



Hybrid Cloud for IBM Z and LinuxONE building on IBM Cloud Infrastructure Center

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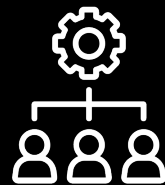
Businesses face three challenges when modernizing



Business Agility



Risk Mitigation



Workload and cost optimization



IBM's hybrid cloud and AI platform approach

IBM Consulting

Business Transformation • Technology Consulting • Application Operations



System Integrator Partners

IBM Software

IBM Cloud Paks®

Automation • Data & AI • Security • Transaction Processing



Software and SaaS Partners

Red Hat® Hybrid Cloud Platform

Development, Security and Operational Services

OpenShift® • Red Hat Enterprise Linux • Ansible® Automation Platform



IBM Infrastructure

IBM Z® / IBM LinuxONE • Distributed Infrastructure (IBM Cloud®, Power®, Storage) • Infrastructure Support



Public Clouds

AWS • Azure • Others



Enterprise Infrastructure



Edge





Red Hat's Hybrid Cloud Platform

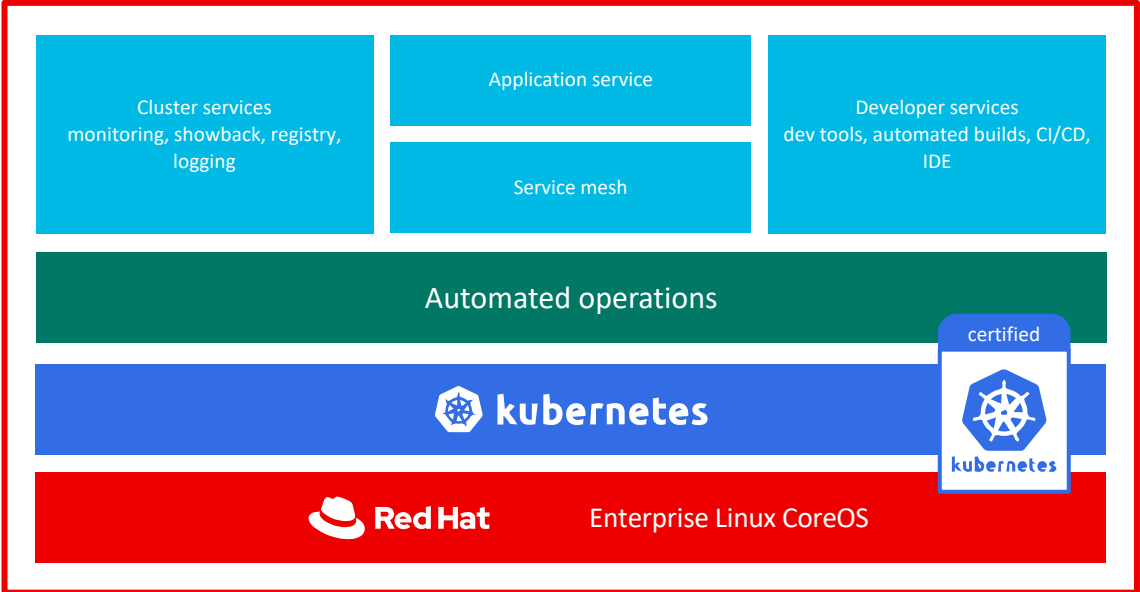


Red Hat® OpenShift® Container Platform

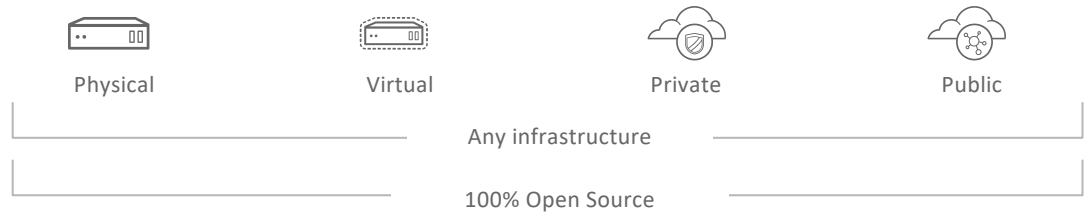


Best IT ops experience

Best developer experience



- **Automated, full-stack installation** from the container host to application services
- **Seamless Kubernetes deployment** to any cloud or on-premises environment
- **Autoscaling** of cloud resources
- **One-click updates** for platform, services, and applications

