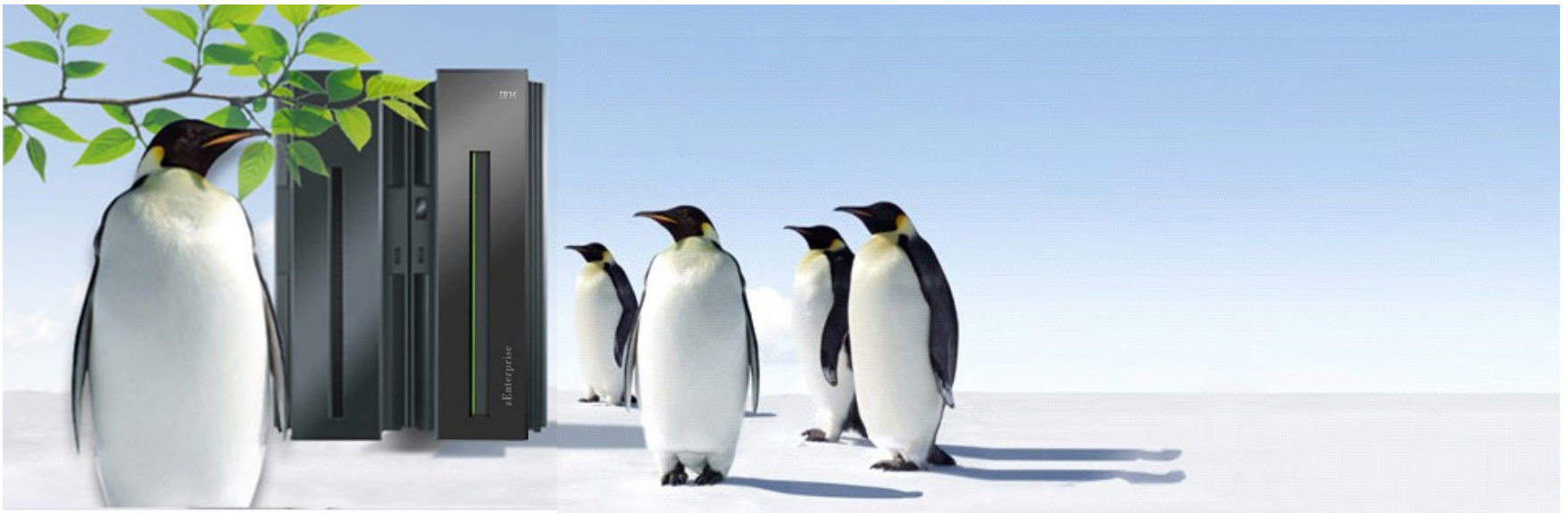


Linux on System z zFCP Performance Analysis

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Linux on System z Development



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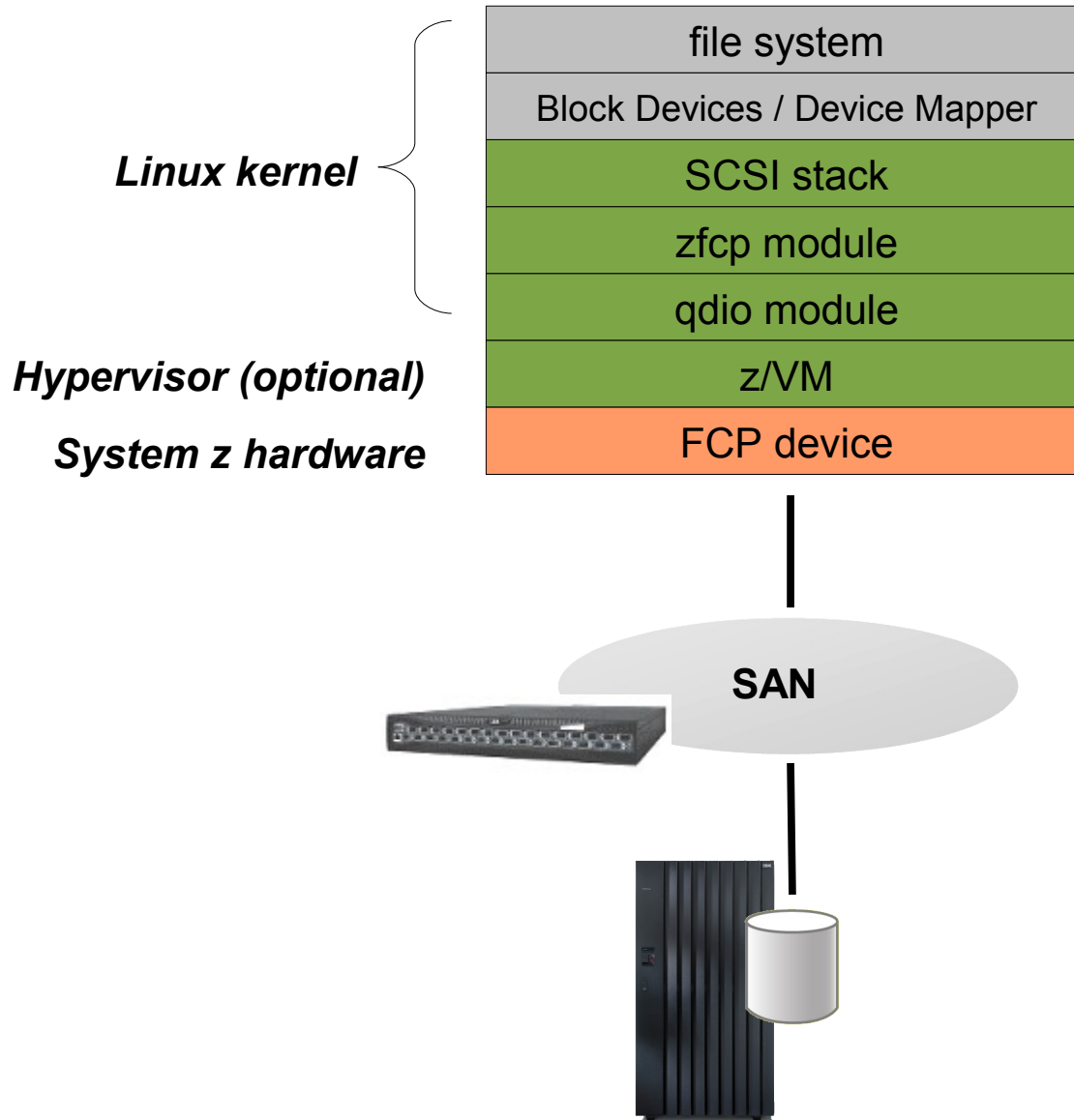
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Agenda

- Purpose
- Workflow Overview
- Collecting Data
 - Data Sources
 - Architecture
 - ziomon Usage
- Analyzing Data
 - ziorep_config
 - ziorep_utilization
 - ziorep_traffic
- Hints & Tips
- Data Analysis on Other Platforms

