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# ***DS-3 Technology and Testing Overview***

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**for**

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## ***TELESYNC®***

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- OC-48/STM-16 Optical Test System
- ISDN PRI (DS-1, E1) and BRI Remote Test and Connectivity Units
- DS-1,E1, DS-3, STS-1, OC-3, OC-12 Sources and Distribution Units
- DS-1 and DS-3 BERTS
- Centralized Modem Telephone Line Testing
- DS-1, E1 108 Digital Loopback Test Lines
- SW56/ISDN and X.21/ISDN Adapters for Video Conferencing and Internet Access

## ***DS-3 Technology Fundamentals***

- DS-3 Network Overview
- DS-3 Framing Structure
- Channelized/Non-Channelized DS-3
- Signal Formats
- Multiplexing Process
- Line Coding

## ***DS-3 Network Elements***

- M13 Mux
- DS-3 Network Interface Unit (NIU)
- Fiber Mux
- 3/3, 3/1, 3/1/0 Digital Cross-Connect Systems (DCS)

## ***What is DS-3?***

- High Capacity Private Line Service
- Data Transmission at 44.736 Mbps
- Bandwidth Equals 672 DS-0's or 28 DS-1's
- Channelized DS-3 Provides 28 DS-1 Channels
- Nonchannelized DS-3 Allows DS-3 End-User to Allocate Bandwidth as Needed

## ***DS-3 Applications***

- End Users
  - LAN Interconnection
  - Data-Intensive Mainframe-to-Mainframe Operations
  - Broadcast-Quality Video
  - CAD/CAM Transfer

## ***DS-3 Applications***

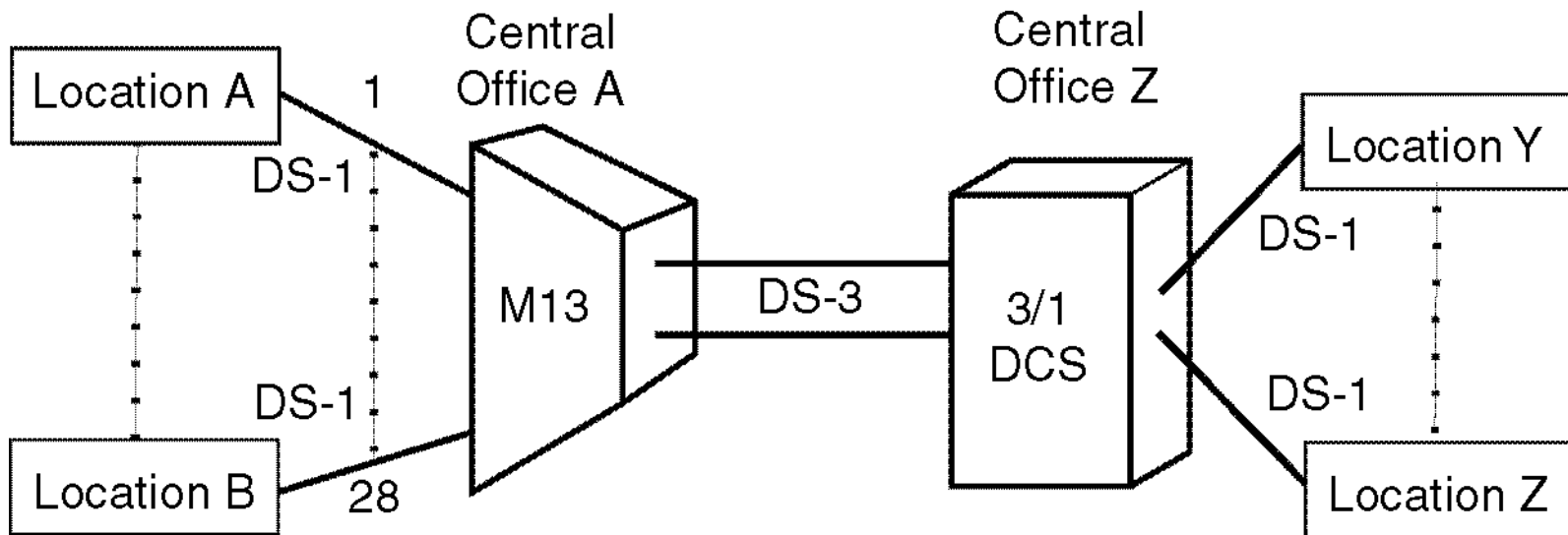
- Service Providers
  - Transmit Multiple DS-1's on a Single Line
  - Interoffice Connections
  - Connection of CLEC's to RBOC Network
  - Connection of ISP's to Internet

## ***DS-3 Benefits***

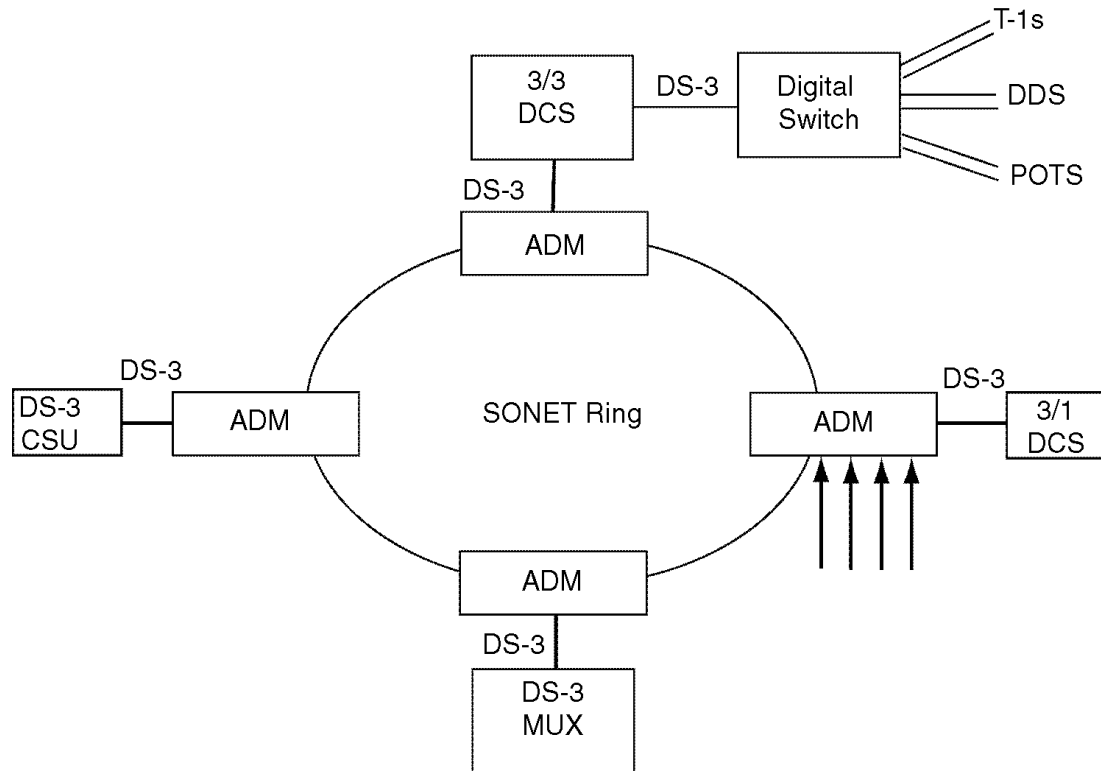
- High Speed, Large Bandwidth Digital Signal Transport
- Can Contain 28 DS-1's (672 DS-0's) and Transmit Them Simultaneously
- Features More Flexibility than a Standard DS-1 Signal Transport
- Supports Wide Range of Applications
  - Video
  - CAD
  - CAM
- Formatted as Channelized or Non-Channelized



