An Overview of the s390x platform

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Z System family (Mainframe)

- s390x architecture
- Big endian
- Each has its own machine type, like z13 has 2964, zEC12 has 2827. Each MT has several models distinguished by its PU, like z13 has N30/N96/NE1
- Hypervisor: PR/SM (manage LPAR which includes LPUs & memory & I/O devices, implement in firmware in 1980s) or z/VM (in software)
- z14 is released in 2017, but later will take z13 as an example.
- `lscpu` can learn more
- OS?

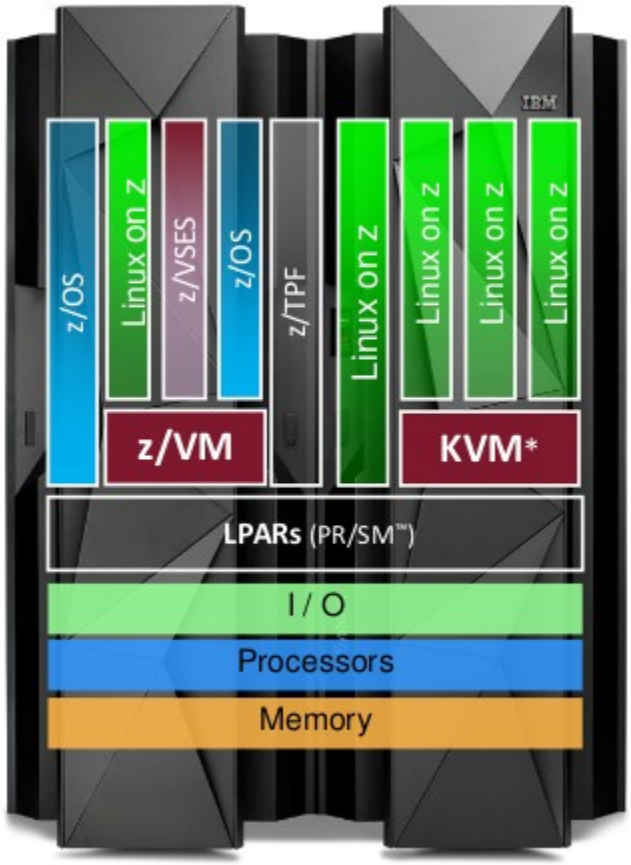
Introduce Linux on z Systems

What offerings can be installed on z Systems processors?

- z/OS
- z/VM (IBM's virt9n, 1967)
- Linux on z Systems (KVM* product)

  (2015-18: k/v/m/z => 2017-: SUSE etc)
- z/VSE
- z/TPF

FYI: PowerVM starts from 1997



Introduce Linux on z Systems (cont.)

Why z/VM => KVM?

- Simplifies configuration and operation of server virtualization
- Use common Linux skills to administer virtualization
- Embrace the Open Source virtualization community
- Easily integration into Cloud/OpenStack environments

To expand customers for z Systems.

