*turbo*IP-45™

TCP/IP Performance Enhancement Proxy
Installation and Operation Manual

Part Number CD/TURBOIP45.IOM
Revision 0

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Installation and Operation Manual

Comtech EF Data is an ISO 9001
Registered Company.

Part Number CD/TURBOIP45.IOM
Revision 0
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Comtech EF Data, 2114 West 7th Street, Tempe, Arizona 85281 USA, (480) 333-2200, FAX: (480) 333-2161.

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Attention: Customer Support Department
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For information regarding this product's warranty policy, refer to page **Error! Bookmark not defined.**.

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About this Manual

This manual provides installation and operation information for Comtech EF Data's *turbo*IP-45™ Performance Enhancement Proxy. This document is intended for network designers and operators responsible for the operation and maintenance of the *turbo*IP-45™.

Comtech EF Data reserves the right to change specifications of products described in this document at any time without notice and without obligation to notify any person of such changes. Information in this document may differ from information published in other Comtech EF Data documents. Refer to the company website or contact Customer Service for the latest released product information.

Conventions and References

Cautions and Warnings

Indicates information critical for proper equipment function.

CAUTION indicates a hazardous situation that, if not avoided, may result in minor or moderate injury. CAUTION may also be used to indicate other unsafe practices or risks of property damage.

WARNING indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.

Metric Conversion

Metric conversion information is located on the inside back cover of this manual. This information is provided to assist the operator in cross-referencing English to Metric conversions.

Trademarks

All product names mentioned in this manual may be trademarks or registered trademarks of their respective companies and are hereby acknowledged.

Reporting Comments or Suggestions Concerning this Manual

Comments and suggestions regarding the content and design of this manual will be appreciated. To submit comments, please contact the Comtech EF Data Customer Support Department.

EMC Compliance

This is a Class A product. In a domestic environment, it may cause radio interference that requires the user to take adequate protection measures.

EN55022 Compliance

This equipment meets the radio disturbance characteristic specifications for information technology equipment as defined in EN55022.

EN50082-1 Compliance

This equipment meets the electromagnetic compatibility/generic immunity standard as defined in EN50082-1.

Federal Communications Commission (FCC)

This equipment has been tested and found to comply with the limits for a Class A digital 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. If not installed and used in accordance with the instruction manual, it may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference; in which case, users are required to correct the interference at their own expense.

Note: To ensure compliance, properly shielded cables for DATA I/O shall be used. More specifically, these cables shall be shielded from end to end, ensuring a continuous shield.

Safety Compliance

EN 60950

Applicable testing is routinely performed as a condition of manufacturing on all units to ensure compliance with safety requirements of EN60950.

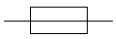
This equipment meets the Safety of Information Technology Equipment specification as defined in EN60950.

Low Voltage Directive (LVD)

The following information is applicable for the European Low Voltage Directive (EN60950):

<HAR>	Type of power cord required for use in the European Community.
	CAUTION: Double-pole/Neutral Fusing. ACHTUNG: Zweipolige bzw. Neutralleiter-Sicherung.

International Symbols:

Symbol	Definition
	Alternating Current.
	**Fuse.**

Symbol	Definition
	**Protective Earth.**
	**Chassis Ground.**

Note: For additional symbols, refer to “Cautions” listed earlier in this preface.

Warranty Policy

Comtech EF Data products are warranted against defects in material and workmanship for a period of two years from the date of shipment. During the warranty period, Comtech EF Data will, at its option, repair or replace products that prove to be defective.

For equipment under warranty, the owner is responsible for freight to Comtech EF Data and all related customs, taxes, tariffs, insurance, etc. Comtech EF Data is responsible for the freight charges only for return of the equipment from the factory to the owner. Comtech EF Data will return the equipment by the same method (i.e., Air, Express, Surface) as the equipment was sent to Comtech EF Data.

All equipment returned for warranty repair must have a valid RMA number issued prior to return and be marked clearly on the return packaging. Comtech EF Data strongly recommends all equipment be returned in its original packaging.

Comtech EF Data Corporation's obligations under this warranty are limited to repair or replacement of failed parts, and the return shipment to the buyer of the repaired or replaced parts.

Limitations of Warranty

The warranty does not apply to any part of a product that has been installed, altered, repaired, or misused in any way that, in the opinion of Comtech EF Data Corporation, would affect the reliability or detracts from the performance of any part of the product, or is damaged as the result of use in a way or with equipment that had not been previously approved by Comtech EF Data Corporation.

The warranty does not apply to any product or parts thereof where the serial number or the serial number of any of its parts has been altered, defaced, or removed.

The warranty does not cover damage or loss incurred in transportation of the product.

The warranty does not cover replacement or repair necessitated by loss or damage from any cause beyond the control of Comtech EF Data Corporation, such as lightning or other natural and weather related events or wartime environments.

The warranty does not cover any labor involved in the removal and or reinstallation of warranted equipment or parts on site, or any labor required to diagnose the necessity for repair or replacement.

The warranty excludes any responsibility by Comtech EF Data Corporation for incidental or consequential damages arising from the use of the equipment or products, or for any inability to use them either separate from or in combination with any other equipment or products.

A fixed charge established for each product will be imposed for all equipment returned for warranty repair where Comtech EF Data Corporation cannot identify the cause of the reported failure.

Exclusive Remedies

Comtech EF Data Corporation's warranty, as stated is in lieu of all other warranties, expressed, implied, or statutory, including those of merchantability and fitness for a particular purpose. The buyer shall pass on to any purchaser, lessee, or other user of Comtech EF Data Corporation's products, the aforementioned warranty, and shall indemnify and hold harmless Comtech EF Data Corporation from any claims or liability of such purchaser, lessee, or user based upon allegations that the buyer, its agents, or employees have made additional warranties or representations as to product preference or use.

The remedies provided herein are the buyer's sole and exclusive remedies. Comtech EF Data shall not be liable for any direct, indirect, special, incidental, or consequential damages, whether based on contract, tort, or any other legal theory.

Chapter 1. Introduction

***turbo*IP-45™**

Performance Enhancement Proxy

1.1 Introduction

This user guide provides an overview of Comtech EF Data's *turbo*IP-45™ Performance Enhancement Proxy, along with instructions on how to configure the *turbo*IP-45, starting from factory default settings, so that it is passing traffic within minutes. It is assumed that the reader is familiar with general IP networking principles.

1.1.1 Definitions

Term	Meaning
Bridge	In this document, this term refers to a network element that receives frames from one network interface and forwards them in the direction of their destination based on their link layer addresses.
Byte	Eight bits (see Octet).
CLI (Command Line Interface)	The user interface of the *turbo*IP-45 system that is available via the serial port.
Compression	A *turbo*IP-45 feature that will attempt both Header and Payload Compression on all accelerated TCP sessions.
Datagram	The portion of a PDU that corresponds to the network layer and higher, that is, that portion that is transferred end to end between IP hosts on different networks.
easyConnect™	The feature of the *turbo*IP-45 system that allows it to operate as a bridge.
Fail to Wire (FTW)	*turbo*IP-45 feature that will allow all traffic to automatically bypass the *turbo*IP-45 in

Term	Meaning
	the event of a failure.
Frame	A link layer PDU.
Gateway	A network device used to perform protocol conversions at a specific protocol layer to interconnect dissimilar networks.
HTTP (Hyper Test Transfer Protocol)	Protocol standard for web access.
kbps (kilobits per second)	A rate of 1,000 bits per second.
LAN (Local Area Network)	On the *turbo*IP-45, this refers to the Ethernet port that would be attached to the LAN.
MB (Megabytes)	1,048,576 Bytes (Octets).
Mbps (Megabits per second)	A rate of 1,000,000 bits per second.
Management IP	The IP assigned to the *turbo*IP-45 for management via HTTP or SNMP. On the *turbo*IP-45, both the LAN and WAN port can be accessed by the Management IP.
ms (millisecond)	A rate of 0.001 second.
Octet	Eight bits (see Byte).
PDU (Protocol Data Unit)	The messages sent between peer entities in a protocol. The PDU includes headers generated or consumed by the protocol implementation as well as the data portion carried by the entity. A PDU may be segmented by a lower layer protocol.
RTT (Round Trip Time)	The elapsed time (in milliseconds) for traffic to be sent from one host and a response received by the sending host.
Selective Acceleration	The ability to provide a different quality of service to different datagrams. The term 'Selective Acceleration' actually applies to all types of IPv4 traffic, not just to accelerated sessions.
Session	A single bi-directional TCP connection between two end systems (hosts)
SkipWare®	SCPS-TP compliant layer-4 gateway software developed by Global Protocols. SkipWare also provides many of the gateway (GW) functions of the *turbo*IP-45 software. Skipware does NOT include management interfaces (i.e., SNMP, CLI< HTTP, etc.), GPOS, and some other *turbo*IP-45 software.
SNMP	Simple Network Management Protocol.
*turbo*IP-45 ™ hardware	The hardware platform provided by Comtech on which the *turbo*IP-45 software executes.
WAN (Wide Area Network)	On the *turbo*IP-45, this refers to the Ethernet port that would be physically attached to the outbound satellite equipment.

1.2 TCP/IP Performance Limitations

Due to its design, TCP/IP does not perform well over impaired links. The link impairment could be due to delay or noise or both. A typical satellite link suffers due to high delay and high noise. The main reasons for poor TCP/IP performance over an impaired link can be summarized as:

Slow start algorithm	Slow start algorithm allows a TCP sender to increase the data transmission rate without overwhelming the network. It achieves this goal by gradually increasing the number of unacknowledged segments at the start of the session. The time required for an acknowledgement over the satellite link severely limits the ramp up in transmission rate.
TCP window size	The most unacknowledged data that a TCP sender can have outstanding is limited by the sender's window size. This limits the transmission rate in the steady state to Window_Size/Round_Trip_Time (e.g., for a typical receive windows size of 64 kbytes and satellite round trip time of 540 ms, the maximum throughput is limited to approximately 121 kbps).
Congestion avoidance algorithms	The congestion avoidance and control mechanism of TCP attributes packet loss to network congestion, as opposed to corruption due to noise in the channel. This leads to drastic reduction in transmission rates. Recovery from congestion is slowed due to the high round trip time and noise in the satellite channel.

1.3 TCP/IP Performance Enhancement Proxy

Comtech EF Data's *turbo*IP-45 Performance Enhancement Proxy is designed to alleviate TCP/IP bottlenecks in an impaired environment (high delay, high bit error rate, or both), while preserving interoperability with any TCP device. It achieves this by combining TCP with a number of enhancements that modernize IP transport.

*turbo*IP-45 is based on SCPS-TP, the Transport Protocol of SCPS, an open standard specifically defined for space communications. This standard is open, published, and internationally distributed. SCPS-TP is an ISO standard (15893), a CCSDS standard (714.0-B-1), and a MIL-STD (MIL-STD-2045-44000).

*turbo*IP-45 is fully compatible with network devices that use TCP, supporting existing Internet standards, including network congestion and retransmission schemes. This allows *turbo*IP-45 at one end of the link to operate with TCP devices at the other end of the link without the need for a peer *turbo*IP-45 device, providing partial performance enhancement. However, it is recommended that TCP traffic pass through a pair of *turbo*IP™ Performance Enhancement Proxies, in order to take full advantage of the SCPS-TP protocol.

The key features of *turbo*IP-45 that help alleviate TCP/IP performance bottlenecks are:

Quick Start	*turbo*IP-45 makes full and immediate use of the links available, eliminating the inefficiencies of the TCP slow-start algorithm.
Window Scaling	*turbo*IP-45 supports window sizes up to 1 Gbyte, far exceeding the standard TCP window size of 64 Kbytes.
Intelligent Congestion Control	*turbo*IP-45 is optimized for real-world, mixed-loss environments. It is capable of distinguishing data corruption from congestion-induced data loss. Doing so prevents unnecessary activation of congestion control mechanisms, which can lead to significant reductions in transmission rates.
Rate Pacing [1]	*turbo*IP-45 meters out bursty traffic at a rate not to exceed the configured transmission rate of the satellite channel. This prevents the satellite channel from becoming congested.
Per-Connection [1]	*turbo*IP-45 allows Per-Connection Mode to support dynamic bandwidth paths, where the bandwidth may be different for any of the paths being accelerated by the *turbo*IP-45.
[1] **Note:** Either Rate Pacing or Pre-Connection Mode can be selected to optimize TCP acceleration performance. **Rate Pacing Mode** Should be used when the bandwidth path for accelerated TCP traffic remains constant with the set WAN Transmission Rate. **Per-Connection Mode** Should be used to support dynamic bandwidth paths, where the bandwidth may be different for any of the paths being accelerated by the *turbo*IP-45.	
Selective Negative Acknowledgments (SNACKs)	SNACKs identify specific lost or damaged packets and request retransmission of those packets. This provides for quicker recovery and better bandwidth utilization in lossy environments.
Path MTU Discovery	*turbo*IP-45 allows Slipware to dynamically detect the allowed MTU for the path between the Skip ware gateway and the peer gateway or end systems for accelerated traffic, thus eliminating fragmentation of TCP segments that are too large for the path MTU.
Error tolerant congestion control	*turbo*IP-45 allows the Per connection congestion control to tolerate some amount of loss due to corrupted packets (bit errors) without reducing the throughput. Previous releases treated any loss as an indication of congestion and reduced the throughput by half
Tolerance for packet reordering	*turbo*IP-45 prevents spurious retransmissions due to packet reordering in the path between two skip ware gateways
Support for large queues with congestion control	*turbo*IP-45 prevents spurious retransmissions timeouts (RTO) caused by an increase in RTT due to queuing, improving throughput when using the Per-Connection congestion control on long delay networks that support large queues.

1.4 Selective Acceleration

Selective Acceleration implemented by the Comtech *turbo*IP-45 is a mechanism for providing different quality of service (QoS) for different datagrams. Selective Acceleration only applies to IPv4 datagrams that are received on the LAN interface and forwarded to the WAN interface.

Selective Acceleration is implemented as an ordered table of rules that determine the QoS to be provided for traffic passing through the *turbo*IP-45. The rules have three parts: an accounting part that specifies the location and status of the rule in the table, a filter part that matches the datagram's passing through the *turbo*IP-45 to each rule, and a QoS part that determines how the data that matches the rule is to be treated. Each rule can specify that either all packets matching the rule be dropped or the following QoS parameters be applied:

- A priority level
- A maximum data rate (bandwidth) for all traffic matching the rule
- Whether or not to accelerate TCP sessions matching the rule (i.e., invoke SCPS-TP)

1.5 Data and Header Compression

The *turbo*IP-45 supports header and payload compression of accelerated TCP traffic. Compression is enabled or disabled by a global setting. If it is enabled, both header and data compression will be attempted on all new accelerated sessions. Compression will be negotiated during the TCP connection establishment. Therefore, even if the *turbo*IP-45 has compression enabled, and if the peer *turbo*IP-45 does not also have compression enabled, then the session will not be compressed.

Data compression on accelerated TCP flows will be handled on a segment-by-segment basis. The compressibility of each segment payload will be evaluated individually and only those segments where the impacts would be beneficial will be compressed.

If a session is to be compressed, then the segments corresponding to that session will be compressed only if:

1. The uncompressed payload length is greater than 90 octets

   and

2. The compressed length is not larger than two octets smaller than the uncompressed length.

1.5.1 Minimum Compression Ratio

The compression ratio is defined as the ratio of the sum of the sizes of all TCP segments in an uncompressed session to the sum of the sizes of the TCP segments if that same session were compressed. Note that this is different from the definition used in the compression ratio statistic. A minimum compression ratio of 1.91:1 shall be achieved with the Canterbury corpus and 1.63:1 with the Calgary corpus, when the data is transferred through the *turbo*IP-45 using FTP.

The *turbo*IP-45 shall never produce a compression ratio less than 1 with any data, that is, the size of the compressed flows shall always be less than or equal to the size that the flow would have been if compression were disabled for that flow.

1.6 *turbo*IP-45™ Physical Description and Specifications

Figure 1-1. *turbo*IP-45 Front Panel View

Front Panel Control/LEDs	
ON/OFF	Recessed power reset switch
POWER	Green when power is applied
LAN/LINK	Green when LAN Port senses 10/100 Base-T link
LAN/ACT	Flashing amber when LAN Port senses Ethernet Activity
WAN/LINK	Green when WAN Port senses 10/100 Base-T link
WAN/ACT	Flashing amber when WAN Port senses Ethernet Activity

Figure 1-2. *turbo*IP-45 Rear Panel View

Rear Panel Connectors	
CONSOLE	EIA-232 Female 9-pin for serial console CLI
WAN	RJ-45, 10 Base-T/100 Base-T Ethernet, Auto-Sensing
LAN	RJ-45, 10 Base-T/100 Base-T Ethernet, Auto-Sensing

Chapter 2. Fail to Wire

2.1 Description

The Fail to Wire (FTW) function provides a low-cost solution for high network availability. If the unit fails, then the installed FTW board allows traffic to bypass the *turbo*IP-45™ as if it were simply a wire. This means that a unit failure will not bring down the whole network. Traffic will continue to pass and, at most, the existing TCP sessions will be terminated and have to be restarted. The FTW functionality provides network reliability without the added cost of one-for-one redundancy.

2.2 Fail to Wire Board Operation

If the *turbo*IP-45 fails (excluding loss of power), then the FTW board switches into "wire" mode approximately 7 to 10 seconds after the failure. At this time, all traffic is bypassed around the *turbo*IP-45. All active TCP sessions will timeout and need to be restarted. Newly started TCP sessions will be bypassed around the *turbo*IP-45 without acceleration.

If *turbo*IP-45 reboots, then the FTW board switches to wire mode seven to 10 seconds after the reboot is initiated, and stays in "wire" mode until the reboot is completed. Hence, 7 to 10 seconds is the extent of network outage caused by a reboot of the *turbo*IP-45.

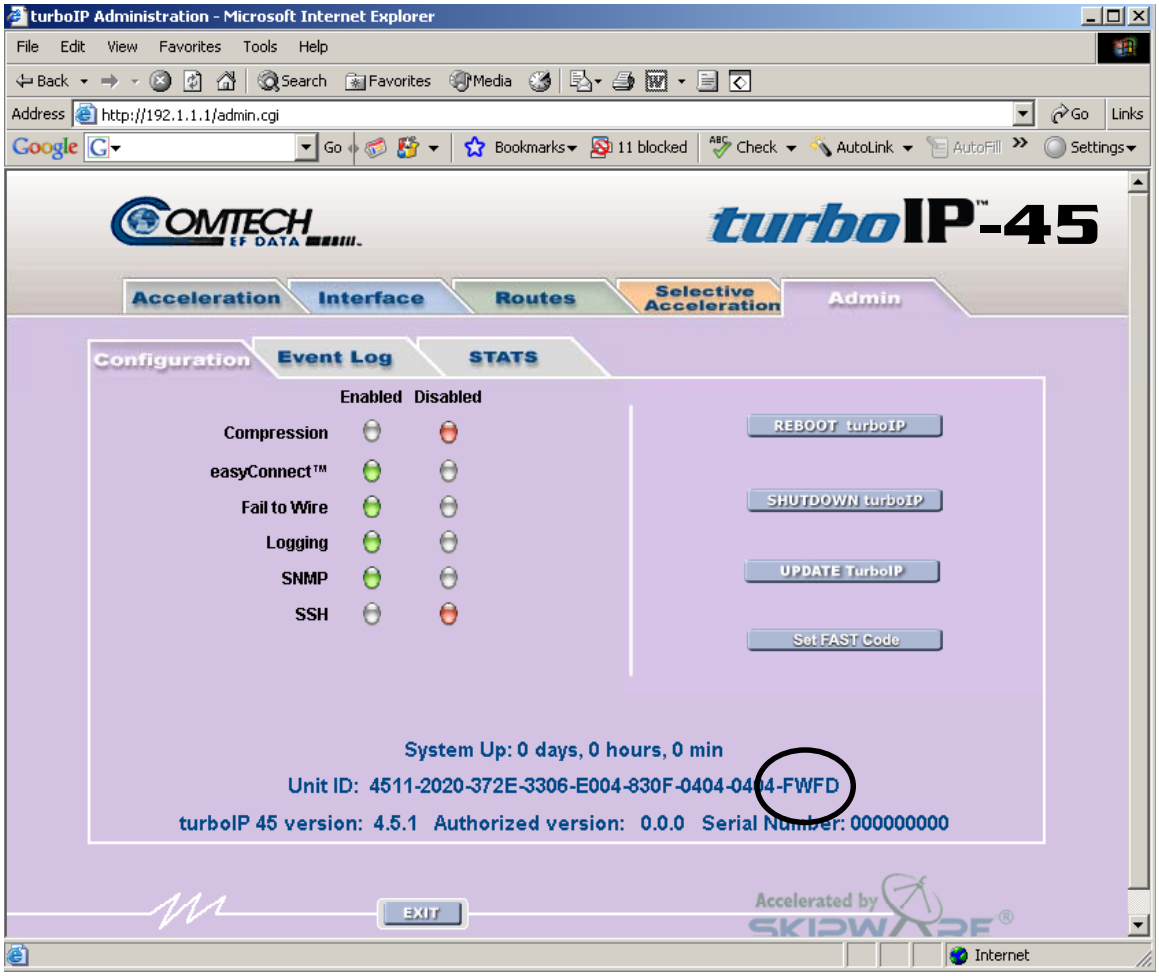
If the *turbo*IP-45 loses power, then the FTW board immediately switches into "wire" mode. Approximately one second of traffic is lost during this switch. In addition, all TCP sessions will timeout and have to be restarted.

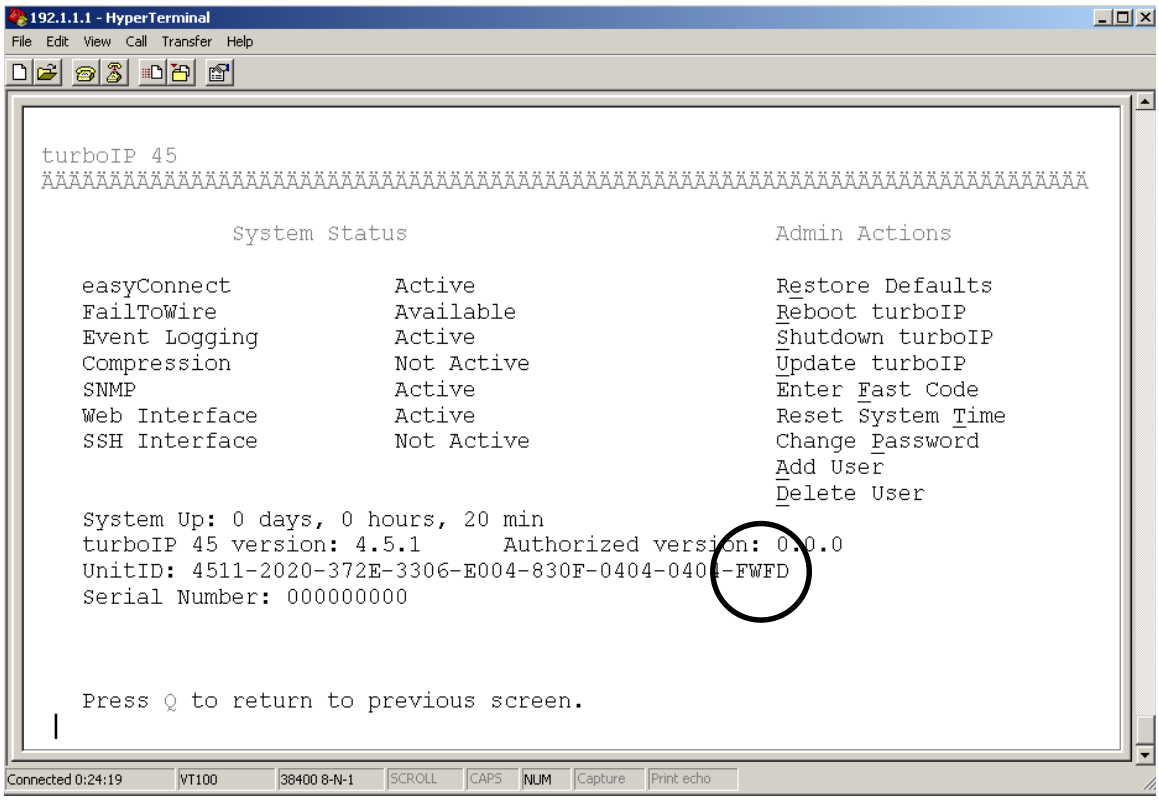
While the *turbo*IP-45 is off, the FTW board is in "wire" mode and all traffic is bypassed around the *turbo*IP-45. When the *turbo*IP-45 is powered on again, the FTW board switches from "wire" mode to "normal" mode during which time no traffic passes through the *turbo*IP-45 for 7 to 10 seconds. After this period, the board will switch back into "wire" mode and bypass traffic around the *turbo*IP-45 for 33 seconds while *turbo*IP-45 is booting. When the *turbo*IP-45 finishes bootup, the FTW board switches from "wire" mode to "normal" mode and the *turbo*IP-45 begins normal operations. About one second of traffic loss is possible during this final switch.

2.3 Fail to Wire Board Installed

If the Fail to Wire (FTW) board is installed in the *turbo*IP-45, then the last four characters of the Unit ID on the Upgrade page will read “FWFD”.

The presence of a FTW board can be verified by looking at the Unit ID on both the HTTP interface and the CLI interface as shown below.




192.1.1.1 - HyperTerminal
File Edit View Call Transfer Help
turboIP 45
System Status
Admin Actions
easyConnect Active
FailToWire Available
Event Logging Active
Compression Not Active
SNMP Active
Web Interface Active
SSH Interface Not Active
Restore Defaults
Reboot turboIP
Shutdown turboIP
Update turboIP
Enter Fast Code
Reset System Time
Change Password
Add User
Delete User
System Up: 0 days, 0 hours, 20 min
turboIP 45 version: 4.5.1 Authorized version: 0.0.0
UnitID: 4511-2020-372E-3306-E004-830F-0404-0404-FWFD
Serial Number: 000000000
Press Q to return to previous screen.
Connected 0:24:19
VT100
38400 8-N-1
SCROLL
CAPS
NUM
Capture
Print echo

Notes:

Chapter 3. easyConnect™

easyConnect™ is Comtech EF Data's intelligent networking technology intended to allow easy integration of *turbo*IP-45™ into existing networks. It also simplifies design and installation of a new network. It reduces network reconfiguration that is required when introducing *turbo*IP-45 into an existing link.

