

H.323 Models User's Guide

7.0

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Disclaimer: As of October 2007, NETWARS was redesignated by the Program Manager Office as the Joint Communications Simulation System (JCSS). JCSS was selected as the new industry name to better reflect the inherent joint communication capabilities of the software. Users should be aware that no software updates were conducted as part of the software name change.

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1 Overview

The H.323 Recommendation is an umbrella recommendation from the ITU Telecommunication Standardization Sector (ITU-T). This recommendation defines the various protocols needed to send audio and video over non-guaranteed quality of service, packet-based networks (i.e., IP networks). Typically, the H.323 recommendation is commonly used in Voice over IP (VoIP) and Internet teleconferencing implementations for phones, computers, teleconferencing equipment, etc.

There are several different types of components inside an H.323 network (as shown in the figure below) including H.323 Terminals, Gatekeepers, Multipoint Control Units (MCUs), gateways, and Border Elements (BEs). Each component inside the network should be thought of as a separate logical component. This means that, while each device has separate functionality, multiple components (and their functionality) can be placed into a single device. Depending on the type of H.323 network and the necessary requirements, this can provide many advantages and is a common implementation of many H.323 devices. Also, note that besides the end terminals, all other components in an H.323 network (i.e., gatekeepers, gateways, MCUs, and BEs) are optional but can provide valuable functionality depending on the network demands and use cases.

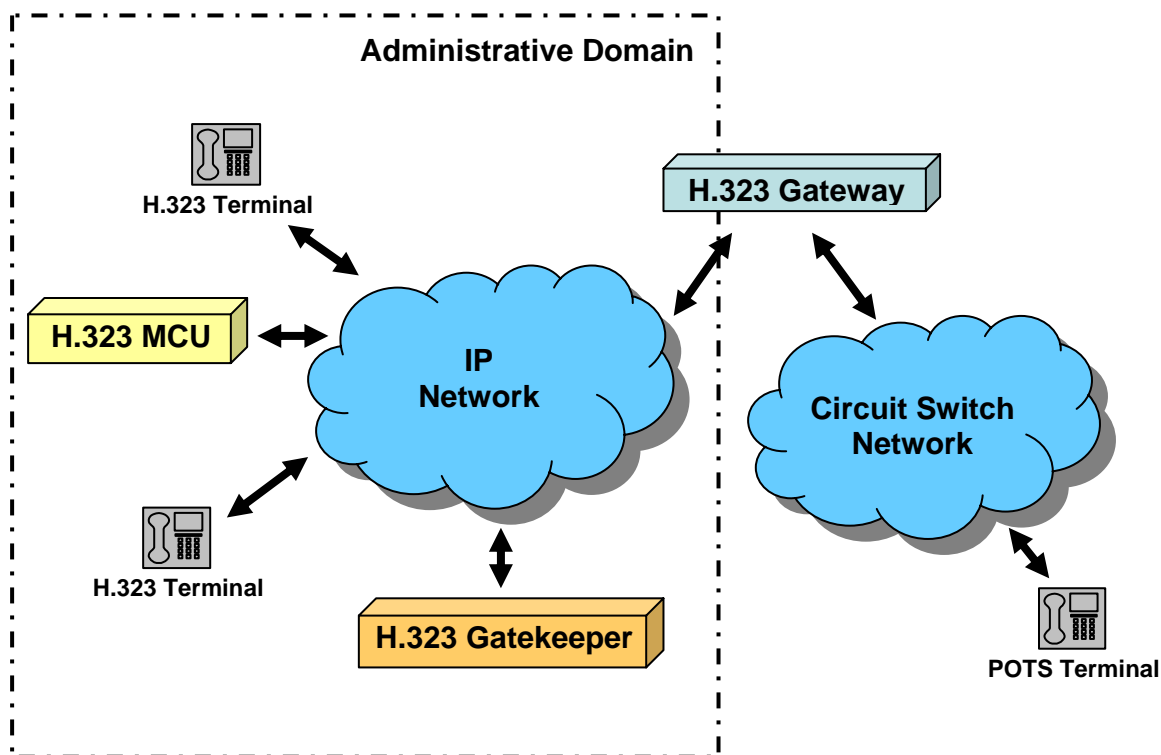


Figure 1. Typical H.323 Network Setup

As H.323 is an umbrella Recommendation, there are several protocols defined in the H.323 standard such as H.225 Call Signaling, H.225 Registration, Admission, and Status, H.245 Signaling, the Real-time Transport Protocol (RTP), and the Real-time Transport

Control Protocol (RTCP). These protocols allow for the various components of the H.323 network to communicate together which makes the voice and video capabilities realistic (as shown in the figure below). The protocols include several types of messages which allow for call initiation, capabilities negotiation, opening/closing media streams, and gatekeeper signaling, among other abilities.

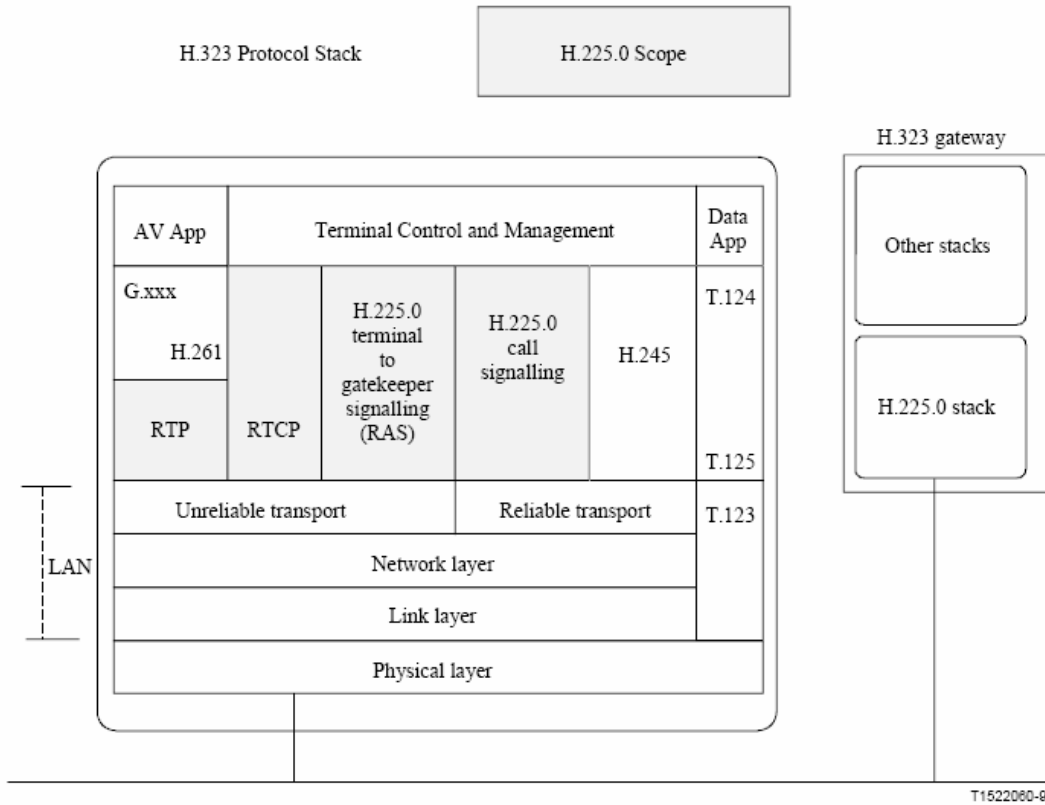


Figure 2. H.323 Protocol Stack

1.1 Intended Use

This document is intended for NETWARS users who have a reasonable level of knowledge about the H.323 family of devices and their use in voice networks. This document is written to help the engineer learn about configuration of H.323 devices in NETWARS and the types of interfaces, attributes, and statistics available in both the Discrete Event Simulation and Capacity Planning use cases.

1.2 Feature Summary

This section provides a list of the main features available in the H.323 model suite.

Table 1: H.323 Features

H.323 Device	Description	Support
Terminals	Terminals provide both Application and IER support.	Supported
Gatekeeper	Based on Cisco IOS Gatekeeper.	Supported
Border Elements (BEs)	Border Elements will only provide basic RAS signaling and will not include the H.225 Annex G signaling.	Supported
Gateways	H.323 gateway design will incorporate the use of the SHOUTip device.	Supported
Multipoint Control Units (MCUs)	Allows for teleconference support.	Not Supported
H.323 Umbrella Protocols		
H.225 Call Signaling		Supported
H.225 Registration, Admission, and Status (RAS)		Supported
H.225 Annex G	H.225 RAS signaling will be used instead.	Not Supported
H.245 Signaling		Not Supported
Real-time Transport Protocol (RTP)	Use of OPNET standard RTP models	Supported
Real-time Transport Control Protocol (RTCP)	RTCP is not supported in the OPNET standard suite of models.	Not Supported
Node Parameters		
Assigned Gatekeeper	Represents the IP address/hierarchical name of the assigned gatekeeper for the particular terminal or gateway. This attribute will only be placed on terminals and gateways.	Supported
Gatekeeper Address	Represents the IP address of the gatekeeper. This attribute will only be provided on gatekeeper and border element nodes.	Supported
Call Signaling Mode	Attribute will be placed on gatekeeper nodes. This attribute will specify whether “Direct Call Signaling” or “Gatekeeper-routed Signaling” will occur for calls setup through this particular gatekeeper.	Supported
Assigned Administrative Domain	Specifies which administrative domain the H.323 device will be placed inside. This attribute will be placed on all H.323 devices.	Supported
Max Number of Calls	Only allows the specified number of calls to pass through the particular H.323 terminal or gateway at a time.	Supported
Encoder Schemes	Provides CODEC information for the device	Supported
Frames per Packet	Provides CODEC information for the device	Supported
Hybrid Mode	Allows the user to represent voice packets using hybrid or explicit traffic.	Supported
SHOUTip Network Signaling Protocol	Attribute placed on gateways. Allows the user to choose which voice signaling protocol should be	Supported

	used to forward a particular call (i.e., H.323 or SIP).	
Lower-layer Protocol Configuration Attributes	All necessary attributes from the OPNET standard processes will be promoted for configuration by the user (i.e., RTP, UDP, etc.).	Supported
Assigned Gatekeeper	Represents the IP address/hierarchical name of the assigned gatekeeper for the particular terminal or gateway. This attribute will only be placed on terminals and gateways.	Supported
Gatekeeper Address	Represents the IP address of the gatekeeper. This attribute will only be provided on gatekeeper and border element nodes.	Supported
Call Signaling Mode	Attribute will be placed on gatekeeper nodes. This attribute will specify whether "Direct Call Signaling" or "Gatekeeper-routed Signaling" will occur for calls setup through this particular gatekeeper.	Supported
Assigned Administrative Domain	Specifies which administrative domain the H.323 device will be placed inside. This attribute will be placed on all H.323 devices.	Supported
Max Number of Calls	Only allows the specified number of calls to pass through the particular H.323 terminal or gateway at a time.	Supported
Encoder Schemes	Provides CODEC information for the device	Supported
Frames per Packet	Provides CODEC information for the device	Supported
Hybrid Mode	Allows the user to represent voice packets using hybrid or explicit traffic.	Supported
SHOUTip Network Signaling Protocol	Attribute placed on gateways. Allows the user to choose which voice signaling protocol should be used to forward a particular call (i.e., H.323 or SIP).	Supported
Lower-layer Protocol Configuration Attributes	All necessary attributes from the OPNET standard processes will be promoted for configuration by the user (i.e., RTP, UDP, etc.).	Supported

1.3 Feature Description

H.323 devices are defined by their hierarchical nature which can then be applied to an IP network. This allows the benefits of traditional circuit switching while allowing the lower costs of using the IP technology. To perform this task, each device contains separate functionality which allows calls to be routed to the destination successfully. Therefore, the configurable parameters of the H.323 devices can be divided into four main groups namely, Terminal, Gatekeeper, Border Element, and Gateway.

Also, as this protocol defines a voice over IP technology, each device inside the network contains ports which connect into the IP network. To correspond to this functionality, every logical device has ports which connect into the IP network. For this H.323 implementation, the Ethernet technology was chosen as it closely resembles real world devices.

1.4 Limitations/Assumptions

Due to the broad spectrum of protocols inside the H.323 umbrella standard, some of the signaling protocols are not supported. These include:

- H.225 RAS Annex G signaling is used for signaling between Border Elements. This signaling supports intra-domain signaling, admission, and address resolution. Border Elements in general support the hierarchical signaling capabilities in the H.323 protocol. For this implementation, the H.225 RAS Annex G signaling has been replaced with the standard H.225 RAS signaling.
- H.245 Call Signaling is a dynamic protocol used while the callers are communicating to change the reserved requirements for a call. Such requirements would be bandwidth, number of users, etc. This signaling protocol is not modeled in this H.323 implementation due to the nature of the signaling in correlation with the NETWARS/OPNET Application. Also, this implementation focuses on call setup/teardown in cases where the call requirements do not change.

The Multipoint Control Units (MCUs) are not supported in this implementation. Instead, encoder schemes have been provided which will load the necessary bandwidth on the particular network.

1.5 Model List

The standard NETWARS model library contains a number of node models representing various H.323 devices. Those models can be located under the “Node Models” Directory of the “NETWARS_VoIP” palette and include the following models.

The model names are shown with the number of ports available for each port type.

Table 2: H.323 Models

Model Name	Ethernet	Circuit Switch	Circuit/Serial	ATM
H323_Border_Element	2	-	-	-
H323_Gatekeeper	2	-	-	-
SHOUTip	2	8	32	-
Media_Gateway	2	8	-	2
VoIP_Phone	1	-	-	-

You can also create custom models with arbitrary number of ports of each type using the Device Creator utility explained later in this document.

1.6 Reference Documents

- “H.225.0 – Call signaling protocols and media stream packetization for packet-based multimedia communication systems”. Version 5. International Telecommunication Union - Telecommunication Standardization Sector (ITU-T).
- “Understanding H.323 Gatekeepers”. Cisco Systems. Document ID 5244. <http://www.cisco.com/warp/public/788/voip/understand-gatekeepers.html>

1.7 Additional Information

For any additional information not provided in this document, consult the NETWARS Model Development Guide (MDG) or other NETWARS documentation. Information provided in the Model Development Guide includes interfacing with NETWARS models, using NETWARS traffic types, expected packet formats and interrupts, and suggested model development processes. This documentation is provided inside a standard NETWARS installation and can be found in the **<NETWARS Installation Directory>\Documents** directory (where **<NETWARS Installation Directory>** is the directory where NETWARS is installed).

Also, for any questions regarding OPNET specific functionality, consult the standard OPNET documentation. This documentation can be accessed inside NETWARS via the **Help > Documentation > ITGuru Documentation** menu.

Finally, all H.323 files can be located under the **<NETWARS Installation Directory>\Sim_Domain\op_models\netwars_std_models\voip** directory and sub-directories. These models and files can be accessed and modified using the OPNET Modeler software.

2 Configuration

One of the advantages of NETWARS is that it provides a great amount of flexibility when configuring network and device models. As the H.323 suite of models contains a large amount of functionality, additional steps may be needed to configure the necessary functionality for the modeled H.323 network.

2.1 Administrative Domains

Administrative Domains act as a major concept inside an H.323 network and provides the protocol's hierarchical nature. The user can most easily think of an Administrative Domain as a single domain or area where a number of devices reside. Typically, these devices would be placed in the same IP network or subnet. In NETWARS, the user is allowed to place any number of terminals, gatekeepers, or gateways into a single Administrative Domain, but can only place a single Border Element.

