

# Circuit-to-Packet (CTP) Models User's Guide

7.0

Contract DASW01 03 D 0008

---



**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.

January 7, 2008

---

Prepared for:  
Defense Contracting Command -  
Washington  
Washington, DC 20310-5200

Prepared by:  
OPNET Technologies, Inc.  
Bethesda, MD 20814-7904

---

**OPNET**<sup>®</sup>  
Optimum Network Performance

# Contents

<b>1</b>	<b>Overview .....</b>	<b>1</b>
<b>1.1</b>	<b>Intended Use .....</b>	<b>1</b>
<b>1.2</b>	<b>Feature Summary .....</b>	<b>2</b>
1.2.1	CTP .....	2
1.2.2	SCREAM .....	4
<b>1.3</b>	<b>Feature Description .....</b>	<b>5</b>
1.3.1	CTP .....	5
1.3.2	SCREAM .....	6
<b>1.4</b>	<b>Limitations/Assumptions.....</b>	<b>6</b>
<b>1.5</b>	<b>Model List.....</b>	<b>7</b>
<b>1.6</b>	<b>Reference Documents .....</b>	<b>7</b>
<b>1.7</b>	<b>Additional Information .....</b>	<b>7</b>
<b>2</b>	<b>Configuration .....</b>	<b>9</b>
<b>2.1</b>	<b>Node Configuration .....</b>	<b>9</b>
2.1.1	CTP Node Attributes.....	10
2.1.2	SCREAM Node Attributes .....	12
2.1.3	Circuit Port Configuration Group .....	15
<b>2.2</b>	<b>Link Configuration .....</b>	<b>16</b>
2.2.1	Circuit (Serial) Port Connections.....	17
2.2.2	Packet (Non-Circuit) Side Connections.....	18
<b>2.3</b>	<b>CTP and SCREAM Circuit Configuration .....</b>	<b>18</b>
<b>3</b>	<b>Usage .....</b>	<b>23</b>
<b>3.1</b>	<b>Capacity Planning Reports .....</b>	<b>24</b>
<b>3.2</b>	<b>Discrete Event Simulation Statistics.....</b>	<b>26</b>
<b>3.3</b>	<b>Logical Views.....</b>	<b>29</b>
<b>3.4</b>	<b>Supported Equipment Strings .....</b>	<b>31</b>
3.4.1	Circuit (Serial) Port Equipment Possibilities .....	32
3.4.2	Packet (Non-Circuit) Side Equipment Possibilities .....	32
3.4.3	SCREAM Other Use Cases .....	33
<b>3.5</b>	<b>Traffic Usage .....</b>	<b>34</b>
<b>3.6</b>	<b>Usage in Modeler.....</b>	<b>34</b>
<b>4</b>	<b>Node Models .....</b>	<b>35</b>
<b>4.1</b>	<b>CTP.....</b>	<b>35</b>
<b>4.2</b>	<b>SCREAM .....</b>	<b>36</b>

## List of Figures

Figure 1: Palette .....	9
Figure 2: CTP Node Attributes .....	11
Figure 3: CTP – Circuit Configuration Compound Attribute .....	11
Figure 4: SCREAM Node Attributes .....	12
Figure 5: SCREAM – Circuit Configuration Compound Attribute .....	12
Figure 6: SCREAM – CESoIP Configuration Compound Attribute .....	13
Figure 7: SCREAM – CESoATM Configuration Compound Attribute .....	14
Figure 8: Circuit Port Configuration Group .....	15
Figure 9: Port Configuration Compound Attribute .....	15
Figure 10: Link Deployment Wizard .....	17
Figure 11: CTP/SCREAM Circuit Diagram .....	19
Figure 12: CTP Circuit Port Configuration .....	20
Figure 13: CTP Circuit Attributes Configuration .....	21
Figure 14: SCREAM Circuit Type Configuration .....	22
Figure 15: CTP Use Case .....	23
Figure 16: SCREAM Use Case .....	24
Figure 17: Capacity Planning Report Executive Summary .....	25
Figure 18: Capacity Planning Report Circuit Report .....	26
Figure 19: CTP and SCREAM Specific Statistics .....	27
Figure 20: Circuit Specific Statistics .....	28
Figure 21: Logical View Selection Dialog Box .....	29
Figure 22: CTP Logical View Example .....	30
Figure 23: SCREAM Logical View Example (From ATM Technology) .....	31
Figure 24: Circuit Side CTP/SCREAM Equipment String .....	32
Figure 25: SCREAM as an ATM Switch .....	33
Figure 26: SCREAM as an IP Router .....	33
Figure 27: CTP Node Model .....	35
Figure 28: SCREAM Node Model .....	36

## List of Tables

Table 1: CTP Features .....	2
Table 2: SCREAM Features .....	4
Table 3: CTP Models .....	7
Table 4: SCREAM Models .....	7
Table 5: Circuit Configuration Compound Attribute .....	11
Table 6: Circuit Configuration Compound Attribute .....	13
Table 7: CESoIP Configuration Compound Attribute .....	13
Table 8: CESoATM Configuration Compound Attribute .....	14
Table 9: Port Configuration Compound Attribute .....	16
Table 10: CTP/SCREAM Circuit Attributes .....	19
Table 11: CTP and SCREAM Specific Statistics .....	28
Table 12: Circuit Specific Statistics .....	29



# 1 Overview

This document describes key features, attributes, usage, and statistics of the Circuit-to-Packet device models shipped as part of the NETWARS models. As part of NETWARS 2007 model development, there are two devices which are modeled to perform Circuit-to-Packet functionality. These devices are:

- Juniper CTP
- N.E.T. SCREAM

Circuit-to-Packet (CTP) devices from Juniper Networks, Inc., allow serial data streams to be converted into IP packets at a source CTP device. After being received by a destination CTP device from the IP network, they are converted back to the serial stream.

The SCREAM multi-service system allows serial data to be converted into IP packets or ATM cells. It also provides broadband switching and routing capabilities that integrates Broadband Remote Access (BRAS), ATM switching, Ethernet, and IP routing capabilities in a single node.

In NETWARS, modeling of serial data to IP functionality is common between Juniper CTP and N.E.T. SCREAM with one difference: in a CTP device, serial data is sent directly over IP, however in a SCREAM device, serial data is sent over UDP and then over IP.

The serial stream can be any bit stream such as a PBX line, the output of a line encryptor, multiplexer aggregate (from Promina WAN side or multiplexer WAN side) or the output of a radio.

## 1.1 Intended Use

This document is intended for NETWARS users who have a reasonable level of knowledge about the CTP and SCREAM family of devices and their use in a tactical network. This document is written to help engineers learn about configuration of CTP and SCREAM 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

### 1.2.1 CTP

This section provides a list of the main features available in the CTP model.

Table 1: CTP Features

Feature	Description	Support
<b>Interfaces</b>		
Serial Ports	Up to 56 ports with 75bps to 12.288 Mbps range of bit rates	Supported (standard COTS receiver and transmitter modules are used for all serial port)
Ethernet Interfaces	Up to six Fast/Gigabit Ethernet ports (100/1000Base-T, 100/1000Base-FX)	Supported (both T and FX ports are modeled with the generic Ethernet interfaces and use generic 100/1000 links. full/half duplex modes available, <i>provided by COTS</i> )
Analog Voice Interface	Analog voice and T1/E1 configuration are available when an optional daughter card is installed	Not Supported (Can be emulated by using the circuit-switch ports)
<b>Port Configuration Parameters</b>		
Remote Port	Port number of the remote CTP device	Supported (If set to "Auto Address" , it will be inferred from the Remote Node name configured by the user)
Remote IP Address	IP address of the port on the remote CTP	Supported
Packet Size	This parameter determines the size of the packets created from the bit streams that would be encapsulated in the IP packets	Supported
Service Type	The service type can be an integer between 0 and 255 and determines the Type Of Service (TOS) value or the DSCP class that will be assigned to the IP packets carrying the data from this connection	Supported
Time To Live	This value defines the TTL value set for the IP packets for this connection	Supported
Pkt Buffer, Min buffer, Max Buffer	This set of parameters determine the size of the receive buffer on the remote node that holds the incoming CTP packets from the IP network and the minimum and maximum average buffer length that indicate normal operations. Buffer length will be readjusted if the Min Buffer or Max	Not Supported (Buffers with hybrid traffic support can't have exact control on the queue length. Hybrid traffic support is deemed to be more valuable than exact representation of receiver queues. Hybrid

	Buffer values are hit	support can significantly increase simulation efficiency)
Clocking Config	Settings for the clocking elements	Not Supported (Synchronization is not needed in OPNET framework)
Port Interface Type	Other interface types like EIA-530, RS-232, etc	Not Supported (Not appropriate in the NETWARS/OPNET Framework.)
Signal In Configuration	Allows the user to configure the incoming electrical signal on the physical wire.	Not Supported (Electrical signaling not supported)
Signal Out Configuration	Allows the user to configure the outgoing electrical signal on the physical wire.	Not Supported (Electrical signaling not supported)
<b>Advanced Options</b>		
OAM chan Rate, OAM pkts for Sync, OAM pkts for Sync Loss	The CTP sends periodic Operation, Administration, and Maintenance (OAM) packets to confirm the connectivity of every end-to-end connection	Not Supported (Periodic “Hello” mechanism is implemented to detect failures in the network)
Virtual IP Address	This IP address will be used as the source address of the IP packets for this connection	Not Supported
Packet Protection	This mechanism can be turned on to force the CTP to send an additional copy (clone) of every packet to the destination. As the receiver of the packets, the CTP can be configured to accept the cloned packet in case the original packet is lost	Supported
Missing Pkt Fill	when an IP packet is lost, the CTP automatically inserts data into the circuit bit stream to compensate the loss of that packet	Not Supported
Consecutive Pkts loss to starve	This parameter specifies how many consecutive circuit packets must be dropped by the IP network	Not Supported
In sequence Pkts after starve	Defines how many consecutive circuit packets must be received so that the connection recovers from the packet starvation	Not Supported
Y cable redundancy	This parameter is set to “yes” when the CTP is configured with a redundant “Y” cable.	Not Supported
Reclock RD	Automatic configuration of the physical wire clocks between connected devices. The CTP devices automatically update these configurations.	Not Supported
Single ended data/clock outputs		Not Supported

## 1.2.2 SCREAM

This section provides a list of the main features available in the SCREAM model.

Table 2: SCREAM Features

Feature	Description	Support
<b>Interfaces</b>		
Serial Ports	Up to 16 ports with 75bps to 12.288 Mbps range of bit rates	Supported (Arbitrary number of serial ports, standard COTS receiver and transmitter modules are used for all serial port)
Ethernet Interfaces	Up to six Fast/Gigabit Ethernet ports (100/1000Base-T, 100/1000Base-FX)	Supported (Arbitrary number of Ethernet ports, 10/100/1000Base-T, can be modeled using standard COTS Ethernet module)
Serial IP interfaces	Up to four ports	Supported (Arbitrary number of Serial IP interfaces provided by the COTS standard IP module)
ATM interfaces	Up to four ports	Supported (Arbitrary number of ATM interfaces provided by the COTS standard ATM switch module)
<b>Main Technologies</b>		
IP		Supported (COTS IP modules)
ATM		Supported (ATM functionality provided by the COTS models)
Ethernet		Supported (COTS Ethernet modules)
BRAS	Broadband Remote Access Server (BRAS) routes traffic to and from the digital subscriber line access multiplexers (DSLAM) on an Internet service provider's (ISP) network	Not Supported
MPLS	Multiprotocol Label Switching (MPLS) is a technology for end-to-end networks (large enterprises and carriers), wherein the full set of features is provided at the network edge	Not Supported (MPLS functionality provided by the COTS models)
CES over IP	Structure-Agnostic mapping of a local serial port to a serial port on a remote SCREAM device over the IP network and specified UDP connection	Supported



CES over ATM	Structure-Agnostic mapping of a local serial port to a serial port on a remote SCREAM device over the ATM network	Supported
IP to ATM internetworking	Receiving and forwarding UDP/IP packets to an ATM network	Supported (Standard COTS “Route Maps”, “Extended ACL” and, “Layer 2 Mapping” capabilities. Mapping of the IP traffic received on a specified IP interface with specific ACL properties to a specified outgoing ATM interface)
ATM pseudowire over IP	Mapping of the ATM traffic received on a specific (S)PVC on UDP/IP packets with specified destination IP address and source UDP port	Not Supported

## 1.3 Feature Description

### 1.3.1 CTP

#### 1.3.1.1 Serial Interfaces

Depending on the model, CTP devices can have up to 56 serial ports. Each port can have a bit rate from 75 bps up to 12.288 Mbps. CTP devices can also have up to 112 analog 4-wire voice inputs that will be converted to 64 kbps PCM upon entry to the device, and will be treated as a digital bit stream from that point on.

