IBM Cluster Systems Management for Linux®

Remote Control Guide and Reference

Version 1.1

SA22-7856-02

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Note!
Before using this information and the product it supports, read the information in “Notices” on page 21.

Third Edition (December 2001)

This edition of the *IBM Cluster Systems Management for Linux Remote Control Guide and Reference* applies to IBM Cluster Systems Management for Linux Version 1.1, program number 5765–E88, and to all subsequent releases of this product until otherwise indicated in new editions.

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Contents

About This Book

This book is the updated version of the *IBM Cluster Systems Management for Linux Remote Control HOWTO* (SA22-7856-00) that was last published in June, 2001. This book describes IBM Cluster Systems Management for Linux (CSM) remote control, and the administrative tasks that can be accomplished with greater ease and efficiency by using CSM remote control functions.

Who Should Use This Book

This book is intended for system administrators who want to use IBM Cluster Systems Management for Linux. The system administrator should have experience in UNIX® administration and networked systems.

How to Use This Book

This book contains information that describes the IBM Cluster Systems Management for Linux Remote Control functions. It is divided into three chapters:

1. Chapter one contains an overview of IBM Cluster Systems Management for Linux Remote Control.
2. Chapter two contains information on the Remote Power function.
3. Chapter three contains information on the Remote Console function.

Highlighting

The following highlighting conventions are used in this book:

Typographic	Usage
Bold	Identifies commands, subroutines, keywords, files, structures, directories, and other items whose names are predefined by the system. Also identifies graphical objects such as buttons, labels, and icons that the user selects
Italic	Identifies parameters whose actual names or values are to be supplied by the user.
`monospace`	Identifies examples of specific data values, examples of text similar to what you might see displayed, examples of portions of program code similar to what you might write as a programmer, messages from the system, or information you should actually type.

ISO 9000

ISO 9000 registered quality systems were used in the development and manufacturing of this product.

Related Information

See the following references for information related to IBM Cluster Systems Management for Linux Remote Control:

Table 1.

Web Site	URL	Resources
IBM CSM for Linux High-performance Cluster Management	http://www.ibm.com/servers/eserver/clusters/software/csm.html	• CSM Publications • CSM FAQ • Firmware updates

Table 1. (continued)

Web Site	URL	Resources
IBM CSM for Linux Remote Control Guide and Reference	http://www.ibm.com/servers/eserver /clusters/library/csmremot.html	• IBM Remote Supervisor Adapter User's Guide • IBM Universal Manageability (UM) Services • Conserver open source software • Linux Documentation Project

For information on using serial devices, see these Linux HOWTO documents, located at /usr/doc/HOWTO or on the Linux Documentation Project Web site (http://metalab.unc.edu/mdw/index.html):

- *Serial-HOWTO*
- *Serial-Programming-HOWTO*
- *Modem-HOWTO*

How to Obtain Publications

The IBM Cluster Systems Management for Linux publications are available as HTML and PDF files on the CD-ROM in the **/doc** directory or on the installed system in the **/opt/csm/doc** directory. The README is available on the CD-ROM in the root directory (/). The file names are as follows:

- *IBM Cluster Systems Management for Linux Administration Guide*, am7LXadm.pdf
- *IBM Cluster Systems Management for Linux Planning and Installation Guide*, am7LXstp.pdf
- *IBM Cluster Systems Management for Linux Remote Control Guide and Reference*, am7LXrem.pdf
- *IBM Cluster Systems Management for Linux Technical Reference*, am7LXcmd.pdf

Publications for IBM Cluster Systems Management for Linux were also available at the time of this release at http://www.ibm.com/servers/eserver/clusters/software/csm.html.

How to Reach Us by E-Mail

If you would like to contact us by e-mail, send your comments to cluster@us.ibm.com.

Chapter 1. Cluster Systems Management Remote Control Overview

IBM Cluster Systems Management for Linux (CSM) Remote Control software allows a system administrator to control nodes in a Linux cluster from a remote location. This essentially frees the CSM cluster from any restrictions associated with geographic node location. The two main functions for CSM Remote Control are the remote power and remote console commands. The **rpower** command allows an administrator to query, power on, power off, and reset remote nodes. The **rconsole** command allows an administrator to open a console for a remote node. The CSM administrator runs the **rpower** and **rconsole** commands from a control node called the management server. See the man pages or the *IBM Cluster Systems Management for Linux Technical Reference* for detailed command usage information.

Hardware Configuration

CSM Remote Control cluster software is dependent upon the hardware configuration. For IBM Netfinity® and xSeries™ clusters, CSM hardware control point and internal service processor database attribute values must match the Remote Supervisor adapter (RSA) host names and Internal Service Processor (ISP) text IDs, respectively. This will ensure that the remote control software understands the physical connections and can properly control the target nodes.

The remote power command, **rpower**, is dependent on the physical cabling of the Remote Supervisor adapters and when applicable, the ISPs they control. It is also dependent on the adapter host names and the ISP Text IDs. The remote console command, **rconsole** is dependent on the cabling of the remote console server and the cabling description in the CSM database. These details will be explained in the remote power and remote console sections to help you understand the interdependencies between the hardware and software. With the correct definitions, the **rpower** and **rconsole** commands will target the intended node or node group. (You can control hardware other than the supported IBM hardware by writing custom power and console methods, which is discussed in later sections.)

CSM for Linux is an integral part of the IBM @server Cluster 1300 platform for deploying Linux applications requiring a cluster. The IBM @server Cluster 1300 includes the following hardware:

- xSeries 330 and 342 nodes
- Remote Supervisor adapters (RSAs)
- Ethernet PCI adapters
- Equinox Serial Providers (ESPs).

