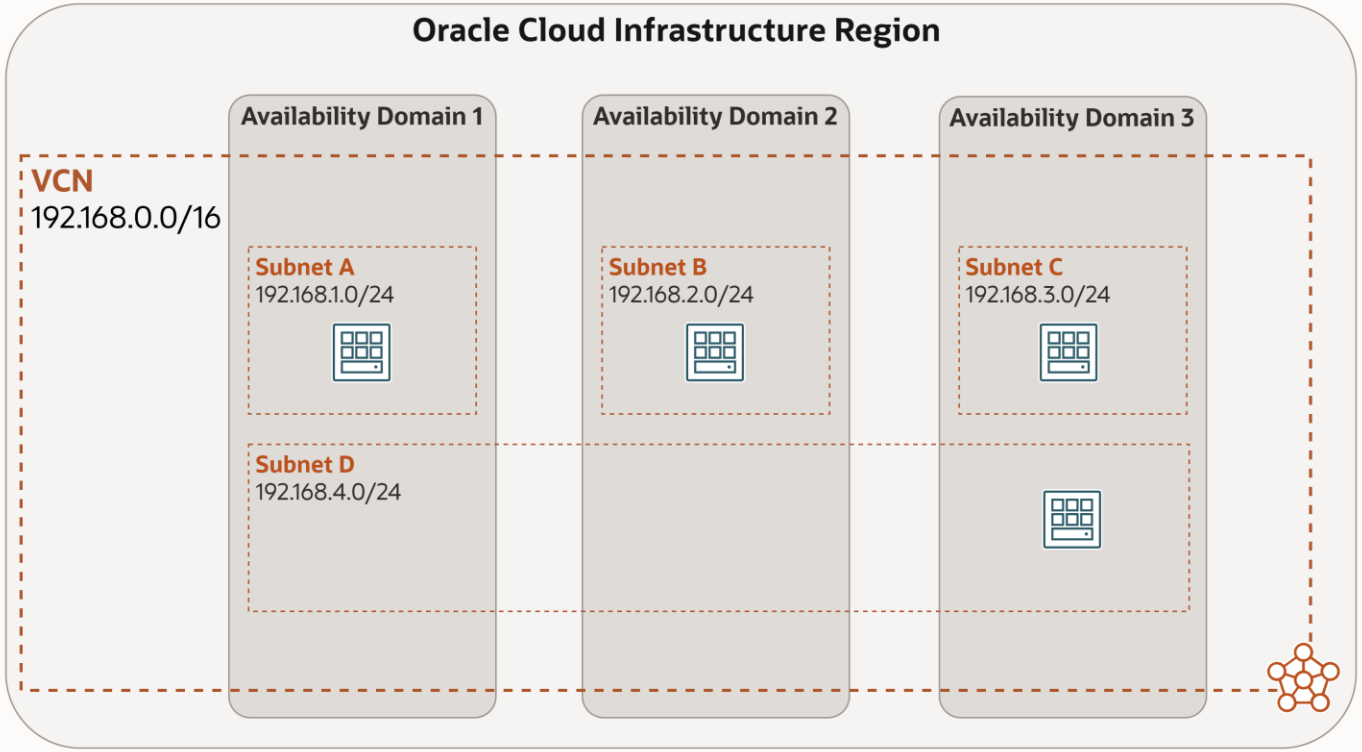
- *What are the **Gateways** types available in OCI ?*



Virtual Cloud Network (VCN)

- A private network that you set up in the Oracle data centers, with firewall rules and specific types of communication gateways that you can choose to use.
- A VCN covers contiguous IPv4 CIDR blocks of your choice.
- A VCN resides within a single region.

Subnet

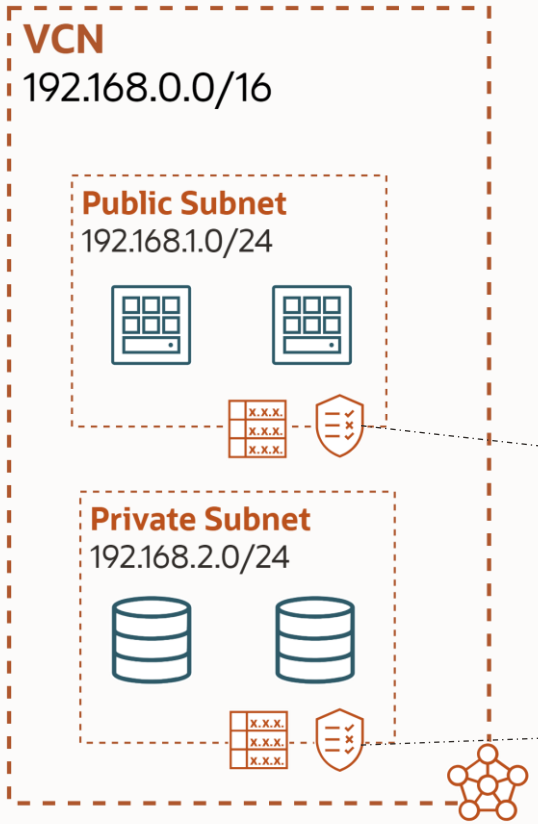


- Each VCN network is subdivided into subnets.
- Each subnet can be AD-specific or **Regional (recommended)**
  - AD specific subnet is contained within a single AD in a multi-AD region.
  - Regional subnet spans all three ADs in a multi-AD region.
- Each subnet has a contiguous range of IPs, described in CIDR notation. Subnet IP ranges cannot overlap .
- Instances are placed in subnets and draw their internal IP address and network configuration from their subnet.
- Subnets can be designated as either
  - **Private** (instances contain private IP addresses assigned to VNICs).
  - **Public** (contain both private and public IP addresses assigned to VNICs).
- VNIC is a component that enables a compute instance to connect to a VCN. The VNIC determines how the instance connects with endpoints inside and outside the VCN.

VCN Security

Security Lists

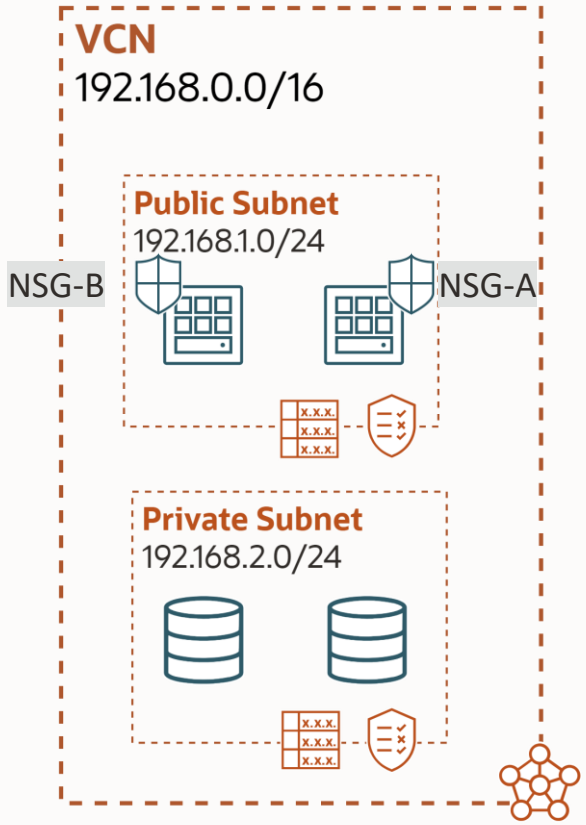
- A common set of firewall rules associated with a subnet and applied to all instances launched inside the subnet.
- Security list consists of rules that specify the types of traffic allowed in and out of the subnet.
- To use a given security list with a particular subnet, you associate the security list with the subnet either during subnet creation or later.
- Security list apply to a given instance whether it's talking with another instance in the VCN or a host outside the VCN.



	Direction	CIDR	Protocol	Source Port	Dest Port
Stateful	Ingress	0.0.0.0/0	TCP	All	80
Stateful	Egress	192.168.2.0/24	TCP	All	1521

	Direction	CIDR	Protocol	Source Port	Dest Port
Stateful	Ingress	192.168.1.0/24	TCP	All	1521

Network Security Group (NSG)



- A network security group (NSG) provides a virtual firewall for a set of cloud resources that all have the same security posture
- NSG consists of set of rules that apply only to a set of VNICs of your choice in a single VCN
- Currently, compute instances, load balancers and DB instances support NSG
- When writing rules for an NSG, you can specify an NSG as the source or destination. Contrast this with SL rules, where you specify a CIDR as the source or destination
- Oracle **recommends** using NSGs instead of SLs because NSGs let you separate the VCN's subnet architecture from your application security requirements

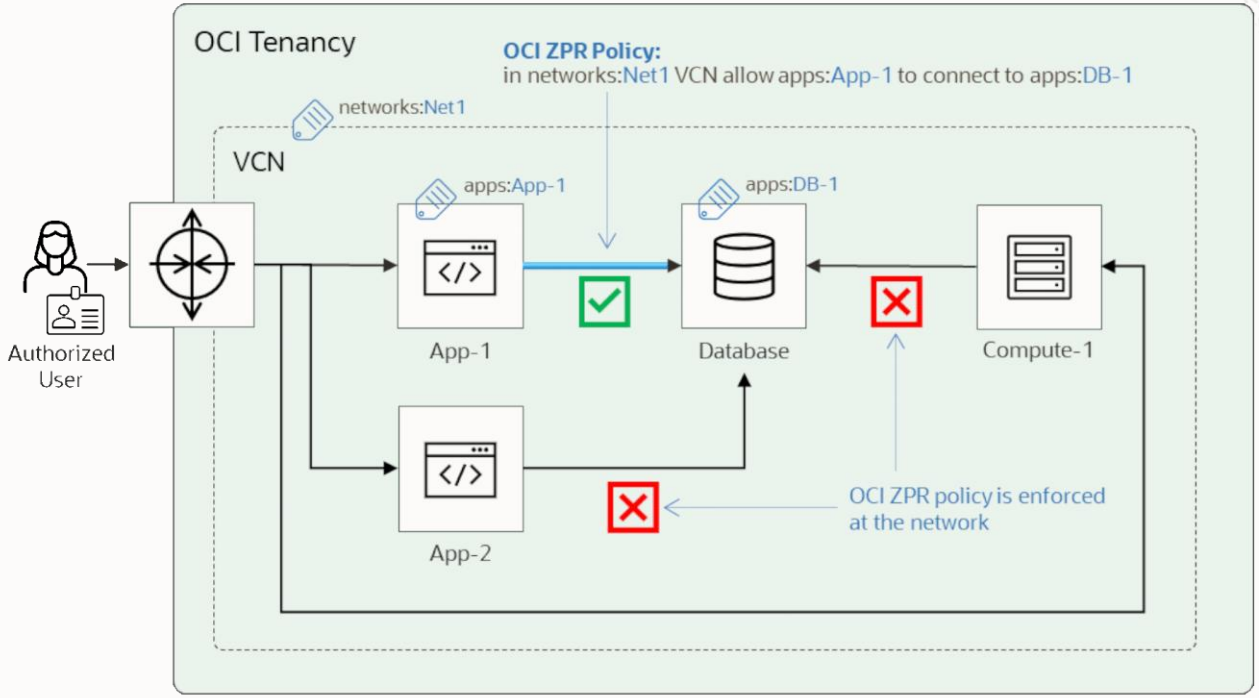
		Direction	CIDR	Protocol	Source Port	Dest Port
NSG-A	Stateful	Ingress	0.0.0.0/0	TCP	All	80
NSG-B	Stateful	Ingress	0.0.0.0/0	TCP	All	22

You can use SLs alone, NSGs alone, or both together.

Zero Trust Packet Routing (ZPR)

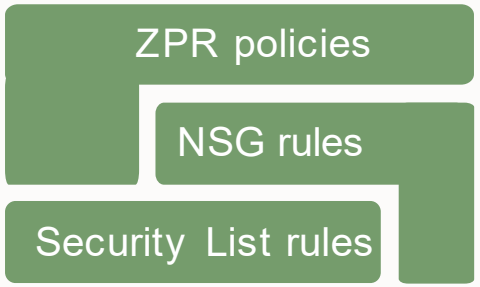
OCI ZPR provides internal and external threat protection from attackers, controlled with an additional network level security layer. It enables customers to define and enforce an intent-based, data-centric security policy, natively integrated with user and application attributes for resources within OCI and On-premises resources.

- **Simple, clear policies:** Protect your data with one easy-to-understand policy.
- **Data tagging for seamless protection:** Tag your sensitive data, and let the network enforce security policies automatically.
- **Future-proofed security:** Even if your network configuration changes, ZPR ensures data remains protected.
- **Provable security compliance:** Validate policies and prove they are working as intended.



Using ZPR with Other Security Methods

- Any VNIC or endpoint must have subnet security list rules that allow it to communicate.
- An NSG can add more rules on top of the security list rules for selected resources anywhere in a VCN.
- **A ZPR policy** can be layered on top of both security lists and NSG rules, or the ZPR policy can be in addition to a security list alone.



ZPR vs Security Rules

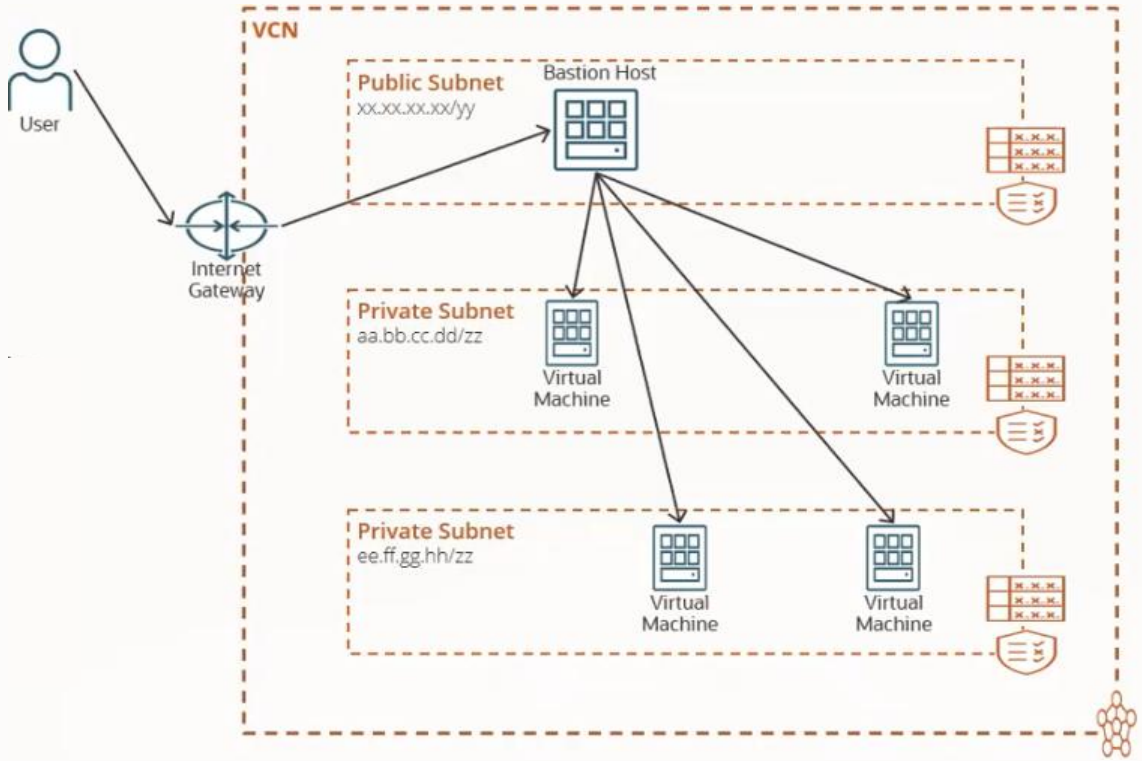
Security method	Applies to	Enable or disable	Limitations
Security list	All VNICs in a subnet or VCN	Not available	Maximum five security lists per subnet
Network security groups	Selected VNICs in a VCN	From the VNIC details page	Maximum five NSGs per VNIC
Zero Trust Packet Routing	Selected resources (VNICs and other resource types) in one or more VCNs	With a security attribute applied to the resource	Maximum three ZPR security attributes per resource

ZPR – Currently Supported OCI Resources

Service	Resource Types
Compute	instance instance configurations
Database	autonomous-databases cloud-autonomous-vmclusters cloud-vmclusters databases db-systems exadb-vm-clusters
Networking	vcns vnics PrivateEndpoint
Network Load Balancer	network load balancers

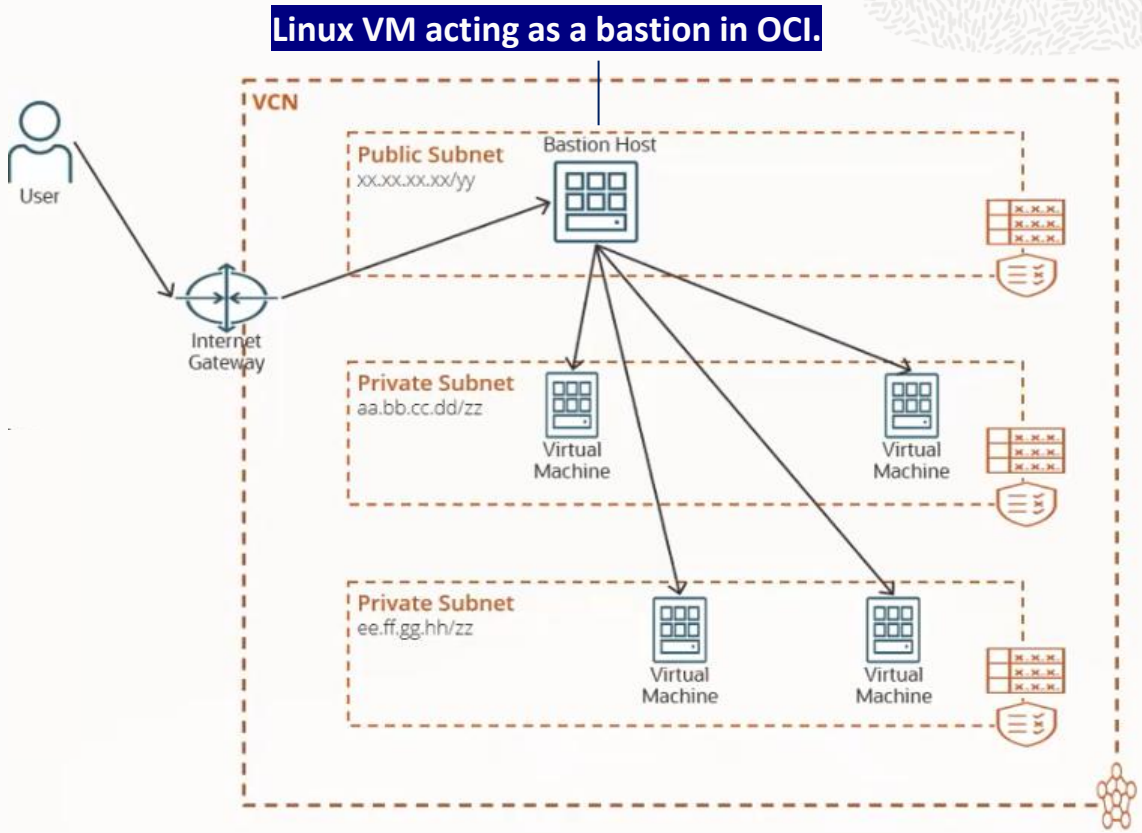
Bastion in the traditional way

- A Bastion host is a special-purpose server or an instance that is used to configure to work against the attacks or threats. It is also known as the “Jump Box”.
- Bastion host basically provide an entry point into the private networks which are to be connected from external network securing from the attacks.
- While using Bastion service you must log in first to your Bastion host and then directed to the private instances.



Bastion in the traditional way

- Create a Public Subnet.
- Allocate public IP for bastion host.
- Compute management by OCI admin.
- Hardening of compute OS.
- SSH Keys management per user basis.
- Storing of SSH private keys for target compute in bastion.
- No session limit enforcement.
- Cost incurred to run the compute in OCI.

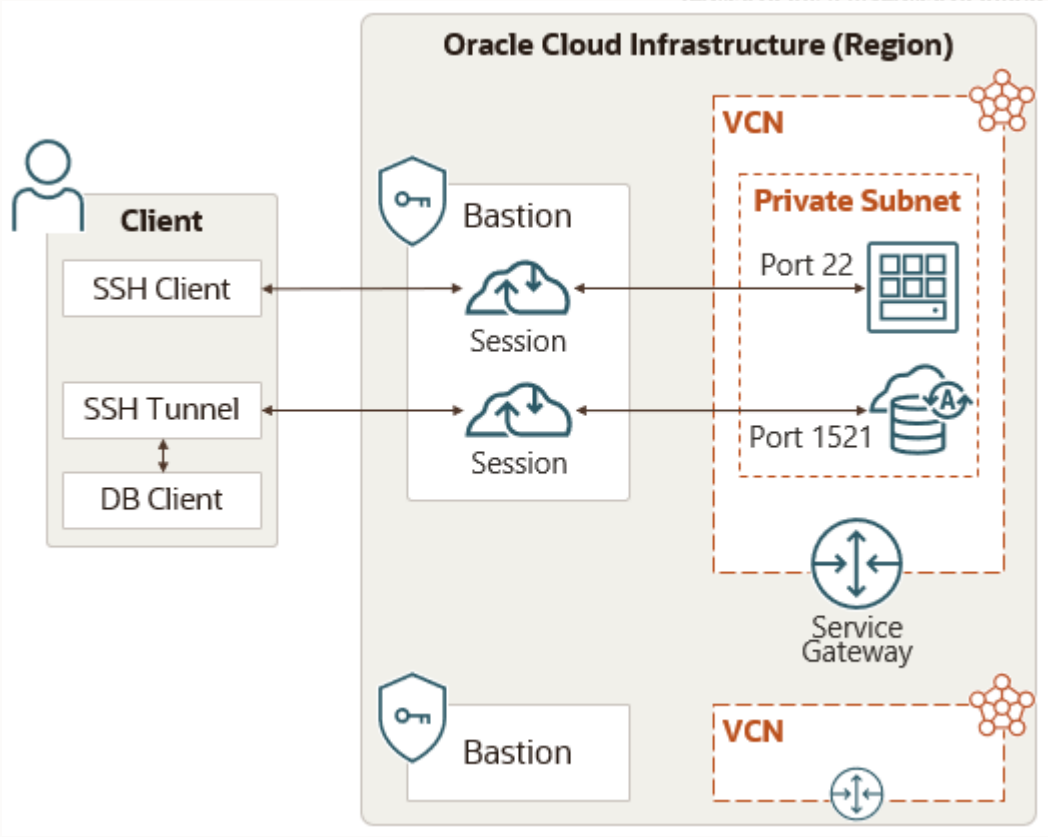


OCI Bastion

- OCI provided and managed service.
- There is no cost for using OCI Bastion.
- No public IP is needed, resulting in no surface attack area or zero-day vulnerabilities.
- Eliminate shared credentials, broad access limits, and other bad habits of using jump hosts.
- Restricted and time-limited access to target resources that don’t have public endpoints.
- Targets can include resources like compute instances, DB systems, and Autonomous Database for Transaction Processing and Mixed Workloads databases.

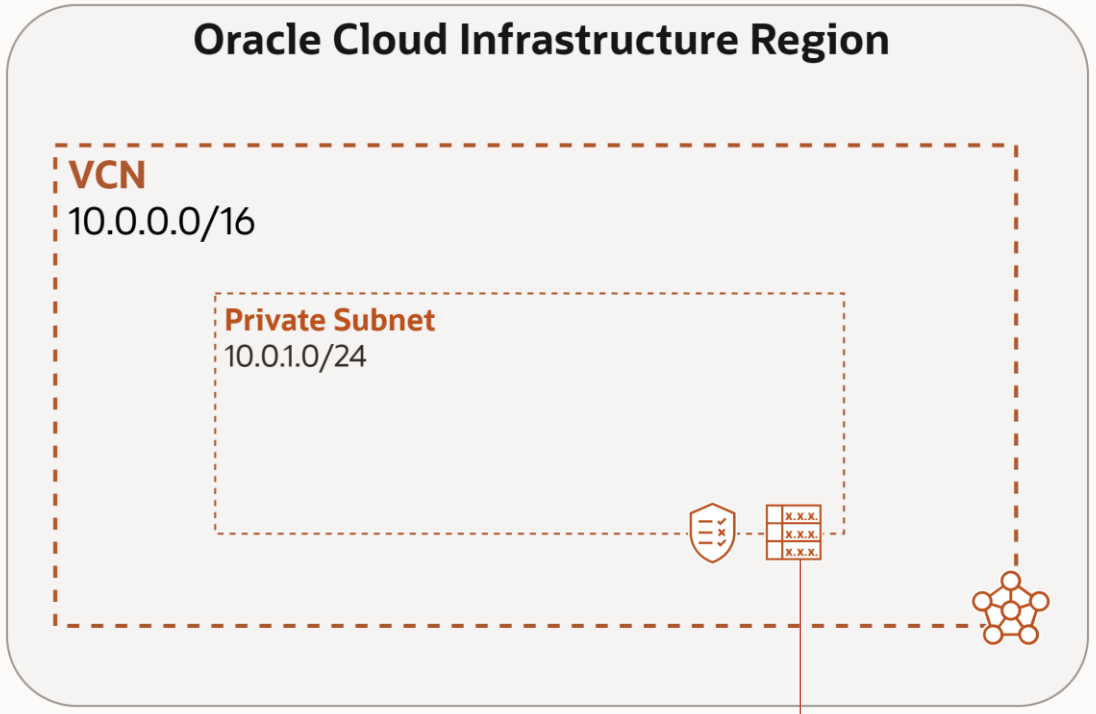
OCI Bastion

- A bastion is associated with a single VCN. You cannot create a bastion in one VCN and then use it to access target resources in a different VCN.
- Bastion is a regional service. For example, bastion created in Frankfurt cannot be used to access resources in London.
- Bastion “Maximum session time-to-live (TTL)” is 3 hours and minimum is 30 minutes. The TTLs is configurable at the session level.
- Bastion is restricted with service limits per region per tenancy.
  - 5 bastions per region.
  - 20 active sessions per bastion.



Routing & Gateways

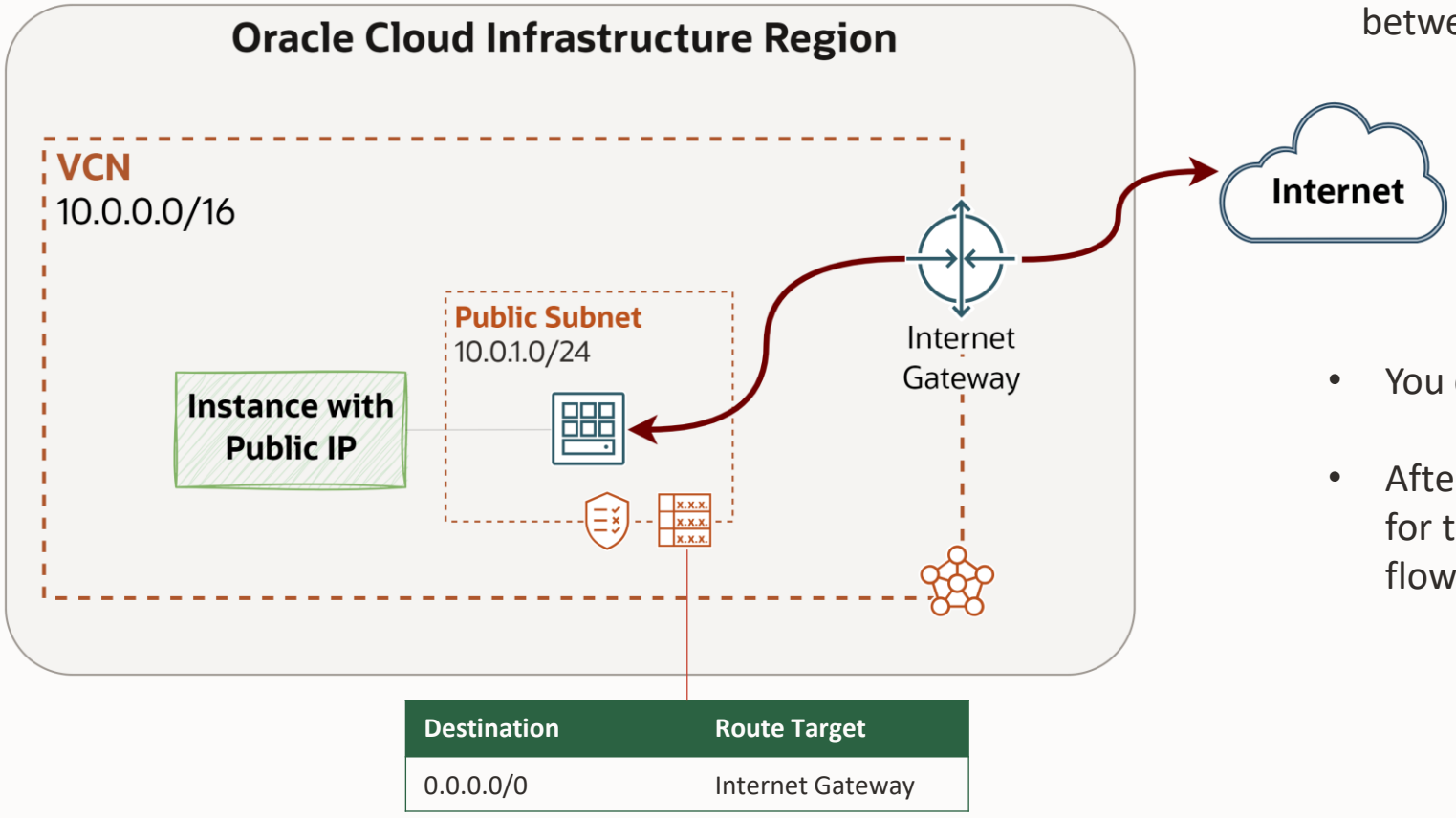
Route Table



Destination	Route Target
0.0.0.0/0	NAT Gateway
Object Storage	Service Gateway

- Associated with a Subnet.
- Used to send traffic out of the VCN.
- Consists of a set of route rules; each rule specifies the:
  - Destination CIDR block.
  - Route target (the next hop) for the traffic that matches the CIDR.
- No route rules are required to enable traffic within the VCN itself

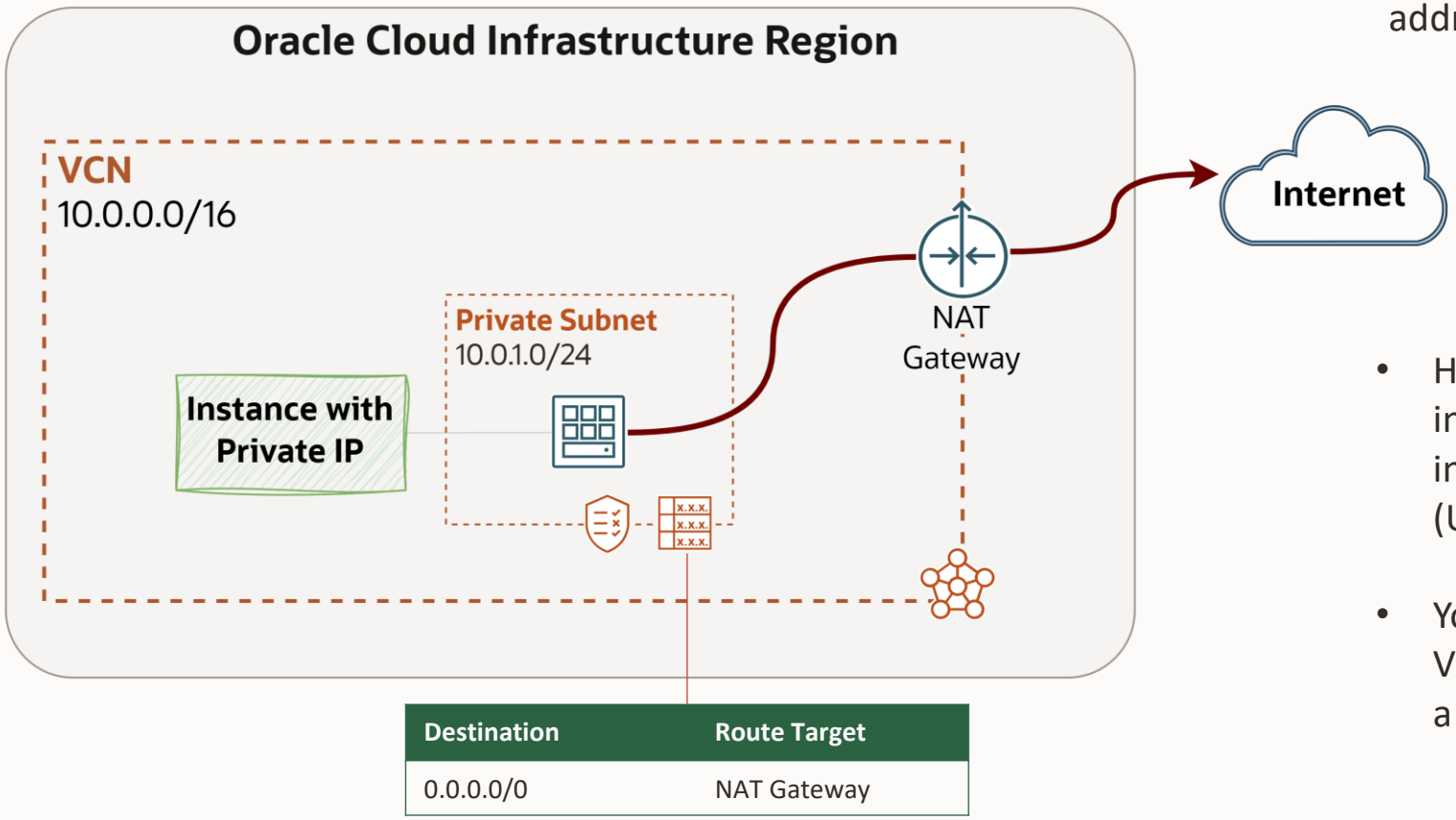
Internet Gateway



Destination	Route Target
0.0.0.0/0	Internet Gateway

- Internet Gateway provides a path for network traffic between your VCN and the Internet.
- You can have only one Internet Gateway for a VCN.
- After creating an Internet Gateway, you must add a route for the gateway in the VCN's Route Table to enable traffic flow.

