Networking with Linux® on zSeries
(Part 1 of 2)

Session 9267

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Agenda

- Linux 2.6 device model
- Networking example
- Linux on zSeries network device drivers:
  - QETH
  - LCS
  - CTC
  - IUCV
- Summary

Linux 2.6 Device Model

- Integrated uniform device model that reflects a system's hardware structure
- Simplified device reference counting and locking
- Unified user interface via sysfs
  - **Hierarchical, tree-like** representation of system's hardware
  - Several subsystems provide **different views** of the hardware
  - **Configuration of devices via attribute files**
  - **Dynamic attach/detach** of devices possible

Linux 2.6 Device Model (cont.)

```
/sys
|--block
|   |...
|--bus
|   |...
|--class
|   |...
|   |--net
|   |...
|--devices
|   |...
|...
```

Block subsystem (view):
Block devices and partitions (dasda, ram0)

Bus subsystem (view):
Device drivers and devices sorted by bus (ccw)

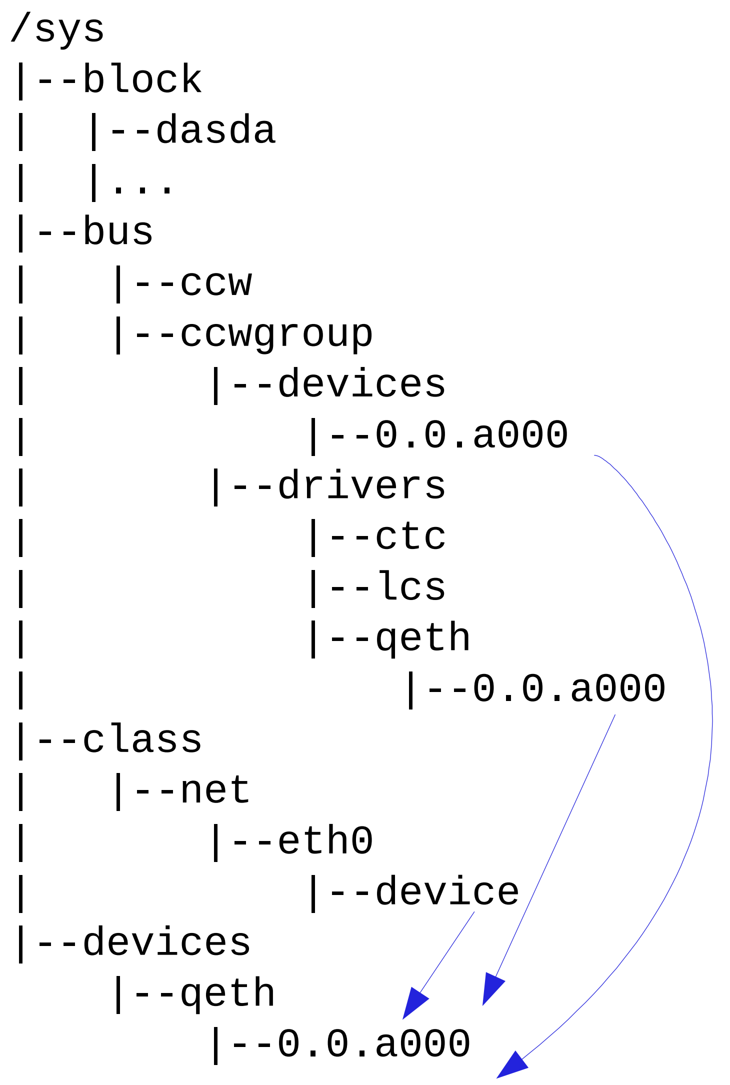
Class subsystem (view):
Logical devices sorted by type, i.e. to which class they belong;
Logical devices have link to hardware device

Devices subsystem (view):
All the devices of a system

Linux 2.6 Device Model - zSeries

- **Fully integrated into common device model** (sysfs and underlying kernel structures)
- Bus and device types:
  - Channel subsystem bus / I/O subchannel devices
    - ID: subchannel number
    - Attributes: channel paths, detach state, path masks
  - CCW device bus / CCW devices
    - ID: device number
    - Attributes: CU type, device type, online state [, group_device] + driver specific
  - CCW group device bus / CCW group devices
    - Groups of single CCW devices make up a functional unit
    - ID: device number of first device in group
    - Attributes: CCW devices, CHPID, aggregate online state, ungroup + driver specific

Linux 2.6 Device Model – zSeries Examples



```
/sys
|--block
|   |--dasda
|   |...
|--bus
|    |--ccw
|    |--ccwgroup
|        |--devices
|            |--0.0.a000
|        |--drivers
|            |--ctc
|            |--lcs
|            |--qeth
|                |--0.0.a000
|--class
|    |--net
|        |--eth0
|            |--device
|--devices
    |--qeth
        |--0.0.a000
```

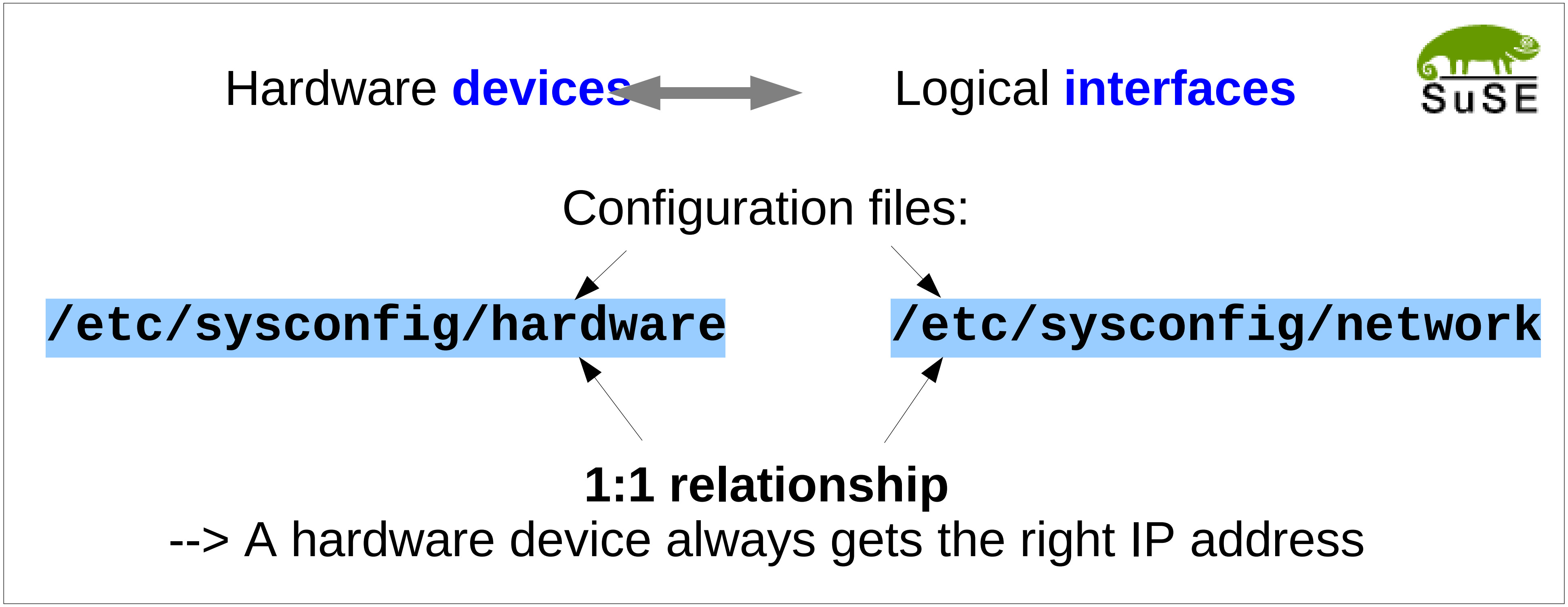
Block Devices:
DASD, RAM-Disk, Minidisk
SCSI, Loopback