Networking Configuration

For security reasons, the networking configuration must separate the remote control functions **rpower** and **rconsole** from other clusters functions. An efficient way to do this is to create a virtual LAN (VLAN) for the remote control functions, which is separate and distinct from the more general purpose VLAN connecting the cluster's nodes. Optionally, the cluster VLAN can be isolated from the larger network. See the following sections for more details.

Management VLAN

The management VLAN connects the management server to the cluster's terminal server(s) and to the Remote Supervisor adapter(s) installed in some or all of the nodes. Since this is intended to be an isolated network, traffic flows without encryption using clear text authentication. Access to the **rpower** and **rconsole** commands is limited to root user on the management server. All other nodes have no access to the Management VLAN.

Cluster VLAN

A cluster VLAN subdivides the Ethernet switch so each node can use the cluster VLAN for Network I/O (NFS, tftp, ftp) and job control traffic.

Public VLAN

Each node connects to a public VLAN to allow authorized access to the nodes in the cluster. You may choose to combine the cluster VLAN and public VLAN.

Hardware and Networking Configuration Diagrams

The following diagram (Figure 1) shows the hardware and networking configuration required for using CSM remote control with IBM xSeries 330 nodes. (Figure 3 shows the configuration for IBM xSeries 342 nodes.) See “Node Attributes Table” on page 9 for example node attribute definitions corresponding to Figure 1.

In Figure 1, the Management Server connects to the Management VLAN and the Cluster VLAN through Ethernet adapters. The terminal server, an Equinox Serial Provider (ESP) in this example, connects to the Management VLAN through its Ethernet adapter, and to the cluster nodes through their serial (COM) ports as shown. (An ESP-16 can connect up to 16 nodes. Other terminal servers may have different capacities.) The nodes must be connected to the Cluster VLAN through their Ethernet adapters, and directly or indirectly to an IBM Netfinity Remote Supervisor adapter (RSA). The Management VLAN connects to the RSA in select nodes. (One RSA is required for every 10 nodes.) The RSAs connect to their own node’s ISP port, and up to 9 more node ISP ports are daisy-chained from there. Configuration for a Public VLAN is optional and can be defined by the system administrator.

Note: Figures 1-4 assume an installation where eth0 is defined as the first Ethernet adapter in the system. IBM suggests using this type of installation, which can be achieved by connecting the eth0 adapter directly to the Cluster VLAN.

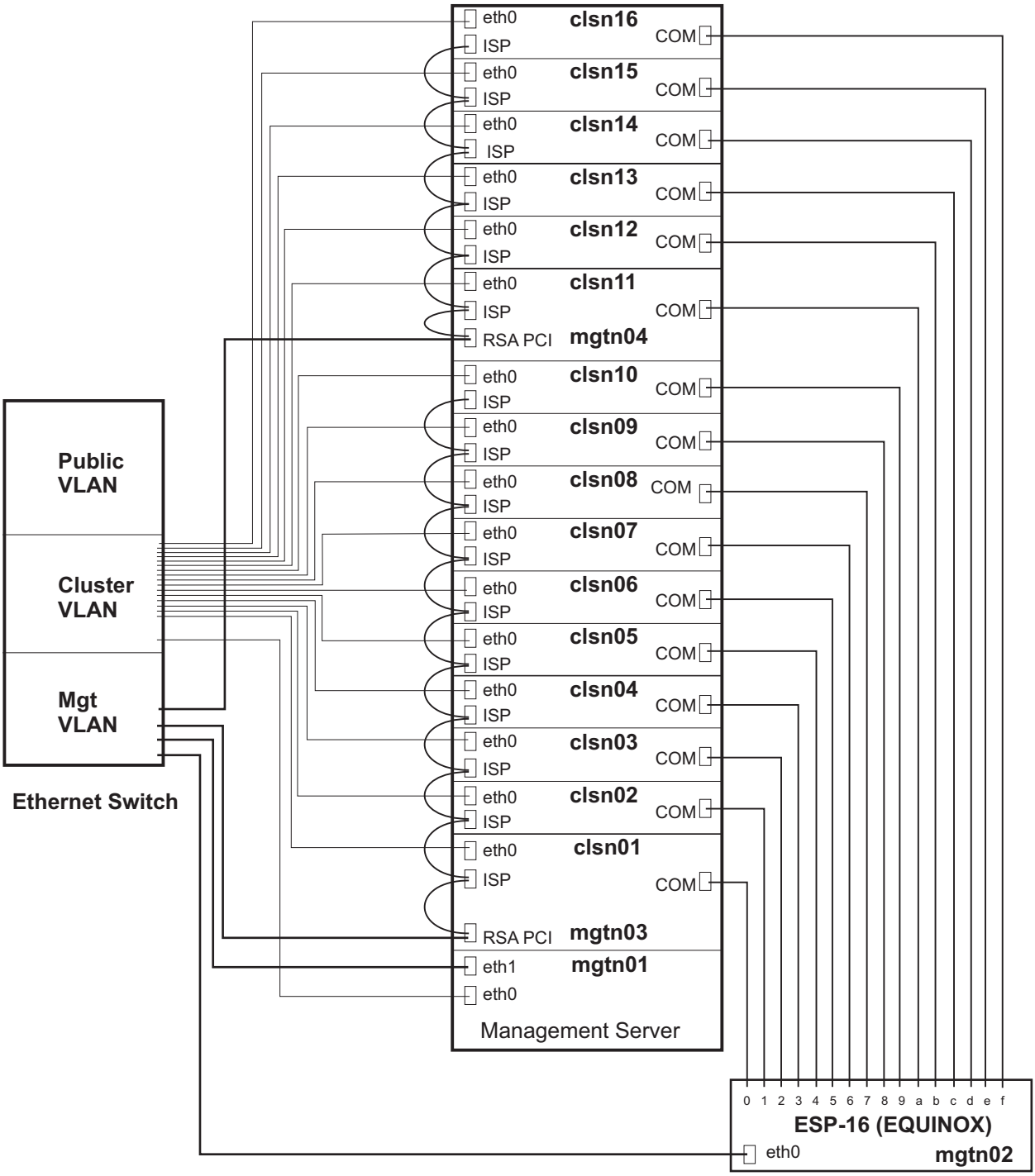

Figure 1. CSM Remote Control Hardware and Networking Configuration for IBM xSeries 330 Nodes

