Nortel Networks Multiservice Switch

7400/15000/20000

# Operations: AAL1 Circuit Emulation

NN10600-720

Nortel Networks Multiservice Switch 7400/15000/20000

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# Publication history

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General availability. Contains information on Nortel Networks Multiservice Switch 7400, 15000, and 20000 for the PCR6.1 release.

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# About this document

This document describes the Nortel Networks Multiservice Switch Asynchronous Transfer Mode Adaptation Layer type 1 Circuit Emulation Service (AAL1 CES) including:

- operation and features
- installation and configuring
- application examples
- how to interpret and resolve problems

The following topics are discussed in this section:



## Who should read this document and why

This document is for persons who perform the following tasks for AAL1 CES:

- planning
- engineering

- installing and configuring
- configuring
- operating and maintaining
- troubleshooting

## What you need to know

This document assumes that you understand Nortel Networks Multiservice Switch network architecture. You can learn more about Multiservice Switch networks and products by reading NN10600-030 *Nortel Networks Multiservice Switch 7400/15000/20000 Overview*.

## How this document is organized

This document contains the following sections:

- "CES configuration" (page 21) describes how to configure the AAL1 CES software.
- "Connection recovery and path optimization" (page 45) describes how to configure these services.
- "Monitoring and maintaining the service" (page 55) describes how to use operational mode commands to monitor AAL1 CES components and attributes.
- "Alarms and troubleshooting" (page 73) describes how to troubleshoot problems that may occur during the installation and operation of AAL1 CES.
- "Understanding AAL1 CES" (page 79) presents an overview of AAL1 CES and lists the standards to which this service conforms.
- "Feature description" (page 85) provides deployment scenarios that illustrate how AAL1 CES routes constant bit rate data.
- "Engineering considerations" (page 139) describes parameters that affect the performance of AAL1 CES.

## What's new in this document

The following feature was added to this document:

- "PNNI local and global rerouting" (page 15)

Other changes made to this document include the following:

- The table “Handling of structured and unstructured services” (page 87) was updated to indicate 4-port OC-3/STM-1Ch TDM/CES FP support for E1 and DS1 unstructured services with and without TDM frame monitoring.
- The terms Passport and PVG have been rebranded in conjunction with the new Nortel Networks’ brand simplified naming format. Passport is now referred to as the Nortel Networks Multiservice Switch, and PVG is now Media Gateway 7480/15000. For more information on the product rebranding, refer to NN10600-000 *Nortel Networks Multiservice Switch 7400/15000/20000 What’s New in PCR6.1*.
- The section “Fractional input” (page 88) was updated to reflect proper terminology. All references to CBR were changed to TDM.
- For CR Q00941677, the section “Interworking with other AAL1 products” (page 105) was updated with a note stating that the 4-port OC-3/STM-1 channelized TDM/CES function processor does not support edge-based rerouting (EBR) for CES.

## PNNI local and global rerouting

The following sections were updated for this feature:

- “Prerequisites to connection recovery and path optimization” (page 45)
- “Configuring connection subscription for Aal1CesReroute” (page 53)
- “Monitoring rerouting” (page 63)
- “Operational attributes for Aal1Ces/n Reroute” (page 69)
- “Operational attributes for Aal1Ces/n Reroute” (page 69)

## Structural changes

This document was restructured into a modular, task-based format to improve the usability of the information. The following changes were made to this document:

- Procedures were grouped into higher-level tasks.

- Task flow charts were added to improve navigation through tasks and procedures, to set tasks and procedures in context, and to provide a visual representation of prerequisites and configuration paths.
- Procedures were restructured into a modular format.
- Purpose statements were added to tasks and procedures to provide context.
- Prerequisites were divided into those applicable to an entire task. those applicable only to a specific procedure, and those applicable only to a specific procedure step. Prerequisites applicable to an entire task were placed in the appropriate task-level prerequisite section, prerequisites applicable only to a specific procedure were placed in the perquisites section of the procedure, and prerequisites applicable only to a specific step were placed in the step.
- 'Where' statements were removed from procedures and the content placed in the 'Variable values' table following the procedure.
- A 'Procedure Job Aid' section was added to procedures where appropriate. This consists of information that supports the procedure, such as a component hierarchy figure, a checklist, or a diagram.
- Conceptual and reference information were removed from procedures, placed in the appropriate conceptual or reference section, and cross-referenced from the procedure where appropriate. If no appropriate conceptual or reference section existed in which to place such information removed from the procedures, the information was placed in temporary sections called 'Supporting information' and 'Additional information' at the end of the affected chapter. Only supporting information is cross-referenced from the procedure. The supporting and additional information sections will be removed when an appropriate location for the information is created.

## Text conventions

This document uses the following text conventions:

- `nonproportional spaced plain type`

  Nonproportional spaced plain type represents system generated text or text that appears on your screen.

- `nonproportional spaced bold type`

  Nonproportional spaced bold type represents words that you should type or that you should select on the screen.

- *italics*

  Statements that appear in italics in a procedure explain the results of a particular step and appear immediately following the step.

  Words that appear in italics in text are for naming.

- `[optional_parameter]`

  Words in square brackets represent optional parameters. The command can be entered with or without the words in the square brackets.

- `<general_term>`

  Words in angle brackets represent variables which are to be replaced with specific values.

- UPPERCASE, lowercase

  Nortel Networks Multiservice Switch node commands are not case-sensitive and do not have to match commands and parameters exactly as shown in this document, with the exception of string options values (for example, file and directory names) and string attribute values.

- |

  This symbol separates items from which you may select one; for example, ON|OFF indicates that you may specify ON or OFF. If you do not make a choice, a default ON is assumed.

- ...

  Three dots in a command indicate that the parameter may be repeated more than once in succession.

The term absolute pathname refers to the full specification of a path starting from the root directory. Absolute pathnames always begin with the slash ( / ) symbol. A relative pathname takes the current directory as its starting point, and starts with any alphanumeric character (other than /).

## Related documents

See the following documents for related information:

- NN10600-030 *Nortel Networks Multiservice Switch 7400/15000/20000 Overview*
- NN10600-170 *Nortel Networks Multiservice Switch 7400 Hardware Description*
- NN10600-120 *Nortel Networks Multiservice Switch 15000/20000 Hardware Description*
- NN10600-175 *Nortel Networks Multiservice Switch 7400 Hardware Installation, Maintenance, and Upgrade*
- NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*
- NN10600-060 *Nortel Networks Multiservice Switch 7400/15000/20000 Component Reference*
- NN10600-435 *Nortel Networks Multiservice Switch 7400/15000/20000 Operations: Path-Oriented Routing System*
- NN10600-550 *Nortel Networks Multiservice Switch 7400/15000/20000 Common Configuration Procedures*
- NN10600-551 *Nortel Networks Multiservice Switch 7400/15000/20000 FP Configuration Reference*
- NN10600-700 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Technology Fundamentals*

The following documents provide additional information on AAL1 CES:

- Draft ITU-T Recommendation I.363.1, B-ISDN ATM Adaptation Layer (AAL) Specification Types 1 and 2, COM 13-R51, September 1995
- ATM Forum AF-VTOA-0078.000, Circuit Emulation Service Interoperability Specification, November 1996

## How to get more help

For information on training, problem reporting, and technical support, see the "Nortel Networks support services" section in NN10600-030 *Nortel Networks Multiservice Switch 7400/15000/20000 Overview*.

# Chapter 1
# CES configuration

Configure the AAL1 Circuit Emulation Service on the Nortel Networks Multiservice Switch function processors (FP) providing AAL1 CES capability.

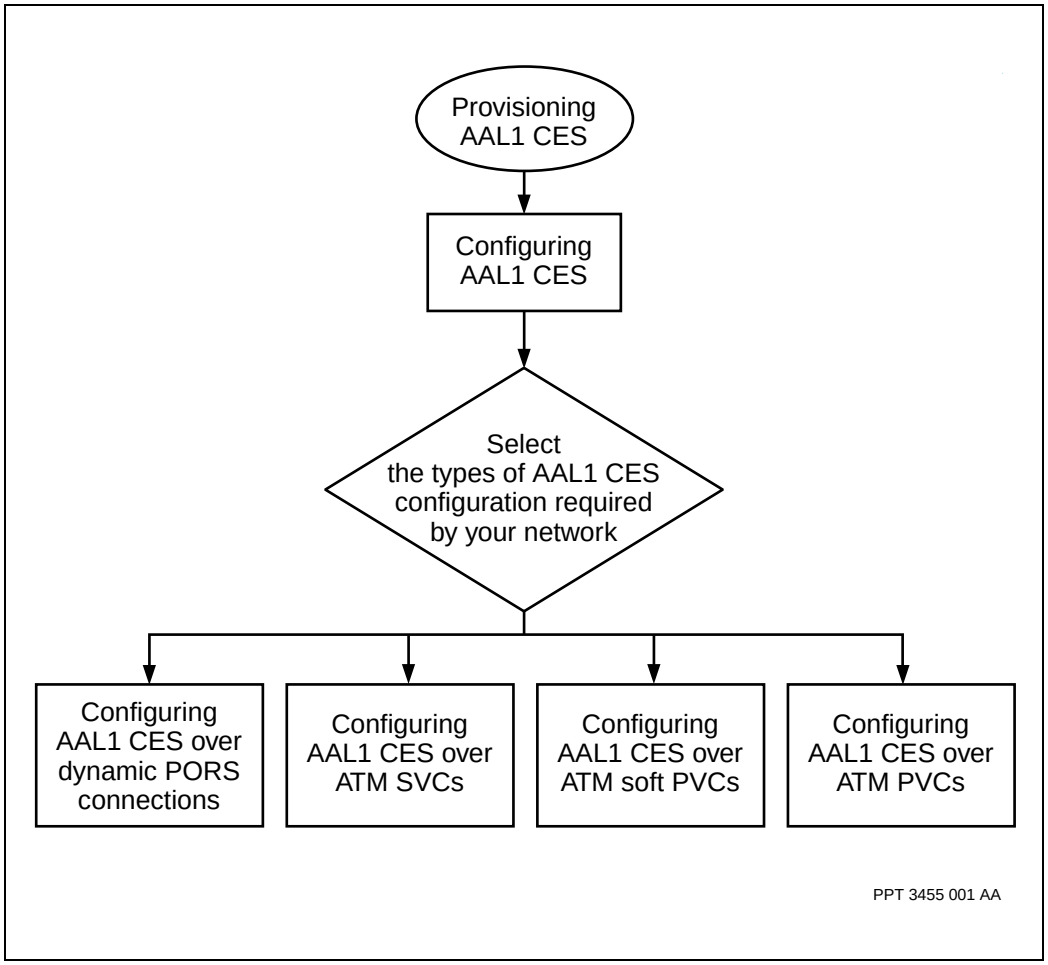
## Prerequisites to CES configuration

- Ensure all nodes that are candidates for AAL1 CES traffic use the same version of AAL1 CES software.
- If you are unfamiliar with AAL1 CES concepts, see “Understanding AAL1 CES” (page 79).
- For information on which FPs support AAL1 CES, see NN10600-551 *Nortel Networks Multiservice Switch 7400/15000/20000 FP Configuration Reference*.

## CES configuration flow

This taskflow shows you the sequence of procedures you perform to configure AAL1 CES. To link to any procedure, go to “Task navigation” (page 22).

**Figure 1**
**CES configuration taskflow**




## Task navigation

- “Configuring AAL1 CES” (page 24)
- “Configuring AAL1 CES over dynamic PORS connections” (page 30)
- “Configuring AAL1 CES over ATM SVCs” (page 33)
- “Configuring AAL1 CES over ATM soft PVCs” (page 37)

- “Configuring AAL1 CES over ATM PVCs” (page 41)

# Configuring AAL1 CES

Configure the AAL1 CES by configuring the appropriate Nortel Networks Multiservice Switch function processors (FP) to support it.

## Prerequisites

- Before proceeding with configuring basic AAL1 CES, you must have completed the requirements specified in “Installing AAL1 CES software” (page 137)
- You must ensure that the FPs and logical processors (LPs) that the service will use have been configured.
- For more information on configuring function processors, see NN10600-551 *Nortel Networks Multiservice Switch 7400/15000/20000 FP Configuration Reference*.
- If you are using the 32-port DS1 or 32-port E1 Multiservice Access FP for both AAL1 CES and ATM, you will need to configure a combined logical processor type with both features.

## Procedure steps

**1** Add the *LogicalProcessor* (*Lp*) component for the FP providing CES capability and the FP providing ATM capability.

```
add Sw Lpt/<cesFPname>
```

```
add Sw Lpt/<atmFPname>
```

**2** Set the feature list for the FP providing CES capability (applicable to Multiservice Switch 7400, Multiservice Switch 15000, and Multiservice Switch 20000 nodes.

```
set Sw Lpt/<cesFPname> featureList! aal1ces
```

**3** Set the feature list for the FP providing ATM capability (applicable to Multiservice Switch 7400 nodes only).

```
set Sw Lpt/<atmfpname> featureList! porsTrunks atmPnni
```

or

Set the feature list for the FP providing ATM capability (applicable to Multiservice Switch 15000 and Multiservice Switch 20000 nodes).

```
set Sw Lpt/ATMfpname> featureList! atmPnni
```

**4** Add the *Lp* component for the FP providing CES capability.

**add Lp/<CES_Lp>**

5 Link the *Lp* component to the slot associated with the FP providing CES capability.

**set Lp/<CES_Lp> mainCard Shelf Card/<CES_Card>**

6 Specify the FP providing CES capability.

**set Shelf Card/<CES_Card> cardType <CES_cardType>**

7 Set the logical processor type (*Lpt*) for FP providing AAL1 CES capability.

**set Lp/<CES_Lp> Lpt Sw Lpt/AAL1CESFP**

8 Add the FP providing ATM capability to transport AAL1 cells into the ATM network by adding the *Lp* component for the FP providing ATM capability, then linking the *Lp* component to the slot associated with the FP providing ATM capability and specifying the FP providing ATM capability

**add Lp/<ATM_Lp>**

**set Lp/<ATM_Lp> mainCard Shelf Card/<ATM_Card>**

**set Shelf Card/<ATM_Card> cardType <ATM_cardType>**

9 Set the logical processor type for the FP providing ATM capability, and then activate and confirm the configuring commands.

**set Lp/<ATM_Lp> Lpt Sw Lpt/<atmfpname>**

10 Add a port and configure all the timeslots of its channel component (The *Channel* (*Chan*) component is added automatically).

11 Add a port to the FP providing AAL1 CES capability

- For a DS1 FP

**add Lp/<CES_Lp> DS1/<DS1>**

- For a DS1 under a 4-port OC-3/STM-1Ch TDM/CES FP:

**add Lp/<CES_Lp>**

**add Lp/<CES_Lp> sonet/<sonet>**

**add Lp/<CES_Lp> sonet/<sonet> sts/<sts>**

**set Lp/<CES_Lp> sonet/<sonet> sts/<sts> concatNumber 1**

**add Lp/<CES_Lp> sonet/<sonet> sts/<sts> VT1dot5/<l,m>**

**add Lp/<CES_Lp> sonet/<sonet> sts/<sts> VT1dot5/<l,m> DS1**

```
add Lp/<CES_Lp> sonet/<sonet> sts/<sts> VT1dot5/<l,m>
DS1 chan/<chan>
```

- For an E1 FP:

```
add Lp/<CES_Lp> E1/<E1>
```

- For an E1 under a 4-port OC-3/STM-1Ch TDM/CES or 2-port STM-1e channelized CES/ATM/IMA FP:

```
add Lp/<CES_Lp>

add Lp/<CES_Lp> sdh/<sdh>

add Lp/<CES_Lp> sdh/<sdh> vc4/<vc4>

add Lp/<CES_Lp> sdh/<sdh> vc4/<vc4> vc12/<k,l,m>

add Lp/<CES_Lp> sdh/<sdh> vc4/<vc4> vc12/<k,l,m> E1

add Lp/<CES_Lp> sdh/<sdh> vc4/<vc4> vc12/<k,l,m> E1
chan/<chanE1>
```

- For a DS3 FP:

```
add Lp/<CES_Lp> DS3/<DS3>

add Lp/<CES_Lp> DS3/<DS3> DS1/<DS1t>
```

**12** Set the DS1 lineType for unstructured CES, structured CCS, or structured CAS:

```
set Lp/<CES_Lp> DS1/<DS1> lineType <lineType_value>
```

***Note:*** The value of the CES *linetype* attribute must match the service configured for the *servicetype* attribute.

**13** Set timeslots under the *Chan* component to support AAL1 CES service.

- For a DS1 FP:

```
set Lp/<CES_Lp> DS1/<DS1> Chan/<Chands1> timeslots
<DS1_set_of_timeslots>
```

- For a DS1 under a 4-port OC-3/STM-1Ch TDM/CES FP:

```
set Lp/<CES_Lp> sonet/<sonet> sts/<sts> VT1dot5/<l,m>
DS1 chan/<chan> timeslots <timeslots>
```

- For an E1 FP:

```
set Lp/<CES_Lp> E1/<E1> Chan/<ChanE1> timeslots
<E1_set_of_timeslots>
```

- For an E1 under a 4-port OC-3/STM-1Ch TDM/CES or 2-port STM-1e channelized CES/ATM/IMA FP:

```
set Lp/<CES_Lp> sdh/<sdh> vc4/<vc4> vc12/<k,l,m> E1
chan/<chanE1> timeslots <timeslots>
```

- For a DS3 FP:

```
set Lp/<CES_Lp> DS3/<DS3> DS1/<DS1t> Chan/<Chan>
timeslots <DS1_set_of_timeslots>
```

**14** In order to provision structured CES, add the *TrunkConditioning (Tc)* component:

```
add Lp/<ATM_Lp> DS1/<DS1> Chan/<Chan> Tc
```

**15** Add the *Aal1Ces* component.

```
Add Aal1Ces/<Aal1Ces>
```

**16** Set the *servicerType (servType)* attribute for unstructured CES, structured CCS, or structured CAS:

```
set Aal1Ces/<Aal1Ces> serviceType <serviceType_value>
```

***Note:*** The value of the *serviceType* attribute must match the service configured for the *lineType* attribute.

**17** Set the *cellDelayVariationTolerance* (*cdvt*) attribute.

```
set Aal1Ces/<Aal1Ces> cdvt <cdvt>
```

## Variable definitions

| Variable | Value |
|---|---|
| <Aal1Ces> | The instance number of the *Aal1Ces* component, having a value between 1 and 65535 inclusive. |
| <ATM_Card> | The instance number of the FP providing ATM service. |
| <ATM_cardType> | A valid Multiservice Switch card type for a FP that supports ATM interfaces. |
| <ATM_Lp> | The instance number of the logical processor associated with the FP providing ATM service. |
| <atm FP name> | The name of the FP providing ATM services |

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| Variable | Value |
|---|---|
| <cdvt> | The value in milliseconds<br>For the 4-port DS1 AAL1 and 4-port E1 AAL1 FPs, you can set a value in the range 0.01 to 655.00 milliseconds inclusive.<br>For the 32-port DS1 and 32-port E1 Multiservice Access FPs, you can set a value in the range 0.01 to 31.87 milliseconds inclusive.<br>For the four-port DS3 channelized AAL1 CES and four-port OC-3/STM-1 channelized TDM/CES FPs, you can set a value in the range 1.00 to 31.00 milliseconds inclusive. |
| <CES_Card> | The instance number of the FP providing CES capability. |
| <CES_cardType> | Indicates the type of FP providing CES capability. |
| <ces FP name> | The name of the FP providing AAL1 CES services |
| <CES_Lp> | The instance number of the logical processor associated with the FP providing CES capability. |
| <chan> | The number of channels, having a value between 0 and 23 |
| <chanDS1> | The instance number of the DS1 channel, having a value between 0 and 24. |
| <chanE1> | The number of channels, having a value between 0 and 31. |
| <DS1> | The instance number of the DS1 component. DS1 for 4pds1 has a value from 0 to 3; MSA32/DS1 has a value between 0 and 31. |
| <DS1_set_of_timeslots> | A set of decimal numbers ranging from 1 to 24 inclusive, with each representing a particular timeslot. One or more DS1 timeslots must be configured for a structured service. Timeslot values for MSA32 DS1 and 4-port DS1 AAL1 FPs are, by default, empty and therefore should be provisioned. |
| <DS1t> | The instance number of the DS1 tributary, having a value between 1 and 28. |
| <DS3> | The instance number of the DS3 component, having a value between 0 and 3. |
| <E1> | The instance number of the E1 component, having a value between 0 and 31. E1 for 4pe1aal1 has a value from 0 to 3; MSA32/E1 has a value between 0 and 31. |

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| Variable | Value |
|---|---|
| <E1_set_of_timeslots> | A set of decimal numbers ranging from 1 to 31 inclusive, with each representing a particular timeslot. One or more E1 timeslots must be configured for a structured service. Note that if the lineType attribute value is set to cas, timeslot number 16 is not valid. Timeslot values for MSA32 E1 and r-port E1 AAL1 FPs are, by default, empty and therefore should be provisioned. |
| <k,l,m> | The E1 tributary, <k> having a value between 1 and 3, <l> having a value between 1 and 7, and <m> having a value between 1 and 3. |
| <l,m> | The ds1 tributary, <l> having a value between 1 and 7, and <m> having a value between 1 and 4. |
| <lineType_value> | Set to unframed for unstructured CES, d4 or esf for structure CCS, or d3cas or esfcas for structured CAS. |
| <sdh> | The instance number of the STM-1 sdh component, having a value between 0 and 3. |
| <serviceType_value> | Set to unstructured for unstructured CES, basicstructured for structured CCS, or casstructured for structured CAS. |
| <sonet> | The instance number of the OC3 sonet component, having a value between 0 and 3. |
| <sts> | The instance number of the STS, having a value between 0 and 2. |
| <timeslots> | A set of decimal numbers ranging from 1 to 24 inclusive, with each representing a particular timeslot. The default channel/0 will have all 24 timeslots provisioned. If multiple channels are provisioned, the timeslots will be reconfigured. |
| <timeslotsE1> | A set of decimal numbers ranging from 1 to 31, inclusive, with each representing a particular timeslot. The default channel/0 will have all 31 timeslots provisioned. If multiple channels are provisioned, the timeslots will be reconfigured. |
| <vc4> | The instance number of the vc4, having a value of 0. |

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# Configuring AAL1 CES over dynamic PORS connections

Configure AAL1 CES to run over dynamic PORS connections.

This procedure explains only the CES-related configuring for dynamic connections.

## Prerequisites

- Install AAL1 CES software. See *"Installing AAL1 CES software" (page 137)*.
- Configure AAL1 CES. See "Configuring AAL1 CES" (page 24).
- Configure a PORS network. See NN10600-435 *Nortel Networks Multiservice Switch 7400/15000/20000 Operations: Path-Oriented Routing System* for more information.
- Configure ATM routing. See NN10600-710 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Configuration Management* and NN10600-702 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Routing and Signalling Fundamentals* and for more information.
- See the table "Connection setups for AAL1 CES" (page 96) for function processors (FP) supporting AAL1 CES over dynamic PORS connections.

## Procedure steps

**1** Add the AAL1 CES application to the FP providing AAL1 CES capability.

```
add Aal1Ces/<Aal1Ces>
```

**2** Add the *ActiveEndPoint* (*Aep*) subcomponent by adding the Aep subcomponent and setting it to one end of the service.

```
add Aal1Ces/<Aal1Ces> Aep
```

```
set Aal1Ces/<Aal1Ces> Aep addressToCall
<addressToCall>
```

By default, the *Aep* subcomponent of *Aal1Ces/<Aal1ces>* has the *retryLimit* attribute set to 0 (which means that it will keep trying to establish the link indefinitely), and the *firstRetryInterval* attribute set to 10 seconds.

**3** Set the Aep component routingOption.

**set Aal1Ces/<Aal1Ces> Aep routingOption atmonly**

For Multiservice Switch 7400 nodes, the *Aep* subcomponent of *Aal1Ces/<Aal1ces>* has a default routingOption of porsOnly. In order to interwork with Multiservice Switch 15000 nodes, the routingOption must be set to its default value of atmOnly.

**4** Link the AAL1 CES application to the FP providing AAL1 CES capability.

- For a DS1 FP:

**set Aal1Ces/<Aal1Ces> interfaceName Lp/<CES_Lp> DS1/<DS1> Chan/<chan>**

- For an E1 FP:

**set Aal1Ces/<Aal1Ces> interfaceName Lp/<CES_Lp> E1/<E1> Chan/<chanE1>**

***Note:*** While any channel value can be provisioned, channel 0 is recommended.

**5** Add the *PassiveEndPoint (Pep*) component at the other end of the service.

**add Aal1Ces/<Aal1Ces> Pep**

**set Aal1Ces/<Aal1Ces> Pep expectedRemoteAddress <RemoteAddress>**

If the module *nodePrefix* already exists, the *Aep* and *Pep* components will be added with default addresses. In this case, you do not need to set both Aep and Pep *localAddress* attribute.

