

Crestron **NAT**
Network Address Translator

Reference Guide



CRESTRON

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Network Address Translator: NAT

Introduction

The purpose of this document is to describe Crestron's implementation of the Network Address Translator (NAT) with respect to a 2-Series Control system with the optional Z-Bus card (C2ENET-2) installed.

Features/Functions of Crestron NAT

Crestron Network Address Translation (NAT) is a method of connecting multiple Crestron IP devices and other IP enabled AV devices on an internal network (LAN) to access the Internet (WAN) using one static IP address.

NOTE: The NAT throughput (from LAN B to LAN A) should not exceed 1Mbps (**m**egabits **p**er second). Crestron does not recommend use of high-volume streaming output devices such as IP-based codecs.

Feature/Function Summary

- Built-In NAT Functionality
 - Included in 2-Series Firmware
 - Enabled Via Dual-Port Ethernet Z-Bus Expansion Card (C2ENET-2)
- Single IP Addressing
 - One External IP Address Represents Multiple Crestron IP Device/IP enabled AV Devices in Internal Network.
 - Controlled Access to Internal Services (eg., load touchpanels individually through different ports)
- Secure Ethernet
 - Built-In Firewall Protection
 - Remote Diagnostics & System Maintenance
- Easy Configuration Through Friendly Web Pages
 - Accessible via Browser
 - Three Pages to Configure Entire System
- Support of up to 16 Portmaps (directing IP traffic from WAN side to LAN side)

*In local area networks, a **node** is any device connected to the LAN.*

***Transparent**, in this context, signifies that the external devices are unaware of the address translation process.*

*An Internet Protocol (**IP**) address is a unique 32-bit identifier for a specific TCP/IP host computer on a network*

***Packets** are groups of data, usually in binary form, organized in a specific way for transmission.*

The IP NAT protocol is a router protocol that allows **transparent** communication between **nodes** on an internal network and nodes on an external network. Since nodes on an internal network are not assigned globally unique **IP addresses**, transparent communication with an external network, without NAT, would be impossible. This transparent communication is accomplished by modifying the IP and protocol-specific headers of **packets** flowing to and from the internal network.

NAT only allows connections that are originated on the internal network, thus it automatically provides firewall-style protection without any special set-up. It is possible to make some internal servers available to the outside world via inbound mapping, which maps certain well known TCP ports, such as 21 for FTP, to specific internal addresses, making services like FTP available in a controlled way.

NOTE: Additional Ethernet and IP networking terms are defined in the Crestron e-Control Reference Guide (D6052). The latest revision of this guide can be obtained from the Downloads | Product Manuals | Software and Wiring Diagrams section of the Crestron website (www.Crestron.com).

Crestron Implementation

Network Address Translation has many forms and can work in several ways. As currently implemented for the Crestron 2-series control systems, NAT is a combination of the Network Address Port Translator protocol (NAPT) and Bi-Directional NAT, and solves three common problems generally experienced with growing networks:

- shortage of globally unique IP addresses,
- firewall-like protection for the internal network, and
- flexibility of network administration.

NAT functionality is included in the firmware of Crestron 2-series control processors, and enabled through a dual port Ethernet Z-bus expansion card.

Single IP Addressing

NAPT lets a single device, such as a router, act as an agent between the internal network and the external network. This solves the problem of a shortage of globally unique addresses by permitting a single, unique external IP address to represent an entire group of computers in the internal network. Specifically, the IP address and TCP/UDP port number of the internal node are replaced with an external IP address and TCP/UDP port number in the IP and TCP/UDP header.