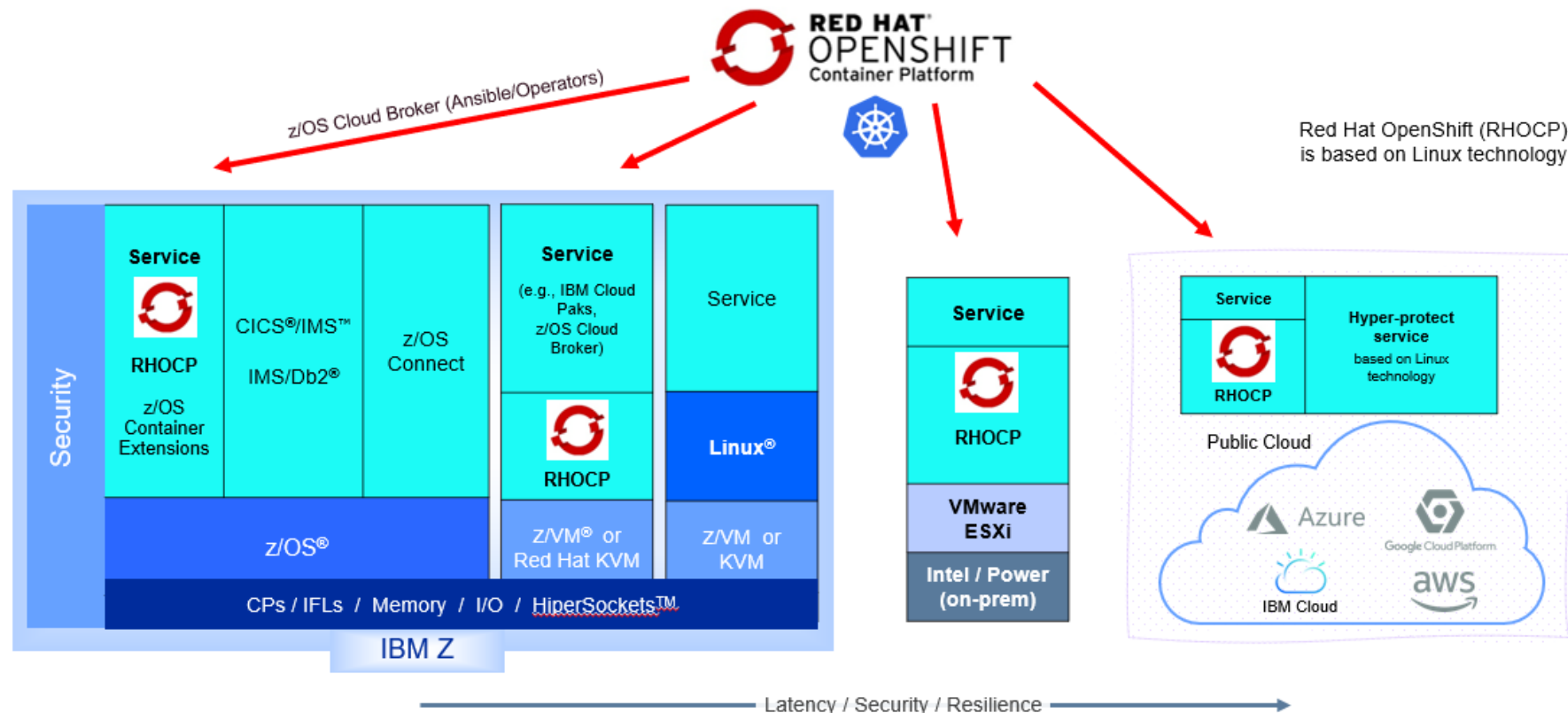


- Rapid Innovation**
- Differentiated Integration**
- Investment Leverage**
- Management and Compliance**



The vision of hybrid cloud and multicloud with Red Hat OpenShift

- Hybrid workloads and multiple Red Hat OpenShift clusters can run in parallel on a physical IBM Z server.





How do I transform traditional mainframe virtualization, delivering an elastic Cloud infrastructure, integrating with other enterprise Cloud tooling, supporting the required business agility?



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Enterprise Infrastructure



Edge





Cloud-centric virtualization

Traditional Virtualization

Role	Tasks
Hypervisor admin (e.g.: z/VM system programmer)	Hypervisor System Setup Receives requests to build VMs VM Guest Provisioning VM Guest Decommissioning VM Resource Infrastructure Management Hypervisor Management

Cloud-Centric Virtualization

"Infrastructure-as-a-Service"

Role	Tasks
Service Consumer or App Developer	Service contract via self-service portal
Cloud Admin	Cloud Infrastructure Mgmt <ul style="list-style-type: none"> • Compute • Network • Storage IaaS and possibly PaaS on top
Resource admin	Hypervisor, Storage, Network Management

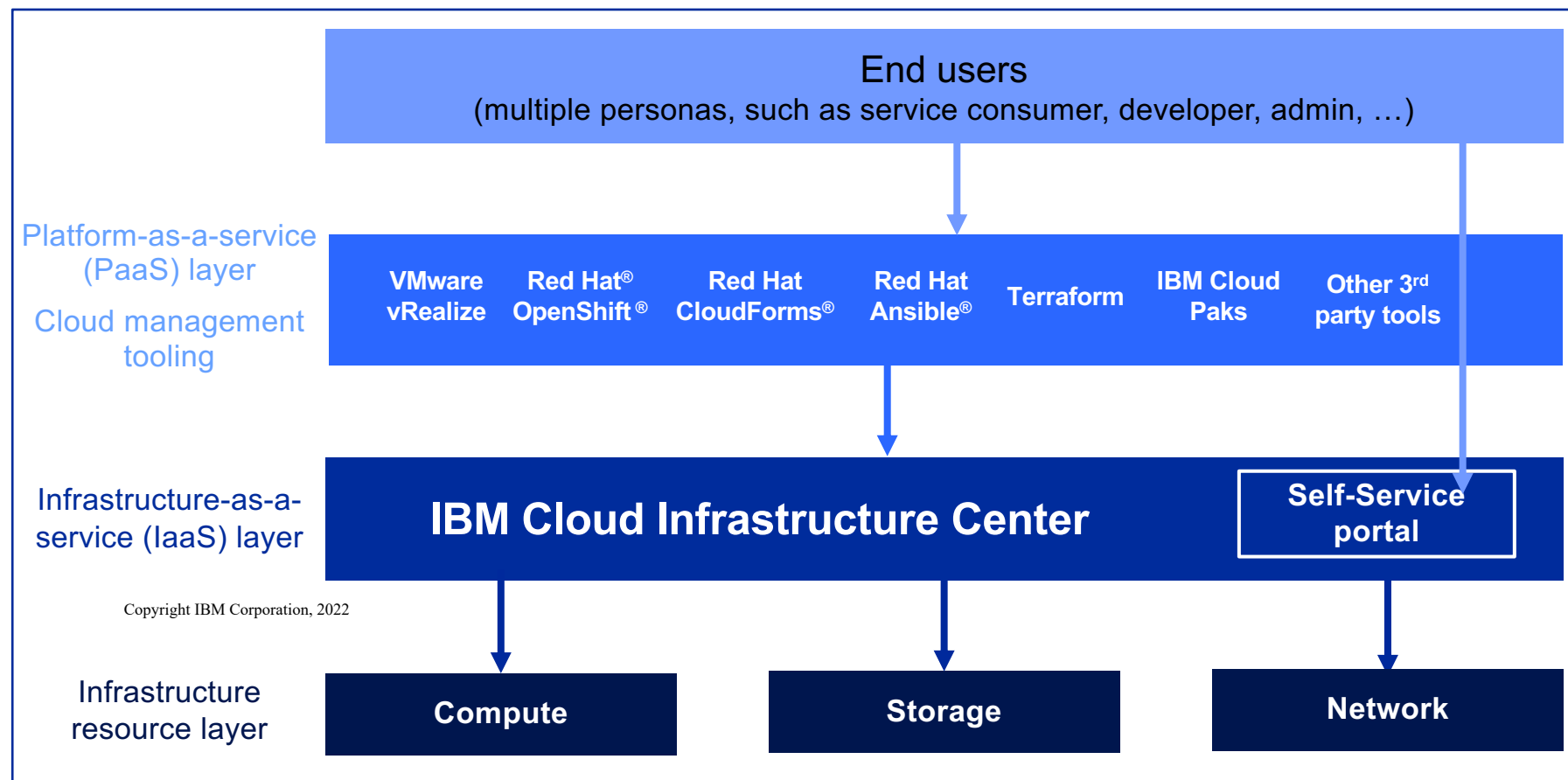
Scope of Cloud Infrastructure Center



How to manage, automate, and integrate infrastructure as a service?