#### 1.3.1.2 IP Interfaces

CTP devices, depending on their models, have up to 6 Ethernet ports that are a combination of 100/1000 Base T, 100 Base FX, and 1000 Base FX types.

#### 1.3.1.3 Circuit Configuration

Configuration of end-to-end circuits between a local serial port and a remote serial port is performed either using the NETWARS circuit wizard or by manually dragging and dropping a circuit path object from palette. The main parameters for this configuration are the *Port A* and *Port B* attributes on the circuit path object. The bit stream received from the local port first will be packetized and the packets will be encapsulated in IP packets and will be sent to the destination CTP device (specified by either remote port or destination IP address). After reception by the destination node, the payload will be extracted and converted back to a bit stream and sent out over the *remote port* of that node. This configuration allows *one* local port to be assigned to *one and only one* remote port (and IP address). Circuit configuration will be covered in detail in a separate section.

## **1.3.2 SCREAM**

### **1.3.2.1 ATM Switching**

SCREAM can perform as an ATM switch that supports Class of Service categories including CBR, ABR, VBR, and UBR traffic. It supports AAL1, AAL2, and AAL5 adaptation layers and supports PVCs, SPVCs, and SVCs and PNNI for defining ATM connections.

### **1.3.2.2 IP Routing and QoS**

SCREAM can perform as an IP router with embedded Cisco IOS. The IP routing module supports RIP, OSPF, IS-IS, BGP-4, IGRP, and EIGRP protocols. It also allows policy enforcement through definition of ACLs and Extended ACL. IP QoS support is provided through DiffServ support, RED congestion control algorithm, Weighted Class-Based Queuing (WCBQ), and Priority Queuing (PQ). In the management side, the IP module supports DHCP and IPCP for address management. IP multicast is supported.

### **1.3.2.3 Circuit Emulation Services (CES)**

Circuit Emulation Service (CES) over ATM allows DS-n and E-n circuits to be transparently extended across an ATM network. The CES over ATM uses constant bit rate (CBR) ATM permanent virtual circuits (PVCs) or soft PVCs.

Unstructured CES (modeled)

The entire DS-n or E-n frame arriving from the customer premises equipment (CPE) (such as a PBX) is converted into AAL1 ATM cells and transmitted across the ATM network using a single VC. The ATM switch or router on the remote end converts the AAL1 ATM cells into a DS-n or E-n frame, which is then transmitted to a Ds-n or E-n CPE device.

SCREAM also supports CES over IP service which encapsulates the received TDM frames in IP packets and transmits them to the destination.

## **1.4 Limitations/Assumptions**

Due to the proprietary nature of the protocols used in real CTP and SCREAM devices, these devices use a generic segmentation/encapsulation method to convert the serial bit stream (which is a packet in OPNET modeling domain) coming from the circuit ports over the CTP and SCREAM network. As in all other NETWARS models, the communications is strictly packet-based and the line signaling and clocking features are not modeled.

The SCREAM models do not currently support Broadband Remote Access Server functionality.

When configuring circuits using CESoATM, the network between the SCREAM devices must consist purely of ATM devices. CESoATM does not support mixing network types. CESoIP does not have this limitation and will work with any network technology that supports IP traffic.

## 1.5 Model List

The standard NETWARS model library contains a number of node models representing various models of CTP and SCREAM devices. Those models can be located under the “Node Models” directory of the “NETWARS Standard Model” palette and include the models provided below.

Table 3: CTP Models

Model Name	Serial/Circuit Ports	Ethernet Ports
CTP_1012	12	2
CTP_2024	24	7

Table 4: SCREAM Models

Model Name	Serial/Circuit Ports	Ethernet Ports	SLIP (IP) Ports	ATM ports
SCREAM_50	8	2	2	4
SCREAM_100	16	4	4	4

The NETWARS model library also contains a SHOUTip node model, which provides Structure-Agnostic Time Division Multiplexing (TDM) over Packet (SAToP) functionality. SATop implementation is generic and it is surrogated from serial data over IP functionality from CTP device.

## 1.6 Reference Documents

- “CTP Product Manual”, Juniper Networks, Inc.
- “TDM over IP”, IETF draft draft-ietf-pwe3-tdmoip-06.txt, Dec. 2006.
- “Juniper Networks Circuit to Packet (CTP) Series”, Data sheet, Juniper Networks Inc., <http://www.juniper.net/products/ctp/dsheet/100139.pdf>
- “Promina BBS10000/BBS5000 Users’ Manual” N.E.T.
- “Structure-Agnostic Time Division Multiplexing (TDM) over Packet (SAToP)”, RFC 4553, IETF, June 2006.
- “TDM over IP”, IETF draft draft-ietf-pwe3-tdmoip-06.txt, Dec. 2006.
- “An Introduction to Circuit Emulation Services”, Cisco Systems, Inc. <http://www.cisco.com/warp/public/121/ces.pdf>.

## 1.7 Additional Information

For any additional information not discussed in this document, please 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, etc. This documentation is provided in 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 dealing with OPNET specific functionality, consult the standard OPNET documentation. This documentation can be accessed inside NETWARS by using the **Help > Documentation > ITGuru Documentation** menu.

Finally, any of the CTP and SCREAM files can be located under the <**NETWARS InstallationDirectory**>\**Sim\_Domain\op\_models\netwars\_std\_models\circuits\circuit\_emulation\_devices** directory. 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.

### 2.1 Node Configuration

Currently, there are a few CTP and SCREAM devices available inside the NETWARS palette. To find the available models, open the object palette (**Topology > Open Object Palette**) and find the “NETWARS Standard Models” palette (shown below).

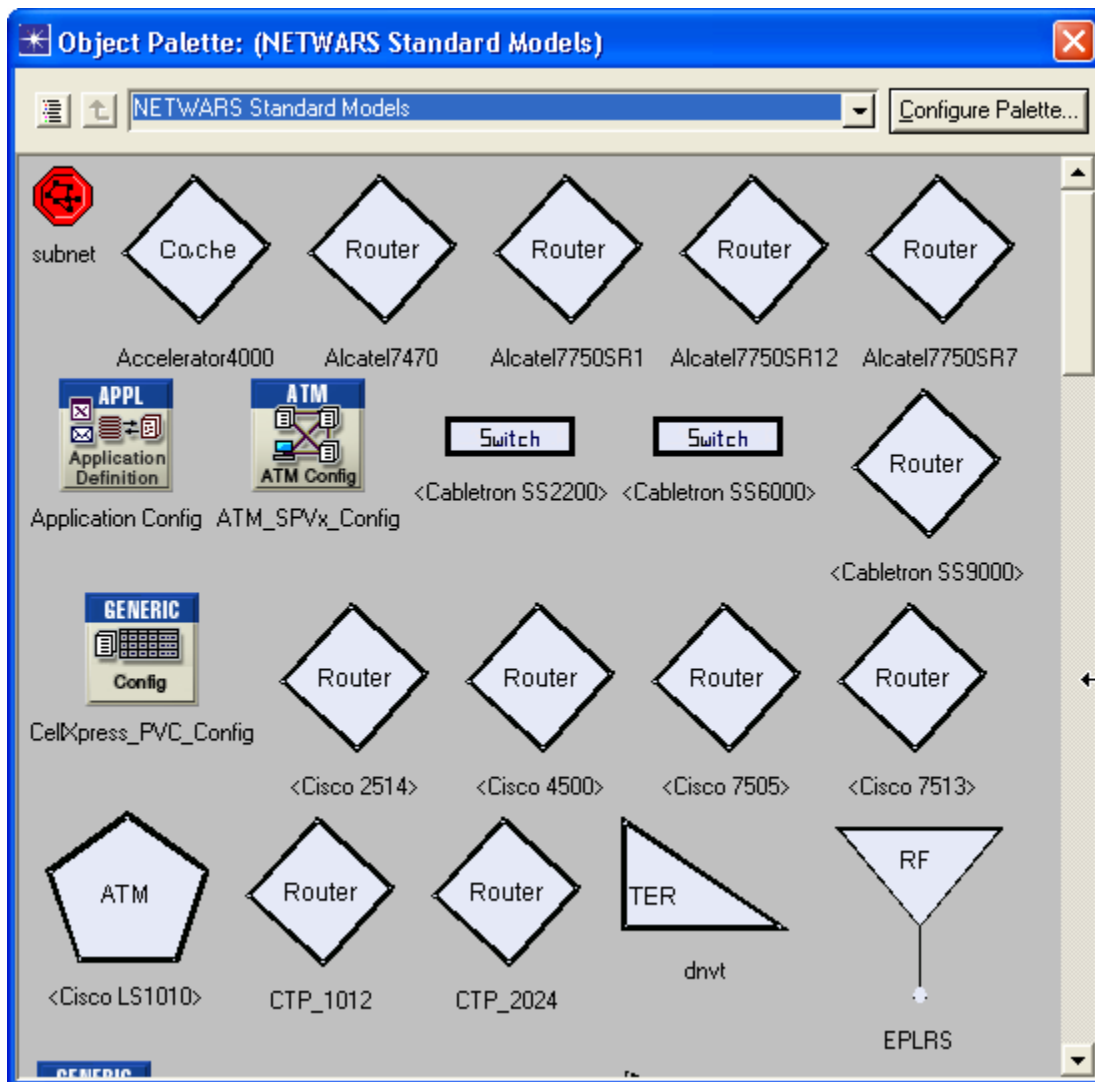


Figure 1: Palette

Once the particular 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 CTP and SCREAM functionality. The following subsections discuss these device attributes.

**NOTE:** The “Circuit Port Configuration” attribute is common to both CTP and SCREAM so it will be described in one subsection.

**NOTE:** The “Circuit Configuration” attribute for both CTP and SCREAM can be either manually configured or use the circuit wizard (discussed in a different section).

### 2.1.1 CTP Node Attributes

The CTP node attributes comprise all of the attributes that can be accessed by right-clicking on a particular CTP device and selecting the **Edit Attributes** menu. Attributes like “Ethernet”, “IP”, and “Reports” are COTS attributes and they are NOT described here. The “Circuit Port Configuration” attribute will be described in a separate subsection.

The “Circuit Configuration” compound attribute is the most important attribute. It is pre-configured (with default values) with one row for each circuit port on the device. Attributes of each row are described in the table below.

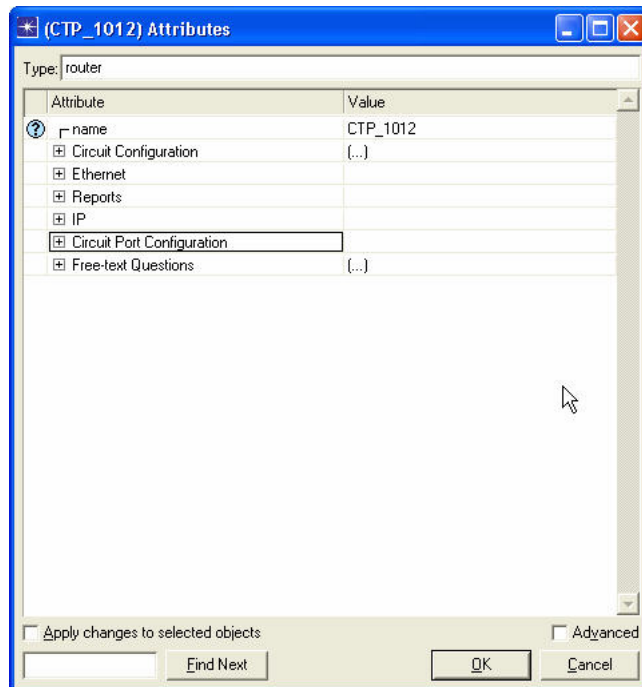


Figure 2: CTP Node Attributes

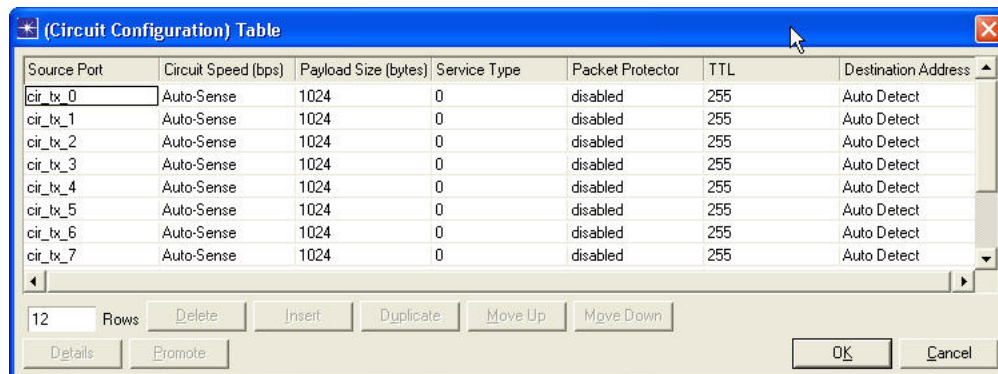


Figure 3: CTP – Circuit Configuration Compound Attribute

Table 5: Circuit Configuration Compound Attribute

Attributes	Description
Source Port	This field should NOT be changed by the user. This field is the name of the transmitter of the corresponding circuit port.
Circuit Speed	Data rate of the circuit. If set to “Auto-Sense”, circuit data rate will be set to the data rate of the link connected to the corresponding circuit port.
Payload Size	Size of the packets created from the bit streams that would be encapsulated in the IP packets
Service Type	The service type can be an integer between 0 and 255 and determines the Type Of Service (TOS) value or the DSCP class that will be assigned to the IP packets carrying the data from this connection
Packet Protector	When this attribute is enabled, a second copy of each packet will be sent over the IP network.