For example, suppose there was a need to remotely upload a project to five Crestron IP enabled touchpanels residing on an internal LAN. Crestron provides a registered port (41795) that can be accessed via the Viewport with the **Remote | TCP/IP | Connect** command. From the “Crestron Viewport TCP/IP Connect” window, enter the IP address, colon, and port number. Without NAT, five distinct IP addresses – one for each touchpanel on the LAN – would be required, as shown below.

```
<IP Address #1>:<41795>
<IP Address #2>:<41795>
<IP Address #3>:<41795>
<IP Address #4>:<41795>
<IP Address #5>:<41795>
```

Only one IP address is required if NAT is employed. The touchpanels on the LAN are recognized only by the single external IP address and distinguished by five unique external port numbers – one for each touchpanel on the LAN. From the “Crestron Viewport TCP/IP Connect” window, enter the single IP address, colon, and external port number, as shown below.

```
<IP Address #1>:<external port # mapped for touchpanel #1>  
<IP Address #1>:<external port # mapped for touchpanel #2>  
<IP Address #1>:<external port # mapped for touchpanel #3>  
<IP Address #1>:<external port # mapped for touchpanel #4>  
<IP Address #1>:<external port # mapped for touchpanel #5>
```

NOTE: Each unique external port number is arbitrarily assigned at the discretion of the individual configuring the NAT.

Secure Ethernet

Bi-Directional NAT - connections initiated from hosts on the external network as well as the internal network - are made possible by mapping specific ports on the NAT router to services on an internal node via a portmap service. The NAT router relays all matching requests from the external network to the specific internal node. This enables nodes on an internal network to be configured as servers accessible by the external network. Since all connections must be initiated from the internal network or be registered with the portmap service, 2-Series NAT provides firewall-like protection for the internal network. An intruder would have to first gain access to the NAT router in order to infiltrate the internal network. Currently, the maximum number of portmaps that can be assigned is 16.

For example, without the Crestron NAT, the creation of an internal or sub-network within an existing network would require the purchase of a separate third-party router and involve major participation from an IT administrator. Instead, the Crestron NAT offers a built-in solution that permits an IT administrator or AV installer to setup a sub-network of Crestron and IP enabled AV products with firewall-like protection. The individual setting up the sub-network determines who and what gets through to the LAN by reassigning its port numbers.

Simple Network Administration

Three built-in, user-friendly web pages are available through your browser. These web pages let you configure the entire NAT feature, including setup of Host Name, IP addressing, port mapping, and password.

Configuration of a sub-network can be a daunting task. However, the approach used within the Crestron NAT provides familiarity for those with prior router configuration experience and yet offers a degree of simplicity for the novice. Refer to “Configuration” on page 8 for details.