3.1 easyConnect™ ON

With easyConnect enabled, *turbo*IP-45 can be added to existing links without impacting existing non-TCP traffic and without having to reconfigure existing network devices. It also reduces the complexity when designing and installing a new network.

easyConnect mode:

- All IP and Non-IP traffic is transparently bridged.
- IP multicast is transparently bridged
- Unicast IP datagrams that do not contain TCP payload are transparently bridged, and can be assigned a Priority or bandwidth restriction with Selective Acceleration Rules.
- Unicast IP datagrams that contain TCP payload can be assigned a Priority or bandwidth restriction with Selective Acceleration Rules. Also, Selective Acceleration can be used to designate which TCP traffic is accelerated and which is not accelerated.

With easyConnect mode, the unit has only one IP address (Management IP Address) that both the LAN and WAN port will respond to.

3.2 Important easyConnect™ Notes

With easyConnect mode, the *turbo*IP-45 cannot be the default gateway or the next hop for any locally attached devices. Instead, the *turbo*IP-45 will work as a transparent bridge.

Notes:

Chapter 4. Configuring *turbo*IP-45™

4.1 Important Configuration Notes

*turbo*IP-45™ must be placed in the link such that it has visibility of TCP traffic in both directions, i.e., the forward traffic as well as the TCP acknowledgments must go through the unit. If the unit is placed such that it only has visibility of forward traffic or TCP acknowledgments, all such TCP sessions through *turbo*IP-45 will not be accelerated.

During configuration of *turbo*IP-45, a reboot is required for the three following changes; all other changes are immediately in effect:

- Initial Configuration Wizard
- Restore to Factory Defaults
- Upgrading of the Unit

4.2 Required Equipment List

In addition to the Ethernet cables and Ethernet switches/hubs required to connect *turbo*IP-45™ to the network, the following equipment is required for the console connection:

1. DB-9 (female) to DB-9 (male) straight-through modem cable
2. PC running terminal emulation program (such as HyperTerminal)

4.3 User Interfaces

*turbo*IP-45 supports a basic menu-driven interface, which is accessible using the console port, or a web-based graphical user interface (GUI). The interfaces contain the same functionality, with one exception. The USERID and PASSWORD are only configurable via the console connection, for obvious security reasons.

4.3.1 Console Settings

Baud Rate	38,400 bps
Data Bits	8
Parity	None
Stop Bits	1
Hardware Flow Control	None
Software Flow Control	None
Terminal Emulation	VT100/VT100J
Cable Configuration	Straight - Through

1. Entry of the numeric pad's arrow keys when the NumLock is OFF will work under Hyperterminal, provided that the client is running Windows 2000, Service Pack 4. Microsoft has acknowledged a bug for Hyperterminal shipped with Windows 2000 prior to Service Pack 2 where the arrow keys were non-functional. (http://support.microsoft.com/default.aspx?kbid=263077).

2. Web-based graphical user interface (GUI) CAN ONLY be turned on in CLI. End-user is required to run Configuration Wizard for initial setup or log into CLI Menu to ENABLE "Web User Interface.'

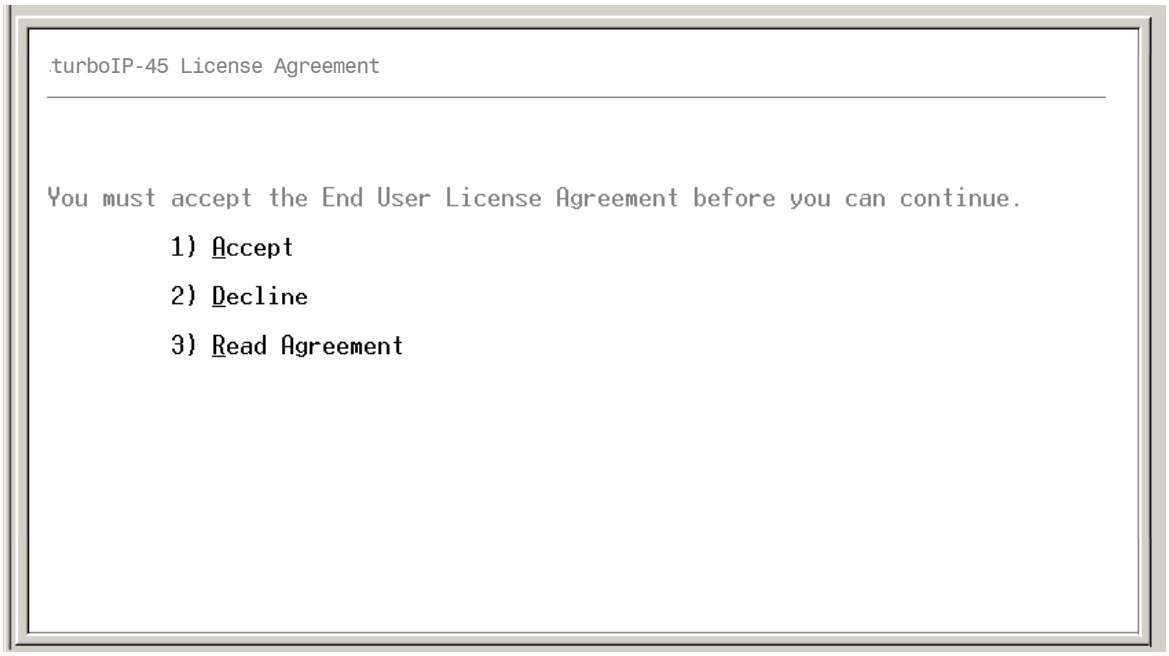
4.4 Configuration Wizard

*turbo*IP-45 has implemented Configuration Wizard to be a user-friendly Command-Line Interface(CLI) through serial console. Initial setup of the *turbo*IP-45 must be done using the serial console. A series of step-by-step instructions will guide you through the initial configuration. End user is required to run the Configuration Wizard with the following conditions:

- Brand new *turbo*IP-45 units shipped with Factory Defaults.
- After Restoring Factory Defaults in the CLI Administration page.

4.4.1 End User License Agreement (EULA)

To use the console interface, launch a terminal window emulation program such as HyperTerminal® on Microsoft Windows®, set the console settings. For a brand new *turbo*IP-45 unit, the console will display the End User License Agreement (EULA).



In order to access to the Configuration Wizard, the end user is required to accept *turbo*IP-45 License Agreement. After Accepting the License Agreement, the user may proceed to *turbo*IP-45 Configuration Wizard.

4.4.2 Configuration Wizard *turbo*IP-45 - Summary

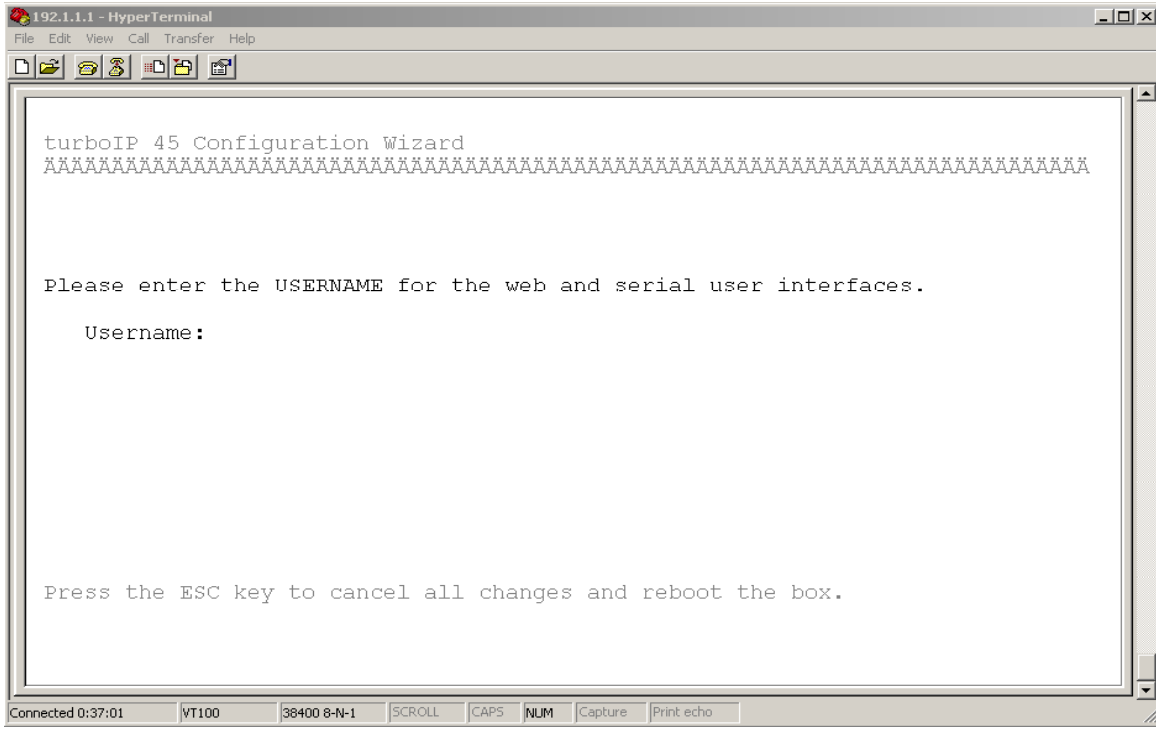
Note: At any time during the initial Configuration Wizard, the ESC key can be used to cancel all changes and reboot.

Information to be provided throughout the Configuration Wizard is listed in the following table. Detailed information is contained in the section listed.

Section	Configuring Item	Default Value	Format	Example
4.4.2.1	Username	N/A	Must be at least 5 and no more than 31 alphanumeric characters in length.	'admin'
4.4.2.2	Password	N/A	Passwords must be at least 8 characters and no more than 31 characters in length. Passwords are case sensitive and must contain at least one character from each of the following groups: uppercase, lowercase, digit, and special character. Special characters include "_!-.;:<>,[]{}|()*&^%$#@`~'+=?/"	'C0mtech!'
	Re-enter password	N/A		'C0mtech!'
N/A	UTC Month	Current system setting	Two digit integer between 1 to 12	'01'
	UTC Day		Two digit integer between 1 to 30 or 31	'01'
	UTC Year		4 digit integer	'2006'
	UTC Military Time		hh:mm:ss	'09:19:51'
4.4.2.3	Management IP Address	10.10.10.1	ddd.ddd.ddd.ddd	'192.9.1.3'
	Management Subnet Mask	255.255.255.0	ddd.ddd.ddd.ddd	'255.255.255.0'
	Default Gateway	0.0.0.0	ddd.ddd.ddd.ddd Must be on same subnet as Management IP.	'192.9.1.4'
4.4.2.4	WAN Rate	45 Mbps	A number, followed by a space and 'bps', 'kbps' or 'Mbps' Must be ≥ 10 kbps and ≤ 45 Mbps	'1000 kbps'
4.4.2.5	DoD Warning Banner	N/A	1 for Enable 2 for Disable Selecting 'Yes' will enable the Department of Defense warning banner on the Serial and SSH interfaces, which will remain on the screen until the user hits a key on their keyboard. Note: The DoD Warning Banner can only be enabled or disabled via the Configuration Wizard.	
4.4.2.6	Web Interface	N/A	1 for Enable 2 for Disable	
4.4.2.7	Configure SNMP	N/A	1 for Enable 2 for Disable	

Section	Configuring Item	Default Value	Format	Example
N/A	Finishing Configuration		Save Changes & Reboot Save Changes & Shutdown Cancel All Changes & Reboot Cancel All Changes & Shutdown	

4.4.2.1 Configuration Wizard *turbo*IP-45 - User Accounts

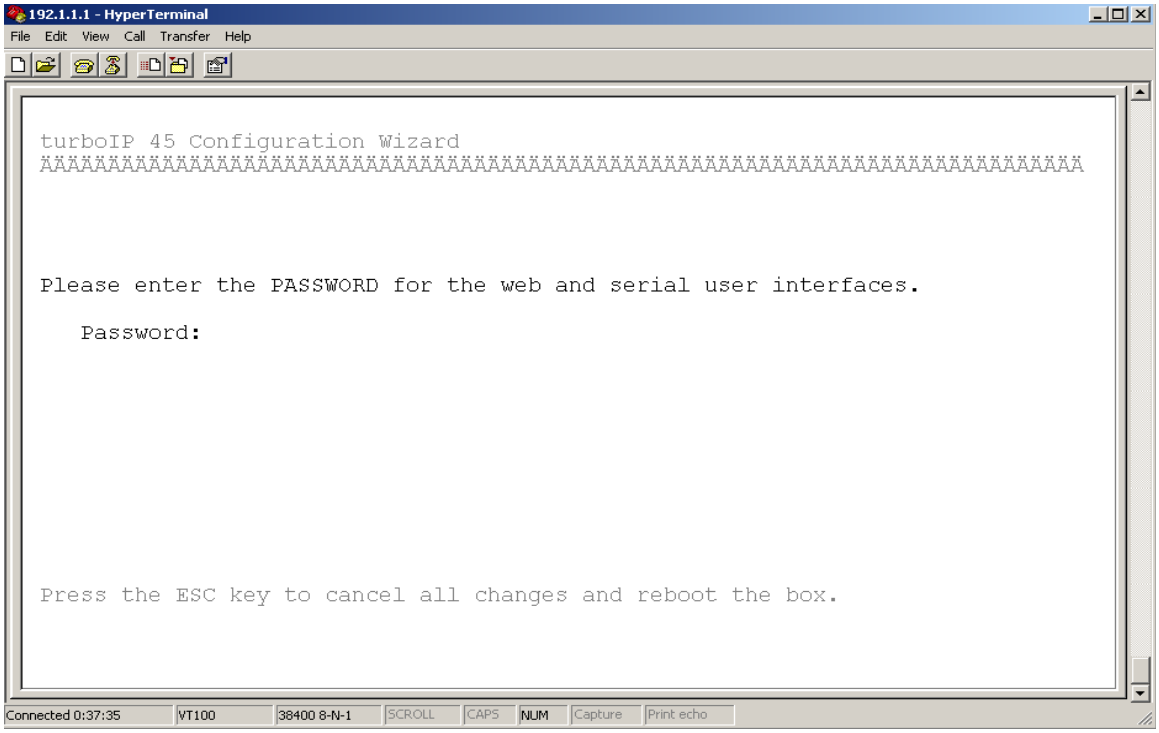


User Accounts - There are two levels of user accounts: Administrator and Normal User. There must always be at least one Administrator account.

The first Administrator account must be created through the Configuration Wizard. If only one Administrator account exists, the user cannot delete the account. An error message will be displayed if there is an attempt to delete the Administrator.

Usernames - must be at least 5 and no more than 31 alphanumeric characters in length.

4.4.2.2 Configuration Wizard *turbo*IP-45 – Password



Password Complexity - Passwords must be at least 8 and no more than 31 characters in length.

Passwords are case-sensitive and must contain at least one character from each of the following types:

- Uppercase
- Lowercase
- Digit
- Special character, including "_!-.;:<>,[]{}\|()*&^%$#@`~'+=?/"

When changing passwords, at least four characters in the new password must be different from the old password. The system does not keep a record of old passwords, once a password is changed.

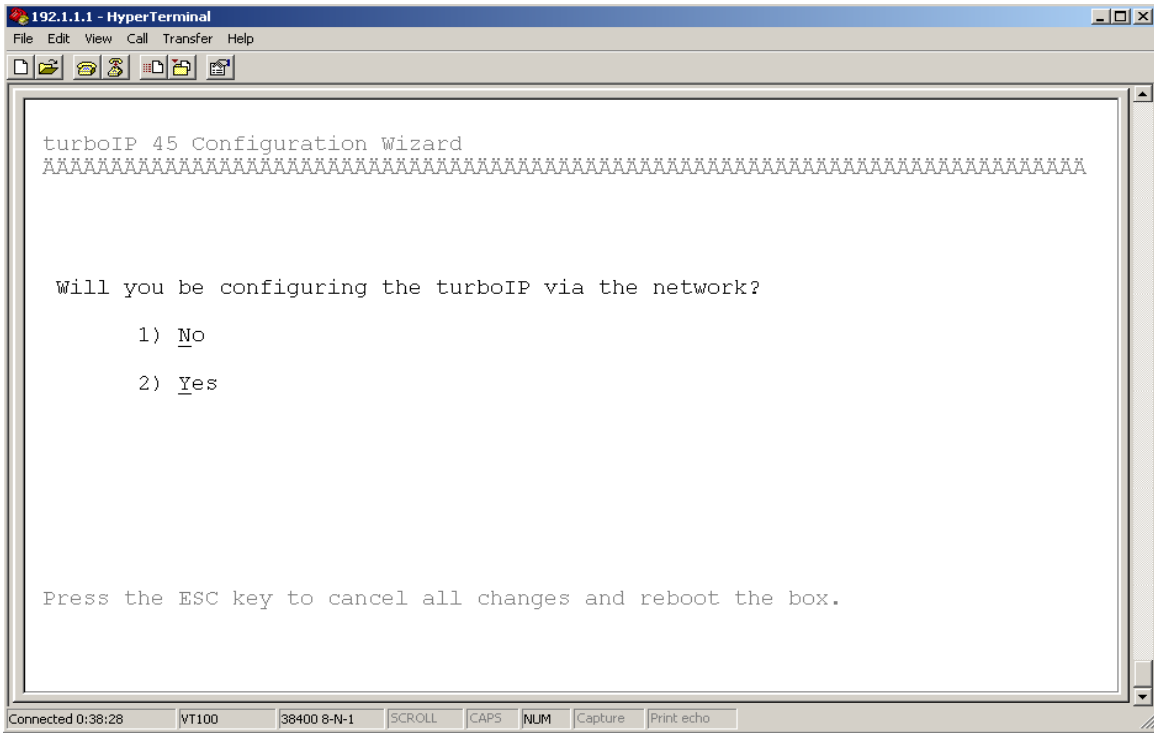
IMPORTANT

If the Administrator login or password is lost, the *turbo*IP-45 can be restored to Factory Defaults using the following account only accessible via the serial interface:

username: safe
password: C0mtech!

Once the factory defaults are restored, the *turbo*IP-45 can be rebooted and the user will be able to accept the EULA and begin the Configuration Wizard.

4.4.2.3 Configuration Wizard *turbo*IP-45 – Network Settings for Remote Access

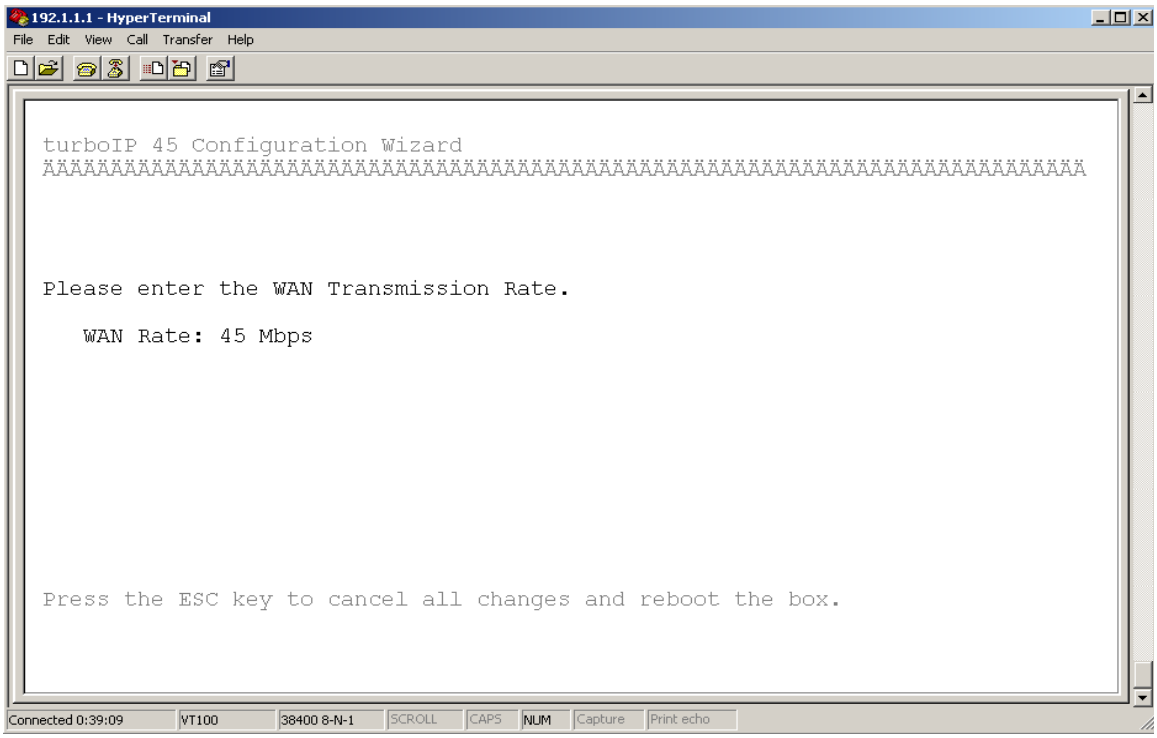


Network Settings – To allow access to the *turbo*IP-45 via the network (using the Web or SNMP IP interface) select 'Yes'.

Management IP Address/Subnet Mask – Enter the IP you wish to assign to the *turbo*IP-45 (both the LAN and WAN port will respond to this IP).

Default Gateway - Enter the IP of the Gateway (must be on same subnet as Management IP).

4.4.2.4 Configuration Wizard *turbo*IP-45 – WAN Transmission Rate



WAN Transmission Rate – Set the maximum bandwidth available for TCP traffic on the WAN interface (a number, followed by a space and 'bps', 'kbps' or 'Mbps'). Must be ≥ 10 kbps and ≤ 45 Mbps. Setting WAN transmission rate in excess of available bandwidth could lead to a packet loss and degraded performance. If you have a mix of TCP and non-TCP traffic, use this setting to limit the bandwidth for TCP traffic.

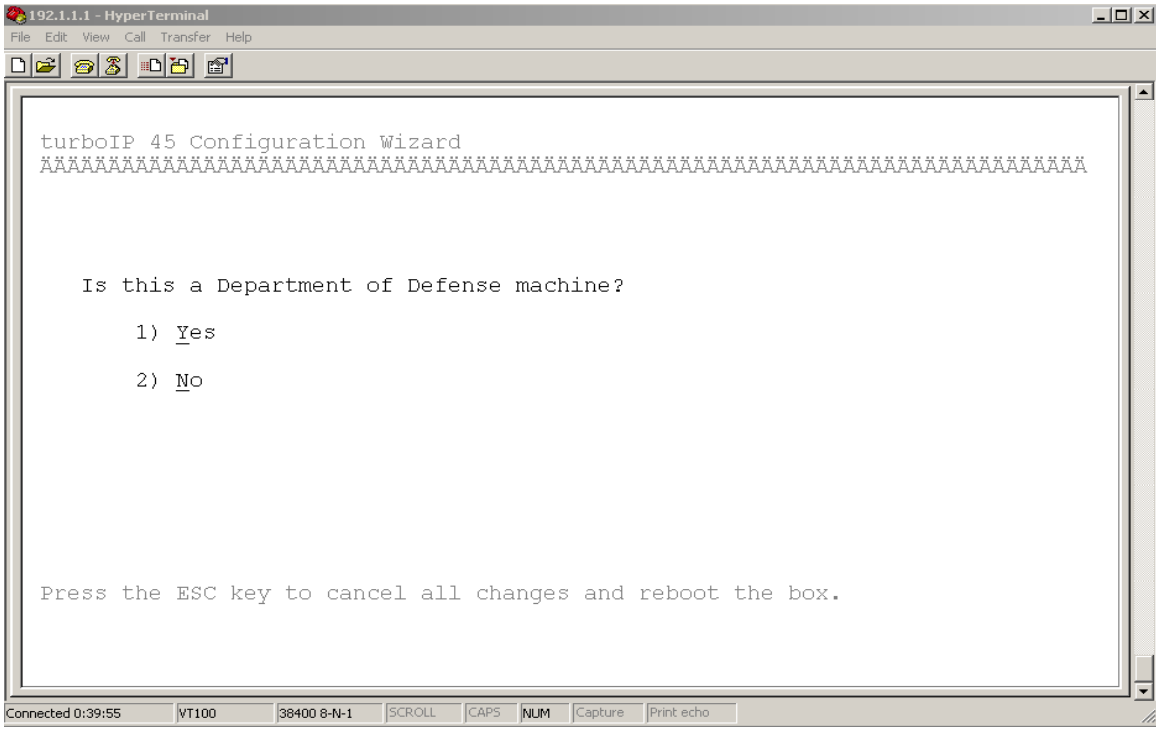
Example 1 – If a pair of *turbo*IP-45s were used to accelerate TCP traffic on a satellite link where satellite modem A has a TX data rate of 12 Mbps and satellite modem B has a TX data rate of 2048 kbps, the WAN setting for *turbo*IP-45 A would be 12 Mbps and would be 2048 kbps for *turbo*IP-45 B.

Example 2 – If a *turbo*IP-45 was in place at a hub where there were three outbound satellite links to three separate remotes with the following links;

- Link A – Hub 4 Mbps Outbound, Remote A 1536 kbps Inbound
- Link B – Hub 3 Mbps Outbound, Remote B 1024 kbps Inbound
- Link A – Hub 2 Mbps Outbound, Remote C 768 kbps Inbound

The Hub *turbo*IP-45 WAN would be set to 9 Mbps to equal the total available Outbound bandwidth (4 + 3 + 2). In this example, Selective Acceleration Rules would need to be created to limit the bandwidth to match the Outbound TX data rate for each Remote. The Remote *turbo*IP-45 WAN setting would be set to the Inbound TX data rate to the Hub.

