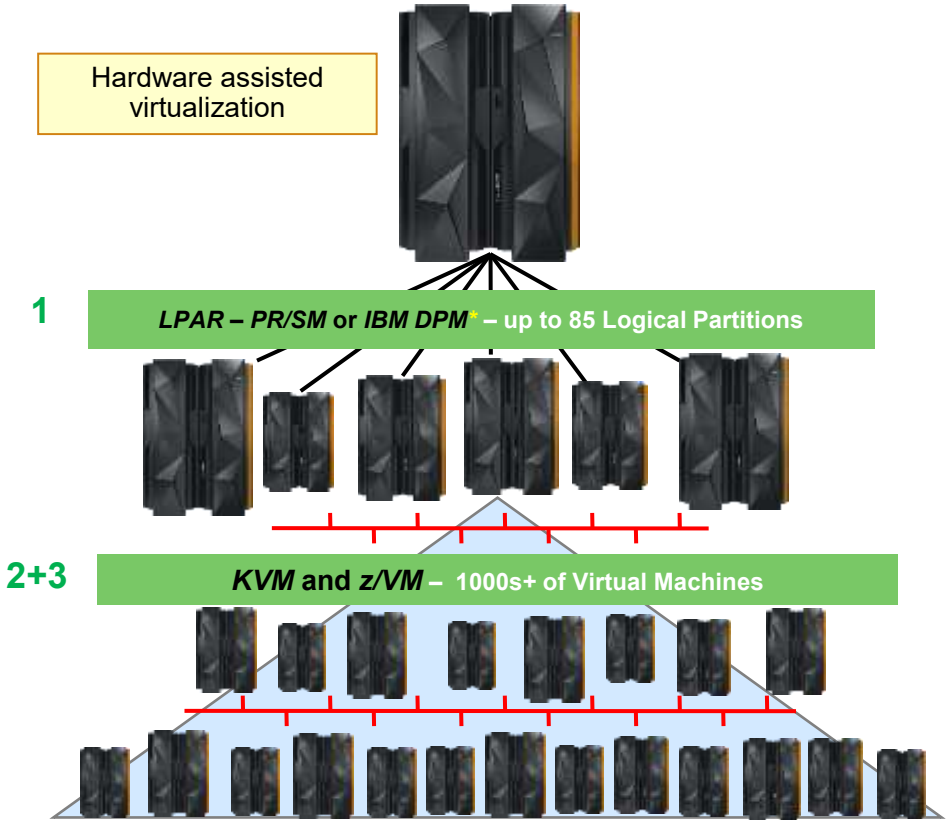
New Virtualization for IBM Z and IBM LinuxONE
OpenShift Virtualization

session 137

Wilhelm Mild
IBM Executive IT Architect
IBM R & D Lab Germany
wilhelm.mild@de.ibm.com

Virtualization on IBM LinuxONE and IBM Z

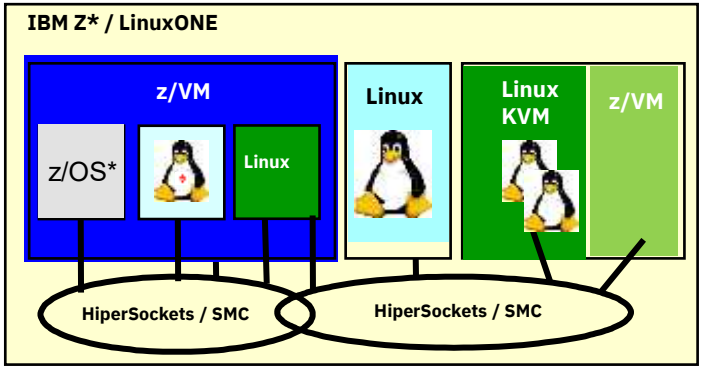
Built-in & Shared Everything Architecture

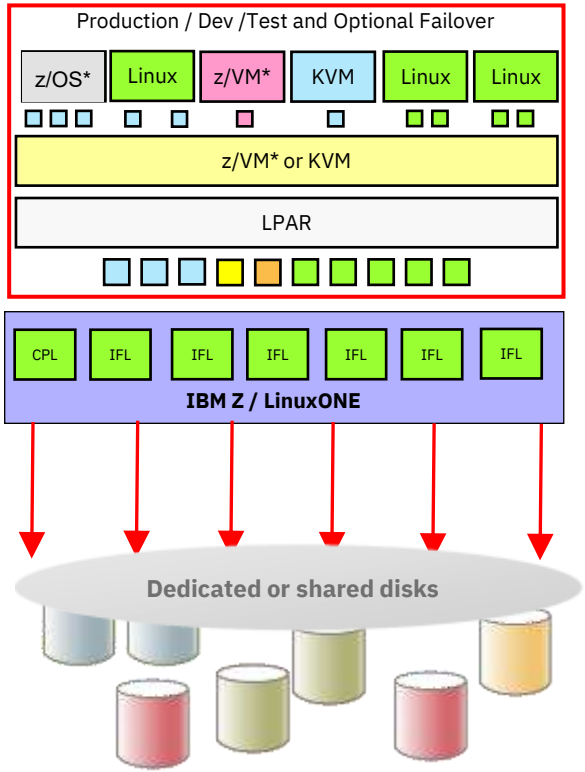


IBM® Z & LinuxONE™ Systems

- Cores are designed to run at near 100% utilization nearly 100% of the time
- Provisioning of virtual servers in seconds
- High granularity of resource sharing (<1%)
- Upgrade of physical resources without taking the system down
- Scalability to 1000s of virtual servers
- More with less: more virtual servers per core, sharing of physical resources
- Extensive lifecycle management
- HW-supported isolation, highly securable (EAL5+ or EAL4+ certified)

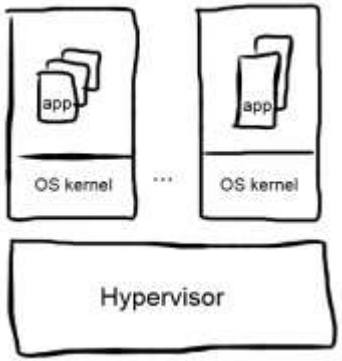
Virtualization options with IBM Z and IBM LinuxONE