Each Administrative Domain is given a domain name (such as Atlanta.com, cisco.com, an area code, etc.). All H.323 devices which are inside this domain would then use the same domain name. In NETWARS, this is accomplished through the **Assigned Administrative Domain** attribute (see the "Node Configuration" section below). In the real world, these devices would then have a second unique name which is based on the assigned domain name (for instance, user1@atlanta.com, or a full telephone number). These names can then be resolved to IP addresses inside the network. Note that the second unique name is not modeled in NETWARS as the user can explicitly assign IP addresses to devices (i.e., no translation is necessary).

When different calls start being generated by the terminals inside the network, a few different scenarios can occur:

1. The user makes a call to a destination terminal which resides in the same administrative domain. In this case, the call is sent from the source terminal to a gatekeeper who resides inside the same Administrative Domain. This Gatekeeper provides services such as address resolution, billing, authorization, flow control, etc. and returns information back to the source terminal. The source terminal can then make a direct connection to the destination terminal if it has been given the necessary information and permission from the gatekeeper.
2. The user makes a call to a destination terminal which resides in a different administrative domain. In this case, the call is sent from the source terminal to a gatekeeper who resides inside the same Administrative Domain. However, this gatekeeper does not know the destination terminal (as it resides in a different Administrative Domain) and cannot complete address translation. The gatekeeper then contacts the border element for its Administrative Domain. This border element can then query other border elements in different Administrative Domains for the destination terminal address. Once found, the address is returned to the source terminal and a call can be initiated directly between the two terminals (saying that permission is granted).

3. Many other situations can occur which are not explained due to scope.

Essentially, by placing the objects inside Administrative Domains, the H.323 network can efficiently spread out responsibility between different logical devices based on the network requirements. Also, it allows the service provider to place different types of devices into separate regions (such as cities or area codes) based on demand or need.

2.2 Node Configuration

Currently, there are several types of H.323 devices available inside the NETWARS palette. To find the available H.323 models, open the object palette (**Topology > Open Object Palette**) and find the “NETWARS_VoIP” palette (shown below).

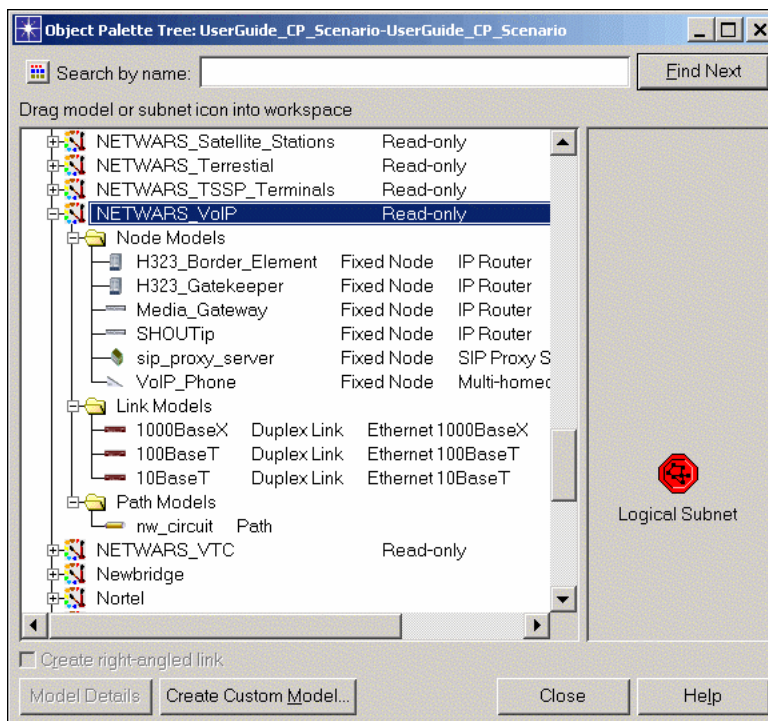


Figure 3: Available H.323 Nodes

Once the particular H.323 model is found, you can drag and drop the model into the scenario to successfully deploy the model. Once the model is deployed, attributes are available on the device which can be modified to activate certain H.323 specific functionality. The following subsections discuss these H.323 device attributes.

2.2.1 H.323 Terminal Attributes

The H.323 Terminal node attributes are all of the attributes which can be accessed by right-clicking on the “VoIP_Phone” device and selecting the **Edit Attributes** menu. The following table describes the node attributes in detail. Any relevant compound node attributes are left for subsequent sections/tables as compound attributes contain another layer of attributes. All other attributes refer to the routing capabilities of this H.323 terminal and are out of scope for this document.

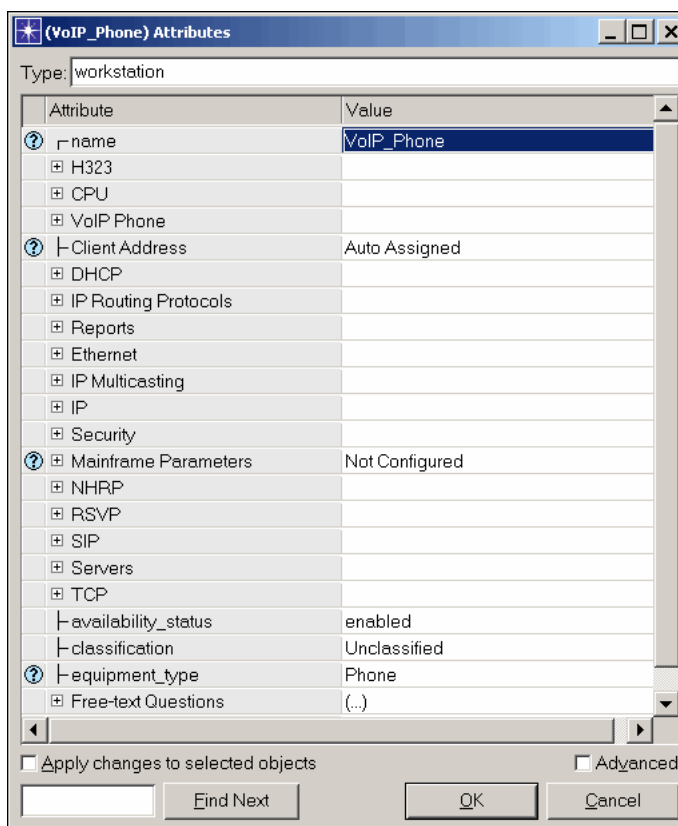


Figure 4: H.323 Terminal Node Attributes

Table 3: H.323 Terminal Node Attributes

Attributes	Description
Availability Status	A NETWARS standard attribute, denotes whether the node is available to receive IER traffic during a simulation.
Classification	A NETWARS standard attribute, sets the classification level (i.e., Unclassified, Classified, etc.) of this particular H.323 terminal.
Equipment Type	A NETWARS standard attribute, sets the device type for NETWARS specific functionality. This attribute should always be set to “Phone.”

2.2.1.1 VoIP Phone Parameters

As the “VoIP_Phone” node model allows configuration of both H.323 and SIP protocol voice calls, the “VoIP Phone” compound attribute was added so the user could configure attributes which would apply to both protocols. The following table illustrates the attributes with descriptions needed to properly configure the “VoIP_Phone”. Note that this compound attribute can only be found inside the “VoIP Phone” node model.

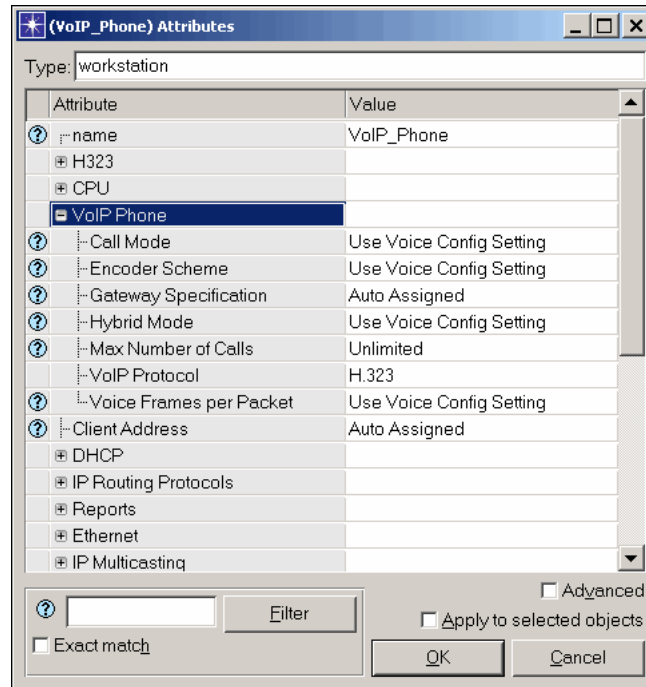


Figure 5: VoIP Phone Parameters

Table 4: VoIP Phone Parameters

Attributes	Description
Call Mode	This attribute specifies the different call modes which are available on the H.323 terminal. If the user selects “Signaling and Data,” then both the VoIP protocol call signaling and the voice data packets will traverse the network. If the user selects “Signaling Only,” then only the VoIP protocol call signaling will occur. In this case, no voice data packets will be sent. If the user selects “Use Voice Config Setting,” then this VoIP Phone will use the setting for the matching attribute located in the Voice Config node. Note that the Voice Config node is located in the Configuration OPFAC.
Encoder Scheme	This attribute specifies the encoder scheme which will be used for all calls which use this particular H.323 terminal. The encoder scheme specifies the information about the voice data packets sent during the call. Such information includes packet intervals and packet size. The available encoder schemes are based on standard VoIP phone technologies. If the user selects “Use Voice Config Setting,” then this VoIP Phone will use the setting for the matching attribute located in the Voice Config node. Note that the Voice Config node is located in the Configuration OPFAC.
Gateway Specification	This attribute specifies the gateway this phone will signal if the destination VoIP phone cannot be found. If a gateway exists in the network, the hierarchical name of that gateway will be available as an

	option for this attribute. If the user selects the “Auto Assigned” option, the VoIP phone will dynamically lookup all gateways available in the simulation and will randomly pick a gateway.
Hybrid Mode	This attribute allows the user to choose between the use of hybrid or explicit voice data packets during a simulation. If the user chooses the “Hybrid Packets” option, the VoIP phone will load the network using hybrid packets for all voice data packets. This option will increase the speed of the simulation with the tradeoff of losing some statistics (such as jitter and end-to-end delay). If the user picks the “Explicit Packets” option, the VoIP Phone will load the network using an explicit packet for each voice data packet. This slows the simulation down but provides a detailed analysis. If the user selects “Use Voice Config Setting,” then this VoIP Phone will use the setting for the matching attribute located in the Voice Config node. Note that the Voice Config node is located in the Configuration OPFAC.
Max Number of Calls	This attribute specifies the maximum number of simultaneous calls on this H.323 terminal. This allows the phone to act as several phones instead of having the user deploy many phones onto the scenario. If the user selects the “Unlimited” option, there is no limit to the number of calls placed on the VoIP phone at a single time.
VoIP Protocol	This attribute specifies the call signaling protocol which will be used to setup/teardown a voice call on this phone. If this attribute is set to “SIP,” the calling signaling protocol will be the Session Initiation Protocol (SIP). If the attribute is set to “H.323,” the protocol used will be the H.323 umbrella protocol.
Voice Frames per Packet	This attribute specifies the number of voice frames per packet. This attribute coincides with the encoder scheme attribute above and further specifies information about the voice data packet. This attribute effects the amount of data which is included inside a voice data packet. If the user selects “Use Voice Config Setting,” then this VoIP Phone will use the setting for the matching attribute located in the Voice Config node. Note that the Voice Config node is located in the Configuration OPFAC.

2.2.1.2 Terminal H.323 Parameters

As the “VoIP_Phone” contains H.323 protocol capabilities, an H.323 compound attribute has been specified on the node model so that the user can configure H.323 specific attributes which apply to the H.323 terminal. The following table specifies the available attributes inside this compound attribute along with a description.

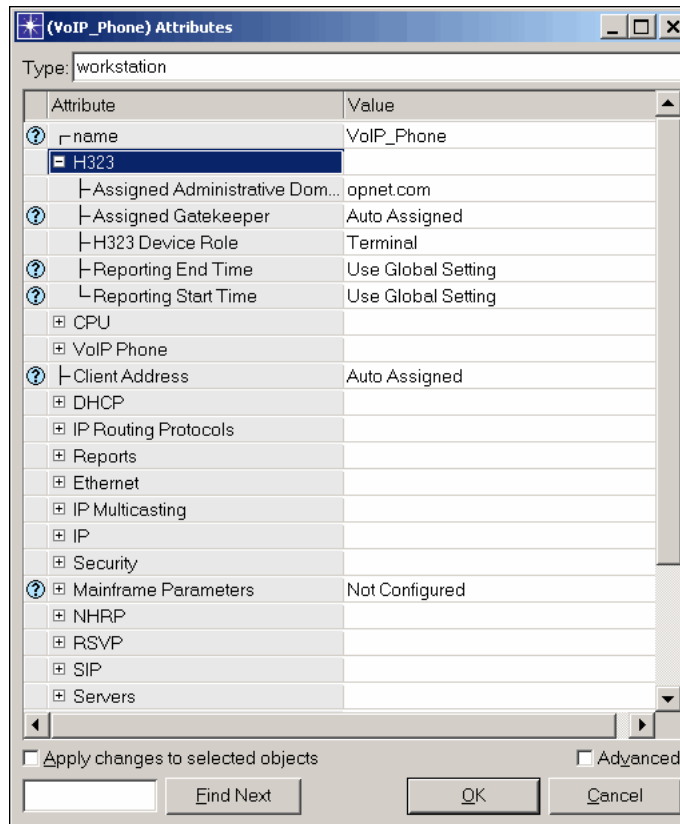


Figure 6: Terminal H.323 Parameters

Table 5: Terminal H.323 Parameters

Attributes	Description
Assigned Administrative Domain	This attribute specifies the administrative domain for this H.323 terminal. Administrative Domains specify the hierarchical nature of H.323 and can typically be looked as IP domains. A single, unique string is used to identify a single Administrative Domain. All H.323 devices which are included in the same Administrative Domain should have this attribute configured to the same string (i.e., “opnet.com”, etc.).
Assigned Gatekeeper	This attribute specifies the gatekeeper assigned to this particular terminal (if one exists). By H.323 rule, if an H.323 gatekeeper is assigned to an administrative domain, then all phones in that domain must use that gatekeeper. If a gatekeeper exists in the network, the hierarchical name of that gatekeeper will be available as an option for this attribute. If the user selects the “Auto Assigned” option, the H.323 terminal will dynamically lookup all gatekeepers available in the administrative domain and will randomly pick a gatekeeper. This static gatekeeper configuration is based on the Cisco IOS Gatekeeper unicast gatekeeper discovery method.
H323 Device Role	This attribute specifies the role of this particular device in the H.323 network. For the H.323 terminal, this attribute should always be set to “Terminal.”
Reporting Start Time	This attribute is used with the reporting capabilities for H.323. If this attribute is set for a particular time (in seconds), the H.323 terminal will not provide any reporting for calls which occur before this time

	period during simulation. If the attribute is set to “User Global Setting,” this H.323 terminal will use the value provided in the matching global simulation attribute. The global simulation attribute can be found when configuration a Discrete Event Simulation (i.e., the “DES->Configure/Run Discrete Event Simulation” menu.
Reporting End Time	This attribute is used with the reporting capabilities for H.323. If this attribute is set for a particular time (in seconds), the H.323 terminal will not provide any reporting for calls which occur after this time period during simulation. If the attribute is set to “User Global Setting,” this H.323 terminal will use the value provided in the matching global simulation attribute. The global simulation attribute can be found when configuration a Discrete Event Simulation (i.e., the “DES->Configure/Run Discrete Event Simulation” menu.