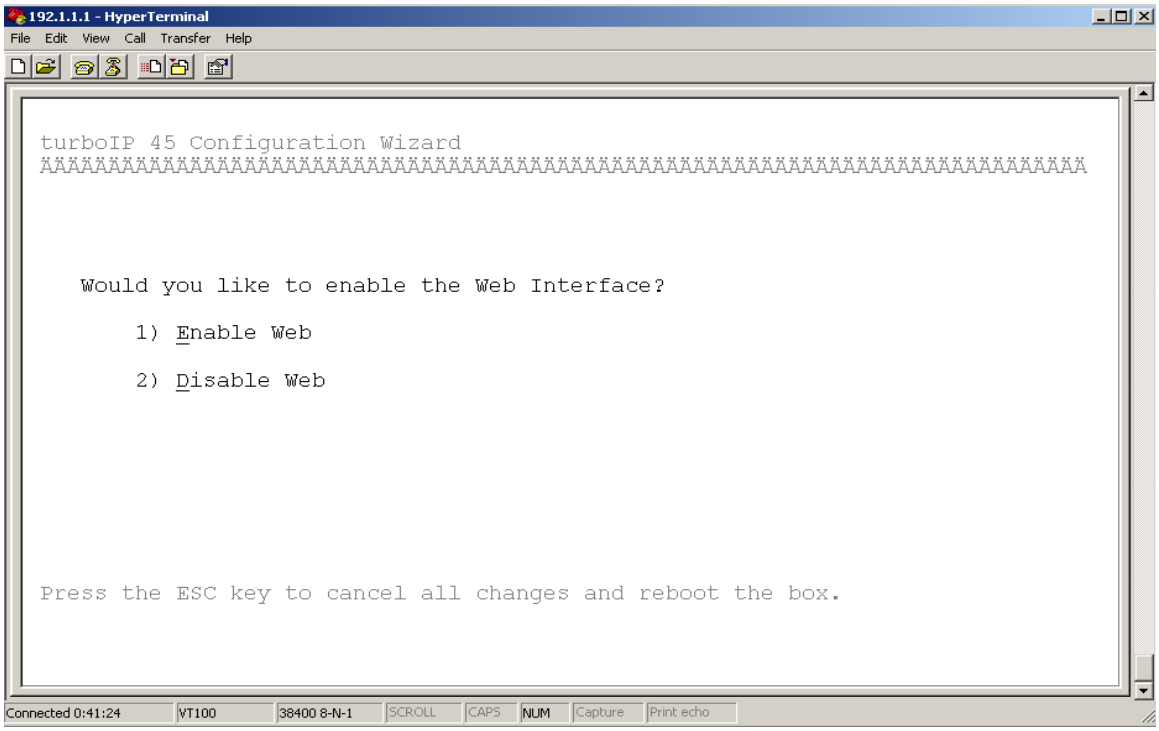
4.4.2.5 Configuration Wizard *turbo*IP-45 – DoD Banner



DoD Warning Banner – Selecting 'Yes' will enable the Department of Defense warning banner on the Serial and SSH interfaces, which will remain on the screen until the user hits a key on their keyboard.

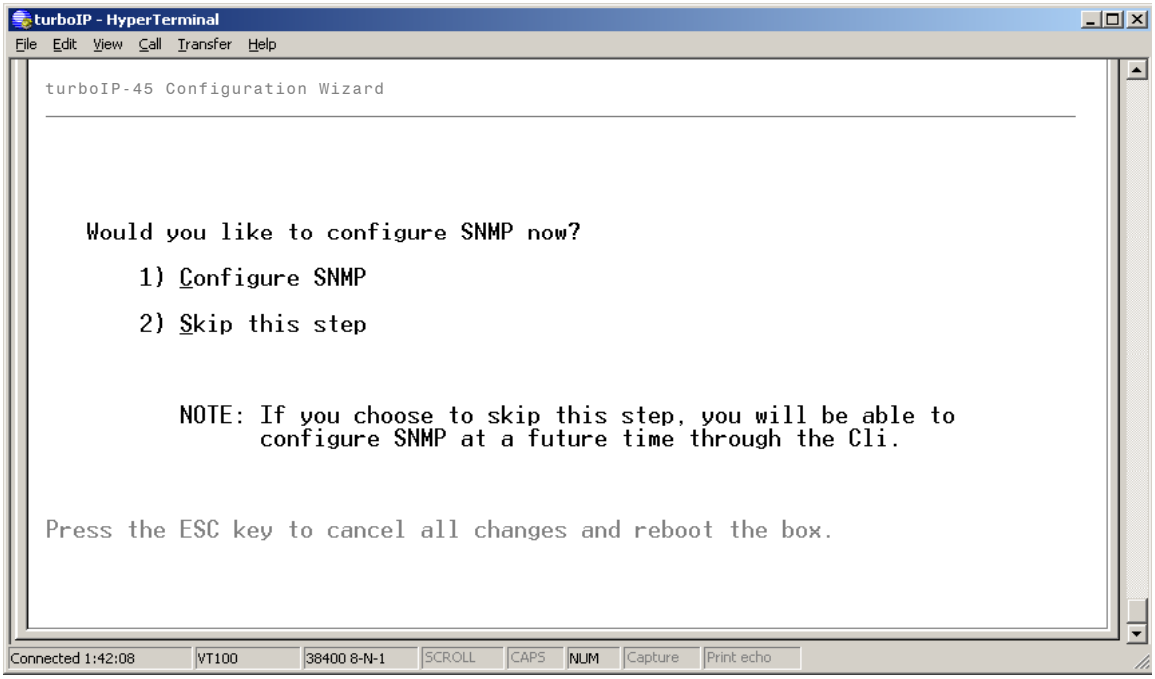
Note - The DoD Warning Banner can only be enabled or disabled via the Configuration Wizard.

4.4.2.6 Configuration Wizard *turbo*IP-45 – Web Interface

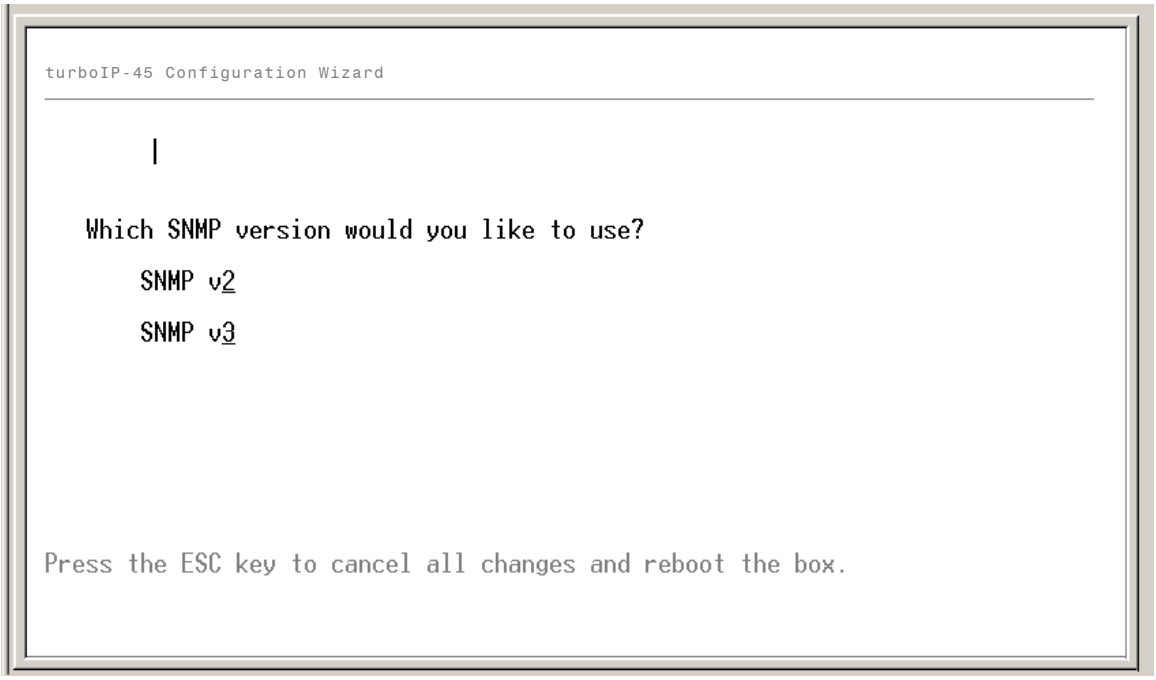


Web Interface – Selecting 'Yes' will enable the *turbo*IP-45 Web interface, for local or remote access.

4.4.2.7 Configuration Wizard *turbo*IP-45 – SNMP



SNMP can be configured via the Configuration Wizard or later via the CLI. If Configuring SNMP is selected during the *turbo*IP-45 Configuration Wizard setup step, the following tables provide the steps for SNMP Configuration.



If **SNMP v2** is selected, see the following table.

Step	Configuring Item for SNMP v2	Default Value	Format	Example
1	SNMP sysName	N/A		'Comtech'
2	SNMP sysLocation	N/A		'Tempe, Arizona'
3	SNMP sysContact	N/A		'TechSupport'
4	Trap Destination Ip Address	N/A	ddd.ddd.ddd.ddd	'192.1.1.1'
5	Read Community	N/A	Between 1-255 characters	'public'
6	Set Community	N/A	Between 1-255 characters	'private'
7	Trap Community	N/A	Between 1-255 characters	'trap'
8	enable SNMP	N/A	1 for Enable 2 for Disable	
9	Save SNMP Changes	N/A	1 for save changes 2 for Cancel changes	
10	Return to Configuration Wizard	N/A		

If **SNMP v3** is selected, see the following table.

Step	Configuring Item for SNMP v3	Default Value	Format	Example
1	SNMP sysName	N/A		'Comtech'
2	SNMP sysLocation	N/A		'Tempe, Arizona'
3	SNMP sysContact	N/A		'TechSupport'
4	Trap Destination IP Address	N/A	ddd.ddd.ddd.ddd	'192.1.1.1'
5	Username			'snmpadmin'
6	Enable Authentication		1 for Yes 2 for No	
6-1	Auth. Passphrase		Enter Authentication Passphrase if Authentication is selected. Between 8-255 characters.	'comtechauth'
7	Enable Privacy		1 for Yes 2 for No	
7-1	Priv. Passphrase		Enter Privacy Passphrase if Privacy is selected. Enter between 8 and 255 characters.	'comtechprivacy'
8	enable SNMP	N/A	1 for Enable 2 for Disable	
9	Save SNMP Changes	N/A	1 for save changes 2 for Cancel changes	
10	Return to Configuration Wizard	N/A		

4.5 Menus and Functions - Summary

4.5.1 CLI Menu

Menu	Description
Configure Interfaces Menu	Enter Management IP Address and subnet mask Turn WEB Interface On/Off Turn SSH Interface On/Off Set LAN/WAN port Link Setting Display LAN/WAN MAC address and Link Status
Gateway Menu	Set LAN and WAN Transmission Rates Set WAN Maximum Transfer Unit (MTU) Turn Compression On/Off Set Congestion Control to Per-Connection or Rate Pacing
Routing Menu	Add, adjust, or delete routes from system routing table Route entries are only required for remote network access to the *turbo*IP-45.
SNMP Menu	Set SNMP subsystem On/Off Set SNMP system variables such as, System Information, Community Strings, and Trap Destination.
Selective Acceleration Menu	Add, move, edit, and delete TCP/UDP QoS/Acceleration rules Monitor statistics by priority Each rule has the following variables - Source IP address/Mask, Destination IP address/Mask, Protocol, Source Port, Destination Port, Priority, Bandwidth, Acceleration ON/OFF, and Status.
Administration Menu	Displays System Status for *turbo*IP-45 features – easyConnect, FailToWre, Event Logging, Compression, SNMP, Web Interface, SSH Interface Displays System Up Time, *turbo*IP-45 Version, Unit ID Used to administer the system functions – Restore Defaults, Reboot, Shutdown, Upgrade, Reset System Time, Change Password, Add User, Delete User Enable Logging, View or Clear Event Log Display/Reset System Statistics – Avg. Compression Ratio, Session Statistics, WAN and LAN Statistics

4.5.2 WEB Menu

Menu	Description
Acceleration	Set LAN and WAN Transmission Rates Set WAN Maximum Transfer Unit (MTU) Turn Compression On/Off Set Congestion Control to Per-Connection or Rate Pacing
Interface	Enter Management IP Address and subnet mask Set LAN/WAN port Link Setting Display LAN/WAN MAC address and Link Status
Routes	Add, adjust, or delete routes from system routing table Route entries are only required for remote network access to the *turbo*IP-45.
Selective Acceleration Rules Stats	Add, move, edit, and delete TCP/UDP QoS/Acceleration rules Monitor statistics by priority Each rule has the following variables - Source IP address/Mask, Destination IP address/Mask, Protocol, Source Port, Destination Port, Priority, Bandwidth, Acceleration ON/OFF, and Status.
Administration Menu Configuration Event Log Stats	Displays System Status for *turbo*IP-45 features – easyConnect, FailToWire, Event Logging, Compression, SNMP, SSH Interface Displays System Up Time, *turbo*IP-45 Version, Unit ID Used to administer the system functions – Reboot, Shutdown, Upgrade Enable Logging, View or Clear Event Log Display/Reset System Statistics – Avg. Compression Ratio, Session Statistics, WAN and LAN Statistics Note: The Web interface Administration menu does not support the following functions - Restore Defaults, Changes to User Accounts or Password, and Reset System Time. These functions are restricted to the CLI or SSH serial interface.

4.5.3 CLI - Log In

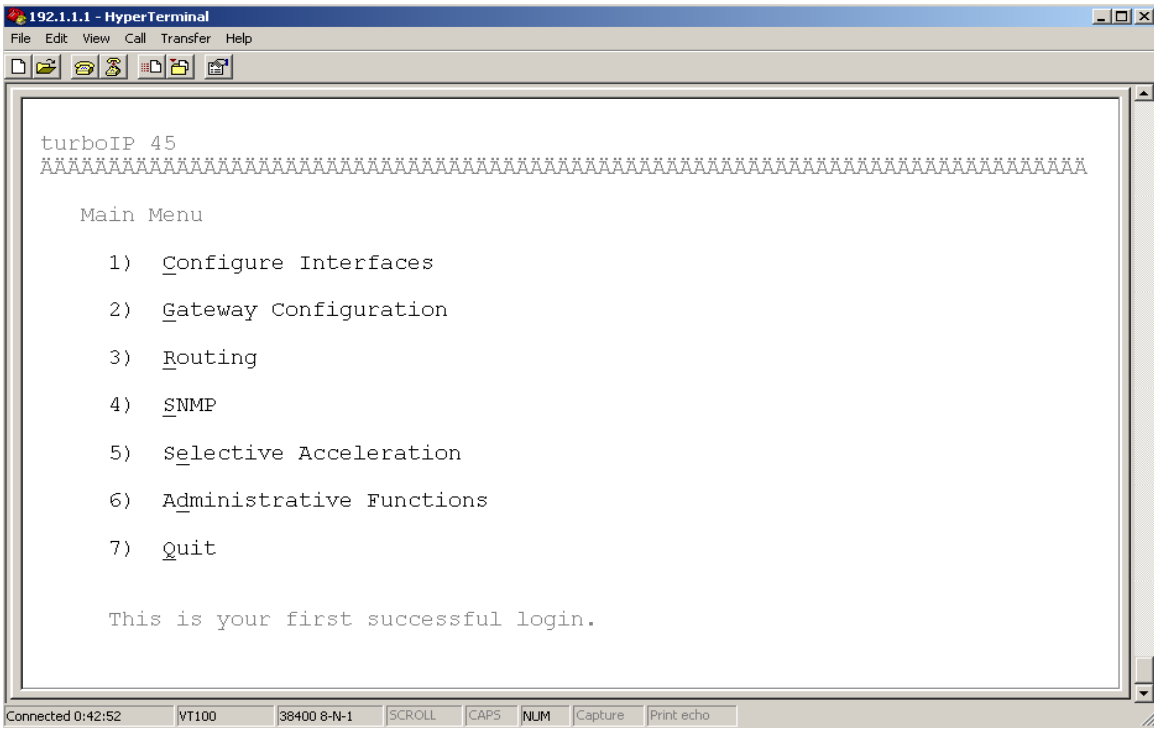
To use the console interface, launch a terminal window emulation program such as HyperTerminal® on Microsoft Windows®, set the console settings. For a brand new *turbo*IP-45 unit, the console will display EULA(End User License Agreement) and running thorough Configuration Wizard is required.

Login with the User ID and Password.

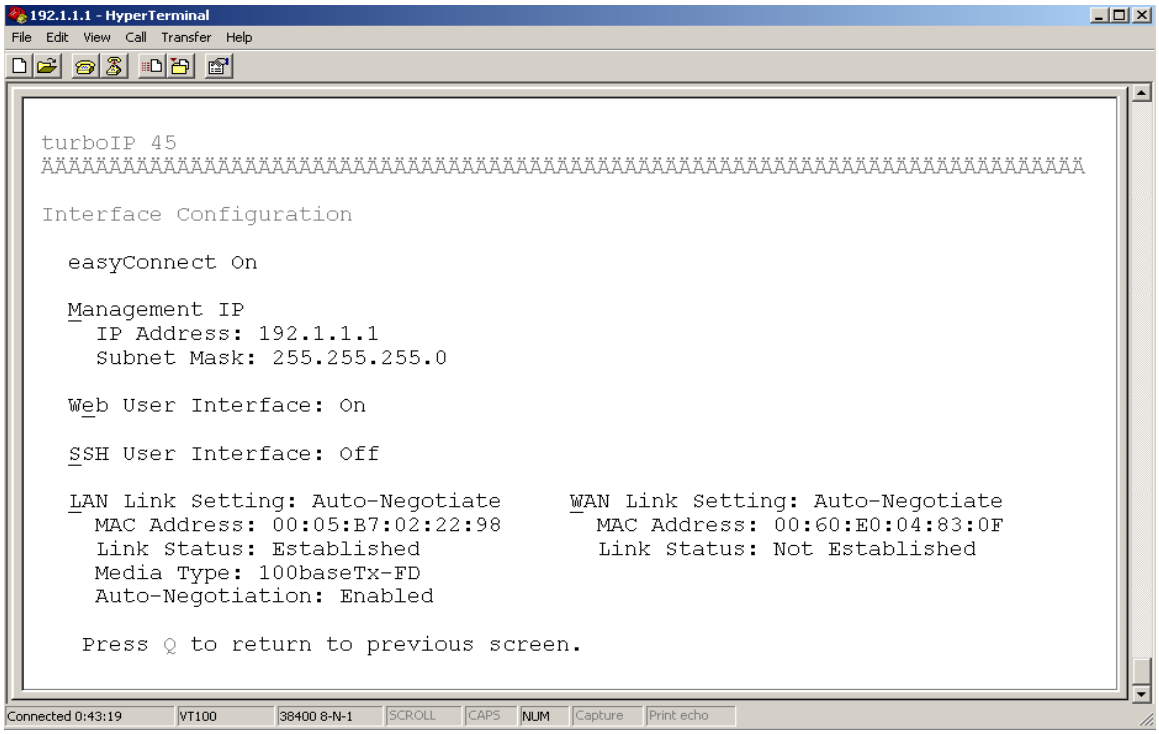
For Example:

```
User ID: admin
Password: *******
```

A successful login from the CLI will open the Main Menu. Note that the first successful login is displayed also. With all subsequent logins, the time and date of the last successful login will be displayed.

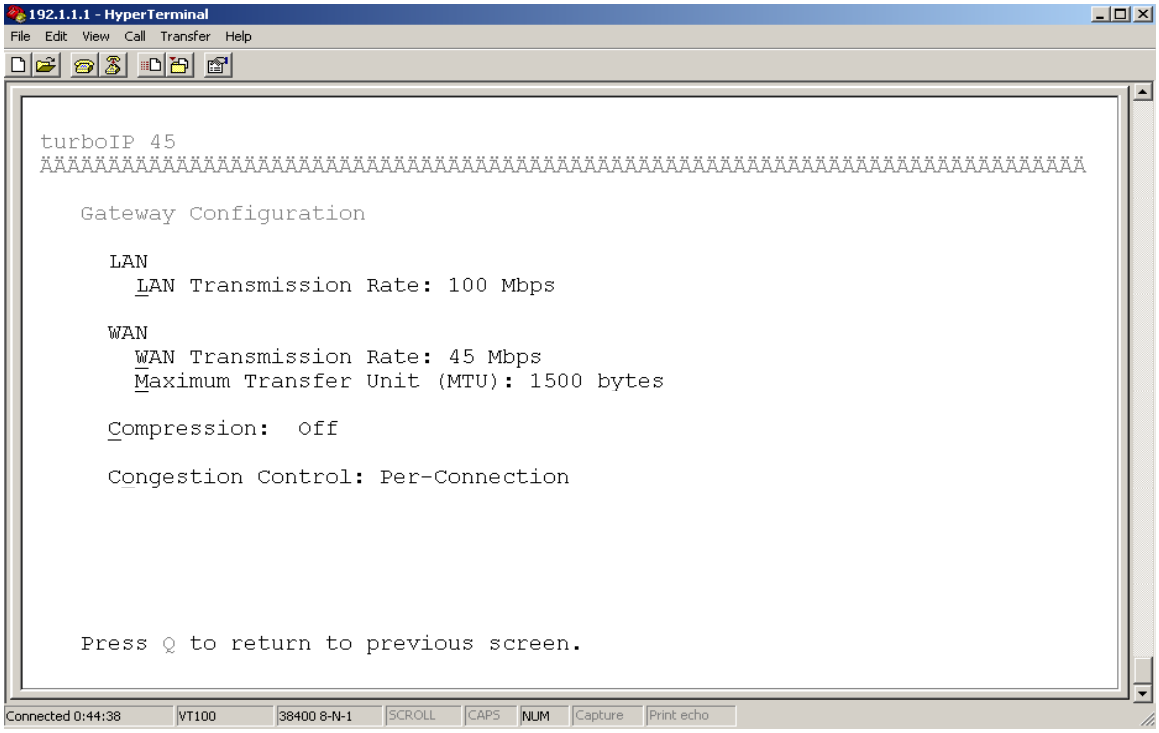


4.5.4 CLI - Configure Interface Menu



Function	Select	Description
easyConnect	N/A	Status Only (On)
Management IP	M	Management IP address Management Subnet Mask
Web Interface	E	Select - On/Off
SSH Interface	S	Select - On/Off
LAN Link Setting	L	Select - Auto-Negotiate, 10baseT, 10baseT-FD, 100baseTx, 100baseTx-FD MAC Address (Read only) Link Status – Established, Not Established Media Type (If Established) Auto-Negotiation - (If in Auto-Negotiate and Established)
WAN Link Setting	W	Select - Auto-Negotiate, 10baseT, 10baseT-FD, 100baseTx, 100baseTx-FD MAC Address (Read only) Link Status – Established, Not Established Media Type (If Established) Auto-Negotiation - (If in Auto-Negotiate and Established)

4.5.5 CLI - Gateway Configuration Menu



Function	Select	Description
LAN	L	LAN Transmission Rate – 10Mbps/100Mbps
WAN	W	WAN Transmission Rate – (a number, followed by a space and 'bps', 'kbps' or 'Mbps'). Must be ≥ 10 kbps and ≤ 45 Mbps
	M	Maximum Transfer Unit (MTU): MTU size in bytes, default 1500
Compression	C	Select - On/Off
Congestion Control	O	Select – Per-Connection or Rate Pacing

4.5.5.1 WAN Transmission Rate

Set the maximum bandwidth available for TCP traffic on the WAN interface (a number, followed by a space and 'bps', 'kbps' or 'Mbps'). Must be ≥ 10 kbps and ≤ 45 Mbps. Setting the WAN transmission rate in excess of available bandwidth could lead to packet loss and degraded performance.

For a mix of TCP / non-TCP traffic, use these settings to limit the bandwidth for TCP traffic:

Example 1 – A pair of *turbo*IP-45s is used to accelerate TCP traffic on a satellite link where satellite Modem A has a TX data rate of 12 Mbps, and satellite Modem B has a TX data rate of 2048 kbps. Use WAN setting 12 Mbps for *turbo*IP-45 A, and 2048 kbps for *turbo*IP-45 B.

Example 2 – A *turbo*IP-45 is in place at a hub where there are three outbound satellite links to three separate remotes with the following links:

- Link A – Hub 4 Mbps Outbound, Remote A 1536 kbps Inbound
- Link B – Hub 3 Mbps Outbound, Remote B 1024 kbps Inbound
- Link A – Hub 2 Mbps Outbound, Remote C 768 kbps Inbound

The Hub *turbo*IP-45 WAN is set to 9 Mbps to equal the total available Outbound bandwidth (4 + 3 + 2). In this example, create Selective Acceleration Rules to limit the bandwidth to match the Outbound TX data rate for each Remote. Set the Remote *turbo*IP-45 WAN setting to the Inbound TX data rate to the Hub.

4.5.5.2 Maximum Transfer Unit (MTU)

This setting enables the *turbo*IP-45 to better support interoperability with other IP devices requiring less than 1500-byte TCP payloads. Default setting for the MTU is 1500 bytes.

4.5.5.3 Compression

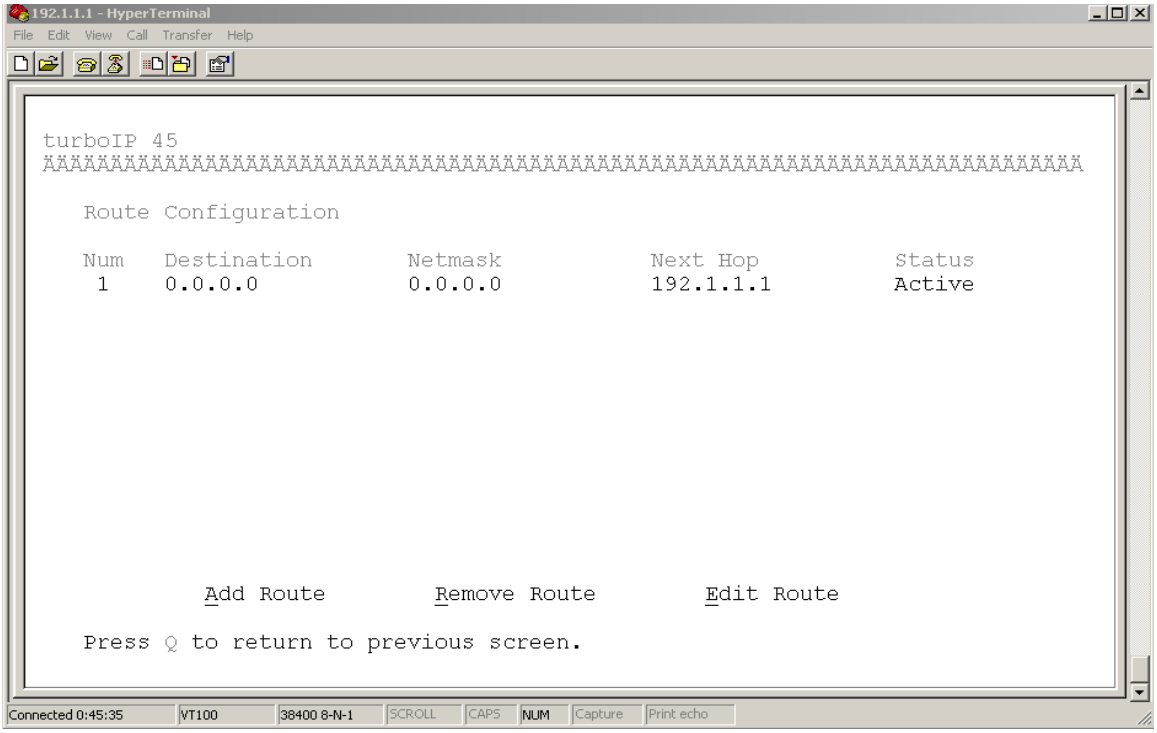
With Compression enabled, the *turbo*IP-45 will compress accelerated TCP Data, Compression is not applied to non-TCP or non accelerated TCP.

