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Chapter 1: Introduction

About *ipMux*

ipMux[™] Ethernet IP Multiplexer is a 10Base-T, 4-Downlink port, SNMP-Manageable IP multiplexer. All ports on *ipMux* are 10 Mbps twisted pair.

ipMux is specifically designed to provide a low-cost, high speed and secure interface between the user and the Internet backbone or Point-of-Presence (POP).

About *ipMux* Modules

The following *ipMux* Module is currently available:

- **LE1025C** — 10Base-T twisted pair; includes one RJ-45 connector for the Uplink port and four RJ-45 connectors for the Downlink ports



About This Manual

This manual provides the information necessary to install, configure and use the *ipMux*, including hardware installation, software installation, configuration and usage.

Chapter 2: Hardware Installation

This chapter details the hardware installation of a SNMP-Manageable *ipMux*.

The hardware installation of an *ipMux Module* involves the following steps:

- 1) Configuration of the Uplink port's duplex mode via a Dip switch on the PCB, if desired.
- 2) Installation of a *PowerChassis* (tabletop or rackmount) to accommodate your *ipMux Module*.
- 3) Installation of a second, redundant *Power Supply Module* into the above-mentioned *PowerChassis*, if needed.
- 4) Installation of *ipMux Module(s)* into the above-mentioned *PowerChassis*.

This chapter also includes detailed information on *ipMux's* LEDs, as well as other faceplate features.

Step 1: Setting the Uplink Port's Duplex Mode

Each port on *ipMux* can operate in either Half-Duplex (HDX, factory default) or Full-Duplex (FDX) mode.

HDX/FDX for the Uplink Port is configured with Dip Switch **1** on the eight-position switch located at position S2 on the PCB (refer to the following page for an illustration of the switch location).

NOTE: *HDX/FDX for each of the Downlink ports can only be configured via the software. More information on setting the Duplex mode of these ports can be found later in this manual.*

The *ipMux TP/5* is shipped from the factory with HDX selected on the Uplink Port.

Select FDX by setting Dip switch **1** to ON.

The following drawing shows the location of switch S2 on *ipMux*:

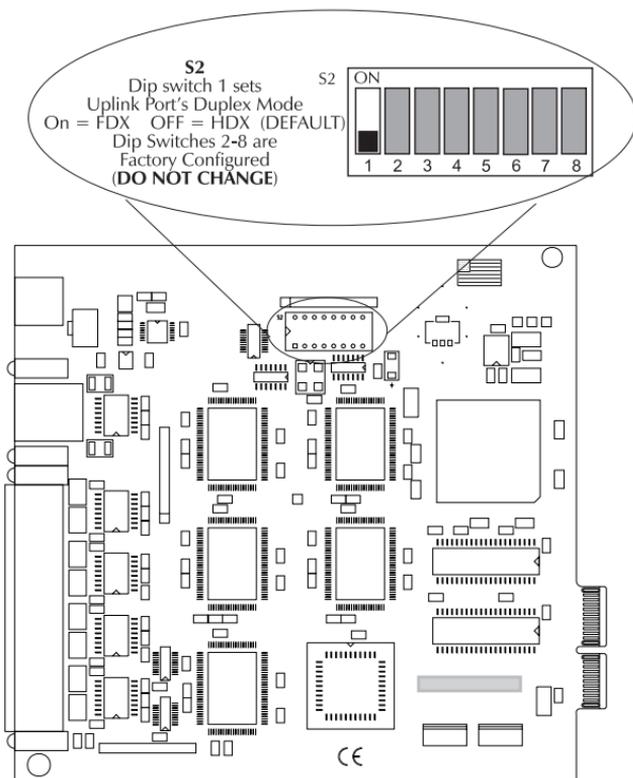


Figure 2.1: Dip Switch Location on ipMux

NOTE: Dip switches 2 through 8 are configured at the factory; do not change.

Step 2: Installing a PowerChassis

ipMux Modules can be installed into any *PowerChassis*. Install your chosen *PowerChassis* before installing the *ipMux Module(s)*.

Installing a Rackmountable PowerChassis

To install a rackmountable *PowerChassis*, you will need eight #10 screws and eight clip nuts (hardware may vary depending on rack type). The rest of the hardware is supplied with the unit.

First, mount the RETMA mounting ears to the chassis with the supplied hardware. Then, locate a suitable location in the rack for

installation, and secure the clip-nuts onto the mounting rails. Use the screws to attach the chassis to the rack. Finally, attach the cables between the chassis and each device that will be interconnected, then plug the chassis into a reliable, filtered power source.

When installing the chassis in an equipment rack, be sure to observe the following precautions to prevent electrical or mechanical damage:

- Stay within the chassis power rating to prevent overload of supply circuits or damage to overcurrent protection and supply wiring.
- Maintain reliable earth ground, especially when connecting to power strip instead of directly to branch circuit.
- Protect your chassis from exposure to sunlight, and electrical or magnetic fields.
- Ensure that the equipment rack remains stable, even with the addition of the chassis and its associated cabling.

Installing a Tabletop PowerChassis

Be sure that the unit is placed on a suitable flat surface, and leave some space at the back of the unit to accommodate the exhaust fans. Attach the cables between the chassis and each device that will be interconnected, then plug the chassis into a reliable, filtered power source.

Step 3: ***Installing a Power Supply Module into a PowerChassis***

PowerChassis are shipped from the factory with one *Power Supply Module* installed. You can install a second, redundant *Power Supply Module* in a *PowerChassis*, if required. *Power Supply Modules* are available in 100/240 VAC or -48 VDC power versions.

A blank bracket covers the slot where a second power supply module can be installed. To install a power supply module in a *PowerChassis*, remove the blank bracket covering the slot where the module is to be installed by loosening the thumbscrews located closest to the outside edges of the bracket. Next, slide the module into the chassis until the module is seated securely in the connector on the backplane. Secure the module to the chassis by tightening the thumbscrews.

Step 4: Installing an *ipMux Module* into a *PowerChassis*

Please read the electrostatic discharge precautions on page 7.1 of this manual before installing your module.

PowerChassis come with blank brackets covering the slots where the modules are to be installed. To install an *ipMux Module*, remove the blank bracket by loosening the thumbscrews located on the outside edges of the bracket. Slide the *ipMux Module* into the chassis, via the cardguides, until the module is seated securely in the connector. Secure the module to the chassis by tightening the thumbscrews.