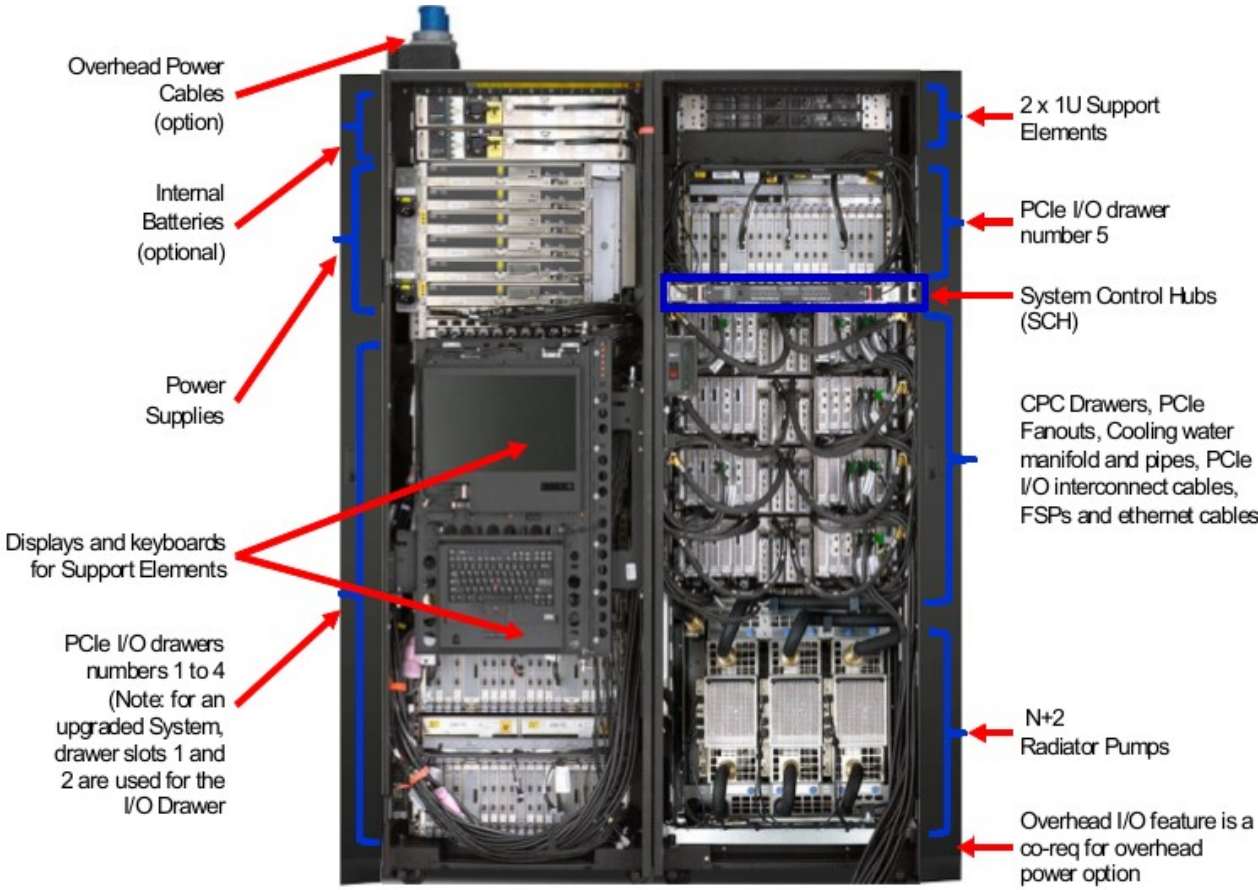
Z13 Hardware Overview

- Up to 141 characterizable PU chips
- Up to 10 TB of addressable real memory per system
- Per CPC drawer: 6 eight-core 5.0 GHz PUs with SMT, SIMD, SMP
- L1 cache: 96KB for instructions & 128KB for data

