

## **Implementing Primary Rate ISDN Adapter as Channelized/Clear Channel T1 on the IBM Routers**

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## Abstract

The intent of this document is to help people understand the implementation of the Primary Rate ISDN Adapter with integrated CSU as Channelized/Clear Channel T1 on the IBM Routers 2210, 2212, and 2216. A LARSCOM SPLIT-T FT1 Access Multiplexer was used as the external CSU in the network configuration examples but any standard CSU is supported.

This document will provide a series of detailed network diagrams which will define the various configurations supported on this feature. All possible configurations will not be included, but will offer several examples to help provide an understanding of this implementation.

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## Preface

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This document will provide a series of detailed network diagrams which will define the various configurations supported on this feature. All possible configurations will not be included, but will offer several examples to help provide an understanding of this implementation.

### Keywords

**FT1** - Fractional T1  
**B8ZS** - Bipolar 8-Zero Substitution  
**CSU** - Channel Service Unit  
**DCE** - Data Communication Equipment  
**DTE** - Data Terminal Equipment  
**ESF** - Extended Superframe

### Product List

**IBM 2216 Nways Multiaccess Connector**  
Model 400

**IBM 2210 Router**  
Models 1U8, 24M, 24T, 24E

**IBM 2212 Access Utility**  
Models 40F, 40H, 10F, 10H

**LARSCOM SPLIT-T**  
**FT1 ACCESS Multiplexer**

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# Chapter 1: Overview

## Introduction

The ISDN Primary Rate T1 is an excellent feature for providing variable subrate T1 connections to remote DTE devices. This document will illustrate the mapping and aggregation of timeslots between the Larscom CSU and the integrated CSU in the ISDN Primary Rate T1 adapter.

The primary focus of this document was on the functionality/connectivity of the ISDN Primary Rate T1 adapter. No extensive performance measurements are included in this document, although there was no significant performance difference observed between the ISDN Primary Rate T1 clear channel configuration and the router back to back configuration. This was accomplished using Chariot by Ganymede Software. Several LANs with endstations are used in the network configurations for the sole purpose of testing functionally and connectivity.

The CSU used in all configurations has only 2 DCE ports therefore all examples are based on this restriction which is a limitation of the CSU and not the ISDN Primary Rate T1 adapter. All examples are using the 2216 Nways Multiaccess Connector to provide the channelized service but functionality is the same for both the 2210 Router and the 2212 Access Utility.

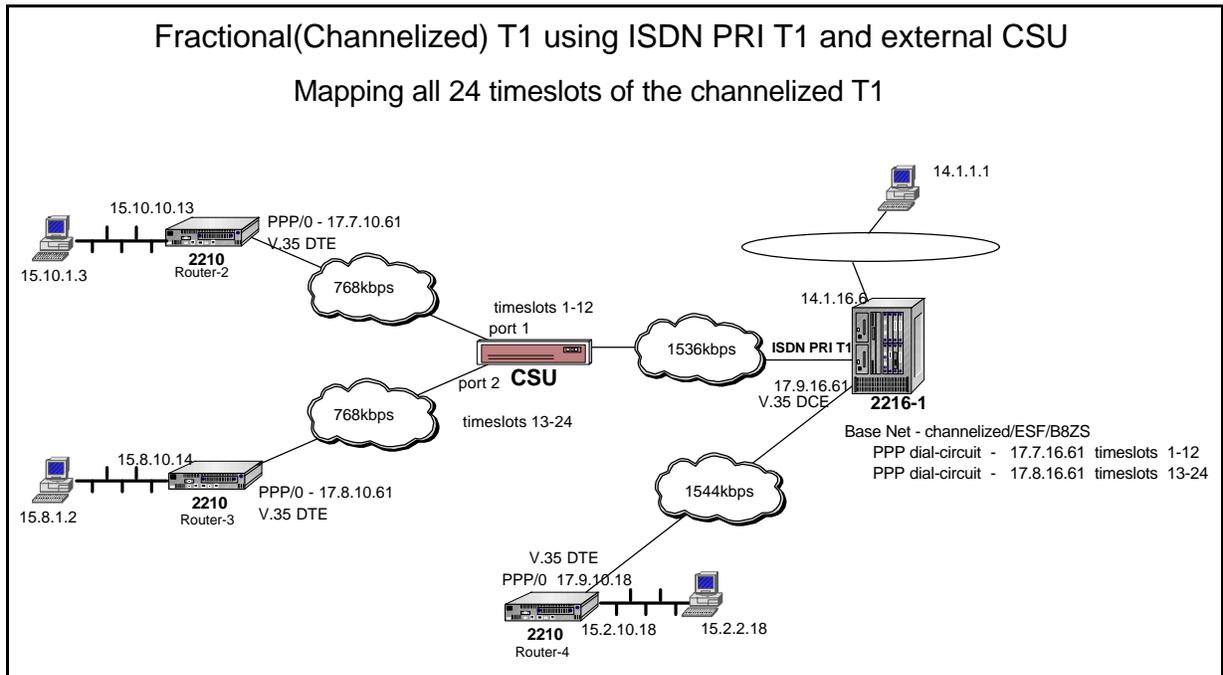
We support a point to point connection from our adapter to any standard DSU/CSU that is connected to 1 or more WAN ports on the other end. We allow selection of which channels to be active and can aggregate channels to get fractional T1(FT1) support (N X 64kbps per channel) in 64kbps increments and are not required to be contiguous. We cannot aggregate in increments of 56kbps but do support a single 56kbps channel. The T1 framing format(ESF) defines 8kbps of overhead which allows for framing and CRC error checking which leaves 1536kbps for user data. This adapter will attempt to sync up with the network clock (which can be the external CSU) and if a network clock is not present the adapter will drop back to its internal timing. This is not a configurable parameter and the sequence happens automatically. Line Build Out(LBO) option is a configurable parameter.