NOTE: *ipMux Modules can be installed into a chassis when power is on — ipMux Modules are “hot-swappable.”*

LED Operation

ipMux features status LEDs for each port. The following illustration shows the LEDs and their locations on *ipMux*:

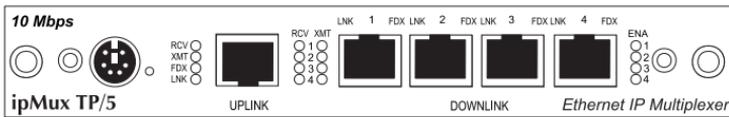


Figure 2.2: LEDs on *ipMux*

LEDs for the Twisted Pair Uplink Port

LED functions for the twisted pair Uplink port are as follows:

RCV	Flickers yellow when port is receiving data
XMT	Flickers green when port is transmitting data
FDX	Glow yellow when Full-Duplex is selected on port
LNK	Glow green when a link is established

LEDs for the Twisted Pair Downlink Ports

LED functions for each of the twisted pair Downlink ports are the same. The functions are as follows:

RCV	Flickers yellow when port is receiving data
XMT	Flickers green when port is transmitting data
ENA	Glow green when port is enabled

LNK	Glows green when a link is established
FDX	Glows yellow when Full Duplex mode is selected on port

Mini-DIN Connector (FUTURE USE)

ipMux features a mini-DIN connector, located on the left of the faceplate (front view). This port is currently disabled.

Reset Switch

ipMux features a reset switch which can be accessed through a tiny hole next to the mini-DIN connector on the faceplate. Use a paper clip to access this switch and reset the unit.

Chapter 3: Pre-Configuration

This chapter details the steps you must complete before configuring your *ipMux* using *iView* or another SNMP-application.

This chapter also reviews the concepts and terms necessary for configuring *ipMux*, including:

- MIBs
- Multiplexing IP Addresses
- Determining the Number of Nodes per Downlink Port
- Calculating Forward Mask and Forward Net
- Bandwidth Allocation

Before Configuring: Required Steps

Before attempting to configure your *ipMux*, you must have completed the following steps:

- 1) Hardware installation of *ipMux Module* (see Chapter 2).
- 2) Execution of HUBCTRL (DOS) or HUBCTRL 32 (Windows NT or 98) on the Management PC for setting the TCP/IP information in the *ipMux* (i.e., IP address, subnet mask and default gateway). Refer to HUBCTRL Installation Guide and/or Help file for information and assistance.
- 3) Installation of SNMP network management software (NMS) (e.g., *iView*) onto the management PC.
- 4) Integration of the MIB into the SNMP management software. (If using *iView*, this will be done for you automatically. Otherwise, refer to your NMS's documentation and Chapter 6 for integration assistance.)
- 5) Determine the maximum number of nodes needed per Downlink port (see this Chapter for assistance).

About MIBs

MIBs, which are similar to databases, contain a series of manageable objects that hold information relating to the managed device (in this case the *ipMux*). This information is Read-Only or it can be SET by the user.

The IPMUX.MIB file contains a series of managed objects for configuring the *ipMux*. For example, information about which IP addresses are assigned to a Downlink port is held within the IPMUX.MIB as the MIB object called *imxConfPortFwdNet*.

NOTE: The names of the MIB objects will be referred to in brackets [].

As stated earlier, if you are using *iView*, you do not need to incorporate any MIBs; this will be done for you automatically. If you plan to use another application to manage your *ipMux*, please see Chapter 6 of this guide as well as the application manufacturer's documentation for information and assistance.

Getting Started

Before discussing the concepts behind configuring *ipMux*, there are a few terms that need to be defined. The following table provides simplified definitions. In-depth explanations follow.

Term	Definition
Node	Individual devices on a downlink port
Forward Mask [<i>imxFwdMask</i>]	Specifies whether multiplexing on the 3rd or 4th byte of IP address as well as how many Forward Nets and the # of Nodes available
Forward Net [<i>imxConfPortFwdNet</i>]	A reference number that specifies the range of IP addresses being forwarded to a downlink port
Forward IP [<i>imxFwdIP</i>]	Specifies the common portion, or "Base IP", of all IP addresses on all downlink ports

About Multiplexing IP Address Ranges

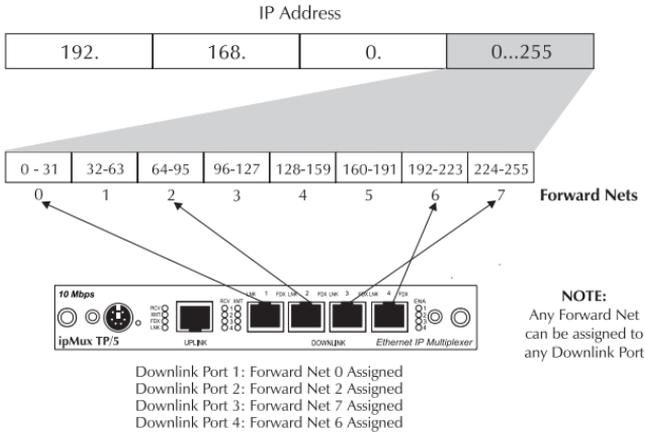
All IP addresses are "members" of a certain range. These ranges are referred to as Subnets and are Class A, B or C. Historically, these classes were used to inform devices on the Internet (i.e., routers) which portion of the IP address is the network and which portion is a node on the network. For example, the IP address 192.168.0.1 is Class C where 192.168.0 represents the network and .1 is the node. The IP address 10.1.8.1 is Class A where 10 represents the network and .1.8.1 is the node.

Class B networks can be split among the four Downlink ports, or an entire Class C network can be assigned to each Downlink port. In both of these instances, all four Downlink ports must have the same two-byte Base IP.

It is also possible to use the same Class C IP address range (256 addresses) and split it among the four Downlink ports (i.e., each Downlink port would be assigned a certain amount of the IP addresses within that Class C range). All four Downlink ports would have the same three-byte Base IP.

The *ipMux* splits a range of IP addresses (Class B or Class C) into segments or “Forward Nets” by multiplexing (which is similar to subnetting) on the third byte or fourth byte of an IP address. The Uplink Port forwards IP addresses to the appropriate Downlink port based upon the Forward Net assigned to that port (i.e., all Downlink ports are secure from one another).

For example, the following illustration shows how the IP address range 192.168.0.0 through 192.168.0.255 can be split into segments, or Forward Nets, in order to assign 32 IP addresses to each Downlink port on *ipMux*.