NAT Gateway



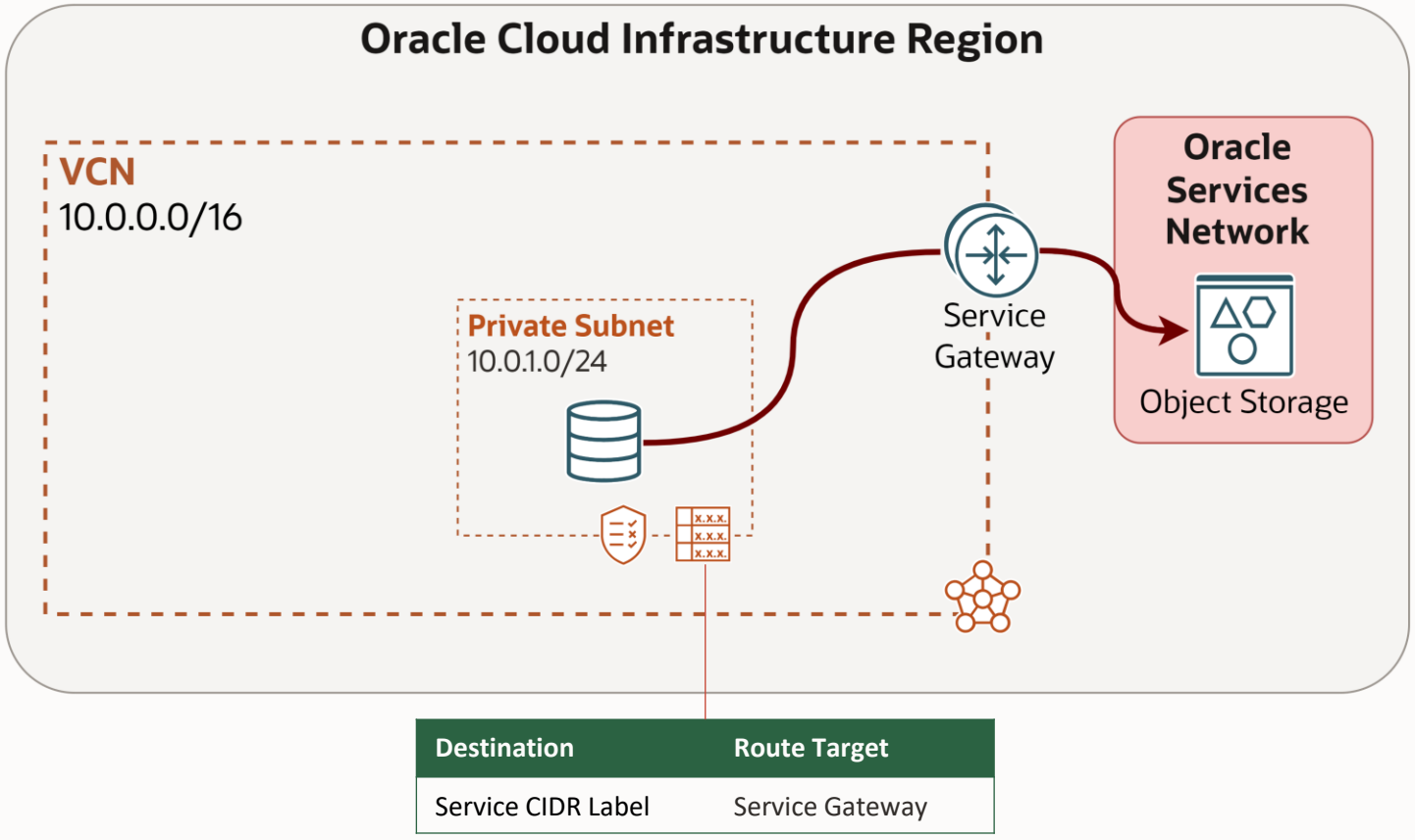
Destination	Route Target
0.0.0.0/0	NAT Gateway

- NAT Gateway gives a private network access to the Internet without assigning each host a public IP address.

- Hosts can initiate outbound connections to the internet and receive responses, but not receive inbound connections initiated from the internet. (Use cases: updates, patches).

- You can have more than one NAT gateway on a VCN, though a given subnet can route traffic to only a single NAT gateway.

Service Gateway



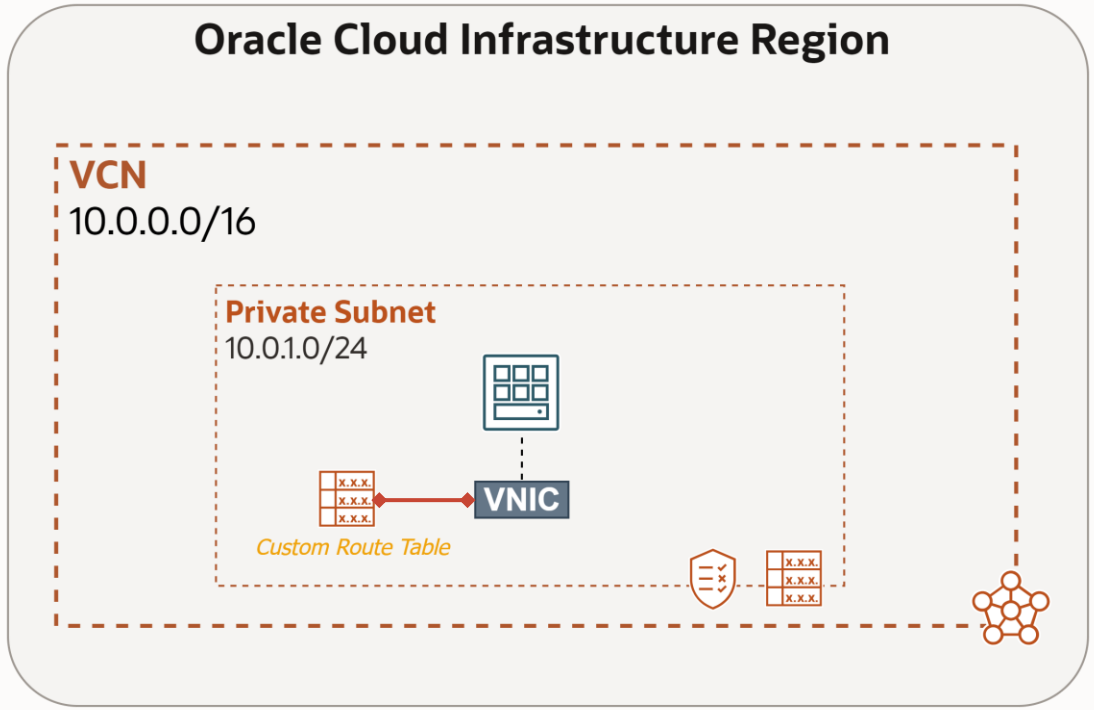
Destination	Route Target
Service CIDR Label	Service Gateway

- Service Gateway lets resources in VCN access public OCI services, exposed on the Oracle Services Network (OSN), such as Object Storage, but without using either Internet or NAT gateway.

- Any traffic from VCN that is destined for one of the supported OCI public services uses the instance's private IP address for routing, travels over OCI network fabric, and never traverses the internet. (Use case: back up DB Systems in VCN to Object Storage).

- Service CIDR labels represent all the public CIDRs for a given Oracle service or a group of Oracle services. E.g.
  - OCI <region> Object Storage
  - All <region> Services

Per-resource Routing



- Used to assign a custom VCN route table to one or more VNICs or to a particular IP addresses on a VNIC.
- This offers enhanced routing control tailored to each resource in a single subnet, in case they have different requirements, rather than relying solely on the subnet-level route table.
- Route Table selection process:
  1. VNIC IP address RT.
  2. VNIC RT.
  3. Subnet RT.

VCN Peering

A method to let VCNs communicate with each other.

Local Peering

Enables communication between VCNs within the same OCI region.

Remote Peering

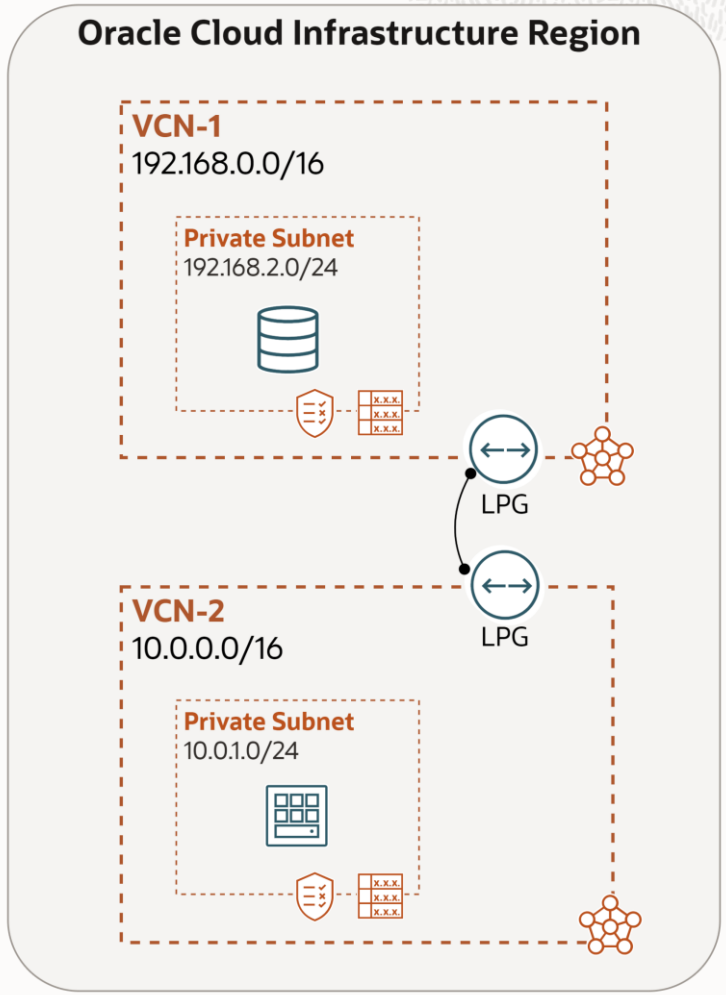
Enables communication between VCNs in different OCI regions.

Local VCN Peering – connecting VCNs in the same region

- Connecting two VCNs in the same region so that their resources can communicate using private IP addresses without routing the traffic over the internet or through your on-premises network.
- VCNs should not have overlapping IP addresses.
- Local Peering VCNs can be either in the same or different tenancies (cross-tenancy peering).

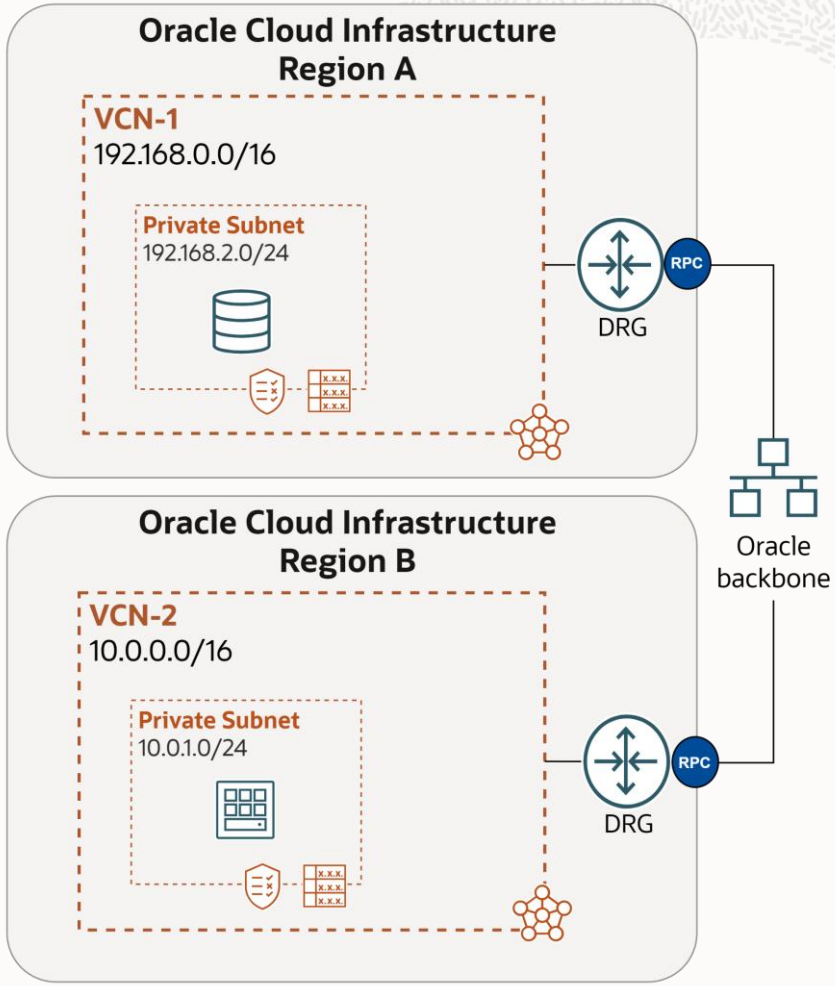
Local Peering Gateway (LPG)

- Like the Internet Gateway, LPG is a component on the VCN.
- LPGs of two VCNs are connected to make a peering relationship.
- Enable the data plane to learn about instances in peered VCNs.



Remote VCN Peering – connecting VCNs in different regions

- Traffic flows between regions through the OCI backbone network.
- The two VCNs in the peering relationship must not have overlapping CIDRs.
- Requires a DRG to set up the Remote Peering connection; vNIC of one VCN instance forwards traffic to its DRG, which forwards traffic to peer DRG in other region over backbone.
- Enables features such as data replication across regions.



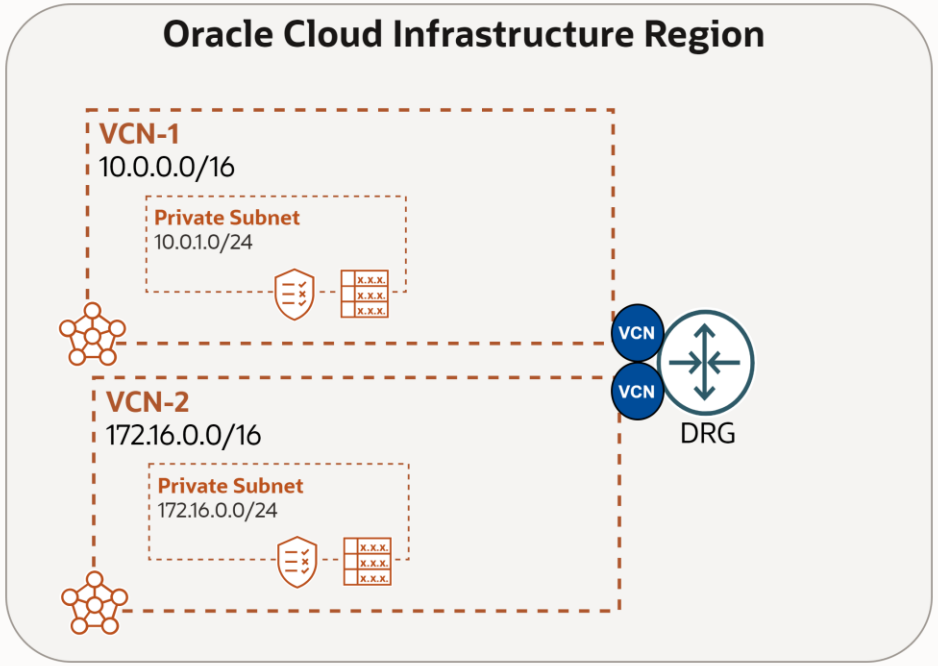
Remote Peering Connection (RPC)

- Like Virtual Circuits, the RPC is a component of DRG.
- RPCs of two DRGs from two regions are connected to create a peering relationship.

Local VCN Peering with DRG

- Oracle recommends using a Dynamic Routing Gateway (DRG) for local VCN peering instead of a Local Peering Gateway (LPG), as DRG offers greater scalability and simplifies the network design.

- Using LPG is **only** recommended in scenarios that require ultra-low latency or high bandwidth. If your use case does not have such requirements, leveraging DRG is preferred due to the flexibility it provides.

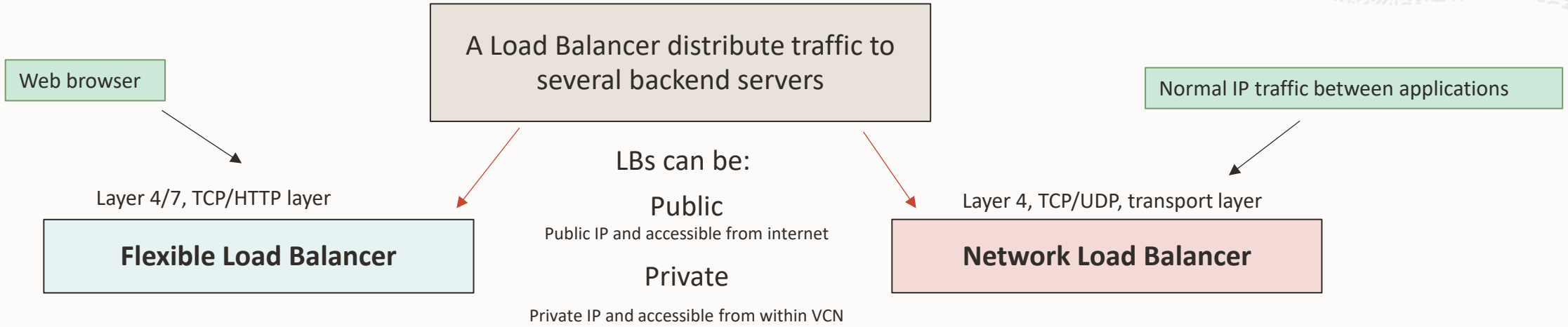


Load Balancing

Load Balancing

- Resides between end users and backend servers.

- Load Balancer Improve Resource Utilization, Scalability and ensure High Availability.

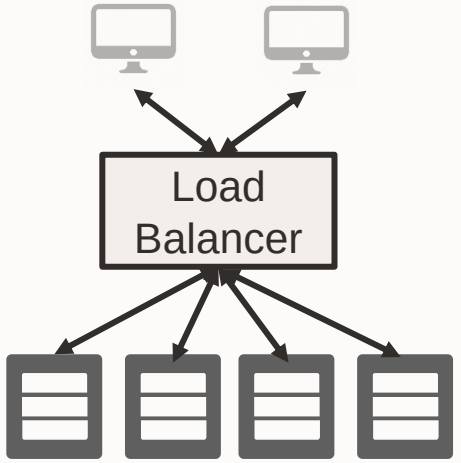


- Can terminate SSL traffic on load balancer or pass it through to backend.
- Standard Load balancer for public facing web servers.
- Directly apply WAF (Web application Firewall) protection onto Flexible Load Balancer.
- Flexible shape will use between Min and Max bandwidth depending on traffic, lower cost if less traffic.

- Non-proxy, pass through load balancing.
- High throughput and ultra low latency.
- Optimized for long-running connections (days or months).
- A connection always goes to same backend server – good for DB.
- Scales up and down automatically based on client traffic, no bandwidth config needed.
- No SSL termination.

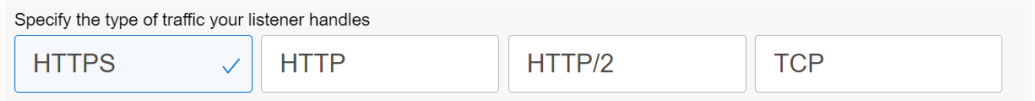
Flexible Load Balancer Benefits (Layer 7)

- **Fault tolerance and HA**: using health check + LB algorithms, a LB can effectively route around a bad or overloaded backend.
- **Scalability**: LB maximizes throughput, minimizes response time, and avoids overload of any single resource
- **Naming abstraction**: name resolution can be delegated to the LB; backends don’t need public IP addresses

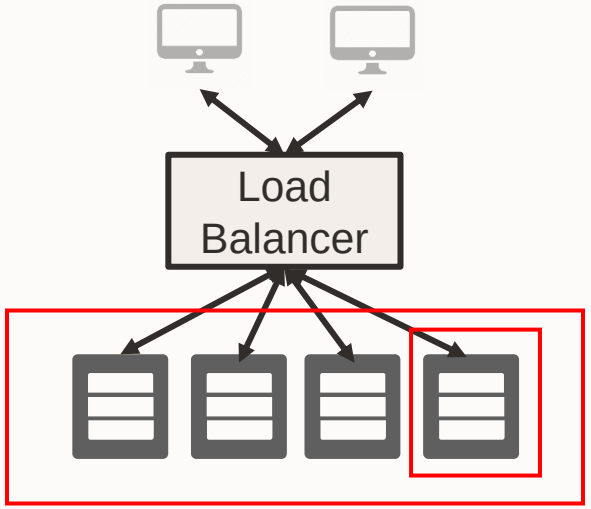


Load Balancer Components

- **Listener** : Checks for incoming traffic on the load balancer's IP address, listener should configure for type of traffic.



- **Load Balancing Policy:** Distribution algorithm of incoming traffic.



- **Health Check**: What backends are currently healthy and available to accept requests?

- **Backend set** is a logical entity defined by a load balancing policy, a health check policy, and a list of backend servers.

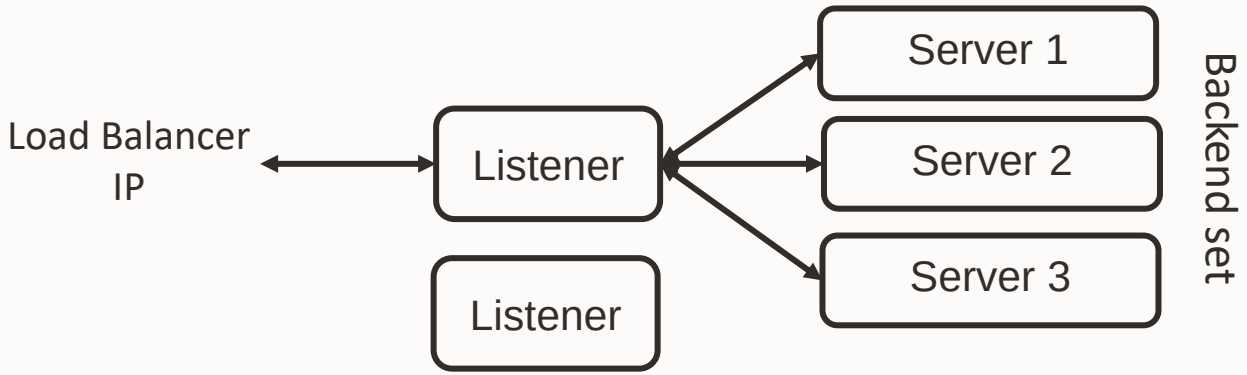
- **Backend Server** – application server responsible for generating content in reply to the incoming TCP or HTTP traffic

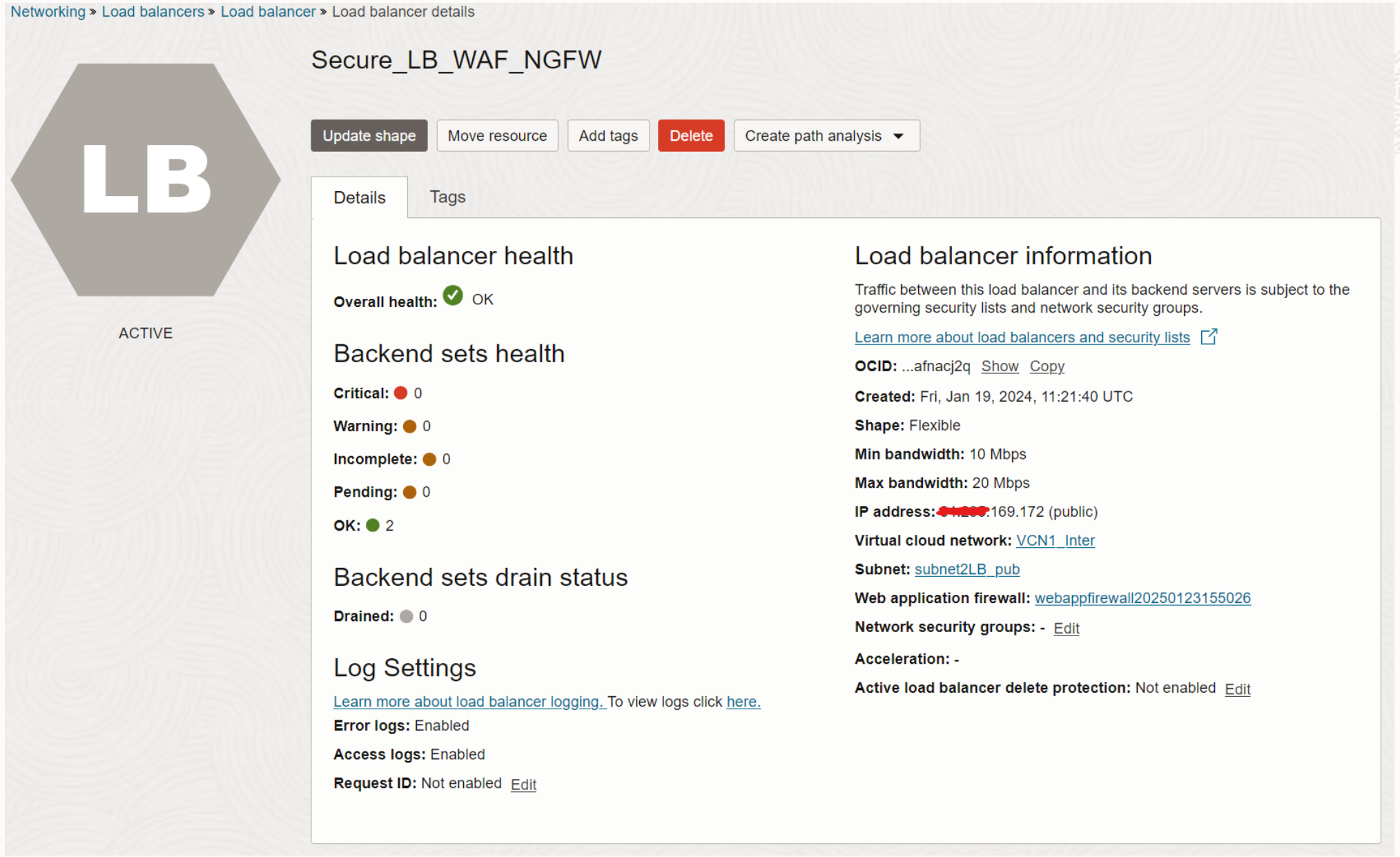
Health Check

- Health check is a test to confirm the availability of backend servers.
- Health API provides a 5-state health status (**ok**, **pending**, **incomplete**, **warning**, **critical**)
- Health status is updated **every three minutes**

Listeners

- A Load Balancer IP can have **up to 16 listeners** (port numbers). Each listener has a backend set that can have 1 to N backend servers





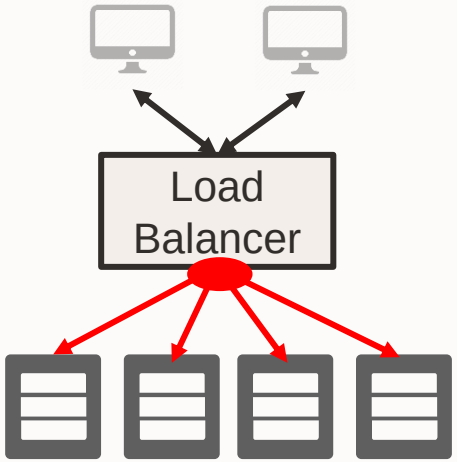
Load Balancing Policies

- **Round Robin**: default policy, distributes incoming traffic sequentially to each server in a backend set. After each server has received a connection, the load balancer repeats the list in the same order.

- **IP Hash**: uses an incoming request's source IP address as a hashing key to route non-sticky traffic to the same backend server.

- **Least Connection**: routes incoming non-sticky request traffic to the backend server with the fewest active connections.

- Load balancer policy decisions apply differently to TCP load balancer, cookie-based session persistent HTTP requests (sticky requests), and non-sticky HTTP requests
  - A TCP load balancer considers policy and weight criteria.
  - An HTTP load balancer w/ cookie-based session persistence forwards requests using cookie's session info.
  - For non-sticky HTTP requests, the load balancer applies policy and weight criteria.



Backend Health Status

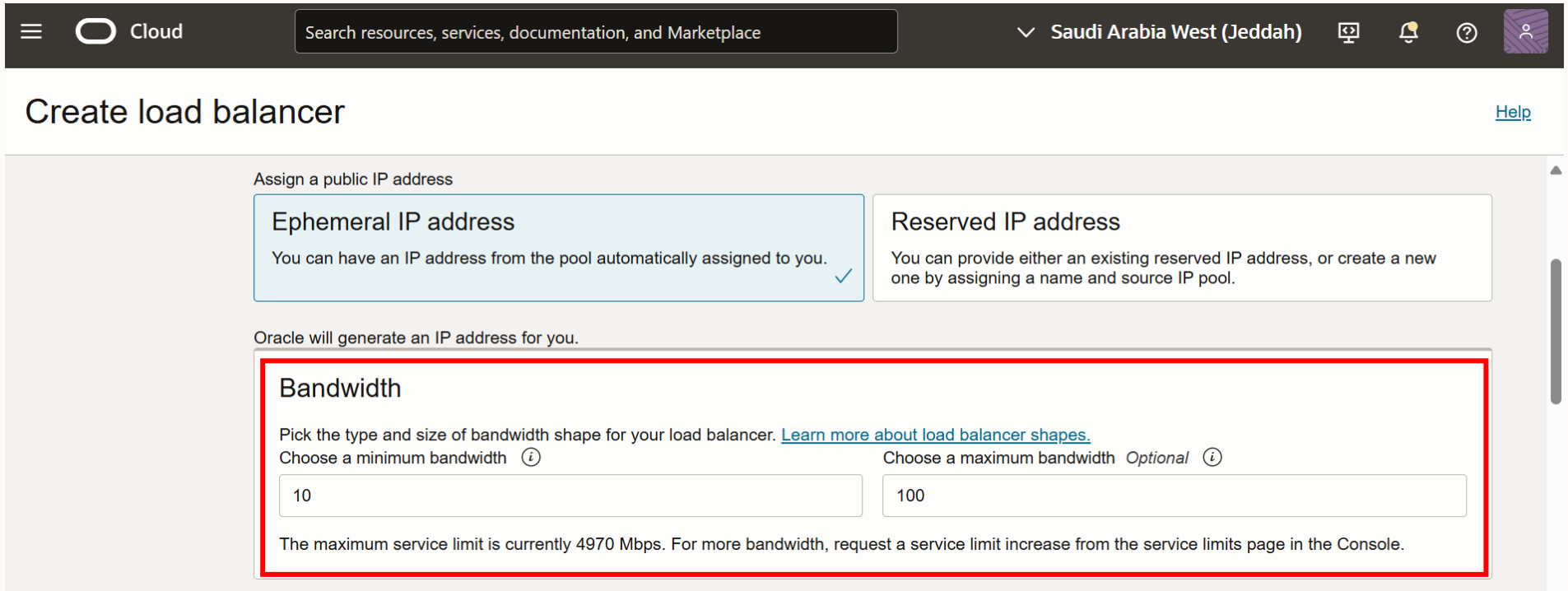
Level	Color	Description
Critical	Red	Some or all reporting entities require immediate attention. The resource is not functioning or unexpected failure is imminent.
Warning	Yellow	Some reporting entities require attention. The resource is not functioning at peak efficiency or the resource is incomplete and requires further work.
Incomplete	Yellow	The load balancer does not have any backend sets configured or backend sets exist that contain no attached backend servers.
Pending	Yellow	The health status cannot be determined. The resource is not responding or is in transition and might resolve to another status over time.
OK	Green	No attention required. The resource is functioning as expected.

