SEP 09 – 11, 2025
CONTAINER days CONFERENCE

mainframes aren’t dead, they’re just running kubernetes now!

CONTAINERDAYS CONFERENCE 2025

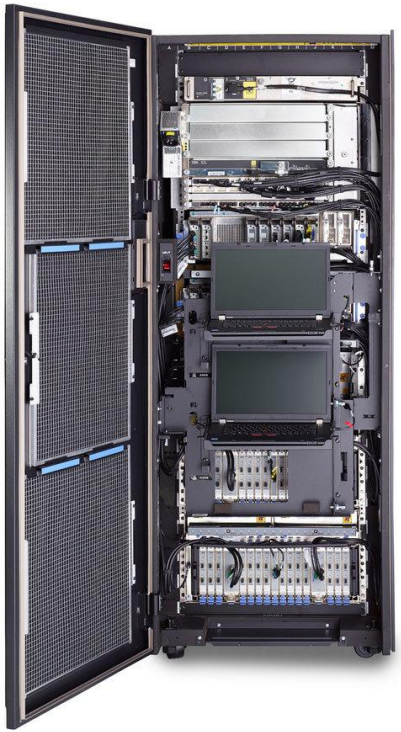
questions I want to answer today

- what are mainframes?
- do they still matter?
- how do they work?
- why would you put containers on them?
- how do you put containers on them?

aren't mainframes legacy infrastructure?

yes... but also no!

aren't mainframes just big, expensive servers?



90%

of all credit card transactions are handled by mainframes [1]

71%

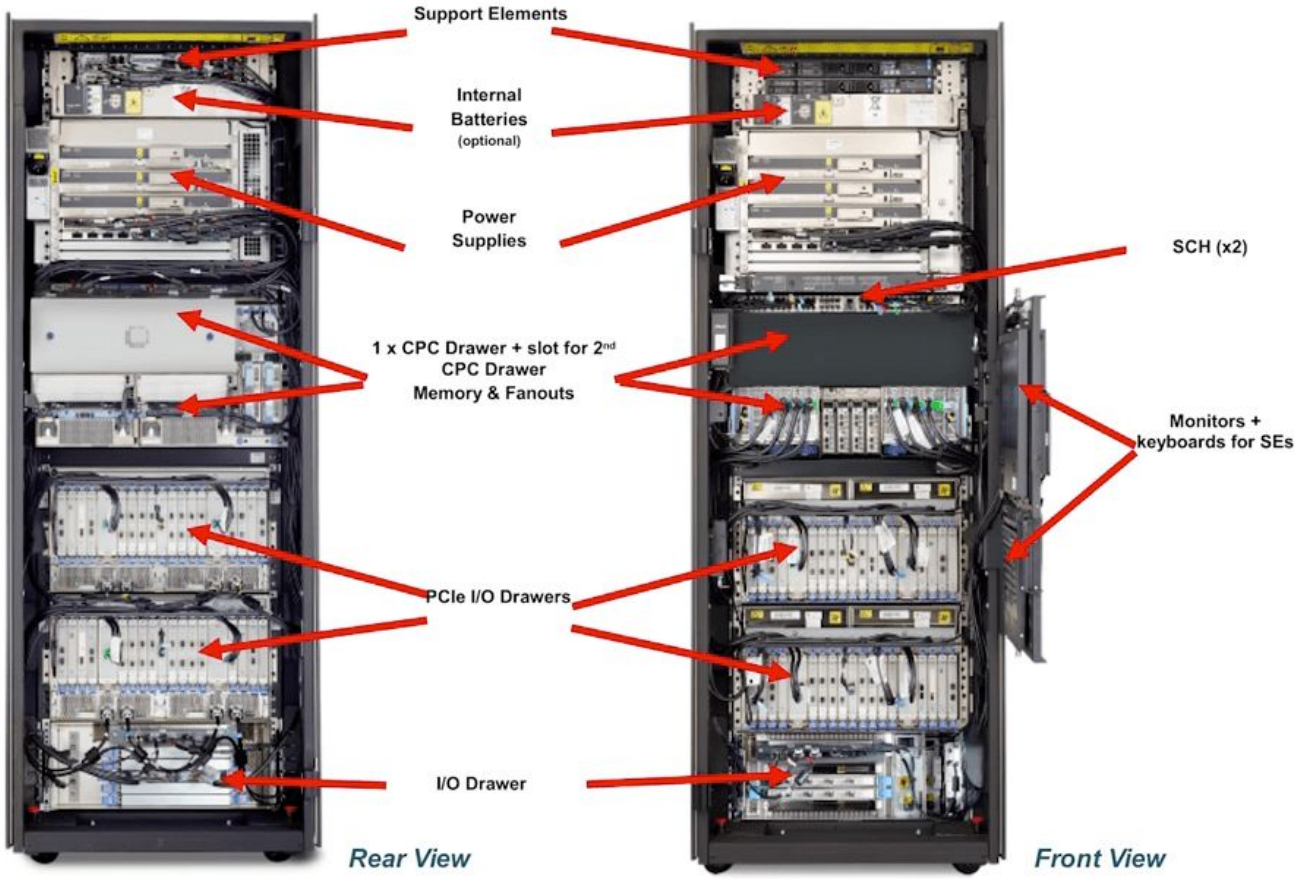
of fortune 500 companies use mainframes [1]

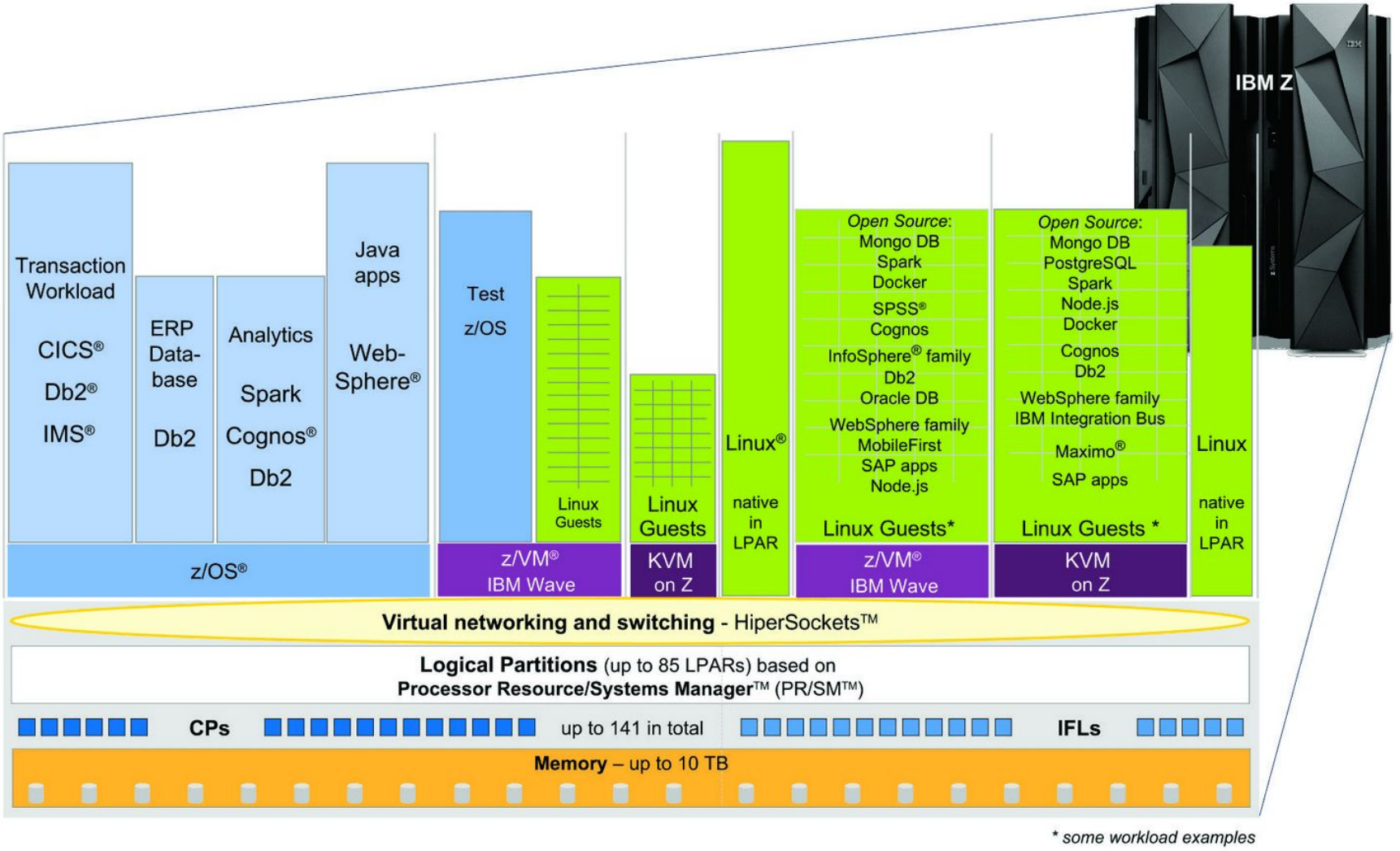
68%

of the world's production workloads run on mainframes, yet they only account for 6% of costs [2]

[1] planetmainframe.com/2022/12/relevance-of-mainframe/
[2] precisely.com/blog/mainframe/mainframe-technology-trends-2023

