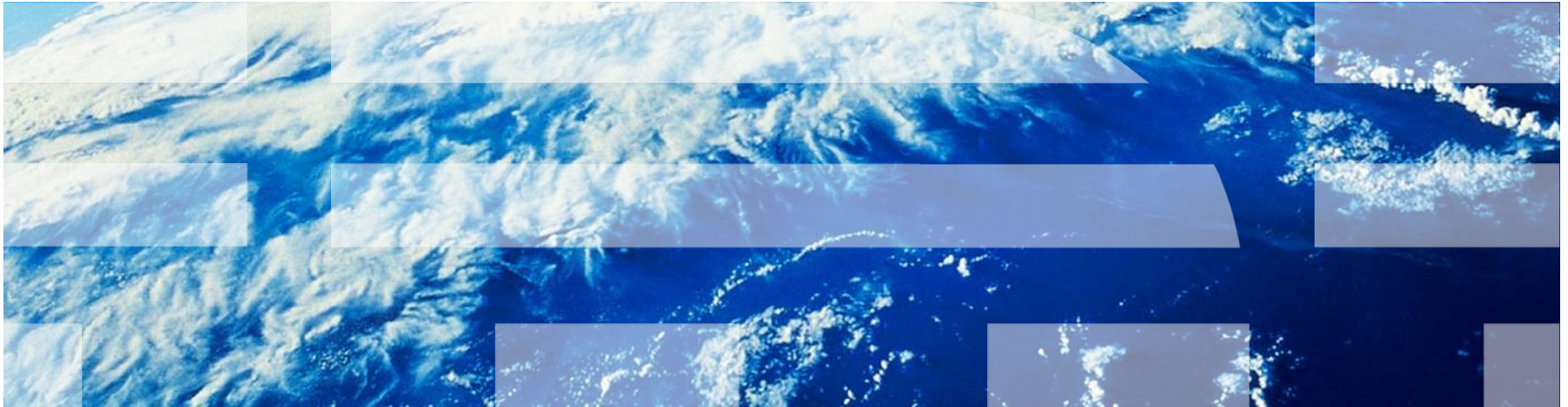


Implementing SCSI over FCP with Linux on System z



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Abstract

SCSI over FCP is an open, standard-based alternative and supplement to existing ESCON or FICON connections.

This session will provide an introduction to the storage attachment via the SCSI over FCP protocol.

It includes setup considerations, related features in Linux on System z and troubleshooting basics.

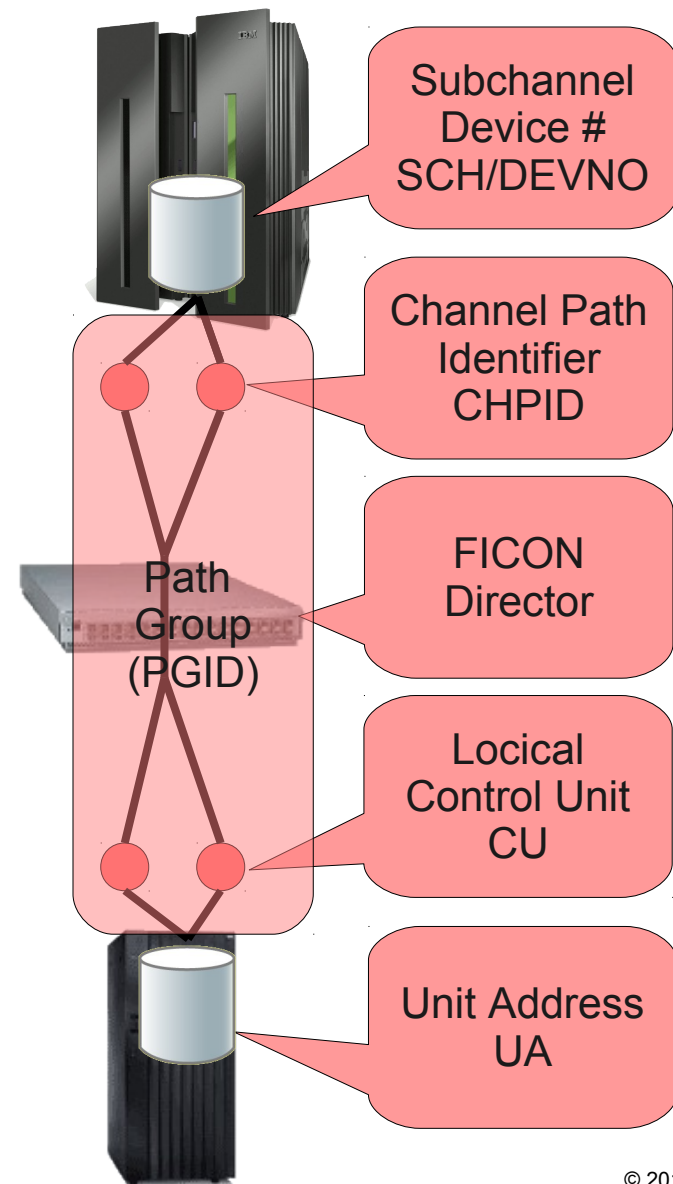


Agenda

- Introduction to SCSI/FCP storage attachment
 - Terminology: FCP vs. FICON channels
 - FCP Channel, Initiator, target & virtual Ports, LUNs
- Setup considerations
 - SAN, FCP devices, NPIV, Storage configuration
- Related features in Linux on System z
 - s390-tools
 - Multipathing
 - SCSI IPL
- Troubleshooting basics
 - Default kernel messages
 - `scsi_logging_level`
 - `zfcplib_show`, `zfcplib_ping`

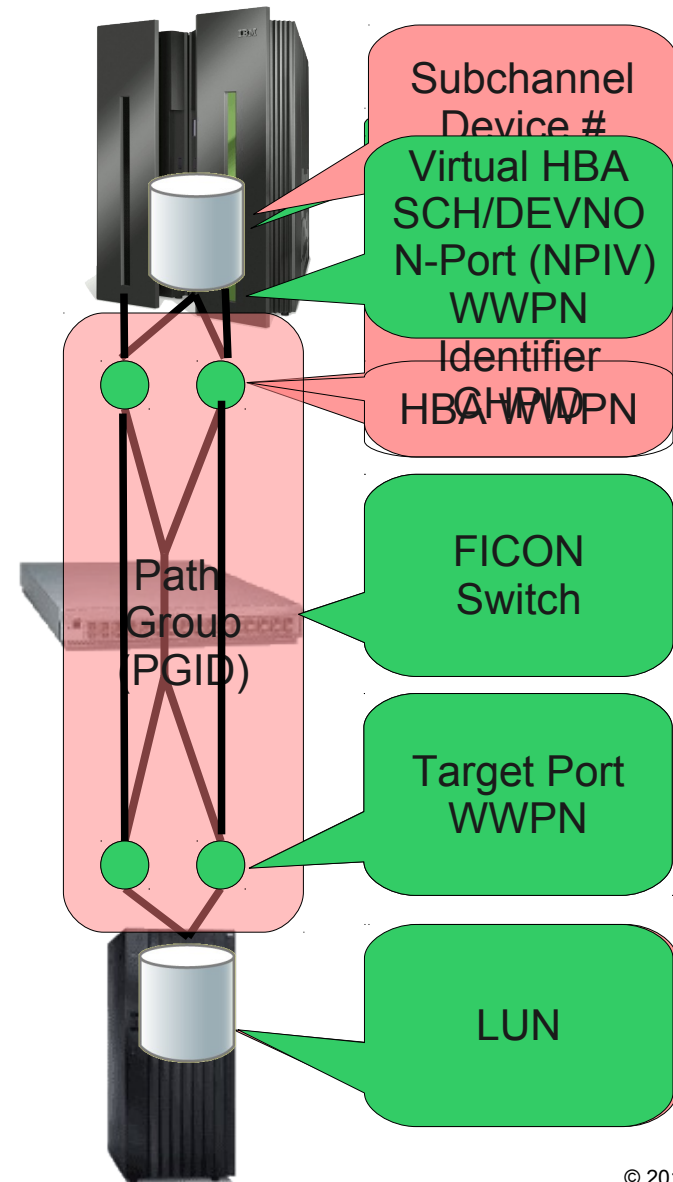
Fibre Channel Storage Area Network (SAN) - FICON terminology

