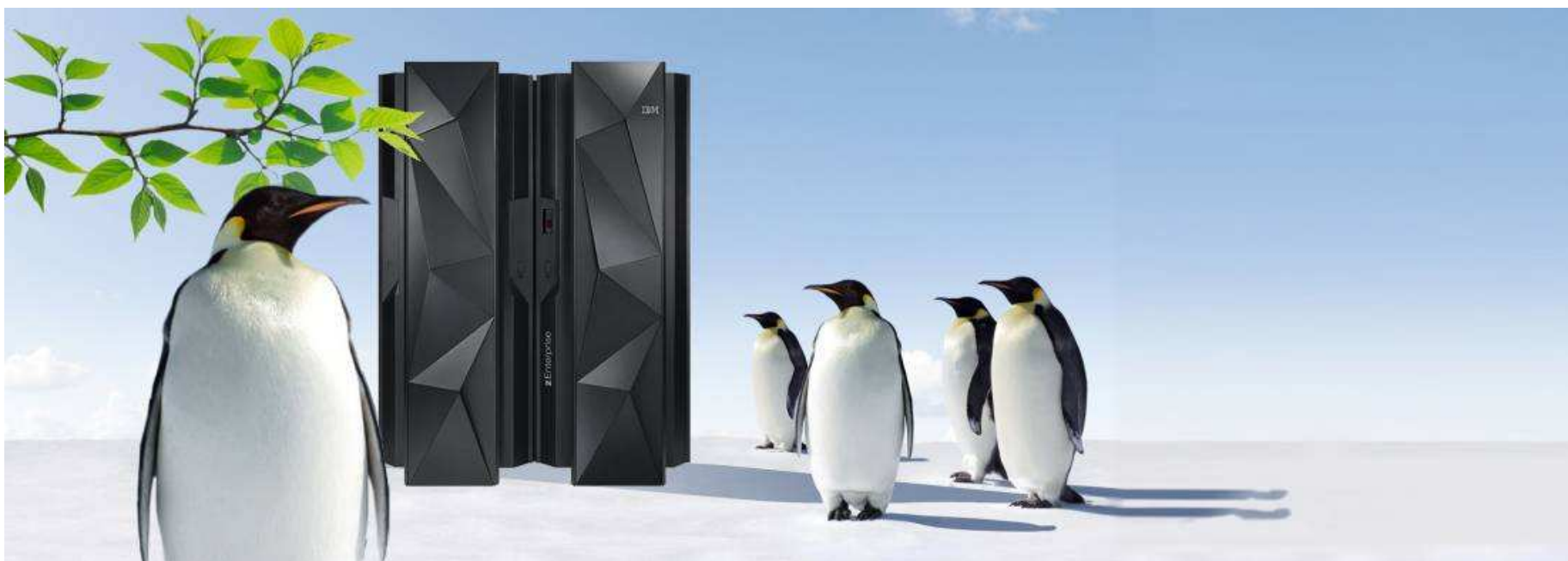


# Networking with Linux on System z



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# Agenda

- Overview
- Basic Network Setup
- Advanced Network Setup
- Networking Tools
- Problem Determination / Debugging

# Networking Options

- OSA
- HiperSockets
- Virtual NIC
  - Guest LAN
  - VSWITCH
- LCS
- CTC
- NETIUCV

# Networking Drivers

- QETH
- LCS
- CTC (functionally stable)
- NETIUCV (functionally stable)

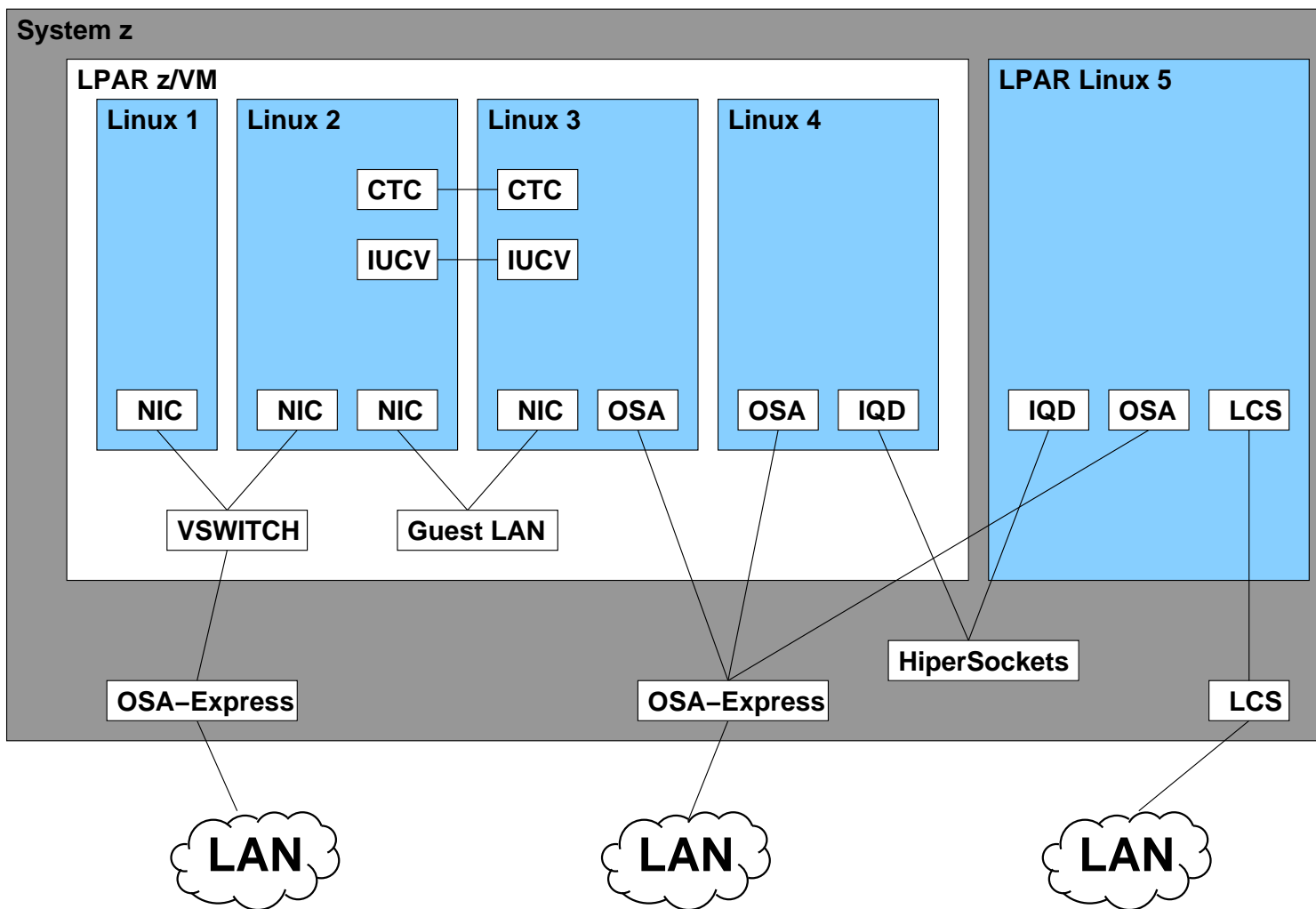
# Networking Drivers

- CTC - Channel-To-Channel Connection
- IUCV - Inter User Communication Vehicle
- Device driver deprecated (kernel 2.6)
- Still available for backwards compatibility
- Migration path
  - Virtual CTC and IUCV ⇒ Guest LAN
  - CTC in LPAR ⇒ HiperSockets
  - CTC ⇒ OSA-Express