Example Configuration

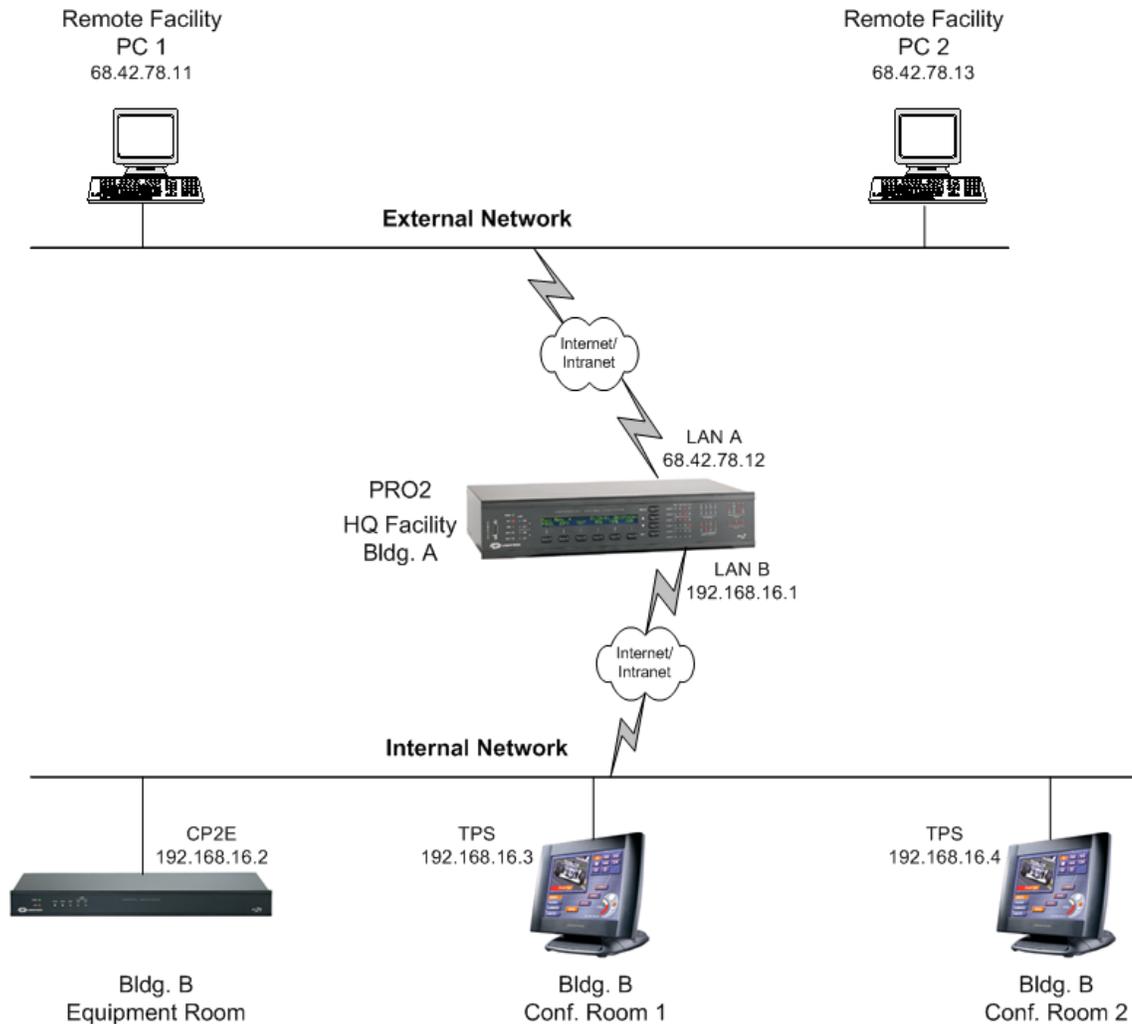
As shown in the illustration on the next page, the internal network 192.168.16.x is hidden from the external network behind the PRO2. The PRO2 has one external connection/port (68.42.78.12) used to communicate with the external network and to protect the anonymity of the internal nodes. The PRO2 has one internal connection/port (192.168.16.1) used to communicate with the internal network.

When a connection is initiated from the external side, the NAT router replaces the TCP/UDP source port with the assigned external TCP/UDP source port. Normally, outbound traffic (internal to external) does not need any configuration. Therefore,

when an internal node sends a packet to the external network, the NAT router intercepts the packet and replaces all instances of the internal source IP address with the external IP address (68.42.78.12).

When an external node responds to an internal node or initiates an acceptable connection with an internal node, the NAT router intercepts the packet and replaces all instances of the external destination IP address (68.42.78.12) and assigned external destination TCP/UDP port with the internal IP address and destination TCP/UDP port.

Sample NAT-Mode Configuration



NOTE: The “IP Setup” section in the C2ENET-1/2 Operations & Installation Guide (Doc. 5962) provides an example of a control system establishing Internet communication via a DSL router. Obtain the latest version of the guide from the [Downloads | Product Manuals](http://www.crestron.com) section of the Crestron website (www.crestron.com).