The following diagram (Figure 2) shows the relationship between the CSM node database attributes and the actual (internal) hardware names used in Figure 1. For remote power and remote console to work as expected, this matching of database attribute names to the internal hardware values must be correct for all RSAs, ISPs, and ESPs in the cluster.

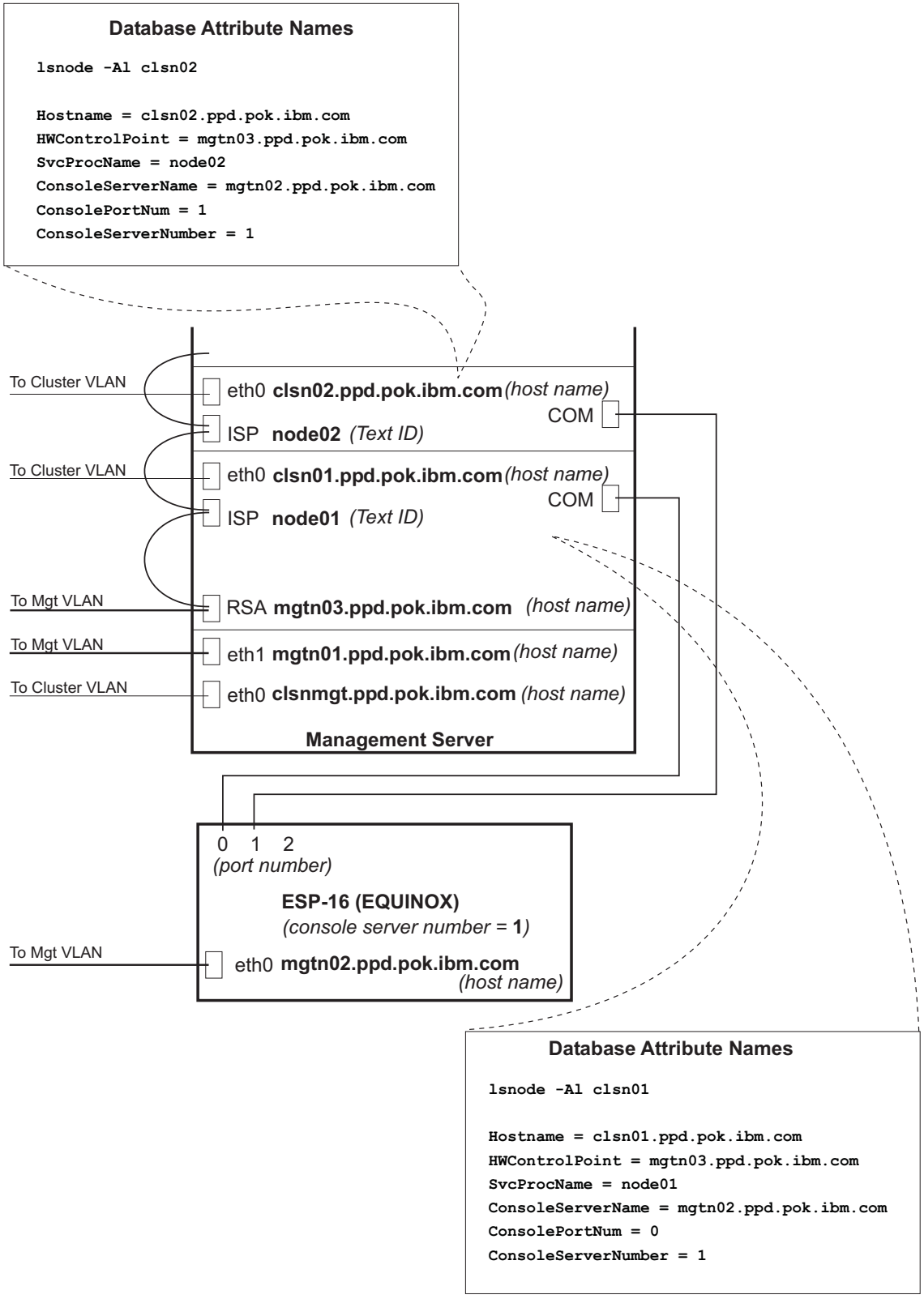

Figure 2. CSM Remote Control Database Attributes for IBM xSeries 330 Nodes

The following diagram (Figure 3) shows the hardware and networking configuration required for using CSM remote control with IBM xSeries 342 nodes. This diagram shows two ways of cabling the RSAs. They can each have their own connection to the Management VLAN (mgtn03.pok.ibm.com – mgtn12.pok.ibm.com), or a number of them can be daisy-chained from one RSA connected to the Management VLAN (mgtn13.pok.ibm.com). See Figure 4 for a more detailed view of a few nodes from Figure 3.