- Each unit (UA) is represented on the host side as a subchannel (SCH) and managed by a device number (DEVNO)
- Each unit is associated to a control unit (CU), which can be reached via a path group (PGID)
- Each path group consists of multiple paths (CHPIDs)
- System z connected via Fibre Channel Connections to FICON Director
- The association is managed by System z IOCDS/IODF



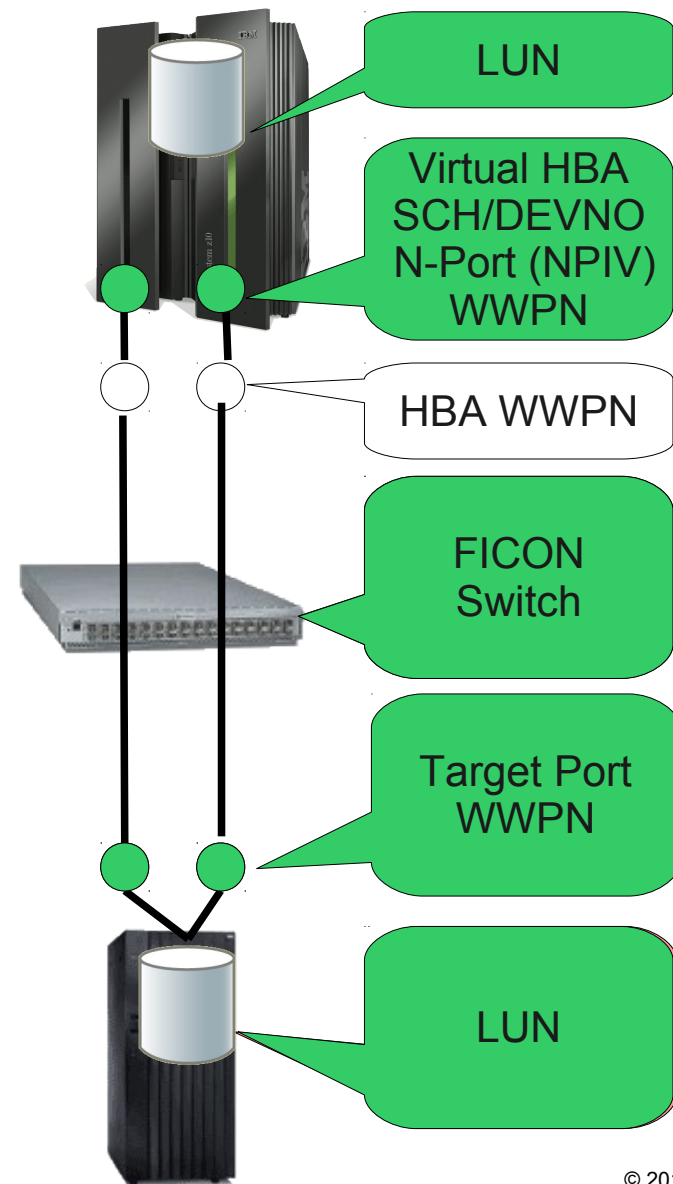
Fibre Channel Storage Area Network (SAN) - FICON vs. FCP terminology

- Each LUN is represented by the OS as a virtual HBA (SCH) and is tagged by a device number (QDEVNO) and a subchannel device number (SCH/DEVNO)
- Each FICON associated (CHPID) hosts unit (multiple HBAs with each a virtual path group (PGID) done through WWPNS.
- Each Path Group consists of multiple paths (CHPIDs) in the firmware.
- System z connected via Fibre Channel Connections to FICON Director
- The association is managed by System z IOCDs/IODF for Virtual HBAs but not for LUNs



Fibre Channel Storage Area Network (SAN) - FCP terminology

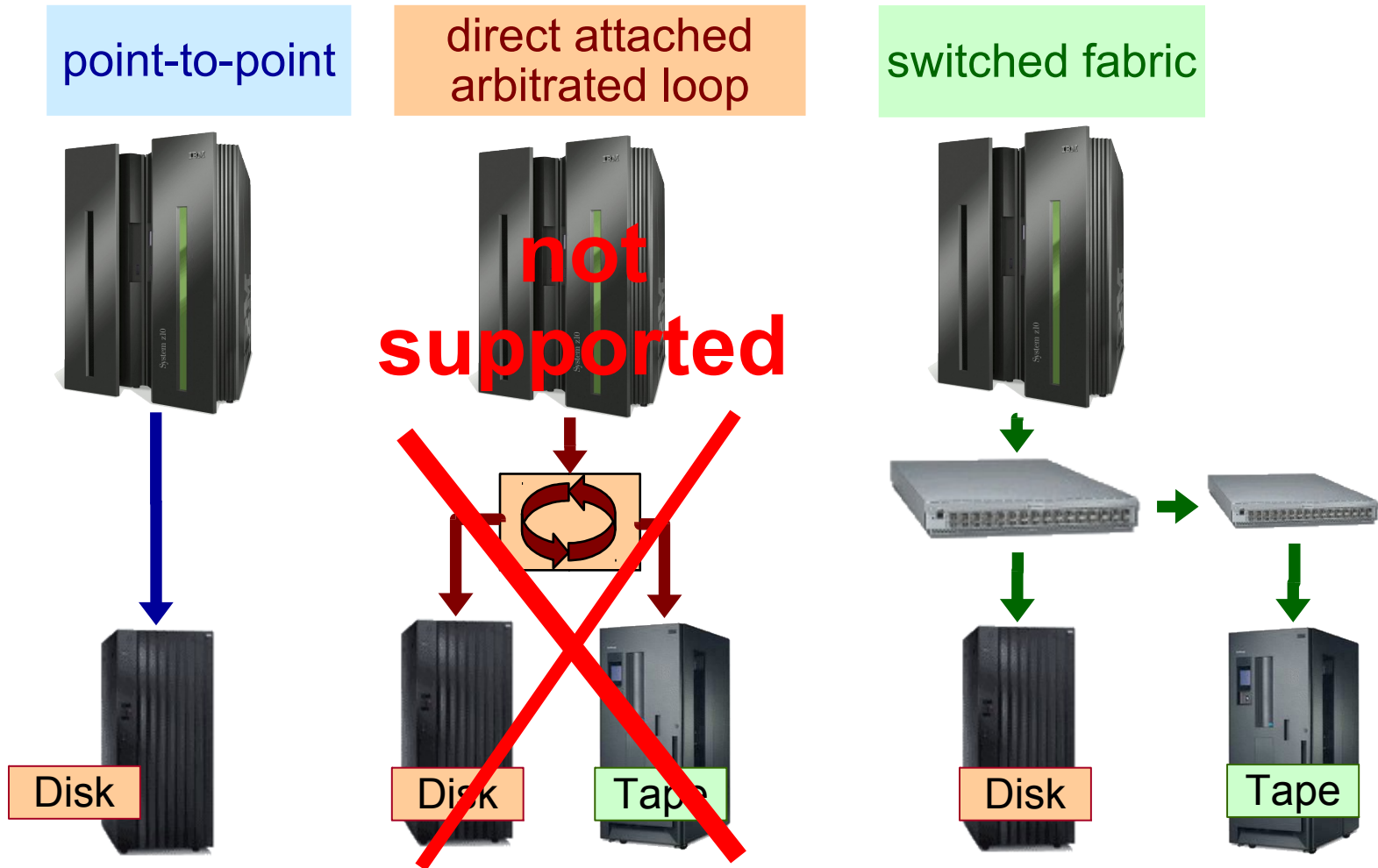
- Units (LUNs) are managed by the OS. A virtual HBA is presented on the host side as a subchannel (SCH) and DEVNO
- Each FICON Adapter (CHPID) hosts multiple HBAs with own N-Port Ids. Addressing is done through WWPNs.
- No Path Grouping is performed by the Hard- or firmware.
- System z connected via Fibre Channel Connections to FICON Switch
- The association is managed by System z IOCDS/IODF for Virtual HBAs but not for LUNs