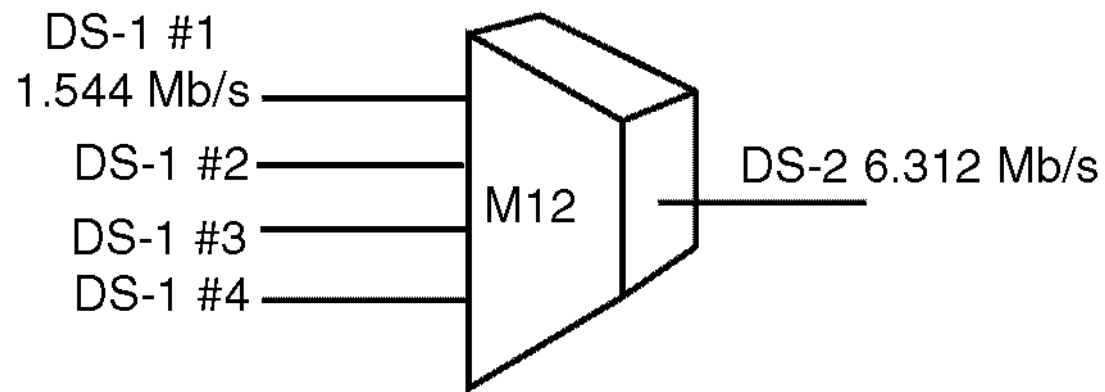
## ***DS-1 Transport via DS-3***



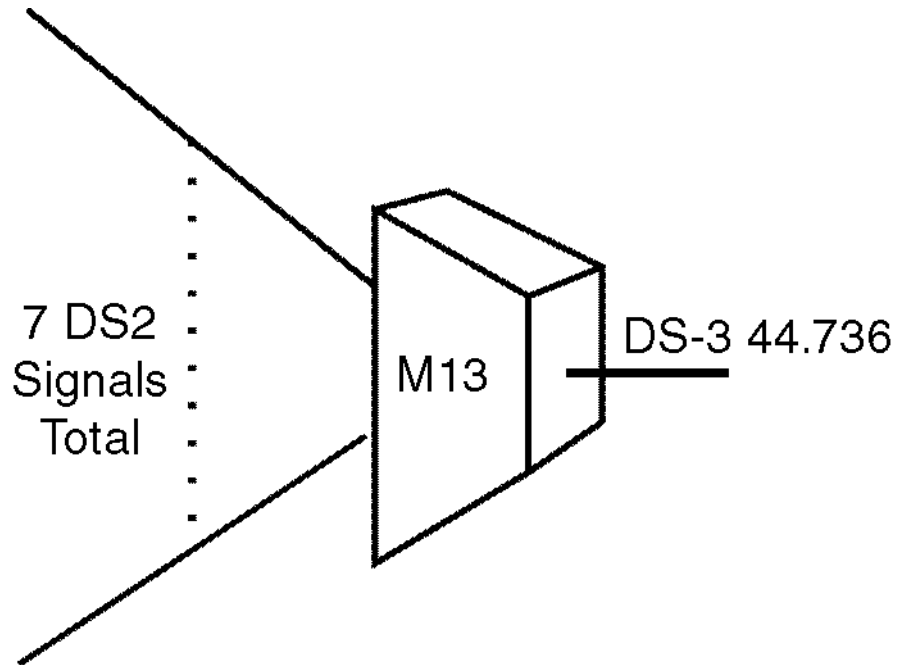
## ***DS-3 and SONET***



***DS-3 Signal Rate  
DS-1 to DS-2 (M12)***

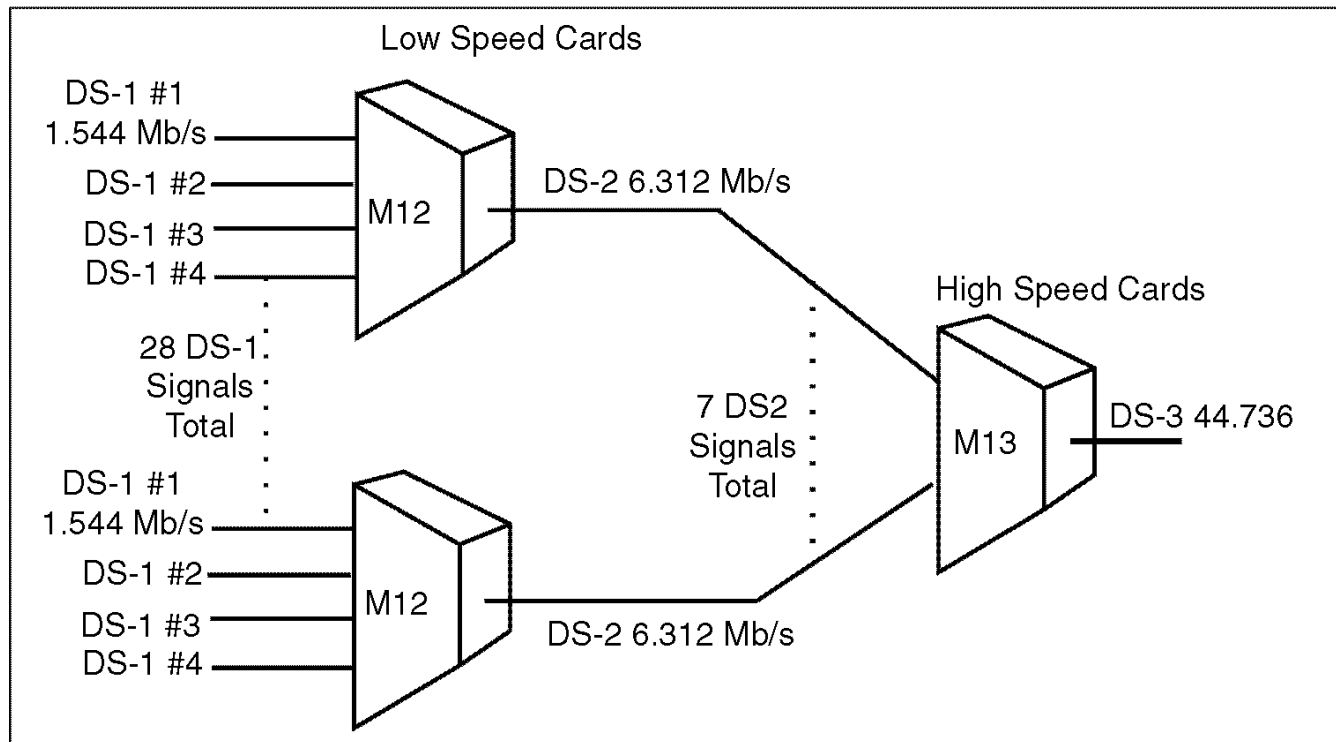


# ***DS-3 Signal Rate DS-2 to DS-3 (M23)***



# M13 Multiplexers

## M13



## ***DS-3 Framing***

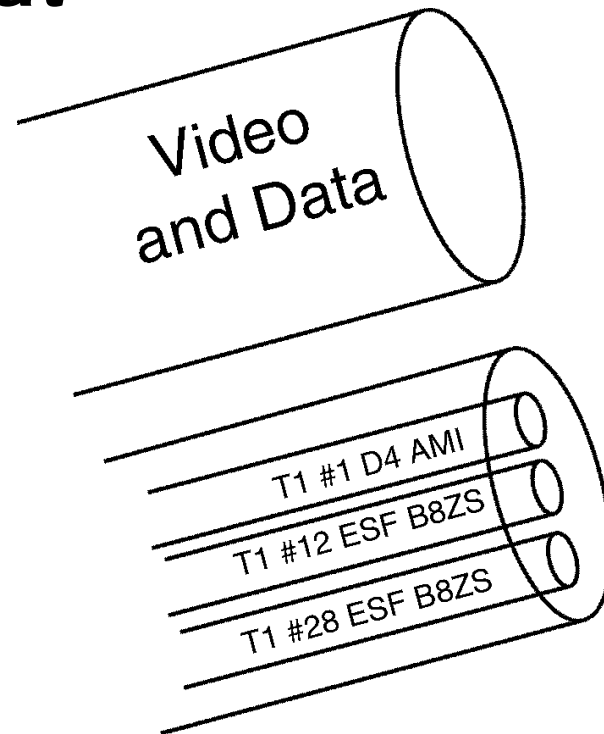
4704	Customer Information Bits
28	F-Bits
2	X-Bits
2	P-Bits
3	M-bits
<u>21</u>	<u>C-Bits</u>
4760	Total Bits

## ***DS-3 Overhead Bits***

- F-bits are frame alignment bits
- X-bits are used for alarm signaling
- P-bits are parity bits
- M-bits identify the M-frame
- C-bits use varies depending on frame format used

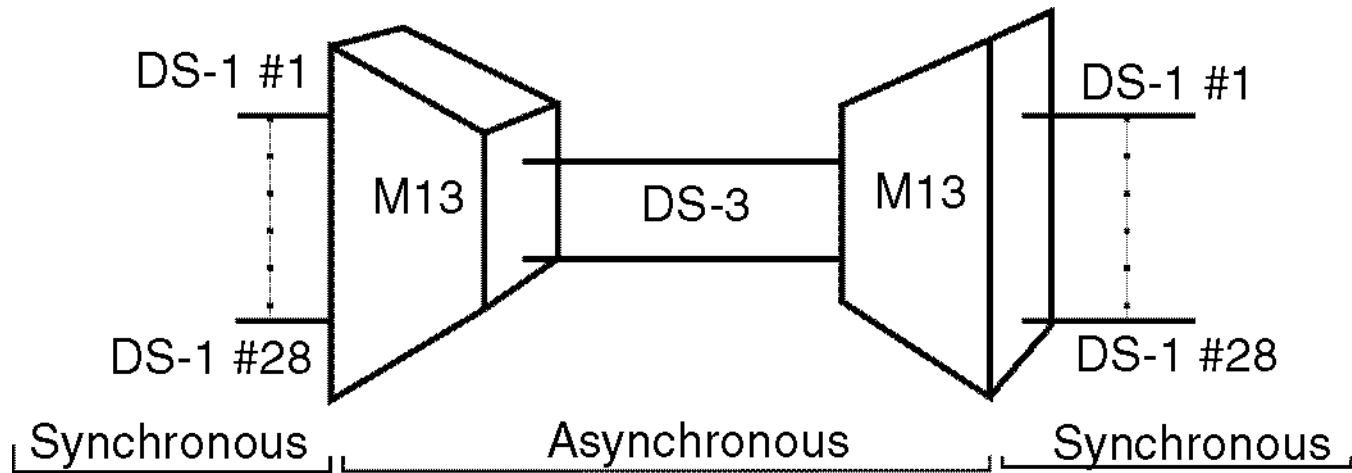
# ***DS-3 Channelized/Non-Channelized Signal Frame Format***

***M13 Asynchronous  
C-Bit Parity***





## ***DS-3 Timing***



## ***Comparison of M13 and C-Bit Framing***

- M13 Framing
  - No loop code and only one Far End Alarm Interpretation (Yellow)
- C-Bit Framing
  - Can Interpret Alarms, FEOOF's and FEBE's, and loop individual DS-1's and DS-3's in the multiplexers.

## ***Comparison of M13 and C-Bit Framing***

- M13 Framing
  - Best In-Service measurement is Parity check (only 50% accurate) and can be altered as the signal is transported through the network.
- C-Bit Framing
  - In-service measurement are Parity and C-Bit Parity. C-Bit Parity will not get altered as the signal is transported through the network.

