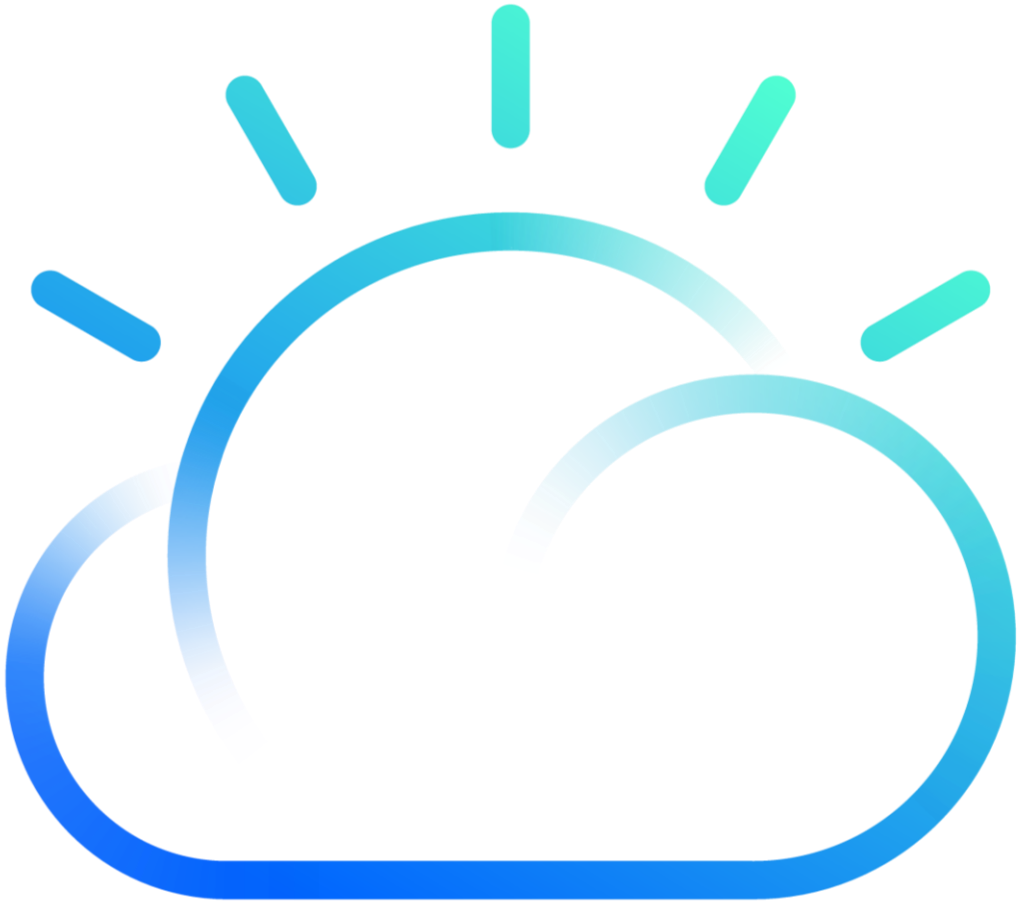
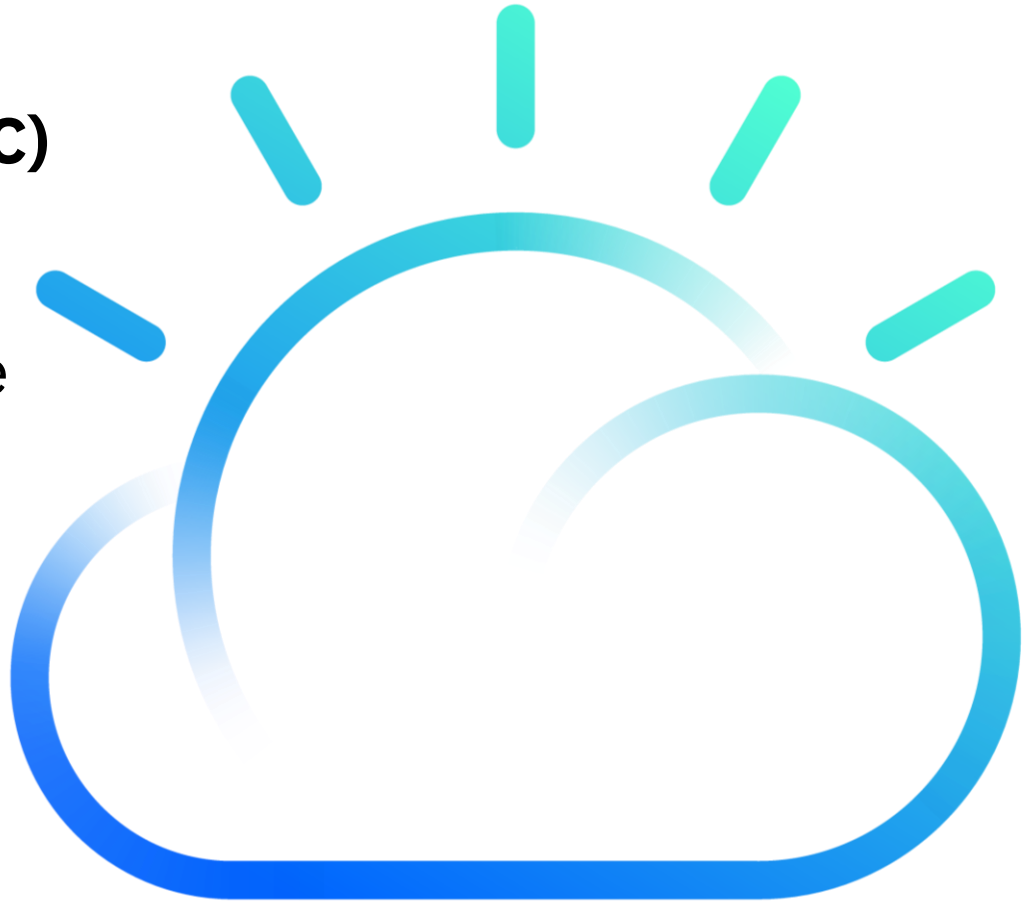
IBM Cloud Virtual Private Cloud Overview



IBM Cloud

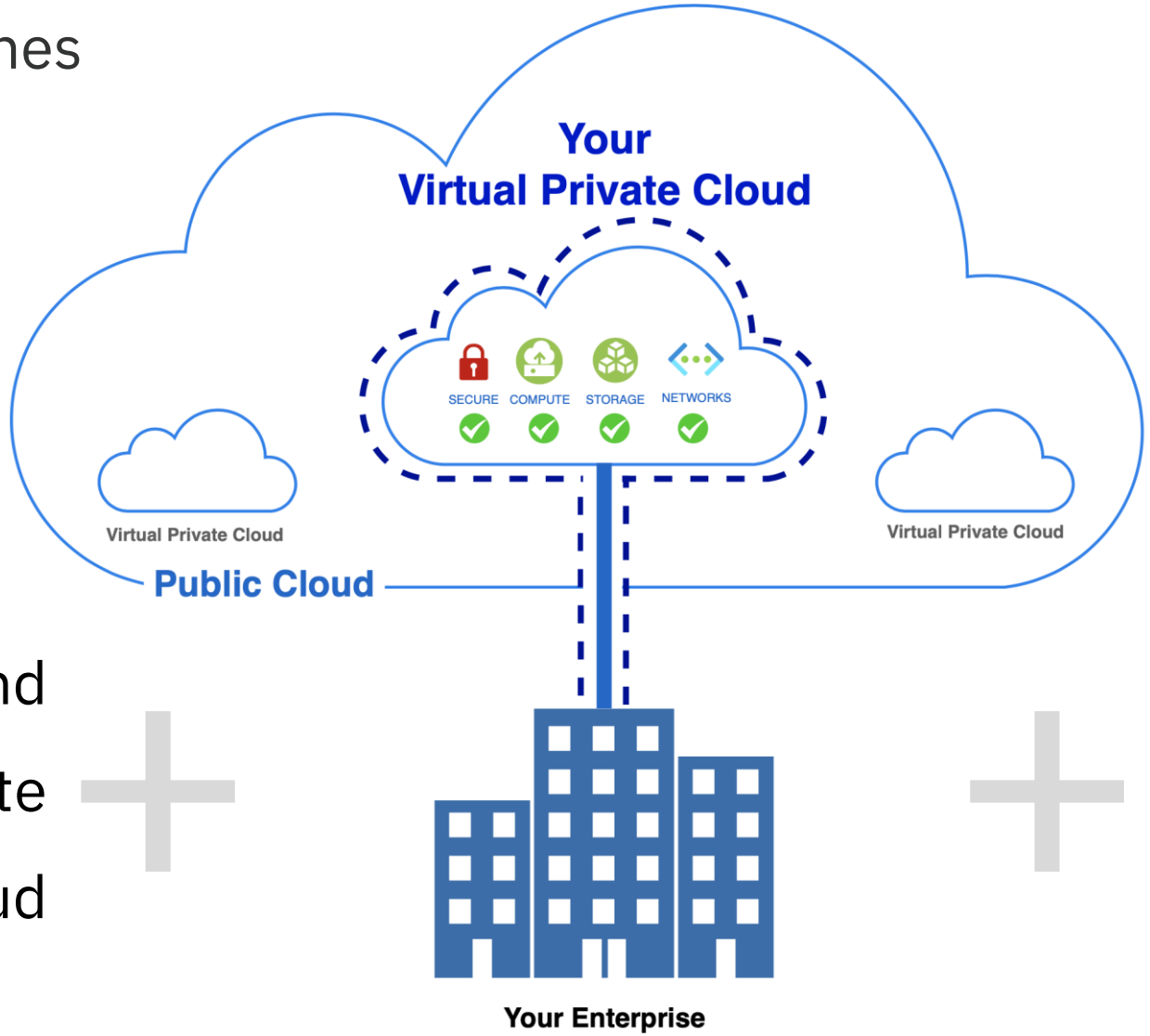
- **Overview of Virtual Private Cloud (VPC)**
- Why VPC – Value Proposition
- Features of VPC – Compute and storage
- Features of VPC – Networking
- Observability on VPC
- Use Cases & Conversation Starters
- Availability & Pricing
- Roadmap + Resources & Key Contacts



IBM **Cloud**

What is a Virtual Private Cloud?

A Virtual Private Cloud (VPC) is **a private network in the public cloud** that combines



he logical **isolation** and **security** of a private cloud

+

+

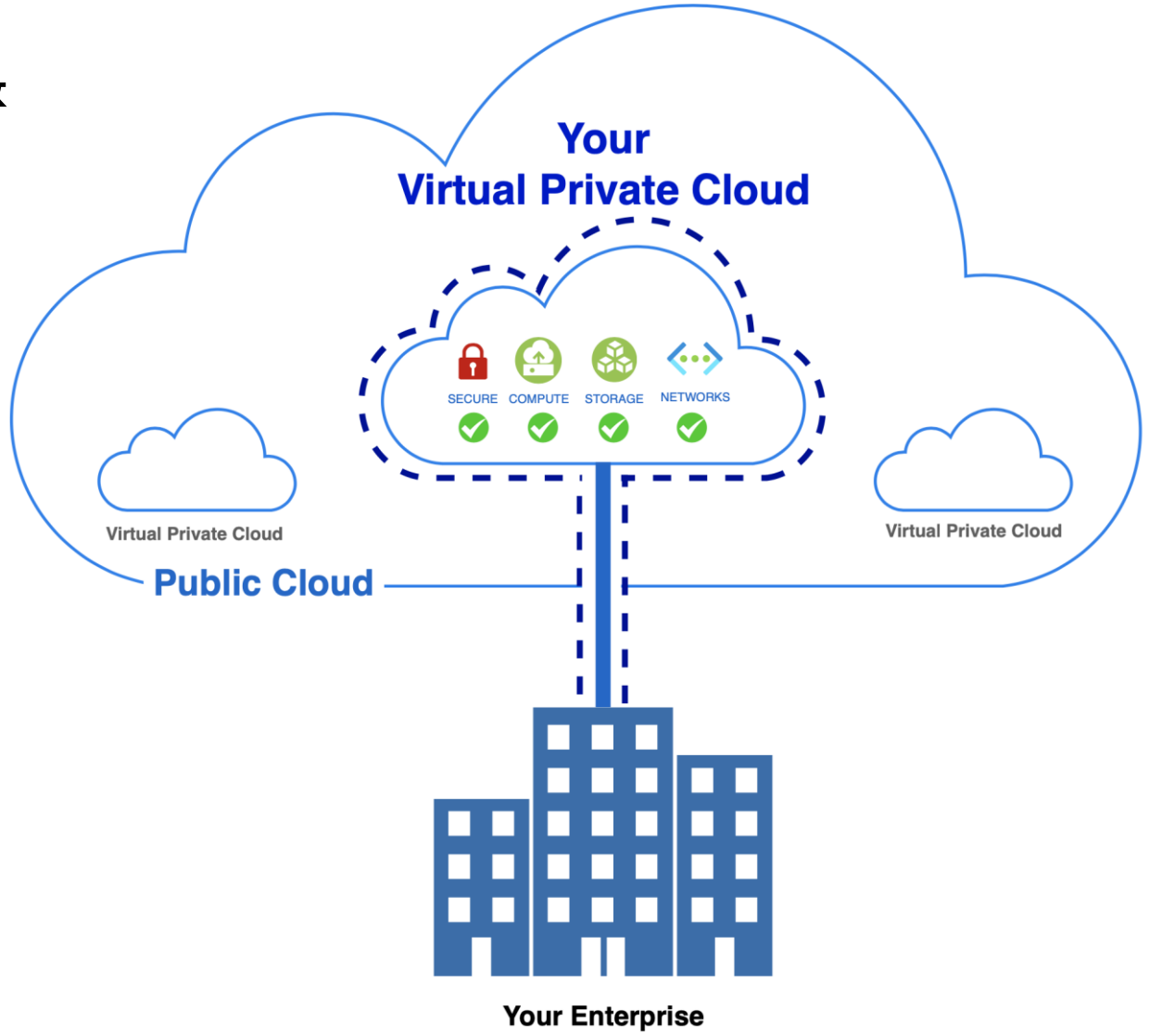
the **availability**, **cost effectiveness** and **scalability** of the public cloud

What is Virtual Private Cloud – Isolation & Security?

What is logical **isolation** & **security** of a private cloud?

A configuration that prevents devices which share a physical network infrastructure, from being able to communicate with each other.

A private secure isolated network which never touches the public internet. Provides a way to share data safely and independently. (members only)

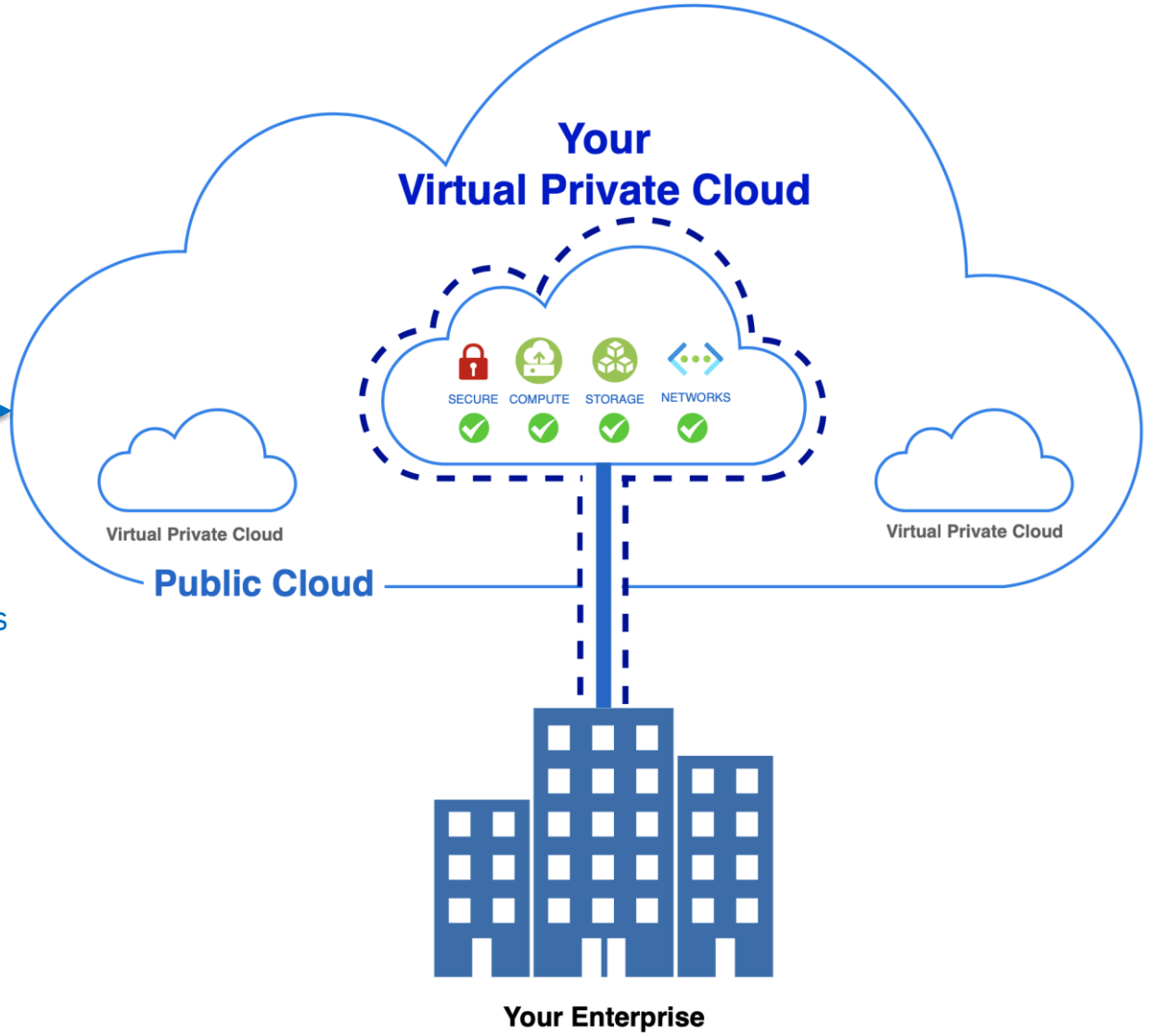


What is Virtual Private Cloud – Availability, Cost, Scale?

What is **availability**, **cost effectiveness** & **scalability** of the Public Cloud?

- Available anytime anywhere
- Pay-as-you-go (PAYGO), and subscription pricing models
- Ability to grow or scale (up or down) compute, storage, and/or network speeds.

  Elasticity for bursting (cloud bursting) from on-premise infrastructure into the public cloud to meet sudden or seasonal demand.

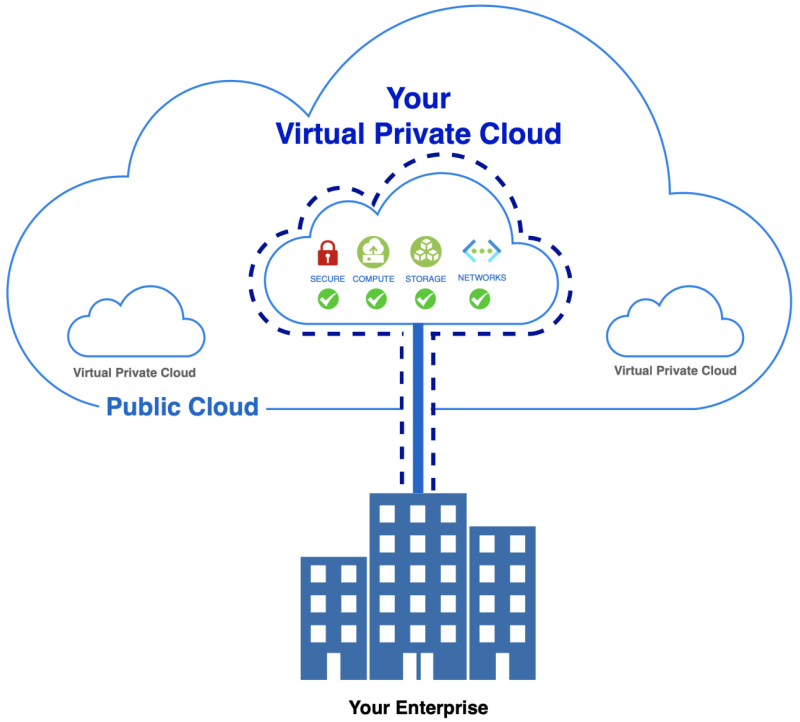


Virtual Private Cloud is?