4.5.5.4 Congestion Control

Per-Connection Mode – Should be used to support dynamic bandwidth paths, where the bandwidth may be different for any of the paths being accelerated by the *turbo*IP-45.

Rate Pacing Mode– Should be when bandwidth path for accelerated TCP traffic remains constant with the set WAN Transmission Rate. In Rate Pacing Mode, the *turbo*IP-45 meters out bursty traffic at a rate not to exceed the configured transmission rate of the satellite channel. This prevents the satellite channel from becoming congested and will maximize accelerated TCP throughput to match the set WAN Transmission Rate.

4.5.6 CLI - Route Configuration Menu



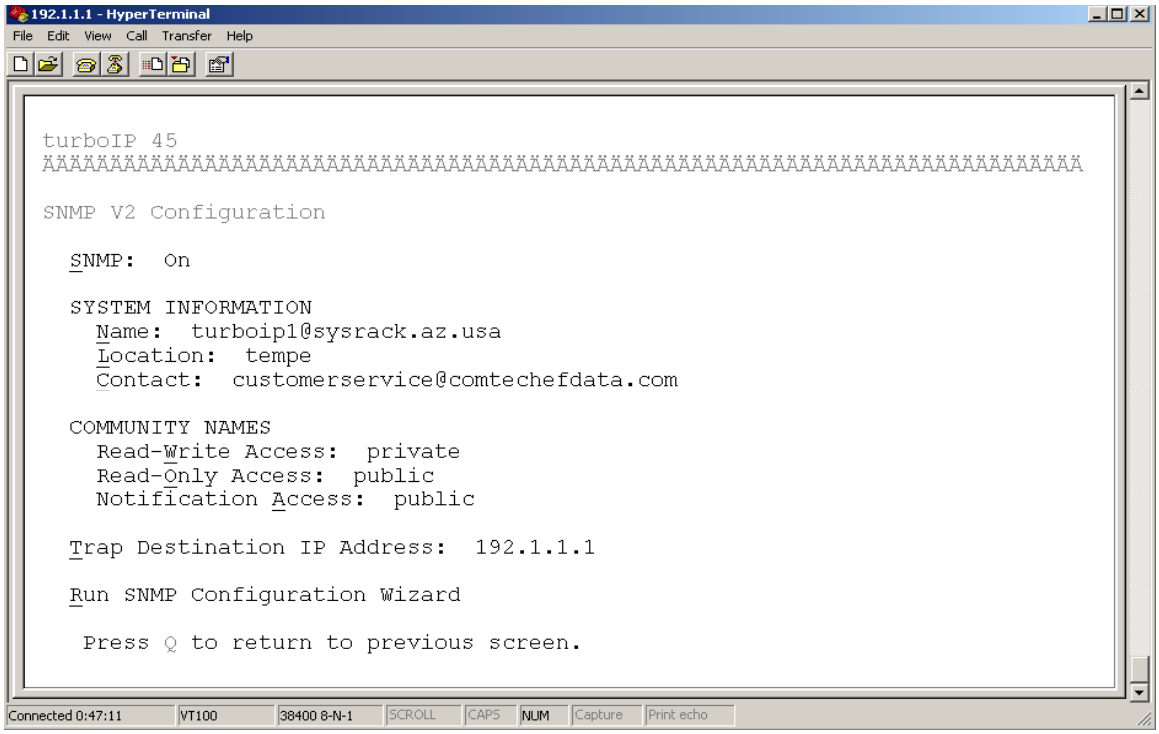
Function	Select	Description
Add Route	A	Enter - Route Number, Destination IP Address, Netmask, Next Hop IP Address Route Status – set to Active or Not in Service Note – Status will display as Invalid if *turbo*IP-45 was not able to create the Route. For example, if the Next Hop was not on the same subnet as the *turbo*IP-45.
Remove Route	R	Select Route Number to remove
Edit Route	E	Select Route Number to edit

IMPORTANT

Route entries are only needed to allow access to the *turbo*IP-45 from an outside network (using the Web or SNMP IP interface).

4.5.7 CLI - SNMP Configuration Menu

4.5.7.1 SNMP V2 CLI Menu Display

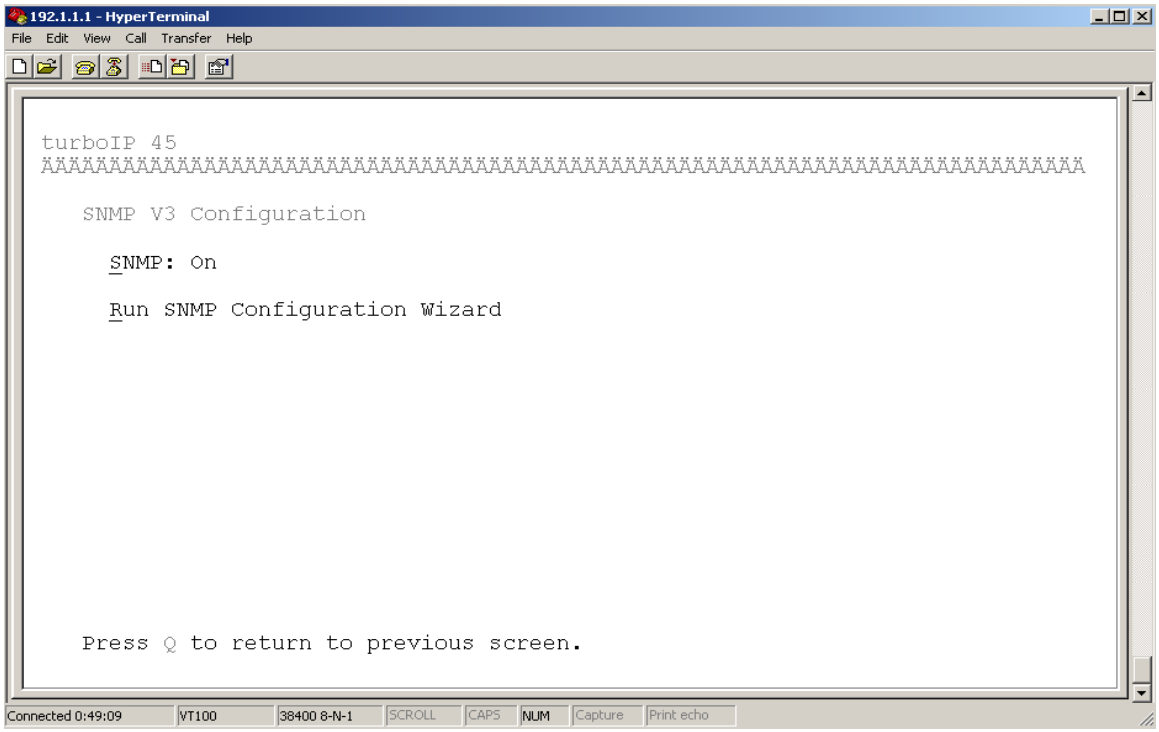


4.5.8 SNMP V2 Configuration

Function	Select	Description
SNMP	S	Select - On/Off
System Information Name Location Contact	N L	 As required As required
	C	As required
Community Names Read-Write Access	W	SNMP SET Community String
Read-Only Access	O	SNMP GET Community String
Notification Access	A	SNMP Trap Community String

Function	Select	Description
Trap Destination IP Address	T	IP address destination for traps
Run SNMP Configuration Wizard	R	Select to erase all SNMP settings or to change to a different SNMP Version (2 or 3) See **Section 4.4.2.7 Configuration Wizard *turboIP-45* – SNMP**

4.5.9 SNMP V3 CLI Menu Display

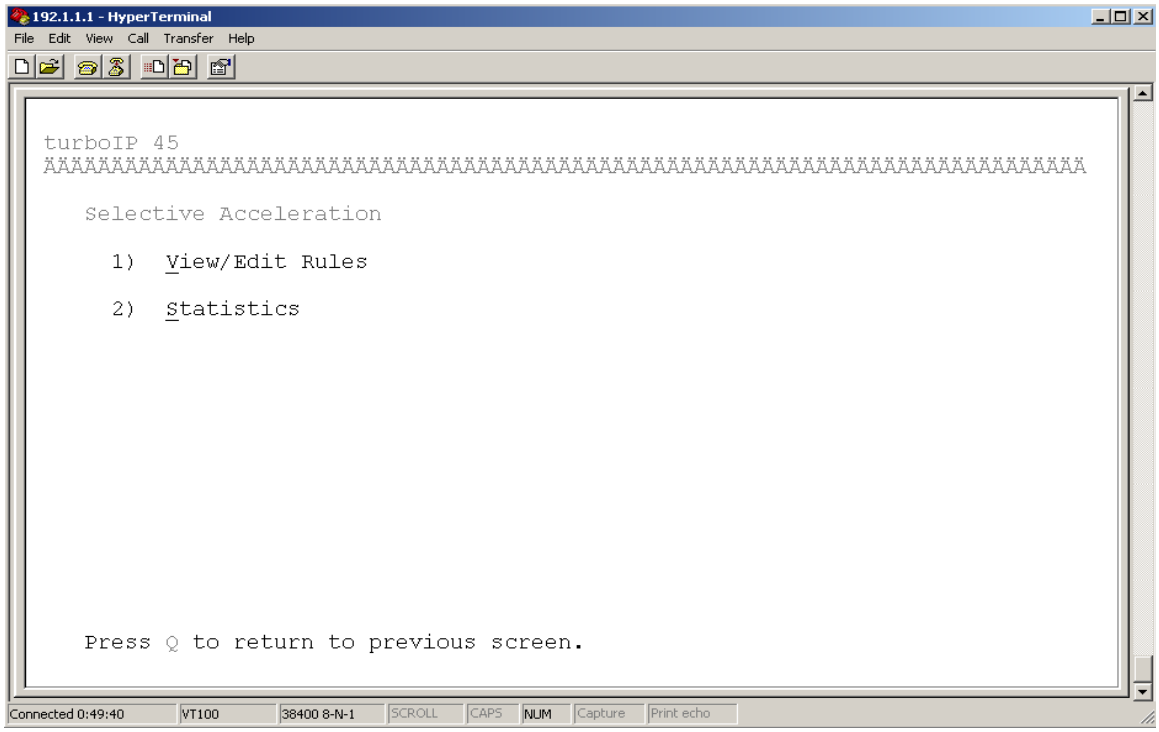


When SNMP V3 is selected, no SNMP V3 settings are displayed.

4.5.10 SNMP V3 Configuration

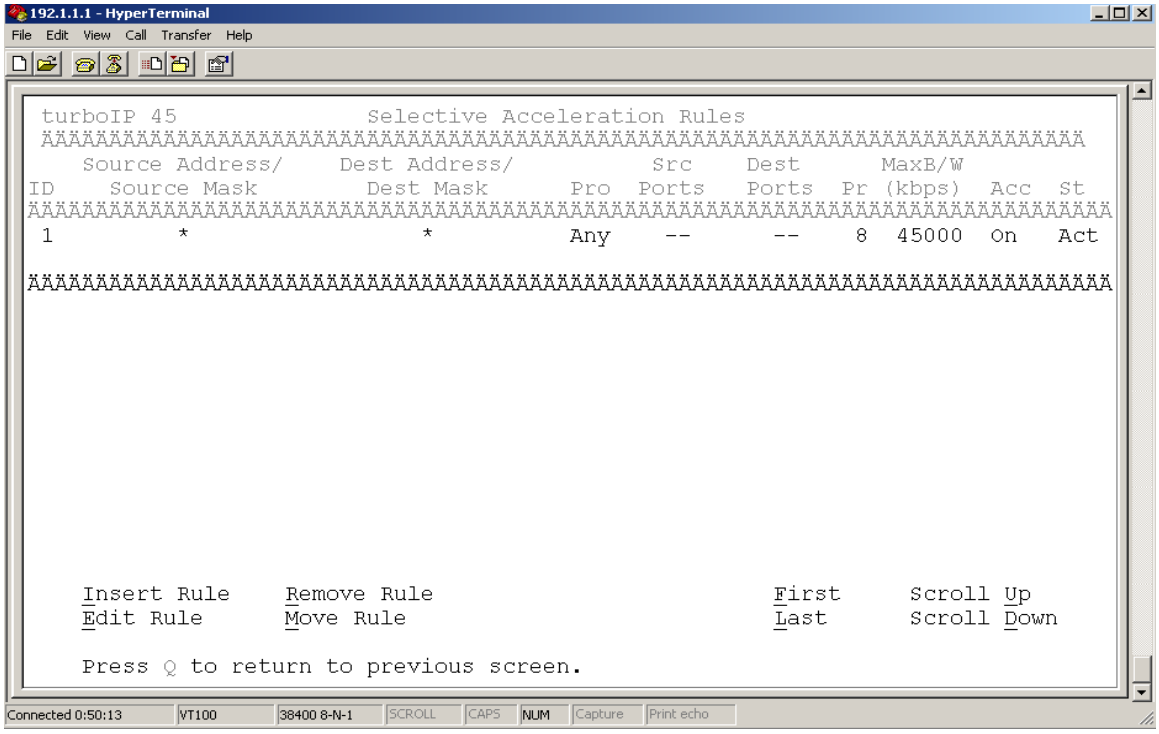
Function	Select	Description
SNMP	S	Select - On/Off
Run SNMP Configuration Wizard	R	Select to erase all SNMP settings or to change to a different SNMP Version (2 or 3) See **Section 4.4.2.7 Configuration Wizard *turboIP-45* – SNMP**

4.5.11 CLI - Selective Acceleration Menu



Function	Select	Description
View/Edit Rules	1 or V	Select to view, edit add or remove Selection Acceleration Rule
Statistics	2 or S	Select to view Selection Acceleration Statistics by Priority

4.5.11.1 Selective Acceleration View/Edit Rules Menu

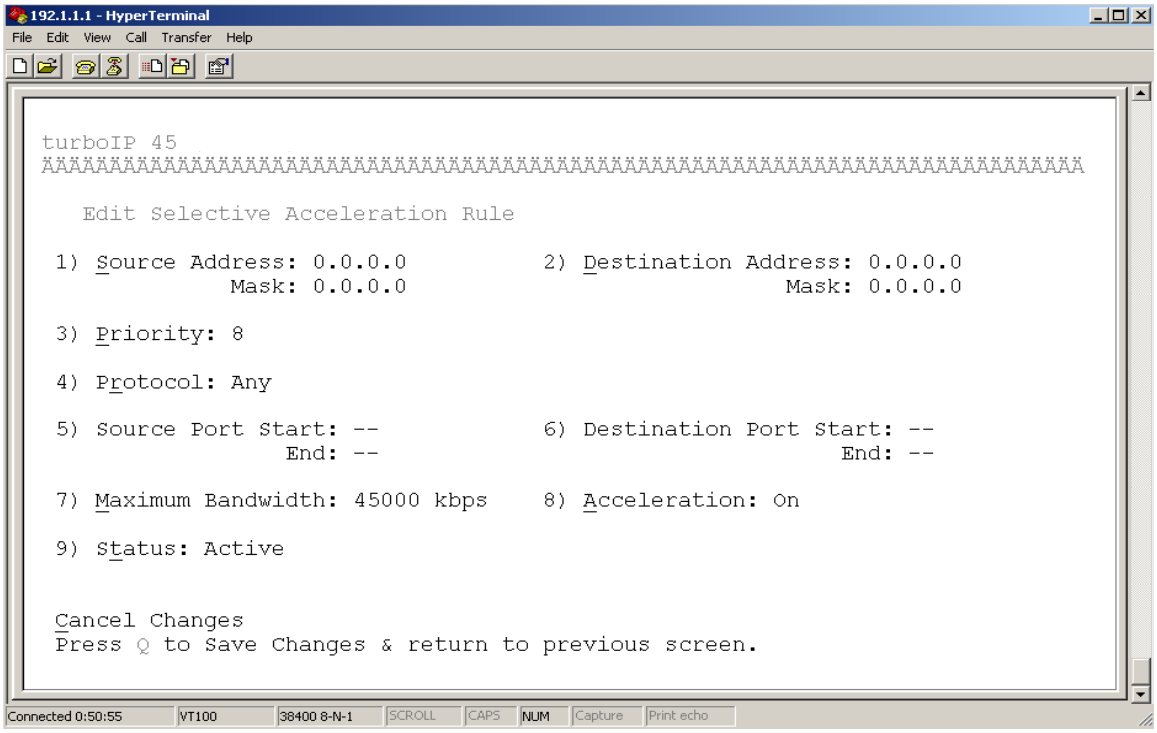


Function	Select	Description
Insert Rule	I	Insert the rule before selected rule.
Move Rule	M	Move the selected rule to higher or lower order of rule ID.
Edit Rule	E	Modify the selected rule to change its variables.
Remove Rule	R	Remove one selected rule at a time.
First	F	Go to the first page where the rule ID at #
Last	L	Go to the last page of the rule table at #
Scroll Up	U	Scroll up one page at a time.
Scroll Down	D	Scroll down one page at a time.

IMPORTANT

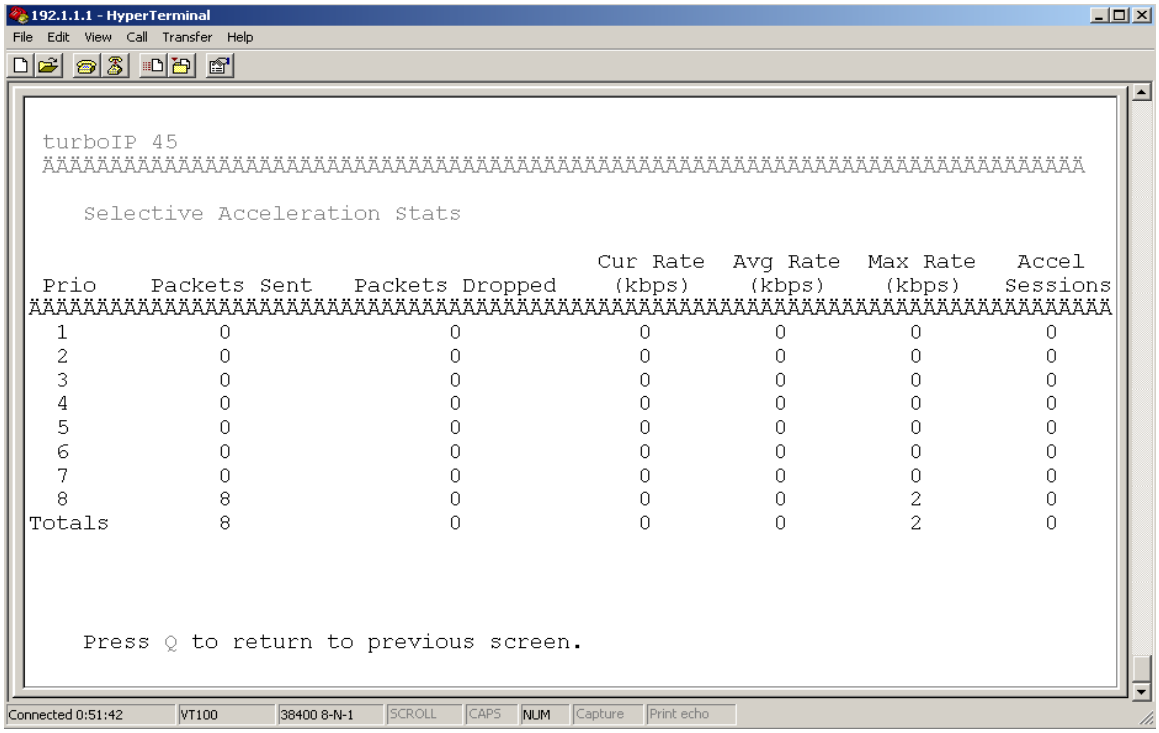
Selective Acceleration Rules can be applied to any IP traffic through the turboIP-45; assigning a Priority (1-8) and Bandwidth limit to IP traffic that falls within the Rule.
For any traffic that meets the criteria of more than one Rule, the first (lowest #) Rule will be applied.
The Default Rule is applied to all traffic not meeting a defined Rule and cannot be edited or removed.

4.5.11.2 Selective Acceleration Insert/Edit Rules Menu



Function	Select	Description
Source Address Mask	1 or S	Default 0.0.0.0 (wild card – applied to any IP address)
Source Address Mask	2 or D	Default 0.0.0.0 (wild card – applied to any IP address)
Priority	3 or P	Select 1 – 8 (1 being highest priority)
Protocol	4 or R	Select TCP, UDP or Any
Source Port Start End	5	Default __ (no entry = wild card – applied to any port) Enter Start and End Port numbers for a range of ports. Enter same port for Start and End for a single port.
Destination Port Start End	6	Default __ (no entry = wild card – applied to any port) Enter Start and End Port numbers for a range of ports. Enter same port for Start and End for a single port.
Maximum Bandwidth	7 or M	Default 45000 kbps
Acceleration	8 or A	Select On to accelerate TCP traffic within this Rule. Select Off to bypass acceleration for TCP traffic within this Rule.
Status	9 or T	Select Active for Rule to be applied. Select Not in Service to have Rule not applied.

4.5.11.3 Selective Acceleration Statistics Menu

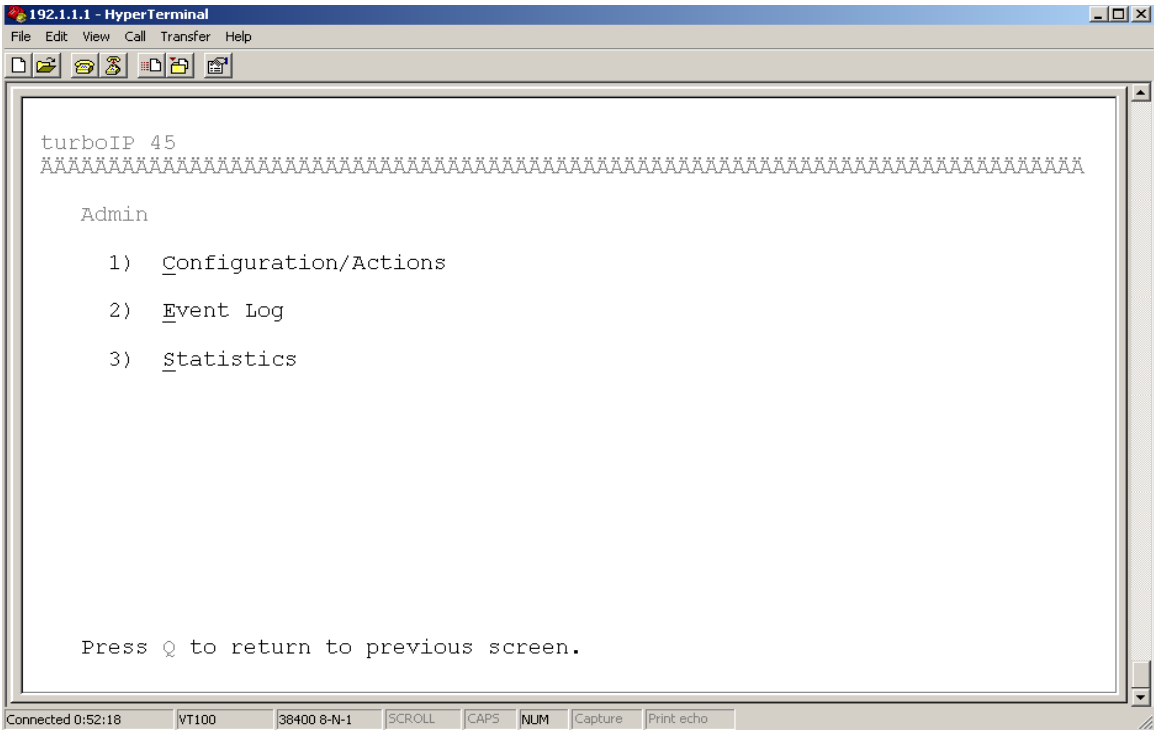


Selective Acceleration Statistics are sorted by Priority (not by Rule #). The Priority 8 Statistics include any Default Rule traffic plus any traffic within a Rule with a Priority of 8.

All Statistics (except Current Rate and Accelerated Sessions) are cumulative from the last instance of clearing Statistics.

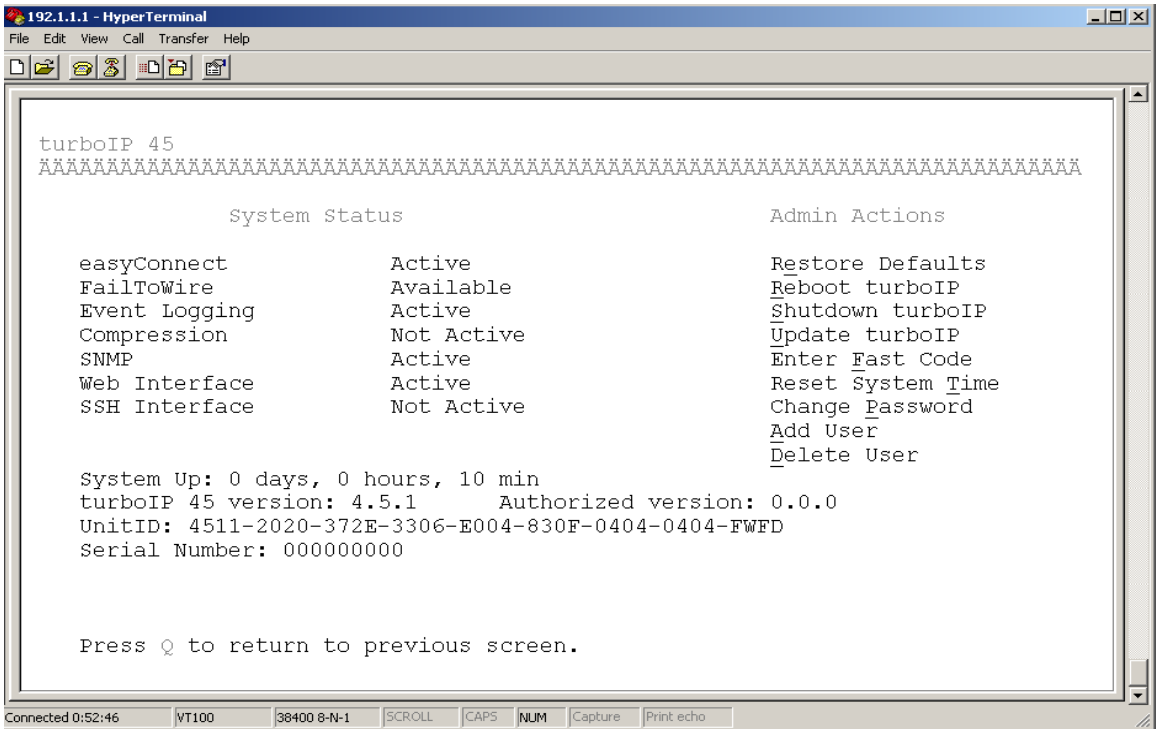
Statistic	Description
Packets Sent	Packets sent for this Priority
Packets Dropped	Packets Dropped for this Priority
Cur Rate (kbps)	Current Rate in kbps for this Priority
Avg Rate (kbps)	Avg Rate in kbps for this Priority
Max Rate (kbps)	Max Rate in kbps for this Priority
Accel Sessions	Current Accelerated Sessions for this Priority

4.5.12 CLI - Administrative Functions Menu



Function	Select	Description
Configuration/ Actions	1 or C	Select to perform administrative functions
Event Log	2 or E	Select to view or clear Event Log
Statistics	3 or S	Select to view or clear statistics

4.5.13 Administrative Configurations/Actions Menu



4.5.14 System Status (Read Only)

***turbo*IP-45 Function**	**Description**
easyConnect	Active (always enabled)
FailToWire	Available/Not Available – indicates presence of Fail to Wire Hardware
Event Logging	Active/Inactive
Compression	Active/Inactive
SNMP	Active/Inactive
Web Interface	Active/Inactive
SSH Interface	Active/Inactive
System Up	Displays System Up Time in days/hours/minutes
*turbo*IP-45 version	Current SW Version
Unit ID	Unit ID #

4.5.15 Admin Actions

Function	Select	Description
Restore Defaults	E	Restore Factory Default settings (SSH/CLI Only function)
Reboot *turbo*IP-45	R	Manual Reboot
Shutdown *turbo*IP-45	S	Manual Shutdown
Upgrade *turbo*IP-45	U	Upgrade *turbo*IP-45 SW – See **Section 4.6**
Reset System Time	T	Time reset (SSH/CLI Only function)
Change Password	P	Change current Password (SSH/CLI Only function)
Add User	A	Add new User account (SSH/CLI Only function)
Delete User	D	Delete User account (SSH/CLI Only function)

Multiple Users – Up to five user accounts are supported via the Web, SSH and Serial interfaces. Account authentication uses passwords, which must follow the complexity requirements described next.