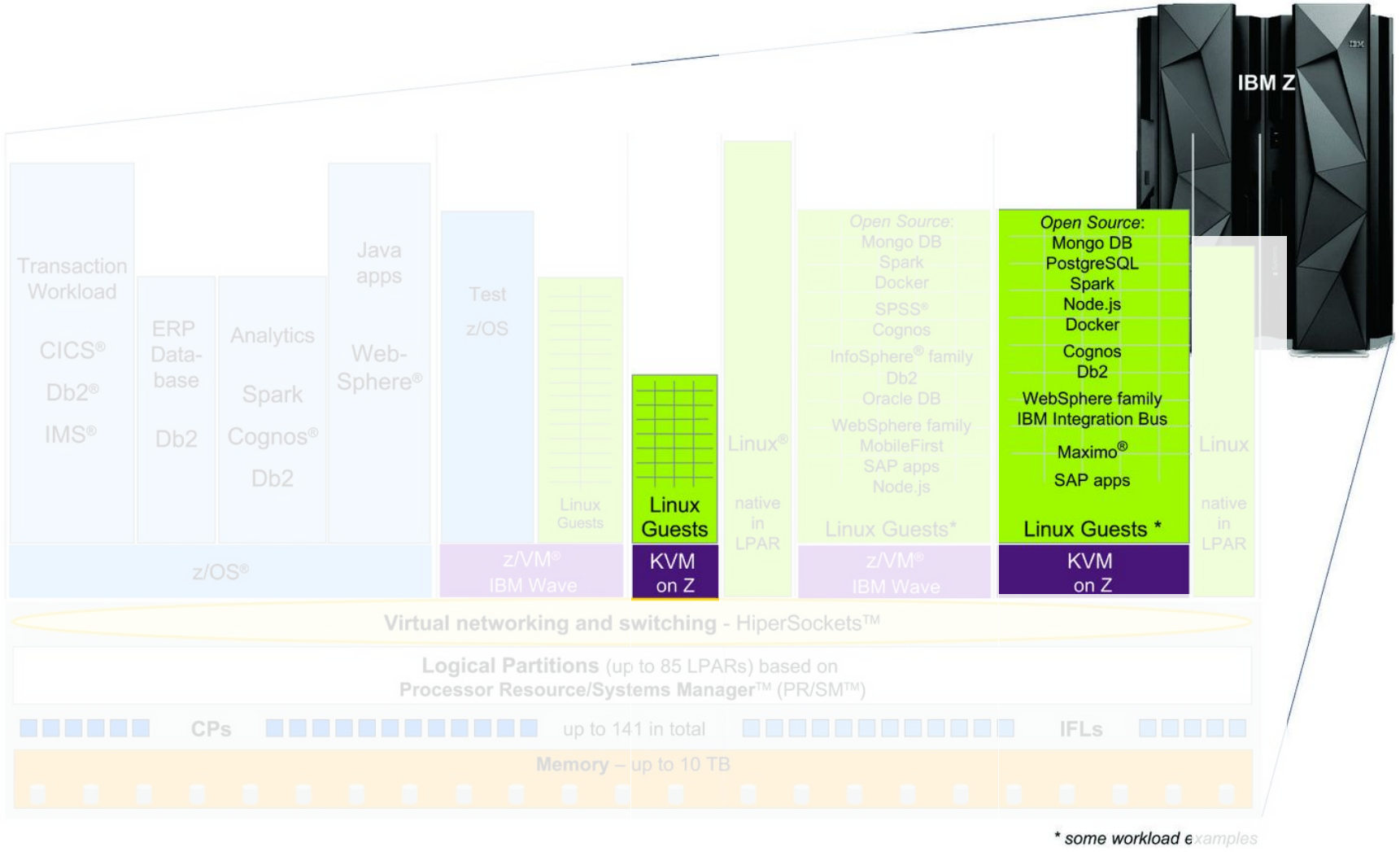
how do they work?





* some workload examples

ibm.com/docs/en/linux-on-systems?topic=knpbptr-overview



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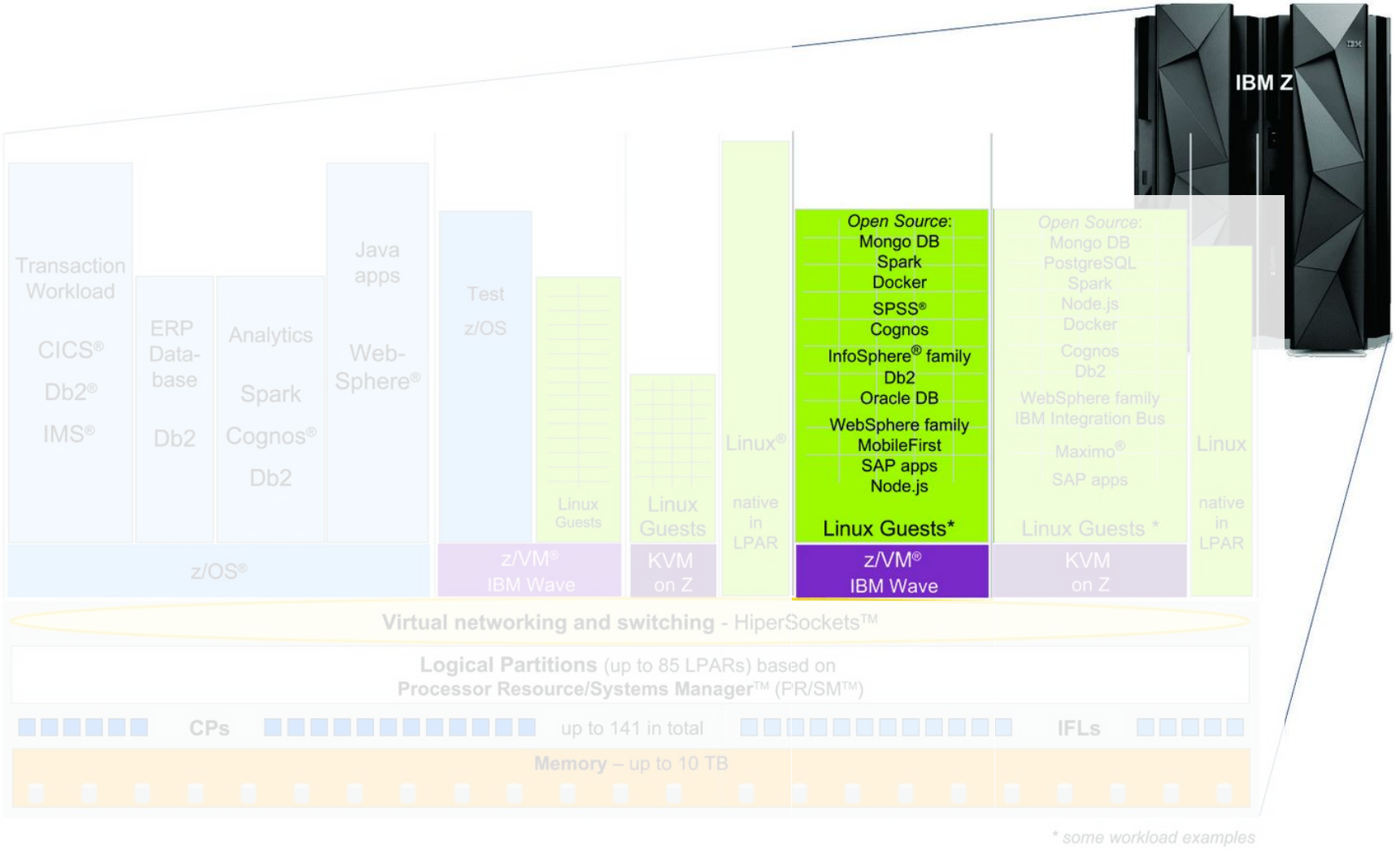