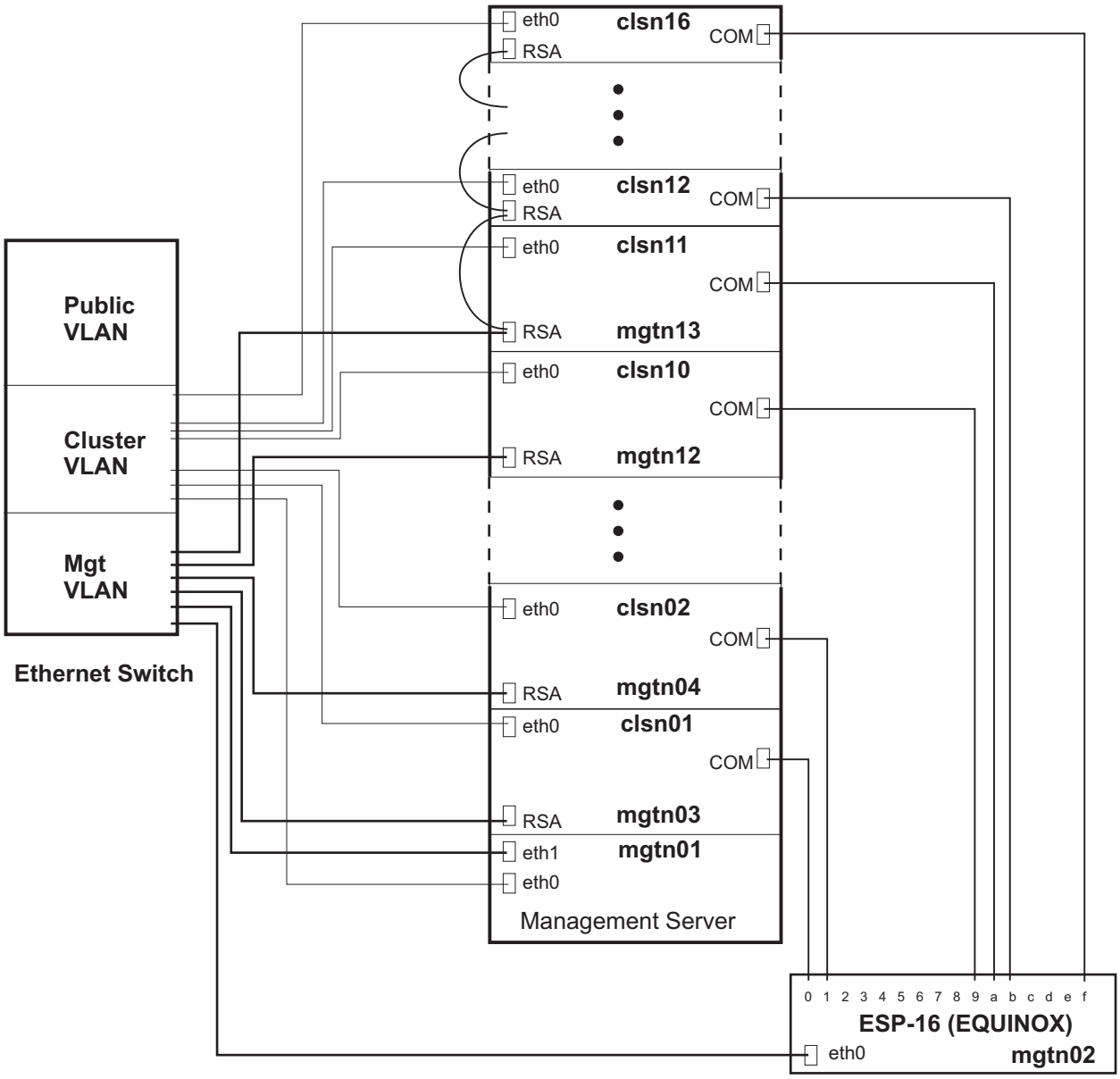

Figure 3. CSM Remote Control Hardware and Networking Configuration for IBM xSeries 342 Nodes

The following diagram (Figure 4) is a more detailed view of a few nodes from Figure 3. The diagram shows the relationship between the CSM node database attributes and the actual (internal) hardware names used in Figure 3. For remote power and remote console to work as expected, this matching of database attribute values to the internal hardware names must be correct for all RSAs and ESPs in the cluster.