CCW Group Devices:
QETH, LCS, CTC

Example: a QETH device

Many ways to find a device

SUSE SLES 9 Network Configuration



Hardware **devices** ⟷ Logical **interfaces**

Configuration files:

`/etc/sysconfig/hardware`

`/etc/sysconfig/network`

1:1 relationship

--> A hardware device always gets the right IP address

Naming convention:

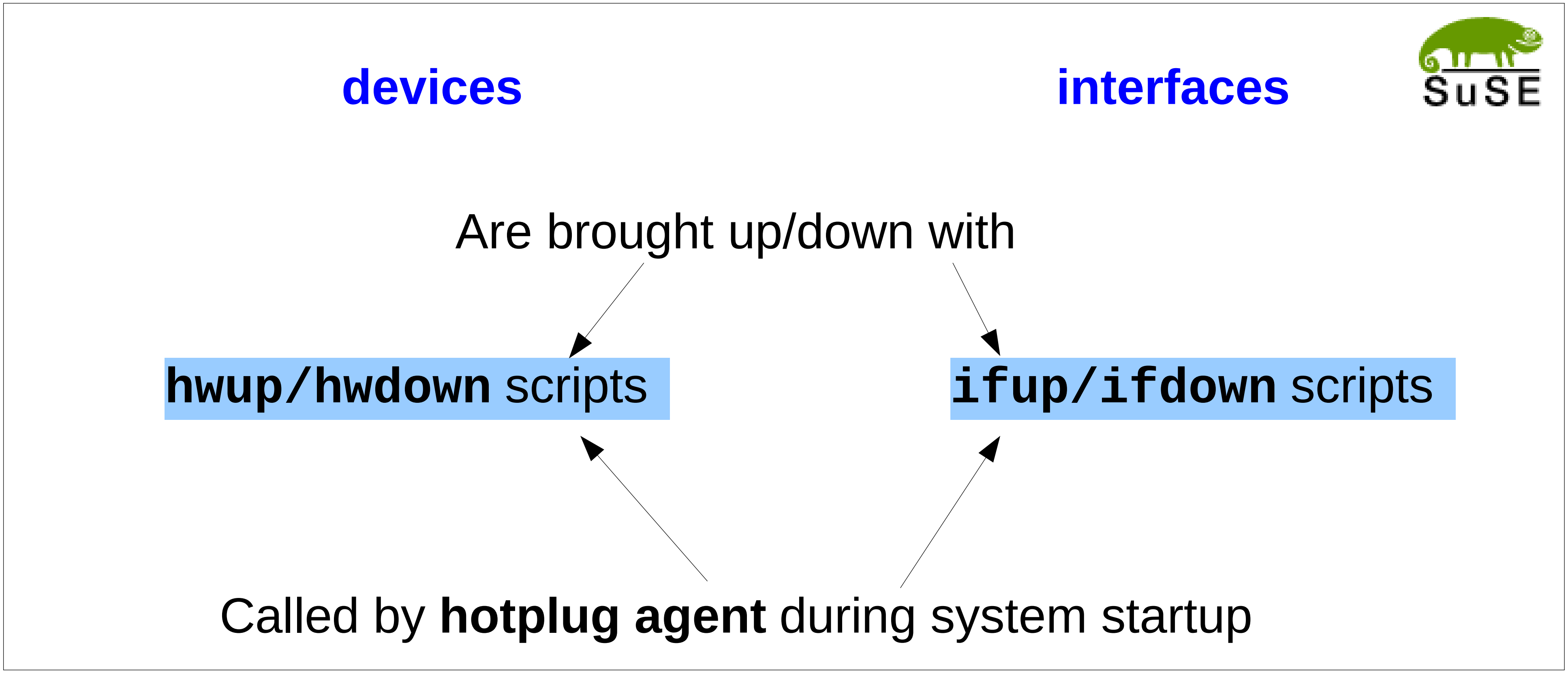
hw/ifcfg-<device type>-bus-<bus type>-<bus location> or

hw/ifcfg-<device type>-id-<identifier> (e.g. for IUCV)

e.g. **hwcfg-qeth-bus-ccw-0.0.a000**

ifcfg-qeth-bus-ccw-0.0.a000

SUSE SLES 9 Network Configuration (cont.)