Flexible Load Balancer

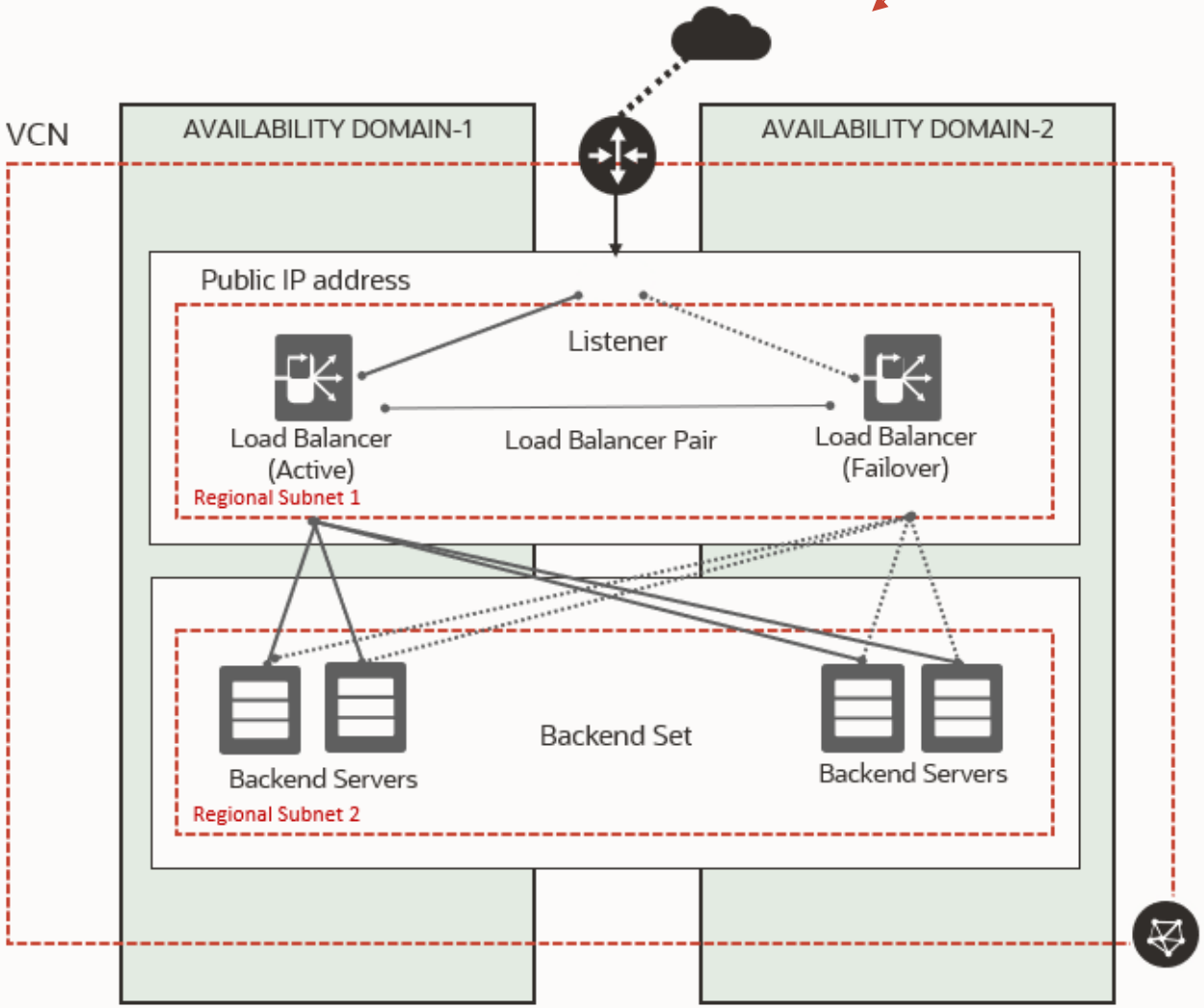
Customer just defines the minimum and maximum bandwidth:

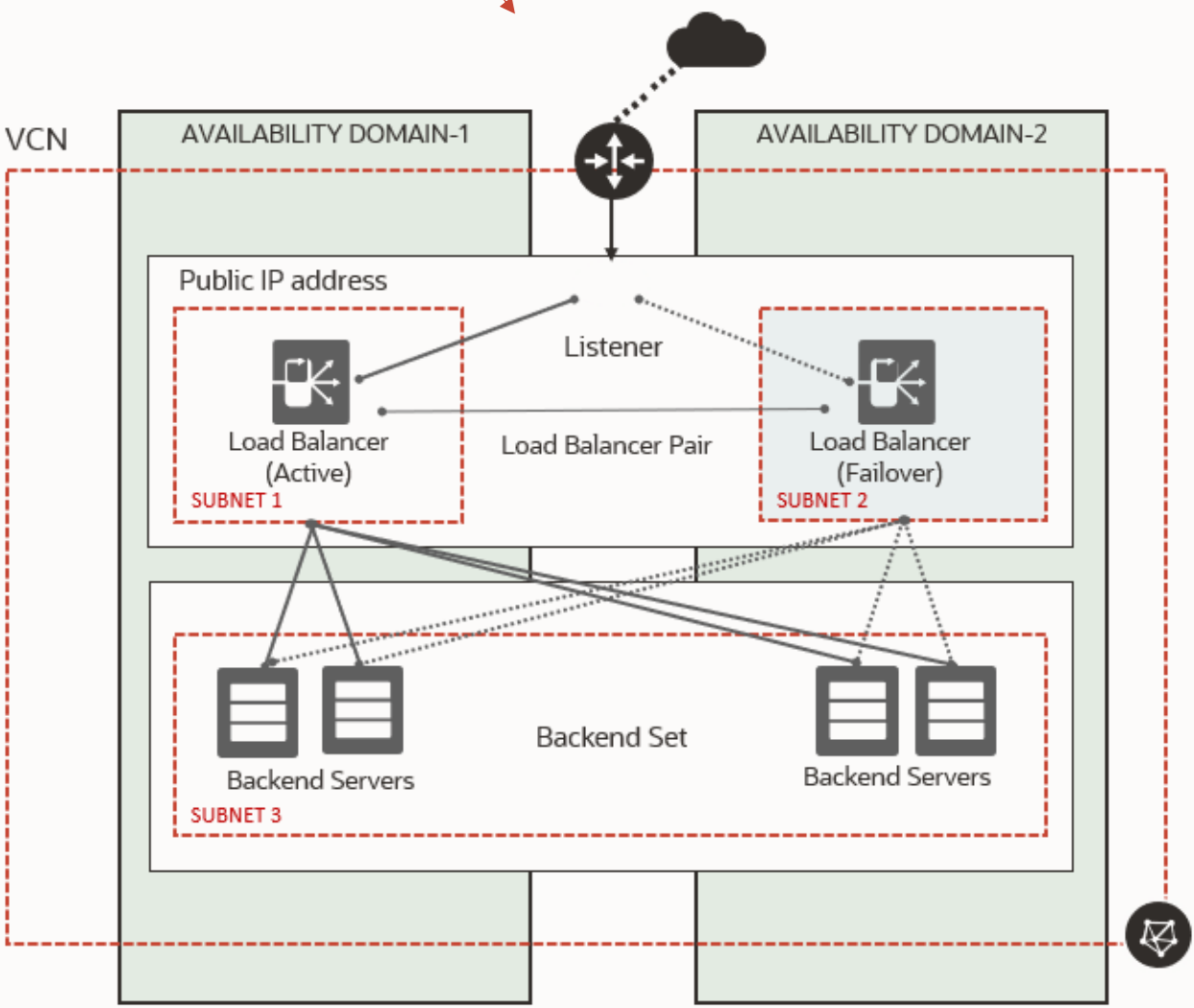
- Minimum bandwidth provides instant readiness for the load balancer.
- Maximum bandwidth allows control of maximum cost.
- Customer pays a minimal base cost for the load balancer and then pays a simple single rate.

For the larger of the reserved bandwidth or the maximum bandwidth actually used each minute.

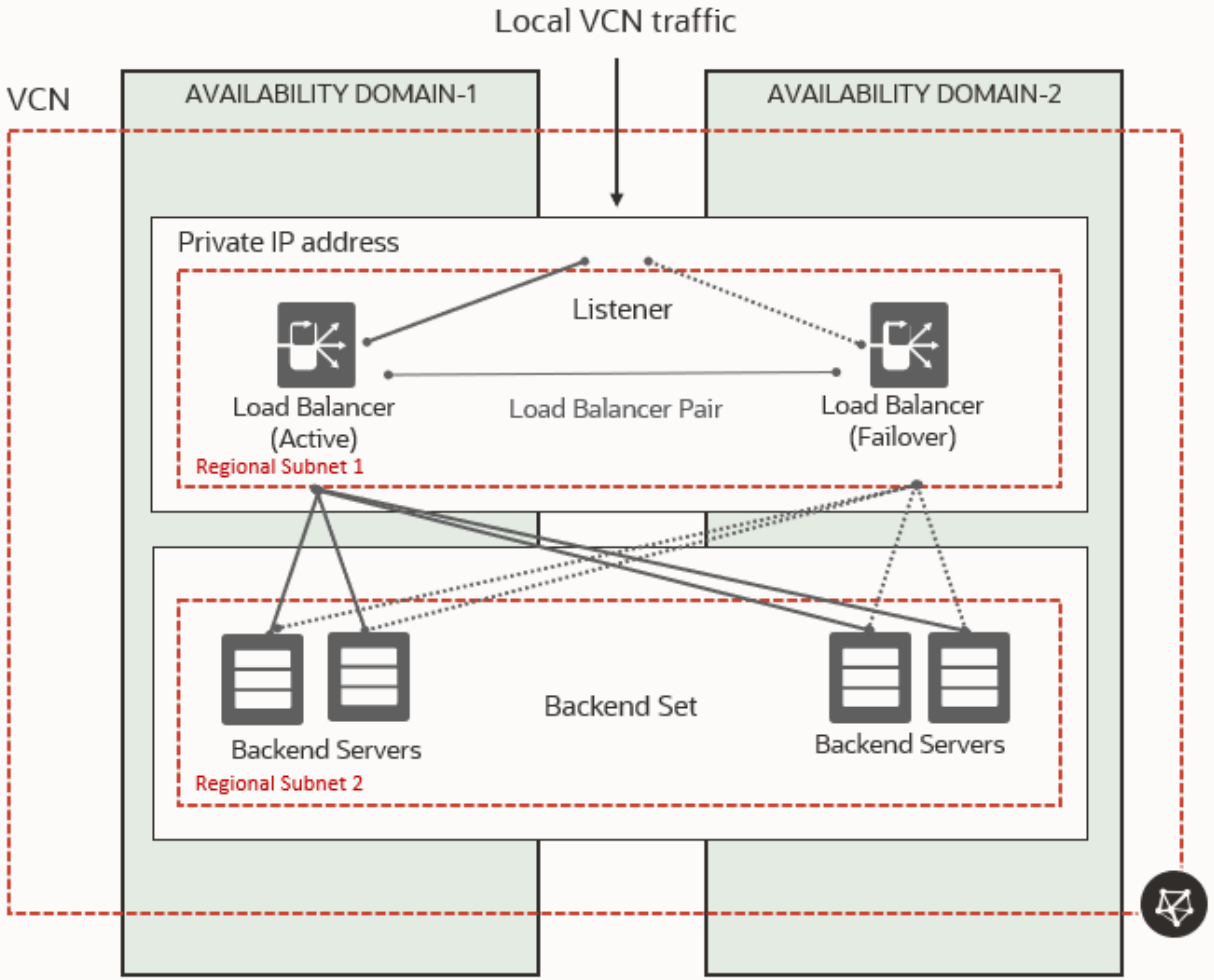


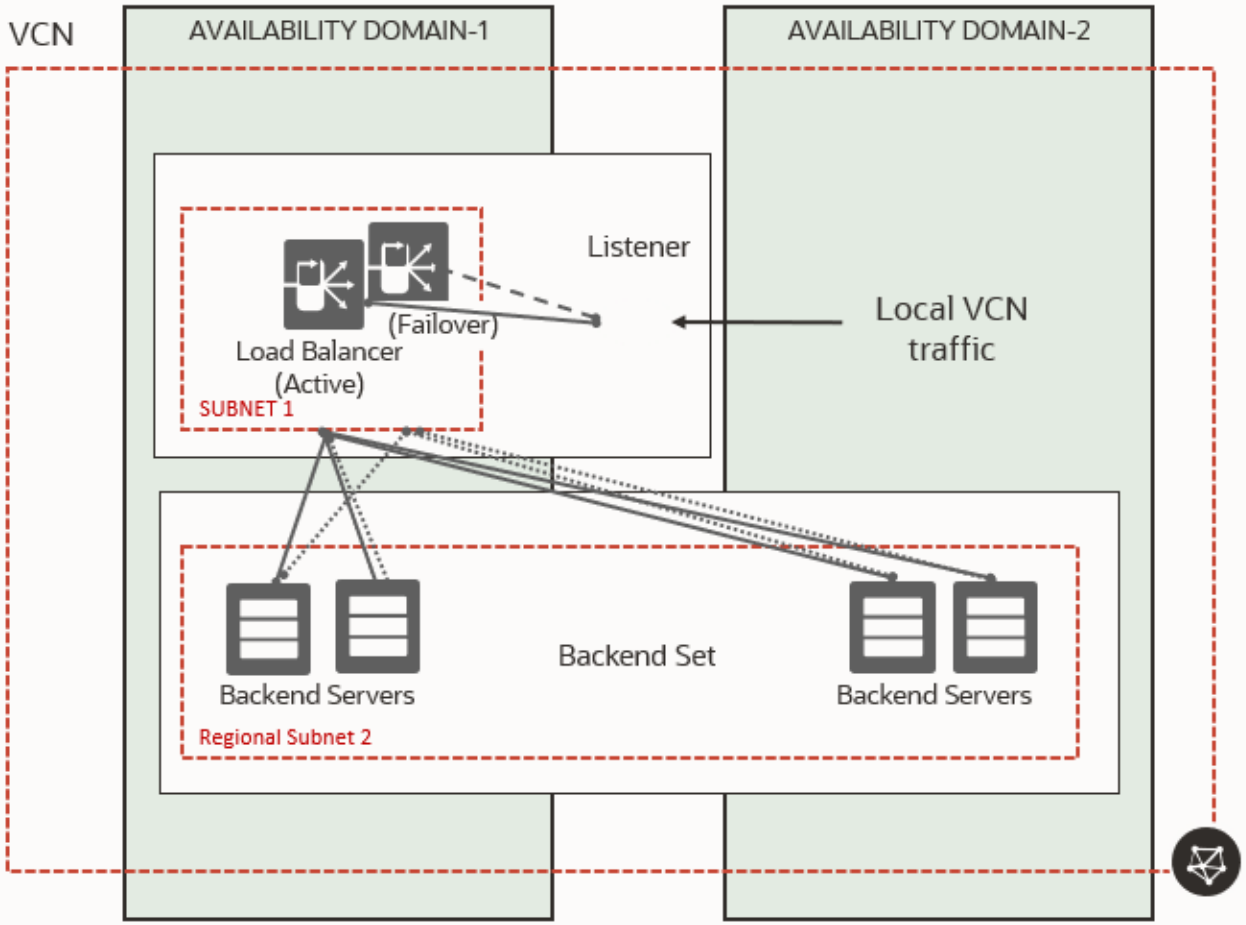
Public Load Balancer (Regional Subnets -Recommended- vs. AD Specific Subnets)





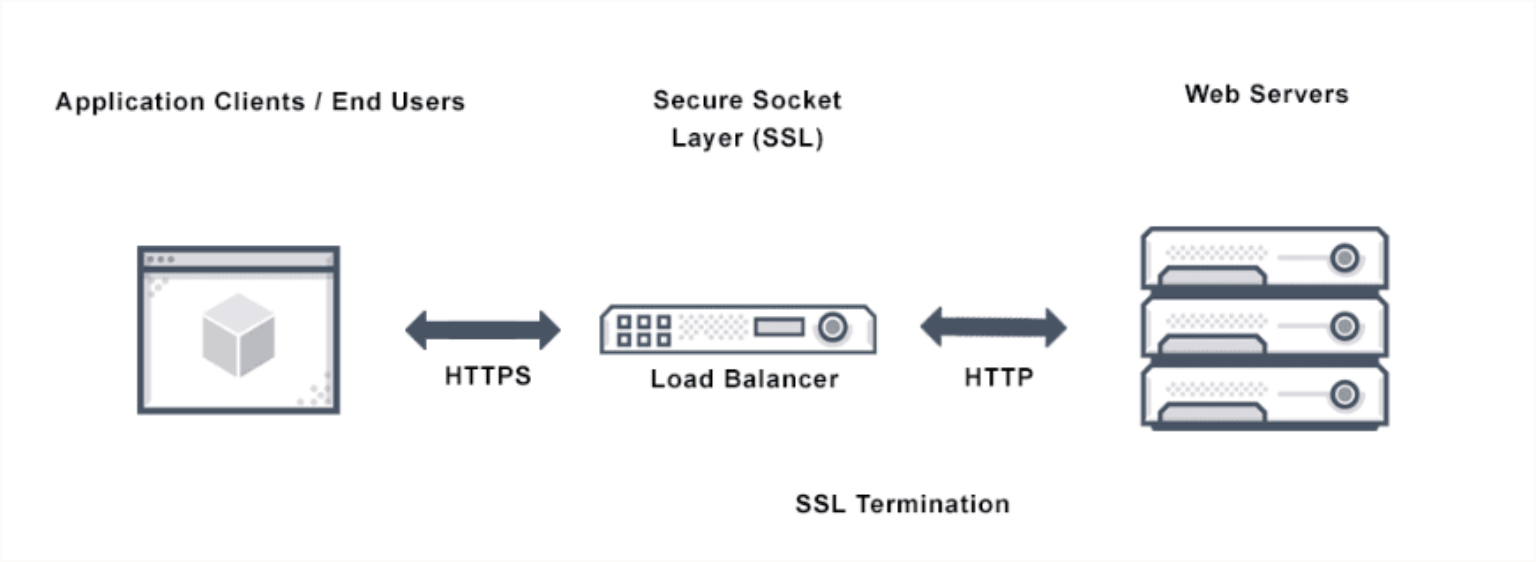
Private Load Balancer (Regional Subnets -Recommended- vs. AD Specific Subnets)





SSL Handling

- **Terminate SSL at the load balancer**. This configuration is *frontend SSL*. Your load balancer can accept encrypted traffic from a client. No encryption of traffic exists between the load balancer and the backend servers.
- **Implement SSL between the load balancer and your backend servers**. This configuration is *backend SSL*. Your load balancer does not accept encrypted traffic from client servers. Traffic between the load balancer and the backend servers is encrypted.
- **Implement point-to-point SSL**. Your load balancer can accept SSL encrypted traffic from clients and encrypts traffic to the backend servers.
  - To use SSL with your load balancer, you must add one or more certificate bundles to your system.
  - Oracle Cloud Infrastructure accepts x.509 type certificates in PEM format only.



Network Load Balancer (Layer 4)

- The Network Load Balancer load balance **layer 3 and layer 4 (TCP/UDP/ICMP) workloads**
- It’s designed to handle volatile traffic patterns and millions of flows, offering high throughput while maintaining **ultra-low latency.**
- Ideal load balancing solution for **latency-sensitive workloads** includes real-time streaming, VoIP, Internet of Things, HA scenarios and trading platforms.
- OCI Network Load Balancer can be public or private.
- **Symmetric Hashing** support for Active/Active configurations.
- Full NAT**,** Source/Destination Header (IP/Port) Preservation (Bump-in-the-wire), Source Header (IP/Port) Preservation.

Network Load Balancer - Policies

5-Tuple Hash: Routes incoming traffic based on 5-Tuple (source IP and port, destination IP and port, protocol) Hash. This is the default network load balancer policy.

3-Tuple Hash: Routs incoming traffic based on 3-Tuple (source IP, destination IP, protocol) Hash.

2-Tuple Hash: Routs incoming traffic based on 2-Tuple (source IP Destination, destination IP) Hash.

OCI Web Application Firewall (WAF)

Increasing cyber attacks

<50%

of companies globally are sufficiently prepared for a cybersecurity attack,
according to a report that surveyed
3,000 business leaders from 80 countries

Source: Eurasia Group, 2019

92%

of IT professionals surveyed feel that immaturity in their cloud security
programs is creating a readiness gap

Source: Oracle and KPMG Cloud Threat Report, 2020

Exploit data
Steal personal data, usernames and passwords to get to more important data

Hold data ransom
Steal records, personal data, usernames and passwords and charge the organization to give it back

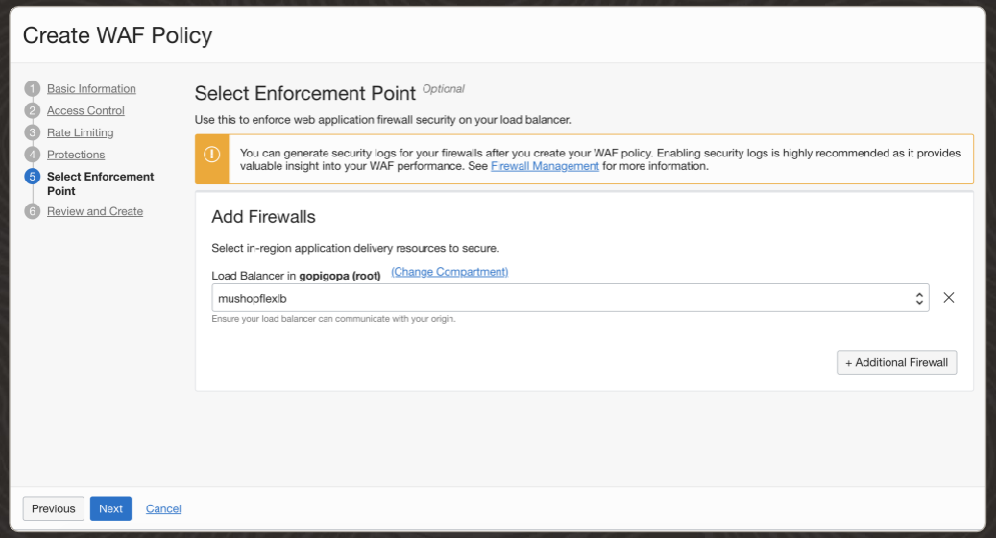
Steal infrastructure
Take control of an organization's compute, storage and network resources so not to pay for them

Deny service
Prevent web services from working to impact organization's reputation or bottom line

OCI Web Application Firewall (WAF)

OCI WAF protects against threats such as OWASP defined top-10 vulnerabilities. It can be used to limit access to the application based on geography or the signature of incoming requests, block unwanted bots.

OCI WAF protects your application infrastructure and workloads no matter where they reside: in OCI, on-premises, multi-cloud and anywhere in between.

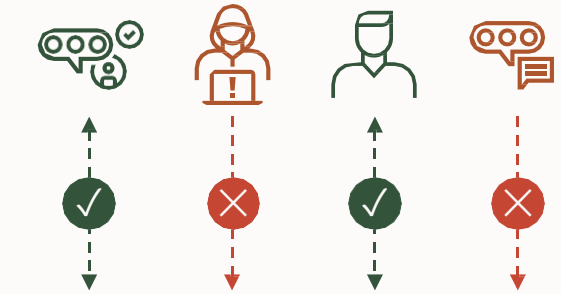


Customer benefits

- Layered defense and flexibility to enforce security at the edge closest to users as well as in-region closest to the application on flexible load balancers.
- WAF policies can be enforced on internet facing web applications, and/or (public/private) flexible load balancer instances.
- Protects internet facing and internal applications against both external and insider threats.
- Supports access rules, protection rules, rate limiting, and bot management*

* Bot management is only supported with edge policies.

OCI WAF Features



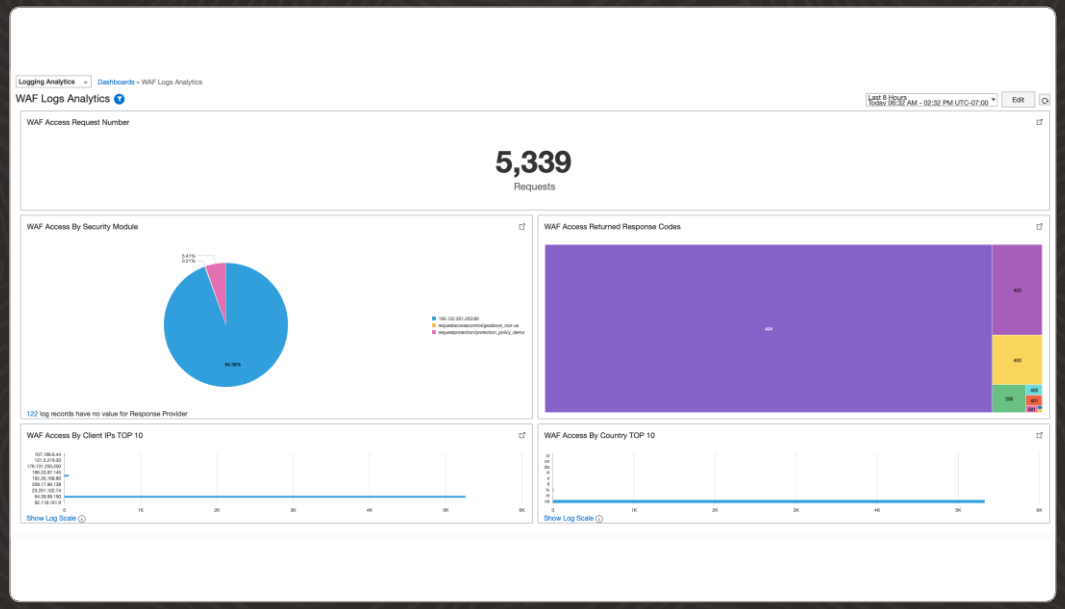
Access control	Restrict or control access to critical web applications, data and service
Bot management	Identifies whether request are from a human or a machine Controls or blocks non-human suspicious requests
Protection rules	Hides the origin server Inspects traffic as it tries to access the server or as it leaves the server
Rate limit	Provides protection against L7 DDOS
Customer applications	

Oracle Cloud Infrastructure

Access controls

Use the access controls to restrict or control access to your critical web applications, data and services. Examples:

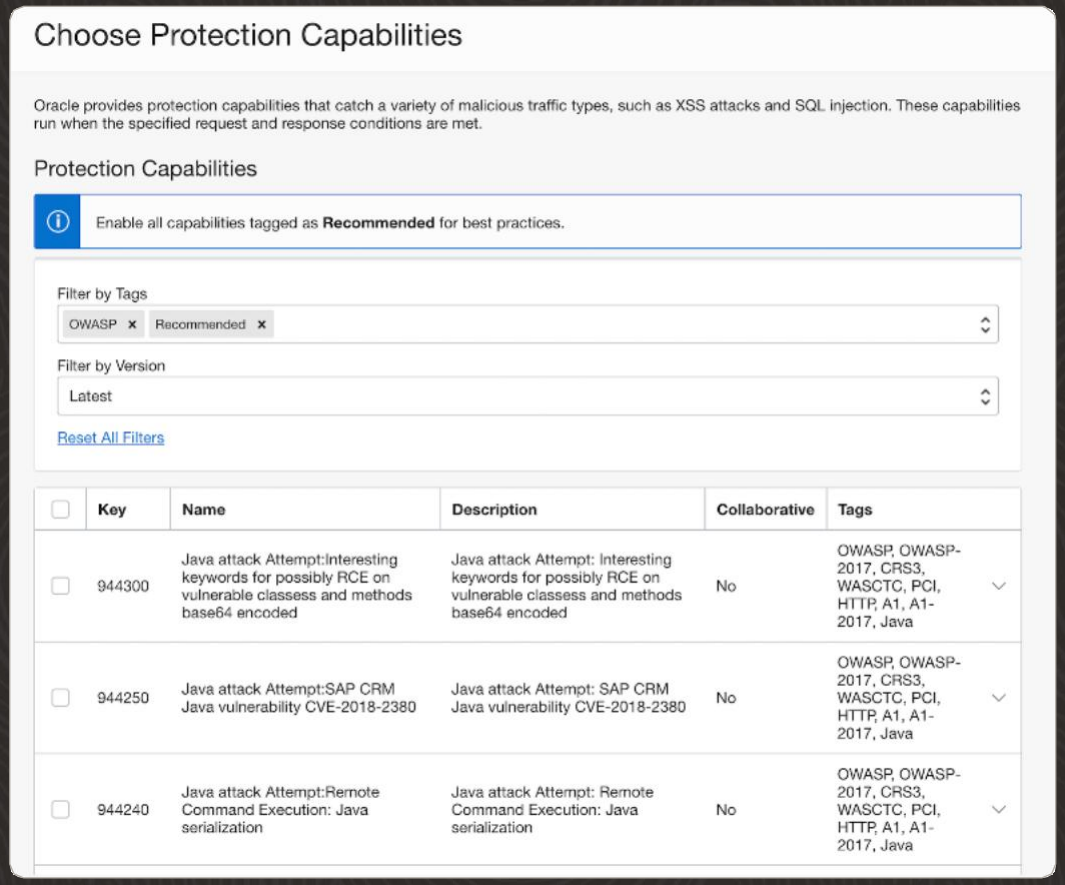
- Control access, based on HTTP header information. Block requests if the HTTP header contains specific names or values or allow traffic with proper HTTP regular expression.
- Control access based on URL address matching or partial matching or match proper URL regular expressions.
- Regional access control can be used to restrict users from certain geographies.



Protection rules

Use these rules to protect your critical web applications against malicious cyber-attacks from bad actors. Incoming requests are inspected to determine if it contains an attack payload as compared to industry-leading threat feeds.

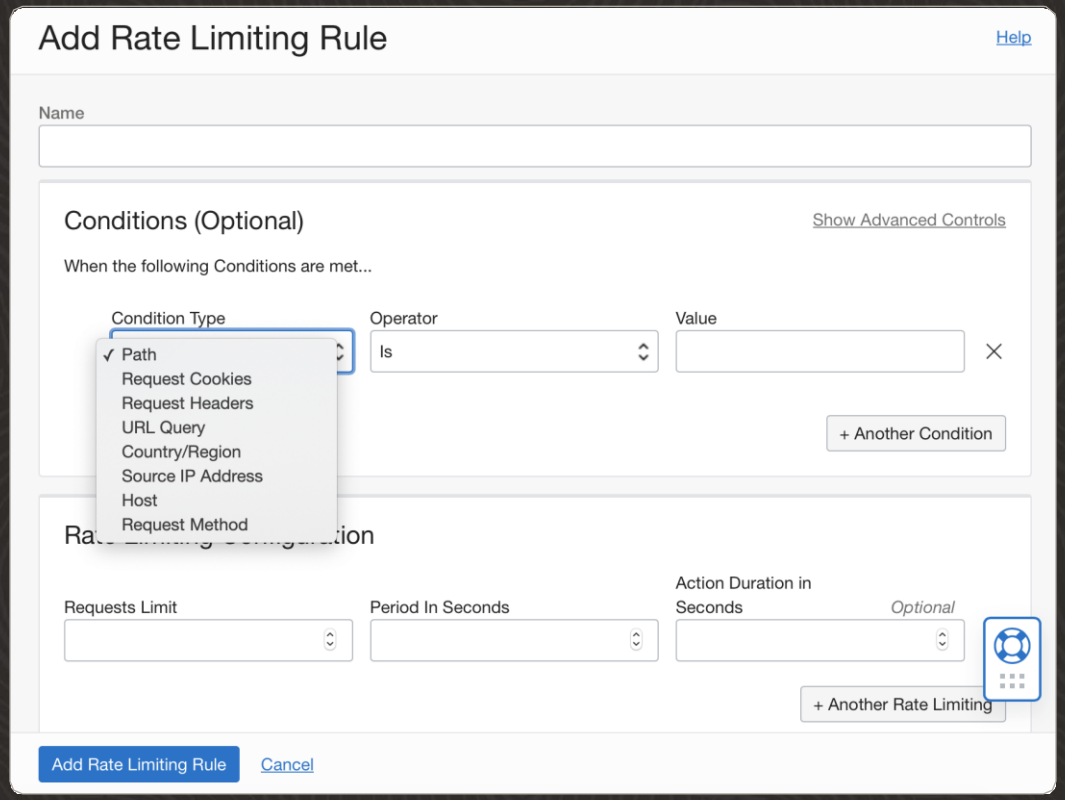
- Supports over 250 rule sets as well as the Open Web Access Security Project (OWASP) rule sets.
- WAF will block and/or alert on the requests: SQL injection, cross-site scripting, HTML injection and many more.



Rate limit rules

Rate limiting rules based on URL request parameters and client IP to protect against layer 7 DDOS attacks.

- Allows inspection of HTTP request properties and limits the frequency of requests for each unique client IP address.



Bot management

Entity attributes and behavioral detection

Human interaction

Oracle WAF identifies normal usage patterns based on legitimate user behavior to the site.
The WAF will challenge with CAPTCHA or block requests when it detects abnormalities, or traffic exceeds defined interaction thresholds.

Device fingerprinting

Oracle WAF collects unique various characteristics about a device entity, generating a hashed signature. This hashed signature is then compared to other requests to determine the same signature is being leverages across different contexts.

Shared responsibility model for OCI WAF

Responsibility	Oracle	Customer
Onboard/configure the WAF policy for the web application	No	Yes
Configure WAF onboarding dependencies (DNS, ingress rules, network)	No	Yes
Provide high availability (HA) for the WAF	Yes	No
Monitor for distributed denial of service (DDoS) attacks	Yes	No
Keep WAF infrastructure patched and up-to-date	Yes	No
Monitor data-plane logs for abnormal, undesired behavior	Yes	Yes
Construct new rules based on new vulnerabilities and mitigations	Yes	No
Review and accept new recommended rules	No	Yes
Tune the WAF's access rules and bot management strategies for your traffic	No	Yes

What's New in OCI WAF

- Include `${http.request.id}` in custom responses for faster troubleshooting and correlation (Release Notes).
- Additional in-region protection rule sets and threat-intel feeds; easier tuning.
- HTTP Request Body Inspection—buffers and scans request bodies.

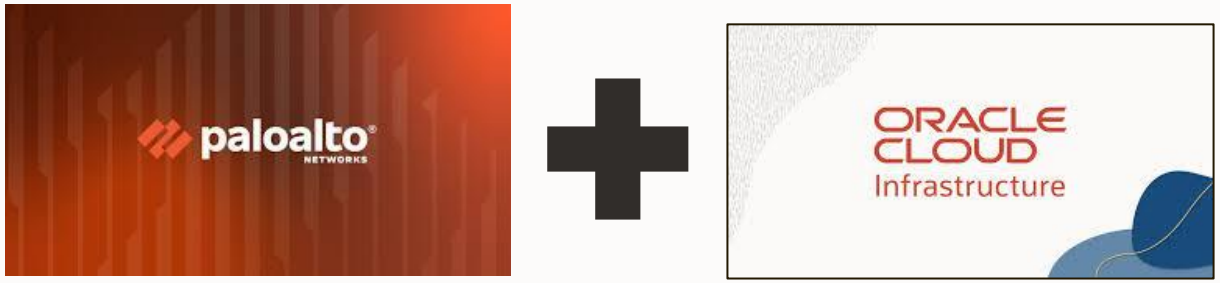
*All features supported on both Edge and Flexible Load Balancers.

Simplified Pricing – 2025

- First WAF instance + first 10 million requests/month are FREE for OCI commercial customers.
- After free tier: charged per WAF instance/month and per 1 million incoming requests.
- Pricing identical for Edge and In-region WAF; pay-as-you-go or commit models.

OCI Network Firewall

Network Firewall Overview



Next-Gen Network Firewall with Advanced Threat Protection

- **Cloud-native Solution** - Scalable cloud-native service, fully integrated with rich set of OCI platform capabilities, eliminating the need to manage additional third-party security infrastructure.
- **Advanced Threat Protection** – Industry leading threat protection to help monitor and block malware, spyware and vulnerability exploits.
- **Layered Defense** - Seamlessly integrates with Access Control Lists (ACLs), Network Security Groups (NSGs), and Web Application Firewalls (WAFs) to establish a Defense in Depth security strategy
- **Compliance** – Helps meet compliance requirements and stringent security needs of regulated environments.