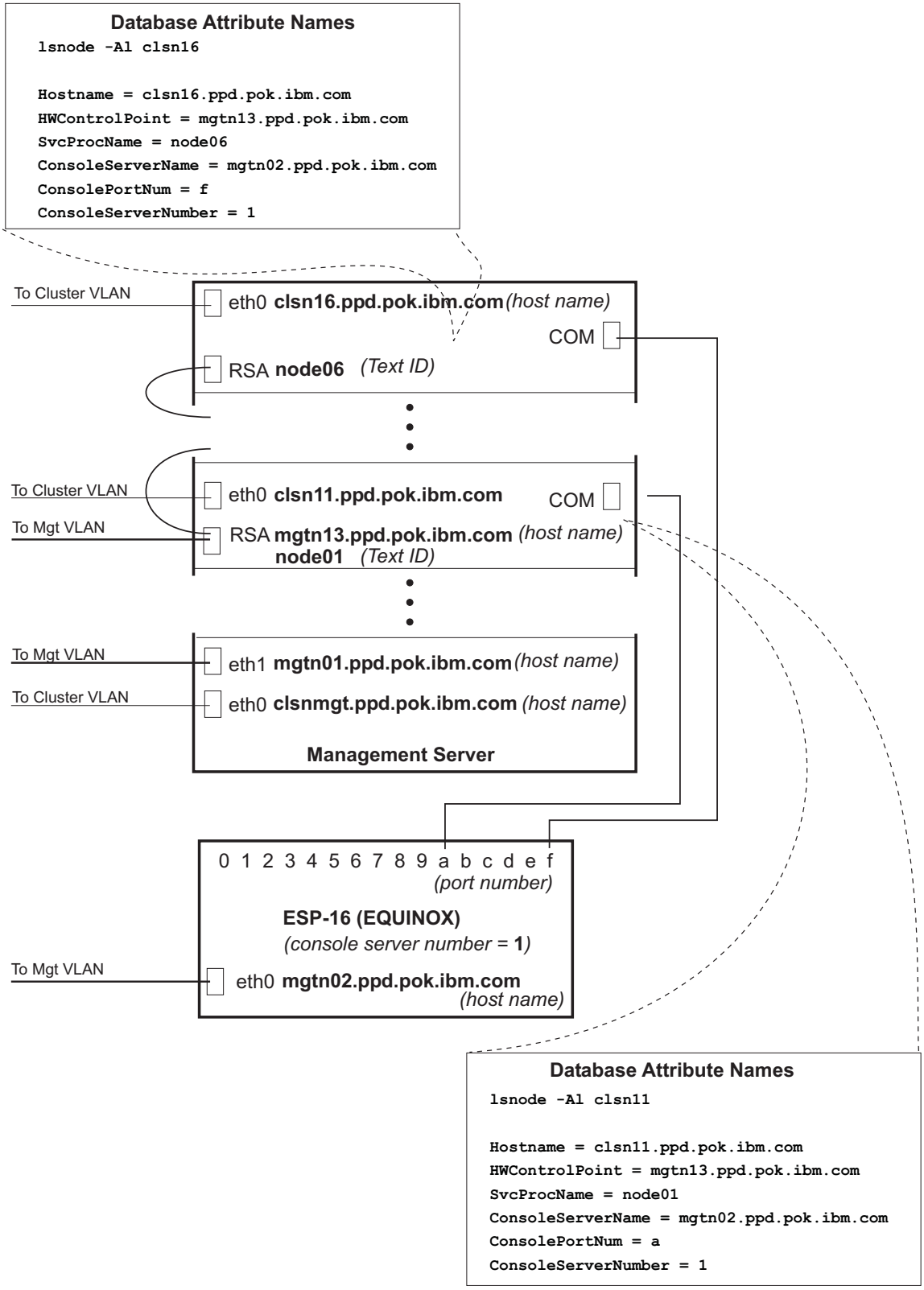

Figure 4. CSM Remote Control Database Attributes for IBM xSeries 342 Nodes

Node Attributes Table

For planning purposes, it is helpful to fill out a table describing all of the nodes' attributes. In the following example, the cluster has 20 nodes. The attributes correspond to the hardware and networking configuration shown in Figure 1 on page 3. The following page contains a blank template you can fill out.

Note: The console port number (*ConsolePortNum*) is the physical port that the node's serial port is connected to in the console server hardware.

Table 2. Node Attributes Table: Example

Hostname	*HWControlPoint*	*Power Method*	*Svc ProcName*	*ConsoleServerName*	*Console Server Number*	*Console Method*	*Console PortNum*	*HWType*	*InstallMethod*
clsn01.pok.ibm.com	mgtn03.pok.ibm.com	netfinity	node01	mgtn02.pok.ibm.com	1	esp	0	netfinity	csmonly
clsn02.pok.ibm.com	mgtn03.pok.ibm.com	netfinity	node02	mgtn02.pok.ibm.com	1	esp	1	netfinity	csmonly
clsn03.pok.ibm.com	mgtn03.pok.ibm.com	netfinity	node03	mgtn02.pok.ibm.com	1	esp	2	netfinity	csmonly
clsn04.pok.ibm.com	mgtn03.pok.ibm.com	netfinity	node04	mgtn02.pok.ibm.com	1	esp	3	netfinity	csmonly
clsn05.pok.ibm.com	mgtn03.pok.ibm.com	netfinity	node05	mgtn02.pok.ibm.com	1	esp	4	netfinity	csmonly
clsn06.pok.ibm.com	mgtn03.pok.ibm.com	netfinity	node06	mgtn02.pok.ibm.com	1	esp	5	netfinity	kickstart
clsn07.pok.ibm.com	mgtn03.pok.ibm.com	netfinity	node07	mgtn02.pok.ibm.com	1	esp	6	netfinity	kickstart
clsn08.pok.ibm.com	mgtn03.pok.ibm.com	netfinity	node08	mgtn02.pok.ibm.com	1	esp	7	netfinity	kickstart
clsn09.pok.ibm.com	mgtn03.pok.ibm.com	netfinity	node09	mgtn02.pok.ibm.com	1	esp	8	netfinity	kickstart
clsn10.pok.ibm.com	mgtn03.pok.ibm.com	netfinity	node10	mgtn02.pok.ibm.com	1	esp	9	netfinity	kickstart
clsn11.pok.ibm.com	mgtn04.pok.ibm.com	netfinity	node01	mgtn02.pok.ibm.com	1	esp	a	netfinity	csmonly
clsn12.pok.ibm.com	mgtn04.pok.ibm.com	netfinity	node02	mgtn02.pok.ibm.com	1	esp	b	netfinity	csmonly
clsn13.pok.ibm.com	mgtn04.pok.ibm.com	netfinity	node03	mgtn02.pok.ibm.com	1	esp	c	netfinity	csmonly
clsn14.pok.ibm.com	mgtn04.pok.ibm.com	netfinity	node04	mgtn02.pok.ibm.com	1	esp	d	netfinity	csmonly
clsn15.pok.ibm.com	mgtn04.pok.ibm.com	netfinity	node05	mgtn02.pok.ibm.com	1	esp	e	netfinity	csmonly
clsn16.pok.ibm.com	mgtn04.pok.ibm.com	netfinity	node06	mgtn02.pok.ibm.com	1	esp	f	netfinity	kickstart
clsn17.pok.ibm.com	mgtn04.pok.ibm.com	netfinity	node07	mgtn03.pok.ibm.com	2	esp	0	netfinity	kickstart
clsn18.pok.ibm.com	mgtn04.pok.ibm.com	netfinity	node08	mgtn03.pok.ibm.com	2	esp	1	netfinity	kickstart
clsn19.pok.ibm.com	mgtn04.pok.ibm.com	netfinity	node09	mgtn03.pok.ibm.com	2	esp	2	netfinity	kickstart
clsn20.pok.ibm.com	mgtn04.pok.ibm.com	netfinity	node10	mgtn03.pok.ibm.com	2	esp	3	netfinity	kickstart