devices

interfaces

Are brought up/down with

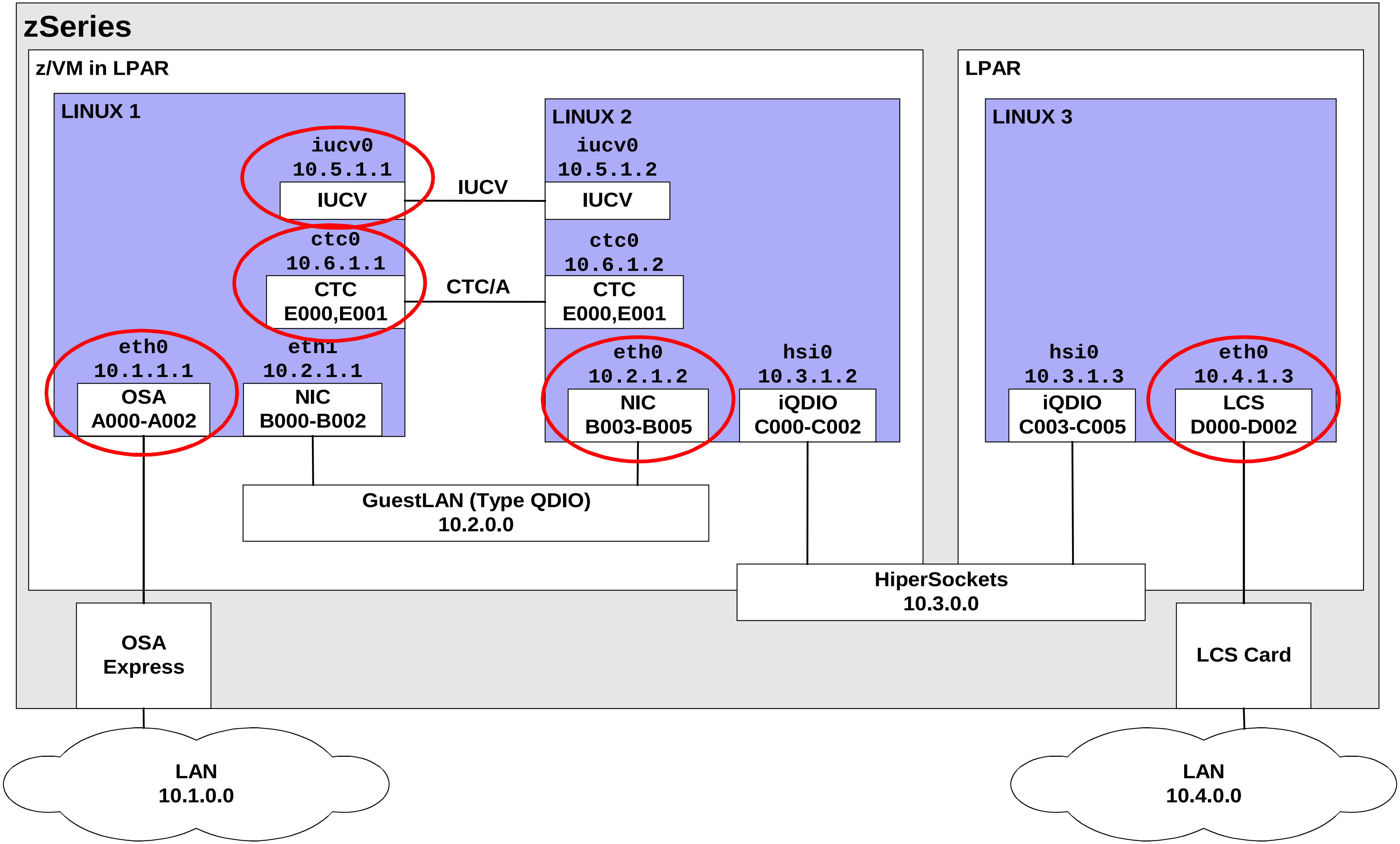
hwup/hwdown scripts

ifup/ifdown scripts

Called by **hotplug agent** during system startup

See also: /usr/share/doc/packages/sysconfig/README and README.s390

Networking Example



Linux for zSeries Network Device Drivers

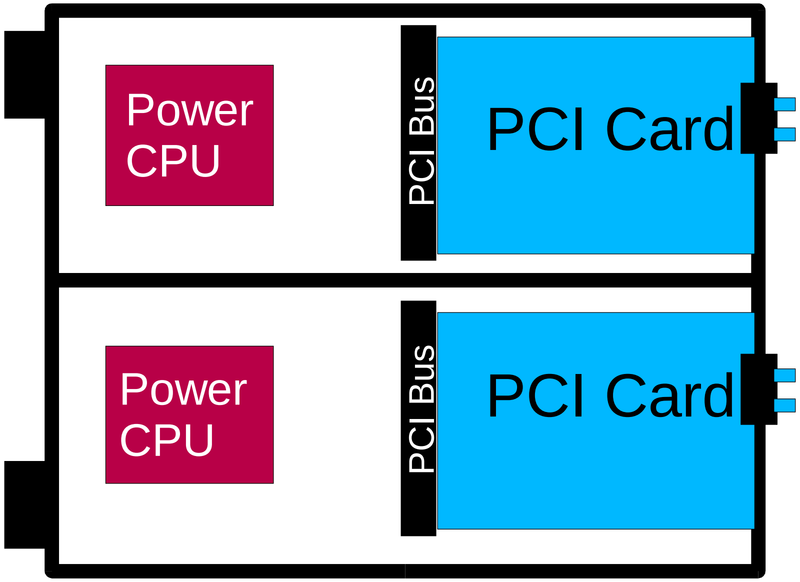
- QETH
- LCS
- CTC
- IUCV
- Major rework of existing Linux 2.4 device drivers
  - To integrate into Linux 2.6 common device model
  - To port old user interfaces to sysfs
  - Cleanup of source code --> improved readability and maintainability
  - Performance improvements

QETH Device Driver

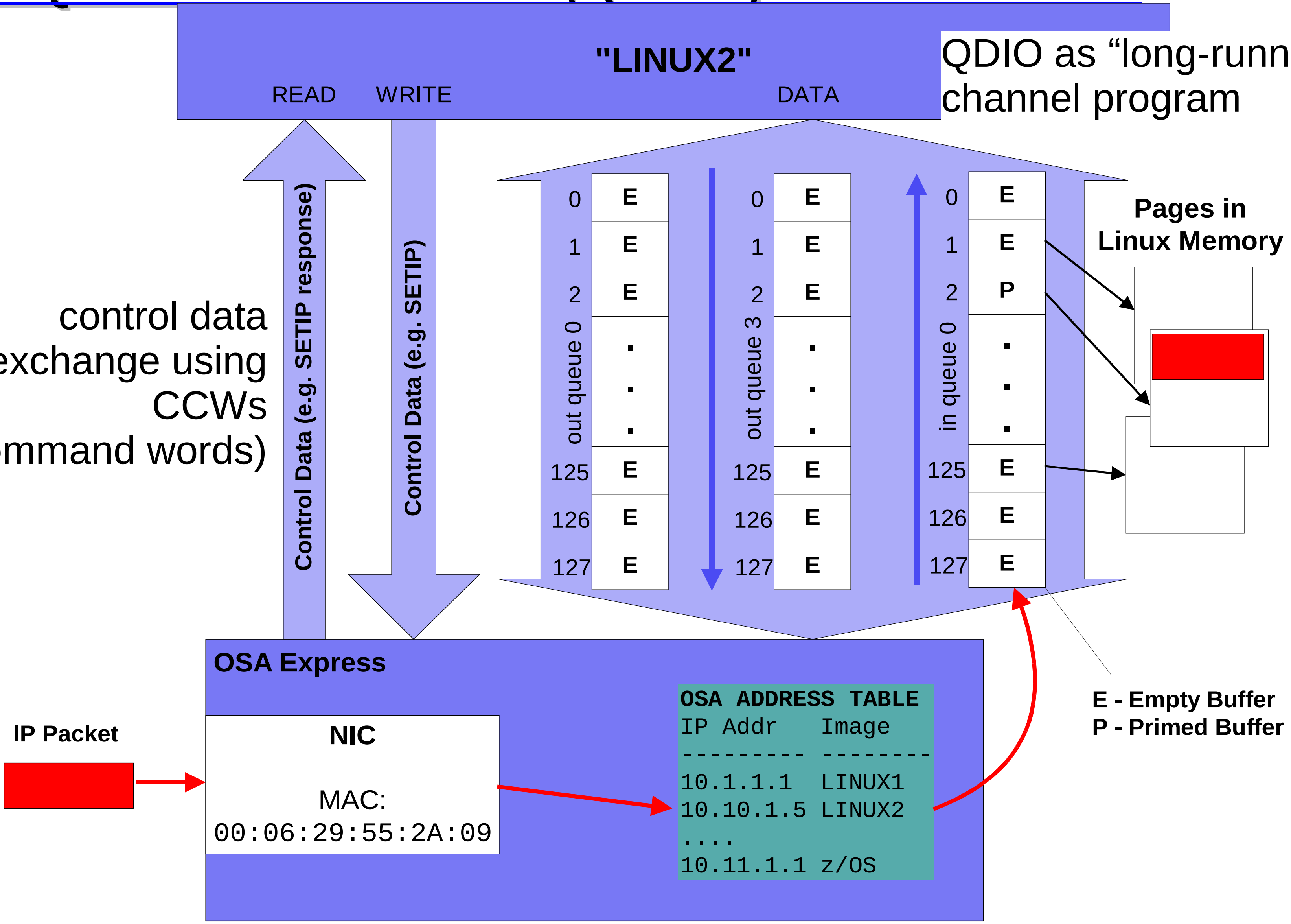
- Supports:
  - OSA Express	Fast Ethernet
    Gigabit Ethernet
    10 Gbit Ethernet
    Highspeed Tokenring
    ATM (running Ethernet LAN Emulation)
  - z/VM GuestLAN	Type QDIO
    Type Hiper
  - zSeries HiperSockets
- IPv4, IPv6, VLAN, VIPA, Proxy ARP, IP Address Takeover
- **Primary network driver for Linux on zSeries**
- **Has main focus in current and future development**