## QETH Device Driver

- Supports
  - OSA-Express
  - HiperSockets
  - Guest LAN
  - VSWITCH
- Primary network driver for Linux on System z

# System z Network





# OSA

- OSA Express (all adapters)
- 10 GbE, GbE, 1000BASE-T
- 640 TCP/IP stacks per CHPID
- Jumbo frame support
- Concurrent LIC update

# OSA

- OSA Express2
  - 2 CHPIDs with 1 port per CHPID (10 GbE 1 CHPID)
- OSA Express3
  - Multimode or single mode fiber or copper cable
  - 2 CHPIDs with 2 port per CHPID (10 GbE 1 port)
  - DMA
  - Hardware data router
- OSA-Express4S
  - Multimode or single mode fiber or copper cable
  - 1 CHPID shared by 2 ports
  - DMA
  - Hardware data router
  - IEDN support
  - Checksum offload for IPv4 and IPv6

# HiperSockets

- Up to 32 HiperSockets Networks
- Shared by 30 LPARs
- Communication through memory
- IPv4 and IPv6 support
- Layer 2 and Layer 3 support
  - Layer 2 and Layer 3 separated
- VLAN
- Sniffer support

## Frame Size

- 4 different frame sizes

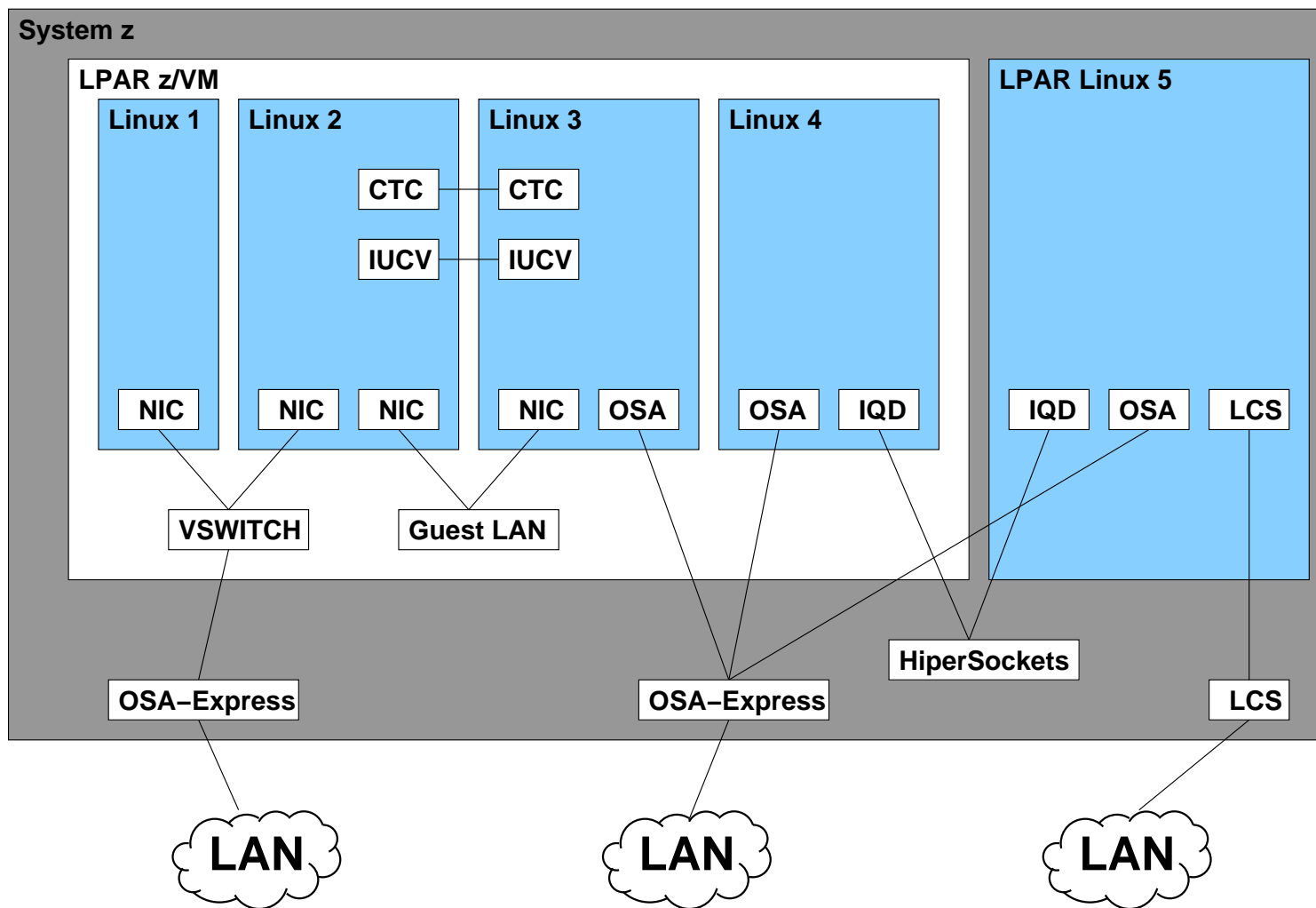
Frame size	MTU size
16k	8k
24k	16k
40k	32k
64k	56k

- Frame size for HiperSockets network specific

## Guest LAN

- Simulated LAN segment
- Used with virtual Network Interface Card (NIC)
- Types
  - QDIO Layer3
  - HiperSockets Layer3
  - Ethernet Layer2
- No physical connection
- Unrestricted / restricted
- Supports IPv4 and IPv6

# Guest LAN



## Guest LAN

- Create Guest LAN

```
# modprobe vmcp
# vmcp define lan mylan ownerid r3515038 type qdio
LAN R3515038 MYLAN is created
```

- Create virtual Network Interface

```
# vmcp define nic 0700 qdio
NIC 0700 is created; devices 0700-0702 defined
```

- Connect virtual Network Interface to Guest LAN

```
# vmcp couple 0700 to r3515038 mylan
RPIMGR031E RESOURCE R3515038.MYLAN SPECIFIED BY COUPLE COMMAND NOT FOUND
NIC 0700 is connected to LAN R3515038 MYLAN
```

## Guest LAN

```
# vmcp query virtual osa
OSA 0700 ON NIC 0700 UNIT 000 SUBCHANNEL = 0018
    0700 DEVTYPE OSA          VIRTUAL CHPID 03 OSD
    0700 MAC 02-35-15-00-00-77 CURRENT
    0700 QDIO-ELIGIBLE      QIOASSIST-ELIGIBLE
OSA 0701 ON NIC 0700 UNIT 001 SUBCHANNEL = 0019
    0701 DEVTYPE OSA          VIRTUAL CHPID 03 OSD
    0701 QDIO-ELIGIBLE      QIOASSIST-ELIGIBLE
OSA 0702 ON NIC 0700 UNIT 002 SUBCHANNEL = 001A
    0702 DEVTYPE OSA          VIRTUAL CHPID 03 OSD
    0702 QDIO-ELIGIBLE      QIOASSIST-ELIGIBLE
```