Network Firewall Benefits

Segment and Filter network traffic

Protect against sophisticated cybersecurity threats

Enforce Compliance

OCI Network Firewall Versus Third-Party Firewall

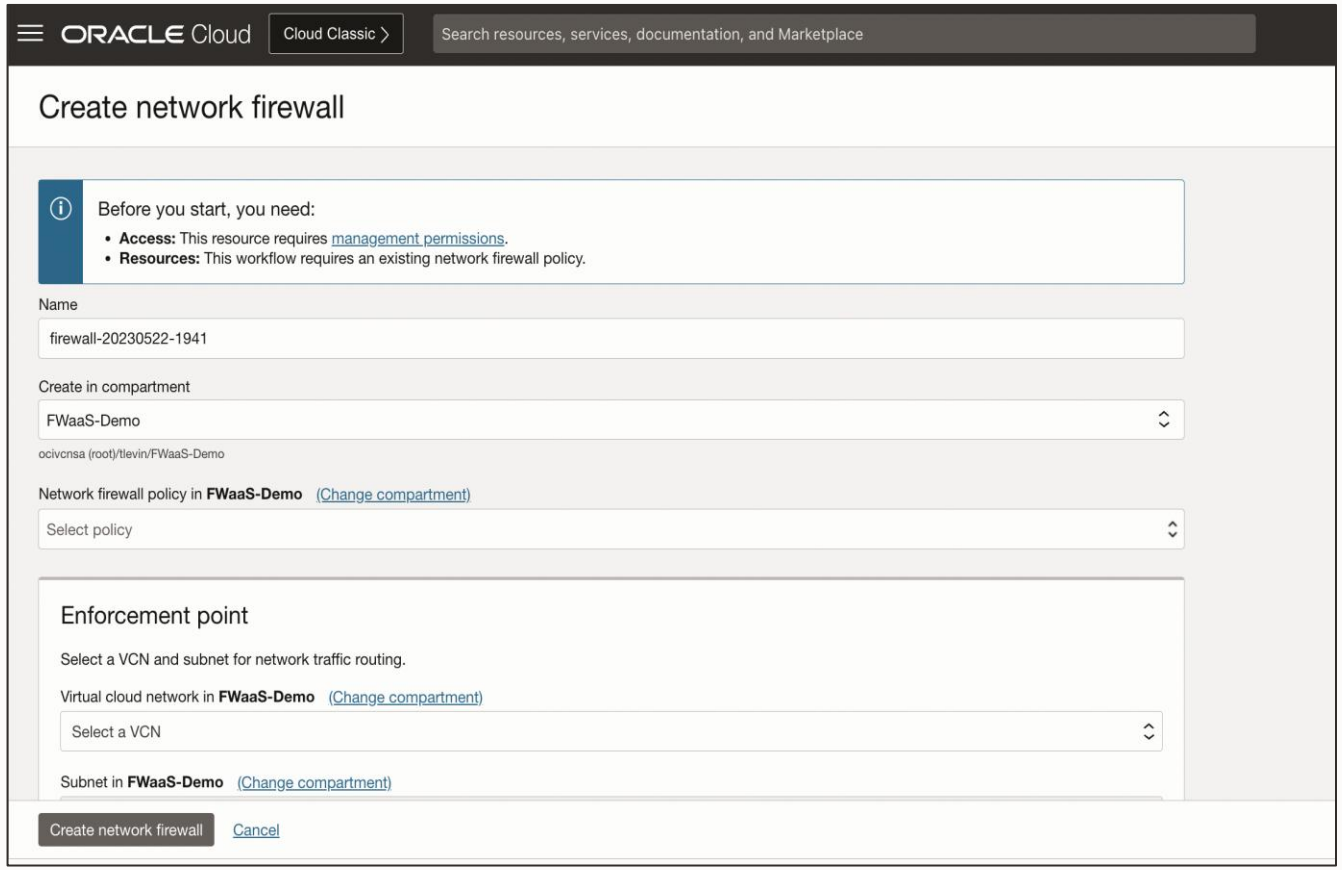
OCI Network Firewall

- Oracle-managed FWaaS
  - Simple deployment
  - Built in HA
  - Patch management and maintenance
  - Customer still responsible for policy
- Direct integration with OCI (Logging, Vaults, and so on)
- No requirement for specialized third-party skills and expertise

Third-Party Firewall

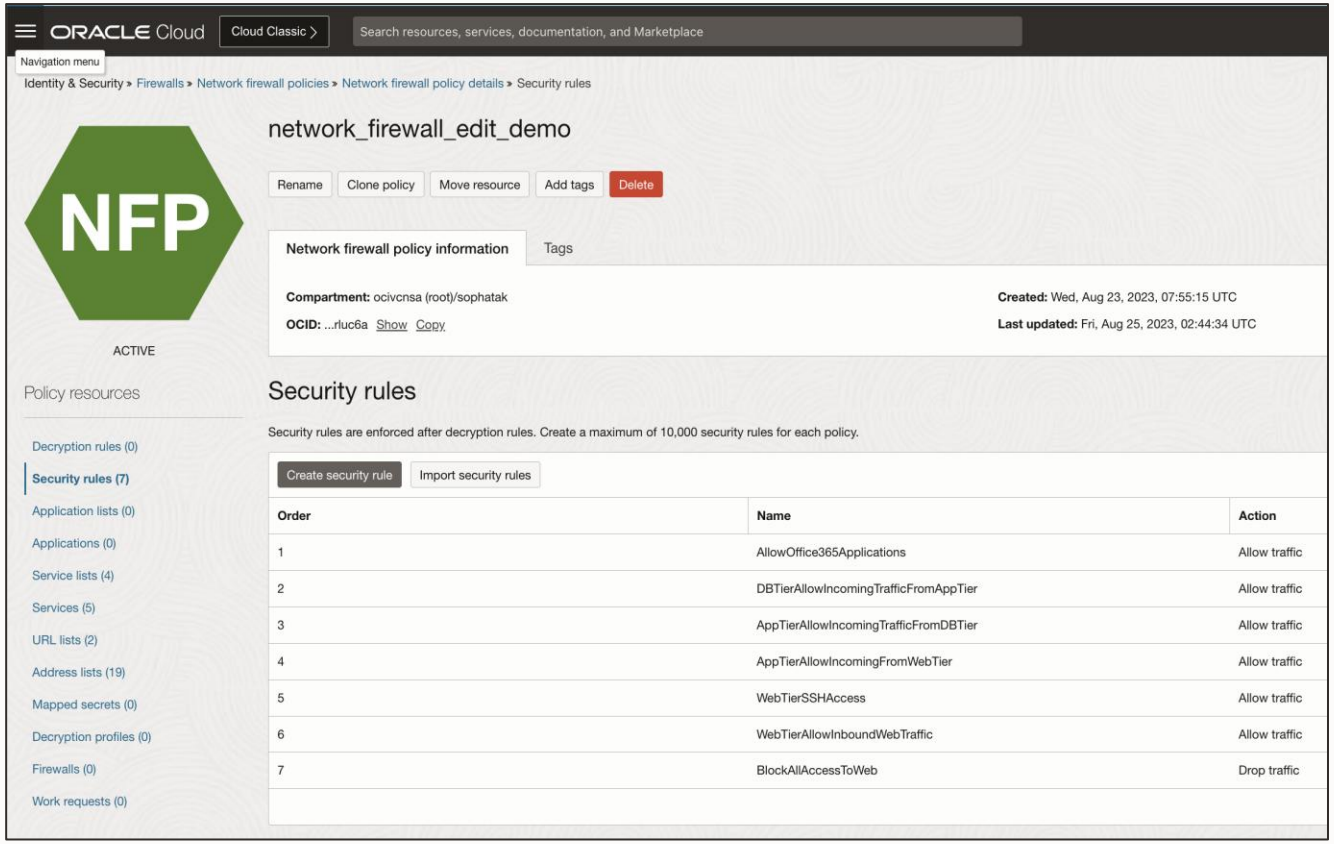
- Flexible deployment options:
  - BYOL
  - Choose your vendor
- Familiar interface and feature set for existing customers of a third-party vendor
- Support for more advanced features
- Integrate with existing tools

Cloud Native Solution



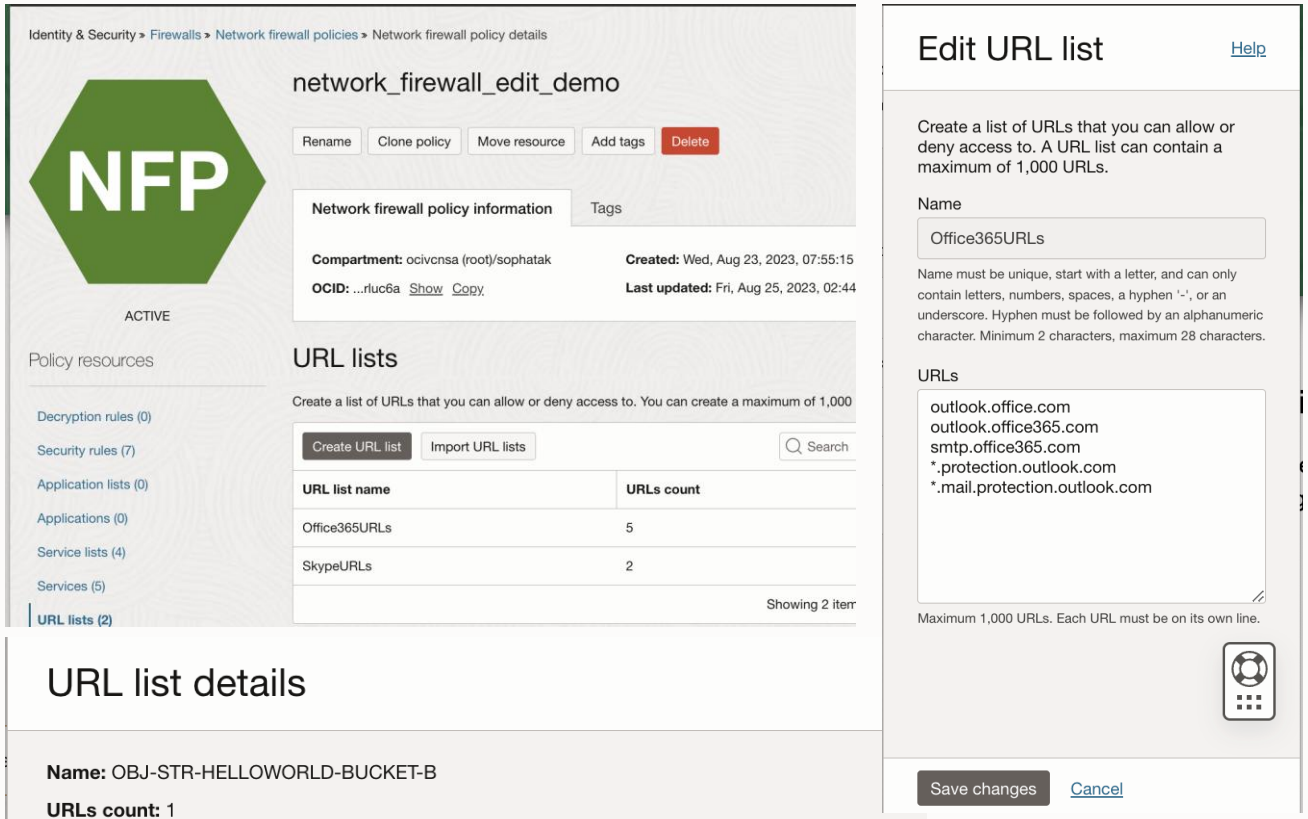
- Best-of-breed Palo Alto network security with OCI-native experience.
- Scalable cloud service supporting 4 -12.5 Gbps.
- Highly available in both multi-AD and mono-AD regions.
- Eliminates management of 3rd Party infrastructure.
- Deep integration with OCI platform capabilities e.g.: metrics, logging, alerting etc.

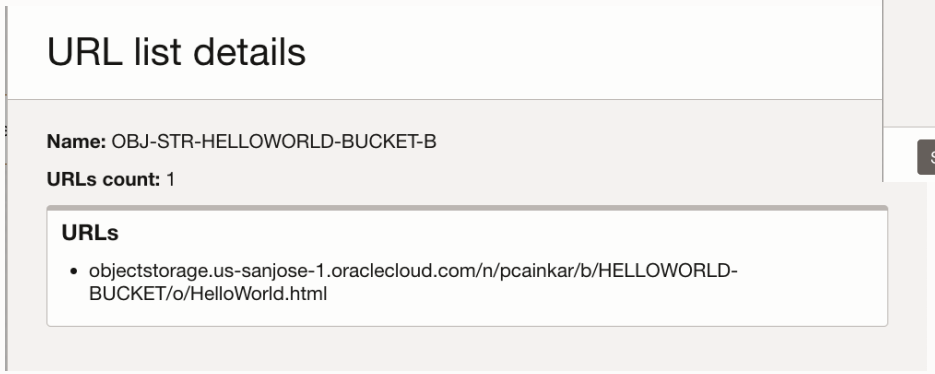
Access Control - Stateful Firewall rules



- *Allow* or *Deny* stateful filtering rules based on 5-tuple information.
- Customer-defined priority order for rules across multiple virtual networks.
- Granular policy enforcement with traffic context-aware stateful firewall.
- Enterprise Scale with 10K Firewall Rules, 20K IP Addresses.

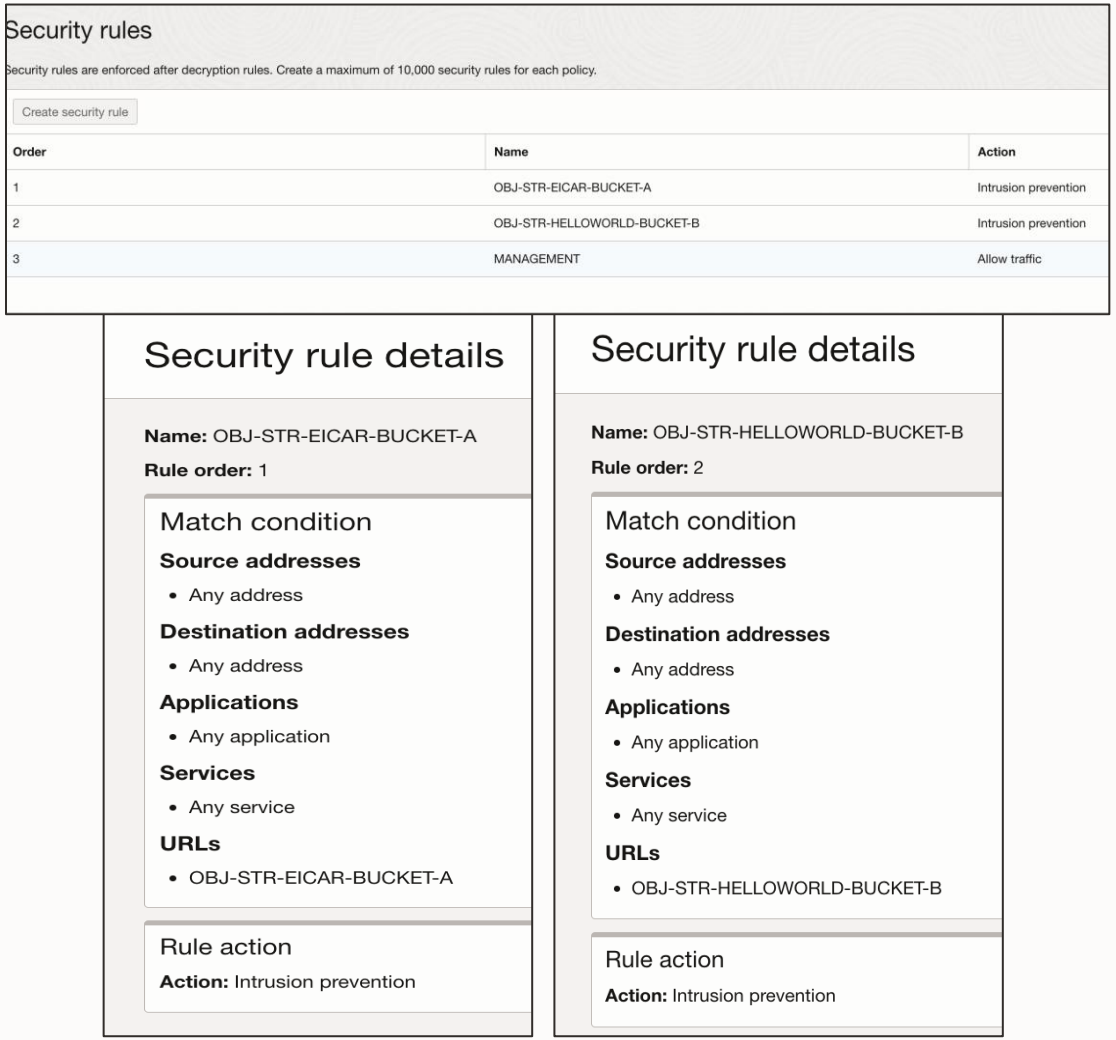
Advanced Threat Protection – URL Filtering





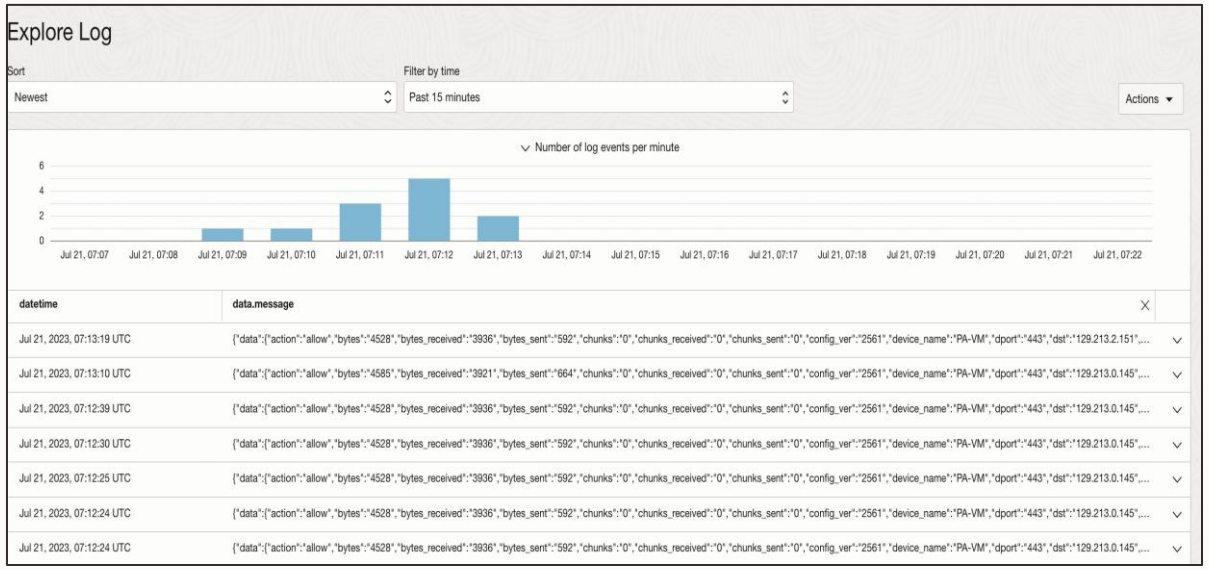
- Block traffic to a user-defined list of URLs with support for wild cards.
- Flexible enforcement for both inbound and outbound traffic.

Intrusion Detection and Prevention



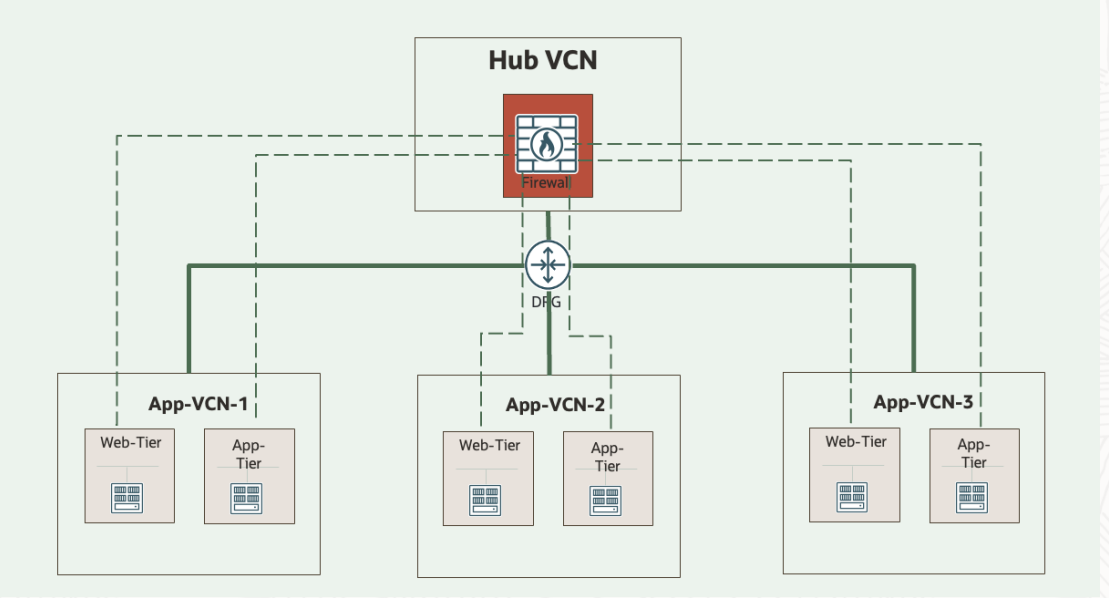
- Detect and block known exploits, malware, malicious URLs, spyware, command and control (C2) attacks.
- Palo Alto Networks security research team uses Advanced Threat Prevention powered by AI to equip the firewall with latest threat intelligence.
- Supports threat detection and prevention on encrypted traffic.

Logging and Observability



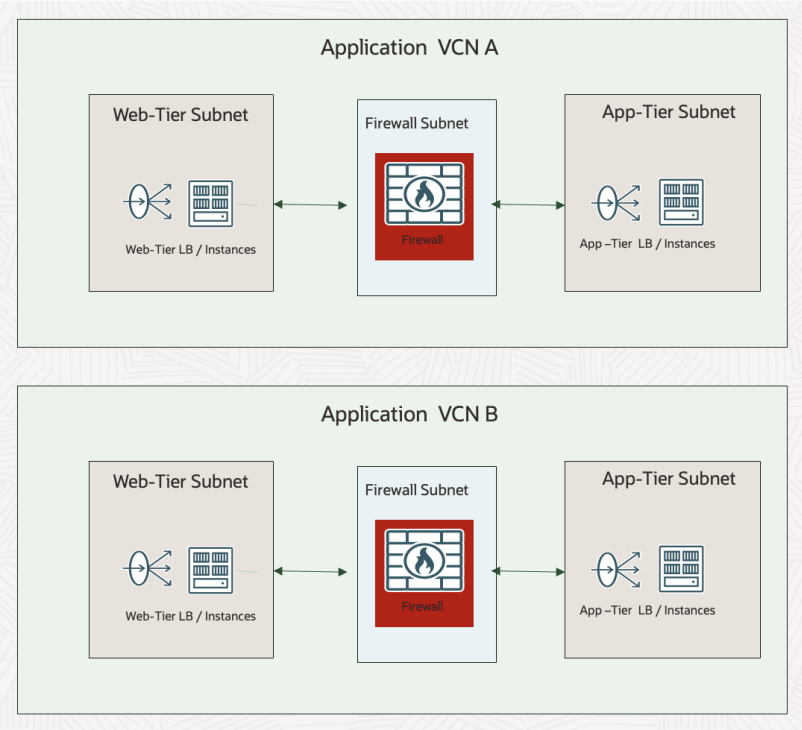
- Network Firewall metrics help monitor the health, capacity, and performance of firewall policies and resources. Alarms and Notifications can be configured to notify you when metrics meet alarm-specified triggers.
- Network Firewall logs (integrated with OCI logging) enable you to understand what rules and the countermeasures triggered by requests.

Flexible Deployment Topologies



Centralized Deployment

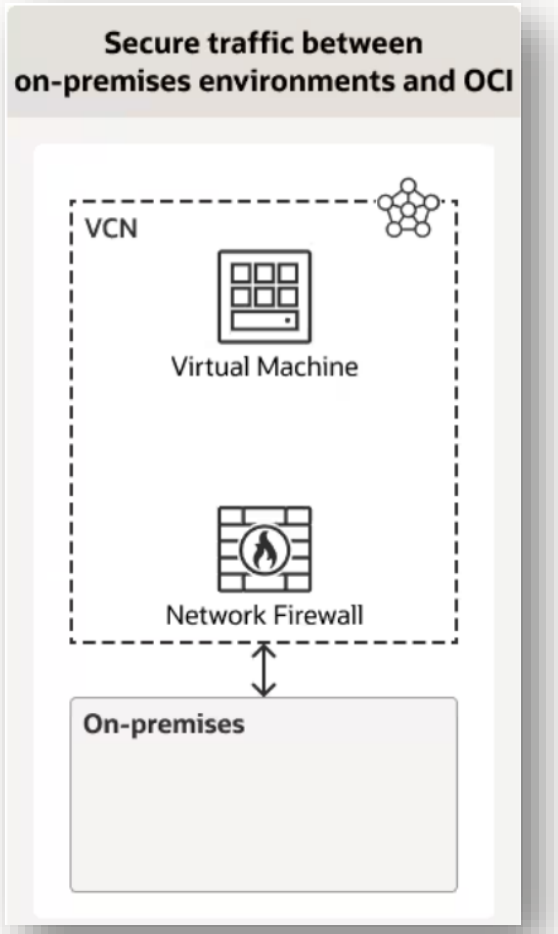
- Network Firewall is deployed in a Hub VCN and connected to spoke VCNs through DRG.

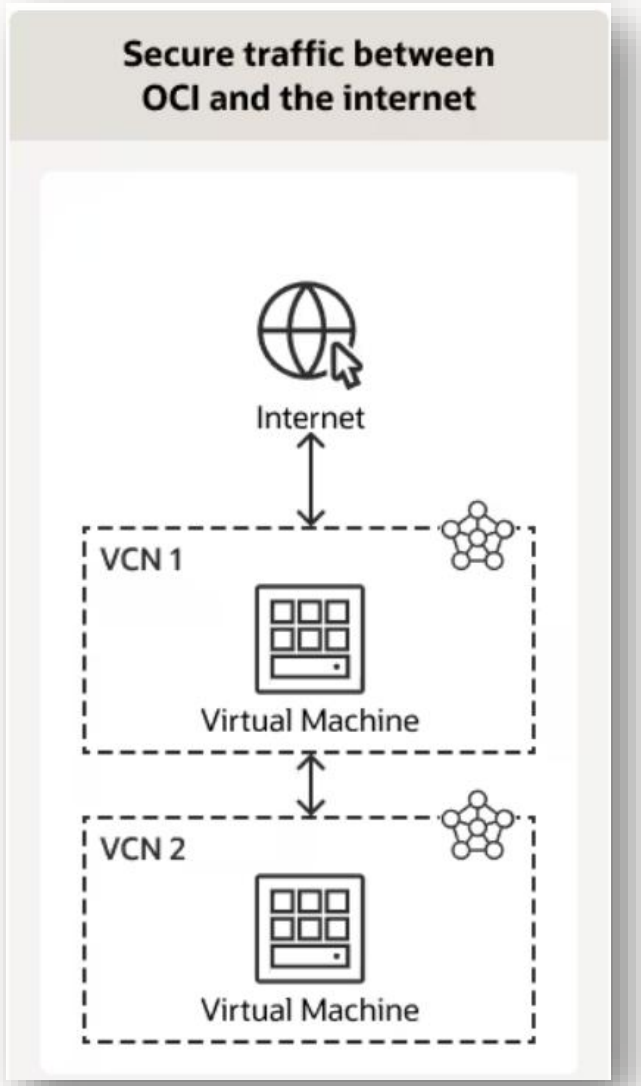


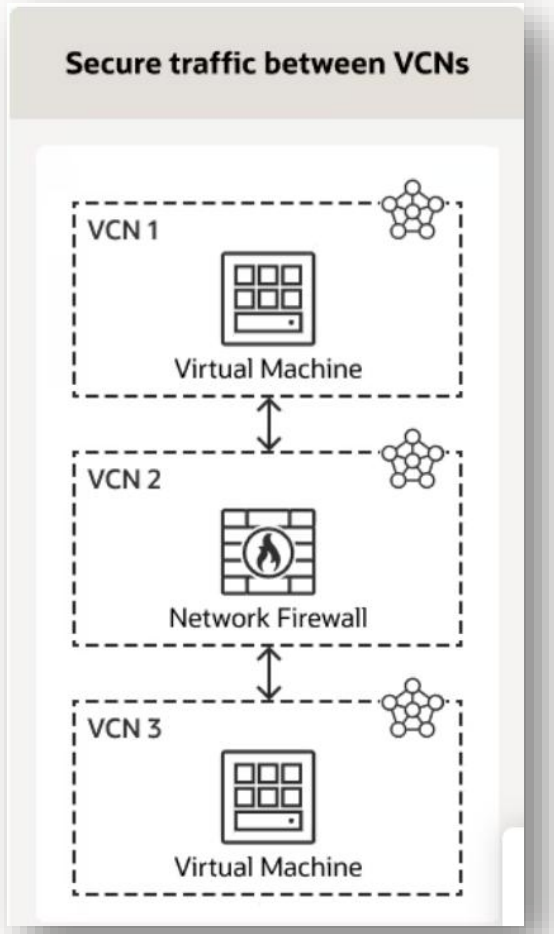
Distributed Deployment

- A dedicated Network Firewall deployed in each VCN.

Use cases for OCI Network Firewall







Domain Name System (DNS)

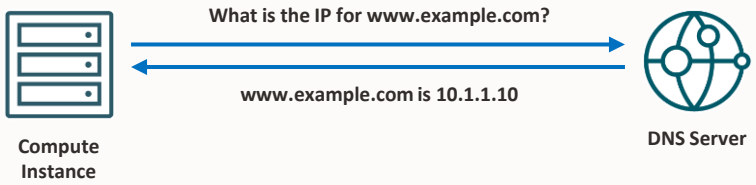
DNS:

"Domain Name System"

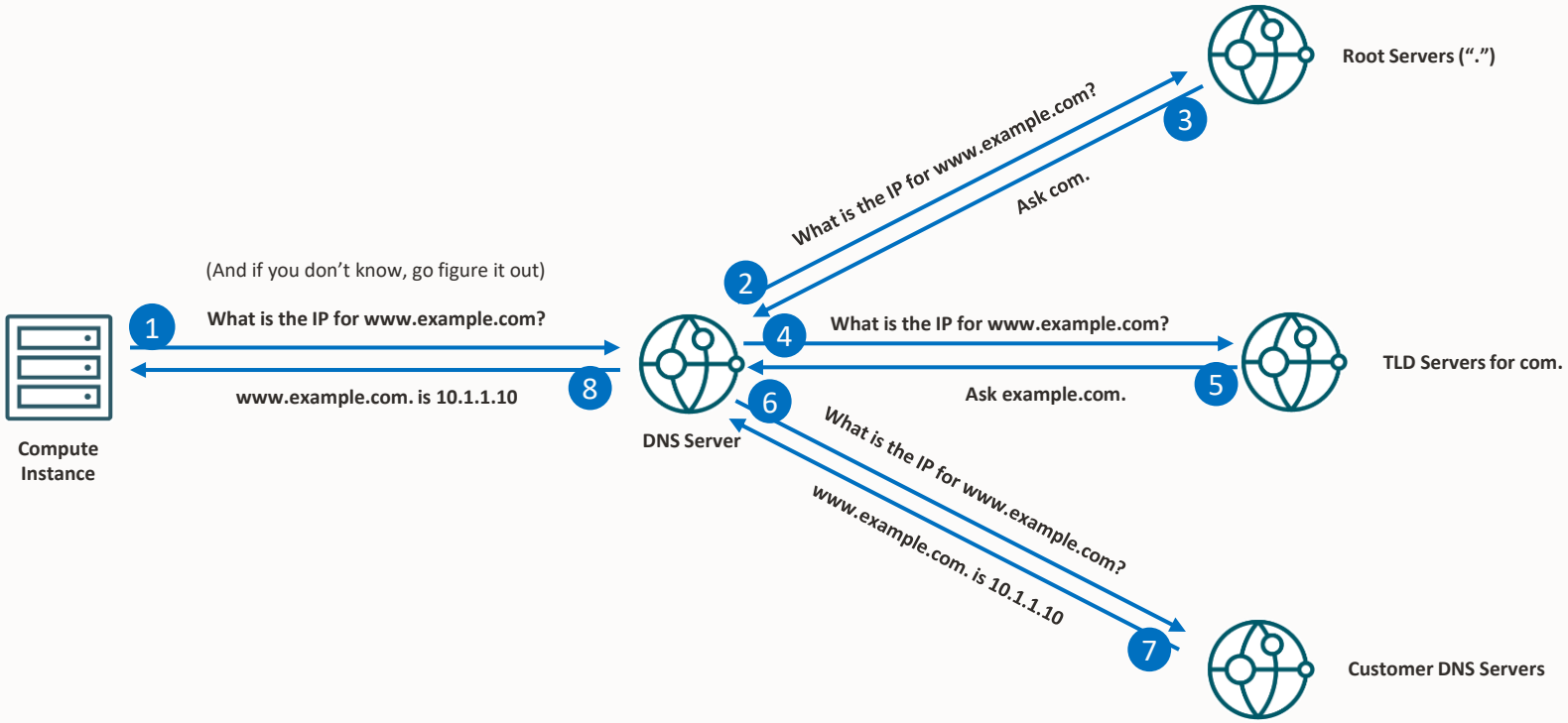
The hierarchical and decentralized naming system used to identify computers, services, and other resources reachable through the Internet or other Internet Protocol (IP) networks.

The resource records contained in the DNS associate domain names with other forms of information. These are most commonly used to map human-friendly domain names to the numerical IP addresses.

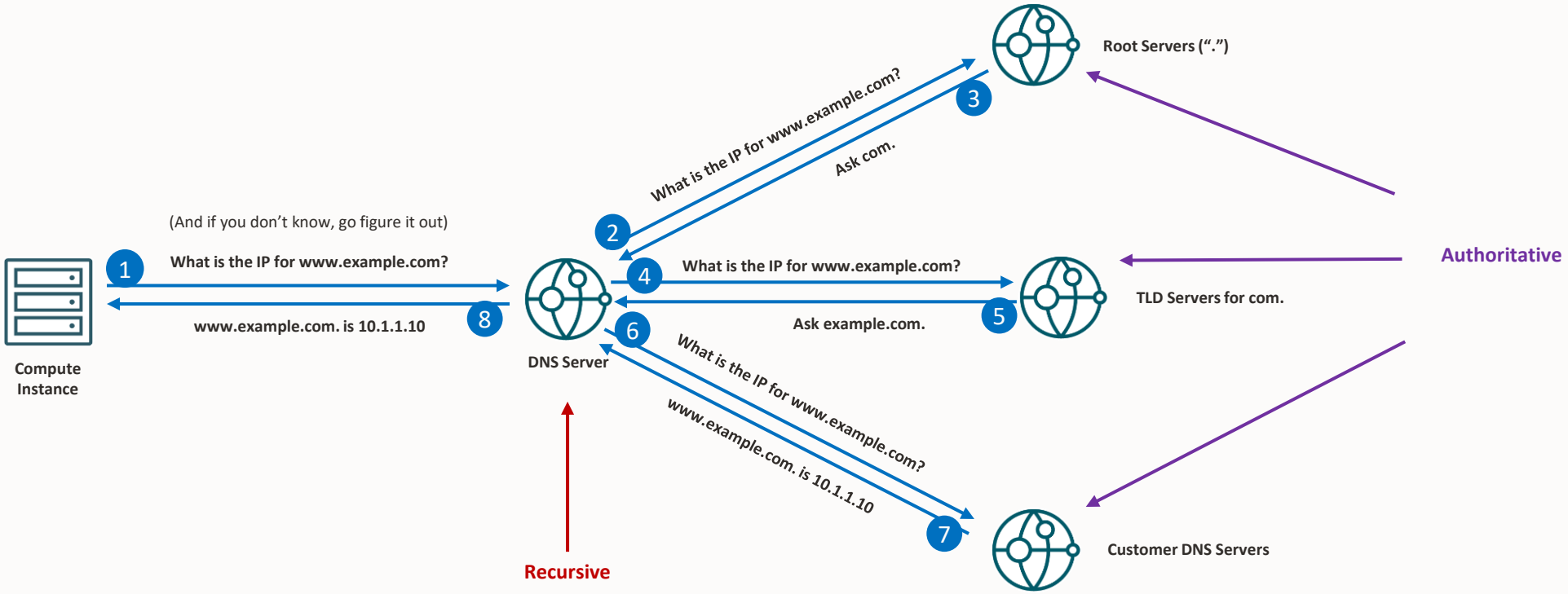
DNS Introduction



DNS Introduction



DNS Introduction

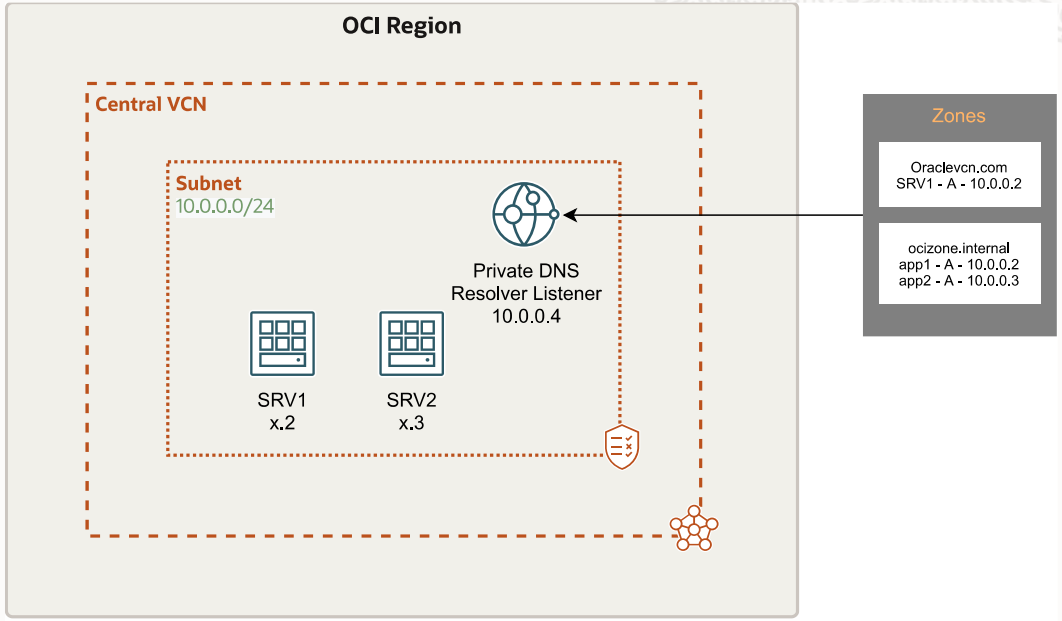


DNS Introduction – Common Resource Record Types

- **A** – An address record.
- **AAAA** – An IPv6 address record.
- **ALIAS** – Non-standard, used to redirect requests.
- **CNAME** – Canonical Name, refers client to use to another name.
- **MX** – Mail Exchanger, the mail servers for a domain.
- **NS** – Name servers, the name servers for domain or subdomain.
- **PTR** – Pointer, enables (reverse) resolution of IP addresses to names.
- **SOA** – Start of Authority, contains primary name server, responsible contacts, serial number.
- **TXT** – Contains text information, various uses including domain validation.