2.2.2 H.323 Gatekeeper Attributes

The H.323 Gatekeeper node attributes are all of the attributes which can be accessed by right-clicking on the “H323_Gatekeeper” device and selecting the **Edit Attributes** menu. As the Gatekeeper is specific to the H.323 network, the only attribute which needs to be configured for the H.323 protocol is the “H323” compound attribute. All other attributes are specific to the routing capabilities of the H.323 Gatekeeper and are out of scope for this user guide. The following table describes the H.323 compound attribute in detail.

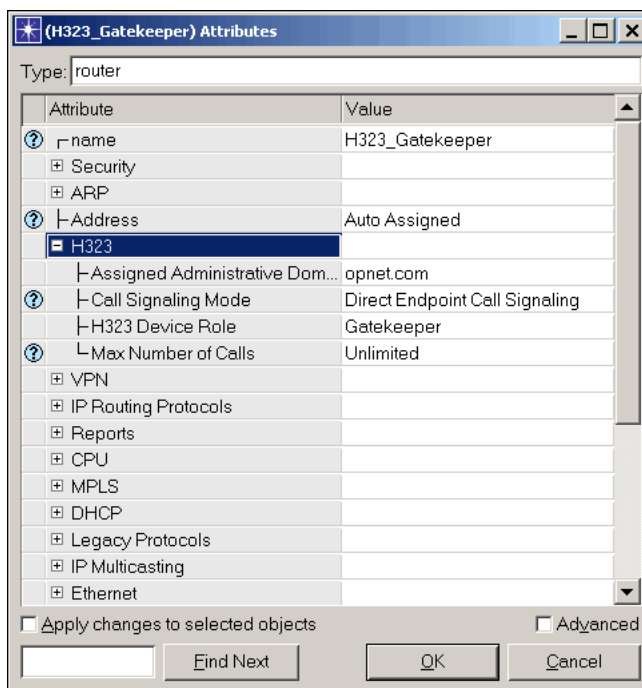


Figure 7: H.323 Gatekeeper Attributes

Table 6: H.323 Gatekeeper Attributes

Attributes	Description
------------	-------------

Assigned Administrative Domain	This attribute specifies the administrative domain for this H.323 gatekeeper. Administrative Domains specify the hierarchical nature of H.323 and can typically be looked as IP domains. A single, unique string is used to identify a single Administrative Domain. All H.323 devices which are included in the same Administrative Domain should have this attribute configured to the same string (i.e., "opnet.com", etc.).
Call Signaling Mode	This attribute specifies the call signaling mode used for this particular gatekeeper. If the user selects the "Direct Endpoint Call Signaling" option, the H.323 terminals will perform H.225 RAS signaling with this gatekeeper but will not forward the H.225 Call Signaling through this particular gatekeeper. If the user selects the "Gatekeeper-routed Signaling (GKRCS)" option, then both H.225 RAS and H.225 Call Signaling will occur through this particular gatekeeper. Note that a mix of the signaling modes between different H.323 Gatekeepers is supported.
H323 Device Role	This attribute specifies the role of this particular device in the H.323 network. For the H.323 gatekeeper, this attribute should always be set to "Gatekeeper."
Max Number of Calls	This attribute specifies the maximum number of simultaneous calls on this H.323 gatekeeper. This allows the user to simulate certain thresholds and policies which might be implemented on a given gatekeeper. If the user selects the "Unlimited" option, there is no limit to the number of calls placed on the H.323 gatekeeper at a single time.

2.2.3 H.323 Border Element Attributes

The H.323 Border Element node attributes are all of the attributes which can be accessed by right-clicking on the "H323_Border_Element" device and selecting the **Edit Attributes** menu. As the Border Element is specific to the H.323 network, the only attribute which needs to be configured for the H.323 protocol is the "H323" compound attribute. All other attributes are specific to the routing capabilities of the H.323 Border Element and are out of scope for this user guide. The following table describes the H.323 compound attribute in detail.

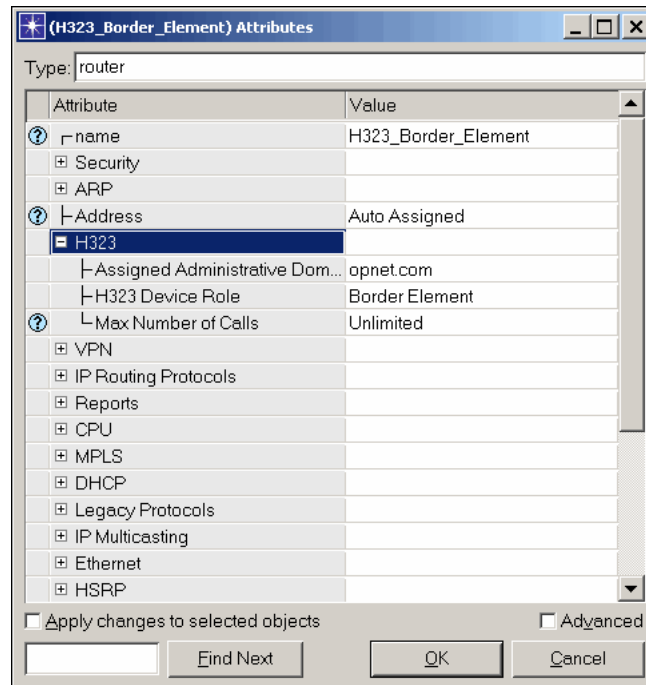


Figure 8: H.323 Border Element Attributes

Table 7: H.323 Border Element Attributes

Attributes	Description
Assigned Administrative Domain	This attribute specifies the administrative domain for this H.323 border element. Administrative Domains specify the hierarchical nature of H.323 and can typically be looked as IP domains. A single, unique string is used to identify a single Administrative Domain. All H.323 devices which are included in the same Administrative Domain should have this attribute configured to the same string (i.e., “opnet.com”, etc.). Note that only a single border element can be placed in one administrative domain.
H323 Device Role	This attribute specifies the role of this particular device in the H.323 network. For the H.323 border element, this attribute should always be set to “Border Element.”
Max Number of Calls	This attribute specifies the maximum number of simultaneous calls on this H.323 border element. This allows the user to simulate certain thresholds and policies which might be implemented on a given border element. If the user selects the “Unlimited” option, there is no limit to the number of calls placed on the H.323 border element at a single time.

2.2.4 H.323 Gateway Attributes

The H.323 Gateway node attributes are all of the attributes which can be accessed by right-clicking on the “Media_Gateway” or “SHOUTip” devices and selecting the **Edit Attributes** menu. In NETWARS, the “Media Gateway” and “SHOUTip” node models act as the H.323 Gateway. The following table describes the node attributes in detail. Any relevant compound node attributes are left for subsequent tables as compound attributes contain another layer of attributes. All other attributes refer to the routing capabilities of this H.323 gateway and are out of scope for this document.

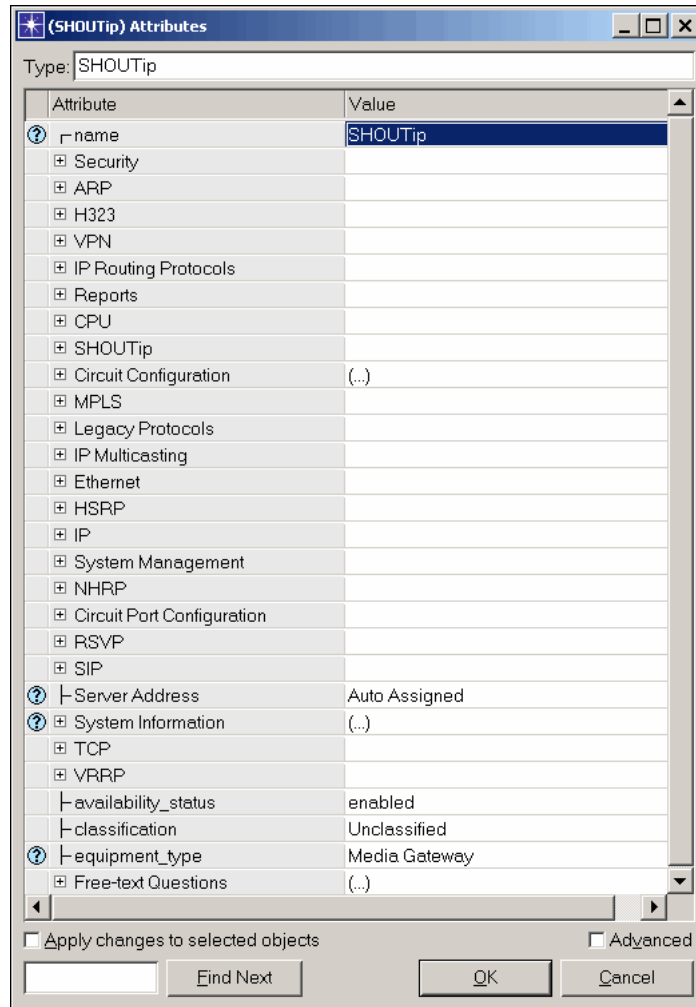


Figure 9: H.323 Gateway Attributes

Table 8: H.323 Gateway Attributes

Attribute	Description
Availability Status	A NETWARS standard attribute, denotes whether the node is available to receive IER traffic during a simulation.
Classification	A NETWARS standard attribute, sets the classification level (i.e., Unclassified, Classified, etc.) of this particular H.323 gateway.

Equipment Type	A NETWARS standard attribute, sets the device type for NETWARS specific functionality. This attribute should always be set to “Media Gateway.”
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2.2.4.1 Media Gateway or SHOUTip Parameters

As the “Media_Gateway” or “SHOUTip” node model allows configuration of both H.323 and SIP protocol voice calls, the “Media Gateway” or “SHOUTip” compound attributes were added so the user could configure attributes which would apply to both protocols. The following table illustrates the attributes with descriptions needed to properly configure the H.323 gateway.

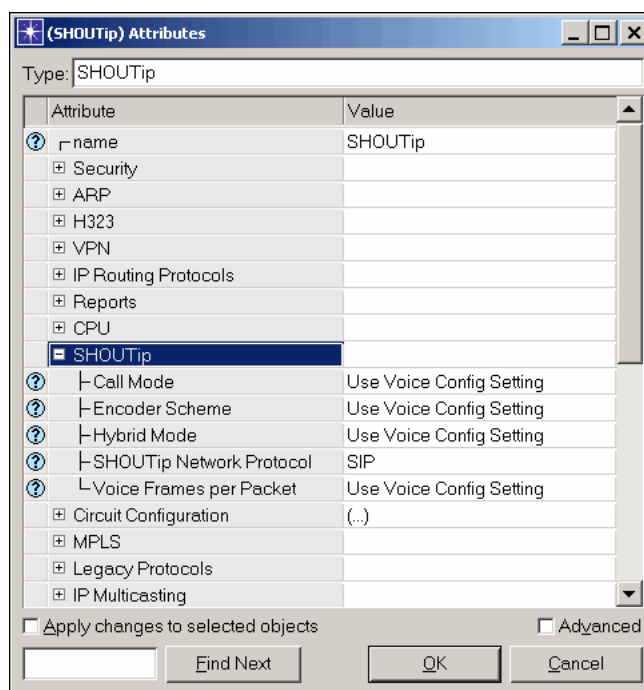


Figure 10: Media Gateway or SHOUTip Parameters

Table 9: Media Gateway or SHOUTip Parameters

Attributes	Description
Call Mode	This attribute specifies the different call modes which are available on the H.323 gateway. If the user selects “Signaling and Data,” then both the VoIP protocol call signaling and the voice data packets will traverse the network. If the user selects “Signaling Only,” then only the VoIP protocol call signaling will occur. In this case, no voice data packets will be sent. If the user selects “Use Voice Config Setting,” then this gateway will use the setting for the matching attribute located in the Voice Config node. Note that the Voice Config node is located in the Configuration OPFAC.
Encoder Scheme	This attribute specifies the encoder scheme which will be used for all calls which use this particular H.323 gateway. The encoder scheme specifies the information about the voice data packets sent during the call. Such information includes packet intervals and packet size. The available encoder schemes are based on standard gateway technologies. If the user selects “Use Voice Config Setting,” then this

	gateway will use the setting for the matching attribute located in the Voice Config node. Note that the Voice Config node is located in the Configuration OPFAC.
Hybrid Mode	This attribute allows the user to choose between the use of hybrid or explicit voice data packets during a simulation. If the user chooses the "Hybrid Packets" option, the gateway will load the network using hybrid packets for all voice data packets. This option will increase the speed of the simulation with the tradeoff of losing some statistics (such as jitter and end-to-end delay). If the user picks the "Explicit Packets" option, the gateway will load the network using an explicit packet for each voice data packet. This slows the simulation down but provides a detailed analysis. If the user selects "Use Voice Config Setting," then this gateway will use the setting for the matching attribute located in the Voice Config node. Note that the Voice Config node is located in the Configuration OPFAC.
SHOUTip Network Protocol	This attribute specifies the call signaling protocol which will be used to setup/teardown a voice call on this gateway. If this attribute is set to "SIP," the calling signaling protocol will be the Session Initiation Protocol (SIP). If the attribute is set to "H.323," the protocol used will be the H.323 umbrella protocol.
Voice Frames per Packet	This attribute specifies the number of voice frames per packet. This attribute coincides with the encoder scheme attribute above and further specifies information about the voice data packet. This attribute affects the amount of data which is included inside a voice data packet. If the user selects "Use Voice Config Setting," then this gateway will use the setting for the matching attribute located in the Voice Config node. Note that the Voice Config node is located in the Configuration OPFAC.

2.2.4.2 Gateway H.323 Parameters

As the H.323 Gateway contains H.323 protocol capabilities, an H.323 compound attribute has been specified on the node model so that the user can configure H.323 specific attributes which apply to the H.323 gateway. The following table specifies the available attributes inside this compound attribute along with a description.