Setup

Requirements

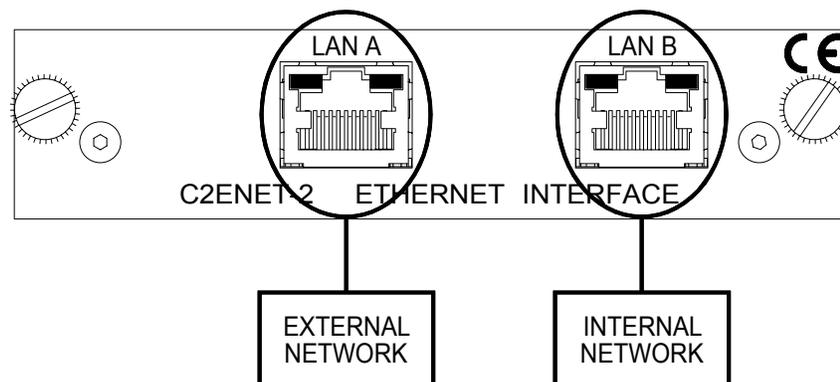
NAT configuration can only be performed via the web server of a 2-Series control system. Therefore, to complete the setup, the following network requirements are necessary.

- Z-Bus Capable 2-Series Crestron control system with
 - C2ENET-2 card installed into the Z-Bus (slot 8)
 - the appropriate operating system (C2-2004.CUZ or later) loaded
 - valid IP addresses for both Ethernet ports on the C2ENET-2
 - NOTE:** IP address for WAN (port A) usually provided by network administrator or network service provider.
 - default gateway (as provided by IT administrator)
 - subnet mask is usually automatically calculated based on the IP address entered (if not, it should be provided by IT administrator)
 - NOTE:** The subnet mask provided by the IT administrator should take precedence.
- Unshielded Twisted Pair CAT5 or better network cables with RJ-45 connectors (for external and internal networks)
- RJ-45 broadband Internet connection ports (for external network)
- PC running
 - Crestron software (e.g., Viewport)
 - Internet Explorer 4.0 and higher, or Netscape Navigator 4.0 or 4.7

Hookup

Prior to making any connections, verify that all hardware is powered down. Refer to the diagram after this paragraph. Use a network cable and connect the internal network to the LAN B connector on the C2ENET-2 card. The internal network connection may be made direct to a network-aware device (i.e., TPS touchpanel with Ethernet card or 2-Series control system) or to a router with additional network-aware devices connected. Use another network cable and connect the LAN A connector on the C2ENET-2 card to the broadband Internet connection port (external network). Apply power to devices on the internal network and the control system with the C2ENET-2 card.

Connections Made to C2ENET-2 Card



IP Setup

It is necessary to configure the control system NAT (C2ENET-2 card installed) to communicate over Ethernet using standard IP. The control system and router for the internal network are assigned IP numbers using Viewport. The instructions assume that the C2ENET-2 is installed, and the PC and control system are powered up.

NOTE: It is assumed that your PC is communicating with the powered control system via RS-232 and the appropriate update file has been loaded. Refer to the appropriate control system Operations Guide for further details about serial communication connections.

1. Obtain appropriate WAN-side static IP and router addresses for the control system WAN address from the network administrator or network service provider. Obtain the LAN-side addresses or choose them yourself if no one else's equipment resides there (eg., 192.168.16.1 is a commonly used class C address).

NOTE: The next three steps verify that the static IP address is not being used by another device.

2. On the PC, select **Start | Run** from the Taskbar to open the "Run" window.
3. Type **command** in the *Open* field and click **OK**. A DOS window appears.
4. At the prompt, type PING and the IP number. Press **Enter**.