OCI Public & Private DNS

- **Public DNS Zones** hold the trusted DNS records that will reside on Oracle Cloud Infrastructure's nameservers. You can create public zones with publicly available domain names – reachable on internet (need to register with a DNS registrar).
- **Private DNS zones** contain domain names that resolve DNS queries for private IP addresses within a VCN.
- You can create private zones to define your own domain name for private address resolution.
- Can also combine VCNs for private DNS resolution over several VCNs.

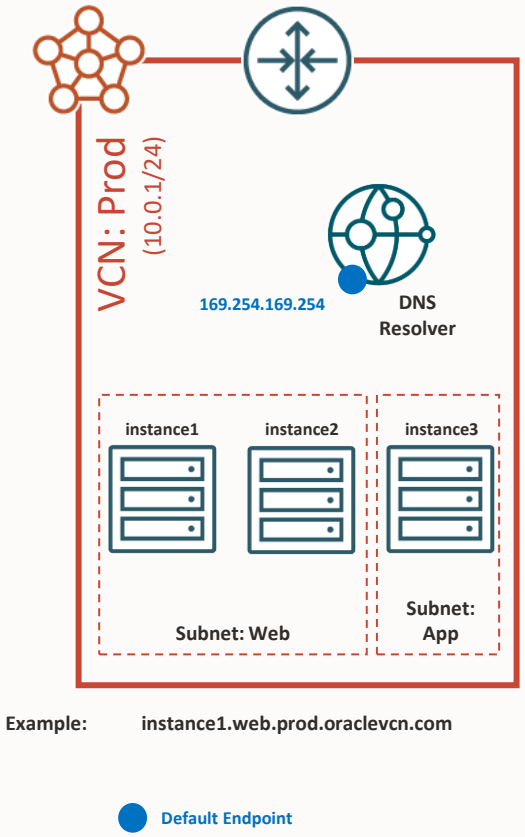


Private DNS for name resolution within OCI

Domain Name System (DNS)

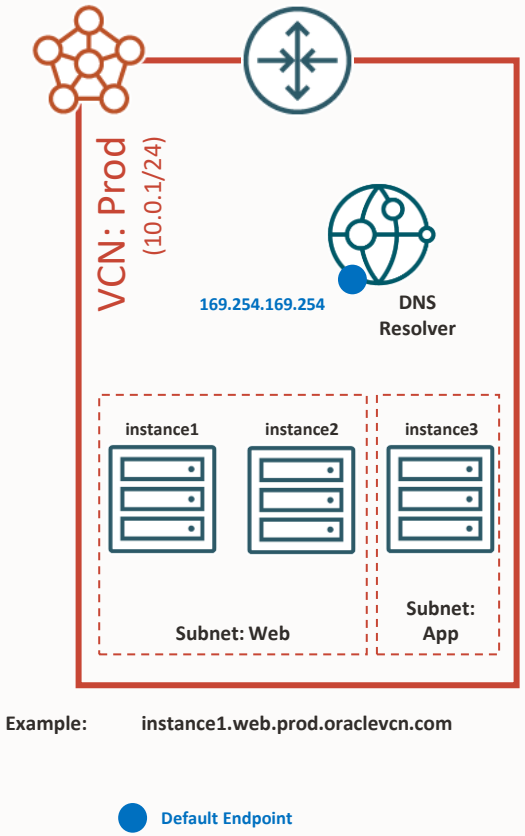
1. Private DNS

Virtual Cloud Network DNS



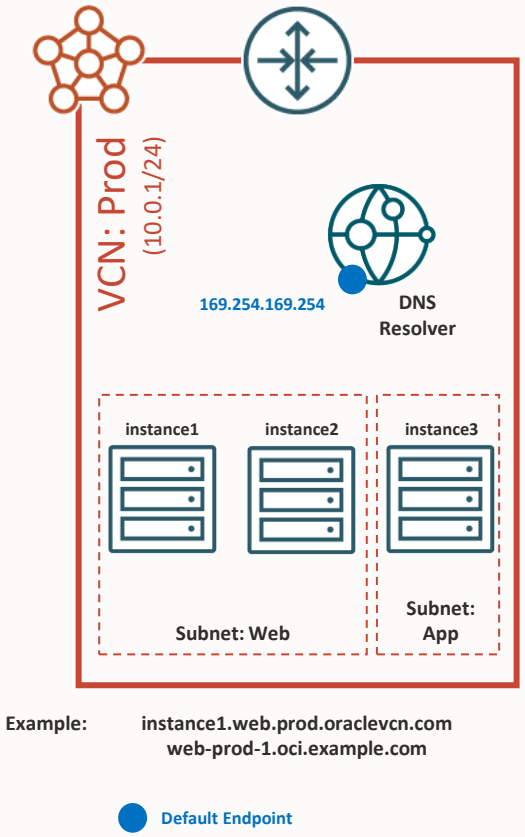
- Each VCN has one DNS Resolver.
  - *It is possible to create VCNs with DNS disabled.*
- Available at 169.254.169.254
- Resolves oraclevcn.com names **within** a VCN.
- Resolves DNS names **on the Internet.**

Private DNS



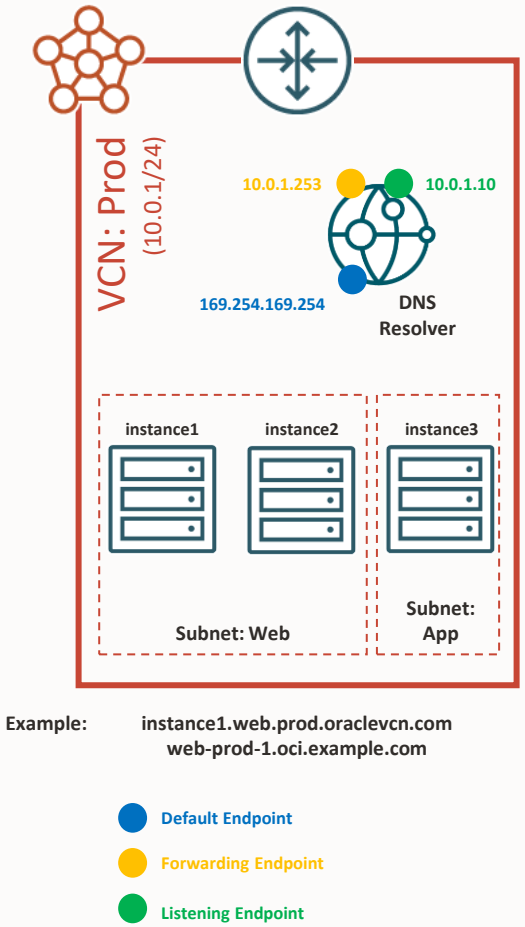
- Continuation of VCN DNS capabilities.
- Available at 169.254.169.254
- By default:
  - Resolves oraclevcn.com names within a VCN.
  - Resolves DNS names on the Internet.
- Adds support for:
  - Private Zones and Views.
  - Endpoints.
  - Rules.

Private DNS – Private Views



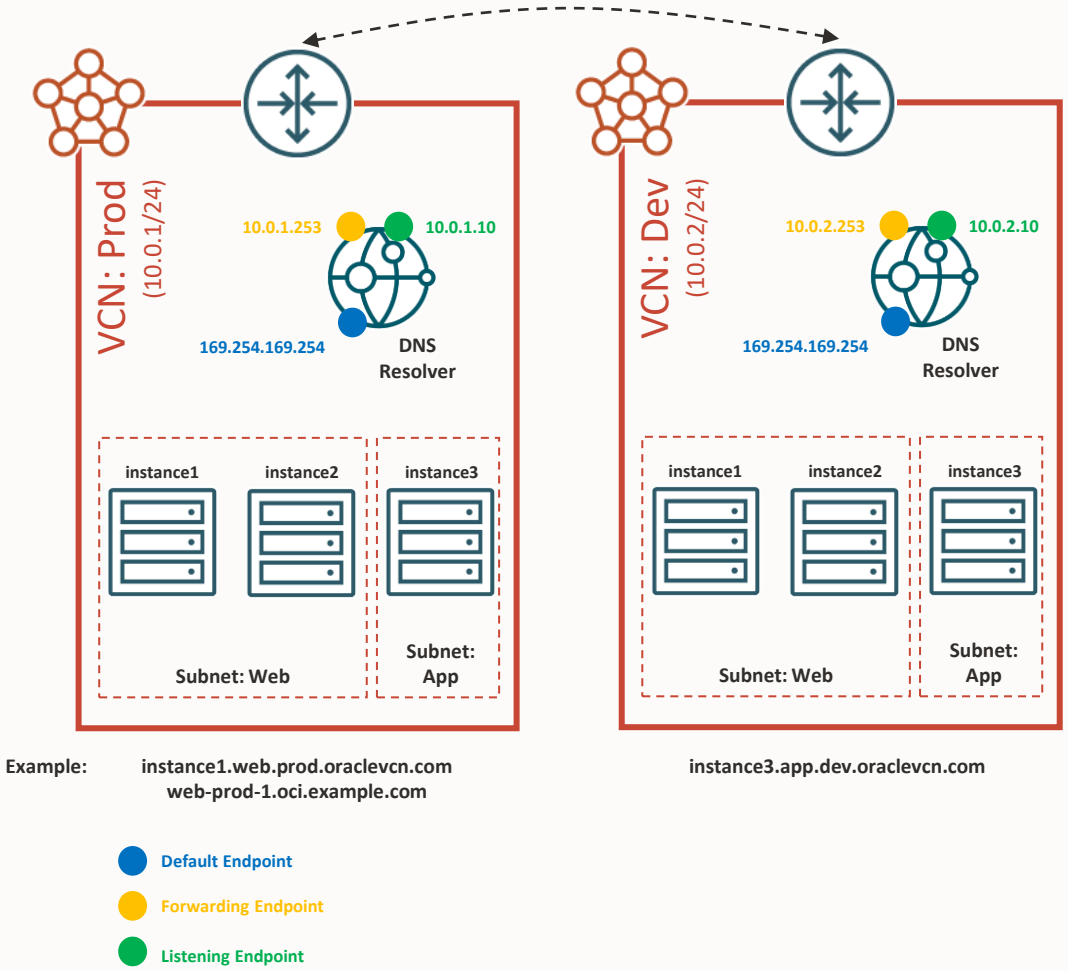
- Allows hosting of custom DNS zones.
- Create custom DNS records in custom zone.
  - Automatically-created DNS records still land in protected DNS zone for subnet in oraclevcn.com.
  - Not possible to assign custom zone to subnet.
- Custom zones can be shared by multiple VCNs.
  - In the same region.
- Private DNS hosts all data for zone.
  - Cannot delegate sub-zones.
  - Cannot be secondary to zone hosted by non-Private DNS server.
  - Cannot have non-Private DNS secondary server.

Private DNS – Endpoints



- Endpoints attach Private DNS resolvers to a subnet in a VCN.
- **Listening Endpoints** receive requests from clients and remote DNS servers.
- **Forwarding Endpoints** are used to send requests to remote DNS servers.
- There must be connectivity between the endpoint and relevant clients or servers.
  - Use DRGs for cross-VCN connectivity.
  - Be mindful of overlapping VCN CIDR ranges.
  - Traffic must be permitted by security lists.

Private DNS – Rules



- Directs requests to a remote DNS resolver.
  - Only used if resolver is not authoritative.
  - Remote DNS server could be **in another VCN or on-prem.**
- Up to 10 rules direct DNS zone to remote Servers.

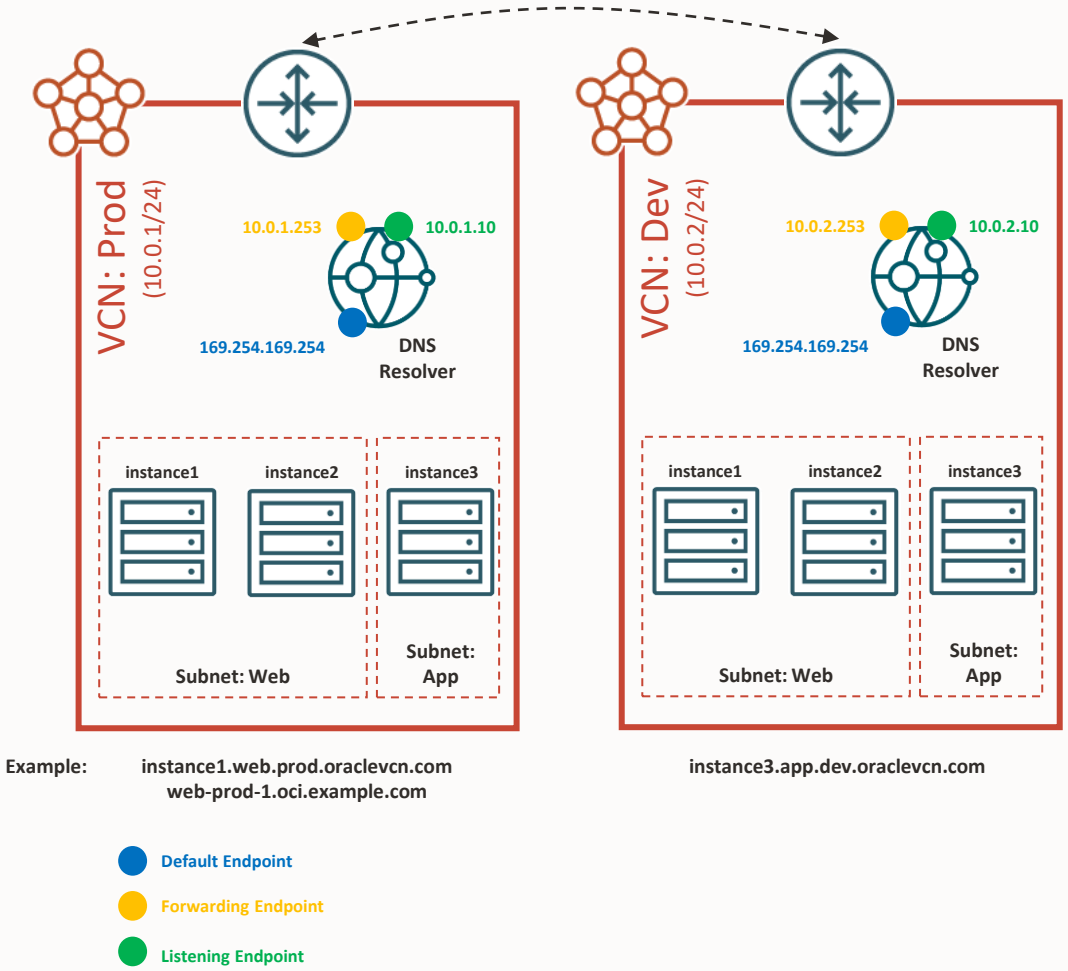
Rules in Prod VCN

Domains	Source (Forwarding Endpoint)	Destination (Listening Endpoint)
dev.oraclevcn.com	10.0.1.253	10.0.2.10

Rules in Dev VCN

Domains	Source (Forwarding Endpoint)	Destination (Listening Endpoint)
prod.oraclevcn.com, oci.example.com	10.0.2.253	10.0.1.10

Private DNS – Demo



1. Create oci.example.com Private View in Prod VCN.
2. Create web-prod-1.oci.example.com DNS record.
3. Create following DNS rules.

Rules in Prod VCN

Domains	Source (Forwarding Endpoint)	Destination (Listening Endpoint)
dev.oraclevcn.com	10.0.1.253	10.0.2.10

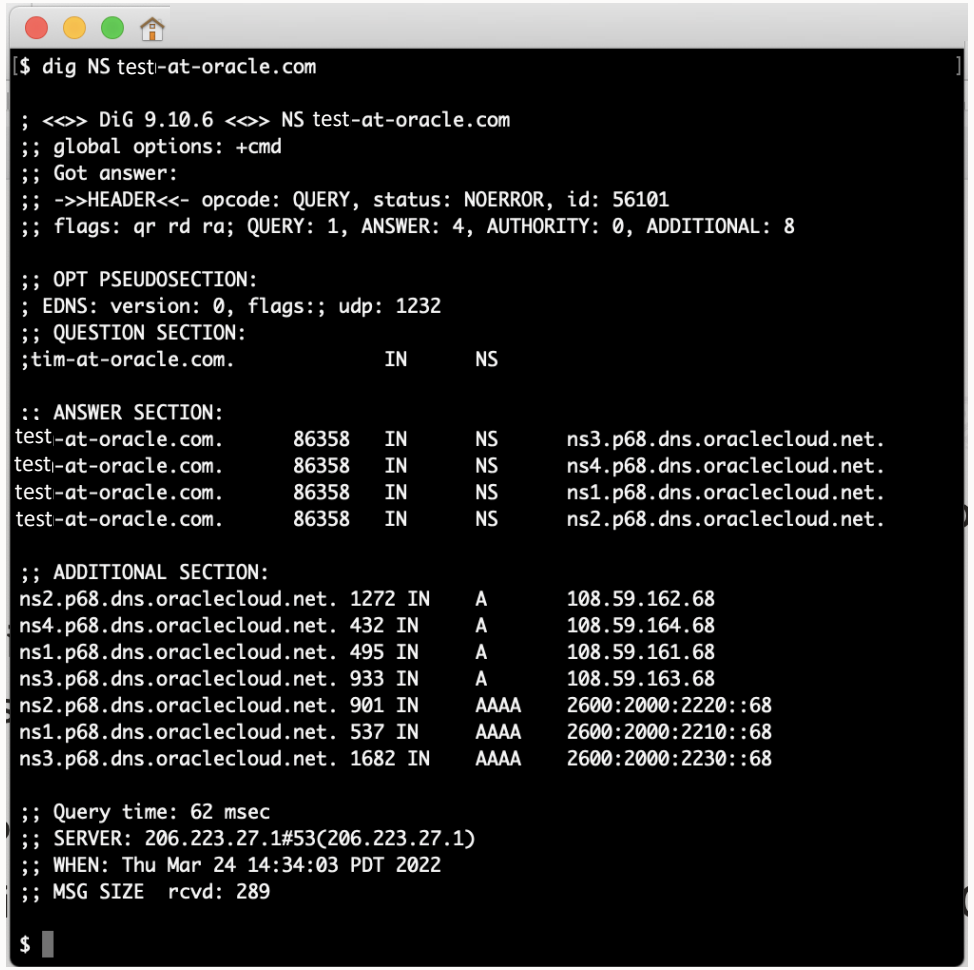
Rules in Dev VCN

Domains	Source (Forwarding Endpoint)	Destination (Listening Endpoint)
prod.oraclevcn.com, oci.example.com	10.0.2.253	10.0.1.10

Domain Name System (DNS)

2. Public DNS

Public DNS



```
[$ dig NS test-at-oracle.com

; <<>> DiG 9.10.6 <<>> NS test-at-oracle.com
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 56101
;; flags: qr rd ra; QUERY: 1, ANSWER: 4, AUTHORITY: 0, ADDITIONAL: 8

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 1232
;; QUESTION SECTION:
;tim-at-oracle.com.             IN      NS

:: ANSWER SECTION:
test-at-oracle.com.      86358   IN      NS      ns3.p68.dns.oraclecloud.net.
test-at-oracle.com.      86358   IN      NS      ns4.p68.dns.oraclecloud.net.
test-at-oracle.com.      86358   IN      NS      ns1.p68.dns.oraclecloud.net.
test-at-oracle.com.      86358   IN      NS      ns2.p68.dns.oraclecloud.net.

;; ADDITIONAL SECTION:
ns2.p68.dns.oraclecloud.net. 1272 IN    A       108.59.162.68
ns4.p68.dns.oraclecloud.net. 432 IN     A       108.59.164.68
ns1.p68.dns.oraclecloud.net. 495 IN     A       108.59.161.68
ns3.p68.dns.oraclecloud.net. 933 IN     A       108.59.163.68
ns2.p68.dns.oraclecloud.net. 901 IN     AAAA    2600:2000:2220::68
ns1.p68.dns.oraclecloud.net. 537 IN     AAAA    2600:2000:2210::68
ns3.p68.dns.oraclecloud.net. 1682 IN    AAAA    2600:2000:2230::68

;; Query time: 62 msec
;; SERVER: 206.223.27.1#53(206.223.27.1)
;; WHEN: Thu Mar 24 14:34:03 PDT 2022
;; MSG SIZE  rcvd: 289

$
```

- Provides **Authoritative DNS** service functionality for public DNS zones.
- Served via anycast from OCI's global commercial regions.
- Supports import in standard BIND zone data format.
- OCI for Primary + Secondary DNS.
  - Hosting a customer's public DNS domains entirely in OCI.
- OCI for Secondary DNS
  - Provides fault tolerance for a customer's public DNS zones hosted on-prem or with other providers.

Public DNS – DNS Traffic Management Steering Policies

- Provides intelligence DNS responses based on user-configured policies
  - **Failover:** Integrates with the OCI Health Checks service to direct clients towards a primary resource while healthy and then failing over to backup resources.
  - **Load Balancing:** Distributes load equally or using user-defined weighting across multiple resources. Uses OCI Health Checks to detect and remove failed resources from service.
  - **Geolocation Steering:** Directs users based on the user's source geography. For example, direct users in Europe to eu.customer.com.
  - **ASN Steering:** Directs users based on the user's source BGP ASN.
  - **IP Prefix Steering:** Directs users based on the user's source IP address.

IP Management

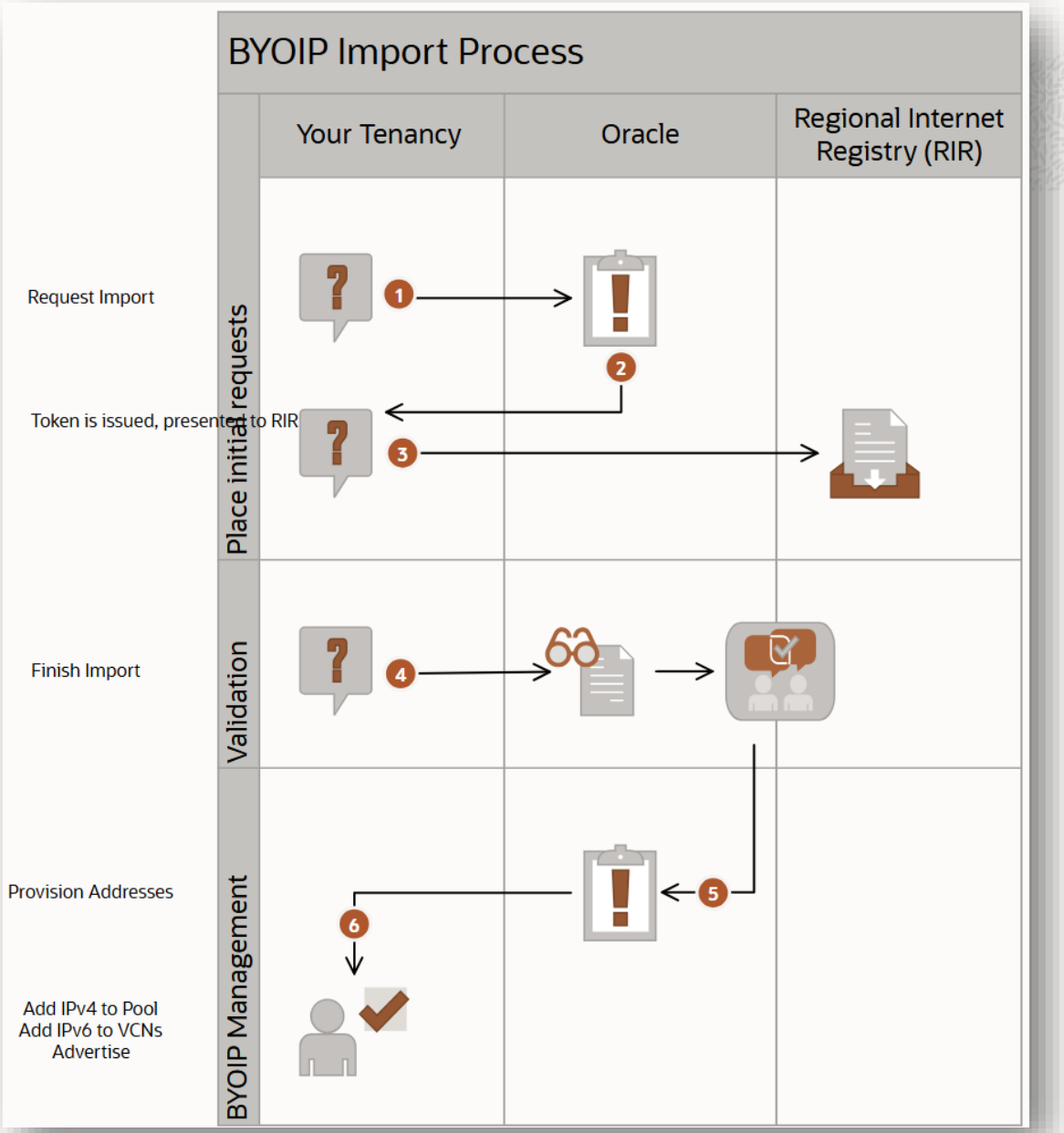
Bring Your Own IP (BYOIP)

Let you manage your IPv4 CIDR blocks and IPv6 prefixes to align with your existing security, management, and deployment policies and achieve:

- **Solution continuity and hardcoded dependencies:** Your VCN is an extension of your public Internet presence, without needing to reinvent policies and management processes. If you have IP addresses hard-coded in devices or built architectural dependencies on specific IP addresses, using BYOIP you have a smooth migration to Oracle Cloud Infrastructure.

- **IP pool management:** Some network administrators require the ability to summarize groups of IPv4 addresses into pools and to create resources for deployment such as load balancers, firewalls, or web servers. IP Pool management provides tools to manage reserved public IPv4 addresses. IPv6 does not use IP Pool management.
- **IP reputation:** Some internet services rely on a contiguous IP address space (such as a full span of IP addresses from 1 through 255) and act as a trusted contact point between services such as major email service providers and mail delivery systems.

Bring Your Own IP (BYOIP)



Bring Your Own ASN (BYOASN)

- Autonomous System Number (ASN) is a unique number assigned to a network over the internet enabling different networks to exchange routing information with each other using the Border Gateway Protocol (BGP). ASN is also used for security policies to identify network traffic source, enabling you to filter traffic based on the originating network.

- Bring your own ASN to Oracle Cloud Infrastructure and use your existing ASN within the OCI environment.

- Currently supported for ARIN, RIPE and APNIC Regional Internet Registries (RIR) and is available across all OCI commercial regions.

BYOASN Key Capabilities

- No limit on the number of ASNs you can import into OCI.
- Import same ASN across multiple regions.
- You can prepend the ASN up to 20 times to influence the route preference, which can be used when setting up an active-standby or disaster recovery site.
- Support for both 2-byte and 4-byte ASN.
- Support for Console UI, CLI, API and Terraform.

Reserved Public IPs

What Are Reserved Public IPs ?

- **Ephemeral:** This is temporary public IP address that is assigned to resources for the lifetime of the resource. For example, once a VM instance with an ephemeral IP address is destroyed, the ephemeral public IP address is returned to the OCI IP pool for re-use by another device.

- **Reserved:** A persistent public IP address can be assigned, unassigned, and re-assigned to resources. For example, you can unassign the reserved public IP address and then reassign it to another instance whenever you want to.

Reserved Private IPs

What Are Reserved Private IPs ?

- Static IPv4/IPv6 addresses you can take out of the dynamic pool inside a subnet.
- Remain assigned across reboots; can be re-attached to any VNIC in the same subnet.
- Avoids IP churn and simplifies DNS / firewall rules.

Reserved Private IPs – Key Use Cases

- 💡 **Failover / HA** – move the IP to a standby instance in seconds.
- 🔄 **Blue-Green Deployments** – swap IP between versions with zero DNS change.
- 🔁 **Maintain Consistent IPs Across Lifecycle** – Reuse reserved IPs across replacements or re-creations of instances.
- 📌 **Static IPs for Licensing or Compliance** – Some apps require fixed IPs for licensing, auditing, or compliance.
- 🧪 **Testing & DevOps Scenarios** – Use reserved IPs to test configurations before VM creation. Helpful in CI/CD pipelines, replicated environments, etc.
- 🔍 **Audit & Compliance** – Predictable IPs simplify security policies.

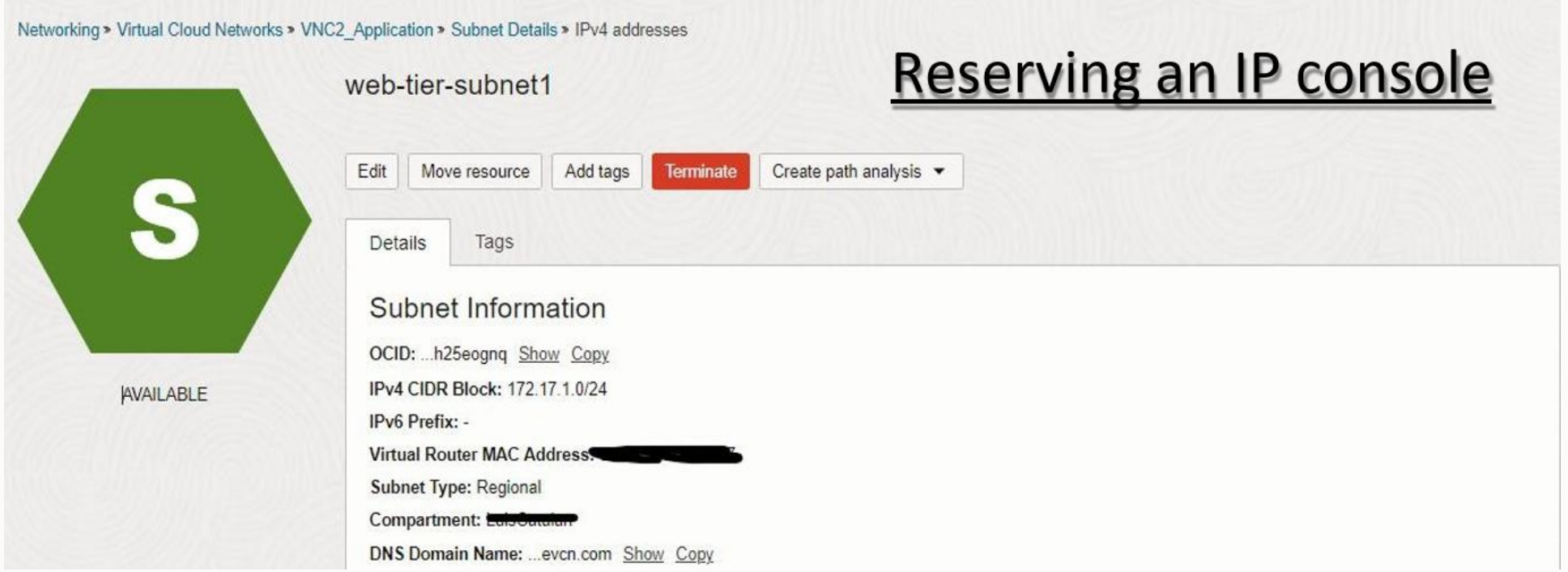
Reserved Private IPs – Feature Highlights

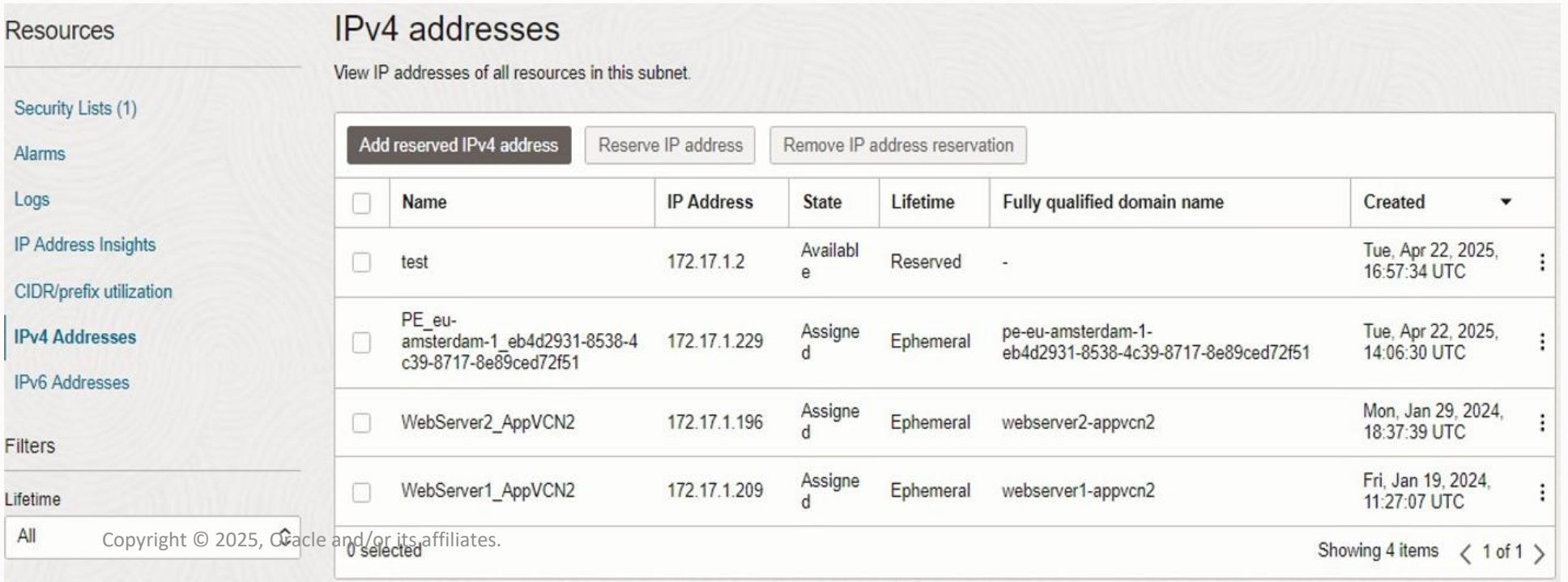
- Supports both IPv4 and IPv6 reserved addresses.
- Integrates with IP Address Insights for subnet-level visibility.
- Console, CLI, and Terraform support on day 1.