Connecting the layers of cloud computing enables to integrate IBM Z and LinuxONE infrastructure across the enterprise

Instantiate, define, capture, and manage the lifecycle of VMs





Solution scenarios

On-premises DB as-a-Service

Data gravity

Select a **database** and automat deployments it in an **as-a-service model** at scale.

Deployment of Red Hat OpenShift clusters

UPI

Provisioning of Red Hat OpenShift Container Platform clusters via the deployment of Red Hat Enterprise Linux CoreOS.

IaaS for service providers

Tenant-safe services

Service providers can offer **tenant-safe infrastructure as a service** in a virtual environment.

Facilitate LinuxONE / IBM Z introduction with new clients

Simplify

As the **platform's infrastructure solution**, Cloud Infrastructure Center **simplifies and the complexity of virtual infrastructure running on IBM LinuxONE and IBM Z**

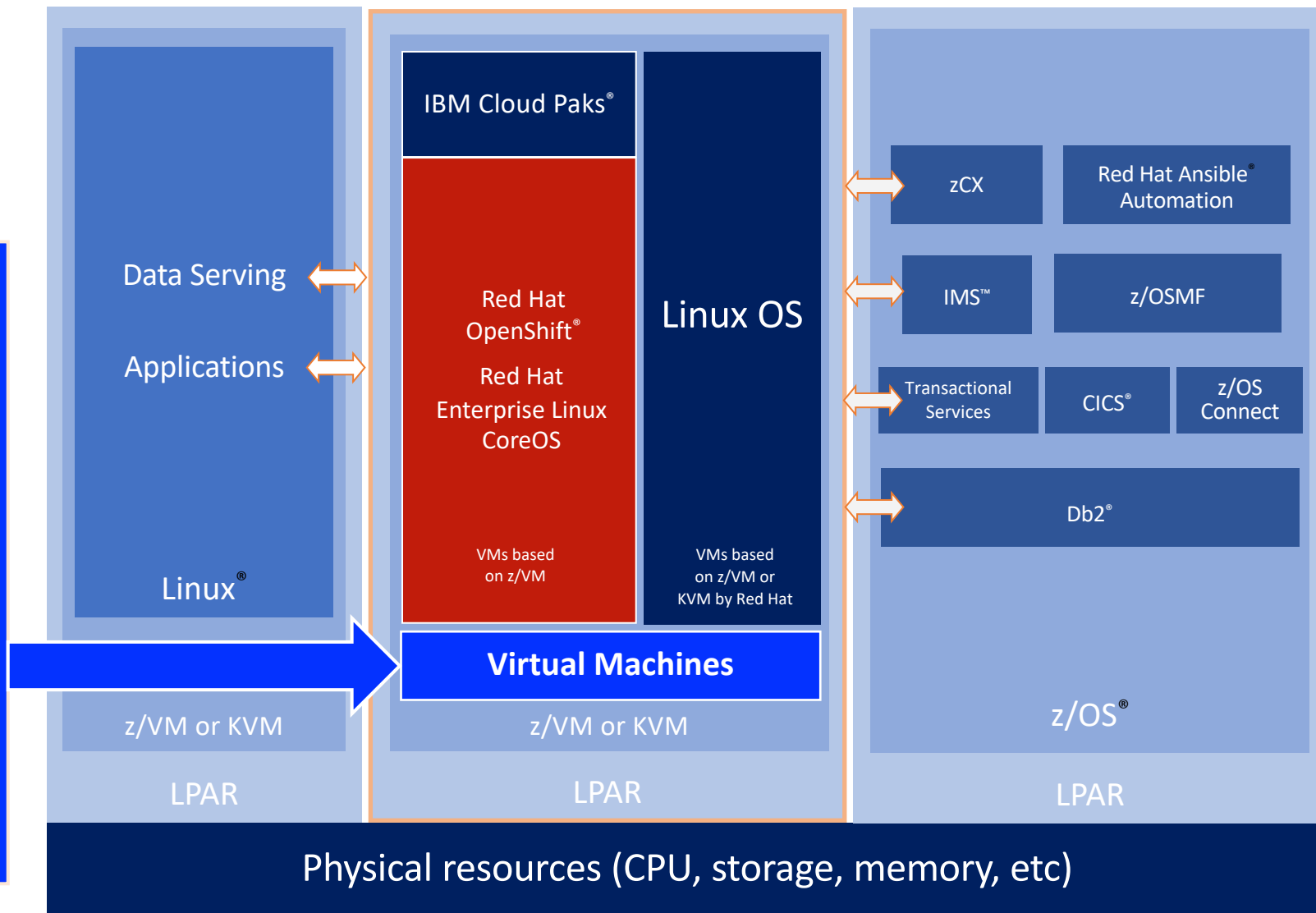
Becoming Cloud-ready



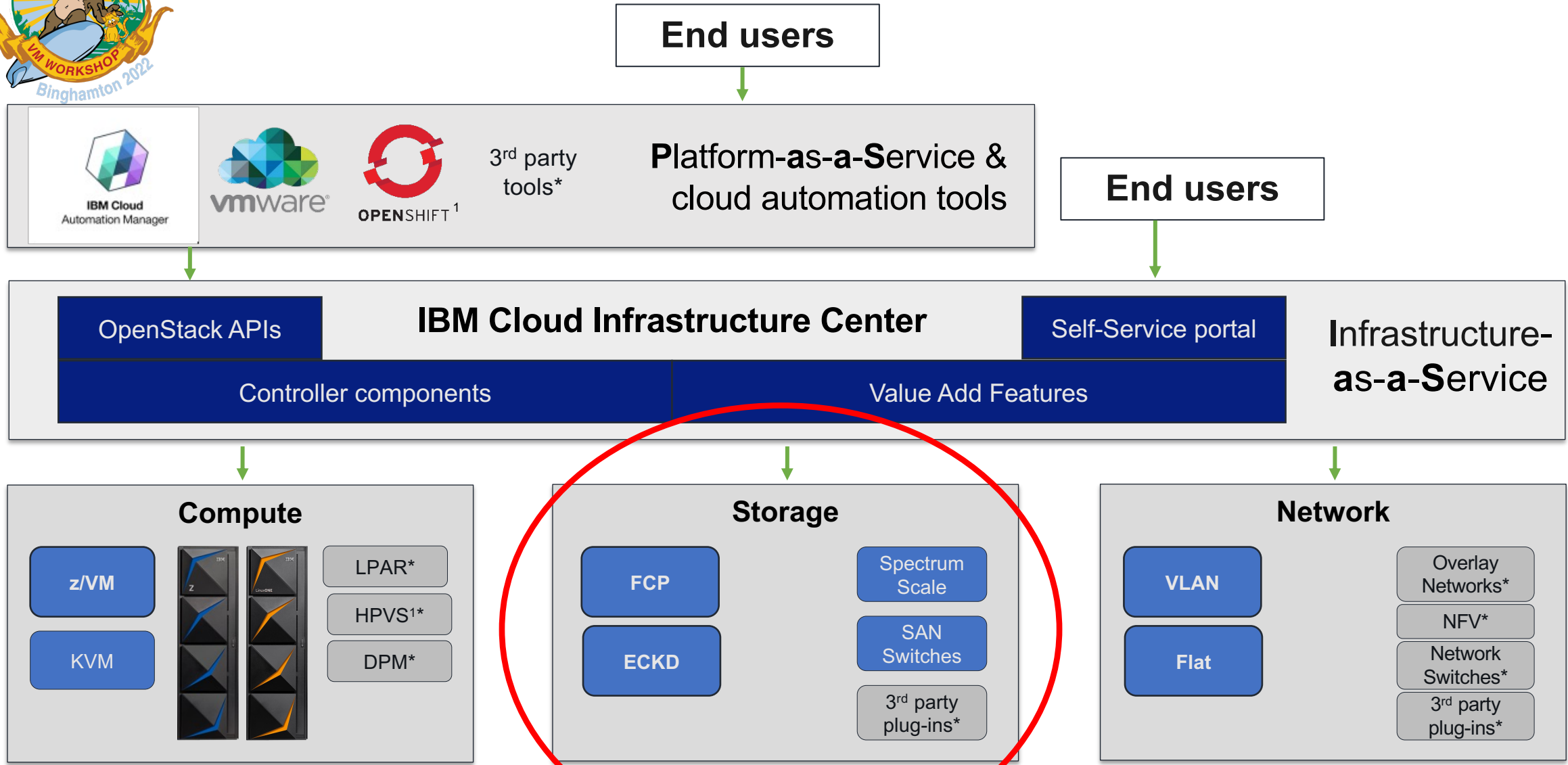
IBM Cloud Infrastructure Center

Provides a consistent industry-standard experience to:

- Integrate with cloud mgmt tools to provision and orchestrate cloud workloads
- Instantiate, define, capture, and manage the lifecycle of virtual machines
- Deploy images into virtual machines



Architecture Overview



¹ IBM Hyper Protect Virtual Server

See statement of direction at <https://ibm.co/2Nq6RBG>