1. A fully virtualized network within a customer account.
2. Offers fine grain control of network traffic.
3. Self-managed network services.
4. Customer defined network topology.
5. Deploy compute, storage & networks.
6. A developer-friendly API, CLI, and UI

You can fine grain control & self-manage:

- VPCs deployed in Multi-zone Regions Globally
- Virtual Servers VSIs, Bare metal BM, & Kubernetes
- Multiple vNics (4x16Gbps) up-to 80 Gbps
- Subnets
- Access Control Lists (ACLs)
- Security Groups (Micro Segment resources)
- Virtual Network Functions (VNFs)
- Load Balancers, Gateways, Direct Links
- Auto-scale Groups
- Snapshots

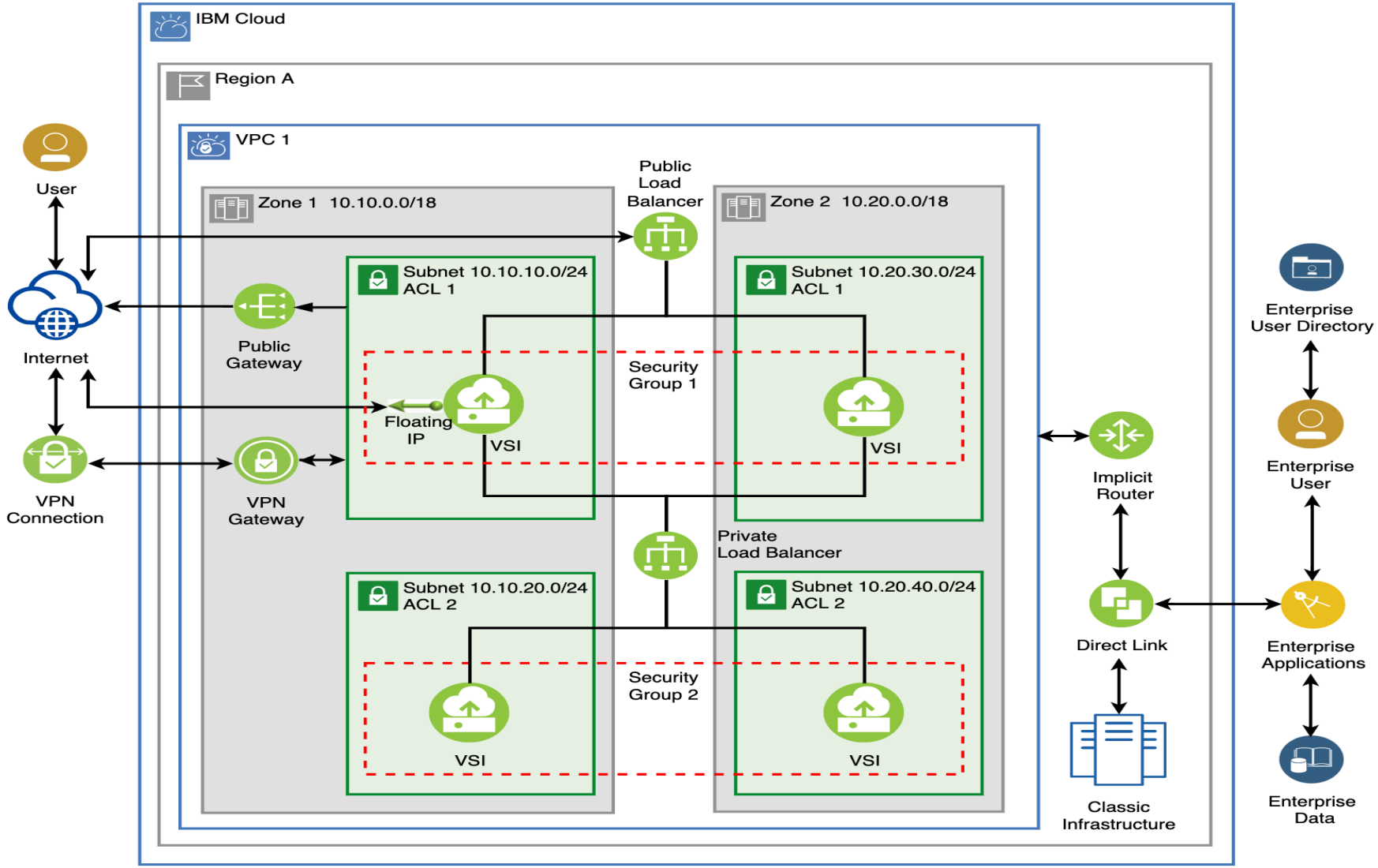


- ✓ A network of devices, servers, virtual machines, and data centers that are **connected through software technology**.
- ✓ A method of **controlling who can access** certain **data**.
- ✓ Autonomy; instead of controlling the network elements individually and directly, the admins define network-wide policies and rules that guide the **self-management** process.
- ✓ **Topology** is an arrangement of the elements of a communication network.
- ✓ **Compute = hardware infrastructure**, **storage = is computer data storage technology** consisting of recording media that is used to retain digital data. **Networking = a set of compute and storage sharing resources** located on or provided by network nodes.
- ✓ **API = application programming interface** (REST) is used by programmers to create applications or interface between modules. **CLI = command-line interface** is used to process commands in the form of lines of text. **UI = user interface** is a graphical layout of an application.

Virtual Private Cloud Toolbox

Public Gateway		Virtual Server Instance (VSI)	
Load Balancers		Bare Metal Instance	
Transit Gateway		Power VS Instance	
Internet Services		Block Storage	
Floating IP		Object Storage	
Virtual Private endpoints		Cloud Backup	
VPN		Cloud Services	

Sample VPC deployment



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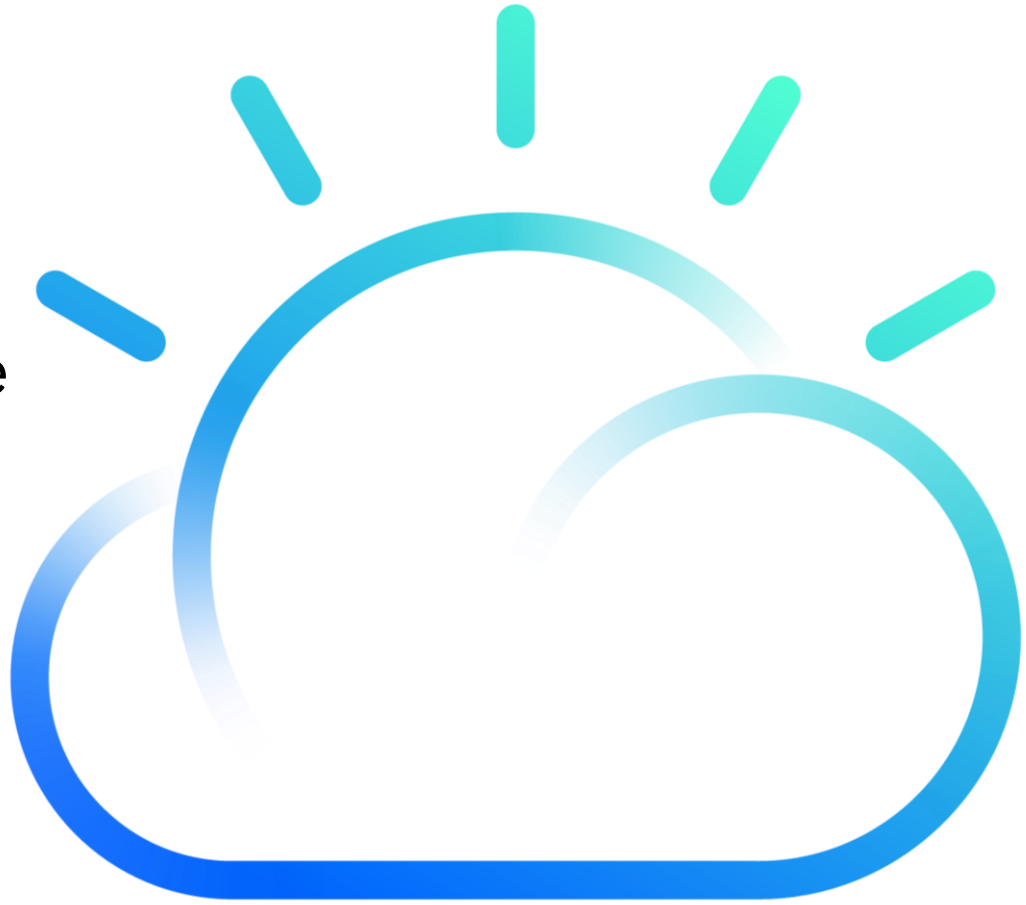


IBM **Cloud**

Why Virtual Private Cloud?

Client Value:

- ✓ Reduce CapEx on traditional IT network devices (routers, switches, load balancers, firewalls, etc.)
- ✓ IBM Cloud leads as a **secure**, **trusted**, and **industry ready** cloud
- ✓ VPC is a "**Purpose built**" cloud services platform for **Power VS**, **VMware**, **SAP**, **IBM Z**, and **x86** leveraging IBM **business process approach**, **domain knowledge and expertise**
- ✓ Focused on our client's journey to hybrid IaaS, PaaS, and platform solutions

Virtual Private Cloud (VPC) **Key Value Advantages**

2019 IBM WINNERS

GOOD DESIGN AWARD® WINNER

Hyperscale rapid provisioning, **1000 VM's in less than 4 mins** consistently

Best in class networking performance between VPC servers – **up to 80 Gbps** for general purpose Virtual Server profiles

Developer friendly, industry norms and

Security – Support for KYOK/BYOK data protection, & with the **highest level of FIPS certification**, 140-2 Level 4

Resiliency – **99.99% SLA availability** across 9 Multizone Region (MZRs) to handle outages.

REST-based API aligned to easily integrate with existing tools

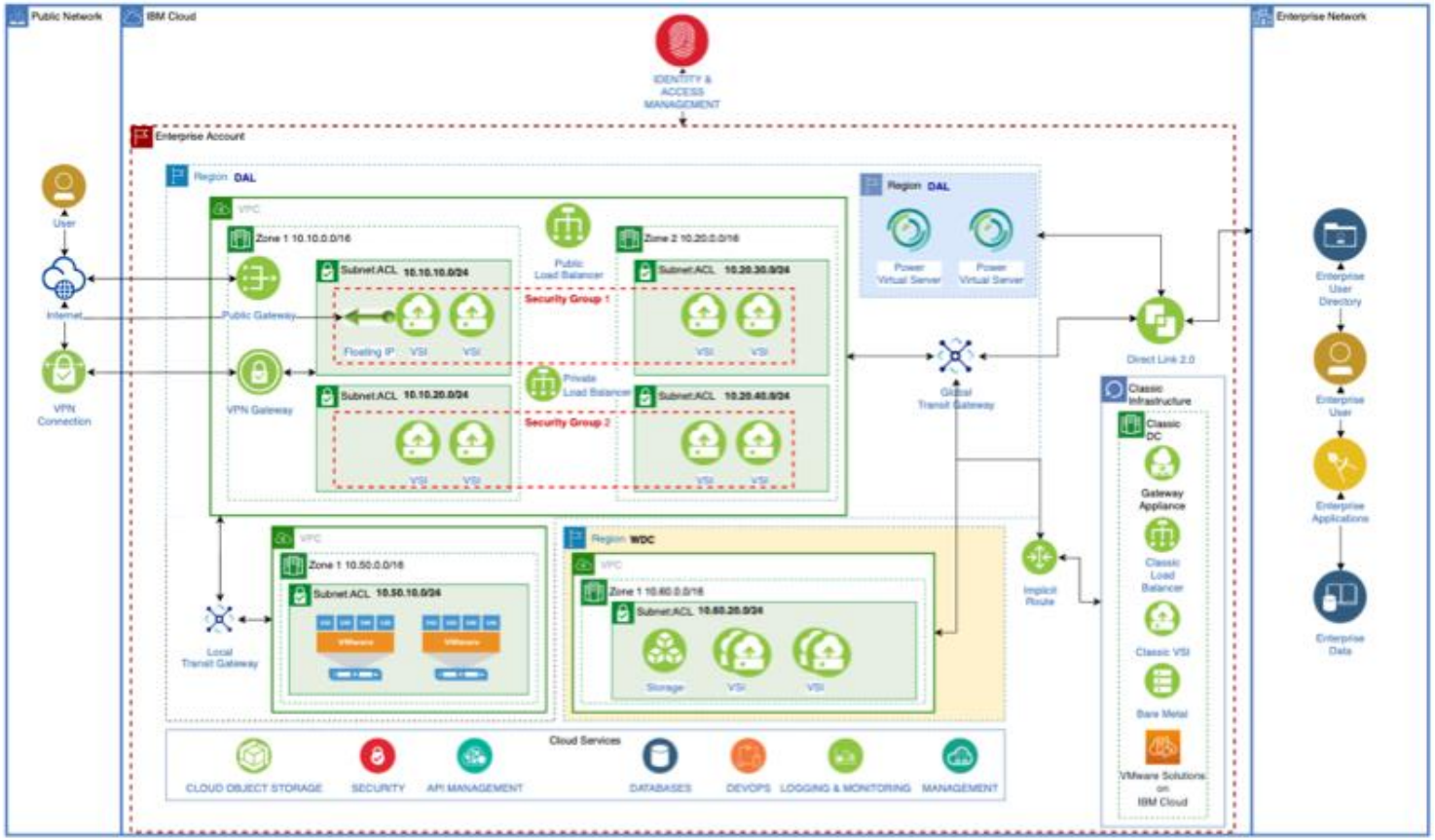
Virtual Private Cloud Benefits

Agility: Control the size of your virtual network and deploy cloud resources whenever your business needs them. You can scale-in or scale-out these resources dynamically and in real-time.

Availability: Redundant resources and highly fault-tolerant availability zone architectures mean your applications and workloads are highly available.

Security: Because the VPC is a logically isolated network, your data and applications won't share space or mix with those of the cloud provider's other customers. You have full and granular control over how resources and workloads are accessed, and by whom.

Affordability: VPC customers can take advantage of the public cloud's cost-effectiveness with Pay-as-you-go Pricing Model for the resources in VPC.



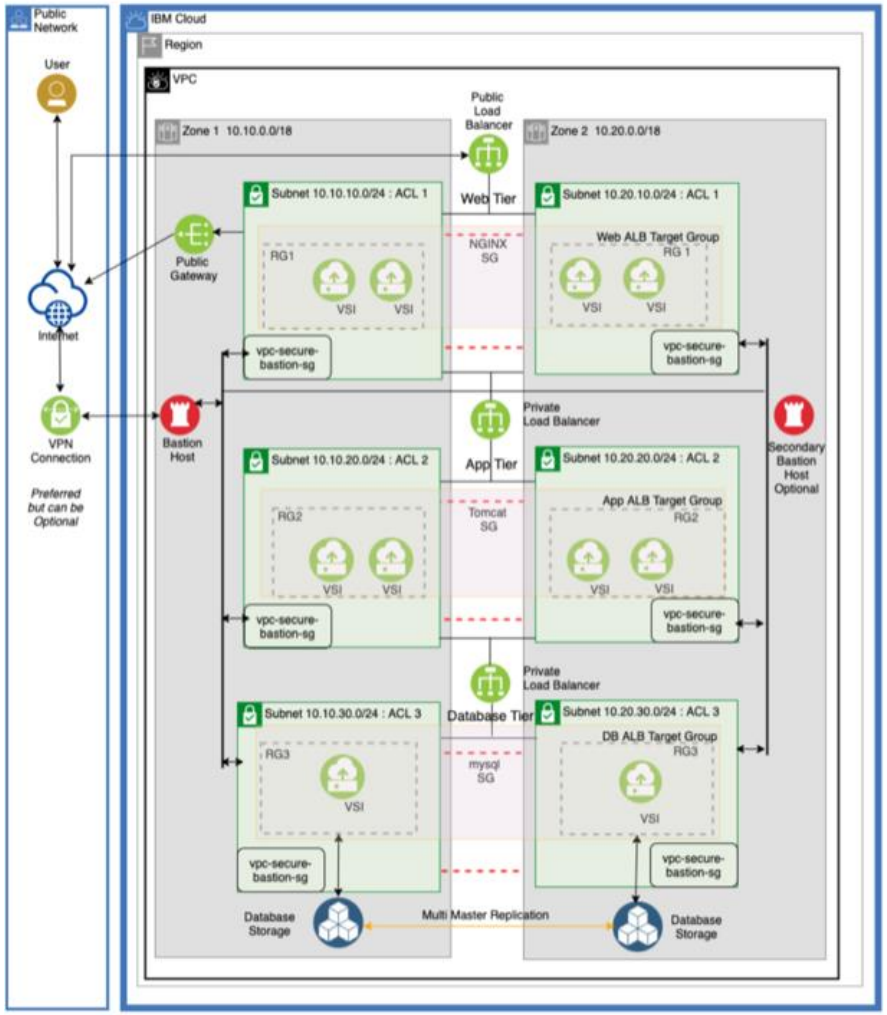
Virtual Private Cloud – Feature Capabilities

COMPUTE	STORAGE	NETWORK	ENABLING SERVICES	PLATFORM
• Virtual Server Instances (VSIs)	• Block Storage	• Access Control List (ACLs)	• Auto-scale Groups	• Multi-zone Regions (MZRs)
• Bare Metal on VPC	• File Storage	• Security Groups (micro segmentation of subnets)	• Volume Snapshots	• Availability Zones (AZs)
• VMware on VPC	• Cloud Object Storage (COS)	• Transit Gateway	• BaaS via Snapshots	• Affinity
• Power VS on VPC	• Snapshots	• Direct Link	• Veeam Backup	• Databases
• Profiles (Balanced, Compute, Memory, Ultra-high Memory, High Memory, GPUs)		• VPN Gateway • VPE • Firewalls • DNS	• Observability services with LogDNA and Sysdig	• IBM Cloud Kubernetes
• Images (Linux, RedHat, Microsoft, & more)		• Load Balancers (NLB, ALB, sDNLB)	• Flow Log for VPC IP Network Traffic Logging to COS Buckets	• RedHat OpenShift on IBM Cloud
• IBM Z		• 16Gbps vNICs up to 4 per VSI (80 Gbps)	• Terraform • Schematics	• Security • IAM
		• SSL/TLS • WAF	• BYOK/KYOK	• Financial Services Cloud (FS) ready
		• IPv4 (only) • Floating IP	• SSH • API REST-based • CLI, UI	• IBM Cloud Monitoring, IBM Cloud Log Analysis

Virtual Private Cloud provides:

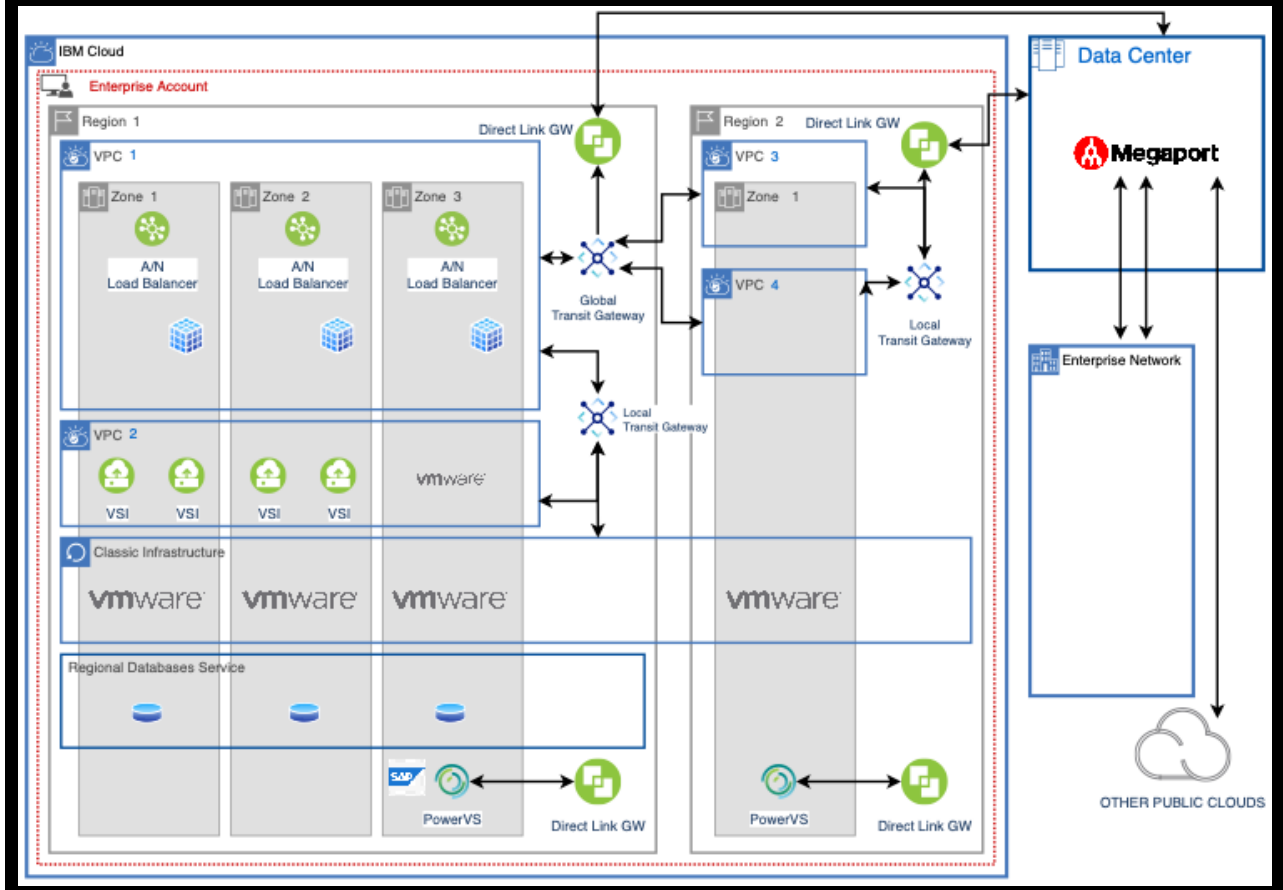
Solid Developer & Rapid Provision Experiences