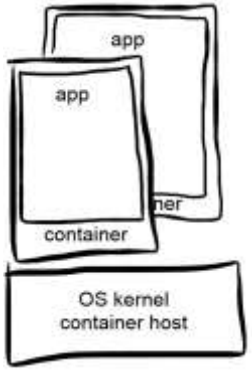




- Network Virtualization
- Memory Virtualization
- Processor Virtualization
- System Virtualization
- Disk Virtualization / Cluster

Isolation: Virtualization v. Containerization





Virtual machines are infrastructure oriented:

- Coming from servers, now virtualized
- Virtual server resource management
- Several applications per server
- Isolation
- Persistence

Containers are service oriented:

- Application-centric
- Application management
- Solution decomposed
- Dev(Sec)Ops
- Dynamic
- Orchestrated, e.g., with Kubernetes / OpenShift

Isolation: Virtualization & Containerization
Cloud-native technologies combining two worlds

Virtual machine management and integration with containers side-by-side:

- KubeVirt community project
  Management of virtual machines side-by-side with containers within a Kubernetes cluster

Virtual machine to isolate containers workloads

- Kata Containers community project
  - Isolate container workloads with virtual machines, for example, to run privileged workloads (builds)
- Confidential Containers community project
  - Enhance Kata Containers with Trusted Execution Technologies for a Confidential Container

https://www.ibm.com/blog/confidential-containers-with-red-hat-openshift-container-platform-and-ibm-secure-execution-for-linux/

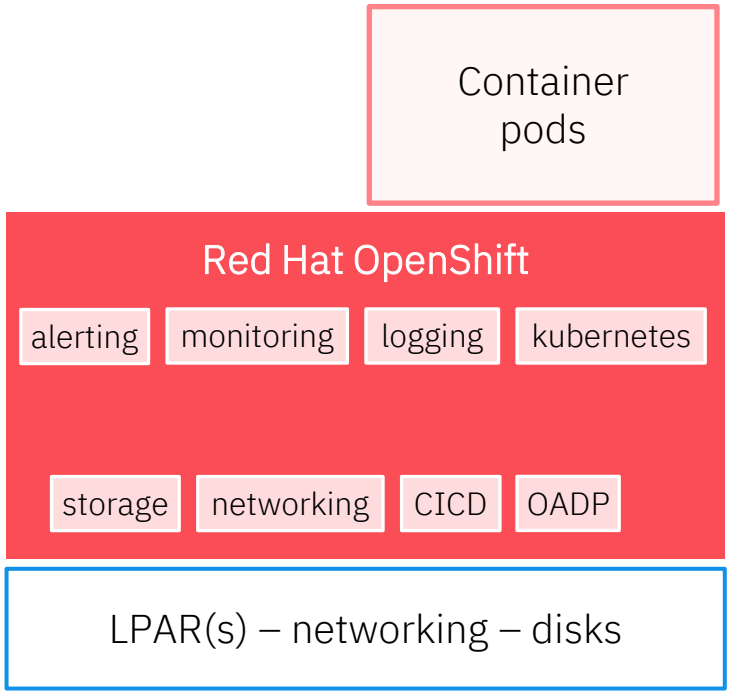
Red Hat OpenShift

Containers running in pods

Red Hat OpenShift Container Platform

Add-ons / Storage / Operators – including OpenShift Virtualization Operator / …

Infrastructure



Red Hat OpenShift Virtualization

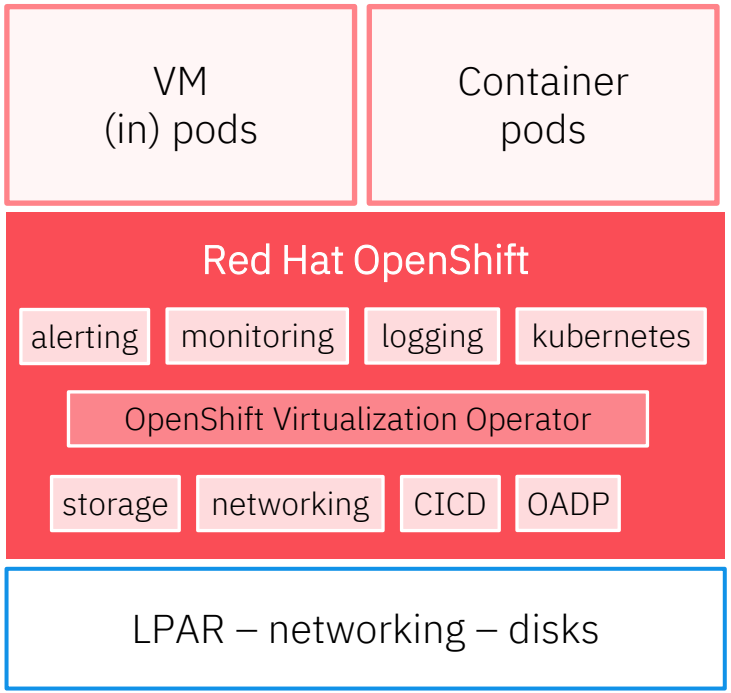
VMs and containers run in pods

Pods exist side-by-side and have the same access to the resources provided by the Red Hat OpenShift platform