IODF for FCP devices

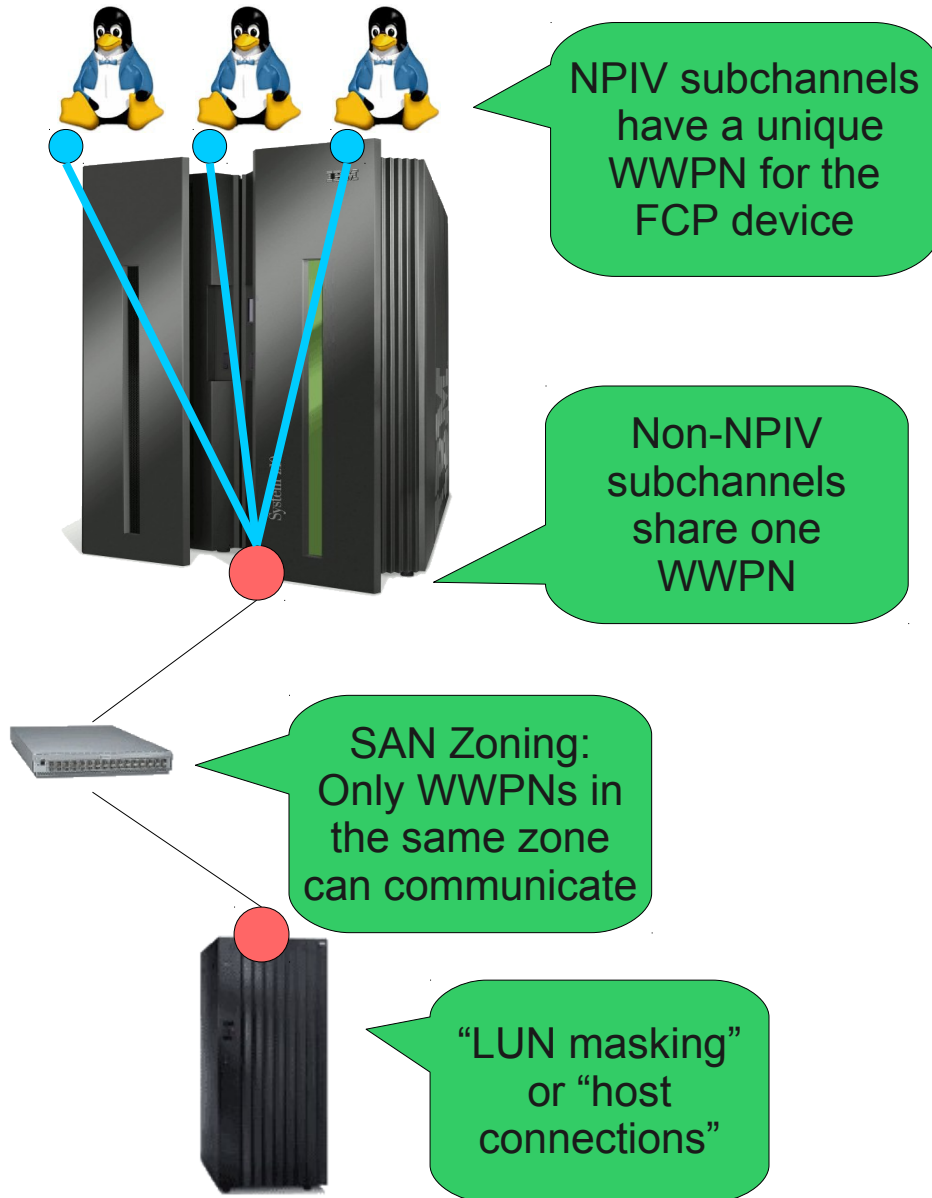
- CHPID PATH=(CSS(0,1,2,3),51),SHARED, *
 - NOTPART=((CSS(1),(TRX1),(=)),(CSS(3),(TRX2,T29CFA),(=)))*
 - ,PCHID=1C3,TYPE=FCP
 - CNTLUNIT CUNUMBR=3D00, *
 - PATH=((CSS(0),51),(CSS(1),51),(CSS(2),51),(CSS(3),51)), *
 - UNIT=FCP
 - IODEVICE ADDRESS=(3D00,001),CUNUMBR=(3D00),UNIT=FCP
 - IODEVICE ADDRESS=(3D01,007),CUNUMBR=(3D00), *
 - PARTITION=((CSS(0),T29LP11,T29LP12,T29LP13,T29LP14,T29LP*
 - 15),(CSS(1),T29LP26,T29LP27,T29LP29,T29LP30),(CSS(2),T29*
 - LP41,T29LP42,T29LP43,T29LP44,T29LP45),(CSS(3),T29LP56,T2*
 - 9LP57,T29LP58,T29LP59,T29LP60)),UNIT=FCP
 - IODEVICE ADDRESS=(3D08,056),CUNUMBR=(3D00), *
 - PARTITION=((CSS(0),T29LP15),(CSS(1),T29LP30),(CSS(2),T29*
 - LP45),(CSS(3),T29LP60)),UNIT=FCP
 -
 -
- Defines only FCP adapter
 - WWPN and LUN configuration inside operating systems (e.g. Linux on System z)

SAN topologies and System z



- A loop with two nodes looks like a point-to-point connection, but uses the unsupported loop protocol. Check device specifications for details.

SAN Access Control based on N-Port-Id-Virtualization (NPIV)



- NPIV: Each virtual adapter has its own WWPN in the SAN. This is the foundation for restricting access to storage.
- SAN zoning: Only WWPNs in same zone can communicate
- “LUN masking” or “host connections”: Each disk volume is only available for a specific list of WWPNs
- With NPIV: Restricted configuration possible where disk volumes are defined for each operating system
- Without NPIV: First operating system to access a disk volume can use it.

NPIV

```
# lszfcp -a | grep port_name
  permanent_port_name = "0xc05076ffe5005611"
  port_name           = "0xc05076ffe5005350"
```

- “port_name” is the WWPN used by the FCP subchannel
- “permanent_port_name” is the WWPN assigned to the FCP channel
- Compare to find out if NPIV is in use:
 - If both are the same, the FCP subchannel does NOT use NPIV
 - If they differ, the FCP subchannel uses NPIV
- Worldwide portname prediction tool
 - <http://publib.boulder.ibm.com/infocenter/zvm/v6r1/index.jsp?topic=/com.ibm.cpa0/>