The terms “channel” and “timeslot” will be used interchangeably throughout this document.

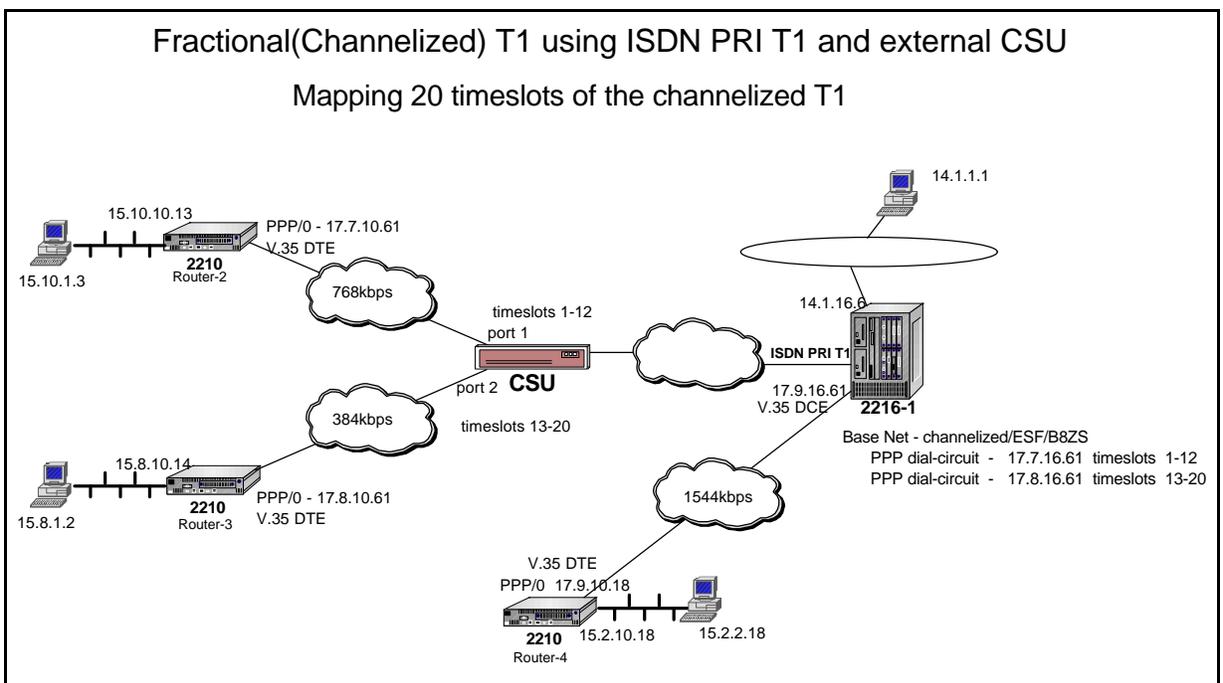
## Network Design

Below are several network diagrams supporting the various timeslot mappings between the Primary Rate ISDN T1 and the external CSU.