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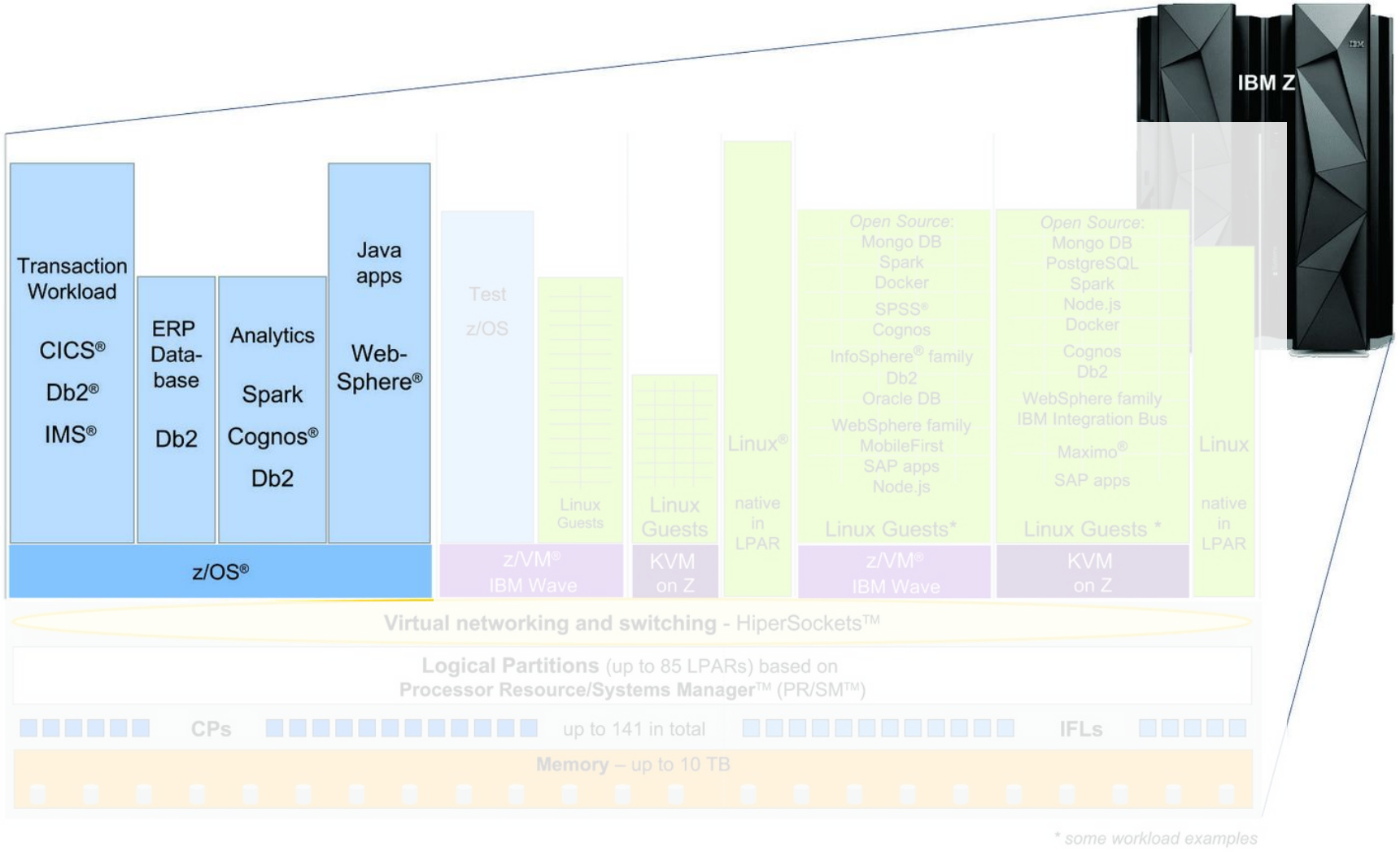
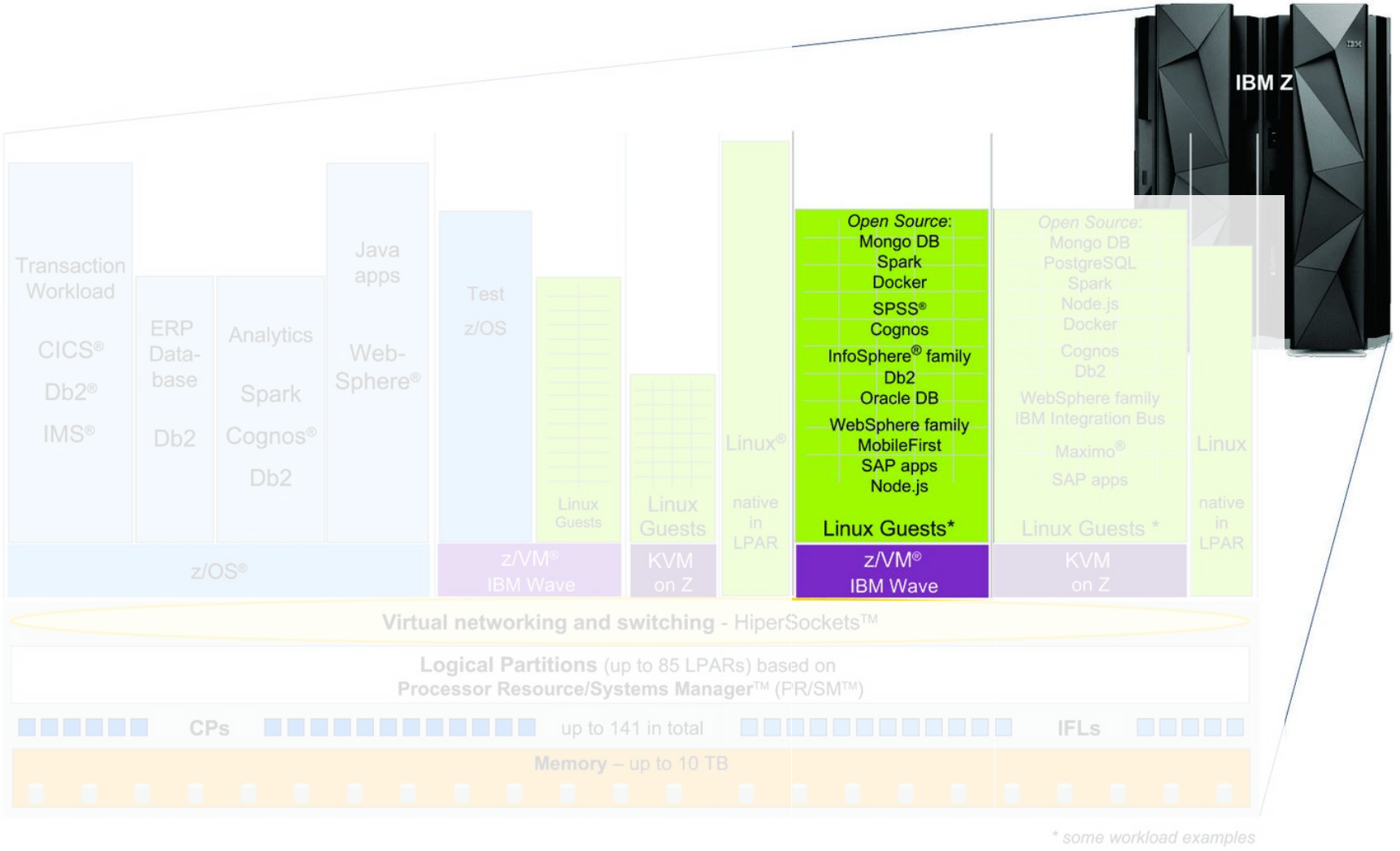
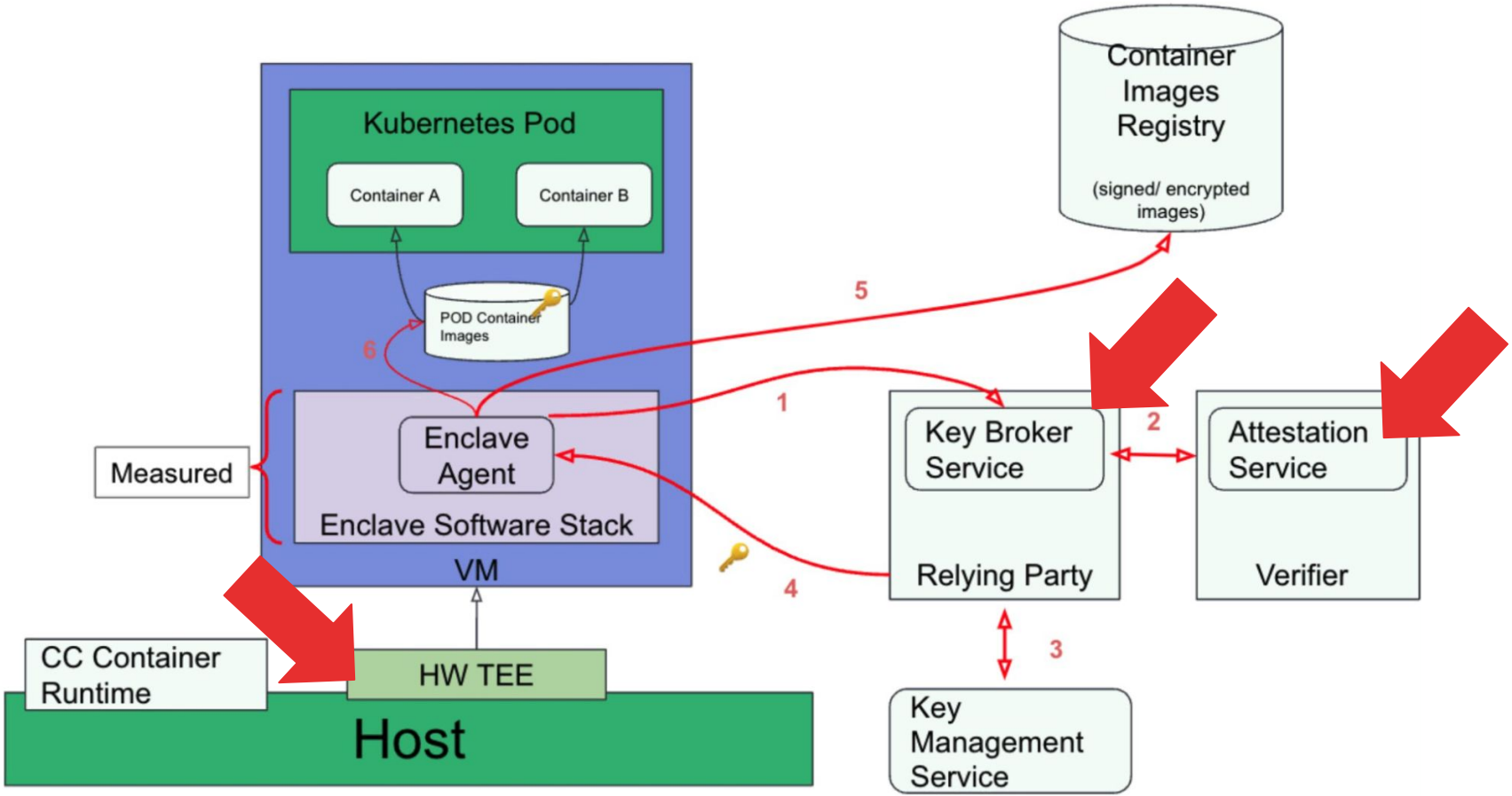


ibm.com/docs/en/linux-on-systems?topic=knpbptr-overview



ibm.com/docs/en/linux-on-systems?topic=knpbptr-overview

why would you put containers on them?


Container Images Registry
(signed/ encrypted images)
Kubernetes Pod
Container A
Container B
POD Container Images
5
6
1
2
Key Broker Service
Attestation Service
Enclave Agent
Measured
Enclave Software Stack
VM
Relying Party
Verifier
4
3
CC Container Runtime
HW TEE
Host
Key Management Service

how do you put containers on them?

s390x vs x86

x86 cluster

(bare metal)

2x ctl plane

1x worker

worker z/VM

it's easy, right?

yea :D

```
Node Details:
  Architecture:                  s390x
  Container Runtime Version:  cri-o://1.33.0
  Kubelet Version:               v1.29.15
  Kube-Proxy Version:            v1.29.15
PodCIDR:                         10.244.2.0/24
PodCIDRs:                        10.244.2.0/24
```

```
NAME          STATUS  AGE         VERSION   OS-IMAGE             KERNEL-VERSION          ARCH
k8s-master-1  Ready   2025-04-16  v1.29.15  Ubuntu 22.04 LTS     5.15.0-136-generic      amd64
k8s-worker-1  Ready   2025-04-16  v1.29.15  Ubuntu 22.04 LTS     5.15.0-136-generic      amd64
k8s-worker-2  Ready   2025-04-16  v1.29.15  Ubuntu 22.04.1 LTS   5.15.0-56-generic       s390x
```

```
1     Image:          s390x/postgres:latest
2     Image ID:       docker.io/s390x/postgres@sha256:<sha>
3     Port:           5432/TCP
4     Host Port:      0/TCP
5     State:          Running
6       Started:      Wed, 16 Apr 2025 21:28:56 +0200
```

x86 cluster

(bare metal)

3x ctl plane

3x worker

worker lpar

it's easy, right?

no :(


CoreOS

LPARs hate me

what's in an s390x iso?