## ***Comparison of M13 and C-Bit Framing***

- C-Bit Framing
  - Has FEAC codes available for looping DS-3 muxes, individual DS-01's, low speed cards and for sending alarm information.

## ***DS-3 Testing Applications***

- DS-3 Out-of-Service Testing
- DS-3 In-Service Monitoring

## ***DS-3 Out-of-Service Testing***

- Installation
  - DS-3 Switches
  - Muxs
  - DCSs
  - ADMs
- Testing Done at Central Office
- Testing Done at CPE
- Requires Disabling the Network and End-to-End Test

## ***DS-3 Out-of-Service Testing***

- Measure every single bit of a transmitted signal
- Ensures absolute measure of performance

## *DS-3 Out-of-Service Testing*

- Selected pattern P1 is substituted for live traffic and then transmitted over the network
- Error detector generates identical pattern to P1. This is called the received pattern P2. P1 and P2 are then compared and any difference means a **BIT ERROR**.



## ***DS-3 In-Service Monitoring***

- Timely detection of performance degradation
- Performed as DS-3 circuits carry live traffic
- Performed at C.O., DSX-3, or at DCS test ports

## ***DS-3 In-Service Monitoring***

- DS-3 Point-of-Interface (POI) carrier-to-carrier interface
- DS-3 Point-of-Presence (POP)
  - Carrier-to-Customer Interface
- At customer DS-3 location

## ***DS-3 In-Service Monitoring***

- Monitoring M13 frame formats detects:
  - Frame Errors
  - Parity Errors
- Monitoring of C-Bit frame format detects:
  - C-bit parity errors
  - Far end block errors (FEBEs)