## Guest LAN

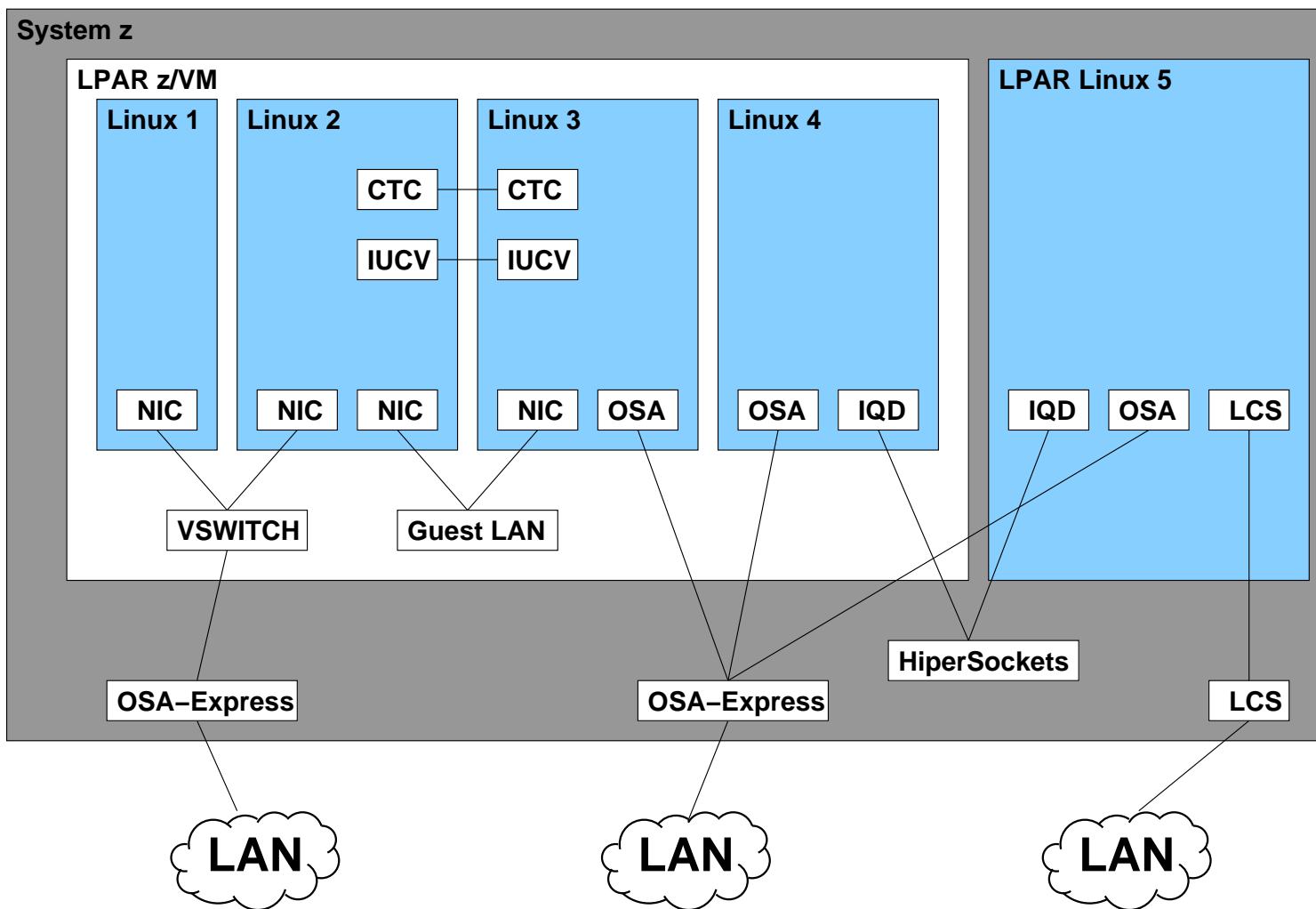
- Remove Guest LAN

```
# vmcp uncouple 0700
NIC 0700 is disconnected from LAN R3515038 MYLAN

# vmcp detach nic 0700
NIC 0700 is destroyed; devices 0700-0702 detached

# vmcp detach lan mylan owner r3515038
LAN R3515038 MYLAN is destroyed
```

# Virtual Switch - VSWITCH



## Virtual Switch

- Connects to Guest LAN
- Up to 8 associated OSA connections
- Connects to external network using OSA-EXPRESS
- Redundant OSA-Express configuration
- Single subnet for physical and virtual network
- No router necessary
- Failover and Link Aggregation
- Port isolation

## LAN Channel Station - LCS

- OSA Express in non-QDIO mode
  - HighSpeed TokenRing
  - ATM running Ethernet LAN Emulation
- May be preferred instead of QETH for security reasons
  - Administrator defines OSA Address Table  $\Rightarrow$  restricted access
  - For QETH each Linux registers its own IP address
- Performance not as good as QETH

# Basic Network Setup

- QETH manual setup
  - General
  - Make it persistent in SLES11
- QETH YaST2 setup in SLES11

# QDIO Device Manual

```
# modprobe vmcp
# vmcp 'attach 8027-8029 *h'

# vmcp q osa
OSA 8027 ATTACHED TO R3515038 8027 DEVTYPE HIPER          CHPID FB IQD
OSA 8028 ATTACHED TO R3515038 8028 DEVTYPE HIPER          CHPID FB IQD
OSA 8029 ATTACHED TO R3515038 8029 DEVTYPE HIPER          CHPID FB IQD
```

# QDIO Device Manual

```
# modprobe qeth
# echo 0.0.8027,0.0.8028,0.0.8029 > /sys/bus/ccwgroup/drivers/qeth/group
# lsqeth
Device name          :
-----
card_type           : HiperSockets
cdev0                : 0.0.8027
cdev1                : 0.0.8028
cdev2                : 0.0.8029
chpid               : FB
online              : 0
portname            : no portname required
portno              : 0
route4              : n/a
route6              : n/a
state               : DOWN
priority_queueing   : always queue 2
buffer_count        : 128
layer2              : -1
isolation           : none
```

# QDIO Device Manual

```
# echo 1 > /sys/devices/qeth/0.0.8027/online
# ifconfig hsi0
hsi0      Link encap:Ethernet  HWaddr 06:00:FB:0F:00:29
          BROADCAST NOARP MULTICAST  MTU:8192  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 b)  TX bytes:0 (0.0 b)
```



# QDIO Device Manual

```
# ifconfig hsi0 10.40.33.38
# ifconfig hsi0
hsi0      Link encap:Ethernet  HWaddr 06:00:FB:0F:00:29
          inet addr:10.40.33.38  Bcast:10.255.255.255  Mask:255.0.0.0
          inet6 addr: fe80::400:fbff:fe0f:29/64  Scope:Link
          UP BROADCAST RUNNING NOARP MULTICAST  MTU:8192  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:1 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 b)  TX bytes:70 (70.0 b)

# ping 10.40.33.39
PING 10.40.33.39 (10.40.33.39) 56(84) bytes of data.
64 bytes from 10.40.33.39: icmp_seq=1 ttl=64 time=0.124 ms
64 bytes from 10.40.33.39: icmp_seq=2 ttl=64 time=0.074 ms
^C
--- 10.40.33.39 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 999ms
rtt min/avg/max/mdev = 0.074/0.099/0.124/0.025 ms
```