* All statements regarding IBM's future direction and intent are subject to change or withdrawal without notice, and represent goals and objectives only.



Ephemeral versus persistent storage

- Ephemeral Storage
 - Local- or Direct-attached storage model
 - Static consumption model
 - Life-cycle identical to VM it is consumed by
 - E.g., all FICON-attached storage, incl. z/VM minidisks and EDEVICES
- Persistent Storage
 - Storage-provider based consumption model
 - Elastic consumption model
 - Life-cycle independent of a particular VM it is consumed by
 - E.g., FCP-attached storage, and Software-defined Storage (SDS)
 - -> **Challenge**: end-to-end storage / data management



Persistent Storage – Fabric Management

- **Switch type:** Brocade only
- **Storage provider types:** IBM Storwize (SVC, FlashSystem) and IBM DS8000
- **Hypervisor:** z/VM and KVM
- **Zoning policy**
 - initiator : create zone per one initiator and multiple targets from all storage providers
 - initiator-target : create one zone with one initiator and one target
- **More than 1 fabric switch can be registered with a single storage provider**
- **Free bindings between Fabric and storage provider**
 - connect storage provider to fabric



Storage topology sample in single DC

- **Sample:**

- Management node as the agent node of the storage provider
- One storage provider connected to IBM Z/LinuxOne via two fabric switches

