DSS NETWORKS
Metro-Switch Gigabit Backplane Switch Fabric
Linux Driver and SDK Users Manual

(Includes models 8261 and 8261-RIO)

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1. INTRODUCTION

The Metro-Switch family of embedded Gigabit Ethernet switches are a high-performance, flexible and cost-effective solution for adding scalable Gigabit Ethernet switching capabilities for use in standalone or rackmount embedded systems applications.

The Model 8261 supports 12-ports of 10/100/1000 Base T over copper or 10-ports copper and 2 ports of 1000 Base X over optical fiber. It provides an extensive list of features including an onboard management processor with extensible value-added firmware making it ideal for use in many embedded systems applications.

1.1 CAPABILITIES OVERVIEW

The model 8261 features 12 ports of 10/100/1000 Base T Gigabit Ethernet over Copper with two 1000 Base SX/LX fiber uplinks. It is PICMG 2.16 6U fabric card compliant and compatible with both standard CompactPCI® and PICMG 2.16 backplanes. All 12-ports may be routed to slots on the Compact PCI backplane or externally via rear I/O. A system management interface is also supported via the PICMG 2.9 IPMI interface. It optionally supports two 1000 base SX/LX gigabit fiber ports with standard SFF LC connectors via the front panel. It has an onboard RISC/DSP processor for local management and can be operated as a standalone or fully managed switch. Remote management via Telnet is provided. LEDs are provided for each port showing link status, transmit and receive and link quality. All LEDs are multifunction and can be used for additional functions including cable testing and energy detection. It is also PICMG 2.1 R2.0 hot-swap compliant providing support for the hardware connection layer.

The model 8261 uses the latest advanced high-performance, full-featured and highly integrated 12-port Broadcom BCM5690 multilayer switch and BCM5464SR quad-port transceivers and is fully 802.3 compliant. It provides a fully non-blocking 24Gb/32 million frames per second aggregate switching fabric. The switching function supports an extended list of features including layer 3 switching, link aggregation, 802.1Q VLANs, 802.1D spanning tree and priority-based 802.1D/802.1p CoS/traffic class expediting and dynamic multicast filtering. The switch can be configured in a fully redundant, non-blocking network that prevents single points of failure from congesting network traffic. It provides advanced cell and packet based “head of line” blocking prevention techniques, has 1MB of onboard memory for packet buffering, and supports a 10-gig uplink interface. Extended ethernet frame sizes to 9KB are supported. Additional advanced features including rules-based layer 2-7 packet classification/filtering on 128 multiple data flows, port trunking and port mirroring are provided for advanced networking and flow techniques. Network management support includes fully configurable routing tables and RMON, SNMP, Ethernet and extended MIB(s). A 32-bit, 66 MHZ PCI interface is also provided to support system management via the PCI bus and the switch can additionally route packets to/from the PCI interface as a “virtual port” function. This
would allow for example, SNMP or other management packets to be routed to an external processing component in a distributed network management scheme.

1.2 USE AND TARGET APPLICATIONS

The Metro-Switch model 8261 12-port switch is equipped ready-to-use out of the box with no additional software or drivers required. In this most basic operational mode it is used as a **standalone switch** installed in a rackmount chassis. An additional mode allows it to be controlled in a **simple managed mode** using a serial port **Command Line Interface** (CLI). The CLI allows more sophisticated configuration and control management while still operating as a standalone switch. The most functional mode allows it to be controlled in a **fully managed switch** mode from an external processor communicating with the Metro-Switch over the PCI bus via the JN1 CPCI connector.

The Metro-Switch model 8261 is targeted for OEMs and Systems Integrators for use in Data and Telecommunications products including switches, multiplexers, edge routers, media gateways and video broadcasting equipment. It is well suited for support of embedded broadband applications including Internet voice, digital video, IP security, network monitoring, military applications and test equipment.