## Variable definitions

| Variable | Value |
|---|---|
| <Aal1Ces> | The instance number of the *Aal1Ces* component, having a value between 1 and 65535 inclusive |
| <Addresstocall> | The address identifier of the remote local address. |
| <CES_Lp> | The instance number of the logical processor associated with the FP providing CES capability. |
| <chan> | The instance number of the DS1 channel, having a value between 0 and 24. |

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| Variable | Value |
|---|---|
| <chanE1> | The instance number of the E1 channel, having a value between 0 and 31. |
| <DS1> | The instance number of the DS1 component, having a value between 0 and 3 for 4-port DS1 AAL1 and between 0 and 31 for MSA32 DS1 FP. |
| <E1> | The instance number of the E1 component, having a value between 0 and 3 for 4-port E1 AAL1 FP and between 0 and 31 for MSA32 E1 FP. |
| <RemoteAddress> | The remote address identifier. This address is the local address of the Aal1Ces Aep component. |

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# Configuring AAL1 CES over ATM SVCs

Configure AAL1 CES over ATM SVCs on either a 32-port DS1 Multiservice Access FP, a 32-port E1 Multiservice Access FP or a 4-port DS3 channelized AAL1 CES FP.

## Prerequisites

- Install AAL1 CES software. See *"Installing AAL1 CES software" (page 137)*.
- Configure AAL1 CES service. See *"Configuring AAL1 CES" (page 24)*.
- Configure ATM routing. See NN10600-710 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Configuration Management* and NN10600-702 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Routing and Signalling Fundamentals* and for more information.
- See the table "Connection setups for AAL1 CES" (page 96) for function processors (FP) supporting AAL1 CES over dynamic ATM SVCs.

## Procedure steps

1. Add the AAL1 CES application to the FP providing AAL1 CES capability.

   ```
   add Aal1Ces/<Aal1Ces>
   ```

2. Add the *ActiveEndPoint* (*Aep*) subcomponent and set it to one end of the service.

   ```
   add Aal1Ces/<Aal1Ces> Aep
   ```

   ```
   set Aal1Ces/<Aal1Ces> Aep addressToCall
   <addressToCall>
   ```

   By default, the *Aep* subcomponent of *Aal1Ces/<Aal1ces>* has the *retryLimit* attribute set to 0 (which means that it will keep trying to establish the link indefinitely), and the *firstRetryInterval* attribute set to 10 seconds.

3. Add the *PassiveEndPoint (Pep*) component at the other end of the service.

   ```
   add Aal1Ces/<Aal1Ces> Pep
   ```

   ```
   set Aal1Ces/<Aal1Ces> Pep expectedRemoteAddress
   <RemoteAddress>
   ```

If the module *nodePrefix* already exists, the *Aep* and *Pep* components will be added with default addresses. In this case, you do not need to set the *localAddress* attribute.

**4** Link the AAL1 CES application to the FP providing AAL1 CES capability.

- For a DS1 FP:

```
set Aal1Ces/<Aal1Ces> interfaceName Lp/<CES_Lp>
DS1/<DS1> Chan/<chan>
```

- For a DS1 under a 4-port OC-3/STM-1Ch TDM/CES FP:

```
set Aal1Ces/<Aal1Ces> interfaceName Lp/<CES_Lp>
Sonet/<sonet> Sts/<sts> VT1dot5/<l,m> DS1 Chan/<chan0>
```

- For an E1 FP:

```
set Aal1Ces/<Aal1Ces> interfaceName Lp/<CES_Lp>
E1/<E1> Chan/<chanE1>
```

- For a DS1 in a DS3 FP:

```
set Aak1Ces/<Aal1Ces> interfaceName Lp/<CES_Lp> DS3/
<DS3> DS1/<DS1> Chan/<chan>
```

- For an E1 under a 4-port OC-3/STM-1Ch TDM/CES or 2-port STM-1e channelized CES/ATM/IMA FP:

```
set Aal1Ces/<Aal1Ces> interfaceName Lp/<CES_Lp>
Sdh/<sdh> Vc4/<vc4> Vc12/<k,l,m> E1 Chan/<chanE14p>
```

***Note:*** While any channel value can be provisioned, channel 0 is recommended.

**5** Set the *routingOption* (*routing*) attribute used to establish the connection.

```
set Aal1Ces/<Aal1Ces> Aep routingOption atmOnly
```

***Note:*** The atmOnly attribute is for the Multiservice Switch 15000 CES FP and supports interworking with Multiservice Switch 7400 nodes.

## Variable definitions

| Variable | Value |
|---|---|
| <Aal1Ces> | The instance number of the *Aal1Ces* component, having a value between 1 and 65535 inclusive. |
| <addressToCall> | The address identifier of the Aal1Ces Pep component. |
| <CES_Lp> | The instance number of the logical processor associated with the FP providing CES capability. |
| <chan> | The instance number of the DS1 channel, having a value between 0 and 24. |
| <chanE1> | The instance number of the E1 channel, having a value between 0 and 31. |
| <chanE14p> | The number of channels, having a value between 0 and 31. |
| <chan0> | The instance number of the channel (group DS0 timeslots), having a value between 0 and 23. |
| <DS1> | The instance number of the DS1 component, having a value between 0 and 28, 0 and 3 for 4pDS1AAL1 FP or 0 and 31 for MSA32DS1 FP or DS3. |
| <DS3> | The instance number of the DS3 component, having a value between 0 and 31. |
| <E1> | The instance number of the E1 component, having a value between 0 and 3 for the 4pE1AAL1 FP or 0 and 31 for the MSA32E1 FP. |
| <k,l,m> | The E1 tributary, <k> having a value between 1 and 3, |
| <l> | A value between 1 and 7, and <m> having a value between 1 and 4. |
| <l,m> | The ds1 tributary, <l> having a value between 1 and 7, and <m> having a value between 1 and 4 |
| <RemoteAddress> | The local address identifier of the Aal1Ces Aep component. |
| <sdh> | The instance number of the STM-1 sdh component, having a value between 0 and 3. |
| <sonet> | The instance number of the OC3 sonet component, having a value between 0 and 3 |

(Sheet 1 of 2)

| Variable | Value |
|---|---|
| <sts> | The instance number of the sts component, having a value between 0 and 3. |
| <vc4> | The instance number of the Vc4, having a value of 0. |
| <Aal1Ces> | The instance number of the Aal1Ces component, having a value between 1 and 65535 inclusive |

(Sheet 2 of 2)

# Configuring AAL1 CES over ATM soft PVCs

Configure AAL1 CES over soft PVCs on 4-port DS1 AAL1 FPs, 4-port E1 AAL1 FPs, 32-port DS1 Multiservice Access FPs or 32-port E1 Multiservice Access FPs.

## Prerequisites

- Install AAL1 CES software. See *"Installing AAL1 CES software" (page 137)*.
- Configure AAL1 CES service. See *"Configuring AAL1 CES" (page 24)*.
- Configure ATM routing. See NN10600-710 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Configuration Management* and NN10600-702 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Routing and Signalling Fundamentals* and for more information.
- See the table "Connection setups for AAL1 CES" (page 96) for function processors (FP) supporting AAL1 CES over dynamic soft PVCs. For more information on configuring soft PVCs, see NN10600-710 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Configuration Management*.

## Procedure steps

**1** Enter configuring mode.

```
start Prov
```

**2** Add the AAL1 CES application to the FP providing AAL1 CES capability.

```
add Aal1Ces/<Aal1Ces>
```

**3** Add the *ActiveEndPoint* (*Aep*) subcomponent.

```
add Aal1Ces/<Aal1Ces> Aep
```

```
set Aal1Ces/<Aal1Ces> Aep addressToCall
<addressToCall>
```

By default, the *Aep* subcomponent of *Aal1Ces/<Aal1ces>* has the *retryLimit* attribute set to 0 (which means that it will keep trying to establish the link indefinitely), and the *firstRetryInterval* attribute set to 10 seconds.

4 Link the AAL1 CES application to the physical TDM port on the FP providing AAL1 CES capability.

- For a DS1 FP:

```
set Aal1Ces/<Aal1Ces> interfaceName Lp/<CES_Lp>
DS1/<DS1> Chan/<chan>
```

- For a DS1 under a 4-port OC-3/STM-1Ch TDM/CES FP:

```
set Aal1Ces/<Aal1Ces> interfaceName Lp/<CES_Lp>
Sonet/<sonet> Sts/<sts> VT1dot5/<l,m> DS1 Chan/<chan0>
```

- For an E1 FP:

```
set Aal1Ces/<Aal1Ces> interfaceName Lp/<CES_Lp>
E1/<E1> Chan/<chanE1>
```

- For a DS1 in a DS3 FP:

```
set Aak1Ces/<Aal1Ces> interfaceName Lp/<CES_Lp> DS3/
<DS3> DS1/<DS1> Chan/<chanDS1>
```

- For an E1 under a 4-port OC-3/STM-1Ch TDM/CES or a 2-port STM-1e channelized CES/ATM/IMA FP:

```
set Aal1Ces/<Aal1Ces> interfaceName Lp/<CES_Lp>
Sdh/<sdh> Vc4/<vc4> Vc12/<k,l,m> E1 Chan/<chanE1>
```

***Note:*** While any channel number can be provisioned, channel 0 is recommended.

5 Set the *Aep* type to *softPVC*.

```
set Aal1Ces/<Aal1Ces> Aep activeEndPointType softPVC
```

***Note:*** The default for active EndPointType is SVC.

6 Set the *routingOption* (*routing*) attribute used to establish the connection.

```
set Aal1Ces/<Aal1Ces> Aep routing atmOnly
```

7 Set the remote address that the *Aep* will call.

```
set Aal1Ces/<Aal1Ces> Aep addressToCall
<addressToCall>
```

8 Set the *Aep calledVpiVci* to that of the connection required to be set up at the remote end.

```
set Aal1Ces/<Aal1Ces> Aep calledVpiVci <calledVpiVci>
```

9 Add the remote *CES* component.

```
add Aal1Ces/<Aal1Ces> Nap
```

## Variable definitions

| Variable | Value |
|---|---|
| <Aal1Ces> | The instance number of the *Aal1Ces* component, having a value between 1 and 65535 inclusive. |
| <addressToCall> | The address identifier. |
| <CES_LP> | The instance number of the logical processor associated with the FP providing CES capability. |
| <calledVpiVci> | The connection identifier. |
| <chan> | The instance number of the DS1 channel, having a value between 0 and 24 |
| <chan0> | The instance number of the channel (group DS0 timeslots), having a value between 0 and 23. |
| <chanDS1> | The instance number of the DS1 channel, having a value between 0 and 23. |
| <chanE1> | The instance number of the E1 channel, having a value between 0 and 31 |
| <DS1> | The instance number of the DS1 component, having a value between 1 and 28, or 0 and 3 for the 4pDS1ALL1FP, or 0 and 31 for the MSA32DS1 FP. |
| <DS3> | The instance number of the DS3 component, having a value between 0 and 31. |
| <E1> | The instance number of the E1 component, having a value between 0 and 3 for the 4pE1AAL1 FP or 0 and 31 for the MSA32E1 FP. |
| <k,l,m> | The E1 tributary, <k> having a value between 1 and 3, <l> having a value between 1 and 7, and <m> having a value between 1 and 3 |
| <l,m> | The ds1 tributary, <l> having a value between 1 and 7 and <m> having a value between 1 and 3. |

(Sheet 1 of 2)

| Variable | Value |
|---|---|
| <sts> | The instance number of the STS, having a value between 0 and 3. |
| <sdh> | The instance number of the STM-1 sdh component, having a value between 0 and 3. |
| <sonet> | The instance number of the OC3 SONET component, having a value between 0 and 3. |
| <vc4> | The instance number of the Vc4, having a value of 0. |

(Sheet 2 of 2)

# Configuring AAL1 CES over ATM PVCs

You can configure AAL1 CES over PVCs on 4-port DS1 AAL1 FPs, 4-port E1 AAL1 FPs, 32-port DS1 Multiservice Access FPs, 32-port E1 Multiservice Access FPs or 4-port DS3 channelized AAL1 CES FPs.

## Prerequisites

- Install AAL1 CES software. See *"Installing AAL1 CES software" (page 137)*.
- Configure AAL1 CES. See "Configuring AAL1 CES" (page 24).
- Configure ATM routing. See NN10600-710 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Configuration Management* and NN10600-702 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Routing and Signalling Fundamentals* and for more information.
- See the table "Connection setups for AAL1 CES" (page 96) for function processors (FP) supporting AAL1 CES over PVCs.

## Procedure steps

1. Add the AtmIf component to the ATM FP.
2. Add the Vcc subcomponent to the ATM FP and define its instance value. The *Vcc* can be associated with an *AtmIf* or a *Vpt (VirtualPathTerminator)* component. See NN10600-710 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Configuration Management* for detailed information on configuring *Vpt Vcc* components.
3. Add the *NailedUpEndPoint* (Nep) component to the ATM FP.
4. Set the appropriate port type for the FP providing ATM capability.
5. Configure the transmit and receive attributes of the connection using step 6 through step 8. See NN10600-710 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Configuration Management* for detailed information on configuring *Vpt Vcc* components.
6. Set the ATM quality of service category for the receive and transmit direction of the connection to CBR under the TrafficManagement (*TM*) subcomponent.
7. Define the traffic descriptor type.
8. Specify the traffic descriptor parameter.

Calculation of <peakRate> for structured services is reasonably involved. For more information, see the ATM Forum *CES Interoperability Specification*.

**9** Add the AAL1 CES application to the FP providing CES capability.

```
add Aal1Ces/<Aal1Ces>
```

**10** Add the Nailedup Adaptation Point (*Nap*) application.

```
add Aal1Ces/<Aal1Ces> Nap
```

**11** Link the application stack to the hardware.

- For DS1 FPs:

```
set Aal1Ces/<Aal1Ces> interfaceName Lp/<CES_Lp>
DS1/<DS1> Chan/<chan>
```

- For E1 FPs:

```
set Aal1Ces/<Aal1Ces> interfaceName Lp/<E1_Lp> E1/<E1>
Chan/<chanE1>
```

- For a DS1 in a DS3 FP:

```
set Aal1Ces/<Aal1Ces> interfaceName Lp/<CES_Lp> DS3/
<DS3> DS1/<DS1> Chan/<chanDS1>
```

- For a DS1 under a 4-port OC-3/STM-1Ch TDM/CES FP:

```
set Aal1Ces/<Aal1Ces> interfaceName Lp/<CES_Lp>
Sonet/<sonet> Sts/<sts> VT1dot5/<vt1dot5> DS1 Chan/
<chanDS1>
```

- For an E1 under a 4-port OC-3/STM-1Ch TDM/CES or a 2-port STM-1e channelized CES/ATM/IMA FP:

```
set Aal1Ces/<Aal1Ces> interfaceName Lp/<CES_Lp>
Sdh <sdh> Vc4/<vc4> Vc12/<vc12> E1 Chan/<chan>
```

- For DS3 FPs:

```
set Aal1Ces/<Aal1Ces> interfaceName Lp/<CES_Lp>
DS3/<DS3> DS1/<DS1> Chan/<chanDS1>
```

***Note:*** While any channel can be provisioned, channel 0 is recommended.

**12** Link the AAL1 Circuit Emulation Service to the ATM connection on the FP providing ATM capability.

```
set Aal1Ces/<Aal1Ces> Nap atmConnection
AtmIf/<AtmIf> Vcc/<Vpi.Vci> Nep
```

## Variable definitions

| Variable | Value |
|---|---|
| <Aal1Ces> | The instance number of the *Aal1Ces* component, having a value between 1 and 65535 inclusive |
| <CES_Lp> | The instance number of the logical processor associated with the FP providing CES capability. |
| <chan> | The instance number of the DS1 channel, having a value between 0 and 24 |
| <chanDS1> | The instance number of the DS1 channel, having a value between 0 and 23. |
| <chanE1> | The instance number of the E1 channel, having a value between 0 and 31. |
| <DS1> | The instance number of the DS1 component, having a value between1 and 28, or 0 and 3 for the 4pDS1AAL1 FP, or 0 and 31 for the MSA32DS1 FP. |
| <DS3> | The instance number of the DS3 component, having a value between 0 and 3. |
| <E1> | The instance number of the E1 component, having a value between 0 and 3 for the 4pE1AAL1 FP or 0 and 31 for the MSA32E1 FP. |
| <k,l,m> | The E1 tributary, <k> having a value between 1 and 3,<l> having a value between 1 and 7, and <m> having a value between 1 and 4. having a value between 1 and 7, and <m> having a value between 1 and 4. |
| <l,m> | The ds1 tributary, <l> having a value between 1 and 7 and <m> having a value between 1 and 4. |
| <sdh> | The instance number of the STM-1 sdh component, having a value between 0 and 3. |
| <sonet> | The instance number of the OC3 SONET component, having a value between 0 and 3. |

(Sheet 1 of 2)

| Variable | Value |
| --- | --- |
| <sts> | The instance number of the STS, having a value between 0 and 2. |
| <vc4> | The instance number of the Vc4, having a value of 0. |

(Sheet 2 of 2)

# Chapter 2
# Connection recovery and path optimization

Recover connections and optimize paths for AAL1 CES connections.

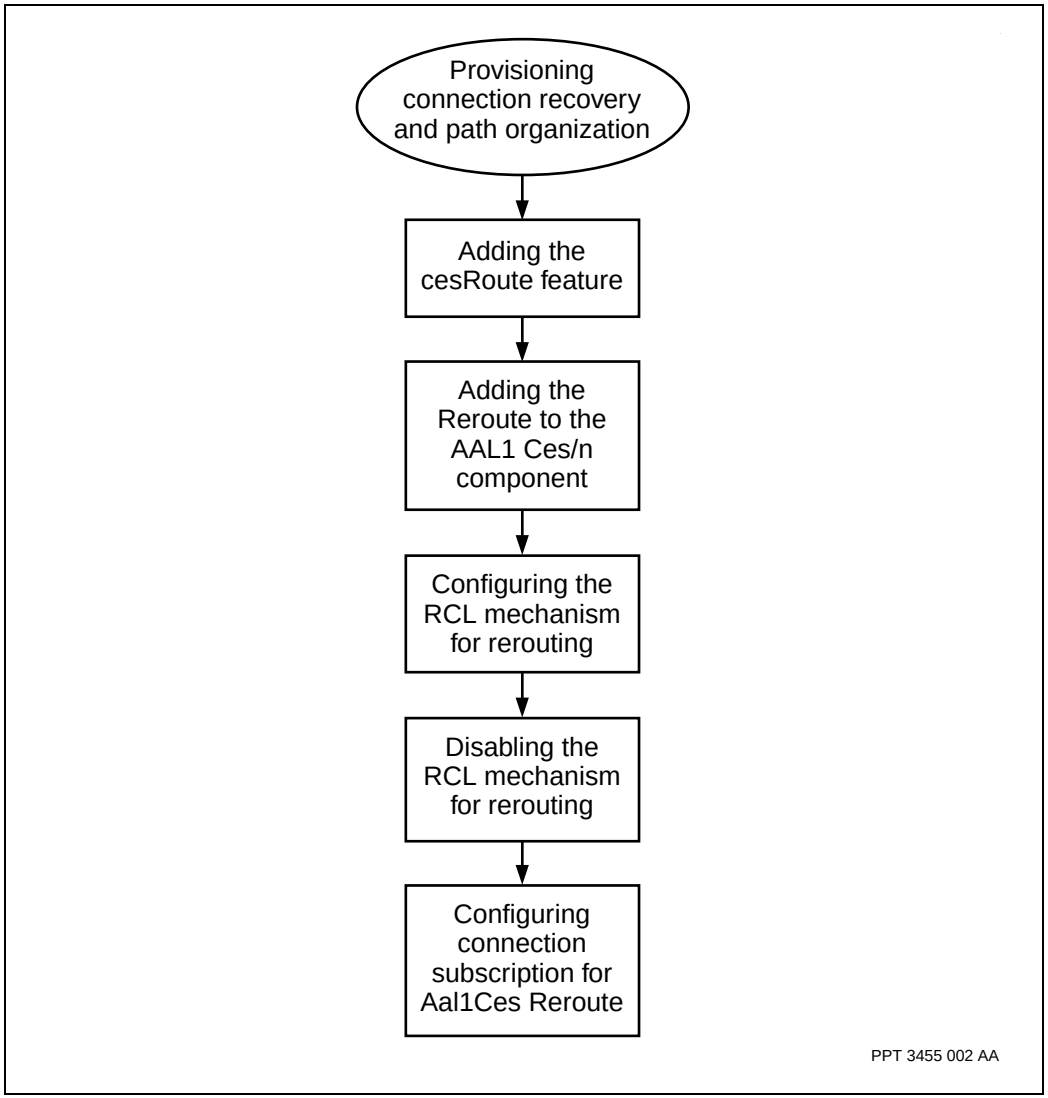
## Prerequisites to connection recovery and path optimization

- When you configure rerouting for a CES service, a dynamic *RerouteInfo* component appears under the *Aal1Ces/n* component if a successful rerouting connection is established on the rerouting node only.
- If both SVCs and SPVCs are provisioned on a CES FP, you can disable rerouting for SVCs so they are simply cleared and do not compete with SPVCs for setup resources. Similarly, you may not want resources consumed by SVC recovery. However, path optimization occurs over a longer period of time and needs less resources. For this reason, rerouting enables you to turn off connection recovery and enable path optimization for SVCs.
- To configure the connection recovery and path optimization capability, refer to “Configuration requirements for rerouting” (page 106).

## Connection recovery and path optimization flow

This task flow shows you the sequence of procedures you perform to connection recovery and path optimization. To link to any procedure, go to “Task navigation” (page 46).

**Figure 2**
**Connection recovery and path optimization task flow**




## Task navigation

- “Adding the cesRoute feature” (page 48)

# Adding the cesRoute feature

Add the cesReroute feature as the first step in configuring connection recovery and path optimization.

## Prerequisites

- For SVC connections, the *Reroute* component must be added at the source and destination nodes.
- This feature must be added to the feature list of both the rerouting and rendezvous nodes. This feature is only used for CES SVC and SPVC.

## Procedure steps

1. Add the *LogicalProcessor* (*Lp*) component for the FP providing the CES capability. For illustrative purposes only, the name *CESREROUTE* is used.

   ```
   add Sw Lpt/CESREROUTE
   ```

2. Add cesReroute to the feature list.

   ```
   set Sw Lpt/CESREROUTE featureList! aal1Ces cesReroute
   ```

3. Activate your configuration changes.
4. If the LP is not using the Sw Lpt configured in the second step, add the LP where the CES service exists.

   ```
   set Lp/<n> Lpt Sw Lpt/CESREROUTE
   ```

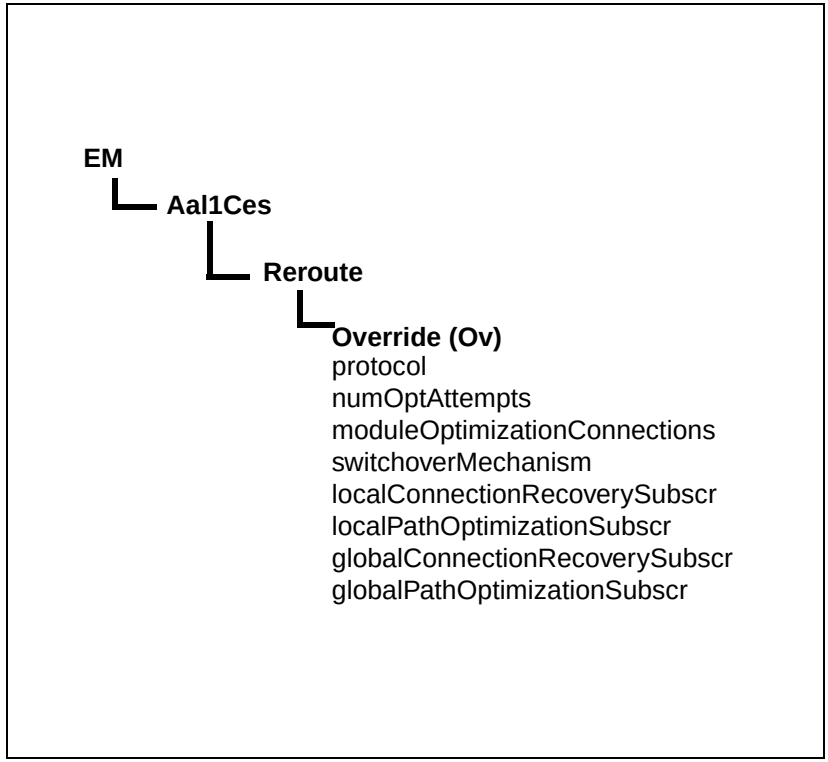
5. Activate your configuration changes.