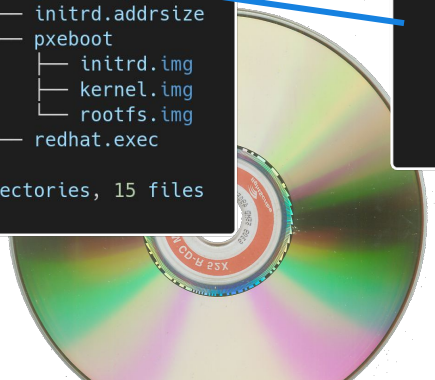
```
tree rhcos
rhcos
├── boot.catalog
├── coreos
│   ├── features.json
│   ├── igninfo.json
│   ├── kargs.json
│   └── miniso.dat
├── generic.ins
└── images
    ├── cdboot.img
    ├── cdboot.prm
    ├── genericdvd.prm
    ├── generic.prm
    ├── initrd.addrsize
    ├── pxeboot
    │   ├── initrd.img
    │   ├── kernel.img
    │   └── rootfs.img
    └── redhat.exec

4 directories, 15 files
```

generic.ins

```
images/kernel.img 0x00000000
images/initrd.img 0x02000000
images/genericdvd.prm 0x00010480
images/initrd.addrsize 0x00010408
```

generic.prm

```
rd.neednet=1 console=ttysclp0 coreos.inst.install_dev=sda
coreos.live.rootfs_url=http://<HTTP_SERVER>/rhcos-416.94.202410211619-0-live-rootfs.s390x.img
coreos.inst.ignition_url=http://<HTTP_SERVER>/ignition/worker.ign ip=dhcp
nameserver=<DNS_IP> cio_ignore=all,!condev zfcp.allow_lun_scan=0
rd.zfcp=0.0.<FCP_DEV>,0x<WWPN>,0x<LUN>
```



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│   ├── generic.prm
│   ├── initrd.addrsize
│   ├── pxeboot
│   │   ├── initrd.img
│   │   ├── kernel.img
│   │   └── rootfs.img
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generic.ins

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images/initrd.img 0x02000000
images/genericdvd.prm 0x00010480
images/initrd.addrsize 0x00010408
```

generic.prm

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rd.neednet=1 console=ttysclp0 coreos.inst.install_dev=sda
coreos.live.rootfs_url=http://<HTTP_SERVER>/rhcos-416.94.202410211619-0-live-rootfs.s390x.img
coreos.inst.ignition_url=http://<HTTP_SERVER>/ignition/worker.ign ip=dhcp
nameserver=<DNS_IP> cio_ignore=all,!condev zfcp.allow_lun_scan=0
rd.zfcp=0.0.<FCP_DEV>,0x<WWPN>,0x<LUN>
```
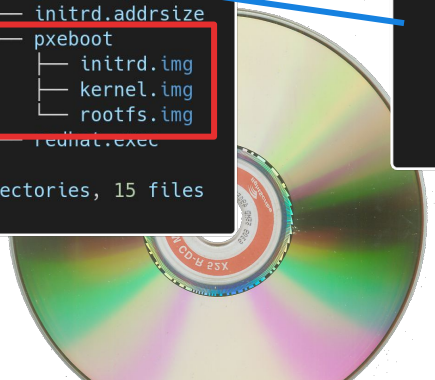
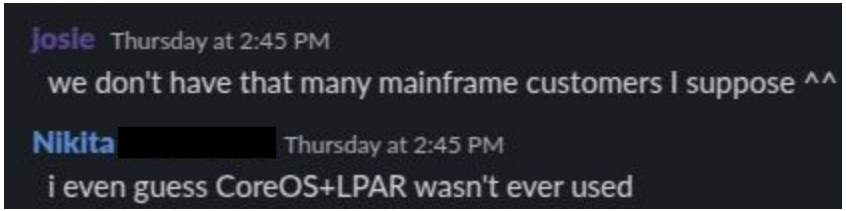




josie Thursday at 2:45 PM
we don't have that many mainframe customers I suppose ^^
Nikita [redacted] Thursday at 2:45 PM
i even guess CoreOS+LPAR wasn't ever used

mainframe LPAR → OSA adapter → VLAN network → k8s cluster

mainframe LPAR → OSA adapter → VLAN network → k8s cluster

```
1 ip=10.0.0.5::10.0.0.1:255.255.255.0:worker1:enc1:none
```

mainframe LPAR → OSA adapter → VLAN network → k8s cluster

```
1 vlan=vlan100:enc1
```

mainframe LPAR → OSA adapter → VLAN network → k8s cluster

```
1 rd.znet=qeth
```