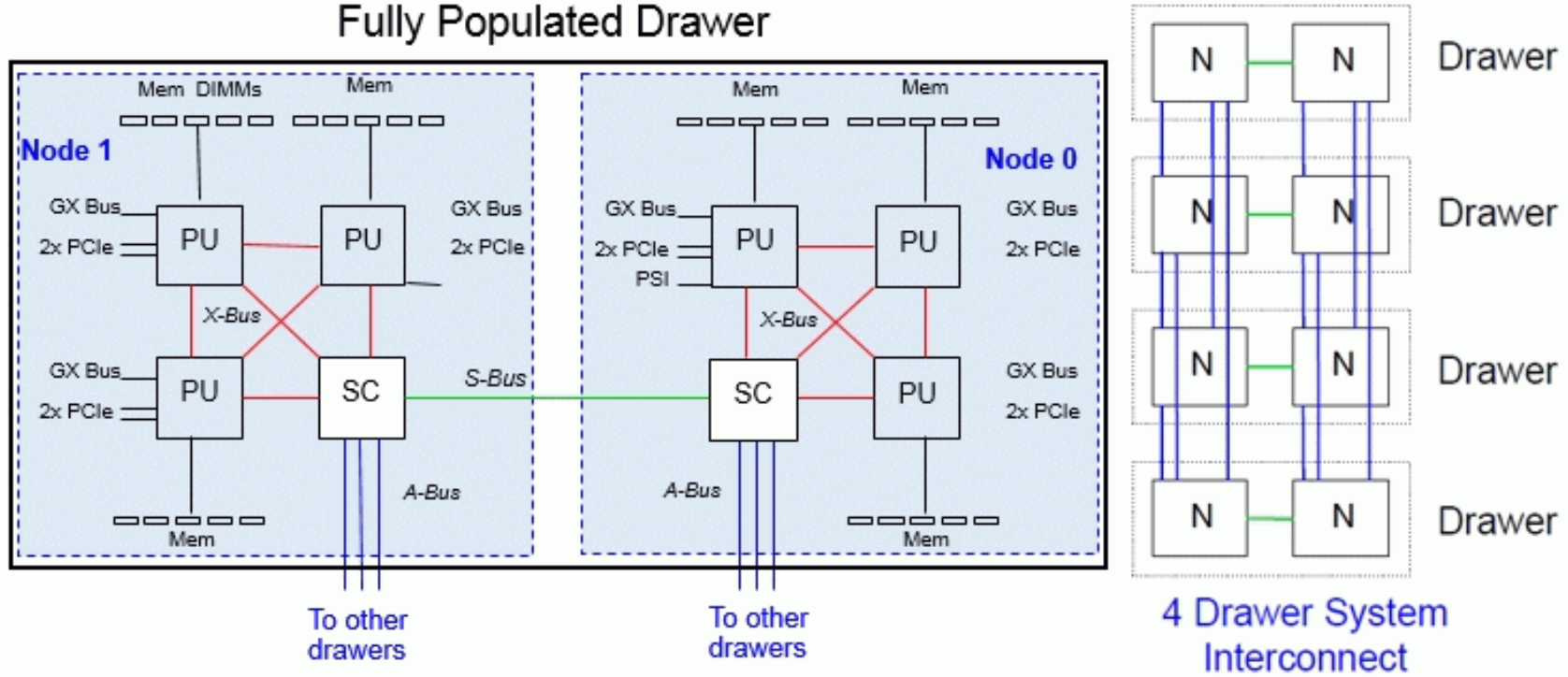
  L2: 2MB, L3 cache: 64 MB, L4: 480MB
- At most 6 LCSSs, 85 LPARs, 32K I/O devices by FICON channel
- Learn more from http://www.redbooks.ibm.com/redpieces/abstracts/sg248250.html?open

Z13 Hardware Overview (cont.)

The CPC (central processing complex)
- Two-frames: A & Z
- 5 PCIe I/O drawers, with each:
  = 32 slots + 4 switch cards
  = 4 domain * 8 features (FICON-2, OSA-2, RoCE, Crypto, Flash, zEDC)
- 4 CPC drawers, with each:
  = 6 PU SCMs (single chip modules) & 2 storage controller SCMs
  = 4 InfiniBand channel adapter & 10 PCIe Gen3 fanouts
  = [256GB, 2.5TB] memory && 20 or 25 DIMMs plugged
- CPC draw communicates via L4 shared caches
- hardware platform management: 2 integrated SE & standalone HMC
- air cooling & water cooling



Z13 Hardware Overview (cont.)



Z13 Hardware Overview (HMC && SE)