NOTE:
Any Forward Net can be assigned to any Downlink Port

IP Address

192.	168.	0.	0...255	
------	------	----	---------	--

0	1	2	3	4	5	6	7	Forward Nets
0 - 31	32-63	64-95	96-127	128-159	160-191	192-223	224-255	IP Range
1	Not Used	2	Not Used	Not Used	Not Used	4	3	Assigned to Port #

Figure 3.2: Example of IP Address Range Split into Eight Forward Nets

Determining the Number of Nodes

Before configuring the *ipMux*, it is important to determine how many nodes are desired per Downlink port.¹ This is because each Downlink port must be configured to accommodate the same maximum number of nodes.

For instance, if three out of four Downlink ports only need to forward eight IP addresses, but the fourth needs to forward 16, the *ipMux* MUST be configured so that each of the Downlink ports can forward a maximum of 16 IP addresses.

This maximum is set in the *ipMux* by configuring the Forward Mask (defined below).

NOTE: *Since the number of Nodes are in powers of 2, you may have to round up if the number of Nodes needed falls between two segments. For example, if you need 25 nodes, round up to 32 nodes per Downlink port. Refer to the section “Determining What Forward Mask and Forward Nets to Assign” in the Appendix for the number of nodes per segment.*

Forward IP

The Forward IP [ipmuxFwdIP] is a four-byte address that tells the *ipMux* what the Base IP, or common portion, is of the IP addresses being forwarded by all of the Downlink ports.

To specify the Forward IP, place a “0” in each byte of the address which is NOT common to all Downlink ports. For example, if the common portion of the IP addresses for all four Downlink ports is 192.168.X.Y, enter 192.168.0.0 for the Forward IP. If the common portion is 192.168.54.X, enter 192.168.54.0.

Forward Mask

The Forward Mask [ipmuxFwdMask] is a four-byte mask that determines whether the *ipMux* multiplexes on the third or fourth byte of an IP address. The Forward Mask also allows the *ipMux* to view your range of IP addresses in separate, equal-sized segments called Forward Nets. Each of the Forward Nets has the same number of IP addresses.

¹*ipMux* can forward up to 32,768 IP addresses per port. In most instances, however, you will not need to configure *ipMux* to forward more than 256 IP addresses per Downlink port.

Forward Net

The Forward Net is a reference number that specifies the range of IP addresses being forwarded to a Downlink port. The Forward Mask determines how many Forward Nets to which an *ipMux* has access. After setting the Forward Mask, assign one of the Forward Nets [imxConfPortFwdNet] to each Downlink port.

NOTE: *The range of Forward Nets always starts at "0." Forward Nets can be assigned randomly, as long as each Downlink port's Forward Net is within the range specified by the Forward Mask. An ipMux's Forward Nets do not have to be assigned in contiguous or numeric order, but **do not assign the same Forward Net to more than one Downlink port.***

Determining What Forward Mask and Forward Nets To Assign

Based on the number of nodes needed by a Downlink port, a list of charts (located in the Appendix) shows you what Forward Mask to use and what Forward Nets are available for you to assign, and what IP addresses are allotted to each Forward Net.

The graphic to the right is an example of one of these charts.

64 Nodes per 4 Forward Networks (Example: 192.168.0.xxx)	
Forward Mask: 255.255.255.192	
Forward Net #	XXX Variable
0	0-63
1	64-127
2	128-191
3	192-155

Configuring Individual Nodes

When configuring TCP/IP services for a node, specify the device's gateway and mask as that of the router in front of the *ipMux*, not any of the Forward Net values used to configure the *ipMux*. Also, make sure you assign the node an IP address that is within the range specified for the node's Downlink port.

Bandwidth Allocation

The four Downlink ports on *ipMux* share a combined total bandwidth of 10 Mbps. You can, however, allocate a specific amount of bandwidth to each Downlink port (i.e., 1 Mbps to Downlink Port 1, 5 Mbps to Downlink Port 2, 2 Mbps to Downlink Port 3 and 2 Mbps to Downlink Port 4) by enabling the Bandwidth Control function and entering a value for each Downlink port being used. The value entered for a Downlink port is the maximum amount of bandwidth that port can use at any given time.

The bits-per-second (bps) for a Downlink port is calculated by multiplying the specified **Bandwidth Granularity** [imxBWGranularity] by the specified **Bandwidth Control** [imxConfBWctrl].

The default for Granularity is set to 1, and the default for Bandwidth Control for each Downlink port is set to 0. This means bandwidth management is not enabled for the Downlink ports ($1 \times 0 = 0$).

If you want speeds similar to ISDN speeds, set the Granularity to 1,024 (which is equal to 1K) then set the Bandwidth Control for a Downlink port to 128. This provides 128K of bandwidth for the port ($1K \times 128 = 128K$).

You can also give each Downlink port a specific amount of Mbps by setting the Granularity to 1,000,000. Then, set the Bandwidth Control for a Downlink port to 1 if you want 1 Mbps, 2 if you want 2 Mbps, etc ($1,000,000 \times 2 = 2Mbps$).

The maximum total Bandwidth Control for all four Downlink ports is 10 Mbps.

See the following chapters for specific information on how to allocate bandwidth using *iView* or another NMS.

Chapter 4: Configuration Examples

This chapter details two examples for configuring *ipMux*.

Example 1: Multiplexing on the Third Byte

An Internet service provider purchases an *ipMux* to serve four customers (A-D). The service provider has the Base IP 192.168.X.Y and would like to assign four customers the following IP address ranges:

- **Customer A:** 192.168.193.y
- **Customer B:** 192.168.217.y
- **Customer C:** 192.168.199.y
- **Customer D:** 192.168.200.y

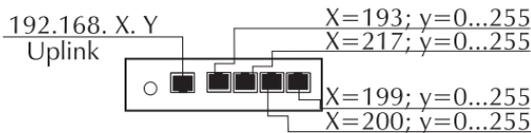


Figure 4.1: *ipMux* Multiplexed on Third Byte

In this example, the *ipMux* multiplexes on the third byte and yields 256 nodes per Downlink port. Configure the *ipMux* as follows:

- **Forward IP:** 192.168.0.0
- **Forward Mask:** 255.255.255.0
- **Downlink Port 1:** Forward Net 193
- **Downlink Port 2:** Forward Net 217
- **Downlink Port 3:** Forward Net 200
- **Downlink Port 4:** Forward Net 199

Example 2: Multiplexing on the Fourth Byte

A company has a total of 256 addresses it wants to sell to various customers (A-D). The company first decides how many nodes to allocate to each of the customers. For example, if 32 nodes is sufficient for each customer, set the Forward Mask of the *ipMux* to 255.255.255.224. The value of this Forward Mask tells the *ipMux* to multiplex on the fourth byte as well as split the fourth byte into eight Forward Nets that each have 32 nodes. An *ipMux* can use four (one for each Downlink port) of those eight Forward Nets.