Password Complexity - Password length is 8 characters minimum, and 31 characters maximum. Passwords are case-sensitive and must contain at least one character from each of the following categories: Uppercase, Lowercase, Digit, and Special character. Special characters include "_!-.;:<>,[]{}\|()*&^%$#@`~'+=?/"

When changing passwords, at least four characters in the new password must be different from the old password. The system does not keep a record of old passwords, once a password is changed.

If the Administrator login or password is lost, the *turbo*IP-45 can be restored to Factory Defaults using the following account only accessible via the serial interface:
username: safe
password: C0mtech!
Once the factory defaults are restored, the *turbo*IP-45 can be rebooted and the user will be able to accept the EULA and begin the Configuration Wizard.

User Accounts - There are two levels of user accounts: Administrator and Normal User. There must always be at least one Administrator account.

The first Administrator account must be created through the Configuration Wizard. If only one Administrator account exists, the user will not be able to delete the account. An error message will be displayed if there is an attempt to delete the Administrator.

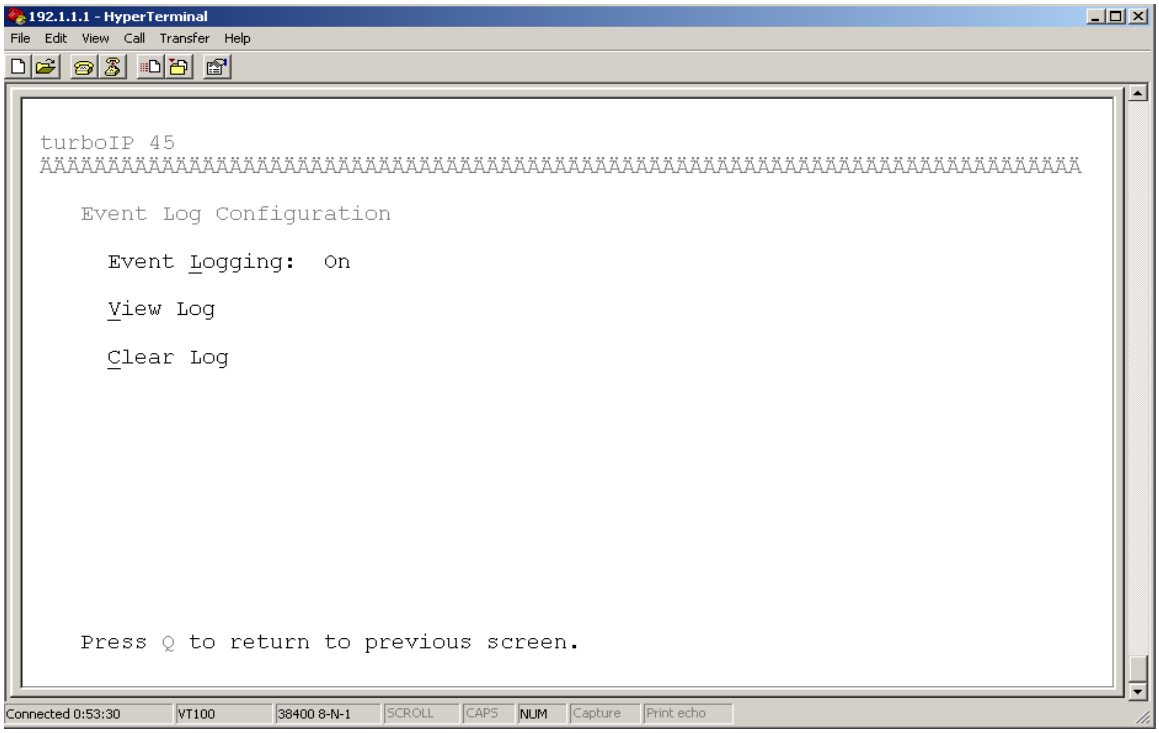
Usernames - must be at least five and no more than thirty-one alphanumeric characters in length.

Administrator Functions - The Administrator changes passwords, adds and deletes users only through the SSH and Serial interfaces. Normal users cannot see or edit these settings.

The Administrator specifies whether an account is an Administrator or Normal User.

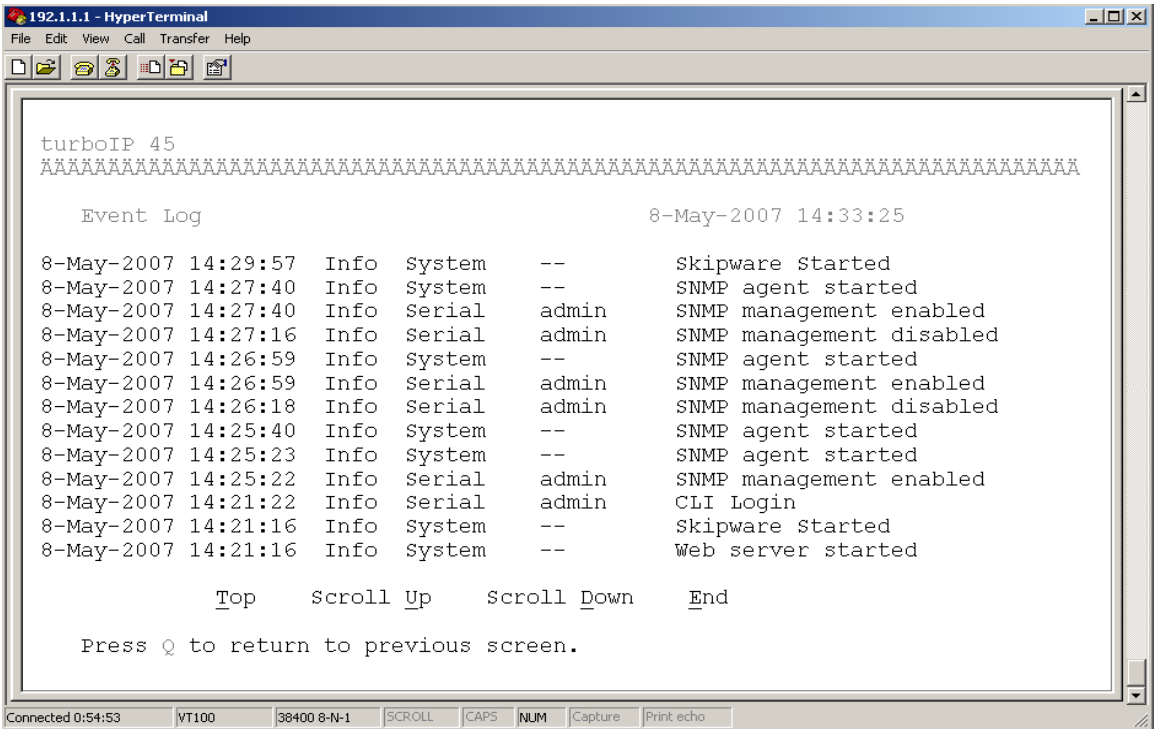
The option to change usernames is not available through the Serial interface. To accomplish this, the Administrator deletes the user account and then recreates it with a new username. If the Administrator tries to add more than the maximum number of user accounts, an error message is displayed.

4.5.16 Administrative Event Log Configuration Menu

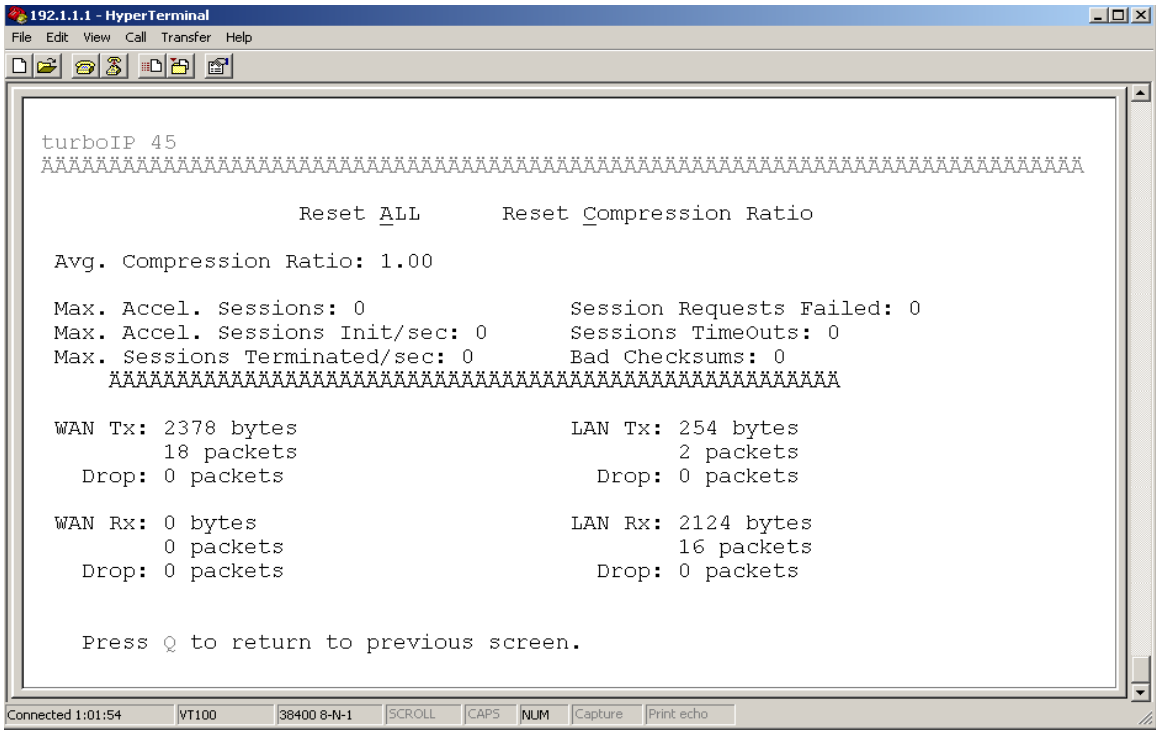


Function	Select	Description
Event Logging	L	Select On/Off
View log	V	Select to view log
Clear log	C	Select to clear log

4.5.17 Administrative View Event Log



4.5.18 Administrative Statistics Menu



Counter Name	Description
Avg. Compression Ratio	Average compression ratio over time (Initial value is 1.00).
Max. Accel. Session:	Maximum number of accelerated TCP sessions currently acting.
Max. Accel. Session Init/Sec	Maximum number of accelerated TCP sessions that are initiated per second.
Max. Accel. Session Terminated/Sec	Maximum number of accelerated TCP sessions that are terminated per second.
Session Requested Failed	Cumulated number that session requests failed.
Sessions TimeOut	Cumulated timeout sessions.
Bad Checksums	Bad checksum packet counts
WAN TX	Indicates data transmitted to the WAN: packets, bytes, and drop.
WAN RX	Indicates data received from the WAN: packets, bytes, and drop.
LAN TX	Indicates data transmitted to the LAN: packets, bytes, and drop.
LAN RX	Indicates data received from the LAN: packets, bytes, and drop.

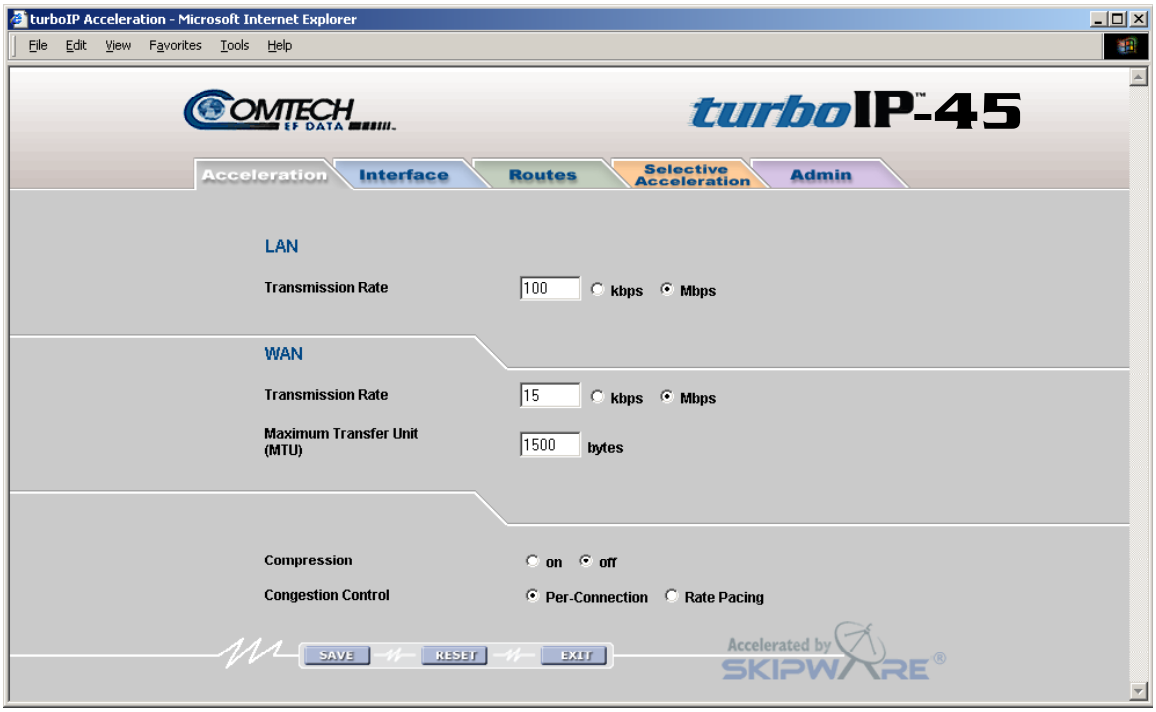
Function/Admin Action	Description	Operation
Reset Compression Ratio	Reset compression ratio counter back to 1.0.	Press “C” on CLI or click “Reset Compression Ratio” button on web.
Reset ALL	Reset counters in the STATS page - also includes the STATS in the selective Acceleration menu.	Press “A” on CLI or click “Reset ALL” button

4.5.19 Web – Log In

To use the web interface, first configure the *turbo*IP™ IP-45 address and enable WEB Interface through the console, then launch any standard web browser program such as Internet Explorer® on Microsoft Windows®, and login using the configured username and password.

Successful Log In will open the Web Acceleration Page

4.5.20 Web – Acceleration page

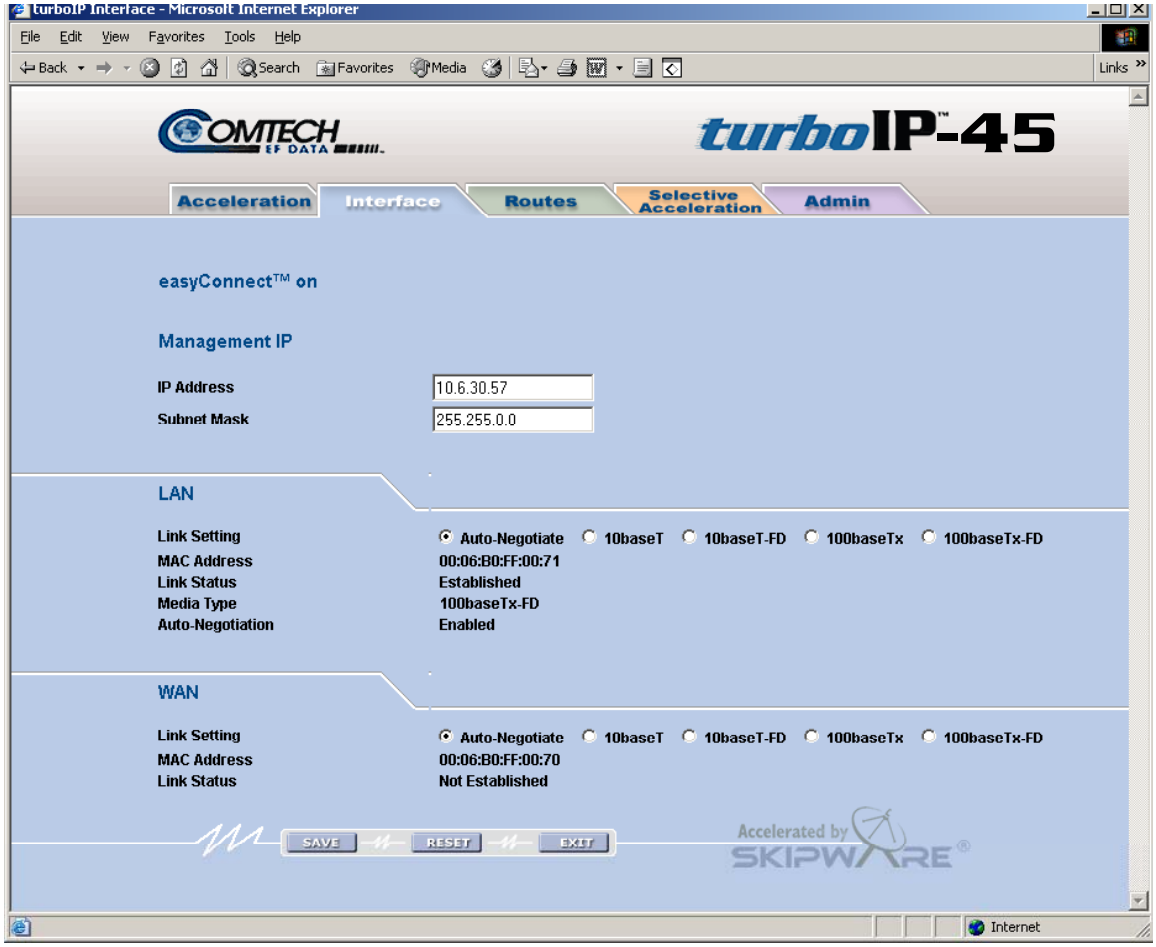


See **Section 4.5.5 CLI - Gateway Configuration Menu** for all details regarding configuring the Acceleration settings.

IMPORTANT

On the web pages, values are enforced once SAVE is clicked.

4.5.21 Web – Interface page

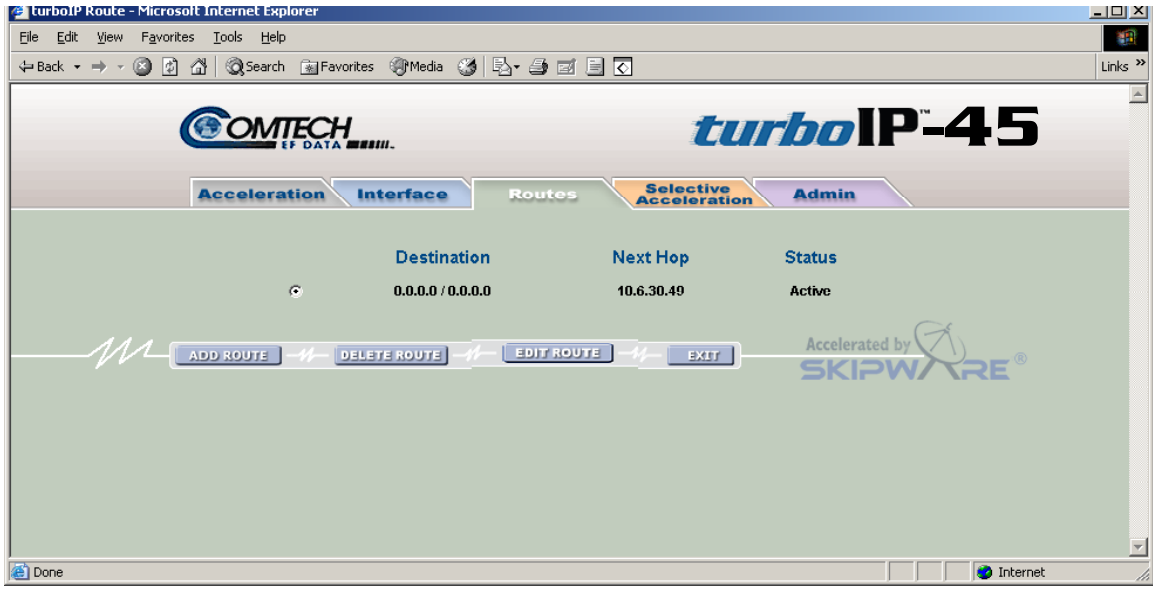


See **Section 4.5.4 CLI - Configure Interface Menu** for all details regarding configuring the Interface settings.

IMPORTANT

On the web pages, values are enforced once SAVE is clicked.

4.5.22 Web – Routes page



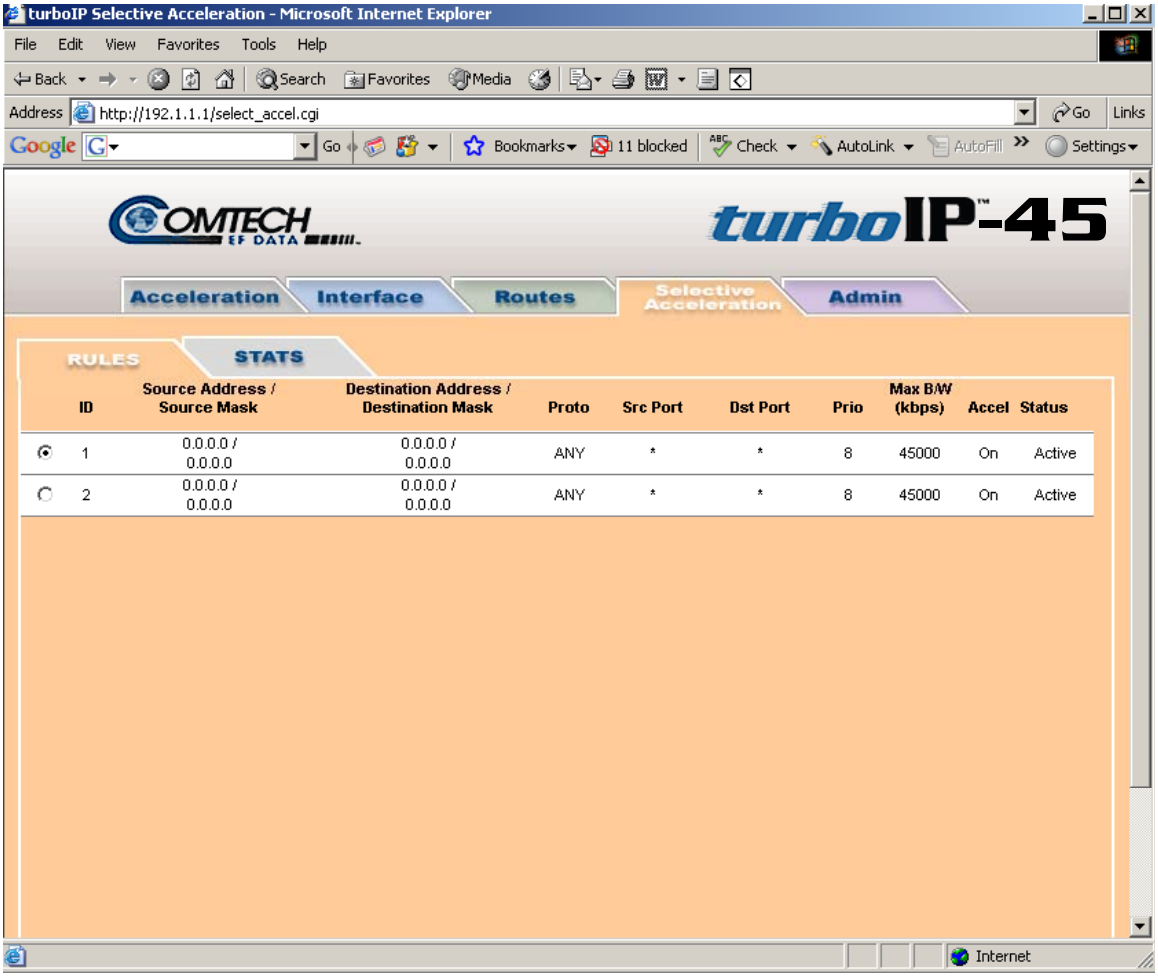
See **Section 4.5.6 CLI - Route Configuration Menu** for all details regarding configuring the Route settings.

IMPORTANT

On the web pages, values are enforced once SAVE is clicked.