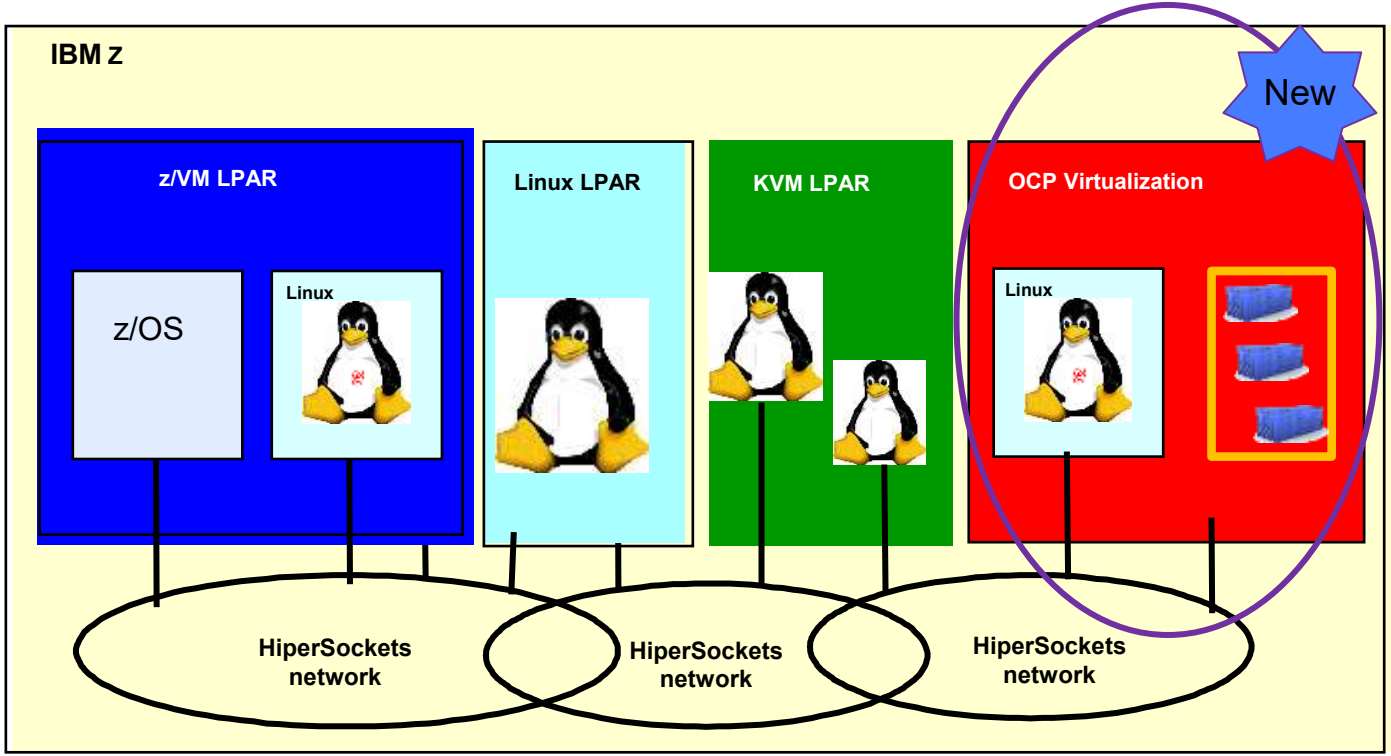
Red Hat OpenShift Container Platform

Add-ons / Storage / Operators – including OpenShift Virtualization Operator / …

Infrastructure



IBM Virtualization options on IBM Z



- z/VM (IBM)
- KVM (Red Hat, SLES, Ubuntu)
- Red Hat OpenShift Virtualization

Virtual machines and containers in a single platform with...

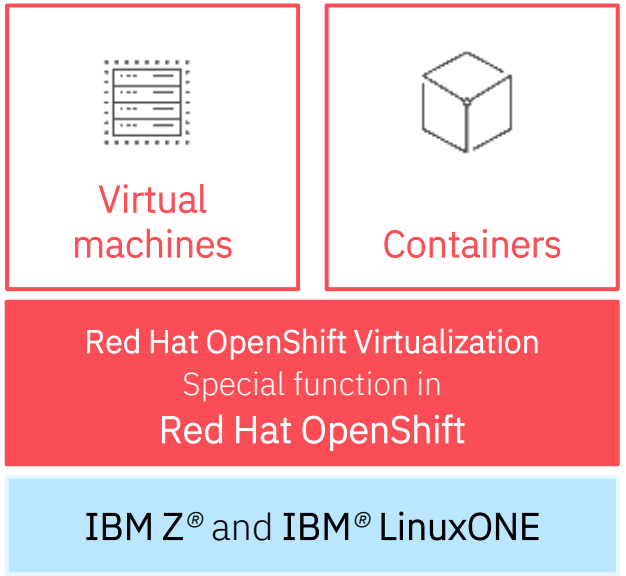
Red Hat OpenShift Virtualization

- *Bringing two worlds together*
- *One solution for VM and container workloads*

OpenShift Virtualization key capabilities:

- Run VMs and containers in the same environment
- Manage modern and heritage workloads with the same tools and within the same interface
- Orchestrate communications between VMs and containers
- It is not requiring additional Hypervisor

Removes the need to maintain different technologies, different skills, and different teams



OpenShift Virtualization since OCP 4.19 on IBM Z and IBM® LinuxONE

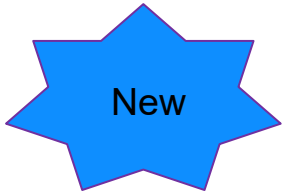
OpenShift Virtualization 4.19 is **first release that includes it** on IBM Z and IBM® LinuxONE.

Release notes

Note: Red Hat OpenShift 4.19 and Red Hat OpenShift Virtualization are supported on IBM z17 and LinuxONE 5

- OpenShift Virtualization Operator **must be installed** on top of a Red Hat OpenShift cluster
  ⇒ OpenShift Virtualization does not come pre-installed
- **OpenShift Virtualization Operator** allows to run and manage VM workloads alongside container workloads I n a Red Hat OpenShift cluster.
  ⇒ No other product installation required *(e.g., no separate KVM or other hypervisor installation)*
- OpenShift Virtualization is based on the open-source project Kubevirt and uses underneath KVM technology to provision the virtual machines.
  ⇒ Manages KVM guests only
    - KVM guests based on s390x architecture
  ⇒ No z/VM, no VMware, no other hypervisor

OpenShift Virtualization 4.21 on IBM Z and IBM® LinuxONE



OpenShift Virtualization 4.21 is the latest GA release on IBM Z and IBM® LinuxONE.