- **TCP/IP connection:**

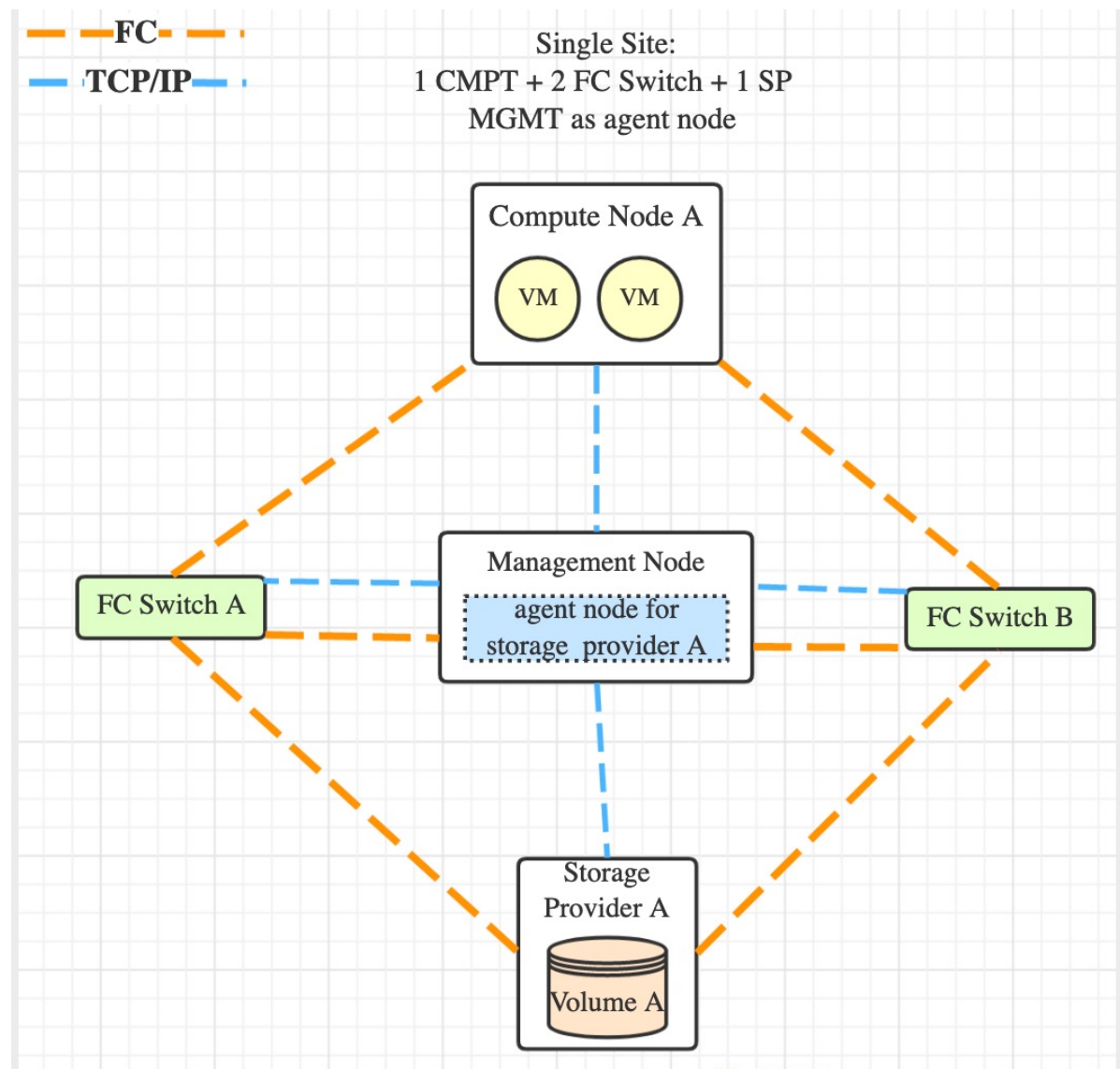
- From management and compute node
- From management node to the storage provider

- **Newly introduced requirement**

- From agent node to all the fabric switches
- From management node to all the fabric switches

- **FC connection:**

- From compute node to all FC switches
- From FC switches to the storage provider
- From management node to the FC switches (BFV requirement)





Storage topology sample in multi-DC

- **Sample: 3 sites**

- site A:
 - Management node as the agent node of SP A
 - SP A connected to switch A
- Site B and Site C:
 - Use compute node as agent node
 - Each SP is connected to one fabric switch

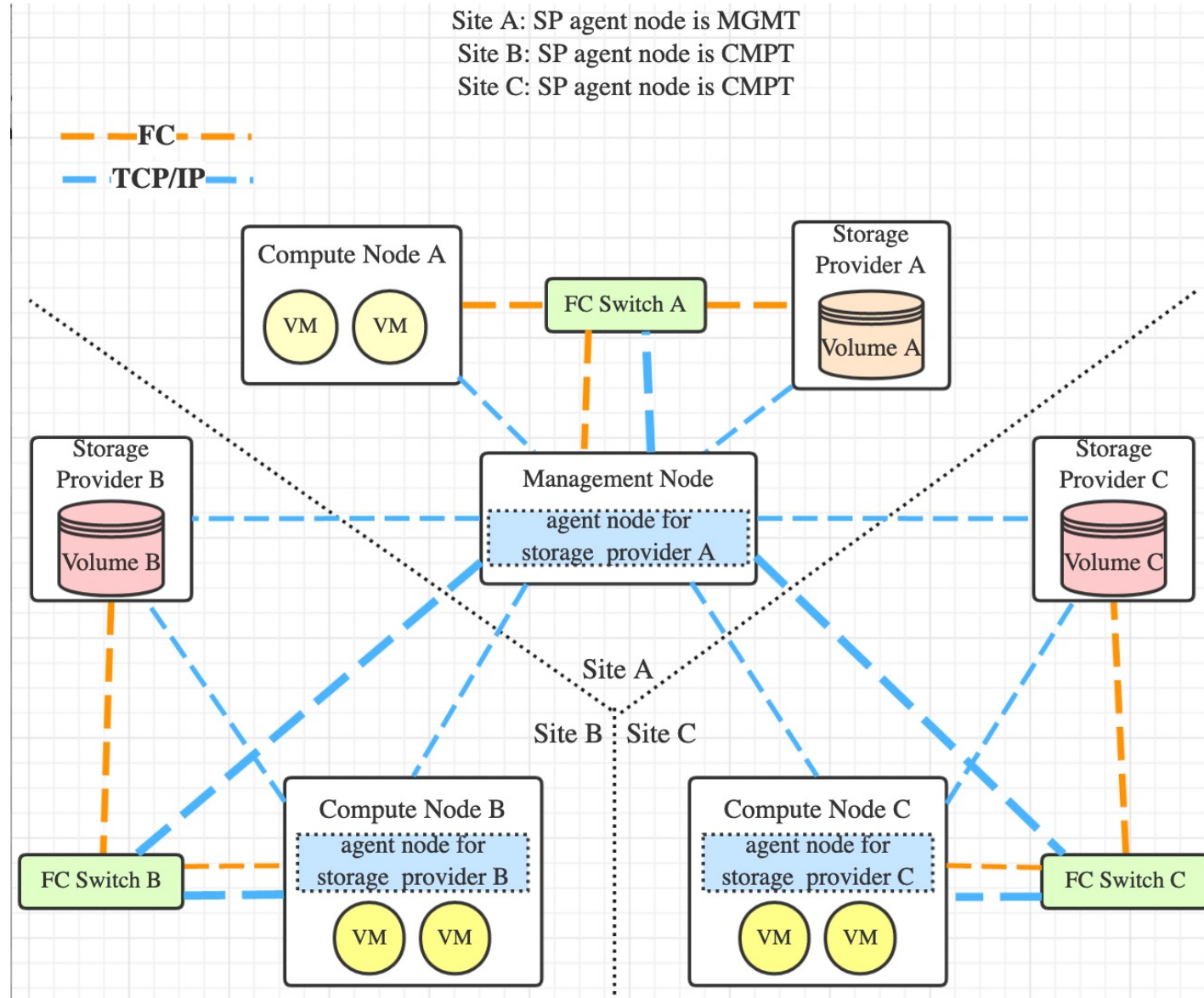
- **TCP/IP connection:**

- From management and compute node
- From management node to all the storage providers
- From agent node to all the fabric switches
- From management node to all the fabric switches