Primary Network Device: OSA Express

- 'Integrated Power computer' with network daughter card
- Shared between up to 640 TCP/IP stacks
- OSA Address Table: which OS image has which IP address
- Three devices (I/O subchannels) per stack:
  - Read device (control data <-- OSA)
  - Write device (control data --> OSA)
  - Data device (network traffic)
- Network traffic Linux <--> OSA at IP or ARP level
- One MAC address for all stacks
- OSA handles ARP (Address Resolution Protocol)



The Queued Direct I/O (QDIO) Architecture



QDIO as “long-running” channel program

control data exchange using CCWs (channel command words)

	out queue 0		out queue 3		in queue 0
0	E	0	E	0	E
1	E	1	E	1	E
2	E	2	E	2	P
	.		.		.
	.		.		.
	.		.		.
125	E	125	E	125	E
126	E	126	E	126	E
127	E	127	E	127	E

```
OSA ADDRESS TABLE
IP Addr    Image
---------  --------
10.1.1.1   LINUX1
10.10.1.5  LINUX2
....
10.11.1.1  z/OS
```

E - Empty Buffer
P - Primed Buffer

Static QETH Device Setup

For LINUX 1 eth0 (see Networking Example)

1. Create a hardware device configuration file:

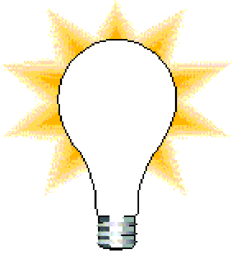
```
/etc/sysconfig/hardware/hwcfg-qeth-bus-ccw-0.0.a000:
  CCW_CHAN_IDS='0.0.a000 0.0.a001 0.0.a002'
  CCW_CHAN_MODE='OSAPORT'
  CCW_CHAN_NUM='3'
  MODULE='qeth'
  MODULE_OPTIONS=''
  SCRIPTDOWN='hwdown-ccw'
  SCRIPTUP='hwup-ccw'
  SCRIPTUP_ccw='hwup-ccw'
  SCRIPTUP_ccwgroup='hwup-qeth'
  STARTMODE='auto'
  QETH_OPTIONS='fake_ll=1'
```

Static QETH Device Setup (cont.)

- **`CCW_CHAN_IDS`** are Read, Write, Data channels
  - Read must be even, Write must be Read + 1 (for older microcode)
  - Hexadecimal characters must be lowercase
- **`STARTMODE`** 'auto' --> started by hotplug agents
  'manual' --> manual startup
- **`QETH_OPTIONS`** allows to set optional attributes

  e.g. `QETH_OPTIONS='fake_ll=1'`

- A sample hwcfg-file for QETH can be found at `/etc/sysconfig/hardware/skel/hwcfg-qeth`



Static QETH Device Setup (cont.)

2. Create an interface configuration file:

```
/etc/sysconfig/network/ifcfg-qeth-bus-ccw-0.0.a000
   BOOTPROTO='static'
   BROADCAST='10.1.255.255'
   IPADDR='10.1.1.1'
   NETMASK='255.255.0.0'
   NETWORK='10.1.0.0'
   STARTMODE='onboot'
   PERSISTANT_NAME='interf0
```

3. Before reboot: test your config files:

```
#> hwup qeth-bus-ccw-0.0.a000
```

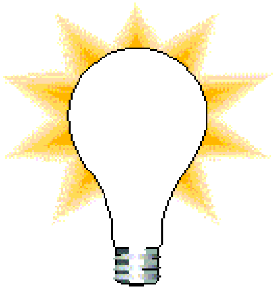
Static QETH Device Setup on Linux 2.4

Hardware configuration is in `/etc/chandev.conf`:

```
qeth0,0xa000,0xa001,0xa002
   add_parms,0x10,0xa000,0xa002,portname:OSAPORT
```

A script exists which can convert your Linux 2.4 chandev.conf into Linux 2.6 hwcfg-files (for QETH, LCS and CTC):

```
/etc/sysconfig/hardware/scripts/chandev-to-hwcfg.sh
```



Static QETH Device Setup on Linux 2.4 (cont.)

Interface configuration:

```
/etc/sysconfig/network-scripts/ifcfg-eth0
  DEVICE=eth0
  USERCTL=no
  ONBOOT=yes
  BOOTPROTO=none
  BROADCAST=10.1.255.255
  NETWORK=10.1.0.0
  NETMASK=255.255.0.0
  IPADDR=10.1.1.1
  ARP=no
```

Device – IP address mapping:

`qeth<n>` notation in chandev.conf

↕

```
ifcfg-eth<n>
   DEVICE=eth<n>
```

Dynamic QETH Device Setup

For LINUX 2 eth0 (see Networking Example)

1. In your z/VM console (if not already defined in user directory) do

   1.1. Create a GuestLAN

   ```
   #CP DEFINE LAN MY_LAN TYPE QDIO
   ```

   1.2. Create a virtual NIC

   ```
   #CP DEFINE NIC B003 TYPE QDIO
   ```

   1.3. Couple virtual NIC to GuestLAN

   ```
   #CP COUPLE B003 TO * MY_LAN
   ```

Dynamic QETH Device Setup (cont.)

2. Load the QETH device driver module:

```
#> modprobe qeth
```

3. Create a new QETH device by grouping its CCW devices:

```
#> echo 0.0.b003,0.0.b004,0.0.b005 > /sys/bus/ccwgroup/
   drivers/qeth/group
```

4. Set optional attributes:

```
#> echo 64 > /sys/bus/ccwgroup/drivers/qeth/0.0.b004/
   buffer_count

#> echo 1 > /sys/devices/qeth/0.0.b004/fake_ll
```

Note the alternative ways to your device

Dynamic QETH Device Setup (cont.)

5. Set the new device online:

```
#> echo 1 > /sys/devices/qeth/0.0.b003/online
```

6. Check your QETH devices:

```
#> cat /proc/qeth
devices                    CHPID interface  cardtype
-------------------------- ----- ---------- -------------- ...
0.0.c000/0.0.c001/0.0.c002 xC0   hsi0       HiperSockets
0.0.b003/0.0.b004/0.0.b005 x01   eth0       GuestLAN QDIO
```

7. Configure your new eth0 interface:

```
#> ifconfig eth0 10.2.1.2 netmask 255.255.0.0
```

Dynamic QETH Device Setup on Linux 2.4

1. Add definition of the new device to `/etc/chandev.conf`:

```
qeth0,0xb003,0xb004,0xb005
add_parms,0x10,0xb003,0xb005,fake_ll:1
```

can also be echoed directly to /proc/chandev

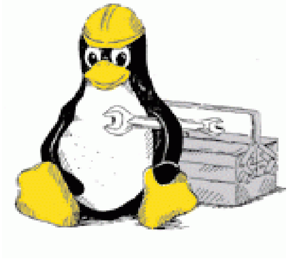
```
#> echo ‟qeth0,0xb003,0xb004,0xb005;
         add_parms,0x10,0xb003,0xb005,fake_ll:1”
         > /proc/chandev
```