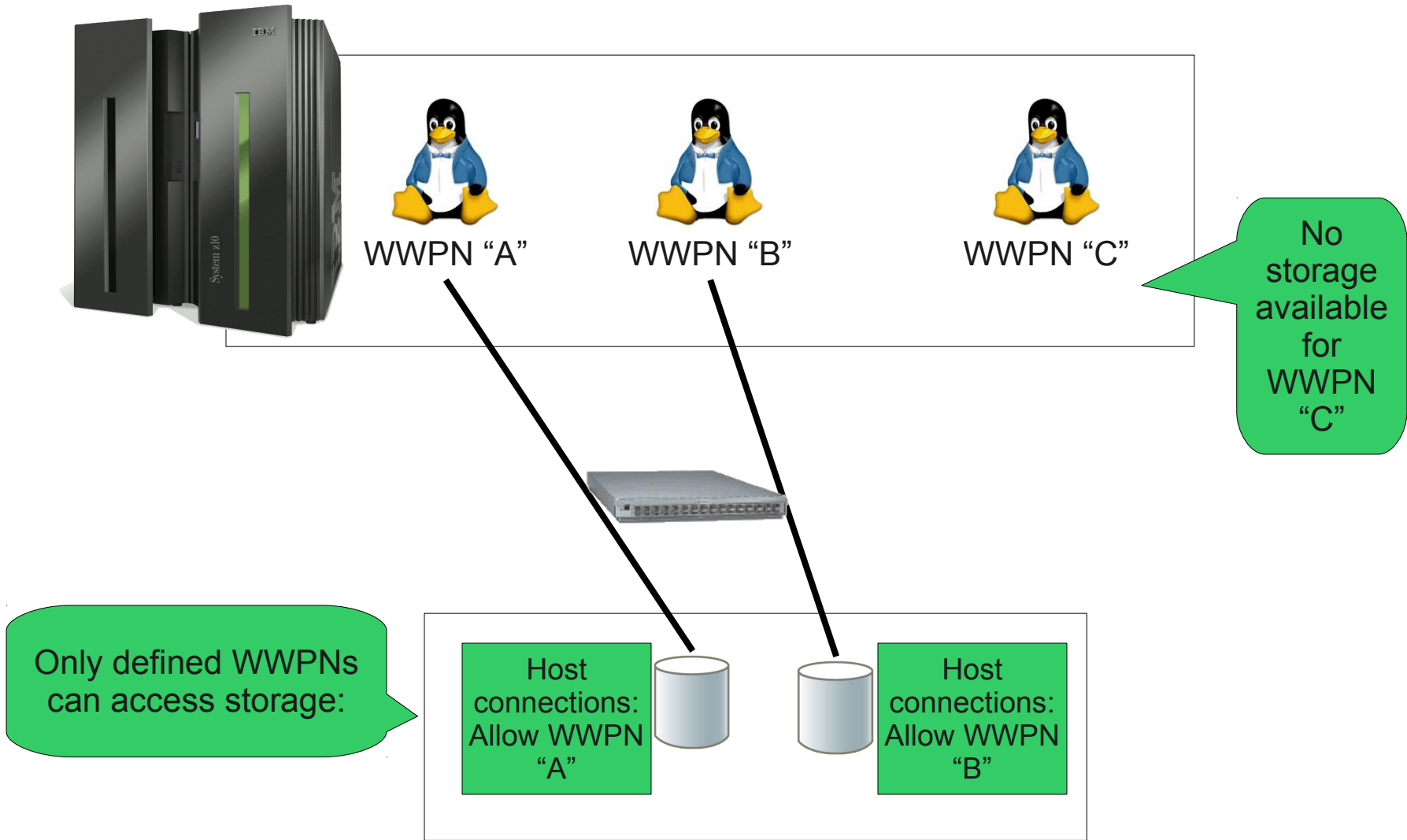


NPIV requirements



- NPIV is available on System z9, System z10 and z/Enterprise z/VM
 - z/VM 5.2 or newer
 - z/VM 5.1 with the PTF for APAR VM63744
- Linux Distribution (LPAR mode or z/VM)
 - SLES9 SP3+, SLES10, SLES11, RHEL5, ...
- NPIV-Capable Switch
 - only required for switch adjacent to System z
 - Mostly firmware upgrades possible (e.g. McData, Brocade)

“Host connections” / “LUN masking” with NPIV



Only defined WWPNs can access storage:

Host connections:
Allow WWPN "A"

Host connections:
Allow WWPN "B"

No storage available for WWPN "C"

zfc, differences to other Linux platforms

- Linux common code:
 - Query available LUNs from storage server (“REPORT LUNS”)
 - Attach all LUNs that are reported by the storage server
- zfc differs from other Linux platforms
 - Only attach LUNs configured in Linux
 - Required for FCP channel sharing in non-NPIV mode (e.g. LUN 1 used by one system, LUN 2 by another)
- Future (planned for Linux kernel 2.6.37):
 - For FCP subchannels in NPIV mode
 - allow automatic attachment of LUNs through common code
 - same behaviour as other Linux platforms



Manual LUN configuration with s390-tools

Show available FCP devices:

```
# lscss -t 1732/03,1732/04
```

Device	Subchan.	DevType	CU Type	Use	PIM	PAM	POM	CHPIDs
0.0.181d	0.0.0010	1732/03	1731/03		80	80	ff	3b000000 00000000
0.0.191d	0.0.0011	1732/03	1731/03		80	80	ff	46000000 00000000

Enable FCP devices:

```
# chccwdev -e 0.0.181d,0.0.191d
```

```
Setting device 0.0.181d online
```

```
Done
```

```
Setting device 0.0.191d online
```

```
Done
```

Show online FCP devices and corresponding SCSI hosts:

```
# lszfcp
```

```
0.0.181d host0
```

```
0.0.191d host1
```



Manual zfcp LUN configuration

Attach ports, only required for older distributions (SLES10, RHEL5, ...):

```
# echo 0x500507630313c562 > /sys/bus/ccw/drivers/zfcp/0.0.181d/port_add
# echo 0x500507630300c562 > /sys/bus/ccw/drivers/zfcp/0.0.191d/port_add
```

Show available storage ports:

```
# lszfcp -P
0.0.181d/0x500507630313c562 rport-0:0-0
0.0.191d/0x500507630300c562 rport-1:0-0
```

Attach LUNs:

```
# echo 0x401040c300000000 >
/sys/bus/ccw/drivers/zfcp/0.0.181d/0x500507630313c562/unit_add
# echo 0x401040c300000000 >
/sys/bus/ccw/drivers/zfcp/0.0.191d/0x500507630300c562/unit_add
```

List available LUNs:

```
# lszfcp -D
0.0.181d/0x500507630313c562/0x401040c300000000 0:0:0:1086537744
0.0.191d/0x500507630300c562/0x401040c300000000 1:0:0:1086537744
```



Linux Tools: Isluns

lsscsi: Show SCSI devices and block device nodes:

```
# lsscsi
[0:0:0:1086537744]disk      IBM          2107900      .280  /dev/sda
[1:0:0:1086537744]disk      IBM          2107900      .280  /dev/sdb
```

Isluns: Which LUNs are available on the storage system for use?

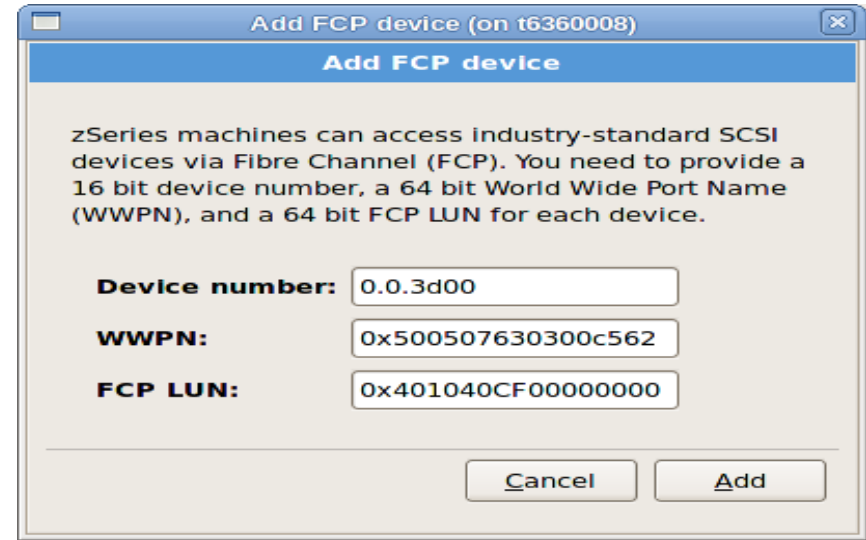
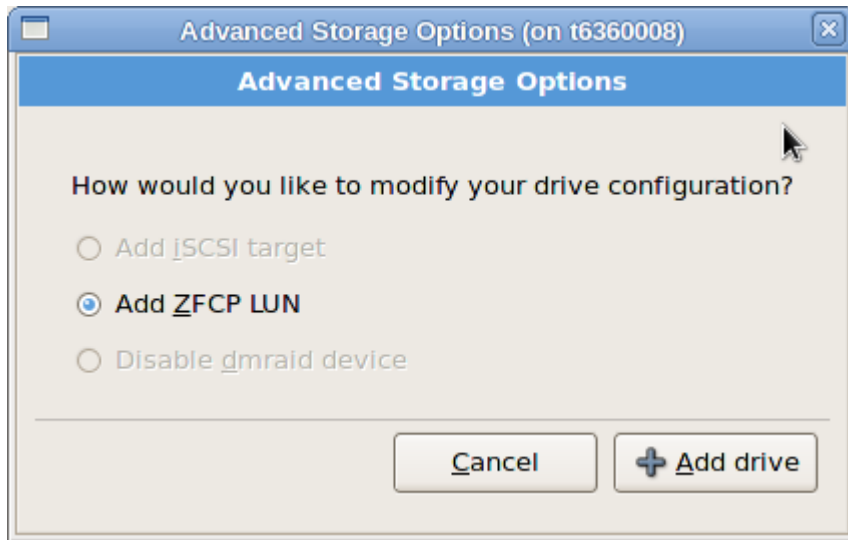
```
# lsluns -c 0.0.181d -p 0x50050763031b0104
Scanning for LUNs on adapter 0.0.181d
  at port 0x50050763031b0104:
    0x4011400000000000
    0x4011400100000000
    0x4011400200000000
    0x4011400300000000
    0x4011400400000000
    0x4011400500000000
    0x4011400600000000
    0x4011400700000000
    0x4011400800000000
    0x4011400900000000
```

zfcplib configuration files

- Configuring LUNs manually through sysfs is not persistent, will be lost after IPL
- Use configuration mechanism provided by distribution for persistent LUN configuration
- See documentation from distributions for details
- zfcplib configuration file in RHEL
 - /etc/zfcplib.conf
- zfcplib configuration files in SLES 10
 - /etc/sysconfig/hardware/hwcfg-zfcplib-bus-ccw-*
- zfcplib configuration files in SLES 11
 - /etc/udev/rules.d/51-zfcplib*



zfcpl LUN configuration in RHEL 5.5



- Dialog to add zfcpl LUN configuration during installation (e.g. root filesystem disks)
- Alternatively: Add zfcpl LUN configuration to /etc/zfcpl.conf config file (e.g. non-root filesystem disks):

```
# cat /etc/zfcpl.conf
0.0.3c00    0x500507630313c562 0x401040c300000000
0.0.3d00    0x500507630300c562 0x401040C300000000
```