Table 3. Node Attributes Table: Template

Hostname	*HWControlPoint*	*Power Method*	*Svc ProcName*	*ConsoleServerName*	*Console Server Number*	*Console Method*	*Console PortNum*	*HWType*	*InstallMethod*

Chapter 2. Remote Power

The remote power command, **rpower**, reboots and resets hardware, powers hardware on and off, and queries node power state. See the **rpower** man page or the *IBM Cluster Systems Management for Linux Technical Reference* for detailed usage information.

The **rpower** command is structured so it can be easily expanded for another hardware type. It uses the *PowerMethod* attribute in the CSM database to determine which underlying hardware control routine will be used. If the *PowerMethod* attribute is *netfinity*, the hardware control routine called is **/opt/csm/bin/netfinity_power**. To use other hardware types you need to change the entry in CSM and write a new custom power method named **/opt/csm/bin/***PowerMethod***_power**. See "Writing a Custom Power Method" on page 14.

Remote Power Architecture

CSM hardware configuration consists of the following components:

- Management Server
- Isolated Management Network (Management VLAN)
- Remote Supervisor adapters (RSAs)
- Ethernet PCI adapters.

For optimal security, the components must be configured so that the management server is the only PCI adapter attached to the management VLAN, and has sole access to the console servers and the RSA hardware control points.

For each node definition in the CSM database, the *HWControlPoint* attribute value must match the appropriate RSA host name. Likewise, the node *SvcProcName* attribute value in the database must match the text ID of the node's ISP or RSA.

In xSeries 330s, each RSA manages a group of up to ten nodes. By default, each group contains nodes with *SvcProcName* attributes node01 – node10. Since you may have more than one group of nodes, the host name *HWControlPoint* attribute specifies the RSA associated with each group.

Note: The CSM **definenode** and **addnode** commands use *nodexx* as the default *SVCProcName*. Whether you accept these default names or specify others (for example, node short host names), you must manually set the ISP or RSA text IDs to match.

Remote Power Configuration

There is a direct relationship between the hardware configuration and the CSM database information created with the **definenode** and **addnode** commands. Planning is required prior to running **definenode** or **addnode** to ensure that nodes are defined correctly. For detailed information on the **definenode** and **addnode** commands, see the man page or the *IBM Cluster Systems Management for Linux Technical Reference*. For the define node procedure, see the *IBM Cluster Systems Management for Linux Planning and Installation Guide*.

You can use the **lsnode** command to verify the *SvcProcName* of the node, and the **chnode** commands to change the *SVCProcName* value when necessary.

You can telnet or establish an http connection to a node's *HWControlPoint* (the host name of an RSA) and use the Advanced Systems Management (ASM) panels or Web pages to verify RSA and ISP text IDs. (You need to know the ISP and RSA user IDs and passwords to make these connections.) To change an ISP's text ID, you must reboot the node of interest using the Remote Supervisor adapter Firmware Update Diskette. The diskette can be downloaded from the ″Firmware updates″ links at:

http://www.ibm.com/servers/eserver/clusters/software/csm.html. The same utilities are available on the Remote Supervisor Adapter Support CD that comes with the adapter. You can also use telnet or Web access to change its text ID by editing ″ASM Name″ under ″Setup/Settings″ / ″System″.

The RSA, and ISP user IDs and passwords are recorded in the **/etc/opt/csm/netfinity_power.config** file on the CSM management server. The file is created and updated by the **addnode** and **definenode** commands, and can be edited manually as required. For ISPs and RSAs, the default user ID shipped with the system is ″USERID″ and the default password is ″PASSW0RD″ (p-a-s-s-w-zero-r-d). The **addnode** and **definenode** commands write these default values to the **netfinity_power.config file**. IBM suggests you change these default values as soon as possible. To change ISP and RSA user IDs and passwords, use the RSA Firmware Update Diskette, the support CD, or telnet or Web access.

Writing a Custom Power Method

You can write a custom power method to suit your hardware environment. Each environment has its own routine (in **/opt/csm/bin/***PowerMethod*_**power**). The **rpower** command runs the power method and passes the following parameters. If you write a new power method to manage another power type, you must include these parameters in the order shown in the interface definition:

1. *option_string*
2. *target_node_hostname*
3. *HWControlPoint_hostname*
4. *SvcProcName*
5. *remote_action*

Node Configuration

Remote power requires the following CSM attributes for each node:

HWControlPoint
: Host name of the RSA on the Management VLAN providing access to the node's remote power capabilities. For an xSeries 330 node, it is the host name of the RSA to which the node's ISP is daisy-chained. For an xSeries 342 node, it is the host name of the node's RSA (if the RSA is connected directly to the Management VLAN), or the host name of the RSA on the Management VLAN to which this node's RSA is daisy-chained.

PowerMethod
: Determines the program to invoke for a specific type of hardware power control. For example: *netfinity* (which corresponds to **/opt/csm/bin/netfinity_power**).