2. Activate the new configuration:

```
#> echo readconf > /proc/chandev
#> echo reprobe > /proc/chandev
```

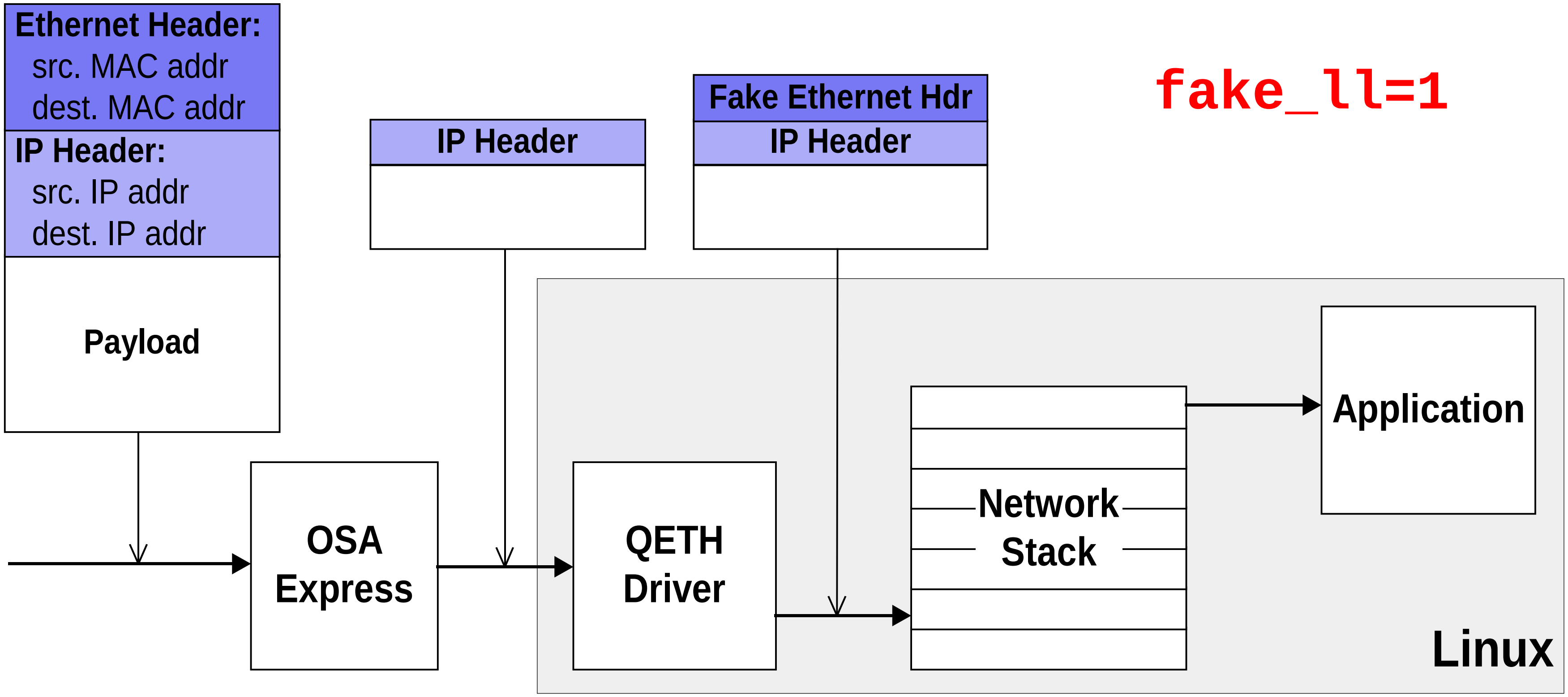
3. Configure the interface:

```
#> ifconfig eth0 10.2.1.2 netmask 255.255.0.0
```



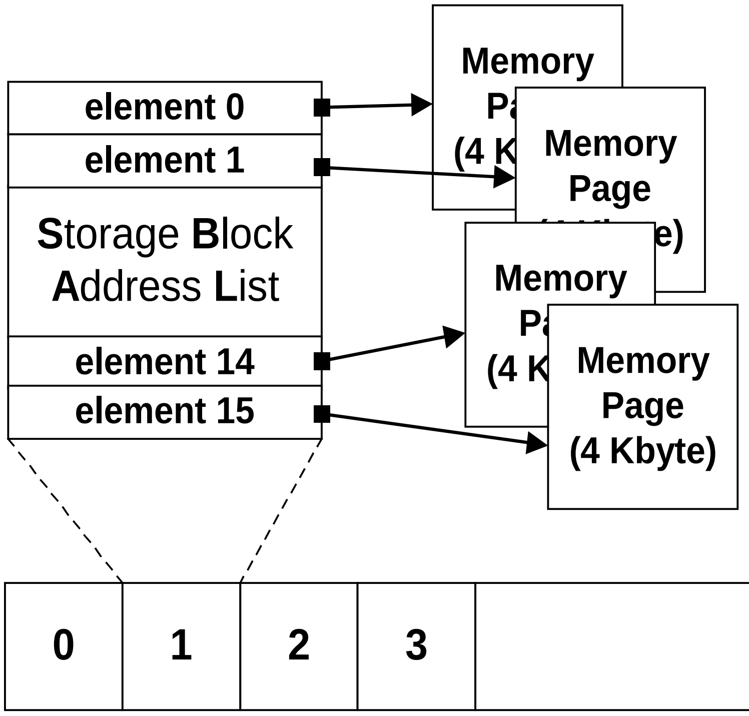
Interesting QETH Device sysfs Attributes
fake_ll

- Build fake ethernet headers before handing packets to the network stack.
- Required by some network applications, e.g. **DHCP** or TCPDUMP



Interesting QETH Device sysfs Attributes buffer_count

- The number of allocated buffers for inbound QDIO traffic --> Memory usage.

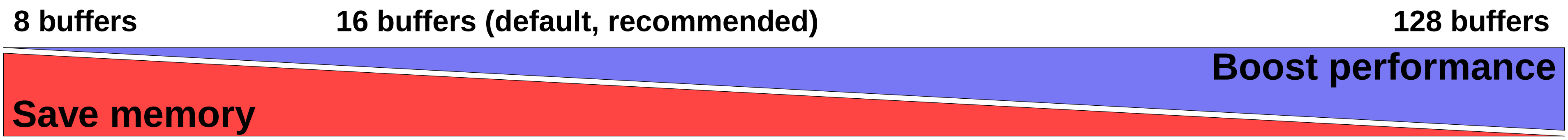


Per QETH card memory usage:

control data structures: ~ 200 KB
memory for one buffer: 64 KB

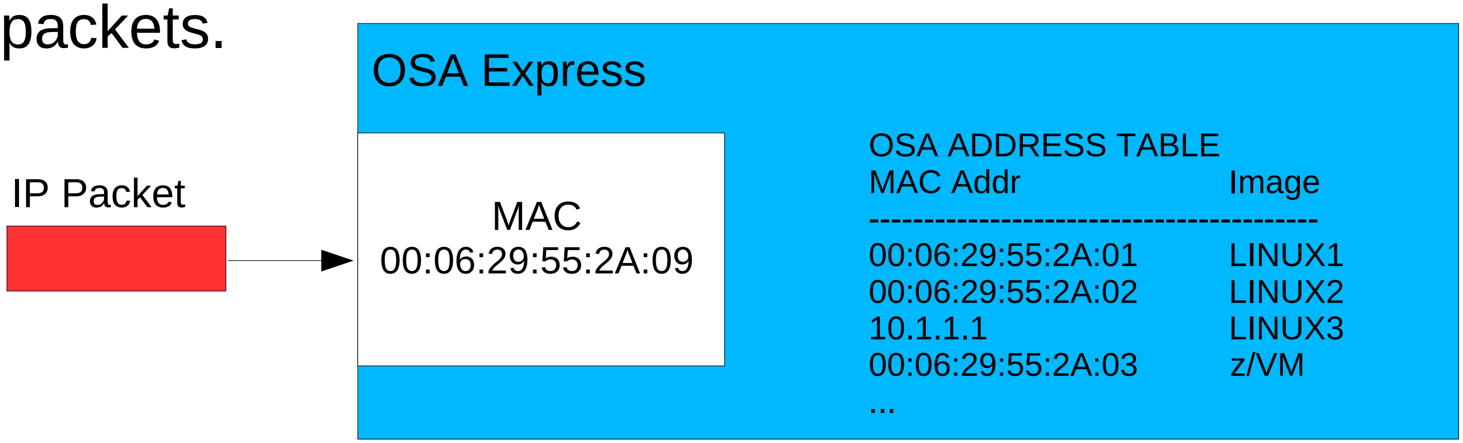
buffer_count = 8 --> ~ 712 KB

buffer_count = 128 --> ~ 8.4 MB



Interesting QETH Device sysfs Attributes - layer2

- OSA works with MAC addresses, MAC addresses no longer stripped from packets.



OSA ADDRESS TABLE

MAC Addr	Image
00:06:29:55:2A:01	LINUX1
00:06:29:55:2A:02	LINUX2
10.1.1.1	LINUX3
00:06:29:55:2A:03	z/VM
...	

- hwcfg-qeth... file : `QETH_LAYER2_SUPPORT=1`
- ifcfg-qeth... file: `LLADDR='<MAC Address>'`
- Direct attached OSA:

  MAC address must be defined with ifconfig manualy

  ```
  ifconifg eth0 hw ether 00:06:29:55:2A:01
  ```
- with VSWITCH under z/VM

  MAC address created by z/VM VSWITCH
- DHCP, tcpdump working without option fake_ll
- channel bonding possible

Interesting QETH Device sysfs Attributes – layer2 (cont.)

- Direct attach OSA and GuestLAN type QDIO supported
  GuestLAN definition for layer2:
  ```
  define lan <lanname> ... type QDIO ETHERNET
  define nic
  ```
- Prerequisites:
  - z/VM 5.1 RSU 1 + PTF VM63505, VM63506, VM 63538, PQ97436
  - OSA code level 6.25(MCL J13477.066, Bundle 28)
  - SUSE SLES8 kernel 2.4.21-266
  - SUSE SLES9 SP2

- Restrictions:
  - Layer2 and Layer3 traffic can be transmitted over the same OSA CHPID, but not between two hosts sharing the same CHPID !

LCS Device Driver

- LCS – LAN Channel Station
- Supports:
  - OSA-2 Ethernet and Tokenring
  - OSA-Express Fast Ethernet and Highspeed Tokenring (in non-QDIO mode)
  - Since z990: OSA-Express Gigabit Ethernet (incl. 1000Base-T) (in non-QDIO mode)
- May be preferred instead of QETH for security reasons
  - Administrator defines OSA Address Table, whereas with QETH each Linux registers its own IP address --> restricted access

But: performance is inferior to QETH's performance!!!

Static LCS Device Setup

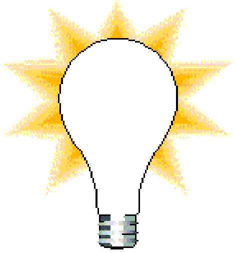
For LINUX 3 eth0 (see Networking Example)

1. Create a hardware device configuration file:

```
/etc/sysconfig/hardware/hwcfg-lcs-bus-ccw-0.0.d000:
  CCW_CHAN_IDS='0.0.d000 0.0.d001'
  CCW_CHAN_MODE='0'
  CCW_CHAN_NUM='2'
  MODULE='lcs'
  MODULE_OPTIONS=''
  SCRIPTDOWN='hwdown-ccw'
  SCRIPTUP='hwup-ccw'
  SCRIPTUP_ccw='hwup-ccw'
  SCRIPTUP_ccwgroup='hwup-lcs'
  STARTMODE='auto'
```

Static LCS Device Setup (cont.)

- **`CCW_CHAN_IDS`** are Read and Write channels
  - Read must be even, Write must be Read + 1
  - Hexadecimal characters must be lowercase
- **`CCW_CHAN_MODE`** selects the card's relative port
  - Applies to OSA-Express ATM cards only
  - Possible values: 0 .. 15
  - Default is 0
- **`STARTMODE`** 'auto' --> started by hotplug agents
  'manual' --> manual startup
- A sample hwcfg-file for QETH can be found at
  `/etc/sysconfig/hardware/skel/hwcfg-lcs`



Static LCS Device Setup (cont.)

2. Create an interface configuration file:

```
/etc/sysconfig/network/ifcfg-lcs-bus-ccw-0.0.d000:
  BOOTPROTO='static'
  BROADCAST='10.4.255.255'
  IPADDR='10.4.1.3'
  NETMASK='255.255.0.0'
  NETWORK='10.4.0.0'
  STARTMODE='onboot'
```

3. Before reboot: test your config files:

```
#> hwup lcs-bus-ccw-0.0.d000
```

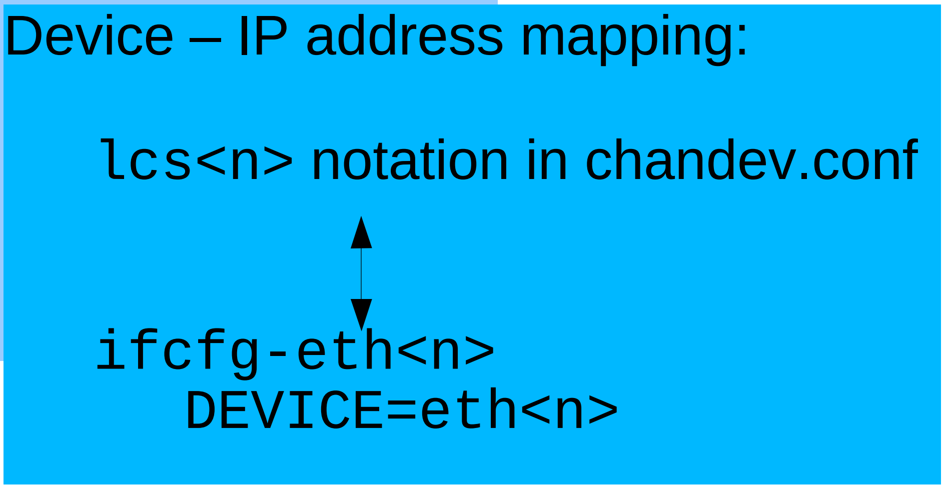
Static LCS Device Setup on Linux 2.4

Hardware configuration is in `/etc/chandev.conf`:

```
 lcs0,0xd000,0xd001
```

Interface configuration:

```
/etc/sysconfig/network-scripts/ifcfg-eth0
  DEVICE=eth0
  USERCTL=no
  ONBOOT=yes
  BOOTPROTO=none
  BROADCAST=10.4.255.255
  NETWORK=10.4.0.0
  NETMASK=255.255.0.0
  IPADDR=10.4.1.3
  ARP=no
```