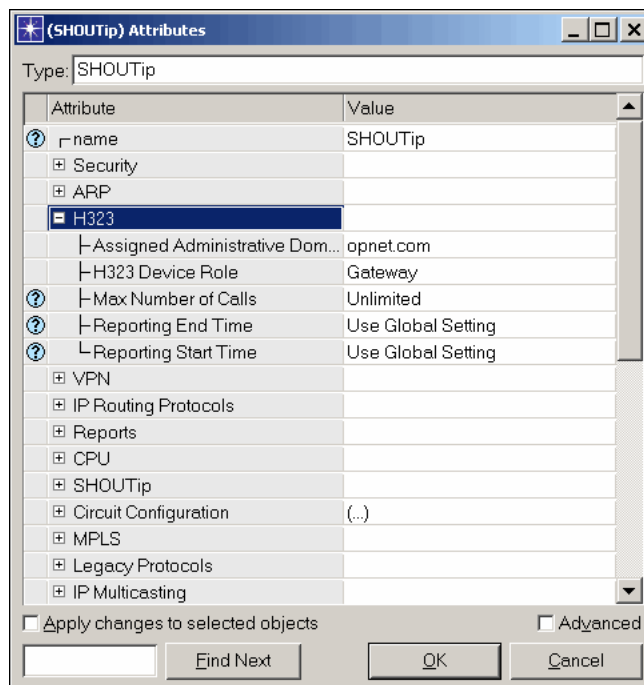


Figure 11: Gateway H.323 Parameters

Table 10: Gateway H.323 Parameters

Attributes	Description
Assigned Administrative Domain	This attribute specifies the administrative domain for this H.323 gateway. Administrative Domains specify the hierarchical nature of H.323 and can typically be looked as IP domains. A single, unique string is used to identify a single Administrative Domain. All H.323 devices which are included in the same Administrative Domain should have this attribute configured to the same string (i.e., “opnet.com”, etc.).
H323 Device Role	This attribute specifies the role of this particular device in the H.323 network. For the H.323 gateway, this attribute should always be set to “Gateway.”
Max Number of Calls	This attribute specifies the maximum number of simultaneous calls on this H.323 gateway. This allows the user to simulate certain thresholds and policies which might be implemented on a given gateway. If the user selects the “Unlimited” option, there is no limit to the number of calls placed on the H.323 gateway at a single time.
Reporting Start Time	This attribute is used with the reporting capabilities for H.323. If this attribute is set for a particular time (in seconds), the H.323 gateway will not provide any reporting for calls which occur before this time period during simulation. If the attribute is set to “User Global Setting,” this H.323 gateway will use the value provided in the matching global simulation attribute. The global simulation attribute can be found when configuration a Discrete Event Simulation (i.e., the “DES->Configure/Run Discrete Event Simulation” menu.
Reporting End Time	This attribute is used with the reporting capabilities for H.323. If this attribute is set for a particular time (in seconds), the H.323 gateway will not provide any reporting for calls which occur after this time period during simulation. If the attribute is set to “User Global Setting,” this H.323 gateway will use the value provided in the

	matching global simulation attribute. The global simulation attribute can be found when configuration a Discrete Event Simulation (i.e., the “DES->Configure/Run Discrete Event Simulation” menu.
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2.3 Link Configuration

As the H.323 devices are used in conjunction with the IP network, these devices contain Ethernet ports. Therefore, the link possibilities for these devices are limited to the Ethernet technology links. Currently, there are two ways to deploy links inside NETWORKS:

3. Link Deployment Wizard (Topology > Link Operations > Deploy Link or Ctrl + L)
4. Object Palette (Topology > Open Object Palette)

Currently, the easiest way to connect an H.323 device is to use the Link Deployment Wizard (LDW). To accomplish a successful configuration, use the following steps (see the matching LDW figure below):

1. Select the two devices which need to be connected and press **Ctrl + L**.
2. When the Link Deployment Wizard appears, select an available link technology from the menu (if an error message appears, the H.323 device is unable to connect to this type of device).
3. Select the link which is appropriate for this technology. For example, if the specified technology is Ethernet then the 10BaseT, 100BaseT, and 1000BaseT links are available. In most cases, the only supported technology will be Ethernet. However, if the user is deploying the H.323 gateway, ATM, Circuit Switch, and Circuit/Serial ports are also available.
4. Check to make sure the ports on both the connecting devices are acceptable. On the H.323 device, the port should be something similar to “eth_tx_#_#”. If deploying the H.323 gateway, the “cs_pt_#” (Circuit Switch), “cir_pt_#” (Circuit/Serial), and “atm_tx_0_0” (ATM) ports are also available.
5. Change the bandwidth on the link. Selecting an initial link (i.e., 10BaseT, 100BaseT, etc.) will set a default bandwidth in the wizard but you can select other bandwidth values as necessary.

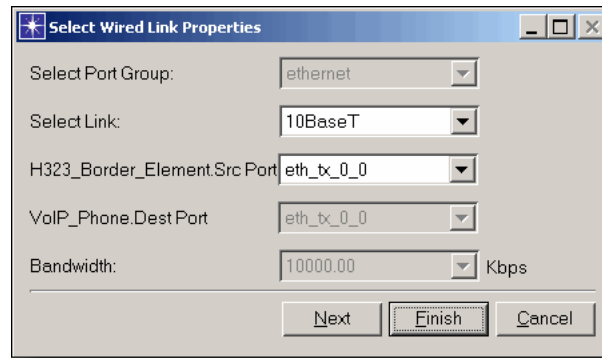


Figure 12: Link Deployment Wizard

Refer to the *NETWARS User's Manual* for further information on deploying links using the above methods.

3 Usage

The H.323 suite of models allows the user to model networks which work with both Discrete Event Simulations and Capacity Planner in NETWARS. Based on the network required, there are several types of H.323 devices which provide the hierarchical approach to voice over IP modeling. Various types of statistics measure the performance in the Node, Port, or Global level. The figures below show an example network with H.323 devices providing a hierarchical network that connects several H.323 terminals together. In this scenario, several administrative domains (Northwest, West, Northeast, and Southeast), which contain different configurations of gatekeepers and terminals, are connected through Border Elements.

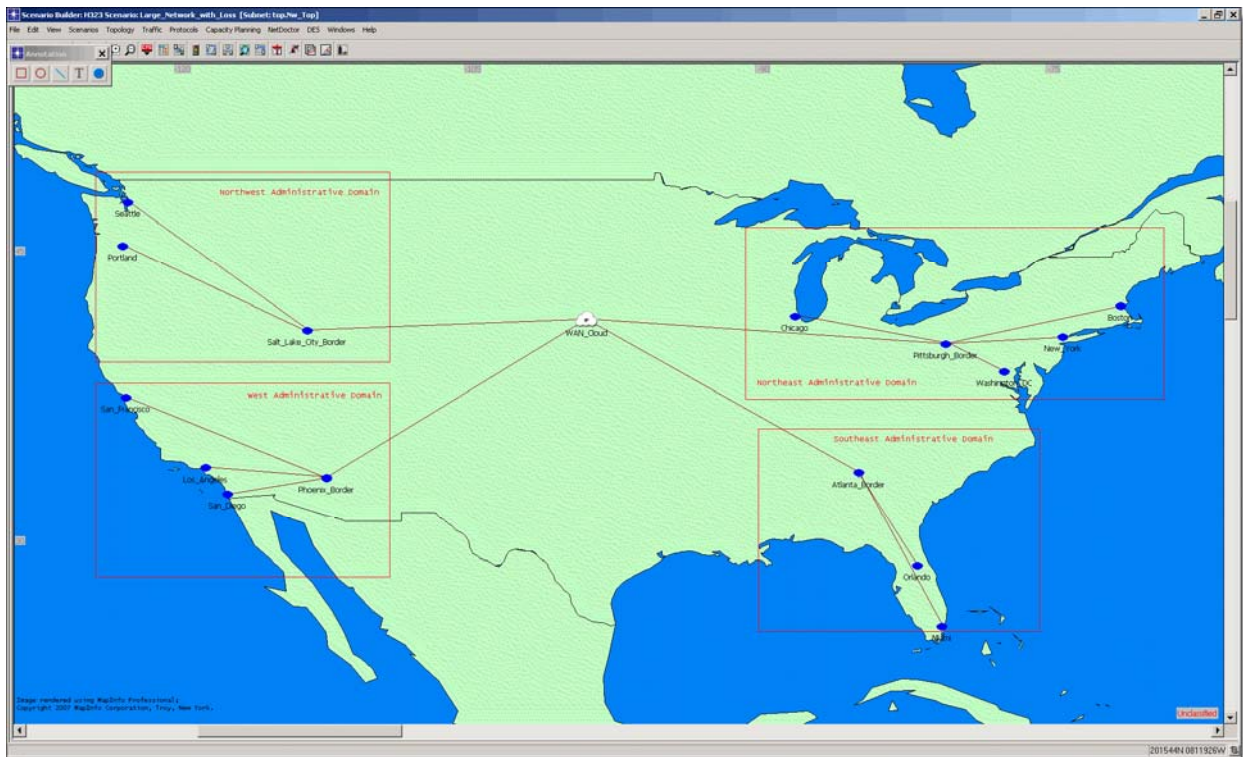


Figure 13: Example H.323 Network

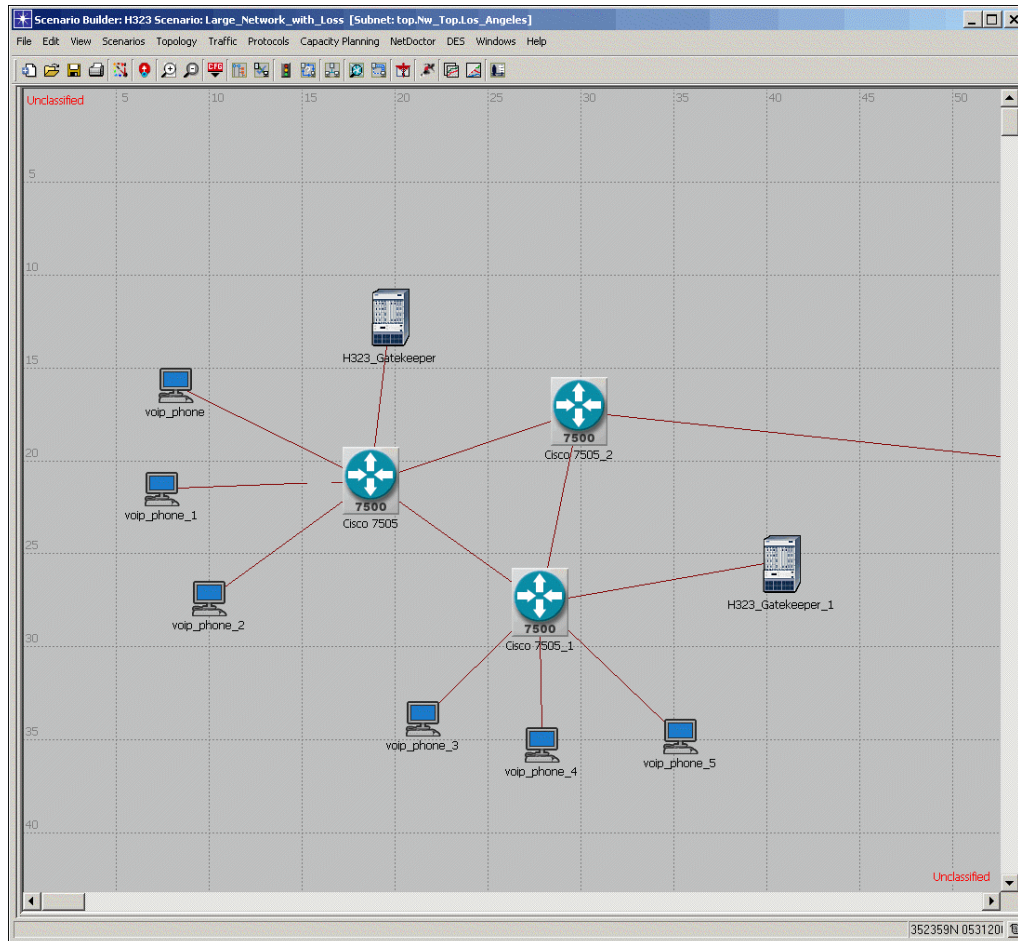


Figure 14: Inter-domain View of H.323 Network

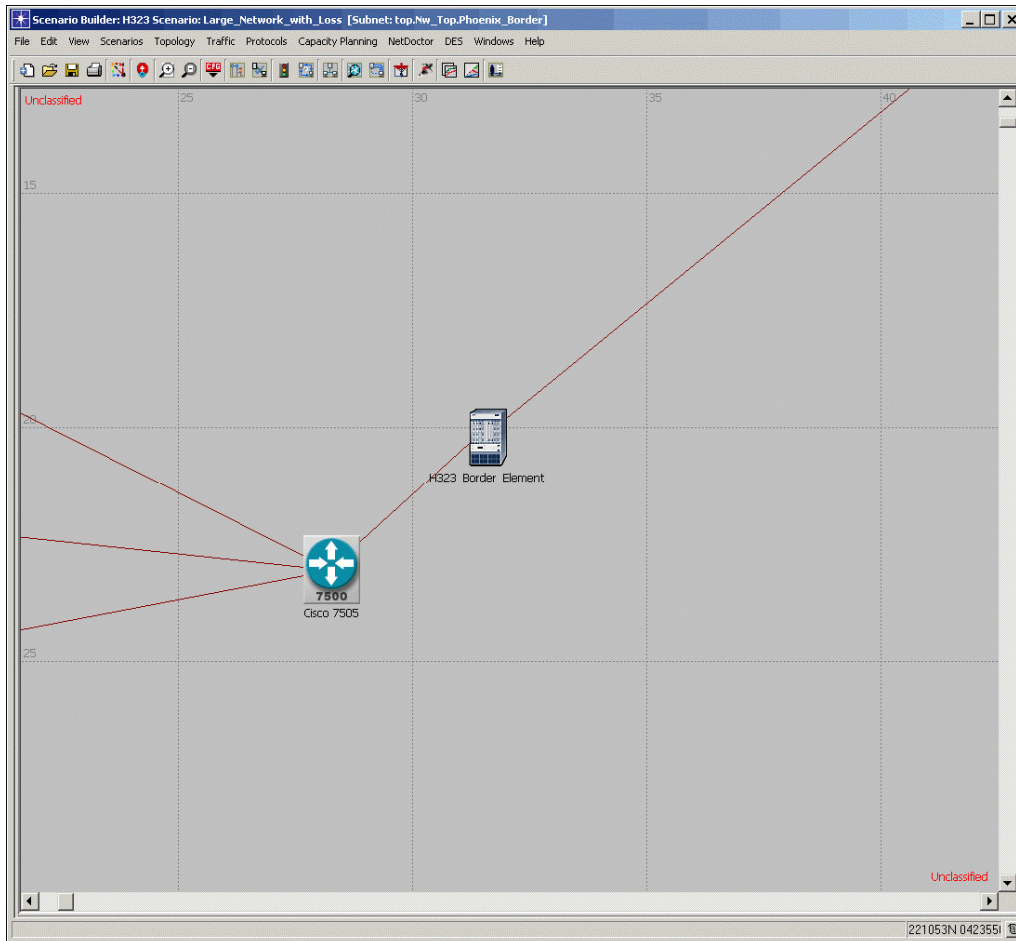


Figure 15: Border Element View of the H.323 Network

3.1 Capacity Planning Reports

The Capacity Planner is a tool which allows you to quickly study a network by analytically calculating the performance. This provides you with a large amount of studies such as failure, configuration, and capacity studies. Inside NETWARS, the Capacity Planner tool has been enhanced to generate web reports. The web reports shown below are helpful when looking at the H.323 devices. The numbers and statistics inside the web report examples are based on Capacity Planner runs using the example project shown above.

To run Capacity Planner on a network, click the **Capacity Planning > Evaluate...** menu after opening a particular NETWARS scenario. Refer to the NETWARS documentation for more information regarding how to use the Capacity Planner tool.

Once the Capacity Planner tool is run, a web report will be shown displaying the results from the analysis. There are two parts of the web report which are specific to H.323 devices (the other parts are important but are not the focus of this discussion). The first report is the Executive Summary portion of the report. This is the first page that displays

after the Capacity Planner tool has finished. This report discusses an overall view of the network and gives you high level points so that you can easily narrow down problems areas.

It is important to note that the Capacity Planner will not route the voice calls based on the H.323 protocol but instead purely on IP connectivity. This means the Capacity Planner will not take into account the H.323 configuration attributes or hierarchy. For detailed analysis of voice calls with the H.323 protocol, the user should run the Discrete Event Simulation (DES). However, Capacity Planner will show the user how much load is placed on the network, the connectivity between the devices, display any network failures, and make sure that the traffic is reaching the destination. This information is useful before investing time running DES which can take much longer periods of time to finish.