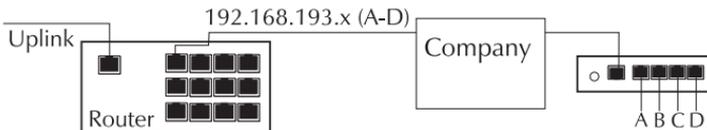


Figure 4.2: *ipMux* Multiplexed on Fourth Byte

NOTE: The company could configure a second *ipMux* to use the same Forward IP and Forward Mask. This second *ipMux* could use the four remaining Forward Nets.

Assuming that the company's Base IP is 192.168.0.X, assign one of the eight Forward Nets to each downlink port. For example, assign Forward Net 0 to Customer A, Forward Net 5 to Customer B, Forward Net 1 to Customer C and Forward Net 7 to Customer D.

For this example, configure *ipMux* as follows:

- **Forward IP:** 192.168.0.0
- **Forward Mask:** 255.255.255.224
- **Downlink Port 1:** Forward Net 0
- **Downlink Port 2:** Forward Net 2
- **Downlink Port 3:** Forward Net 7
- **Downlink Port 4:** Forward Net 6

Chapter 5: Configuring *ipMux* with *iView*

This chapter details how to configure *ipMux* using *iView* cross-platform management application, provided with your *ipMux*.

Please read Chapter 3 of this manual and make sure you understand the concepts discussed therein before proceeding.

If you have decided to use an application other than *iView* to manage your *ipMux*, please read “Chapter 6: If Not Using *iView*” for configuration and management instructions.

Required Configuration Steps

After installing *iView*, assigning the module's IP address, subnet mask and default gateway via HUBCTRL 32, and completing the hardware installation, you will need to do the following to configure your module:

NOTE: Steps 2, 3 and 4 are mandatory for an operational *ipMux*.

- 1) Determine the number of nodes needed by each Downlink port
- 2) **Assign the Forward IP**
- 3) **Assign a Forward Mask**
- 4) **Assign a Forward Net to each Downlink port**
- 5) Allocate bandwidth, if desired
- 6) Assign descriptions to unit/ports, if desired

Please see Chapter 3 of this manual for definitions and examples of the above terms and concepts.



CAUTION: Make sure the IP address of your SNMP agent **DOES NOT** fall within the range of any IP addresses being forwarded by a Downlink port. If this happens, you will no longer be able to communicate with your *ipMux*. If you configured your SNMP agent with one of the IP addresses being forwarded by a Downlink port, you must reconfigure your SNMP agent via HUBCTRL.

iView for ipMux Configuration Walkthrough

Following is a step-by-step guide to configuring your *ipMux Module* using *iView*:

- 1) After installing *iView* and *iView for ipMux*, go to the management PC's Start menu (if running Windows 98/NT) and choose:
 - **Programs**
 - ***iView***
 - ***ipMux***
 - Click on the ***iView for ipMux*** icon.
- 2) At the Target Device Prompt pop-up box, enter the IP address you assigned the unit using HUBCTRL. Click **OK**.
- 3) The *ipMux* Module Detail screen will now appear. This is the main operating screen for *iView*. Under the *ipMux* virtual faceplate, you will see a horizontal button bar. Click on the **Uplink** tab to bring up the Uplink Configuration window.
- 4) From the Port 1 Uplink Configuration window, you will assign the *ipMux* Module's Forward IP and Forward Mask (Steps 2 and 3 in *Required Steps*).

For assistance in calculating the correct variables, click on the **IP Configuration Utility** button on the right-hand side of the screen. (**Note:** *This Configuration Utility requires a Web browser such as Netscape or Internet Explorer to run.*)

NOTE: *If you do not need to use the IP Configuration Utility, skip ahead to Step 10.*

- 5) From the *ipMux* Configuration Utility window, enter the Base (i.e., "Forward") IP address where instructed.
- 6) Under Step two, click on the pull-down list to select the maximum number of nodes desired per Download port.

NOTE: *The maximum number of addresses per node you can choose in this utility is 128. If you need a higher allocation, use the charts in the Appendix section of this manual to get the necessary pre-calculated variables. Then proceed to Step 10.*

- 7) Click on the **Configure the *ipMux!*** button. The *ipMux* Configuration Results window will appear. This window contains all of the variables needed to configure your *ipMux*, including the correct Forward Mask, Forward Nets and IP address ranges.

Choose **File, Print** to print this screen (you will need this information later).

- 8) Close out of the Configuration Utility by choosing **File, Exit** from your browser menu.
- 9) Return to the Uplink Configuration window (choose **Uplink** from *iView's* horizontal button bar).
- 10) In the IP Configuration box (right-hand side of Uplink Configuration Window), enter the Base IP address and Forward Mask where indicated. Click **Set** for each.

Next, you will need to assign a Forward Net for each of the Downlink ports:

- 11) Click on the **Port 1** button in the horizontal button bar. This will bring up the Port 1 Configuration window.
- 12) To assign the Forward Net, enter the chosen Forward Net assignment for that Downlink port into the appropriate text box and click **Set**.
- 13) In the Port Configuration Window, you can also assign a description to the port (e.g., company or department name), allocate bandwidth, and set the Duplex setting, if desired.

When done configuring Port 1, click on the **Port 2** button to bring up the Port 2 Configuration window.

- 14) Repeat Steps 11 through 13 for Downlink ports 2, 3 and 4.

You have now completed configuring your *ipMux*.

Using *iView* To Manage Your *ipMux*

iView offers a graphic user interface (GUI) for remotely monitoring and managing your *ipMux*.

For a window-by-window guide to *iView* for *ipMux's* management features, please see the Help file included with *iView* for *ipMux*.

Chapter 6:

If Not Using *iView*

This chapter details the installation of the SNMP Vendor files (MIBs) required to set up and manage a SNMP-Manageable *ipMux*, as well as how to configure *ipMux* using an application other than *iView* (e.g., SNMPc, etc.). If you will be using *iView* (provided with your *ipMux*), please refer instead to Chapter 5.

Please read Chapter 3 of this manual and make sure you understand the concepts discussed therein before proceeding.