mainframe LPAR → OSA adapter → VLAN network → k8s cluster

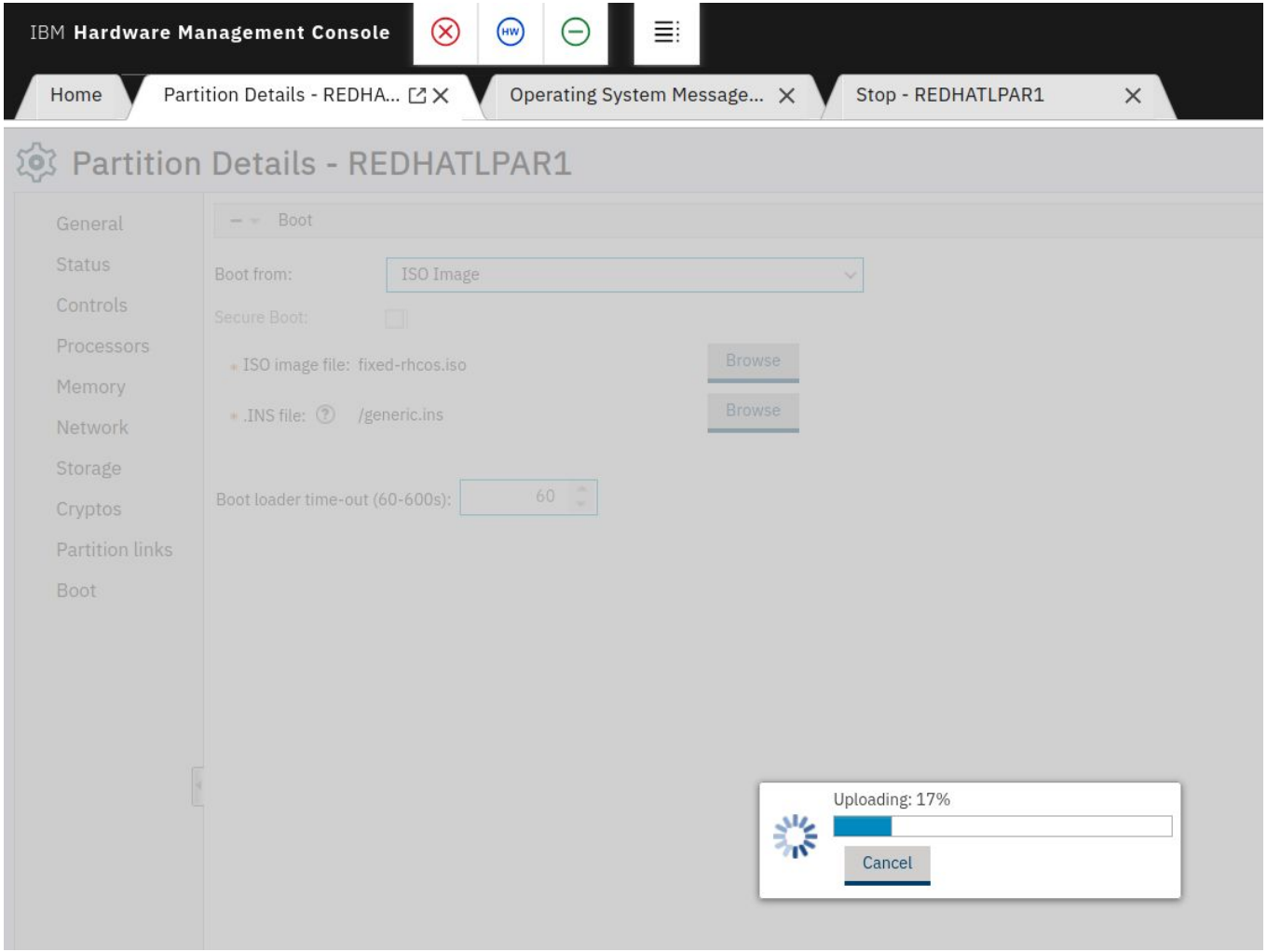
```
1 layer2=1
```

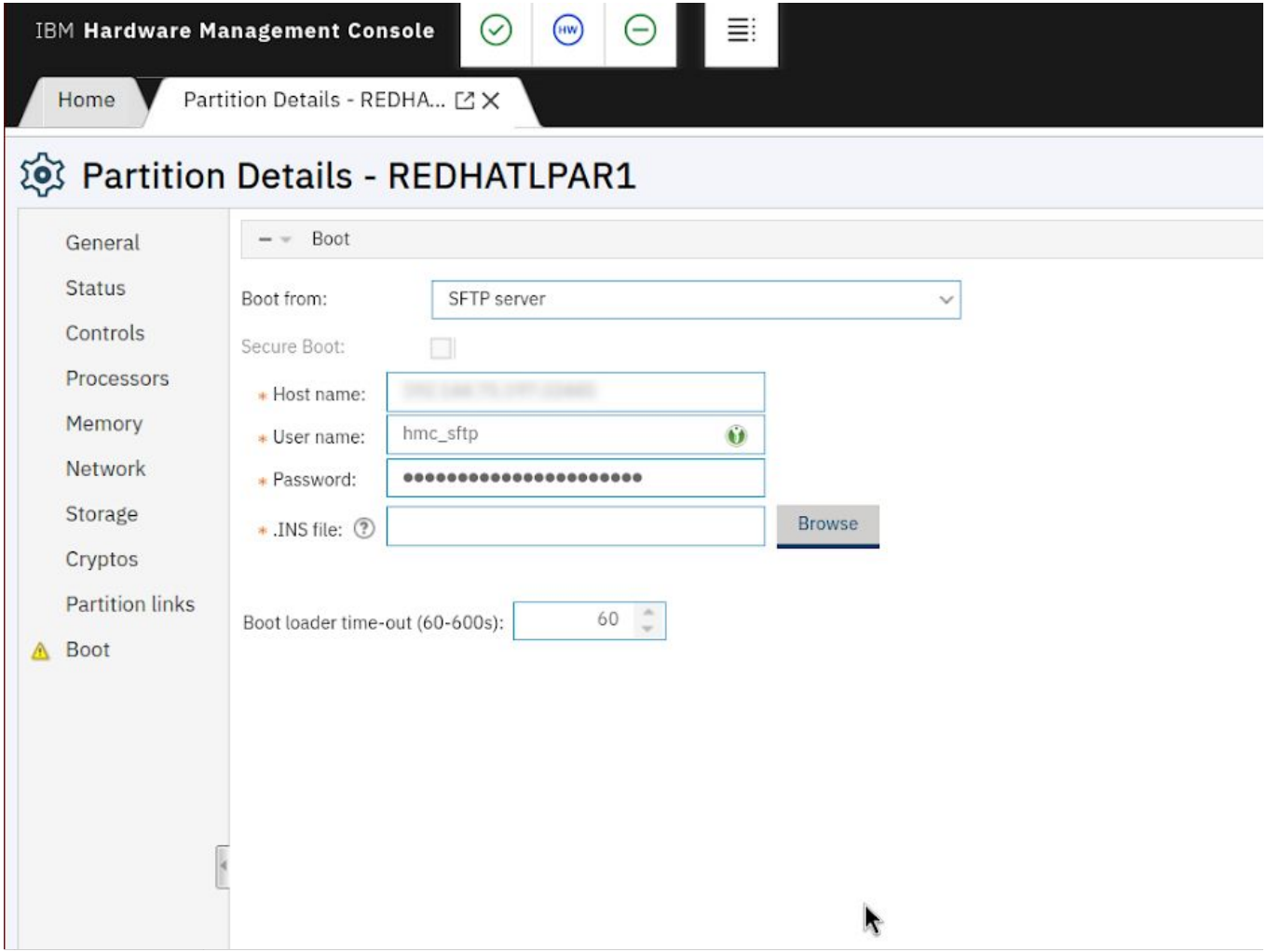

behringer

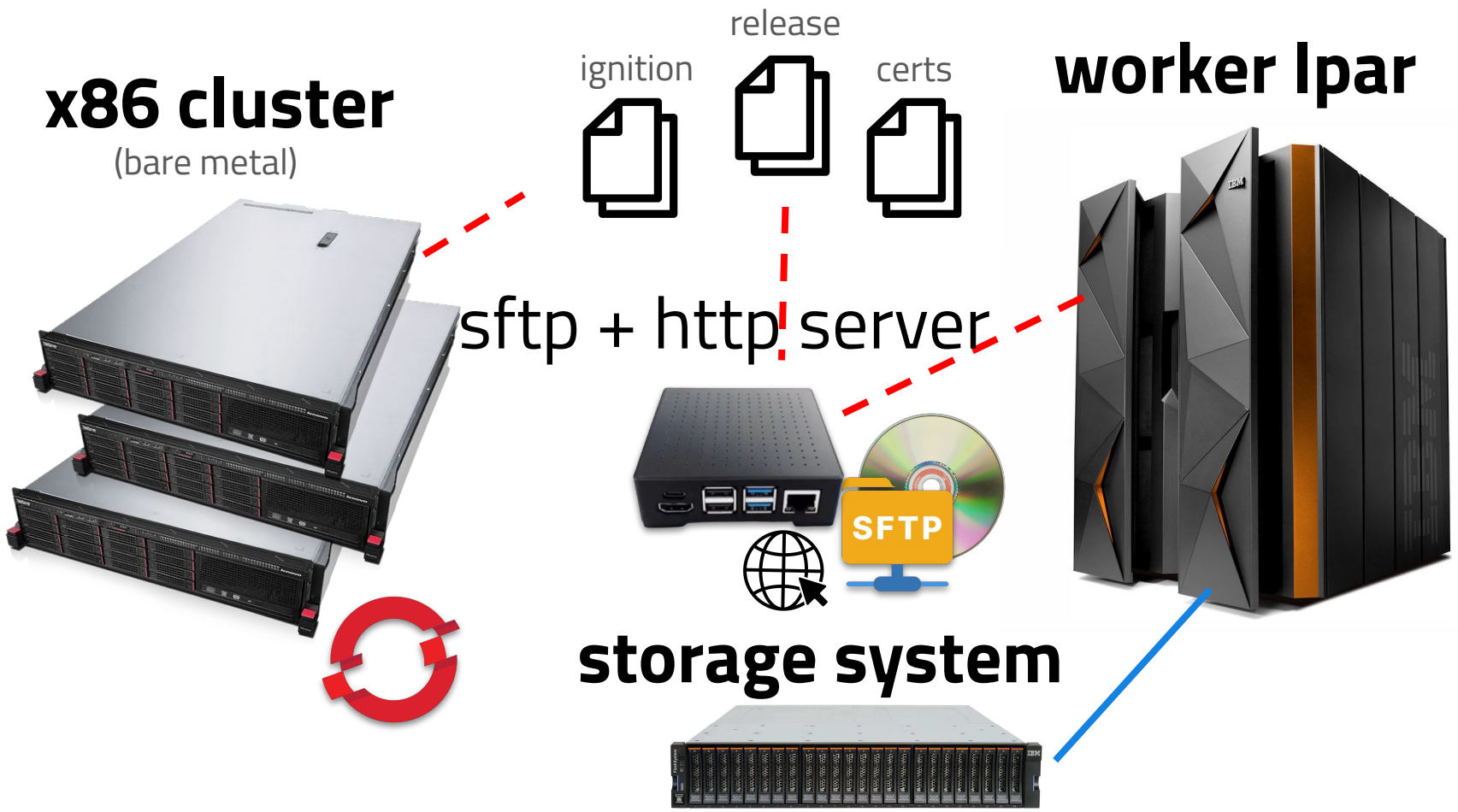
```
1 rd.zfcp=0.0.0007,0x500507630718 45e3,0x0000000000000000
```

```
1 rd.multipath=default
```

```
1 coreos.inst.install_dev=/dev/mapper/mpatha
```


IBM Hardware Management Console
Home
Partition Details - REDHA...
Operating System Message...
Stop - REDHATLPAR1
Partition Details - REDHATLPAR1
General
Status
Controls
Processors
Memory
Network
Storage
Cryptos
Partition links
Boot
Boot
Boot from:
ISO Image
Secure Boot:
ISO image file: fixed-rhcos.iso
Browse
.INS file:
/generic.ins
Browse
Boot loader time-out (60-600s):
60
Uploading: 17%
Cancel


IBM Hardware Management Console
Home
Partition Details - REDHA...
Partition Details - REDHATLPAR1
General
Status
Controls
Processors
Memory
Network
Storage
Cryptos
Partition links
Boot
Boot
Boot from:
SFTP server
Secure Boot:
* Host name:
* User name:
hmc_sftp
* Password:
* .INS file:
Browse
Boot loader time-out (60-600s):
60


release
ignition
certs
x86 cluster
(bare metal)
worker lpar
sftp + http server
SFTP
storage system

x86 cluster

(bare metal)

release

ignition

certs

sftp + http server

worker lpar

storage system

x86 cluster

(bare metal)