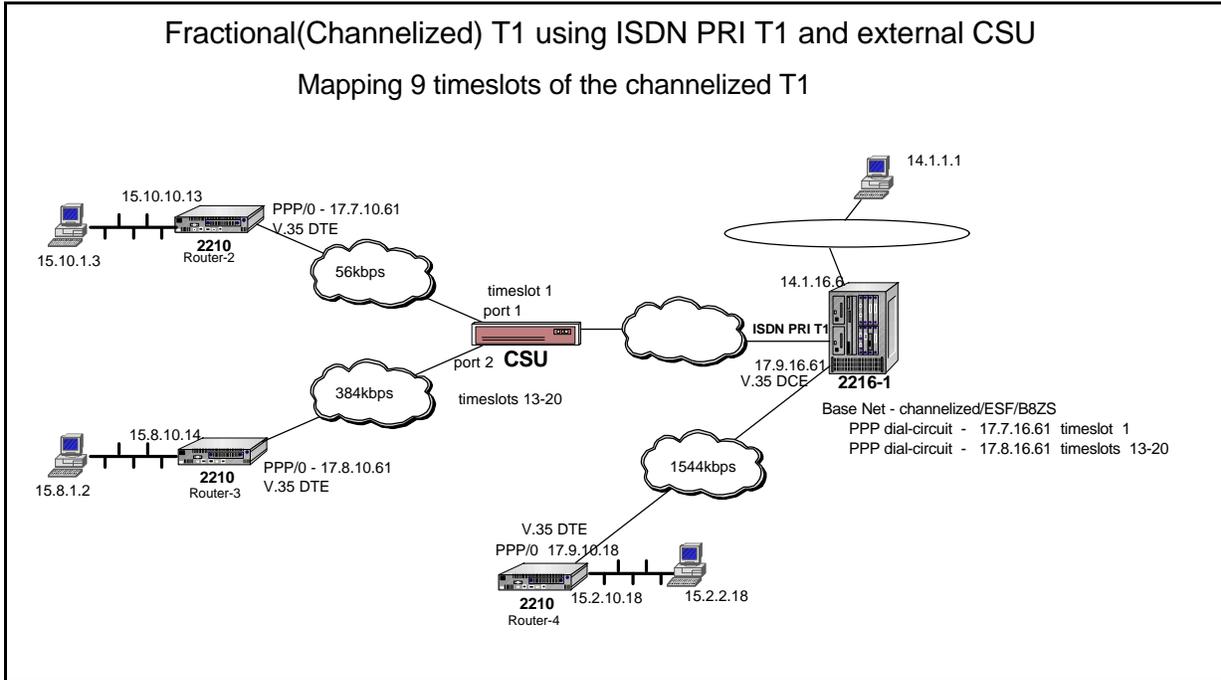
**Diagram mapping 12 timeslots to Port 1 of the CSU and 12 timeslots to Port 2.**



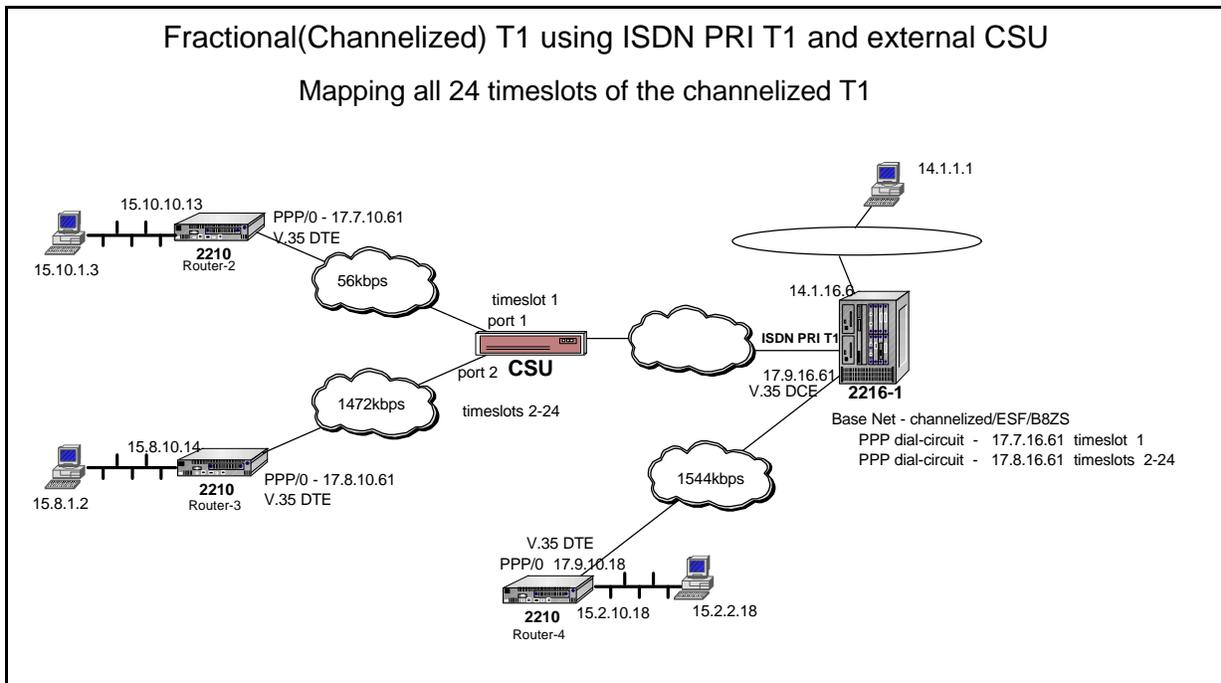
**Diagram mapping 12 timeslots to Port 1 of the CSU and 8 timeslots to port 2**