SvcProcName
: For x330s, the node's ISP text ID. For x342s, the node's RSA text ID. For example: node01.

To specify the user IDs and passwords for remote power, edit the /etc/opt/csm/netfinity_power.config file, and ensure that the ISPs, and RSAs in the nodes have the user IDs and passwords listed in this file.

To replace a node, set the user ID, password, and text ID of the new node's ISP or RSA to the values that were configured for the replaced node.

Adding a New Node

Adding a new node requires some initial planning using the "Node Attributes Table" on page 9 and the **lsnode** command. The text ID of the node's ISP or RSA and the *SvcProcName* attribute must match. The host name of the RSA controlling the node and *HWControlPoint* attribute must also match. Verify that these attributes are correct before running the **definenode** or **addnode** command.

Testing Remote Control

Test your remote control functions before using them in a production environment. Use the **rpower** command to run **query**, **power on**, and **power off** on the nodes to verify that they are configured correctly and are responding accordingly. See the **rpower** man page or the *IBM Cluster Systems Management for Linux Technical Reference* for detailed examples.

Chapter 3. Remote Console

The remote console command, **rconsole**, opens a remote console for each node specified with the command. The method used for opening a remote console is dependent upon the hardware and software supporting the remote console. This section describes remote console hardware configuration, software support, and the relationship between them.

Notes:

1. For Equinox Serial Provider (ESP) terminal servers, you must install Equinox espx RPM version 3.02 or later on the Management Server, because this is the minimum level required by Red Hat version 7.1
2. Ethernet adapters on some Equinox terminal servers are only 10 Mb/s, so you must ensure the ports on the Ethernet switches are set accordingly.

Hardware Console Configuration

The console or terminal server is connected to the management VLAN by an Ethernet connection. Each console port is connected to the serial port of a node. The default console configuration is Equinox (ESP); any other terminal server hardware requires different configuration by the system administrator.

ESP and Serial Ports

The serial ports' connection from the ESP to the nodes must be in the same order that the nodes are defined for the Equinox console server in CSM. The CSM database has a number associated with each ESP, and with each port within the ESP. Attention to detail is required when configuring both the hardware connectivity and the definitions of this relationship in the CSM database. More detailed information on this relationship is covered in "Remote Console Configuration".

Remote Console Configuration

The **definenode** command updates the CSM database with the information describing the console server and each node's associated port number. There is a direct relationship between the hardware configuration and the CSM database information created with this command. Planning is required prior to running **definenode** to ensure that nodes are defined correctly. (A sample worksheet is shown in "Node Attributes Table" on page 9.) This section will expand on the CSM database contents and its relationship to the hardware and the **rconsole** command.

The remote console function supports two software environments: Equinox and Conserver. You specify which environment you want to use for the console for each node with the *ConsoleMethod* attribute. Supported values for this attribute are *esp* and *conserver*. For more information about the Conserver software environment, see the Conserver open source software Web site (http://www.conserver.com).

Writing a Custom Console Method

You can write a custom console method to suit your hardware environment. Each environment has its own routine (in **/opt/csm/bin/***ConsoleMethod*_**console**) that returns the command that **rconsole** uses in the **xterm** window where the command is run. For example:

- *esp_console*: `cu –l /dev/ttyQ01e0 –s 9600`
- *conserver_console*: `console – Mlocalhost hostname`

The following parameters are passed to any console method. If you write a new console method to manage another console type, you must include these parameters in the order shown in the interface definition:

1. *console_server_hostname*
2. *target_system_hostname*
3. *console_port_number*

4. *console_server_number*

Node Configuration

The **/etc/lilo.conf** and **/etc/inittab** files on each node must contain the following settings, which direct the console to the serial port. When **installnode** is run, these files are automatically modified on each node.

Note: To enable remote console for a CSM-only installation, you must reboot all new nodes after running **installnode**.

- **/etc/lilo.conf** file:

```
serial = 1,9600n8
append = "console=tty1 console=ttyS1,9600"
```

- **/etc/inittab** file:

```
s1:345:respawn:/sbin/agetty 9600 ttyS1 xterm
```

Remote console requires the following CSM attributes for each node:

ConsoleServerName	The console server host name. For example: mgtn02.pok.ibm.com.
ConsoleServerNumber	The console server number. For example: some number, 1 – N. For ESP this is the ESP number associated with the Equinox Serial Provider system.
ConsoleMethod	Determines the program to invoke for a specific type of console server. The attribute value is one of two options: *esp* | *conserver*.
ConsolePortNum	The console port number. For ESP, this must be a 0 – f single hexadecimal digit.

Verifying Remote Console Configuration

The **lsnode –Al** command lists the node attributes in the CSM database. When the host parameter is specified, either by host name or IP address, the command displays all of the host's attributes.

Verifying Equinox ESP Console

To verify the remote console configuration, use the **esptty** and **lsnode** commands. The **esptty** command opens the Equinox Serial Provider (ESP) Port Diagnostic Utility. This utility allows system administrators and users to verify or modify port characteristics or dump status information about ESP Serial Hub serial ports (ttys).

You can also verify or change a Console Server configuration using the **espcfg** command. This command opens the ESP Configuration Wizard, which allows you to manage Equinox Service Processors. For further information on these verification commands, see the command man pages.

Equinox Configuration and Diagnostics

Note: The **espcfg espdiag**, and **esptty** commands are installed when you install the ESP RPM. For more information about ESP software configuration, see **/usr/doc/espx-3.00/INSTALL**.