Reserving an IP

1. Navigate to Networking>Virtual Cloud Networks>VCN Name>Subnet Details>IPv4 addresses or IPv6 addresses.
2. Click **Add Reserved IP Address**, IPv4 or IPv6 and add a specific address.
3. Provide a name & description (and optionally hostname), then add reserved IPv4 or IPv6 address.
4. Attach the reserved IP to a VNIC in the same subnet.
5. You can reserve existing subnets private IPs to make sure is not going to be reused in the future by other resources.

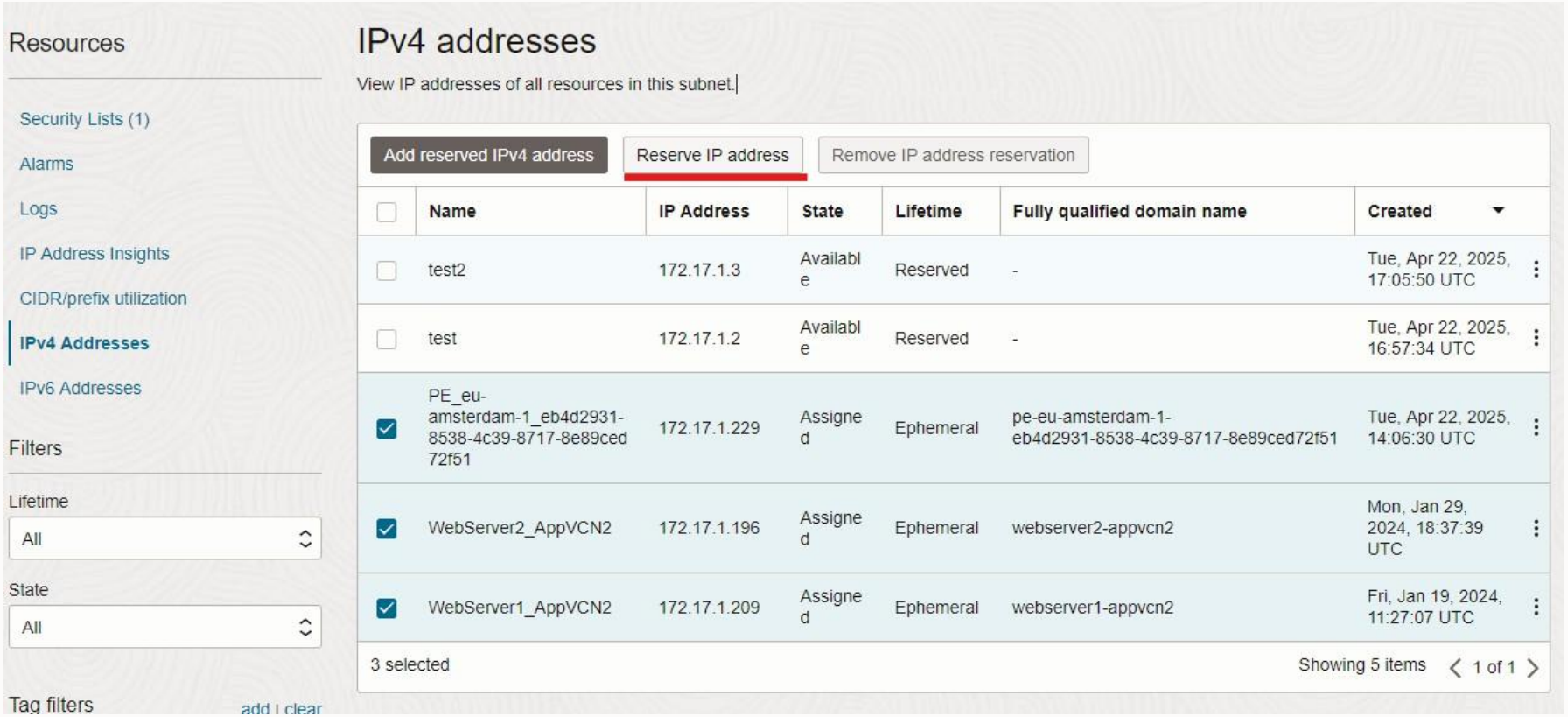
Reserving an IP console





Reserving Existing Ephemeral in Bulk

- To reserve all IP addresses in bulk, select the **Name** checkbox, and click **Reserve IP address**. You can also select several IP addresses individually.



Reserved Private IPs – Best Practices

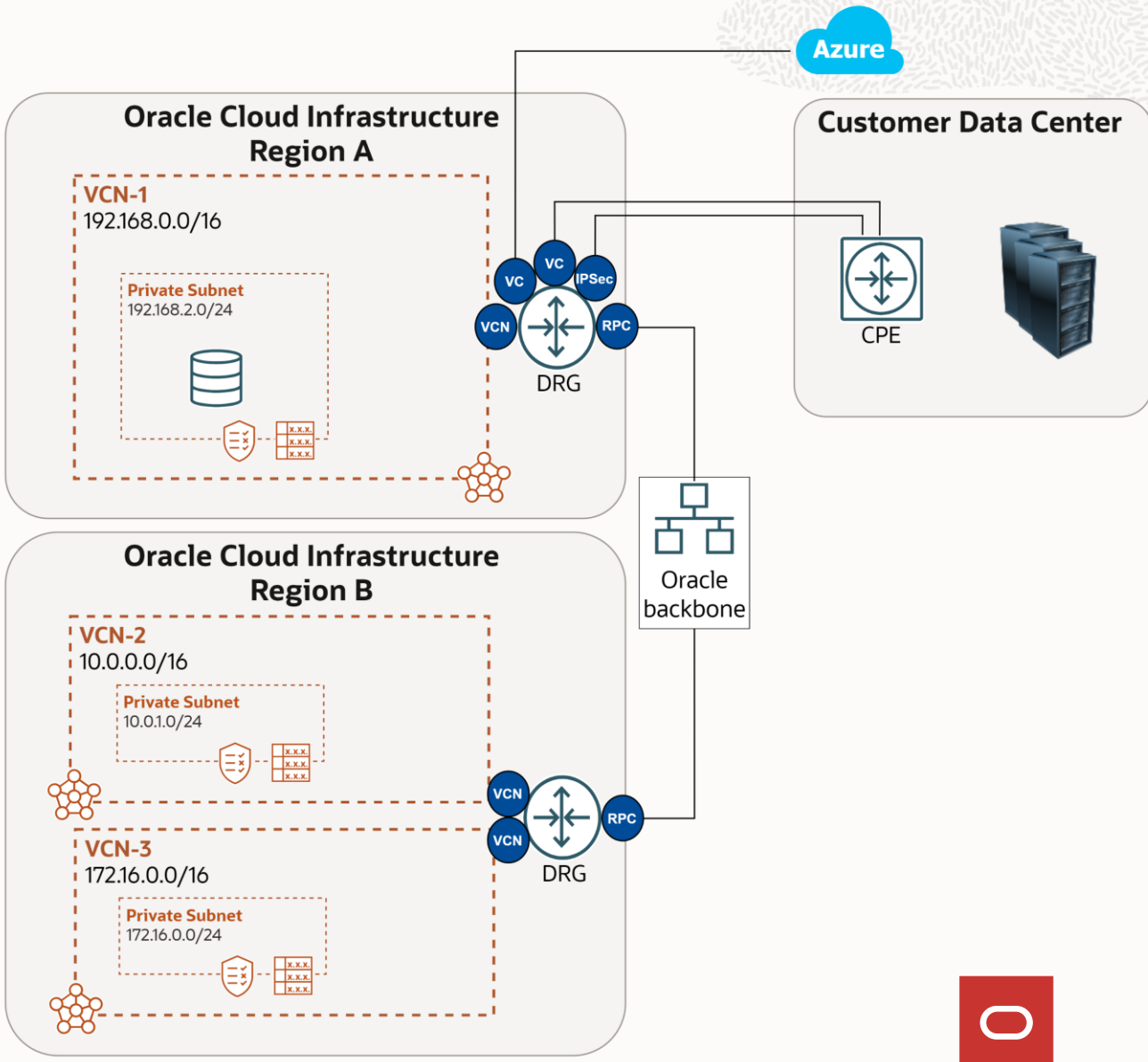
- 📌 Reserve IPs early in project design to avoid mid-stream renumbering.
- 🗑️ Periodically audit unused reserved IPs to free them for other teams.
- 🚫 Remember: reservations are **subnet-scoped**, not VCN-wide.
- 🔄 Moving an IP briefly interrupts traffic—plan maintenance windows.

WAN Connectivity (On-prem/OCI/Multicloud)

Dynamic Routing Gateway (DRG)

Dynamic Routing Gateway (DRG)

- A virtual router that provides a path for private traffic between your VCN and destinations other than the internet.
- DRG is a standalone object. You must attach it to a VCN. VCN and DRG have n:1 relationship.
- You can use it to establish a connection with your on-premises network via IPSec VPN or FastConnect (private, dedicated connectivity).
- After attaching a DRG, you must add a route for the DRG in the VCN's route table to enable traffic flow.

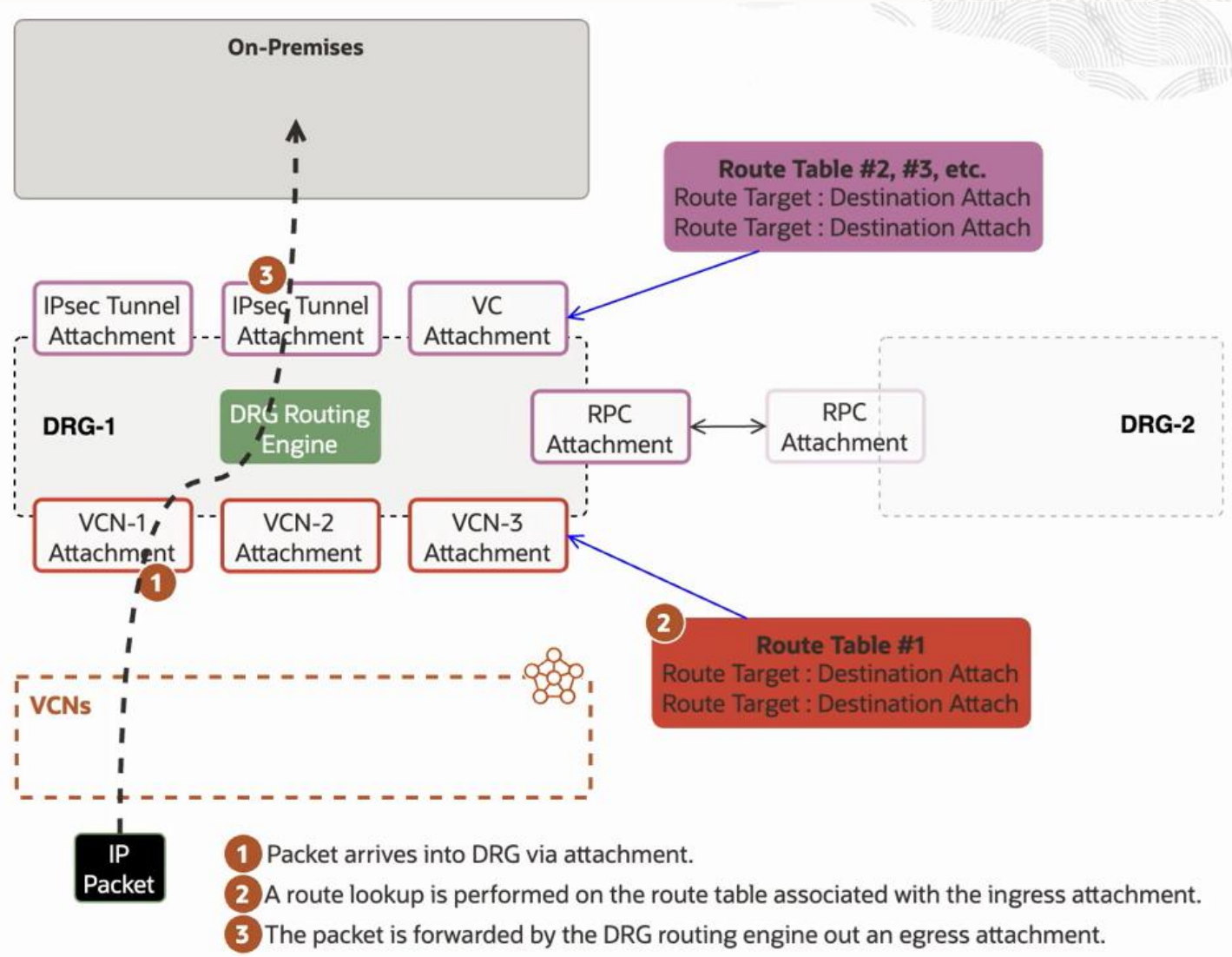


DRG Routing Engine

1) An attachment connects a DRG to another network resource:
   - *Virtual Cloud Network (VCN).*
   - *Remote Peering Connection (RPC).*
   - *FastConnect (Virtual Circuit).*
   - *IPSec VPN.*

   It enables traffic routing between OCI networks and external networks through the DRG.

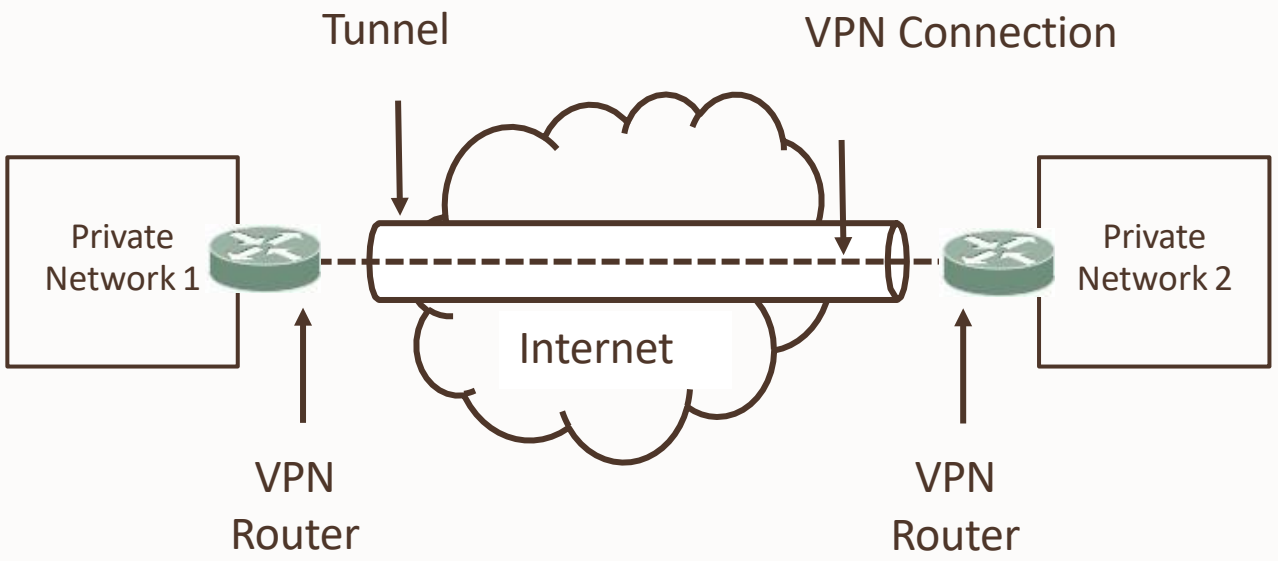
2) Each “Attachment” has a route table assigned, which directs ingress traffic to a specific egress attachment.



Site-to-Site VPN

VPN Basics

VPN (Virtual Private Network): using a public network to make end to end connection between two private networks in a secure fashion.



- **Tunnel:** A way to deliver packets securely through the internet to private RFC 1918 addresses.
- **Authentication:** Provides a mechanism to authenticate who you are.
- **Encryption:** Packets need to be encrypted, so they cannot be sniffed over the public internet.
- **Static routing:** Configure a router manually to send traffic to a particular destination in preconfigured directions.
- **Dynamic routing:** Use a routing protocol such as BGP to figure out what paths traffic should take.

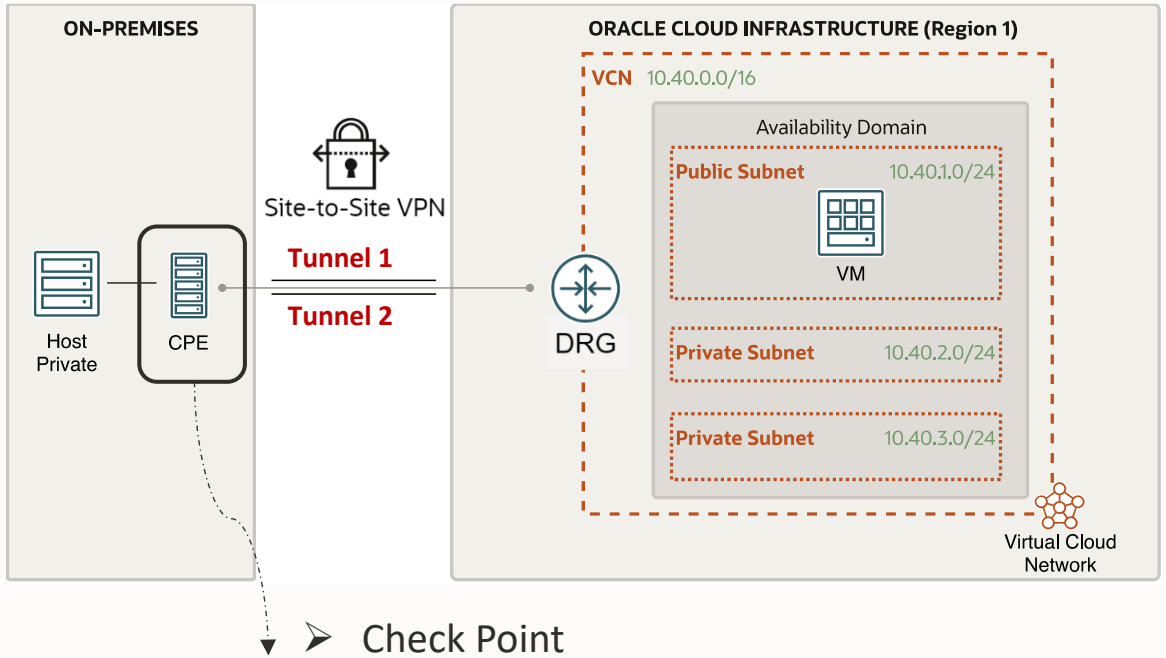
Site-to-Site VPN

- A managed OCI service that encrypts your data and tunnels it through the public internet for enhanced security and privacy with an IPSec VPN connection.
- Bandwidth depends on the customer’s access to the Internet and general Internet congestion (Typically less than 250 Mbps – but your mileage may vary).
- OCI provisions redundant VPN tunnels located on physically and logically isolate tunnel endpoints.
- Free service.

Site-to-Site VPN

Use Cases

- Customer Proof of Concepts usually start as a VPN and then morph into FastConnect designs.
- Connect your headquarters branch locations, and private datacenters to the Oracle Cloud so all of your offices can access applications.
- Securely connect your existing infrastructure to the cloud or connect multiple clouds.
- Use VPN as a backup connection for FastConnect.



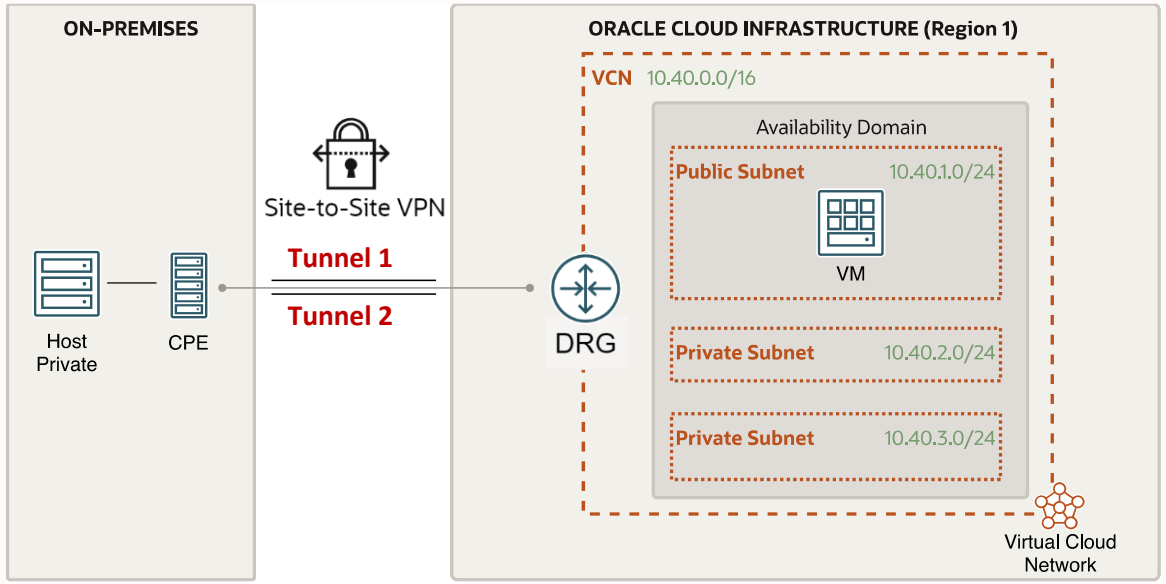
Verified CPE Devices

- Check Point
- Cisco
- FortiGate
- Palo Alto
- Libreswan
- Openswan
- Strongswan
- Juniper
- WatchGuard
- Yamaha
- Furukawa Electric
- NEC

Site-to-Site VPN

Workflow

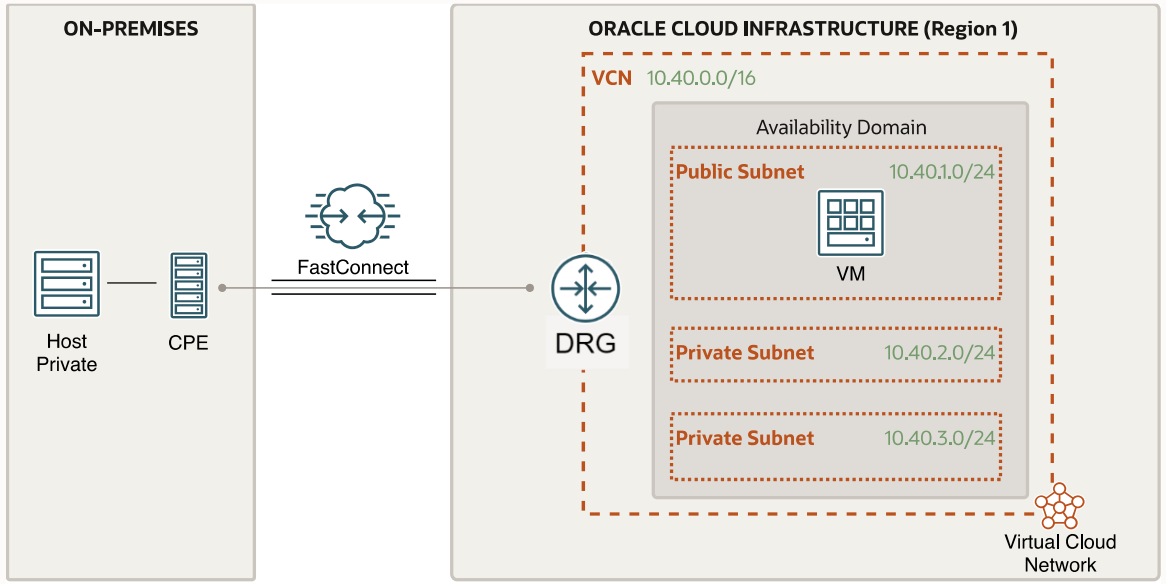
1. Create a Virtual Cloud Network (VCN).
2. Create a Dynamic Routing Gateway (DRG).
3. Attach DRG to your VCN.
4. Update VCN routing to send traffic to DRG.
5. Create a CPE Object and add on-premises router (firewall) Public IP address.
6. Create an IPsec Connection between CPE and DRG and provide a Static Route or use BGP routing.
7. Configure on-premises CPE Router. Make sure to configure the appropriate IPSec parameters on both ends.



FastConnect

FastConnect

- Dedicated, private, secure network connectivity from customer locations to OCI via integrated Network Partners.
- Port speeds of 1Gbps, 10Gbps, 100Gbps, or 400Gbps are available.
- Recommended to use 2x for redundancy.
- Use BGP protocol.
- No charges for inbound/outbound data transfer. FastConnect only charges a per-hour port fee based on the port speed.



FastConnect

Use Cases

- Latency-sensitive enterprise applications.
  - Ensures consistent network performance and low latency.
- Big data and high-performance computing.
  - When transferring large amounts of data, FastConnect provides the throughput and consistency required for data-intensive jobs.
- Sensitive data that cannot traverse the internet.
  - FastConnect isolates sensitive data traffic and improves security and privacy because data traffic flows strictly over trusted endpoints.
- Lift and shift to the cloud.
  - Migration involves large data transfers and short-time windows. FastConnect provides high performance and dedicated network connectivity.

FastConnect Models

1) Oracle FastConnect Partner Network

- Direct connection between the customer and Oracle through a pre-established FastConnect partner.
- The most flexible and typically least expensive to set up.

Partners like:

- AT&T Business
- BT
- Digital Realty
- EdgeConnex
- Equinix
- InterCloud
- Interxion
- Megaport
- NextDC
- NTT Communications
- Orange Business Services
- TATA Communications
- Verizon

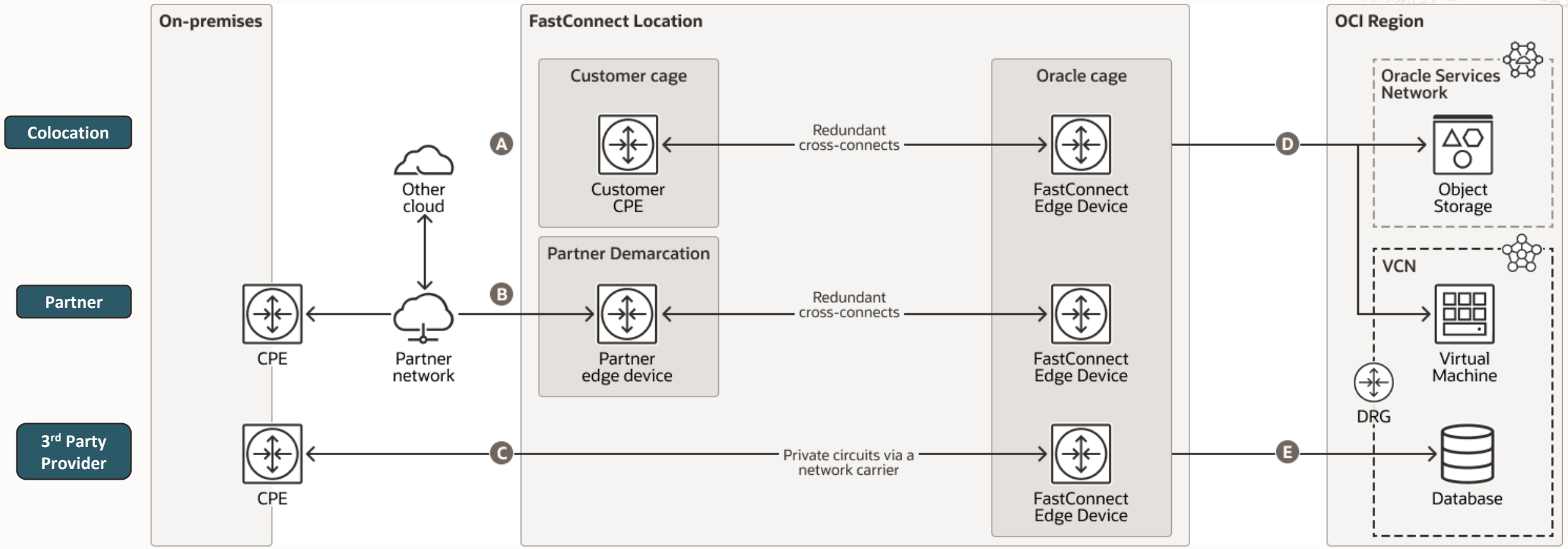
2) Direct Cross-Connect (Colocation)

- Direct connection between the customer and Oracle when both are in the same FastConnect facility.
- Good model if the customer and Oracle are already collocated.

3) Direct Cross-Connect (Third-Party Provider)

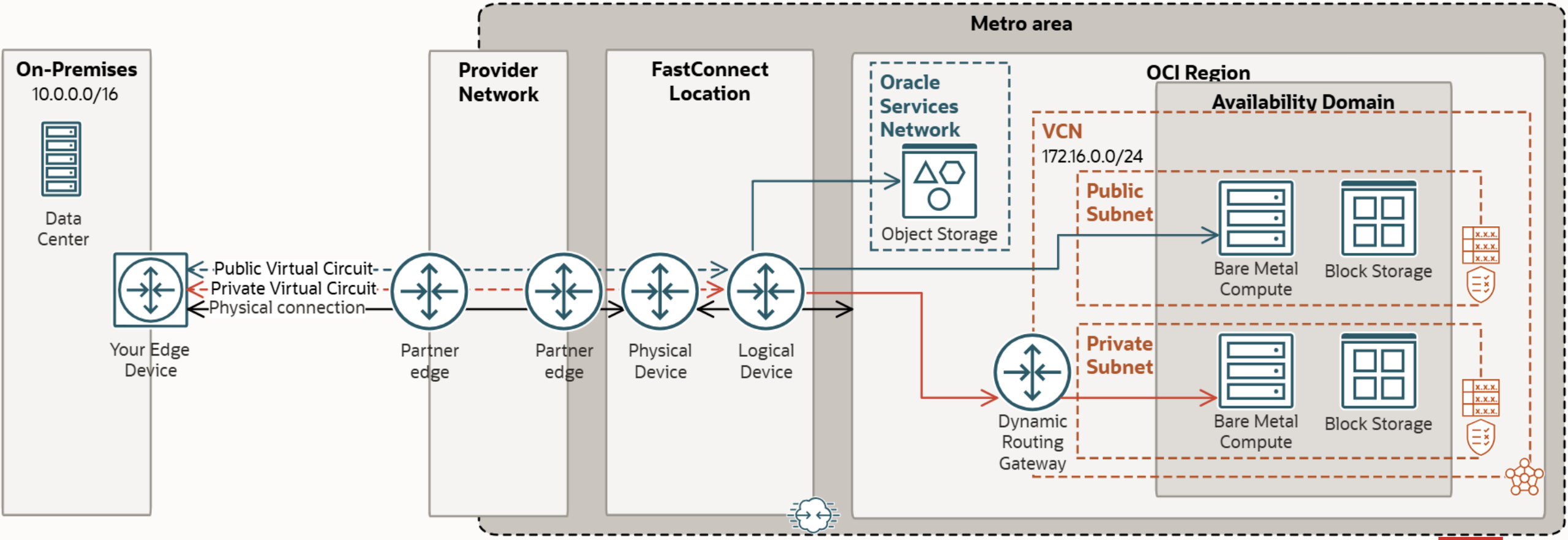
- Connection between the customer's network provider and Oracle using a dedicated circuit.
- Least flexible and typically most expensive to set up.

FastConnect Models



FastConnect Peering Types

- **Private Peering (Infrastructure Extension):** When a dedicated connection between on-premise and OCI VCN is needed. Traffic does not go over public internet.
- **Public Peering (Internet Alternative):** If customer requires only direct access to Oracle Service Network from on-premise.



Private Peering Network Design

- **Routing Protocol**
  - OCI currently supporting BGP (Border Gateway protocol) as a routing protocol for FastConnect connectivity to connect to partners as well as customers.
  - BGP is standardized exterior gateway protocols designed to exchange routing and reachability information between ASNs.
  - BGP is open standard protocol supported by all hardware vendor.

- **BGP IP address assignment**
  - Customer/L3 Provider can use any /30 or /31 IP address that they want to use.
  - This IP address is used for point-to-point addressing as well as BGP peer addresses.

Private Peering Network Design

- **BGP ASN**
  - Similar to public and private addresses there are private (64512- 65535) & public ASN allocation.
  - 2-byte or 4-byte ASNs are supported.
  - Oracle's BGP ASN for the commercial cloud is 31898.
  - Customer can use any ASN that they comfortable using.

- **LAG Support (Cross-Connect Groups)**
  - You can aggregate multiple physical links into a single logical channel based on IEEE 802.3ad also known as LACP (Link Aggregation Control Protocol).
  - LAG provides link level redundancy and OCI always recommend partners and customer to build LAG even with a single physical member so when we have to scale up there is no downtime.

Private Peering Network Design

- **BGP Authentication**
  - OCI supports BGP authentication mechanisms like Message Digest5 (MD5) algorithms. When authentication in enable any TCP segment belonging to BGP exchanged between peers is verified and accepted only if authentication is successful.
  - Most types of authentication require administration and can disproportionately consume router resources as a result. OCI doesn't recommend using it unless customer have hardcore requirement.
  - OCI will not use MD5 with partners.

- **BGP Prefix-Acceptance**
  - OCI will accept any-prefix advertise by customer over the FastConnect BGP session.
  - No restriction on prefix-length.
  - The only limit is the number of prefixes that customer can advertise over the VC/BGP session:
    - For private virtual circuits: 2000 IPv4, and 500 IPv6 prefixes.

Public Peering Network Design

- **BGP IP address assignment**
  - In contrast to FastConnect-private, Customer's Layer 3 point-to-point interface will be part of shared Internet routing-instance instead of unique DRG routing-instance.
  - Because of customers are going to share same routing-instance we need to make sure that the IP addresses are unique.
  - OCI will assign the point-to-point IPs from range (169.254.0.0/16).

- **BGP Prefix-advertisement**
  - You can use route filtering to choose to advertise public routes used by ephemeral IP address ranges, reserved IP address ranges, and Oracle Services Network (OSN) to your on-premises network at the region, market, or global (all regions in all markets) scope.
  - Public prefixes will include IP ranges that covers all public services offering by OCI.
  - Public prefixes will also covers all the customer's public VCN host prefixes.