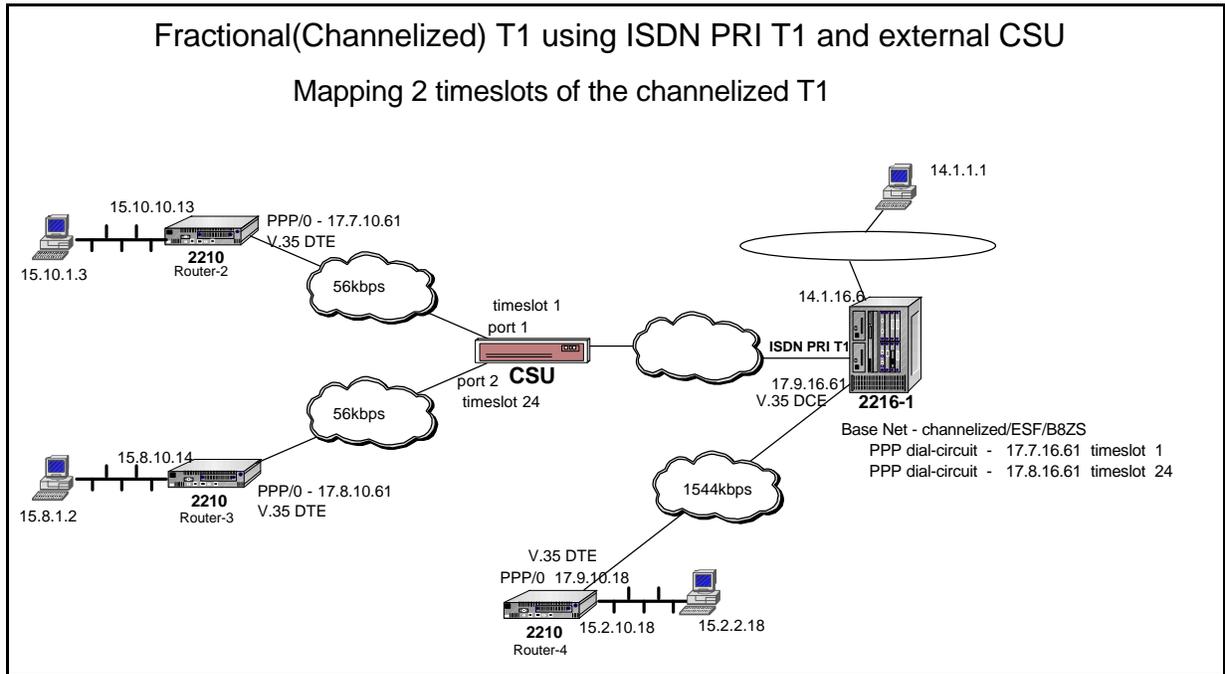
**Diagram mapping 1 timeslot to Port 1 of the CSU and 8 timeslots to Port 2.**



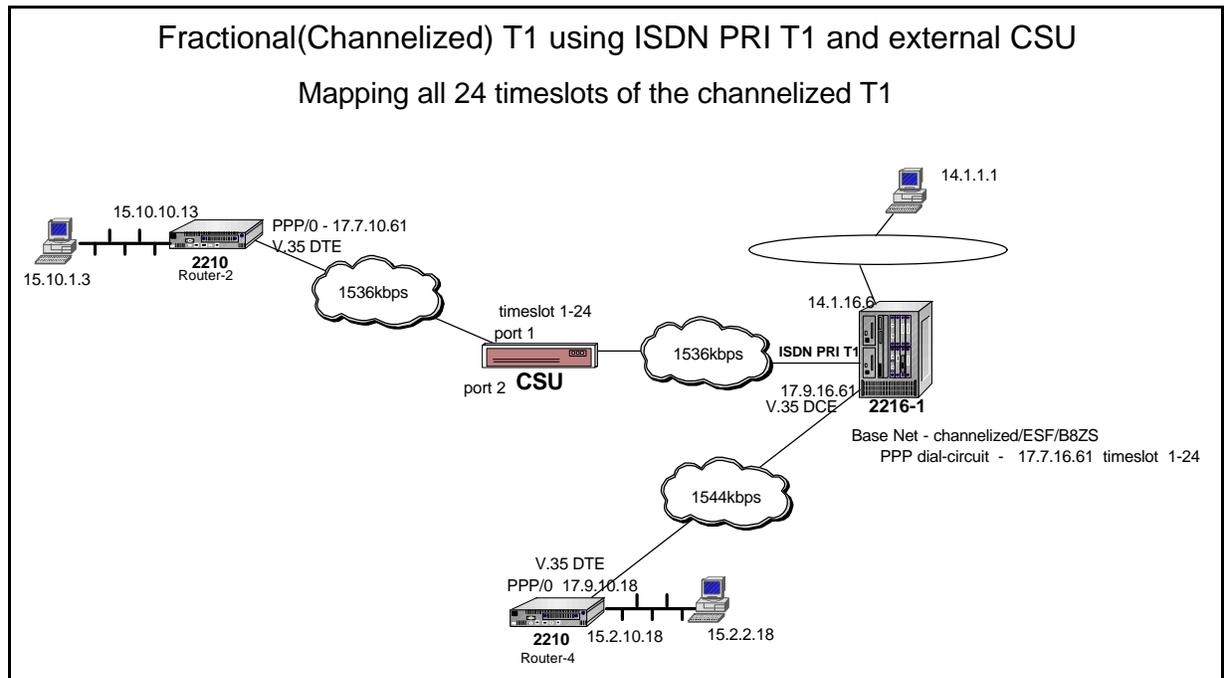
**Diagram mapping 1 timeslot to Port 1 of the CSU and 23 timeslots to port 2**



**Diagram mapping 1 timeslot to Port 1 of the CSU and 1 timeslot to port 2**



**Diagram mapping all 24 timeslots to Port 1 of the CSU**



## Detailed Design

The network examples are variations of the same design with a modification in link speeds. All serial interfaces are using PPP encapsulation, which was selected for these examples. The network provides connectivity to both 16Mbps Token-Ring and 10Mbps Ethernet LAN devices such as FTP/TFTP servers and Chariot traffic generators via the channelized T1.