# QDIO Device Manual

```
# ifconfig hsi0 10.40.33.38 netmask 255.255.255.0
# ifconfig hsi0
hsi0      Link encap:Ethernet  HWaddr 06:00:FB:0F:00:29
          inet addr:10.40.33.38  Bcast:10.40.33.255  Mask:255.255.255.0
          inet6 addr: fe80::400:fbff:fe0f:29/64  Scope:Link
          UP BROADCAST RUNNING NOARP MULTICAST  MTU:8192  Metric:1
          RX packets:4  errors:0  dropped:0  overruns:0  frame:0
          TX packets:7  errors:0  dropped:0  overruns:0  carrier:0
          collisions:0  txqueuelen:1000
          RX bytes:336 (336.0 b)  TX bytes:602 (602.0 b)
```

# QDIO Device Manual

```
# route -n
Kernel IP routing table
Destination      Gateway          Genmask         Flags Metric Ref    Use  Iface
10.40.33.0       0.0.0.0         255.255.255.0  U      0      0      0   hsi0
127.0.0.0        0.0.0.0         255.0.0.0      U      0      0      0   lo
```

```
# route add default gw 10.40.33.1 hsi0
```

```
# route -n
Kernel IP routing table
Destination      Gateway          Genmask         Flags Metric Ref    Use  Iface
0.0.0.0          10.40.33.1      0.0.0.0         UG     0      0      0   hsi0
10.40.33.0       0.0.0.0         255.255.255.0  U      0      0      0   hsi0
127.0.0.0        0.0.0.0         255.0.0.0      U      0      0      0   lo
```

# QDIO Device Manual

- Network configuration lost after reboot
- Devices still attached to z/VM guest

```
# vmcp q osa
OSA 8027 ATTACHED TO R3515038 8027 DEVTYPE HIPER CHPID FB IQD
OSA 8028 ATTACHED TO R3515038 8028 DEVTYPE HIPER CHPID FB IQD
OSA 8029 ATTACHED TO R3515038 8029 DEVTYPE HIPER CHPID FB IQD
```

## QDIO Device Manual - SLES11

- Making it persistent

```
qeth_configure 0.0.8027 0.0.8028 0.0.8029 1
```

- Adds the udev rules in
  - /etc/udev/rules.d/51-hsi-0.0.8027.rules
  - /etc/udev/rules.d/70-persistent-net.rules
- Create /etc/sysconfig/network/ifcfg-hsi0
  - Can copy ifcfg-hsi0 and modify

```
# /etc/sysconfig/network/ifcfg-hsi0
BOOTPROTO='static'
IPADDR='10.40.33.38'
BROADCAST='10.40.33.255'
STARTMODE='auto'
NETMASK='255.255.255.0'
```

## QDIO Device Manual - SLES11

```
# /etc/udev/rules.d/51-hsi-0.0.8027.rules

# Configure hsi device at 0.0.8027/0.0.8028/0.0.8029
ACTION=="add", SUBSYSTEM=="drivers", KERNEL=="qeth", IMPORT{program}="collect 0.
0.8027 %k 0.0.8027 0.0.8028 0.0.8029 qeth"
ACTION=="add", SUBSYSTEM=="ccw", KERNEL=="0.0.8027", IMPORT{program}="collect 0.
0.8027 %k 0.0.8027 0.0.8028 0.0.8029 qeth"
ACTION=="add", SUBSYSTEM=="ccw", KERNEL=="0.0.8028", IMPORT{program}="collect 0.
0.8027 %k 0.0.8027 0.0.8028 0.0.8029 qeth"
ACTION=="add", SUBSYSTEM=="ccw", KERNEL=="0.0.8029", IMPORT{program}="collect 0.
0.8027 %k 0.0.8027 0.0.8028 0.0.8029 qeth"
ACTION=="remove", SUBSYSTEM=="drivers", KERNEL=="qeth", IMPORT{program}="collect
--remove 0.0.8027 %k 0.0.8027 0.0.8028 0.0.8029 qeth"
ACTION=="remove", SUBSYSTEM=="ccw", KERNEL=="0.0.8027", IMPORT{program}="collect
--remove 0.0.8027 %k 0.0.8027 0.0.8028 0.0.8029 qeth"
ACTION=="remove", SUBSYSTEM=="ccw", KERNEL=="0.0.8028", IMPORT{program}="collect
--remove 0.0.8027 %k 0.0.8027 0.0.8028 0.0.8029 qeth"
ACTION=="remove", SUBSYSTEM=="ccw", KERNEL=="0.0.8029", IMPORT{program}="collect
--remove 0.0.8027 %k 0.0.8027 0.0.8028 0.0.8029 qeth"
TEST=="[ccwgroup/0.0.8027]", GOTO="hsi-0.0.8027-end"
ACTION=="add", SUBSYSTEM=="ccw", ENV{COLLECT_0.0.8027}=="0", ATTR{[drivers/ccwgr
oup:qeth]group}="0.0.8027,0.0.8028,0.0.8029"
ACTION=="add", SUBSYSTEM=="drivers", KERNEL=="qeth", ENV{COLLECT_0.0.8027}=="0",
ATTR{[drivers/ccwgroup:qeth]group}="0.0.8027,0.0.8028,0.0.8029"
LABEL="hsi-0.0.8027-end"
ACTION=="add", SUBSYSTEM=="ccwgroup", KERNEL=="0.0.8027", ATTR{layer2}="0"
ACTION=="add", SUBSYSTEM=="ccwgroup", KERNEL=="0.0.8027", ATTR{online}="1"
```

# QDIO Device Manual - SLES11

## • /etc/udev/rules.d/70-persistent-net.rules

```
# /etc/udev/rules.d/70-persistent-net.rules

# S/390 qeth device at 0.0.8027
SUBSYSTEM=="net", ACTION=="add", DRIVERS=="qeth", KERNELS=="0.0.8027", ATTR{type
}=="1", KERNEL=="hsi*", NAME="hsi0"
```

# QDIO Device YaST2 - SLES 11

YaST2 - lan @ r3515038

**Network Settings**

Global Options — **Overview** — Hostname/DNS — Routing

Name	IP Address
OSA-Express or QDIO Device (QETH)	9.152.111.98
OSA Express Network card (0.0.f5f0)	Not configured
OSA Express Network card (0.0.f5f2)	Not configured
OSA Express Network card (0.0.f5f1)	Not configured
<b>Hipersocket (0.0.8027)</b>	<b>Not configured</b>
Hipersocket (0.0.8028)	Not configured
Hipersocket (0.0.8029)	Not configured

Hipersocket (0.0.8027) BusID : 0.0.8027  
The device is not configured. Press **Edit** to configure.