## Variable definitions

| Variable | Value |
|---|---|
| <n> | The instance number of the LP where the CES service exists. |
| | |

## Procedure job aid

**Figure 3**
**CesRoute feature component hierarchy**



# Adding Reroute to the AAL1Ces/n component

Add Reroute to an *Aal1Ces/n* component.

## Prerequisites

- If the CES connection is provisioned over an SVC, ensure that the *addressToCall* attribute under *Aep* is set to the local address of the *Aal Ces/n Pep* component provisioned on the Rendezvous node. Also, ensure that the *expectedRemoteAddress* attribute under the *Pep* is set to the local address of the *Aal1Ces/n Aep* component provisioned on the source node.
- If the CES connection is provisioned over an SPVC, ensure that the *addressToCall* attribute under *Aep* is set to the address of the PNNI/UNI/IISP/AINI Atm Interface provisioned on the rendezvous node. A *Reroute* component must be added under Atmif/n Pnni/Uni/Iisp/Aini.
- The node must already have an *Artg Pnni* component provisioned. For more information, see NN10600-702 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Routing and Signalling Fundamentals*

## Procedure steps

1. Enter configuring mode.

   ```
   start Prov
   ```

2. Add the Reroute component under Aal1Ces/n that will originate the call.

   ```
   add Aal1Ces/<n> Reroute
   ```

3. Display the attributes under Aal1Ces/n Reroute Ov.

   ```
   display Aal1Ces/<n> Reroute Ov
   ```

4. Activate your configuration changes.

## Variable definitions

| Variable | Value |
|---|---|
| <n> | The instance number of the CES service |
| | |

# Configuring the RCL mechanism for rerouting

Configure the RCL (reduced cell loss) mechanism to minimize disruption by reducing the amount of cell loss that occurs during a path optimization.

## Prerequisites

- Before using this procedure, you must complete the following procedure: “Configuring AAL1 CES” (page 24):

## Procedure steps

1. Add the Reroute component under Aal1Ces/n that will accept the call.

   ```
   add Aal1Ces/<n> Reroute
   ```

2. Set the rerouting reduced cell loss mechanism.

   ```
   set Aal1Ces/<n> Reroute Ov switchovermechanism rcl
   ```

3. To revert from the enhanced (where the RCL mechanism is activated) rerouting capability to the standards-based rerouting capability, provision a *Reroute* component on the called Aal1Ces/n as well as on the calling Aal1Ces/n.

   ```
   set Aal1Ces/<n> Reroute Ov switchovermechanism
   standard
   ```

## Variable definitions

| Variable | Value |
|---|---|
| <n> | The instance number of the CES service. |
| | |

# Disabling the RCL mechanism for rerouting

Provisioning the *Reroute* component at the rerouting and rendezvous nodes to disable the reduced cell loss data path swap mechanism

## Prerequisites

- If RCL is used, then it is not necessary to provision an *Reroute* component on the rendezvous node.

## Procedure steps

1. Add the Reroute component under Aal1Ces/n that will accept the call.

   **`add Aal1Ces/<n> Reroute`**

2. Set the value of the switchoverMechanism attribute to standard on the rerouting and rendezvous nodes.

   **`set Aal1Ces/<n> Reroute Ov switchoverMechanism standard`**

3. Activate your configuration changes.

## Variable definitions

| Variable | Value |
|---|---|
| <n> | The instance number of the CES service. |
| | |

# Configuring connection subscription for Aal1CesReroute

Configure the path optimization capability and the RCL (reduced cell loss) mechanism to minimize disruption by reducing the amount of cell loss that occurs during path optimization.

***Note:*** If the rerouting protocol is localOnly or localGlobal, only local attributes are shown. If the protocol is ebrOnly, only global attributes are shown.

## Prerequisites

- The *Reroute* component always needs to be configured from the source. The *Reroute* component for the destination ATM is only used to configure RCL versus standard optimization in the *SwitchOverMechanism* attribute.
- Connections that exist before configuring connection subscription for rerouting retain the options determined at call establishment. New call set up requests initiated after configuring connection subscription for rerouting will use the new connection subscription options.

## Procedure steps

**1** Add the *Reroute* component to the Aal1Ces interface.

```
add Aal1Ces/<n> Reroute
```

The only case in which Reroute is configured on a PNNI interface is when a network-initiated connection (SPVC) is configured on that interface.

***Note:*** The default values for the attributes are added after the Reroute component is added.

**2** Set the connection recovery subscription option.

```
set Aal1Ces/<n> Reroute Ov
globalConnectionRecoverySubscr <globalcon>
```

**3** Set the path optimization subscription option.

```
set Aal1Ces/<n> Reroute Ov
globalPathOptimizationSubscr <globalpath>
```

**4** Set the switchover subscription option.

```
set Aal1Ces/<n> Reroute Ov switchoverMechanism
<switchoverMechanism>
```

**5** Set the module optimization subscription option.

```
set Aal1Ces/<n> Reroute Ov
moduleOptimizationConnections <moduleOptimization>
```

## Variable definitions

| Variable | Value |
|---|---|
| <globalcon> | Specifies the subscription of connections to rerouting connection recovery. The value can be set to either yes, no, or sameAsARtgPnni (sameAs). The default value is sameAs. |
| <globalpath> | Specifies the subscription of connections to rerouting path optimization. The value can be set to either yes, no, or sameAsARtgPnni (sameAs). The default value is sameAs. |
| <moduleOptimization> | Specifies the connections that are considered by a module optimization pass. It can either consider only the connections recovered since the last optimization pass or all connections that subscribe to optimization. The value can be set to none, recoveredOnly, allSubscribed, or sameAsARtgPnni. The default value is sameAsARtgPnni. |
| <n> | The instance number of the Aal1Ces interface |
| <switchoverMechanism> | Specifies the mechanism used to switchover to the rerouted connection segment. The value can be set to standard, rcl, or sameAs. The default value is sameAs. |
| | |

# Chapter 3
# Monitoring and maintaining the service

This section provides information on monitoring and maintaining AAL1 CES and includes the following sections:



## Monitoring CES

To monitor AAL1 CES, use the display and list commands as described in NN10600-050 *Nortel Networks Multiservice Switch 7400/15000/20000 Command Reference*.

### Operational commands

The display operational command is used to monitor the AAL1 CES components.

**Example**
1

To display all the operational attribute names along with their values, which are associated with AAL1 CES:

```
display Aal1Ces/2
```

**Example**
2

To display the value of a specific operational attribute:

```
display Aal1Ces/2 <attribute name>
```

# Operational attributes for Aal1Ces

The table "Operational attributes for Aal1Ces" (page 56) lists the operational attributes for the *Aal1Ces* component. The figure "Data flow and statistics collected by Multiservice Switch AAL1 CES" (page 59) illustrates the data flow through the AAL1 CES function processor and shows how the operational attributes are collected.

**Table 1**
**Operational attributes for Aal1Ces**

| Attributes | Description |
|---|---|
| cellLossStatus (cellLoss) | This attribute is set to loss when a loss of cells alarm is raised and noLoss when it is clear. |
| aal1LayerLossStatus (aal1Loss) | This attribute is set to loss when an AAL1 layer alarm is raised and noLoss when it is clear. The default value is noLoss<br><br>The four-port DS3 channelized AAL1 CES and four-port OC-3/STM-1 channelized TDM/CES function processors do not support the aal1LayerLossStatus attribute. The value of the aal1LayerLossStatus attribute will always be displayed as noLoss. |
| (Sheet 1 of 3) | |

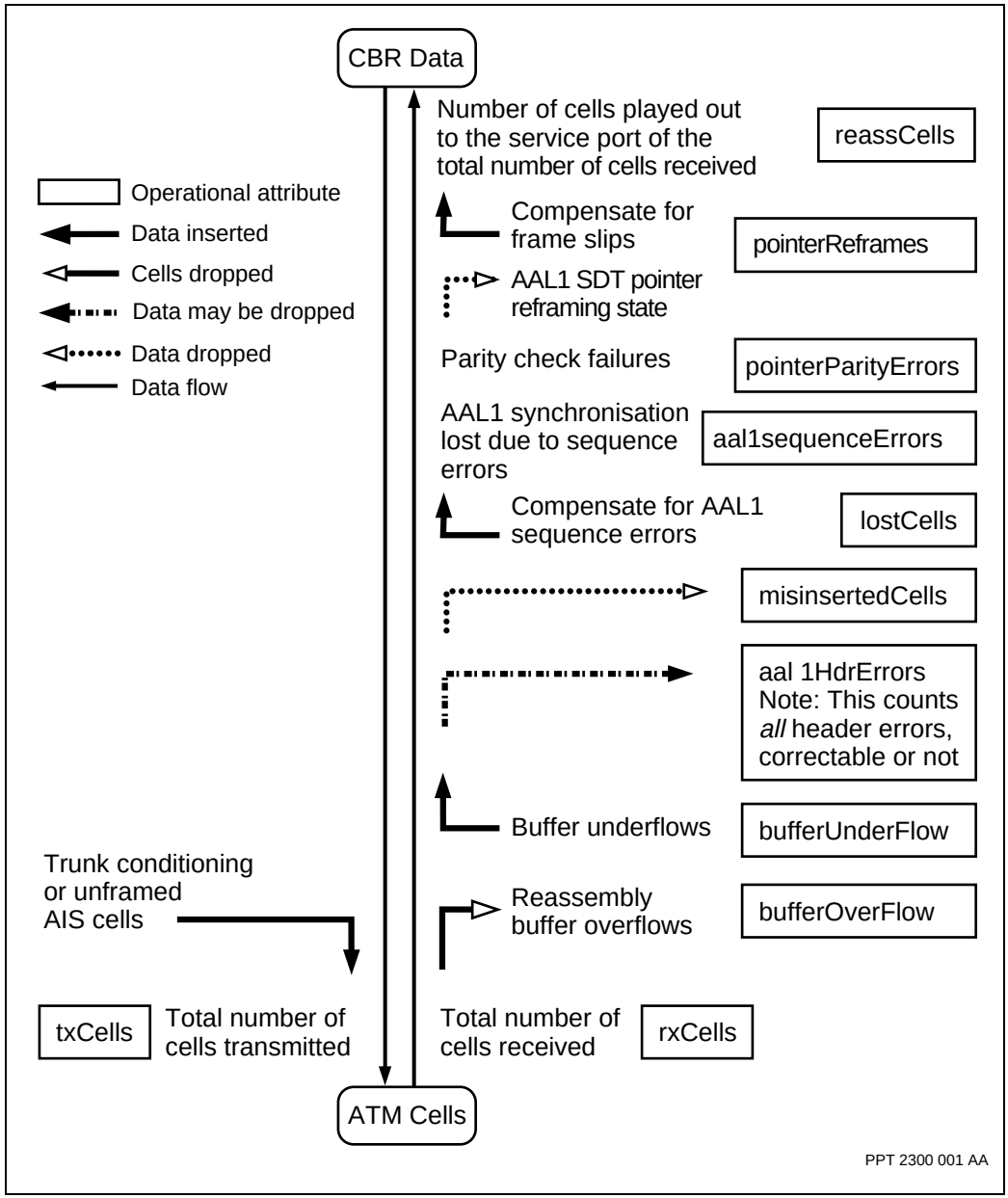
**Table 1 (continued)**
**Operational attributes for Aal1Ces**

| Attributes | Description |
|---|---|
| connectionStatus (connStatus) | This attribute is set to connected when the OSI attribute operationalState is enabled.<br><br>When *operationalState* is disabled, the *connectionStatus* attribute indicates whether the service is non-operational because of a problem with the PDH side of the connection (when it is set to channelNotReady), or because of a problem with the ATM side of the connection (when it is set to atmNotReady).<br><br>When the attribute is set to channelNotReady, it indicates that the corresponding *Chan* component (or its parent port component) is locked.<br><br>When the attribute is set to atmNotReady, it indicates that the connection with the ATM network has been lost, or that the connection is unable to carry CES data. |
| cellsTransmitted (txCells) | Total number of cells transmitted for a specific CES connection. These are the CBR user data cells and unframed AIS cells. |
| cellsReceived (rxCells) | Total number of cells received for a specific CES connection. These are the CBR user data cells, unframed AIS cells, cells with AAL1 header errors and mis-inserted cells (that is, cells with an unexpected AAL1 sequence number). |
| lostCells (lostCells) | Number of cells declared as never received by the AAL1 layer. For each cell declared as lost, the system inserts an AAL1 cell containing all ‘1’s in its user data portion, to maintain bit integrity. |
| reassembledCells (reassCells) | Number of received cells whose payload has actually been played out to the service interface–received cells which have been dropped for any reason are not counted here. |
| headerErrors (hdrErrors) | This attribute counts the number of AAL1 cells with an error in the AAL1 header.<br><br>Not all cells with AAL1 header errors are necessarily dropped; some header errors can be corrected. |
| (Sheet 2 of 3) | |

**Table 1 (continued)**
**Operational attributes for Aal1Ces**

| Attributes | Description |
|---|---|
| bufferOverFlows (oFlows) | This attribute counts the number of times the AAL1 reassembly buffer overflows. You can reduce occurrences of this condition by increasing the value of the *bufferSize* or *maxBufferDelay* attribute. (Changing the *bufferSize* attribute has no effect on the 4-port OC-3/STM-1Ch TDM/CES FP) |
| bufferUnderFlows (uFlows) | This attribute counts the number of times the AAL1 reassembly buffer underflows. In the case of continuous buffer starvation, a single buffer underflow event is counted. |
| pointerReframes (ptrReframes) | Number of events in which the AAL1 reassembler had to reacquire a structured data pointer. |
| aal1SequenceErrors (seqErrors) | This attribute counts the number of times that the sequence number of an incoming AAL1 Type 1 segmentation and reassembly (SAR) PDU causes a transition from the sync state to the out-of-sync state. |
| misinsertedCells (misinsertCells) | This attribute counts the number of AAL1 sequence violations that the AAL Convergence sublayer interprets as mis-inserted cells. |
| pointerParityErrors (ptrParityErrors) | This attribute counts the number of events in which the AAL1 reassembler detects a parity check failure at the point at which a structured data pointer is expected. This count applies only to structured CES modes, and is zero for unstructured CES. |
| (Sheet 3 of 3) | |

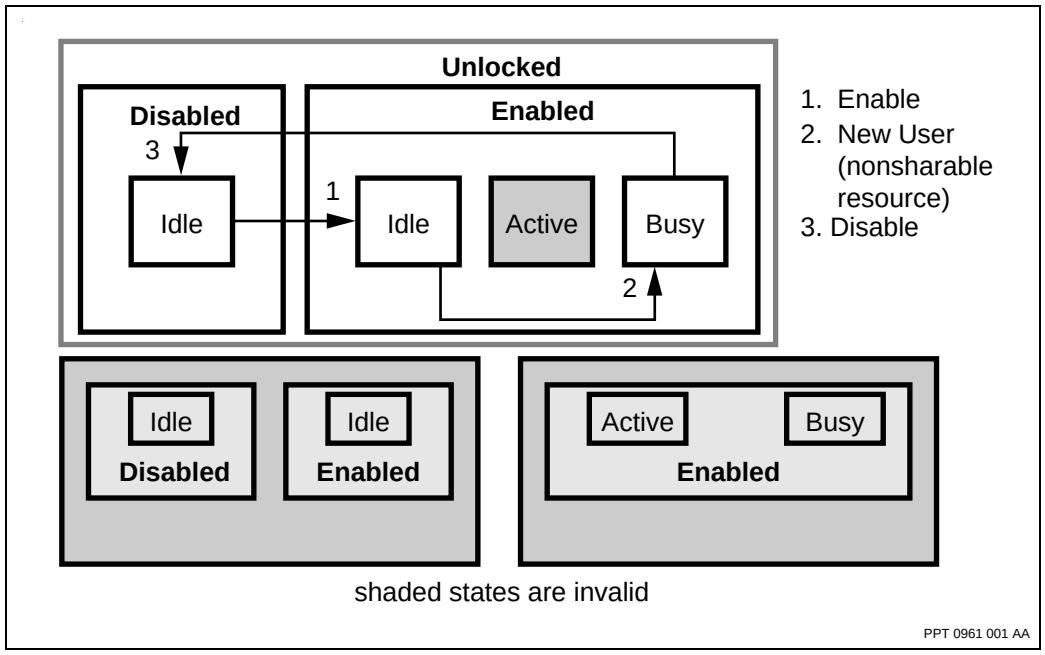
**Figure 4**
**Data flow and statistics collected by Multiservice Switch AAL1 CES**



# OSI state

Valid OSI states for AAL1 CES are shown in the following figure. The combination Unlocked, Enabled, Idle is never seen by the operator, as it is a purely transitory state.

**Figure 5**
**OSI state combinations**




## Supported OSI states and statuses

Within the AAL1 CES component hierarchy, only the *Aal1Ces* component has OSI state information. The following table explains the component state combinations.

**Table 2**
**CES component state combinations**

| Combination (Administrative, Operational, Usage) | Details |
|---|---|
| Unlocked, Disabled, Idle | This is valid when the *Aal1Ces* component has been configured and activated, but no data is being transferred (for example if the port it is linked to is locked, or it is unable to connect to the ATM network. No traffic statistics are collected in this state. If the service was up and running immediately prior to entering this state, then up to 1 second of traffic statistics may be lost. |
| Unlocked, Enabled, Idle | This is a purely transitory state as the CES progresses from the Unlocked, Disabled, Idle state to the Unlocked, Enabled, Busy state. This state will never be visible to the operator. |
| Unlocked, Enabled, Busy | This state is valid when the service is receiving and transferring data (in either direction) and collecting traffic statistics. Note that even if user data is not being transferred the CES remains in this state until the connection is actually disabled (this is because the *Aal1Ces* component may still be capable of gathering useful operational statistics). |
| | |

### State change notification

The *Aal1Ces* component generates two state change notifications.

- When the CES enables a connection and starts to collect traffic statistics, a state change up notification is generated.
- When the CES disables a connection and ceases to collect traffic statistics, a state change down notification is generated.

In addition, should the AAL1 FP crash, CAS will generate a proxy state change notification on behalf of the *Aal1Ces* component.

## Operational attributes for Pep

The following table lists the operational attributes for the *Pep* component.

**Table 3**
**Operational attributes for Pep**

| Attributes | Description |
|---|---|
| remoteAddress (remoteAddr) | This attribute defines the address of the remote end-point.<br><br>If a connection is currently established, the *remoteAddress* attribute contains the address of the remote end-point. If no connection is established, *remoteAddress* is unknown. |
| svcStatus (status) | This attribute defines the status of the incoming connection (initializing, connecting, connected, or idle). |
| lastTearDownCause (cause) | This attribute contains the cause code in the last call release message that contained a CAUSE information element.<br><br>The call must be successfully established before it can be torn down. |
| lastTearDownDiagnostic (diag) | This attribute contains the diagnostic code in the last call release message. The diagnostic code is contained in the CAUSE information element, and is present only if a procedural error is detected by the signalling protocol. A diagnostic code is always accompanied by a cause code. |
| | |

# Operational attributes for Aep

The following table lists the operational attributes for the *Aep* component.

**Table 4**
**Operational attributes for Aep**

| Attributes | Description |
|---|---|
| svcStatus (status) | This attribute defines the status of the connection (initializing, connecting, connected, idle, retriesExhausted, or failed). |
| retryTimeRemaining (timer) | This attribute contains the current value of the retry timer for this connection. When the value reaches zero, the component makes an attempt to establish the connection. When the timer is not running, the attribute contains a value of zero. |
| (Sheet 1 of 2) | |

**Table 4 (continued)**
**Operational attributes for Aep**

| Attributes | Description |
|---|---|
| retryFailures (failures) | This attribute contains the number of consecutive failed connection attempts. This count is reset to zero whenever a connection is successfully established, or when the connection is restarted. |
| remoteAddress (remoteAddr) | This attribute defines the address of the remote end-point.<br><br>If a connection is currently established, the *remoteAddress* attribute contains the address of the remote end-point. If no connection is established, *remoteAddress* is empty. |
| lastTearDownCause (cause) | This attribute contains the cause code in the last call release message that contained a CAUSE information element.<br><br>The call must be successfully established before it can be torn down. |
| lastTearDownDiagnostic (diag) | This attribute contains the diagnostic code in the last call release message. The diagnostic code is contained in the CAUSE information element, and is present only if a procedural error is detected by the signalling protocol. A diagnostic code is always accompanied by a cause code. |
| lastSetupFailureCause (failCause) | This attribute contains the cause code in the last call release message following an unsuccessful call setup attempt. |
| lastSetupFailureDiagnostic (failDiag) | This attribute contains the diagnostic code in the last call release message following an unsuccessful call setup attempt. The diagnostic code is contained in the CAUSE information element, and is present only if a procedural error is detected by the signalling protocol. A diagnostic code is always accompanied by a cause code. |
| (Sheet 2 of 2) | |

# Monitoring rerouting

To monitor connections, use the display and list commands as described in NN10600-050 *Nortel Networks Multiservice Switch 7400/15000/20000 Command Reference*.

### Operational commands

The display operational command is used to monitor the connections.

Example 1

To determine the rerouting attributes of a connection:

```
display Aal1Ces/2 RerouteInfo
```

Example 2

To determine the rerouting capabilities of a connection for the Ebr, local, or global operational group:

```
display Aal1Ces/2 RerouteInfo EbrRecoverySubscribed
display Aal1Ces/2 RerouteInfo localRecoverySubscribed
display Aal1Ces/2 RerouteInfo globalRecoverySubscribed
display Aal1Ces/2 RerouteInfo
EbrOptimizationSubscribed
display Aal1Ces/2 RerouteInfo
localOptimizationSubscribed
display Aal1Ces/2 RerouteInfo
globalOptimizationSubscribed
```

Example 3

To determine which connections were rerouted:

```
display Aal1Ces/2 RerouteInfo connectionRecovered
display Aal1Ces/2 RerouteInfo
totalconnectionRecoveries
```

## Optimizing connections

You can start module optimization using the Optimize command.

If a nodal optimization pass is in progress when the OPTIMIZE command is executed, for example:

```
OPTIMIZE Artg Pnni Reroute
```

Issue the OPTIMIZE command against a specific connection, for example:

```
OPTIMIZE Aal1/<x> Reroute
```

Then, the command fails and displays the following message:

```
A module optimization pass is already in progress.
```

When the command is executed, the following response is displayed:

```
Module optimization pass completed.
```

A nodal optimization pass is cancelled through the use of the -cancel option of the OPTIMIZE verb.

```
optimize -cancel Artg Pnni Reroute
```

If there is no nodal optimization pass in progress, the following response is displayed:

```
There is no module optimization pass currently in
progress.
```

If there is a nodal optimization pass in progress, the following response is displayed:

```
The current module optimization pass has been
cancelled.
```

## Operational attributes for RerouteInfo

The following tables list the common, Ebr, local, and global operational group attributes for the *RerouteInfo* component.