A developer can build, deploy and have running a basic 3-tier Web Application on **VPC Infrastructure** in 30 mins or less, **using the same tools and techniques they are familiar with.**



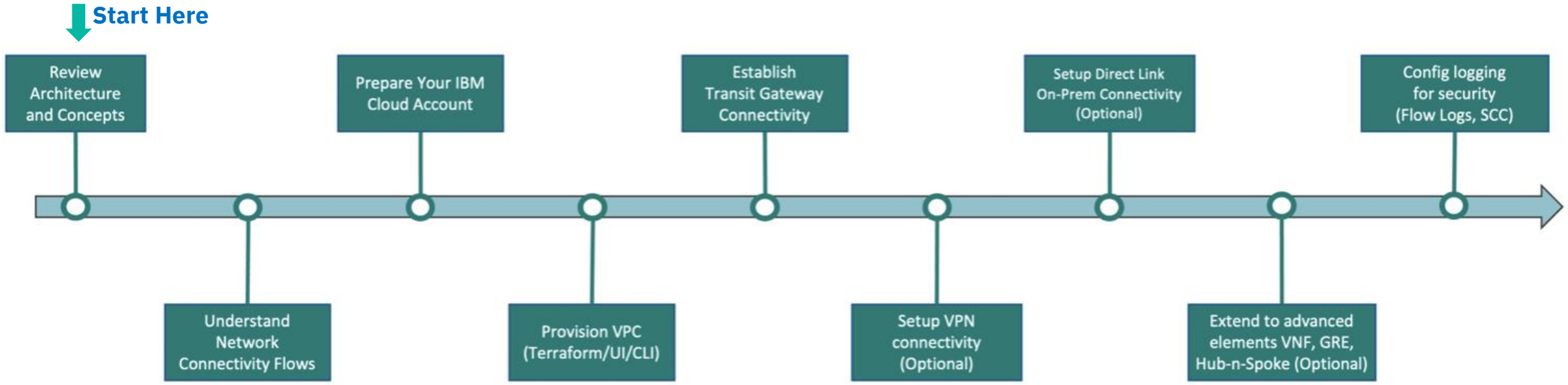
Strong Connecitivty

A network administrator can connect their VPC to existing networks, whether IBM Classic Infrastructure or their on-premises network (or both) **to leverage their existing investments.**



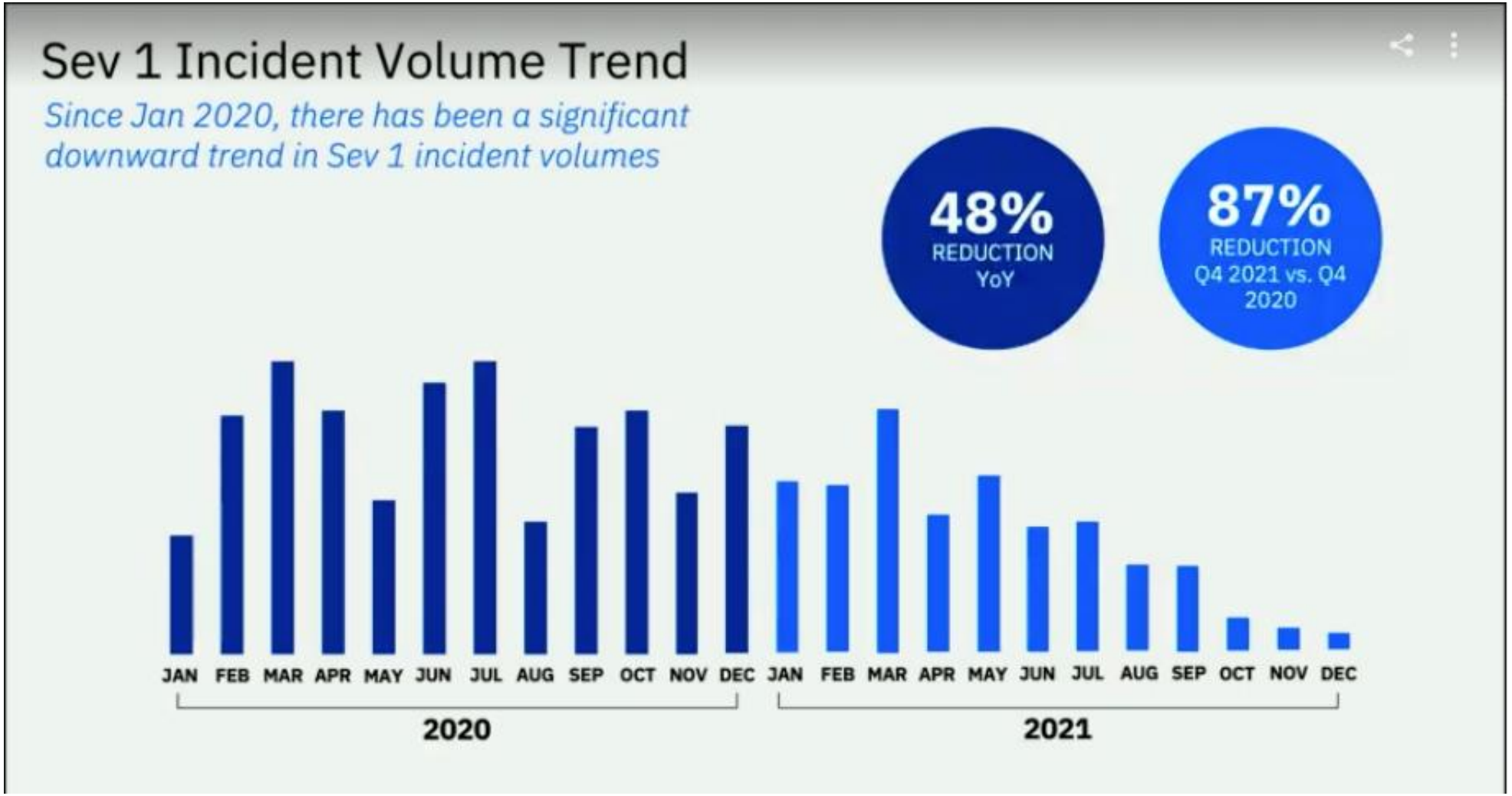
A Virtual Private Cloud Deployment Journey – Journey Overview

IBM Cloud® Virtual Private Cloud(VPC) allows you to establish your own virtual private cloud by defining a virtual network that is logically isolated from all other public cloud tenants. The underlying software defined networking (SDN) and virtual network functions allow you to quickly establish the network constructs and on-premise connectivity needed to run your workload. The image below is a map to your IBM Cloud VPC journey which will lead you towards a fully configured VPC network environment.



Click her to start the journey today!

Why Virtual Private Cloud on IBM Cloud? – Continuous Improvement



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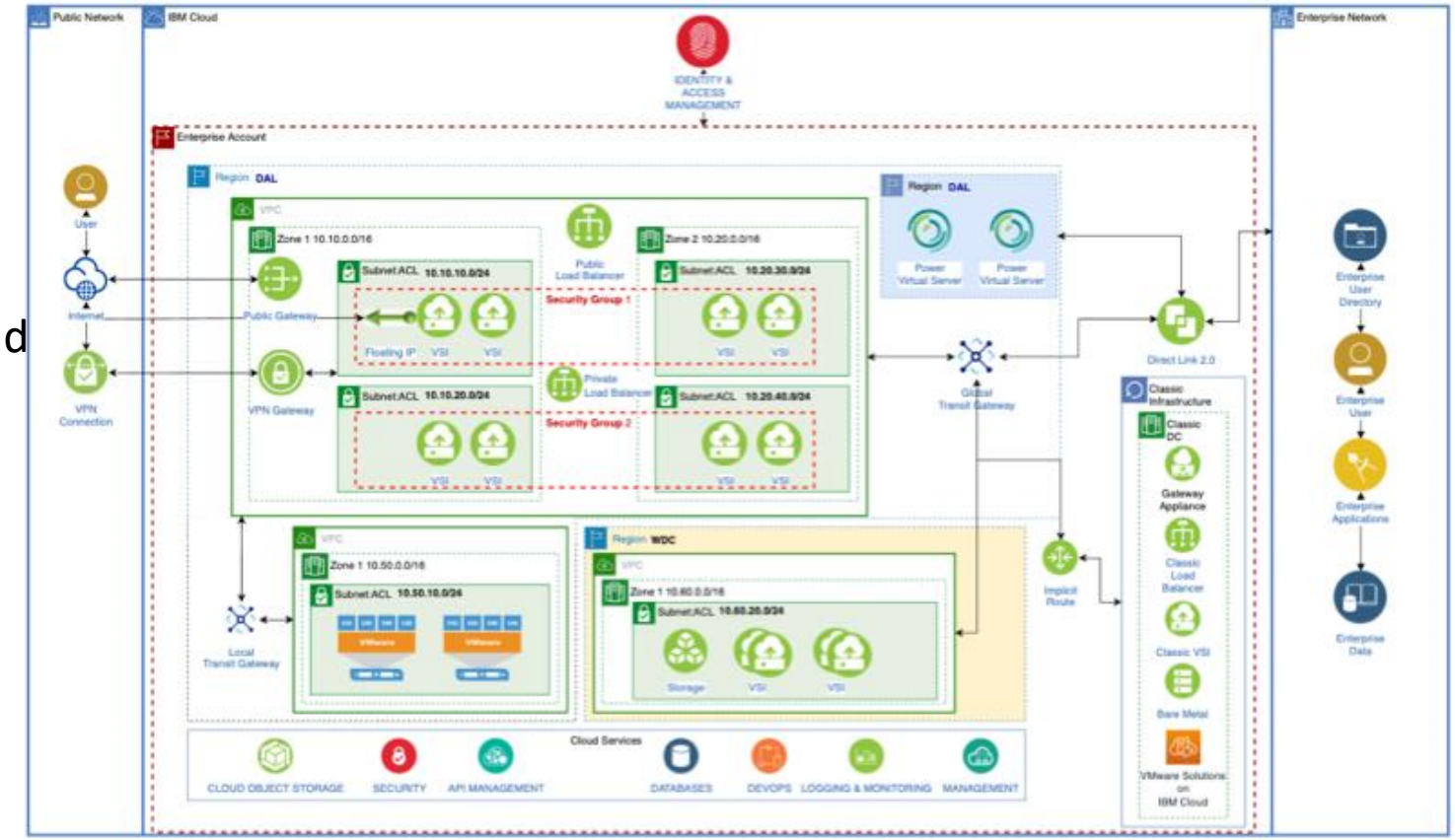
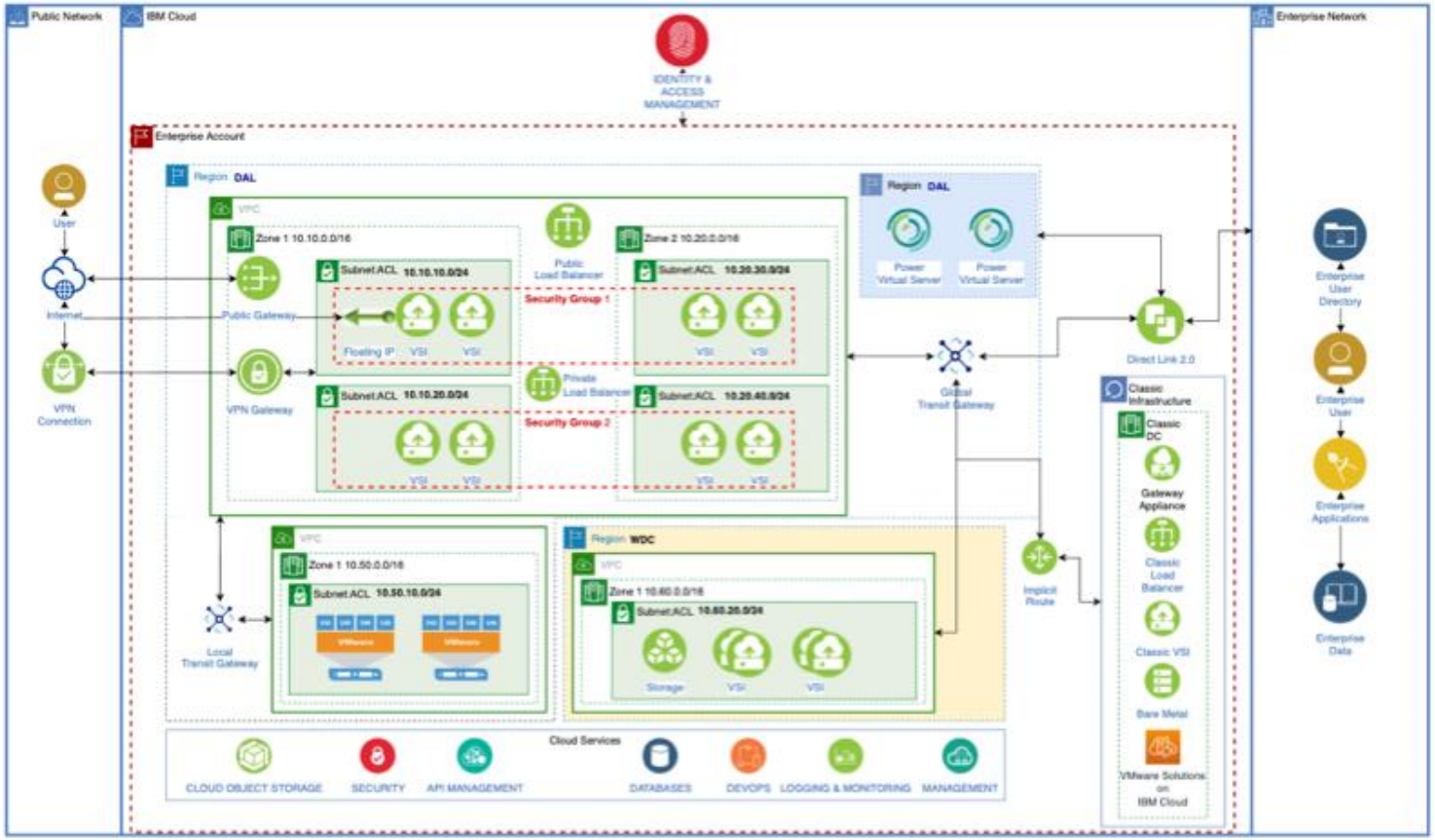


Why Virtual Private Cloud?

2. Differentiated Value:

- ✓ Composability of VPC
- ✓ Rapid provisioning of VSIs or BM
- ✓ Up-to **80 Gbps performance** with multiple vNICs (16Gbps per vNIC)
- ✓ IBM **meet clients where they are**, and supports their entire cloud journey
- ✓ Autonomous network & security management
- ✓ Technical assurance that **only clients can see their data**
- ✓ Enterprise scale
- ✓ Proven regulatory compliance FIPS 140-2
- ✓ Enable workloads anywhere, any cloud, on-premise and the edge



IBM Cloud – Classic and Virtual Private Cloud (VPC) Comparison

Classic Infrastructure	VPC Infrastructure
Network isolation Using Physical Networking Devices.	Network isolation Using software Defined Networking (SDN).
Single datacenter redundancy using pods	Multi availability Zones and regional redundancy using MZR datacenter architecture
Hybrid Connectivity using IPSec VPN and Direct link exchange	Hybrid Connectivity using Site to Site VPNaaS, Client to Site VPNaaS, Direct Link Connect, Direct Link dedicated, and Direct Link Hosted
Network functions are available primarily using physical and virtual appliances from multiple vendors with some as-a-service.	Cloud native, as-a-service network functions for key function such as VPNs, Firewalls, Load Balancing (GLB, private, public) and Virtualized Network functions from third party vendors.
Ideal for Lift and shift workloads	Ideal for cloud native as well as Lift and Shift workloads with scalability requirements.

Classic Infrastructure and VPC Infrastructure are cost neutral at launch.
Direct customers to the environment that best fits their use cases.

IBM

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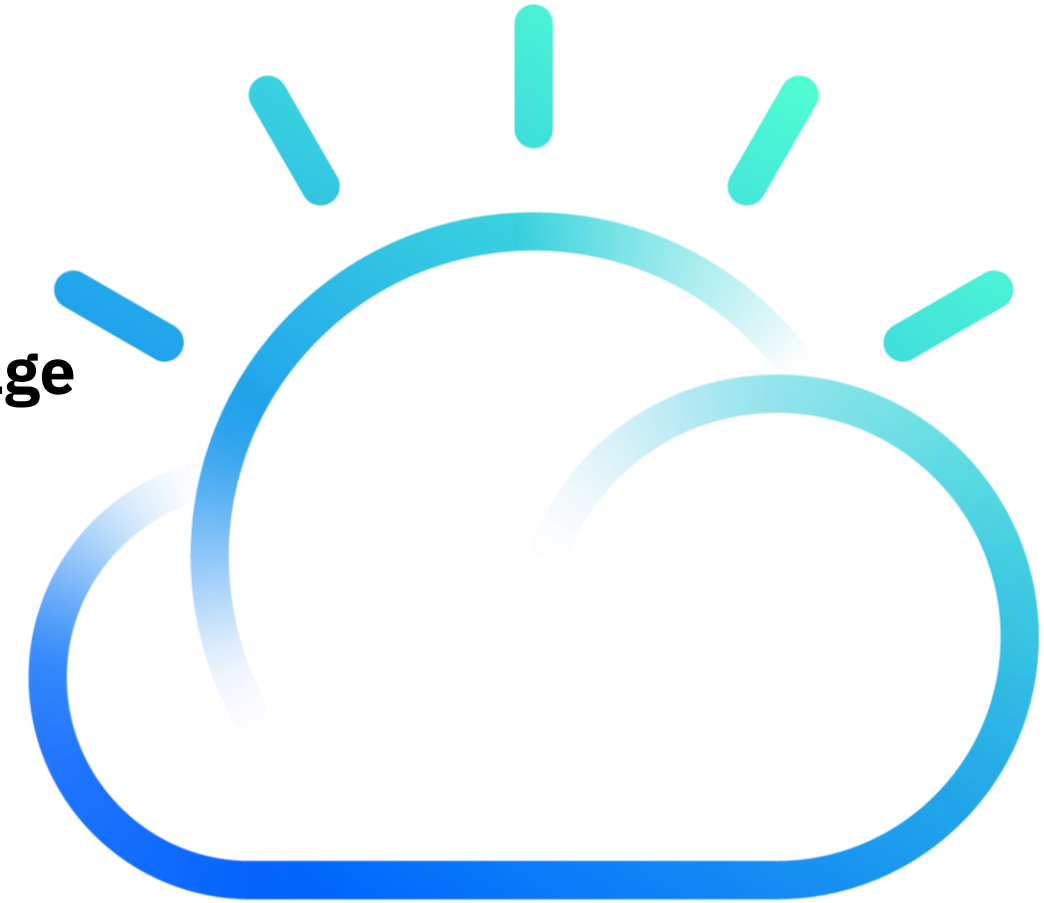

IBM **Cloud**

VPC Virtual Server Instance (VSI) – Provisioning Performance

5X

Performance improvement

40s

100-vm provisioning time

156s

1000-vm provisioning time

VPC Virtual Server Instance (VSI) Profile Families

Name	Short Name	Ratio	Description	HW	Availability
Balanced	bx2	1 vCPU : 4 GiB	Profiles provide a mix of performance and scalability for more common workloads		WW GA
Balanced w/ Instance Storage (IS)	bx2d	1:4 + 37.5 GB /vCPU			
Compute	cx2	1:2	Compute profiles are best for workloads with intensive CPU demands, such as high web traffic workloads, production batch processing, and front-end web servers		WW GA
Compute w/ I.S.	cx2d	1:2 + 37.5 GB /vCPU			
Memory	mx2	1:8	Memory profiles are best for memory intensive workloads such as intensive database applications, or in-memory analytics workloads		WW GA
Memory w/IS	mx2d	1:8 + 37.5 GB /vCPU			
Very High Memory	vx2d	1:14 + 30GB /vCPU	Best for medium-sized in-memory databases and OLAP data stores that need a moderate amount of compute and lots of memory		WW GA (Except SAO)
Ultra High Memory	ux2d	1:28 + 30GB /vCPU	Optimized to run large in–memory databases and OLTP workloads such as SAP HANA which don't need much compute power but require a very large amounts of memory. Featuring memory rich profiles up to 5.7 TB.	Intel Platinum Cascade Lake 8280Ls	DAL, FRA (LA)
Storage Optimized	ox2	1:8 + 300GB /vCPU	Tailored for modern data and transaction-intensive workloads such as relational and NoSQL databases, distributed file systems, search engines, and data warehousing apps like Hadoop, GPFS, Lustre, GlusterFS with 30GB of local SSD per vCPU.	Host varies, NVIDIDIA V100 GPU w/ 16GB	LA – 1Q '22 GA – 3Q '22
V100 GPUs	gx2	Varies, no IS	GPU-enabled instances allow clients to run workloads with more powerful compute capabilities using NVIDIA GPUs. Machine Learning, Deep Learning, AI graphical rendering, and simulations require GPUs to compute at efficiency and scale	Host varies, NVIDIDIA V100 GPU w/ 16GB	WW GA