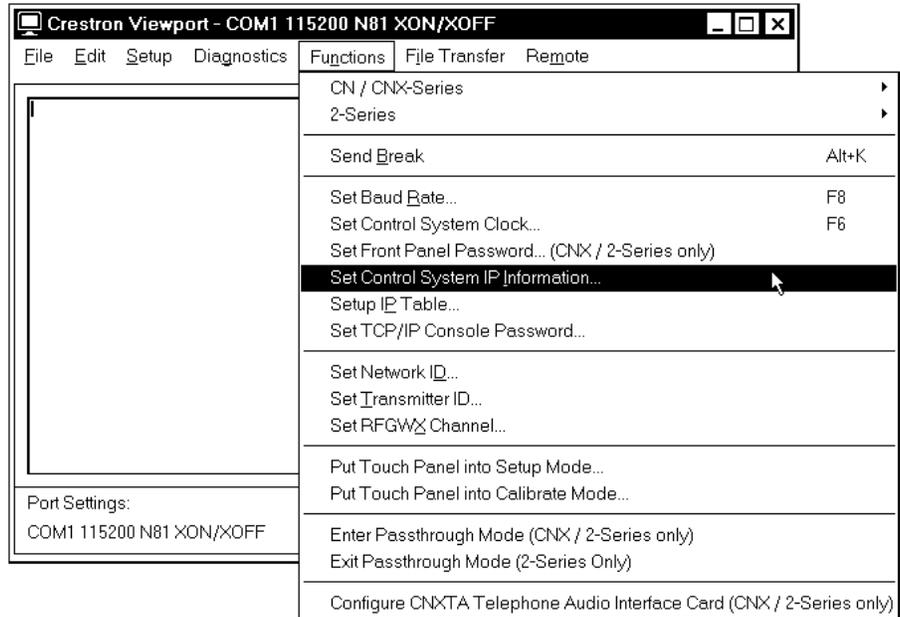
Example: `PING 68.42.78.12`

NOTE: Make sure a space is between PING and the IP number.

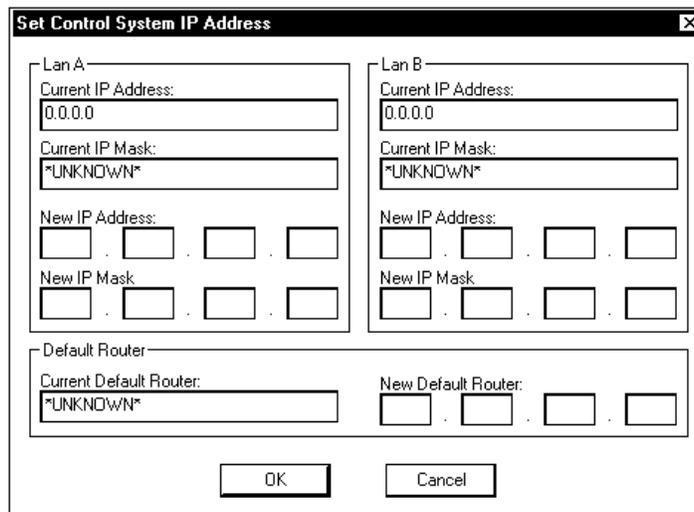
NOTE: If the system responds with "Request timed out", proceed to step 5. If the system shows a "Reply from" with a time, the IP number is already in use. Obtain another IP number and repeat step 4.

- Open the Crestron Viewport and select **Functions | Set Control System IP Information** from the menu bar. The “Set Control System IP Address” window opens.

Pulldown from Menu Bar



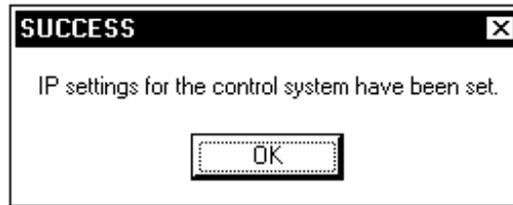
“Set Control System IP Address” Window



- Enter the external (LAN A) and internal (LAN B) IP numbers in the *New IP Address* fields and the router number in the *New Default Router* field. The subnet mask numbers (*New IP Mask* fields) are set automatically.

- Click **OK** to accept the values. The “Success” window opens.

“Success” Window



- Click **OK** to enable the control system to reboot.
- Disconnect the RS-232 cable from your PC and the control system.