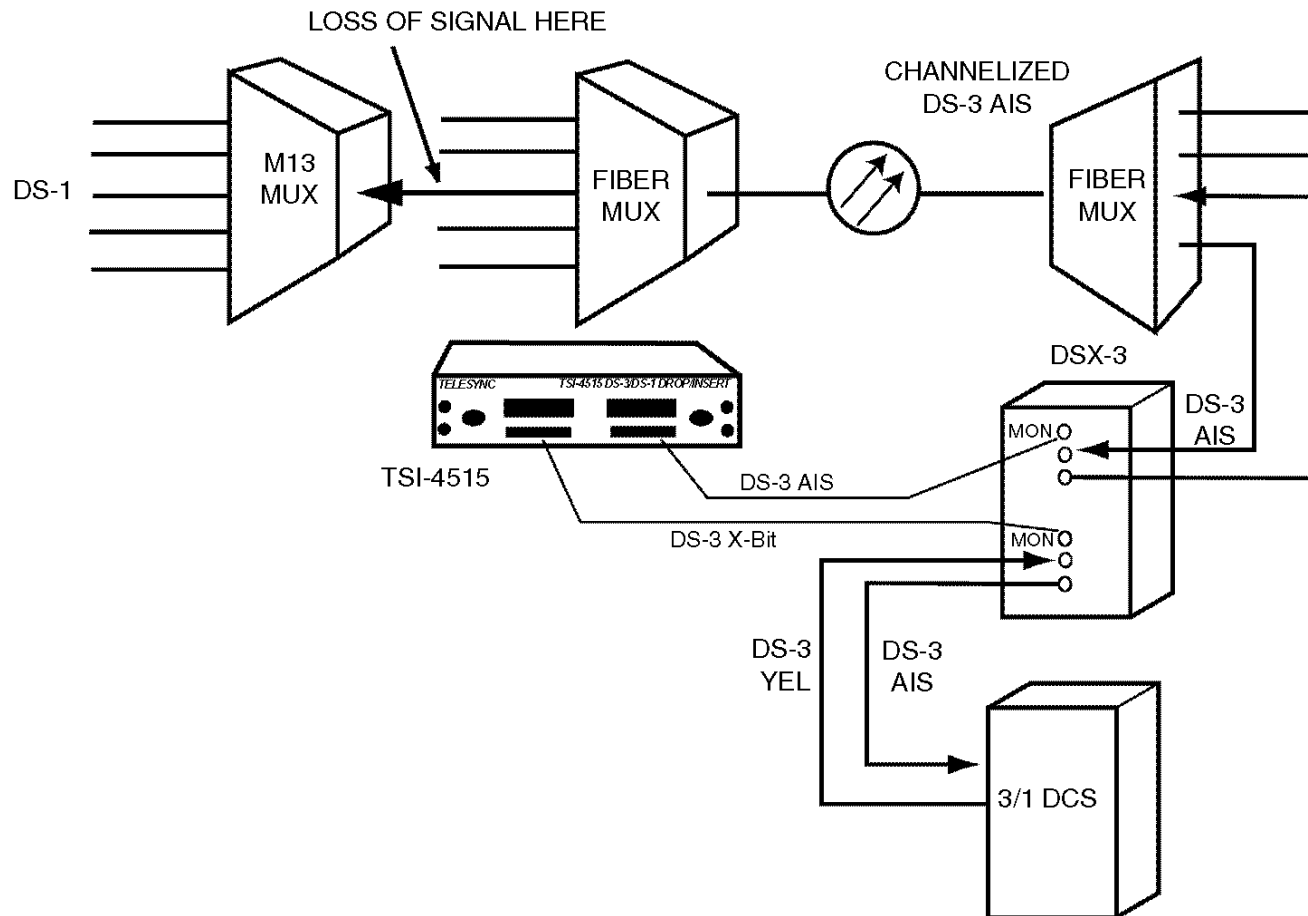
## ***DS-3 Alarms***

- LOS (Loss of Signal)
- LOF (Loss of Frame)
- AIS (Alarm Indicator Signal)
- Idle (DS-3 Idle Signal)
- Yellow (X-Bit)

## ***DS-3 Alarms***

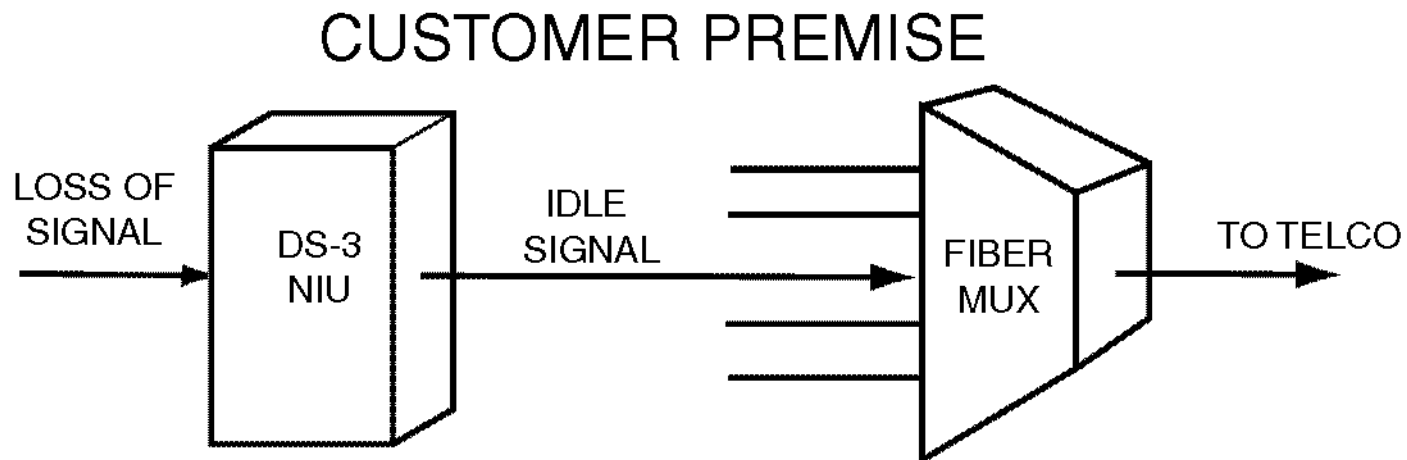
- AIS - Alarm Indicator Signal
  - Problem on the line somewhere behind the last multiplexer (MUX), DCS, Fiber Mux
- Yellow - Far End Alarm
  - Terminating element such as an M13 Mux loses framing on its received DS-3 signal or receives an AIS signal

## DS-3 Alarms



## ***DS-3 Alarms***

- Idle Signal
  - DS-3 Idle signal allows DS-3 circuits to stay out of service without triggering network alarm



## ***DS-3 Out-of Service Testing***

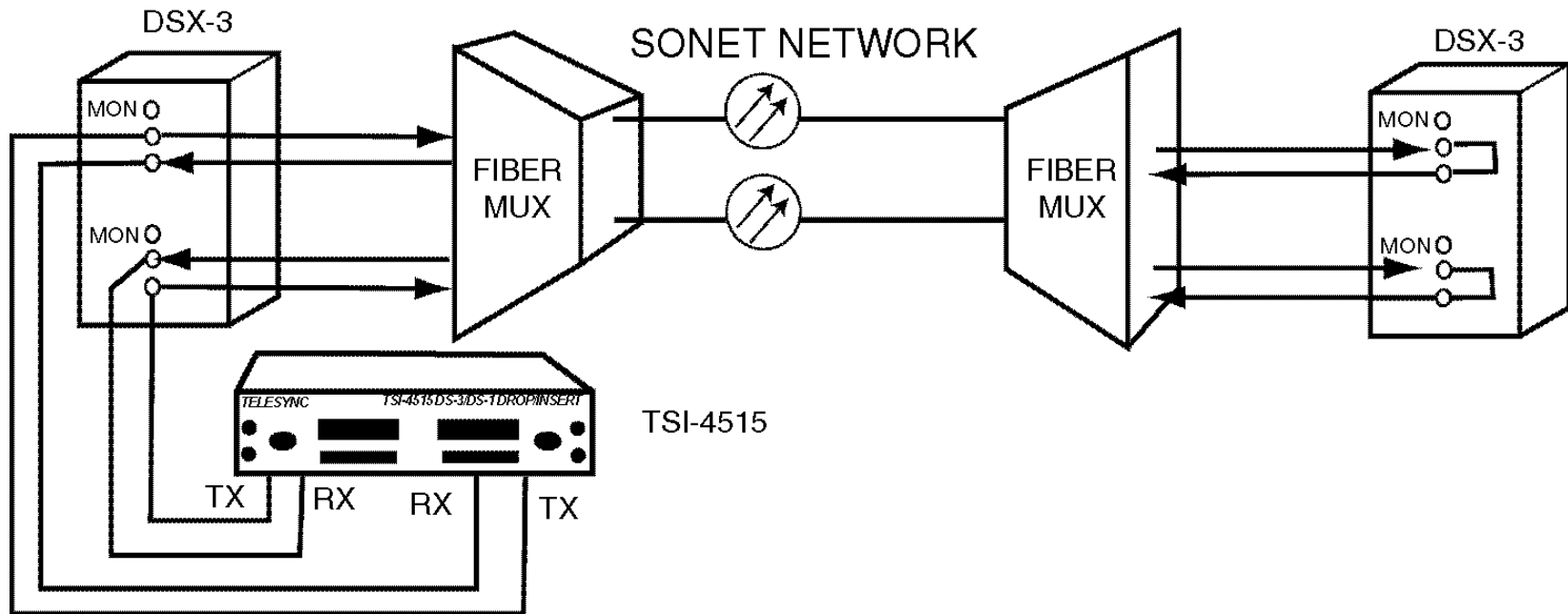
- Loop the DS-3 at the far end
- Loop the DS-1s at the far end