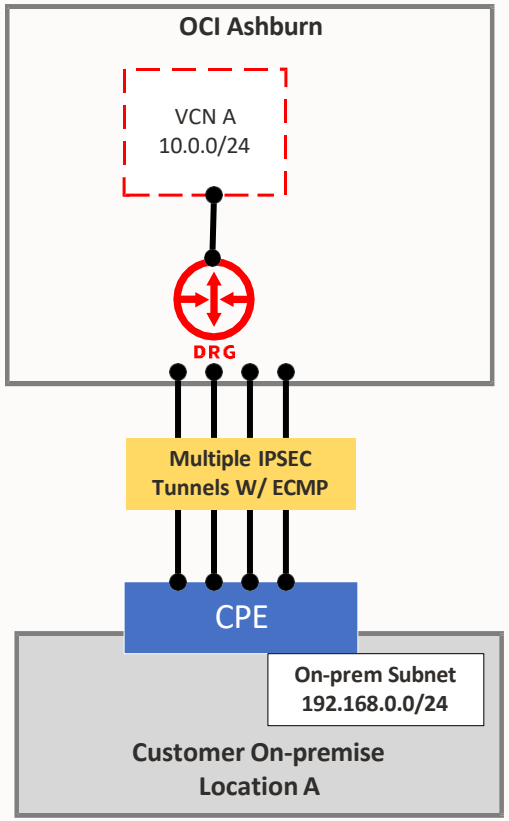
Public Peering Network Design

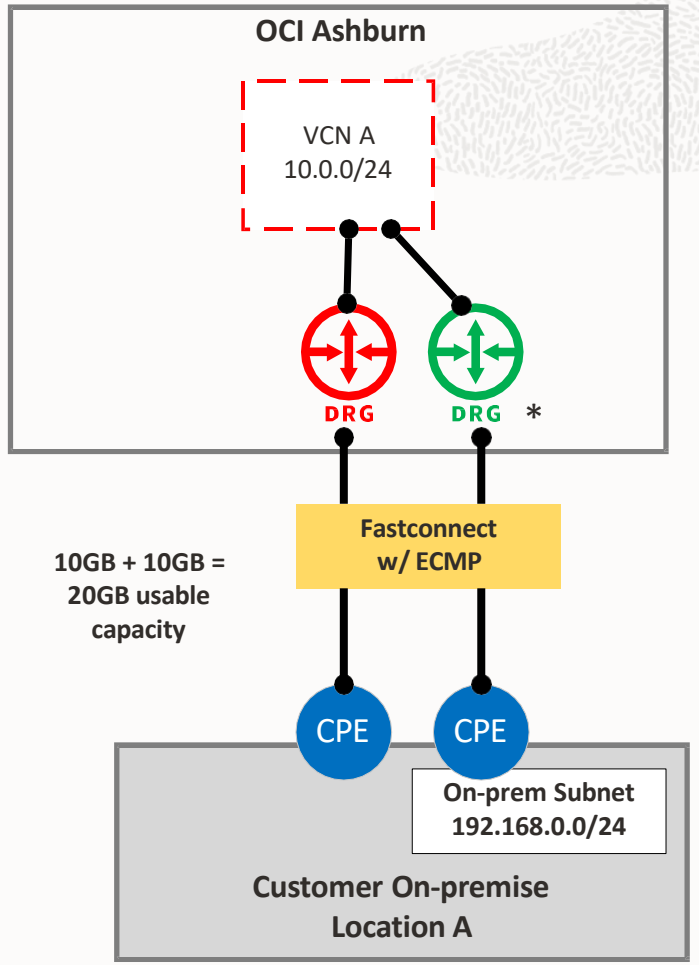
- **BGP Prefix-acceptance**
  - Customer provides list of prefixes that they want to advertise via console.
  - OCI accepts the public-prefixes only if prefixes are owned by customer.
  - OCI Check multiple Internet Route Registry database (Using Dyn tool) to verify who owns the prefixes before accepting the prefix from the customer.
  - There is a limit on the number of prefixes that customer can advertise over the VC/BGP session:
    - For public virtual circuits: 200 prefixes.

- **BGP ASN**
  - OCI will use 31898 ASN.
  - Customer needs public ASN to peer with OCI.

DRG: ECMP (Active/Active)

- OCI Supports **Equal-Cost Multi-Path** for Active/Active load sharing and failover of network traffic between on-premise and OCI.
- You can bundle up to **8** IPSec or FastConnect connections (but not mix of them).
- Enabled on a per-route table basis.

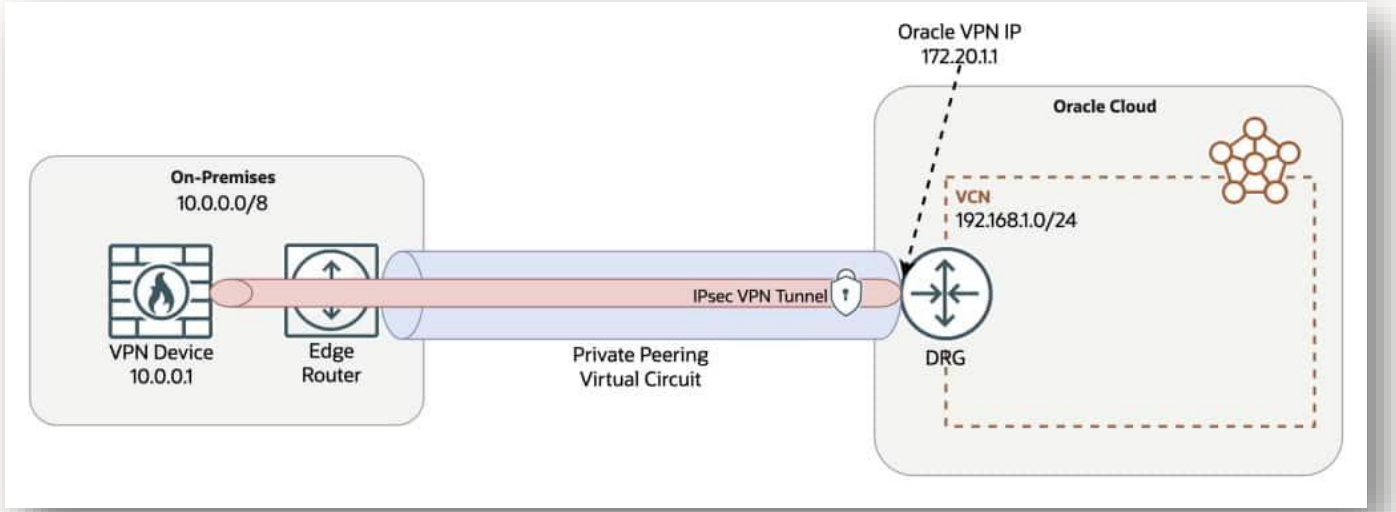




* OCI only has a single DRG , but it can contain multiple physical routers.
For clarity, the second DRG refers to a different physical Oracle (PE) router.

IPSec Over FastConnect

- Standard IPSec VPNs to encrypt FastConnect private peering traffic.
- Combine Site-to-Site VPN and FastConnect services.
- No need for public peering/customer-managed network virtual appliance.
- Multiple tunnels per virtual circuit.
- Route encrypted and unencrypted traffic on the same virtual circuit.



Oracle Interconnect with Azure and GCP

Multicloud Architecture

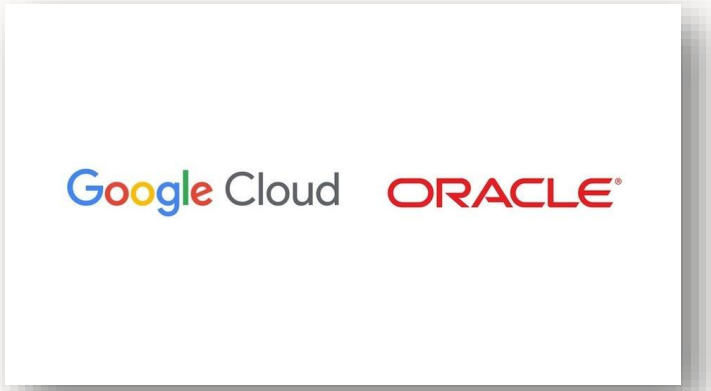
Offers private, low-latency connectivity between selected OCI Regions, with Azure and GCP Networks.

Oracle Interconnect for Azure

- Use a direct interconnection between OCI and Microsoft Azure that provides less than two milliseconds of latency for superior multicloud network performance.
- Run applications, including Oracle E-Business Suite, on OCI with distributed data stores on OCI and Microsoft Azure.
- Maximize application performance by connecting directly to Oracle Autonomous Database, Exadata Database Service, and MySQL HeatWave environments in OCI.

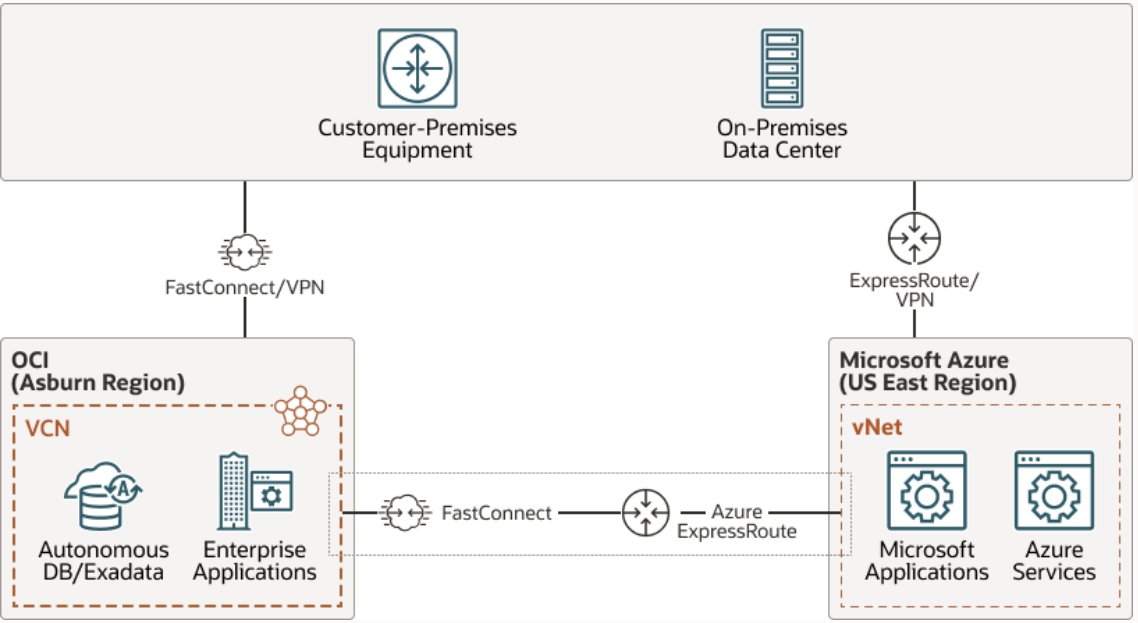
Oracle Interconnect for Google Cloud

- Create a low-latency, high-throughput, private connection with seamless interoperability for first-class multicloud network performance.
- Deploy workloads across both OCI and Google Cloud regions with no cross-cloud data transfer charges.
- Raise support issues through Oracle or Google. Oracle and Google will collaborate to resolve them.

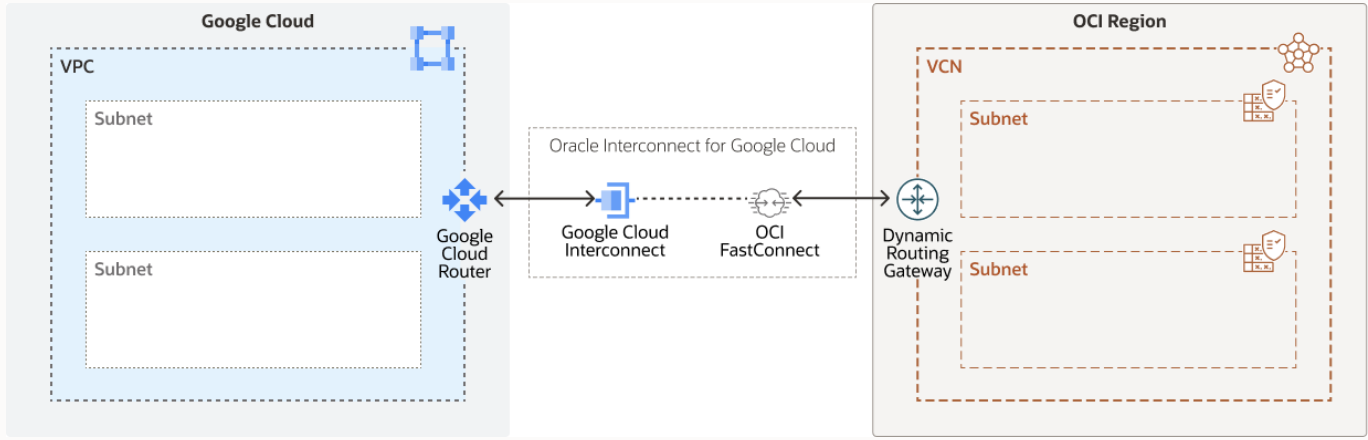


Multicloud Architecture

Oracle Interconnect for Azure



Oracle Interconnect for Google Cloud

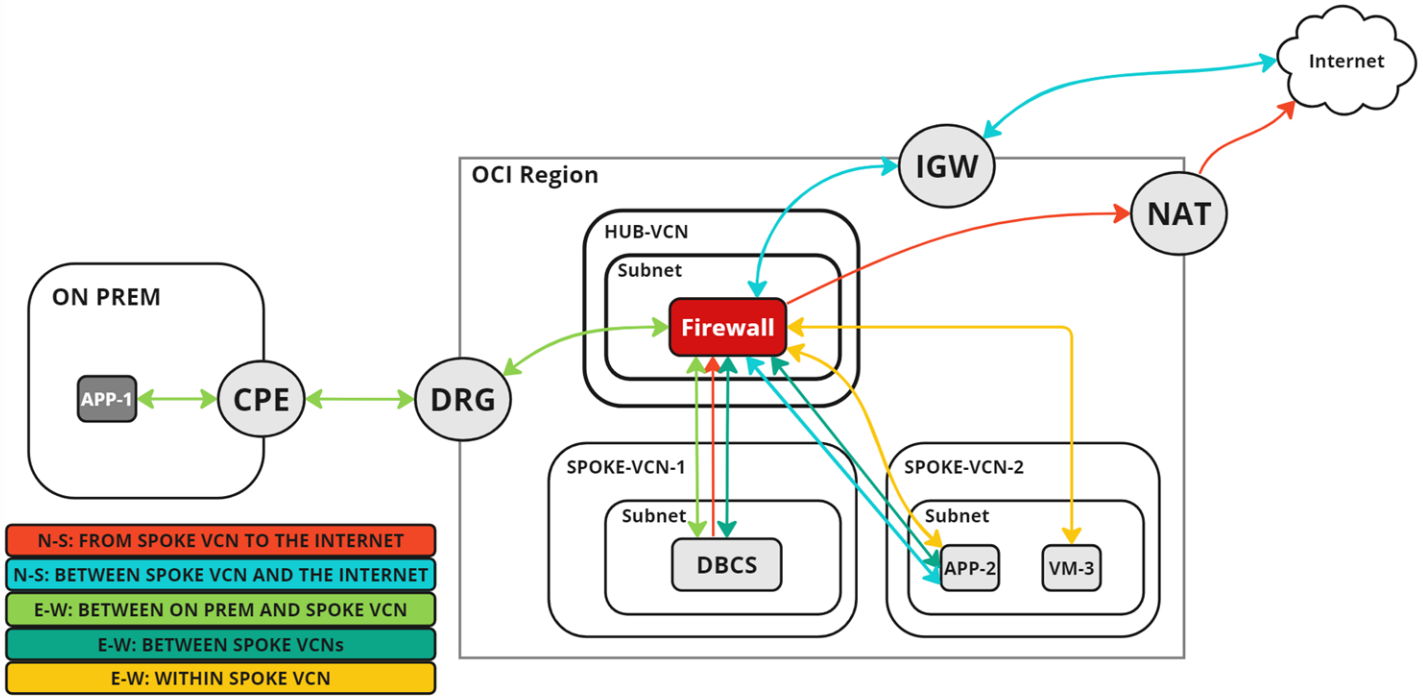


Customer Onboarding

Case Study 1: Hub & Spoke Architecture

It is the most common due to the security and ease of management advantages it gives to organizations. In this scenario, all the communication traverse through a Central “Hub” network, where a Firewall inspect traffic before it reaches the Destination “Spoke” network where the actual workload resides. This provides enhanced security, improved management to your network environment as routing can be controlled between other networks using the hub, and higher scalability as customer can add new networks at any point of time to their existing hub.

- **North-South Traffic:**
  - Between Internet and OCI networks.
- **East-West Traffic:**
  - Between OCI Spoke networks.
  - Between OCI and on-premise networks.
  - Within the Spoke VCN.

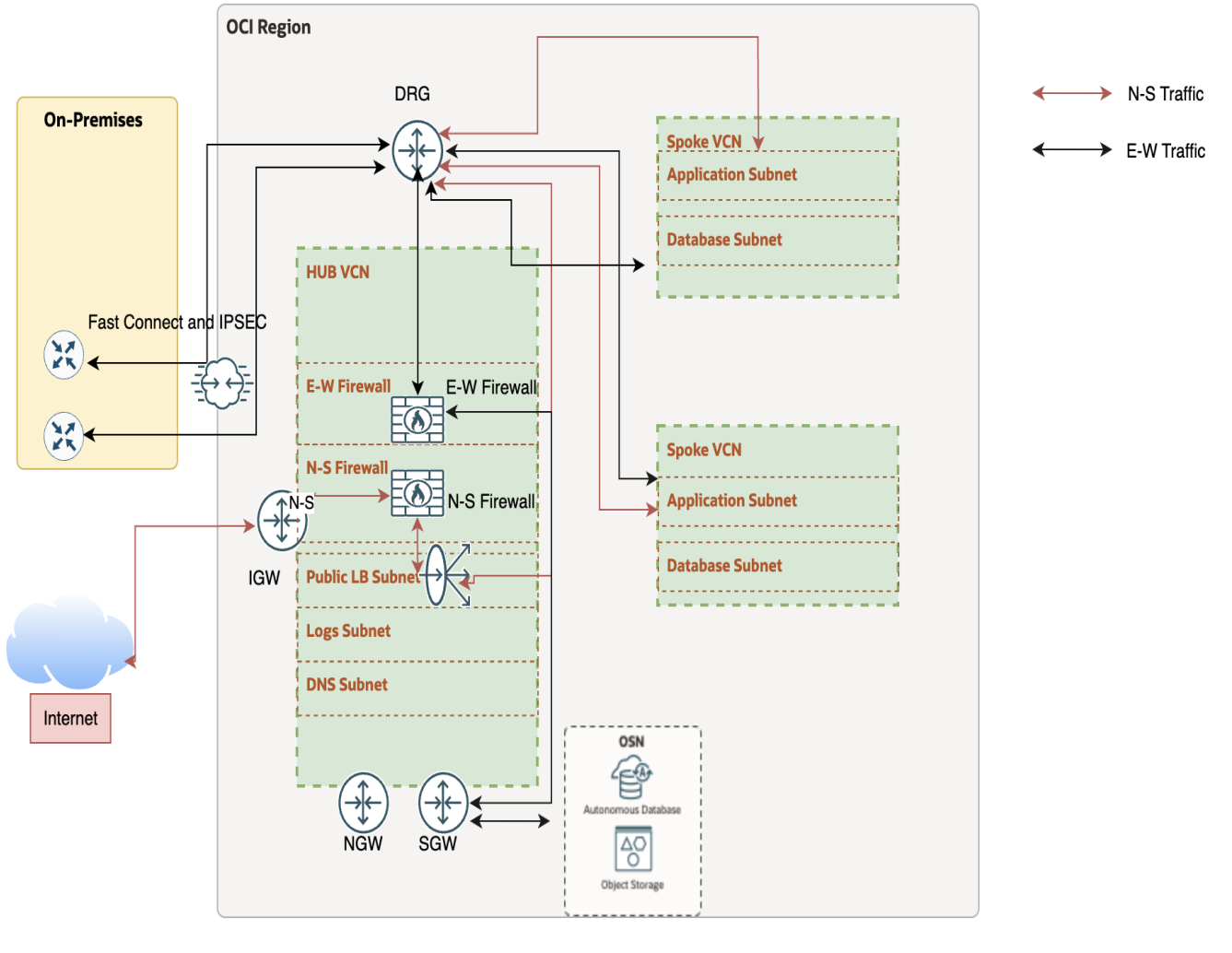


Case Study 2: Monitoring traffic using OCI Network firewall

Scenario: Monitoring E-W and N-S traffic using different Network firewalls.

Enhance Security by segregating and monitoring different types of network traffic.

- **E-W firewall Monitoring:**
  - Focuses on traffic exchanged between private IP addresses over DRG and subnet to subnet communication for inter VCN and intra VCN both.
  - Monitors the traffic initiated for OSN over SGW on OCI Backbone and initiated traffic for internet over NAT GW.
- **N-S Firewall Monitoring:**
  - Concentrates on supervising traffic utilizing the IGW (Internet Gateway).
  - It provides granular visibility and enables better detection of internal and external attacks.

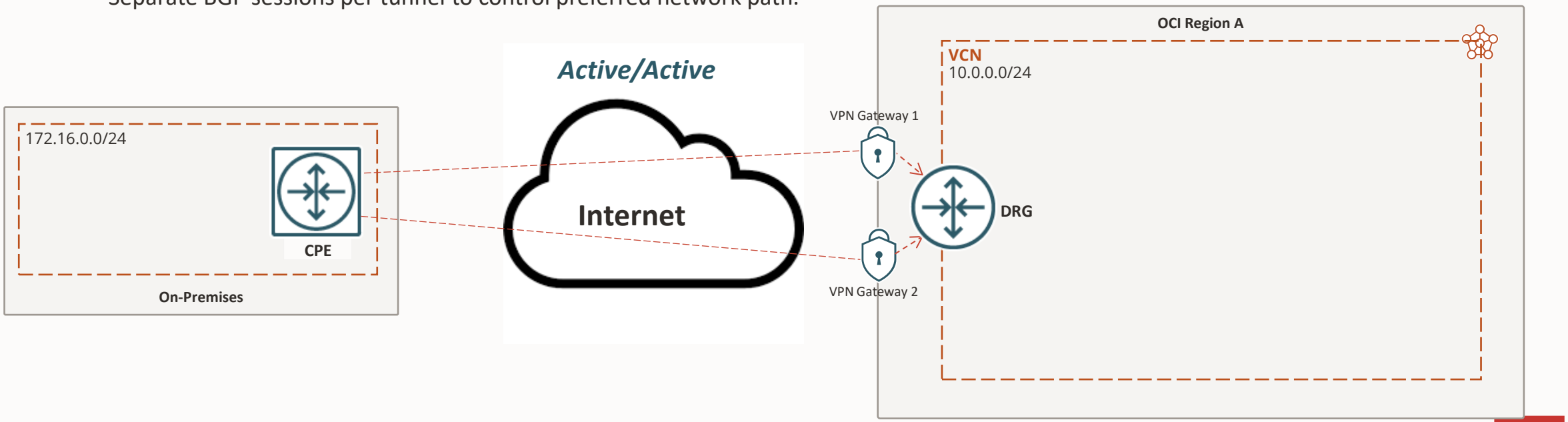


Case Study 3: Redundant Connectivity

To avoid single point of failure, there are many options to design a highly available network, depending on the cost, and how critical your workload is:

Scenario A: Site-to-Site IPSec VPN Redundancy (Single CPE)

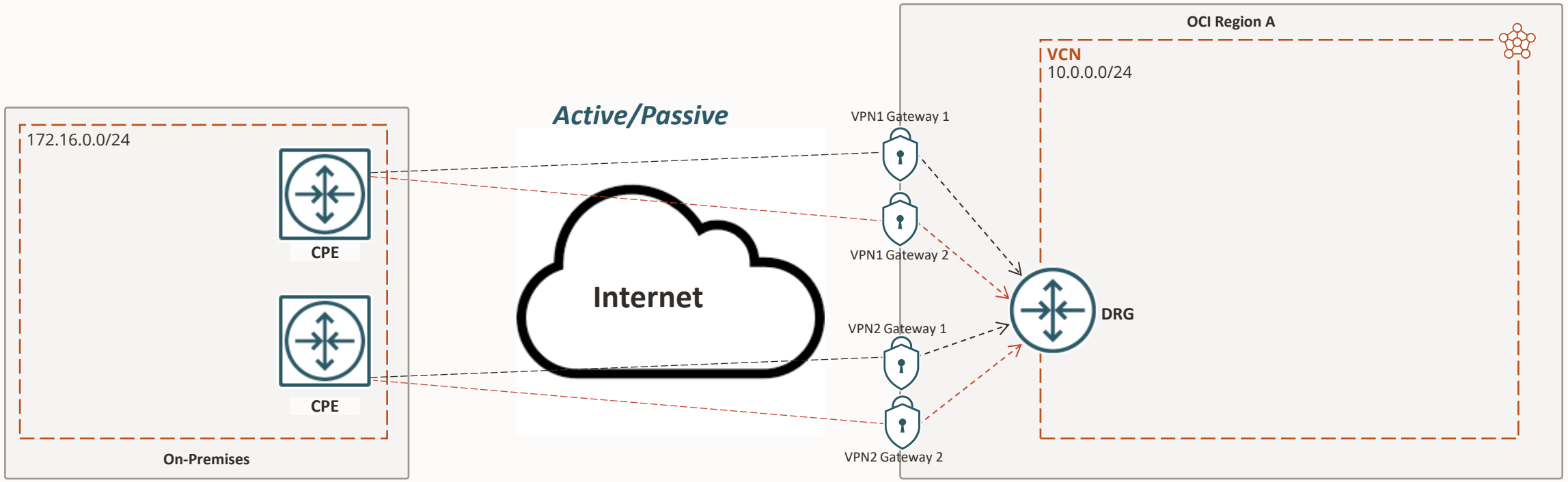
- Two redundant tunnels per IPsec connection.
- Each tunnel in an IPSec Connection terminates on a different VPN Gateway.
- Multiple IPSec Connections is more than two tunnels are required.
- Separate BGP sessions per tunnel to control preferred network path.



Case Study 3: Redundant Connectivity

Scenario B: Site-to-Site IPSec VPN Redundancy (Multiple CPEs)

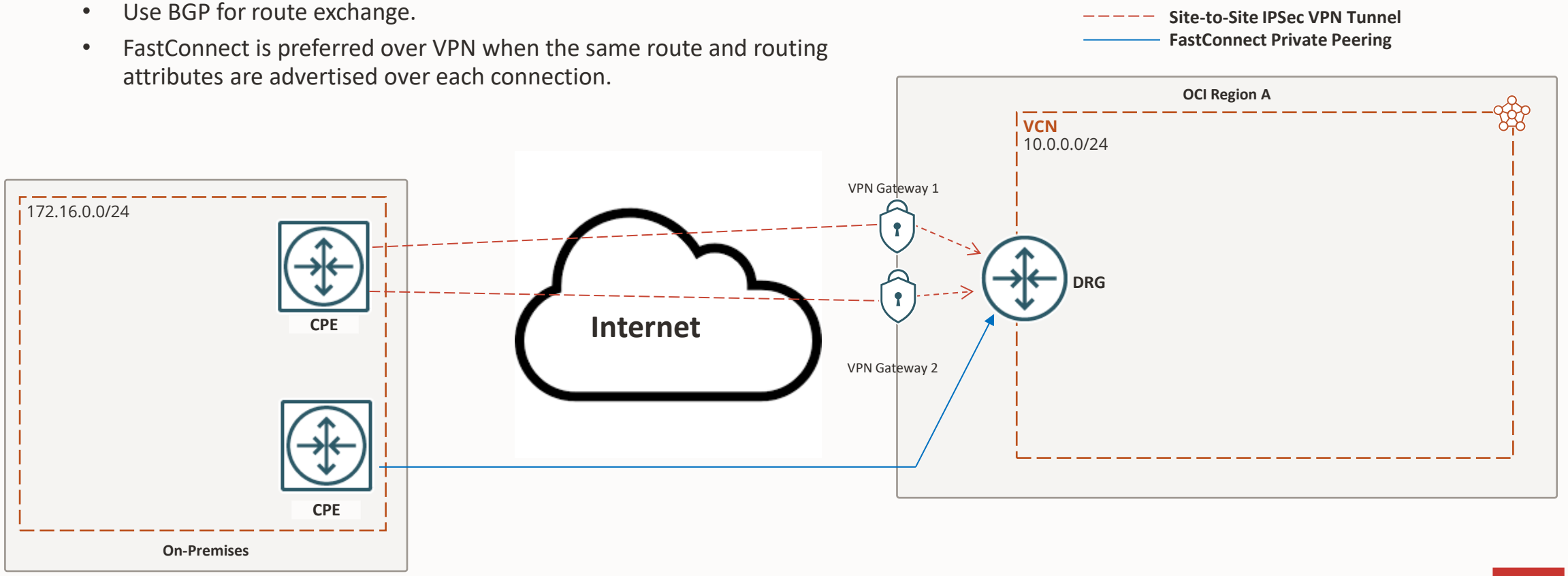
- One active tunnel per IPSec connection.
- Each tunnel in one IPSec connection.
- Two different CPEs On-premises.



Case Study 3: Redundant Connectivity

Scenario C: FastConnect with Site-to-Site IPSec VPN Backup

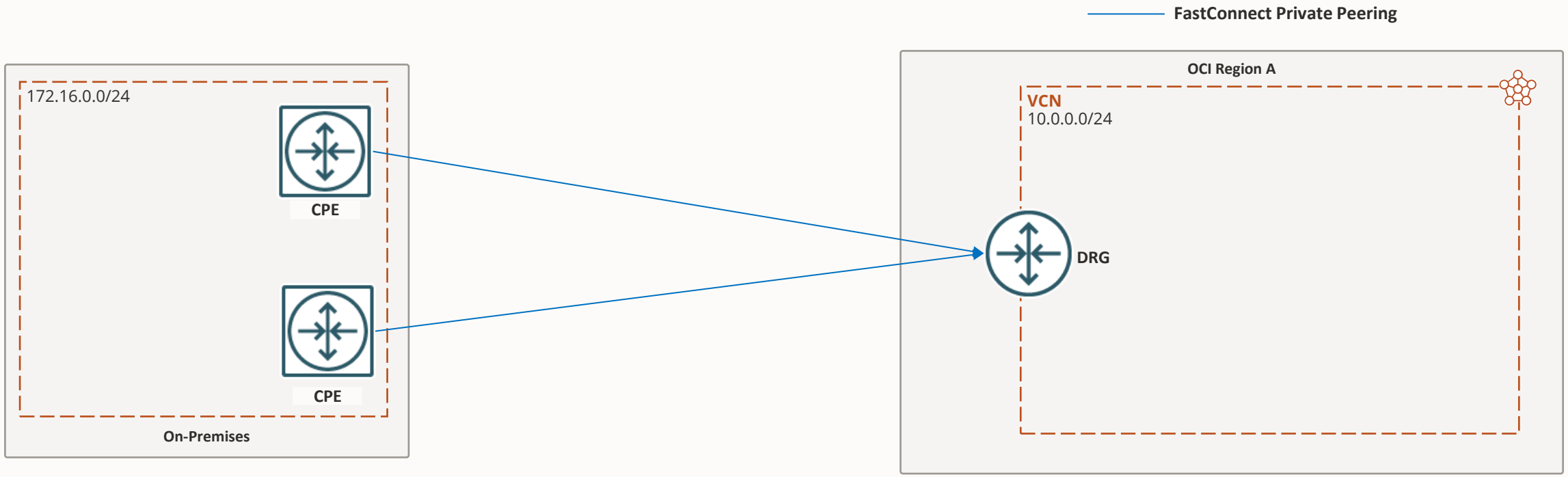
- Configure at least one available tunnel.
- Use ECMP across multiple tunnels for additional VPN bandwidth.
- Prefer FastConnect as primary.
- Use BGP for route exchange.
- FastConnect is preferred over VPN when the same route and routing attributes are advertised over each connection.