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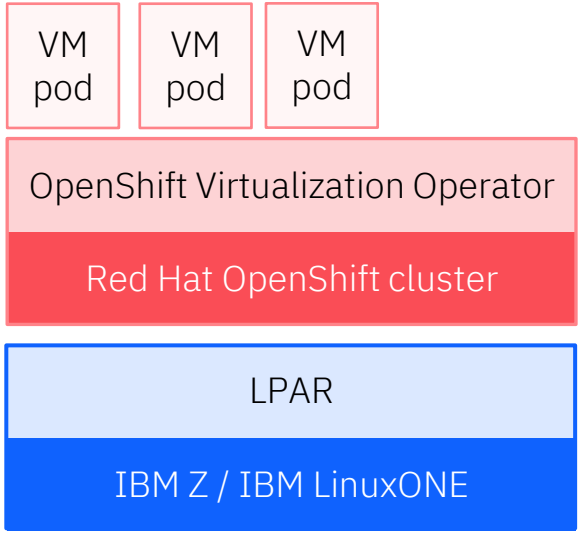
OpenShift Virtualization Operator

Requirements

- OpenShift Virtualization 4.19+ must be installed on a Red Hat OpenShift cluster 4.19+ on LPAR.
  ⇒ Installation of 4.19+ or upgrade to 4.19+ required
- Minimum required resources for OpenShift Virtualization Operator are aligned with the minimum required resources for an OpenShift Cluster.
- Each deployed VM requires additional resources, depending on the VM specifics and/or the T-shirt size of the VM.
- It's recommended to plan ahead for additional resources: IFLs, memory, and storage for the individual workload on top of the cluster.

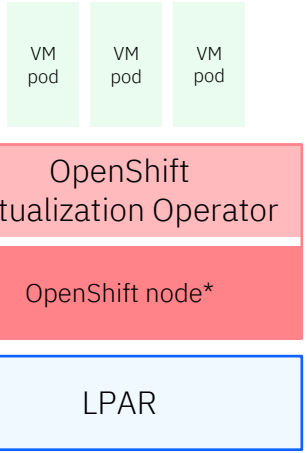


https://docs.redhat.com/en/documentation/openshift_container_platform/4.19/html/virtualization/release-notes

OpenShift Virtualization Installation Options

- OpenShift Virtualization - It **requires** OpenShift on LPAR(s) cluster
- Existing OpenShift cluster on LPAR(s) can be used when upgraded to **4.19**

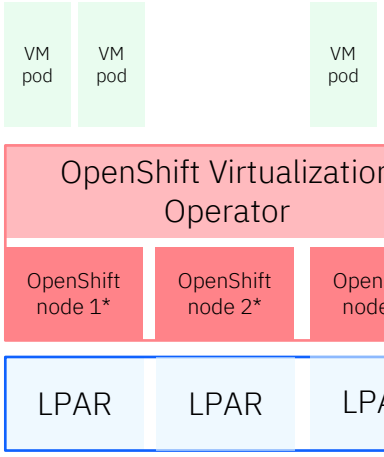
Single Node OpenShift (SNO) cluster



Good for:

- Quick Start
- POCs, Learning, Dev
- Dev / Test

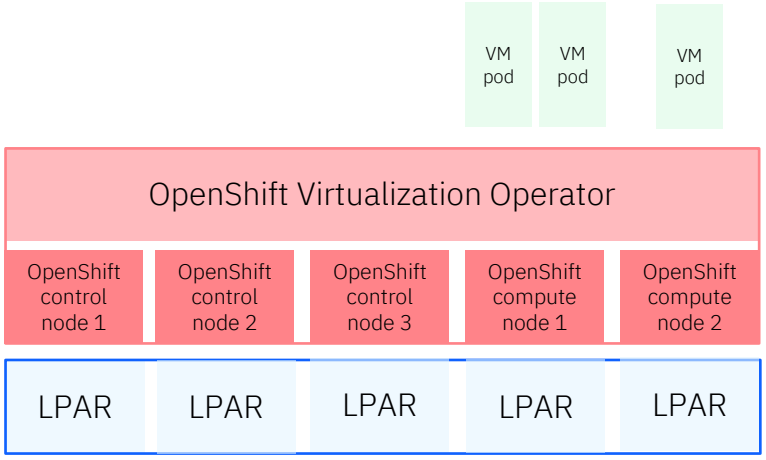
3 nodes OpenShift cluster



Good for:

- High Availability
- Scalability
- Guest Migration

"Classic" OpenShift cluster



Good for:

- High Availability
- Further Scalability
- Guest Migration

* includes control and compute node

OpenShift Virtualization Installation Options

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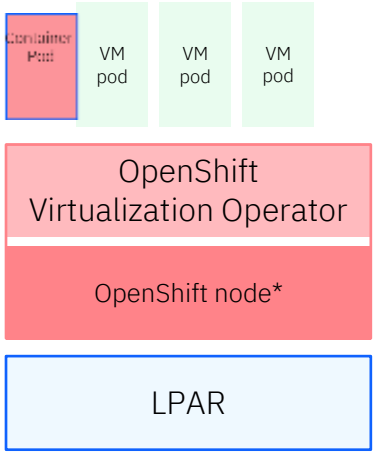

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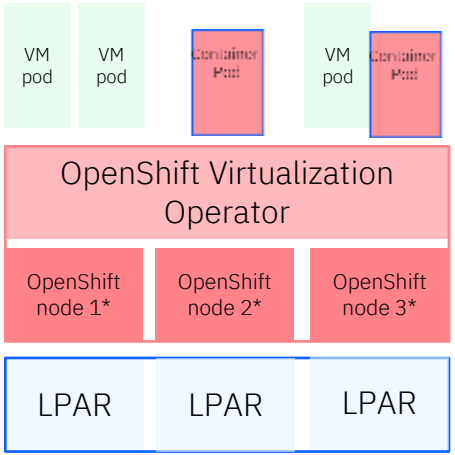