Inside the Executive Summary is a section titled “Link Utilization.” This section shows maximum link utilization for a single link out of all the links inside the scenario. This gives the user a quick insight on whether any links show bottlenecks (i.e., are over utilized). Also, the section titled “Traffic Performance” is useful in making sure that all Traffic instances (IERS or Applications) have been routed successfully inside the network. A successful route of a traffic instance is based purely on IP connectivity between the source and destination phones.

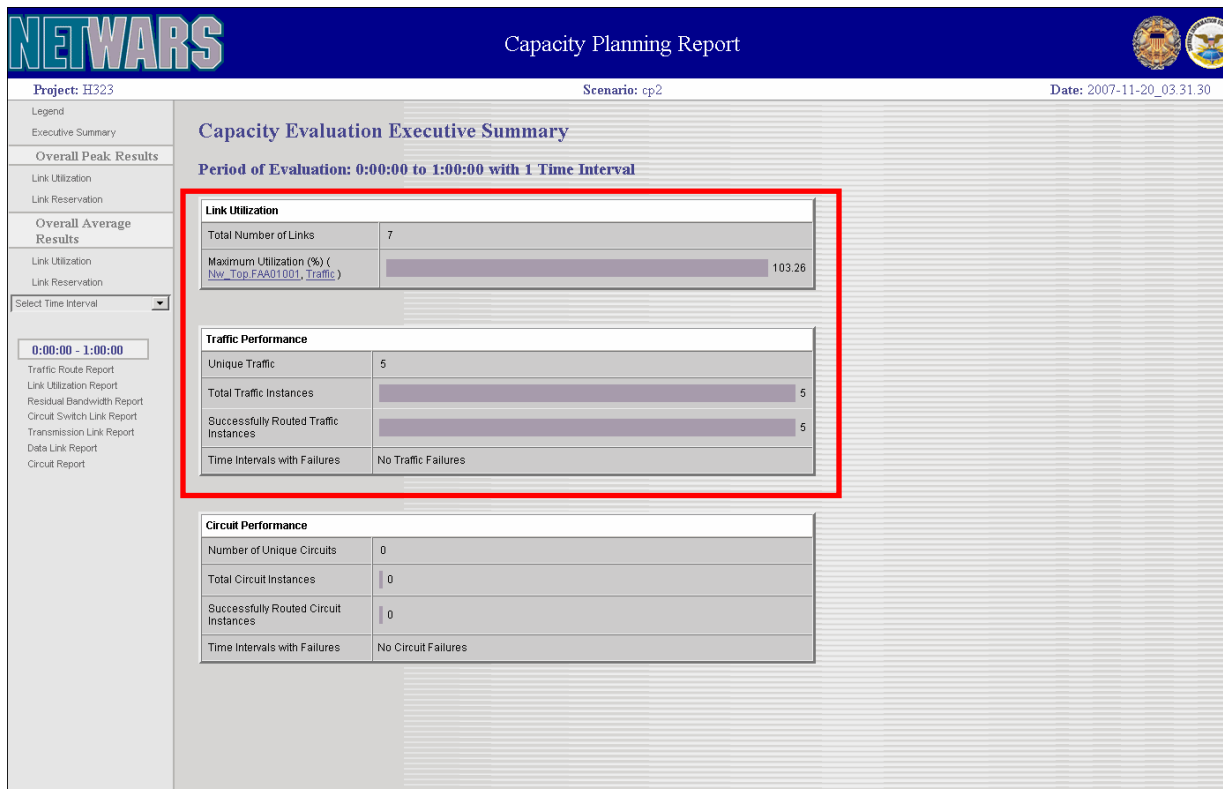


Figure 16: Capacity Planning Report Executive Summary

Secondly, the “Link Utilization Report” is another section inside the Capacity Planning web report. This section can be accessed by clicking on the hyperlink located on the left side of the Capacity Planning report. The “Link Utilization” shows a complete list of links inside the network. It provides a quick way of seeing all of the utilization numbers for each link inside the network. This allows you to easily debug any problems where traffic is could be providing a bottleneck to a particular link. This is also a continuation of the Executive Summary which only showed the link with the maximum utilization. Also, much of the data displayed is shown in hyperlink form so you can click the necessary object in the report and the Scenario Builder will display the relevant link. You are then able to check the necessary attributes or devices to look for configuration issues. Note that the links in the report are color coded to represent the utilization of the link (green is low, yellow is medium, and red is high utilization).

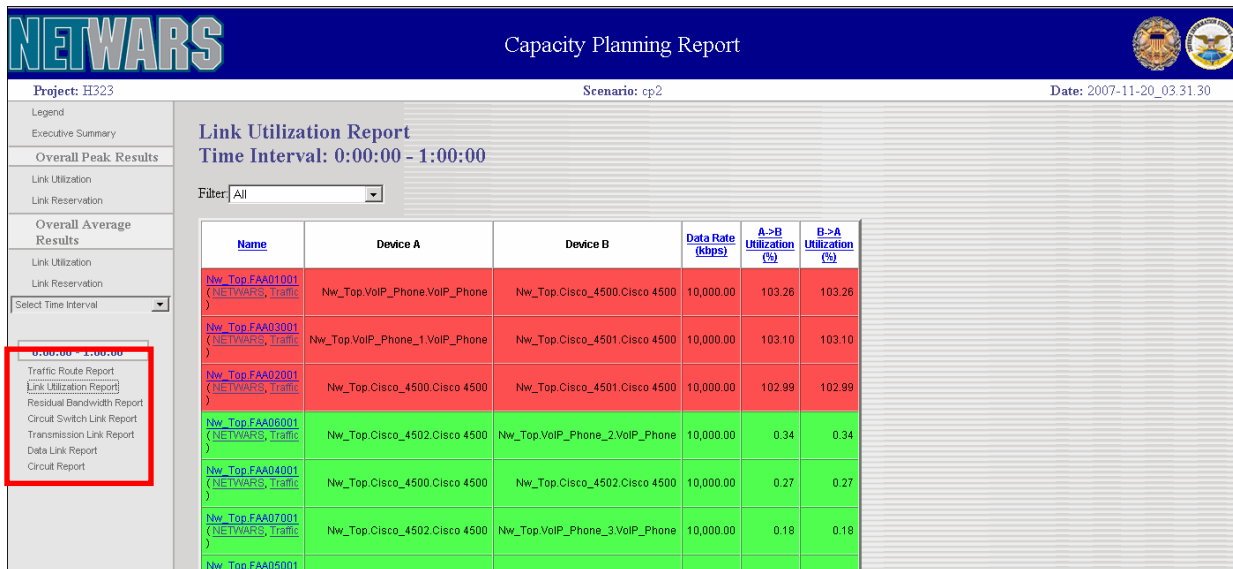


Figure 17: Capacity Planning Link Utilization Report

Finally, the “Traffic Route Report” is another section inside the Capacity Planning web report. Similar to the “Link Utilization Report,” this section can be accessed by clicking on the hyperlink located on the left side of the Capacity Planning report. The “Traffic Route Report” provides the ability to look at the different instances of traffic inside the scenario. This report is important for looking at where the traffic was being routed, how the traffic defined, whether the traffic routed, and any type of failure reasons. This can help the user determine whether the network has IP connectivity between the source and destination nodes. Again, this report is hyperlinked to help the user easily determine the configuration of the devices involved with the traffic instance.

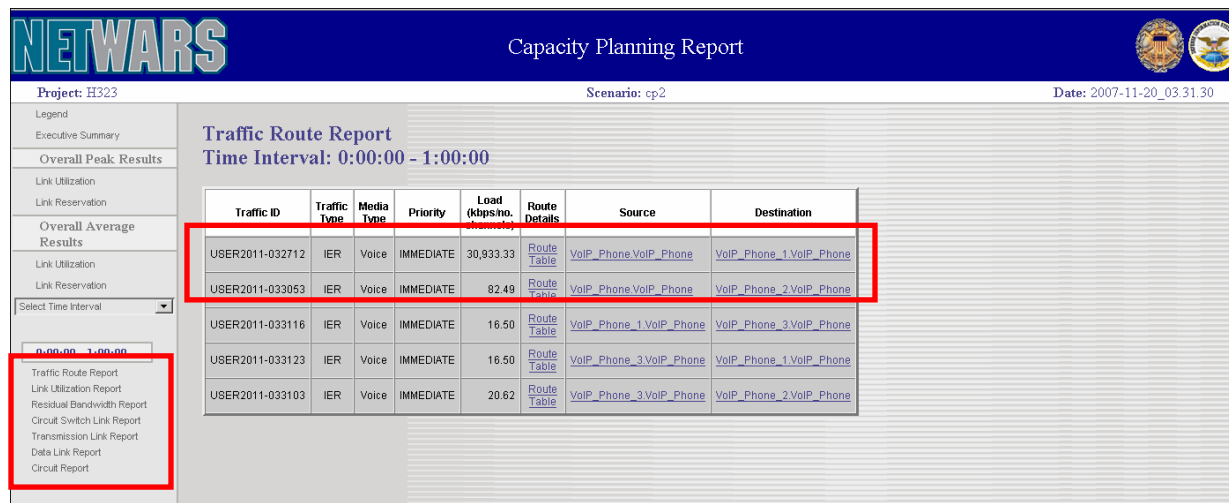


Figure 18: Capacity Planning Traffic Route Report

3.2 Discrete Event Simulation Statistics

The Discrete Event Simulation (DES) allows you to simulate the performance of a network in detail by actually sending packets and data across a created NETWARS scenario. The statistics gathered during this simulation allow you to gain specific details about how a network and particular devices are performing. This information provides you with a widespread picture of the simulated network and allows you to perform a wide variety of studies. The listed statistics below are the specific statistics available when using the NETWARS H.323 models. Many other DES statistics are available based on the type of technologies deployed inside the scenario. However, as this document is based purely on the H.323 devices, the other available statistics are outside of the scope of this document. Refer to the NETWARS and OPNET IT Guru standard documentation for more details on other statistics.

H.323 DES global statistics refer to statistics that are defined on a global network level basis. To define these type of statistics, right-click anywhere on the scenario map (not on a device, link, etc.) and select the **Choose Individual DES Statistics** menu item. After the Choose Results dialog box displays, the H.323 statistics under the “Global Statistics” section (see table below) are shown.

Table 11: DES H.323 Global Statistics

Statistic	Description
H323.Setup Time	This statistic holds the average setup time (in seconds) for a H.323 call in the network.
H323.Total Calls	This statistic holds the total number of H.323 calls signaled in the network during a simulation.
H323.Total Failed Calls	This statistic holds the total number of H.323 calls in the network which had a signaling failure during simulation.
H323.Total Successful Calls	This statistic holds the total number of H.323 calls in the network which were signaled successfully during a simulation.

H.323 DES node statistics refer to statistics that are defined on a per H.323 node basis. To define these type of statistics, right-click on the H.323 device and select the **Choose Individual DES Statistics** menu item. After the Choose Results dialog box displays, the H.323 statistics (see table below) are shown.

Table 12: DES H.323 Node Statistics

Statistic	Description
H323.Active Calls	This statistic holds the number of active calls on this H.323 device at a given time period.
H323.Setup Time	This statistic holds the average setup time (in seconds) for a H.323 call on this node.
H323.Total Calls	This statistic holds the total number of H.323 calls signaled on this node during a simulation.
H323.Total Failed Calls	This statistic holds the total number of H.323 calls on this node which had a signaling failure during simulation.
H323.Total Successful Calls	This statistic holds the total number of H.323 calls on this node which were signaled successfully during a simulation.
VoIP Phone.Jitter (sec)	Statistic holds the jitter (in seconds) between the previously received packet and the currently received packet. Only available on the H.323 terminals.
VoIP Phone.Generated Phone Calls	Statistic holds the number of calls placed on this phone where this phone is acting as the source (caller) phone. Only available on the H.323 terminals.
VoIP Phone.Received Phone Calls	Statistic holds the number of calls placed on this phone where this phone is acting as the destination (callee) phone. Only available on the H.323 terminals.
VoIP Phone.Packet Delay (sec)	Statistic holds the average delay (in seconds) for each packet received by this device. Only available on the H.323 terminals.
VoIP Phone.Total Data Sent Over IP Network	Statistic holds the total amount of data sent over the IP network by this phone during a simulation. Only available on the H.323 terminals.

3.3 H.323 DES Reporting Capabilities

In addition to the Discrete Event Simulation (DES) statistics, extra DES reporting capabilities were added to the H.323 model suite. These reports allow the user to access further information which would be difficult to view with normal DES statistics. To view these reports, use the following steps:

1. The user needs to enable the H.323 reporting capabilities. This functionality is enabled at the global scenario-wide level while configuring a Discrete Event Simulation by using the **H323 Call Reports** attribute in the **Global attributes** tab. To configure a simulation, navigate to the **DES > Configure/Run Discrete Event Simulation...** menu.

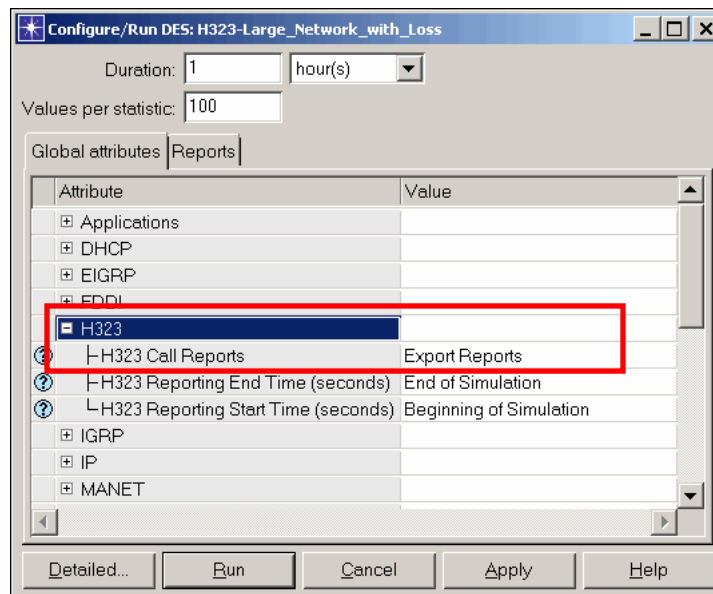


Figure 19: Enabling H.323 Reporting Capabilities

- Specify the times which the H.323 reporting should occur for voice calls. This can be accomplished at the global level using the **H323 Reporting Start Time (seconds)** or **H323 Reporting End Time (seconds)** attributes located in the same section as in Step #1. Any calls inside the scenario which begin after the reporting start time but before the reporting end time will be reported. If the user wishes to configure the reporting times on a per-node basis, the user can right-click on an H.323 terminal or gateway, select **Edit Attributes**, and modify the **Reporting Start Time** and **Reporting End Time** attributes. The default on the H.323 devices is to use the global simulation setting, but this allows the user to single out important devices to report upon (as simulation slow down can occur in large networks due to the extra report processing).