TTL	TTL value set for the IP packets for this connection.
Destination Address	Destination IP address for this connection. If set to “Auto Detect”, the loopback IP address of the destination node will be used.

### 2.1.2 SCREAM Node Attributes

Attributes like “ATM-IP Interface”, “IP”, “Reports”, etc., are COTS attributes and they are NOT described here. The “Circuit Port Configuration” attribute will be described in a separate subsection.

The “Circuit Configuration” compound attribute is the most important attribute. It is pre-configured (with default values) with one row for each circuit port on the device. Attributes of each row are described in the table below.

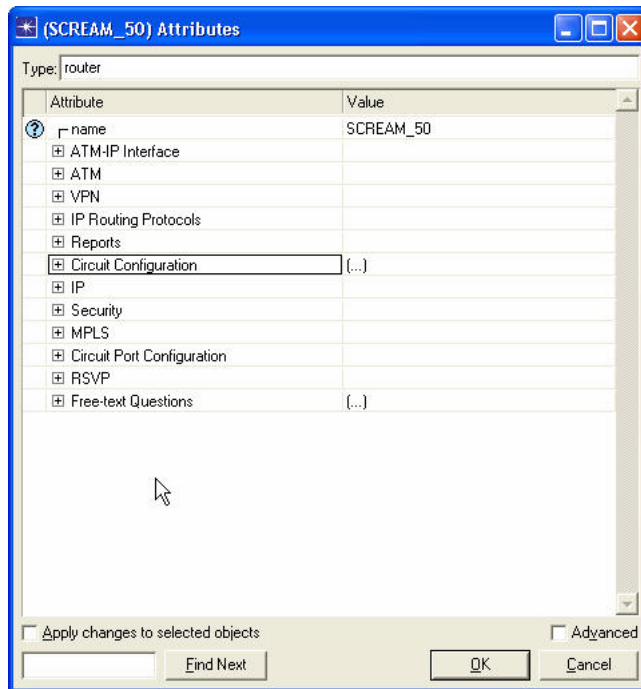


Figure 4: SCREAM Node Attributes

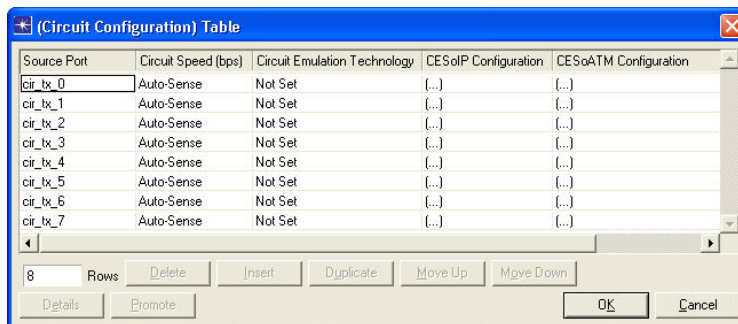


Figure 5: SCREAM – Circuit Configuration Compound Attribute



Table 6: Circuit Configuration Compound Attribute

Attributes	Description
Source Port	This field should NOT be changed by the user. This field is the name of the transmitter of the corresponding circuit port.
Circuit Speed	Data rate of the circuit. If set to “Auto-Sense”, circuit data rate will be set to the data rate of the link connected to the corresponding circuit port.
Circuit Emulation Technology	This attribute should always be configured by the user to either “CES over IP” or “CES over ATM”. If the value of the attribute is set to “CES over IP”, packets (from serial bit stream) will be sent over IP network and “CESoIP Configuration” compound attribute will be used for advanced settings. If the value of is set to “CES over ATM”, packets (from serial bit stream) will be sent over ATM network and “CESoATM Configuration” compound attribute will be used for advanced settings.

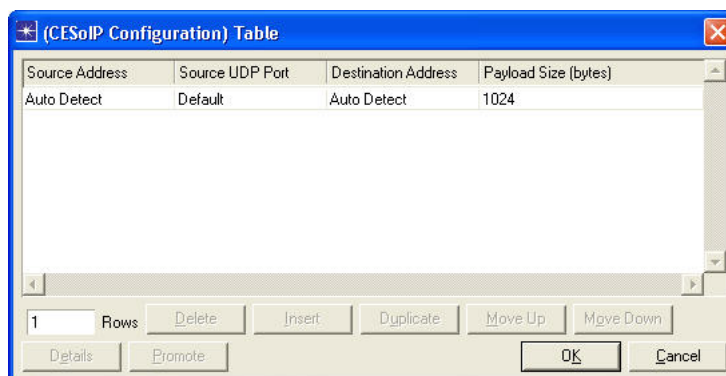


Figure 6: SCREAM – CESoIP Configuration Compound Attribute

Table 7: CESoIP Configuration Compound Attribute

Attributes	Description
Source Address	Source IP address for this connection. If set to “Auto Detect”, the loopback IP address of the source node will be used
Source UDP Port	Source UDP port for this connection.
Destination Address	Destination IP address for this connection. If set to “Auto Detect”, the loopback IP address of the destination node will be used.
Payload Size	Size of the packets created from the bit streams that would be encapsulated in the IP packets

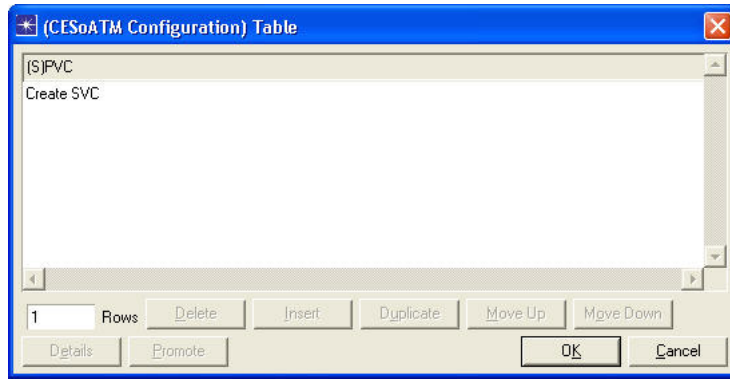


Figure 7: SCREAM – CESoATM Configuration Compound Attribute

Table 8: CESoATM Configuration Compound Attribute

Attributes	Description
(S)PVC	Name of the PVC object in the ATM network over which packets (from serial bit stream) should be sent. The default value is “Create SVC” which means, there is no PVC specified and a SVC should be created on demand when the packets are sent.

### 2.1.3 Circuit Port Configuration Group

Both CTP and SCREAM have this group of attributes. This group has one compound attribute named “Port Configuration” for each circuit port. The “Port Configuration” attribute has some advanced settings which are discussed in the table below.

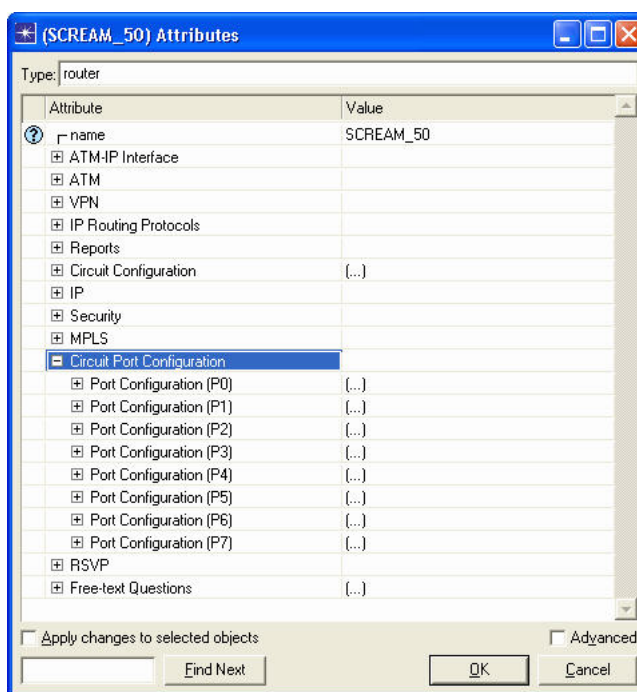


Figure 8: Circuit Port Configuration Group

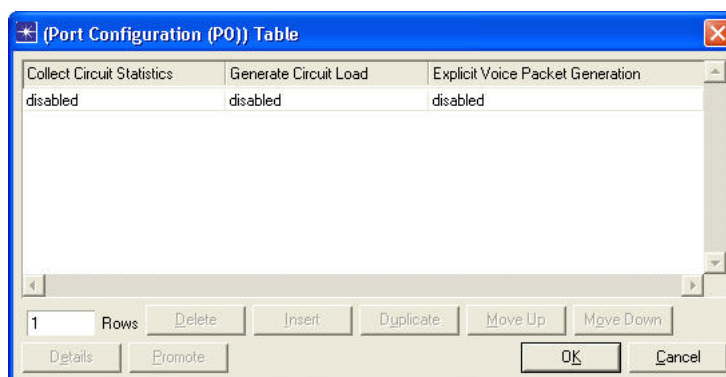


Figure 9: Port Configuration Compound Attribute

Table 9: Port Configuration Compound Attribute

Attributes	Description
Collect Circuit Statistics	This attribute controls whether user wants to collect circuit level statistics like throughput (bps, pps) and utilization for the circuit defined from this port
Generate Circuit Load	This attribute controls whether user wants to generate full circuit load for the circuit defined from this port. When the attribute is enabled, this port will generate hybrid packets to load the network with the same traffic load introduced by the circuit defined for this port. Since in OPNET, everything is a discrete packet, it is NOT possible to represent TDM (such as T1 or E1) framing with discrete packets (if you represent each frame as a packet, it will slow down the simulation). The incoming link is only busy when discrete packets arrive to the port; however TDM lines such as T1 or E1 are always sending frames (they send out NULL frames if there is no actual data). Because of limitation discussed above, it is not possible to perform "Structure Agnostic" emulation of the TDM link on the IP network. In other words, the load on the IP network will be only the load introduced by real data packets and not the full link bandwidth such as T1 or E1 load. When this attribute is set to enabled, hybrid traffic is generated with the same source-destination characteristics and with a bandwidth that is the difference between the link bandwidth and the real packet traffic on the link measured over small time intervals.
Explicit Voice Packet Generation	This attribute controls whether user wants to generate explicit (discrete) packets for the voice load (NETWARS circuit switched voice calls) flowing through this port. If the attribute is disabled, it will generate hybrid packets to represent voice load.

## 2.2 Link Configuration

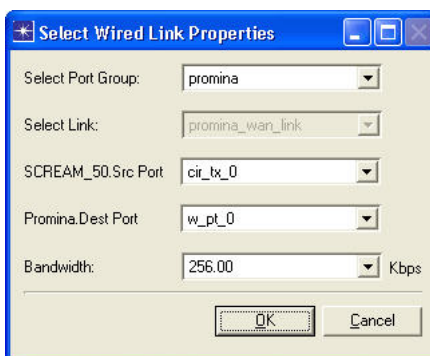
As CTP and SCREAM devices can connect to several types of technologies, they can also accept many different types of links. The link possibilities depend on the whether you are trying to connect a device to the circuit port or to the non-circuit port. Currently, there are two ways to deploy links inside NETWARS:

- Link Deployment Wizard (**Topology > Link Operations > Deploy Link** or **Ctrl + L**)
- Object Palette (**Topology > Open Object Palette**)

Currently, the easiest way to connect a CTP or SCREAM device is to use the Link Deployment Wizard. To accomplish a successful configuration, follow these steps:

Select the two devices which need to be connected and press **Ctrl + L**.