How files end up on Storage Devices

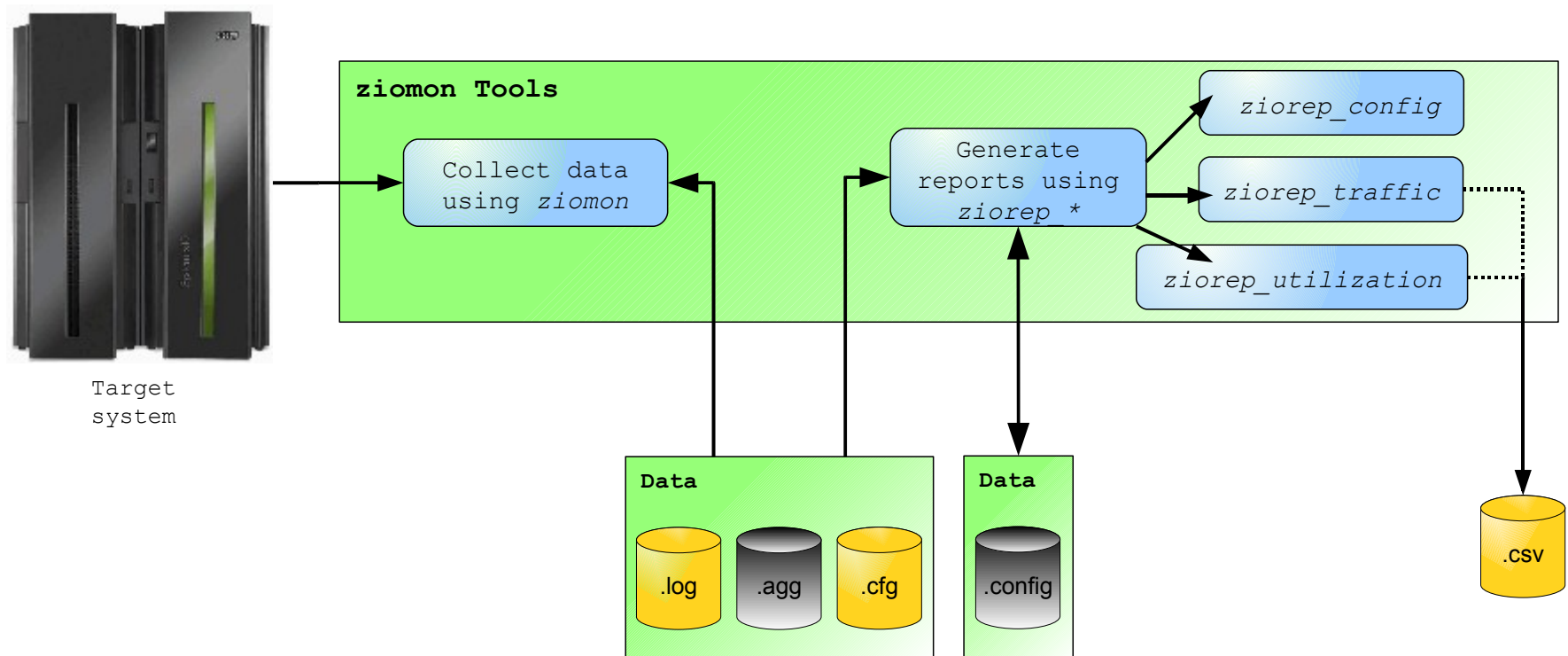


Motivation

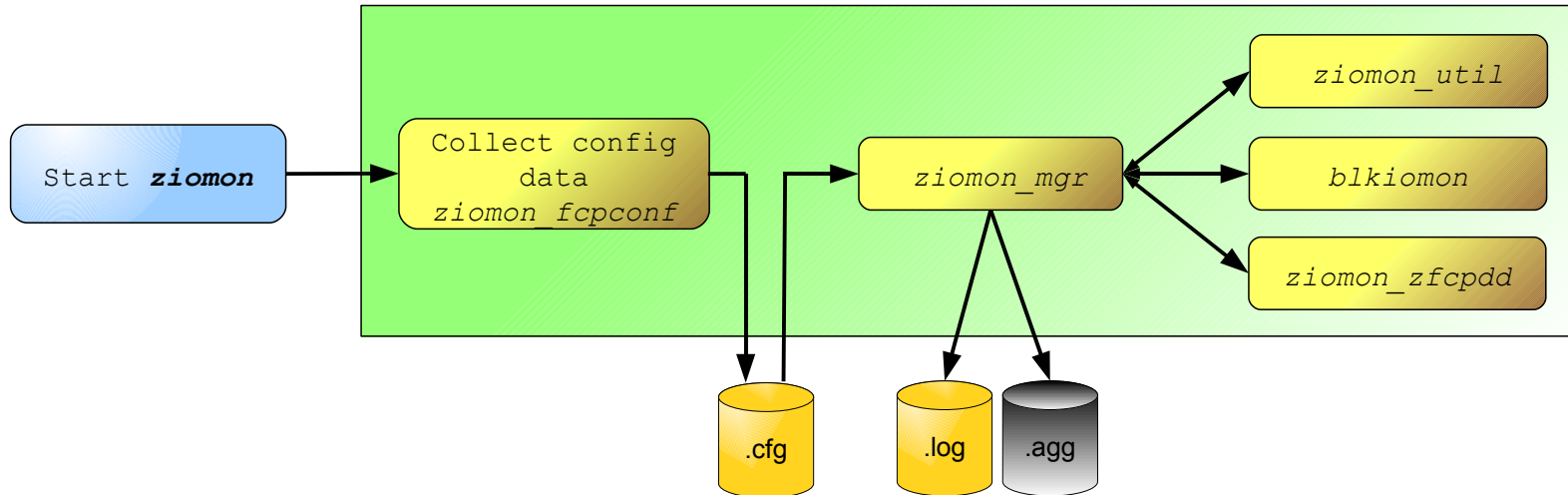
- Performance issues can potentially stem from multiple sources
- Focusing on a single component will not tell the whole story
- Holistic approach, considering all components involved (Linux, hypervisors, HBAs, SAN with storage devices) is required
- Requires advanced data analysis features, e.g. for filtering and aggregation
- *ziomon* tools aim at providing all of the above
- Availability:
 - SLES: Part of the *s390-tools* package starting with SLES10 SP3 and SLES11 SP1
 - RHEL: Part of the *s390utils* package starting with RHEL 5.4 and provided as *s390utils-ziomon* beginning with RHEL 6
- Dependencies: Requires the *blktrace* package as well as `CONFIG_BLK_DEV_IO_TRACE` enabled in the kernel config

Workflow Overview

- Collect data using *ziomon*
- Yield resulting files (*.log*, *.agg* & *.cfg* - all required)
- Use reporting tools to analyze data



Collecting Data: Components



- Components used by ziomon to collect data:
 - *ziomon_fcpconf* : zfcf configuration
 - *ziomon_zfcpdd*: Channel & fabric latencies, QDIO outbound queue utilization
 - *ziomon_util*: zfcf adapter utilization
 - *blkionom*: blktrace component for SCSI subsystem latencies
- Note: Data collection only starts after the configuration has been captured

Collecting Data: Invocation

- Minimum invocation:

```
user@larsson:~> ziomon -d 5 -o data /dev/sda
```

- Mandatory parameters to use:

`-d` : total data collection duration in minutes
`-o` : output file – should be on a device not sampled by *ziomon*!
`<device>` : SCSI device to monitor

- *ziomon* will aggregate data during collection, defaults to 60 seconds. I.e. it will not collect data on individual I/O operations.
- Use `'-i'` to specify an arbitrary interval length for aggregation. E.g. to invoke with highest possible resolution (2 seconds) use

```
user@larsson:~> ziomon -d 5 -i 2 -o data /dev/sda
```

- Use `'-l'` to specify size limit for `.log` file.

```
user@larsson:~> ziomon -d 5 -l 137M -o data /dev/sda
```

Will wrap around in case specified limit is too low (like in a ring buffer).
The overwritten data is aggregated into a single (bigger) interval in
a `.agg` file.

Collecting Data: Specifying Devices

- Example:

```
user@larsson:~> multipath -ll
36005076303ffc56200000000000010cc dm-0 IBM,2107900
[size=5.0G][features=0][hw_handler=0]
\_ round-robin 0 [prio=2][active]
\_ 1:0:0:1087127568 sdb 8:16 [active][ready]
\_ 0:0:0:1087127568 sda 8:0 [active][ready]
```

- Multiple ways to specify devices for collecting data:

- Provide a list of single path devices:

```
user@larsson:~> ziomon [...] /dev/sda /dev/sdb
```

- Specifying multipath devices will identify all underlying devices (*recommended*):

```
user@larsson:~> ziomon [...] /dev/mapper/36005076303ff...
```

- Mixing single path and multipath devices is possible

```
user@larsson:~> ziomon [...] /dev/mapper/36005076303ff... \
/dev/sdc /dev/sdd
```

Collecting Data: Specifying Devices (continued)

- Notes:

- SCSI tape devices are supported, too
- *blktrace* (as used by *ziomon*) requires 2MB vmalloc memory per device *and* processor
- Check current configuration:

```
user@larsson:~> grep Vmalloc /proc/meminfo
```

- Use kernel parameter vmalloc to increase, e.g. `vmalloc=512M`

Data Analysis

- Use the *ziorep_** commands to generate reports and investigate data:
 - *ziorep_config*: Insight into the zfcf configuration
 - *ziorep_utilization*: Adapter utilization statistics
 - *ziorep_traffic*: Traffic statistics
- Note: Always pass on all files (*.log* and *.cfg*, and possibly *.agg*) when forwarding data to others for analysis

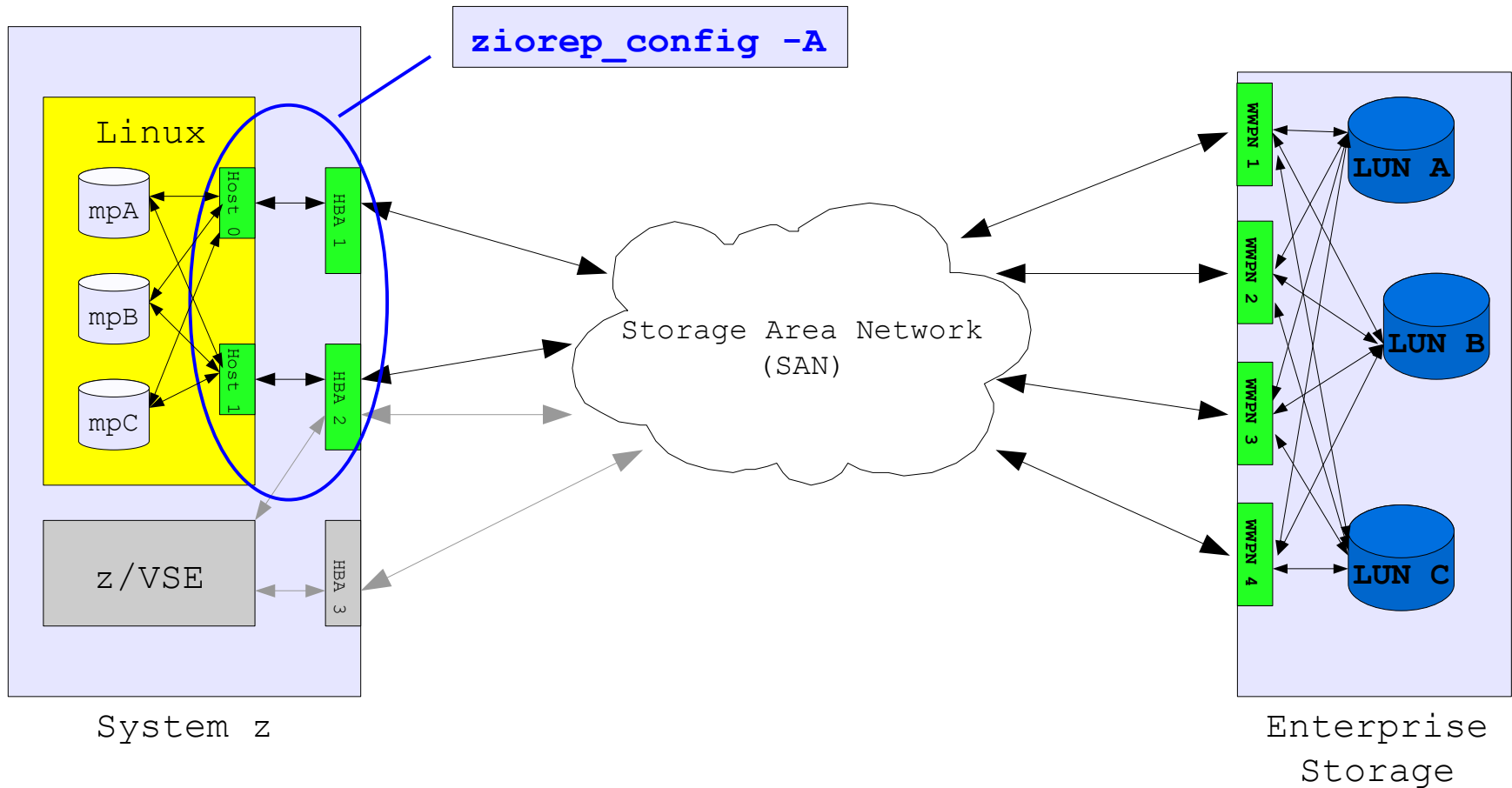
Data Analysis: Configuration Report Overview