VPC Virtual Server Instance (VSI) – Operating System Overview

	What we Offer	How to Buy	Licensing Model	Limitations

Virtual Servers for VPC
 	
Learn more
	CentOS:
	• CentOS 8.4 = EOS 31 DEC 2021
	• CentOS 8.3 - EOS 31 DEC 2021
	• CentOS 7.9 – EOS 30 JUN 2024
	Debian:
	• Debian 11 – MAR 2022
	• Debian 10.8 – EOS 1 JUN 2024
	• Debian 9.13 – EOS 1 JUN 2022
	Fedora:
	• Fedora Core 34 – EOS MAY 2022
	Red Hat Enterprise Linux (RHEL):
	• RHEL 9 – MAY 2022
	• RHEL 8.6 – MAY 2022
	• RHEL 8.4 – EOS 30 MAY 2023
	• RHEL 8.3 – EOS 30 APR 2021
	• RHEL 8.2 – EOS 30 APR 2022
	• RHEL 8.1 – EOS 30 NOV 2021
	• RHEL 9 for SAP – TBD
	• RHEL 8.6 for SAP – MAY 2022
	• RHEL 8.4 for SAP – EOS 30 MAY 2025
	• RHEL 8.2 for SAP – EOS 20 APR 2022
	• RHEL 8.1 for SAP – EOS 30 NOV 2023
	• RHEL 7.9 for SAP – EOS 30 JUN 2024
	• RHEL 7.6 for SAP – EOS 31 OCT 2022
	Rocky Linux:
	• Rocky Linux 8.6 – JUN 2022
	• Rocky Linux 8.5 – EOS APR 2022
	SUSE Linux Enterprise Server (SLES):
	• SLES 15 SPR – Q2 2022
	• SLES 15 SP3 – EOS release SP4 + 6 months
	• SLES 15 SP2 – EOS 31 DEC 2024
	• SLES 15 SP1 – EOS 31 JAN 2024
	• SLES 12 SP5 – EOS 31 OCT 2024
	• SLES 12 SP4 – EOS 30 JAN 2023
	Windows Server:
	• Windows Server 2022 – MAR 2022
	• Windows Server 2019 – EOS 9 JAN 2029
	• Windows Server 2016 – EOS 11 JAN 2027
	• Windows Server 2012 r2 – EOS 10 JAN 2023
	• Windows Server 2012 – EOS 10 JAN 2023
	Ubuntu:
	• Ubuntu 22.04 – April 2022
	• Ubuntu 20.04 – EOS 30 APR 2025
	• Ubuntu 18.04 – EOS 30 APR 2023
	• Ubuntu 16.04 – EOS 1 APR 2022
		View pricing	• **CentOS:** This Guest OS is a free version. For more info, see CentOS.
			• **Debian:** This Guest OS is a free version. For more information, see Debian.
			• **Fedora:** This Guest OS is a free version. For more information, see Fedora.
			• **Red Hat Enterprise Linux (RHEL):** This Guest OS is a paid version -pay as you go- & BYOL. For more information, see RHEL.
			  ○ BYOL: For RHEL, you can bring your own license (BYOL) to the IBM Cloud® VPC when you import a custom image. These images are registered and licensed by you. You maintain control over your license and incur no additional costs by using your license. Acquisition and activation of the license is between you and the OS vendor. BYOL is not supported on RHEL for SAP. For additional information, see BYOL on IBM Cloud
			• **Rocky Linux:** This Guest OS is a free version. For additional information, see Rocky Linux.
			• **SUSE Linux Enterprise Server (SLES):** This Guest OS is a paid version -pay as you go-. For additional information, see SUSE Linux Enterprise Server (SLES).
			• **Ubuntu:** This Guest OS is a free version. For additional information, see Ubuntu.
			• **Windows Server:** This Guest OS is a paid version -pay as you go- & BYOL. For additional information, see Microsoft Windows Server.
			  ○ BYOL: For Windows® operating systems, you can bring your own license (BYOL) to the IBM Cloud® VPC when you import a custom image on dedicated hosts only. Windows BYOL custom images cannot be used to provision public instances. These images are registered and licensed by you. You maintain control over your license and incur no additional costs by using your license. Acquisition and activation of the license is between you and the OS vendor. For additional information, see BYOL on IBM Cloud
				• Red Hat does not currently support VPC due to the underlying hypervisor. While this is limiting the introduction of new Red Hat offerings, IBM and Red Hat teams are in discussions to resolve this issue.

VPC Bare Metal (BM) – Operating System Overview

	What we Offer	How to Buy	Licensing Model	Limitations
Bare Metal for VPC Learn more	**VMware:** • ESXi 7.0 **Coming soon (end of Q1/early Q2):** • Ubuntu • Red Hat Enterprise Linux (RHEL) • Windows Server • Debian • Custom Images	View pricing	• VMware ESX is prorated CPU per month per sever pricing. • You can license the ESXi hypervisor that is installed on a bare metal server with your own license (bring-your-own-license), or IBM can handle the licensing for you. • You can specify how a bare metal server is licensed by selecting from different ESXi image options: "ESXi 7.x BYOL" or "ESXi 7.x". • The "ESXi 7.x BYOL" option provides ESXi in evaluation mode. The evaluation period is 60 days and begins at the time of provisioning. At any time during the 60-day evaluation period, you can convert from evaluation mode to licensed mode with your appropriate customer provided license. • The "ESXi 7.x" option provides ESXi in licensed mode and is activated during the provisioning process. Billing applies for IBM rented licenses.	• Only support ESXi version 7.x • VMware ESXi on a Bare Metal Server for VPC is charged monthly and is calculated on a per CPU based on the selected profile. If you choose to rent VMware ESXi with your server, you are subject to a prorated monthly cost for the license instead of an hourly rate. Proration amount is variable based on your billing anniversary date.

IBM Cloud & VPC – Microsoft Options

- All offerings are Paygo, except where BYOL is indicated
- *= selected configurations
- Windows RDS SALs on IBM Cloud are sold only for Classic through Support tickets and offered in packages of 5 licenses.
  - RDS=Remote desktop service
  - SAL=Subscriber Access License

Microsoft Offerings	Classic		VPC	
	BM	VSI	BM	VSI
Windows Server	☑ *(Billed* mo/1-year/3-year)* v2022 -> Std (1Q) v2019 -> Std, DC, DC w/HV v2016 -> Std, DC, DC w/HV	☑ *(Billed* hr/mo)* v2022 -> Std (3Q) v2019 -> Std v2016 -> Std v2012 -> Std v2012 R2 -> Std, DC v2008 R2 - > Std RDS as SAL	V2022 -> Std (1Q) V2019 -> Std (1Q)	☑ *(Billed* hourly)* v2022 -> Std (1Q) v2019 -> Std Full, Core v2016 -> Std Full, Core v2012 -> Std Full v2012 R2 -> Std Full BYOL only Dedicated Hosts
SQL Server	☑ *(Billed* mo/1-year/3-year)* v2019 -> Std, Ent, Web v2017 -> Std, Ent, Web v2016 -> Std v2014 -> Std	☑ *(Billed* monthly)* v2019 -> Std, Ent, Web v2017 -> Std, Ent, Web v2016 -> Std v2014 -> Std	⊘	☑ BYOL only Dedicated Hosts
Bundle: Windows Server + SQL Server	⊘	⊘	⊘	Windows v2019 Std + SQL Server v2019 Web (2Q)

Bare Metal Servers for VPC

Initial release of bare metal will support VMware ESXi 7 users in our two most popular MZRs. BMVPC aims to offer 4CPU and 2CPU fixed profiles that can address ~90% of VMware server configs found in Classic BM today.

Post launch items include 2CPU profiles and more image support for Linux & Windows images.

Available in limited Gen2 MZRs at GA:

- DAL
- FRA

- Will develop into a standard offering in new Gen2 MZRs

Key Benefits:

End user managed virtualization

Bare metal performance profiles w/o KVM hypervisor

Priced hourly

Key Capabilities:

- 2CPU and 4CPU profiles ranging from 16 to 96 physical cores
- 100 Gbps network uplinks supporting customer managed virtual NICs
- VMware ESXi 7 is first major OS supporting rented and BYOL licensing

Market:

- This is a standard offering from major cloud providers namely AWS and Azure.
- Instance-like bare metal is the standard for hyperscaler cloud providers.

Bare Metal Servers (BM) for VPC – Benefits

In addition to natively landing within VPC for its advantages across compute, networking, and storage, BM VPC provides:

- Dedicated single tenancy
- Hardware level performance
- Larger core and memory profiles
- 4x faster network performance
- Customer managed virtualization

Bare Metal Comparison

Category	Classic infrastructure	VPC infrastructure*
Provisioning	2 to 4 hours	~10 minutes
HW configurations	Thousands of HW combinations and highly customizable servers	Fixed profile sizes (S/M/L/XL)
OS Support	No-OS VMware RedHat Windows CentOS Ubuntu Debian Citrix OS Nexus FreeBSD	VMware ESXi 7.0u1 Custom Image** RedHat** Ubuntu** Windows**
Storage options	Flexible HDD, SSD, NVMe File storage Block Storage	JBOD NVMe secondary storage File Storage Block Storage**
Networking options	100 Mbps, 1 Gbps, 10 Gbps, 25 Gbps	100 Gbps
Availability	All MZRs, SZRs	DAL, FRA
Billing options	Limited hourly configs & locations Monthly Reserved	Hourly

*Indicative of service readiness at time of public release
**Roadmap items

Volumes vs. Instance Storage

	Volume	Instance Storage
Block Device	Yes	Yes
Life Cycle	Independent	Tied to Instance
Attachable	Yes	No
Bootable	Yes	No
Reliable	Yes	No – disk may fail
Resizable	Yes	No
Performance	Up to 20 IOPs / GB	>60 IOPS / GB
Live Migratable	Yes	No
Cost	Mid –to High	Low

Instance Storage and Remote Volumes are ***complementary***.

Instance Storage is prime for hot data – caches, scratch space, data requiring low latency

Volumes store reliably on remote storage & provide more capabilities.

I/O Performance Comparison

Same speed at drive level, 2X the density

	Volumes				Instance Storage		
Performance Per GB	**3 IOP**	**5 IOP**	**10 IOP**	**20 IOP**	**Virtio**	**NVMe Passthru (3.2 TB)**	**NVMe Passthru (6.4 TB)**
Read IOPs	3	5	10	20	190	199	102
Write IOPs	3	5	10	20	69	69	33
Read Bandwidth	0.048 MB/s	0.08 MB/s	0.16 MB/s	0.32 MB/s	0.76 MB/s	1 MB/s	0.5 MB/s
Write Bandwidth	0.048 MB/s	0.08 MB/s	0.16 MB/s	0.32 MB/s	0.27 MB/s	0.95 MB/s	0.5 MB/s
Max Disk BW	750 MB/s				1.5 GB/s	2 GB/s	
Max Disk Size	16 TB	9.6 TB	4.8 TB	2.4 TB	900 GB	3.2 TB	6.4 TB
Price	$0.12	$0.16	$0.48	$1.50	$0.08	Roadmap	

Key Differences:

- Volumes marry IOPs to Bandwidth, delivering linear performance across all block types
- Instance Storage uses separate IOP and Bandwidth rate limiters

Due to expected workloads types, this was needed. This model delivers:

- Significantly higher small block I/O performance
- Fairly sizable bandwidth improvements

Remember, Volumes and Instance Storage are complimentary solutions.

- Instance Storage is **ephemeral** storage, where data will be lost on an instance shutdown or a disk failure.
- Volumes are **persistent** storage, where data is reliable and has an independent lifecycle from the VSI itself
- Disks and Volumes can be used concurrently on the system, and have **independent** bandwidth

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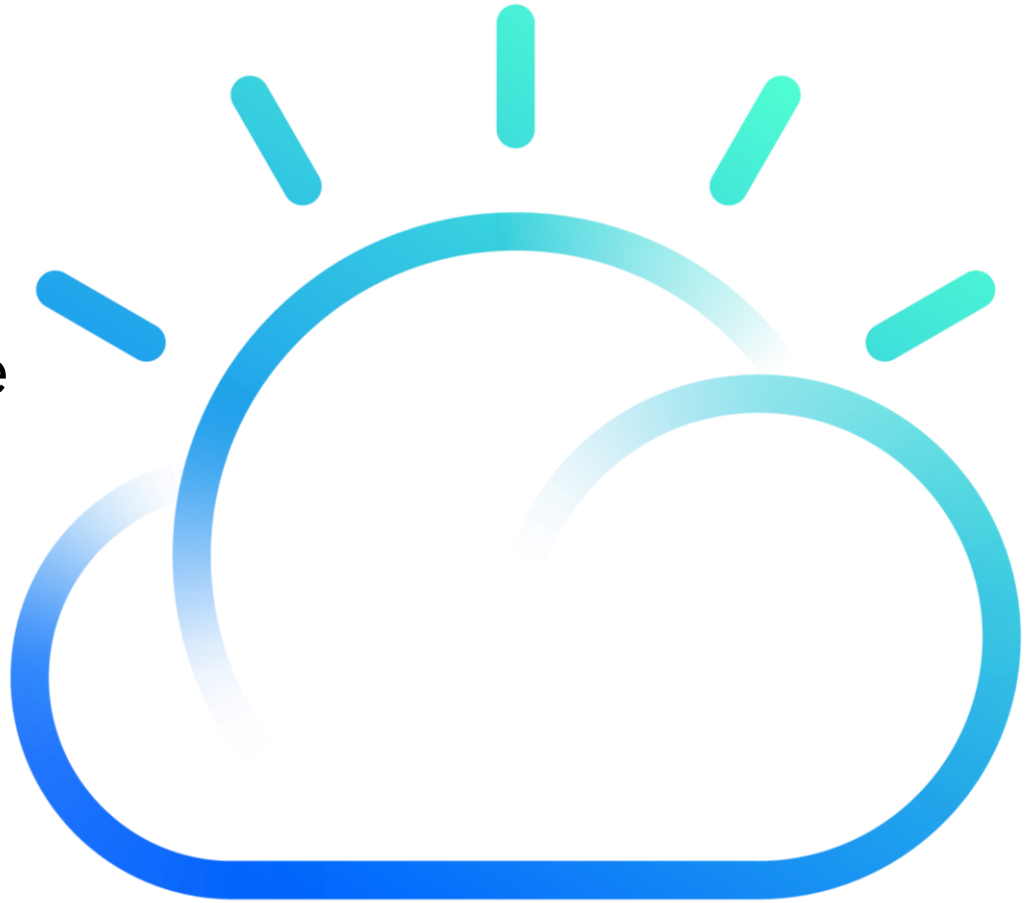
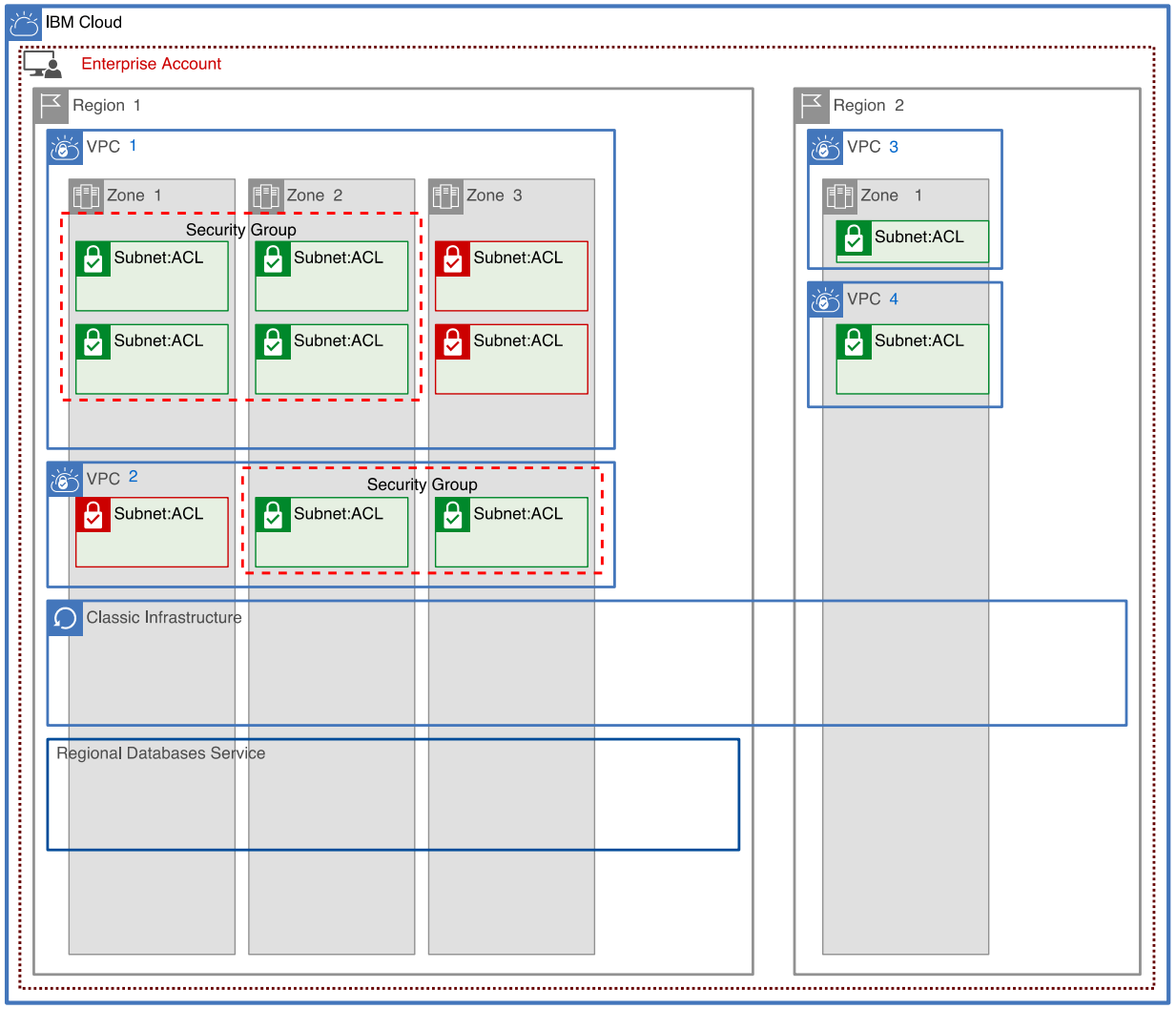
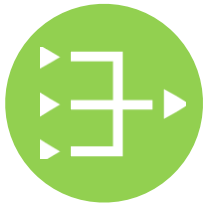


IBM **Cloud**

Virtual Private Cloud (VPC) – Key Feature Symbols





PUBLIC GATEWAY

VPN

DIRECT LINK

FIP

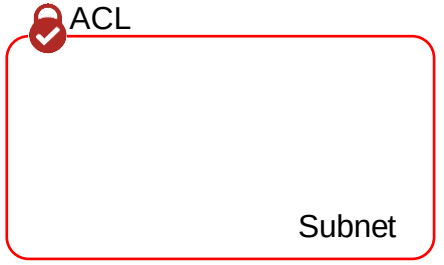
FLOATING IP

LOAD BALANCER

CONTAINERIZED APPS

VIRTUAL MACHINE

BLOCK STORAGE



KUBERNETES SERVICE

Virtual Private Cloud (VPC) – Multi-zone Regions, Availability Zones, & Subnets

Multi Zone Regions (MZR)

- An IBM Cloud region with three availability zones that are logically and physically independent from one another but networked together