## ***DS-3 Out-of-Service Testing***

- Perform when installing DS-3 circuits
- Prevents call-backs by proactively verifying:
  - Configuration of DS-3 NEs responsible for DS-3 signal transmission
  - Quality of transmitted signal and circuit connections
  - Correct synchronization of DS-3 circuit

# Connecting TSI-4515 for Out-of-Service Testing

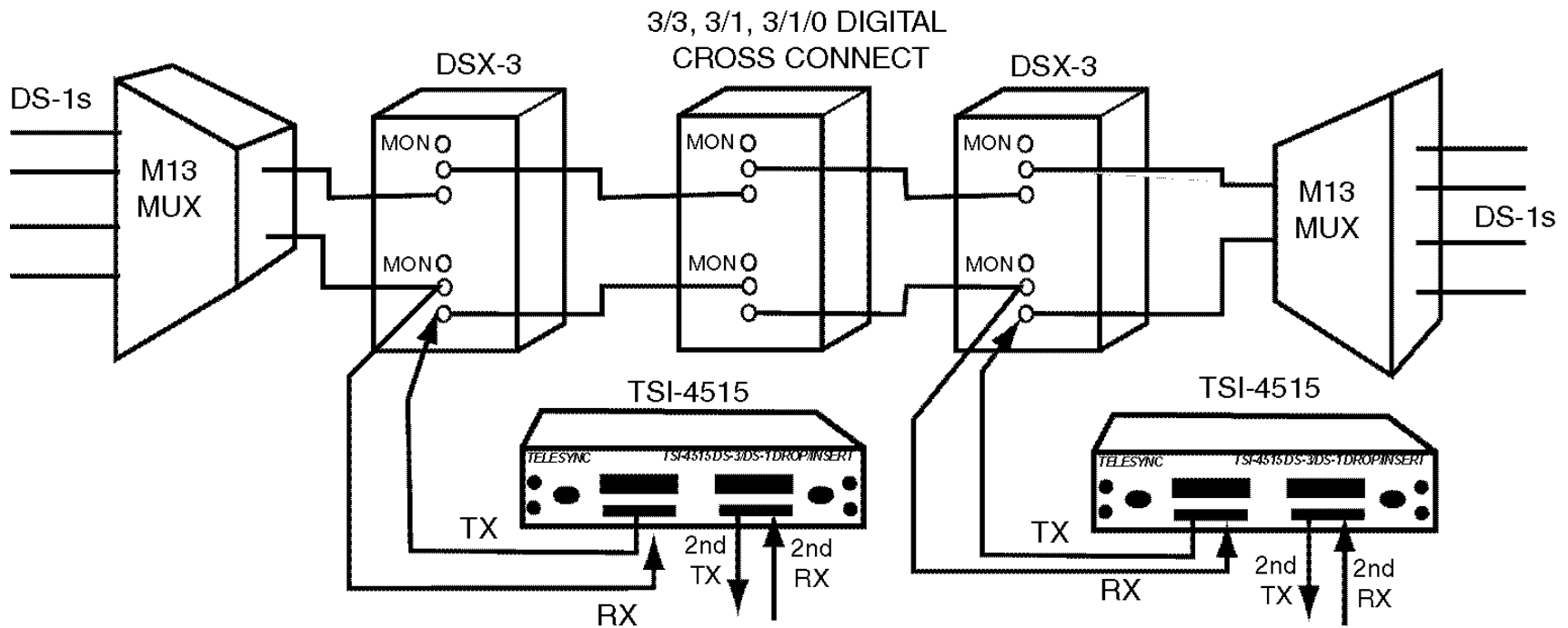


## ***DS-3 Out-of-Service Testing End-to-End***

- Transmits an end-to-end or looped back PRBS pattern for commissioning
- Transmits single errors for continuity checks

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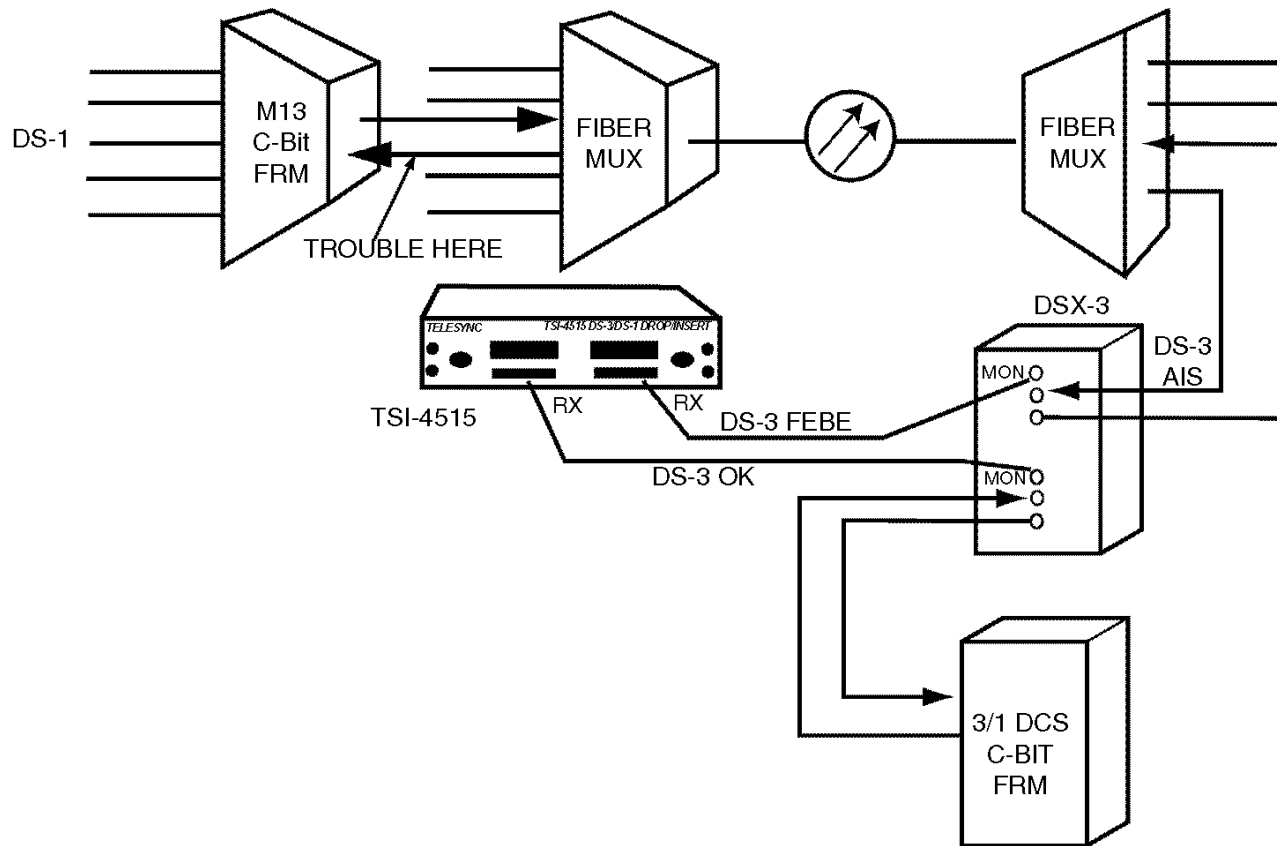
# DS-3 Out-of-Service Testing End-to-End