release

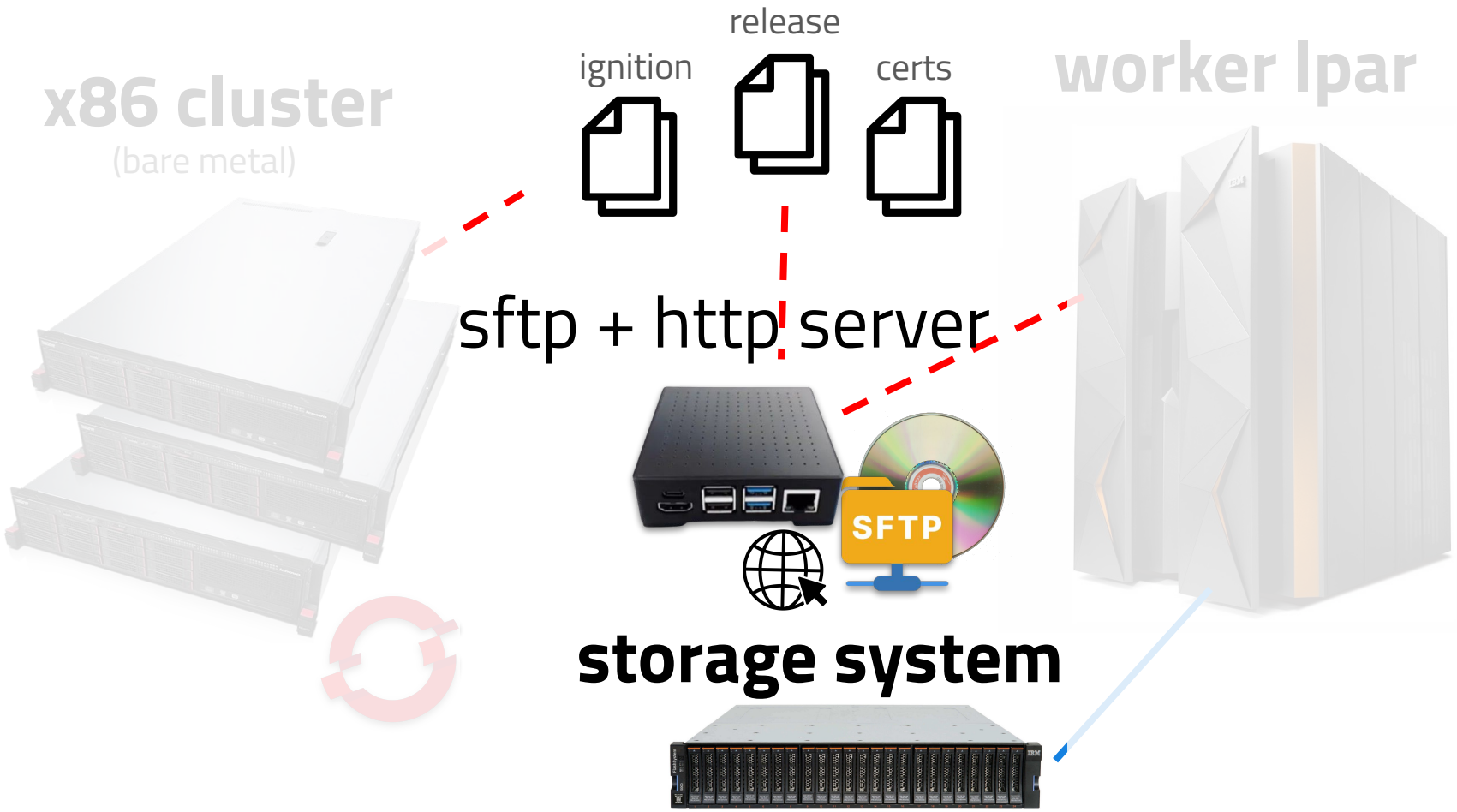
ignition

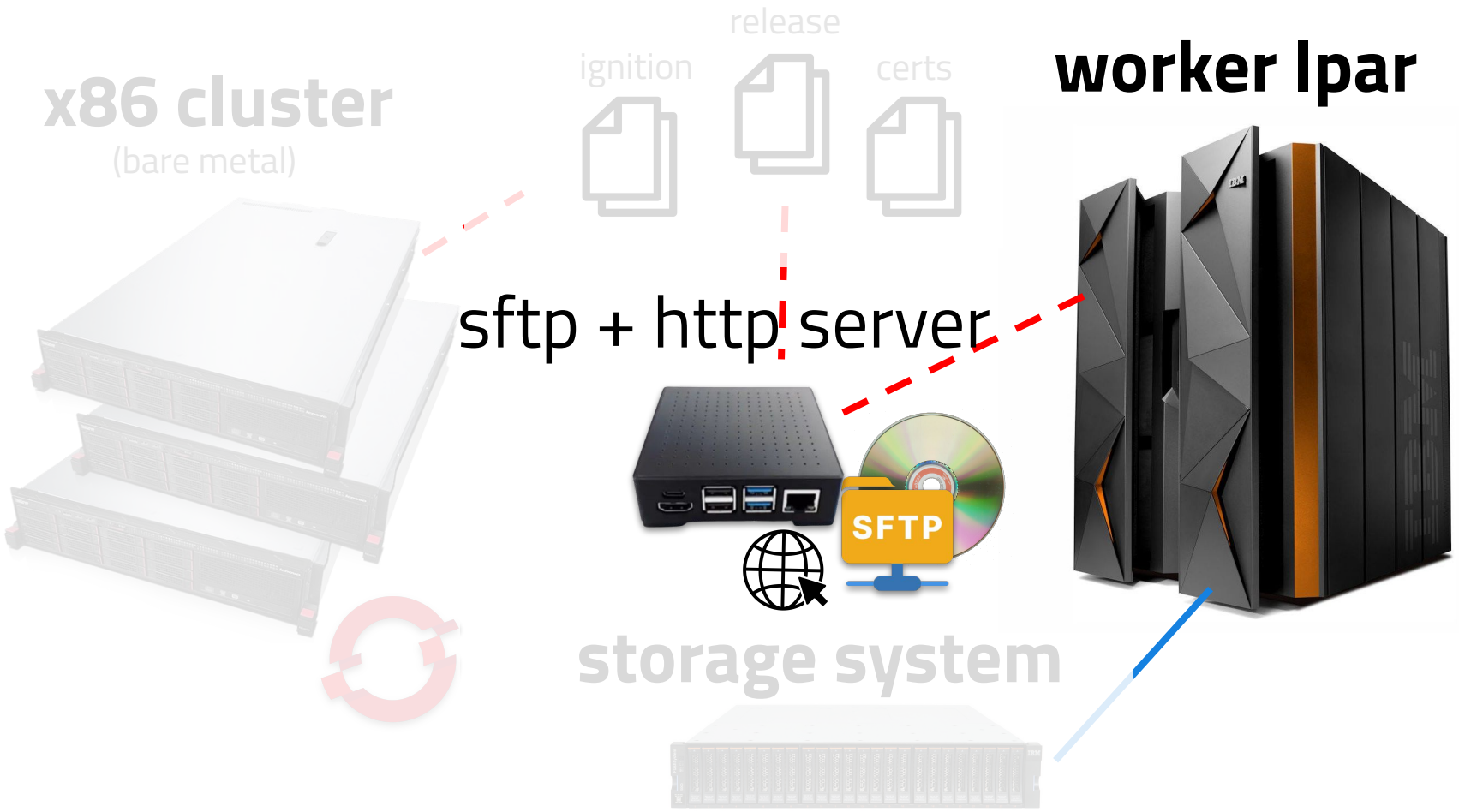
certs

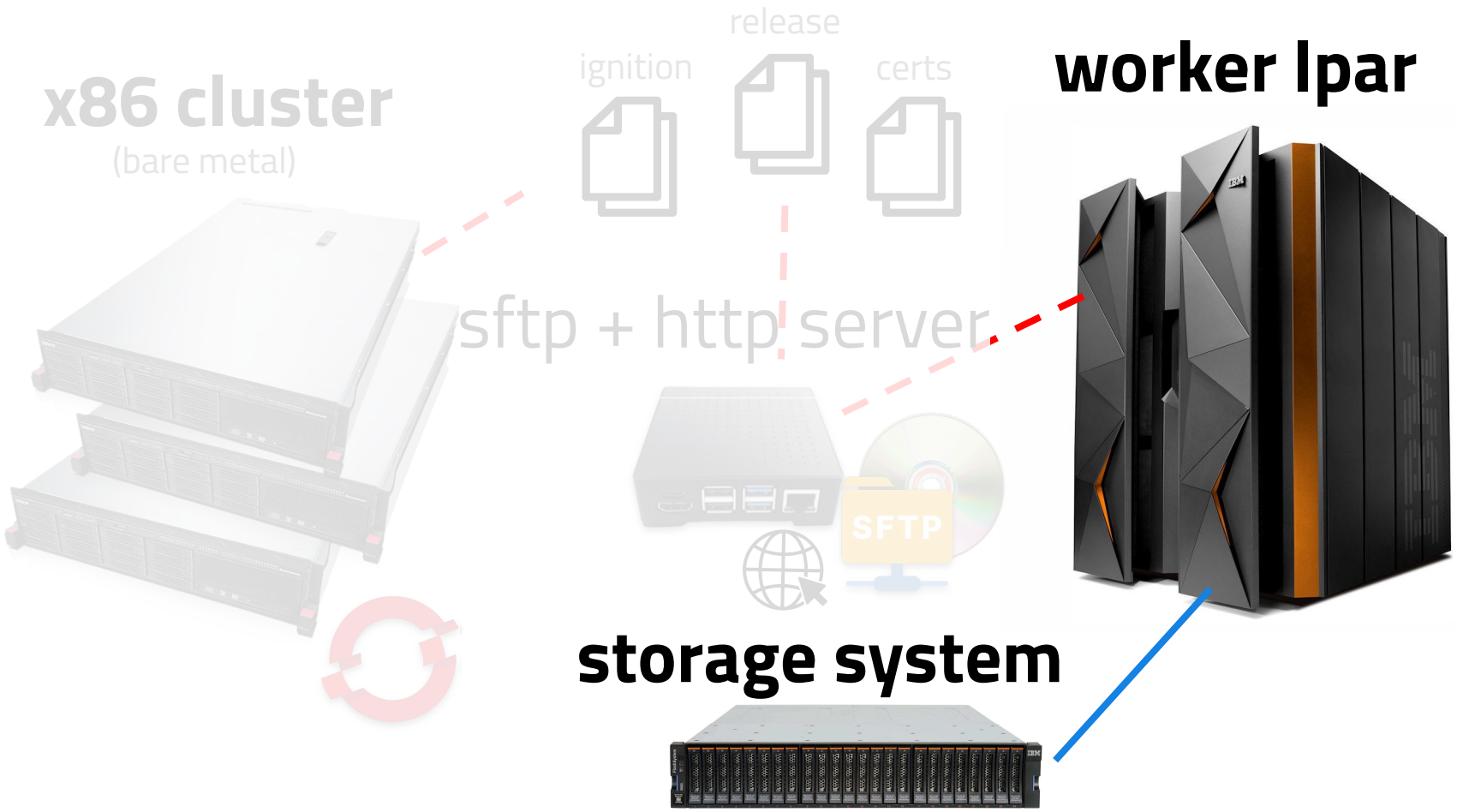
sftp + http server

storage system

worker lpar


release
ignition
certs
x86 cluster
(bare metal)
worker lpar
sftp + http server
SFTP
storage system


release
ignition
certs
x86 cluster
(bare metal)
worker lpar
sftp + http server
SFTP
storage system