Required Steps for Management

In order for the *ipMux* to be managed, the following steps need to be completed on the Management PC:

- Installation of a TCP/IP stack compatible with the SNMP network management software (NMS) being used.
- Installation of the SNMP network management software.
- Integration of MIBs into the management software.
- If using SNMPc NMS, integration of the device graphics into SNMPc.

NOTE: *This manual assumes the chosen NMS is already installed and functioning properly.*

MIB Utilization

ipMux utilizes the following MIBs, which can be found in the directory \MIBFILES on the CD included with the *ipMux*:

MIB-I/MIB-II	SNMP statistics, transport protocol orientated statistics (IP, ICMP, UDP, TCP), information collected on frames sent to/from all MAC interfaces inside the <i>ipMux</i> .
IPMUX MIB	Enterprise specific information for the <i>ipMux</i> . For example, configuration information, port type information, link status, etc.

Integrating MIBs into SNMP-Compatible Software

NOTE: *This section describes in general terms the steps required to integrate the required agent with other management software. For specific details on the management software being used, refer to the manufacturer's documentation.*

The SNMP management protocol is an industry standard. Any management software which is 100 percent compatible with the SNMP standard can manage any device which is also 100 percent compatible with the same standard.

The only area where incompatibilities may occur is with the device graphics. For example, SNMPc from Castle Rock provides a Graphical User Interface (GUI) for which the manufacturer of the *ipMux* has developed graphical interface files. Other management software packages, such as HP OpenView for Windows, are not directly compatible with the SNMPc graphical files. However, SNMPc will run "inside" HP OpenView. For this software configuration, HP OpenView must be installed first, then SNMPc. The required files can then be installed within SNMPc as described earlier in this chapter.

NOTE: *Incompatibility may occur with the same management software running on different platforms.*

Although graphics are a desirable feature for viewing *ipMux* information (such as the status of ports, etc.), this same information can be 'seen' by browsing the MIB information to which the management software has access.

In order to successfully manage an *ipMux*, all of the MIBs mentioned in the MIB Utilization section need to be integrated into the management software. The MIBs are included on the CD supplied with the *ipMux*.

MIB COMPILER

The majority of management packages have a function known as a MIB COMPILER. This function reads the MIB information and converts it to machine readable format. Refer to the management software documentation regarding how MIBs are integrated into the software.

MIB BROWSER

The information held within the *ipMux* can be retrieved by using the MIB BROWSER function of the management software.

In addition to integrating the MIB information, please ensure that the community strings configured in the *ipMux* are also the ones used by the management software. Failure to do this will result in the inability to SET, or retrieve, MIB variables.

Required Configuration Steps

After installing your NMS, assigning the module's IP address, subnet mask and default gateway via HUBCTRL 32, completing the hardware installation and integrating the MIBs, you will need to do the following to configure your module:

NOTE: Steps 2, 3 and 4 are mandatory for an operational *ipMux*.

- 1) Determine the number of nodes needed by each Downlink port
- 2) **Assign the Forward IP**
- 3) **Assign a Forward Mask**
- 4) **Assign a Forward Net to each Downlink port**
- 5) Allocate bandwidth, if desired
- 6) Assign descriptions to unit/ports, if desired

Please see Chapter 3 of this manual for definitions and examples of the above terms and concepts.



CAUTION: Make sure the IP address of your SNMP agent **DOES NOT** fall within the range of any IP addresses being forwarded by a Downlink port. If this happens, you will no longer be able to communicate with your *ipMux*. If you configured your SNMP agent with one of the IP addresses being forwarded by a Downlink port, you must reconfigure your SNMP agent via HUBCTRL.

Configuring *ipMux* Using Your MIB Browser

You can configure your *ipMux* by using your MIB Browser and changing the values in the IPMUX MIB.

The following table lists all of the MIB objects along with a description of what each does:

MIB Object	Definition
unitReset	Reboots unit
imxFwdIP	Specifies common portion of IP addresses used by all downlink ports
imxFwdMask	Specifies the Forward Mask
imxBWctrl	Currently not implemented
imxBWGranularity	Sets the Bandwidth Granularity
imxConfPortFwdNet	Specifies the Forward Net a Downlink port will use
imxConfBWctrl	Specifies a specific amount of bandwidth for Downlink ports
imxConfPortEnable	Enables a port (Set to 1); Disables a port (Set to 2)
imxConfPortDuplex	Specifies whether the port will be Half-/Full-Duplex
imxFiberAlert	Currently not implemented
imxDescr	Allows you to name the unit
imxPortText	Allows you to name each port

Table 6.1: MIB Objects

For MIB objects that are port-specific, add the number of the port after the MIB object name. In these objects, the Uplink Port is considered 1, Downlink Port 1 is 2, Downlink Port 2 is 3, etc. For example, to specify the Forward Net for the last Downlink Port, input a value for the MIB object `imxConfPortFwdNet.4`. To give Downlink Port 1 a name or description, change the MIB object `imxPortText.2`.

Configuring *ipMux* Using SNMPc

Once you have installed your *ipMux* SNMP Vendor Files into SNMPc, you can view the *ipMux* in your managed network. Double-clicking on the icon for the *ipMux* produces a window displaying the *ipMux*.

The minimum configuration requirements for *ipMux*, as stated earlier, are a configured Forward Mask, Forward IP and a configured Forward Net for each Downlink port being used.

To configure the Forward Mask and Forward IP, click on the Uplink port, then select the menu option **Advanced Configuration, Edit IP Forwarding**. The Edit IP Forwarding screen is displayed.

Enter the desired values for the Forward IP and Forward Mask, then click on the **Set** button for each of those fields. Click on the *Done* button when both values are set.

To set a Forward Net for a Downlink port, click once on the port then select the menu option **Port Information, Port Settings**. The Port Settings screen is displayed.

Enter the desired Forward Net, click on the **Set** button, then click on the **Done** button. The Forward Net for the Downlink port is configured.

NOTE: Once in this screen, you can configure all of the ports. Click on the **First** button to bring up the Uplink port. You can click on the **Next** button to advance to the next port or you can type the number of the port you want to configure (i.e., 1 for the Uplink Port, 2 for Downlink Port 1, 3 for Downlink Port 2, etc.) then click on the **Get** button.

Additional Uplink Port Settings

In addition to specifying a Forward Mask and the Forward IP, the *Port Settings* screen for the Uplink Port allows you to set the granularity for bandwidth control. Enter the desired value for granularity, click on the **Set** button, then click on the *Done* button.

NOTE: The field “Wctrl” is not currently implemented.