1.3 KIT CONTENTS

- Linux PCI Management driver for Model 8261 and onboard Broadcom Switch
- Linux driver test utility
- User Manual (this document)

1.4 REFERENCES

Please also see the following documents on our website at [www.dssnetworks.com](http://www.dssnetworks.com) and also included in the OEM developers kit CD:

- **Datasheets** – please see product datasheets and other updated product information on OEM developer CD and on website.

- **Release Notes** -- where updated information is provided on new features, compatibility, performance benchmarks, platform information and corrected problems.

1.5 COMPATIBILITY

The Metro-Switch is fully compliant with the following standards:
IEEE 802.3-2002 (all sections applicable to 1000 Base T, 1000 Base SX, 1000 Base LX)

IEEE 802.1D and IEEE 802.1Q as applicable for VLAN and priority queuing support

PCI 2.2 bus compliant, 32-bit 33/66 MHZ

PICMG 2.0 R3.0 Compact PCI compliant (6U form factor)

PICMG specifications: 2.16 R1.0 Packet Switching Backplane (PSB) compliant fabric board

PICMG 2.9 IPMI support

PICMG 2.1 R2.0 hot-swap (basic hot-swap hardware connection layer)

Telnet remote terminal access.

2. LINUX DRIVER AND UTILITY OVERVIEW

Broadcom Bcm5690 Gigabit Ethernet Switch driver and R/W utility version 1.1a.

Tested on Linux kernels up to 2.6.10.

Interrupts are not currently used or supported as they are not required for management API interface. Interrupts will be used in future releases of the SDK in the MAC driver portion for a “virtual” Ethernet port across the PCI interface.

Set of IOCTL commands for read and write registers and memory in all modes is supported.

The driver does limited validity checks for memory and register accesses, but it is assumed that the application should not send invalid commands.

The sample of using the driver is in the “rwBcm” utility software where all driver-supported commands are implemented.

The driver currently supports 5690 version of the Broadcom chip. The future release will include Chip selector command line argument to select the 5695 chip.

The provided utility is only simple sample to illustrate and exercise the ioctl commands supported by the driver.
3. BOARD LEVEL FEATURES

The Metro-Switch adapter offers the following key features:

- 12-port full-duplex Gigabit Ethernet interfaces routed to 2.16 backplane or rear I/O
- Optional support for 2 multimode or singlemode fiber links (850nm MM or 1310nm SM LC)
- Sustained aggregate throughput of 24 Gbps (3 GB)
- Frame processing rate of up to 32 million frames per
- Onboard RISC management processor and EEPROM configuration
- 4 multi-function LEDs per port (TX, RX, LINK, Signal Quality)
- 32-bit, 66 MHZ PCI interface
- Onboard RS232 (RJ-11 jack) for serial port console support
- Telnet access for serial port console support
- Basic hot-swap support for hardware connection layer
- Installs in CompactPCI PICMG 2.16 compliant system chassis
- Optionally installs in standard Compact PCI PICMG 2.0 R3.0 chassis
- Available with 12-port rear I/O transition module
- Ideal solution for CompactPCI rackmount embedded systems
- Utilizes single 5V power from JN1/JP1 PCI connector
- Provides power regulators onboard for power distribution (3.3V, 2.5V, 1.25V)
- Complies with all PCI revision 2.2 mechanical and electrical requirements
- Fully IEEE 802.3z, IEEE 802.3ab, 802.3u and IEEE 1386 compliant
- Compatible with all 10/100/1000BaseT hubs, switches and routers
- Operates as standalone Layer 2 switch or fully managed L3/multiplayer switch
- Jumbo frame support for up to 9K
- 802.3x full duplex flow control
4. HARDWARE SYSTEM REQUIREMENTS

Compact PCI PSB Platform:

- Compact PCI compliant (PICMG 2.16, PICMG 2.0 R3.0)
- Size 6U chassis and slots, power supply and fan(s)
- Packet Switching Backplane Compliant to PICMG 2.16 R1.0
- At least one fabric slot required
- Metro-Switch installs into fabric slot in PICMG 2.16 PSB backplane