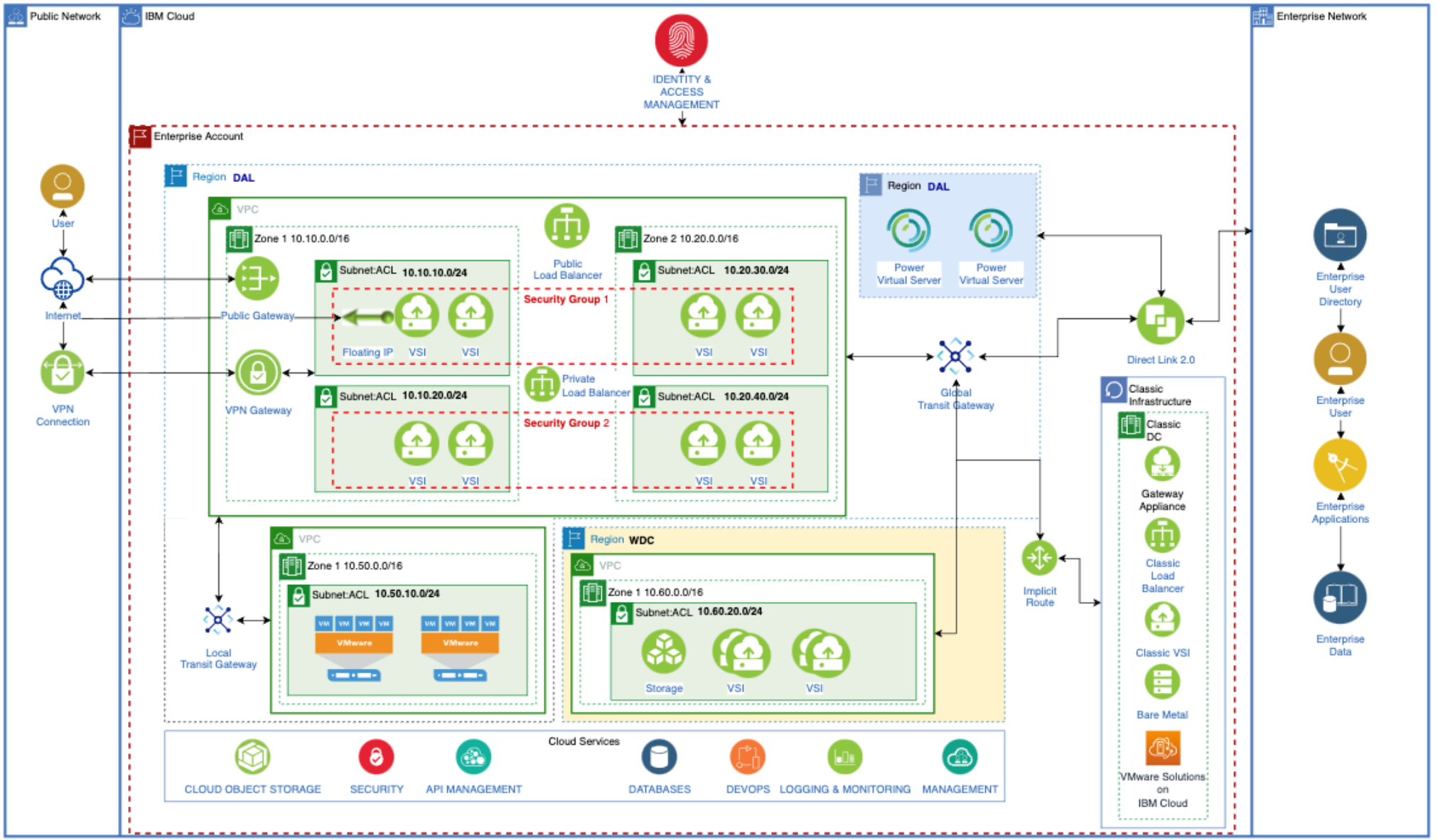
Availability Zones (AZ)

- Independent fault domains that do not share physical infrastructure
- An abstracted service end-point for fault tolerance
- Have latency requirement of <500 usec intra-zone & <2 ms inter-zone

Subnet

- Isolated networks, typically with open communication within the subnet, but controlled access to networks outside of the subnet, including the internet.
- Allows private address spaces with RFC1918
- Allows BYO Subnet range in addition to default range provided

Virtual Private Cloud (VPC) – Multi-zone Regions, Availability Zones, & Subnets



KEY

VIRTUAL MACHINE

BLOCK STORAGE

REGION

ZONE

SUBNET

Virtual Private Cloud (VPC) – Network Security

Access Control List (ACL)

- Enables customers to allow/deny ingress traffic to subnet and egress traffic from subnet
- ACL is stateless
- ACL consists of rules and each rule has source IP, source port, destination IP, destination port and protocol

Security Groups for VPC

- A virtual firewall that controls the traffic for one or more VSIs within a VPC
- A collection of rules that allow traffic to or from its associated VSI
- Allows for modification of those rules

Virtual Private Cloud (VPC) – Internet Connectivity

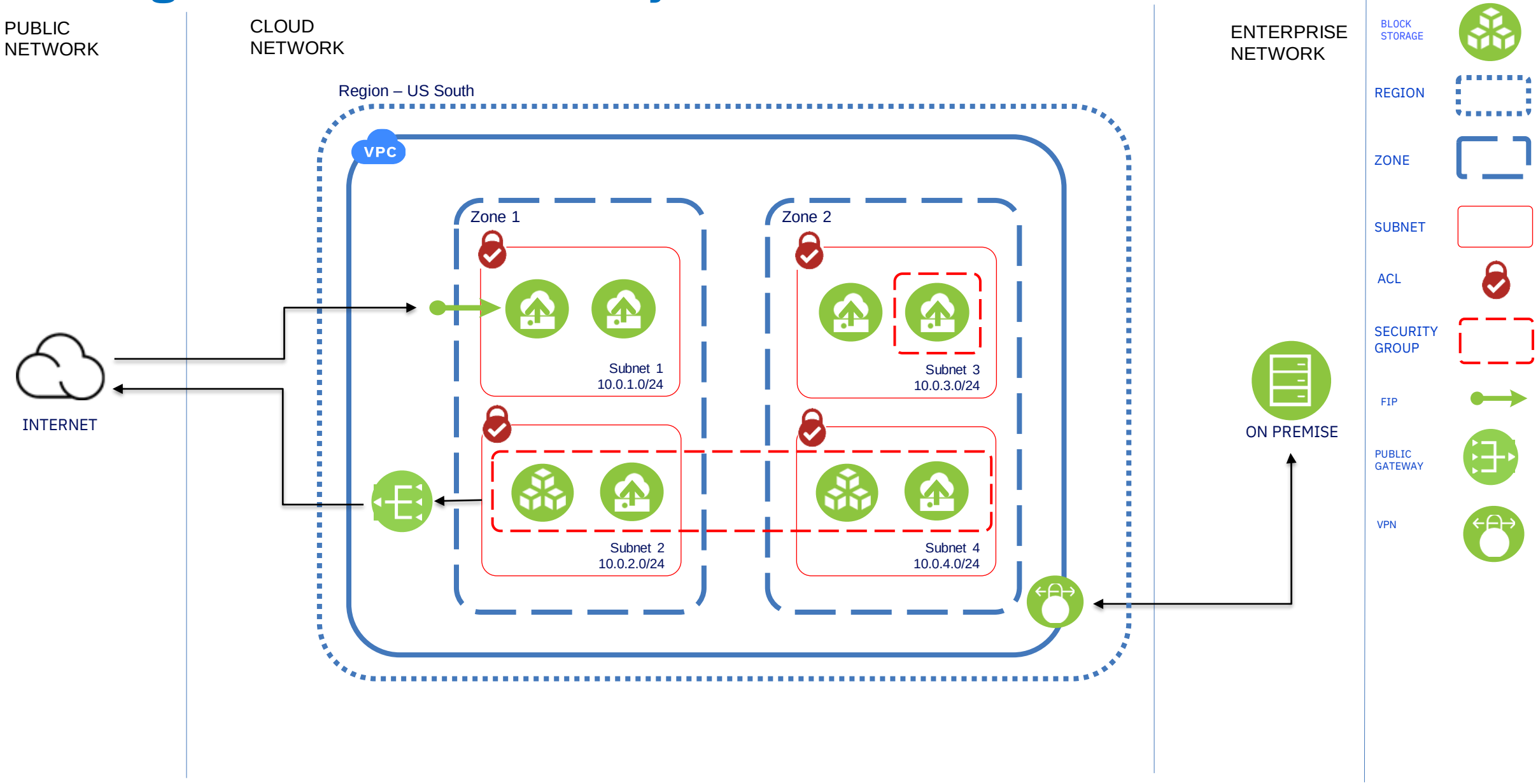
Public Gateway (PGW)

- enables a subnet (with all the VSIs attached to the subnet) to connect to the Internet
- optionally create a PGW and attach a subnet to the PGW

Floating IP (FIP)

- A public IP address reachable by the Internet
- FIP addresses are associated to instances in a VPC
- Floating IP address are reserved from a pool of available Floating IP addresses
- FIPs can be associated / un-associated to any instance in the same VPC

Virtual Private Cloud (VPC) – Public Connectivity
Floating IP and Public Gateway



Virtual Private Cloud (VPC) – Application Load Balancing

Application Load Balancer for VPC

- Layer 4/7 load balancing w/ HTTP, HTTPS, TCP ports
- Integrated health checks
- Round Robin, Weighted Round Robin and Least Connections Algorithms
- FQDN for VIP on public subnet, backend servers on customer's private network
- SSL Offload
- Termination of incoming HTTPS traffic
- Seamless integration with Certificate Manager service

Network Load Balancer for VPC

- Layer 4 (transport layer)load balancing on TCP and UDP ports
- Supports public, private, and private-type with routing mode enabled
- Round Robin, Weighted Round Robin and Least Connections Algorithms
- Ideal for High traffic volume and low latency requirements

Virtual Private Cloud (VPC) – Cloud Internet Services

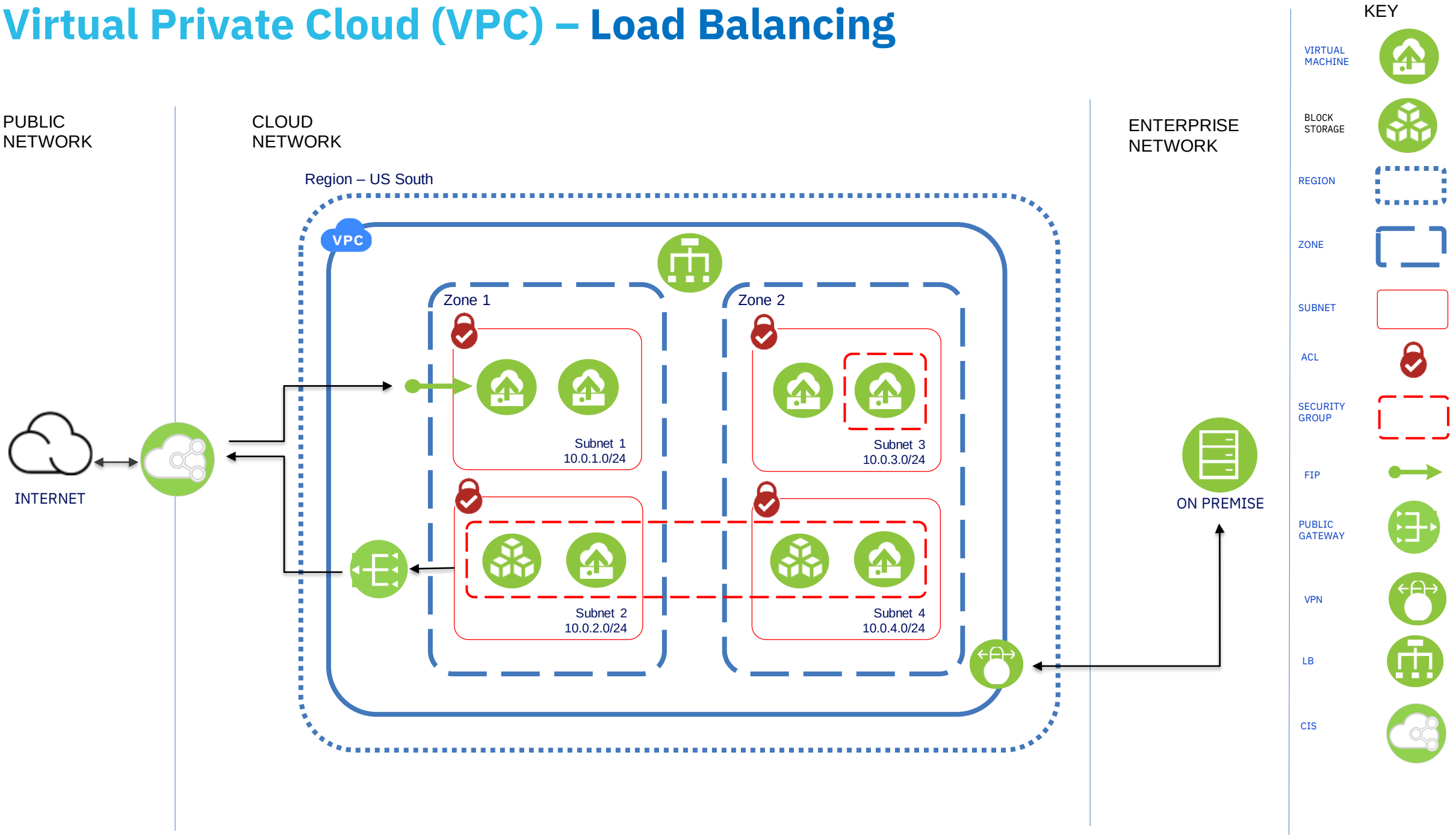
Cloud Internet Services

- A Global Load Balancer (GLB) and more

Load balancing, edge performance and security services across over 150 global locations:

- Global Load Balancing: 6 origins with 60s health checks originating from one geo-region
- DDoS Protection: Un-metered protection with 14Tbps always-on capacity
- Web Application Firewall with on/off security policy
- TLS Certificate Support: Wildcard certificate or upload customer certificate
- Domain Name Server (DNS)
- Caching / Content Delivery Network with 50-page rules

Virtual Private Cloud (VPC) – Load Balancing



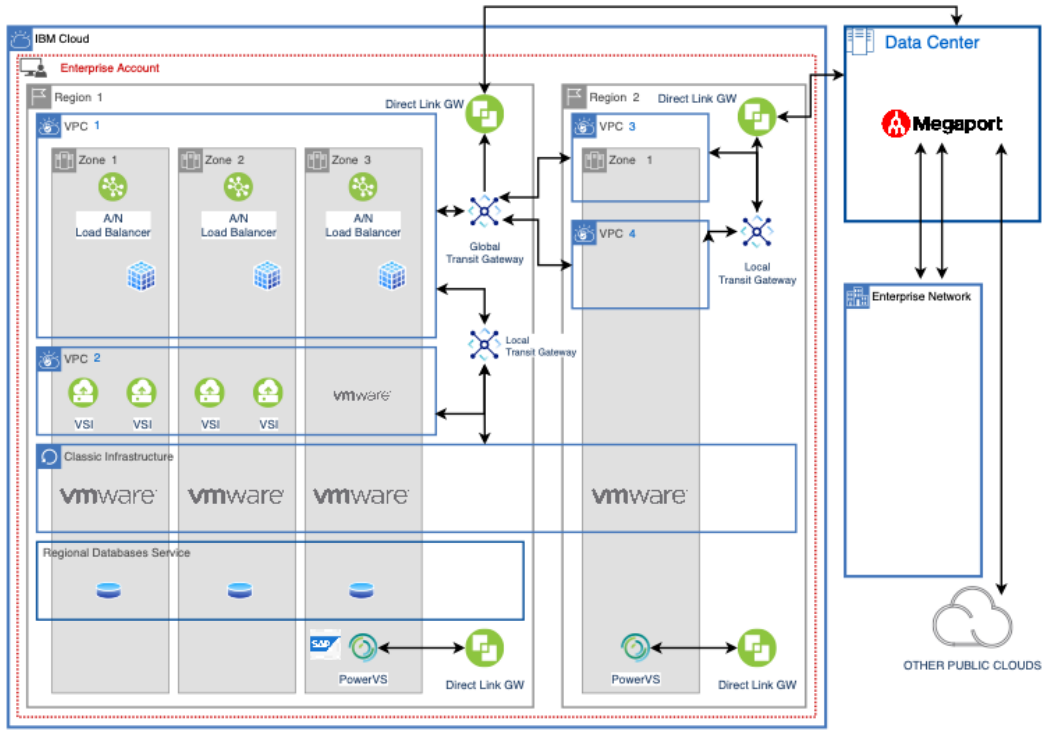
Virtual Private Cloud (VPC) – Hybrid Connectivity

VPN Gateway

- Secure connection via an encrypted tunnel between customer and VPC or VPC to VPC
- Adheres to common protocol and encryption standards

Direct Link

- Private connectivity for maximum speed, security and resiliency
- Variety of connectivity options and port speeds from 50Mbps to 10Gbps in one of IBM Cloud's global data centers
- Over 30 partners to choose from worldwide



Transit Gateway

VPC to Classic	VPC to VPC
Point-to-point connectivity	Point-to-point connectivity
VPC hub to Classic as a spoke	Hub-to-spoke connectivity
Up to five interconnected VPCs per region and one Classic domain	Up to five interconnected VPCs per region Inter-region VPC connectivity with no complications from Classic IP networks

IBM

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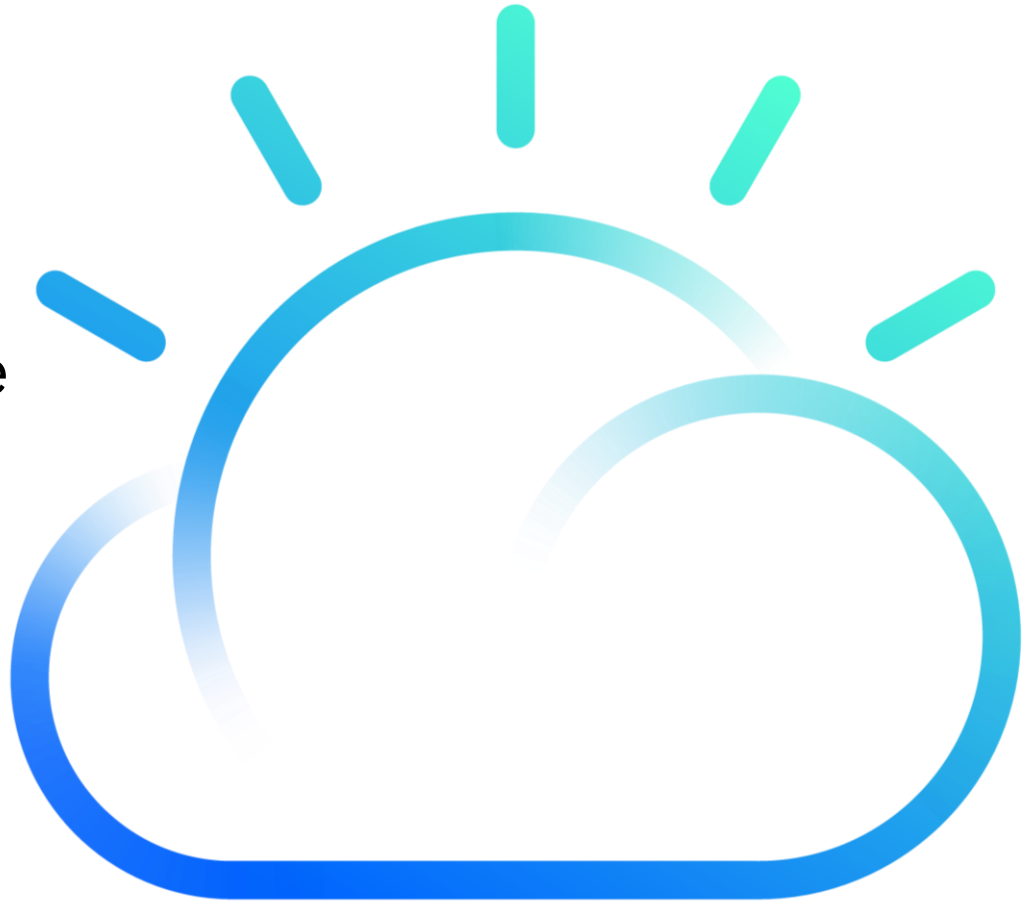
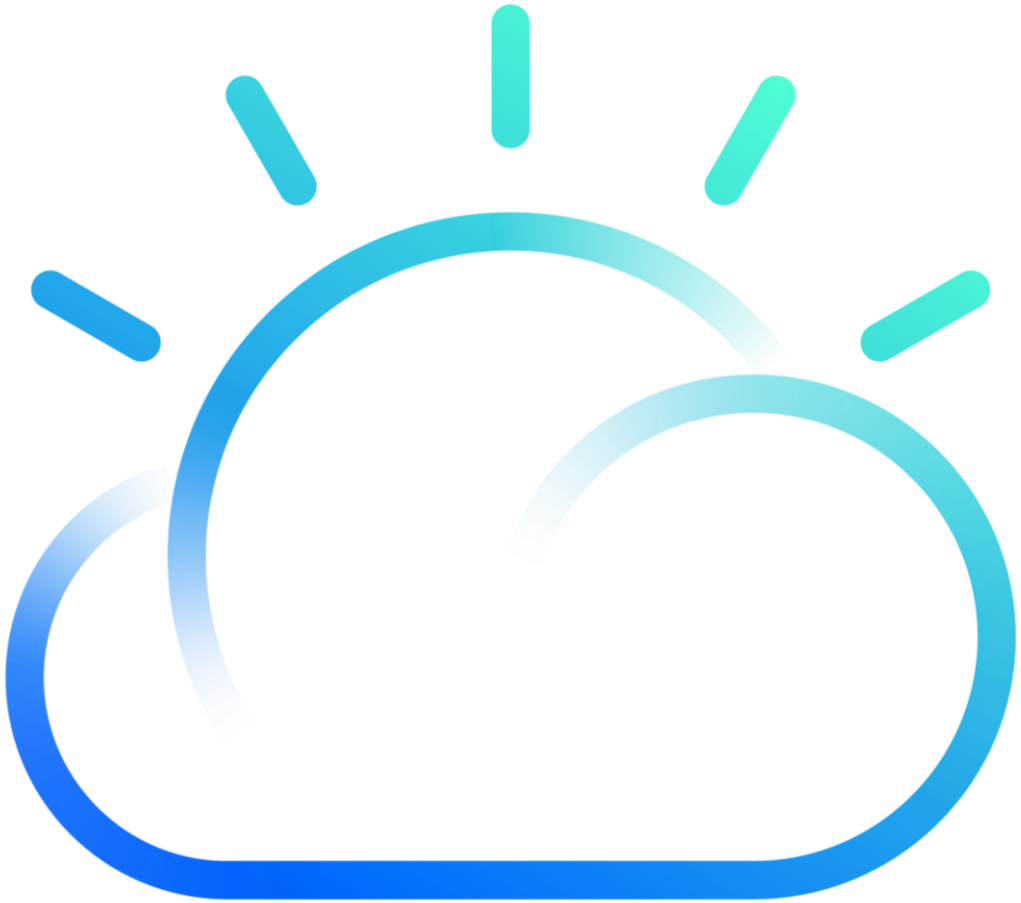


IBM **Cloud**

Overview of IBM Cloud VPC Logging, Monitoring, and Troubleshooting

- IBM Cloud VPC Logging, Monitoring, & Troubleshooting
  Here is what we can do today, and the capturable metrics associated
  - **IBM Cloud Log Analysis with LogDNA** – provides log collection & search for IBM Cloud. You can define alerts and design custom views to monitor system and application logs.
  - **IBM Cloud Flow Logs for VPC** – allows you to capture information about Internet Protocol (IP) traffic going to and from networks of your VPC.
  - **IBM Cloud Monitoring with Sysdig** – provides you visibility into the performance and health of your infrastructure and application, for in-depth troubleshooting and alerting.
  - **IBM Cloud Activity Tracker** – provides records of your IBM Cloud activities, which you can search and alert on activity events.