When the Link Deployment Wizard displays, select an available link technology from the menu (if no matching ports exist, the CTP or SCREAM device is unable to connect to this type of device).



*Figure 10: Link Deployment Wizard*

Select the link which is appropriate for this technology. For example, if the specified technology is Promina, then the promina\_wan\_link is available.

Check to make sure the ports on both the connecting devices are acceptable. On the CTP or SCREAM device, if the port is “cir\_tx\_#” then this device is connecting to the circuit port of the CTP or SCREAM device.

Change the bandwidth on the link if desired.

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

### **2.2.1 Circuit (Serial) Port Connections**

The circuit port of a CTP or SCREAM device is a serial port where any serial bit stream can be fed into the device (which is then packetized and sent over IP or ATM network).

Typical circuit side connections include multiplexer aggregate, promina aggregate, serial encrypted data or voice (circuit switch). Therefore, devices such as multiplexers (FCC\_100V7, etc.), Promina, encryptors (KG-84, etc.) and circuit switch nodes are all capable of directly connecting into the circuit port of the CTP or SCREAM device. The connections between the circuit-side device and the CTP or SCREAM device would be provided by the standard links given for each type of technology (the list below is not complete as other custom links could be added by the user):

- Multiplexer (MUX Aggregate)
- Promina (Promina WAN link)
- Circuit Switch (Wire PTP)
- Encryptor (KIV19, KG94, KG75, KG95-2, KG194)

## 2.2.2 Packet (Non-Circuit) Side Connections

The packet side port of a CTP or SCREAM device is the port which can be connected to either IP or ATM network (serial bit stream data from circuit port is converted into packets and sent out to the external network from the packet side port).

The packet side port of a CTP device can only be connected by ethernet link to an IP based device like an IP router, Ethernet switch, etc.

The connections between a packet-side device and the CTP device would be provided ONLY by ethernet links:

- Ethernet (10BaseT, 100BaseT, 1000BaseT)

The packet side port of a SCREAM device can be connected either by:

- Ethernet link to an IP based device like an IP router, Ethernet switch, etc.,
- ATM link to an ATM device like ATM switch,
- IP SLIP link to an IP router.

The connections between a packet-side device and a SCREAM device would be provided either by:

- Ethernet (10BaseT, 100BaseT, 1000BaseT),
- ATM (SONET OC1, OC3, OC12, OC24, OC48, ATM Generic),
- IP SLIP (T1, T3, PPP\_DS0, PPP\_E1, PPP\_E3, etc.)

## 2.3 CTP and SCREAM Circuit Configuration

Users need to configure circuits between two CTP or SCREAM devices for successful transmission of traffic. These circuits provide a mapping of a local circuit port on one CTP or SCREAM device to a remote circuit port on a separate (pair) CTP or SCREAM device.

A new path model, *nw\_circuit*, is created to represent generic circuits. Paths are standard OPNET objects that can connect two or more nodes in sequence. A custom path model is used so that the NETWARS generic circuit support does not interfere with the use of any OPNET path models.

The *nw\_circuit* path model has following attributes:

Table 10: CTP/SCREAM Circuit Attributes

Name	Type	Description
Circuit Type	string	Describes the name of circuit
Port A	string	Name of the port used on the first end device
Port B	string	Name of the port used on the last end device

The *Port A/B* attributes record the port assignment for the circuit and should be set to values matching the *Circuit Configuration.Source Port* attributes of the end devices.

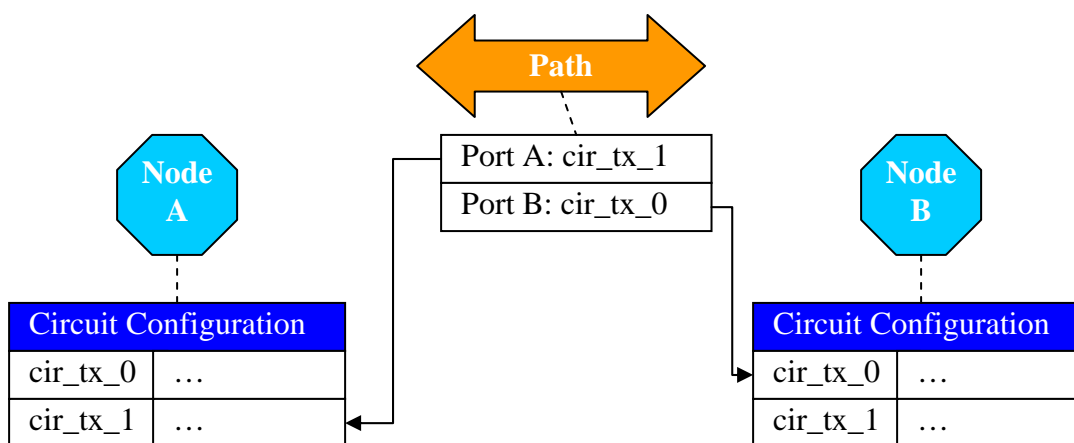


Figure 11: CTP/SCREAM Circuit Diagram

CTP and SCREAM devices use generic circuit framework (use of `nw_circuit` path object) for circuit configuration.

Circuits can be configured by two ways:

1. Use circuit wizard
2. Select two devices (CTP or SCREAM)

Use *Topology -> Deploy Circuits* menu option or the keyboard short cut (*Ctrl + D*)

Choose the two ports (local and remote port)

Users also have the option to set the circuit related attributes (sub attributes of *Circuit Configuration* compound attribute.)

Drag and drop from palette:

- Drag and drop a `nw_circuit path` object from palette

- Connect two end devices with this path object

The Circuit Deployment Wizard dialog box will display allowing users to choose the two ports and provide the user with the option to set circuit related attributes.

Circuit wizard workflow for CTP devices:

- Select two CTP devices
- Use *Topology -> Deploy Circuits* menu option or the keyboard short cut (*Ctrl + D*)

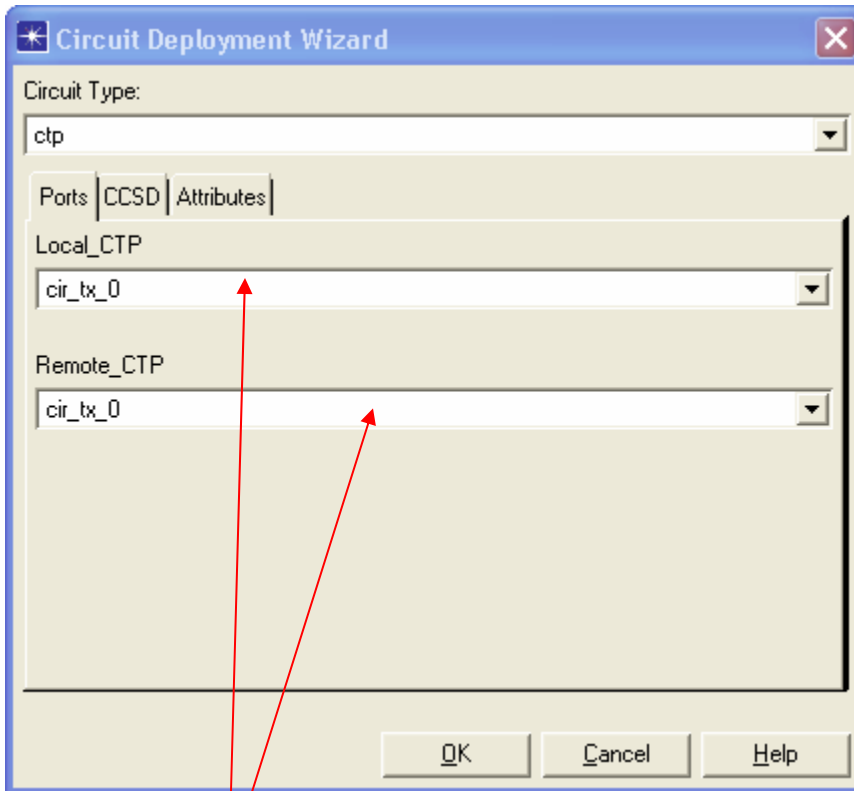


Figure 12: CTP Circuit Port Configuration

- Choose the two circuit ports for both devices
- Optionally set the circuit specific attributes by clicking on the Attributes tab



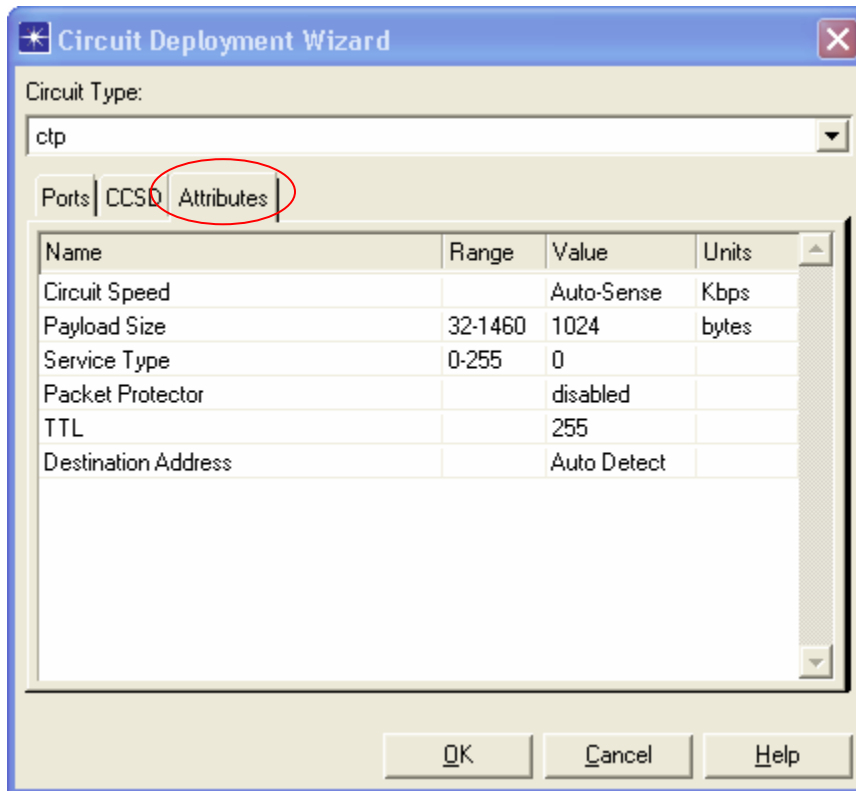


Figure 13: CTP Circuit Attributes Configuration

Circuit wizard workflow for SCREAM devices:

- Select two SCREAM devices
- Use *Topology -> Deploy Circuits* menu option or the keyboard short cut (*Ctrl + D*)

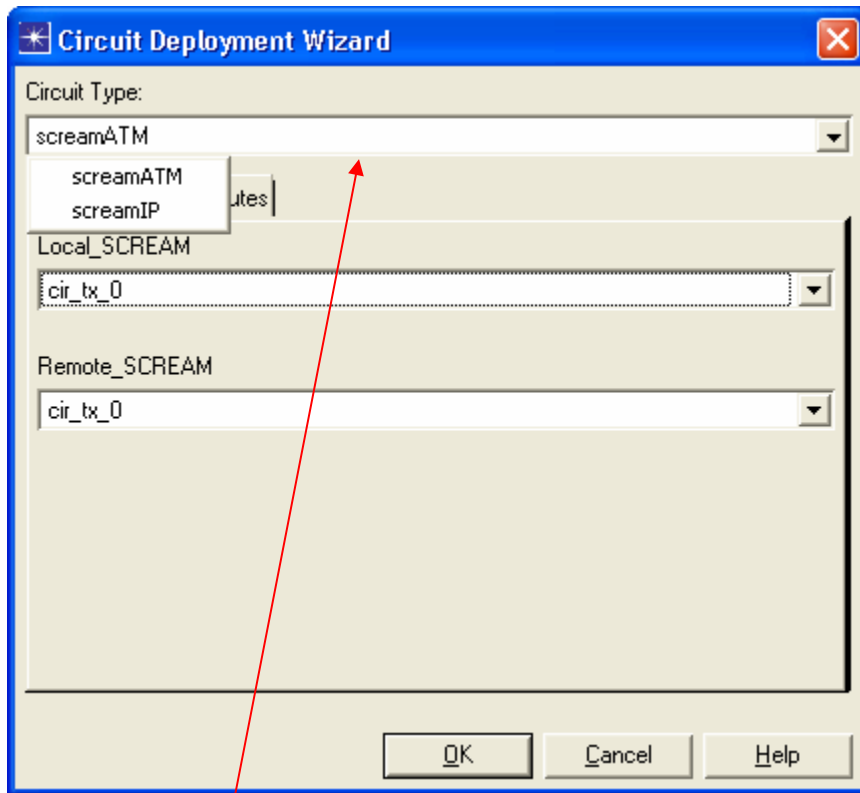


Figure 14: SCREAM Circuit Type Configuration

- Choose the circuit type (screamATM for sending serial data over ATM network or screamIP for sending serial data over IP network)
- Choose the two circuit ports for both devices
- Optionally set the circuit specific attributes by clicking on the Attributes tab