[Add][Edit][Delete]

[Help] [Back] [Cancel] [OK]

F1 Help F3 Add F4 Edit F5 Delete F9 Cancel F10 OK



# QDIO Device YaST2 - SLES 11

```
YaST2 - lan @ r3515038

S/390 Network Card Configuration
S/390 Device Settings
-----
Port Name                               Port Number
0                                         0

Options
-----

[ ] Enable IPA Takeover

[ ] Enable Layer 2 Support
Layer2 MAC Address
00:00:00:00:00:00

Read Channel   Write Channel   Control Channel
0.0.8027       0.0.8028         0.0.8029

[Help]                [Back]                [Cancel]                [Next]

F1 Help  F8 Back  F9 Cancel  F10 Next
```

# QDIO Device YaST2 - SLES 11

```
YaST2 - lan @ r3515038

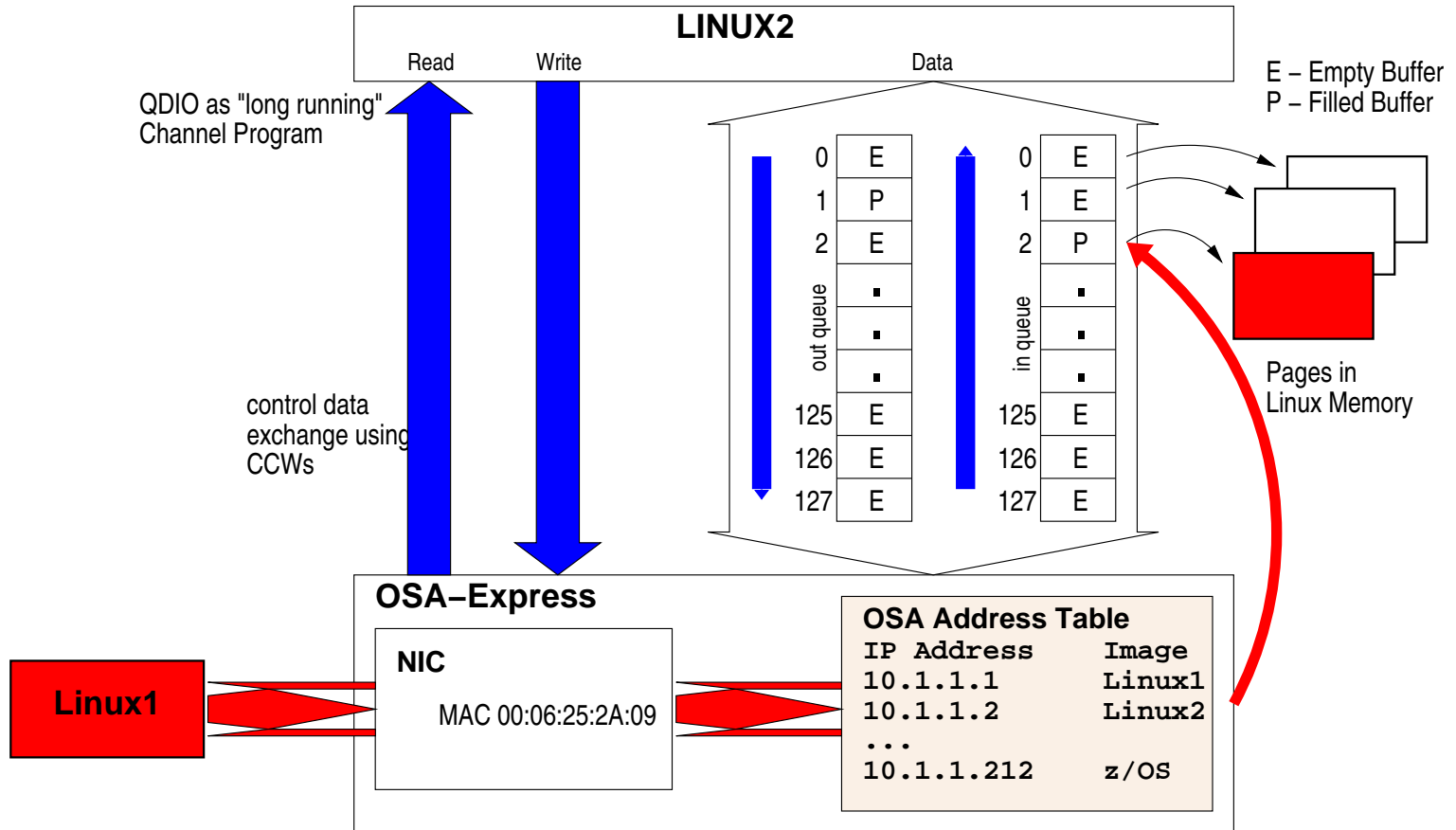
Network Card Setup
General—Address—Hardware—
Device Type _____ Configuration Name _____
Hipersockets _____ hsi0 _____
( ) No Link and IP Setup (Bonding Slaves)
( ) Dynamic Address
      DHCP _____ DHCP both version 4 and 6 _____
(x) Statically assigned IP Address
IP Address _____ Subnet Mask _____ Hostname _____
10.40.33.38 _____ 255.255.255.0 _____
Additional Addresses
Alias Name|IP Address|Netmask
[Add][Edit][Delete]

[Help] [Back] [Cancel] [Next]
F1 Help F3 Add F9 Cancel F10 Next
```