To give the Uplink Port a name or description, click on the Uplink Port, then select the menu option **Port Information, Port Status**. The *Port Status* screen is displayed. Most of this screen allows you to monitor the status of the port, but on the second page you can enter a name or description for the port in the *Text* field. Enter the description, click on the **Set** button, then on the **Done** button. The port’s description is entered.

Additional Downlink Port Settings

In addition to specifying a Forward Net, the *Port Settings* screen for a Downlink port allows you to allocate bandwidth to the port, set the port’s Duplex mode (Half- or Full-) and enable and disable the port. Enter the desired values and make any modifications to the various fields in the screen. Click on the **Set** button next to each field you modify. After making all your modifications, click on the **Done** button.

NOTE: You can also enable a port by double clicking on the port. You will be asked if you want to enable the port. Answer Yes. When the port is enabled, you can disable it in the same manner.

To give a Downlink port a name or description, click on the Downlink port, then select the menu option **Port Information, Port Status**. The *Port Status* screen is displayed. Most of this screen allows you to monitor the status of the port, but on the second page you can enter a name or description for the port in the *Text* field. Enter the description, click on the **Set** button, then on the **Done** button. The port’s description is entered.

Port Status Information

You can monitor the status of the Uplink and Downlink ports by clicking on the port then selecting **Port Information**. You have three options: *Port Status*, *Traffic Statistics* and *Error Statistics*. These screens provide the management information for the *ipMux*.

Port LED Information

This section provides a diagram of the *ipMux TP/5* and describes its LEDs. Because the management software only polls the *ipMux* every few seconds, the software only reflects functions/features that are constant. For example, the link LED of a twisted pair port will be illuminated as long as the port is connected to another device and is enabled and functioning properly. On the other hand, the receive LED of a twisted pair port will never be illuminated even when there is traffic on the segment. The status of this LED is only reflected on the device itself, not in the software.

LEDs for the Twisted Pair Uplink Port

LED functions for the twisted pair Uplink port are as follows:

RCV	This LED is only reflected on the device itself, not in the software
XMT	This LED is only reflected on the device itself, not in the software
FDX	Glows yellow when Full-Duplex is selected on port
LNK	Glows green when a link is established

LEDs for the Twisted Pair Downlink Ports

LED functions for each of the twisted pair Downlink ports are the same. The functions are as follows:

RCV	This LED is only reflected on the device itself, not in the software
XMT	This LED is only reflected on the device itself, not in the software
ENA	Glows green when port is enabled

Traps

Traps are sent by *ipMux* to a management PC when a certain event takes place. Traps are configured via HUBCTRL 32.

The following traps can be used by *ipMux*:

-
- Link lost
 - Security — Currently not implemented

Chapter 7:

General Information

Specifications

Environmental

Operating Temperature: 32° - 122° F (0° - 40° C)

Storage Temperature: 22° - 160° F (-6° - 71° C)

Humidity: 5 - 95% non-condensing

Power

AC Input Load: 100/240V ~ 50/60 Hz, 0.2/0.1A
(stand-alone chassis)

Heat generated: 50 BTU/hr.

Black Box Technical Support

Phone: (724) 746-5500

Fax: (724) 746-0746, or in North America **1-800-321-0746**

E-Mail: techsupport@blackbox.com

Technical Support 24 hours a day.

Electrostatic Discharge Precautions

Electrostatic discharge (ESD) can cause damage to your add-in modules. Always observe the following precautions when installing or handling an add-in module or any board assembly.

- 1) Do not remove unit from its protective packaging until you're ready to install it.
- 2) Wear an ESD wrist grounding strap before handling any module or component. If you do not have a wrist strap, maintain grounded contact with the system unit throughout any procedure requiring ESD protection.



WARNING! Integrated circuits and fiber optic components are extremely susceptible to electro-static discharge damage. Do not handle these components directly unless

you are a qualified service technician and use tools and techniques that conform to accepted industry practices.

- 3) Hold boards by the edges only; do not touch the electronic components or gold connectors.
- 4) After removal, always place the boards on a grounded, static free surface, ESD pad or in a proper ESD bag. Do not slide the board over any surface.

Warranty

Please contact Black Box for complete warranty and license information.

Federal Communications Commission Radio Frequency Interference Statement

This equipment has been tested and found to comply with the limits for a Class A computing device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which chassis the user will be required to correct the interference at his own expense. Any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

The use of non-shielded I/O cables may not guarantee compliance with FCC RFI limits.

This digital apparatus does not exceed the Class A limits for radio noise emission from digital apparatus set out in the Radio Interference Regulation of the Canadian Department of Communications.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de classe A prescrites dans le Règlement sur le brouillage radioélectrique publié par le ministère des Communications du Canada.

Appendix

Determining What Forward Mask and Forward Nets To Assign

Based on the number of nodes needed by a Downlink port, the following list of charts shows you what Forward Mask to use and what Forward Nets are available for you to assign as well as what IP addresses are allotted to each Forward Net.

1 Node per 256 Forward Nets (Example: 192.168.0.XXX)	
Forward Mask: 255.255.255.255	
Forward Net #	XXX Variable
0	0
1	1
2	2
↓	↓
255	255

2 Nodes per 128 Forward Nets (Example: 192.168.0.XXX)	
Forward Mask: 255.255.255.254	
Forward <u>Net #</u>	XXX <u>Variable</u>
0	0-1
1	2-3
2	4-5
3	6-7
4	8-9
5	10-11
6	12-13
7	14-15
8	16-17
9	18-19
10	20-21
11	22-23
12	24-25
13	26-27
14	28-29
15	30-31
16	32-33
17	34-35
18	36-37
19	38-39
20	40-41
21	42-43
22	44-45
23	46-47
24	48-49
25	50-51
26	52-53
27	54-55
28	56-57
29	58-59
30	60-61
31	62-63

2 Nodes per 128 Forward Nets (Con't.) (Example: 192.168.0.XXX)	
Forward Mask: 255.255.255.254	
Forward <u>Net #</u>	XXX <u>Variable</u>
32	64-65
33	66-67
34	68-69
35	70-71
36	72-73
37	74-75
38	76-77
39	78-79
40	80-81
41	82-83
42	84-85
43	86-87
44	88-89
45	90-91
46	92-93
47	94-95
48	96-97
49	98-99
50	100-101
51	102-103
52	104-105
53	106-107
54	108-109
55	110-111
56	112-113
57	114-115
58	116-117
59	118-119
50	120-121
61	122-123
62	124-125
63	126-127