- `ziorep_config` can take a `.cfg` file as input

```
user@larsson:~> ziorep_config -i sample.cfg
```

- Displays information on zfcplib-related hardware (HBAs, single and multipath devices) data was collected on.
- Skip the `-i` parameter for a report on the current system.
- 3 different report types available:
 - Adapter report (**default**, option `-A`): HBA details
 - Multipath report (option `-M`): Multipath/device mapper details
 - Devices report (option `-D`): SCSI device details
- Selection options to limit output to a subset only (can be combined):
 - `-p <port>` limits output to specified WWPN, e.g. `'-p 0x5005123456789000'`
 - `-l <lun>` limits output to specified LUN, e.g. `'-l 0x401040a600000000'`
 - `-m <mdev>` limits output to specified multipath device, e.g. `'-m 36005076303ffc562000000000000010a6'`
 - `-a <adapter>` limits output to specified adapter, e.g. `'-a 0.0.3c07'`
 - `-s <scsi_host>` limits output to specified SCSI host, e.g. `'-s host0'`
 - `-d <device>` limits output to specified device, e.g. `'-d sde'`

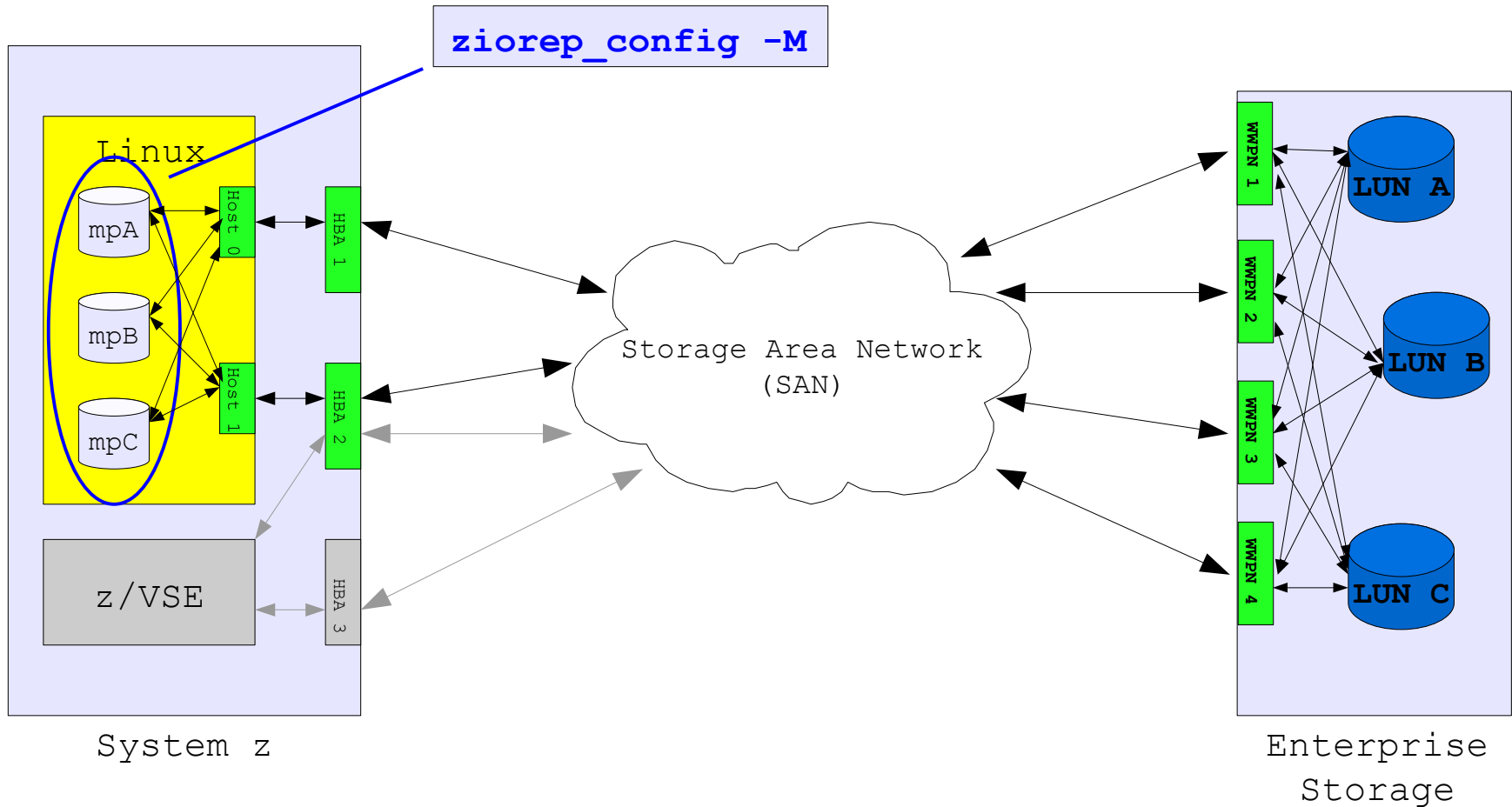
Data Analysis: Adapter Configuration Report



Data Analysis: Adapter Configuration Report (continued)

```
user@larsson:~> ziorep_config -A -i sample.cfg \  
-a 0.0.1800 -a 0.0.1820  
Host:      host0  
CHPID:    64  
Adapter:  0.0.1800  
Sub-Ch.:  0.0.0842  
Name:     0xc05076ffe4805611  
P-Name:   0xc05076ffe4805611  
Version:  0x0005  
LIC:      0x0000014c  
Type:     NPort (fabric via point-to-point)  
Speed:    8 Gbit  
State:    Online  
  
Host:      host2  
CHPID:    66  
Adapter:  0.0.1820  
Sub-Ch.:  0.0.08a2  
Name:     0xc05076ffe4805e11  
P-Name:   0xc05076ffe4805e11  
Version:  0x0005  
LIC:      0x0000014c  
Type:     NPort (fabric via point-to-point)  
Speed:    8 Gbit  
State:    Online
```