**Table 5**
**Common operational group attributes for RerouteInfo**

| Attributes | Description |
|---|---|
| lastOptimizationMetric | This attribute indicates the metric that was used to optimize the call during the most recent call establishment. |
| | |

**Table 6**
**Ebr operational group attributes for RerouteInfo**

| Attributes | Description |
|---|---|
| | |
| ebrRecoverySubscribed | This attribute indicates the actual subscription value for ebr connection recovery. The value does not change during the lifetime of the connection. |
| ebrOptimizationSubscribed | This attribute indicates the actual subscription value for ebr path optimization. The value does not change during the lifetime of the connection. |
| ebrOptimizationMetricValue | This attribute indicates the ebr optimization value that was collected for the call during the most recent call establishment. It represents the segment of the connection between the local rerouting and rendez-vous nodes. |
| ebrOptimalMetricValue | This attribute indicates the optimization metric value of the connection's best path. It is initialized to the value collected during initial call establishment. It is set to the currentOptimationValue whenever a connection is optimized onto a path which has a better optimization value or the number of optimization attempts is exhausted. It represents the segment of the connection between the rerouting and rendez-vous nodes. |
| ebrOptimizationState | This attribute indicates the connection's current optimization state. |
| ebrTimeOfLastRecovery- | This attribute indicates the date and time of the last local connection recovery. |
| totalEbrConnectionRecoveries | This attribute counts the number of successful Ebr connection recoveries that were performed over the lifetime of the connection. |
| (Sheet 1 of 2) | |

**Table 6 (continued)**
**Ebr operational group attributes for RerouteInfo**

| Attributes | Description |
|---|---|
| totalEbrPathOptimizations | This attribute counts the number of successful Ebr path optimizations that were performed over the lifetime of the connection. Both manual and automatic successful optimizations are included. |
| totalEbrlOptimizationAttempts | This attribute counts the number of attempted Ebr path optimizations that were performed over the lifetime of the connection. Both manual and automatic optimizations are included. |
| (Sheet 2 of 2) | |

**Table 7**
**Local operational group attributes for RerouteInfo**

| Attributes | Description |
|---|---|
| localRecoverySubscribed | This attribute indicates the actual subscription value for local connection recovery. The value does not change during the lifetime of the connection. |
| localOptimizationSubscribed | This attribute indicates the actual subscription value for local path optimization. The value does not change during the lifetime of the connection. |
| localOptimizationMetricValue | This attribute indicates the local optimization value that was collected for the call during the most recent call establishment. It represents the segment of the connection between the local rerouting and rendez-vous nodes. |
| localOptimalMetricValue | This attribute indicates the optimization metric value of the connection's best path. It is initialized to the value collected during initial call establishment. It is set to the currentOptimationValue whenever a connection is optimized onto a path which has a better optimization value or the number of optimization attempts is exhausted. It represents the segment of the connection between the rerouting and rendez-vous nodes. |
| localOptimizationState | This attribute indicates the connection's current optimization state. |
| (Sheet 1 of 2) | |

**Table 7 (continued)**
**Local operational group attributes for RerouteInfo**

| Attributes | Description |
|---|---|
| localTimeOfLastRecovery | This attribute indicates the date and time of the last local connection recovery. |
| totalLocalConnectionRecoveries | This attribute counts the number of successful local connection recoveries that were performed over the lifetime of the connection. |
| totalLocalPathOptimizations | This attribute counts the number of successful local path optimizations that were performed over the lifetime of the connection. Both manual and automatic successful optimizations are included. |
| totalLocallOptimizationAttempts | This attribute counts the attempted local path optimizations that were performed over the lifetime of the connection. Both manual and automatic optimizations are included. |
| (Sheet 2 of 2) | |

**Table 8**
**Global operational group attributes for RerouteInfo**

| Attributes | Description |
|---|---|
| globalRecoverySubscribed | This attribute indicates the actual subscription value for global connection recovery. The value does not change during the lifetime of the connection. |
| globalOptimizationSubscribed | This attribute indicates the actual subscription value for global path optimization. The value does not change during the lifetime of the connection. |
| globalOptimizationMetricValue | This attribute indicates the global optimization value that was collected for the call during the most recent call establishment. It represents the segment of the connection between the local rerouting and rendez-vous nodes. |
| (Sheet 1 of 2) | |

**Table 8 (continued)**
**Global operational group attributes for RerouteInfo**

| Attributes | Description |
|---|---|
| globalOptimalMetricValue | This attribute indicates the optimization metric value of the connection's best path. It is initialized to the value collected during initial call establishment. It is set to the currentOptimationValue whenever a connection is optimized onto a path which has a better optimization value or the number of optimization attempts is exhausted. It represents the segment of the connection between the rerouting and rendez-vous nodes. |
| globalOptimizationState | This attribute indicates the connection's current optimization state. |
| globalTimeOfLastRecovery | This attribute indicates the date and time of the last global connection recovery. |
| totalGlobalConnectionRecoveries | This attribute counts the number of successful global connection recoveries that were performed over the lifetime of the connection. |
| totalGlobalPathOptimizations | This attribute counts the number of successful global path optimizations that were performed over the lifetime of the connection. Both manual and automatic successful optimizations are included. |
| totalGlobalOptimizationAttempts | This attribute counts the attempted global path optimizations that were performed over the lifetime of the connection. Both manual and automatic optimizations are included. |
| (Sheet 2 of 2) | |

# Operational attributes for Aal1Ces/n Reroute

The following table lists the global and local operational group attributes for the *Aal1Ces/n Reroute* component.

**Table 9**
**Global and local operational group attributes for Aal1Ces/n Reroute**

| Attributes | Description |
|---|---|
| globalLastRrCauseCode | This attribute indicates the value of the last Ebr or global reroute cause information element received at the interface. This value is useful for determining why a connection failed to recover or optimize. |
| localLastRrCauseCode | This attribute indicates the value of the last local reroute cause information element received at the interface. This value is useful for determining why a connection failed to recover or optimize. |
| | |

Refer to *241-5701-715 ATM Monitoring and Troubleshooting Guide* for a list of rerouting cause codes and their descriptions.

# Maintaining CES

AAL1 CES is dependent upon port management, the ATM core capabilities and the ATM networking capabilities. Change the values of attributes as required to optimize your Nortel Networks Multiservice Switch network.

> ***Note:*** Before changing attribute values, be sure that you understand the impact of a change on the node and on the network.

For a list of the ATM Circuit Emulation Service attributes and their associated values, see NN10600-060 *Nortel Networks Multiservice Switch 7400/15000/20000 Component Reference*.

## SNMP management

All management information defined in the CES components is accessible through Nortel Networks Multiservice Switch Enterprise MIB.

> ***Note:*** Support for standard MIBs which contain general information about Circuit Emulation Services is not available.

## Restarting an active endpoint

You may need to restart an *Aep* component to pick up new configuring information or because it has reached its retry limit. To restart an *Aep* component, use the restart verb of the *Aep*. For example:

```
restart aal1Ces/2 Aep
```

# Chapter 4
# Alarms and troubleshooting

This section helps you solve problems that occur after you install AAL1 CES and includes the following sections:



## Alarms

During normal operation of AAL1 CES, no alarms should be present on the node. For a full description of specific alarms, see NN10600-500 *Nortel Networks Multiservice Switch 6400/7400/15000/20000 Alarms Reference*.

See the table "Alarms" (page 74), for a listing of alarms supported by the function processors (FP) providing AAL1 CES capability.

**Table 10**
**Alarms**

| Alarm type | 4-port DS1 and 4-port E1 AAL1 function processors | 32-port DS1 and 32-port E1 Multiservice Access function processors | 4-port DS3 channelized AAL1 CES and 4-port OC-3/ STM-1 channelized TDM/CES function processors |
|---|---|---|---|
| loss of cells | Supported | Not supported | Not supported |
| AAL1 errors | Supported | Not supported | Not supported |
| retry limit reached | Supported | Supported | Supported |
| | | | |

The loss of cells and AAL1 errors alarms are triggered in a number of situations, as follows:

- If there is initial network starvation, the AAL1 errors alarm will be set.

  Network starvation means no valid AAL1 cells are arriving from the ATM network. This could be no cells at all, or cells which do not conform to the AAL1 protocol.

- If there is continuous network starvation both the loss of cells alarm and the AAL1 errors alarm will be set.
- If there is a low rate of AAL1 cell arrival only the loss of cells alarm will be set.

The retry limit alarm is triggered when the *Aep* component has initiated a number of unsuccessful call attempts equal to the configured value of the *retryLimit* attribute. When this situation occurs, no further call setups are attempted and the alarm is raised.

While the loss of cells alarm is set, any data received from the ATM network causes the CES *rxCells* attribute to be incremented. However, the system replaces this data with all 1’s onto the DS1 or E1 line, until the alarm is cleared, at which point the data can be allowed to pass through. The time taken for this alarm to clear can be controlled by the configurable attribute, *cellLossIntegrationPeriod*.

## Interaction with shelf tests - potential loss of cells

Test data can be sent to the node backplane every 24 hours, if automated testing is enabled. During each test, AAL1 services may lose up to (approximately) five cells of user data. This is expected behavior if automated testing of the backplane is enabled.

Automated testing of the backplane can be disabled.

The *PcsTest* component (a subcomponent of the *Shelf* component) defines whether or not automated testing occurs. The *automaticBusClockTest* attribute of *PcsTest* is set to enabled by default-allowing the automated tests to run. Set this attribute to disabled if automated testing of the backplane is not desired.

## Handling problems

The table “Detecting problems with AAL1 CES” (page 76) provides guidelines on how to respond to problems that may occur when you are using AAL1 CES.

The table contains three columns. The first column describes the problem, the second column provides a probable cause for that problem, and the third column explains how to correct the problem.

**Table 11**
**Detecting problems with AAL1 CES**

| Problem | Probable Cause | Corrective Action |
|---|---|---|
| Loss of Signal (LOS) Alarm | A cable may be disconnected or broken.<br><br>An incorrect *lineLength* attribute may have been used. | Verify the cabling.<br><br>Verify the *lineLength* attribute is set to a value between 0 and 655. |
| Loss of Frame (LOF) Alarm | There may be a fault in the cable.<br><br>An incorrect *lineLength* attribute may have been used.<br><br>An incorrect *lineType* attribute may have been used. | Verify the cabling.<br><br>Verify the *lineLength* attribute is set to a value between 0 and 655.<br><br>Verify the *lineType* attribute is set to the appropriate value for incoming data (for example, esf configured, unframed data on input). |
| Receive Alarm Indication Signal (AIS) Alarm | There is a fault in the equipment or cabling upstream from the node. | Verify the cabling. |
| Receive Remote Alarm Indication (RAI) Signal Alarm | There is a fault condition detected downstream from the node. | Verify the cabling. |
| Transmit Alarm Indication (AIS) Alarm | The port is locked or the CES is not bound to the PMS. | Unlock the port.<br><br>Check that a CES is linked to the port's *Chan* component. See NN10600-551 *Nortel Networks Multiservice Switch 7400/15000/20000 FP Configuration Reference*. |

(Sheet 1 of 3)

**Table 11 (continued)**
**Detecting problems with AAL1 CES**

| Problem | Probable Cause | Corrective Action |
|---|---|---|
| Retry Limit Alarm | The automatic connection procedure has stopped, because the *retryLimit* has been reached. | Check the *lastSetupFailureCause* attribute in the *Aep* subcomponent of the *Aal1Ces*, and take appropriate management action, such as reconfiguring. See NN10600-551 *Nortel Networks Multiservice Switch 7400/15000/ 20000 FP Configuration Reference*.<br><br>When the appropriate action has been taken, issue a restart against the relevant *Aep* subcomponent to restart the automatic connection procedure. See "Restarting an active endpoint" (page 71). |
| An alarm, other than those mentioned above, occurs to indicate there is a problem with the FP or with the far-end FP. | | For more information, see NN10600-500 *Nortel Networks Multiservice Switch 6400/7400/15000/ 20000 Alarms Reference*. |
| A link problem is occurring that may be caused by the FP. | • incorrect configuring<br>• bent pin<br>• wrong termination panel | Check to make sure the configuring data is correct. See "Configuring AAL1 CES" (page 24)<br><br>Check cable connections. Make sure the connectors have no bent pins.<br><br>Make sure that the correct termination panel is used for the FP. |
| (Sheet 2 of 3) | | |

**Table 11 (continued)**
**Detecting problems with AAL1 CES**

| Problem | Probable Cause | Corrective Action |
|---|---|---|
| The value of *Aep* attribute *lastSetupFailure* Cause is 21. | The configuring at one end of the connection does not match the configuring at the other end. | Check and update the configuring (including the port management configuring) for the service. See “Configuring AAL1 CES” (page 24). |
| Unexplained traffic errors. | The *lineType* attribute of the port at one end of the connection may have been changed during a dynamic call. | Lock and then unlock the channel to which the service is connected, or restart the *Aep* (see “Restarting an active endpoint” (page 71)). After either of these operations, the call will fail with the *lastSetupFaulureCause* attribute value equal to 21, indicating a configuring mismatch. See “Configuring AAL1 CES” (page 24). |
| (Sheet 3 of 3) | | |

***Note:*** If an AAL1 CES experiences an excessively high cell rate on its ATM connection, then all services on the AAL1 FP may be affected. Symptoms may include very high buffer overflow rates or even loss of all services on the FP due to card reset.

# Chapter 5
# Understanding AAL1 CES

This section presents an overview of Nortel Networks Multiservice Switch Asynchronous Transfer Mode Adaptation Layer type 1 Circuit Emulation Service (AAL1 CES) in the following sections:



Use this information to establish AAL1 Circuit Emulation services that take full advantage of your system's resources.

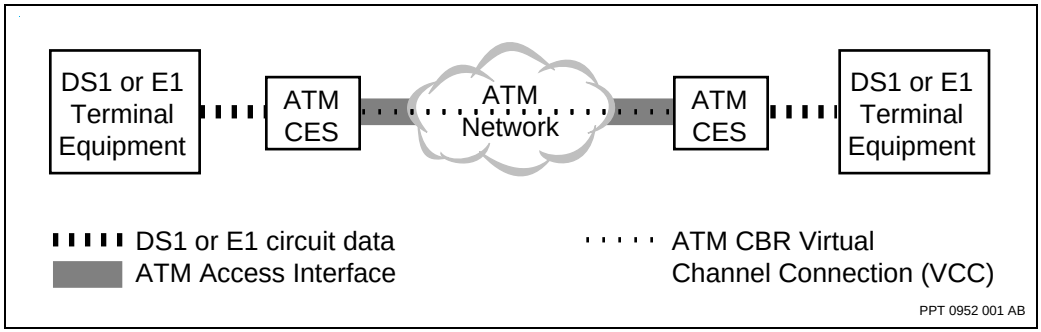
For more information about AAL1 CES features, see "Feature description" (page 85)

## AAL1 CES description

AAL1 CES transports DS1 and E1 time division multiplexed (TDM) constant bit rate (CBR) data over an ATM network at the high-performance level of a dedicated (leased) circuit. This is accomplished by converting the DS1 or E1 circuit data to ATM cells, transferring the cells across an ATM network, and

then reconverting the data to its original DS1 or E1 circuit form (see the figure "AAL1 CES transports DS1 or E1 circuit data through an ATM network" (page 80)). Examples of CBR data are voice and video.

**Figure 6**
**AAL1 CES transports DS1 or E1 circuit data through an ATM network**




# AAL1 CES benefits

AAL1 CES provides:

- multi-vendor interoperability for DS1 or E1 TDM circuits over ATM networks
- the flexibility of maintaining existing leased circuits while gradually upgrading the network to full ATM capability

With AAL1 CES, full DS1 or E1 services operate over ATM networks without requiring that the existing DS1 or E1 terminal equipment be upgraded.

# Applications for AAL1 CES

AAL1 CES applications include:

- backbone to multiplexors deployed in networks providing for network and device consolidation
- video transport for video codecs over ATM

  Support of video codecs having either proprietary encoding schemes or standard H.320 compatible encoding.

- transport of any protocol over ATM

  As with DS1 or E1 leased line, Nortel Networks Multiservice Switch AAL1 CES transports full DS1 or E1 bandwidths for any protocol (HDLC or Non-HDLC) since the carriage is transparent to AAL1 CES.

- voice transport in limited scenarios over ATM

  In general, PBX/voice transport is recommended via the Multiservice Switch voice function processor with bandwidth savings capabilities such as compression, silence suppression, and speech activity detection (SAD). However, if multi-vendor interoperability is desired and compression and SAD is not required, then AAL1 CES provides an alternate solution. However, since the AAL1 FP does not contain echo cancellers, in cases where deployment configurations result in round trip delays exceeding 30 milliseconds, external echo cancellers are required.

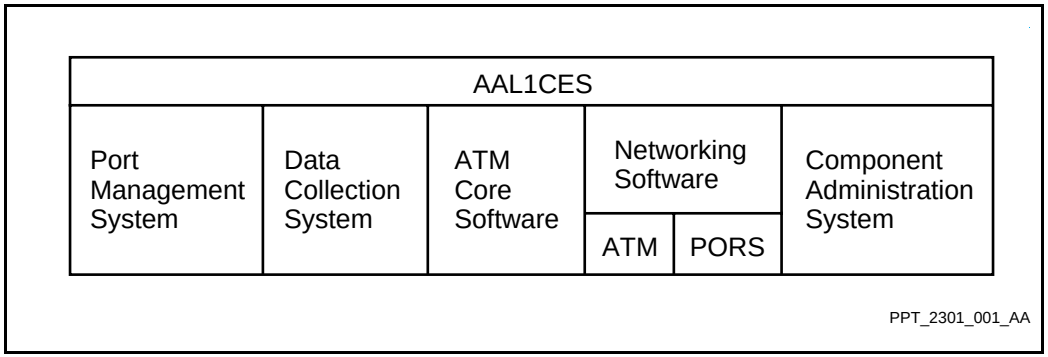
## Function processors supporting AAL1 CES

For information on which function processors support AAL1 CES, see NN10600-551 *Nortel Networks Multiservice Switch 7400/15000/20000 FP Configuration Reference*.

## Multiservice Switch software subsystems supporting AAL1 CES

AAL1 CES interacts with Nortel Networks Multiservice Switch software subsystems shown in the following figure.

**Figure 7**
**AAL1 CES interactions**




These software subsections have the following functions:

- Port Management System (PMS) is used to configure the physical ports which transmit or receive the CBR traffic.
- Data Collection System (DCS) is used to collect and store alarms generated by AAL1 CES.
- ATM Core software is used to set up and tear down (route) ATM connections within a node.
- ATM networking software can be used for dynamic routing of ATM over PNNI, IISP, AINI, and UNI.
- Networking software provides end-to-end transport of the ATM cells through an ATM network.
- Path Oriented Routing System (PORS) software can be used for dynamic routing of ATM cells for Nortel Networks Multiservice Switch 7400 function processor providing AAL1 CES capability.
- Component Administration System is used to configure and monitor the hardware and software components which make up AAL1 CES.

## Where is AAL1 CES hardware and software required?

AAL1 CES hardware and software is required on ingress and egress Nortel Networks Multiservice Switch nodes that are providing AAL1 CES. Tandem nodes that only transport ATM traffic through the subnet do not require AAL1 CES hardware and software.

## Compliance with standards

Nortel Networks Multiservice Switch AAL1 CES complies with the following standards:

- Circuit Emulation Service Interoperability Specification Version 2.0 (af-vtoa-0078.000), November 1996, with the exception of AAL1 CES SNMP Management Information Base (MIB)

  ***Note:*** All variables defined in the AAL1 CES SNMP MIB are supported through the Multiservice Switch Enterprise MIB.

- Private Network-Network Interface (PNNI) Specification Version 1.0, (PNNI 1.0) (af-pnni-0055.000), ATM Forum Technical Committee, March,1996
- PNNI SPVC Addendum version 1.0 (af-cs-0127.000), July, 1999
- ITU I.363.1 (ITU study group 13) November 1994, B-ISDN ATM AAL Specification, Type 1, 2
- ANSI T1.630, B-ISDN ATM Adaptation Layer CBR Services
- ANSI T1.627, B-ISDN ATM Layer Functionality and Specification
- ATM Inter-Network Interface (AINI) Specification, (af-cs-0125.000), ATM Forum, July, 1999

# Chapter 6
# Feature description

Nortel Networks Multiservice Switch AAL1 CES converts DS1 or E1 circuit constant bit rate (CBR) traffic into ATM cells for transport over an ATM network. Upon arrival at their destination, AAL1 CES converts these cells back to DS1 or E1 circuit CBR traffic.

Multiservice SwitchAAL1 CES provides the following features:

- at the source node, an ingress interface that recognizes the format of the input frames and extracts the user data
- an AAL1 facility which formats the user data into ATM cells according to the AAL1 standard
- mechanisms for routing the ATM cells to an egress ATM function processor (FP) and out to an ATM network (the egress ATM FP must have the appropriate bandwidth to accommodate the cell throughput)
- at the destination node, mechanisms for routing the ATM cells from an ATM FP to the appropriate FP providing AAL1 CES capability (the ATM FP must be capable of accommodating the cell throughput)
- the ability to reassemble the AAL1 data from the ATM cells, and then place the user data into the appropriate frames for transport off the node

# Incoming traffic description

The incoming traffic is interpreted in the following ways at the line interface:

- Unstructured with no TDM frame monitoring (sometimes called ‘clear pipe’).

  In this case, the user data is a contiguous stream of bits ($U_{cp}$ traffic) arriving at the line rate of the input port. No interpretation is placed on the incoming bit stream, and no framing structure is assumed. All the incoming bits are packaged into AAL1 cells and forwarded to the far end of the connection.

- Unstructured with TDM frame-based monitoring.

  In this case, all of the incoming information ($U_{pm}$ traffic) is packaged into AAL1 cells and forwarded under the assumption that the input is framed according to the framing type of the input port. Thus, frame-based performance monitoring and alarm generation can be supported.

- Structured with Channel Associated Signalling (CAS)

  In this case, the incoming data ($S_c$ traffic) is assumed to be framed, with each frame containing a number of different timeslots, or channels (the number of timeslots depending on the supporting technology). As with $U_{pm}$ traffic, framing bits are used to monitor performance and alarms, but they are not forwarded.

  When CAS is specified, the signalling bits in each channel are recognized and stored in an AAL1 signalling sub-structure before transfer. No further interpretation is placed on the signalling information. Signal processing is the responsibility of the receiving equipment.

- Structured with no CAS (basic structured)

  In this case, as with $S_c$ input, the incoming data ($S_{nc}$ traffic) is assumed to be framed, and the framing bits are used for performance monitoring. However, any signalling bits present are not processed in any way, and complete channels are forwarded transparently.

***Note:*** For the E1 FP, select common channel signaling (CCS). CCS may be present in the incoming traffic in situations in which all the incoming timeslots are forwarded to a single destination that can interpret CCS information. However, in such cases, the CCS information is forwarded transparently, and is not interpreted as part of the CES.

The table "Handling of structured and unstructured services" (page 87) summarizes the applicable methods of interpreting incoming traffic for each function processor.

**Table 12**
**Handling of structured and unstructured services**

| Function processor | Unstructured with no TDM frame monitoring (clear pipe) | Unstructured with TDM frame based monitoring | Structured with Channel Associated Signalling (CAS) | Structured with no CAS (basic structured) |
|---|---|---|---|---|
| 4-port DS1 AAL1 | yes | yes | yes | yes |
| 4-port E1 AAL1 | yes | yes | yes | yes |
| 32-port DS1 Multiservice Access | yes | yes | yes | yes |
| 32-port E1 Multiservice Access | yes | yes | yes | yes |
| 4-port DS3 channelized AAL1 CES | yes (DS1) | yes (DS1) | no | yes |
| 4-port OC-3/STM-1Ch TDM/CES | yes (DS1 and E1) | yes (DS1 and E1) | no | yes |
| 2-port STM-1e Ch CES/ ATM/IMA | yes (E1) | yes (E1) | no | no |
| ***Note:*** For the 4-port DS1 and E1 AAL1 FPs, all connections must be configured for either unstructured or structured services, not a combination of the two service types. Structured FPs may be configured with a combination of basicStructured and casStructured service types. | | | | |
| | | | | |

# Fractional input

In accommodating structured information, it is possible to define multiple mappings between ATM interfaces and time domain multiplexing (TDM) interfaces for unchannelized DS1 and E1, and channelized DS3 and OC-3/ STM-1 ports. All ATM-to-TDM cross connections are bidirectional. Nortel Networks Multiservice Switch AAL1 CES feature can support more than one structured CES instance on a single TDM DS1/E1 stream. For more information, see the following sections:

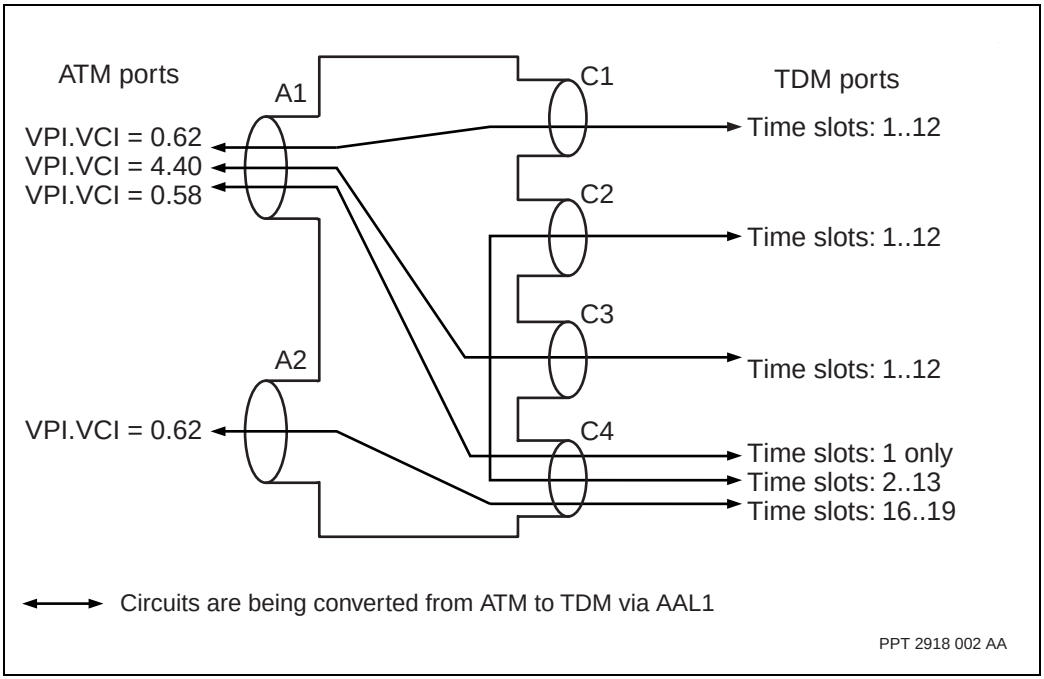
- “ATM-to-TDM cross connections on DS1 or E1 ports” (page 88)
- “ATM-to-TDM cross connections on DS3/OC-3/STM-1 ports” (page 89)

***Note:*** Mapping from multiple ATM or TDM interfaces to a single TDM interface is not possible for unstructured ($U_{cp}$ or $U_{pm}$) traffic.