### 3 Usage

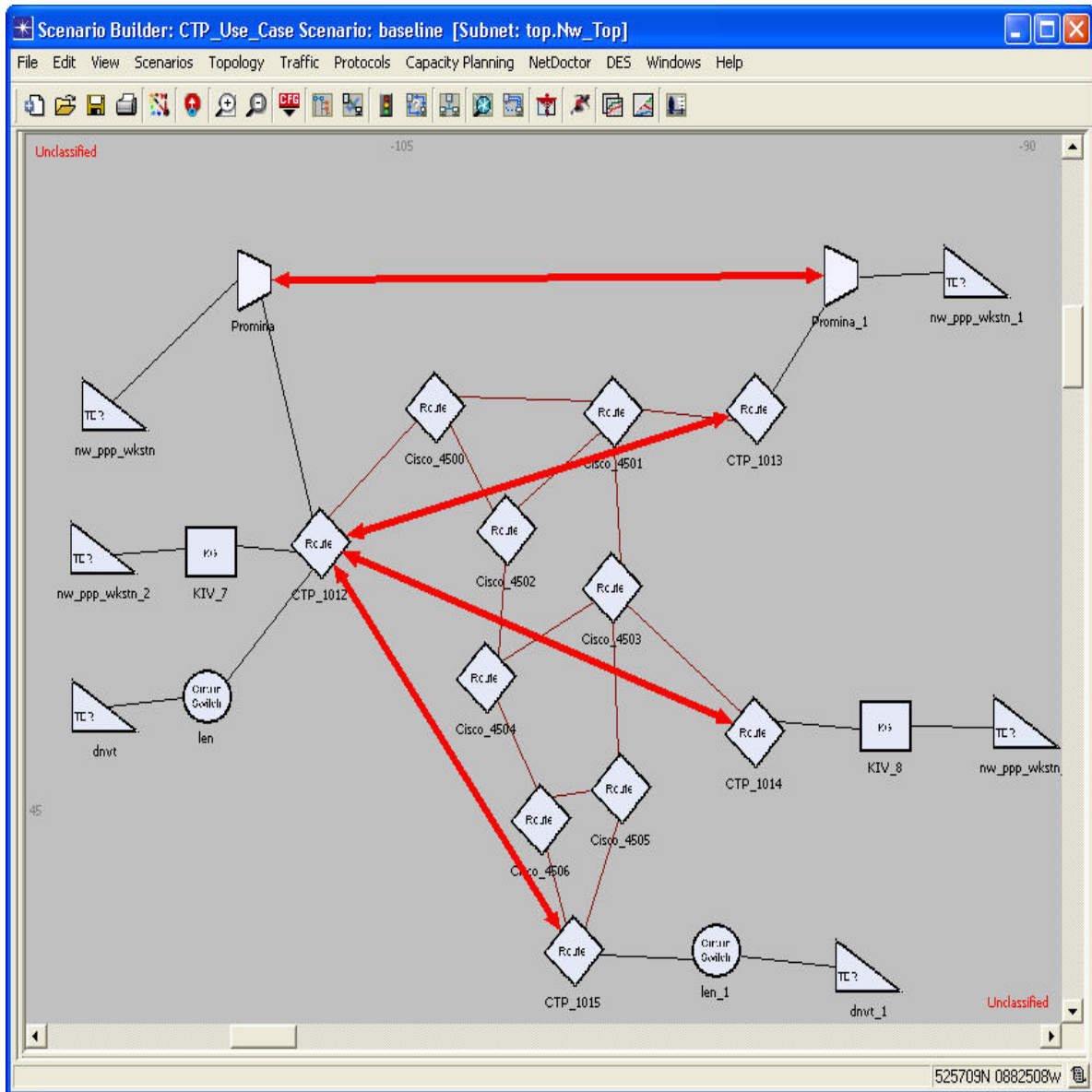


Figure 15: CTP Use Case

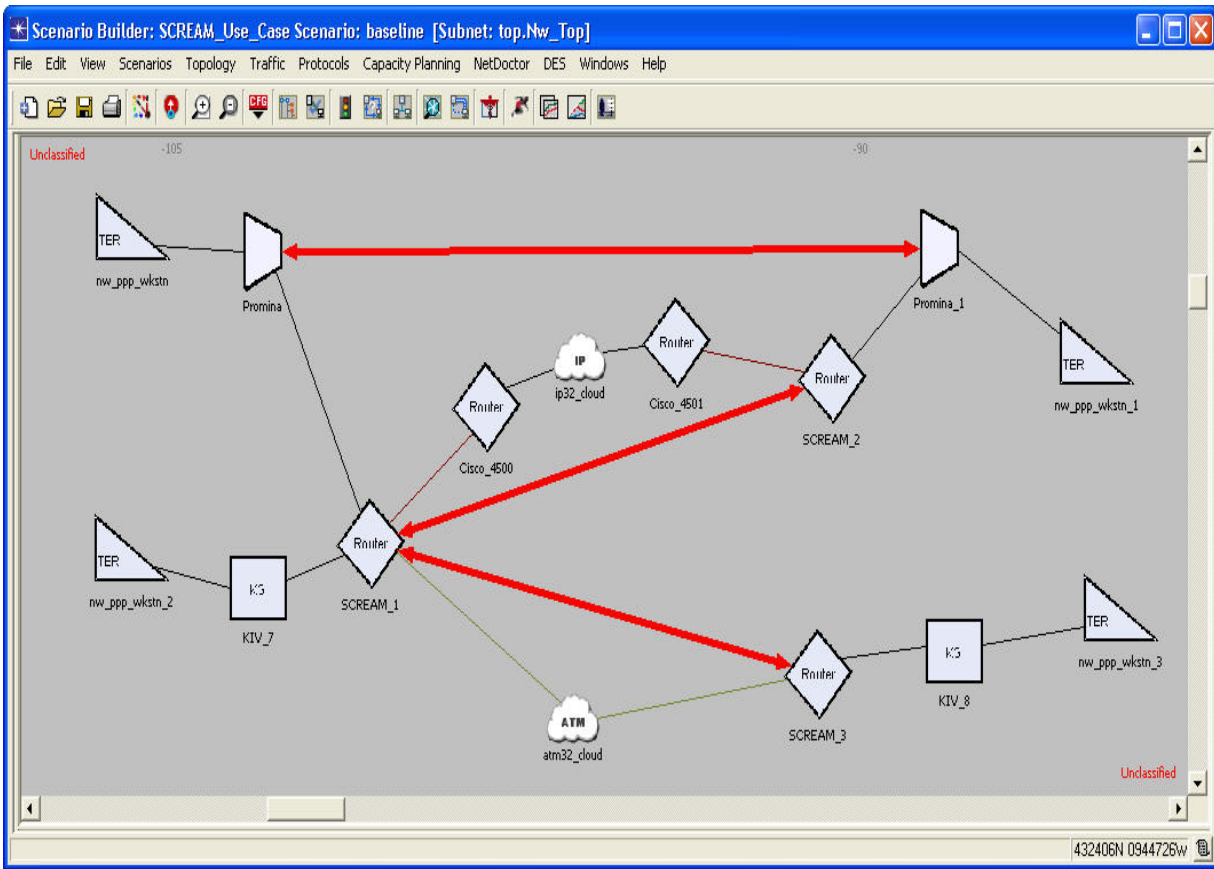


Figure 16: SCREAM Use Case

### 3.1 Capacity Planning Reports

The Capacity Planner is a tool that allows you to quickly study a network by analytically calculating the performance. Large number of studies such as failure, configuration, and capacity studies can be done using Capacity Planner tool. Inside NETWARS, the Capacity Planner tool has been enhanced to generate CTP and SCREAM circuit specific web reports. The web reports shown below are helpful when looking at the CTP and SCREAM devices.

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 displays the results from the analysis. There are two parts of the web report which are specific to CTP and SCREAM (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 once the Capacity Planner tool has finished. This report discusses an overall view of the network and gives the user high level points so that a reader can easily narrow down problems areas.

Inside the Executive Summary is a section titled “Circuit Performance.” This section shows the number of circuits defined and the number which were routed successfully. This gives you a quick method of checking whether the circuits deployed in the network were set up correctly.

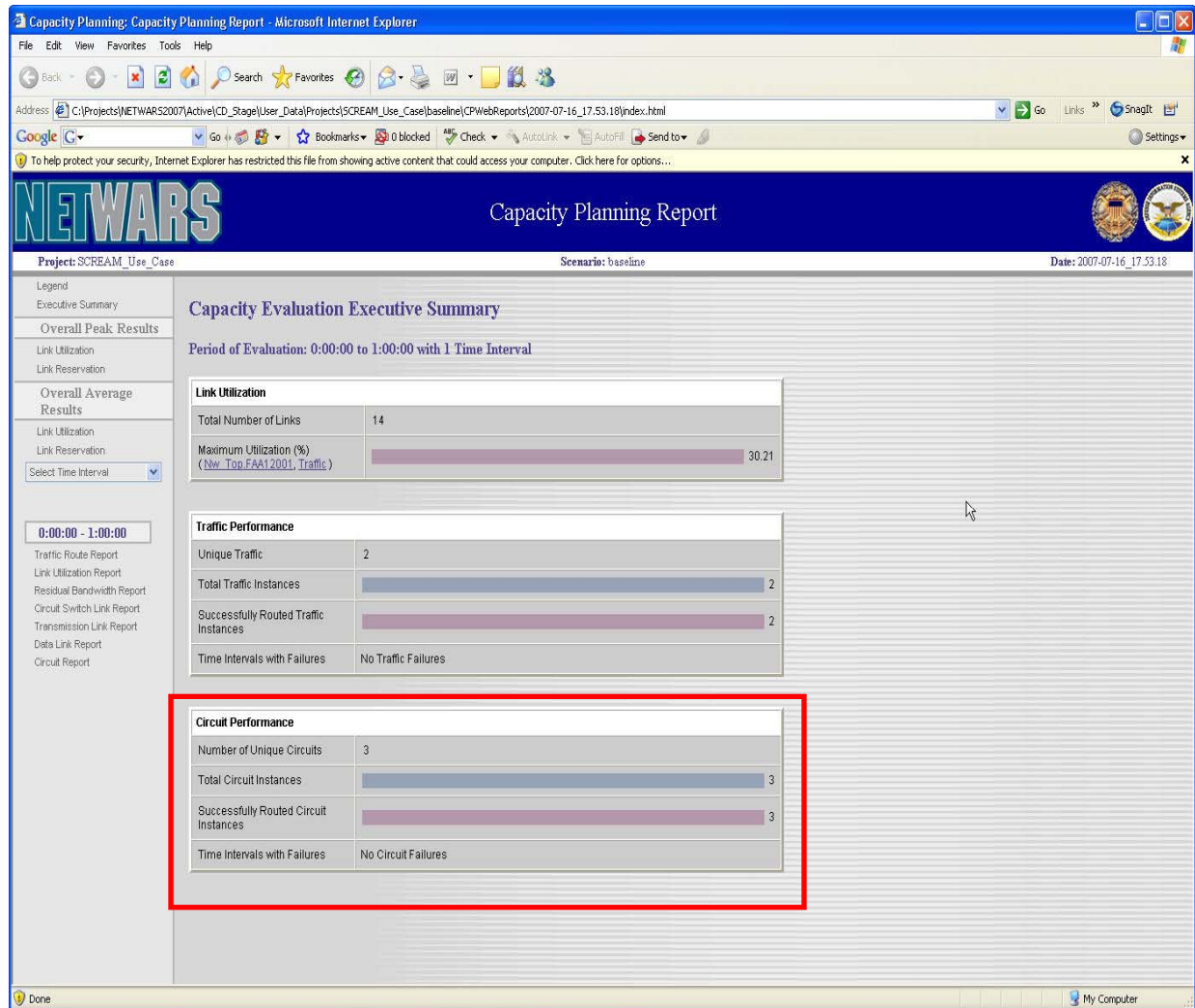


Figure 17: Capacity Planning Report Executive Summary

Secondly, the “Circuit Report” is another section inside the Capacity Planning Report. This section can be accessed by clicking on the hyperlink located on the left side of the Capacity Planning Report. The “Circuit Report” shows a complete list of circuits inside the network (including CTP, SCREAM, Promina, FCC, etc.) It provides a quick way of seeing what circuits have been defined, for which ports the circuit is defined, what devices are connected (or are subscribed) to that particular circuit, and information about the circuit (data rate, direction, etc.) This allows you to easily debug any problems where traffic is navigating that particular circuit. Also, much of the data displayed is shown in hyperlink form so you can click the necessary device or port in the report and the

Scenario Builder will display the relevant device. You are then able to check the necessary attributes or links to look for configuration issues.