Device – IP address mapping:

`lcs<n>` notation in chandev.conf

```
ifcfg-eth<n>
   DEVICE=eth<n>
```

Dynamic LCS Device Setup

1. Load the LCS device driver module:

```
#> modprobe lcs
```

2. Create a new LCS device by grouping its CCW devices:

```
#> echo 0.0.d000,0.0.d001 > /sys/bus/ccwgroup/drivers/
    lcs/group
```

3. Set optional attributes:

```
#> echo 2 > /sys/bus/ccwgroup/drivers/lcs/0.0.d000/
   portno
```

4. Set the new device online:

```
#> echo 1 > /sys/devices/lcs/0.0.d000/online
```

Note the alternative ways to your device

Dynamic LCS Device Setup (cont.)

5. Find out the interface for your new device:

   At the moment only possible by checking the 'device' link of each `/sys/class/net` entry:

```
#>ls -Al /sys/class/net/*/device
lrwxrwxrwx  1 root root 0 Jul  6 11:17
    /sys/class/net/eth0/device -> ../../../devices/lcs/0.0.d000
lrwxrwxrwx  1 root root 0 Jul 12 15:14
    /sys/class/net/hsi0/device -> ../../../devices/qeth/0.0.c0
```

6. Configure your new eth0 interface:

```
#> ifconfig eth0 10.4.1.3 netmask 255.255.0.0
```

Dynamic LCS Device Setup on Linux 2.4

1. Add definition of the new device to `/etc/chandev.conf`:

```
lcs0,0xd000,0xd001
```

2. Activate the new configuration:

```
#>echo reandconf > /proc/chandev
#>echo reprobe > /proc/chandev
```

3. Configure the interface:

```
#> ifconfig eth0 10.4.1.3 netmask 255.255.0.0
```

CTC Device Driver

- CTC – Channel-to-Channel connection
- Direct intra- or inter-mainframe communication
- Supports:
  - ESCON
  - FICON
  - Virtual CTC/A (VM)

Static CTC Device Setup

For LINUX 1 ctc0 (see Networking Example)

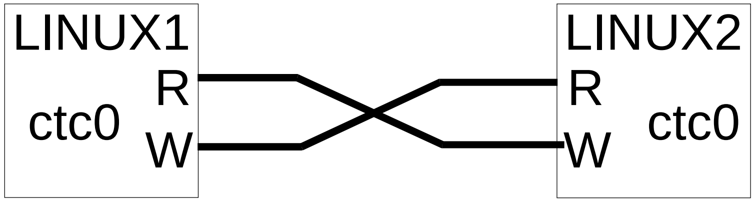
1. Create a virtual CTC connection on your VM console

   1.1. Create virtual CTC devices in both LINUX1 and LINUX2

```
#CP DEFINE CTC E000
#CP DEFINE CTC E001
```

   1.2. Couple CTC devices cross-over, i.e. LINUX1's Read device with LINUX2's Write device ...

```
#CP COUPLE E000 TO LINUX2 E001
#CP COUPLE E001 TO LINUX2 E000
```



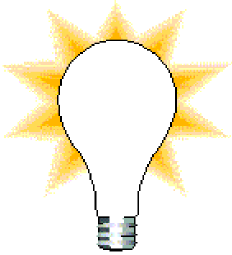
Static CTC Device Setup (cont.)

2. Create a hardware device configuration file:

```
/etc/sysconfig/hardware/hwcfg-ctc-bus-ccw-0.0.e000:
  CCW_CHAN_IDS='0.0.e000 0.0.e001'
  CCW_CHAN_MODE='0'
  CCW_CHAN_NUM='2'
  MODULE='ctc'
  MODULE_OPTIONS=''
  SCRIPTDOWN='hwdown-ccw'
  SCRIPTUP='hwup-ccw'
  SCRIPTUP_ccw='hwup-ccw'
  SCRIPTUP_ccwgroup='hwup-ctc'
  STARTMODE='auto'
```

Static CTC Device Setup (cont.)

- **`CCW_CHAN_IDS`** are Read and Write channels
  - Hexadecimal characters must be lowercase
- **`CCW_CHAN_MODE`** selects protocol for CTC
  - 0 – compatibility with peers other than OS/390 and z/OS (default)
  - 1 – extended mode for Linux peers
  - 2 – for CTC tty based connections to Linux peers
  - 3 – compatibility with OS/390 and z/OS
- **`STARTMODE`** 'auto' --> started by hotplug agents
  'manual' --> manual startup
- A sample hwcfg-file for QETH can be found at
  `/etc/sysconfig/hardware/skel/hwcfg-ctc`



Static CTC Device Setup (cont.)

3. Create an interface configuration file:

```
/etc/sysconfig/network/ifcfg-ctc-bus-ccw-0.0.e000:
  BOOTPROTO='static'
  BROADCAST='10.6.255.255'
  IPADDR='10.6.1.1'
  MTU=''
  NETMASK='255.255.0.0'
  NETWORK='10.6.0.0'
  REMOTE_IPADDR='10.6.1.2'
  STARTMODE='onboot'
```

4. Before reboot: test your config files:

```
#> hwup lcs-bus-ccw-0.0.e000
```

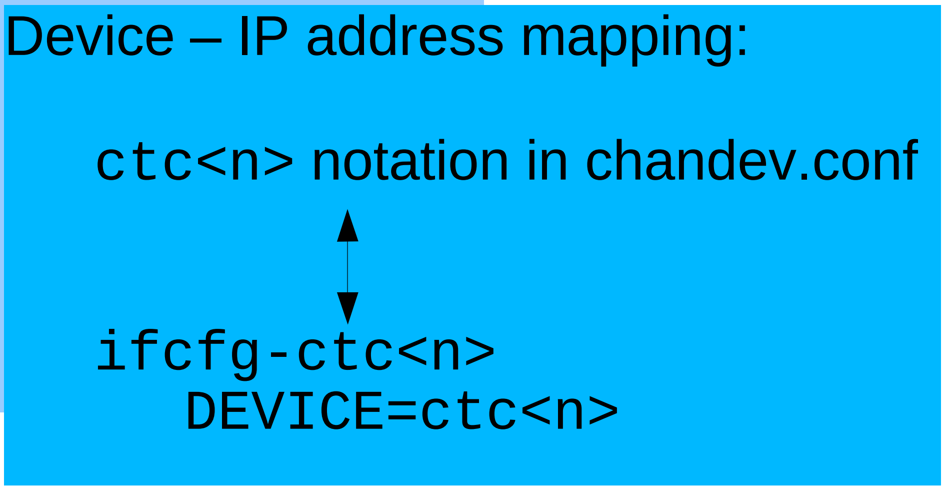
Static CTC Device Setup on Linux 2.4

Hardware configuration is in `/etc/chandev.conf`:

```
ctc0,0xe000,0xe001
```

Interface configuration:

```
/etc/sysconfig/network-scripts/ifcfg-ctc0
  DEVICE=ctc0
  USERCTL=no
  ONBOOT=yes
  BOOTPROTO=none
  BROADCAST=10.6.255.255
  NETWORK=10.6.0.0
  NETMASK=255.255.0.0
  IPADDR=10.6.1.1
  REMOTE_IPADDR=10.6.1.2
  ARP=no
```