Note: The Metro-Switch may also be installed into peripheral slot on standard Compact PCI chassis with H.110 compatible backplane for connections via rear I/O only, however all pins on CPCI connectors “J3” and “J5” must be passive and comply to PICMG 2.16 signal definitions and routed to rear I/O.
5. BOARD AND CONNECTOR INFORMATION

5.1 COMPONENT DIAGRAM
5.2 BOARD PHOTOS

Model 8261 - P/N 182612 (shown without heat sinks)
5.3 BOARD LED INDICATORS

There are 12 LED arrays marked “P0” thru “P11” on the front panel. Each port array has 4 green LEDs and their meaning is described in the following table:

Port LED Arrays (P0 – P11) Function Table (from left to right)

<table>
<thead>
<tr>
<th>Gigabit Switch Model</th>
<th>LED #1 Green</th>
<th>LED #2 Green</th>
<th>LED #3 Yellow</th>
<th>LED #4 Yellow</th>
</tr>
</thead>
<tbody>
<tr>
<td>8261</td>
<td>Link</td>
<td>TX</td>
<td>RX</td>
<td>Quality*</td>
</tr>
</tbody>
</table>

Note: The Quality LED is only available for ports in 1000-Base-T copper mode.

There is also a single LED Array containing a row of 3 LEDs (2 Yellow, 1 Green) described in the following table:

Processor LED (LED1) Function Table (left to right)

<table>
<thead>
<tr>
<th>Gigabit Switch Model</th>
<th>LED #1 YEL</th>
<th>LED #2 YEL</th>
<th>LED #3 Green</th>
</tr>
</thead>
<tbody>
<tr>
<td>8261</td>
<td>Warn</td>
<td>LinkSt</td>
<td>RUN</td>
</tr>
</tbody>
</table>

Note: After power on and during normal operation, the green “RUN” LED should always blink at a slow steady heartbeat pace of about once per every 2 seconds.
5. BLOCK DIAGRAM OF MODEL 8261

Switch data path block diagram
6. DRIVER INSTALLATION AND EXAMPLE USAGE

Installation:

Both the driver and the utility can be copied into any directory.

Both of them can be built just simply typing “make clean” and “make” at the command prompt.

Using the driver and the read/write register utility:

To load and activate the driver, you must login as super user root and do “insmod ./bcm.o” in the directory where you built the driver.

Once the driver is loaded, go the directory where you compiled the utility. The first command you should execute is:

RwBcm –finddev

This command will find the name that was assigned to your device. You need to use this name to bring the interface up and all subsequent commands have to use this name.

For example if the output of RwBcm –finddev is:

Found Device eth2; then “eth2” is the assigned name for the interface.

To bring the device up type: ifconfig eth2 <ip address> up

[Note: To execute this command you need to be logged in as a root.]

The driver is now ready to accept and execute commands.

For short overview of the available commands, use the help command [rwBcm –help]

For details about the register and memory access modes refer to the "BCM569X Programmer’s Reference Guide" document available from a Broadcom representative or distributor.

The following is the sample session illustrating all commands and their outputs. All examples are just random reads and writes. They do not represent valid configuration.

1. The First Command that should be executed is to identify the device:
2. Register Access Commands

2.1 Read Directly mapped register

```bash
[util-1.1a]$ ./rwBcm -finddev
Find Ethernet Switch Device
Found Device eth2

$ ./rwBcm -rrd 0x50
Read Register Direct
R[0x00000050] = 0x00048002
```

2.2 Read Directly mapped register

```bash
[util-1.1a]$ ./rwBcm -rrd 0x54
Read Register Direct
R[0x00000054] = 0x00000020
```

2.3 Write Directly mapped register

```bash
[util-1.1a]$ ./rwBcm -wrd 0x54 0x00002ABC
Write Register Direct
```

2.4 Verify the new value in Directly mapped register

```bash
[util-1.1a]$ ./rwBcm -rrd 0x54
Read Register Direct
R[0x00000054] = 0x00002ABC
```