4.5.23 Web – Selective Acceleration Page

4.5.24 Selective Acceleration View/Edit Rules Page

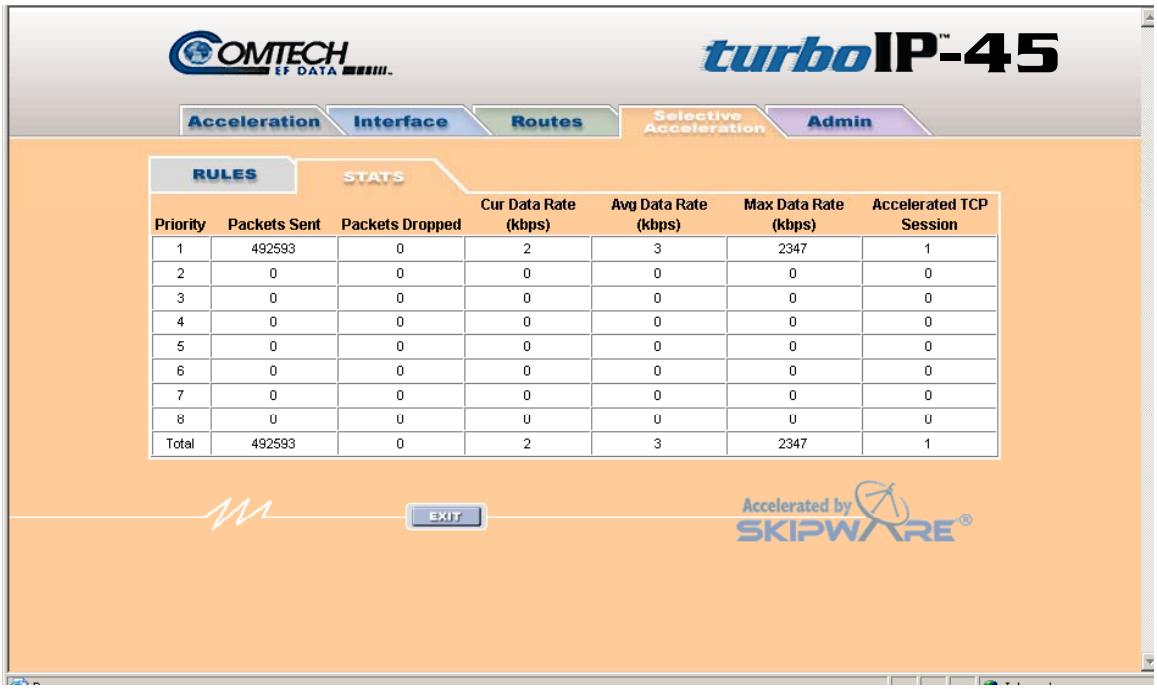


See **Section 4.5.11 CLI - Selective Acceleration Menu** for all details regarding configuring the Selective Acceleration settings.

IMPORTANT

On the web pages, values are enforced once SAVE is clicked.

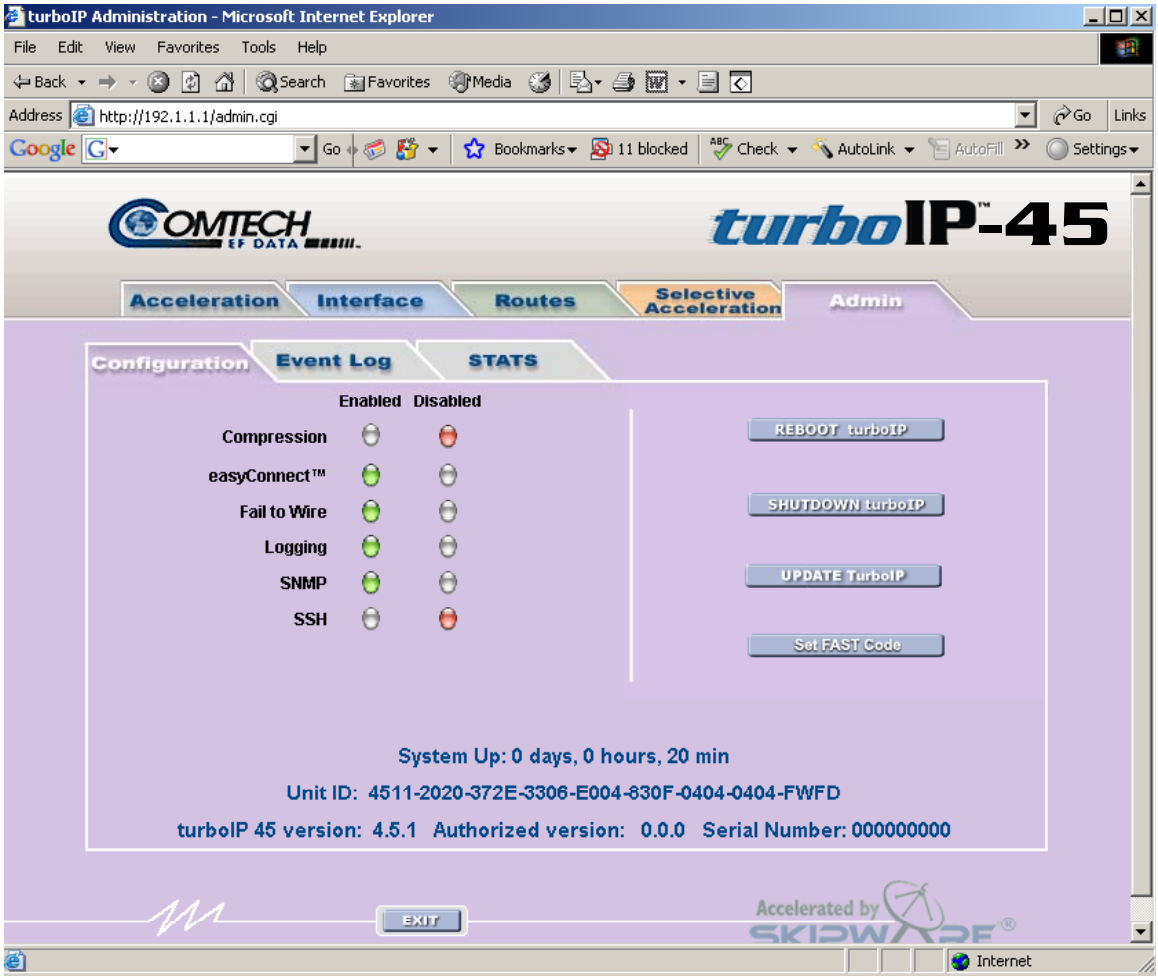
4.5.25 Selective Acceleration Statistics Page



Priority	Packets Sent	Packets Dropped	Cur Data Rate (kbps)	Avg Data Rate (kbps)	Max Data Rate (kbps)	Accelerated TCP Session
1	492593	0	2	3	2347	1
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
Total	492593	0	2	3	2347	1

4.5.26 Web – Admin Page

4.5.27 Admin Configuration Page

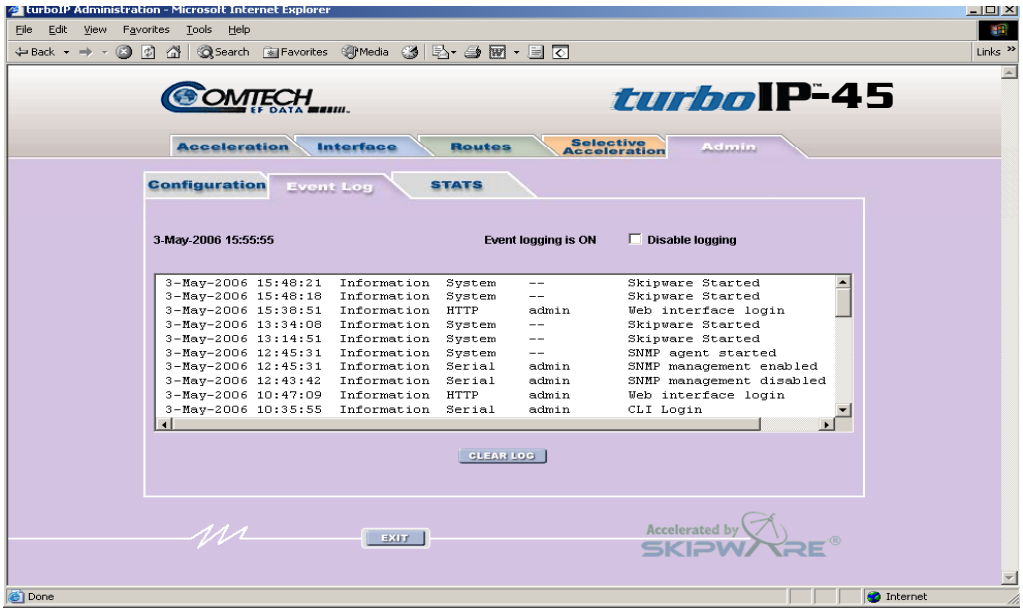


See Section **4.5.12 CLI - Administrative Functions Menu** for all details regarding configuring the Administrative settings.

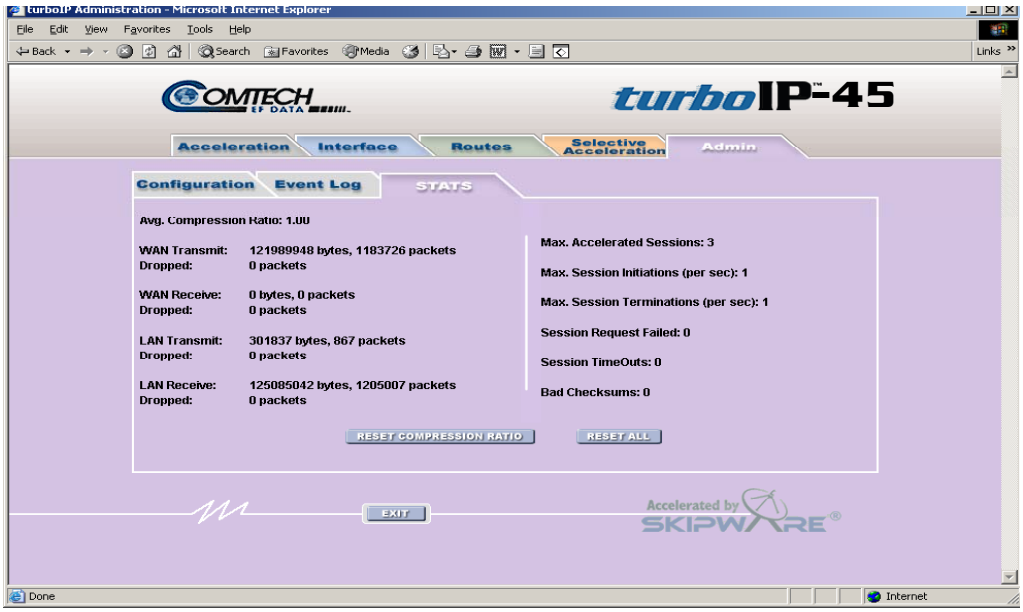
IMPORTANT

On the web pages, values are enforced once SAVE is clicked.

4.5.28 Admin Event Log Page



4.5.29 Admin Statistics Page



4.6 Upgrade *turbo*IP-45™

All *turbo*IP-45 upgrades must be done in sequential order, that is, in order to upgrade to the most recent *turbo*IP-45 SW, the *turbo*IP-45 must be operating with the previous *turbo*IP-45 software release. Please see the *turbo*IP-45 software release notes for specific upgrading details.

All *turbo*IP-45 SW Upgrade Packages can be downloaded from the Comtech EF Data website:

http://www.comtechefdata.com/

Select Downloads/Flash Upgrades/flash firmware update files/*turbo*IP-45.

Each SW Upgrade Package contains:

- Upgrade image
- MIB files
- Release Notes
- Upgrade Instructions

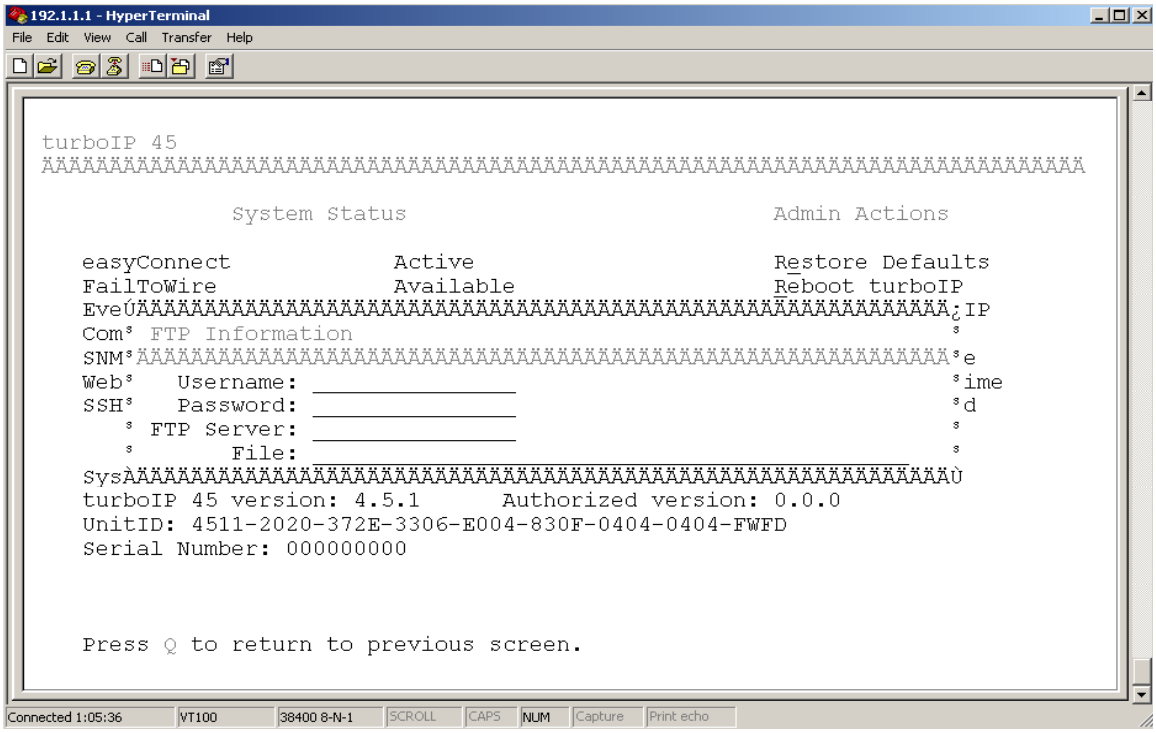
All *turbo*IP-45 SW image files have a '.zip' file extension, but they are not a Windows ZIP file – do not try to unzip the SW image file.

Always review the Upgrade Instructions for the particular SW you are upgrading to as some details in the upgrade procedure may change.

4.6.1 CLI - Upgrade *turbo*IP-45™

The *turbo*IP-45 can be upgraded from a PC with an FTP Server, locally via the LAN port or remotely via the WAN port. Configure the FTP Server Home Directory to be where the *turbo*IP-45 SW Upgrade Image file is located. Verify connectivity to the *turbo*IP-45 by verifying a Ping response.

From Administrative Functions Menu, select Configurations/Actions and then select "U" to Upgrade *turbo*IP-45.



Enter the appropriate FTP User/Password log in information, the IP address of the FTP Server and the name of the *turbo*IP-45 SW Upgrade Image file. A prompt will display to re-enter the FTP password and then the *turbo*IP-45 will connect to the FTP server and download the Upgrade Image. When the download is complete, a prompt will appear to confirm the upgrade is complete and the unit will need to be rebooted. The *turbo*IP-45 will then reboot to the new SW and retain all configurations settings.

If the upgrade process fails, the failure may be due to any of these causes:

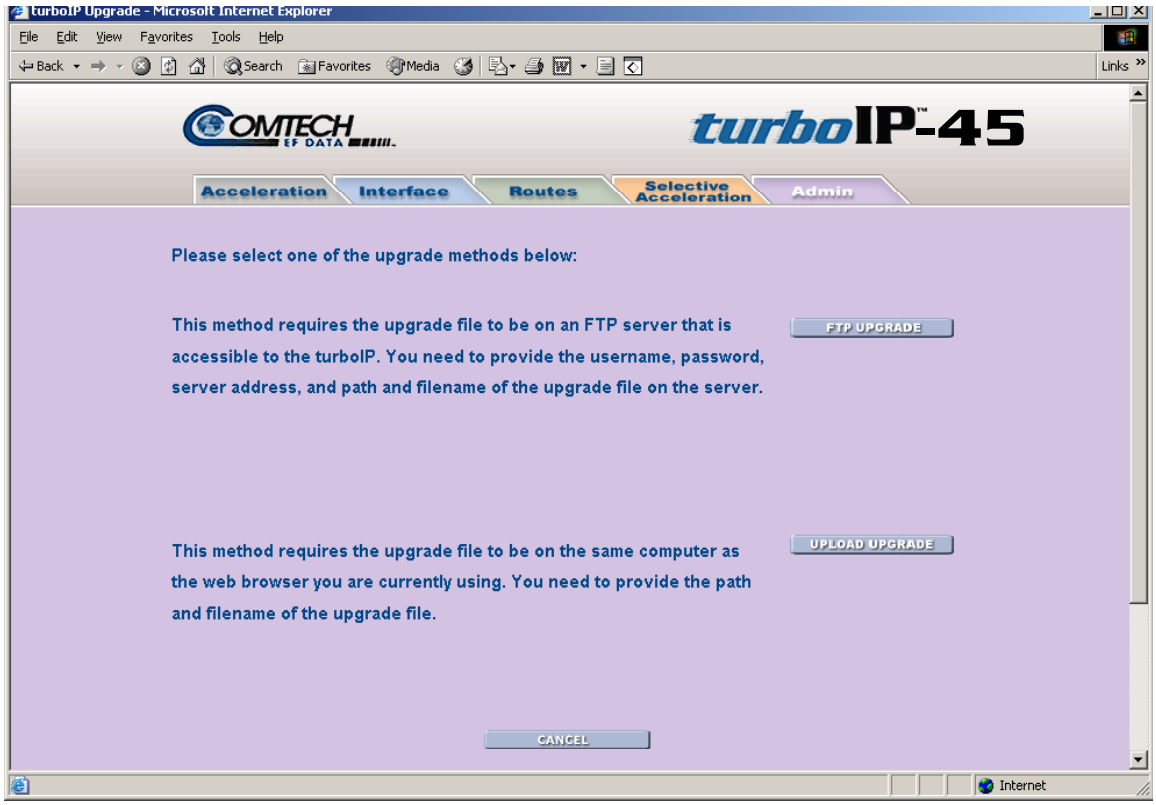
- Incorrect username / password
- Incorrect FTP server IP address
- File does not exist
- Specified file is not a valid upgrade file

Contact CEFD Network Product Support cdmipsupport@comtechefdata.com if there are any difficulties or questions about upgrading your *turbo*IP-45.

4.6.2 Web - Upgrade *turbo*IP-45™

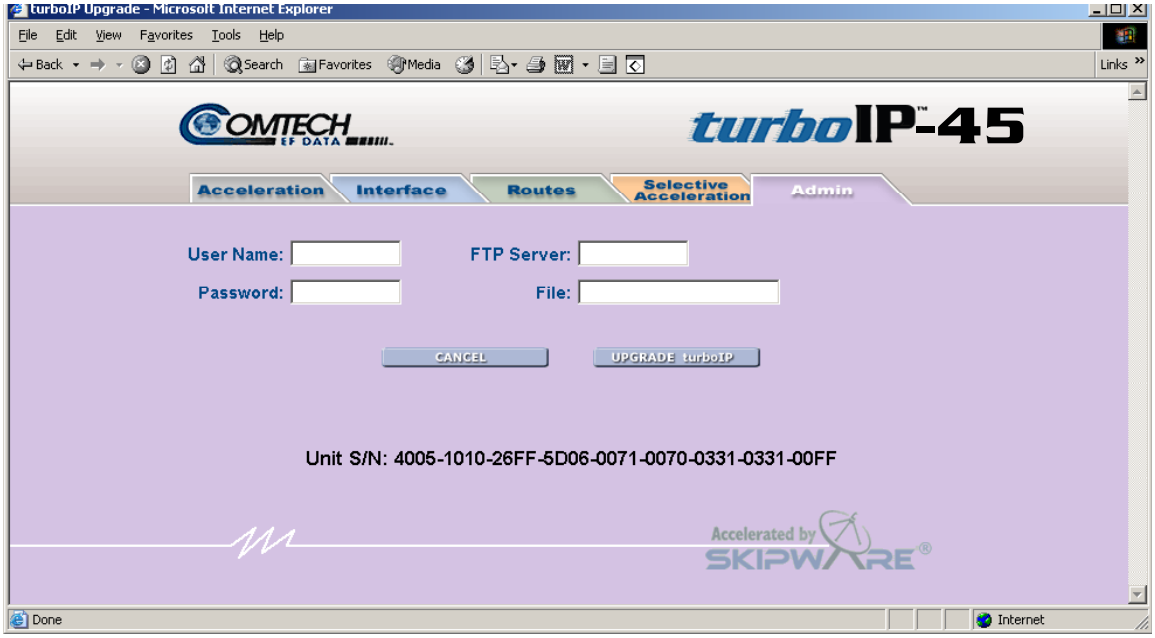
The *turbo*IP-45 can be upgraded from a PC with an FTP Server, locally via the LAN port or remotely via the WAN port. To use this method, select **FTP UPGRADE**.

Or, the *turbo*IP-45 can be upgraded from the PC that is currently web browsing the *turbo*IP-45. To use this method, select **UPLOAD UPGRADE**.



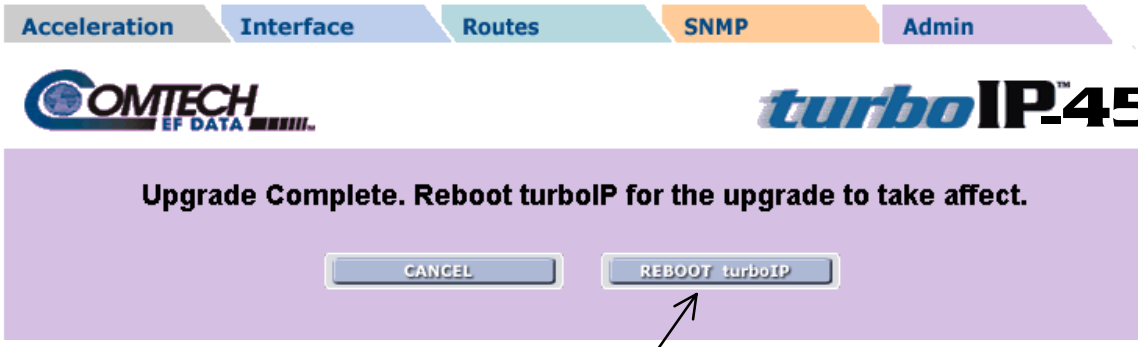
4.6.3 Web - FTP Upgrade

Configure the FTP Server Home Directory to be where the *turbo*IP-45 SW Upgrade Image file is located. Verify connectivity to the *turbo*IP-45 by verifying a Ping response.



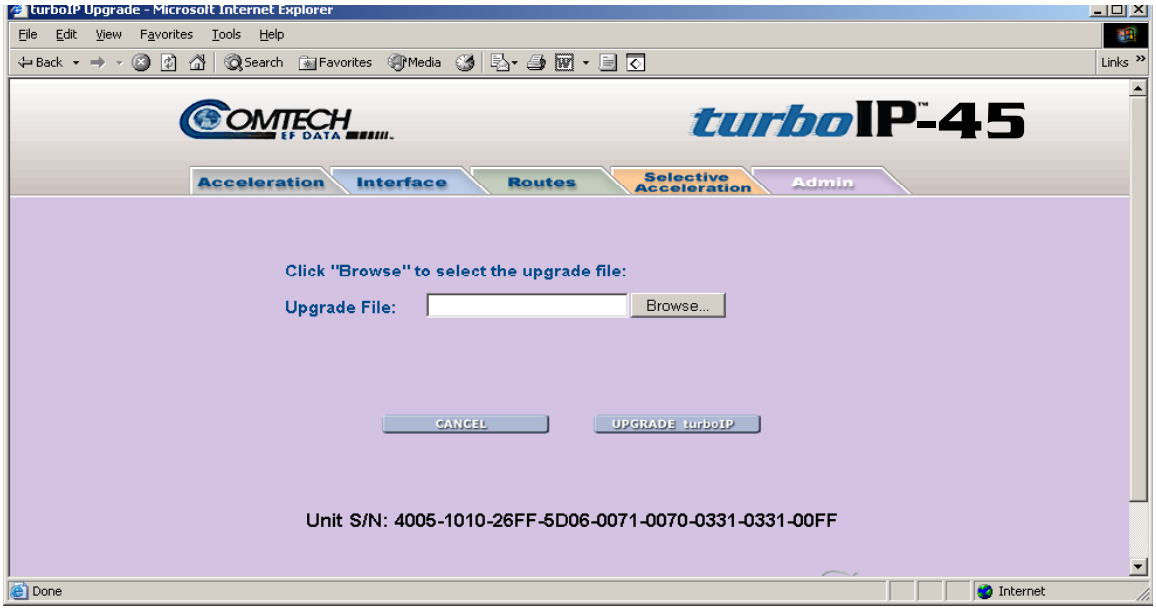
Enter the appropriate FTP User/Password log in information, the IP address of the FTP Server and the name of the *turbo*IP-45 SW Upgrade Image file. Use the **UPGRADE *turbo*IP-45** function to upgrade the unit's software.

Once the upgrade completes successfully, the following message is displayed:



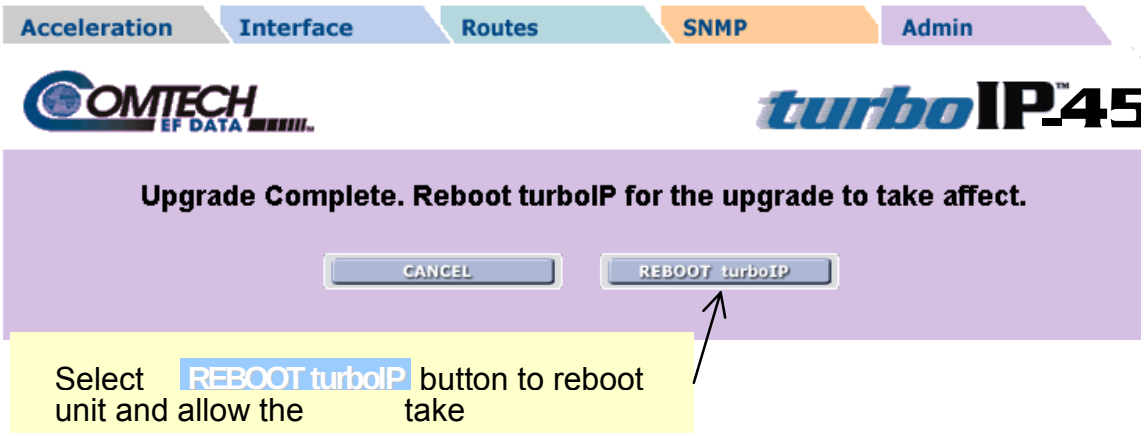
Select **REBOOT turboIP** button to the unit and allow the upgrade to take

4.6.4 Web - Upload Upgrade



Click “Browse” to select the upgrade file and then select the **UPGRADE *turbo*IP-45** function to upgrade the unit's software.