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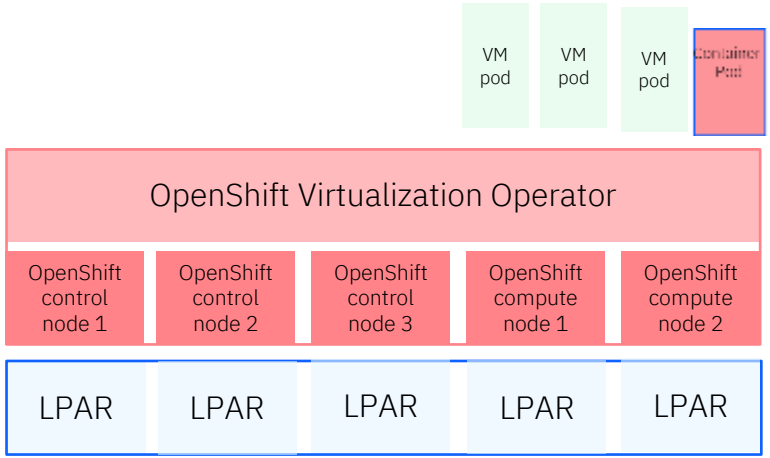


Good for:

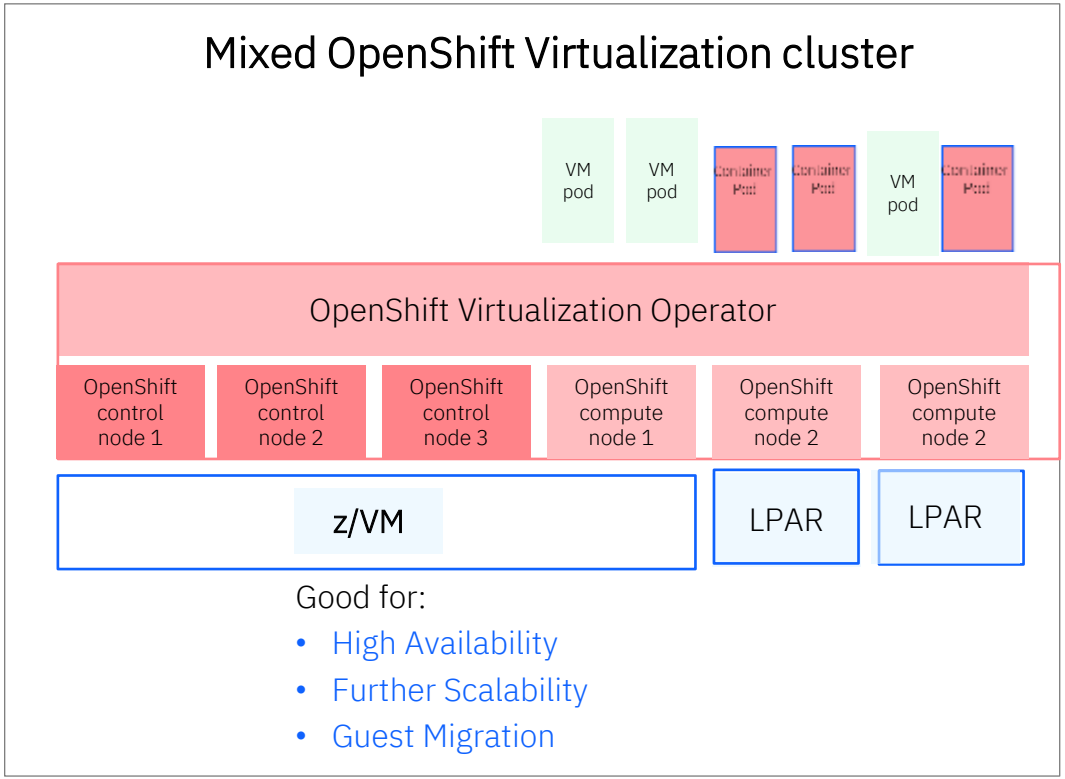
- High Availability
- Further Scalability
- Guest Migration

* includes control and compute node

OpenShift Virtualization

Installation Options in RH OpenShift 4.21

- OpenShift Virtualization – It **allows mixed** OpenShift on z/VM & LPAR(s) cluster
- Existing OpenShift cluster on z/VM can be used when upgraded to **4.21**



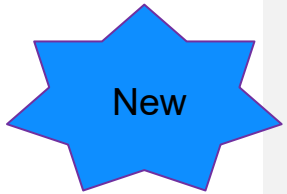
New

Usecase :

Extending an existing RHOCP cluster on z/VM with one or more compute nodes on LPARs and levaraging RHOCPV to create VMs on the new compute nodes

- Reusing existing clusters
- Saving LPARs by deploying control nodes on z/VM
- Requires z/VM

OpenShift Virtualization
Confidential Computing



OpenShift Virtualization :

- Leverages Confidential Computing technology on IBM Z and LinuxONE (IBM Secure Execution)
- This capability provides hardware based memory encryption that protects virtual machine workloads from access by the host or hypervisor environment. For more information, see Configuring IBM® Secure Execution virtual machines on IBM Z® and IBM® LinuxONE.

Simplifies exploitation on a solution platform layer by providing :

- Ease of use of the underlying technology
- Automation to build IBM Secure Execution (SE) VM images
- Integration with CI/CD frameworks (like OpenShift Pipelines) to automate build of SE Images and management of SE VMs

OpenShift Virtualization

Extends the Red Hat OpenShift platform capabilities to VMs

OpenShift Virtualization provides integration with:

- OperatorHub for easy installation
- OpenShift UI and CLI for management
- Storage management with Local Storage and IBM Storage Fusion
- Network management with SDN for VMs
- Cluster Logging and Monitoring of the VMs
- High Availability within the cluster

OpenShift Virtualization provides

⇒ Same look & feel

⇒ Management of the VMs and the environment of the VMs

- Orchestration of VMs, network, storage, logging, etc. - the environment where the VMs run

⇒ Same tooling as for containers

- If you’re used to containers, it’s the same for VMs now

OpenShift Virtualization

Simplified VMs lifecycle management

OpenShift Virtualization provides:

- Managing the hypervisor deployment and its lifecycle
- Managing the VM and VM images
- Easy deployment from templates and/or common instances types
- Importing VM images
- Providing pre-built guest images* for use by OpenShift Virtualization (RHEL8 , RHEL9, RHEL10, ...)