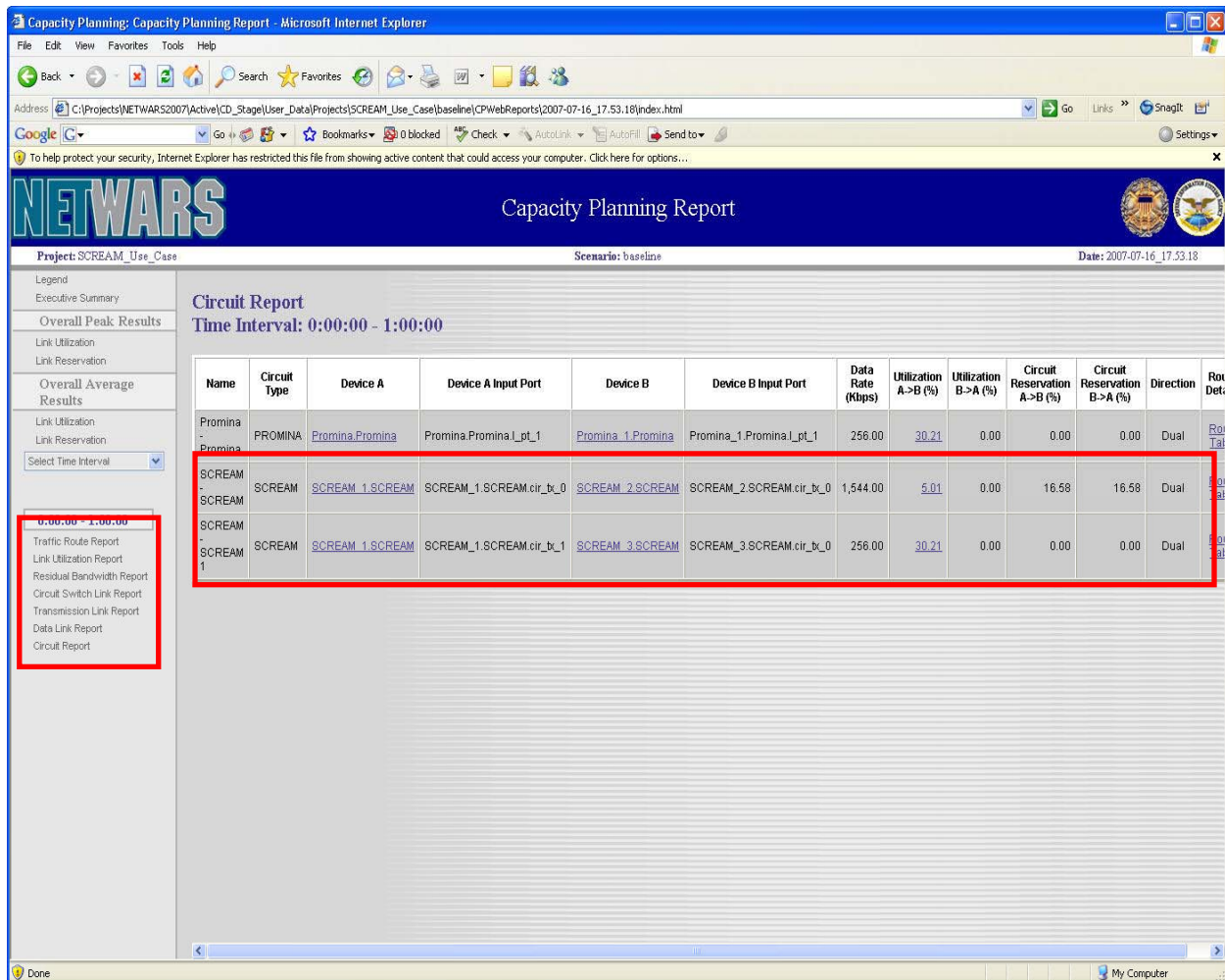
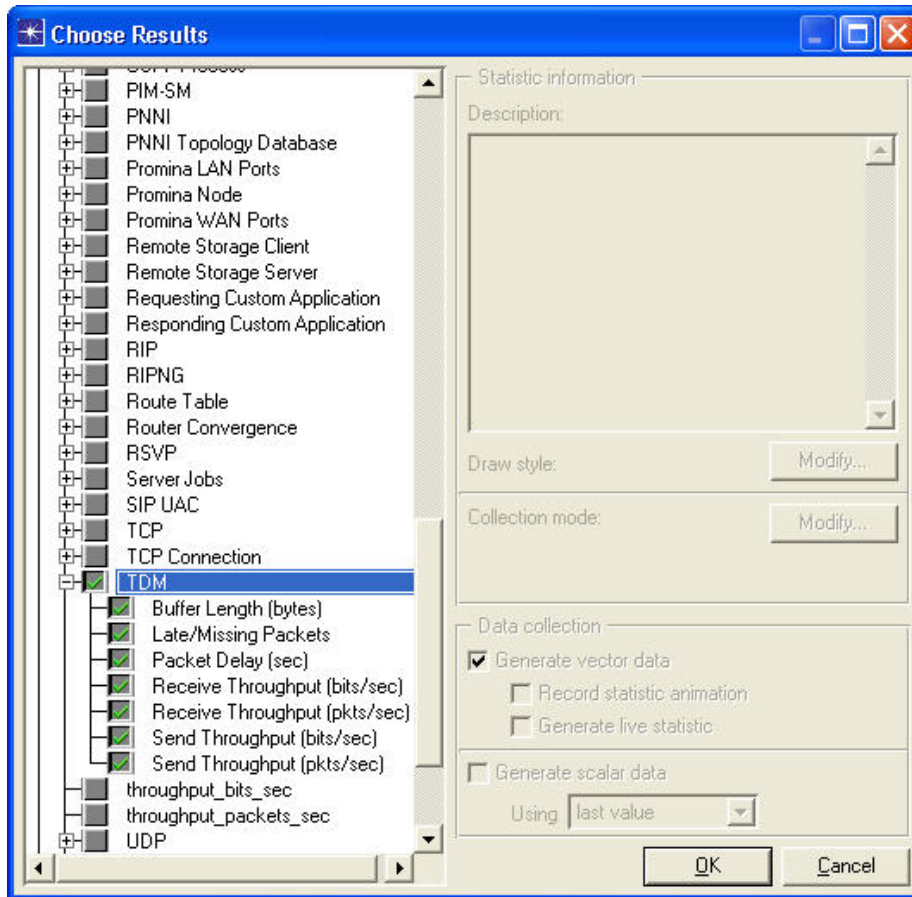


Figure 18: Capacity Planning Report Circuit Report

### 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 CTP and SCREAM 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 CTP and SCREAM device, the other available statistics are outside the scope of this document. Refer to the NETWARS and OPNET IT Guru standard documentation for more details on other statistics. CTP and SCREAM

collect a common set of statistics, and these statistics are grouped under “TDM” group (under “Node Statistics”). To choose these statistics, right-click on a node or right-click in the workspace, and select “Choose Individual DES Statistics”.



*Figure 19: CTP and SCREAM Specific Statistics*

You can also collect circuit level statistics (refer to section 2.1.3 for more details.)



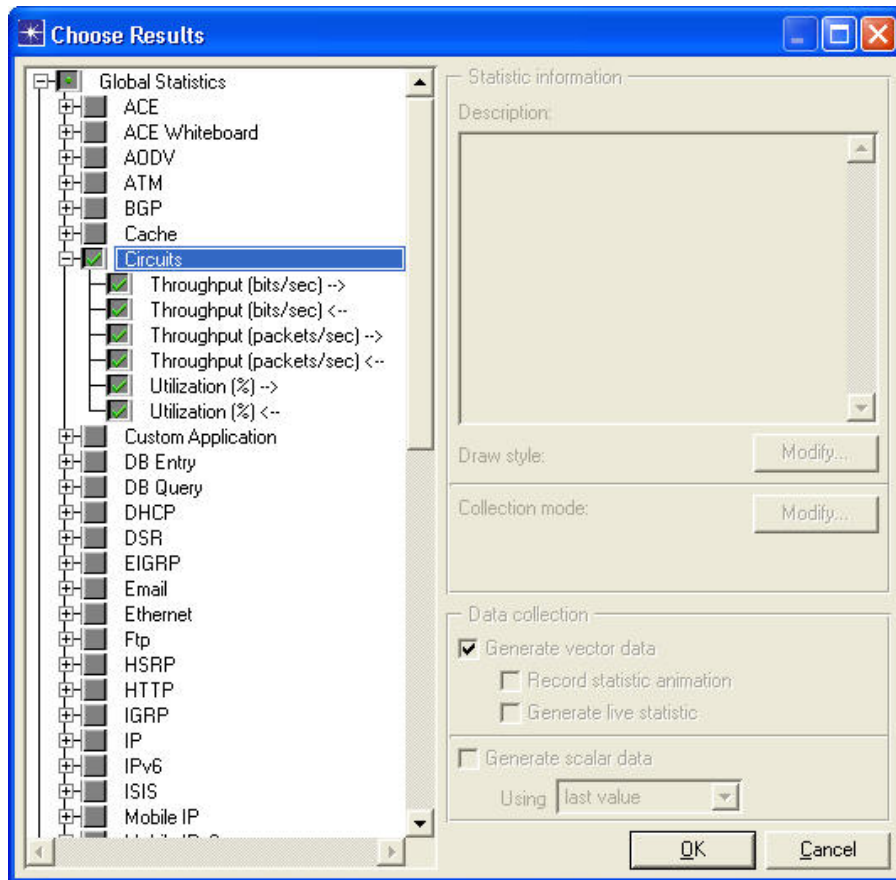


Figure 20: Circuit Specific Statistics

Table 11: CTP and SCREAM Specific Statistics

Statistic	Description
Buffer Length (bytes)	Size of the receive buffer at the destination CTP or SCREAM
Late/Missing Packets	The number of packets that are either lost in the network or not delivered in enough time to be relayed to the circuit. Missing packets are those packets destined for the serial interface that were not available at the time that data was needed. This may be due to a dropped packet in the IP/ATM network. Late packets are those packets that arrive too late to be sent to the serial interface
Packet Delay (secs)	The time it takes for a packet to go from the source CTP or SCREAM to the destination CTP or SCREAM
Receive Throughput (bits/sec)	The incoming network data rate in bits per second at the destination CTP or SCREAM
Receive Throughput (packets/sec)	The incoming network data rate in packets per second at the destination CTP or SCREAM
Send Throughput (bits/sec)	The outgoing network data rate in bits per second from the source CTP or SCREAM
Send Throughput (packets/sec)	The outgoing network data rate in bits per second from the source CTP or SCREAM



Table 12: Circuit Specific Statistics

Statistic	Description
Throughput (bits/sec) →	Data (in bits per second) sent on this circuit in the direction A→B
Throughput (packets/sec) →	Data (in packets per second) sent on this circuit in the direction A→B
Throughput (bits/sec) ←	Data (in bits per second) sent on this circuit in the direction B→A
Throughput (packets/sec) ←	Data (in packets per second) sent on this circuit in the direction B→A
Utilization (%) →	Utilization (data sent/data rate of circuit) of the circuit in the direction A→B
Utilization (%) ←	Utilization (data sent/data rate of circuit) of the circuit in the direction B→A

### 3.3 Logical Views

Logical views provide the ability to filter the network so that particular layers or technologies can be looked at more closely by the user.

CTP devices have IP technology so you can look at the CTP devices in the network by using the IP layer. This layer can be located in the “Network Layer Filters” section of the Logical View Selection dialog box. Note that the logical links functionality can be found under the **View > Show Logical Views...** menu (dialog box shown below).