Configuration

From a PC access the control system (C2ENET-2 card installed) web server via a browser. The web server contains SETUP, PORTMAP, and PASSWORD pages, which enable NAT. Open the browser and enter the address

`http://xxx.xxx.xxx.xxx/setup/admin.ssi`

where xxx.xxx.xxx.xxx is the IP address of the control system.

NOTE: This phase of NAT allows for administrative rights that can be protected by a password. Administrative rights allow for the redirection of IP traffic as defined by port assignments. Additional rights will be permitted in future releases.

Setup Page

The SETUP page, shown below, is the default opening page delivered by the web server.

SETUP Page

Configure the following values:

Host Name

Assign an easy-to-remember identifier in the Host Name field. Rather than having to recall IP address of the control system, the Host Name identifies the system. Host name assignment is completely arbitrary, therefore be descriptive as possible. However, valid characters are '0' to '9', 'A' to 'Z', 'a' to 'z', and '-'. The maximum length is 64 characters. Leaving the field blank will not deter operation.

Firmware Version

No entry is necessary. The firmware version of the 2-Series processor is provided for reference only.

WAN IP Address

Specify the IP address of the control system (marked as LAN A on the Ethernet card). This control system IP address is visible to the public. Obtain the subnet mask and default gateway addresses from the IT personnel. Enter the values into the appropriate fields.

NOTE: The MAC Address is automatically provided and is determined by the loaded firmware.

NOTE: Unlike the Crestron Viewport, the subnet mask is not set up automatically.

LAN IP Address

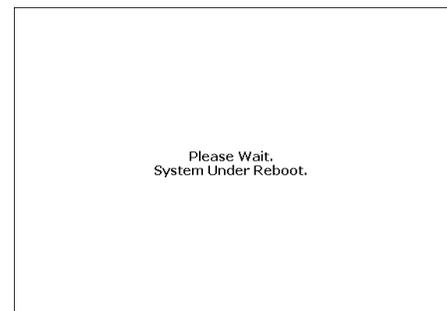
Specify the IP address of the control system (marked as LAN B on the Ethernet card). This IP address exists only on the private side of the router. Obtain the subnet mask from the IT personnel. Enter the value into the appropriate field.

NOTE: The IP address for the LAN is arbitrary (exception: no one else's equipment resides there). If there is uncertainty, Crestron recommends 192.168.xxx.xxx (a commonly used class C address).

Remote Management

If enabled, remote management allows the NAT configuration to be accessible from WAN (external network). Chose Disable to make it accessible locally. This is the only command that does not require a reboot of the control system.

NOTE: After the appropriate setup fields are complete, click **Apply**. The control system needs to reboot. A series of windows, shown below, appear to initiate the process. Otherwise, click **Cancel**.

Reboot Process

Portmap Page

The PORTMAP page, shown below, permits public access from the external network onto the internal network. The IP address of the internal network is protected by reassignment of port numbers via NAT. Port numbers are used to route the packets to the correct process, or program running on the network-aware device. For example, a process such as a telnet session receives a temporary port number when the session starts; data is sent using that port number, and the port number goes out of use when the session ends. Other port numbers, called "well-known" port numbers, are permanently assigned; for example, e-mail data under SMTP goes to port number 25. Other well-known ports are listed at the end of this section.

NOTE: This phase of NAT allows up to 16 port assignments. The value of each port number can range from 0 to 65535.