Device – IP address mapping:

`ctc<n>` notation in chandev.conf

```
ifcfg-ctc<n>
   DEVICE=ctc<n>
```

Dynamic CTC Device Setup

1. Load the CTC device driver module:

```
#> modprobe ctc
```

2. Create a new CTC device by grouping its CCW devices:

```
#> echo 0.0.e000,0.0.e001 > /sys/bus/ccwgroup/drivers/
   ctc/group
```

3. Set optional attributes:

```
#> echo 0 > /sys/bus/ccwgroup/drivers/ctc/0.0.e000/
   protocol
```

4. Set the new device online:

```
#> echo 1 > /sys/bus/ccwgroup/drivers/ctc/0.0.e000/
   online
```

Dynamic CTC Device Setup (cont.)

5. Find out the interface for your new device:

   At the moment only possible by checking the 'device' link of each `/sys/class/net/ctc*` entry:

```
#>ls -Al /sys/class/net/ctc*/device
lrwxrwxrwx  1 root root 0 Jul  6 11:17
  /sys/class/net/ctc0/device -> ../../../devices/cu3088/0.0.e000
lrwxrwxrwx  1 root root 0 Jul 12 15:14
  /sys/class/net/ctc1/device -> ../../../devices/cu3088/0.0.f000
```

6. Configure your new ctc0 interface:

```
#> ifconfig ctc0 10.6.1.1 pointopoint 10.6.1.2
```

Dynamic CTC Device Setup on Linux 2.4

1. Add definition of the new device to `/etc/chandev.conf`:

```
ctc0,0xe000,0xe001
```

2. Activate the new configuration:

```
#>echo readconf > /proc/chandev
#>echo reprobe > /proc/chandev
```

3. Configure the interface:

```
#> ifconfig ctc0 10.6.1.1 pointopoint 10.6.1.2
```

IUCV Device Driver

- IUCV – Inter User Communication Vehicle
- VM communication facility for inter guest data exchange
- Point to point communication
- Linux device driver builds IP networking semantics on top of IUCV --> NETIUCV

- Recommendation:
  Use GuestLAN where possible

Static IUCV Device Setup

For LINUX 1 iucv0 (see Networking Example)

1. Create a hardware device configuration file:

```
/etc/sysconfig/hardware/hwcfg-iucv-id-linux2:
  STARTMODE="auto"
  MODULE="netiucv"
  MODULE_OPTIONS=""
  MODULE_UNLOAD="yes"
  SCRIPTUP="hwup-iucv"
  SCRIPTDOWN="hwdown-iucv"
```

Note, that the peer user “LINUX2” is specified solely via the file name.

Static IUCV Device Setup (cont.)

2. Create an interface configuration file:

```
/etc/sysconfig/network/ifcfg-iucv-id-linux2:
  BOOTPROTO='static'
  BROADCAST='10.5.255.255'
  IPADDR='10.5.1.1'
  MTU=''
  NETMASK='255.255.0.0'
  NETWORK='10.5.0.0'
  REMOTE_IPADDR='10.5.1.2'
  STARTMODE='onboot'
```

3. Before reboot: test your config files:

```
#> hwup iucv-id-linux2
```

Static IUCV Device Setup on Linux 2.4

Peer VM guests to connect to are specified as kernel parameters:

```
iucv=<vm guest ID>[{:vm guest ID}]
```

e.g.

```
iucv=LINUX2:VMTCPIP
```

Interface configuration:

```
/etc/sysconfig/network-scripts/ifcfg-iucv0
  DEVICE=iucv0
  USERCTL=no
  ONBOOT=yes
  BOOTPROTO=none
  BROADCAST=10.5.255.255
  NETWORK=10.5.0.0
  NETMASK=255.255.0.0
  IPADDR=10.5.1.1
  REMOTE_IPADDR=10.5.1.2
  ARP=no
```

Device – IP address mapping:

position in kernel parameter line

↕

```
ifcfg-iucv<n>
   DEVICE=iucv<n>
```

Dynamic IUCV Device Setup

1. Load the IUCV network device driver module:

```
#> modprobe netiucv
```

2. Create a connection to the peer user:

```
#> echo linux2 > /sys/bus/iucv/drivers/netiucv/
   connection
```

This creates the following sysfs entries:

```
/sys/bus/iucv/devices/netiucv<n>
/sys/devices/iucv/netiucv<n>
/sys/class/net/iucv<n>
```

where *n* is the first free index assigned to the new iucv device
(in our example 0).

Dynamic IUCV Device Setup (cont.)

3. Verify which iucv interface is connected to which user:

```
#> cat /sys/bus/iucv/devices/iucv0/user
linux2
```

4. Configure your new iucv interface:

```
#> ifconfig iucv0 10.5.1.1 pointopoint 10.5.1.2
```

Dynamic IUCV Device Setup on Linux 2.4

Only possible if netiucv is compiled as a loadable module

1. Unload the module. This removes all current connections!

```
#> rmmod netiucv
```

2. Load module and specify all peers as module parameters:

```
#> modprobe netiucv iucv=LINUX2:VMTCPIP
```

3. Configure the interfaces:

```
#> ifconfig iucv0 10.5.1.1 pointopoint 10.5.1.2
#> ifconfig iucv1 ...
```

Summary of Linux Network Device Drivers

	QETH				LCS	CTC	IUCV
	OSA	HiperSockets	GuestLAN QDIO	GuestLAN Hiper			
Adapters	100 Mbps, 1Gbps, 1000 Base-T, HSTR				100 Mbps, 1000 Base-T, HSTR	ESCON, FICON, Virtual CTC/A	
Connection type	LAN	LAN	LAN	LAN	LAN	point-to-point	point-to-point
Protocols	IPv4, IPv6	IPv4	IPv4, IPv6	IPv4	IPv4	IPv4	IPv4
Max bandwith	0.9 Gbps	9.6 Gbps	3.6 Gbps	4.8 Gbps	0.48 Gbps (1000Base-T)	1.2 Gbps (VCTC)	1.44 Gbps
Avg response time	0.9 ms	0.09 ms	0.28 ms	0.24 ms	4.4 ms (1000Base-T)	0.39 ms (VCTC)	0.28 ms
Remarks	**Primary network device driver for Linux on zSeries**				restricted access (admin defines OSA Address Table)		

References

- Linux for zSeries and S/390 on DeveloperWorks

  http://www-128.ibm.com/developerworks/linux/linux390/index.html

- Linux for zSeries and S/390 Documentation

  http://www-128.ibm.com/developerworks/linux/linux390/april2004_documentation.html

- Linux for zSeries and S/390, useful add-ons

  http://www-128.ibm.com/developerworks/linux/linux390/useful_add-ons.html

Outlook for Session 2

- Router setup for Linux on zSeries
- Failover and availability solutions:
  - IP Address Takeover
  - Virtual IP Addresses (VIPA)
  - Proxy ARP
- The qethconf tool
- The qetharp tool
- HiperSockets Network Concentrator (HSNC)