-

YaST zfcplun configuration in SLES11 SP1

Configured ZFCP Disks

Minimum Channel: Maximum Channel:

Channel Number	WWPN
0.0.1801	0x500507630300c562
0.0.1701	0x500507630300c562
0.0.1701	0x500507630300c562

Add New ZFCP Disk

Channel Number:

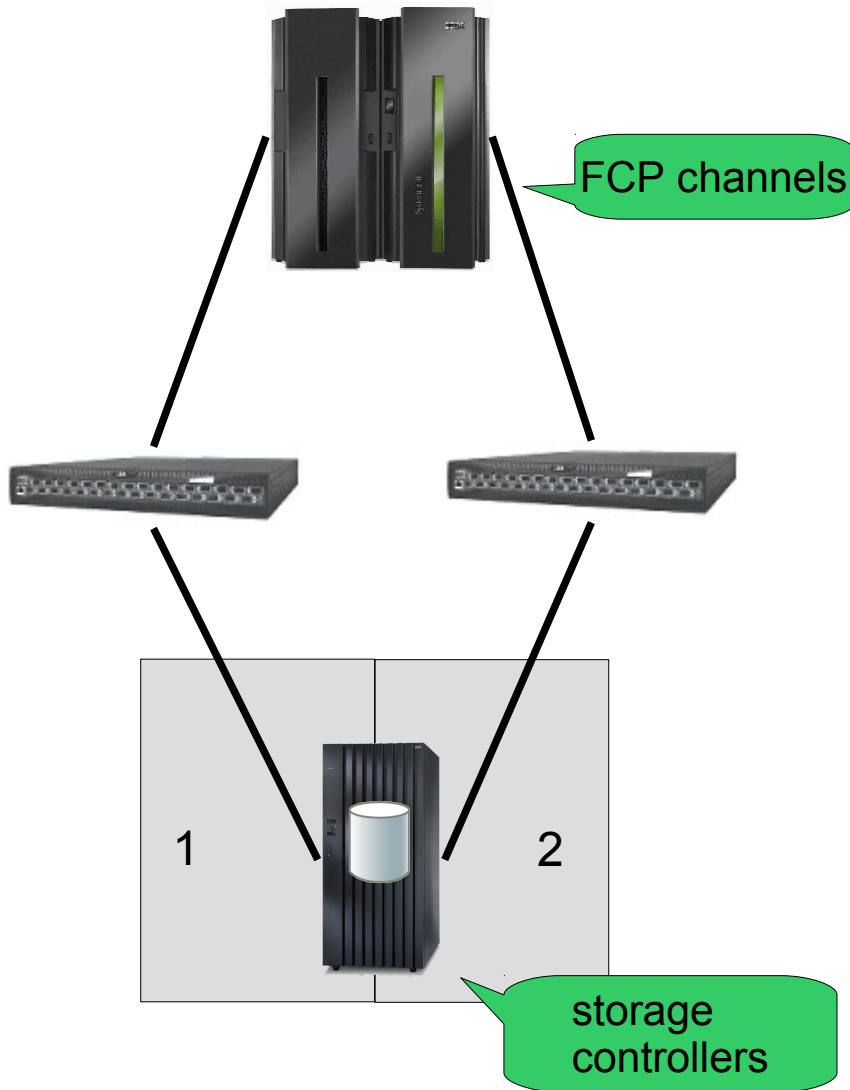
WWPN:

FCP-LUN:

Multipathing is mandatory

- Use multiple paths from operating system to storage
- Why is multipathing mandatory?
 - Remove single points of failure – single components WILL fail according to standards
 - Performance: I/O requests can be spread across multiple paths,
 - Usually a requirement for SAN connected storage servers
 - e.g. when one storage controller is in maintenance mode I/O continues to run through second controller
- Multipathing in Linux
 - Implemented in Linux in multipath-tools package, together with the device-mapper in the Linux kernel
 - The default configuration is already included, configuration changes only for special requirements
 - SCSI device (“LUN”) in Linux represents one path to the disk volume on the storage server
- Multipath devices are block devices in Linux, must be used e.g.
 - Directly for a filesystem
 - Logical Volume Manager (LVM)
 - Partitioning is possible

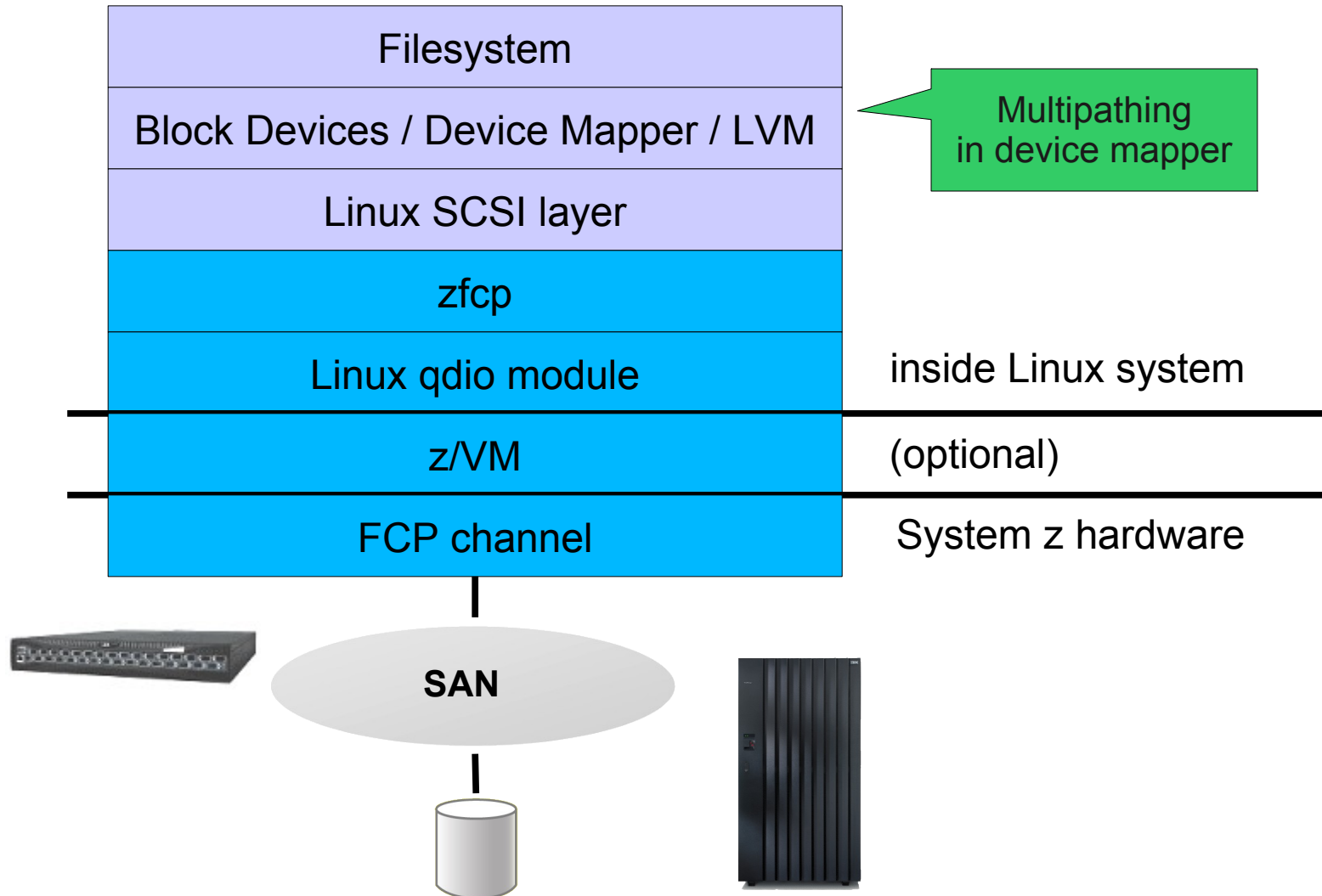
Multipathing overview



- multiple paths to storage volumes
- maintain access to storage volume
 - during storage system update
 - SAN fabric maintenance
 - FCP channel maintenance
- for FCP/SCSI managed by the operating system (Linux)
- WWID for storage volume, e.g. `36005076303ffc562000000000000010cc`