Equinox Diagnostics

To test the Equinox hardware configuration:

1. Ping the console server from the management server to test the connection.
2. Run the **espcfg** command to:
   - discover ESPs on a network

- configure ESPs
- install ESPs
- remove ESPs
- replace ESPs
- update ESP flash memory

3. Run the **espdiag** command to:
   - obtain ESP device and driver information
   - obtain detailed information about a selected ESP serial port
4. Verify that the ESP is on the management network associated with the management server by comparing the IP address and *SubNetMask* attribute in the ESP panel to the **ifconfig** command output.

Equinox Configuration Examples

1. To query Equinox Serial Provider (ESP) ports on a remote cluster, type:

   ```
   esptty -c
   ```

   Output is similar to:

   ```
   ESP Device   UdpState           TcpState         Ports
   /dev/esp1    HEARTBEAT          TCP_ACTIVE         16
   /dev/esp2    HEARTBEAT          TCP_ACTIVE         16
   /dev/esp3    HEARTBEAT          TCP_ACTIVE         16
   /dev/esp4    HEARTBEAT          TCP_ACTIVE         16
   /dev/esp5    HEARTBEAT          TCP_ACTIVE         16
   /dev/esp6    HEARTBEAT          TCP_ACTIVE         16
   ```

2. To list the ttys for each port, type:

   ```
   ls /dev/ttyQ*
   ```

   The format of the tty is: **ttyQ***esp_number***e***port_number* where:
   - *esp_number* is two digits starting with 01
   - *port_number* is one hexadecimal digit 0 – f.

   Output is similar to:

   ```
   /dev/ttyQ01e0  /dev/ttyQ02e4  /dev/ttyQ03e8  /dev/ttyQ04ec  /dev/ttyQ06e0
   /dev/ttyQ01e1  /dev/ttyQ02e5  /dev/ttyQ03e9  /dev/ttyQ04ed  /dev/ttyQ06e1
   /dev/ttyQ01e2  /dev/ttyQ02e6  /dev/ttyQ03ea  /dev/ttyQ04ee  /dev/ttyQ06e2
   /dev/ttyQ01e3  /dev/ttyQ02e7  /dev/ttyQ03eb  /dev/ttyQ04ef  /dev/ttyQ06e3
   /dev/ttyQ01e4  /dev/ttyQ02e8  /dev/ttyQ03ec  /dev/ttyQ05e0  /dev/ttyQ06e4
   /dev/ttyQ01e5  /dev/ttyQ02e9  /dev/ttyQ03ed  /dev/ttyQ05e1  /dev/ttyQ06e5
   /dev/ttyQ01e6  /dev/ttyQ02ea  /dev/ttyQ03ee  /dev/ttyQ05e2  /dev/ttyQ06e6
   /dev/ttyQ01e7  /dev/ttyQ02eb  /dev/ttyQ03ef  /dev/ttyQ05e3  /dev/ttyQ06e7
   /dev/ttyQ01e8  /dev/ttyQ02ec  /dev/ttyQ04e0  /dev/ttyQ05e4  /dev/ttyQ06e8
   /dev/ttyQ01e9  /dev/ttyQ02ed  /dev/ttyQ04e1  /dev/ttyQ05e5  /dev/ttyQ06e9
   /dev/ttyQ01ea  /dev/ttyQ02ee  /dev/ttyQ04e2  /dev/ttyQ05e6  /dev/ttyQ06ea
   /dev/ttyQ01eb  /dev/ttyQ02ef  /dev/ttyQ04e3  /dev/ttyQ05e7  /dev/ttyQ06eb
   /dev/ttyQ01ec  /dev/ttyQ03e0  /dev/ttyQ04e4  /dev/ttyQ05e8  /dev/ttyQ06ec
   /dev/ttyQ01ed  /dev/ttyQ03e1  /dev/ttyQ04e5  /dev/ttyQ05e9  /dev/ttyQ06ed
   /dev/ttyQ01ee  /dev/ttyQ03e2  /dev/ttyQ04e6  /dev/ttyQ05ea  /dev/ttyQ06ee
   /dev/ttyQ01ef  /dev/ttyQ03e3  /dev/ttyQ04e7  /dev/ttyQ05eb  /dev/ttyQ06ef
   /dev/ttyQ02e0  /dev/ttyQ03e4  /dev/ttyQ04e8  /dev/ttyQ05ec
   /dev/ttyQ02e1  /dev/ttyQ03e5  /dev/ttyQ04e9  /dev/ttyQ05ed
   /dev/ttyQ02e2  /dev/ttyQ03e6  /dev/ttyQ04ea  /dev/ttyQ05ee
   /dev/ttyQ02e3  /dev/ttyQ03e7  /dev/ttyQ04eb  /dev/ttyQ05ef
   ```

3. To query remote nodes, enter:

   ```
   lsnode -Al clsn03
   ```

Output is similar to:

```
Hostname = clsn03.pok.ibm.com
OSVersion =
UniversalId = 0
InstallDisk =
ConsoleServerName = mgtn02.pok.ibm.com
ConfigChanged = 0
Status = 1
HWControlPoint = mgtn03.pok.ibm.com
OSType =
SvcProcName = node03
InstallMethod =
PowerMethod = netfinity
Macaddr =
PowerStatus = 127
ConsolePortNum = 2
HWType = netfinity
HWModel =
OSDistribution =
ConsoleMethod = esp
LParID =
OSKernel =
InstallDiskType =
ConsoleServerNumber = 1
HWSerialNum =
```

Serial References

For more information on using serial devices, see the following Linux HOWTO documents, located at **/usr/doc/HOWTO** or on the Linux Documentation Project Web site (http://metalab.unc.edu/mdw/index.html):

- *Serial-HOWTO*
- *Serial-Programming-HOWTO*
- *Modem-HOWTO*

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