2 Nodes per 128 Forward Nets (Con't.) (Example: 192.168.0.XXX)	
Forward Mask: 255.255.255.254	
Forward <u>Net #</u>	XXX <u>Variable</u>
64	128-129
65	130-131
66	132-133
67	134-135
68	136-137
69	138-139
70	140-141
71	142-143
72	144-145
73	146-147
74	148-149
75	150-151
76	152-153
77	154-155
78	156-157
79	158-159
80	160-161
81	162-163
82	164-165
83	166-167
84	168-169
85	170-171
86	172-173
87	174-175
88	176-177
89	178-179
90	180-181
91	182-183
92	184-185
93	186-187
94	188-189
95	190-191

2 Nodes per 128 Forward Nets (Con't.) (Example: 192.168.0.XXX)	
Forward Mask: 255.255.255.254	
Forward <u>Net #</u>	XXX <u>Variable</u>
96	192-193
97	194-195
98	196-197
99	198-199
100	200-201
101	202-203
102	204-205
103	206-207
104	208-209
105	210-211
106	212-213
107	214-215
108	216-217
109	218-219
110	220-221
111	222-223
112	224-225
113	226-227
114	228-229
115	230-231
116	232-233
117	234-235
118	236-237
119	238-239
120	240-241
121	242-243
122	244-245
123	246-247
124	248-249
125	250-251
126	252-253
127	254-255

4 Nodes per 64 Forward Nets (Example: 192.168.0.XXX)			
Forward Mask: 255.255.255.252			
Forward	XXX	Forward	XXX
<u>Net #</u>	<u>Variable</u>	<u>Net #</u>	<u>Variable</u>
0	0-3	32	128-131
1	4-7	33	132-135
2	8-11	34	136-139
3	12-15	35	140-143
4	16-19	36	144-147
5	20-23	37	148-151
6	24-27	38	152-155
7	28-31	39	156-159
8	32-35	40	160-163
9	36-39	41	164-167
10	40-43	42	168-171
11	44-47	43	172-175
12	48-51	44	176-179
13	52-55	45	180-183
14	56-59	46	184-187
15	60-63	47	188-191
16	64-67	48	192-195
17	68-71	49	196-199
18	72-75	50	200-203
19	76-79	51	204-207
20	80-83	52	208-211
21	84-87	53	212-215
22	88-91	54	216-219
23	92-95	55	220-223
24	96-99	56	224-227
25	100-103	57	228-231
26	104-107	58	232-235
27	108-111	59	236-239
28	112-115	50	240-243
29	116-119	61	244-247
30	120-123	62	248-251
31	124-127	63	252-255

8 Nodes per 32 Forward Nets (Example: 192.168.0.XXX)	
Forward Mask: 255.255.255.248	
Forward	XXX
<u>Net #</u>	<u>Variable</u>
0	0-7
1	8-15
2	16-23
3	24-31
4	32-39
5	40-47
6	48-55
7	56-63
8	64-71
9	72-79
10	80-87
11	88-95
12	96-103
13	104-111
14	112-119
15	120-127
16	128-135
17	136-143
18	144-151
19	152-159
20	160-167
21	168-175
22	176-183
23	184-191
24	192-199
25	200-207
26	208-215
27	216-223
28	224-231
29	232-239
30	240-247
31	248-255

16 Nodes per 16 Forward Nets (Example: 192.168.0.XXX)	
Forward Mask: 255.255.255.240	
Forward Net #	XXX Variable
0	0-15
1	16-31
2	32-47
3	48-63
4	64-79
5	80-95
6	96-111
7	112-127
8	128-143
9	144-159
10	160-175
11	176-191
12	192-207
13	208-223
14	224-239
15	240-255

64 Nodes per 4 Forward Nets (Example: 192.168.0.XXX)	
Forward Mask: 255.255.255.192	
Forward Net #	XXX Variable
0	0-63
1	64-127
2	128-191
3	192-255

128 Nodes per 2 Forward Nets (Example: 192.168.0.XXX)	
Forward Mask: 255.255.255.128	
Forward Net #	XXX Variable
0	0-127
1	128-255

32 Nodes per 8 Forward Nets (Example: 192.168.0.XXX)	
Forward Mask: 255.255.255.224	
Forward Net #	XXX Variable
0	0-31
1	32-63
2	64-95
3	96-127
4	128-159
5	160-191
6	192-223
7	224-255

256 Nodes per 256 Forward Nets (Example: 192.168.XXX.YYY)		
Forward Mask: 255.255.255.0		
Forward Net #	XXX Variable	YYY Variable
0	0	0...255
1	1	0...255
2	2	0...255
↓	↓	↓
255	255	0...255

512 Nodes per 128 Forward Nets (Example: 192.168.XXX.YYY)		
Forward Mask: 255.255.254.0		
Forward Net #	XXX Variable	YYY Variable
0	0-1	0...255
1	2-3	0...255
2	4-5	0...255
3	6-7	0...255
4	8-9	0...255
5	10-11	0...255
6	12-13	0...255
7	14-15	0...255
8	16-17	0...255
9	18-19	0...255
10	20-21	0...255
11	22-23	0...255
12	24-25	0...255
13	26-27	0...255
14	28-29	0...255
15	30-31	0...255
16	32-33	0...255
17	34-35	0...255
18	36-37	0...255
19	38-39	0...255
20	40-41	0...255
21	42-43	0...255
22	44-45	0...255
23	46-47	0...255
24	48-49	0...255
25	50-51	0...255
26	52-53	0...255
27	54-55	0...255
28	56-57	0...255
29	58-59	0...255
30	60-61	0...255
31	62-63	0...255

512 Nodes per 128 Forward Nets (Con't.) (Example: 192.168.XXX.YYY)		
Forward Mask: 255.255.254.0		
Forward Net #	XXX Variable	YYY Variable
32	64-65	0...255
33	66-67	0...255
34	68-69	0...255
35	70-71	0...255
36	72-73	0...255
37	74-75	0...255
38	76-77	0...255
39	78-79	0...255
40	80-81	0...255
41	82-83	0...255
42	84-85	0...255
43	86-87	0...255
44	88-89	0...255
45	90-91	0...255
46	92-93	0...255
47	94-95	0...255
48	96-97	0...255
49	98-99	0...255
50	100-101	0...255
51	102-103	0...255
52	104-105	0...255
53	106-107	0...255
54	108-109	0...255
55	110-111	0...255
56	112-113	0...255
57	114-115	0...255
58	116-117	0...255
59	118-119	0...255
60	120-121	0...255
61	122-123	0...255
62	124-125	0...255
63	126-127	0...255