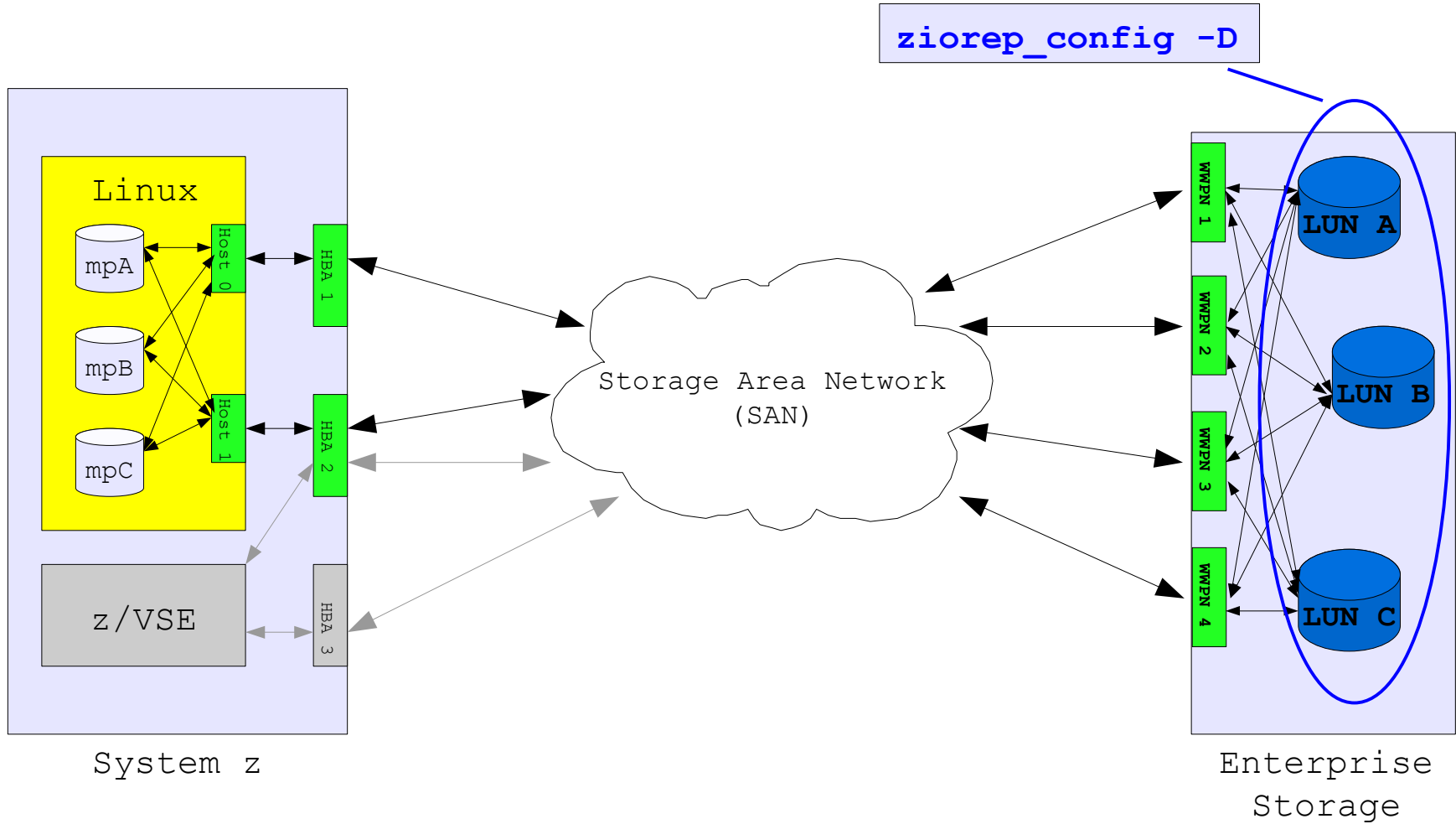
Data Analysis: Multipath Report



Data Analysis: Multipath Report (continued)

```
user@larsson:~> ziorep_config -i sample.cfg -M \  
-m 36005076303ffc52a0000000000005502  
0.0.1800 0x500507630303c52a /dev/sda /dev/mapper/36005076303ffc52a0000000000005502  
0.0.1810 0x500507630303c52a /dev/sde /dev/mapper/36005076303ffc52a0000000000005502  
0.0.1820 0x500507630303c52a /dev/sdi /dev/mapper/36005076303ffc52a0000000000005502  
0.0.1830 0x500507630303c52a /dev/sdm /dev/mapper/36005076303ffc52a0000000000005502  
0.0.1800 0x500507630308c52a /dev/sdd /dev/mapper/36005076303ffc52a0000000000005502  
0.0.1810 0x500507630308c52a /dev/sdh /dev/mapper/36005076303ffc52a0000000000005502  
0.0.1820 0x500507630308c52a /dev/sdl /dev/mapper/36005076303ffc52a0000000000005502  
0.0.1830 0x500507630308c52a /dev/sdp /dev/mapper/36005076303ffc52a0000000000005502  
0.0.1800 0x500507630310c52a /dev/sdc /dev/mapper/36005076303ffc52a0000000000005502  
0.0.1810 0x500507630310c52a /dev/sdg /dev/mapper/36005076303ffc52a0000000000005502  
0.0.1820 0x500507630310c52a /dev/sdj /dev/mapper/36005076303ffc52a0000000000005502  
0.0.1830 0x500507630310c52a /dev/sdo /dev/mapper/36005076303ffc52a0000000000005502  
0.0.1800 0x500507630318c52a /dev/sdb /dev/mapper/36005076303ffc52a0000000000005502  
0.0.1810 0x500507630318c52a /dev/sdf /dev/mapper/36005076303ffc52a0000000000005502  
0.0.1820 0x500507630318c52a /dev/sdk /dev/mapper/36005076303ffc52a0000000000005502  
0.0.1830 0x500507630318c52a /dev/sdn /dev/mapper/36005076303ffc52a0000000000005502
```


Data Analysis: Device Configuration Report



Data Analysis: Device Configuration Report (continued)

```

user@larsson:~> ziorep_config -i sample.cfg -D \
-1 0x4055400500000000 -1 0x4055400000000000
0.0.1800 0x500507630303c52a 0x4055400000000000 host0 /dev/sg49 /dev/sdax 67:16 Disk 2107900 IBM 0:0:0:1073758293
0.0.1800 0x500507630303c52a 0x4055400500000000 host0 /dev/sg108 /dev/sdde 70:192 Disk 2107900 IBM 0:0:0:1074085973
0.0.1800 0x500507630318c52a 0x4055400000000000 host0 /dev/sg74 /dev/sdbw 68:160 Disk 2107900 IBM 0:0:1:1073758293
0.0.1800 0x500507630318c52a 0x4055400500000000 host0 /dev/sg118 /dev/sddo 71:96 Disk 2107900 IBM 0:0:1:1074085973
0.0.1800 0x500507630310c52a 0x4055400000000000 host0 /dev/sg56 /dev/sdbe 67:128 Disk 2107900 IBM 0:0:2:1073758293
0.0.1800 0x500507630310c52a 0x4055400500000000 host0 /dev/sg122 /dev/sdds 71:160 Disk 2107900 IBM 0:0:2:1074085973
0.0.1800 0x500507630308c52a 0x4055400000000000 host0 /dev/sg87 /dev/sdcj 69:112 Disk 2107900 IBM 0:0:3:1073758293
0.0.1800 0x500507630308c52a 0x4055400500000000 host0 /dev/sg89 /dev/sdcl 69:144 Disk 2107900 IBM 0:0:3:1074085973
0.0.1810 0x500507630303c52a 0x4055400000000000 host1 /dev/sg80 /dev/sdcc 69:0 Disk 2107900 IBM 1:0:0:1073758293
0.0.1810 0x500507630303c52a 0x4055400500000000 host1 /dev/sg113 /dev/sddj 71:16 Disk 2107900 IBM 1:0:0:1074085973
0.0.1810 0x500507630318c52a 0x4055400000000000 host1 /dev/sg103 /dev/sdcz 70:112 Disk 2107900 IBM 1:0:1:1073758293
0.0.1810 0x500507630318c52a 0x4055400500000000 host1 /dev/sg124 /dev/sddu 71:192 Disk 2107900 IBM 1:0:1:1074085973
0.0.1810 0x500507630310c52a 0x4055400000000000 host1 /dev/sg46 /dev/sdau 66:224 Disk 2107900 IBM 1:0:2:1073758293
0.0.1810 0x500507630310c52a 0x4055400500000000 host1 /dev/sg105 /dev/sddb 70:144 Disk 2107900 IBM 1:0:2:1074085973
0.0.1810 0x500507630308c52a 0x4055400000000000 host1 /dev/sg86 /dev/sdci 69:96 Disk 2107900 IBM 1:0:3:1073758293
0.0.1810 0x500507630308c52a 0x4055400500000000 host1 /dev/sg107 /dev/sddd 70:176 Disk 2107900 IBM 1:0:3:1074085973
0.0.1820 0x500507630303c52a 0x4055400000000000 host2 /dev/sg110 /dev/sddg 70:224 Disk 2107900 IBM 2:0:0:1073758293
0.0.1820 0x500507630303c52a 0x4055400500000000 host2 /dev/sg120 /dev/sddq 71:128 Disk 2107900 IBM 2:0:0:1074085973
0.0.1820 0x500507630310c52a 0x4055400000000000 host2 /dev/sg69 /dev/sdbr 68:80 Disk 2107900 IBM 2:0:1:1073758293
0.0.1820 0x500507630310c52a 0x4055400500000000 host2 /dev/sg71 /dev/sdbt 68:112 Disk 2107900 IBM 2:0:1:1074085973
0.0.1820 0x500507630318c52a 0x4055400000000000 host2 /dev/sg109 /dev/sddf 70:208 Disk 2107900 IBM 2:0:2:1073758293
0.0.1820 0x500507630318c52a 0x4055400500000000 host2 /dev/sg116 /dev/sddm 71:64 Disk 2107900 IBM 2:0:2:1074085973
0.0.1820 0x500507630308c52a 0x4055400000000000 host2 /dev/sg92 /dev/sdco 69:192 Disk 2107900 IBM 2:0:3:1073758293
0.0.1820 0x500507630308c52a 0x4055400500000000 host2 /dev/sg117 /dev/sddn 71:80 Disk 2107900 IBM 2:0:3:1074085973
0.0.1830 0x500507630303c52a 0x4055400000000000 host3 /dev/sg83 /dev/sdcf 69:48 Disk 2107900 IBM 3:0:0:1073758293
0.0.1830 0x500507630303c52a 0x4055400500000000 host3 /dev/sg125 /dev/sddv 71:208 Disk 2107900 IBM 3:0:0:1074085973
0.0.1830 0x500507630318c52a 0x4055400000000000 host3 /dev/sg97 /dev/sdct 70:16 Disk 2107900 IBM 3:0:1:1073758293
0.0.1830 0x500507630318c52a 0x4055400500000000 host3 /dev/sg99 /dev/sdcv 70:48 Disk 2107900 IBM 3:0:1:1074085973
0.0.1830 0x500507630310c52a 0x4055400000000000 host3 /dev/sg114 /dev/sddk 71:32 Disk 2107900 IBM 3:0:2:1073758293
0.0.1830 0x500507630310c52a 0x4055400500000000 host3 /dev/sg128 /dev/sddy 128:0 Disk 2107900 IBM 3:0:2:1074085973
0.0.1830 0x500507630308c52a 0x4055400000000000 host3 /dev/sg112 /dev/sddi 71:0 Disk 2107900 IBM 3:0:3:1073758293
0.0.1830 0x500507630308c52a 0x4055400500000000 host3 /dev/sg127 /dev/sddx 71:240 Disk 2107900 IBM 3:0:3:1074085973

```

Data Analysis: Adapter Utilization Report

- Ficon Express card with FCP CHPIDs has a CPU, bus and adapter chip
- Utilization report provides two sections:
 - **FCP channel** report provides details on
 - CPU utilization
 - Bus utilization
 - Adapter utilization
 - **Virtual HBA** report provides details on
 - QDIO utilization, queue full and failure conditions
 - Throughput
 - I/O requests numbers
- **Purpose:** Identify potential bottlenecks within the adapter
- **Note:** Percentages reported are for entire FCP channel – no fraction according to utilization given when FCP channel is shared by multiple OS images!
I.e. high utilization during phases of inactivity point to activity on other OS images sharing the same channel.

Data Analysis: Adapter Utilization Report

- Use '-s' to get a quick overview of the available data

```

user@larsson:~> ziorep_utilization -s sample.log
Data Summary
-----
Aggregated range: none
Detailed range:   2012-12-11 10:51:55 to 2012-12-11 11:51:55
Interval length:  2 seconds
HBA/CHPID:       0.0.591d/42
                  0.0.5b1d/43
WWPN/LUN (dev):  0x5005076303000104/0x4021402100000000 (/dev/sdi)
                  0x5005076303000104/0x4021402100000000 (/dev/sdj)
                  0x50050763030b0104/0x4021402100000000 (/dev/sdk)
                  0x50050763030b0104/0x4021402100000000 (/dev/sdl)
                  0x5005076303100104/0x4021402100000000 (/dev/sdm)
                  0x5005076303100104/0x4021402100000000 (/dev/sdn)
                  [...]