## ATM-to-TDM cross connections on DS1 or E1 ports

The figure “Example of ATM-to-TDM cross-connections on DS1 or E1 ports” (page 89) shows the bidirectional cross-connects configured in a Nortel Networks Multiservice Switch 7400 node with two ATM ports and four structured TDM DS1 or E1 ports. A certain fraction of the streams at the C4 interface is transported to A1, and a different fraction is transported to A2. In addition, it is possible to transport another fraction of the TDM data at C4 to the TDM interface at C2. In this case, ATM is used within the node to provide a TDM switching feature.

**Figure 8**
**Example of ATM-to-TDM cross-connections on DS1 or E1 ports**

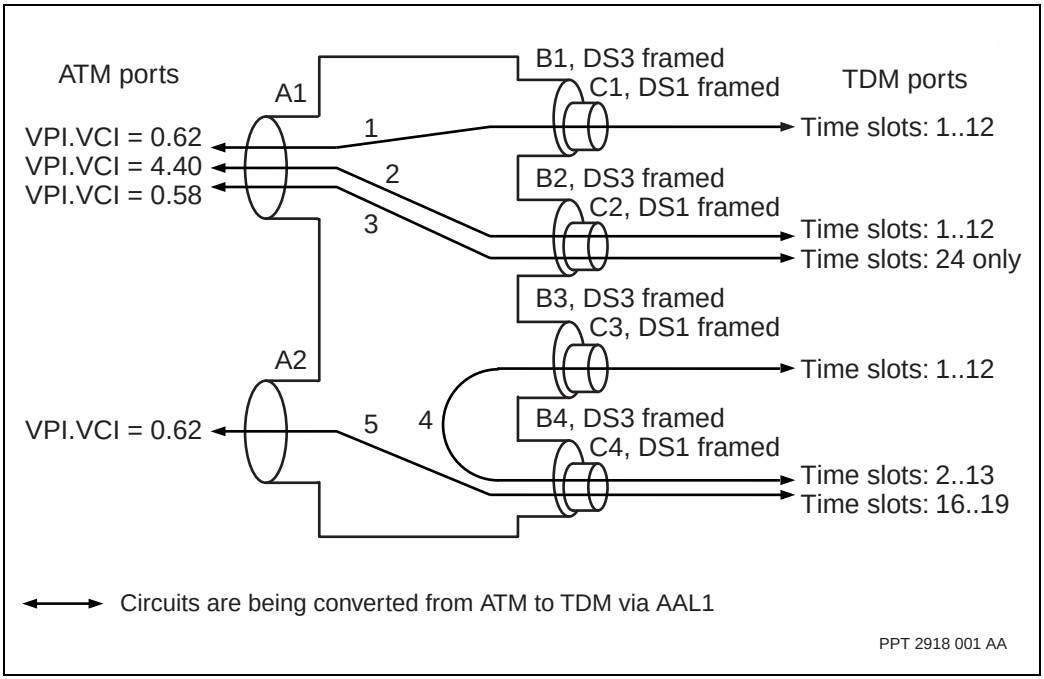



## ATM-to-TDM cross connections on DS3/OC-3/STM-1 ports

The figure "Example of ATM-to-TDM cross-connections on DS3 ports" (page 90) shows the bidirectional cross-connects configured in Nortel Networks Multiservice Switch 15000 and Multiservice Switch 20000 nodes with two ATM ports, four structured DS3 (B1, B2, B3, B4) ports, and five TDM DS1 streams. The example shows five different CES connections between the ATM ports and the TDM DS1 streams. Services 1, 2, and 3 run over ATM port A1 and service 5 runs over ATM port A2. Service 4 connects twelve timeslots between TDM DS1 stream C3 and TDM DS1 stream C4 without passing through an ATM port. In this case, ATM is used within the node to provide a TDM switching feature.

***Note:*** Similar ATM-to-TDM cross connections apply to OC-3/STM-1 ports. However, in the case of OC-3, DS3 would be replaced by OC-3 and in the case of STM-1, DS3 and DS1 would be replaced by STM-1 and E1, respectively.

**Figure 9**
**Example of ATM-to-TDM cross-connections on DS3 ports**




# Deployment scenarios

This section illustrates how AAL1 CES is deployed in some typical applications:

- To connect two AAL1 ports on the same node, using ATM internally to node CBR traffic. See the figure “Switching CES traffic using AAL1 internally” (page 91).
- To connect two AAL1 ports on different nodes that may be connected using Nortel Networks Multiservice Switch ATM links. See the figure “Using Multiservice Switch trunks to carry AAL1 CES traffic” (page 92).
- To connect two AAL1 ports that reside on different nodes that are part of a network consisting of Nortel Networks products only. That is, the CES traffic may be routed through a node that is not a Multiservice Switch device. This situation differs from the case of a general ATM network in

that certain proprietary services may be available (see the figure “Using a Multiservice Switch network to carry AAL1 CES traffic” (page 93)). In such a scenario, Multiservice Switch AAL1 CES is able to take advantage of any Nortel Networks range proprietary facilities.

- To connect two AAL1 ports which reside on different Multiservice Switch nodes that may be connected through an external third-party ATM network. See the figure “Using an ATM network to carry AAL1 CES traffic” (page 94).
- To connect an AAL1 port to a third-party constant bit rate port over an ATM network (either external or internal). See the figure “Using an ATM network to carry AAL1 CES traffic to a third party device” (page 94).

**Figure 10**
**Switching CES traffic using AAL1 internally**

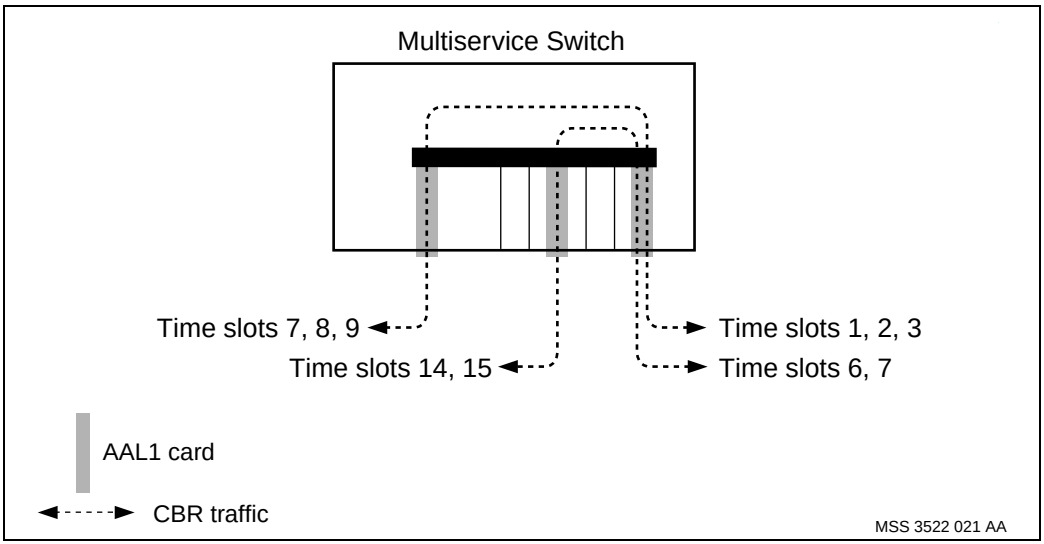


**Figure 11**
**Using Multiservice Switch trunks to carry AAL1 CES traffic**

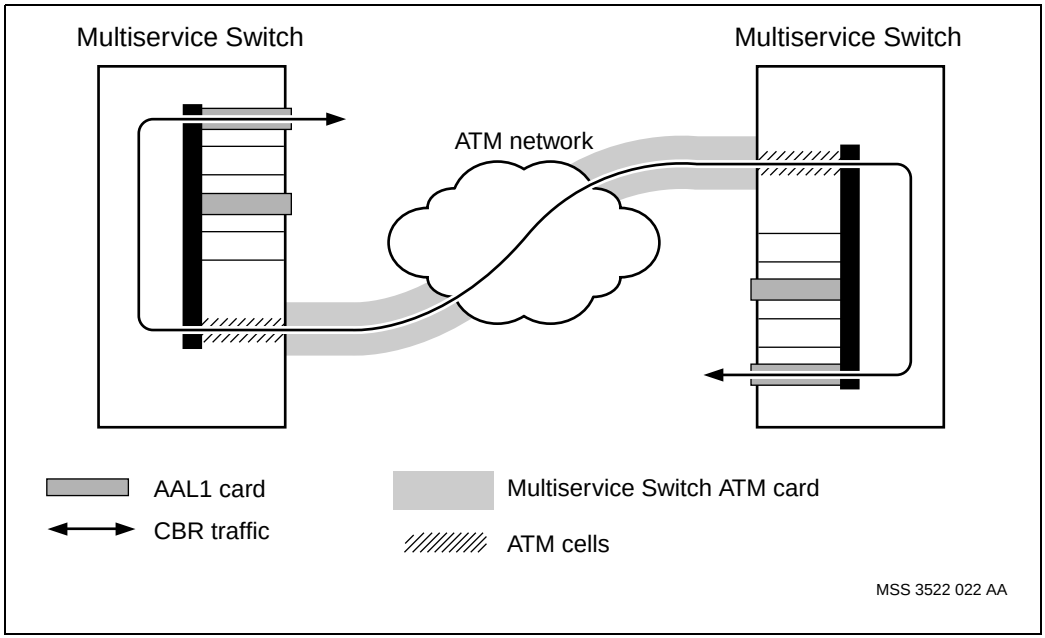


**Figure 12**
**Using a Multiservice Switch network to carry AAL1 CES traffic**

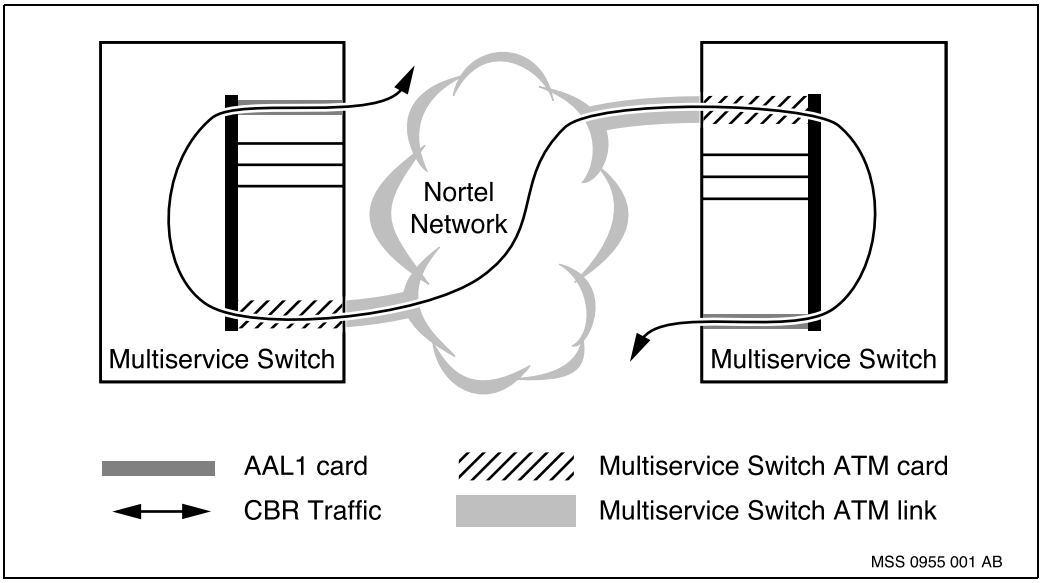


**Figure 13**
**Using an ATM network to carry AAL1 CES traffic**

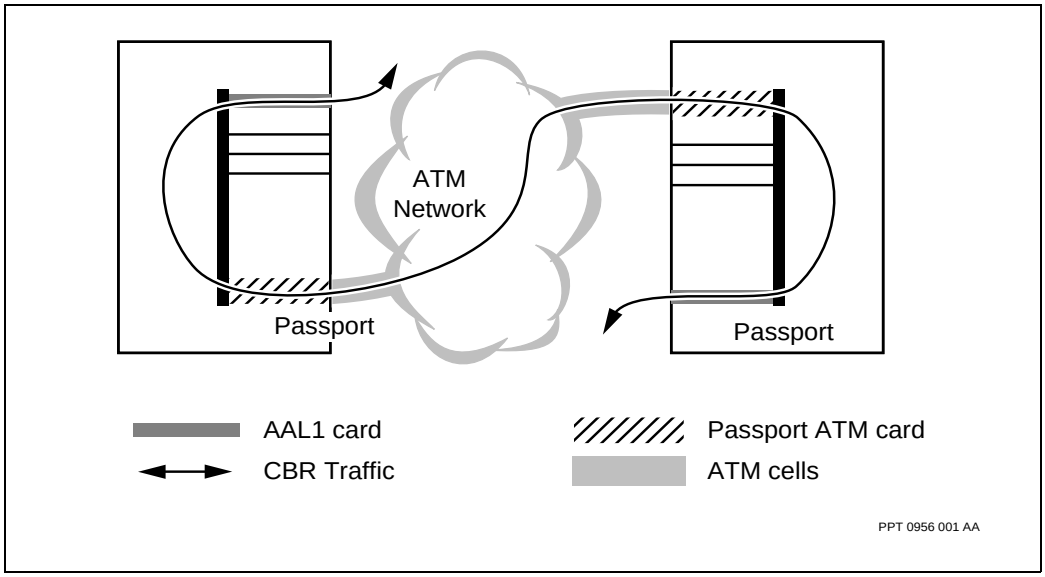
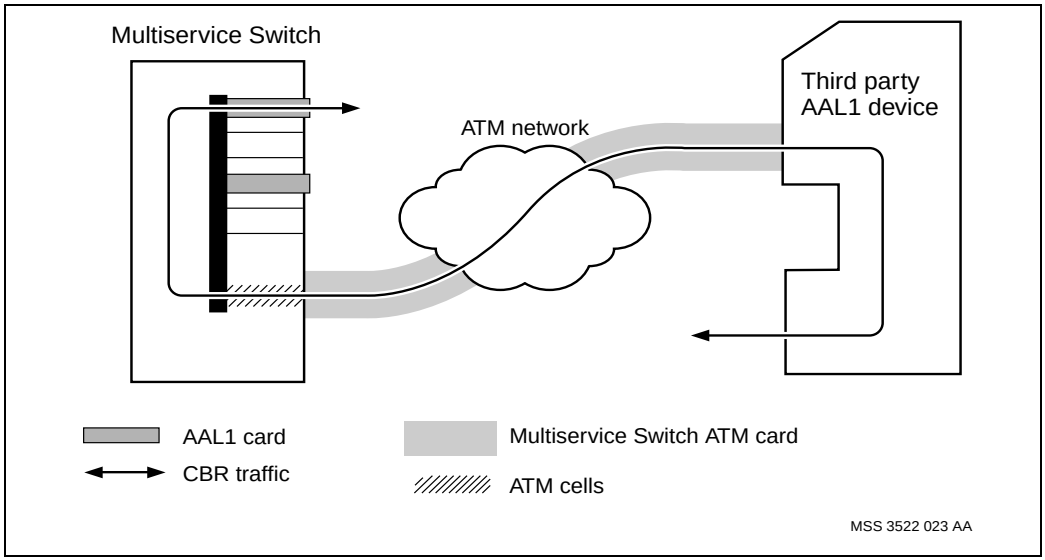



**Figure 14**
**Using an ATM network to carry AAL1 CES traffic to a third party device**



## Supporting technologies

CES depends on ports that can accommodate CBR input and convert this into AAL1 traffic. The table “Ports accommodating CBR conversion to AAL1 traffic” (page 95), summarizes this information for Nortel Networks Multiservice Switch function processors.

**Table 13**
**Ports accommodating CBR conversion to AAL1 traffic**

| Port type | Function processors | Line rate (Mbit/s interface) | AAL1 traffic types |
|---|---|---|---|
| DS1 | 4-port DS1 AAL1, 32-port DS1 Multiservice Access | 1.544 | $U_{cp}$, $U_{pm}$, $S_{nc}$, $S_c$ |
| E1 | 4-port E1 AAL1, 32-port E1 Multiservice Access | 2.048 | $U_{cp}$, $U_{pm}$, $S_{nc}$, $S_c$ |
| DS3 | 4-port DS3 channelized AAL1 CES | 1.544 (per DS1 tributary) | $U_{cp}$, $U_{pm}$, $S_{nc}$ (DS3 port is $S_{nc}$) |
| OC3 | 4-port OC-3/STM-1 channelized TDM/ CES | 1.544 (per DS1 tributary) | $U_{cp}$, $U_{pm}$, $S_{nc}$ (DS1 level) |
| SDH | 2-port STM-1electrical channelized CES/ ATM/IMA | 2.048 (per E1 tributary) | $U_{cp}$, $U_{pm}$ (E1 level) |
| | | | |

CES also depends on:

- Path Oriented Routing System (PORS), which provides dynamic routing of ATM services.

  See NN10600-435 *Nortel Networks Multiservice Switch 7400/15000/ 20000 Operations: Path-Oriented Routing System* for more information.

  ***Note:*** See the table “Connection setups for AAL1 CES” (page 96) for the function processors supporting PORS routing.

- The ATM Bearer Service (ABS), which transfers ATM cells through Nortel Networks Multiservice Switch nodes and off-switch on permanent connections.

  See NN10600-700 *Nortel Networks Multiservice Switch 7400/15000/ 20000 ATM Technology Fundamentals* for more information.

- Network clock synchronization.

  See NN10600-550 *Nortel Networks Multiservice Switch 7400/15000/ 20000 Common Configuration Procedures* for more information.

- ATM Networking which provides dynamic routing of ATM connections.

  See NN10600-702 *Nortel Networks Multiservice Switch 7400/15000/ 20000 ATM Routing and Signalling Fundamentals* for more information.

## Dynamic and permanent connections

After the AAL1 function processor formats the DS1 or E1 circuit traffic into ATM cells, Nortel Networks Multiservice Switch PORS or ATM networking connections can route the cells dynamically across the network to the required destination. Alternatively, Multiservice Switch ATM Bearer Service (ABS) can deliver the cells across the network over permanent connections (PVCs).

The table “Connection setups for AAL1 CES” (page 96) shows the connections according to function processor type.

**Table 14**
**Connection setups for AAL1 CES**

| Function processor | Dynamic PORS connections | Dynamic connections through standards-based ATM routing (CES SVCs) | Dynamic soft permanent virtual connections (CES soft PVCs) | Permanent virtual connections (CES PVCs) |
|---|---|---|---|---|
| 4-port DS1 AAL1 | yes | yes | yes | yes |
| 4-port E1 AAL1 | yes | yes | yes | yes |

(Sheet 1 of 2)

**Table 14 (continued)**
**Connection setups for AAL1 CES**

| Function processor | Dynamic PORS connections | Dynamic connections through standards-based ATM routing (CES SVCs) | Dynamic soft permanent virtual connections (CES soft PVCs) | Permanent virtual connections (CES PVCs) |
|---|---|---|---|---|
| 32-port DS1 Multiservice Access | yes | yes | yes | yes |
| 32-port E1 Multiservice Access | yes | yes | yes | yes |
| 4-port DS3 channelized AAL1 CES | no | yes | yes | yes |
| 4-port OC-3/STM-1 channelized TDM/ CES | no | yes | yes | yes |
| 2-port STM-1e channelized CES/ATM/ IMA | no | yes | yes | yes |

***Note 1:*** A CES SVC connection can be used to connect channels when connecting intra-node channels (within the card or shelf) and inter-node channels (in PNNI networks).

***Note 2:*** Interoperability of Multiservice Switch function processors supporting AAL1 CES is possible only if they support the same connection setup. For example, a 32-port DS1 Multiservice Access FP will interoperate with a 4-port DS3 channelized AAL1 CES FP over ATM with CES SVC, PVC, or SPVC connection but will not interoperate over a PORS connection.

***Note 3:*** The 4-port E1 AAl1CES and 4-port DS1 AAL1 CES FPs support a maximum of 96 channels each.

(Sheet 2 of 2)

## Dynamic connections through PORS

In a dynamic connection, the operator configures a connection between two ATM end-points and leaves the actual routing to the PORS routing software The operator configures the system with information that indicates that a link must be established between end-point x and end-point y. The software then routes the traffic transparently, allocating VPI/VCI pairs for each hop of the

route, and ensures that the required quality of service is maintained across the network. If part of the connection goes down, the networking software performs the reconnection automatically, without operator intervention.

From the user's point of view, this type of connection appears as a PVC. However, the connection is set up internally using switched virtual circuits (SVC). Connections that have been established using PORS benefit from all the PORS features, such as path bumping and route optimization. (See NN10600-435 *Nortel Networks Multiservice Switch 7400/15000/20000 Operations: Path-Oriented Routing System* for more information.)

Because PORS is a proprietary Nortel Networks Multiservice Switch routing system, dynamic connections established through PORS must terminate on Multiservice Switch nodes.

See the table "Connection setups for AAL1 CES" (page 96) for the function processors that support AAL1 CES over dynamic PORS connections.

## Dynamic connections through standards-based ATM routing (ATM SVCs)

Nortel Networks Multiservice Switch supports dynamic connections through standards-based ATM routing, through IISP, UNI, AINI, or PNNI on all function processors providing AAL1 CES capability. Each AAL1 CES instance requires the exclusive use of a SVC, thus minimizing the configuration requirements for an end-to-end AAL1 CES service connection. The ATM routing system selects the connection's route and performs the intermediate hop-by-hop setup. All signalling will be performed by the AAL1 CES application and the ATM networking system.

See the table "Connection setups for AAL1 CES" (page 96) for the function processors that support AAL1 CES over dynamic PORS connections.

## Dynamic soft permanent virtual connections (soft PVCs)

The AAL1 CES soft PVC mechanism makes use of a soft PVC configured between two ATM interfaces, either physical or logical, in the network, to provide a dynamic ATM segment for a connection between AAL1 CES interworking functions. One end of such a segment must end at an intra-network ATM interface, and must be configured to terminate into an AAL1 CES interworking function. The other end of the dynamic ATM segment can

end on any intra-network or inter-network interface. By combining two such dynamic ATM segments or by concatenating such a dynamic ATM segment over a PVC segment, end-to end ATM connectivity can be built between peer AAL1 CES interworking functions.

See the table “Connection setups for AAL1 CES” (page 96) for the function processors that support AAL1 CES over dynamic soft PVCs.

### Permanent virtual connections (PVCs)

In a permanent virtual connection, each hop of the connection is defined individually (that is, the VPI and VCI values of the cells on each link are configured by the operator). If a link goes down, the operator has to manually reconfigure the connection to route round the problem.

See the table “Connection setups for AAL1 CES” (page 96) for the function processors that support AAL1 CES over PVCs.

## OAM support

Support for ATM OAM cells is provided as part of the ABS; loopbacks and tracing of connections are provided. In addition, end-to-end VCC loopback OAM cells (known as F5 cells) will be terminated appropriately on the relevant ATM FP (note that they will not be transferred across the node’s backplane to the AAL1 FP).