The HMC

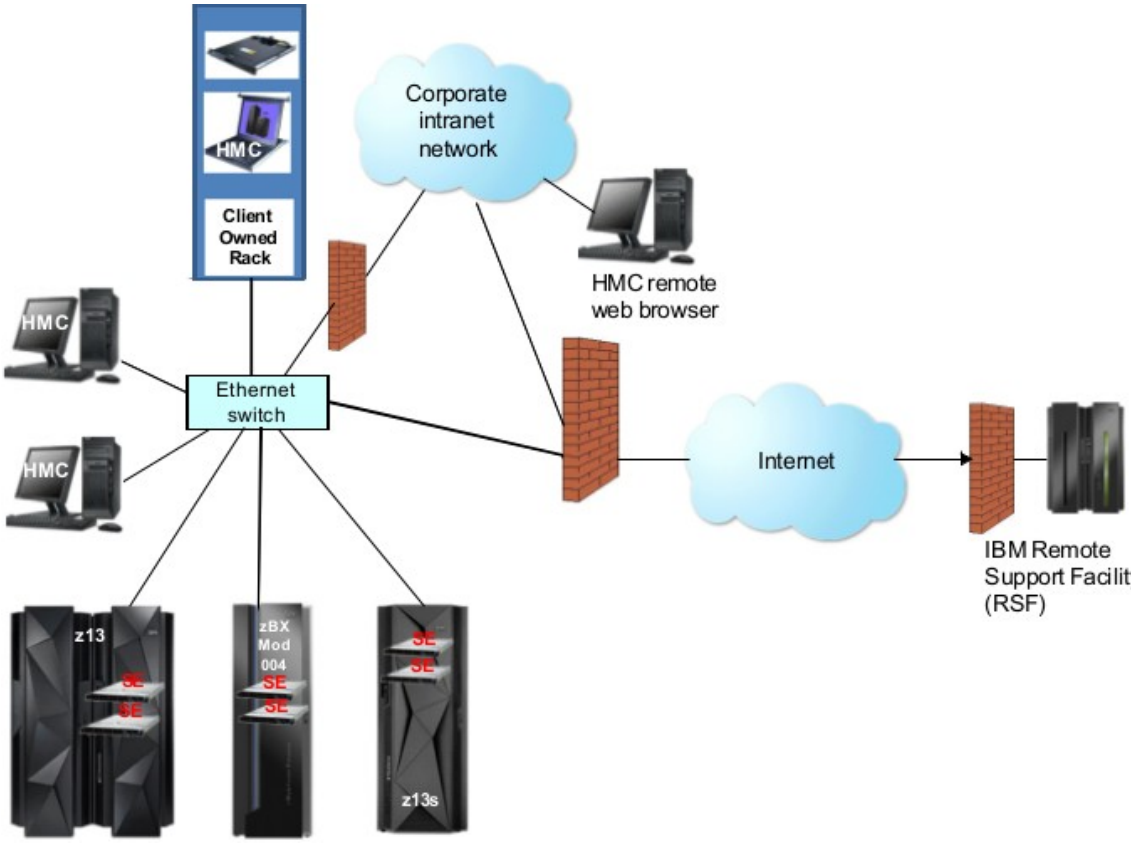
- is a stand-alone desktop computer
  or an optional rack-mounted computer

- communicates with 1 or more z Systems
  (also with POWER/x86 Systems)

The HMC && SE

- are closed systems, no other apps
  can be installed on them

- when tasks are performs on the HMC,
  the commands are sent to one or more
  SEs, which then issue commands to
  their CPCs



Channel in IBM System

- Channel I/O is a separate, simple, self-contained processor to share complex I/O tasks off CPU. Even (Initial Program Load) IPL is carried out by Channel.
- A Channel subsystem (CSS) manages the flow of data and I/O commands to an appropriate control unit which, in turn, controls I/O devices through the channel path.
- A channel program is a sequence of channel command words (CCWs) which are executed by the I/O channel subsystem.
- A channel command word (CCW) is an instruction to a specialized I/O channel processor. It is used to initiate an I/O operation, such as "read", "write" or "sense", on a channel-attached device.
- E.g. a CCW device: 0xfe.0.0001 (cssid.ssid.devno)

DASD (Direct Access Storage Device)

- set it online:

```
# chccwdev –e 0.0.7500

# lsdasd
Bus-ID    Status     Name     Device  Type  BlkSz  Size     Blocks
==============================================================
0.0.7500  active     dasde    94:0    ECKD  4096   7043MB   1803060
```

- The udev-created by-path device node for it:

```
# ls /dev/disk/by-path -l
total 0
lrwxrwxrwx 1 root root 11 Mar 11  2014 ccw-0.0.7500 -> ../../dasde
```

- set it offline

```
# chccwdev –d 0.0.7500
```

- Format the dasd

```
# dasdfmt -b 4096 /dev/disk/by-path/ccw-0.0.7500 -p
```

Virtualization on the s390x platform

- SIE
- Nested virtualization
- CPU model
- Qemu emulated main-system-bus
- PCI passthrough

Note: s390x only needs one ‘kvm’ module, not like x86 which has the ‘kvm’ module and another ‘kvm_intel/amd’ module .