```

- Use '-b <begin>' and '-e <end>' to limit output to specified timeframe
- Use '-i <length>' to aggregate data to bigger intervals
- Use '-c <chpid>' to limit output to specified adapter
- Notes:
 - Check the interval length to figure out available aggregation values
 - Aggregated range only listed in case of wrap-around in .log file (.agg exists)

Data Analysis: FCP Channel Utilization Report

```
user@larsson:~> ziorep_utilization sample.log -b "2012-12-11
10:58:55"
```

```
CHP|adapter in %-|--bus in %---|--cpu in %---|
  ID min max   avg min max   avg min max   avg
```

```
2012-12-11 10:58:55
```

```
 42  3  3  3.0 20 20 20.0  2  2  2.0
 43  3  3  3.0 12 12 12.0  1  1  1.0
```

```
10:58:57
```

```
 42  3  3  3.0 18 18 18.0  2  2  2.0
 43  4  4  4.0 15 15 15.0  1  1  1.0
```

```
10:58:59
```

```
 42  2  2  2.0 16 16 16.0  2  2  2.0
 43  3  3  3.0 17 17 17.0  1  1  1.0
```

```
10:59:01
```

```
 42  3  3  3.0 16 16 16.0  2  2  2.0
 43  5  5  5.0 17 17 17.0  1  1  1.0
```

```
10:59:03
```

```
 42  1  1  1.0 16 16 16.0  2  2  2.0
 43  4  4  4.0 15 15 15.0  1  1  1.0
```

```
[...]
```

```
CHP Bus-ID |qdio util.>%|queu|fail|-thp in MB/s-|I/O reqs-|
  ID          max   avg full  erc      rd    wrt   rd  wrt
```

```
2008-12-11 10:58:55
```

```
 42/0.0.591d 99.2 14.0 12  0  1.0  2.7  5 692
 43/0.0.5b1d 91.4  9.3  0  0  0.5  3.3  4 517
```

```
[...]
```

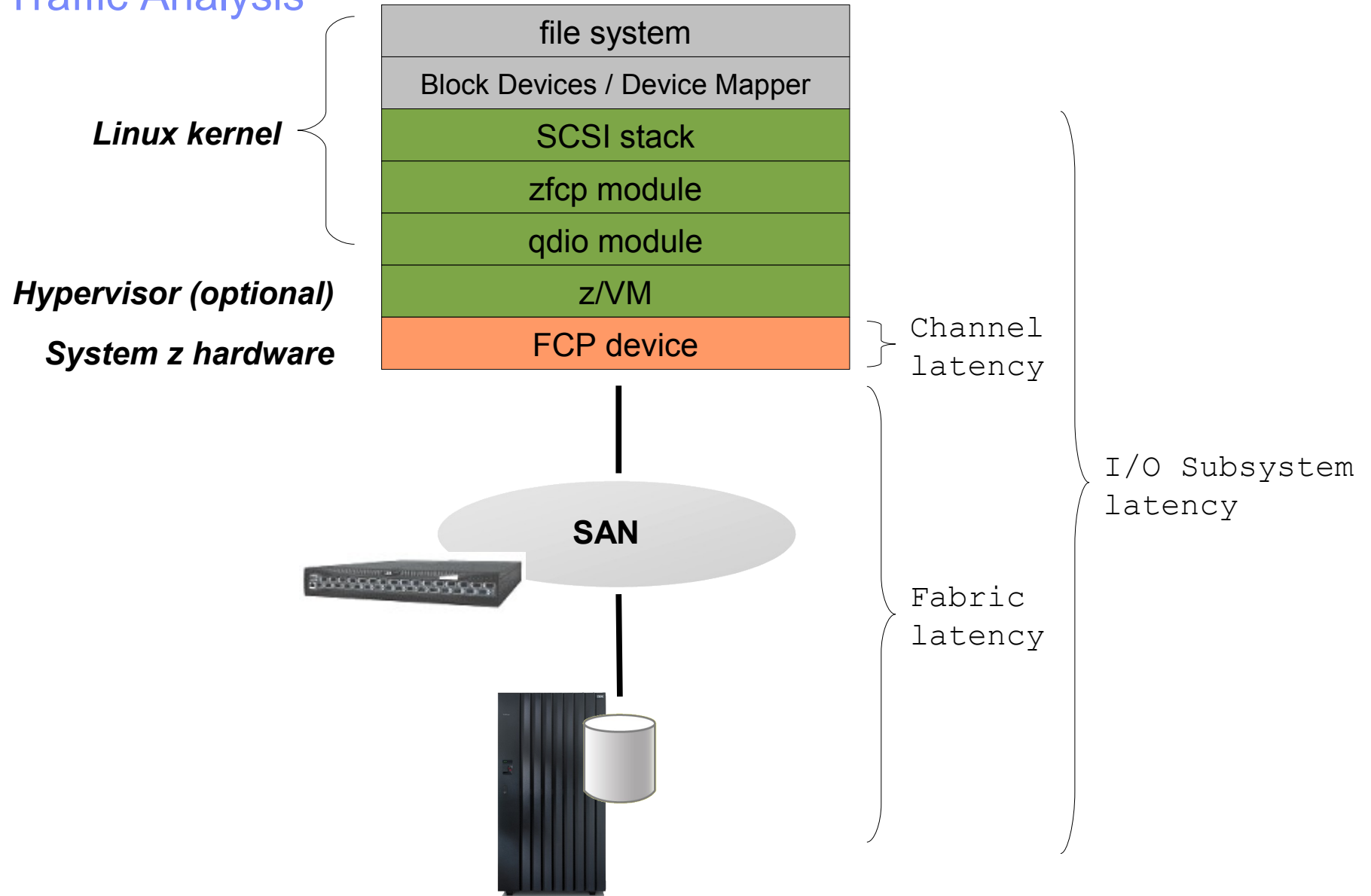
Data Analysis: Virtual HBA Utilization Report

```

user@larsson:~> ziorep_utilization sample.log -i 60 -c 43
[...]
CHP Bus-ID |qdio util.%(max|avg|full|erc|-thp in MB/s-|I/O reqs-|
ID          |max  avg  full  erc   rd   wrt   rd   wrt
2012-12-11 10:52:55
 43/0.0.5b1d 99.2 13.4 302   0    0.2   2.6   880  15K
10:53:55
 43/0.0.5b1d 98.4 10.0 203   0    0.3   3.1   163  1.3K
10:54:55
 43/0.0.5b1d 99.2 12.6 178   0    0.2   3.1   1.3K  10K
10:55:55
 43/0.0.5b1d 99.2  4.2  79   0    0.3   3.0   729  4.6K
10:56:55
 43/0.0.5b1d  0.0  0.0   0   0    0.0   0.0   168   0
10:57:55
 43/0.0.5b1d 99.2  8.9 136   0    3.7   1.9   2.9K  11K
10:58:55
 43/0.0.5b1d 100.0 12.6 177   0    0.6   2.8   335  15K
10:59:55
 43/0.0.5b1d 99.2 14.0 177   0    0.3   3.1   367  19K
11:00:55
 43/0.0.5b1d 99.2 13.9 188   0    0.3   3.8   1.5K  14K
11:01:55
 43/0.0.5b1d 99.2 14.1 162   0    0.4   3.4   1.8K  14K
11:02:55
 43/0.0.5b1d 99.2  8.5 150   0    0.3   3.1   1.1K  8.2K
[...]

```

Traffic Analysis



Data Analysis: Traffic Report

- *ziorep_traffic* aims at identifying latencies of all components involved
- Provides two views on data
 - Regular view listing min/max/avg/std (default)
 - Detailed view providing histograms
- Supports option '-s' for a data summary (just like *ziorep_utilization*)
- Supports device selection options '-c/-u/-p/-l/-d/-m' (similar to *ziorep_config*)
- Provides data aggregation capabilities
- **Notes:**
 - Numbers reported consider *serialized* traffic! I.e. parallelism of requests is not accounted for. Hence throughputs are likely to divert from what other tools will report!
 - *ziomon* has a performance impact of approx. 5 percent on CPU utilization

Data Analysis: Traffic Report - Default View

```
user@larsson:~> ziorep_traffic sample.log -i 60 -l \
0x4021402f00000000 -l 0x4021402d00000000
```