The AAL1 CES does not receive nor generate any OAM cells. All OAM cells will be terminated by the ABS. However, when the ABS detects a fault condition in the ATM connection, CES will be disabled. Thus, OAM cells like AIS, RDI and loopback cells do affect the CES operation.

When any one of the *Vcc* operational attributes *aisState*, *rdiState*, *segLinkSideLoopbackState* or *endToEndLoopbackState* is set to bad, the corresponding AAL1 CES will be disabled. See NN10600-060 *Nortel Networks Multiservice Switch 7400/15000/20000 Component Reference* for further details on these attributes.

## Network synchronization

For constant bit rate AAL1 CES, it is important that network synchronization is available to ensure accurate transmission and reproduction of synchronous data. The method of synchronization is dependent upon:

- if the CES is structured or unstructured
- the type of Nortel Networks Multiservice Switch function processor providing AAL1 CES capability

The table “Methods of network synchronization” (page 101) shows the methods for each function processor.

**Table 15**
**Methods of network synchronization**

| | Network clock synchronization | Synchronous Residual Time Stamp (SRTS) | Adaptive clocking |
|---|---|---|---|
| structured CES | • 4-port DS1 AAL1<br>• 4-port E1 AAL1<br>• 32-port DS1 Multiservice Access<br>• 32-port E1 Multiservice Access<br>• 4-port DS3 channelized AAL1 CES<br>• 4-port OC-3/STM-1 channelized TDM/ CES | not applicable | not applicable |

(Sheet 1 of 2)

**Table 15 (continued)**
**Methods of network synchronization**

| | Network clock synchronization | Synchronous Residual Time Stamp (SRTS) | Adaptive clocking |
|---|---|---|---|
| unstructured CES | • 4-port DS1 AAL1<br>• 4-port E1 AAL1<br>• 32-port DS1 Multiservice Access<br>• 32-port E1 Multiservice Access<br>• 4-port DS3 channelized AAL1 CES<br>• 4-port OC-3/STM-1 channelized TDM/ CES<br>• 2-port STM-1 electrical channelized CES/ ATM/IMA | • 32-port DS1 Multiservice Access<br>• 32-port E1 Multiservice Access | • 32-port DS1 Multiservice Access<br>• 32-port E1 Multiservice Access |
| (Sheet 2 of 2) | | | |

For further information on methods of network synchronization, see

- “Network clock synchronization” (page 102)
- “Synchronous Residual Time Stamp (SRTS)” (page 103)
- “Adaptive clocking” (page 104)

## Network clock synchronization

For structured services, the transmit and receive interfaces must be timed from a single, common clock. This is achieved using the network clock synchronization, which forces the terminating equipment to transmit and

receive at the same frequency. For more information about network clock synchronization, see NN10600-550 *Nortel Networks Multiservice Switch 7400/15000/20000 Common Configuration Procedures*.

See the table “Methods of network synchronization” (page 101) for clocking modes applicable for the different Nortel Networks Multiservice Switch function processors running.

## Synchronous Residual Time Stamp (SRTS)

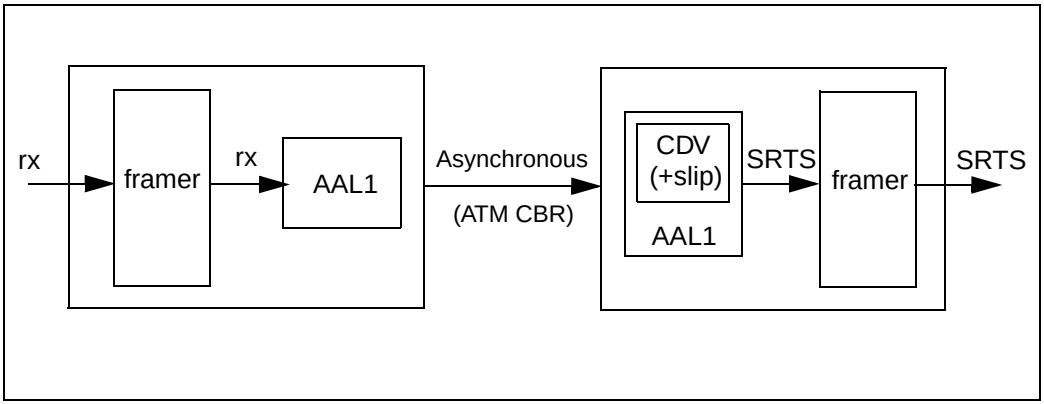
For unstructured services, the service can use the same clocking method as structured services. Alternatively, the service can allow the transmitting equipment to supply the clock, which is then carried through the ATM network and used to drive the receiving equipment.

See the table “Methods of network synchronization” (page 101) for clocking modes applicable for the different function processors running.

When SRTS is used, network clock synchronization is still used to ensure common clocking for the Nortel Networks Multiservice Switch network. SRTS essentially gives clock difference measurements between the terminal equipment and the adjacent node. These differences are valid at the far end only if the receiving node applies the differences to an identical clock.

SRTS clocking requires that the FP at either end of the ATM network is synchronized to a common network reference clock which is used to calculate or decode SRTS values. In such configurations as illustrated in the figure “Unstructured CES using SRTS in an ATM network” (page 104), the egress framers will clock data in and out using the derived SRTS clock as their transmit clock. Ingress framers will clock data in and out using the received clock. Any wander in the network reference clocks as perceived by the two end multi-service access systems will be absorbed by the egress cell delay variation (CDV) buffer. Excess wander results in a controlled slip as the FP resynchronizes.

**Figure 15**
**Unstructured CES using SRTS in an ATM network**




### Adaptive clocking

Adaptive clocking requires no correlation between system clocks. The transmit clock rate is being adapted to keep the CDV (cell delay variation) buffer fill at its midpoint. If the adaptive clock reacts quickly while filtering the CDV effects, there will be no data loss. If the adaptive clock is unable to react quickly, data is lost by the controlled slip that occurs when the CDV buffer resynchronizes.

See the table “Methods of network synchronization” (page 101) for clocking modes applicable for the different Nortel Networks Multiservice Switch function processors running.

## Cell generation during line error

When loss of signal (LOS), framing error, or alarm indication signal (AIS) failure conditions occur for structured services, trunk conditioning cells are generated in the ingress direction for every CES connection. Under these conditions, the AAL1 FP continues to emit cells at the nominal rate, but it generates the appropriate data to indicate the error condition. For CAS in $S_c$ traffic, appropriate signalling codes are also inserted into the AAL1 cells.

When an LOS condition occurs for unstructured services, AAL1 cells containing all-ones are generated, effectively propagating an unframed AIS signal.

Trunk conditioning and AIS cell generation functionality is described in the ATM Forum CES Interoperability Specification.

# Dummy data

The ATM forum specification indicates that when valid data is not available from the ATM network, dummy data bytes can be inserted into the data stream to maintain bit integrity.

## 4-port DS1 and 4-port E1 AAL1 function processors

For basic structured services, the 4-port DS1 AAL1 and 4-port E1 AAL1 function processors allow users to configure the value of the dummy data byte. For unstructured services in which compliance with the ATM Forum specification is necessary, the value of the dummy data byte should be set to its default of all ones.

## 32-port DS1 and 32-port E1 Multi-Service Access function processors

Dummy data is not configurable on the 32-port DS1 and 32-port E1 Multiservice Access function processors. Only Oxff is allowed.

## 4-port DS3 channelized AAL1 CES function processors

Users cannot configure the value of the dummy data byte. This value must be set to Oxff for both structured and unstructured services.

## 4-port OC-3/STM-1 channelized TDM/CES function processors

For structured services, the 4-port OC-3/STM-1 channelized TDM/CES function processors allow users to configure the value of the dummy data byte. For unstructured services in which compliance with the ATM Forum specification is necessary, the value of the dummy data byte should be set to its default of Oxff.

# Interworking with other AAL1 products

Nortel Networks Multiservice Switch implementation of AAL1 CES will generate and terminate AAL1 cells as described by the ATM Forum interoperability specification and should therefore be compatible with other AAL1 products which conform to the same standard.

Because the 4-port DS3 channelized AAL1 CES and the 4-port OC-3/STM-1 channelized TDM/CES function processors support only standards-based ATM routing, interworking with other function processors is possible only if all function processors are configured to use standards-based ATM routing.

> ***Note:*** The 4-port OC-3/STM-1 channelized TDM/CES FP does not support edge-based rerouting (EBR) for CES.

For function processors capable of using PORS, dynamic connections that are established using PORS must terminate on nodes, which support PORS.

# Rerouting for CES

Rerouting provides connection recovery and path optimization capabilities within a PNNI network for CES SVC and SPVC connections. Rerouting enhances the capabilities of PNNI networks to provide high availability during network failures and path optimizations without requiring intervention by the originator of the connection. For more conceptual information on rerouting including connection recovery, path optimization, and time of day optimization see, NN10600-702 *Nortel Networks Multiservice Switch 7400/ 15000/20000 ATM Routing and Signalling Fundamentals*.

> ***Note:*** CES rerouting does not support PORS.

For configuration information on rerouting for CES, see the following sections:

- “Configuration requirements for rerouting” (page 106)
- “Rerouting behavior in CES” (page 108)
- “Rerouting CES limitations” (page 109)

## Configuration requirements for rerouting

Rerouting procedures enable connections that traverse the PNNI network to be eligible for PNNI rerouting capabilities. For a connection to be eligible for rerouting, both ingress and egress PNNI nodes used by the connection need to support AAL1 rerouting.

The figures “CES connections after rerouting” (page 108) and “CES connections after rerouting” (page 108) illustrate typical examples of CES connections in an ATM network. After a link failure occurs in the figure “CES connections after rerouting” (page 108), figure “CES connections after rerouting” (page 108) displays the rerouted connection segments.

**Figure 16**
**CES connections before connection recovery**

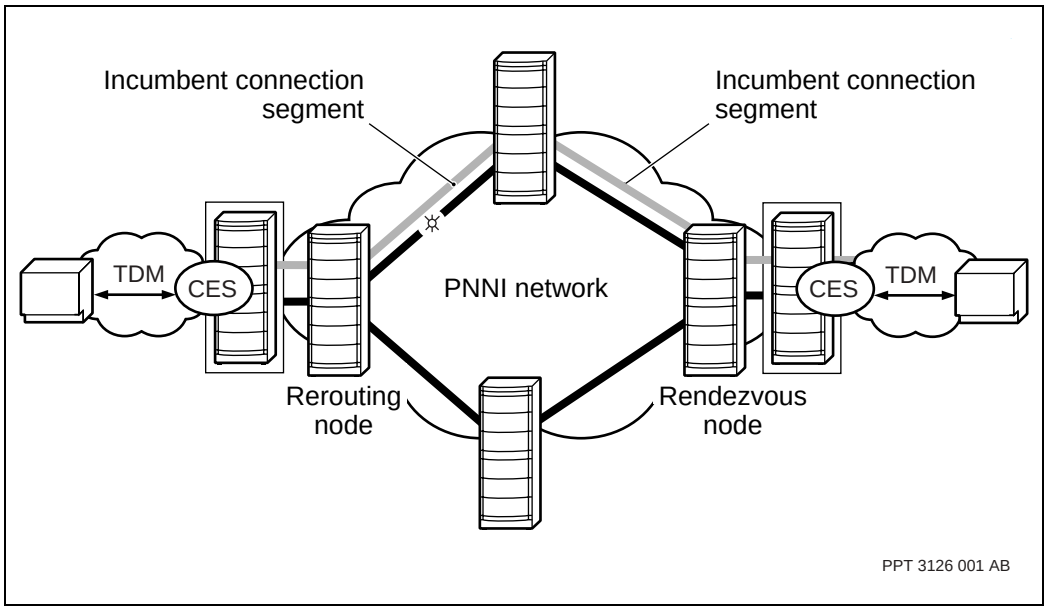
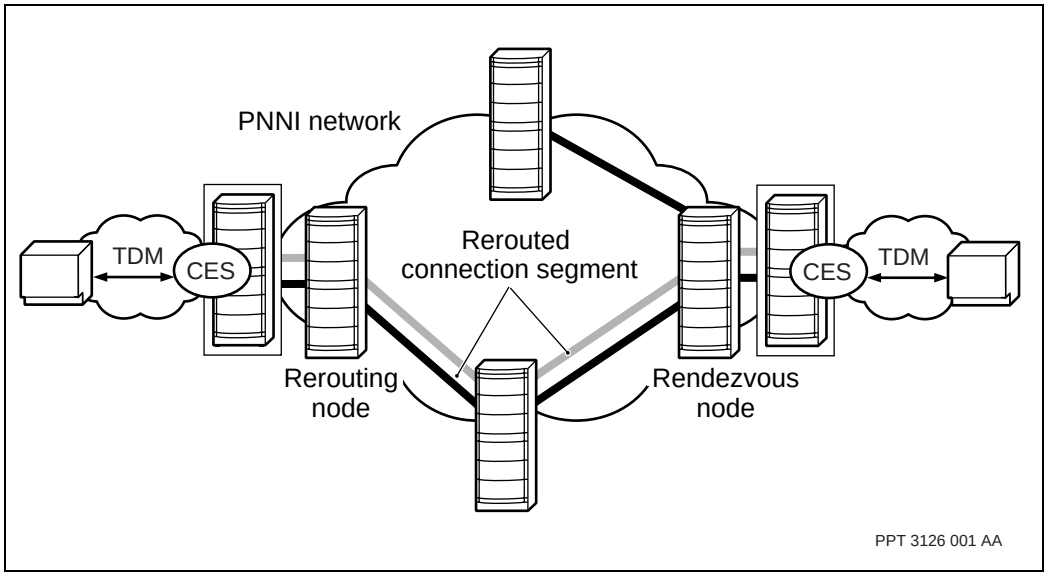


**Figure 17**
**CES connections after rerouting**




To configure the rerouting capability:

- The cesReroute feature must be installed on the CES FP.
- The *Reroute* component must be added under the CES service.

***Note:*** As of PCR 5.1, *cesEbr* has migrated to *cesReroute*.

For more information on configuring rerouting, see “Connection recovery and path optimization” (page 45).

## Rerouting behavior in CES

The following behavior is applicable to CES SVC and SPVC connections with Nortel Networks Multiservice Switch ATM PNNI rerouting capabilities:

- During connection recovery or path optimization, ATM cells can be lost. If a disruption to the AAL1 traffic occurs, cells will not arrive at the CES reassembly buffer at the rate required to maintain bit count integrity on the TDM interface. This disruption will cause the reassembly buffer to empty. If the traffic disruption lasts more than the provisioned

cellDelayVariationTolerance, the buffer will underflow. This will result in CES inserting dummy cells to maintain bit count integrity, and therefore, for dummy data to be used in the TDM interface.

- If the buffer underflow condition persists for a period greater than or equal to the cellLossIntegrationPeriod, CES will enter its persistent buffer underflow state, and will apply AIS (for unstructured service) or trunk conditioning (for structured service). Persistent buffer underflow will clear when valid cells have continuously arrived for a period equal to cellLossRecoveryPeriod (usually 10 times the cellLossIntegrationPeriod). AIS or trunk conditioning will cease to be applied as soon as the buffer has reached its CDVT level again. This behavior complies with ATM Forum recommendations described in [7]
- If a failure occurs on the ATM network and connection recovery is successful, the CES REROUTE SVC/SPVC connection is not released and therefore the Aal1Ces/n connectionStatus attribute remains connected. The user is not aware of the outage of the connection. Nevertheless as explained previously, the TDM user may receive dummy cells, AIS or trunk conditioning.
- If a failure occurs on the ATM network and reroute connection recovery is not successful, the CES REROUTE SVC/SPVC is released and the connectionStatus goes to atmNotReady. CES applies AIS or trunk conditioning. The call is retried automatically by the active end.

## Rerouting CES limitations

The following section contains information about two CES limitations:

- route recovery limitation
- path optimization pacing

In the event of connection failure, approximately 200 connections will attempt recovery. The remaining connections timeout on a route to destination failure, clear to the destination, and are re-established by the application.

Rerouting path optimization is performed one connection at a time, to minimize impacts to new call setup attempts. To optimize a large connection space takes time. Rerouting optimizes most connections within 60ms, depending on the network configuration.

# Software architecture of AAL1 CES

This section describes the software architecture of Nortel Networks Multiservice Switch AAL1 CES:

- "AAL1 CES over dynamic PORS connections" (page 110)
- "AAL1 CES over dynamic ATM SVCs" (page 112)
- "AAL1 CES over dynamic soft PVCs" (page 114)
- "AAL1 CES over PVCs" (page 118)

See the table "Connection setups for AAL1 CES" (page 96) for function processors supporting the above connection types.

## AAL1 CES over dynamic PORS connections

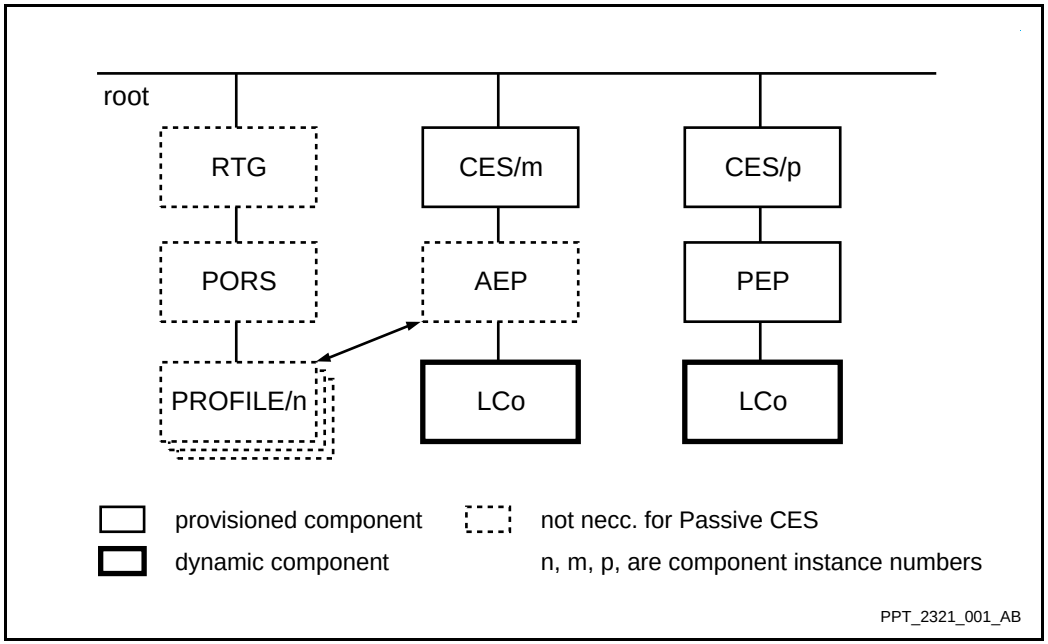
To achieve dynamic routing, the AAL1 CES connection needs only minimal configuring. Route selection and intermediate link setup are done automatically. When an intermediate link or node in the route fails, the path is re-established automatically by rerouting the connection around the failed link or node (if possible).

In this case, establishing the ATM connection is initiated by one end point, known as the active end. The other end is a passive end that waits for an incoming connection request through the ATM network.

The figure "Component hierarchy for AAL1 CES over dynamic PORS connections" (page 111) shows the component hierarchy for a dynamic connection. The *Aal1Ces* component has either an *ActiveEndPoint* (*Aep*) or *PassiveEndPoint* (*Pep*) component that defines its role in the connection. The CES component is linked to a *LogicalConnection* (*LCo*) component that provides operational information about the connection through the network. The *LCo* component is not configured; it is created dynamically during the connection.

The *Aal1Ces* component may also be associated with a PORS routing profile, which defines the routing parameters for the connection.

**Figure 18**
**Component hierarchy for AAL1 CES over dynamic PORS connections**




The components supporting AAL1 CES over dynamic connections are as follows:

- *Pep* defines the CES access information, which includes local and remote addresses for the connection (*Pep* is a required component when a passive dynamic CES connection is required).
- *Aep* defines logical connectivity information for active CES components that initiate calls.
- *LCo* provides operational information about the actual connection through the network.
- *routing* (*rtg*), *pors*, and *profile* define the required properties of the PORS route over ATM links.

The *Aal1Ces*, *Aep*, and *Pep* components are instantiated on the AAL1 function processor.

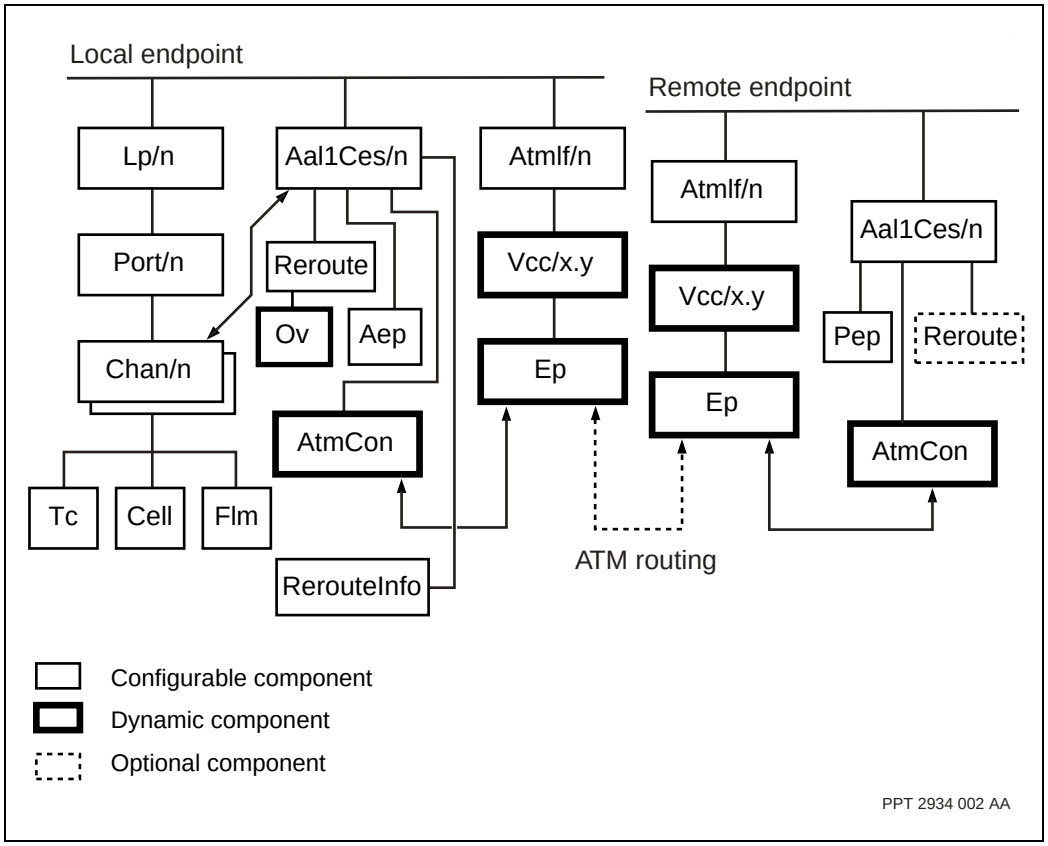
## AAL1 CES over dynamic ATM SVCs

The AAL1 CES connection to an ATM network can be achieved using dynamic SVC (switched virtual circuit). Each *Aal1Ces* instance requires exclusive use of a SVC. This allows minimal configuring for end-to-end AAL1 CES service connection to be performed. Route selection and intermediate hop-by-hop setup will be done automatically. Furthermore, when an intermediate link or node in the route fails, the path will be re-established automatically by rerouting the connection around the failed link or node (if possible). The end user (TDM traffic user) does not require any signalling capability. All required signalling will be performed by the AAL1 CES application and Nortel Networks Multiservice Switch ATM networking system.

The internal ATM connection is achieved using the Multiservice Switch ATM Networking Application Programming Interface (API). External ATM connection is achieved using either IISP, UNI, AINI or PNNI signalling over ATM interfaces. Each service connection will have two AAL1 CES application end points. The ATM connection establishment between them will be initiated by the *ActiveEndPoint* (*Aep*), while the *PassiveEndPoint* (*Pep*) waits for an incoming connection request through the ATM network. The *Aal1Ces* component is linked to an *AtmConnection* (*AtmCon*) component that provides operational information about the connection through the network. The AtmCon component is not configured; it is created dynamically during the connection.