- **FC connection:**

- **rules: no cross-site FC connection requirement**
- From compute node to switch in same site
- From FC switch to the storage provider in same site
- From management node to the FC switch A
 - Site A only
 - Requirement of BFV

Site A: SP agent node is MGMT
 Site B: SP agent node is CMPT
 Site C: SP agent node is CMPT





User experience/workflow

- Support from both UI and API
- Zone lifecycle is transparent to ICIC users
 - Automatically created in volume attachment task
 - Automatically removed in volume detachment task
- Free mappings between storage provider and Fabric

1. Install ICIC

install
ICIC
1.1.4+

2. Register physical resources

add fabric

add
storage
provider

3. Manage vms and volumes

BFV

attach volume
to vm

detach volume
from vm

4. Update/Check physical resources

show fabric info

edit fabric

remove storage
provider from a fabric

5. Remove physical resources from ICIC

remove
fabric

remove
storage
provider



Deploying Red Hat OpenShift



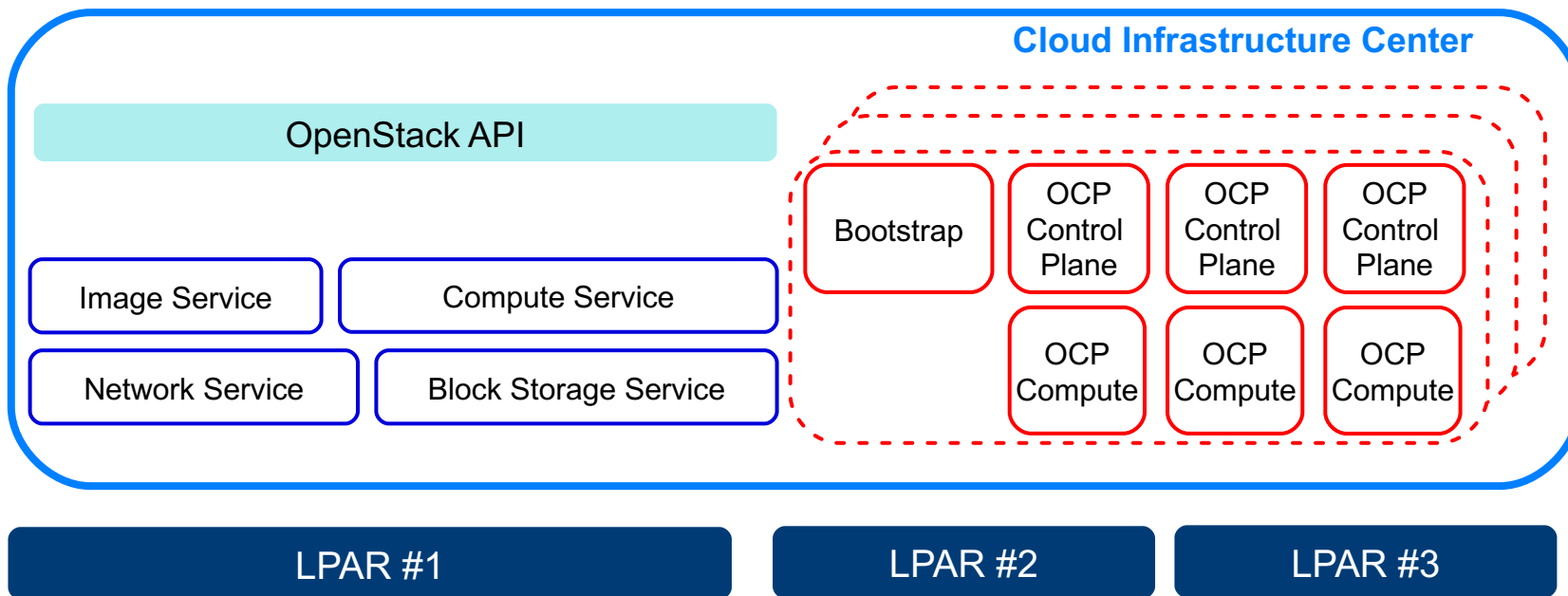
Red Hat OpenShift (OCP) UPI with Cloud Infrastructure Center

RHCOS disk image from <http://mirror.openshift.com/>

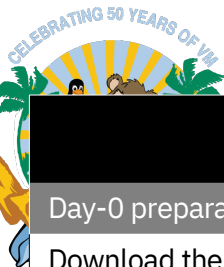
Ignition

Ansible

DNS server
Load Balancer



- **Image Service**
 - Red Hat CoreOS (RHCOS) image
 - bootstrap ignition file
- **Compute Service**
 - provision RHCOS OCP nodes
- **Network Service**
 - RHCOS network configuration
 - Static IP, DHCP or allocate from IP range
- **Block Storage Service**
 - RHCOS FCP root disk
 - OCP persistent volume
- Provides OCP nodes **multi-tenancy** support and **life cycle management**