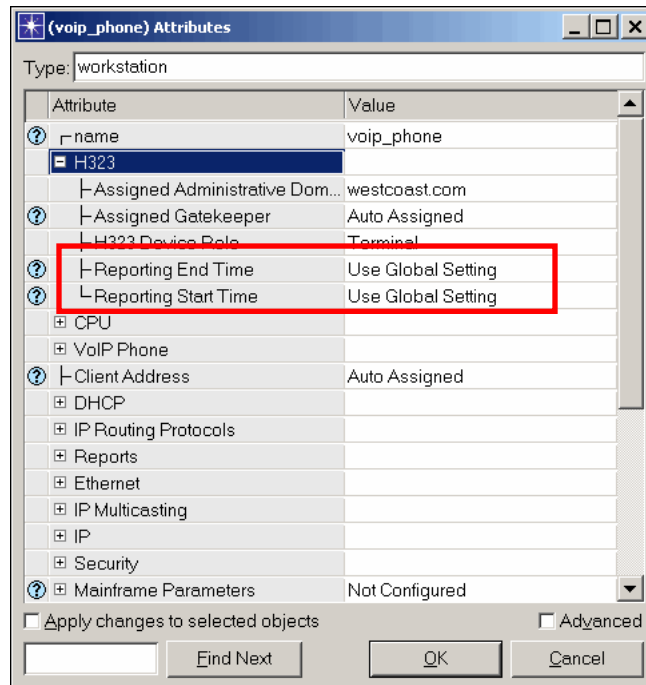


Figure 20: Specifying H.323 Reporting Start and End Times on H.323 Devices

3. The user must run a Discrete Event Simulation to completion on a particular H.323 scenario. This can be accomplished using the **DES > Configure/Run Discrete Event Simulation...** menu.
4. Once a simulation is finished, the user can either right-click on the scenario and select **View Results** or navigate to the **DES > Results > View Results...** menu. This will launch the **Results Browser** dialog box which shows the normal DES statistics, as well as, the additional H.323 reports. To navigate to the reports, select the **DES Run (1) Tables** tab in the **Results Browser** dialog box. All H.323 reports will be located under the **H323** section in the treeview for this tab.

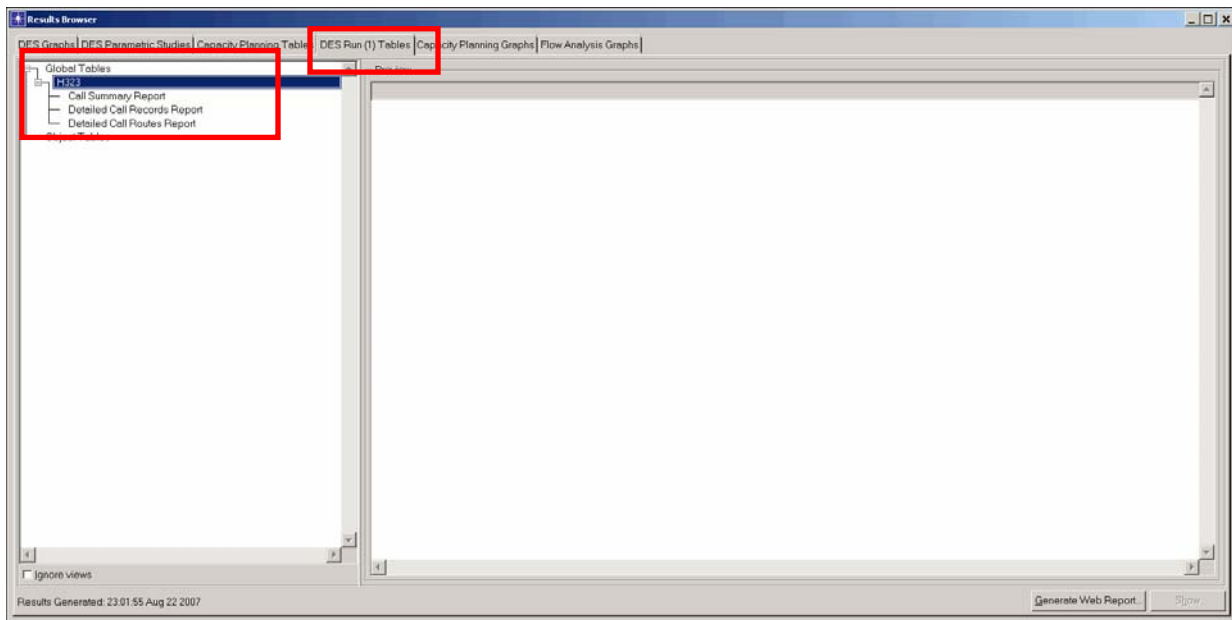


Figure 21: Viewing the H.323 Reports

5. Select the H.323 report inside the treewiew. Once the report is selected, a preview will be shown with a portion of the information found in the report. Click the **Show** button to view the entire report. Note that when viewing these reports, hyperlinks and export capabilities allow the user to easily understand and translate the report information.

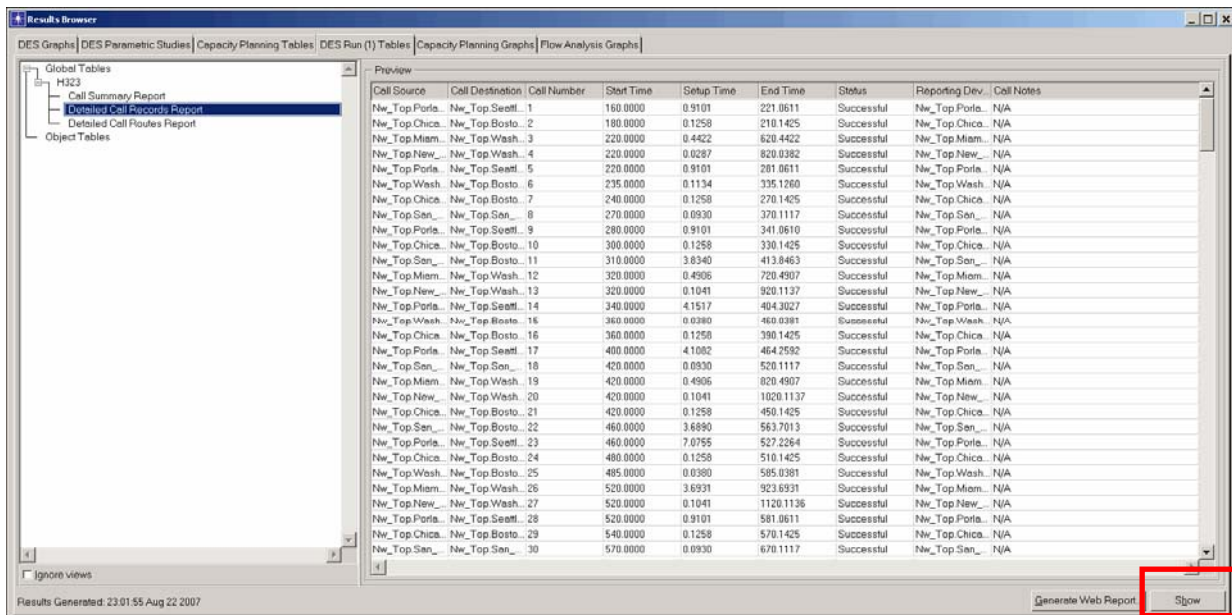


Figure 22: Selecting an H.323 Report

There are currently three DES Reports available to the user. The **Call Summary Report** allows the user to see overall H.323 network information (calls in the network, average

network setup time, average call duration, etc.). The **Detailed Call Records Report** allows the user to see information specific to certain calls (call source, call destination, setup time, completion status, start time, duration, etc.). The **Detailed Call Routes Report** allows the user to view the signaling routes associated with the call (for H.225 Call Signaling and H.225 RAS Signaling) and which H.323 devices were relevant to the signaling of the call.

3.4 Logical Views

Logical Views provide the ability to filter the network so that the user can look at particular layers or technologies more closely. In the case of H.323 devices, the user can look strictly at these devices in the network by using the “IP” layer. This layer can be located under the “Network Layer Filters” section of the logical links dialog box. Note that the logical links functionality can be found under the **View > Show Logical Views...** menu (dialog box shown below).

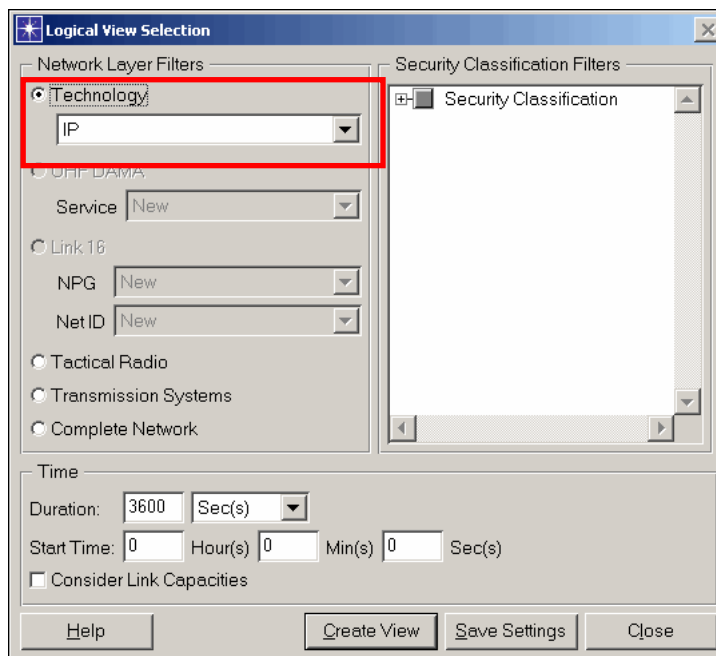


Figure 23: Logical View Dialog Box

Once a logical view of the H.323 devices is created, you are able to see a graphical representation of the IP connectivity of the H.323 devices inside the scenario. The figure provided below shows the IP connectivity of the example project above. In this particular case, it is easy to see the hierarchy and connectivity between the different H.323 administrative domains. Upon further inspection, the user is able to see that all H.323 devices are connected inside the network.

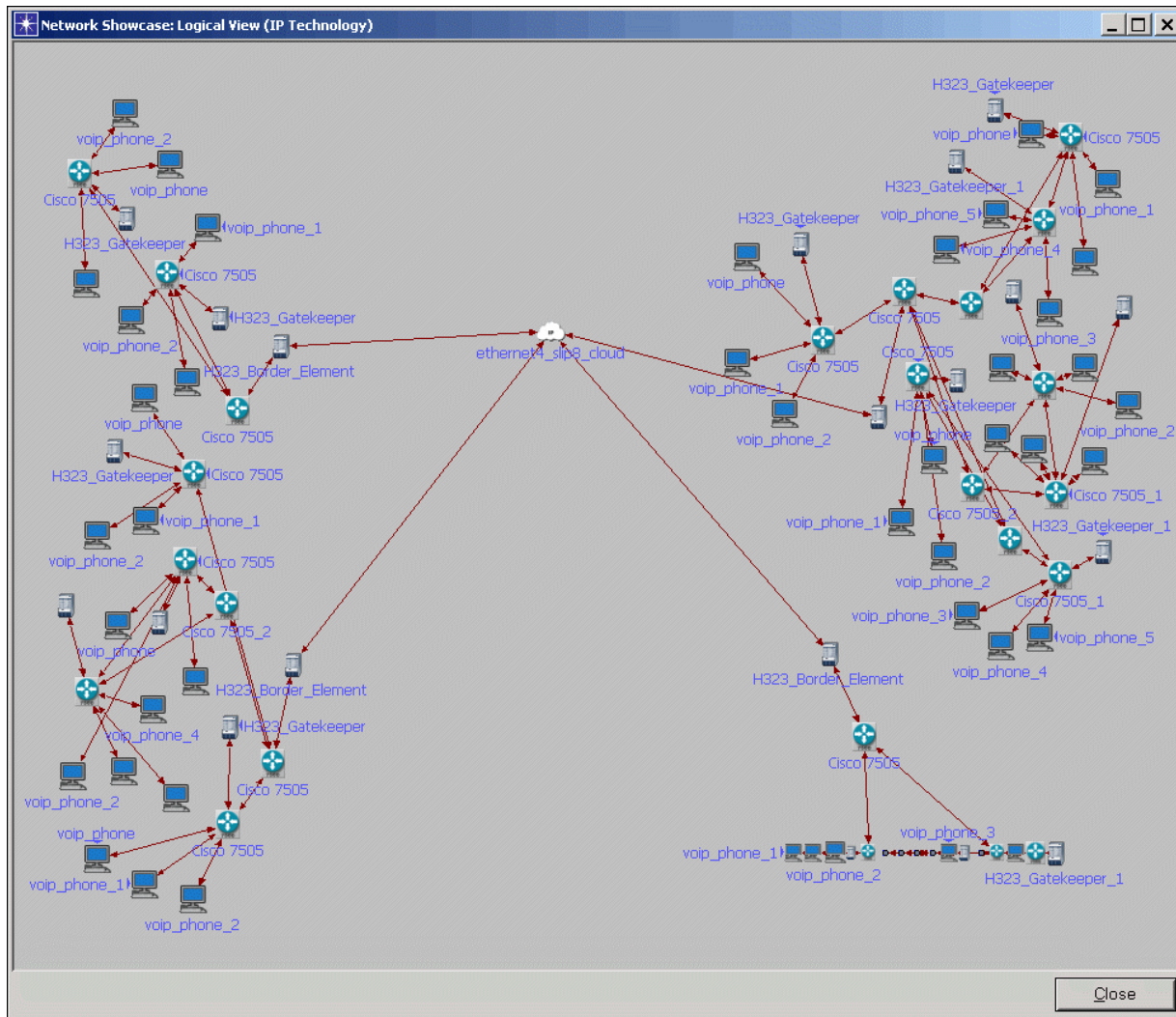


Figure 24: H.323 Logical View Example

To view more information on the Logical Views functionality, refer to the *NETWARS User's Manual* for more details.

3.5 Example Equipment Strings

Equipment strings are combinations of connected devices which can typically be found inside a network. The below equipment strings should be considered as normal use cases for the H.323 devices and are supported by NETWARS. Any additional equipment strings not shown could still be supported by the H.323 models. Note that arrows denote links inside the network.