Virt -> SIE (Start Interpretive Execution)

- The SIE instruction is used to run a virtual machine in emulation mode.
- vm is in the sie operation mode, like the vmx in x86
- ENTRY(sie64a) in arch/s390/kernel/entry.S
- SIE is exited either by interception or interruption. An intercept is caused by any condition that requires CP interaction such as I/O or an instruction that has to be simulated by CP.
- `lscpu | grep sie` to check if a linux instance is a hypervisor

Virt → nested virtualization

- Supported machine types: from ‘s390-ccw-virtio-2.8’
- Enable nested
  = when load kvm kernel module: `modprobe kvm nested=1`
  = append ‘kvm.nested=1’ to kernel command line
- Check if nested is enabled in the host terminal:
  `cat /sys/module/kvm/parameters/nested`, ‘Y’ is enabled.
- Check if the guest can be a hypervisor in the guest terminal:
  `cat /proc/cpuinfo | grep sie

Virt → CPU Models

- Supported since kernel 4.8/qemu 2.8

- How to use:

  = in qemu: -cpu host,+/-SomeFeature

  = in libvirt: <cpu mode='host-passthrough'/>

- Use QMP to query host's cpu model information:

  = in qemu:

    1. enable qmp in qemu command line: -qmp tcp:localhost:4444,server,nowait

    2. in another console, run `telnet localhost 4444`, and input:

       {"execute":"qmp_capabilities"}

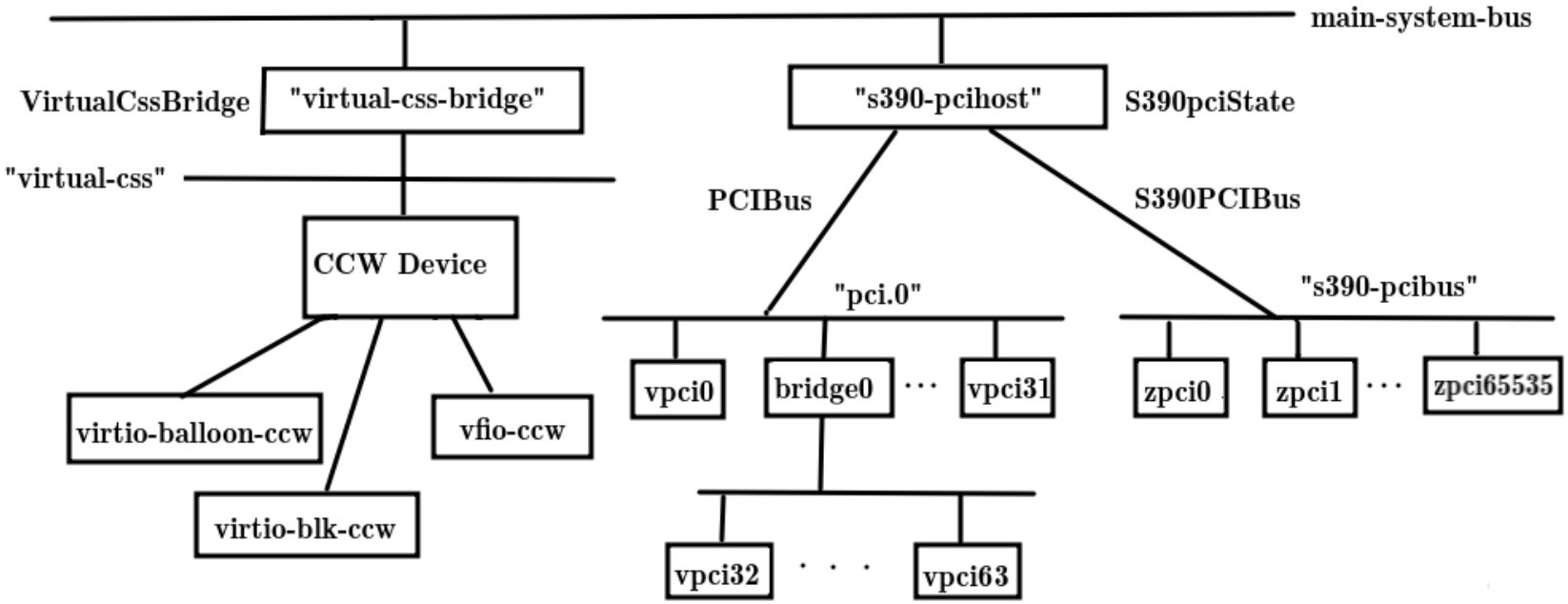
       {"execute": "query-cpu-model-expansion", "arguments":{"model" {"name":"host"},"type":"static"}}