IBM **Cloud**

IBM Cloud Log Analysis with Log DNA - LOGGING

The **IBM Cloud Log Analysis** service allows you to collect troubleshoot, search, issue alert, view and monitor system and application logs & export JSON. You can manage, view and analyze

What can you do?

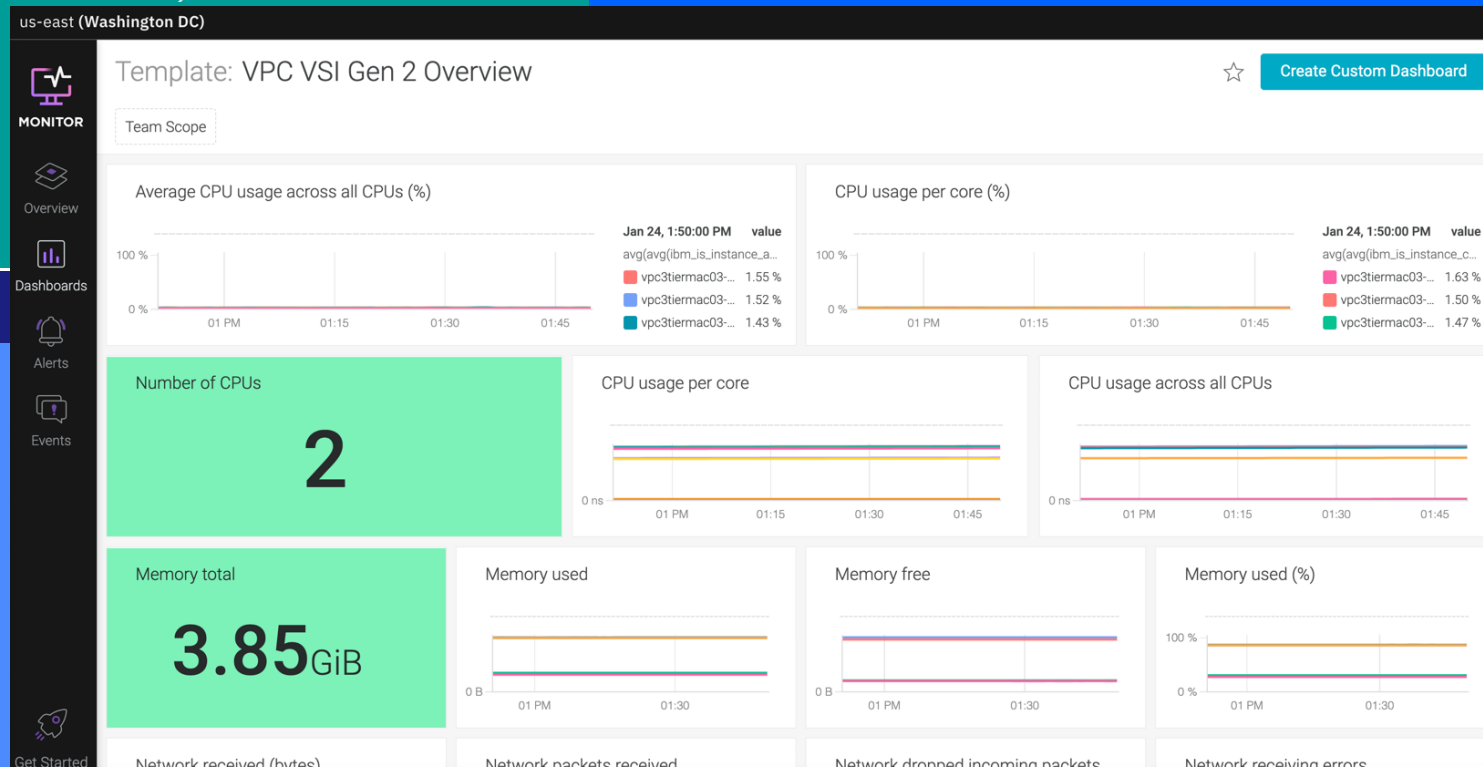
- You can define 1 or more notification channels (email, SMS, Slack, Webhook, PagerDuty, IBM Cloud Monitoring)
- You can configure and view alert types (presence or absence) to each notification channel, ”mute” and “unmute”
- You can configure trigger conditions based on (time frequency, event line counter)

What is created?

- Configurable using UI or CLI
- Collects logs from available enabled services & VSIs with LogDNA agent
- Once configured logs are automatically collected and available for analysis

VPC System & Application Logging

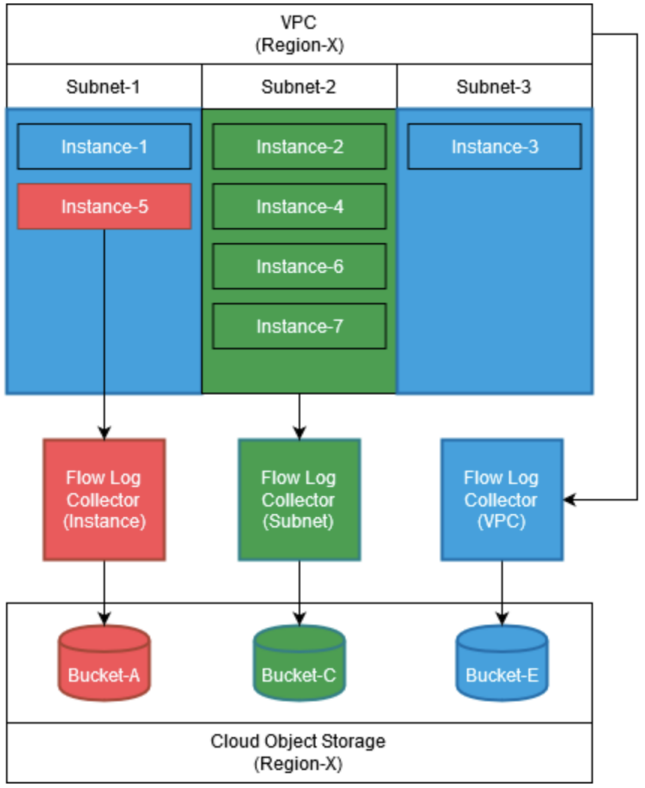
VSI system and application logging when **LogDNA** agent is installed.



IBM Cloud Flow Log for VPC – IP TRAFFIC METRICS

IBM Cloud Flow Log for VPC service allows you to collect, store, and present information about Intern Protocol (IP) traffic going to and from networks of your VPC.

Log collection and analysis supports operationalization, availability and security of your VPC infrastructure and application. Provides information for Troubleshooting, Recording, Determining, Adherence to Compliance, and Root Cause Analysis (RCA).



- **Steps to begin collection of IBM Cloud Flow Logs for VPC**:
  - Create a Cloud Object Store (COS) bucket created to store flow logs
  - Create an IAM authorization for flow log collector to write to the bucket
  - Create the flow log collector

What can you do?

- Deploy Collectors in all VPC Multi-Zone Regions (MZR)
- Collect network traffic data for **VPC**, **Subnets**, **Instances**, & **Interfaces**
- Stop and start collectors from the UI
- Store output in IBM Cloud Object Storage (COS)
- View and analyze stored logs with IBM Cloud SQL Query of COS buckets data
- Advance queries with Kentik Networks Observability Cloud

IBM Cloud Monitoring – PERFORMANCE AND HEALTH

IBM Cloud Monitoring is a platform level regionally deployed service instance. One instance per region. Monitoring allows VPC service monitoring via cloud **dashboards**.

DASHBOARDS AND METRICS PROVIDE YOU VISIBILITY INTO PERFORMANCE AND HEALTH OF INFR & APP

VPC Gen 2 VSI Metrics

Average CPU usage %	Bytes received for network interface
CPU usage Total # CPUs	Bytes sent for network interface
CPU usage % Total CPU usage	Free memory Total memory
Bytes read for a volume	Memory usage %
Bytes written for a volume	Dropped packets incoming
Read request for a volume	Dropped packets outgoing
Write request for a volume	Packets received
Receiving errors Sending errors	Packets sent

VPC VPN GW Metric

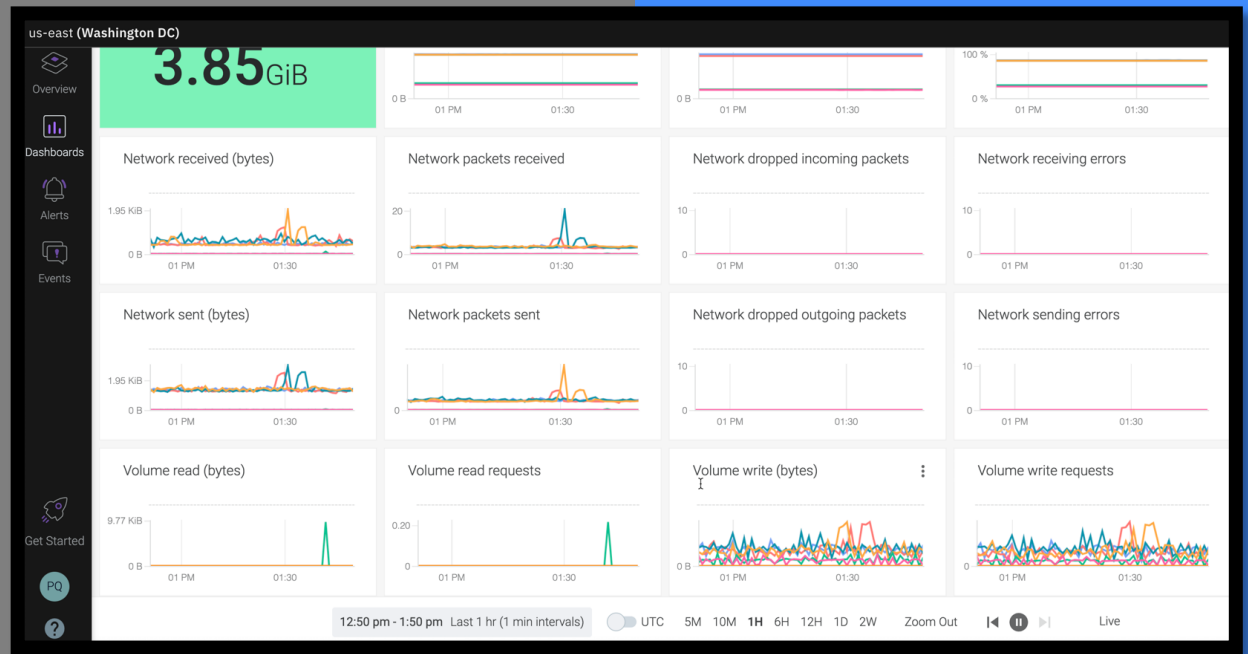
Bytes received	Bytes sent
Packets received	Packets sent
Gateway status	Connection bytes received
Connection bytes sent	Connection packets received
Connection packets output	Connection status

VPC Flow Log Metrics

Bytes sent	Global attributes
Additional attributes	

VPC Resource Quotas

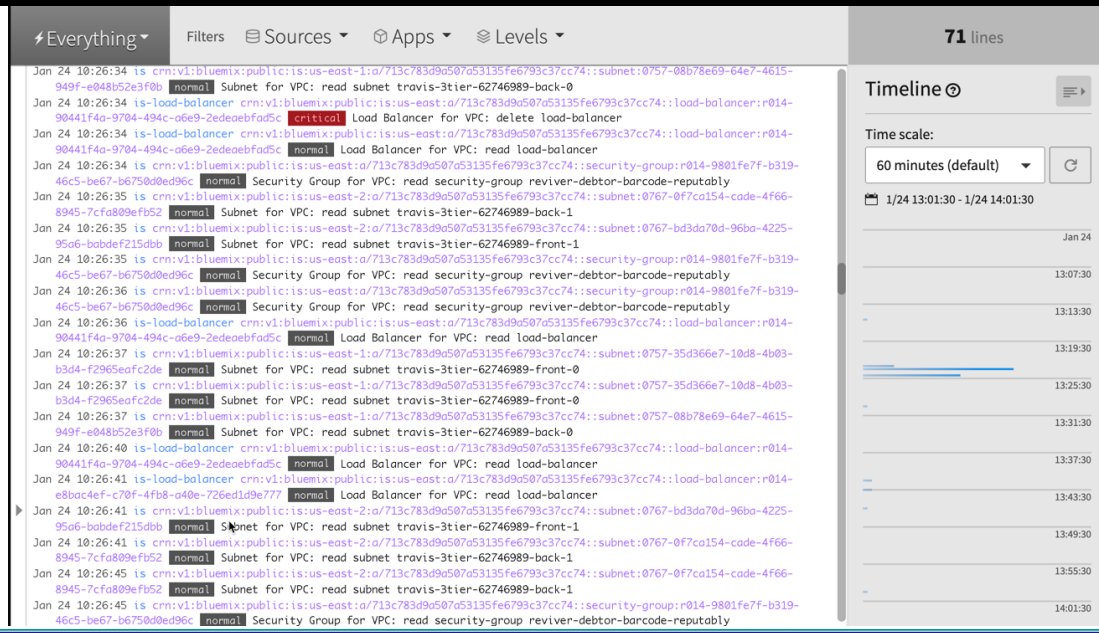
Quota consumption	Quota limit



IBM Cloud Activity Tracker – AUDIT

IBM Cloud Activity Tracker service

- You can capture, store, view, search and monitor API activity
  - on how users and applications interact with IBM Cloud VPC
  - on user-initiated activities that change the state of a service
  - be alerted as actions happen
  - insure Cloud Auditing Data Federation (CADF) standard compliance, as well as internal policy compliance
  - view and search events using the web UI or CLI for that region's tracker.



IBM Cloud Activity Tracker Metrics – What events can I search and alert on? (create, delete, & update)

• ACL events	• Custom Route events	• Floating IP events	• Flow log event	• Load balancer events	• Public gateway events
• Security group events	• Subnet events	• VPE (Virtual Private Endpoint) events	• VPC events	• VPN (gateway & server) events	• Instance events
• BareMetal events	• Key events	• Dedicated host events	• Dedicated host group events	• Instance group events	• Image resources events
• Placement group events	• Instance metadata service events	• Block storage events	• Snapshots events	• File storage events	

IBM

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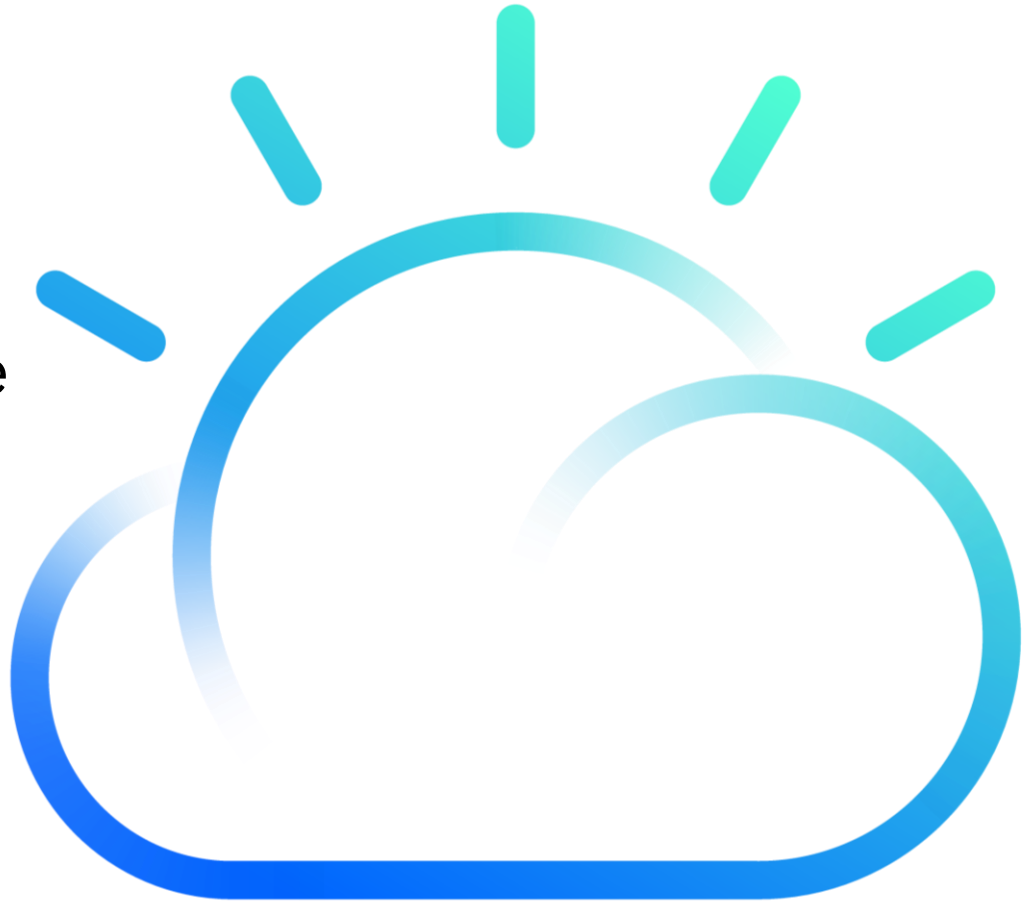


IBM **Cloud**

Use Cases

Targets

- **Existing IBM Cloud customers in need of greater network autonomy, rapid provisioning time, seeking to move to more cloud native application development.** Cloud Native customers are typically using services such as Kubernetes Service, or Functions or looking for wider memory bandwidth.
- **Existing IBM Cloud bare metal customers looking to expand into virtual server uses cases**, especially when targeted at developer-centric audiences, cloud native development, and “Purpose Built” cloud platforms for Power VS, VMware, SAP and x86 workloads.
- **Enterprise Clients looking to** quickly burst into the cloud and take advantage of the most advanced, secure, trusted industry ready cloud infrastructure that IBM Cloud Platform offers.

Development and testing

Host and Scale Web Applications

Extend capacity to the Cloud

Bare Metal & VMware Use Cases

General bare metal users can deploy…

End User Virtualization

Pain Point: VPC doesn't allow me a way to create and manage my own VMs

Solution: Bare metal VPC does not install a KVM hypervisor offering users the option to virtualize with a software/hypervisor of their choosing

Network Intensive Applications

Pain Point: Classic networking speeds create a bottleneck for my workload

Solution: 100Gbps network uplinks in VPC allow up to 8 customer managed vNICs per server eliminating throughput concerns.