Linux on System z: SCSI stack and multipathing



Multipathing setup

- Config file /etc/multipath.conf
- Ensure devices are not blacklisted and multipathd is running
- Multipath tools include defaults for standard storage systems
- Multipath devices are created automatically when SCSI LUNs are attached

```
# multipath -ll
36005076303ffc5620000000000000010cc dm-0 IBM,2107900
size=5.0G features='1 queue_if_no_path' hwhandler='0' wp=rw
`-+- policy='round-robin 0' prio=1 status=active
  |- 0:0:26:1087127568 sda 8:0 active ready running
  `- 1:0:11:1087127568 sdb 8:16 active ready running
```

Each, sda and sdb
represent one path

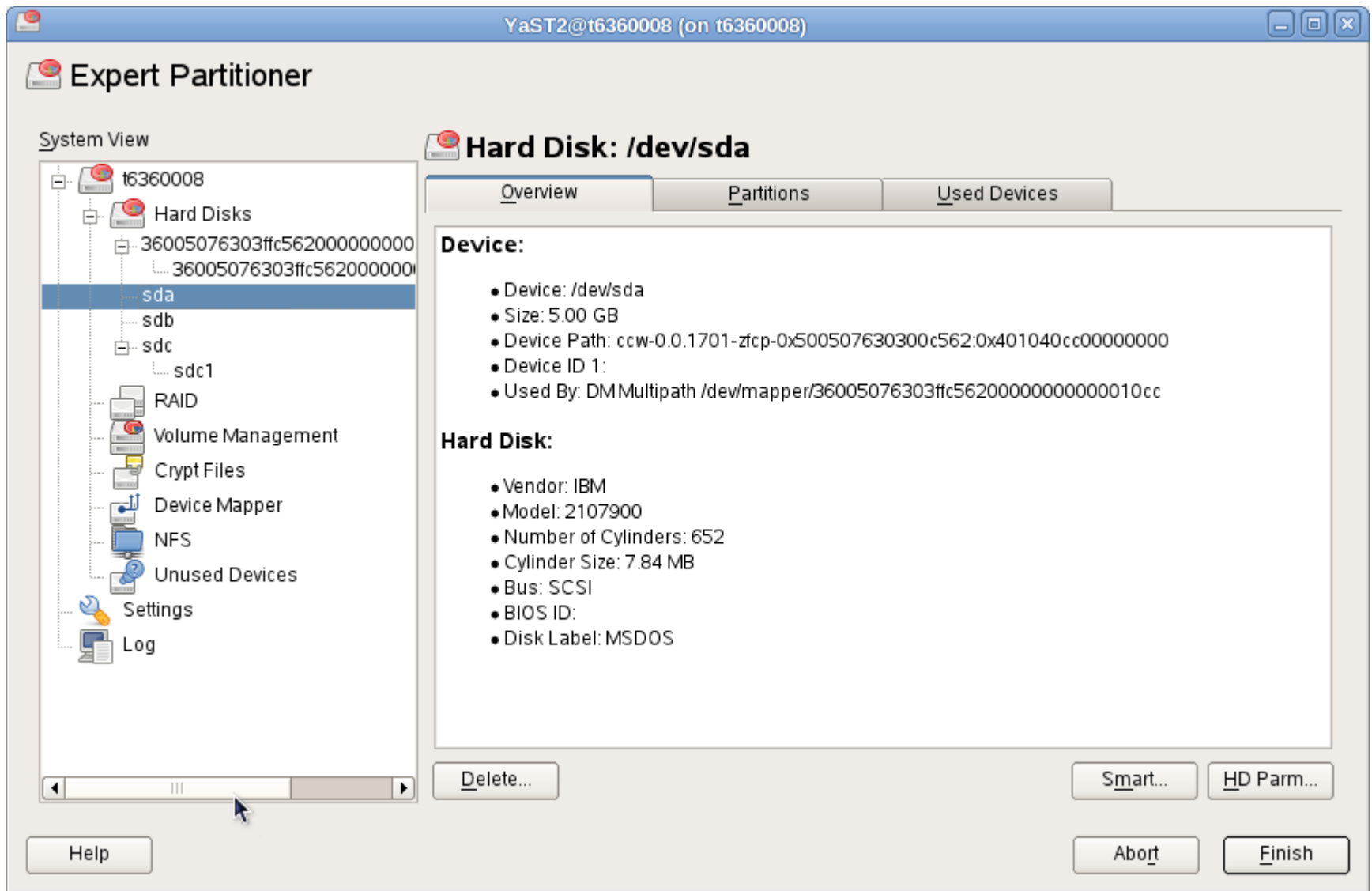
Resulting
multipath block
device

```
# mkfs.ext3 /dev/mapper/36005076303ffc5620000000000000010cc
```

```
...
```

```
# mount /dev/mapper/36005076303ffc5620000000000000010cc /mnt/
```


SLES11 multipathing setup through YaST



Multipath configuration

```
# cat /etc/multipath.conf
multipaths {
    multipath {
        wwid "36005076303ffc562000000000000010cc"
        rr_min_io "10"
        path_selector "service-time 0"
    }
}

# multipath -l
36005076303ffc562000000000000010cc dm-0 IBM,2107900
size=5.0G features='1 queue_if_no_path' hwhandler='0' wp=rw
`-+- policy='service-time 0' prio=-1 status=active
  |- 0:0:26:1087127568 sda 8:0 active undef running
  `- 1:0:11:1087127568 sdb 8:16 active undef running
```

- Default settings are usually good
- Can be overwritten in /etc/multipath.conf
- Example: Change path selector policy from default (“round robin”) to “service time”
- See multipath.conf manpage and documentation from distributions for details

Root filesystem on SCSI multipath volume

- Possibility to put root filesystem on SCSI multipath volume
- Older zipl versions do not support writing on multipath device
- Workaround: Use additional single path volume for /boot, use this volume for IPL
- Newer Linux distributions (e.g. SLES 11 SP1) support root filesystem on multipath device without workaround with s390-tools 1.8.3 or newer
- <http://www.ibm.com/developerworks/linux/linux390/s390-tools-1.8.3.html>
 - zipl: Add support for device mapper devices.
 - zipl now allows installation of and booting from a boot record on logical devices, i.e. devices managed by device mapper (or similar packages), e.g. multipath devices.

▪

SCSI IPL with z/VM

- setup load device
 - WWPN
 - LUN
- IPL from FCP device
- When using dedicated /boot, this LUN becomes IPL device

```

x3270-4 t6360008
File Options
00:
00: CP SET LOADDEV PORTNAME 50050763 0300C562 LUN 401040CD 00000000
00:
00: CP Q LOADDEV
PORTNAME 50050763 0300C562 LUN 401040CD 00000000 BOOTPRG 0
BR_LBA 00000000 00000000
00:
00: CP IPL 1701
00: HCPLDI2816I Acquiring the machine loader from the processor controller.
00: HCPLDI2817I Load completed from the processor controller.
00: HCPLDI2817I Now starting the machine loader.
01: HCPGSP2630I The virtual machine is placed in CP mode due to a SIGP stop and
store status from CPU 00.
00: MLDEVLO12I: Machine loader up and running (version v2.3).
00: MLQPD003I: Machine loader finished, moving data to final storage location.
Initializing cgroup subsys cpuset
Initializing cgroup subsys cpu
Linux version 2.6.27.42-0.1-default (geeko@buildhost) (gcc version 4.3.2 [gcc-4_
3-branch revision 141291] (SUSE Linux) ) #1 SMP 2010-01-06 16:07:25 +0100
setup.1a06a7: Linux is running as a z/VM guest operating system in 64-bit mode
Zone PFN ranges:
DMA 0x00000000 -> 0x00080000
Normal 0x00080000 -> 0x00080000
Movable zone start PFN for each node
early_node_map[1] active PFN ranges
0: 0x00000000 -> 0x00030000
Built 1 zonelists in Zone order, mobility grouping on. Total pages: 193536
Kernel command line: root=/dev/disk/by-id/scsi-36005076303ffc56200000000000010cc
-part1 TERM=dumb
PID hash table entries: 4096 (order: 12, 32768 bytes)
console [ttyS0] enabled
Dentry cache hash table entries: 131072 (order: 8, 1048576 bytes)
Inode-cache hash table entries: 65536 (order: 7, 524288 bytes)
Memory: 758784k/786432k available (3829k kernel code, 0k reserved, 2557k data, 1
88k init)
Write protected kernel read-only data: 0x100000 - 0x5fffff
Security Framework initialized
AppArmor: AppArmor initialized
Mount-cache hash table entries: 256
Initializing cgroup subsys ns
Initializing cgroup subsys cpuacct
-
Holding BOET6360
4a MA 042/001