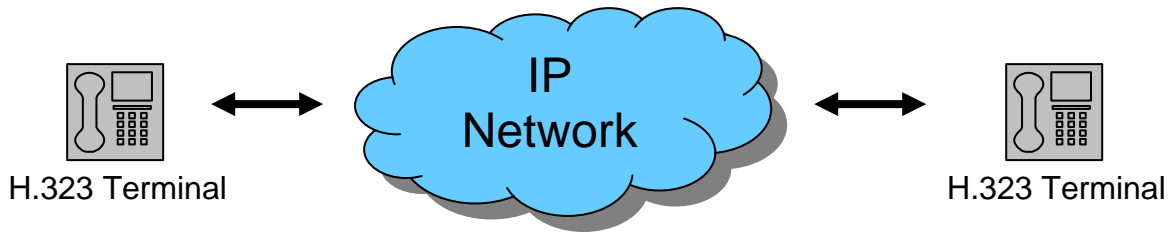


Figure 25: Terminal to Terminal Equipment String

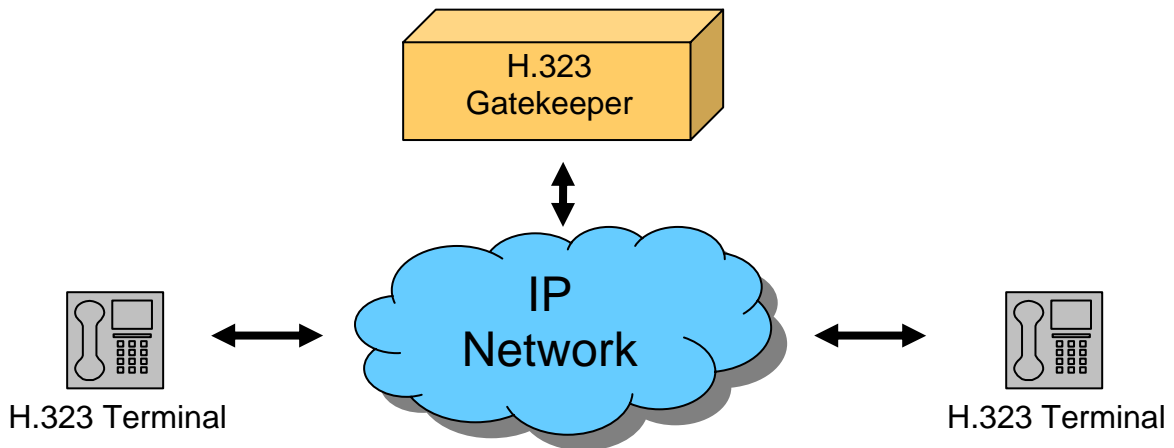


Figure 26: Single Gatekeeper Equipment String

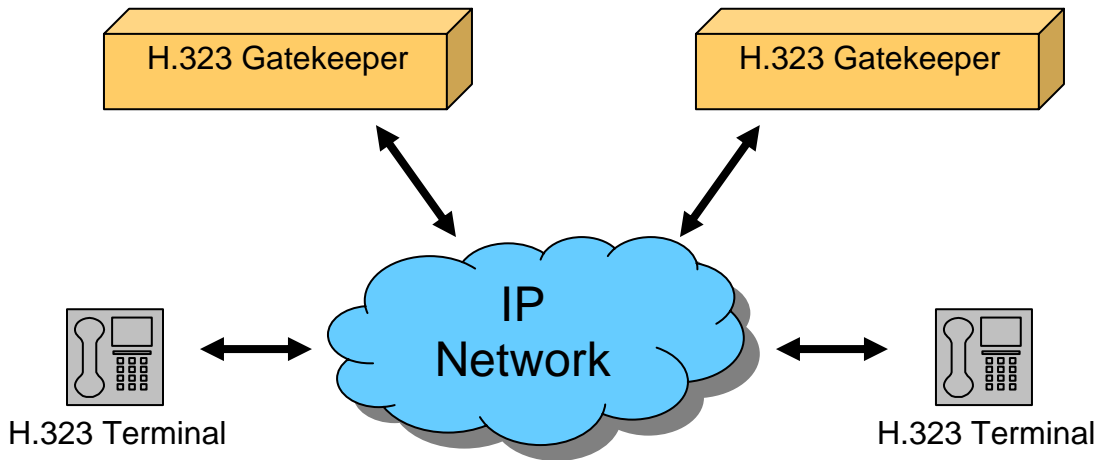


Figure 27: Multiple Gatekeeper Equipment String

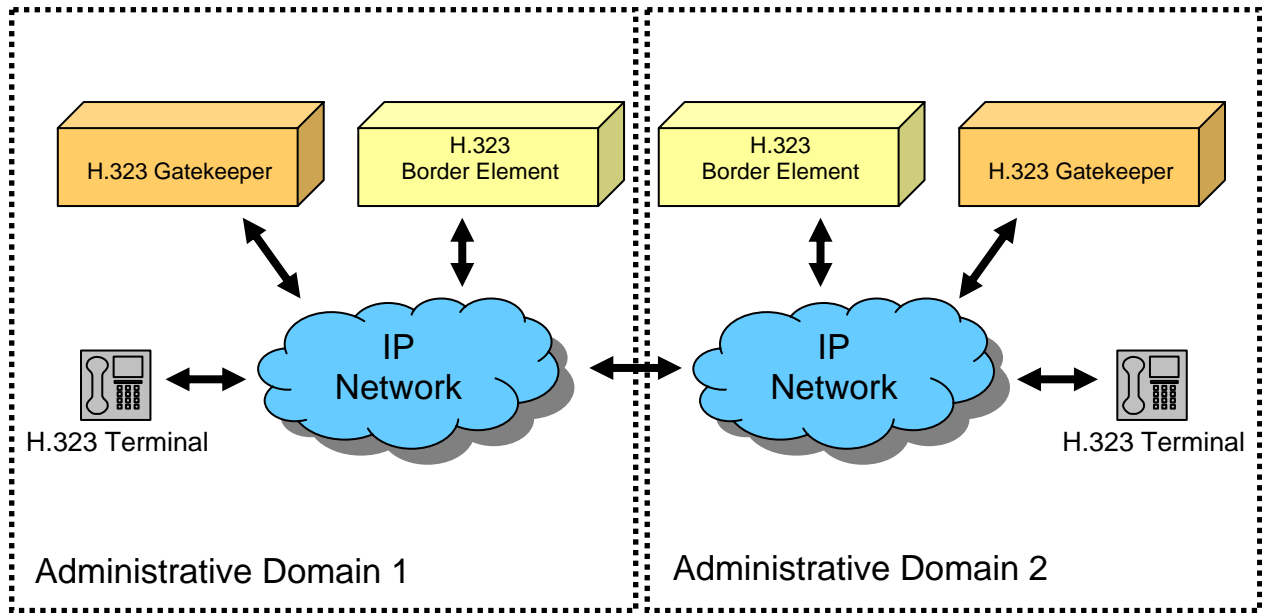


Figure 28: Multiple Administrative Domains Equipment String

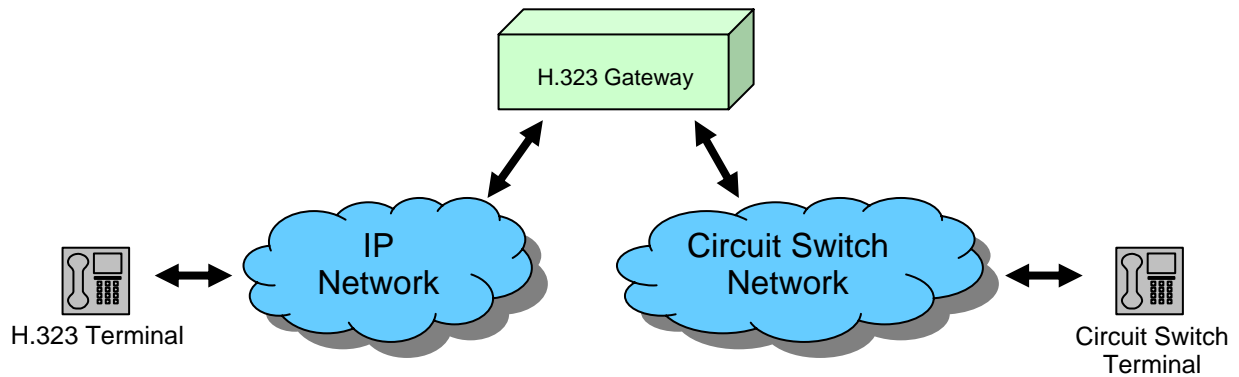


Figure 29: H.323 to Circuit Switch Equipment String

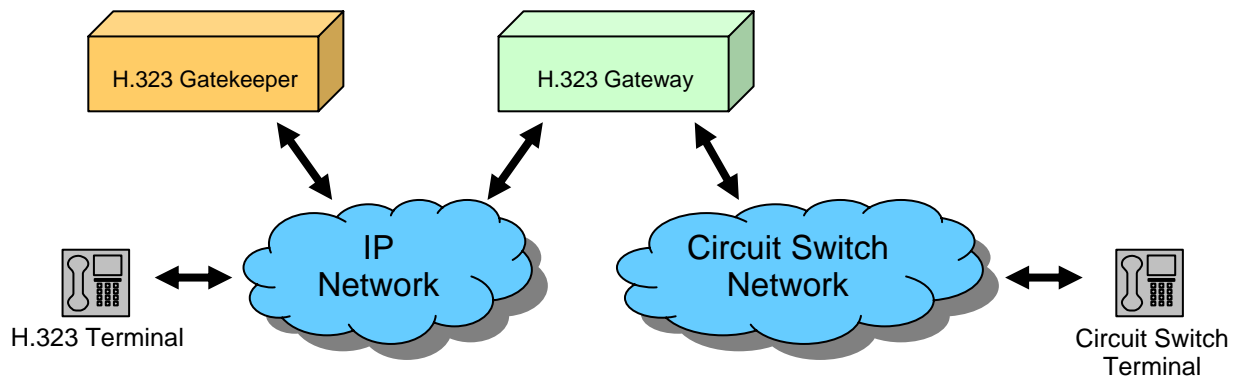


Figure 30: H.323 to Circuit Switch (Multiple Gatekeepers) Equipment String

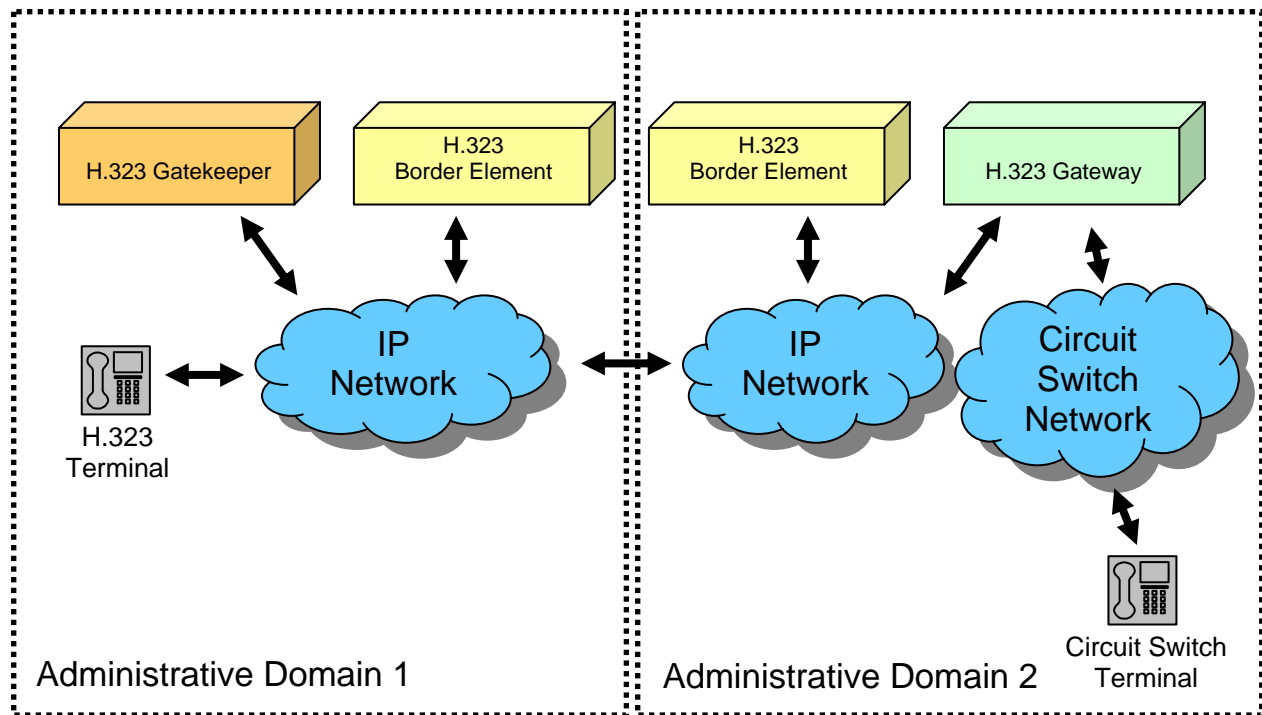


Figure 31: H.323 to Circuit Switch (Multiple Administrative Domains) Equipment String

3.6 Traffic Usage

The H.323 models are able to handle all type of traffic inside NETWARS. This includes NETWARS IERs, OPNET traffic (Applications, Flows, ACE, etc.), and even custom traffic types.

3.7 Usage in Modeler

The NETWARS H.323 models (Terminal, Gatekeeper, and Border Element) will work directly in OPNET Modeler with no modification necessary. The user only needs to move the necessary node and process models (listed below) into an OPNET Modeler directory (i.e., a “mod_dirs” directory). The H.323 Gateway cannot be imported into OPNET Modeler as this node interfaces with the NETWARS circuit switch models. The NETWARS circuit switch models are currently not available in OPNET Modeler.

Below is the list of necessary files to fully use the NETWARS H.323 models inside OPNET Modeler:

- VoIP_Phone.nd.m
- voip_phone_call_mgr.pr.c, voip_phone_call_mgr.pr.m
- voip_se.pr.c, voip_se.pr.m
- h225_call_signaling_pkt.pk.m

- h225_ras_pkt.pk.m
- h323_active_attribute_handler.ets.c, h323_active_attribute_handler.i0.ets.dll
- h323_api.ex.c
- h323_application_interrupt_ici.ic.m
- H323_Border_Element.nd.m
- h323_border_element_mgr.pr.c, h323_border_element_mgr.pr.m
- h323_border_element_ras.pr.c, h323_border_element_ras.pr.m
- h323_callee_signaling.pr.c, h323_callee_signaling.pr.m
- h323_caller_signaling.pr.c, h323_caller_signaling.pr.m
- h323_connection_status_interrupt_ici.ic.m
- H323_Gatekeeper.nd.m
- h323_gatekeeper_mgr.pr.c, h323_gatekeeper_mgr.pr.m
- h323_gatekeeper_ras.pr.c, h323_gatekeeper_ras.pr.m
- h323_gateway_mgr.pr.c, h323_gateway_mgr.pr.m
- h323_gateway_ras.pr.c, h323_gateway_ras.pr.m
- h323_mgr.pr.c, h323_mgr.pr.m
- h323_reporting.ex.c
- h323_support.ex.c
- h323_terminal_mgr.pr.c, h323_terminal_mgr.pr.m
- h323_terminal_ras.pr.c, h323_terminal_ras.pr.m
- ras_signaling_ici.ic.m

4 Node Models

4.1 Architecture

The figure below shows the node models for the H.323 devices. These node models provide an example of the full range of features available in the NETWARS H.323 model suite. The specific process models which make up the modules inside the node models are out of scope for this document. However, all of the H.323 related devices and files can be located under the **<NETWARS Installation Directory>\Sim_Domain\op_models\netwars_std_models\voip** directory and sub-directories (where **<NETWARS Installation Directory>** is the directory where NETWARS is installed). Note that all of the files and models in this directory can be opened and modified using the OPNET Modeler software.

4.1.1 H.323 Terminal Node Model

The H.323 Terminal node represents the H.323 terminal device described in the H.323 recommendation. Essentially, this node will act as the endpoint where all calls can be initiated and received (i.e., the caller and callee). Note that the H.323 terminal node will use the same “VoIP_Phone” developed for previous development. This way the user can toggle between the VoIP signaling protocols using a single “Phone VoIP Protocol” attribute. The SIP protocol for this phone will remain as the default but H.323 will now be available.

To perform the designated functionality defined by the H.323 recommendation, both a “se” and “application” module are added to the standard OPNET IP stack to create the H.323 Terminal node. These two application layer modules will provide the H.323 terminal functionality by allowing the user to specify voice calls between end terminals.

The “se” module is responsible for interacting with the standard NETWARS IER structure. All voice IERs sent to the H.323 terminal from the overlying “OE” node will be received by the “se” module and translated into actual voice traffic. This translation is performed by the *voip_se* process which can provide H.323 functionality by interfacing with its H.323 child processes.

The “application” module is provided to interface with the standard OPNET application framework. Support for H.323 applications will be added to the standard OPNET library and *gna_clsvr_mgr* process model (due for OPNET 14.5). Once completed, the “application” module will translate any application definitions (including H.323 definitions) to voice traffic. When H.323 application definitions are created, the *gna_clsvr_mgr* process will interface with the *h323_mgr* child process model (similar to the “se” module) to perform the necessary H.323 terminal functionality.