The Larscom CSU and 2216 Primary Rate ISDN adapter are connected using a copper crossover T1 cable for lab setup. The remote routers are connected via the WAN ports to the external CSU DCE data ports.

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## Chapter 2: Detailed Design and Implementation

### Installation Experience

The hardware configuration consists of an IBM 2216 router with an ISDN Primary Rate T1 Adapter installed. This adapter is connected to an external CSU using a T1 crossover cable to simulate T1 network connectivity. Two 2210 routers are connected via the WAN ports to the external CSU DCE data ports. Each of the routers is also connected to isolated LAN segments. Appendix A can be referenced for screen captures for the configuration and setup of the IBM router using the GUI Configuration Tool as well as screen captures for the configuration and setup of the Larscom CSU.

Below are the IBM router commands for configuring configuration procedures for setting up the ISDN Primary Adapter for channelized T1 service.

This example will setup 2 dial circuits, the 1st defined with a single 56kbps timeslot and the second with 23 X 64kbps timeslots.

**\* This command adds the adapter and assigns the “base network” interface for the dial circuits.**

```
T1-ISDN Chan Config> add device T1-IPORT-ISDN
Device Slot #(1-8) [1]? 8
Adding 1-port ISDN Primary T1/J1 device in slot 8 port 1 as interface #5
Use "net 5" to configure 1-port ISDN Primary T1/J1 parameters
```

**\* This command adds the dial circuits and network interface for each circuit.**

```
T1-ISDN Chan Config> add device DIAL-CIRCUIT
Enter the number of PPP Dial Circuit interfaces [1]? 2
Adding devices as interfaces 6 8
Defaulting data-link protocol to PPP
Base net for the circuit(s) [0]? 5
Adding devices please wait...
Use "set data-link" command to change the data-link protocol
Use "net <intf #>" command to configure dial circuit parameters
```

**\* Setup the Base network interface**

```
T1-ISDN Chan Config>network 5
ISDN user configuration
T1-ISDN Chan ISDN Config: 5>set switch-variant CHAN
```

**\* the following options are defaults after setting the switch variant to CHAN**

```
T1-ISDN Chan ISDN Config: 5>set interface code B8ZS
T1-ISDN Chan ISDN Config: 5>set interface FRAME ESF
T1-ISDN Chan ISDN Config: 5>set interface ESF-Data-Link ANSI-T1.403
T1-ISDN Chan ISDN Config: 5>exit
```

**\* List configuration of Base Net**

T1-ISDN Chan ISDN Config: 5>**list all**  
ISDN Configuration

Maximum frame size in bytes = 2048  
Switch Variant/Service Type = Channelized

Available Timeslots:

T1 Interface Parameters:

LBO = -00.0 dB  
Code = B8ZS  
Frame = ESF  
ZBTISI = Disabled  
ESF-Data-Link = ANSI-T1.403

T1-ISDN Chan ISDN Config: 5>

**\* Setup circuits**

T1-ISDN Chan Config>**network 6**

Circuit configuration

**\* Define the Base Net for this circuit.**

T1-ISDN Chan Circuit config: 6>**set net**

Base net for this circuit [0]? **5**

**\* Define the Base Net for this circuit.**

T1-ISDN Chan Circuit config: 6>**set timeslot**

Timeslots for this circuit (separated by spaces): []? **24**

T1-ISDN Chan Circuit config: 6>**set bandwidth**

Bandwidth(kbps) for this circuit [64]? **56**

**\* Define the Base Net for this circuit.**

T1-ISDN Chan Config>**network 8**

Circuit configuration

T1-ISDN Chan Circuit config: 8>**set net**

Base net for this circuit [0]? **5**

T1-ISDN Chan Circuit config: 8>**set timeslot 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23**

T1-ISDN Chan Circuit config: 8> **exit**

**\* List configuration of circuit 6**

T1-ISDN Chan Config>**network 6**

Circuit configuration

T1-ISDN Chan Circuit config: 6>**list all**

Base net = 5  
Idle character = FF  
Bandwidth per timeslot = 56 kbps  
Timeslot = 24

T1-ISDN Chan Circuit config: 6>**exit**

T1-ISDN Chan Config>

### List configuration of circuit 8

T1-ISDN Chan Config>**network 8**

Circuit configuration

T1-ISDN Chan Circuit config: 8>**list all**

```
Base net                = 5
Idle character          = FF
Bandwidth per timeslot = 64 kbps
Timeslot                = 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
19 20 21 22 23
T1-ISDN Chan Circuit config: 8>
```

\*

## Special Characteristics and Considerations

All 24 timeslots are not required to be mapped, but it is important to **insure** that the timeslots used are “**match exactly**” between the external CSU and the Primary Rate ISDN integrated CSU.