WWPN	LUN	I/O rt MB/s thrp in MB/s ----I/O requests----			-I/O subs. lat. in us--			--channel lat. in us---			---fabric lat. in us---										
		min	max	avg	stdev	#reqs	rd	wrt	bidi	min	max	avg	stdev	min	max	avg	stdev				
2012-12-11 10:52:55																					
10:54:55																					
0x5005076303000104:0x4021402d00000000		0.0	0.0	0.0	0.0	2	2	0	0	626	660	643.0	17.0	21	22K	4.009K	3.416K	124	271K	126.8K	69.29K
0x5005076303000104:0x4021402d00000000		0.0	65.3	2.9	1.162K	31	5	26	0	182	242K	108.5K	83.07K	22	21K	4.104K	3.522K	75	265K	124.4K	71.39K
0x50050763030b0104:0x4021402d00000000		0.0	45.6	2.8	1.168K	997	110	887	0	297	279K	126.1K	67.83K	20	19K	4.019K	3.537K	160	265K	120.2K	67.08K
0x50050763030b0104:0x4021402d00000000		0.0	32.8	3.3	1.256K	999	107	892	0	232	245K	110.1K	55.35K	20	22K	3.959K	3.673K	79	222K	104.4K	54.60K
0x5005076303100104:0x4021402d00000000		0.0	88.3	48.7	4.829K	14	2	12	0	559	13K	7.093K	3.963K	25	5.2K	1.603K	1.468K	78	8.1K	3.592K	2.943K
0x5005076303100104:0x4021402d00000000		0.0	0.0	0.0	0.0	2	2	0	0	179	270	224.5	45.5	23	28	26.2	5.3	75	573	175.2	181.5
0x50050763031b0104:0x4021402d00000000		0.0	0.0	0.0	0.0	2	2	0	0	439	591	515.0	76.0	25	28	25.8	4.6	75	385	259.5	126.9
0x50050763031b0104:0x4021402d00000000		0.0	0.0	0.0	0.0	2	2	0	0	184	416	300.0	116.0	21	23K	3.929K	3.669K	74	210K	108.9K	63.93K
0x5005076303000104:0x4021402f00000000		0.0	0.0	0.0	0.0	2	2	0	0	422	426	424.0	2.0	21	17K	3.656K	3.283K	109	656K	126.6K	70.67K
0x5005076303000104:0x4021402f00000000		0.0	62.3	2.9	1.179K	562	60	502	0	173	285K	123.9K	71.17K	20	20K	4.116K	3.833K	76	282K	121.9K	68.26K
0x50050763030b0104:0x4021402f00000000		0.0	10.3	2.8	1.168K	997	110	887	0	649	574K	128.1K	59.23K	20	17K	3.638K	3.328K	204	573K	122.3K	58.95K
0x50050763030b0104:0x4021402f00000000		0.0	4.2	2.9	1.177K	288	34	254	0	257	219K	123.1K	55.86K	20	19K	3.743K	3.798K	75	211K	116.1K	56.76K
0x5005076303100104:0x4021402f00000000		0.0	0.0	0.0	0.0	2	2	0	0	190	641	415.5	225.5	23	27	24.7	4.4	75	358	208.5	113.2
0x5005076303100104:0x4021402f00000000		0.0	0.0	0.0	0.0	2	2	0	0	199	985	592.0	393.0	24	27	25.0	4.4	71	858	270.3	297.1
0x50050763031b0104:0x4021402f00000000		0.0	0.0	0.0	0.0	2	2	0	0	514	972	743.0	229.0	24	28	26.0	5.0	76	864	344.0	263.7
0x50050763031b0104:0x4021402f00000000		0.0	0.0	0.0	0.0	2	2	0	0	184	999	591.5	407.5	21	23K	3.930K	3.601K	74	294K	112.0K	60.19K
10:55:55																					
0x5005076303000104:0x4021402d00000000		0.0	0.0	0.0	0.0	3	3	0	0	180	234	212.7	23.5	24	26	25.0	5.7	75	82	78.0	2.9
0x5005076303000104:0x4021402d00000000		0.0	0.0	0.0	0.0	3	3	0	0	183	726	370.0	251.8	25	30	27.7	5.6	75	521	224.3	209.8
0x50050763030b0104:0x4021402d00000000		0.0	0.0	0.0	0.0	3	3	0	0	194	340	267.3	59.6	25	26	25.3	5.2	78	235	140.3	68.1
0x50050763030b0104:0x4021402d00000000		0.0	0.0	0.0	0.0	3	3	0	0	186	729	370.0	253.9	24	25	24.3	4.2	86	622	268.0	250.3
0x5005076303100104:0x4021402d00000000		0.0	87.6	4.3	1.444K	737	80	657	0	178	262K	82.96K	65.64K	23	23K	3.930K	3.802K	73	251K	77.59K	64.65K
0x5005076303100104:0x4021402d00000000		0.0	0.0	0.0	0.0	3	3	0	0	184	641	341.3	212.0	25	29	27.0	6.9	76	538	230.0	217.8
0x50050763031b0104:0x4021402d00000000		0.0	0.0	0.0	0.0	3	3	0	0	178	330	236.7	66.7	24	27	25.3	5.7	76	79	77.7	1.2
0x50050763031b0104:0x4021402d00000000		0.0	0.0	0.0	0.0	3	3	0	0	173	645	333.0	220.6	24	26	25.3	4.5	73	531	227.0	215.0
0x5005076303000104:0x4021402f00000000		0.0	0.0	0.0	0.0	3	3	0	0	177	217	193.7	17.0	24	28	26.3	5.4	75	80	78.0	2.2
0x5005076303000104:0x4021402f00000000		0.0	0.0	0.0	0.0	3	3	0	0	172	415	255.7	112.7	24	24	24.0	5.2	74	307	152.0	109.6
0x50050763030b0104:0x4021402f00000000		0.0	0.0	0.0	0.0	3	3	0	0	181	311	236.3	54.8	24	30	26.7	5.4	75	185	123.0	46.0
0x50050763030b0104:0x4021402f00000000		0.0	9.6	3.0	1.205K	607	69	538	0	188	280K	117.3K	62.60K	20	22K	4.040K	3.986K	74	249K	111.3K	61.86K
0x5005076303100104:0x4021402f00000000		0.0	0.0	0.0	0.0	3	3	0	0	171	188	182.0	7.8	24	26	25.0	4.1	77	78	77.7	0.5
0x5005076303100104:0x4021402f00000000		0.0	0.0	0.0	0.0	3	3	0	0	174	691	347.3	243.0	24	25	24.3	6.8	74	582	243.7	239.2
0x50050763031b0104:0x4021402f00000000		0.0	0.0	0.0	0.0	3	3	0	0	182	482	300.0	130.6	27	30	28.0	4.2	75	119	91.0	19.9
0x50050763031b0104:0x4021402f00000000		0.0	0.0	0.0	0.0	3	3	0	0	176	522	300.3	157.1	25	30	27.7	5.6	73	388	184.3	144.2
10:56:55																					
0x5005076303000104:0x4021402d00000000		0.0	0.0	0.0	0.0	3	3	0	0	185	199	191.3	5.8	27	30	28.0	5.1	78	81	79.3	1.2
0x5005076303000104:0x4021402d00000000		0.0	0.0	0.0	0.0	3	3	0	0	179	191	184.3	5.0	24	24	24.0	6.2	72	77	74.3	2.1
0x50050763030b0104:0x4021402d00000000		0.0	0.0	0.0	0.0	3	3	0	0	192	205	200.3	5.9	24	25	24.3	4.2	75	102	87.7	11.1
0x50050763030b0104:0x4021402d00000000		0.0	0.0	0.0	0.0	3	3	0	0	185	264	229.3	33.0	28	29	28.7	4.9	77	134	112.7	25.4
0x5005076303100104:0x4021402d00000000		0.0	0.0	0.0	0.0	3	3	0	0	185	219	198.0	15.0	25	30	28.0	6.6	74	77	76.0	1.4
0x5005076303100104:0x4021402d00000000		0.0	0.0	0.0	0.0	3	3	0	0	177	183	180.7	2.6	24	25	24.3	5.2	74	78	76.3	1.7
[...]																					

Data Analysis: Traffic Report – Data Filtering Options

- To focus on individual devices, use '-d'

```
user@larsson:~> ziorep_traffic sample.log -i 60 -d sdi
```

WWPN	LUN	I/O rt	MB/s thrp	in MB/s	----I/O	requests----	I/O subs.	lat. in us--	--channel	lat. in us---	---fabric	lat. in us---								
		min	max	avg	stdev	#reqs	rd wrt bidi	min	max	avg	stdev	min	max	avg	stdev	min	max	avg	stdev	
2012-12-11 10:52:55																				
0x5005076303000104:0x4021402100000000		0.0	0.0	0.0	0.0	2	2 0	544	562	553.0	9.0	21	23K	5.001K	4.371K	131	725K	135.1K	77.31K	
10:55:55																				
0x5005076303000104:0x4021402100000000		0.0	0.0	0.0	0.0	3	3 0	173	340	229.0	78.5	24	27	25.3	5.3	77	236	131.0	74.3	
10:56:55																				
0x5005076303000104:0x4021402100000000		0.0	0.0	0.0	0.0	3	3 0	196	211	203.0	6.2	24	30	27.3	5.4	78	86	82.0	3.3	
10:57:55																				
0x5005076303000104:0x4021402100000000		0.0	0.0	0.0	0.0	3	3 0	185	464	278.7	131.1	25	28	26.7	5.0	81	321	161.3	112.9	
10:58:55																				
0x5005076303000104:0x4021402100000000		0.0	6.9	2.7	1.159K	624	13 611	0	201	501K	109.5K	67.44K	25	19K	4.332K	3.588K	79	494K	103.5K	66.52K
10:59:55																				
0x5005076303000104:0x4021402100000000		0.0	12.2	2.8	1.182K	320	6 314	0	336	397K	116.0K	68.55K	25	19K	4.993K	4.443K	169	396K	109.1K	66.56K
11:00:55																				
0x5005076303000104:0x4021402100000000		0.0	0.0	0.0	0.0	3	3 0	0	183	969	449.7	367.3	24	27	25.7	5.7	79	866	341.7	370.8
[...]																				

- Specifying devices over a number of specifiers will use the union

```
user@larsson:~> ziorep_traffic sample.log -i 60 -d sdi -p
0x5005076303100104
```

WWPN	LUN	I/O rt	MB/s thrp	in MB/s	----I/O	requests----	I/O subs.	lat. in us--	--channel	lat. in us---	---fabric	lat. in us---								
		min	max	avg	stdev	#reqs	rd wrt bidi	min	max	avg	stdev	min	max	avg	stdev	min	max	avg	stdev	
2012-12-11 10:52:55																				
0x5005076303000104:0x4021402100000000		0.0	0.0	0.0	0.0	2	2 0	179	315	247.0	68.0	25	26	25.5	6.3	76	210	143.0	67.0	
0x5005076303100104:0x4021402100000000		0.0	4.4	1.5	857.7	114	2 112	0	183	2.5M	196.1K	407.2K	24	12K	3.965K	3.247K	84	250K	94.80K	71.81K
0x5005076303100104:0x4021402100000000		0.0	14.5	2.7	1.151K	895	17 878	0	186	1.5M	119.3K	101.6K	21	20K	4.908K	4.167K	76	422K	100.6K	63.88K
0x5005076303100104:0x4021402200000000		0.0	4.8	1.5	850.5	144	6 138	0	171	2.7M	175.9K	351.2K	25	18K	4.155K	4.465K	75	254K	91.53K	74.27K
0x5005076303100104:0x4021402200000000		0.0	76.1	2.7	1.133K	907	12 895	0	185	1.8M	111.9K	111.8K	24	19K	4.867K	4.170K	78	265K	98.43K	69.61K
0x5005076303100104:0x4021402300000000		0.0	2.9	1.2	769.3	170	7 163	0	175	3.4M	281.8K	313.2K	24	13K	3.930K	3.370K	75	969K	224.1K	157.4K
0x5005076303100104:0x4021402300000000		0.0	8.4	2.5	1.112K	871	13 858	0	179	1.9M	123.1K	95.66K	26	20K	4.565K	3.862K	76	296K	109.3K	72.82K
0x5005076303100104:0x4021402400000000		0.0	1.9	1.1	742.5	116	4 112	0	177	1.4M	307.5K	234.0K	26	19K	2.490K	3.468K	75	504K	248.5K	152.6K
0x5005076303100104:0x4021402400000000		0.0	18.1	2.4	1.082K	896	11 885	0	190	2.7M	129.9K	164.8K	25	19K	4.469K	3.766K	79	313K	108.9K	72.26K
0x5005076303100104:0x4021402500000000		0.0	0.0	0.0	0.0	3	3 0	0	178	224	194.7	20.8	22	26	24.3	5.5	75	119	90.0	20.5
0x5005076303100104:0x4021402500000000		0.0	7.3	1.7	906.8	782	18 764	0	183	8.8M	185.6K	460.9K	24	17K	4.648K	3.825K	76	584K	142.5K	118.0K
0x5005076303100104:0x4021402600000000		0.0	0.0	0.0	0.0	3	3 0	0	171	447	264.7	128.9	24	26	25.0	5.3	76	339	163.7	124.0
[...]																				