```

SCSI IPL with z/VM

```
00:
00: CP SET LOADDEV PORTNAME 50050763 0300C562 LUN 401040CD 00000000
00:
00: CP Q LOADDEV
PORTNAME 50050763 0300C562      LUN  401040CD 00000000      BOOTPROG 0
BR_LBA   00000000 00000000
00:
00: CP IPL 1701
00: HCPLDI2816I Acquiring the machine loader from the processor controller.
00: HCPLDI2817I Load completed from the processor controller.
00: HCPLDI2817I Now starting the machine loader.
01: HCPGSP2630I The virtual machine is placed in CP mode due to a SIGP stop
and
store status from CPU 00.
00: MLOEVL012I: Machine loader up and running (version v2.3).
00: MLOPDM003I: Machine loader finished, moving data to final storage
location.
Initializing cgroup subsys cpuset
Initializing cgroup subsys cpu
Linux version 2.6.27.42-0.1-default (geeko@buildhost) (gcc version 4.3.2 [gcc-
4_
3-branch revision 141291] (SUSE Linux) ) #1 SMP 2010-01-06 16:07:25 +0100
setup.1a06a7: Linux is running as a z/VM guest operating system in 64-bit mode
Zone PFN ranges:
   DMA          0x00000000 -> 0x00080000
  Normal      0x00080000 -> 0x00080000
```

SCSI IPL LPAR from HMC

▼ **Load - H05:H05LP26**

CPC:	H05:H05LP26	
Image:	H05:H05LP26	
Load type	<input type="radio"/> Normal <input type="radio"/> Clear <input checked="" type="radio"/> SCSI <input type="radio"/> SCSI dump	
<input type="checkbox"/> Store status		
Load address	* 5900	
Load parameter	<input type="text"/>	
Time-out value	60 <input type="button" value="▲"/> <input type="button" value="▼"/>	60 to 600 seconds
Worldwide port name	<input type="text" value="50050763030BC562"/>	
Logical unit number	<input type="text" value="4011400B00000000"/>	
Boot program selector	<input type="text" value="0"/>	
Boot record logical block address	<input type="text" value="0"/>	
Operating system specific load parameters		

OK
Reset
Cancel
Help

Troubleshooting

- Check kernel messages that are possibly related to SCSI on Linux on System z:
 - scsi (common SCSI code)
 - sd (SCSI disk)
 - rport (common SCSI code FC remote port messages)
 - qdio (communication between Linux and FCP Channel)
 - zfcplib driver kernel messages
 - See “Kernel Messages” book on <https://www.ibm.com/developerworks/linux/linux390/>
 - “device-mapper: multipath”
- Other syslog messages
 - Multipathd
- zfcplib driver traces available in /sys/kernel/debug/s390dbf/
- Collect data with dbginfo.sh when reporting a problem to capture configuration, messages and traces
 -

Troubleshooting: scsi_logging_level

```
# scsi_logging_level -g
Current scsi logging level:
dev.scsi.logging_level = 0
SCSI_LOG_ERROR=0
SCSI_LOG_TIMEOUT=0
SCSI_LOG_SCAN=0
SCSI_LOG_MLQUEUE=0
SCSI_LOG_MLCOMPLETE=0
SCSI_LOG_LLQUEUE=0
SCSI_LOG_LLCOMPLETE=0
SCSI_LOG_HLQUEUE=0
SCSI_LOG_HLCOMPLETE=0
SCSI_LOG_IOCTL=0
```

- More SCSI output in kernel messages
- Higher levels can create lots of messages and slow down system

```
# scsi_logging_level -s -a 1
New scsi logging level:
dev.scsi.logging_level =
153391689
SCSI_LOG_ERROR=1
SCSI_LOG_TIMEOUT=1
SCSI_LOG_SCAN=1
SCSI_LOG_MLQUEUE=1
SCSI_LOG_MLCOMPLETE=1
SCSI_LOG_LLQUEUE=1
SCSI_LOG_LLCOMPLETE=1
SCSI_LOG_HLQUEUE=1
SCSI_LOG_HLCOMPLETE=1
SCSI_LOG_IOCTL=1
```


zfcplib / zfcplib_ping

Query Fibre Channel nameserver about ports available for my system:

```
# zfcplib_show -n
Local Port List:
    0x500507630313c562 / 0x656000 [N_Port] proto = SCSI-FCP   FICON
    0x50050764012241e4 / 0x656100 [N_Port] proto = SCSI-FCP
    0x5005076401221b97 / 0x656400 [N_Port] proto = SCSI-FCP
```

Query SAN topology, requires FC management server access:

```
# zfcplib_show

Interconnect Element Name      0x1000000051e4f7c00
Interconnect Element Domain ID 005
Interconnect Element Type      Switch
Interconnect Element Ports     256
  ICE Port 000  Online
    Attached Port [WWPN/ID] 0x50050763030b0562 / 0x650000 [N_Port]
  ICE Port 001  Online
    Attached Port [WWPN/ID] 0x50050764012241e5 / 0x650100 [N_Port]
  ICE Port 002  Online
    Attached Port [WWPN/ID] 0x5005076303008562 / 0x650200 [N_Port]
  ICE Port 003  Offline
...

```

zfcg_ping

Check if remote port responds (requires FC management service access):

```
# zfcg_ping 0x5005076303104562
Sending PNG from BUS_ID=0.0.3c00 speed=8 GBit/s
    echo received from WPN (0x5005076303104562) tok=0 time=1.905 ms
    echo received from WPN (0x5005076303104562) tok=1 time=2.447 ms
    echo received from WPN (0x5005076303104562) tok=2 time=2.394 ms
```

```
----- ping statistics -----
min/avg/max = 1.905/2.249/2.447 ms
-----
```

zfcg_show and zfcg_ping are part of the zfcg-hbaapi 2.1 package:
<http://www.ibm.com/developerworks/linux/linux390/zfcg-hbaapi-2.1.html>