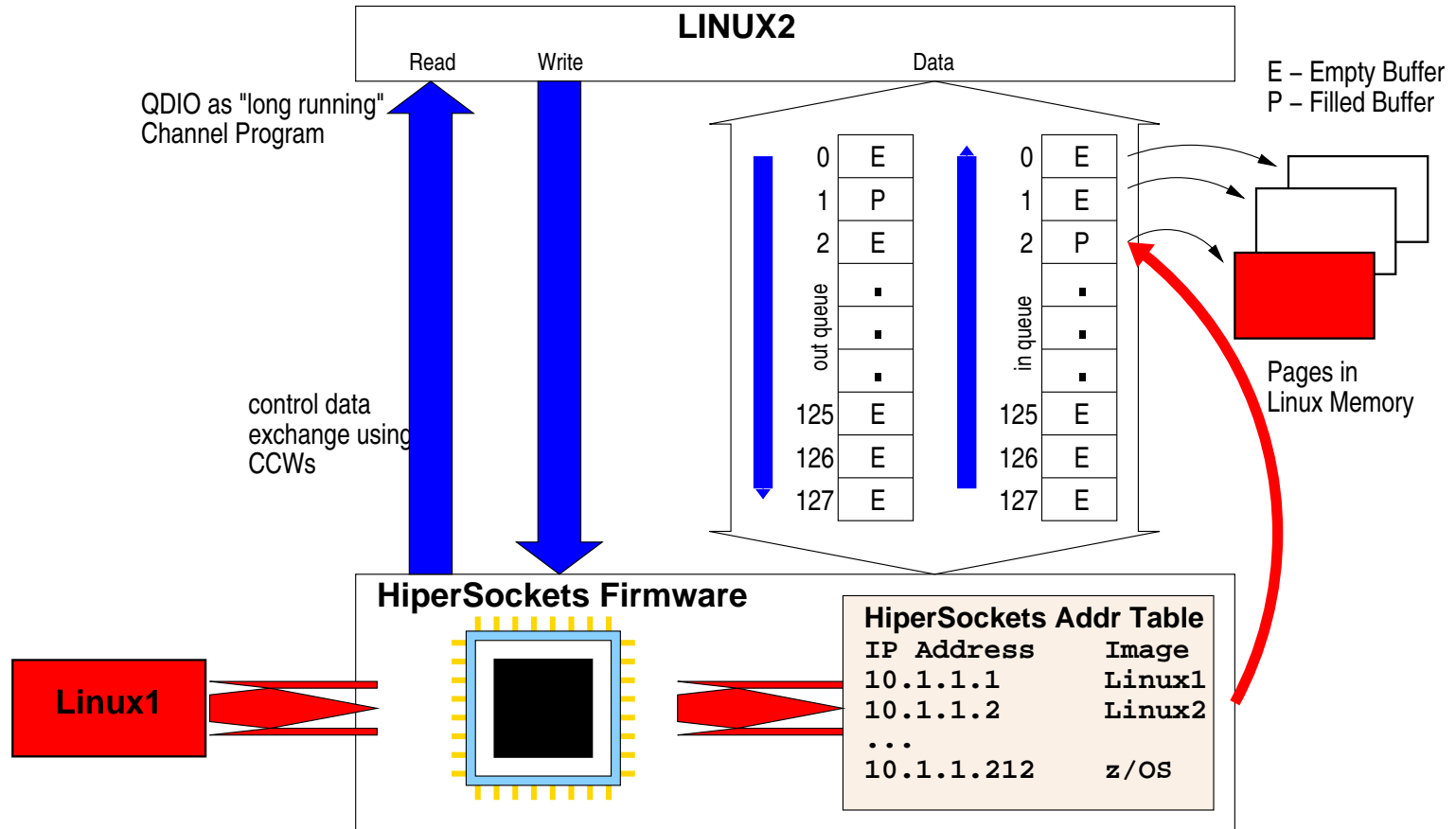
## QDIO - Queued Direct I/O

- OSA
- HiperSockets
- FCP

# QDIO Architecture



# QDIO Architecture



# Layer 2 Mode

## OSI Model

7 Application
6 Presentation
5 Session
4 Transport
3 Network
2 Data Link
1 Physical

## TCP/IP Model

Layer	Protocol
Application	FTP, HTTP
Transport	TCP, UDP
Internet	IP, ICMP
Network Access	Ethernet