Data Analysis: Traffic Report - Details View

```
user@larsson:~> ziorep_traffic sample.log -i 60 -l \ 0x4021402f00000000
-l 0x4021402d00000000 -D
```

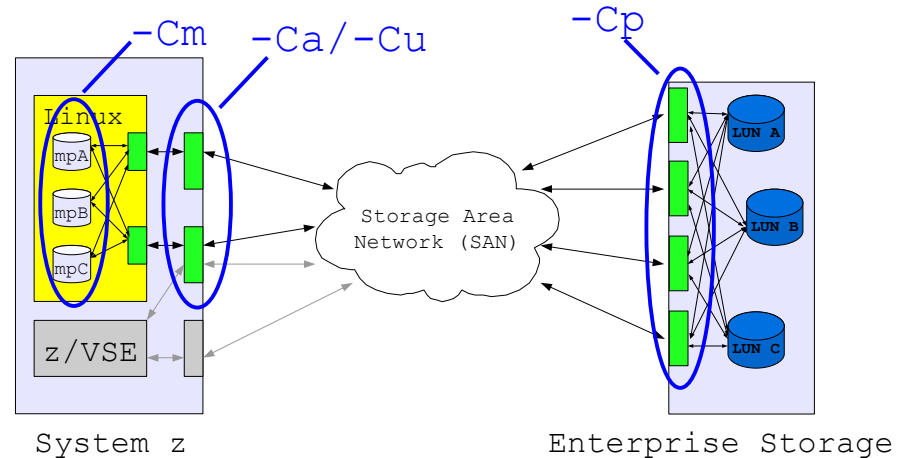
WWPN	LUN	-----I/O request sizes in KBytes-----																									
		0	1	2	4	8	16	32	64	128	256	512	1K	2K	4K	8K	>8K										
		-----I/O subsystem latency in us-----																									
		0	8	16	32	64	128	256	512	1K	2K	4K	8K	16K	32K	64K	128K	256K	512K	1M	2M	4M	8M	16M	32M	>32M	
		-----channel latency in us-----																									
		0	1	2	4	8	16	32	64	128	256	512	1K	2K	4K	8K	16K	32K	64K	128K	>128K						
		-----fabric latency in us-----																									
		0	8	16	32	64	128	256	512	1K	2K	4K	8K	16K	32K	64K	128K	256K	512K	1M	2M	4M	8M	16M	32M	>32M	
2012-12-11 10:52:55																											
0x5005076303000104:0x4021402d00000000		2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
0x5005076303000104:0x4021402d00000000		2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
0x50050763030b0104:0x4021402d00000000		2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
0x50050763030b0104:0x4021402d00000000		2	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
0x5005076303100104:0x4021402d00000000		2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
0x5005076303100104:0x4021402d00000000		2	0	0	77	1	4	6	10	15	20	191	0	0	0	0	0	0	0	0	0	0	0	0	0		
		0	0	0	0	0	0	1	0	1	1	0	1	14	25	60	63	137	20	2	1	0	0	0	0		
		0	0	0	0	0	0	2	20	8	6	3	37	70	91	84	47	0	0	0	0	0	0	0	0		
		0	0	0	0	0	1	0	0	1	2	0	2	16	59	69	64	137	17	0	0	0	0	0	0		
0x50050763031b0104:0x4021402d00000000		2	0	0	243	6	4	11	23	29	63	522	0	0	0	0	0	0	0	0	0	0	0	0	0		
		0	0	0	0	0	0	1	0	1	4	2	5	32	139	152	196	366	5	0	0	0	0	0	0		
		0	0	0	0	0	0	13	67	4	11	11	86	143	239	252	87	7	0	0	0	0	0	0	0		
		0	0	0	0	0	1	0	2	2	3	2	7	58	171	124	197	348	5	0	0	0	0	0	0		
0x50050763031b0104:0x4021402d00000000		2	0	0	83	2	0	3	9	22	42	344	0	0	0	0	0	0	0	0	0	0	0	0	0		
		0	0	0	0	0	0	1	0	6	8	6	5	7	23	51	92	308	0	0	0	0	0	0	0		
		0	0	0	0	0	0	34	5	3	0	6	46	82	130	145	56	0	0	0	0	0	0	0	0		
0x5005076303000104:0x4021402f00000000		2	0	0	0	0	0	0	0	17	6	6	2	6	26	49	103	291	0	0	0	0	0	0	0		
		0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		

[...]

Data Analysis: Traffic Aggregation

- Use option '-C' to specify an aggregation level:

- 'a'/'u' aggregates by CHPID / bus-ID
- 'p' aggregates by WWPN
- 'm' aggregates by multipath device
- 'A' aggregates **all** data



- Can be combined with device selection options '-c/-u/-p/-l/-d/-m'

- Note: Don't confuse *device selection* with *aggregation* options:

- **Device Selection:** restricts use of data records according to the scope specified (e.g. data records for specific LUNs only)
- **Aggregation:** generates combined results for given level of detail (e.g. combined result for all I/O handled by specified adapter)

➔ **Filtering** applies to *input* data, **aggregation** shapes the resulting *output*

Data Analysis: Traffic Aggregation Examples

Aggregate by bus-ID

```

user@larsson:~> ziorep_traffic sample.log -i 60 -Cu
Bus-ID |I/O rt MB/s|thrp in MB/s|----I/O requests----|I/O subs. lat. in us--|--channel lat. in us--|---fabric lat. in us---|
      min max      avg stdev #reqs  rd wrt bidi  min max      avg stdev  min max      avg stdev  min max      avg stdev
2012-12-11 10:52:55
0.0.591d 0.0 115.5  2.8 1.154K 12.8K 338 12K  0 169 6.7M 112.0K 126.9K  20 23K 3.877K 3.513K  72 969K 100.8K 74.16K
0.0.5b1d 0.0  76.1  2.6 1.112K 15.8K 880 15K  0 166 8.8M 127.1K 198.4K  20 23K 4.262K 3.668K  72 584K 110.7K 77.29K
10:53:55
0.0.591d 0.0 104.1  9.2 2.113K  183  20 163  0 272 191K 39.98K 51.86K  20 23K 4.460K 4.129K  73 387K 110.1K 67.69K
0.0.5b1d 0.0  12.4  3.1 1.224K 1496 163 1.3K  0 329 827K 115.6K 62.18K  20 16K 4.179K 3.406K  73 262K 108.4K 61.32K
10:54:55
0.0.591d 0.0 115.9  2.9 1.193K 14.1K 1.6K 12K  0 166 574K 120.9K 68.88K  20 24K 4.378K 3.793K  73 725K 119.8K 69.71K
0.0.5b1d 0.0  91.8  3.1 1.215K 11.7K 1.3K 10K  0 168 702K 116.6K 67.06K  20 24K 4.448K 3.916K  71 696K 116.4K 68.05K
[...]
```

Aggregate all available devices in detailed traffic analysis mode

```

user@larsson:~> ziorep_traffic sample.log -i 60 -CA -D
|-----I/O request sizes in KBytes-----|
| 0  1  2  4  8 16 32 64 128 256 512 1K 2K 4K 8K >8K |
|-----I/O subsystem latency in us-----|
| 0  8 16 32 64 128 256 512 1K 2K 4K 8K 16K 32K 64K 128K 256K 512K 1M 2M 4M 8M 16M 32M >32M |
|-----channel latency in us-----|
| 0  1  2  4  8 16 32 64 128 256 512 1K 2K 4K 8K 16K 32K 64K 128K>128K |
* |-----fabric latency in us-----|
| 0  8 16 32 64 128 256 512 1K 2K 4K 8K 16K 32K 64K 128K 256K 512K 1M 2M 4M 8M 16M 32M >32M |
2012-12-11 10:52:55
* 293 0 0 0 7.0K 154 138 260 575 983 1.9K 17K 0 0 0 0 0
  0 0 0 0 0 0 208 84 111 130 116 245 1.1K 3.4K 4.3K 5.9K 12K 747 59 40 12 6 2 0 0
  0 0 0 0 0 0 1.0K 2.2K 266 224 404 2.4K 4.3K 6.9K 7.8K 3.9K 191 0 0 0
  0 0 0 0 0 214 77 60 253 124 126 359 1.6K 4.2K 4.2K 6.1K 11K 777 4 0 0 0 0 0
10:53:55
* 0 0 0 261 6 10 24 40 66 128 1.1K 0 0 0 0 0
  0 0 0 0 0 0 0 20 33 48 27 32 69 115 163 317 852 2 1 0 0 0 0 0
  0 0 0 0 0 0 335 108 14 24 63 376 658 960 1.1K 664 53 0 0 0
  0 0 0 0 0 32 149 38 147 53 44 68 111 258 381 921 2.2K 2 0 0 0 0 0 0
[...]
```

Data Analysis: Traffic Aggregation Examples (continued)

- Aggregate a selection of devices into a single interval

```

user@larsson:~> ziorep_traffic sample.log -i 0 -C A -d sdp \
-p 0x50050763030b0104 -c 42
* |I/O rt MB/s|thrp in MB/s|----I/O requests----|I/O subs. lat. in us--|--channel lat. in us---|---fabric lat. in us---|
  min max avg stdev #reqs rd wrt bidi min max avg stdev min max avg stdev min max avg stdev
2012-12-11 11:51:55
* 0.0 115.9 2.9 1.181K 192K 42K 150K 0 154 315M 95.63K 1.048M 19 25K 3.725K 4.056K 68 969K 85.31K 109.5K
[...]
```