2.5 Read Indirectly Mapped Register

```bash
[util-1.1a]$ ./rwBcm -rri 0x00E80024
Read Register Indirect (S-Channel)
Indirect Register Access at 0x00E80024 Using S-Channel
R[0x00E80024] = 0x0010000A
```

2.6 Write Indirectly Mapped Register

```bash
[util-1.1a]$ ./rwBcm -wri 0x00E80024 0x0012C
Write Register Indirect
```

2.7 Verify the new value

```bash
[util-1.1a]$ ./rwBcm -rri 0x00E80024
Read Register Indirect (S-Channel)
```
Indirect Register Access at 0x00E80024 Using S-Channel
R[0x00E80024] = 0x0000012C

2.8 Incorrect command. The register cannot be accessed in direct mode

[util-1.1a]$ ./rwBcm eth2 -rrd 0x00E80024
Read Register Direct

Address 0x00E80024 is out of range for Direct Access Mode

2.9 Read Internal Phy SerDes Register

[util-1.1a]$ ./rwBcm eth2 -rrpsi 0x3 0x10
Read Register Phy SerDes Internal

Internal SERDES Register Access at 0x00000010 Using CMIC_MIIM_PARAM
Port <03> Reg[16] = 0x0400

2.10 Read External Phy SerDes Register

util-1.1a]$ ./rwBcm eth2 -rrpse 0x4 0x10
Read Register Phy SerDes External

External SERDES Register Access at 0x00000010 Using CMIC_MIIM_PARAM
Port <04> Reg[16] = 0x0001

2.11 Read another Internal Phy SerDes Register

util-1.1a]$ ./rwBcm eth2 -rrpsi 0x3 0xB
Read Register Phy SerDes Internal

Internal SERDES Register Access at 0x0000000B Using CMIC_MIIM_PARAM
Port <03> Reg[11] = 0x0000

2.12 Write to it new value

[util-1.1a]$ ./rwBcm eth2 -wrpsi 0x3 0xB 0x2
Write Register Phy SerDes Internal

2.13 Value verification

[util-1.1a]$ ./rwBcm eth2 -rrpsi 0x3 0xB
Read Register Phy SerDes Internal

Internal SERDES Register Access at 0x0000000B Using CMIC_MIIM_PARAM
Port <03> Reg[11] = 0x0002

3. Memory Access Commands

3.1 Read the Trunk Group table with index 4
[util-1.1a]$ ./rwBcm eth2 -rm 0x04E00000 0x4
Read Memory

TRUNK_GROUP[4]:
<095 : 064>   0x017E23FC
<063 : 032>   0x2789DEE5
<031 : 000>   0x2E0FB7C9

3.2 Read the Trunk Group table with index 0x44. The max index for this table is 31 so the command should fail

[util-1.1a]$ ./rwBcm eth2 -rm 0x04E00000 0x44
Read Memory
Command Failed

3.3 The following command reads XQn table for port 3 index 4. Notice that the port is in bits [19:16] of the address

[util-1.1a]$ ./rwBcm eth2 -rm 0x0BD30000 4
Read Memory
XQ3[4]:
<031 : 000>   0x81F281F2

3.4 Write some value into the L2 Table with index 0x10

[util-1.1a]$ ./rwBcm eth2 -wmb 0x01E00000 0x10 0 0x0033FF44 1 0x07E1234AA 2 0x0000BAD0
Write Memory Buffered
The Following Entries will be updated:
----------------------------------------
Table Offset: 0x01E00000
Table Index:  0x00000010
----------------------------------------
Position               Value
----------------------------------------
< 095 : 064>        0x0000BAD0
< 063 : 032>        0x7E1234AA
< 031 : 000>        0x0033FF44
----------------------------------------

3.5 Read the L2 Table index 0x10

[util-1.1a]$ ./rwBcm eth2 -rm 0x01E00000 0x10
Read Memory
L2_TABLE[16]:
<095 : 064>   0x0000BAD0
<063 : 032>   0x7E1234AA
<031 : 000>   0x0033FF44

3.6 Memory commands to access FFP tables.
The last pair of commands is used to read and write FFP Tables \texttt{rmp} and \texttt{wmbp}. Both of these commands are using port 0 relative addressing. The address is defined as \texttt{0x07gXXXXX} where the \texttt{g} is the port number. Rather than replacing the \texttt{g} with port number, these commands use port 0 as base and the port is specified in port command line argument.