## ***DS-3 In-Service Performance Monitoring Using FEBEs***

- FEBE - Far End Block Error
- C-Bit parity framing allows end-to-end performance monitoring of DS-3 circuits
- Verify end-to-end performance of DS-3 circuits while it is in service

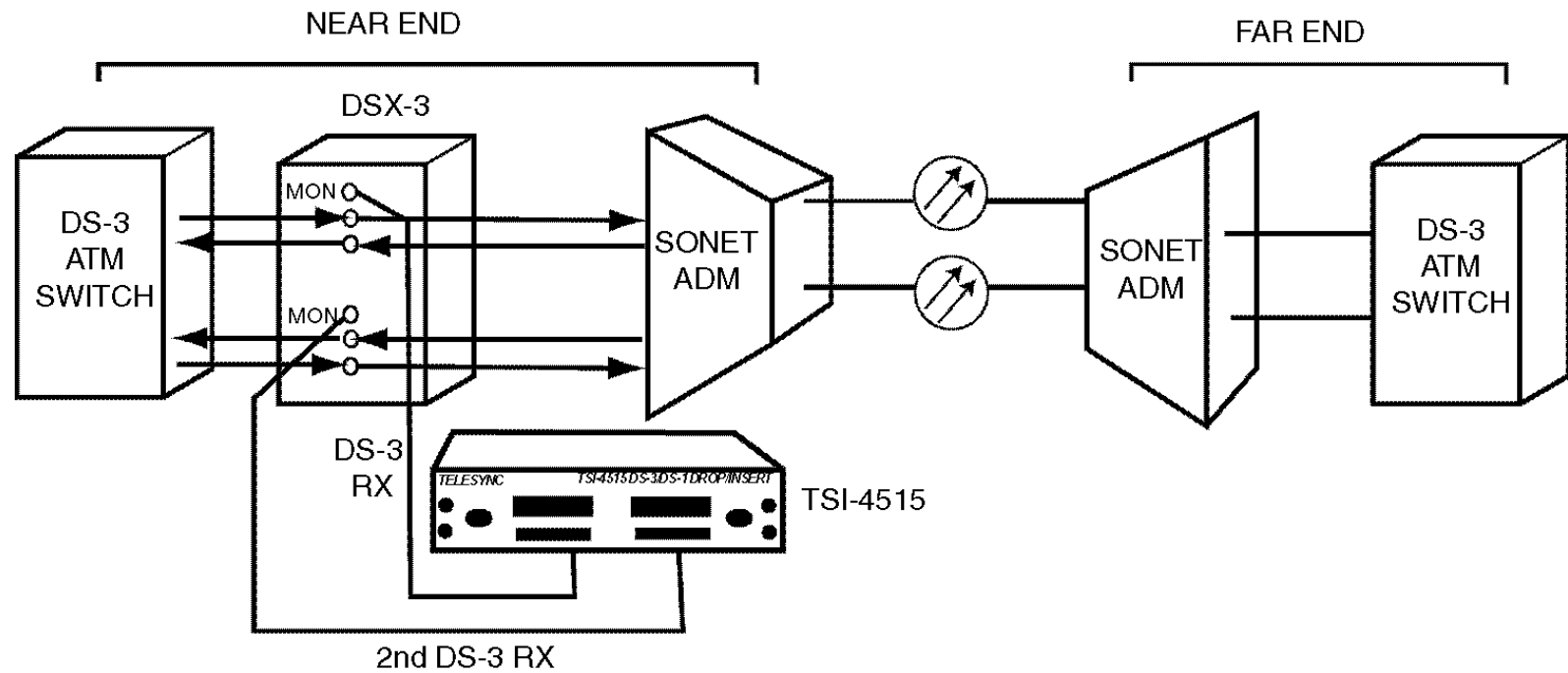
# DS-3 FEBE Errors



## ***DS-3 In-Service Monitoring***

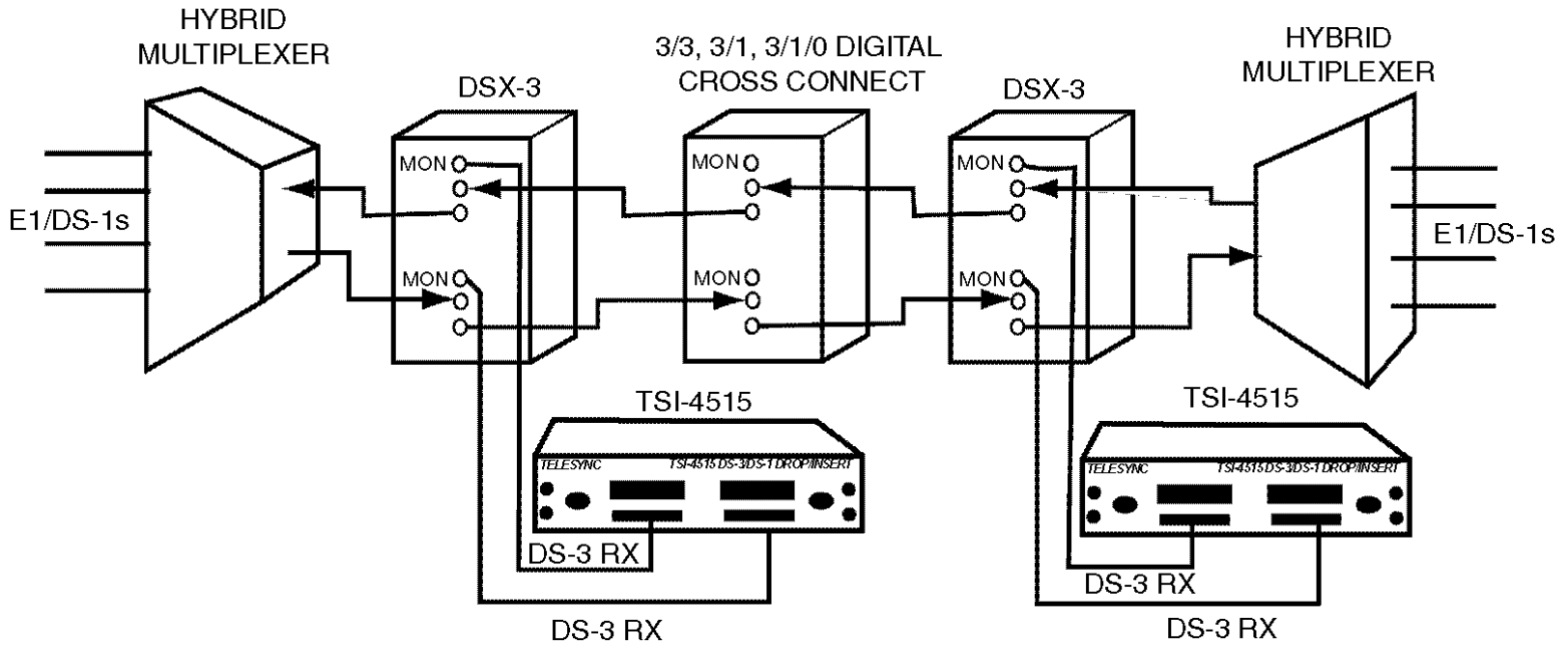
- Provides in-service monitoring of F-bits, C-bits, X-bits, P-bits, C-parity bits and Far End Block Errors
- Counts all error categories simultaneously
- Notifies operator of thresholds and end of test.