OpenShift Virtualization provides

⇒ Hypervisor lifecycle management

⇒ Simplified management of the VMs and VMs' images

Additional community images for Ubuntu, Fedora and CentOS Stream are available on quay

*List of all available Linux distributions for RHOCPV

OpenShift Virtualization
Automation and Day 2 Operations

OpenShift Virtualization provides:

- Live guest migration
- Control over VMs resources via customizable quotas.
- Scaling the VMs in capacity via CPU hot plugin and/or Memory ballooning.
- Backup and Restore via:
  - Snapshot of VMs, Cloning of VMs images and VMs disks
  - OADP (OpenShift APIs for Data Protection Operator)
- Integration with OpenShift Pipelines Operator (CI/CD framework) for automating VMs management

OpenShift Virtualization provides

⇒ Simplified Day 2 operations

⇒ Easy automation of the environment and the applications

OpenShift Virtualization

Persistent storage options for VMs

Host path provisioner (HPP, included in RHOCPV):

- Local storage provisioner and uses the directory on the OpenShift compute nodes
- Provides:
  - Easy, straight forward setup
  - Local to the node where the VM is running
  - Fast access to storage (local disk access)
- Lacks enterprise storage features (backup, guest migration etc.)

→ Recommended for a Quickstart , POC ...

RedHat OpenShift Data Foundation (ODF) and IBM Fusion Data Foundation (FDF)

- RH ODF and IBM FDF are shared persistent storage providers for containers and VMs
- Provides:
  - High Availability and Data Resiliency
  - Scale Horizontally
  - Unified shared storage cross nodes
  - Live guest migration
- Requires provisioning additional resources

→ Recommended for Production environments

OpenShift Virtualization
Low Effort, High Gain

OpenShift Virtualization is based on the open source project Kubevirt and uses KVM technologies underneath to provision the virtual machines

⇒ Manages KVM guests only
KVM guests based on s390x architecture

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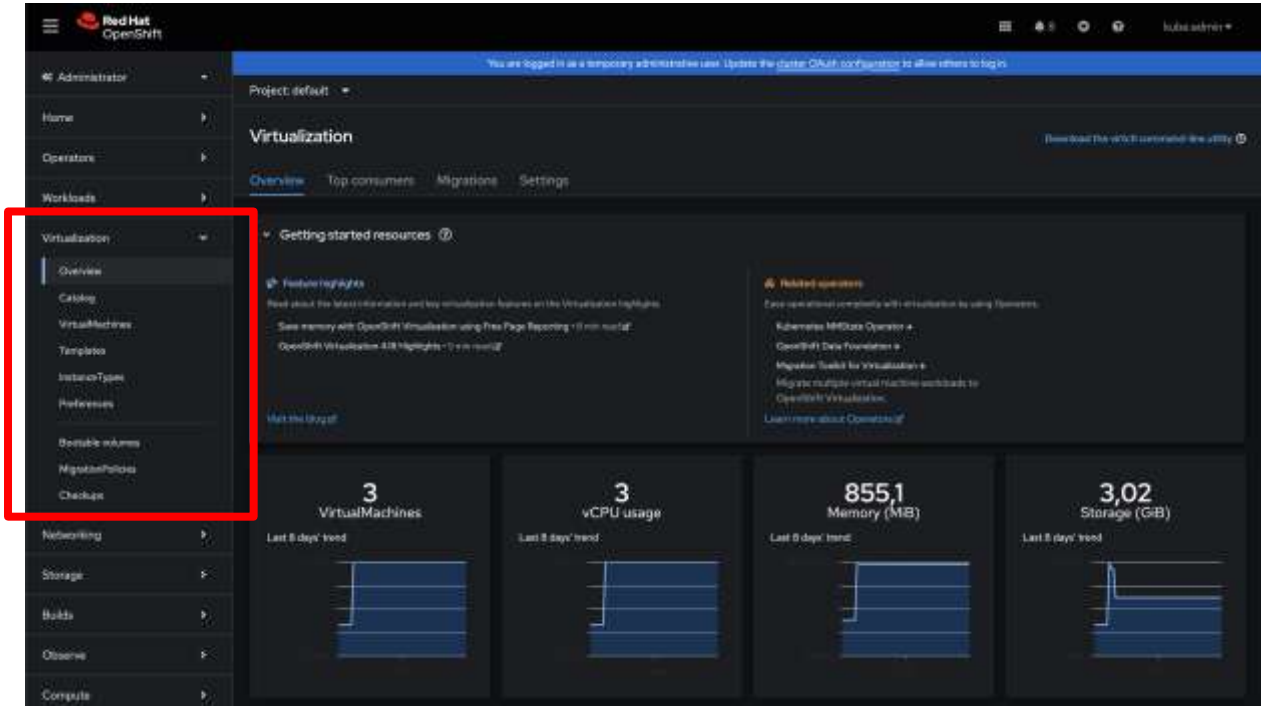
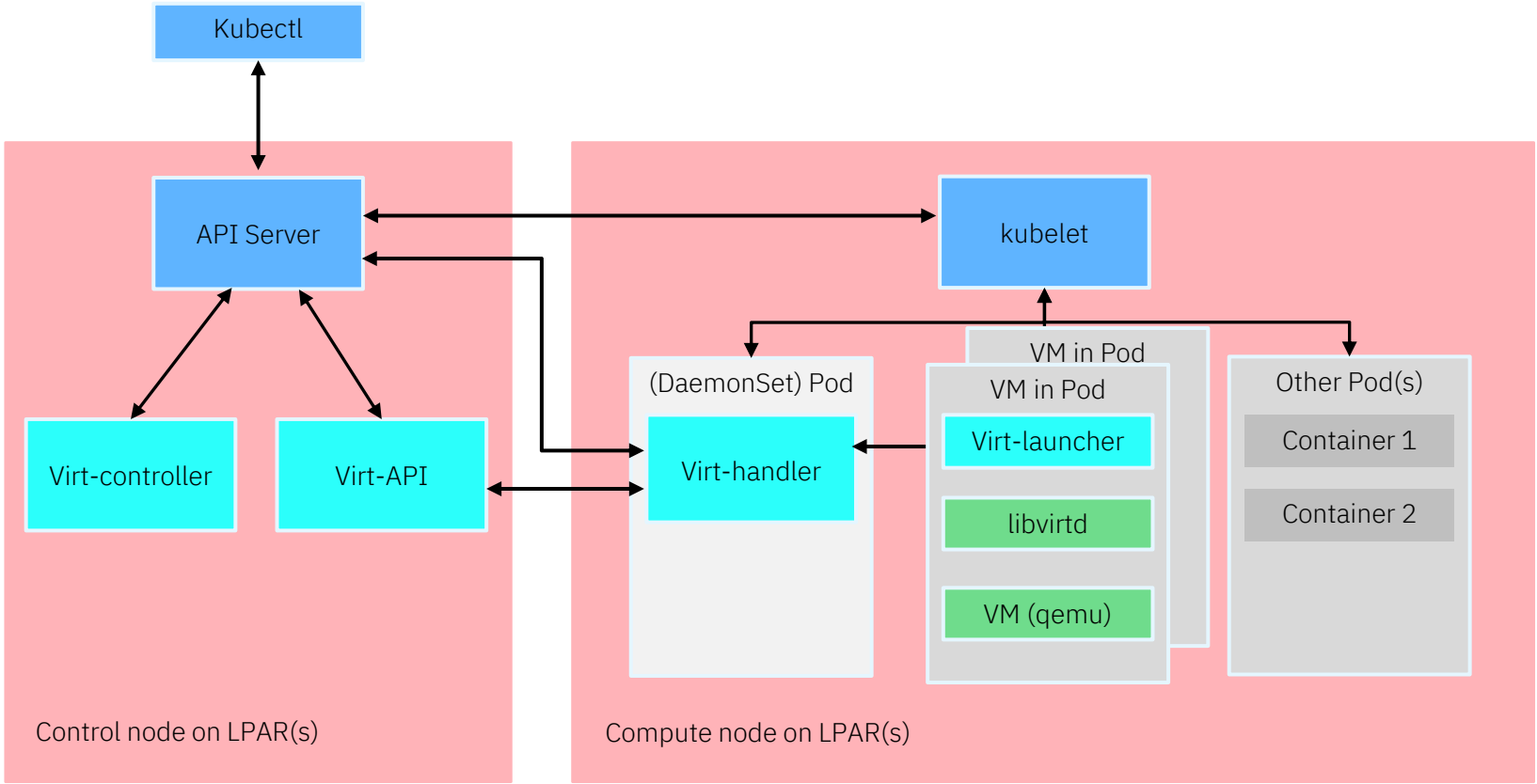