Manual UPI vs. Cloud Infrastructure Center UPI

Manual UPI	Cloud Infrastructure Center UPI	Cloud Infrastructure Center UPI + icic_ocp_upi_playbooks (Ansible)
Day-0 preparation		
Download the OpenShift installation program and CLI, Generate install config and ignition files, Setup DNS, load balancer	Download the Red Hat OpenShift installation program and CLI, Generate install config and ignition files, Setup DNS, load balancer	01-preparation.yaml bastion.yaml
Day-1 installation&configuration		
Download Red Hat CoreOS kernel image and initramfs image , send to each zvm systems	Download Red Hat CoreOS disk image and upload onto Cloud Infrastructure Center image service. One time effort, the image will be sent to each compute nodes automatically	02-create-cluster-control.yaml 03-create-cluster-compute.yaml
Setup HTTP/ HTTPS/ FTP server, upload Red Hat CoreOS rootfs image and ignition config file	Ignition file can be uploaded onto Cloud Infrastructure Center image service	02-create-cluster-control.yaml 03-create-cluster-compute.yaml
Create VM definition for Red Hat OpenShift nodes	Provision Red Hat CoreOS via Cloud Infrastructure Center (API or web UI), specify ignition file as user data when provisioning the Red Hat CoreOS virtual machine Be able to create deploy template for Red Hat OpenShift master nodes and worker nodes	02-create-cluster-control.yaml 03-create-cluster-compute.yaml
Prepare kernel parm file for each Red Hat OpenShift nodes		
prepare kernel image, initramfis and kernel parmfile to target VM's reader device		
Boot the VM, load initramfs, install Red Hat CoreOS via coreos-installer		
Day-2 operation		
Red Hat OpenShift node life-cycle management	Cloud Infrastructure Center support	-
Add new worker nodes	Add new worker nodes via Cloud Infrastructure Center (API or web UI)	add-new-compute-node.yaml
Destroy the OCP cluster	Cloud Infrastructure Center supports	04-destroy.yaml

Benefits

- **Simplified & automated installation steps!**
- **Less mainframe skills required!**

- **Better user experience!**
- **Helpful to manage and maintain Red Hat OpenShift nodes!**
- **Easy to be integrated!**

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All Steps Automated!

https://github.com/IBM/z_ansible_collections_samples/tree/master/z_infra_provisioning/cloud_infra_center/ocp_upi



Demo

OCP UPI install:

```
$ git clone https://github.com/IBM/z\_ansible\_collections\_samples.git
$ vi inventory.yaml
$ ansible-playbook -i inventory.yaml 01-preparation.yaml
$ ansible-playbook -i inventory.yaml bastion.yaml
$ ansible-playbook -i inventory.yaml 02-create-cluster-control.yaml
$ ansible-playbook -i inventory.yaml 03-create-cluster-compute.yaml
```

Delete bootstrap server:

```
$ ansible-playbook -i inventory.yaml destroy-bootstrap.yaml
```

Add new worker node:

```
$ ansible-playbook -i inventory.yaml add-new-compute-node.yaml
```



Hybrid?!



Automation, chargeback, observability ...
integrating with enterprise tooling, successfully
managing a Cloud environment?!



IBM Cloud Pak for Watson Alops

Application Impact Avoidance

Hybrid application management

INSTANA
Observability

Governance and compliance

turbonomic
Efficiency & Cost management

AI and machine learning

Technology Partners

Data feeds

IT service mgmt

Log ingestion

Code provenance

App resource mgmt

Container security

Scalable memory

Collaboration

----- CI/CD, Tickets, logs, metrics, events, topology, Digital experience, Organizational, Cost & Budget, Weather, Energy -----

Automation foundation

- Robotic Process Automation
- Natural language interactions
- Process and task mining
- Event detection
- Machine learning
- 3rd Party integrations
- Operational models



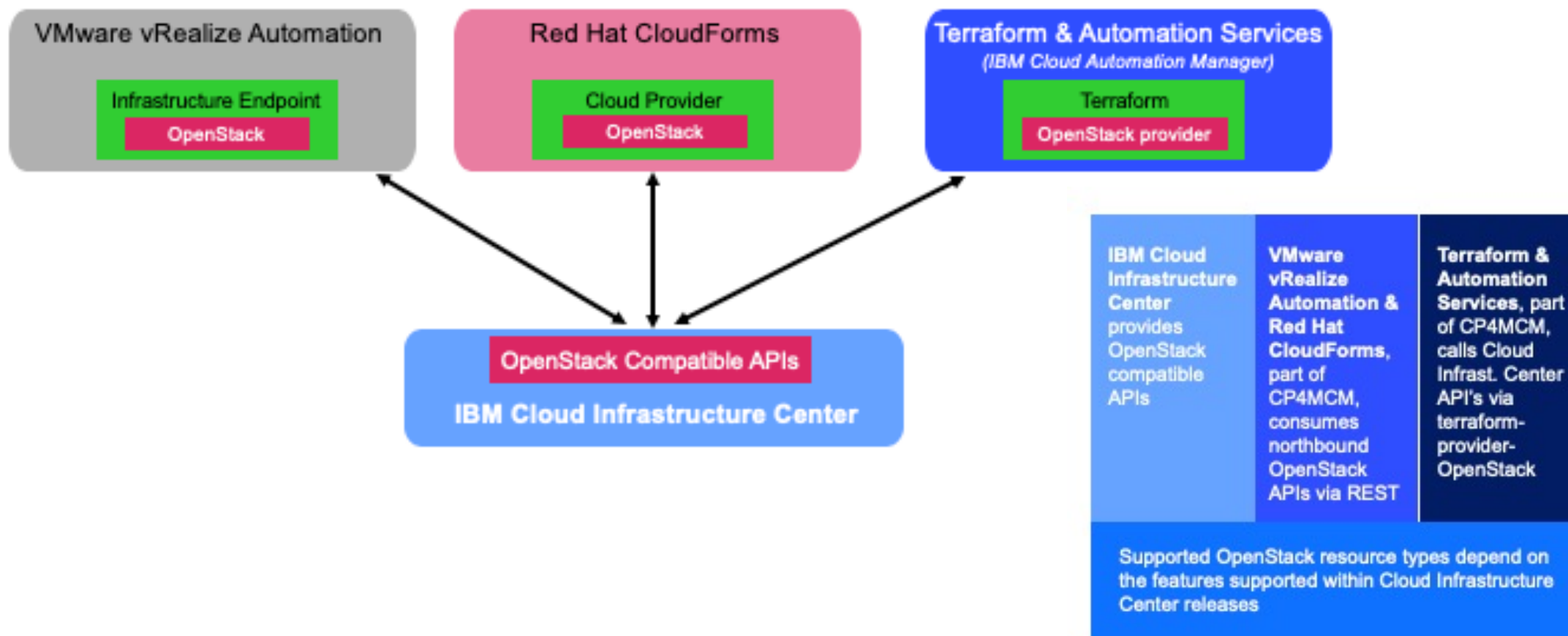
IBM Cloud AWS Microsoft Azure Google Cloud VMware Private X86