\subsection*{3.6.1 Read Gmask for port 2 index 7}

util-1.1a]$ ./rwBcm eth2 -rmp 0x07000000 0x2 0x7

Read Memory for Port

\begin{verbatim}
FFP: GIMASK [port 2] [index 7]:
<383 : 352> 0x4B934E6A
<351 : 320> 0x00C5CDC9
<319 : 288> 0x006AAB0F
<287 : 256> 0x0009008F
<255 : 224> 0xDFAAE265
<223 : 192> 0xAF8F03FF
<191 : 160> 0x1DBD157F
<159 : 128> 0xB1B53E77
<127 :  96> 0xFDE2F458
< 95 :  64> 0x669DD7F7
< 63 :  32> 0xAFB7FFC7
< 31 :  00> 0xF1A4F39C
\end{verbatim}
3.6.2 Write Gimask for port 2 index 7

This is an ugly long command, but the table is 12 words wide and you have to write it in one shot. This command could be extended to write only one ore more words at the time, but it has to first read the whole table, change the specified entries and write the whole updated table back.

```
[util-1.1a]$ ./rwBcm eth2 -wmbp 0x07000000 0x2 0x7 0 0x00000000 1 0x11111111
2 0x22222222 3 0x33333333 4 0x44444444 5 0x55555555 6 0x66666666 7 0x77777777
8 0x88888888 9 0x99999999 10 0xAAAAAAAA 11 0xBBBBBBBB
```

Write Memory Buffered for Port

The Following Entries will be updated:

```
Table Offset: 0x07200000
Table Index: 0x00000007
```

```
Position               Value
----------------------------------------
< 383 : 352>        0xBBBBBBBB
< 351 : 320>        0xAAAAAAAA
< 319 : 288>        0x99999999
< 287 : 256>        0x88888888
< 255 : 224>        0x77777777
< 223 : 192>        0x66666666
< 191 : 160>        0x55555555
< 159 : 128>        0x44444444
< 127 : 096>        0x33333333
< 095 : 064>        0x22222222
< 063 : 032>        0x11111111
< 031 : 000>        0x00000000
----------------------------------------
```

3.6.3 Read the Gimask for port 2 index 7.

It should have new values. As you can see, not all fields were updated as specified in the previous write command. These fields are reserved.

```
[util-1.1a]$ ./rwBcm eth2 -rmp 0x07000000 0x2 0x7
Read Memory for Port

FFP: GIMASK [port 2] [index 7]:
<383 : 352> 0x3BBBBBBB
<351 : 320> 0x00AAAAAA
<319 : 288> 0x00199999
<287 : 256> 0x00080088
<255 : 224> 0x77777777
<223 : 192> 0x66666666
<191 : 160> 0x55555555
<159 : 128> 0x44444444
<127 : 096> 0x33333333
<095 : 064> 0x22222222
```
6. SWITCH MANAGEMENT DRIVER API

Examples of the switch management driver API can be found in the source code of the “rwBcm.c” driver utility or this utility may be invoked directly from the command line.

The driver management API will be documented in the next revision of this manual.
7. WARRANTEE AND SUPPORT INFO

Technical Support and Warranty:

24-hour support via web email and 1 year product warranty on controller hardware (subject to Standard Warrantee Policy and Purchase Terms and Conditions).

Contacting Us

You may contact DSS Networks in one of several ways: via the Web, e-mail, fax or telephone.

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