The figure “Component hierarchy for AAL1 CES over dynamic ATM SVCs” (page 113) illustrates the CAS naming tree for AAL1Ces over SVC. When the Aal1Ces/n Aep routingOption is set to atmOnly, for example, and an AtmIf is configured on the same shelf with *Iisp* or *Pnni* such that a route to the remoteAddress can be determined, *Vcc* (virtual channel connection) and *Ep* (end point) are automatically added to complete the route to the remote Aal1Ces with the correct address.

**Figure 19**
**Component hierarchy for AAL1 CES over dynamic ATM SVCs**




The components supporting AAL1 CES over ATM SVCs are as follows:

- *Pep* defines the CES access information, which includes local and remote addresses for the connection (*Pep* is a required component when a passive dynamic CES connection is required).
- *Aep* defines logical connectivity information for active CES components that initiate calls.
- *Vcc* defines the VPI/VCI values for the connection. The *Vcc* component can be associated with an ATM interface (*AtmIf*) or a virtual path terminator (*Vpt*).

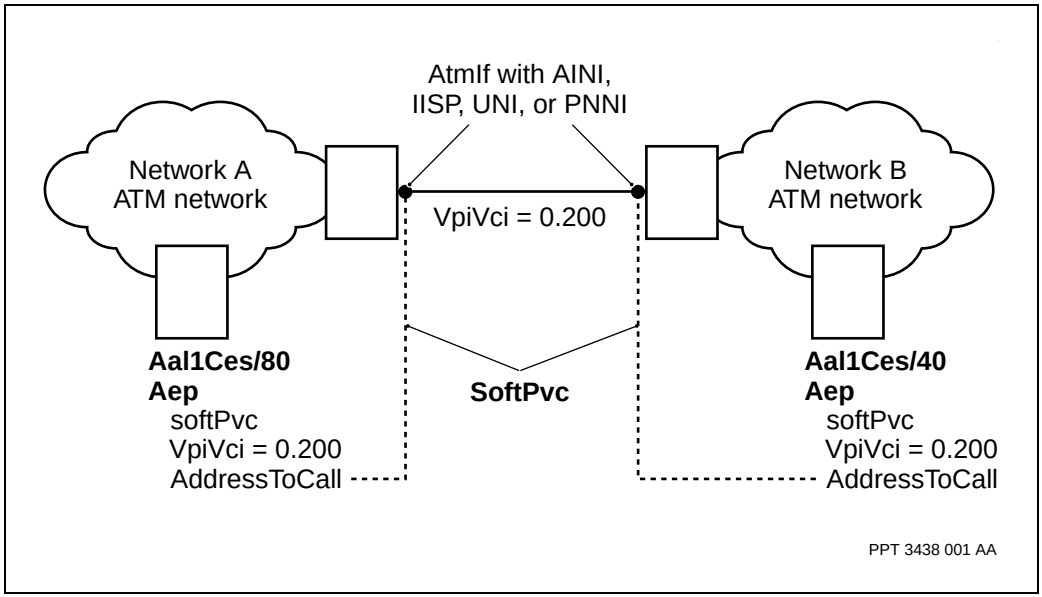
- *AtmCon* provides operational information about the actual connection through the network.
- *RerouteInfo* provides operational information about Reroute on a per connection basis (only under source node).
- *Reroute* controls the behavior of rerouting for one CES connection. Rerouting on the remote endpoint is an option which can be set to the standard *switchoverMechanism* on the remote site.
- *Ov* is dynamically added and includes all the provisionable attributes of the rerouting interface.
- *AtmIf* controls an external ATM interface

The *Aal1Ces*, *Aep*, and *Pep* components are instantiated on the AAL1 function processor.

## AAL1 CES over dynamic soft PVCs

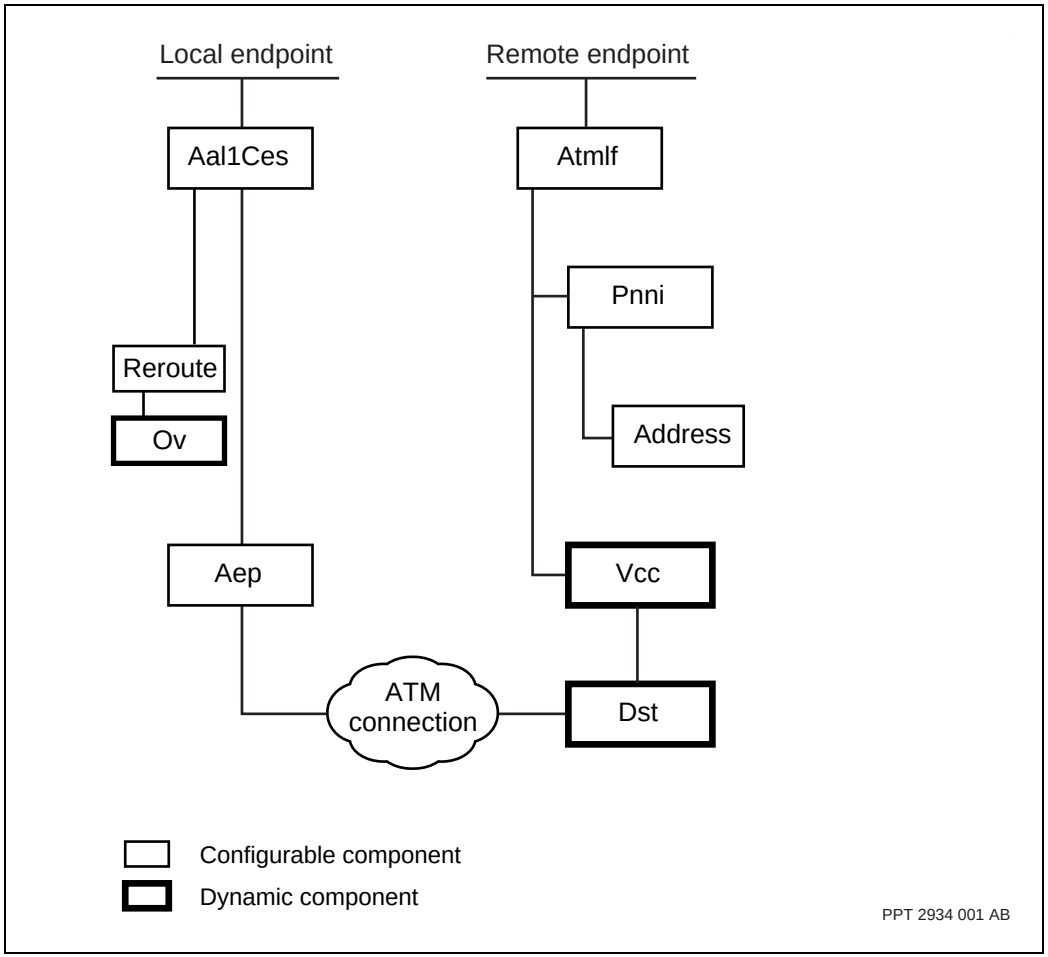
By using soft PVC connections, you can set up a dynamic connection between an AAL1 CES active endpoint (*Aep*) and an ATM interface configured with AINI, IISP, UNI or PNNI signaling. Also, AAL1 CES over dynamic soft PVCs allows you to connect to nodes that do not support switched virtual channel (SVC) connections. See the figure, “Dynamic connection between an AAL1 CES active endpoint (Aep) and an ATM interface configured with AINI, IISP, UNI, or PNNI signalling” (page 115).

**Figure 20**
**Dynamic connection between an AAL1 CES active endpoint (Aep) and an ATM interface configured with AINI, IISP, UNI, or PNNI signalling**




The figure “Component hierarchy for AAL1 CES over dynamic soft PVCs” (page 116) illustrates the CAS naming tree.

**Figure 21**
**Component hierarchy for AAL1 CES over dynamic soft PVCs**




The components supporting AAL1 CES over soft PVCs are as follows:

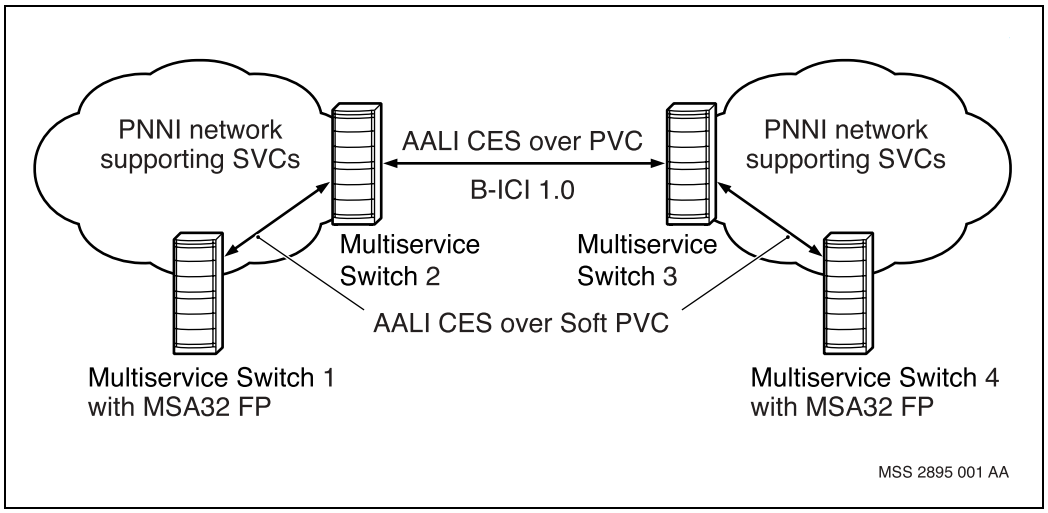
- *Reroute* controls the behavior of rerouting for one CES connection.
- *Aep* defines logical connectivity information for active CES components that initiate calls.
- Vcc defines the VPI/VCI values for the agreed PVC connection between networks.

- Dst defines the destination end of a soft PVC.
- AtmIf controls an external ATM interface.

The CES components are instantiated on the function processor providing AAL1 CES capability. The *AtmIf*, *Vpt*, *Vcc* and *Nep* components are instantiated on an ATM FP.

The AAL1 CES over soft PVC permits interoperability with nodes that do not support SVC routing. For example, it is useful in routing calls between independently operated networks where there is support for PNNI and SVC within each network but no support across their inter-carrier interface. The example in the figure "Inter-carrier example using AAL1 CES routing over soft PVC" (page 117) shows how you can use AAL1 CES over soft PVC to connect to a node that only supports PVCs.

**Figure 22**
**Inter-carrier example using AAL1 CES routing over soft PVC**




In this scenario, each network operator will

- agree on a common VPI and VCI for PVC across the Broadband Inter Carrier Interface (B-ICI) connecting the two networks, and

- set up an AAL1 CES routing over soft PVC connection within their own network between their B-ICI and the AAL1 CES TDM service interface running Nortel Networks Multiservice Switch FP providing AAL1 CES capability.

In this manner, network operators can achieve resilient connectivity within their networks.

For information on soft PVCs, see NN10600-700 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Technology Fundamentals* and NN10600-702 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Routing and Signalling Fundamentals*,

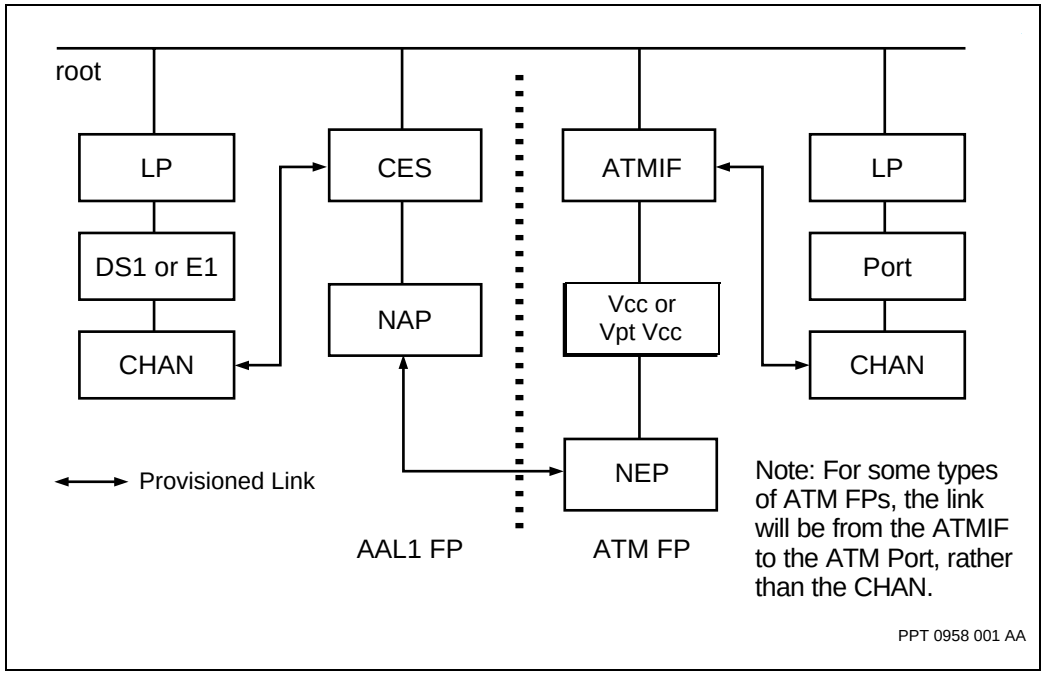
## AAL1 CES over PVCs

The AAL1 CES connection to an ATM network can be achieved using PVCs. Each hop in the ATM network is configured manually and the route does not change during the lifetime of the end-to-end connection.

When any one of the ATM links in the PVC path fails, the ATM connection between the CES interfaces fails. The connection stays down until the permanent connection is re-established manually, or is re-routed through configuring.

The figure “Component hierarchy for AAL1 CES over PVCs” (page 119) shows the component hierarchy involved in a permanent connection. The *Aal1Ces* component is associated with an *AtmIf* component on the same Nortel Networks Multiservice Switch node. The AAL1 cells which are generated by the *Aal1Ces* component are transported off-switch through the ABS, which is controlled by the *AtmIf*, *Vpt* (if applicable) and *Vcc* components.

**Figure 23**
**Component hierarchy for AAL1 CES over PVCs**




The components supporting AAL1 CES over PVCs are as follows:

- *AtmIf* controls an external ATM interface
- *Vcc* defines the VPI/VCI values for the connection. The *Vcc* component can be associated with an ATM interface (*AtmIf*) or a virtual path terminator (*Vpt*).
- *NailedupEndPoint* (*Nep*) defines the end point application for the ATM connection. A link is configured between *Nep* and the *NailedupAdaptationPoint* (*Nap*) to give AAL1 CES access to the ABS.

The CES components are instantiated on the AAL1 function processor. The *AtmIf*, *Vpt*, *Vcc* and *Nep* components are instantiated on an ATM FP.

***Note:*** The *Tc* component is a related component that controls trunk conditioning on structured services. The *Tc* component is a subcomponent of the *Chan* component, and must be present for structured CES services to operate.

# AAL1 CES components and attributes

This section describes the AAL1 CES components and attributes:



## Aal1Ces component

This component is used to register an AAL1 Circuit Emulation service on a Nortel Networks Multiservice Switch node. The configurable attributes for *Aal1Ces* are described in the following table.

**Table 16**
**Configurable attributes for Aal1Ces**

| Attributes | Description |
|---|---|
| customerIdentifier (cid) | Identification of the customer that owns the CES. |
| serviceType (servType) | CES service type: *unstructured*, *basicStructured*, or *casStructured*.<br><br>The four-port DS3 channelized AAL1CES and four-port OC-3/STM-1 channelized TDM/CES function processors support only the values of *unstructured* and *basicStructured*. |
| (Sheet 1 of 7) | |

**Table 16 (continued)**
**Configurable attributes for Aal1Ces**

| Attributes | Description |
|---|---|
| partialFill (partFill) | Number of payload bytes carried in each AAL1 cell.<br><br>This attribute allows the AAL1 cell to be partially filled, reducing the cell assembly delay for the service (at the expense of a higher call rate).<br><br>For unstructured services, this attribute must be set to the default of 47, implying no partial fill. For structured services, it must be between 8 and 47, inclusive.<br><br>For the four-port DS3 channelized AAL1 CES and four-port OC-3/STM-1 channelized TDM/CES function processors, this attribute must be set to a value of 47. |
| (Sheet 2 of 7) | |

**Table 16 (continued)**
**Configurable attributes for Aal1Ces**

| Attributes | Description |
|---|---|
| bufferSize (bufSize) | Size of the AAL1 payload cell reassembly buffer, in octets (or *autoConfigure*). The default value is autoConfigure.<br><br>During initialization, a reserve of data is built up in the reassembly buffer before any data is released, at a constant rate, to the Plesiochronous Digital Hierarchy (PDH) stream. If data is received continuously at an appropriate rate the buffer remains filled to its initialization level. If data arrives too fast the buffer overflows and data is lost. If data arrives too slowly the buffer drains until user data is no longer available, at which point the system outputs a stream of dummy data at the appropriate constant bit rate.<br><br>See the *cellDelayVariationTolerance* attribute description.<br><br>For the 4-port DS1 AAL1 and 4-port E1 AAL1 function processors:<br>Size of the AAL1 payload cell reassembly buffer, in bytes (or set to *autoConfigure)*.<br><br>For the 32-port DS1 and 32-port E1 Multiservice Access function processors:<br>Size of the AAL1 payload cell reassembly buffer must be set to *autoConfigure*.<br><br>For the four-port DS3 channelized AAL1 CES and four-port OC-3/STM-1 channelized TDM/CES function processors:<br>Size of the AAL1 payload cell reassembly buffer must be set to *autoConfigure*. |
| (Sheet 3 of 7) | |

**Table 16 (continued)**
**Configurable attributes for Aal1Ces**

| Attributes | Description |
|---|---|
| maximumBufferDelay (maxBufDelay) | Maximum delay allowed in the CDV buffer, in milliseconds to 2 decimal places (or set to *autoConfigure*).<br><br>For the 32-port DS1 and 32-port E1 multiservice access (MSA) function processors, this attribute has a valid range of 0.12 to 63.62 milliseconds, inclusive, in multiples of 0.125 milliseconds. The upper limit may be reduced by up to 6 milliseconds on a channel with high cdvt and low ATM bandwidth.<br><br>For the four-port DS3 channelized AAL1 CES, four-port OC-3/STM-1 channelized TDM/CES and two-port STM-1 electrical channelized CES/ATM/IMA function processors, this attribute has a valid integer range of 2.00 to 32.00 milliseconds, inclusive in integer multiples of 1 millisecond.<br><br>***Note:*** If this attribute is set to *autoConfigure* for the four-port OC-3/STM-1 channelized TDM/CES function processor, the *maxBufDelay* that is tolerated is two times the cdvt. |
| (Sheet 4 of 7) | |

**Table 16 (continued)**
**Configurable attributes for Aal1Ces**

| Attributes | Description |
|---|---|
| cellDelayVariationTolerance (cdvt) | Maximum cell delay variation tolerance, in milliseconds to 2 decimal places.<br><br>The amount of data released to the PDH interface in time *cdvt* is equal to the size of the initialization reserve in the reassembly buffer.<br><br>This attribute accommodates variations in the rate at which AAL1 data arrives at the reassembly buffer. Immediately after initialization, there is enough data in the reassembly buffer to allow constant bit rate (CBR) transmission for time *cdvt* even if no more cells arrive in that time.<br><br>See the *bufferSize* attribute description.<br><br>Building up the initialization reserve introduces a fixed delay in the end-to-end delivery of cells. A smaller value of *cdvt* produces a smaller end-to-end delay.<br><br>For the 32-port DS1 and 32-port E1 MSA function processors, the valid range is 0.01 to 32 in multiples of 0.125 milliseconds.<br><br>For the four-port DS3 channelized AAL1 CES, four-port OC-3/STM-1 channelized TDM/CES and two-port STM-1 electrical channelized CES/ATM/IMA function processors, this attribute has a valid range of 1.00 to 31.00 milliseconds, inclusive, in integer multiples of 1 millisecond. |
| (Sheet 5 of 7) | |

**Table 16 (continued)**
**Configurable attributes for Aal1Ces**

| Attributes | Description |
|---|---|
| cellLossIntegrationPeriod (lossPeriod) | The cellLossIntegrationPeriod attribute defines the period of time, in milliseconds, for which a loss of cells condition must persist before a buffer underflow alarm is raised. A loss of cells condition occurs when the flow of cells to the AAL1 assembly buffer stops, causing a buffer underflow or starvation condition.<br><br>The operational attribute, *cellLossStatus,* is set to *loss* when the buffer underflow alarm is raised. Clearing the buffer underflow alarm sets the *cellLossStatus* attribute to no_loss.<br><br>For the four-port DS3 channelized AAL1 CES function processor, this attribute has a minimum value of 10 seconds.<br><br>The default value for all function processors is autoConfigure: For the four-port DS3 channelized AAL1 CES function processor, a value of autoConfigure corresponds to a setting of 10 seconds.<br>For all other Multiservice Switch function processors, a value of autoConfigure corresponds to a setting of 2 seconds. |
| cellLossRecoveryPeriod (recPeriod) | Following a persistent reassembly buffer underflow condition, cells eventually begin arriving from the network and reinitialize the reassembly buffer, filling it to the *cdvt* level.<br><br>This attribute determines the length of time to wait following buffer initialization before transmitting the received data onto the line interface. During this period, the data received from the ATM network is discarded, and AIS (for unstructured services) or trunk conditioning (for structured services) is transmitted on the line interface. |
| idlePattern (idlePat) | This attribute sets the unused byte fill pattern when using *partiaFill*. All bytes in the cell above the *partialFill* level will be set to this pattern. |
| (Sheet 6 of 7) | |

**Table 16 (continued)**
**Configurable attributes for Aal1Ces**

| Attributes | Description |
|---|---|
| dummyDataByte (dummyDataByte) | This attribute sets the value of the dummy data bytes that are inserted into the bit stream to maintain bit integrity when valid network data is not available.<br><br>For unstructured services, this attribute must be set to OxFF.<br><br>The *dummyDataByte* attribute is not configurable on the 32-port DS1 and 32-port E1 Multiservice Access function processors: this attribute must be set to OxFF. |
| interfaceName (ifName) | This attribute associates the CES application with a specific group of input timeslots (*Chan)* associated with a particular physical DS1 or E1 or DS3 port.<br><br>This attribute must be set to a *Chan* component under either a DS1 or E1 subcomponent, under an *Lp* that is associated (through its *mainCard* attribute) with an AAL1 FP given by the *cardType* attribute. |
| remoteEndType (remoteEndType) | Values: *ces, pvgExclusivePrs, pvgSharedPrs*<br><br>When the 4-port OC-3/STM-1Ch TDM/CES FP is configured for Media Gateway, any of the three remoteEndType values can be used. When this FP is configured for CES, only the value *ces* can be used.<br><br>If this attribute is set to *ces*, the remote end is a CES IWF. This is the default value for all card types.<br><br>If this attribute is set to *pvgExclusivePrs*, the remote end is a CES IWF in a voice services processor (VSP) and the TDM channel is used as a Media Gateway TDM service channel. The primary rate stream (PRS) can be shared only with CES components that have this attribute set to *ces*.<br><br>If this attribute is set to *pvgSharedPrs*, the remote end is a CES IWF in a VSP FP and the TDM channel is used as a Media Gateway TDM service component. The PRS can be shared only with CES components that have this attribute set to *pvgSharedPrs* or *ces.* |
| (Sheet 7 of 7) | |

## Buffer size and cell delay variation tolerance

The configured cell delay variation tolerance (*cdvt* attribute) must represent the amount of data normally held in the CDV (cell delay variation) buffer, expressed as the time taken to transmit the data on the CBR interface. The CDV buffer absorbs the variation in network propagation delay of cells associated with CBR services. The size of the buffer is determined by the *bufferSize* or the *maximumBufferDelay* attribute.

The *maximumBufferDelay attribute defines the maximum delay allowed in the CDV buffer. It relates to the network's CDV characteristics rather than to a hardware implementation.*

Be aware of the following considerations when configuring the *bufferSize*, *maximumBufferDelay*, and *cdvt attributes*:

- *bufferSize* is configured in bytes. The bufferSize default value is autoConfigure. On the 32-port DS1, 32-port E1 Multiservice Access FPs, four-port DS3 channelized AAL1 CES FPs, four-port OC-3/STM-1 channelized TDM/CES FPs and the two-port STM-1 electrical channelized CES/ATM/IMA FPs, bufferSize must be set to the value of autoConfigure to acknowledge that maximumBufferDelay is provisioned instead of this attribute.
- *maximumBufferDelay* is configured in milliseconds to two decimal places with a range compatible with cdvt. Note that for the four-port DS3 channelized AAL1 CES, four-port OC-3/STM-1 channelized TDM/CES and two-port STM-1 electrical channelized CES/ATM/IMA FPs, the valid integer range is 2 to 32 milliseconds inclusive. The maximumBufferDelay default value is autoConfigure.
- The autoConfigure default value for bufferSize and *maximumBufferDelay* is adequate for most system configurations. It anticipates symmetrical CDV. Using autoConfigure applies a value equivalent to two times the cdvt value (on a best efforts basis) to the CDV buffer.
- Use numerical values for bufferSize and *maximumBufferDelay* instead of autoConfigure when the maximum delay in the CDV buffer is critical or when early warning of exceptional conditions on the network is critical.