Case Study 3: Redundant Connectivity

Scenario D: Redundant FastConnects

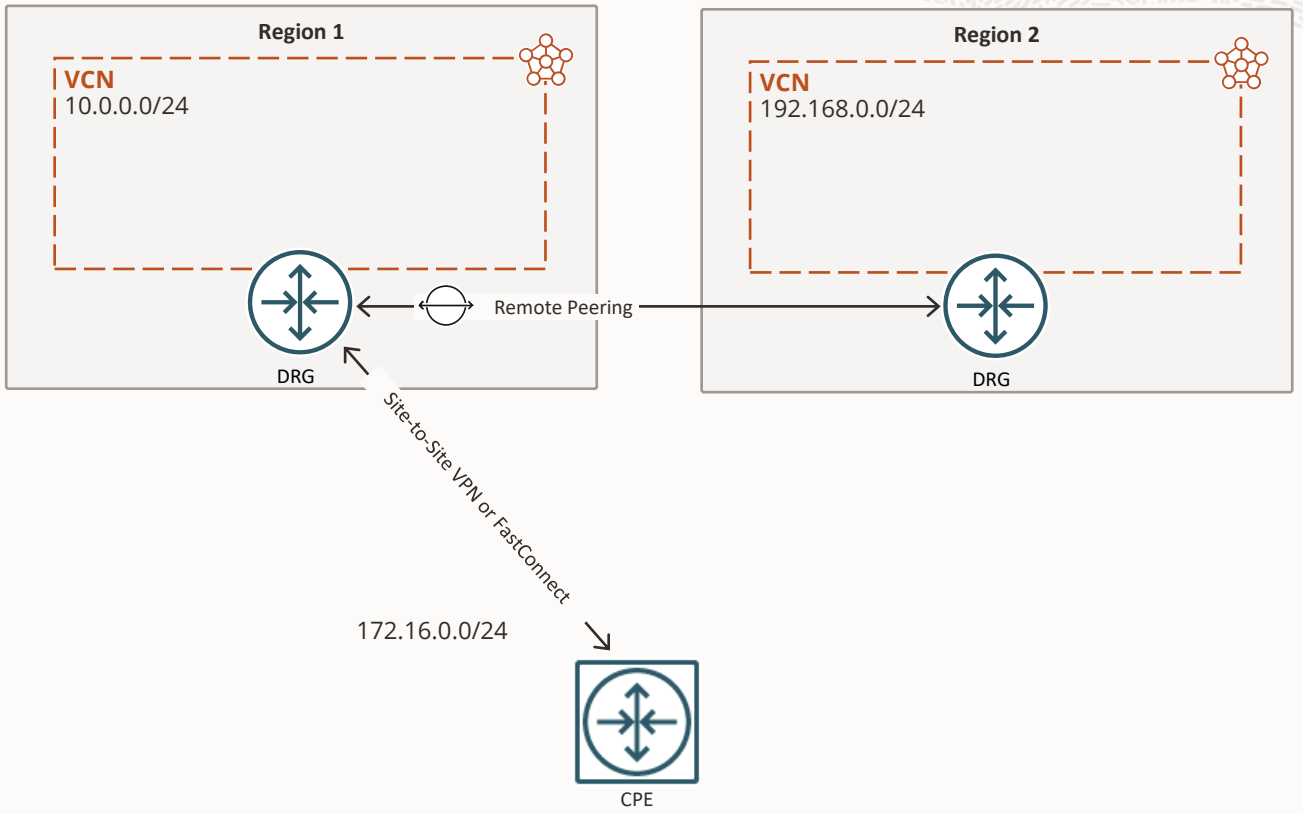
- Primary and Secondary Cross-Connect



Case Study 4: Multi-Region Communication

Scenario A: Remote On-ramp/Transit Routing

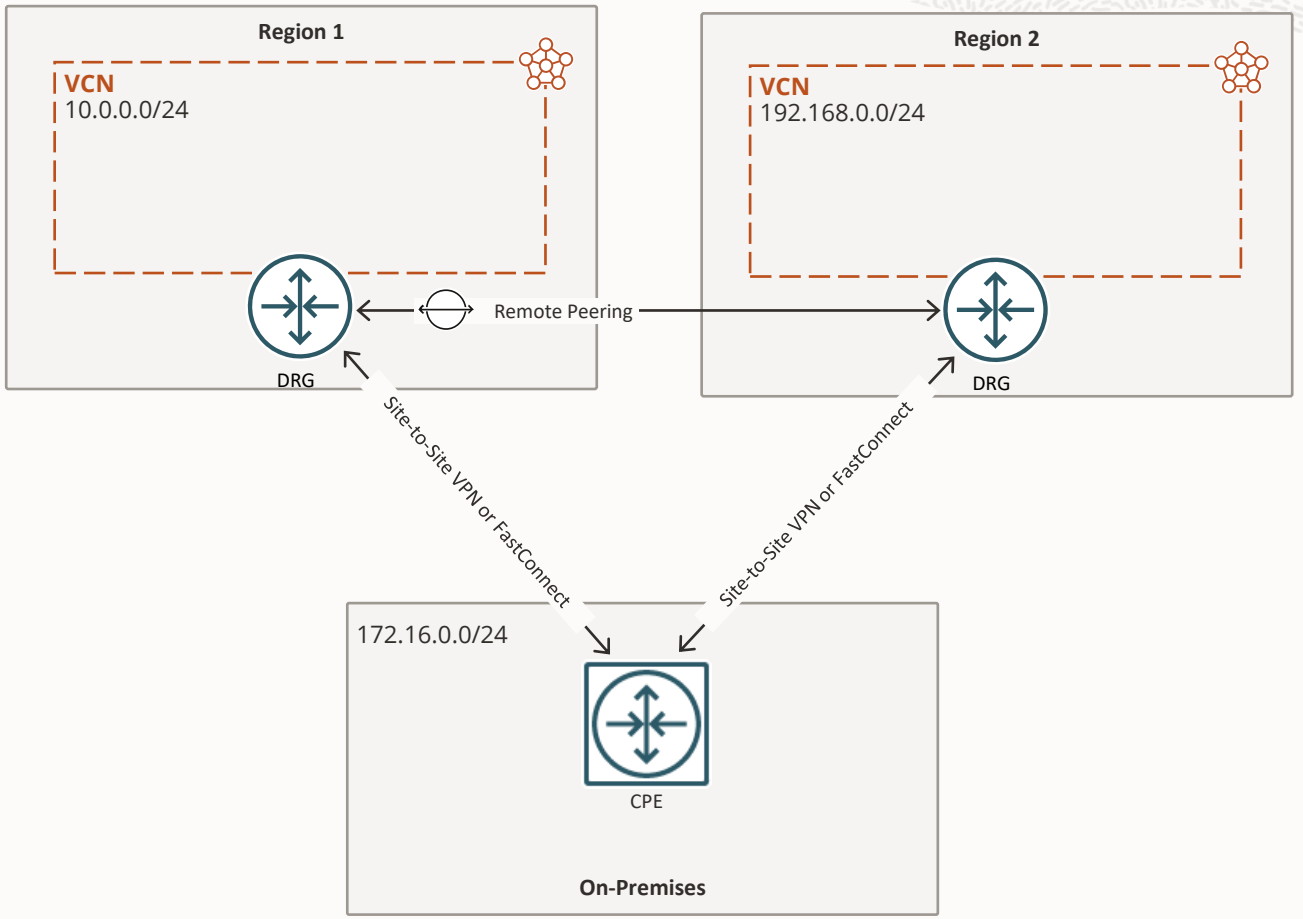
- FastConnect or Site-to-Site IPsec VPN to Region A.
- Access resources in Region A and Region B.
- Uses the OCI private Backbone.
- Transit Routing can use similar configuration.
- Can also provide redundancy.



Case Study 4: Multi-Region Communication

Scenario B: Multiple Region Redundancy

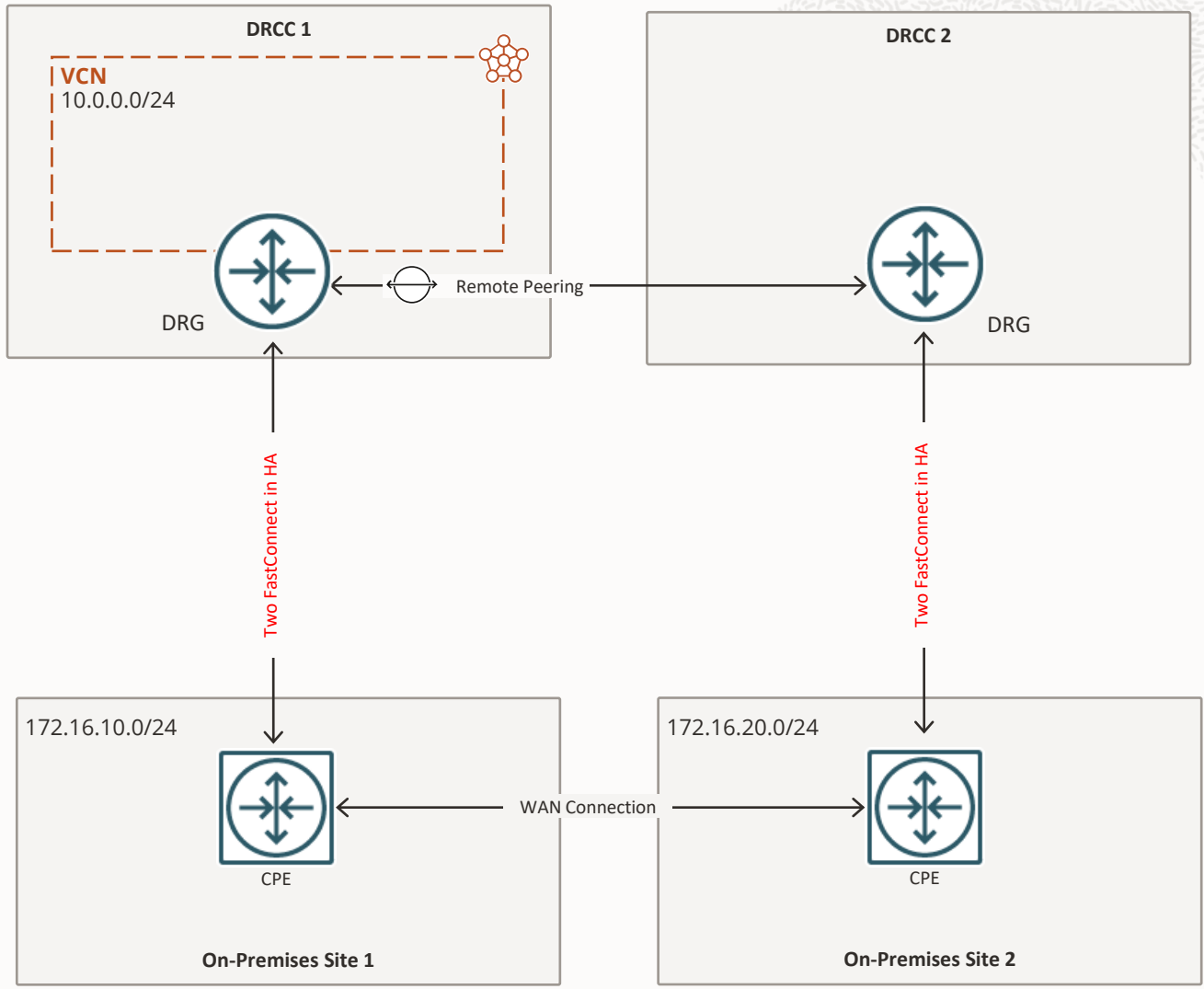
- FastConnect or Site-to-Site IPsec VPN to both regions.
- Uses the OCI private backbone.
- Use BGP attributes like local preference and AS PATH prepending to influence egress/ingress routing.
- Oracle will prefer local region egress in case of routing tiebreaks.



Case Study 4: Multi-Region Communication

Scenario C: Multiple Region with Multiple CPEs Redundancy

- Two FastConnect in HA to both regions.
- Uses the OCI private backbone in HA.
- Use BGP attributes like local preference and AS PATH prepending to influence egress/ingress routing.
- Configure DRG routing to advertised routes for RPC to On-premises Sites.



Case Study 5: DRCC

We assist customers in adopting DRCC for running their applications, which involves designing network architecture and collaborating with the DC team to establish various connections such as Fast Connect, inter-region connectivity, and internet connectivity.

DRCC Physical Network components

Inter-Region Routers.

- Private and public peering between OCI regions over Oracle backbone.
- Oracle managed Layer-2 connections with MACsec.

Fast Connect Routers.

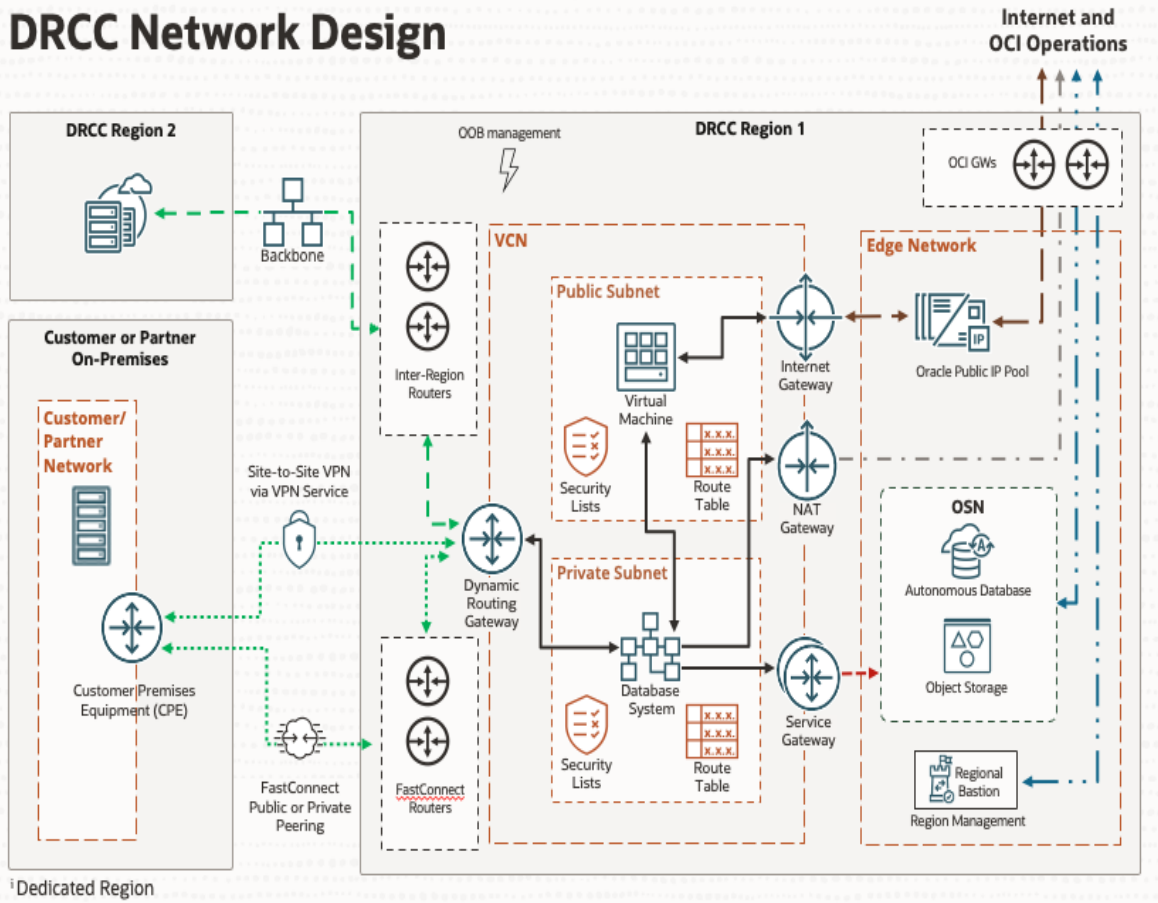
- Private and public peering between customer premises and OCI region.
- MACsec option for customer managed Layer-2 connections.
- IPsec VPN option inside partner managed Layer-3 connections.

OCI Gateways (OCI GW).

- Direct peering between region ASN and diverse Internet providers.
- Always on DDoS.

Edge Network.

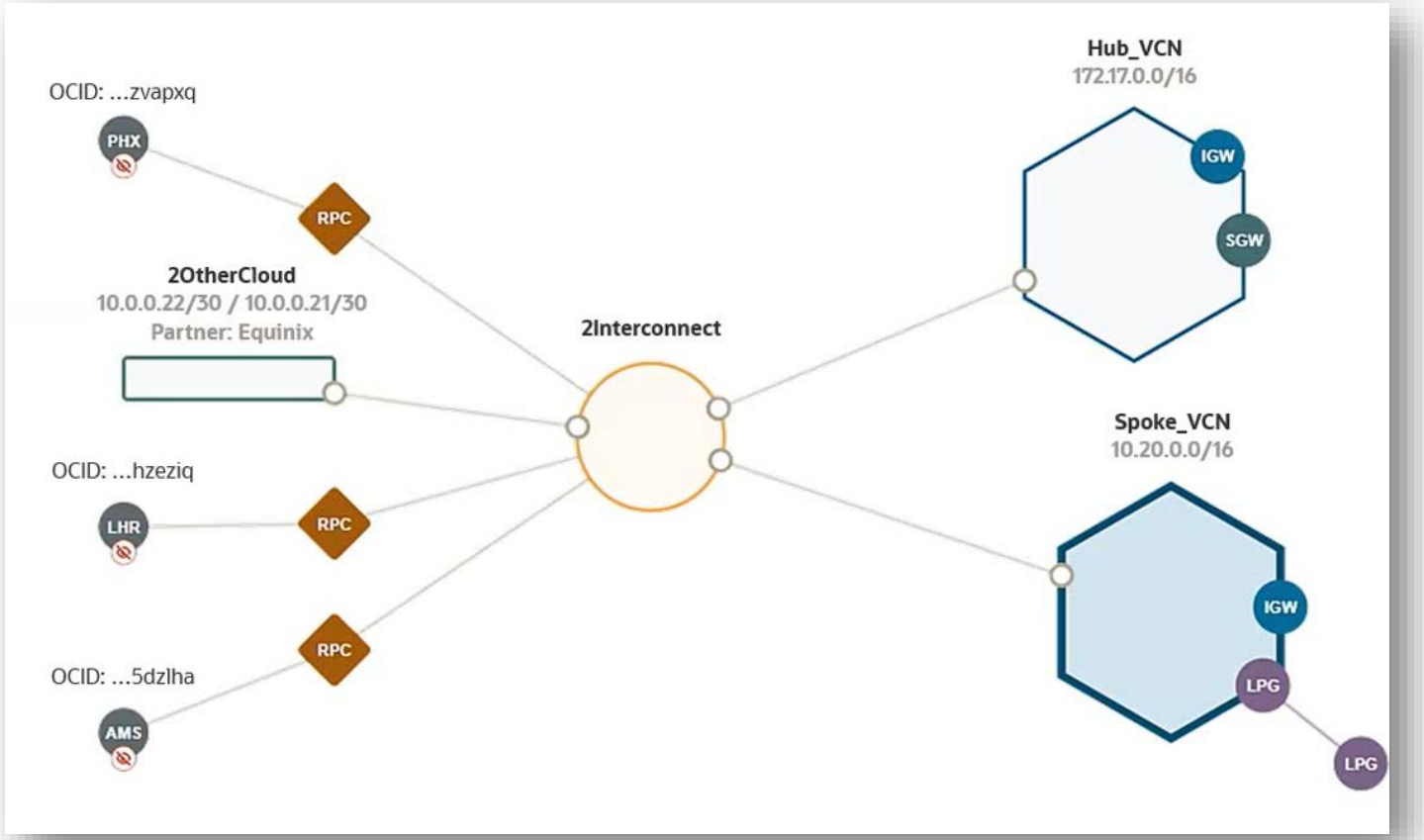
- Internet access to customer workloads via region public IPs mapped to tenant public subnets.
- Access to Oracle Service Network (OSN) endpoints.
- OCI operator access to regional bastions.



Troubleshoot Network Issues

Network Visualizer

- Provides a diagram of the implemented topology of all VCNs in a selected region and tenancy.
- Each resource is represented with a notation.



Network Path Analyzer

Overview

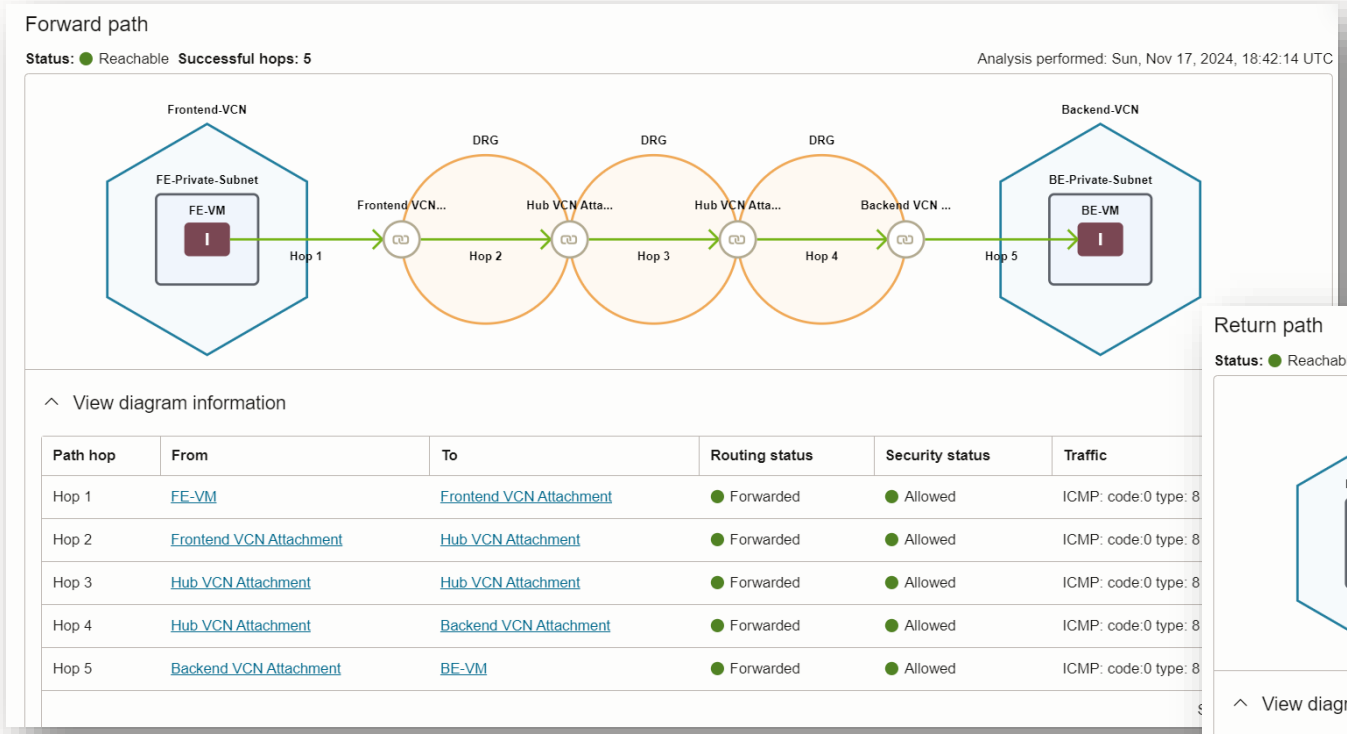
- **Network Path Analyzer (NPA)** is your virtual network detective, designed to inspect your network routing and security configuration in real-time. It collects and analyzes them to determine how the paths between the source and the destination **function** or **fail**.

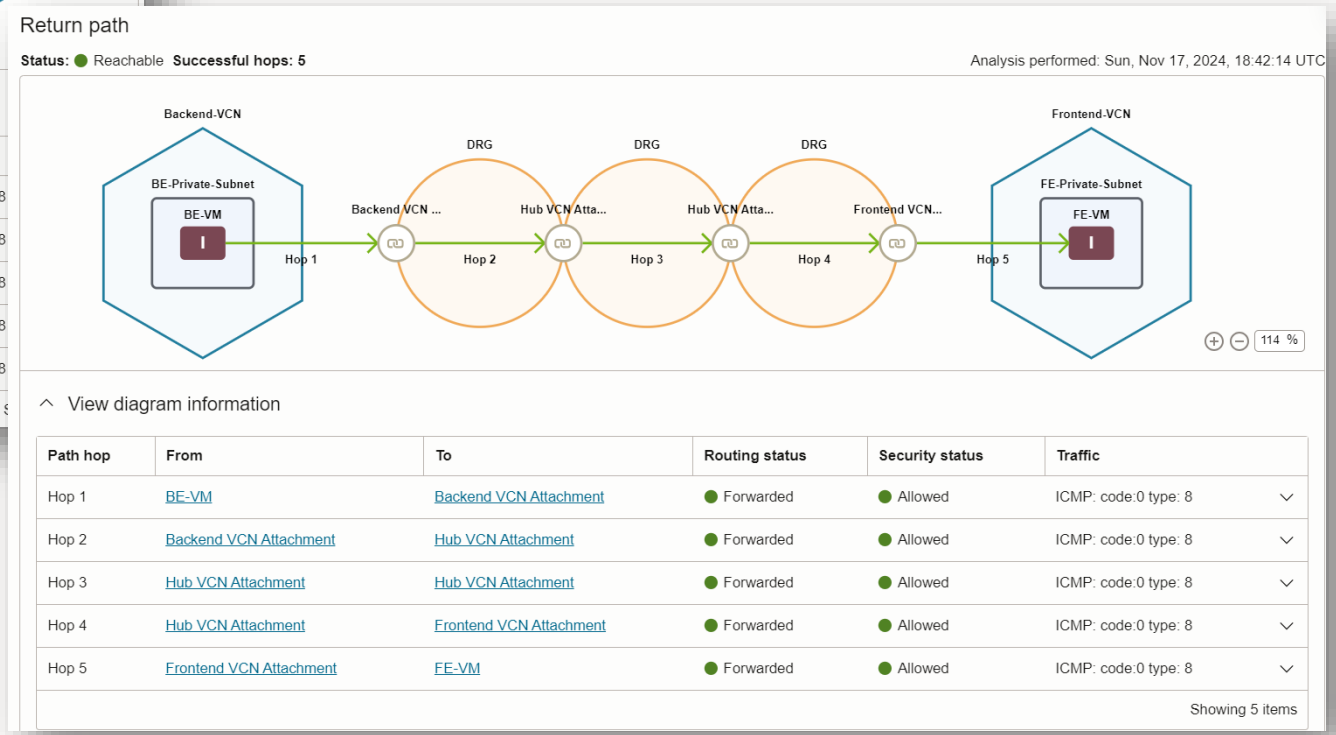
- No actual traffic is sent, instead it identifies connectivity problems using automated configuration analysis.

Supported scenarios

- OCI ⟷ OCI
- OCI ⟷ On-premises
- OCI ⟷ Internet

Network Path Analyzer – Example 1



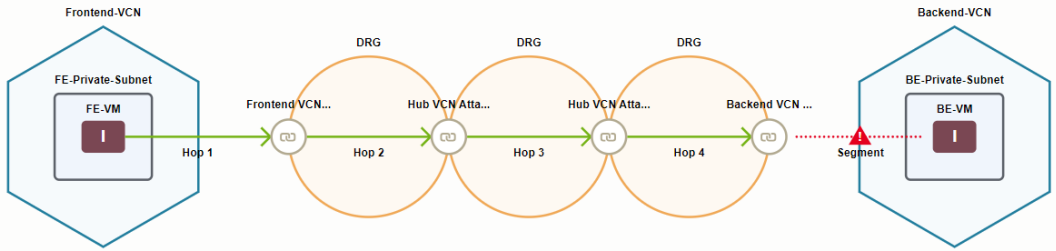


Network Path Analyzer – Example 2

Forward path

Status: Unreachable **Successful hops: 4**

Analysis performed: Sun, Nov 17, 2024, 19:04:10 UTC



View diagram information

Path hop	From	To	Routing status	Security status	Traffic
Hop 1	FE-VM	Frontend VCN Attachment	Forwarded	Allowed	ICMP: code:0 type: 8
Hop 2	Frontend VCN Attachment	Hub VCN Attachment	Forwarded	Allowed	ICMP: code:0 type: 8
Hop 3	Hub VCN Attachment	Hub VCN Attachment	Forwarded	Allowed	ICMP: code:0 type: 8
Hop 4	Hub VCN Attachment	Backend VCN Attachment	Forwarded	Allowed	ICMP: code:0 type: 8
Segment	Backend VCN Attachment	BE-VM	Forwarded	Denied	ICMP: code:0 type: 8

Showing 5 items

Return path

We didn't analyze a return path.

Path hop	From	To	Routing status	Security status	Traffic
Segment	Backend VCN Attachment	BE-VM	Forwarded	Denied	ICMP: code:0 type: 8

Routing forwarded

Routing status: Forwarded

Routing action: Forwarded based on implicit routing.

Security denied

Egress access control status: Allowed

Egress access control action: Allowed based on implicit rules.

Ingress access control status: Denied

Ingress access control action: We couldn't find a matching security rule for the traffic in the following security resources:

- Default Security List for Backend-VCN

Segment from

DRG attachment: Backend VCN Attachment

DRG: DRG

Segment to

VNIC: ...j3wcumgviq Show Copy

Instance: BE-VM

VCN: Backend-VCN

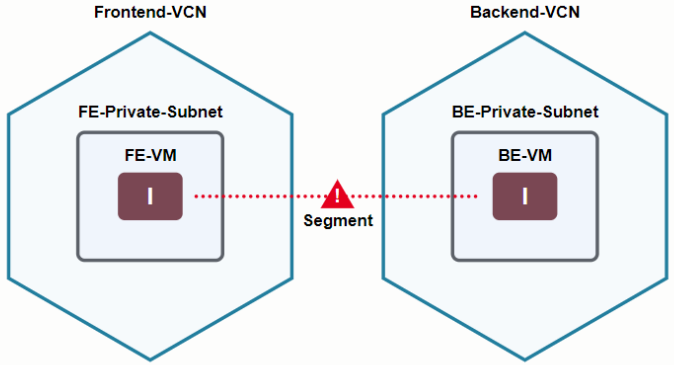
Subnet: BE-Private-Subnet

Network Path Analyzer – Example 3

Forward path

Status: Unreachable **Successful hops: 0**

Analysis performed: Sun, Nov 17, 2024, 19:19:47 UTC



View diagram information

Path hop	From	To	Routing status	Security status	Traffic
Segment	FE-VM	BE-VM	No route	Allowed	ICMP: code:0 type: 8

Showing 1 item

Path hop	From	To	Routing status	Security status	Traffic
Segment	FE-VM	BE-VM	No route	Allowed	ICMP: code:0 type: 8

No route

Routing status: No route

Routing action: We couldn't find a matching routing rule for this destination in the following route table: Default Route Table for Frontend-VCN

Security allowed

Egress access control status: Allowed

Egress access control action: Allowed based on rule: [all protocols to 0.0.0.0/0 : any port] found in the following security list: Default Security List for Frontend-VCN

Ingress access control status: Not applicable

Ingress access control action: Security information is not applicable

Segment from

VNIC: ...rp5unb32jq Show Copy

Instance: FE-VM

VCN: Frontend-VCN

Subnet: FE-Private-Subnet

Segment to

VNIC: ...j3wcumgviq Show Copy

Instance: BE-VM

VCN: Backend-VCN

Subnet: BE-Private-Subnet

Return path

We didn't analyze a return path.

Inter-Region Latency Dashboard

- A tool that provides insights into the average network round-trip latency (RTT) between all OCI regions in a given realm. This dashboard is designed to help users plan scenarios such as data replication, backup, or disaster recovery by offering visibility into latency metrics between regional pairs.
- OCI users can verify latency value between two any OCI public regions from one single dashboard".
- Mostly used for troubleshooting and testing purposes.

Current Inter-Region Round Trip Time (ms)

JED: Saudi Arabia West (Jeddah) To FRA: Germany Central (Frankfurt) Show

Last Updated: Sun, Nov 17, 2024, 21:00:00 UTC

Region	AUH	BMC	BOG	BOM	CDG	CWL	DFW	DXB	FRA	GRU	HYD	IAD	ICN	JED	JNB
AGA	204.60	⚠	139.47	235.22	128.89	122.72	⚠	207.12	130.91	158.46	218.89	53.62	139.64	182.76	281.54
AMS	92.77	⚠	168.42	120.26	7.85	8.72	⚠	95.29	7.87	183.77	134.00	83.81	265.31	70.56	166.28
ARN	108.74	⚠	193.68	144.06	31.53	32.57	⚠	116.30	37.11	207.76	157.82	105.97	288.28	91.27	190.29
AUH		⚠	240.07	31.25	78.89	93.74	⚠	2.88	85.82	263.10	43.77	154.03	171.59	22.61	251.27
BMC			⚠	⚠	⚠	⚠	⚠	⚠	⚠	⚠	⚠	⚠	⚠	⚠	⚠
BOG				274.64	162.01	165.48	⚠	242.61	174.52	113.37	287.85	87.10	254.64	217.88	324.91
BOM					113.42	122.83	⚠	33.92	110.20	297.90	14.39	188.62	151.74	55.05	278.25
CDG						10.40	⚠	81.42	8.31	185.19	127.12	76.02	263.99	56.68	168.06
CWL							⚠	96.27	14.22	184.08	136.72	79.38	261.85	71.80	163.04
DFW								⚠	⚠	⚠	⚠	⚠	⚠	⚠	⚠
DXB									88.38	266.73	48.62	156.56	170.26	25.13	253.88
FRA										190.71	122.88	87.36	269.99	63.62	173.17
GRU											312.89	115.63	298.10	240.86	340.19

VCN Flow Logs

With **VCN flow logs**, you can record detailed information about network traffic flowing in and out of your VCNs. These logs provide visibility into traffic patterns, helping you monitor network activity, troubleshoot connectivity, and audit network traffic for compliance.

Flow logs capture metadata such as source and destination IPs, ports, and protocols, making it an essential tool for network analysis and security management.

VCN Flow Logs – Example

Accessing a web application through an OCI Load Balancer over HTTPS (port 443) from the internet.

Showing **4** log event(s) for the **past 5 minutes** starting at Mon, Feb 10, 2025, 16:49:11 UTC

Actions

datetime	type	data.message
Feb 10, 2025, 16:53:09 UTC	vcn.flowlogs.DataEvent	ACCEPT TCP 192.168.0.19 Port 40412 → 84.8.88.160 Port 443 B…
Feb 10, 2025, 16:53:09 UTC	vcn.flowlogs.DataEvent	ACCEPT TCP 84.8.88.160 Port 443 → 192.168.0.19 Port 40412 B…

...


```
"datetime": 1739206389000
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  "time": "2025-02-10T16:53:09Z"
  "oracle": {
    "compartmentid": "ocid1.compartment.oc1..aaaaaaaacmshv5fz52nhmn4p3juzja3waom4lehfeyeeykxgy3qvetychowq"
    "filterOcid:": "DEFAULT_CAPTURE_FILTER"
    "format": "IngestorFormat"
    "ingestedtime": "2025-02-10T16:53:29.417Z"
    "instanceOcid:": "ocid1.instance.oc1.me-riyadh-1.anqwuljrldij5aicuzwiaqb5w6gepnv5vnh5flzxpp2gabvrkevvhlryp6mq"
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    "logid": "ocid1.log.oc1.me-riyadh-1.amaaaaaaldij5aianee7sviwouth6diopuzmv2c2tlf4mpc7hhcxcof3l5qq"
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    "version": "2"
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    "sourcePort": 443
    "destinationPort": 40412
    "bytesOut": 215
    "protocol": 6
    "protocolName": "TCP"
    "packets": 4
    "status": "OK"
    "startTime": 1739206389
    "endTime": 1739206389
    "action": "ACCEPT"
  }
 }
 "regionId": "me-riyadh-1"
}
```
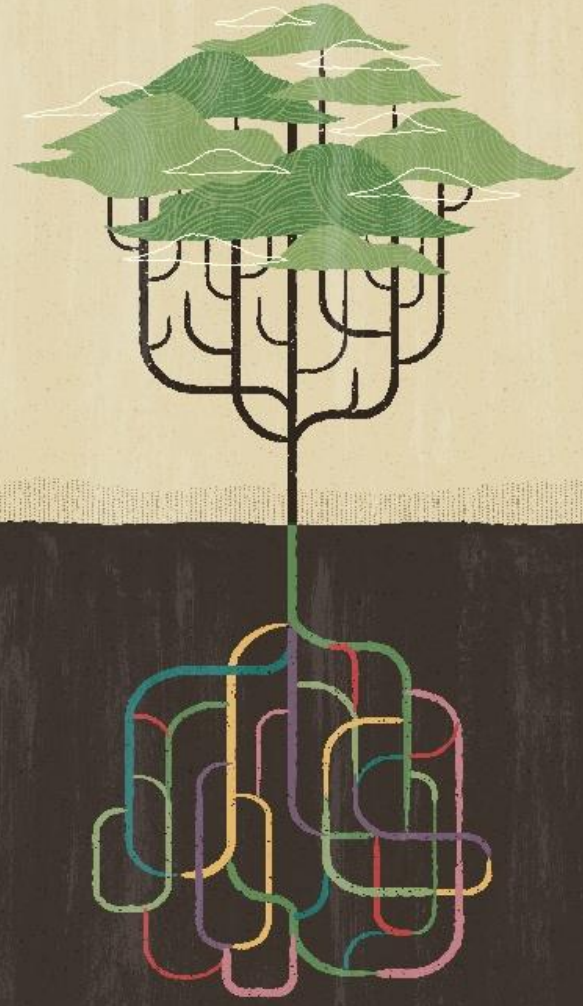

Thank You



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