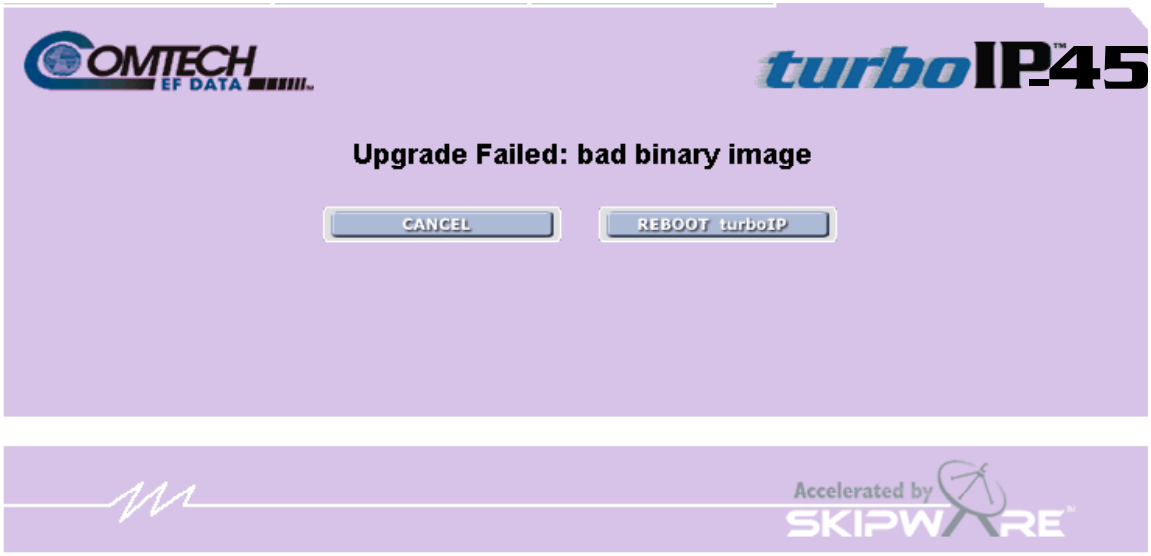
Once the upgrade completes successfully, the following message is displayed:



If the upgrade process fails, the failure may be due to any of these causes:

- Incorrect username / password
- Incorrect FTP server IP address
- File does not exist
- Specified file is not a valid upgrade file

Appropriate messages are displayed in each case. For example, if the file is not a valid upgrade file or has been corrupted, the following message is displayed:



Contact CEFD Network Product Support at mailto:cdmipsupport@comtechefdata.com if there are any difficulties or questions about upgrading *turbo*IP-45.

Chapter 5. SNMP

5.1 MIBII Support

*turbo*IP-45™ supports RFC 1213 (MIBII) for managing the *turbo*IP-45. All public OIDs in the system, interface, IP, ICMP, TCP, UDP, and SNMP groups are supported with the exception of the ipRouteTable OIDs which are Read-Only. Routes should be entered via the console's routing screen or Web's Routes page instead of through the MIBII's ipRouteTable OIDs.

5.2 Private MIB Support

The following sections describe the SNMP private (product specific) MIB as provided for the Comtech EF Data *turbo*IP-45 unit. Shown below is the OID tree of the *turbo*IP-45 private MIB, followed by the data type of each OID.

5.3 MIB Tree:

```
1 --- iso
1.3 --- org
1.3.6 --- dod
1.3.6.1 --- internet
1.3.6.1.4 --- private
1.3.6.1.4.1 --- enterprises
1.3.6.1.4.1.6247 --- comtechEFData
1.3.6.1.4.1.6247.23 --- turboIP45
1.3.6.1.4.1.6247.23.1 --- turboIP45Objects
1.3.6.1.4.1.6247.23.1.1 --- turboIP45GatewayConfiguration
1.3.6.1.4.1.6247.23.1.1.1 --- turboIP45Lan
1.3.6.1.4.1.6247.23.1.1.1.1 --- turboIP45LanTransmissionRate (INTEGER)
1.3.6.1.4.1.6247.23.1.1.2 --- turboIP45Wan
1.3.6.1.4.1.6247.23.1.1.2.1 --- turboIP45WanTransmissionRate (INTEGER)
1.3.6.1.4.1.6247.23.1.1.2.2 --- turboIP45WanMTU (INTEGER)
1.3.6.1.4.1.6247.23.1.1.3 --- turboIP45CongestionControl (INTEGER)
1.3.6.1.4.1.6247.23.1.2 --- turboIP45Interface
1.3.6.1.4.1.6247.23.1.2.1 --- turboIP45EasyConnectActive (INTEGER)
1.3.6.1.4.1.6247.23.1.2.2 --- turboIP45EasyConnectMode
1.3.6.1.4.1.6247.23.1.2.2.1 --- turboIP45ManagementIpAddress (IpAddress)
```

1.3.6.1.4.1.6247.23.1.2.2.2 --- *turbo*IP45ManagementSubnetMask (IpAddress)
1.3.6.1.4.1.6247.23.1.3 --- *turbo*IP45Route
1.3.6.1.4.1.6247.23.1.3.1 --- *turbo*IP45RouteTable (SEQUENCE OF TurboIP45RouteEntry)
1.3.6.1.4.1.6247.23.1.3.1.1 --- *turbo*IP45RouteEntry (TurboIP45RouteEntry)
1.3.6.1.4.1.6247.23.1.3.1.1.1 --- *turbo*IP45RowStatus (RowStatus)
1.3.6.1.4.1.6247.23.1.3.1.1.2 --- *turbo*IP45RouteDestAddress (IpAddress)
1.3.6.1.4.1.6247.23.1.3.1.1.3 --- *turbo*IP45RouteDestSubnetMask (IpAddress)
1.3.6.1.4.1.6247.23.1.3.1.1.4 --- *turbo*IP45NextHopAddress (IpAddress)
1.3.6.1.4.1.6247.23.1.4 --- *turbo*IP45SelectiveAcceleration
1.3.6.1.4.1.6247.23.1.4.1 --- *turbo*IP45QoSRuleTable (SEQUENCE OF TurboIP45QoSRuleEntry)
1.3.6.1.4.1.6247.23.1.4.1.1 --- *turbo*IP45QoSRuleEntry (TurboIP45QoSRuleEntry)
1.3.6.1.4.1.6247.23.1.4.1.1.1 --- *turbo*IP45QoSRuleAction (RuleAction)
1.3.6.1.4.1.6247.23.1.4.1.1.2 --- *turbo*IP45QoSRuleOrder (INTEGER)
1.3.6.1.4.1.6247.23.1.4.1.1.3 --- *turbo*IP45QoSRuleSrcAddress (IpAddress)
1.3.6.1.4.1.6247.23.1.4.1.1.4 --- *turbo*IP45QoSRuleSrcSubnetMask (IpAddress)
1.3.6.1.4.1.6247.23.1.4.1.1.5 --- *turbo*IP45QoSRuleDestAddress (IpAddress)
1.3.6.1.4.1.6247.23.1.4.1.1.6 --- *turbo*IP45QoSRuleDestSubnetMask (IpAddress)
1.3.6.1.4.1.6247.23.1.4.1.1.7 --- *turbo*IP45QoSRuleProtocol (INTEGER)
1.3.6.1.4.1.6247.23.1.4.1.1.8 --- *turbo*IP45QoSRuleSrcPortStart (INTEGER)
1.3.6.1.4.1.6247.23.1.4.1.1.9 --- *turbo*IP45QoSRuleSrcPortEnd (INTEGER)
1.3.6.1.4.1.6247.23.1.4.1.1.10 --- *turbo*IP45QoSRuleDestPortStart (INTEGER)
1.3.6.1.4.1.6247.23.1.4.1.1.11 --- *turbo*IP45QoSRuleDestPortEnd (INTEGER)
1.3.6.1.4.1.6247.23.1.4.1.1.12 --- *turbo*IP45QoSRulePriority (INTEGER)
1.3.6.1.4.1.6247.23.1.4.1.1.13 --- *turbo*IP45QoSRuleMaxBandwidth (INTEGER)
1.3.6.1.4.1.6247.23.1.4.1.1.14 --- *turbo*IP45QoSRuleTcpAcceleration (INTEGER)
1.3.6.1.4.1.6247.23.1.4.1.1.15 --- *turbo*IP45QoSRuleFilterAll (INTEGER)
1.3.6.1.4.1.6247.23.1.4.2 --- *turbo*IP45QoSStatisticsTable (SEQUENCE OF TurboIP45QoSStatisticsEntry)
1.3.6.1.4.1.6247.23.1.4.2.1 --- *turbo*IP45QoSStatisticsEntry (TurboIP45QoSStatisticsEntry)
1.3.6.1.4.1.6247.23.1.4.2.1.1 --- *turbo*IP45QoSPriority (INTEGER)
1.3.6.1.4.1.6247.23.1.4.2.1.2 --- *turbo*IP45QoSSentPkts (Counter32)
1.3.6.1.4.1.6247.23.1.4.2.1.3 --- *turbo*IP45QoSDroppedPkts (Counter32)
1.3.6.1.4.1.6247.23.1.4.2.1.4 --- *turbo*IP45QoSCurDataRate (Gauge32)
1.3.6.1.4.1.6247.23.1.4.2.1.5 --- *turbo*IP45QoSAvgDataRate (Gauge32)
1.3.6.1.4.1.6247.23.1.4.2.1.6 --- *turbo*IP45QoSMaxDataRate (Gauge32)
1.3.6.1.4.1.6247.23.1.4.2.1.7 --- *turbo*IP45QoSAcceleratedTcpSessions (Gauge32)
1.3.6.1.4.1.6247.23.1.5 --- *turbo*IP45Compression
1.3.6.1.4.1.6247.23.1.5.1 --- *turbo*IP45CompressionActive (INTEGER)
1.3.6.1.4.1.6247.23.1.5.2 --- *turbo*IP45CompressionStats
1.3.6.1.4.1.6247.23.1.5.2.1 --- *turbo*IP45CompressionRatio (INTEGER)
1.3.6.1.4.1.6247.23.1.5.2.2 --- *turbo*IP45ResetCompressionRatio (INTEGER)
1.3.6.1.4.1.6247.23.1.6 --- *turbo*IP45Admin
1.3.6.1.4.1.6247.23.1.6.1 --- *turbo*IP45AdminFunctions
1.3.6.1.4.1.6247.23.1.6.1.1 --- *turbo*IP45SystemDateAndTime (DateAndTime)
1.3.6.1.4.1.6247.23.1.6.1.2 --- *turbo*IP45SystemReboot (INTEGER)
1.3.6.1.4.1.6247.23.1.6.1.3 --- *turbo*IP45SystemShutdown (INTEGER)
1.3.6.1.4.1.6247.23.1.6.2 --- *turbo*IP45AdminInfo
1.3.6.1.4.1.6247.23.1.6.2.1 --- *turbo*IP45Version (DisplayString)
1.3.6.1.4.1.6247.23.1.6.2.2 --- *turbo*IP45UnitId (DisplayString)
1.3.6.1.4.1.6247.23.1.7 --- *turbo*IP45EventLog
1.3.6.1.4.1.6247.23.1.7.1 --- *turbo*IP45EventLogActive (INTEGER)
1.3.6.1.4.1.6247.23.1.7.2 --- *turbo*IP45EventLogClear (INTEGER)
1.3.6.1.4.1.6247.23.1.7.3 --- *turbo*IP45EventLogTable (SEQUENCE OF TurboIP45EventLogEntry)
1.3.6.1.4.1.6247.23.1.7.3.1 --- *turbo*IP45EventLogEntry (TurboIP45EventLogEntry)
1.3.6.1.4.1.6247.23.1.7.3.1.1 --- *turbo*IP45EventLogIndex (INTEGER)
1.3.6.1.4.1.6247.23.1.7.3.1.2 --- *turbo*IP45EventLogEvent (TurboIPLogEntry)
1.3.6.1.4.1.6247.23.1.8 --- *turbo*IP45Statistics
1.3.6.1.4.1.6247.23.1.8.1 --- *turbo*IP45ResetStats (INTEGER)
1.3.6.1.4.1.6247.23.1.8.2 --- *turbo*IP45ResetStatsTimeStamp (TimeStamp)
1.3.6.1.4.1.6247.23.1.8.3 --- *turbo*IP45OperationalStats
1.3.6.1.4.1.6247.23.1.8.3.1 --- *turbo*IP45MaxAcceleratedTcpSessions (Gauge32)
1.3.6.1.4.1.6247.23.1.8.3.2 --- *turbo*IP45MaxTcpSessionInitiationsPerSec (Gauge32)

1.3.6.1.4.1.6247.23.1.8.3.3 --- *turbo*IP45MaxTcpSessionTerminationsPerSec (Gauge32)
1.3.6.1.4.1.6247.23.1.8.4 --- *turbo*IP45ErrorStats
1.3.6.1.4.1.6247.23.1.8.4.1 --- *turbo*IP45TotalTcpSessionsRequestFailed (Counter32)
1.3.6.1.4.1.6247.23.1.8.4.2 --- *turbo*IP45TotalTcpSessionsTimedOut (Counter32)
1.3.6.1.4.1.6247.23.1.8.4.3 --- *turbo*IP45TotalTcpSegmentBadChecksum (Counter32)
1.3.6.1.4.1.6247.23.1.9 --- *turbo*IP45FailToWire
1.3.6.1.4.1.6247.23.1.9.1 --- *turbo*IP45FailToWireAvailable (INTEGER)
1.3.6.1.4.1.6247.23.1.10 --- *turbo*IP45HTTP
1.3.6.1.4.1.6247.23.1.10.1 --- *turbo*IP45HttpOperationalState (INTEGER)
1.3.6.1.4.1.6247.23.2 --- *turbo*IP45Notifications
1.3.6.1.4.1.6247.23.2.1 --- *turbo*IP45LoginNotifications
1.3.6.1.4.1.6247.23.2.1.1 --- *turbo*IP45LoginFailure
1.3.6.1.4.1.6247.23.2.2 --- *turbo*IP45ProcessNotifications
1.3.6.1.4.1.6247.23.2.2.1 --- *turbo*IP45SkipwareStart
1.3.6.1.4.1.6247.23.2.2.2 --- *turbo*IP45HttpServerStart
1.3.6.1.4.1.6247.23.2.2.3 --- *turbo*IP45SnmpShutdown
1.3.6.1.4.1.6247.23.3 --- *turbo*IP45Conformance
1.3.6.1.4.1.6247.23.3.1 --- *turbo*IP45Groups
1.3.6.1.4.1.6247.23.3.1.1 --- *turbo*IP45SystemGroup
1.3.6.1.4.1.6247.23.3.1.2 --- *turbo*IP45NotificationGroup

5.4 *turbo*IP-45™ Gateway Configuration

OID	1.3.6.1.4.1.6247.23.1.1.1.1
Leaf	*turbo*IP45LanTransmissionRate
Type	Integer
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RW
Description	kbps The transmission rate in kbps of the LAN interface.

OID	1.3.6.1.4.1.6247.23.1.1.2.1
Leaf	*turbo*IP45WanTransmissionRate
Type	Integer
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RW
Description	kbps The transmission rate in kbps of the WAN interface.

OID	1.3.6.1.4.1.6247.23.1.1.2.2
Leaf	*turbo*IP45WanMTU
Type	Integer
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RW
Description	bytes The maximum transmission unit (MTU) in bytes for the WAN interface.

OID	1.3.6.1.4.1.6247.23.1.1.3
Leaf	*turbo*IP45CongestionControl
Type	Integer
ACCESS: GET = RO	RW

GET/SET = RW RC = READ/CREATE	
Description	1:perConnection(1) 2:ratePacing(2) Apply per-connection congestion control or rate pacing.

OID	1.3.6.1.4.1.6247.23.1.8.1
Leaf	*turbo*IP45ResetStats
Type	Integer
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RW
Description	Resets all the statistics counters to their initial values.

OID	1.3.6.1.4.1.6247.23.1.8.2
Leaf	*turbo*IP45ResetStatsTimeStamp
Type	Time Ticks
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RO
Description	The value of sys UpTime at which the statistics counters were last reset. At any time, the elapsed time from the last reset can be calculated by subtracting this object from sysUpTime.

OID	1.3.6.1.4.1.6247.23.1.8.3.1
Leaf	*turbo*IP45MaxAcceleratedTcpSessions
Type	Gauge32
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RO
Description	The maximum number of concurrent accelerated TCP sessions (high water mark) since system startup or counter reset.

OID	1.3.6.1.4.1.6247.23.1.8.3.2
Leaf	*turbo*IP45MaxTcpSessionInitiationsPerSec

Type	Gauge32
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RO
Description	Maximum number of TCP sessions established in a single 1-second period.

5.5 *turbo*IP-45™ Interface

OID	1.3.6.1.4.1.6247.23.1.2.1
Leaf	*turbo*IP45EasyConnectActive
Type	Integer
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RO
Description	1: yes (name) Indicates whether or not the easyConnect feature is turned on.

OID	1.3.6.1.4.1.6247.23.1.2.2.1
Leaf	*turbo*IP45ManagementIpAddress
Type	IpAddress
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RW
Description	The management IP address in network byte order when in easyConnect mode.

OID	1.3.6.1.4.1.6247.23.1.2.2.2
Leaf	*turbo*IP45ManagementSubnetMask
Type	IpAddress
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RW

Description	The management subnet mask in network byter order when in easyConnect mode.

5.6 *turbo*IP-45™ Route

OID	1.3.6.1.4.1.6247.23.1.3.1.1.1
Leaf	*turbo*IP45RowStatus
Type	Integer
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RC
Description	Status of this entry in *turbo*IP-45 Route Table.

OID	1.3.6.1.4.1.6247.23.1.3.1.1.2
Leaf	*turbo*IP45RouteDestAddress
Type	IpAddress
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RC
Description	The destination IP address for this route in the Route Table.

OID	1.3.6.1.4.1.6247.23.1.3.1.1.3
Leaf	*turbo*IP45RouteDestSubnetMask
Type	IpAddress
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RC
Description	The destination subnet mask for this route in the Route Table.

OID	1.3.6.1.4.1.6247.23.1.3.1.1.4
Leaf	*turbo*IP45NextHopAddress
Type	IpAddress
ACCESS:	RC

GET = RO GET/SET = RW RC = READ/CREATE	
Description	The next hop IP address (locally attached) for this route in the Route Table.

OID	1.3.6.1.4.1.6247.23.1.4.1.1.1
Leaf	*turbo*IP45QoSRuleAction
Type	Integer
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RC
Description	Rule action for this entry in the *turbo*IP45QoSRuleTable.

5.7 *turbo*IP-45™ Selective Acceleration

OID	1.3.6.1.4.1.6247.23.1.4.1
Leaf	*turbo*IP45QoSRuleTable
Type	Integer
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	N/A
Description	Table entry for routes in Route Table.

OID	1.3.6.1.4.1.6247.23.1.4.1.1.1
Leaf	*turbo*IP45QoSRuleAction
Type	Integer
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RC
Description	Rule action for this entry in the *turbo*IP45QoSRuleTable.

OID	1.3.6.1.4.1.6247.23.1.4.1.1.2

Leaf	*turbo*IP45QoSRuleOrder
Type	Integer
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RC
Description	The order of the rule in the Rule Table. Consecutively numbered from 1 with highest numbered rule being the default and unchangeable. When *turbo*IP45QoSRuleOrder is set to a different valid rule number in the *turbo*IP-45 QoS Rule Table the rule referenced by the new value is moved to the location of the rule referenced by the index and the rules are renumbered to reflect the new locations.

OID	1.3.6.1.4.1.6247.23.1.4.1.1.3
Leaf	*turbo*IP45QoSRuleScrAddress
Type	IpAddress
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RC
Description	The source IP address in network byte order for matching packets to this rule.

OID	1.3.6.1.4.1.6247.23.1.4.1.1.4
Leaf	*turbo*IP45QoSRuleScrSubnetMask
Type	IpAddress
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RC
Description	The source subnet mask in network byte order for matching packets.

OID	1.3.6.1.4.1.6247.23.1.4.1.1.5
Leaf	*turbo*IP45QoSRuleDestAddress
Type	IpAddress
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RC

Description	The destination IP address in network byte order for matching packets to this rule.

OID	1.3.6.1.4.1.6247.23.1.4.1.1.6
Leaf	*turbo*IP45QoSRuleDestSubnetMask
Type	IpAddress
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RC
Description	The destination subnet mask in network byte order for matching packets to this rule.

OID	1.3.6.1.4.1.6247.23.1.4.1.1.7
Leaf	*turbo*IP45QoSRuleProtocol
Type	Integer
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RC
Description	The protocol for matching packets to this rule.

OID	1.3.6.1.4.1.6247.23.1.4.1.1.8
Leaf	*turbo*IP45QoSRuleScrPortStart
Type	Integer
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RC
Description	The start of the TCP/UDP source port range for matching packets to this rule.

OID	1.3.6.1.4.1.6247.23.1.4.1.1.9
Leaf	*turbo*IP45QoSRuleScrPortEnd
Type	Integer
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RC
Description	The end of the TCP/UDP source port range for matching packets to this rule.

OID	1.3.6.1.4.1.6247.23.1.4.1.1.10
Leaf	*turbo*IP45QoSRuleDestPortStart
Type	Integer
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RC
Description	The start of the TCP/UDP destination port range for matching packets to this rule.

OID	1.3.6.1.4.1.6247.23.1.4.1.1.11
Leaf	*turbo*IP45QoSRuleDestPortEnd
Type	Integer
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RC
Description	The end of the TCP/UDP destination port range for matching packets to this rule.

OID	1.3.6.1.4.1.6247.23.1.4.1.1.12
Leaf	*turbo*IP45QoSRulePriority
Type	Integer
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RC
Description	The proiority number of the WAN transmission queue into which packets will be put when they match this rule.

OID	1.3.6.1.4.1.6247.23.1.4.1.1.13
Leaf	*turbo*IP45QoSRuleMaxBandwidth
Type	Integer
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RC
Description	The maximum bacdwidth allowed (within a given priority level) for a flow of packets that match this rule.

OID	1.3.6.1.4.1.6247.23.1.4.1.1.14

Leaf	*turbo*IP45QoSRuleTcpAcceleration
Type	Integer
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RC
Description	Turns ON or OFF the TCP acceleration for TCP session that matches this rule.

OID	1.3.6.1.4.1.6247.23.1.4.1.1.15
Leaf	*turbo*IP45QoSRuleFilterAll
Type	Integer
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RC
Description	If set to 'yes' it drops packets matching this rule.

5.8 *turbo*IP-45™ QoS Statistics Table

OID	1.3.6.1.4.1.6247.23.1.4.2.1
Leaf	*turbo*IP45QoSStatisticsEntry
Type	
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	
Description	Table entries of rules for selective acceleration and quality of service.

OID	1.3.6.1.4.1.6247.23.1.4.2.1.1
Leaf	*turbo*IP45QoSPriority
Type	Integer
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RO
Description	The priority number of the WAN transmission queue.

OID	1.3.6.1.4.1.6247.23.1.4.2.1.2
Leaf	*turbo*IP45QoSSentPkts
Type	Counter
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RO
Description	The number of packets sent on this WAN transmission queue.

OID	1.3.6.1.4.1.6247.23.1.4.2.1.3
Leaf	*turbo*IP45QoSDroppedPkts
Type	Counter
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RO
Description	The number of packets dropped on this WAN transmission queue.

OID	1.3.6.1.4.1.6247.23.1.4.2.1.4
Leaf	*turbo*IP45QoSCurDataRate
Type	Counter
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RO
Description	The current data rate being sent on this WAN transmission queue (average per second).

OID	1.3.6.1.4.1.6247.23.1.4.2.1.5
Leaf	*turbo*IP45QoSAvgDataRate
Type	Counter
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RO
Description	The average data rate that has been sent on this WAN transmission queue since the last statistics reset.

OID	1.3.6.1.4.1.6247.23.1.4.2.1.6
Leaf	*turbo*IP45QoSMaxDataRate
Type	Counter

ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RO
Description	The maximum data rate that has been sent on this WAN transmission queue.

OID	1.3.6.1.4.1.6247.23.1.4.2.1.7
Leaf	*turbo*IP45QoSAcceleratedTcpSessions
Type	Counter
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RO
Description	The current number of Accelerated TCP sessions being put into this WAN transmission queue.

5.9 *turbo*IP-45™ Compression

OID	1.3.6.1.4.1.6247.23.1.5.1
Leaf	*turbo*IP45CompressionActive
Type	Integer
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RW
Description	Global enable and disable for compression.

OID	1.3.6.1.4.1.6247.23.1.5.2
Leaf	*turbo*IP45CompressionStats
Type	N/A
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	N/A
Description	Table entry of *turbo*IP-45 v3 Compression Stats.

OID	1.3.6.1.4.1.6247.23.1.5.2.1

Leaf	*turbo*IP45CompressionRatio
Type	Integer
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RO
Description	The average, since last statistic reset, over all data passing from the LAN to WAN interfaces over all compressed accelerated sessions,of the ratio of the payload size of the transmitted segments to the size that the payloads would have if the data were not compressed.

OID	1.3.6.1.4.1.6247.23.1.5.2.2
Leaf	*turbo*IP45ResetCompressionRatio
Type	Integer
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RW
Description	Allows reset of the average compression ratio.

5.10 *turbo*IP-45™ Admin

OID	1.3.6.1.4.1.6247.23.1.6.1
Leaf	*turbo*IP45AdminFunctions
Type	N/A
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	N/A
Description	

OID	1.3.6.1.4.1.6247.23.1.6.1.1
Leaf	*turbo*IP45SystemDateAndTime
Type	DateAndTime
ACCESS: GET = RO	RO

GET/SET = RW RC = READ/CREATE	
Description	Current date and time.

OID	1.3.6.1.4.1.6247.23.1.6.1.2
Leaf	*turbo*IP45SystemReboot
Type	Integer
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RW
Description	Performs system reboot.

OID	1.3.6.1.4.1.6247.23.1.6.1.3
Leaf	*turbo*IP45SystemShutdown
Type	Integer
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RW
Description	Performs system shutdown.