Compute Sensitive Workloads

Pain Point: VSIs do not offer the full server resource and consistent performance I need to run my application.

Solution: 100% of bare metal compute resources are provided to the customer for dedicated physical core performance and maximum memory consumption

VMware users can…

1.Migrate existing VMware workloads to VPC

- Accelerate your digital transformation by migrating existing VMware workloads to Bare Metal Servers for VPC, while maintaining your existing tools and skills with VPC native servers available in 10 minutes or less.

2. Upgrade VMware NSX-V to NSX-T on VPC

- Upgrade your NSX-V networking to NSX-T on Bare Metal Servers on VPC and obtain full control of your IP space, on 100 Gpbs uplinks and overlay connectivity across on-premise, hybrid, and multicloud.

3. Modernize your VMware workloads on VPC

- Modernize applications at your own pace through containers, Kubernetes, or Red Hat OpenShift container management platform.

Virtual Private Cloud Bare Metal – User Stories

In a customer journey to VPC, virtual servers can address most use cases. When VPC VSIs can't meet a user's requirements their only option is to build in Classic Infrastructure. In the following user stories, Bare Metal on VPC is positioned to solve for certain performance, tenancy, or application demands.

General User Stories:

- As an enterprise customer of IBM Cloud, I want to migrate my applications from Classic IaaS to VPC to eliminate networking challenges behind traditional gateways, VLANs, and assigned IPs.
- As a bare metal user, I need scalability, elasticity, and performance. VSI VPC and VSI Classic do not meet my application performance requirements and do not want to make trade-offs.
- As a VPC user I want to manage my own virtualization and use bare metal for its single tenancy and consistent higher performance.

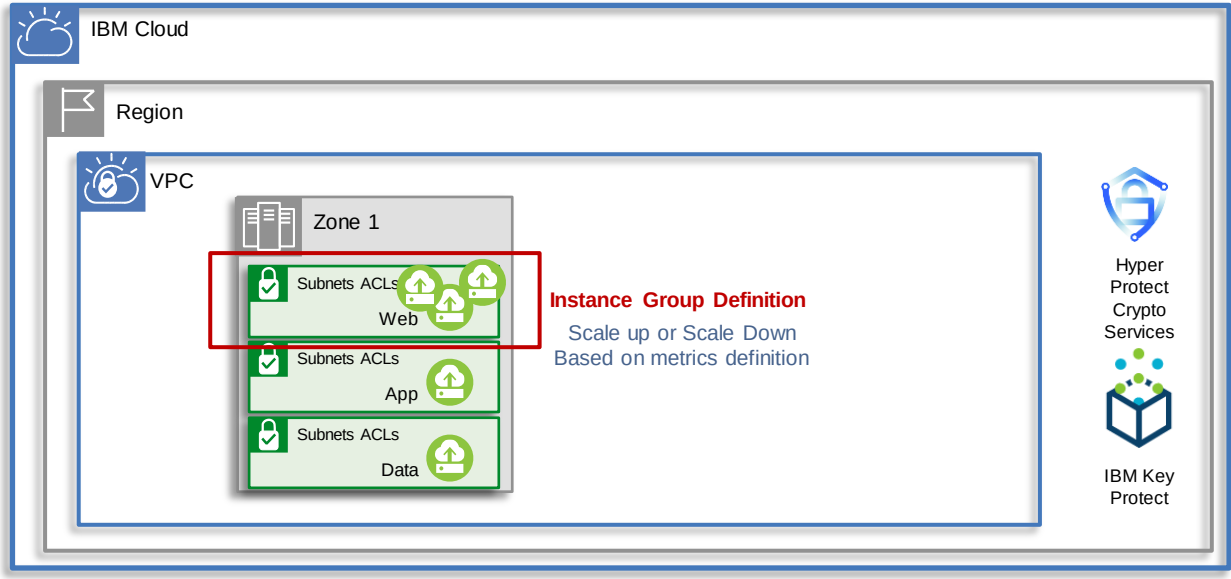
VMware User Stories:

- As an enterprise customer of IBM Cloud, I want to deploy and manage a VMware-based hypervisor on bare metal systems on the Next Gen platform to take advantage of IBM Cloud's VPC features, functionality and performance characteristics.
- As a VMware customer on IBM Cloud, I want to deploy my ESXi hosts within my IBM Cloud VPC and support VMware's clustering, high availability and workload mobility features (vMotion).
- As a current VMware customer, I want support for VMware's NSX-T software defined networking stack in order to fully control my IP space and overlay connectivity.

Production Self-Contained Microservices with Autoscaling

Application Developer

- **Roman** is the lead developer for software solutions to meet key market demands. Creating and implementing source code for new and existing applications. Testing and debugging, as well evaluating application performance.



Challenges

Application scale is essential to meet market demand. Use of microservices application development approach needs an infrastructure platform that can provide the needed agility.

Scaling of virtual private server instances (VSI) have been challenging to explement with ease.

With Auto Scale for VPC Roman can create an instance group to scale according to your requirements. Based on the target utilization metrics that you define the instance group can dynamically add or remove instances to achieve your specified instance availability.

IBM Cloud VPC Gen 2 – MVP Criteria for Microservices with Autoscaling

FEATURE	DESCRIPTION
Backup & Snapshot	Manual agent (BYOL Veeam) deployment on VSI for file-based backup and restore. Block storage snapshot support (UI, CLI, API) rollback, AZ failure, dev app change
Autoscaling with Metrics	includes vCPU, Memory, Network i/o metric policies, static or dynamic scaling methods. Editable scaling that can be enable or disabled to meet enterprise needs
Load Balancing	provides two **ALB** (private & public facing with L7 and L4 and SSL offload) or **NLB** (public facing only, L4 only and no SSL offload). **GLB** (DNS, CIS, F5, and Check Point)

FEATURE	DESCRIPTION
Compliance	HIPPA, ISO, Soc 1T1
Network Flow Logs	collect, store, and present IP traffic information for VPC interfaces
Cross VPC Communication & Cross Account VPC Support	with Local or Global Transit Gateway and/or Direct Link Service configuration over Private Network
Bring Your Own Key (BYOK)	Supported through Key Protect
Keep Your Own Key (KYOK)	Supported through Hyper Protect
VNF Support - Custom Routes	Anti-spoofing, custom routes include ingress routing, reserve IP, VPC/NG Routing Subnets toward a VSI vNIC

Use Case

Extend Capacity to Cloud

ELECTRONICS DESIGN AND LIFE SCIENCES WORKLOADS

- Seamlessly connect on-premises to IBM Cloud with up to 10Gbps port speed
- Automate creating your environment with infrastructure as code and auto scaling rules
- Virtual servers are created in seconds to make sure you have the compute capacity you need when you need it – scale to 5000 compute nodes on demand

Key Services

Securely and seamlessly connect globally with:

- *Direct Link*
- *VPNaaS for VPC*

Automate with:

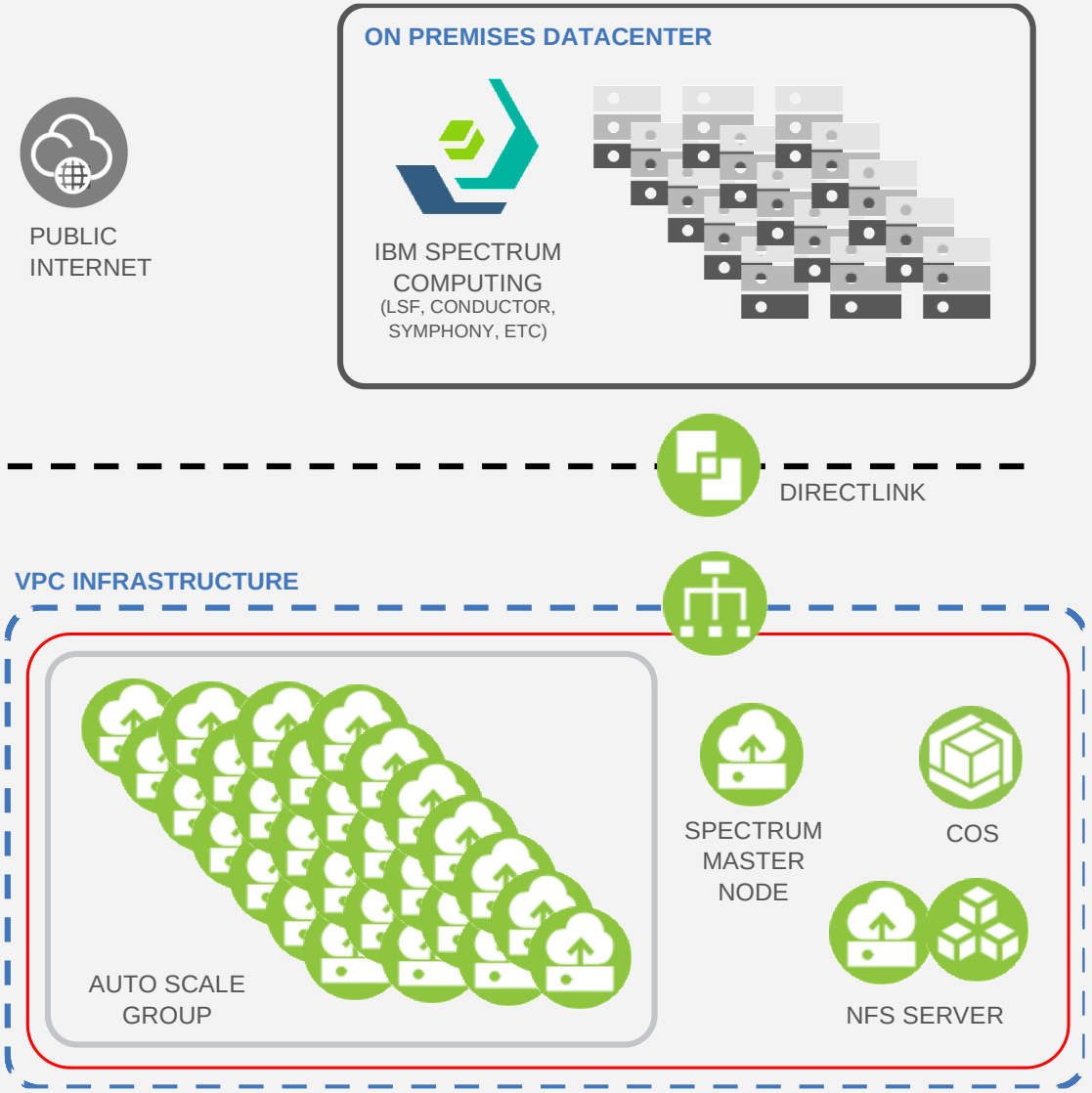
- *Spectrum LSF, Conductor, or Symphony*
- *Terraform Provider for VPC Infra*
- *Auto Scale for VPC*

Secure Network with:

- *Access Control Lists*
- *Security Groups*

Run workloads on:

- *Virtual Servers for VPC*



EXAMPLE SOFTWARE STACKS:

Electronics Design Automation: Calibre, Proteus, Mentor, Synopsys
Computational Genomics: GATK4, Spark, Hadoop, OpenMP

* Solution Tutorial in Development

Leading multinational financial services institution

All customer examples described are presented as illustrations of how those customers have used IBM products and the results they may have achieved. Actual environmental costs and performance characteristics may vary by customer.

Business Need:

The client needed a solution that had high-performance storage requirements to run their HPC application in the cloud and minimized application changes.

Solution:

IBM Cloud Bare Metal Servers gave the client the ability to minimize change by using the same IBM Spectrum Scale filesystem used on premise ultimately achieving the required high storage and network throughput needed for data access in the HPC workload.

Outcomes:

- Met high throughput requirements on network and storage, while balancing costs
- Reduce data center capacity requirements for lower costs

Solution Components:

- IBM Cloud Bare Metal Servers for VPC
- Virtual Servers for VPC
- IBM Spectrum Scale
- IBM Spectrum Symphony

IBM

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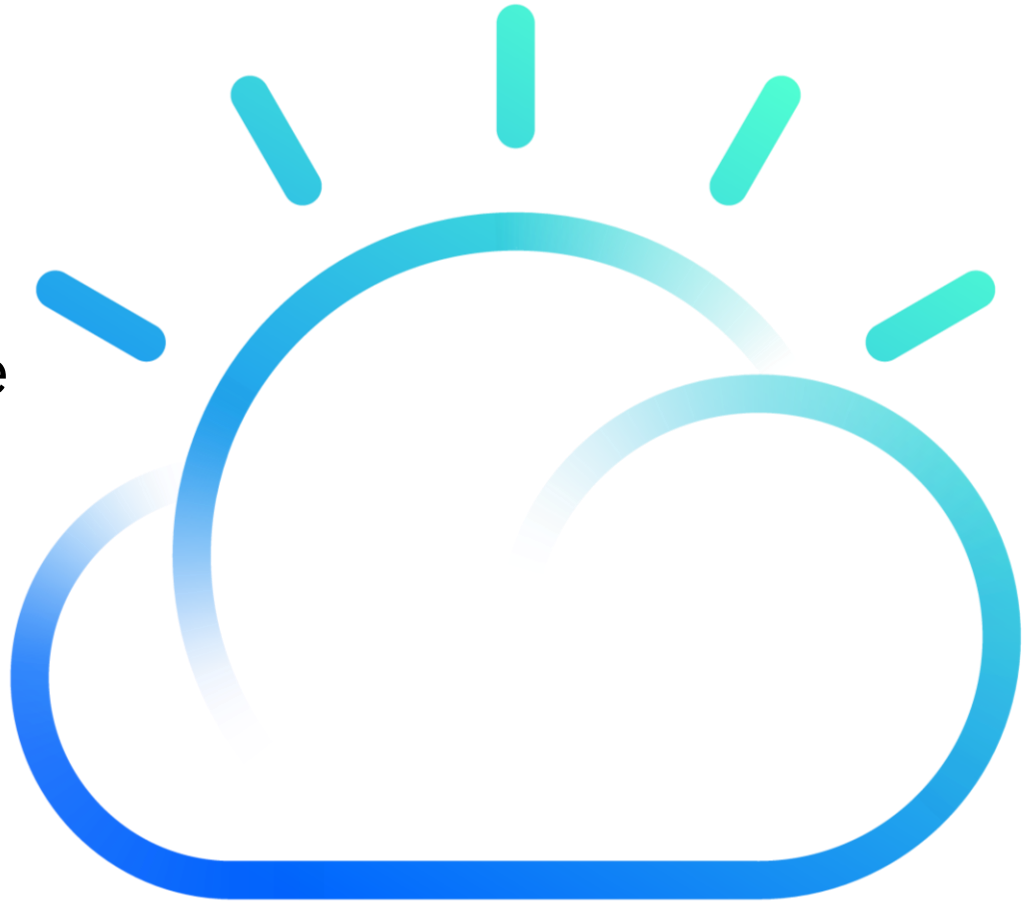


IBM **Cloud**

Virtual Servers on Virtual Private Cloud (VPC) – Availability and Pricing

- **All VPC Products are provisioned via IBM Cloud catalog.**
- **Billed on a consumption basis.** Pricing per hour, billed and metered per second.
- **VPC Locations:**
  - **North America** (Dallas, Washington D.C., and Toronto)
  - **Europe** (Frankfurt, and London)
  - **Asia Pacific** (Osaka, Sydney, and Tokyo)
  - **South America** (Sao Paulo)
- **VPC Pricing available on** VPC Pricing Page**.**
- Visit the VPC Seismic page for more information and IBM
- Visit IBM Cloud announcement blog for updates post-GA.

Bare Metal for VPC – Availability and Pricing

- Bare Metal for VPC profiles are available in Dallas, Washington DC, and Frankfurt data centers
- Provisioned via IBM Cloud catalog API, and CLI
- Subject to existing regional uplifts
- Pay-per-GB bandwidth only. VPC networking cost detail here
- Hourly billing applies to the server profile only
  - Additional OS costs may apply
- Read our announcement blog for more details on this launch

IBM Cloud Virtual Private Cloud (VPC) – Multi-zone Region

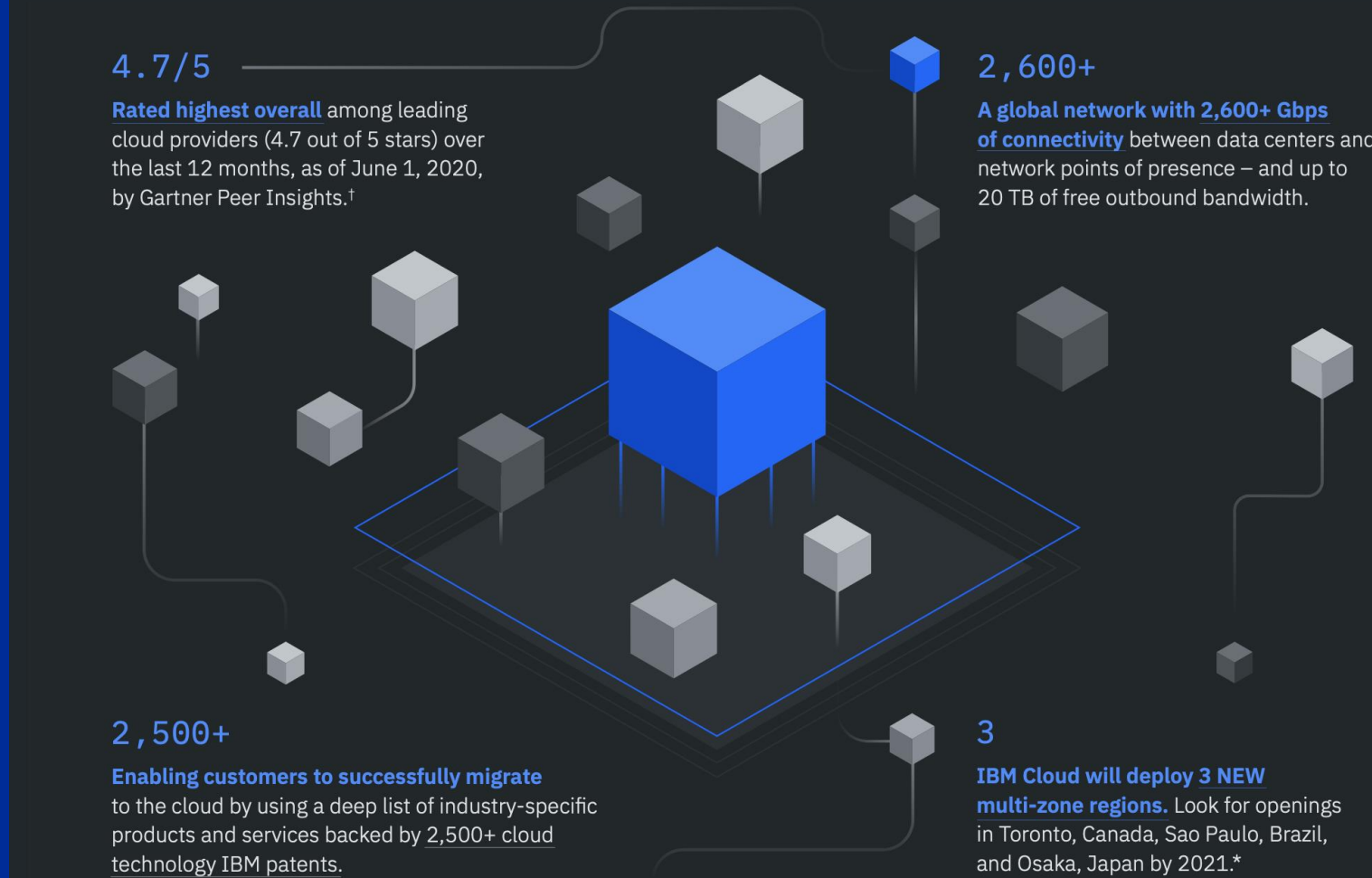
Why? **In the event of a networking failure** in one zone of a multi-zone region, data is automatically re-directed to a failover zone to keep your data up and running.

How?

End-to-end data traffic encryption with backend encryption. Traffic between the load balancer and client is encrypted, as is traffic between the load balancer and the cloud service.

What?

A multi-zone region (MZR) is one or more independent availability zones (AZs) located in proximity, designed to ensure low-latency and continuous availability of enterprise workloads.