# ***DS-3 Bi-Directional In-Service Monitoring***

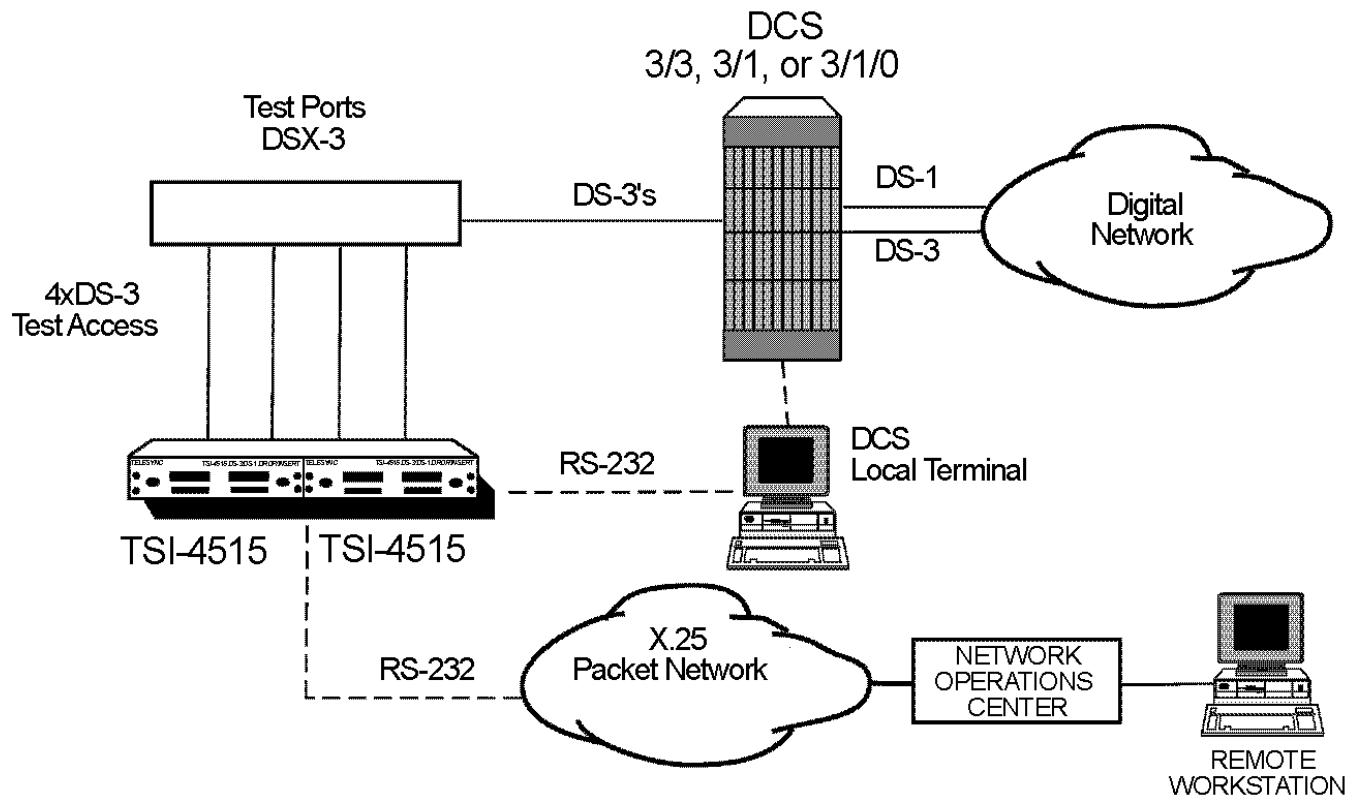




# *DS-3 In-Service Long Term Monitoring*



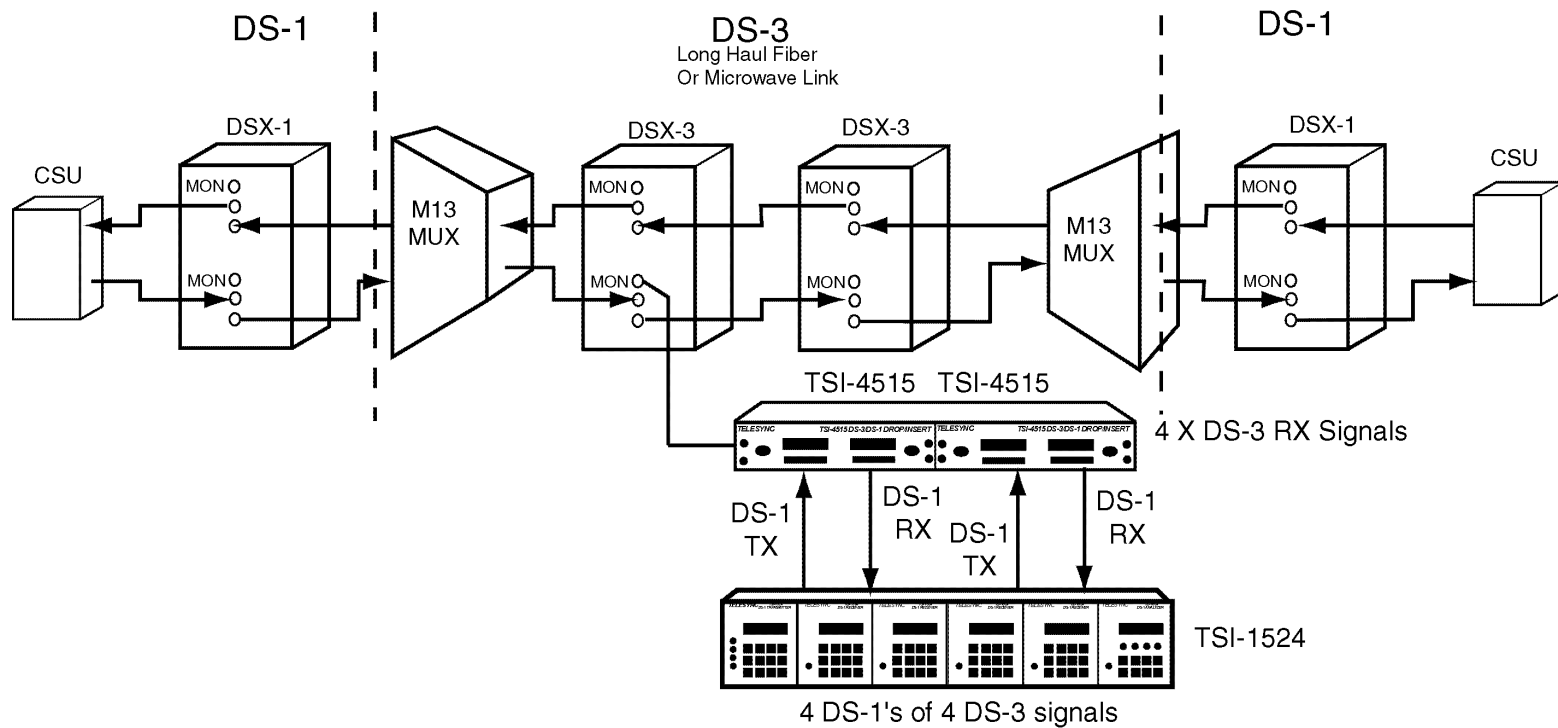
# DS-3 In-Service Circuit Test



## ***DS-3 In-Service Test with DS-1 Drop/Insert***

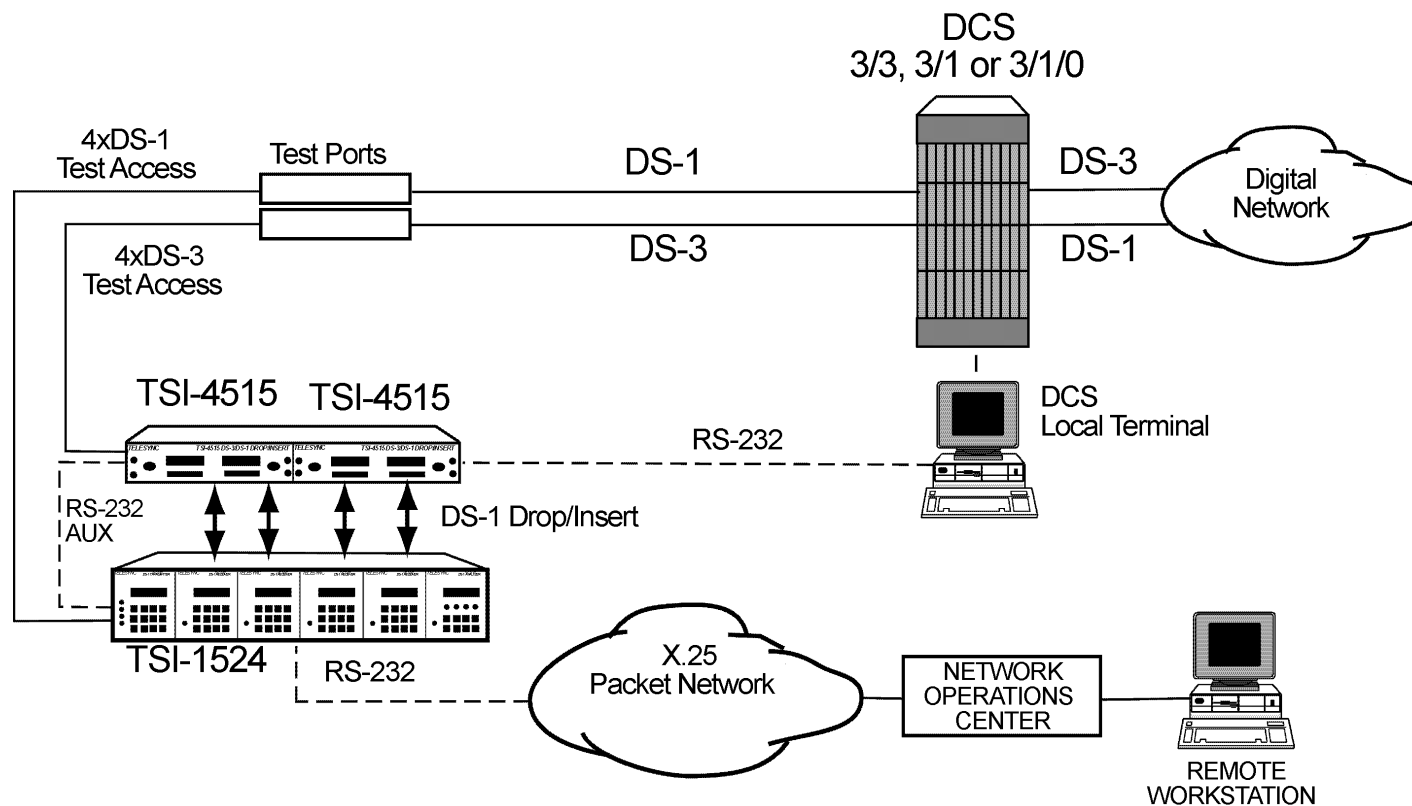
- Drop the DS-1 channel from the received DS-3 signal and perform complete DS-1 bit error rate testing
- Insert an internally generated DS-1 test pattern or loop code
- Perform out-of-service DS-1 testing over live DS-3 signal

# ***DS-3 In-Service Test with DS-1 Drop/Insert***



# DS-3/DS-1 Circuit Test

## Test DS-1s within DS-3 Service



## ***TSI-4515 DS-3/DS-1 Drop/Insert with BERTS***

- Monitor and test DS-3 channels in the 3/1, 3/3, 3/1/0 DCS system
- Monitor and test DS-3 at any DSX-3 locations
- Used at DS-3 Point-of-Interface (POI) and Point-of-Presence (POP) locations for long term monitoring and testing
- Installed in an CO. 19/23" rack mount
- Optional portable chassis

## ***TSI-4515 DS-3/DS-1 Drop/Insert with BERTS***

- Provide dual DS-3(TX/RX) performance monitoring and testing plus DS-1 Drop and Insert
- RS-232 interface for full remote control and monitoring from PC or terminal
- 15 Minute error bins over 24 hour period allows the unit to be used for long term monitoring of DS-3 and DS-1 circuits

## ***TSI-4515 DS-3/DS-1 Drop/Insert with BERTS***

- DS-1 signals can be routed to the TSI-1524 DS-1 Multichannel test unit for DS-1 measurements
- Cost effective solution of dropping and inserting DS-1 signals into the DS-3 network
- Test and monitor M13 or C-bit DS-3 signals



## ***TSI-4515 DS-3/DS-1 Drop/Insert with BERTS***

- Modular configuration can test up to 20 DS-3's using 10 interconnecting chassis through a single RS-232 interface
- Can be used as a dual bridging repeater when the Thru Mode is selected
- Small size - 1.75"H x 11"W x 8.5"D
- Light weight - 3 pounds
- Most economical solution for dual DS-3 testing and monitoring

## ***Thank You For Joining US!***

- **Look to TELESYNC For:**
- OC-48/STM-16 Optical Test System
- ISDN PRI (DS-1, E1) and BRI Remote Test and Connectivity Units
- DS-1,E1, DS-3, STS-1, OC-3, OC-12 Sources and Distribution Units
- DS-1 and DS-3 BERTS
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- DS-1, E1 108 Digital Loopback Test Lines
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