Aggregated 56kbps timeslots are not supported but a single timeslot of 56kbps is supported which means you can have as many 56kbps circuits as you have DCE interface ports on the external CSU.

Insure Switch Variant is set to “**chan**” (channelized).

Set line coding to “**B8ZS**”.

Set framing to “**ESF**”

## Test Procedures

Using talk 5 issue the “**configuration**” command to display configuration as well as the interface status.

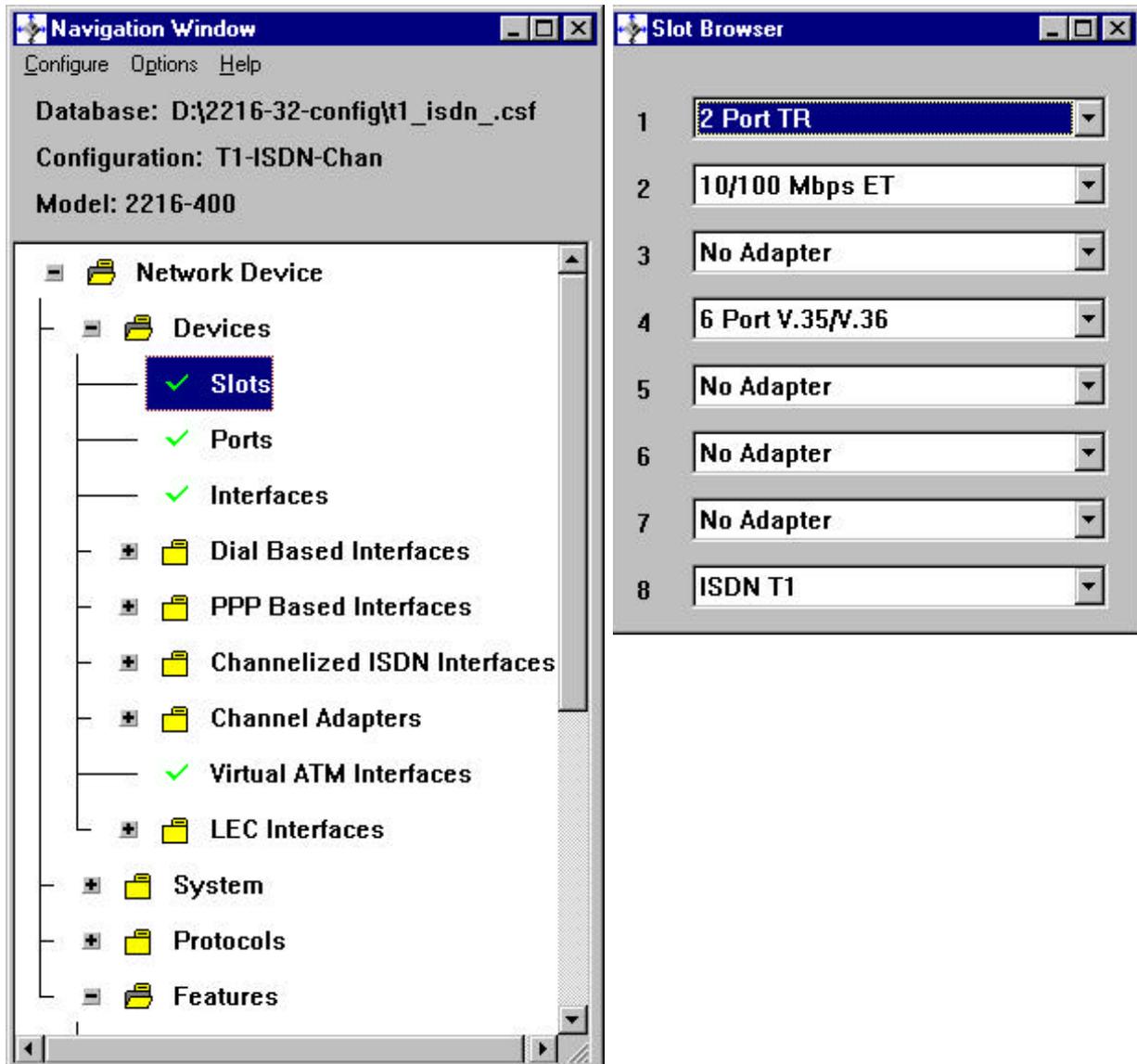
Using talk 6 issue the “**list devices**” command which will display a list of installed devices which should have the base network as well each of the dial circuits.

Using “**net <intf # of dial circuit>**” command and then issuing “**list all**” to display configured circuit information.