A single 10/100Mbps Ethernet interface has been added to the standard NETWARS IP stack to give the H.323 terminal model access to the IP network. This port can be

recognized by the “eth_tx_#_#” name given to the transmitter module and the “eth_rx_#_#” name given to the receiver module.

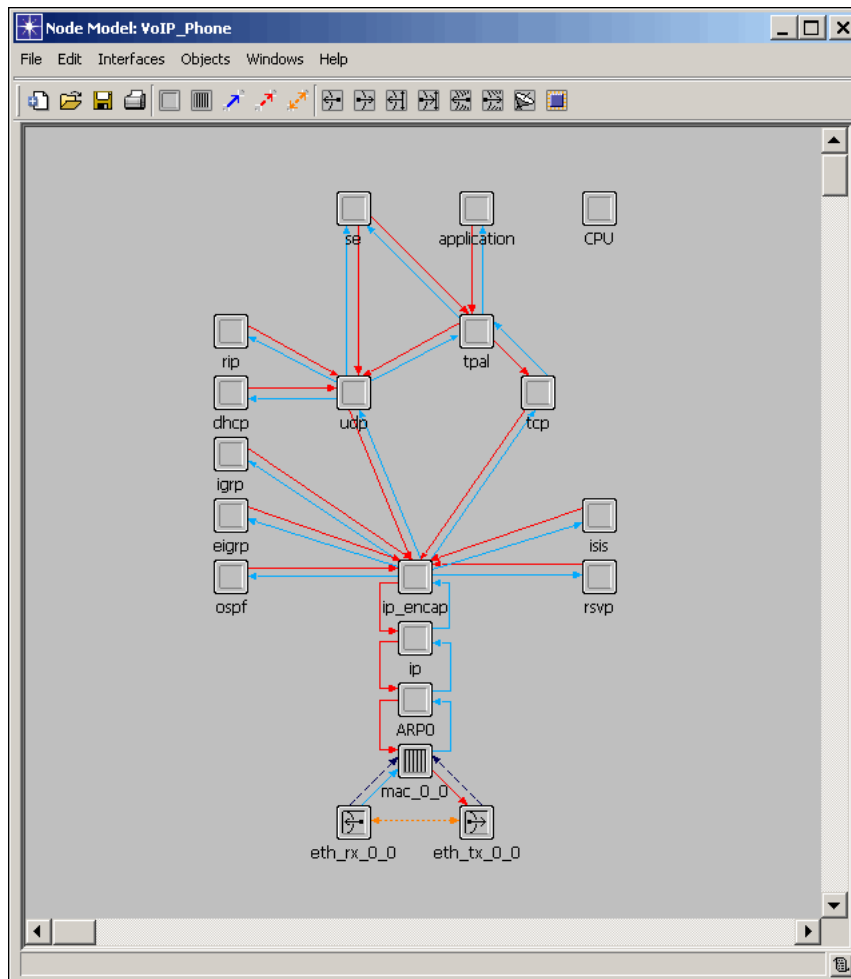


Figure 32: VoIP Phone Node Model

4.1.2 H.323 Gateway Node Model

The H.323 Gateway provides the ability to convert H.323 voice calls into non-H.323 standard voice calls (and vice versa). This includes the H.323 to circuit switch and H.323 to SIP conversions. The H.323 Gateway design will use the Media Gateway and SHOUTip devices as the base models. Note that the H.323 Gateway will only interface with the NETWARS circuit switch devices and IER traffic. OPNET applications will not be supported through the H.323 Gateway as NETWARS circuit switch devices currently do not support OPNET applications.

The Media Gateway and N.E.T. SHOUTip devices contain many different types of functionality including SIP, H.323, and SAToP support. Due to scope, this document will only reference the H.323 portions of this device. Essentially, the H.323 Gateway portion of the Media Gateway and SHOUTip devices include the *nw_voice_dispatch*

process. This process provides the necessary H.323 functionality by interfacing with the *h323_mgr* child process. Special care must be taken by the H.323 Gateway as it can act as both a client (i.e., terminal/endpoint) for a call and as an H.323 Gatekeeper. Because of this, the *nw_voice_dispatch* process signals the *h323_mgr* process based on the actions required by the received call.

All “circuit switch” voice interfaces (labeled *cs_pt_#*”) are directly sent into the “voice_dispatch” module. This module either forwards the voice data to the VoIP protocol (i.e., H.323) to be translated appropriately or sent back to another “circuit switch” interface. Secondly, dual 10/100Mbps Ethernet interfaces (labeled *eth_pt_#_#*”) have been added to the standard NETWARS IP stack to give the H.323 Gateway access to the IP network. Finally, dual ATM interfaces (labeled *atm_pt_#_#*”) have been added to the standard NETWARS ATM/IP stack to give the H.323 Gateway access to ATM networks. Note that ATM interfaces are only available on the Media Gateway device and not on the N.E.T. SHOUTip device.

The remaining circuit interfaces (labeled “*cir_intf_#*”) are out of scope for this document (not shown below). These interfaces provide the necessary SAToP functionality for the N.E.T. SHOUTip device. Please refer to the Circuit-to-Packet Model User Guide documentation for further details.

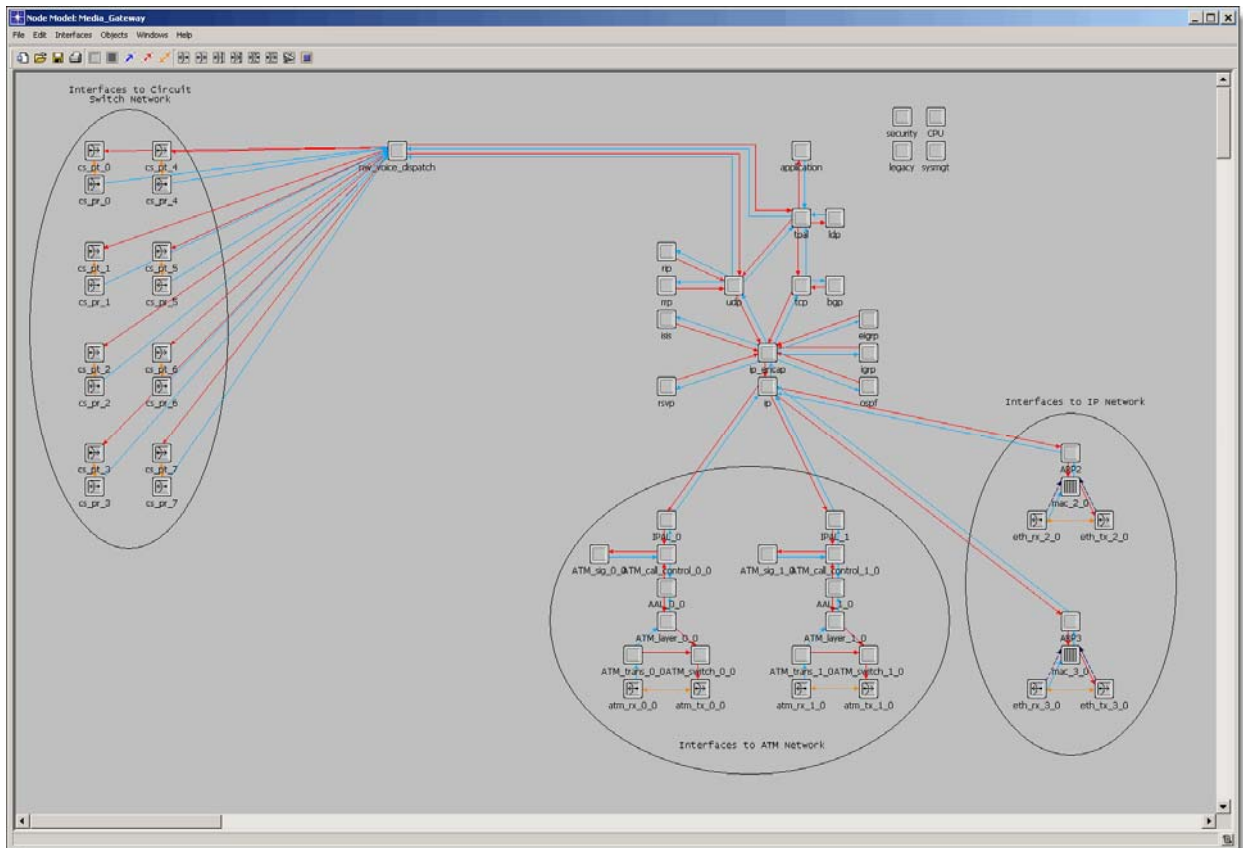


Figure 33: Media Gateway Node Model

4.1.3 H.323 Gatekeeper Node Model

The H.323 Gatekeeper is the central point for all calls within an H.323 “zone” and provides call services for registered H.323 endpoints. If a Gatekeeper is inside the H.323 network, all endpoints must register with the Gatekeeper and use the services available.

To provide this functionality, the “gkr_mgr” module is added to the node model. The “gkr_mgr” module provides the necessary Gatekeeper functionality for the NETWARS IER and OPNET application features. Currently, the “gkr_mgr” module uses the *h323_mgr* process to provide the necessary gatekeeper features. This includes accepting H.323 RAS and Call Signaling packets and interpreting them correctly. Note that the *h323_mgr* process provides H.323 functionality by interfacing with other H.323 child processes (such as *h323_gatekeeper_mgr* process).

Dual 10/100Mbps Ethernet interfaces are added to the standard NETWARS IP stack to give the H.323 gatekeeper access to the IP network. The decision of having two Ethernet interfaces ensures that the gatekeeper can act as both a router and a bridge between two IP networks. These interfaces can be recognized by the “eth_tx_#_#” name given to the transmitter module and the “eth_rx_#_#” name given to the receiver module.

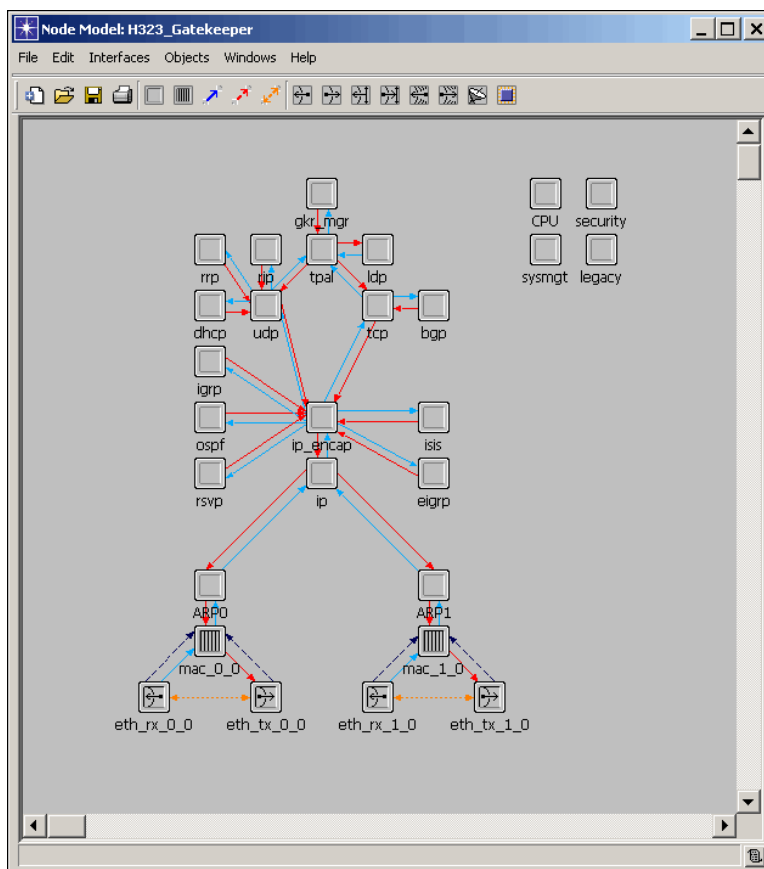


Figure 34: H.323 Gatekeeper Node Model

4.1.4 H.323 Border Element Node Model

The H.323 Border Element allows the ability to forward calls between different H.323 administrative domains. In many aspects, the Border Element acts as a specialized H.323 Gatekeeper. It is important to note that the Border Element inside NETWARS only performs H.225 RAS signaling and will not perform H.225 Call Signaling.

To provide the Border Element functionality, the “be_mgr” module has been added to the node model. The “be_mgr” module provides the necessary Border Element functionality for the NETWARS IER and OPNET application features. All H.323 RAS packets can be accepted by this module and interpreted properly. The “be_mgr” module uses the *h323_mgr* process to provide the necessary Border Element features. Note that the *h323_mgr* process provides H.323 functionality by interfacing with the other H.323 child processes (such as the *h323_border_element_mgr* process).

Dual 10/100Mbps Ethernet interfaces are added to the standard NETWARS IP stack to give the H.323 Border Element access to the IP network. The decision of having two Ethernet interfaces ensures that the border element can act as both a router and a bridge between two IP networks. These interfaces can be recognized by the “eth_tx_#_#” name given to the transmitter module and the “eth_rx_#_#” name given to the receiver module.

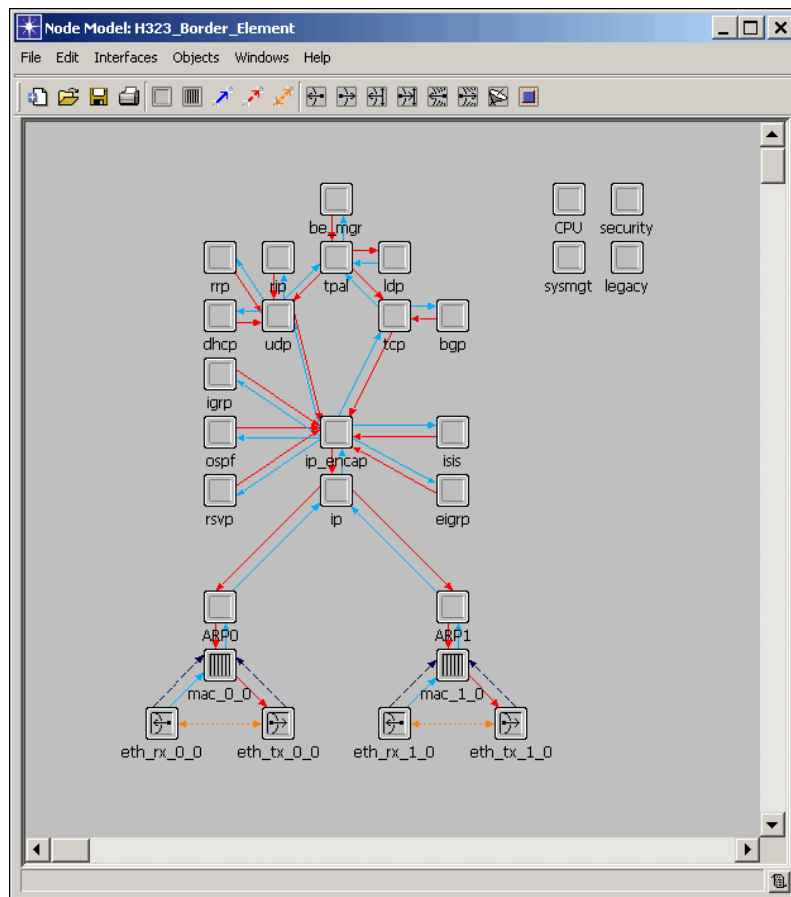


Figure 35: H.323 Border Element Node Model

4.2 Device Creator

Currently, there is no device creator support with the H.323 models in NETWARS. When NETWARS upgrades to the OPNET 14.5 release, device creator support will be added. In this case, H.323 support will be added as an optional capability for standard routers.