- Same selection, but detailed view

```

user@larsson:~> ziorep_traffic sample.log -i 0 -C A -d sdp \
-p 0x50050763030b0104 -c 42 -D
|-----I/O request sizes in KBytes-----|
  0  1  2  4  8  16  32  64 128 256 512 1K  2K  4K  8K >8K
|-----I/O subsystem latency in us-----|
  0  8  16  32  64 128 256 512 1K  2K  4K  8K 16K 32K 64K 128K 256K 512K 1M  2M  4M  8M 16M 32M >32M
|-----channel latency in us-----|
  0  1  2  4  8  16  32  64 128 256 512 1K  2K  4K  8K 16K 32K 64K 128K>128K
* |-----fabric latency in us-----|
  0  8  16  32  64 128 256 512 1K  2K  4K  8K 16K 32K 64K 128K 256K 512K 1M  2M  4M  8M 16M 32M >32M
2012-12-11 11:51:55
* 13K  0  0  55K 614 663 1.6K 3.2K 5.8K 12K 100K  0  0  0  0  0
  0  0  0  0  0  0  0  12K 8.0K 2.1K 3.3K 6.1K 7.6K 5.5K 18K 23K 36K 70K 826 157 21 7 4 1 0 3
  0  0  0  0  0  0  0  38K 11K 1.0K 963 2.4K 13K 23K 36K 41K 25K 2.4K 0 0 0
  0  0  0  0  0  0  11K 8.4K 2.6K 2.2K 3.6K 6.3K 7.7K 7.2K 21K 20K 39K 64K 693 126 0 0 0 0 0 0
[...]
```

Data Analysis: Hints & Tips

- Use '-i 0' to get a good starting point to identify anomalies quickly

```
user@larsson:~> ziorep_utilization sample.log -i 0
```

```
CHP|adapter in %|--bus in %---|--cpu in %---|
ID min max   avg min max   avg min max   avg
2012-12-11 11:51:55
42  0  7   0.3  0 29   2.1  1  2   1.1
43  0 10   0.4  0 32   2.3  0  2   0.1
```

```
CHP Bus-ID |qdio util.%|queu|fail|thp in MB/s-|I/O reqs-|
ID          max  avg full  erc    rd   wrt  rd wrt
2008-12-11 11:51:55
42/0.0.591d 99.2  1.8 1.6K  0  0.5  2.9 33K 124K
43/0.0.5b1d 100.0 1.9 1.8K  0  0.5  2.9 31K 126K
```

```
user@larsson:~> ziorep_traffic sample.log -i 0
```

```
WWPN              LUN          |I/O rt MB/s|thrp in MB/s|----I/O requests----|I/O subs. lat. in us|---channel lat. in us---|---fabric lat. in us---|
            min  max    avg stdev #reqs  rd wrt bidi min max    avg stdev min max    avg stdev min max    avg stdev
2012-12-11 11:51:55
0x5005076303000104:0x4021402100000000  0.0 54.5  2.9 1.195K 3094 421 2.7K  0 165 731K 115.9K 73.45K  21 23K 4.934K 4.689K  72 725K 109.3K 71.47K
0x5005076303000104:0x4021402100000000  0.0 46.4  2.9 1.192K 3106 419 2.7K  0 170 558K 117.3K 73.41K  20 24K 5.140K 4.621K  72 513K 110.5K 71.49K
0x50050763030b0104:0x4021402100000000  0.0 17.1  2.8 1.182K 2218 336 1.9K  0 171 544K 112.7K 70.57K  20 22K 4.563K 4.364K  72 543K 106.2K 68.57K
0x50050763030b0104:0x4021402100000000  0.0 47.8  3.3 1.269K 1514 228 1.3K  0 172 333K 95.84K 65.99K  22 20K 4.190K 3.936K  74 323K 89.22K 63.65K
0x5005076303100104:0x4021402100000000  0.0 48.3  1.2 750.4 1784 797 987  0 163 178M 189.0K 4.210M  19 21K 3.192K 4.309K  72 717K 78.39K 98.46K
[...]
```

```
user@larsson:~> ziorep_traffic sample.log -i 0 -D
```

```
-----I/O request sizes in KBytes-----
0  1  2  4  8 16 32 64 128 256 512 1K 2K 4K 8K >8K
-----I/O subsystem latency in us-----
0  8 16 32 64 128 256 512 1K 2K 4K 8K 16K 32K 64K 128K 256K 512K 1M 2M 4M 8M 16M 32M >32M
-----channel latency in us-----
0  1  2  4  8 16 32 64 128 256 512 1K 2K 4K 8K 16K 32K 64K 128K>128K
-----fabric latency in us-----
0  8 16 32 64 128 256 512 1K 2K 4K 8K 16K 32K 64K 128K 256K 512K 1M 2M 4M 8M 16M 32M >32M
2012-12-11 11:51:55
0x5005076303000104:0x4021402100000000 179 0 0 591 14 7 21 37 103 168 2.0K 0 0 0 0 0
0 0 0 0 0 0 0 160 23 46 35 36 41 65 214 308 596 1.5K 40 1 0 0 0 0 0 0 0
0 0 0 0 0 0 0 314 110 7 9 36 251 361 604 763 549 92 0 0 0
0 0 0 0 0 0 160 38 14 75 38 32 37 61 240 282 671 1.4K 33 1 0 0 0 0 0 0 0
0x5005076303100104:0x4021402100000000 179 0 0 725 3 3 13 28 27 76 730 0 0 0 0 0
0 0 0 0 0 0 0 178 431 24 11 18 48 56 97 125 176 578 9 29 0 3 0 0 0 0 0 0 0
0 0 0 0 0 0 0 658 139 20 11 12 75 137 205 254 261 22 0 0 0
0 0 0 0 0 0 163 451 15 18 10 21 55 56 123 118 185 545 8 26 0 0 0 0 0 0 0
[...]
```

Data Analysis on Other Platforms

- Reporting tools do not depend on s390 architecture
- To compile on other platforms:
 - Extract source of *s390-tools* package, either from your distribution's source rpm, or download from <http://www.ibm.com/developerworks/linux/linux390/s390-tools.html> and extract via

```
user@larsson:~> tar xvfj s390-tools-1.17.0.tar.bz2
```

- Change to *ziomon* subdirectory, build and install

```
user@larsson:~> cd s390-tools-1.17.0
user@larsson:~> make
user@larsson:~> sudo make install
```

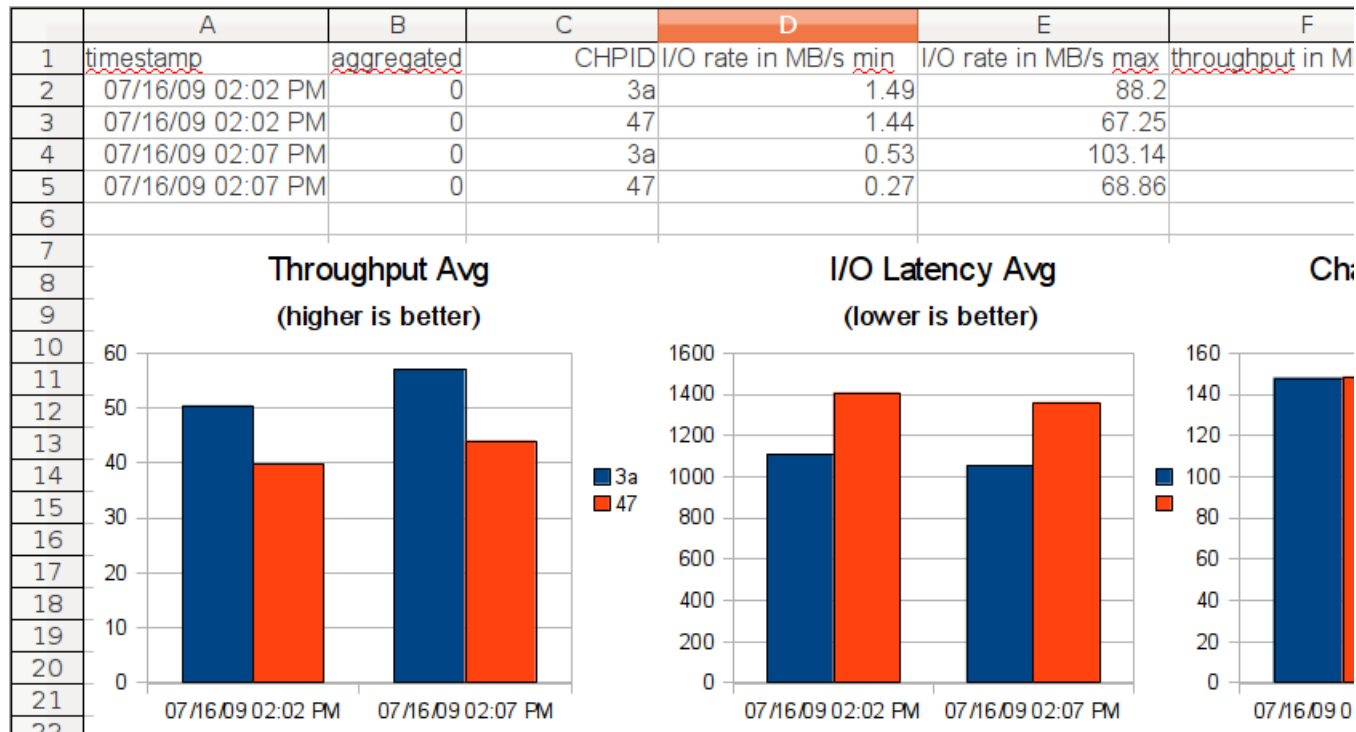
- Run reporting tools on any given data

Data Analysis on Other Platforms (continued)

- Use option '-x' in *ziorep_utilization* and *ziorep_traffic* to export data to .csv format, e.g.

```
user@larsson:~> ziorep_traffic data.log -x -i 300 -b "2012-11-27
08:45:21" -C a
```

- All data filtering options specified will apply to exported data
- Import in spreadsheet and perform further processing



References

- Linux on System z on DeveloperWorks
<http://www.ibm.com/developerworks/linux/linux390>

- Linux on System z Documentation
http://www.ibm.com/developerworks/linux/linux390/distribution_hints.html
Specifically:
 - Device Drivers, Features, and Commands
 - How to use FC-attached SCSI devices with Linux on System z (chapters 11&12)

- Linux on System z – Downloads
http://www.ibm.com/developerworks/linux/linux390/development_recommended.html

Questions?



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