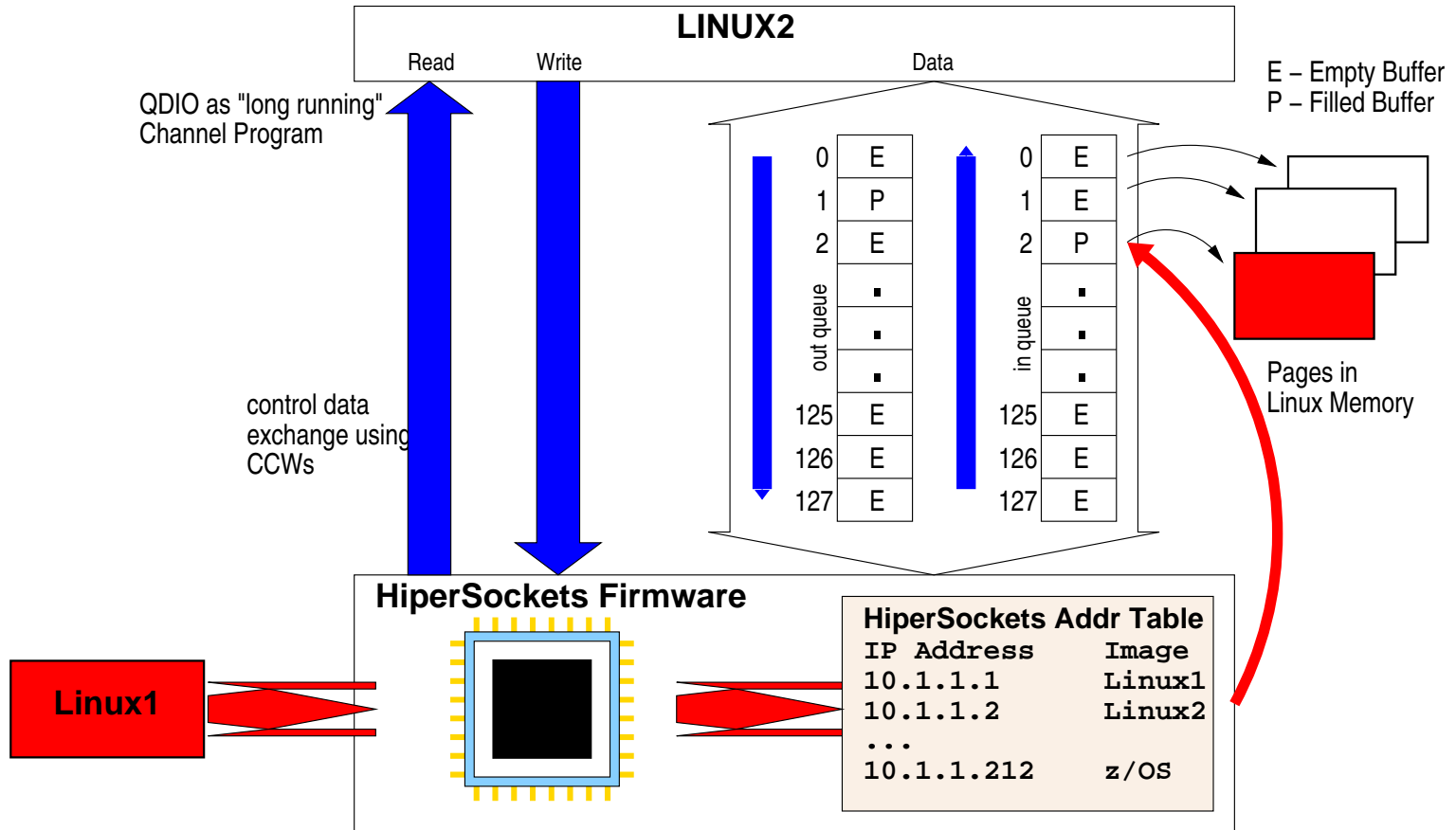
Layer 3 Frame

IP	TCP	Data
----	-----	------

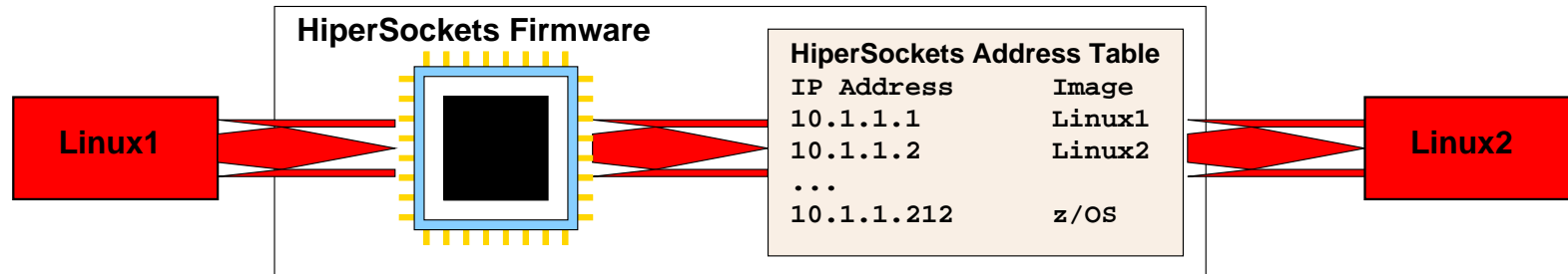
Layer 2 Frame

TGT MAC	SRC MAC	IP	TCP	Data
---------	---------	----	-----	------

# Layer 3 Mode

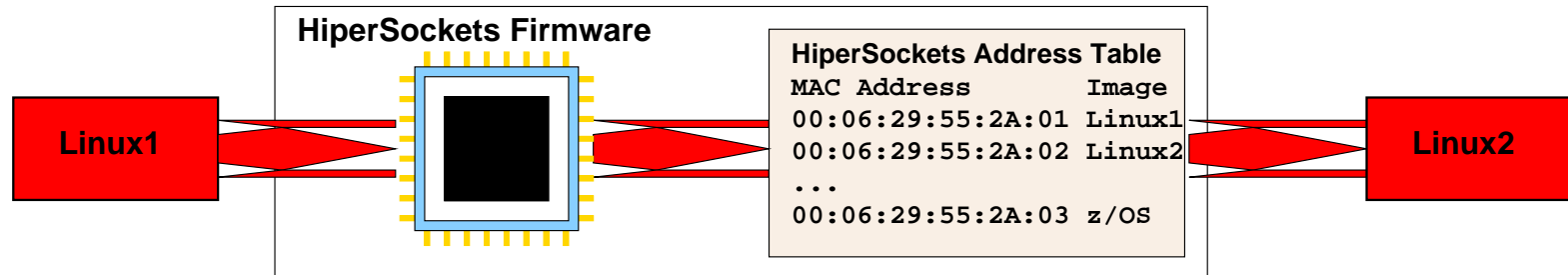


# Layer 3 Mode





# Layer 2 Mode



# Statistics

```
# cd /sys/kernel/debug/qdio/0.0.8029
# echo 1 > statistics

# cat statistics
Assumed adapter interrupts:      121424
    QDIO interrupts:             0
    Requested PCIs:              0
    Inbound tasklet runs:         0
    Inbound tasklet resched:      0
    Inbound tasklet resched2:    0
    Outbound tasklet runs:        15135
        SIGA read:                1891
        SIGA write:               121030
        SIGA sync:                 0
    Inbound calls:                1891
    Inbound handler:              0
    Inbound stop_polling:         121029
    Inbound queue full:           0
    Outbound calls:               121030
    Outbound handler:             15135
    Outbound queue full:          0
    Outbound fast_requeue:        0
    Outbound target_full:         0
        QEBSM eqbs:                378223
        QEBSM eqbs partial:         19
        QEBSM sqbs:                243951
        QEBSM sqbs partial:         49
    Discarded interrupts:         395
```

## Virtual LAN - VLAN

```
# vconfig add eth0 5
WARNING: Could not open /proc/net/vlan/config.
Maybe you need to load the 8021q module, or maybe you are not using PROCFS??
Added VLAN with VID == 5 to IF -:eth0:-
```

```
# ifconfig eth0.5
eth0.5      Link encap:Ethernet  HWaddr 02:35:15:00:00:3F
            BROADCAST MULTICAST  MTU:1492  Metric:1
            RX packets:0 errors:0 dropped:0 overruns:0 frame:0
            TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
            collisions:0 txqueuelen:0
            RX bytes:0 (0.0 b)  TX bytes:0 (0.0 b)
```

```
# modprobe 8021q
```

## Virtual LAN - VLAN

```
# ifconfig eth0.5 192.168.10.10
```

```
# ifconfig eth0.5 192.168.10.10 netmask 255.255.255.0
```

## Virtual LAN - VLAN

```
# route -n
Kernel IP routing table
Destination      Gateway          Genmask         Flags Metric Ref    Use  Iface
0.0.0.0          9.152.108.1    0.0.0.0         UG    0      0      0   eth0
9.152.108.0     0.0.0.0        255.255.252.0   U     0      0      0   eth0
127.0.0.0       0.0.0.0        255.0.0.0       U     0      0      0   lo
169.254.0.0     0.0.0.0        255.255.0.0     U     0      0      0   eth0
192.168.10.0    0.0.0.0        255.255.255.0   U     0      0      0   eth0.5
```

## Virtual LAN - VLAN

```
# ifconfig eth0.5 down  
# vconfig rem eth0.5  
Removed VLAN -:eth0.5:-
```

# Bonding

```
# ifconfig eth0 hw ether 00:06:29:55:2A:01
# ifconfig eth1 hw ether 00:06:29:55:2A:02

# modprobe bonding

# ifconfig bond0 10.40.33.38 netmask 255.255.255.0

# ifenslave bond0 eth0
# ifenslave bond0 eth1

# ifenslave bond0
The result of SIOCGIFFLAGS on bond0 is 1443.
The result of SIOCGIFADDR is 0a.28.21.26.
The result of SIOCGIFHWADDR is type 1 06:00:fb:0f:00:2c.
```

# Bonding

```
cat /proc/net/bonding/bond0
Ethernet Channel Bonding Driver: v3.7.1 (April 27, 2011)

Bonding Mode: load balancing (round-robin)
MII Status: up
MII Polling Interval (ms): 0
Up Delay (ms): 0
Down Delay (ms): 0

Slave Interface: hsi0
MII Status: up
Speed: 10000 Mbps
Duplex: full
Link Failure Count: 0
Permanent HW addr: 06:00:fb:0f:00:2c
Slave queue ID: 0
```



## QETH - large\_send

- Offload TCP segmentation from TCP/IP stack to OSA card
- Move workload to OSA-Express adapter
- Better performance with large outgoing packets

```
# echo TSO > /sys/devices/qeth/0.0.8027/large_send
```

```
QETH_OPTIONS='large_send=TSO'
```

- Offload TCP segmentation from TCP/IP stack to device driver

```
# echo EDDP > /sys/devices/qeth/0.0.8027/large_send
```

```
QETH_OPTIONS='large_send=EDDP'
```

## QETH - checksumming

- Offload checksum calculation for incoming packets from TCP/IP stack to OSA card
- Move workload to OSA-Express adapter
- Available for OSA devices in Layer 3 mode

```
# echo hw_checksumming > /sys/devices/qeth/0.0.8027/checksumming
```

```
QETH_OPTIONS='checksumming=hw_checksumming'
```

## QETH - checksumming

- Remove checksum calculation for trusted HiperSockets connections
- Reduce CPU load of TCP/IP stack

```
# echo no_checksumming > /sys/devices/qeth/0.0.8027/checksumming
```

```
QETH_OPTIONS='checksumming=no_checksumming'
```

## QETH - buffer\_count

- Reduce buffers to reduce memory usage
- Increase buffers to increase performance

```
# echo 64 > /sys/devices/qeth/0.0.8027/buffer_count
```