Summary

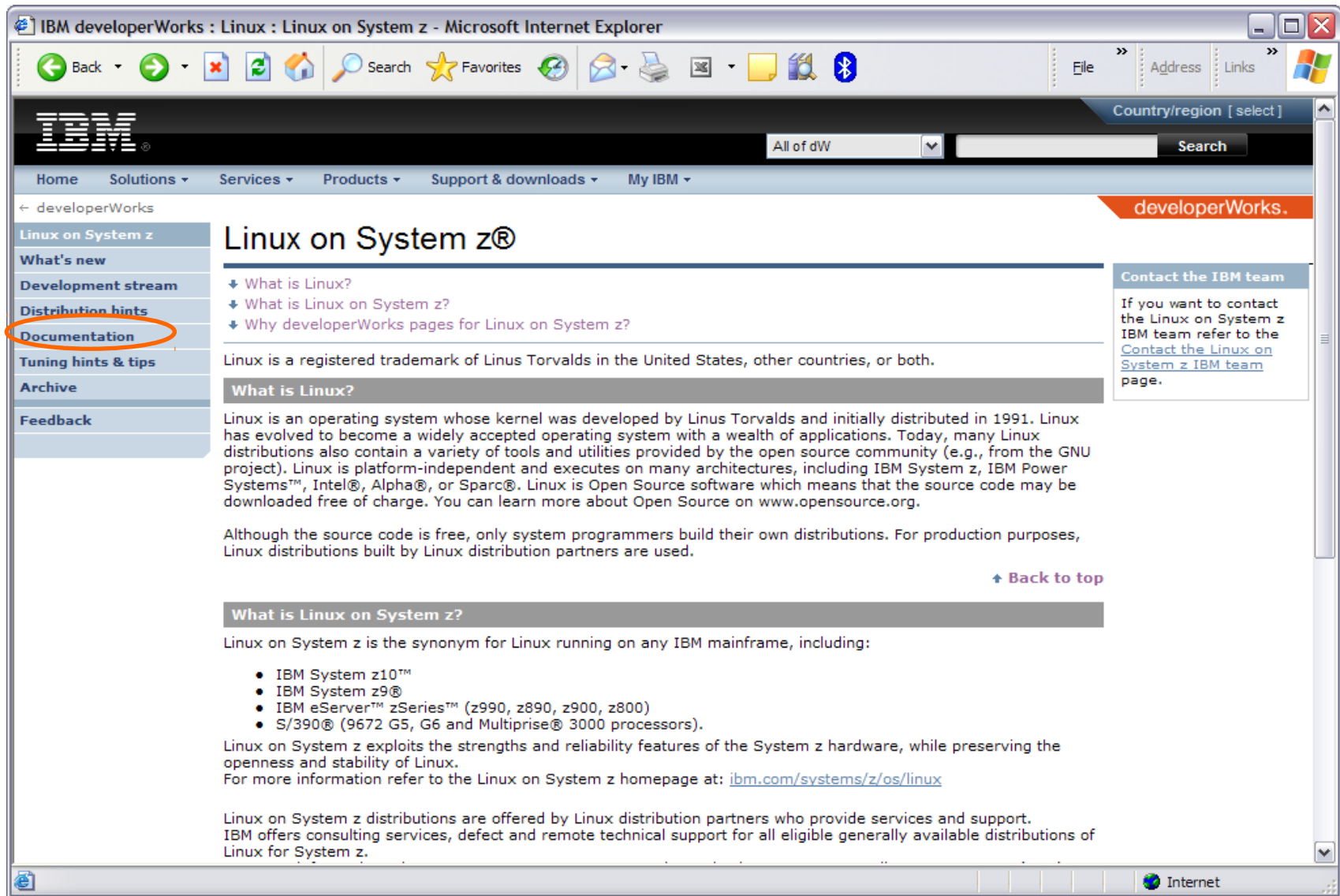
- Use standard FCP/SCSI storage with Linux on System z
- FCP subchannels defined in System z IODF; ports and LUNs managed in Linux
- Use NPIV to enable storage management and access control
- Use multipathing to avoid single points of failure (check storage requirements)
- Pure SCSI setup possible with root on multipath SCSI device and SCSI IPL
- Troubleshooting through error messages and utilities in s390-tools



Resources

- Device Drivers, Features, and Commands
 - Chapter 5. SCSI-over-Fibre Channel device driver
 - http://www.ibm.com/developerworks/linux/linux390/documentation_dev.html
- How to use FC-attached SCSI devices with Linux on System z
 - http://www.ibm.com/developerworks/linux/linux390/documentation_dev.html
- lsscsi utility for linux
 - <http://sg.danny.cz/scsi/lsscsi.html>
- SLES 11 SP1: Storage Administration Guide
 - http://www.novell.com/documentation/sles11/stor_admin/?page=/documentation/sles11/stor_admin/data/bookinfo.html
- Red Hat Enterprise Linux 6: Storage Administration Guide
 - http://docs.redhat.com/docs/en-US/Red_Hat_Enterprise_Linux/6/html/Storage_Administration
- System Storage Interoperation Center (SSIC)
 - <http://www.ibm.com/systems/support/storage/config/ssic/>
- System z FCP channels
 - <http://www.ibm.com/systems/z/hardware/connectivity/fcp.html>

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Linux on System z®

- What is Linux?
- What is Linux on System z?
- Why developerWorks pages for Linux on System z?

Linux is a registered trademark of Linus Torvalds in the United States, other countries, or both.

What is Linux?

Linux is an operating system whose kernel was developed by Linus Torvalds and initially distributed in 1991. Linux has evolved to become a widely accepted operating system with a wealth of applications. Today, many Linux distributions also contain a variety of tools and utilities provided by the open source community (e.g., from the GNU project). Linux is platform-independent and executes on many architectures, including IBM System z, IBM Power Systems™, Intel®, Alpha®, or Sparc®. Linux is Open Source software which means that the source code may be downloaded free of charge. You can learn more about Open Source on www.opensource.org.

Although the source code is free, only system programmers build their own distributions. For production purposes, Linux distributions built by Linux distribution partners are used.

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What is Linux on System z?

Linux on System z is the synonym for Linux running on any IBM mainframe, including:

- IBM System z10™
- IBM System z9®
- IBM eServer™ zSeries™ (z990, z890, z900, z800)
- S/390® (9672 G5, G6 and Multiprise® 3000 processors).

Linux on System z exploits the strengths and reliability features of the System z hardware, while preserving the openness and stability of Linux.

For more information refer to the Linux on System z homepage at: ibm.com/systems/z/os/linux

Linux on System z distributions are offered by Linux distribution partners who provide services and support. IBM offers consulting services, defect and remote technical support for all eligible generally available distributions of Linux for System z.

Contact the IBM team

If you want to contact the Linux on System z IBM team refer to the [Contact the Linux on System z IBM team](#) page.

Internet

Development stream – Novell SUSE – Red Hat documentation

The screenshot shows a Microsoft Internet Explorer browser window displaying the IBM developerWorks website. The address bar shows the URL: http://www.ibm.com/developerworks/linux/linux390/documentation_dev.html. The page title is "IBM developerWorks : Linux : Linux on System z : Documentation : Development stream".

The website header includes the IBM logo, a search bar, and navigation links: Home, Solutions, Services, Products, Support & downloads, My IBM. A "Country/region" dropdown menu is set to "All of dW".

The main content area is titled "Documentation for Development stream" and features a navigation menu with the following items: Linux on System z, What's new, Development stream (selected), Distribution hints, Documentation, Tuning hints & tips, Archive, and Feedback. The "Development stream" section includes links for "Development stream", "Novell SUSE", and "Red Hat".

Below the navigation menu, there is a section titled "Introduction" with the following text: "This page contains links to IBM documentation applicable to the Linux on System z 'Development stream'. The 'Documentation'-tab of the 'Development stream' has the same information as this page." Below this is a link to "Linux on System z documentation for 'Development stream'".

The "Base documentation" section contains a table of links:

Document Title	Document ID	Date
Device Drivers, Features, and Commands (kernel 2.6.33) (PDF, 4.4MB)	SC33-8411-05	March 2010
Using the Dump Tools (kernel 2.6.33) (PDF, 0.6MB)	SC33-8412-04	March 2010

The "How to documents" section contains a table of links:

Document Title	Document ID	Date
How to Improve Performance with PAV (PDF, 0.1MB)	SC33-8414-00	May 2008
How to use FC-attached SCSI devices with Linux on System z (kernel 2.6.33) - SC33-8413-04 (PDF, 1.0MB)	SC33-8413-04	March 2010
How to use Execute-in-Place Technology with Linux on z/VM - SC34-2594-01	SC34-2594-01	March 2010

On the right side of the page, there are several sidebar sections: "Contact the IBM team" (with a link to "Contact the Linux on System z IBM team refer to the Contact the Linux on System z IBM team page."), "IBM Information Center for Linux" (with a link to "Find the information you need about Linux on System z in the IBM Information Center for Linux."), "z/VM Documentation" (with a link to "Find the information you need about z/VM at the z/VM Internet library."), "IBM Redbooks" (with a link to "Find more Linux on System z information at Redbooks."), and "IBM Techdocs".

The footer of the browser window shows "javascript:void(0);" on the left and "Internet" on the right.

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Summary of News and Updates

View 03 June 2008 updates.

Read the [z/VM and VM Site News and Changes](#) for a summary of VM-related news, announcements, pointers, new classes, and places to hear about z/VM virtualization technology.

Worldwide announcement letters (US letters / product links below)

- May 06, 2008 z10™ EC Internet access and coupling improvements
- Feb. 26, 2008 Announcing System z10™ Enterprise Class
- Jan. 25, 2008 Internet delivery for z/VM orders via ShopzSeries
- Aug. 07, 2007 IBM Integrated Removable Media Manager (IRMM)
- Jun. 12, 2007 IBM z/VM V5.3 - Additional enhancements available
- Apr. 18, 2007 z9 EC and z9 BC - delivering greater value for everyone
- Feb. 06, 2007 IBM z/VM V5.3 - Improving scalability, security, and virtualization technology
- Apr. 27, 2006 z/VM V5.2 New Function Added in Support of System z9

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Questions?



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