x86 cluster
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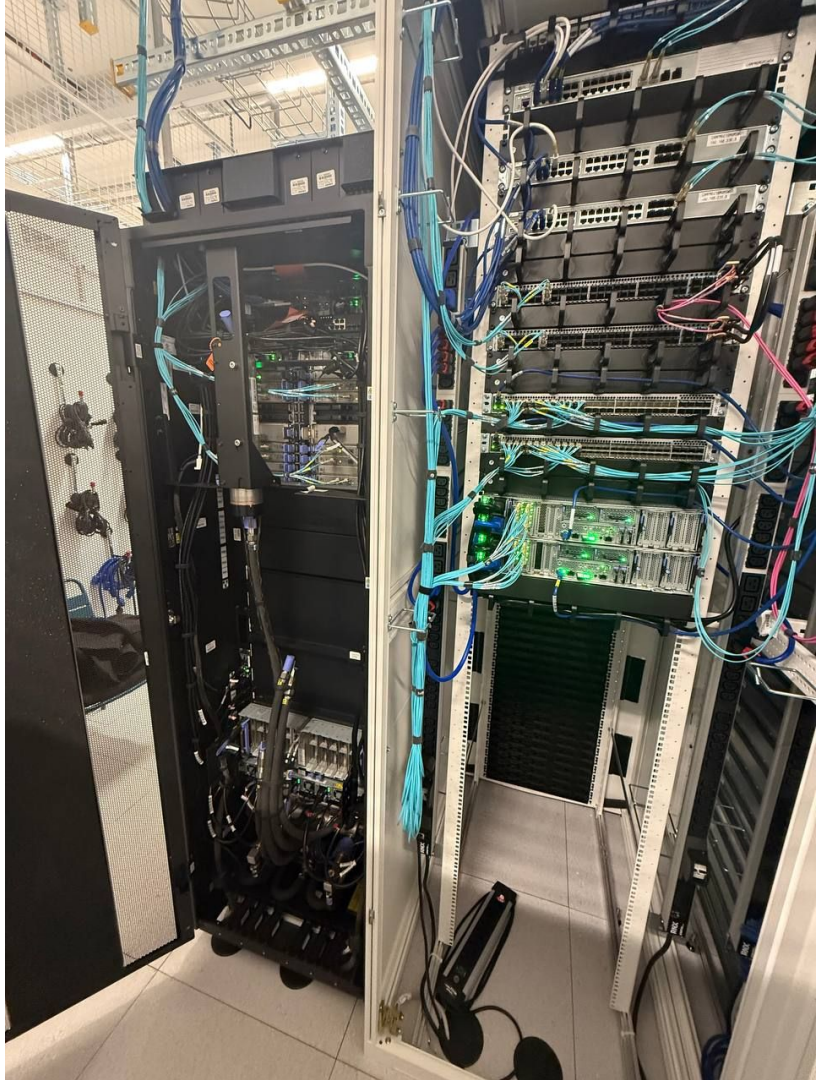
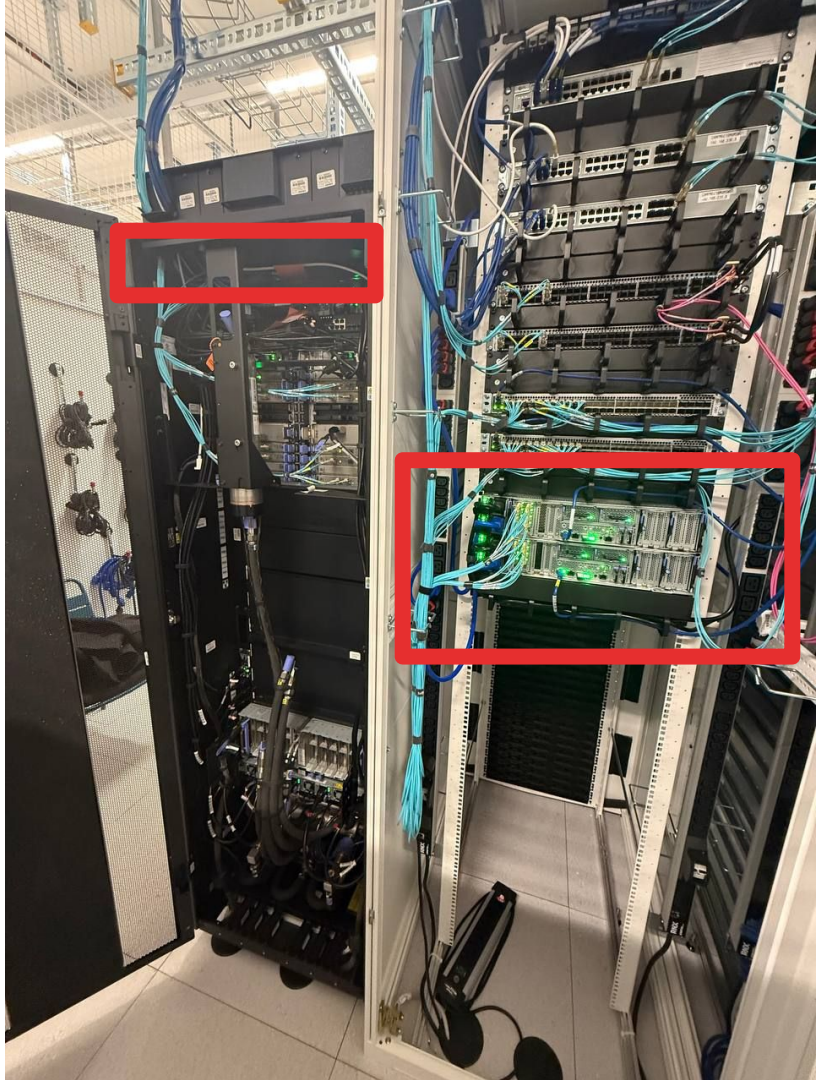
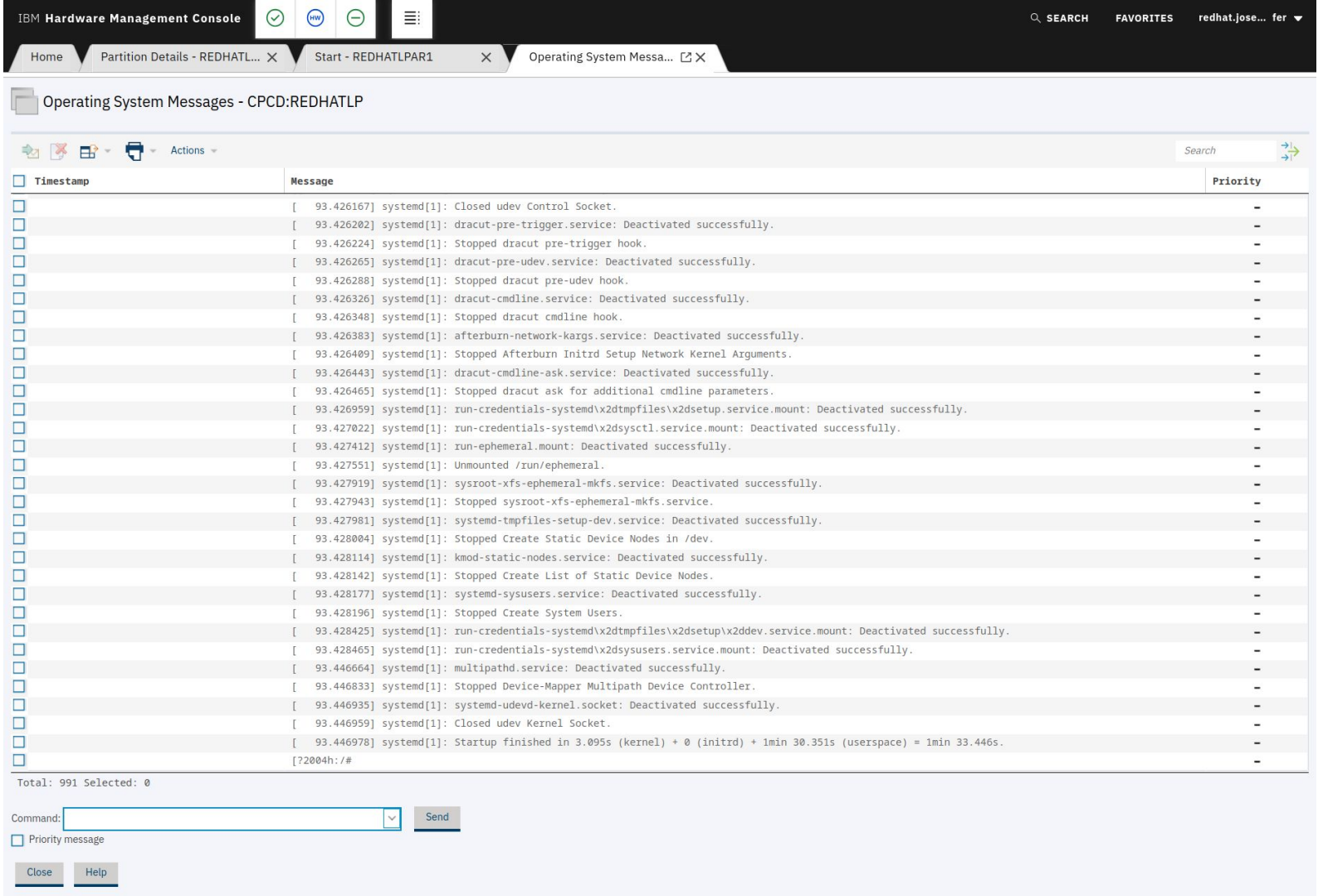
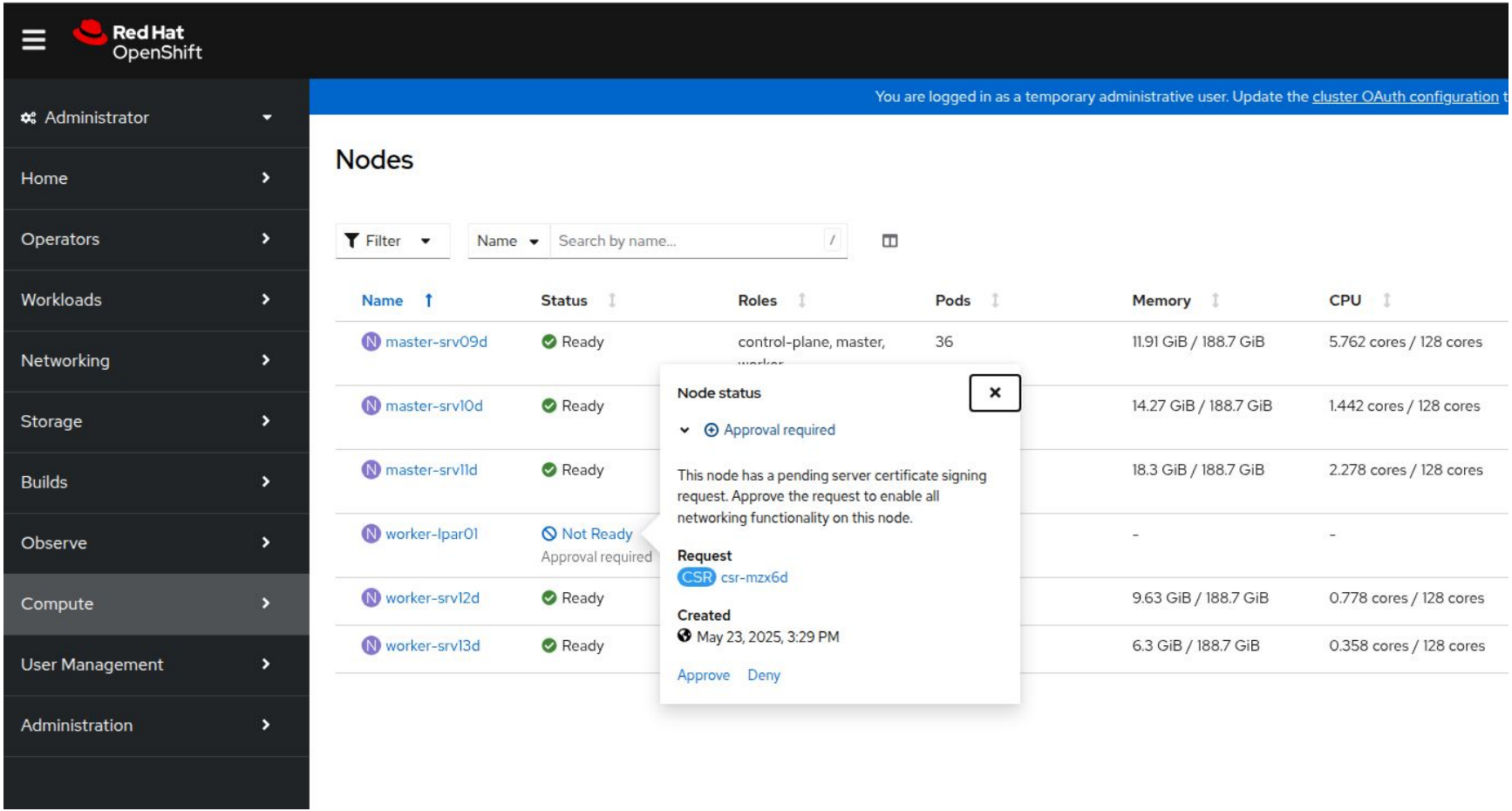