IBM zSystem & IBM LinuxOne
IBM Power Systems



IBM Cloud Infrastructure Center Integrations

Integrations of IBM Cloud Infrastructure Center via OpenStack REST API's consumed by upper layer Cloud Management Platforms to provision/orchestrate workloads





RH CloudForms Integration

Red Hat CloudForms Administrator | EVM

Compute > Clouds > Providers > Cloud Providers > ICIC-POK (Dashboard)

Configuration Policy Monitoring Authentication

	13 Flavors	1 Cloud Tenants	1 Images	3 Instances
	2 Availability Zones	1 Security Groups	1 Cloud Networks	0 Cloud Volumes

Recent Instances

Last 30 Days

Recent Images

Last 30 Days

- Overview
- Services
- Compute
- Migration
- Configuration
- Networks
- Storage
- Control
- Automation
- Monitor



VMware vRealize Automation (vRA) Integration

Configuring Cloud Infrastructure Center as an OpenStack Endpoint in vRA

The screenshot displays the vRealize Automation Catalog interface. At the top, there is a navigation bar with the following menu items: Catalog, Deployments, Design, Inbox, Administration, Infrastructure, and Containers. The main content area shows a grid of 16 items, each representing a different operating system or service offering. Each item includes an icon, a title, a description, business group, DevOps group, service provider, and a 'REQUEST' button.

Item Name	Description	Business Group	DevOps Group	Service Provider
AIX	AIX 7.1	Business group	DevOPS	IBM Power
CentOS	CentOS Linux Distro for ESXi	Business group	DevOPS	VMware vSphere
IBM i	System i on PowerVM	Business group	DevOPS	IBM Power
Kubernetes	Test containers	Business group	DevOPS	IBM Z
Linux on Power	RHEL for Power	Business group	DevOPS	IBM Power
LinuxOnZ	vRO plugin & zVM CC	Business group	DevOPS	IBM Z
My Blueprint	New Blueprint for Power Systems	Business group	DevOPS	IBM Power
Oracle	Oracle DB for AIX	Business group	DevOPS	IBM Power
Rhel_CIC	Linux on Z via Cloud Infrastructure Center (CIC)	Business group	DevOPS	IBM Z
Rhel - LinuxONE	RedHat Linux on Z	Business group	DevOPS	IBM Z
SAP_HANA_Power	SAP HANA for Power on RHEL 7.7	Business group	DevOPS	IBM Power
SLES - LinuxONE	SUSE Linux on Z	Business group	DevOPS	IBM Z
SUSE	SUSE for SAP HANA	Business group	DevOPS	IBM Power
techU	Multi platform deployment vSphere, AIX and LoZ	Business group	DevOPS	IBM Power
Test_Blueprint_Power	new blueprint for Power Systems	Business group	DevOPS	IBM Power
Windows	W2K	Business group	DevOPS	VMware vSphere



Examples



Eating your own cookies ... the IBM CIO Office



Welcome to

Cloud Provisioning

We provide Virtual Machines (VMs) that run on physical hardware with resources that are shared by multiple tenants. Each VM runs its own operating system and optional middleware products that you support.

Login

Login

Business challenge

Using a traditional IT operations model, it is hard and complex to manage the infrastructure assets across multiple platforms. Individual management pillars exist for the infrastructure components. The existing management tooling does not support all Linux® commands, which requires to develop scripts, and many admin tasks are done manually.

Transformation

As part of the consolidation of the IT environment, the transition from the traditional IT operations model to a cloud operations model was implemented. The tooling is now based on the industry-standard OpenStack APIs, which enabled the integration of the IBM Z environment into CIO Office's hybrid cloud, and with the new user portal the user experience is strongly improved.

Business benefits:

Standardization

enabled the integration of all platforms into end user portal

Accelerates

the entire setup, can be done in a few steps, quickly and cost efficiently

Reduces

costs and complexity to manage a huge environment

[Read the full story](#)

IBM CIO Office

Transformed to a cloud operations model and integrated IBM Z into hybrid cloud

The company owns delivery of the private cloud strategy and provides the tools and infrastructure that developers and application owners use to do their jobs every day with speed, scale and security.

IBM Cloud Infrastructure Center provides an infrastructure-as-a-service (IaaS) layer for IBM Z, enabling virtual machines to be provisioned and managed and the automation of services, and providing a platform for building higher-level cloud services.

“IBM Cloud Infrastructure Center allows us to substantially improve our infrastructure management and reduce cost & complexity to manage from simple to complex environments.”

—Eric Everson Mendes Marins,
PCS_ZVM squad at IBM CIO Office



Mongo as a Service on IBM zSystems – a large NA Bank

Solution elements

Function	On IBM zSystems
Deployment Catalog	Integrated with existing tools
Automation	Provision via Ansible / Cloud Infrastructure Center
Mongo Instance	Mongo Enterprise on IBM zSystems
OS & Virtualization	RHEL 8 / IBM z/VM
Encrypt Data @ Rest	H/W accelerated on IBM zSystems and Storage
Compression	H/W accelerated on IBM zSystems and Storage
FFIEC Appendix J	IBM Safeguarded Copy
Logging	Mongo Ops Manager

Solution benefits

- 50% more efficient in terms of data center space, power, cooling
- Support for Franchise Critical Applications
- FFIEC Appendix J Support for backup and restore via storage

Today

- In Production for an initial set of Mongo Applications

Future

- Expand to more Mongo deployments as use grows
- Apply same approach to Oracle, EDB, Kafka, Cassandra (ScyllaDB), OpenShift etc.

Business requirements from the large North American bank

- FFIEC Appendix J compliant technology solution for Franchise Critical applications running MongoDB
- Sub-second recovery speed for multi-TB instances to meet strict RTO requirements



Additional Useful information



OK ... but where to get more information?

- **ibm.com/products/cloud-infrastructure-center**



Thank You!