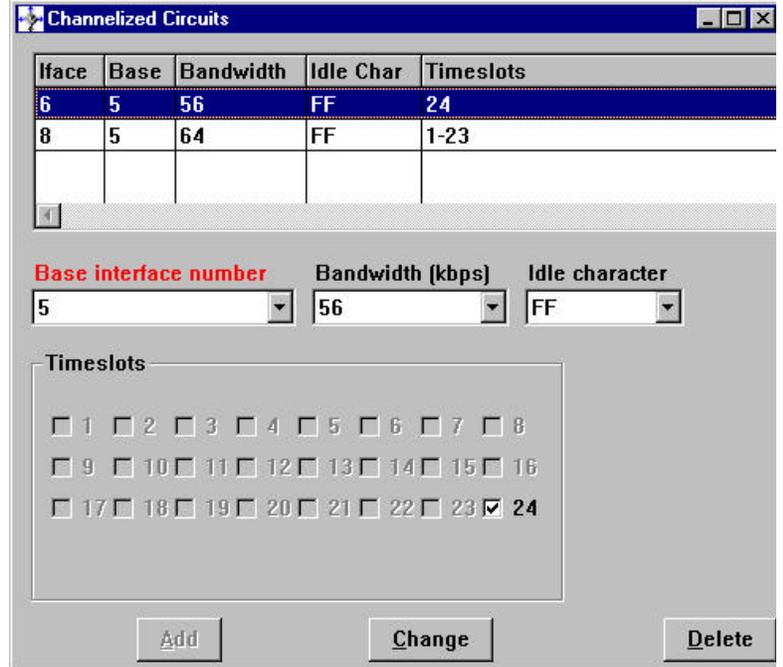
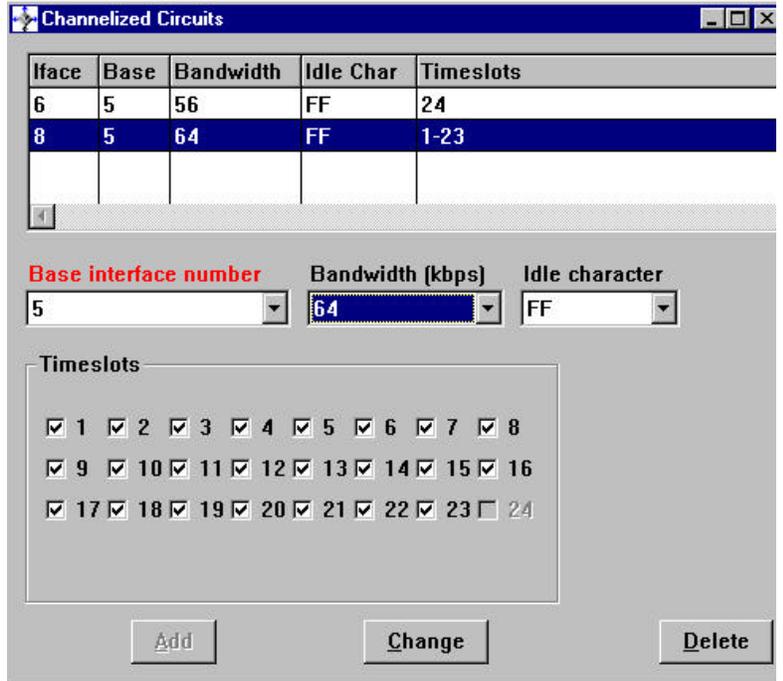
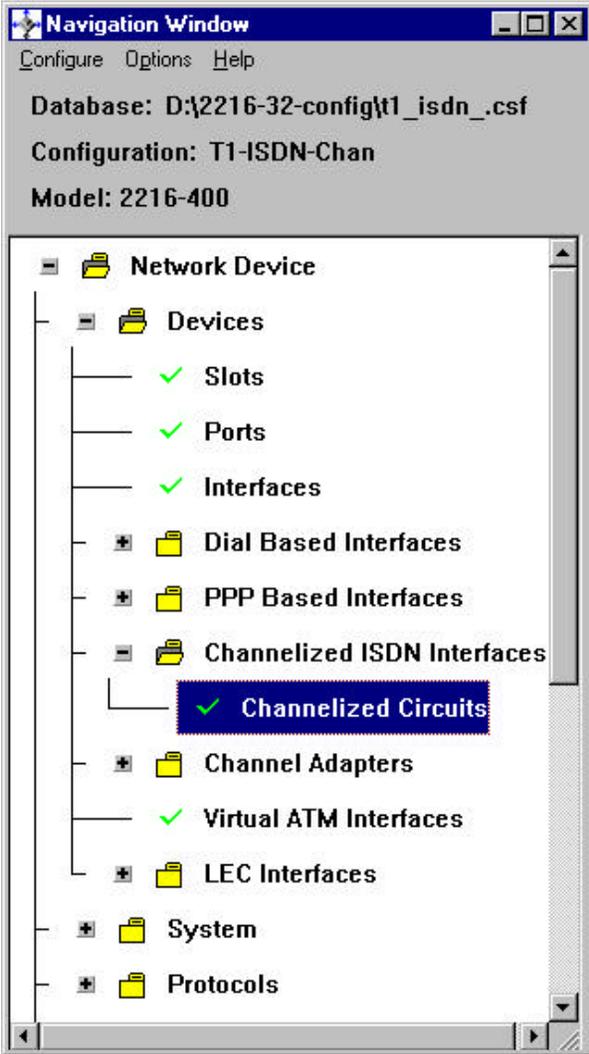
## Appendix A: Detailed Configuration Information

Following are screen captures of the GUI Configuration Tool used for the IBM routers.