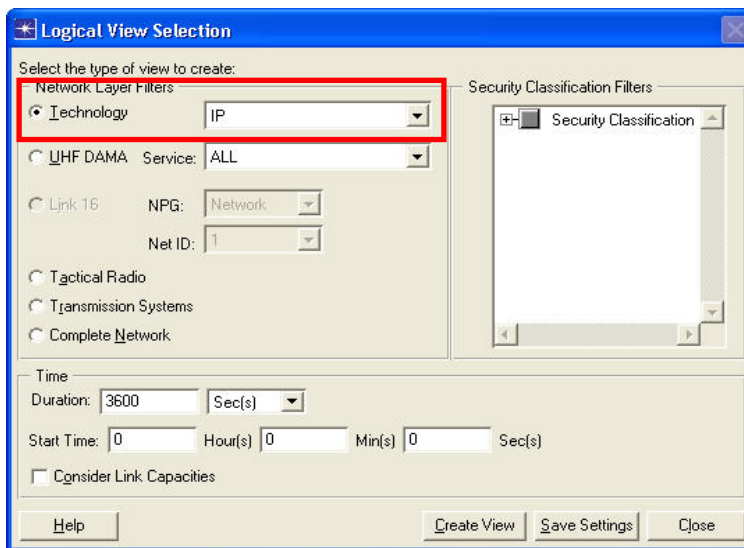


Figure 21: Logical View Selection Dialog Box

Once a logical view of the CTP devices is created, you are able to see a graphical representation of the connectivity of the CTP devices inside the scenario with other IP based devices.

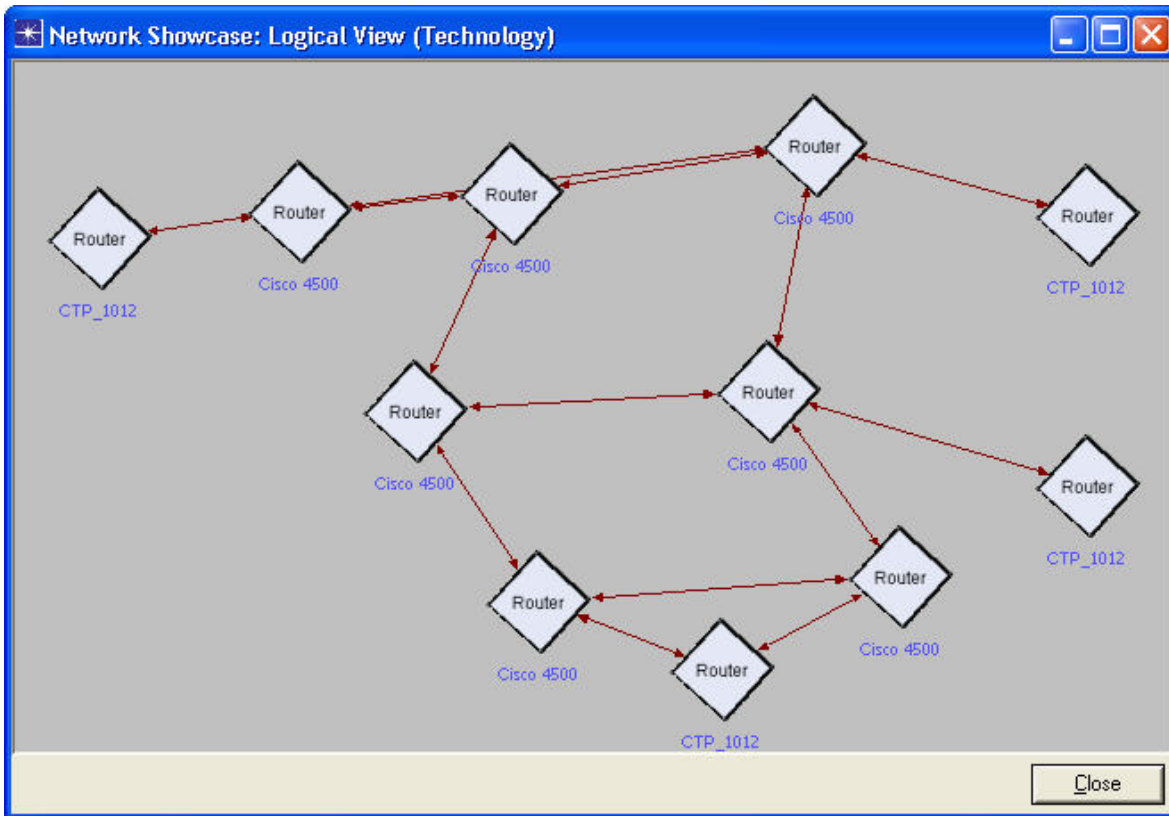


Figure 22: CTP Logical View Example

SCREAM devices have both IP and ATM technology, so you can look at the SCREAM devices in the network by using the IP and ATM layer.

If you create a logical view of the SCREAM devices using IP technology, you will be able to see a graphical representation of the connectivity of the SCREAM devices inside the scenario with other IP based devices.

If you create a logical view of the SCREAM devices using ATM technology, you will be able to see a graphical representation of the connectivity of the SCREAM devices inside the scenario with other ATM based devices.

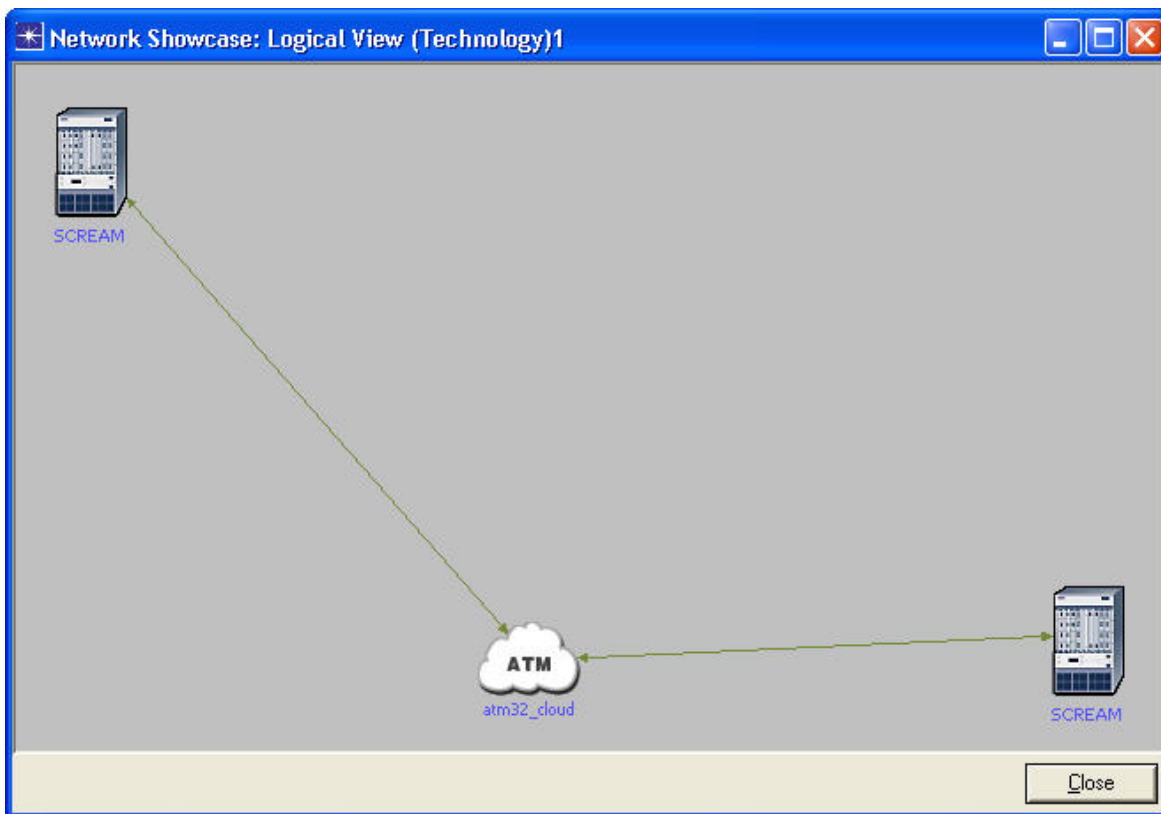


Figure 23: SCREAM Logical View Example (From ATM Technology)

### 3.4 Supported Equipment Strings

Equipment strings are combinations of connected devices which can typically be found inside a network. The equipment strings discussed in the following subsections should be considered as normal use cases for the CTP and SCREAM devices and are supported by NETWARS. Note that the arrows in red designate a non-circuit-side connection; the blue arrows designate a circuit-side connection (serial port). CTP and SCREAM share the same set of equipment strings for the circuit (serial port) side connections.

### 3.4.1 Circuit (Serial) Port Equipment Possibilities

The equipment strings in this subsection illustrate all of the circuit (serial) side equipment possibilities. Blue path objects represent Promina circuits while red path objects are CTP/SCREAM circuits.

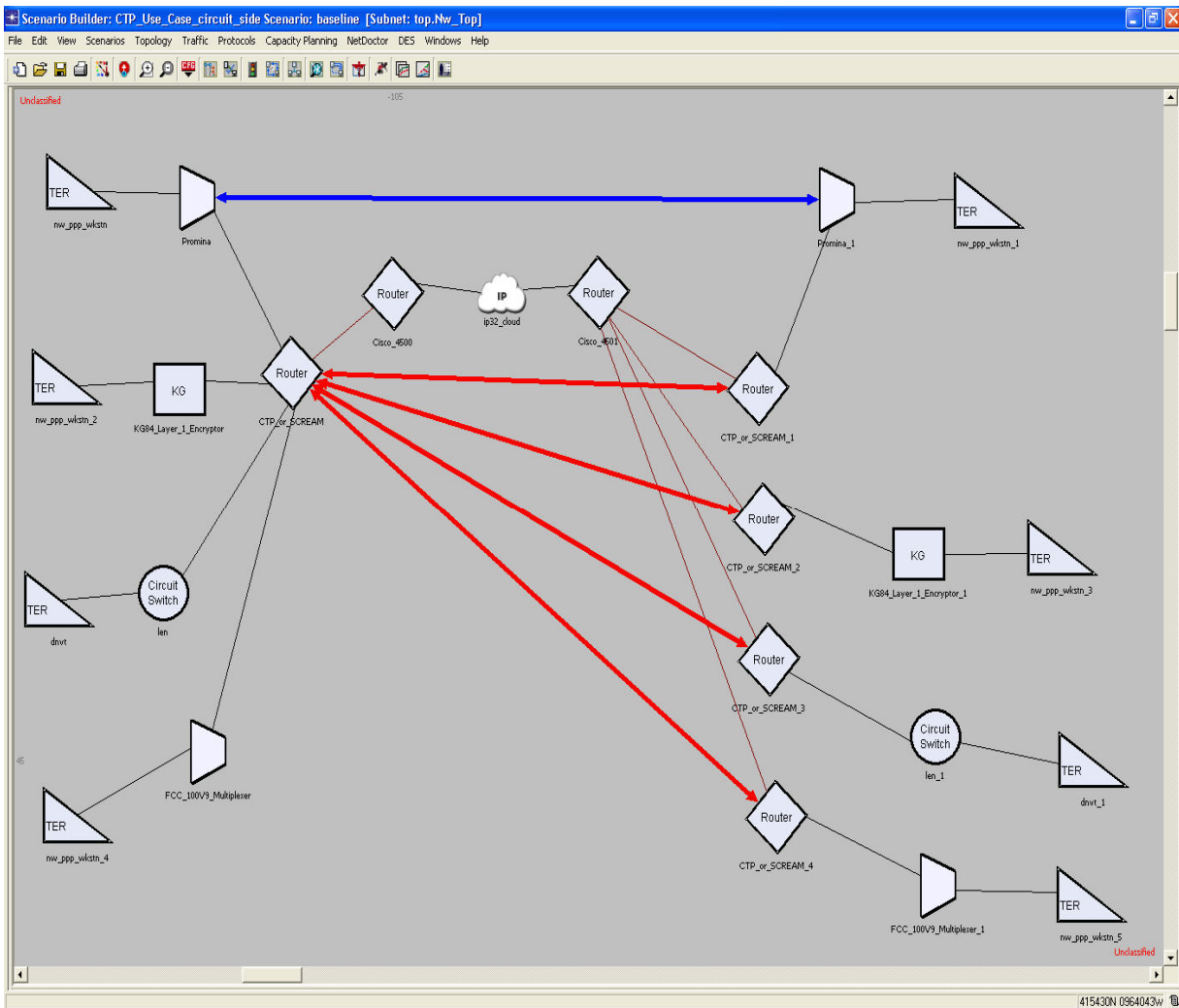


Figure 24: Circuit Side CTP/SCREAM Equipment String

### 3.4.2 Packet (Non-Circuit) Side Equipment Possibilities

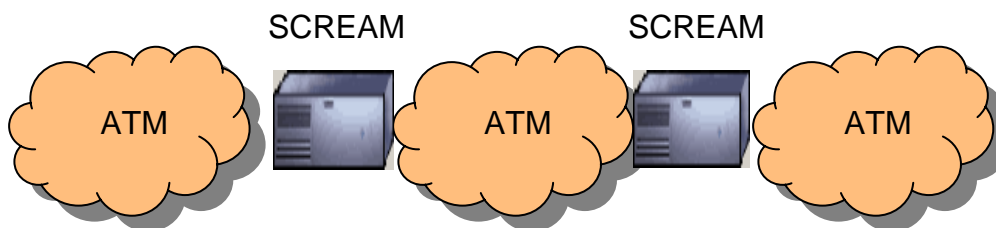
Ethernet ports are the ONLY type of packet side connection in a CTP device, so packet side can only be connected through an Ethernet link (10baseT, 100BaseT, 1000BaseX) to an Ethernet switch or an IP router with Ethernet ports (Ethernet switch node models like ethernet16\_switch, ethernet32\_switch, etc., in “ethernet” palette, IP router with Ethernet ports like Cisco4500, Cisco7505, etc., in “NETWARS Standard model” palette).