512 Nodes per 128 Forward Nets (Con't.) (Example: 192.168.XXX.YYY)		
Forward Mask: 255.255.254.0		
Forward Net #	XXX Variable	YYY Variable
64	128-129	0...255
65	130-131	0...255
66	132-133	0...255
67	134-135	0...255
68	136-137	0...255
69	138-139	0...255
70	140-141	0...255
71	142-143	0...255
72	144-145	0...255
73	146-147	0...255
74	148-149	0...255
75	150-151	0...255
76	152-153	0...255
77	154-155	0...255
78	156-157	0...255
79	158-159	0...255
80	160-161	0...255
81	162-163	0...255
82	164-165	0...255
83	166-167	0...255
84	168-169	0...255
85	170-171	0...255
86	172-173	0...255
87	174-175	0...255
88	176-177	0...255
89	178-179	0...255
90	180-181	0...255
91	182-183	0...255
92	184-185	0...255
93	186-187	0...255
94	188-189	0...255
95	190-191	0...255

512 Nodes per 128 Forward Nets (Con't.) (Example: 192.168.XXX.YYY)		
Forward Mask: 255.255.254.0		
Forward Net #	XXX Variable	YYY Variable
96	192-193	0...255
97	194-195	0...255
98	196-197	0...255
99	198-199	0...255
100	200-201	0...255
101	202-203	0...255
102	204-205	0...255
103	206-207	0...255
104	208-209	0...255
105	210-211	0...255
106	212-213	0...255
107	214-215	0...255
108	216-217	0...255
109	218-219	0...255
110	220-221	0...255
111	222-223	0...255
112	224-225	0...255
113	226-227	0...255
114	228-229	0...255
115	230-231	0...255
116	232-233	0...255
117	234-235	0...255
118	236-237	0...255
119	238-239	0...255
120	240-241	0...255
121	242-243	0...255
122	244-245	0...255
123	246-247	0...255
124	248-249	0...255
125	250-251	0...255
126	252-253	0...255
127	254-255	0...255

1,024 Nodes per 64 Forward Nets (Example: 192.168.XXX.YYY)		
Forward Mask: 255.255.252.0		
Forward Net #	XXX Variable	YYY Variable
0	0-3	0...255
1	4-7	0...255
2	8-11	0...255
3	12-15	0...255
4	16-19	0...255
5	20-23	0...255
6	24-27	0...255
7	28-31	0...255
8	32-35	0...255
9	36-39	0...255
10	40-43	0...255
11	44-47	0...255
12	48-51	0...255
13	52-55	0...255
14	56-59	0...255
15	60-63	0...255
16	64-67	0...255
17	68-71	0...255
18	72-75	0...255
19	76-79	0...255
20	80-83	0...255
21	84-87	0...255
22	88-91	0...255
23	92-95	0...255
24	96-99	0...255
25	100-103	0...255
26	104-107	0...255
27	108-111	0...255
28	112-115	0...255
29	116-119	0...255
30	120-123	0...255
31	124-127	0...255

1,024 Nodes per (Con't.) 64 Forward Nets (Example: 192.168.XXX.YYY)		
Forward Mask: 255.255.252.0		
Forward Net #	XXX Variable	YYY Variable
32	128-131	0...255
33	132-135	0...255
34	136-139	0...255
35	140-143	0...255
36	144-147	0...255
37	148-151	0...255
38	152-155	0...255
39	156-159	0...255
40	160-163	0...255
41	164-167	0...255
42	168-171	0...255
43	172-175	0...255
44	176-179	0...255
45	180-183	0...255
46	184-187	0...255
47	188-191	0...255
48	192-195	0...255
49	196-199	0...255
50	200-203	0...255
51	204-207	0...255
52	208-211	0...255
53	212-215	0...255
54	216-219	0...255
55	220-223	0...255
56	224-227	0...255
57	228-231	0...255
58	232-235	0...255
59	236-239	0...255
50	240-243	0...255
61	244-247	0...255
62	248-251	0...255
63	252-255	0...255

2,048 Nodes per 32 Forward Nets (Example: 192.168.XXX.YYY)		
Forward Mask: 255.255.248.0		
Forward Net #	XXX Variable	YYY Variable
0	0-7	0...255
1	8-15	0...255
2	16-23	0...255
3	24-31	0...255
4	32-39	0...255
5	40-47	0...255
6	48-55	0...255
7	56-63	0...255
8	64-71	0...255
9	72-79	0...255
10	80-87	0...255
11	88-95	0...255
12	96-103	0...255
13	104-111	0...255
14	112-119	0...255
15	120-127	0...255
16	128-135	0...255
17	136-143	0...255
18	144-151	0...255
19	152-159	0...255
20	160-167	0...255
21	168-175	0...255
22	176-183	0...255
23	184-191	0...255
24	192-199	0...255
25	200-207	0...255
26	208-215	0...255
27	216-223	0...255
28	224-231	0...255
29	232-239	0...255
30	240-247	0...255
31	248-255	0...255

4,096 Nodes per 16 Forward Nets (Example: 192.168.XXX.YYY)		
Forward Mask: 255.255.240.0		
Forward Net #	XXX Variable	YYY Variable
0	0-15	0-255
1	16-31	0-255
2	32-47	0-255
3	48-63	0-255
4	64-79	0-255
5	80-95	0-255
6	96-111	0-255
7	112-127	0-255
8	128-143	0-255
9	144-159	0-255
10	160-175	0-255
11	176-191	0-255
12	192-207	0-255
13	208-223	0-255
14	224-239	0-255
15	240-255	0-255

8,192 Nodes per 8 Forward Nets (Example: 192.168.XXX.YYY)		
Forward Mask: 255.255.224.0		
Forward Net #	XXX Variable	YYY Variable
0	0-31	0-255
1	32-63	0-255
2	64-95	0-255
3	96-127	0-255
4	128-159	0-255
5	160-191	0-255
6	192-223	0-255
7	224-255	0-255

16,384 Nodes per 4 Forward Nets (Example: 192.168.XXX.YYY)		
Forward Mask: 255.255.192.0		
Forward <u>Net #</u>	XXX <u>Variable</u>	YYY <u>Variable</u>
0	0-63	0-255
1	64-127	0-255
2	128-191	0-255
3	192-155	0-255

32,768 Nodes per 2 Forward Nets (Example: 192.168.XXX.YYY)		
Forward Mask: 255.255.128.0		
Forward <u>Net #</u>	XXX <u>Variable</u>	YYY <u>Variable</u>
0	0-127	0...255
1	128-255	0...255



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