5.11 *turbo*IP-45™ Admin Info

OID	1.3.6.1.4.1.6247.23.1.6.2.1
Leaf	*turbo*IP45Version
Type	DisplayString
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RO
Description	The version of the *turbo*IP-45 software.

OID	1.3.6.1.4.1.6247.23.1.6.2.2
Leaf	*turbo*IP45UnitId

Type	DisplayString
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RO
Description	The Unit ID of the *turbo*IP-45 system.

5.12 *turbo*IP-45™ Event Log

OID	1.3.6.1.4.1.6247.23.1.7.1
Leaf	*turbo*IP45EventLogActive
Type	Integer
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RW
Description	Global enable and disable for event logging.

OID	1.3.6.1.4.1.6247.23.1.7.2
Leaf	*turbo*IP45EventLogClear
Type	Integer
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RW
Description	Clears all entries in the *turbo*IP45EventLogTable.

OID	1.3.6.1.4.1.6247.23.1.7.3
Leaf	*turbo*IP45EventLogTable
Type	N/A
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	N/A
Description	Sequence of *turbo*IP45EventLogEntry.

OID	1.3.6.1.4.1.6247.23.1.7.3.1.1

Leaf	*turbo*IP45EventLogIndex
Type	Integer
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RO
Description	Index for event log entry.

OID	1.3.6.1.4.1.6247.23.1.7.3.1.2
Leaf	*turbo*IP45EventLogEvent
Type	OCTET STRING
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RO
Description	Text string for event log entry. The log entry has the floowing format: date, time, severity_level, source_component, event_description.

5.13 *turbo*IP-45™ Statistics

OID	1.3.6.1.4.1.6247.23.1.8.1
Leaf	*turbo*IP45ResetStats
Type	Integer
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RW
Description	Resets all the statistics counters to their initial values.

OID	1.3.6.1.4.1.6247.23.1.8.2
Leaf	*turbo*IP45ResetStatsTimeStamp
Type	TimeTicks
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RO
Description	The value of sysUpTime at which the statistics counters were last reset. At any time, the elapsed time from the last reset can be calculated by subtracting this object from sysUpTime.

OID	1.3.6.1.4.1.6247.23.1.8.3
Leaf	*turbo*IP45OperationalStats
Type	N/A
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	N/A
Description	

OID	1.3.6.1.4.1.6247.23.1.8.3.1
Leaf	*turbo*IP45MaxAcceleratedTcpSessions
Type	Gauge32
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RO
Description	The maximum number of concurrent accelerated TCP sessions (high water mark) since system startup or counter reset.

OID	1.3.6.1.4.1.6247.23.1.8.3.2
Leaf	*turbo*IP45MaxTcpSessionInitiationsPerSec
Type	Gauge32
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RO
Description	Maximum number of TCP sessions established in a single 1-second period.

OID	1.3.6.1.4.1.6247.23.1.8.3.3
Leaf	*turbo*IP45MaxTcpSession TerminationsPerSec
Type	Gauge32
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RO
Description	Maximum number of TCP session's terminations in a single 1-second period.

OID	1.3.6.1.4.1.6247.23.1.8.4
Leaf	*turbo*IP45ErrorStats

Type	N/A
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	N/A
Description	

OID	1.3.6.1.4.1.6247.23.1.8.4.1
Leaf	*turbo*IP45TotalTcpSessionsRequestFailed
Type	Counter
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RO
Description	The total number of valid new sessions requested which were rejected.

OID	1.3.6.1.4.1.6247.23.1.8.4.2
Leaf	*turbo*IP45TotalTcpSessionsTimedOut
Type	Counter
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RO
Description	The total number of TCP sessions which were terminated because they were idle for too long.

OID	1.3.6.1.4.1.6247.23.1.8.4.3
Leaf	*turbo*IP45TotalTcpSegmentBadCheckSum
Type	Counter
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RO
Description	The total number of TCP segments which were dropped because of an incorrect TCP checksum.

5.14 *turbo*IP-45™ Fail To Wire

OID	1.3.6.1.4.1.6247.23.1.9.1
Leaf	*turbo*IP45FailToWireAvailable
Type	Integer
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RO
Description	Availability of the fail-to-wire board.

5.15 *turbo*IP-45™ HTTP

OID	1.3.6.1.4.1.6247.23.1.10.1
Leaf	*turbo*IP45HttpOperationalState
Type	Integer
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	RO
Description	Indication of the operational state of the WEB server process.

5.16 *turbo*IP-45™ Notifications

OID	1.3.6.1.4.1.6247.23.2.1.1
Leaf	*turbo*IP45LoginFailure
Type	
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	Trap
Description	Notification to indicate that a failed login attempt occurred on the HTTP interface.

OID	1.3.6.1.4.1.6247.23.2.2.1
Leaf	*turbo*IP45SkipwareStart

Type	
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	Trap
Description	Notification indicates that the Skipware task has started.

OID	1.3.6.1.4.1.6247.23.1.2.2.2
Leaf	*turbo*IP45HttpServerStart
Type	
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	Trap
Description	Notification indicates that the HTTP server has started.

OID	1.3.6.1.4.1.6247.23.2.2.3
Leaf	*turbo*IP45SnmpShutdown
Type	
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	Trap
Description	Notification indicates that the SNMP agent has shutdown.

5.17 *turbo*IP-45™ Process Notifications

OID	1.3.6.1.4.1.6247.23.2.2.1
Leaf	*turbo*IP45SkipwareStart
Type	
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	Trap
Description	Notification indicates that the Skipware task has started.

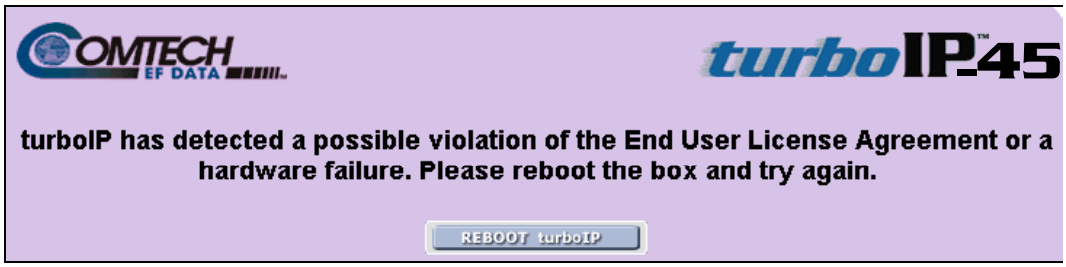
OID	1.3.6.1.4.1.6247.23.2.2.2
Leaf	*turbo*IP45HttpServerStart
Type	
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	Trap
Description	Notification indicates that the HTTP server has started.

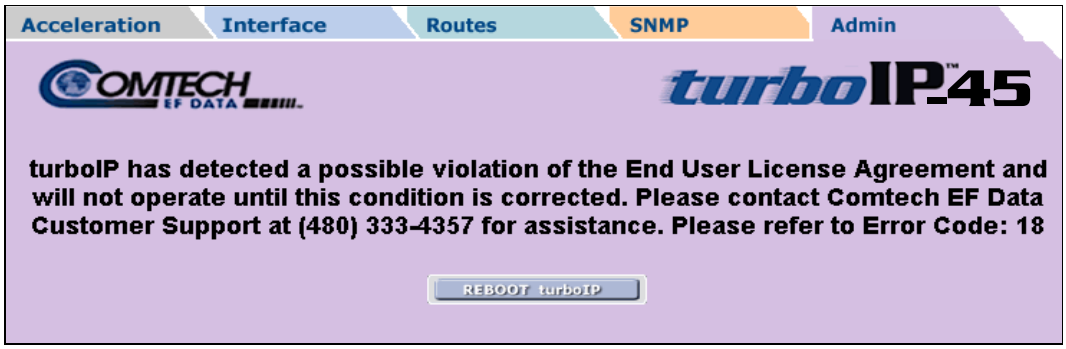
OID	1.3.6.1.4.1.6247.23.2.2.3
Leaf	*turbo*IP45SnmpShutdown
Type	
ACCESS: GET = RO GET/SET = RW RC = READ/CREATE	Trap
Description	Notification indicates that the SNMP agent has shutdown.

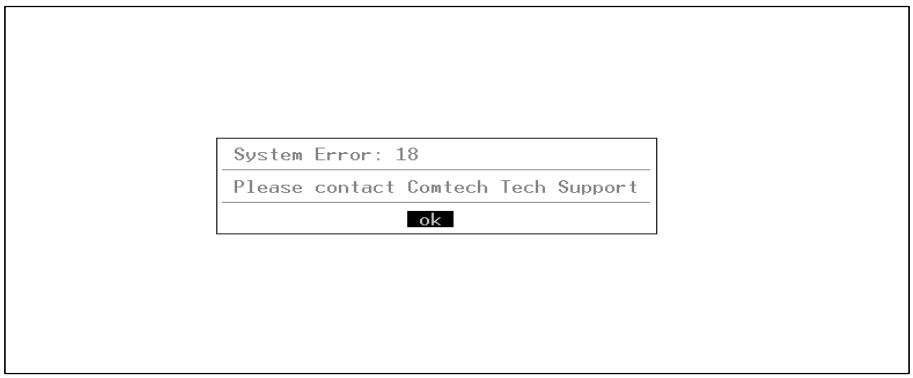
Notes:

Chapter 6. Copy Protection

*turbo*IP-45™ uses copy protection mechanisms to enforce the End User License Agreement (EULA, see Chapter 8). If the unit detects tampering, it will stop functioning and display an appropriate message. Sample messages include:







Notes:

Chapter 7. Sample Configurations

7.1 Sample Configurations Introduction

This chapter will describe typical topologies that the *turbo*IP-45™ can be used in. Each sample configuration will show how the *turbo*IP-45 would be configured for optimal performance. The following list will apply to the *turbo*IP-45 in all cases –

- The *turbo*IP-45 must be placed in the network so that all TCP traffic that is to be accelerated will be directed through the *turbo*IP-45. The local network would be connected to *turbo*IP-45 LAN port and the WAN port would be connected to the satellite modem (or to a router which connects directly to the satellite modem).
- With easyConnect mode, the *turbo*IP-45 is never a "Next Hop" or a Default Gateway for any locally attached devices. Instead, the *turbo*IP-45™ will work as a transparent bridge, so a *turbo*IP-45 can be placed in any network without having to reconfigure any network devices.
- The *turbo*IP-45 Fail-to-Wire feature insures that all traffic continues to flow, even if there is a *turbo*IP-45 failure, such as a power supply failure.
- The *turbo*IP-45 is fully compatible with network devices that use TCP, supporting existing Internet standards, including network congestion and retransmission schemes. This allows *turbo*IP-45 at one end of the link to operate with TCP devices at the other end of the link without the need for a peer *turbo*IP-45 device, providing partial performance enhancement. However, it is recommended that TCP traffic pass through a pair of *turbo*IP-45 Performance Enhancement Proxies, in order to take full advantage of the SCPS-TP protocol.

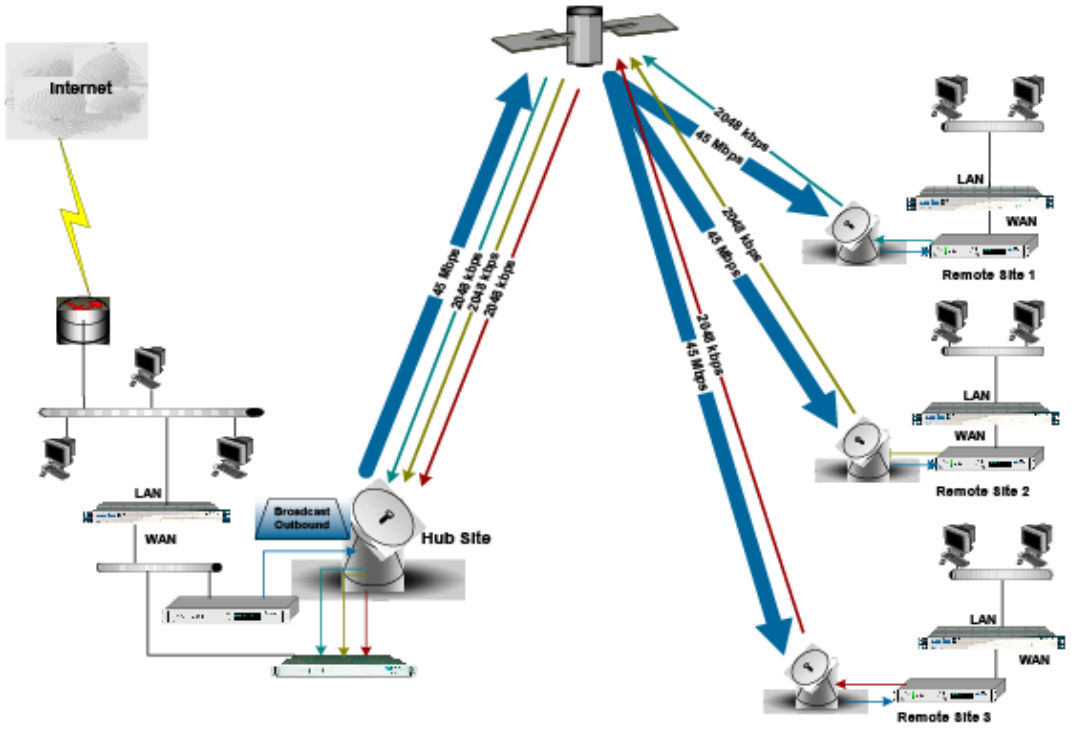
The following sections show and describe the addition of *turbo*IP-45 to an existing network.

7.2 Point-to-Point Configuration

This configuration is a typical example where *turbo*IP-45s are used to maximize the TCP throughput in a Point-to-Point system. Note the *turbo*IP-45s are placed so that all TCP traffic between the Remote and the hub must pass through the *turbo*IP-45. The following table defines the configuration settings for each *turbo*IP-45.

Configuration Parameter	Hub *turbo*IP-45	Remote *turbo*IP-45
WAN Transmission Rate	45 Mbps (equal to the TX data rate of Hub modem)	2048 kbps (equal to the TX data rate of Remote modem)
Congestion Control	Rate Pacing	Rate Pacing
Selective Acceleration	No Selective Acceleration Rules are required. Rules could be added to prioritize or set BW limits on any type of traffic.	
Route Table	No Route Table entries are required. Routes could be added to allow remote access from outside of LAN subnet.	

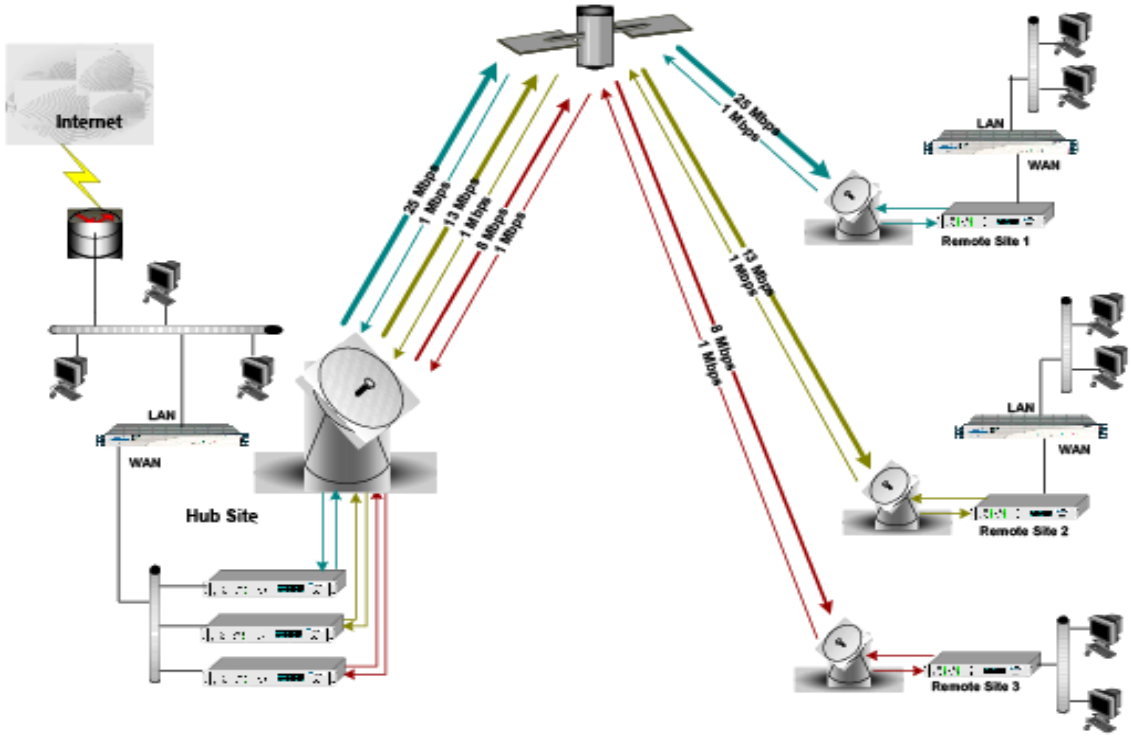
7.3 Point-to-MultiPoint Configuration



In the Point-to-Multipoint configuration, a single *turbo*IP-45 is used at the Hub to accelerate TCP traffic to three Remote sites, each with a *turbo*IP-45. The following table defines the configuration settings for each *turbo*IP-45.

Configuration Parameter	Hub *turbo*IP-45	Remote *turbo*IP-45 (1, 2, & 3)
WAN Transmission Rate	45 Mbps (equal to the TX data rate of Hub modem)	2048 kbps (equal to the TX data rate of Remote modem)
Congestion Control	Rate Pacing	Rate Pacing
Selective Acceleration	No Selective Acceleration Rules are required. Rules could be added to prioritize or set BW limits on types of traffic. Rules could also be added to set a priority or BW limit on traffic to a particular site.	
Route Table	No Route Table entries are required. Routes could be added to allow remote access from outside of LAN subnet.	

7.4 Hub-Spoke Configuration

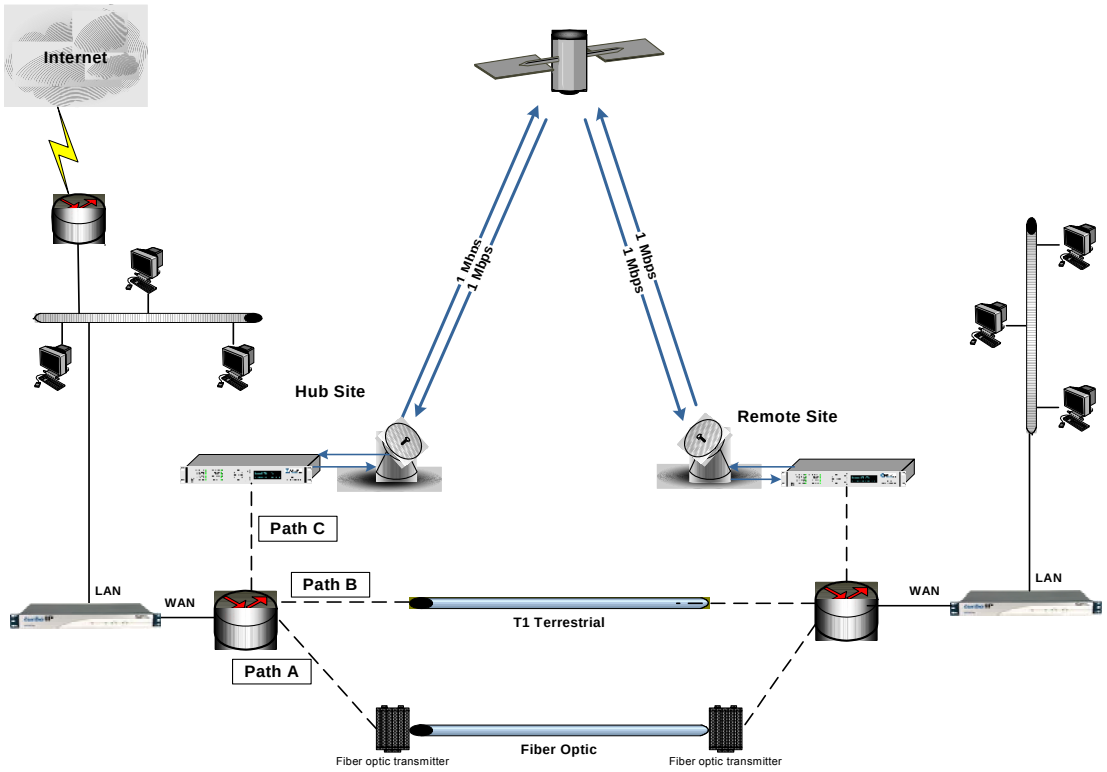


The Hub-Spoke differs from the Point-to-Multipoint configuration in that there are separate satellite links between the Hub and each Remote site, but a single *turbo*IP-45 is still used at the Hub. Also note that there is no *turbo*IP-45 at Remote Site 3, this is to illustrate that *turbo*IP-45s can be deployed at Remote Sites at a future date and still be compatible with the Hub. Sites without a *turbo*IP-45 would only get partial benefit for *turbo*IP-45 TCP acceleration.

The following table defines the configuration settings for each *turbo*IP-45.

Configuration Parameter	**Hub *turbo*IP-45**	**Remote *turbo*IP-45 (1 & 2)**
WAN Transmission Rate	45 Mbps (equal to the total TX data rates of Hub modems, 25 + 13 + 8 Mbps)	1 Mbps (equal to the TX data rate of Remote modem.
Congestion Control	Rate Pacing	Rate Pacing
Selective Acceleration	Selective Acceleration Rules are required to limit the bandwidth for all of the traffic destined for a particular Remote site. The BW limit would be equal to the TX data rate of Hub modem that is linked to the particular site 25 Mbps for Site 1, 13 Mbps for Site 2, and 8 Mbps for Site 3.	No Selective Acceleration Rules are required. Rules could be added to prioritize or set BW limits on types of traffic.
Route Table	No Route Table entries are required. Routes could be added to allow remote access from outside of LAN subnet.	

7.5 Dynamic Bandwidth Configuration



In this configuration, there are *turbo*IP-45s in place in a simple Point-to-Point link, but there is more than a single path available between the Hub and the Remote Sites. Path A is a fiber optic link, Path B is a terrestrial T1 link, and Path C is a 1 Mbps satellite link. Routers are used at both sites to dynamically select the best path available. The *turbo*IP-45s are placed just before the router so that all traffic passes through the *turbo*IP-45s regardless of the path used. In this dynamic bandwidth environment, the *turbo*IP-45s need to set to Per-Connection Congestion Control to optimize the TCP acceleration for whichever path is used.

The following table defines the configuration settings for each *turbo*IP-45.

Configuration Parameter	**Hub *turbo*IP-45**	**Remote *turbo*IP-45 (1 & 2)**
WAN Transmission Rate	45 Mbps (set to the maximum rate)	45 Mbps (set to the maximum rate)
Congestion Control	Per-Connection	Per-Connection
Selective Acceleration	No Selective Acceleration Rules are required. Rules could be added to prioritize or set BW limits on any type of traffic.	
Route Table	No Route Table entries are required. Routes could be added to allow remote access from outside of LAN subnet.	

Notes:

Chapter 8. End User License Agreement

Upon successful login for the first time, the following End User License Agreement (EULA) is displayed:

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10. Notice

All notices to CEFD shall be in writing and shall be made either via e-mail or conventional mail. Notices to CEFD must be sent to the attention of Customer Service at techsupport@comtechefdata.com, if by e-mail, or at Comtech EF Data Corporation, 2114 West 7th Street, Tempe, AZ 85821 USA if by conventional mail. Notices to you may be sent either to the e-mail address, or to the conventional mail address, if supplied to GPI or posted as a notice on our Web site located at www.comtechefdata.com.

Any notices or communication under this EULA will be deemed delivered to the party receiving such communication (i) two business days after deposit with a commercial overnight carrier, with written verification of receipt; (ii) five business days after the mailing date, if sent by conventional US mail, return receipt requested; or (iii) on the delivery date if transmitted by confirmed e-mail.

11. Gesneral

This EULA shall be construed, interpreted and governed by the laws of the State of Maryland without regard to conflicts of law provisions thereof. Notwithstanding, the parties agree that none of the provisions in this EULA will be governed by the Uniform Computer Information Transactions Act ("UCITA") as enacted by the State of Maryland or any other jurisdiction. The exclusive forum for any disputes arising out of or relating to this EULA shall be an appropriate state court sitting in Montgomery County, Maryland, or a federal court sitting in the State of Maryland, USA. You may not transfer or assign this EULA or any of your rights or obligations hereunder to any third party. Any waiver or modification of this EULA shall only be effective if it is in writing and signed by both parties hereto. If any part of this EULA is held invalid or unenforceable, that portion shall be construed in a manner consistent with applicable law to reflect, as nearly as possible, the original intentions of the parties, and the remaining portions shall remain in full force and effect. This EULA shall constitute the entire Agreement between the parties hereto.

METRIC CONVERSIONS

Units of Length

Unit	Centimeter	Inch	Foot	Yard	Mile	Meter	Kilometer	Millimeter
1 centimeter	—	0.3937	0.03281	0.01094	6.214×10^{-6}	0.01	—	—
1 inch	2.540	—	0.08333	0.2778	1.578×10^{-5}	0.254	—	25.4
1 foot	30.480	12.0	—	0.3333	1.893×10^{-4}	0.3048	—	—
1 yard	91.44	36.0	3.0	—	5.679×10^{-4}	0.9144	—	—
1 meter	100.0	39.37	3.281	1.094	6.214×10^{-4}	—	—	—
1 mile	1.609×10^{5}	6.336×10^{4}	5.280×10^{3}	1.760×10^{3}	—	1.609×10^{3}	1.609	—
1 mm	—	0.03937	—	—	—	—	—	—
1 kilometer	—	—	—	—	0.621	—	—	—

Temperature Conversions

Unit	° Fahrenheit	° Centigrade
32° Fahrenheit	—	0 (water freezes)
212° Fahrenheit	—	100 (water boils)
-459.6° Fahrenheit	—	273.1 (absolute 0)

Formulas
C = (F - 32) * 0.555
F = (C * 1.8) + 32

Units of Weight

Unit	Gram	Ounce Avoirdupois	Ounce Troy	Pound Avoir.	Pound Troy	Kilogram
1 gram	—	0.03527	0.03215	0.002205	0.002679	0.001
1 oz. avoir.	28.35	—	0.9115	0.0625	0.07595	0.02835
1 oz. troy	31.10	1.097	—	0.06857	0.08333	0.03110
1 lb. avoir.	453.6	16.0	14.58	—	1.215	0.4536
1 lb. Troy	373.2	13.17	12.0	0.8229	—	0.3732
1 kilogram	1.0×10^{3}	35.27	32.15	2.205	2.679	—

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