Display of the adapters residing in the slots.



Display of the selectable options for the channelized circuits.



Display of the selectable options for base net.

The screenshot shows a window titled "Device Interfaces" with a table of interface configurations. The table has four columns: Interface, Slot/Port, Type, and Configure Data Link. Interface 5 is selected, showing "ISDN T1" as the type and "Not Applicable" as the data link option. Below the table, configuration parameters for the selected interface are shown, including LBO (-0.00 dB), Code (B8ZS), ZBTSI (unchecked), Frame type (ESF), ESF-Data-Link (ANSI-T1.403), and RAI type (ANSI). A sidebar on the right contains tabs for General, Sw Var Params, Acct. Entries, Cause Codes, Iface Params, and Call Blocking.

Interface	Slot/Port	Type	Configure Data Link
4	4/1	Serial	Frame Relay
5	8/1	ISDN T1	Not Applicable
6	N/A	Dial-Circuit	PPP
7	4/2	Serial	PPP

Configuration parameters for the selected interface (Interface 5):

- LBO: -0.00 dB
- Code: B8ZS
- ZBTSI:
- Frame type: ESF
- ESF-Data-Link: ANSI-T1.403
- RAI type: ANSI

Available tabs in the sidebar:

- General
- Sw Var Params
- Acct. Entries
- Cause Codes
- Iface Params
- Call Blocking

Following are screen captures from the Larcom CSU configuration menu that is accessible by a terminal emulation program or ASCII terminal emulating a VT100 at 9600 baud with no parity, 8 data bits and 1 stop bit.

### Main Menu of the Larcom CSU indicating all available options

```
— Larscom Split-T FT1 Access MUX —  
[MAIN]  SYSTEM  LINE  DTE  TEST  ALARM  
ALERT   ds0cnf  mast  freq  addr  more
```

### Clock configuration for the T1

```
— Larscom Split-T FT1 Access MUX —  
[SYSTEM] DS0CNF  MAST  FREQ  ADDR  MORE  
ALERT          INT   1544  00
```

### Line coding and framing for the T1

```
— Larscom Split-T FT1 Access MUX —  
[LINE]  FRAMING  CODING  LBO   AIS  MORE  
ALERT   ESF      B8ZS   0.0  OFF
```

### DCE port interface configuration

```
— Larscom Split-T FT1 Access MUX —  
[PORT1] CSLOOP  INTRFC  RTS   TTM  V54RL  
ALERT   OFF    V.35   ACT  ON  LP-UP
```



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## Appendix B: Glossary

### **Baud Rate**

Baud rate refers to the speed at which data is transmitted.

**B8ZS** *Bipolar 8-Zero Substitution*

**CSU** *Channel Service Unit*

### **Clear Channel Capability**

Clear Channel capacity means that the 192 “information” bits in a frame are all used for data; no bits are dedicated to pulse density assurance or signaling. Clear channel capability makes 1.536 Mbps available for user data.

### **Data Rate**

Data rate is the speed at which data is transmitted.

**DCE** *Data Communication Equipment.*

**DTE** *Data Terminal Equipment.*

### **DTE Port**

A substrate interface between a DTE and a Split-T.

**DSU** *Data Service Unit.*

**ESF** *Extended SuperFrame*

An Extended SuperFrame consists of 24 frames of 193 bits each (4632 bits total). In each frame, one “F bit” is followed by 24 8-bit bytes. The 8 kbps of F-bit overhead is divided into 2 kbps for framing, 2 kbps of CRC-6 code for logic error checking, and a 4 kbps Data Link for maintenance communications. As in the SuperFrame (D4) format, 1.536 Mbps is available bandwidth for user information.

### **Fractional T1**

Fractional T1 refers to the leasing of portions of T1 bandwidth (a specific number of DS0s) by carriers. FT1 Allows for more economical networking in some applications.

**LBO** *Line Build-Out*

Line build-out is an impedance compensator used to compensate for various cable lengths and conditions between CSUs and the last telco Line repeater.

**Line Coding**

The method of encoding data for transmission over a particular facility. Line coding schemes for T1 include AMI and B8Zs. It is critical that all equipment on the line be configured for the same line coding, or transmission will not be reliable.

**Master Clock**

The clock providing the timing reference for the Split-T, including all DTE and T1 interfaces.

**Point-to-Point Connection**

In a point-to-point connection, a single T1 or FT1 link connects equipment at two locations. In such a connection, the signal is not reframed and the data link is not lost.

**T1**

T1 refers to a digital bipolar link with a data capacity of 1.544 Mbps, also known as Digital Signal Level 1 (DS1). The T1 digital transmission system is the primary digital communication system in North America.

## Appendix C: References

LARSCOM SPLIT-T FT1 Access Multiplexer  
Installation & Operation