SCREAM has three types of packet side ports, Ethernet, ATM and SLIP (serial IP). So the packet side can be connected by one or more of the following:

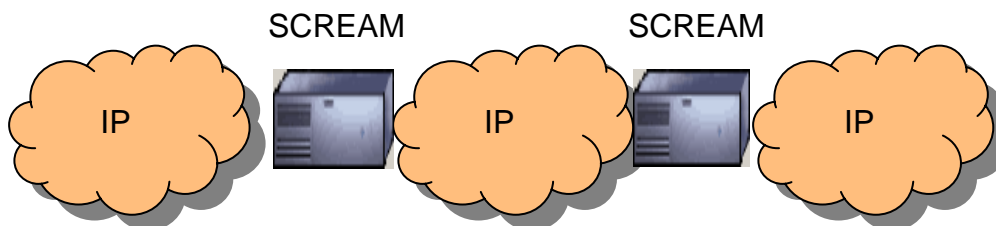
- Through an Ethernet link (10baseT, 100BaseT, 1000BaseX) to an Ethernet switch or an IP router with Ethernet ports (Ethernet switch node models like ethernet16\_switch, ethernet32\_switch, etc., in “ethernet” palette, IP router with Ethernet ports like Cisco4500, Cisco7505, etc., in “NETWARS Standard model” palette)
- Through an ATM link (like ATM\_OC3, ATM\_OC12, etc.) to an ATM switch or ATM cloud (node models like atm8\_crosscon, atm32\_cloud, etc., in “atm” palette)
- Through a serial IP (like T1, T3, PPP\_DS0, PPP\_E1, etc.) to an IP router with SLIP ports (IP router with SLIP ports like Cisco4500, Cisco7505, etc., in “NETWARS Standard model” palette)

### 3.4.3 SCREAM Other Use Cases

SCREAM can also be used as an ATM switch or an IP router. Circuit ports are NOT configured in this kind of setup. When used as an ATM switch, ATM ports are used for connections, while when used as an IP router, Ethernet ports are used for connections. In these configurations, you will ONLY get the COTS IP and ATM functionality.



*Figure 25: SCREAM as an ATM Switch*



*Figure 26: SCREAM as an IP Router*

### **3.5 Traffic Usage**

The CTP and SCREAM nodes treat the data coming to the circuit (serial) ports as a generic packet stream regardless of the underlying protocols in the packet. There is therefore no particular restriction on the traffic type from the CTP and SCREAM point-of-view. This means that the CTP and SCREAM nodes are able to handle NETWARS IERs, standard OPNET traffic (Applications, Flows, ACE, etc.), and even custom traffic types.

### **3.6 Usage in Modeler**

It is possible to use the NETWARS CTP and SCREAM models in OPNET Modeler. In a combined NETWARS/Modeler environment (when you launch Modeler from NETWARS), you need to drag and drop *nw\_modeler\_support* utility node in your scenario (this node will perform the circuit initialization and will include all the relevant external files).

## 4 Node Models

### 4.1 CTP

The following CTP model (node model: CTP\_1012) has the following ports:

- 12 circuit side ports (serial)
- 2 packet side ports (Ethernet).

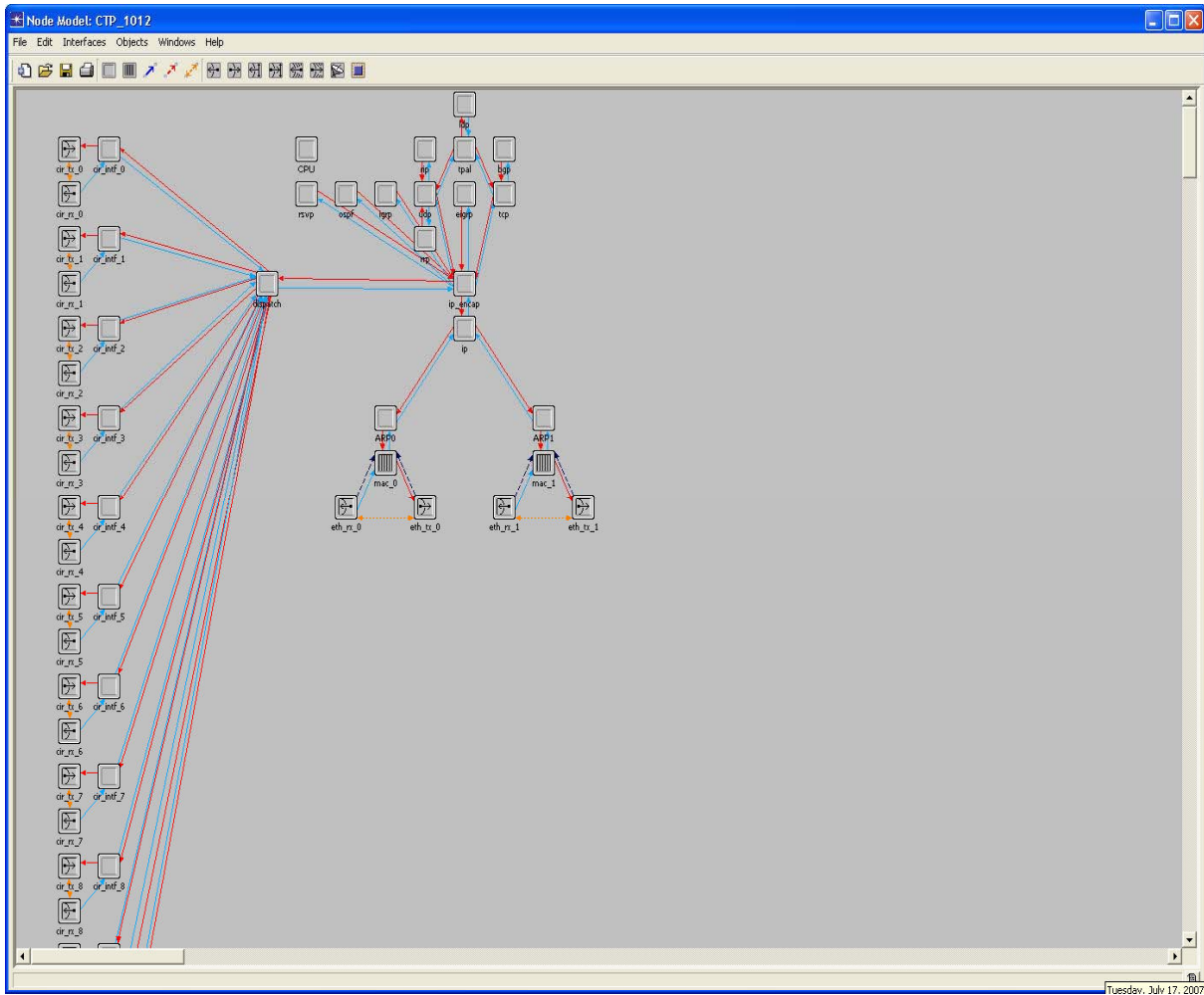


Figure 27: CTP Node Model

## 4.2 SCREAM

The following SCREAM model (node model: SCREAM\_50) has the following ports:

- 8 circuit side ports
- 4 ATM ports
- 2 Ethernet ports
- 2 SLIP ports (serial IP ports)

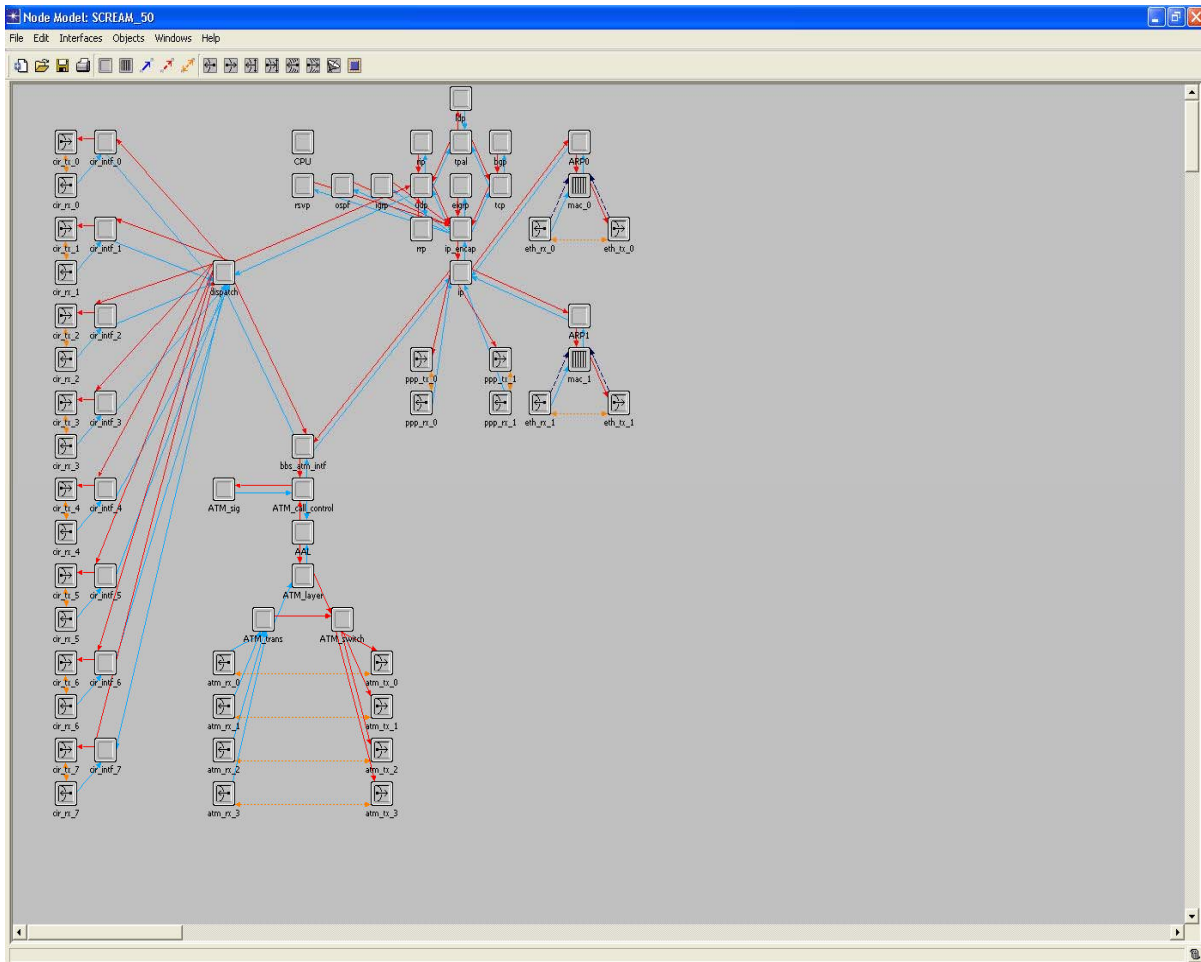


Figure 28: SCREAM Node Model

## 4.3 Device Creator

Currently there is no support for creating custom CTP or SCREAM node models using device creator utility in Scenario Builder.