- *cdvt* is configured in milliseconds, which corresponds to a number of bytes, or cells, in the reassembly buffer. You may set cdvt values to two decimal places. On the 4-port DS1 AAL1 and 4-port E1 AAL1 FPs, these cdvt values are internally rounded up to the nearest integer. On the 32-port DS1 and 32-port E1 Multiservice Access FPs, cdvt values are rounded up to the nearest integral multiple of 125 microseconds. On the four-port DS3 channelized AAL1 CES, four-port OC-3/STM-1 channelized TDM/CES, and two-port STM-1 electrical channelized CES/ATM/IMA FPs, the cdvt value range is 1.00 to 31.00 milliseconds. The configured value is internally rounded up to the nearest integer.

Be aware of the following considerations *for the 4-port DS1 AAL1 and 4-port E1 AAL1 FPs*:

- For an unstructured service, the following must be true:

  *cdvtInCells* + 1 cell < *bufferSizeInCells*

- For a structured service, the following must be true:

  *cdvtInCells* + *multiFrameStructureSizeInCells* + 1 cell < *bufferSizeInCells*

  (all calculations are integer-based, rounding down)

- To determine the value of *cdvtInCells*, use the following formula:

  *cdvtInCells* = (*peakCellRate*/1000) * *cdvt*

  For details, see chapter 5, ATM virtual channel requirements, in the ATM Forum Circuit Emulation Service Interoperability Specification, No. AF-VTOA-0078-000.

  ***Note:*** The ATM Forum specification can be used to calculate PCR.

- The *bufferSizeInCells* is determined by the following formula:

  — *bufferSizeInCells* = (*bufferSize* + 46) / 47

- To calculate *multiFrameStructureSizeInCells*, see the table “Calculating multiFrameStructureSizeInCells for the 4-port DS1 AAL1, 4-port E1 AAL1, 4-port DS3 channelized AAL1, 4-port OC-3/STM-1 channelized TDM/CES, and 2-port STM-1e channelized CES/ATM/IMA FPs” (page 129).

**Table 17**
**Calculating multiFrameStructureSizeInCells for the 4-port DS1 AAL1, 4-port E1 AAL1, 4-port DS3 channelized AAL1, 4-port OC-3/STM-1 channelized TDM/CES, and 2-port STM-1e channelized CES/ATM/IMA FPs**

| Port type | Aal1Ces service type | multiFrameStructureSizeInCells |
|---|---|---|
| DS1, E1 | basicStructured | (N + 46)/47 |
| DS1 | casStructured | ([N*24) + (N+1)/2] + 46)/47 |
| E1 | casStructured | ([N*16) + (N+1)/2] + 46)/47 |
| ***Note:*** N = number of timeslots allocated to the service. | | |
| | | |

You should set the *cdvt* and *bufferSize* (or *maximumBufferDelay*) attributes appropriately to match the performance of your ATM network. Where applicable, please note the following:

- Increasing the value of the CES *cdvt* attribute increases the end-to-end cell transfer delay by the same amount. Decreasing the value of the *cdvt* attribute increases the probability of reassembly buffer underflows.
- A cell arriving at the reassembly buffer must wait for data from the previous cell to be processed at the PDH interface (at constant bit rate) before its own data can be processed. Normally, the time a cell has to wait is approximately the value set for the *cdvt* attribute in milliseconds. However, if the reassembly buffer is almost full, the waiting time (as well as the end-to-end cell delay) increases. This can happen if a certain number of cells arrive in a bursty fashion, faster than expected. Therefore, although configuring a relatively large value for the *bufferSize* or the *maximumBufferDelay* attributes tends to decrease the likelihood of reassembly buffer overflows, it may also result in unacceptable cell transfer delays.

- You can define a CDVT value for a VCC on an ATM FP by configuring the appropriate traffic descriptor parameter. If the CDVT traffic descriptor parameter is set to *0*, then the CDVT defaults to the value of the *cbrCdvt* attribute—or the *vbrRtCdvt* or *vbrNrtCdvt* attribute, depending on the value in the *atmServiceCategory* attribute. These CDVT values should not be confused with the *cdvt* attribute described in this section under the *Aal1Ces* component. For details on setting CDVT for ATM bearer service, see NN10600-710 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Configuration Management*.

## Partial cell fill

The ATM bandwidth needed to support a service depends on the partial fill level, the number of timeslots, and the type of service:

- A service configured with a low partial fill level needs a higher rate of ATM cells than a service with a higher partial fill level.
- A service configured with many timeslots needs a higher rate of ATM cells than a service with fewer timeslots.
- A service configured with CAS needs a higher rate of ATM cells than a service without CAS.

The following table shows these dependencies.

**Table 18**
**ATM bandwidth requirements**

| Lower ATM bandwidth | Higher ATM bandwidth |
|---|---|
| High or no partial fill | Low partial fill |
| Few timeslots | Many timeslots |
| Unstructured service, or structured service without CAS | Structured service with CAS |
| | |

There is an internal limit on the total ATM bandwidth available for all services on an FP. Consequently, it may not be possible to support the maximum number of services when one or more services is configured so that they need a higher ATM bandwidth. A semantic check during configuring ensures that

the total ATM bandwidth needed for all services on each individual LP is less than the threshold that can be tolerated by the firmware. If an LP is at fault, a semantic check error is generated.

In addition to overall bandwidth limitations, there are restrictions on the value of the partialFill attribute that depend on the number of timeslots carried by the service. The following table shows these limitations.

**Table 19**
**Bandwidth limitations**

| Number of timeslots | Minimum partialFill |
|---|---|
| 1 | 8 |
| 2 | 16 |
| 3 | 24 |
| 4 | 32 |
| 5 | 40 |
| ***Note:*** For services carrying more than five timeslots, partial fill is not supported, so you must set the partialFill attribute to 47. | |

## Pep component

When a passive dynamic CES connection is needed, the *Aal1Ces* component is configured with a *Pep* subcomponent. The configurable attributes for *Pep* are described in the following table.

**Table 20**
**Configurable attributes for Pep**

| Attributes | Description |
|---|---|
| localAddress (localAddr) | This attribute specifies the local NSAP address of the connection.<br><br>If a node prefix has been configured in the *Module* component, a default value of *localAddress* is provided. If no prefix has been configured, *localAddress defaults* to an empty string. |
| expectedRemoteAddress (expectedAddr) | This attribute defines the expected remote address for an incoming connection setup request.<br><br>If *expectedRemoteAddress* is configured, only matching connections are considered for acceptance. If this attribute is 40 characters long, the remote address must match exactly to be accepted. If it is less than 40 characters long, the remote address must begin with *expectedRemoteAddress.*<br><br>If *expectedRemoteAddress* is not configured, the component processes connection requests from any remote address. |
| ***Note:*** For more information about configuring NSAP addresses, see NN10600-435 *Nortel Networks Multiservice Switch 7400/15000/20000 Operations: Path-Oriented Routing System*, and in NN10600-702 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Routing and Signalling Fundamentals*. | |
| | |

## Aep component

When an active dynamic CES connection is needed, the *Aal1Ces* component is configured with a *Aep* subcomponent. The *Aep* component is used to define logical connectivity information for the connection. The configurable attributes for *Aep* are described in the table "Configurable attributes for Aep" (page 133).

***Note:*** To align Nortel Networks Multiservice Switch CES with the ATM Forum specification for AAL1 Circuit Emulation, operators must be able to specify a maximum number of consecutive unsuccessful setup attempts. The ATM Forum MIB indicates that when those attempts have failed, a restart variable in the MIB can set the connection procedures going again. However, Nortel Networks Multiservice Switch nodes permit a more sophisticated management mechanism: the use of the non-standard restart verb for this component.

**Table 21**
**Configurable attributes for Aep**

| Attributes | Description |
|---|---|
| routingOption (routing) | For the 4-port DS1 AAL1 and 4-port E1 AAL1 function processors:<br>• this attribute defines PORS as the type of routing to be used (*porsOnly, atmOnly, porsFirst, atmFirst*).<br>For the 32-port DS1 and 32-port E1 Multiservice Access function processors:<br>• this attribute defines the type of routing to be used (*porsOnly, atmOnly, porsFirst, atmFirst*).<br>For the four-port DS3 channelized AAL1 CES, four-port OC-3/STM-1 channelized TDM/CES, and 2-port STM-1e channelized CES/ATM/IMA function processors:<br>• this attribute defines *atmOnly* as the type of routing to be used (*atmOnly*). |
| profile (profile) | This attribute defines the PORS routing profile to use for the connection. If the routingOption attribute is set to atmOnly, this attribute is ignored.<br>If PORS routing is invoked and there is no value for this attribute, PORS takes profile information from the signalling setup message. This practice is particularly useful when the connection is to be made to a CES on the same module. |
| firstRetryInterval (int) | This attribute defines the time to wait before trying to establish the connection after the first failed call attempt. |
| retryLimit (limit) | This attribute defines the maximum number of consecutive unsuccessful setup attempts before further attempts are abandoned. If this limit is reached, the operator must restart the connection attempts.<br>A value of zero for this attribute indicates no limit. Attempts continue indefinitely until a successful connection is established. |
| addressToCall (addrToCall) | This attribute defines the remote NSAP address to be called. |
| (Sheet 1 of 3) | |

**Table 21 (continued)**
**Configurable attributes for Aep**

| Attributes | Description |
|---|---|
| localAddress (localAddr) | This attribute specifies the local NSAP address of the connection.<br><br>If a node prefix has been configured in the *Module* component, a default value of *localAddress* is provided. If no prefix has been configured, *localAddress* defaults to an empty string.<br><br>The value of *localAddress* cannot be the same as that of *addressToCall*.<br><br>The *localAddress* attribute must begin with the string of characters that matches one of the configured *nodePrefix* values in the *Module* component. For more information, see NN10600-435 *Nortel Networks Multiservice Switch 7400/15000/20000 Operations: Path-Oriented Routing System*, and "Network addressing" in NN10600-702 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Routing and Signalling Fundamentals*. |
| expectedRemoteAddress (expectedAddr) | This attribute defines the expected remote address for an incoming connection setup request.<br><br>If *expectedRemoteAddress* is configured, only matching connections are considered for acceptance. If this attribute is 40 characters long, the remote address must match exactly to be accepted. If it is less than 40 characters long, the remote address must begin with *expectedRemoteAddress*.<br><br>If *expectedRemoteAddress* is not configured, the component processes connection requests from any remote address. |
| activeEndPointType (type) | This attribute specifies the type of end point, either svc or softPvc.<br><br>If the *activeEndPoint* is svc, the *calledVpiVci* attribute is not relevant.<br><br>If the activeEndPoint is softPvc, the *routingOption* attribute must be set to atmOnly. The *profile* attribute is not relevant.<br><br>The default value for *activeEndPointType* is svc. |
| (Sheet 2 of 3) | |

**Table 21 (continued)**
**Configurable attributes for Aep**

| Attributes | Description |
|---|---|
| calledVpiVci (vc) | This attribute represents the remote VPI and VCI when the *activeEndPoint* has a value of softPvc.<br><br>The default value for *calledVpiVci* is 0.1. |
| ***Note:*** For more information about configuring NSAP addresses, see NN10600-435 *Nortel Networks Multiservice Switch 7400/15000/20000 Operations: Path-Oriented Routing System*, and in NN10600-702 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Routing and Signalling Fundamentals*. | |
| (Sheet 3 of 3) | |

## Nap component

When AAL1 CES cells are transmitted over permanent connections, that subcomponent is the *Nap*. The *Nap* component is the service termination point for CES over PVCs. This component is linked to a corresponding *Nep* component, defining the user view of the service connection. The configurable attribute for *Nap* is described in the following table.

**Table 22**
**Configurable attribute for Nap**

| Attributes | Description |
|---|---|
| atmConnection (ac) | Defines the *Vcc Nep* component the CES is connected to. |
| ***Note:*** The corresponding *Vcc* traffic management attributes must be configured as follows:<br>• *atmServiceCategory* must be *cbr*<br>***Note:*** *txTrafficDescType* and *rxTrafficDescType* must be between 3 and 8, inclusive<br>• *txTrafficDescParm 1* (or peak cell rate) must be between 100% and 105% of the ATM bandwidth needed by the service (the PCR can be calculated using the ATM Forum CES Interoperability Specification)<br>• *rxTrafficDescParm 1* must be between 100% and 105% of the ATM bandwidth needed by the service | |
| | |

### Reroute component

The *Aal1Ces/n Reroute* component describes rerouting capabilities for one CES service. Addition or deletion of the Reroute component has no impact on the existing connection. The SVC/SPVC is not subscribed to rerouting until it is released and set up again. It is defined as an additional subcomponent of *Aal1Ces/n*. When adding a *Reroute* component, an *Ov* component is automatically added.

*Aal1Ces/n Reroute* is used for SVC and SPVC connections. This component can exist even if no *Aep/Pep* has been provisioned under *Aal1Ces/n*. However Aal1Ces/n reroute can not be added if a *Nap* component is already provisioned under Aal1Ces/n.

In order for rerouting to be enabled, it is necessary to provision a *Reroute* component under the source *Aal1Ces/n* (typically the one where an *Aep* is provisioned) but not under the destination *Aal1Ces/n*. However a *Reroute* component is required under the destination *Aal1Ces/n* if the you want to enable the reduced cell loss mechanism.

### RerouteInfo component

The *Aal1Ces/n RerouteInfo* component appears dynamically under the *Aal1Ces* component for connections that have successfully negociated rerouting capabilities.

This component appears only if the

- current CES connection is subscribed to rerouting capabilities
- *Aal1Ces/n* component is the source of the connection (Rerouting node)

The *Aal1Ces/n RerouteInfo* component is visible on the source side only, not on the destination side. The destination side is usually the one where a *Pep* component is provisioned.

## AAL1 CES configuration information

The following sections provide background information to assist in configuring AAL! CES services:


- “Installing AAL1 CES software” (page 137)
- “Traffic type” (page 137)

- "Clock recovery mechanism" (page 138)

For configuration procedures, see "CES configuration" (page 21).

## Installing AAL1 CES software

Use the procedures in NN10600-270 *Nortel Networks Multiservice Switch 7400/15000/20000 Software Installation* to install AAL1 CES software. The AAL1 CES software is named aal1Ces.

Before you can configure AAL1 CES software, you must also download base, networking, ATM networking, and trunks software onto the Nortel Networks Multiservice Switch node.

If you are configuring both frame relay and AAL1 CES on the same port (you can do this only on 32-port DS1 and 32-port E1 Multiservice Access function processors), you must also download the frame relay software.

## Traffic type

The configuring details given in "Installing AAL1 CES software" (page 137) define the connectivity of the AAL1 CES. However, in addition to connectivity, it is necessary to define the type of traffic which will be carried. This is configured by the AAL1 CES *serviceType* attribute, and by the *lineType* attribute which is configured at the port level. The following table, "Configuring traffic type based on line type" (page 137) lists the AAL1 CES traffic types and the corresponding service types and line types.

**Table 23**
**Configuring traffic type based on line type**

| Traffic type | CES service type | DS1 line type | E1 line type |
|---|---|---|---|
| $U_{cp}$ | unstructured | unframed | unframed |
| $U_{pm}$ | unstructured | d4, d4Cas, esf, esfCas (See Note 1). | ccs, cas (see Note 2) |
| $S_{nc}$ | basicStructured | d4, d4Cas, esf, esfCas (see Note 1). | ccs, cas (see Note 2) |

(Sheet 1 of 2)

**Table 23 (continued)**
**Configuring traffic type based on line type**

| Traffic type | CES service type | DS1 line type | E1 line type |
|---|---|---|---|
| $S_c$ | casStructured | d4Cas, esfCas | cas |
| ***Note 1:*** For the DS1 tributaries of the 4-port DS3 channelized AAL1 CES and 4-port OC-3/STM-1 channelized TDM/CES FPs, you can configure only d4, esf, and unframed.<br>***Note 2:*** For the E1 tributaries of the 4-port DS3 channelized AAL1 CES FP, you can only configure ccs and unframed. For the E1 tributaries of the 4-port OC-3/STM-1 channelized TDM/CES FP, you can only configure ccs.<br>***Note 3:*** If you set the E1 *lineType* attribute to channel associated signaling (CAS), you can not use timeslot 16. If you set the E1 *lineType* attribute to common channel signaling (CCS), timeslot 16 needs to be provisioned if you want it to carry signaling data. Once provisioned, it could also be used to carry user traffic.<br>The 4-port DS3 channelized AAL1 CES and 4-port OC-3/STM-1 channelized TDM/CES FPs support only the $U_{cp}$, $U_{pm}$ and $S_{nc}$ traffic types.<br>Facility Data Link is not available for d4 and d4Cas line types.<br>Structured services cannot be configured with the unframed linetype. | | | |
| (Sheet 2 of 2) | | | |

For configuration information at the port level, see the following documents:

- NN10600-551 *Nortel Networks Multiservice Switch 7400/15000/20000 FP Configuration Reference*
- NN10600-550 *Nortel Networks Multiservice Switch 7400/15000/20000 Common Configuration Procedures*

## Clock recovery mechanism

If SRTS clocking is used to recover the transmitting clock at the receiving end, configure the DS1 or E1 port *clockingSource* attribute as srtsMode. If adaptive clocking is used to recover the transmitting clock at the receiving end, configure the DS1 or E1 port *clockingSource* attribute as module or adaptive at the far end of the connection. Do no set *clockingSource* to srtsMode or adaptiveMode for structured services (*serviceType* configured as basicStructured or casStructured).

***Note:*** Only the 32-port DS1 and 32-port E1 Multiservice Access FPs support SRTS and adaptive clocking.

# Appendix
# Engineering considerations

This section provides a brief description of the engineering parameters that affect AAL1 CES and includes the following sections:



For more details, see the *Nortel Networks Multiservice Switch Release Notes*.

## Performance

Since AALl CES provides transparent transport of CBR traffic, the type of service requested determines the performance of AAL1 CES, up to the maximum bandwidth supported by the input port.

End-to-end delay depends on the following factors:

1 time spent on the ingress AAL1 function processors (receipt from external line interface, call assembly and delivery to the node backplane)

2 time spent traversing the backplane and egress ATM FP

3 time spent in the ATM network

4 time spent traversing the ingress ATM FP and backplane

5 time spent on the egress AAL1 FP reassembly buffer, delivery to external line interface)

Items 2, 3 and 4 depend on the configuration of the ABS used to transport the AAL1 cells.

Items 1 and 5 are directly influenced by the AAL1 CES and the FPs which support it. The most significant source of delay is potentially the time taken to fill the reassembly buffer to its nominal value (of the *cdvt* attribute) before continuous operation can begin. Filling the reassembly buffer ensures that any expected variation in the arrival of cells can be accommodated without the generation of service alarms.

This is controlled by the *cdvt* attribute. Data is allowed to collect in the reassembly buffer until the service can accommodate the expected CDV before PDH frames are forwarded off the FP. If a buffer underflow event occurs, the same overhead is incurred when cells start arriving again.

Certain user applications are critically dependent on cell delay variation. This must be considered when configuring the ABS for the CES link.

Given the considerations above, the overall delay is as follows (all times measured in seconds):

$D_t = K/(N*8000) + D_n + D_b$

where:‘
$D_t$ = total end-to-end delay in one direction
K = partial cell fill (number of bytes used in a single cell payload)
N = the number of timeslots used by the service
$D_n$ = network delay (through backplanes, ATM FPs and the external network)
$D_b$= buffer initialization delay (that is, the configured value of *cdvt*)

Other delay overheads should be relatively small.

## Bandwidth considerations

This section contains information on:

- “Bandwidth considerations for unstructured services” (page 140)
- “Bandwidth considerations for structured services” (page 141)

### Bandwidth considerations for unstructured services

With unstructured service, there are no limitations on the number of timeslots that can be used.

### Bandwidth considerations for structured services

With structured service, there are limitations on the number of timeslots that can be used without exceeding the bandwidth of the card. See “Bandwidth limitations on a 4 port E1 AAL1 card” (page 141) and “Bandwidth limitations on a 4 port DS1 AAL1 card” (page 141) for maximum provisioned timeslots.

**Table 24**
**Bandwidth limitations on a 4 port E1 AAL1 card**

| Effective size of largest service on card | CAS | No CAS |
|---|---|---|
| 1 -12 | 72 | 106 |
| 13 - 18 | 65 | 98 |
| 19 - 24 | 62 | 94 |
| 25 - 30 | 60 | 92 |
| ***Note:*** All numbers represent timeslots | | |

**Table 25**
**Bandwidth limitations on a 4 port DS1 AAL1 card**

| Effective size of largest service on card | CAS | No CAS |
|---|---|---|
| 1 -12 | 88 | 96 |
| 13 -18 | 77 | 96 |
| 19 - 24 | 72 | 96 |
| ***Note:*** All numbers represent timeslots | | |

# System capabilities

This section describes the DS1 AAL1 and E1 AAL1 system capabilities:

## Maximum permitted AAL1 CES on one device

The AAL1 CES service transfers a fixed number of input channels across the network at a constant bit rate. This means that the total number of CES that can be created for a particular AAL1 FP is dependent on the number of ports on the FP and the number of channels that each port carries:

```
max number of CES/AAL1 FP = number ports on AAL1 FP x
number channels per port
```

For the 4-port channelized DS3 FP, the computation for the total number of CES also includes the DS1 tributaries:

```
max number CES/AAL1 FP = number ports on DS3 FP x number
of DS1 tributaries x number channels per tributary
```

For the 4-port OC-3/STM-1 channelized TDM/CES and 2-port STM-1e channelized CES/ATM/IMA FPs, the computation for the total number of CES also includes the DS1 tributaries:

```
max number CES/AAL1 FP = number ports on Sonet/FP x
number of STS tributaries x number of VT1dot5
tributaries x number of channels per tributary

(4-port OC-3/STM-1 channelized TDM/CES FP only)
```

or

```
max number CES/AAL1 FP = number ports on Sdh/FP x
number of Vc12 tributaries x number of channels per
tributary
```

***Note:*** There is a limit of 255 CES VCCs per STS-1/TUG-3.

## Ensuring AAL1 CES bandwidth

Perhaps the most typical AAL1 CES deployment scenario is one in which channelized PDH traffic arrives at a node, is segmented by an AAL1 FP and the resulting cells transported into an ATM network via an ATM FP.

It is essential, when engineering the network, to ensure that the egress bandwidth into the ATM network is sufficient to accommodate the AAL1 CES traffic (the same is true at the receiving end where the cells are extracted from the ATM network).

For DS1 AAL1 unstructured service, it will not be possible to transport the AAL1 cells into the ATM network using a DS1 ATM FP. A port on a DS1 AAL1 FP generates AAL1 cells at a rate of approximately 4107 cells/second, whereas a port on a DS1 ATM FP can only transport cells at a rate of approximately 3622 cells/second. This lower cell rate is due to signaling overhead that uses approximately 15% bandwidth, a higher capacity ATM port is therefore required to transport DS1 AAL1 unstructured traffic (for example, E1, DS3 or OC3). The DS1 AAL1 bandwidth is not equal to DS1 ATM bandwidth, this holds true for E1, DS3, OC3, and STM-1.

## Using SRTS

When SRTS is selected for transmit clocks in an unstructured service, clock synchronization is still required between the transmitting and receiving AAL1 FPs.

If clock synchronization is provided through the network, it must be recovered from a network link. For the network clock synchronization (NCS) system to use the recovered clock at that link, the transmit clocking source at the link must be set to line or module. If the node is loaded with only AAL1 FPs (and a CP), it is not possible to configure all the ports to be in SRTS mode, as at least one port on the shelf must have its clocking source set to module or line. However, if the shelf has another card from which the network clock can be recovered (such as an ATM card), all AAL1 ports can be configured for SRTS. For more information on NCS, see NN10600-550 *Nortel Networks Multiservice Switch 7400/15000/20000 Common Configuration Procedures*.

Nortel Networks Multiservice Switch 7400/15000/20000

# Operations: AAL1 Circuit Emulation

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