- Need to set device offline

# Problem Determination

- QETH errors
- QDIO statistics

## QETH Errors

```
# cd /sys/kernel/debug/s390dbf/qeth_card_0.0.8027/  
# ls  
flush  hex_ascii  level  pages
```

## QETH Errors

```
# cat hex_ascii
...
00 01349287113:989584 2 - 00 000003c000d4edd6 00 00 00 00 3e 8d 20 00 | ....>. .
00 01349287113:989584 2 - 00 000003c000d4ea9c 73 65 74 61 64 64 72 34 | setaddr4
00 01349287113:989584 3 - 00 000003c000d4ead8 0a 28 21 27 00 00 00 00 | .(!'....
00 01349287113:989585 2 - 00 000003c0009a58d2 73 65 6e 64 63 74 6c 00 | sendctl.
00 01349287281:325948 2 - 00 000003c0009a4202 71 6f 75 74 65 72 72 00 | qouterr.
00 01349287281:325948 2 - 00 000003c0009a19f2 20 46 31 35 3d 30 34 00 | F15=04.
00 01349287281:325948 2 - 00 000003c0009a19f2 20 46 31 34 3d 30 30 00 | F14=00.
00 01349287281:325948 2 - 00 000003c0009a19f2 20 71 65 72 72 3d 31 00 | qerr=1.
00 01349287281:325949 1 - 00 000003c0009aaf50 6c 6e 6b 66 61 69 6c 00 | lnkfail.
00 01349287281:325949 1 - 00 000003c0009a19f2 30 30 30 31 20 30 34 00 | 0001 04.
00 01349287282:335929 2 - 00 000003c0009a4202 71 6f 75 74 65 72 72 00 | qouterr.
00 01349287282:335930 2 - 00 000003c0009a19f2 20 46 31 35 3d 30 34 00 | F15=04.
00 01349287282:335930 2 - 00 000003c0009a19f2 20 46 31 34 3d 30 30 00 | F14=00.
00 01349287282:335930 2 - 00 000003c0009a19f2 20 71 65 72 72 3d 31 00 | qerr=1.
00 01349287282:335930 1 - 00 000003c0009aaf50 6c 6e 6b 66 61 69 6c 00 | lnkfail.
00 01349287282:335930 1 - 00 000003c0009a19f2 30 30 30 31 20 30 34 00 | 0001 04.
00 01349287283:335931 2 - 00 000003c0009a4202 71 6f 75 74 65 72 72 00 | qouterr.
00 01349287283:335931 2 - 00 000003c0009a19f2 20 46 31 35 3d 30 34 00 | F15=04.
00 01349287283:335931 2 - 00 000003c0009a19f2 20 46 31 34 3d 30 30 00 | F14=00.
00 01349287283:335932 2 - 00 000003c0009a19f2 20 71 65 72 72 3d 31 00 | qerr=1.
00 01349287283:335932 1 - 00 000003c0009aaf50 6c 6e 6b 66 61 69 6c 00 | lnkfail.
00 01349287283:335932 1 - 00 000003c0009a19f2 30 30 30 31 20 30 34 00 | 0001 04.
```

## QDIO Errors

```
# cd /sys/kernel/debug/s390dbf/qdio_0.0.8029/
# ls
flush  hex_ascii  level  pages

# cat hex_ascii
00 01349290790:794098 4 - 01 000003c000949a68
45 51 42 53 20 70 61 72 74 3a 37 37 00 00 00 00 | EQBS part:77....
00 01349290790:794119 4 - 00 000003c000949a68
45 51 42 53 20 70 61 72 74 3a 37 34 00 00 00 00 | EQBS part:74....
00 01349290790:917227 4 - 00 000003c000949a68
45 51 42 53 20 70 61 72 74 3a 30 37 00 00 00 00 | EQBS part:07....
00 01349290790:917228 4 - 00 000003c000949a68
45 51 42 53 20 70 61 72 74 3a 30 35 00 00 00 00 | EQBS part:05....
00 01349290790:918473 4 - 01 000003c000949a68
45 51 42 53 20 70 61 72 74 3a 34 36 00 00 00 00 | EQBS part:46....
00 01349290790:918474 4 - 01 000003c000949a68
45 51 42 53 20 70 61 72 74 3a 34 35 00 00 00 00 | EQBS part:45....
00 01349290790:918481 4 - 01 000003c000949a68
45 51 42 53 20 70 61 72 74 3a 34 34 00 00 00 00 | EQBS part:44....
00 01349290790:936371 4 - 00 000003c000949a68
45 51 42 53 20 70 61 72 74 3a 30 37 00 00 00 00 | EQBS part:07....
```



# Problem Determination

```
# cd /sys/kernel/debug/qdio/0.0.8029  
# echo 1 > statistics
```

## Problem Determination

```

# cat input_0
DSCI: 0   nr_used: 119
ftc: 72  last_move: 72
polling: 0  ack start: 71  ack count: 0
IRQs disabled: 0
SBAL states:
|0      |8      |16     |24     |32     |40     |48     |56  63|
-----N
NNNNNNNN-----
|64     |72     |80     |88     |96     |104    |112    | 127|

SBAL statistics:
1      2..   4..   8..   16..  32..  64..  127
121030 0     0     0     0     0     0     0
Error  NOP   Total
0      121029 121030

```

# Problem Determination

```
# cat output_2
DSCI: 0   nr_used: 0
ftc: 72  last_move: 72
SBAL states:
|0      |8      |16     |24     |32     |40     |48     |56  63|
-----
-----
|64     |72     |80     |88     |96     |104    |112    | 127|

SBAL statistics:
1       2..   4..   8..   16..  32..  64..  127
0       8    2    15125  0    0    0    0
Error   NOP   Total
0       0    121030
```





# Redbooks

IBM

## OSA-Express Implementation Guide

IBM

- Product, planning, and quick start information
- Realistic examples and considerations
- Hardware and software

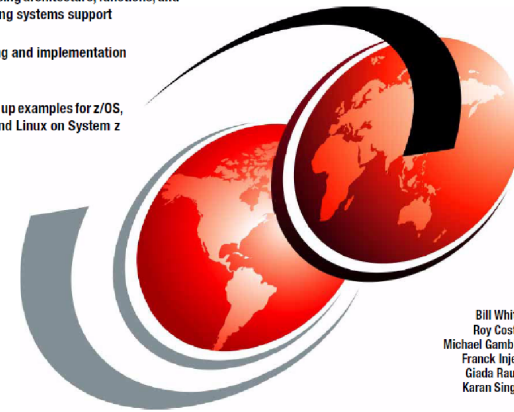
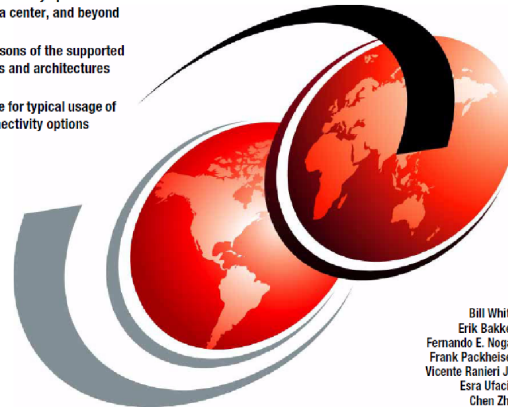
## HiperSockets Implementation Guide

IBM

## IBM System z Connectivity Handbook

- Design architecture, functions, and existing systems support
- Configuration and implementation
- Setup examples for z/OS, and Linux on System z

- The connectivity options available for your data center, and beyond
- Comparisons of the supported protocols and architectures
- Guidance for typical usage of the connectivity options



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## Links

- Linux on System z - Tuning Hints & Tips  
<http://www.ibm.com/developerworks/linux/linux390/perf/index.html>
- developerWorks  
<http://www.ibm.com/developerworks/linux/linux390>
- IBM Redbooks  
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# Thank You !



For starting out with their very good presentations

- Susanne Wintenberger
- Mario Held



# Questions ?



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