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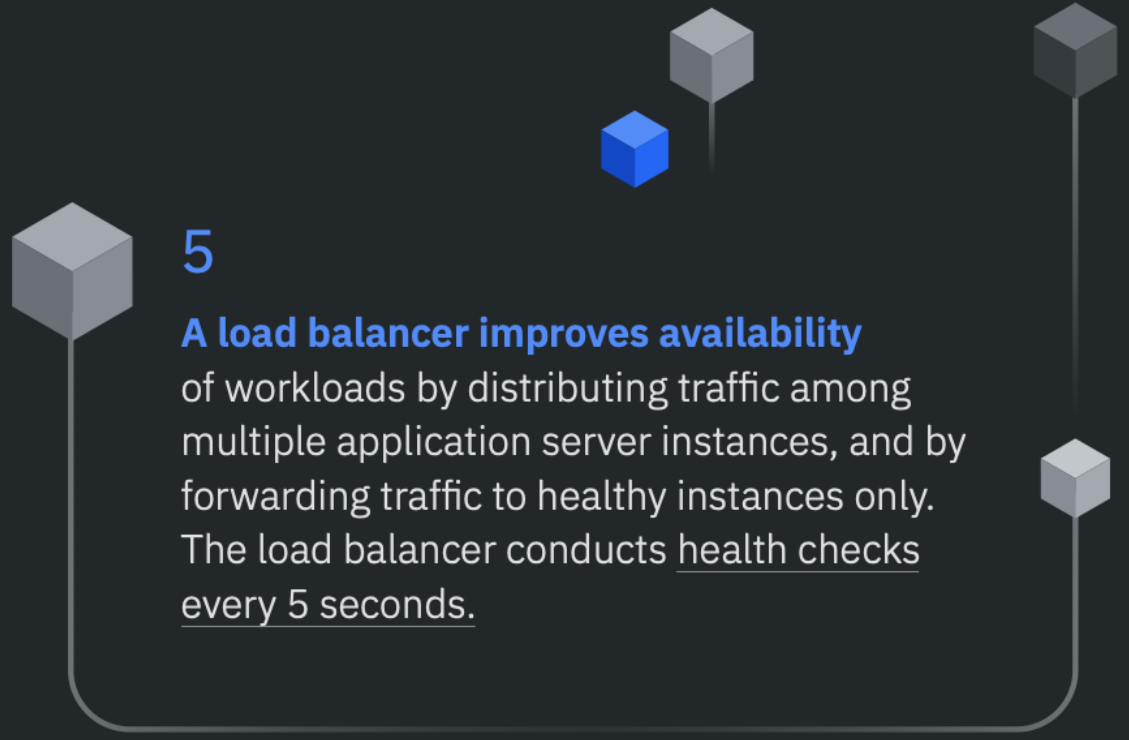


5

A load balancer improves availability of workloads by distributing traffic among multiple application server instances, and by forwarding traffic to healthy instances only. The load balancer conducts health checks every 5 seconds.

60 x 6 x 6

Location matters! Suboptimal data location can slow uploads and downloads. The IBM global network offers 60+ data centers, 6 multi-zone regions located near areas of high Internet traffic in 6 continents.

99.99%

Each IBM Cloud platform service has a 99.99% availability Service Level Agreement. Failover design uses multiple AZs to automatically keep your resources up and running in the event of a disruption.

Virtual Private Cloud (VPC) – Geolocation Map Multi-Zone Regions (MZRs)

IBM Cloud for VPC Network

9 Multi-zone Regions

27 Availability Zones

Virtual Private Cloud (VPC) – Multi-Zone Regions (MZRs) - Deployment-at-a-glance

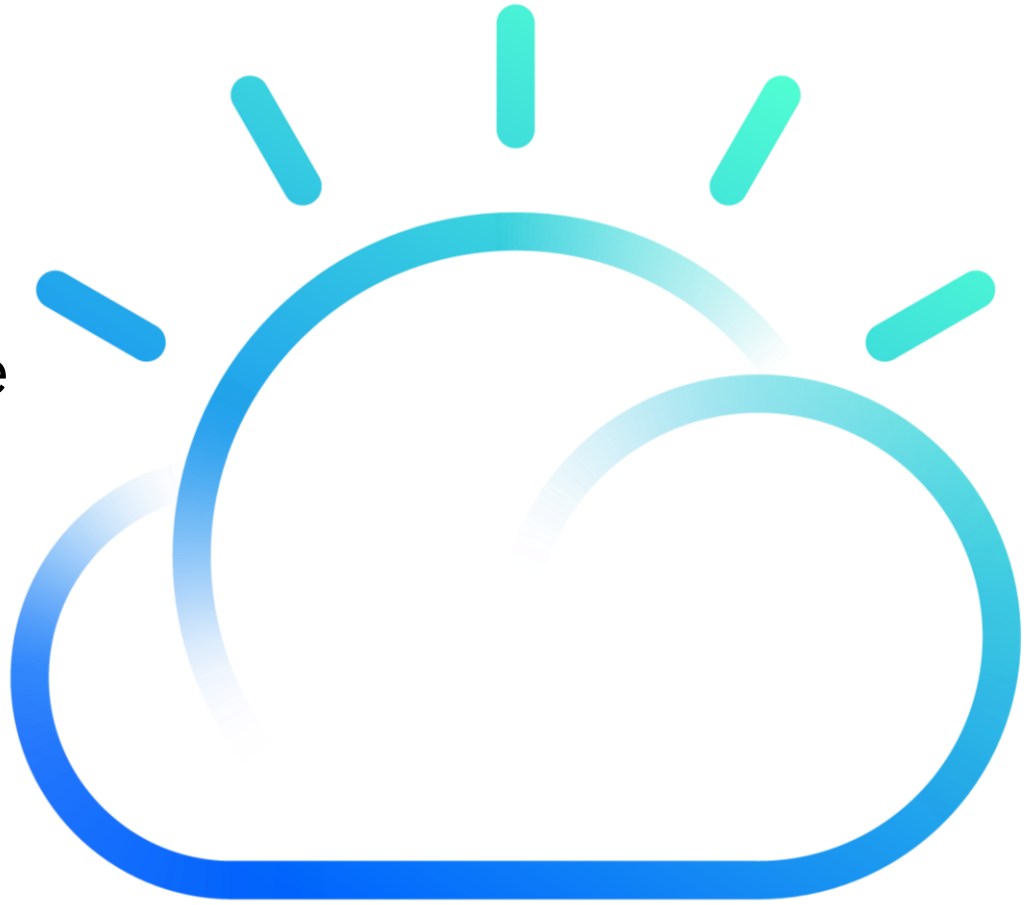
IBM Cloud Multizone Region (MZR)

- 3 Per Region
- Logically and physically isolated
- Independent power, cooling, infrastructure
- Strong fault tolerance
- Guaranteed high bandwidth
- Low inter-zone latency

Location	Region	Zone	Data center
Dallas	us-south	us-south-1 us-south-2 us-south-3	DAL10 DAL12 DAL13
Washington DC	us-east	us-east-1 us-east-2 us-east-3	WDC04 WDC06 WDC07
Sao Paulo	br-sao	br-sao-1 br-sao-2 br-sao-3	SAO01 SAO02 SAO03
Toronto	ca-tor	ca-tor-1 ca-tor-3 ca-tor-3	TOR01 TOR02 TOR03
Frankfurt	eu-de	eu-de-1 eu-de-2 eu-de-3	FRA02 FRA04 FRA05
London	eu-gb	eu-gb-1 eu-gb-2 eu-gb-3	LON04 LON05 LON06
Osaka	jp=osa	jp-osa-1 jp-osa-2 jp-osa-3	OSA21 OSA22 OSA23
Tokyo	jp-tok	jp-tok-1 jp-tok-2 jp-tok-3	TOK02 TOK04 TOK05
Sydney	au-syd	au-syd-1 au-syd-2 au-syd-3	SYD01 SYD04 SYD05

IBM

- Overview of Virtual Private Cloud (VPC)
- Why VPC – Value Proposition
- Features of VPC – Compute and storage
- Features of VPC – Networking
- Observability on VPC
- Use Cases & Conversation Starters
- Availability & Pricing
- **Resources & Key Contacts**



IBM **Cloud**

Stay Connected, Contribute

VPC Communities

• **Compute & Storage**	#ibmcloud-computerstorage-community
• **Networking**	#ibmcloud-networking-community
• **Security**	#ibmcloud-security-community
• **Offering Management**	#offering_management
• **IBM Cloud VPC**	#ibmcloud-vpc
• **IBM WIN Room**	#iaas-public-cloud-win-room

Resources

Seismic (Enablement + FAQ): VPC Seismic Kits

Roadmap: Click here to view VPC Roadmap

Technical Demo of Deploying VPC Components

VPC Deployment Journey: Start Here

Networking FastStart: VPC Networking

Ideas: ibm.biz/cloudideas

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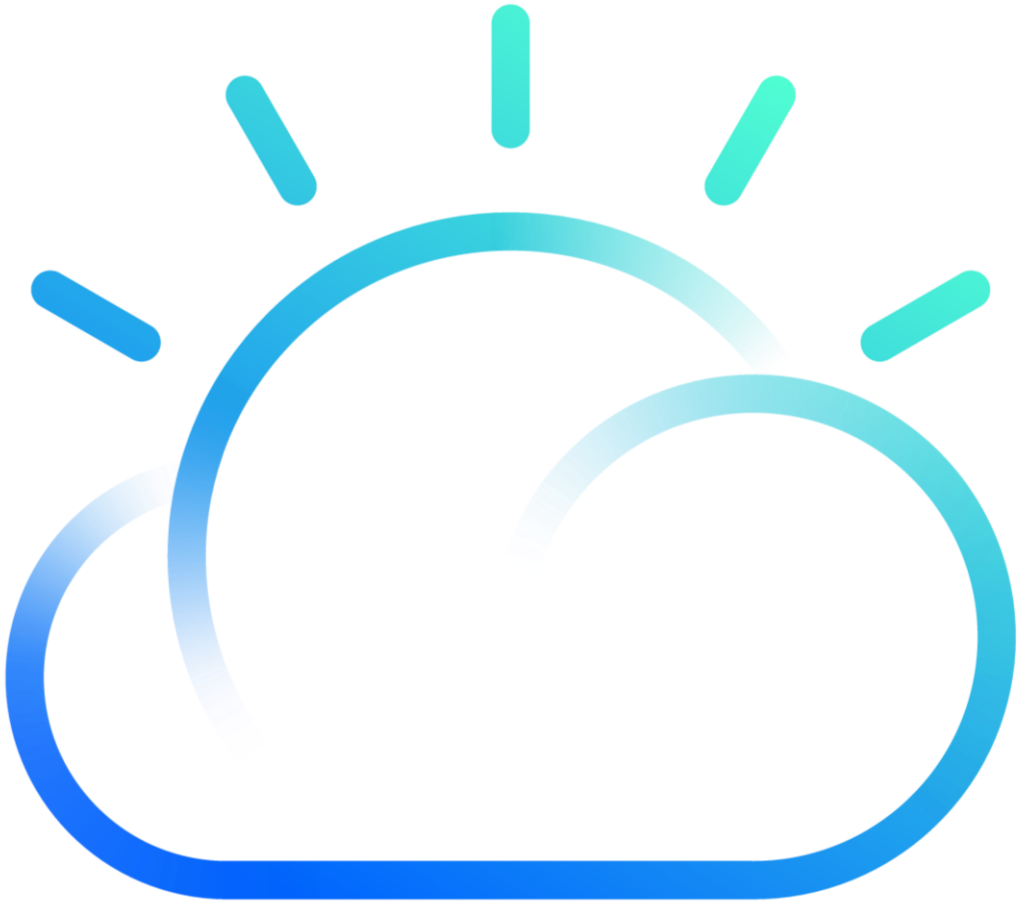
IBM

Thank You



IBM **Cloud**

IBM Cloud for VMware Solutions (IC4V)

All customer examples described are presented as illustrations of how those customers have used IBM products and the results they may have achieved. Actual environmental costs and performance characteristics may vary by customer.

Business Need:

The IC4V team was trying to deploy and manage a VMware-based hypervisor on bare metal systems for Next Gen Platform in order to take advantage of IBM Cloud's VPC features, functionality, and performance characteristics.

Solution:

IC4V had a BYOIP scenario where they used IBM Cloud Bare Metal Servers to achieve faster network and provisioning, unlimited VLANs, and the ability to align to IBM's Cloud ecosystem including Transit Gateway, VPN, and Cloud DNS.

Outcomes:

- Faster network speeds
- Easier configuration for internet access with Public Gateway
- Faster provisioning

Solution Components:

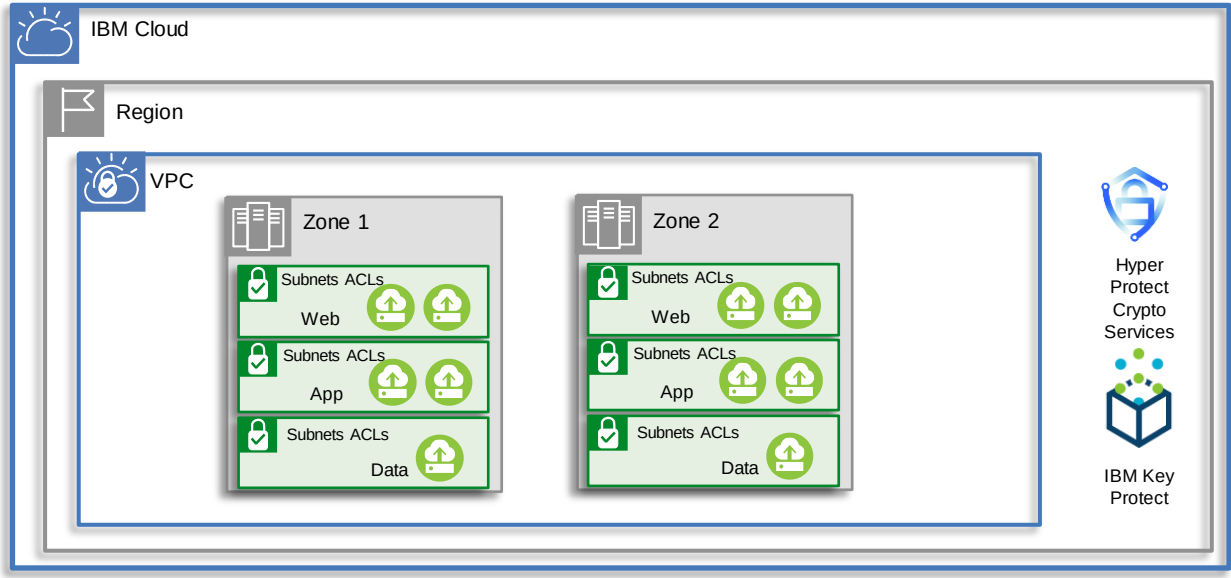
- IBM Cloud Bare Metal Servers for VPC

Production 3-Tier Web Application for Enterprise

Application Owner

- **Sonya** is the go between across Application Development and the business unit this production web app service supports. She facilitates assurance through articulating clear requirement communication and boundaries to ensure policy compliance.

*IBM Cloud client **Ultimus** is leveraging the power IBM Cloud VPC Gen 2, and the features listed below to deploy Web Applications today. Additionally, IBM Cloud client **Vertex** is leveraging VPC Gen 2 for Application Development. Both clients leverage VPC for 3-Tier Web App as well as MZRs.*



IBM Cloud VPC Gen 2 – MVP Criteria for Production 3-Tier Web Application

Challenges

Deploying enterprise workloads to cloud has been difficult to meet production workload security, adoption and compliance requirements

Cloud learning curve and slow ramp up impact market competitiveness. Too many varying cloud services and options to choose from making solution challenging

Cloud service gaps to meet enterprise needs. Too many workarounds required.

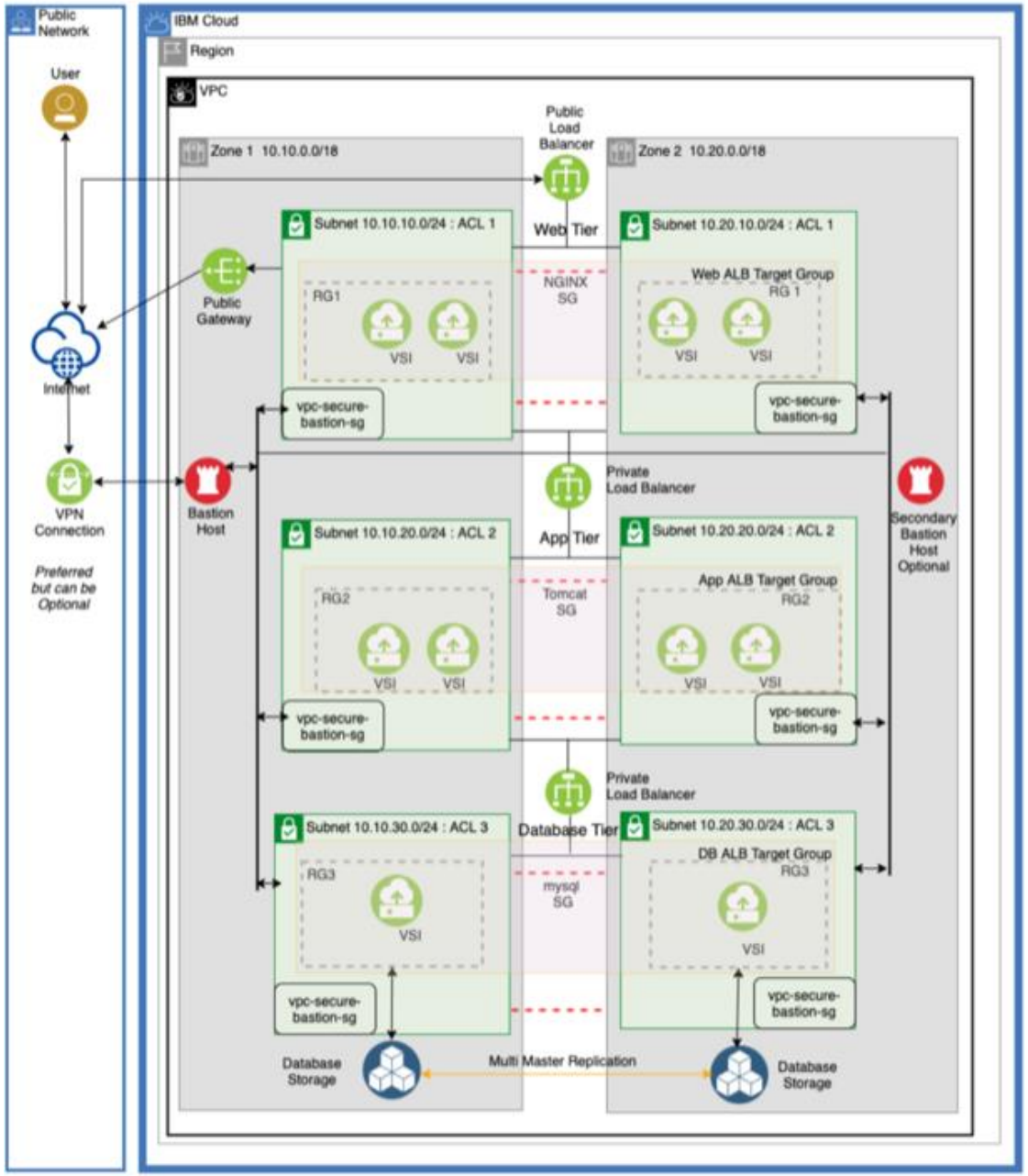
FEATURE	DESCRIPTION
Backup & Snapshot	Manual agent (BYOL Veeam) deployment on VSI for file-based backup and restore. Block storage snapshot support (UI, CLI, API) rollback, AZ failure, dev app change
Autoscaling with Metrics	includes vCPU, Memory, Network i/o metric policies, static or dynamic scaling methods. Editable scaling that can be enable or disabled to meet enterprise needs
Load Balancing	provides two **ALB** (private & public facing with L7 and L4 and SSL offload) or **NLB** (public facing only, L4 only and no SSL offload). **GLB** (DNS, CIS, F5, and Check Point)

FEATURE	DESCRIPTION
Compliance	HIPPA, ISO, Soc 1T1
Network Flow Logs	collect, store, and present IP traffic information for VPC interfaces
Cross VPC Communication & Cross Account VPC Support	with Local or Global Transit Gateway and/or Direct Link Service configuration over Private Network
Bring Your Own Key (BYOK)	Supported through Key Protect
Keep Your Own Key (KYOK)	Supported through Hyper Protect
VNF Support - Custom Routes	Anti-spoofing, custom routes include ingress routing, reserve IP, VPC/NG Routing Subnets toward a VSI vNIC

Use Case

Host and Scale Enterprise 3-tier Web Applications

- Host your mission critical web application in a global infrastructure with 9 MZRs distributed around the world, all connected via our secure Transit Gateway
- Handle spikes in traffic with ease using autoscaling and load balancing
- Host your app with the highest level of enterprise security using BYOK/KYOK technology and **FIPS certification**, (140-2 Level 4)



Handle Scale with:

- *Application Load Balancer for VPC*
- *Auto Scale for VPC*

Run your web application on:

- *Virtual Server for VPC*
- *Dedicated Host for VPC*
- *VMware ESXi*
- *Power VS*

Run your database on:

- *IBM Cloud Databases*
- *Bare Metal Servers*

like:

- *Functions for transaction processing*
- *CDN for quick asset access*
- *AppID for 2 factor authentication*