<rack>


IBM Hardware Management Console
SEARCH
FAVORITES
redhat.jose... fer
Home
Partition Details - REDHATL...
Start - REDHATLPAR1
Operating System Messa...
Operating System Messages - CPCD:REDHATLP
Actions
Search
Timestamp
Message
Priority
[93.426167] systemd[1]: Closed udev Control Socket.
[93.426202] systemd[1]: dracut-pre-trigger.service: Deactivated successfully.
[93.426224] systemd[1]: Stopped dracut pre-trigger hook.
[93.426265] systemd[1]: dracut-pre-udev.service: Deactivated successfully.
[93.426288] systemd[1]: Stopped dracut pre-udev hook.
[93.426326] systemd[1]: dracut-cmdline.service: Deactivated successfully.
[93.426348] systemd[1]: Stopped dracut cmdline hook.
[93.426383] systemd[1]: afterburn-network-kargs.service: Deactivated successfully.
[93.426409] systemd[1]: Stopped Afterburn Initrd Setup Network Kernel Arguments.
[93.426443] systemd[1]: dracut-cmdline-ask.service: Deactivated successfully.
[93.426465] systemd[1]: Stopped dracut ask for additional cmdline parameters.
[93.426959] systemd[1]: run-credentials-systemd\x2dtmpfiles\x2dsetup.service.mount: Deactivated successfully.
[93.427022] systemd[1]: run-credentials-systemd\x2dsysctl.service.mount: Deactivated successfully.
[93.427412] systemd[1]: run-ephemeral.mount: Deactivated successfully.
[93.427551] systemd[1]: Unmounted /run/ephemeral.
[93.427919] systemd[1]: sysroot-xfs-ephemeral-mkfs.service: Deactivated successfully.
[93.427943] systemd[1]: Stopped sysroot-xfs-ephemeral-mkfs.service.
[93.427981] systemd[1]: systemd-tmpfiles-setup-dev.service: Deactivated successfully.
[93.428004] systemd[1]: Stopped Create Static Device Nodes in /dev.
[93.428114] systemd[1]: kmod-static-nodes.service: Deactivated successfully.
[93.428142] systemd[1]: Stopped Create List of Static Device Nodes.
[93.428177] systemd[1]: systemd-sysusers.service: Deactivated successfully.
[93.428196] systemd[1]: Stopped Create System Users.
[93.428425] systemd[1]: run-credentials-systemd\x2dtmpfiles\x2dsetup\x2ddev.service.mount: Deactivated successfully.
[93.428465] systemd[1]: run-credentials-systemd\x2dsysusers.service.mount: Deactivated successfully.
[93.446664] systemd[1]: multipathd.service: Deactivated successfully.
[93.446833] systemd[1]: Stopped Device-Mapper Multipath Device Controller.
[93.446935] systemd[1]: systemd-udevd-kernel.socket: Deactivated successfully.
[93.446959] systemd[1]: Closed udev Kernel Socket.
[93.446978] systemd[1]: Startup finished in 3.095s (kernel) + 0 (initrd) + 1min 30.351s (userspace) = 1min 33.446s.
[?2004h:/#
Total: 991 Selected: 0
Command:
Send
Priority message
Close
Help


Red Hat OpenShift
Administrator
Home
Operators
Workloads
Networking
Storage
Builds
Observe
Compute
User Management
Administration
You are logged in as a temporary administrative user. Update the cluster OAuth configuration t
Nodes
Filter
Name
Search by name...
Name
Status
Roles
Pods
Memory
CPU
master-srv09d
Ready
control-plane, master,
36
11.91 GiB / 188.7 GiB
5.762 cores / 128 cores
master-srv10d
Ready
14.27 GiB / 188.7 GiB
1.442 cores / 128 cores
master-srv11d
Ready
18.3 GiB / 188.7 GiB
2.278 cores / 128 cores
worker-lpar01
Not Ready
Approval required
-
-
worker-srv12d
Ready
9.63 GiB / 188.7 GiB
0.778 cores / 128 cores
worker-srv13d
Ready
6.3 GiB / 188.7 GiB
0.358 cores / 128 cores
Node status
Approval required
This node has a pending server certificate signing request. Approve the request to enable all networking functionality on this node.
Request
CSR csr-mzx6d
Created
May 23, 2025, 3:29 PM
Approve
Deny

```
NAME             STATUS   ROLES                          AGE   ARCH
master-srv09d    Ready    control-plane,master,worker    22d   amd64
master-srv10d    Ready    control-plane,master,worker    22d   amd64
master-srv11d    Ready    control-plane,master,worker    22d   amd64
worker-lpar01    Ready    worker                         13d   s390x
worker-srv12d    Ready    worker                         22d   amd64
worker-srv13d    Ready    worker                         22d   amd64
```

yay :D

wrap up

further reading

porting FOSS to mainframe architecture
go.josie.lol/ambitus

IBM LinuxONE Community Cloud (play with z/VM)
go.josie.lol/linux1cc

OpenShift Sandboxed Containers
go.josie.lol/coco

Implement a multi-architecture OpenShift cluster with s390x LPAR

Learning path | 4 resources | 1 hr and 10 mins | Published on August 19, 2025

Josephine Pfeiffer, Yannic Ahrens

Learn how to integrate s390x workers into your OpenShift cluster in order to layer new microservices over existing architecture.

Access the Developer Sandbox

Overview: Implement a multi-architecture OpenShift cluster with s390x LPAR

You probably didn't wake up thinking, "I need to add some IBM Z mainframes to my Kubernetes cluster." But maybe you should've. Integrating s390x (a.k.a. IBM Z architecture) workers into your Red Hat OpenShift cluster isn't just possible. It's actually useful.

Running containers on mainframes lets you take what some might consider legacy estate – your COBOL apps, your DB2 monoliths – and layer in shiny new microservices without forklifting the whole thing into an overpriced hyperscaler sandbox. You get cloud-native workflows, but on iron that was built for uptime and isolation. Bonus points: s390x punches way above its weight in I/O-heavy workloads, and in some cases, can outcompete cloud infra on cost per transaction.

In this learning path, we'll go over the steps necessary to add an s390x worker LPAR to an x86 OpenShift cluster. There are different ways to achieve the same outcome, but the reference architecture for this learning path post is based on Figure 1:

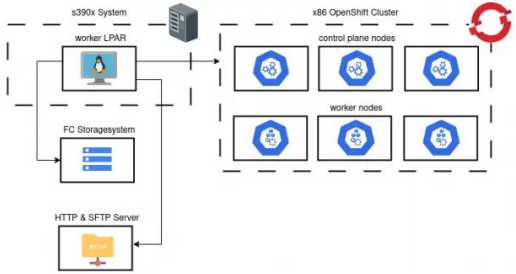


Figure 1: A diagram showing the opc cluster and mainframe systems.

q&a

🌐 josie.lol
📩 josie@redhat.com