OpenShift Virtualization



OpenShift Virtualization

Minimum required resources

OpenShift Virtualization Operator deployment has the following requirements:

	Additional required resources
IFL Cores	< 0.2 IFLs
Memory	Red Hat Sizing Formula [1] 2.2 GiB + 150 MiB * N_{Infra} + 360 MiB * $N_{Compute}$

The minimum required resources for an OpenShift Clusters with 6 IFLs and 16 GiB Memory per control and 8 GiB Memory per compute are sufficient for installing the RHOCPV Operator.

Example: On an OCP cluster with 3 Control Nodes & 3 Compute Nodes, RHOCPV consumes only additional 3 GiB Memory & 0.2 IFLs shared across all nodes on top of the RHOCP base load.

[1] Link to Red Hat sizing formula **(verified and applicable for s390x)**

OpenShift Virtualization
Sizing for the Virtual Machines

RHOCPV is very resource efficient in managing Virtual Machines (VMs):

- RHOCPV is capable of provisioning up to 50 idling VMs on one single IFL
- IFL demand for the VMs is mainly driven by the workload itself

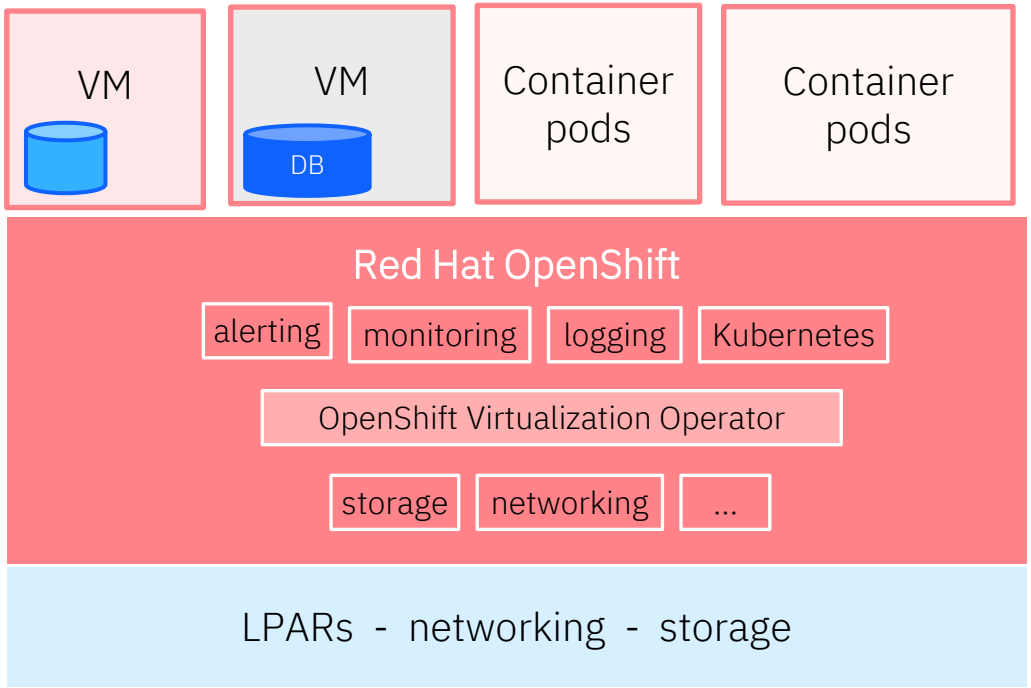
Memory demand of a VM can be accuratly calculated with a Red Hat formula [1]:

$$1.002 * Memory_{Requested} + 218\ MiB + 8\ MiB * N_{VCPU}$$

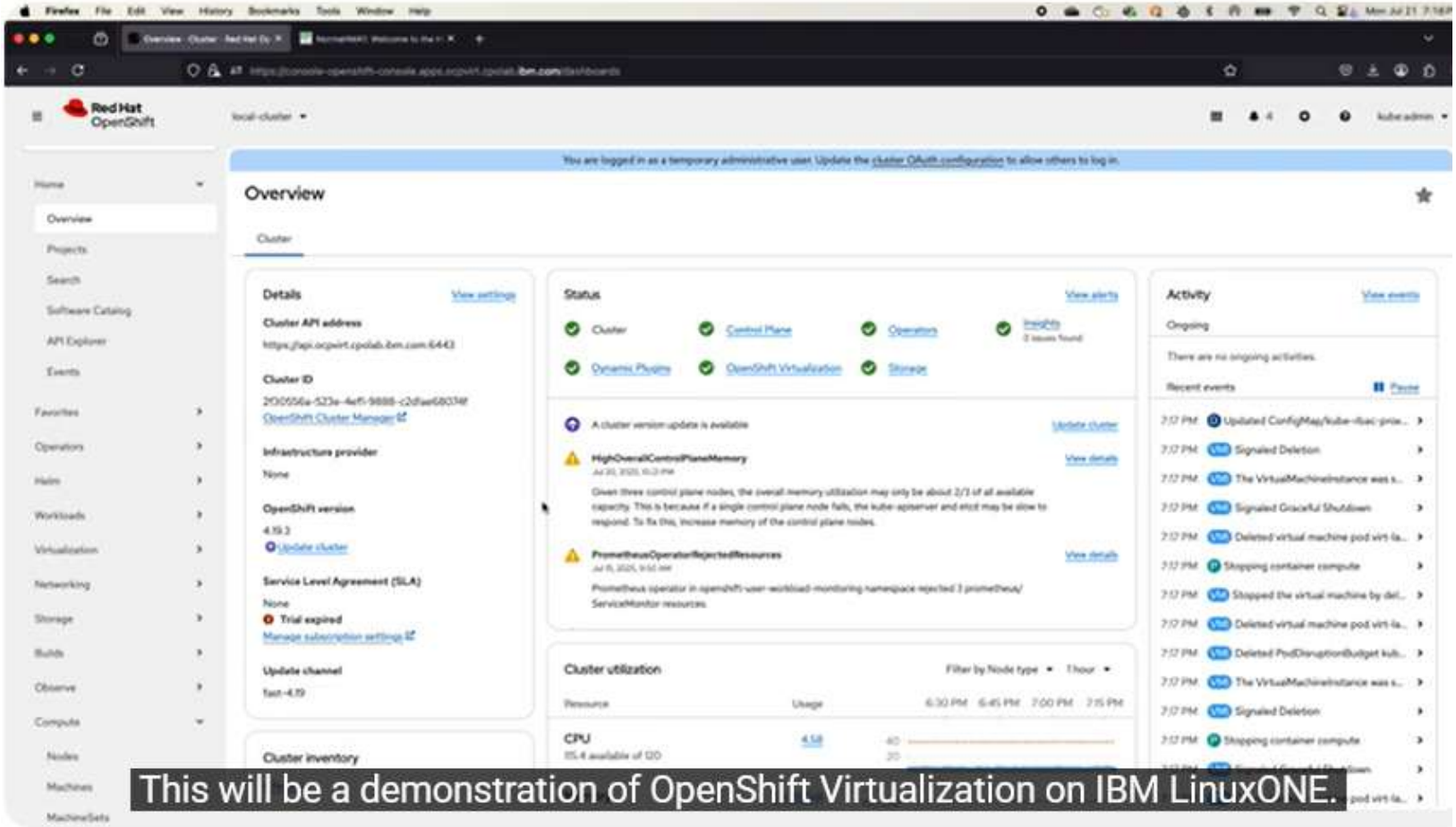
Example: For operating a VM with a requested size of 2 GiB Memory and 8 vCPUs you need to plan for 286 MiB additional memory (on top of the 2 GiB)

[1] Link to Red Hat sizing formula **(verified and applicable for s390x)**

Start and run your Applications in VMs co-located with your Containerized workload



OpenShift Virtualization on IBM LinuxONE - Introduction



https://www.youtube.com/watch?v=OEYIKnIxEkk

Red Hat OpenShift Virtualization on IBM Z and IBM LinuxONE

- Announcement Blog: https://community.ibm.com/community/user/blogs/kelly-pushong/2025/08/12/red-hat-openshift-virtualization-now-available
- Documentation: https://docs.redhat.com/en/documentation/openshift_container_platform/4.21/html/virtualization/release-notes
- Technical Blog: https://community.ibm.com/community/user/blogs/jan-schintag/2025/07/28/openshift-virtualization-on-ibm-z-installation
- RHOCPV Demo Video: https://youtu.be/OEYIKnIxEkk

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IBM Executive IT Architect

IBM Deutschland Research & Development GmbH
IBM Campus 1
71139 Ehningen, Germany
Office: +49 (0)7031-16-3796
wilhelm.mild@de.ibm.com

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