  = in libvirt:

    virsh # qemu-monitor-command vm-name '{"execute": "qmp_capabilities"}'

    virsh # qemu-monitor-command vm-name '{"execute": "query-cpu-model-expansion", "arguments": {"model": {"name": "host"}, "type": "full"}}'

Virt -> QEMU emulated main-system-bus



Virt → PCI passthrough via vfio

- Background: PCI is supported quite recently on the z Systems

- Special:

  = An add on facility, can not be usable as boot device.

  = PCI device configuration space and memory spaces can not be accessed by memory operations, but by z specific special instructions.

  = No I/O MMU driver support, instead implement it in kernel

  = Intercept not handled in kernl, goto qemu

- Enable: `modprobe vfio-pci disable_idle_d3=1 ids="0x1111:0x2222"`

- Supported since qemu 2.7, currently libvirt does not support it

- How to use:

  = in qemu: -device zpci,uid=23,fid=45,target=vpci0,id=zpci0 \

  -device vfio-pci,host=0001:00:00.0,id=vpci0 \

Reference

- IBM Knowledge Center
- IBM RedBooks
- kvmonz.blogspot.hk

Questions?

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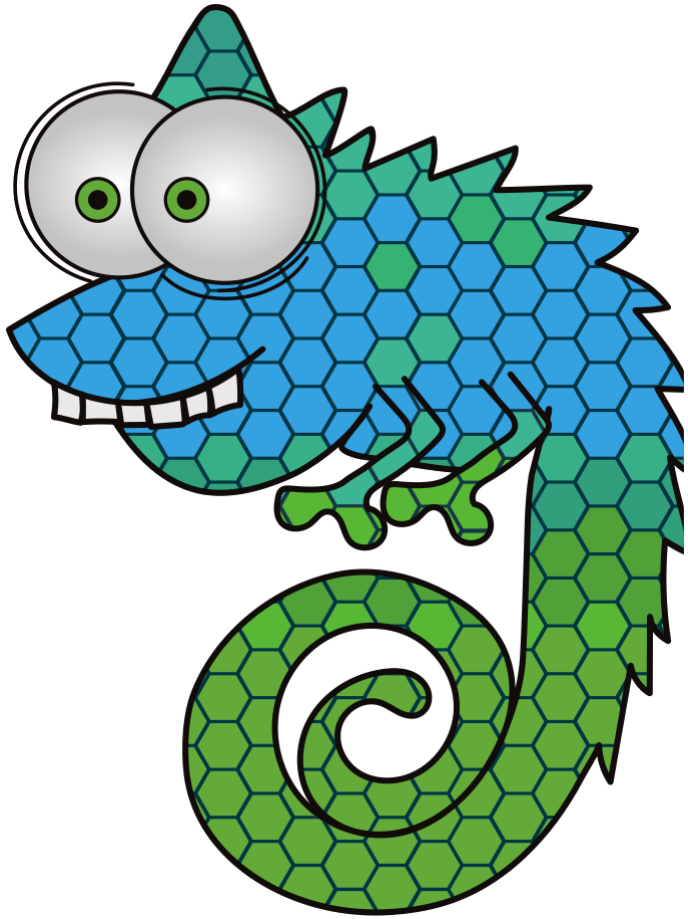
Thank you.



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