PORTMAP Page

External Port	Protocol	IP Address				Internal Port
1000	Both	192	168	16	2	41794
1001	TCP	192	168	16	2	41795
1002	Both	192	168	16	3	41794
1003	TCP	192	168	16	3	41795
1004	Both	192	168	16	4	41794
1005	TCP	192	168	16	4	41795
0	TCP	0	0	0	0	0
0	TCP	0	0	0	0	0
0	TCP	0	0	0	0	0
0	TCP	0	0	0	0	0
0	TCP	0	0	0	0	0
0	TCP	0	0	0	0	0
0	TCP	0	0	0	0	0
0	TCP	0	0	0	0	0
0	TCP	0	0	0	0	0
0	TCP	0	0	0	0	0
0	TCP	0	0	0	0	0
0	TCP	0	0	0	0	0

NOTE: The three items entered on the page above corresponds to the internal network, which includes a CP2E and two Isys touchpanels as shown in the example on page 3.

A process performed by a network-aware device on the internal network can be initiated from the external network. The NAT protects the anonymity of the internal network by remapping its known port assignments to ones that it publicizes. Each publicly accessible process must have an arbitrary external port number assigned to its known internal port number.

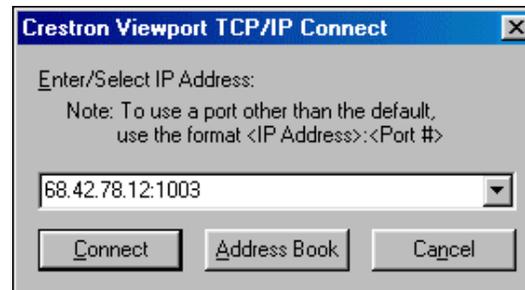
For example, suppose there was a need to remotely upload a project to the Crestron touchpanel that resides on the internal LAN at IP address 192.168.16.3, as shown on the PORTMAP page above. Configure the following values.

External Port

The external port field requires an arbitrary number assignment for the known internal network process. The user on the external network initiates the process by entering the IP address (of the 2-Series control system with C2ENET-2 card

installed), colon (:), and external port (number for the item) from the Crestron Viewport. For example, to upload to the touchpanel in Conference Room 1, select **Remote | TCP/IP | Connect** and enter **68.42.78.12:1003** in the window as shown below. Click on the **Connect** button to access the touchpanel on the internal network.

Crestron Viewport TCP/IP Connect Window



Protocol

Options for protocol are: **TCP**, **UDP**, or **Both**. Selection depends on the type of application for the given process. For example, choose **TCP** for console commands and select **UDP** for CIP communication (i.e., processor to panel, etc.).

IP Address

Depending on the subnet of the internal network, one or two groups of decimal digits separated by periods may be required to be entered in the *IP Address* column. Enter the IP address of the Network-aware device residing on the internal network.

Internal Port

Enter the port number for the given process performed on a network-aware internal device that needs to be exposed to the external network. Refer to the table of well-known port numbers, below.

NOTE: After the appropriate portmap fields are complete, click **Apply**. Otherwise, click **Cancel**.

*Well-Known Port Numbers**

PORT NUMBER	DESCRIPTION
7	Echo
20	File Transfer protocol (FTP)
21	File Transfer protocol (FTP)
23	Telnet
25	E-Mail (SMTP)
53	Domain Name Service (DNS)
79	Finger
80	World Wide Web (HTTP - Crestron default)
119	Network News Transfer Protocol (NTP)
123	Network Time Protocol
8080	Alternate Web Port (de facto standard - not official)
41794	Crestron registered port for CIP (i.e., Crestron to Crestron)
41795	Crestron registered port for TCP (i.e., console commands and Viewport)

* Except for the last two items in the table, information source gathered from the Internet Assigned Numbers (www.iana.org/assignments/port-numbers).

NOTE: When remapping a service (like HTTP port 80) to a different port number, Crestron suggests that values greater than 1024 are used to prevent conflicts with established services.

Password Page

The PASSWORD page, shown below, protects the NAT administrative rights from other users. Enter the same password in both fields and click the **Apply** button.

PASSWORD Page

Once a password is applied, the “Enter Network Password” window appears so that the user can verify the password. Although the *User Name* field is not implemented at this time, Crestron suggests that “admin” be entered so that users become accustomed to entering something into the field. Enter the password into the *Password* field and click **OK**. Once a password is assigned, the “Enter Network Password” window appears when trying to access the web server.

“Enter Network Password” Window

NOTE: If the password is forgotten, the password can be reset via console commands. Some of the NAT specific console commands are shown in a table on the next page. For a complete listing and description of each, refer to the latest version of the 2-Series Console Commands Reference Guide (Doc. 6002) available from the Downloads | Product Manuals | Software and Wiring Diagrams section of the Crestron website (www.crestron.com).

NAT Related Console Commands (for 2 Series only)

COMMAND	DESCRIPTION
ADDPORTRMAP	Add a port map to the NAT table
NATENABLE	Enable/disable Network Address Translator (NAT)
NATREMOTE	Enable/disable configuring the Network Address Translator (NAT) from the WAN (LAN A) port
PASSWORD	Set console and secure webpages password
REMPORTRMAP	Remove a port map from the NAT table
SHOWPORTRMAP	Display the portmap from the NAT table
WEBPORT	Specify the port for the Webserver
XPUTFILE	Use Xmodem to transfer file to ROM

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Return and Warranty Policies

Merchandise Returns / Repair Service

1. No merchandise may be returned for credit, exchange, or service without prior authorization from CRESTRON. To obtain warranty service for CRESTRON products, contact the factory and request an RMA (Return Merchandise Authorization) number. Enclose a note specifying the nature of the problem, name and phone number of contact person, RMA number, and return address.
2. Products may be returned for credit, exchange, or service with a CRESTRON Return Merchandise Authorization (RMA) number. Authorized returns must be shipped freight prepaid to CRESTRON, Cresskill, N.J., or its authorized subsidiaries, with RMA number clearly marked on the outside of all cartons. Shipments arriving freight collect or without an RMA number shall be subject to refusal. CRESTRON reserves the right in its sole and absolute discretion to charge a 15% restocking fee, plus shipping costs, on any products returned with an RMA.
3. Return freight charges following repair of items under warranty shall be paid by CRESTRON, shipping by standard ground carrier. In the event repairs are found to be non-warranty, return freight costs shall be paid by the purchaser.

CRESTRON Limited Warranty

CRESTRON ELECTRONICS, Inc. warrants its products to be free from manufacturing defects in materials and workmanship under normal use for a period of three (3) years from the date of purchase from CRESTRON, with the following exceptions: disk drives and any other moving or rotating mechanical parts, pan/tilt heads and power supplies are covered for a period of one (1) year; touchscreen display and overlay components are covered for 90 days; batteries and incandescent lamps are not covered.

This warranty extends to products purchased directly from CRESTRON or an authorized CRESTRON dealer. Purchasers should inquire of the dealer regarding the nature and extent of the dealer's warranty, if any.

CRESTRON shall not be liable to honor the terms of this warranty if the product has been used in any application other than that for which it was intended, or if it has been subjected to misuse, accidental damage, modification, or improper installation procedures. Furthermore, this warranty does not cover any product that has had the serial number altered, defaced, or removed.

This warranty shall be the sole and exclusive remedy to the original purchaser. In no event shall CRESTRON be liable for incidental or consequential damages of any kind (property or economic damages inclusive) arising from the sale or use of this equipment. CRESTRON is not liable for any claim made by a third party or made by the purchaser for a third party.

CRESTRON shall, at its option, repair or replace any product found defective, without charge for parts or labor. Repaired or replaced equipment and parts supplied under this warranty shall be covered only by the unexpired portion of the warranty.

Except as expressly set forth in this warranty, CRESTRON makes no other warranties, expressed or implied, nor authorizes any other party to offer any other party to offer any warranty, including any implied warranties of merchantability or fitness for a particular purpose. Any implied warranties that may be imposed by law are limited to the terms of this limited warranty. This warranty statement supercedes all previous warranties.

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