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Unclassified	Unclassified	Unclassified	Unclassified	14	Sid Jones (301) 342-1601

## *NexGenBus*

### Fibre Channel Test and Evaluation

## *Approach*

- Objective:
  - Determine as reasonably possible, can Fibre Channel meet our future Operational Requirements.
- Methods:
  - Analysis
  - Demonstration
  - Simulation

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## *Methods*



- Analysis
  - Port Functions
    - Physical Plant
    - Transmission Protocol
    - Signaling Protocol
  - Node Functions
    - Common Services
    - Mapping Layer for Upper-Level Protocol

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## *Analysis Method*



- Port Functions
  - Physical Plant
    - Cable assemblies
      - Balanced transmission line
      - Unbalanced transmission line
      - Connectors
      - Operational Environmental
    - Transmitters and Receivers
      - clock recovery
      - bit error detection

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## *Analysis Method*

- Port Functions (continued)
  - Transmission Protocol
    - 8b/10b encoding/decoding
      - ensures a minimum number of clock transitions while maintaining a dc balance and providing word alignment
    - ordered sets
      - identify frame boundaries and maintain the link
  - Signaling Protocol
    - defines the rules for transferring blocks of data
      - frame structure and byte sequences

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## *Analysis Method*

- Node Functions
  - Common Services
    - a set of services that are common across multiple ports of a node
  - Mapping Layer
    - defines the steps required to perform the functions identified by a Upper-Level Protocol
      - for each ULP there is a corresponding mapping
      - a construct for establishing the endpoint of the node

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## *Analysis Results*

- Determined that most of the test elements could not be isolated for testing.
- Identify specific test objectives for Demonstration and Simulation.
  - Demonstration
    - Physical plant
  - Simulation
    - Node to Node functions

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## *Analysis Results*

- Test objectives for Demonstration
  - Physical Plant
    - Eye-diagram waveform test
    - Cable interoperability test
    - Transmission rate test
    - Noise rejection test

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## *Analysis Results*

- Cable assemblies for the tests
  - Gore Quad (balanced pair)
    - FCN-1056 w/Mil-C-38999 style connector
  - Mil-C-17/94 (unbalanced)
    - RG-179 w/BNC connector
  - Mil-C-17/110 (unbalanced)
    - RG-302 w/BNC connector

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## *Analysis Results*

- Test objectives for Simulation
  - Node to Node functions
    - Class of Service
    - Latency
    - Synchronicity
    - Topologies
    - Upper-Level Protocols

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## *Methods*



- **Demonstration**
  - Eye-diagram waveform
    - overall signal quality
  - Cable interoperability
    - meet the specific requirements
  - Transmission rate
    - maximum frame data rate
  - Noise rejection
    - simulate EMI interference

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## *Demonstration Method*



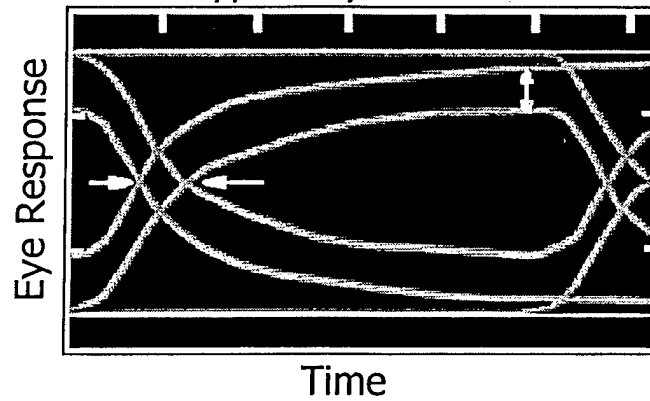
- **Eye-diagram waveform**
  - Jitter
    - bit times
    - differential skew
    - rise and fall times
  - Noise
    - amplitude

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## *Eye-diagram Waveform*

Typical Eye Pattern



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## *Demonstration Method*

- Cable interoperability
  - cable length
  - connector loss
- Transmission rate
  - maximum frame data rate
- Noise rejection
  - signal to noise ratio

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## Demonstration Method

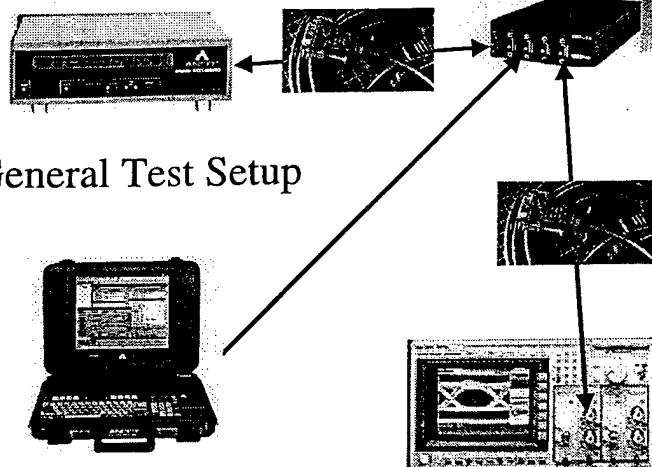
- Test data transmission
  - valid Fibre Channel data sequences
    - low frequency pattern (106.25Mhz)
    - low transition density pattern (433433...)
    - jitter tolerance pattern (50%, 100%, 30%, ...)
    - random data pattern
    - supply noise data pattern (...D31.3, ...)

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## Demonstration Method

- General Test Setup

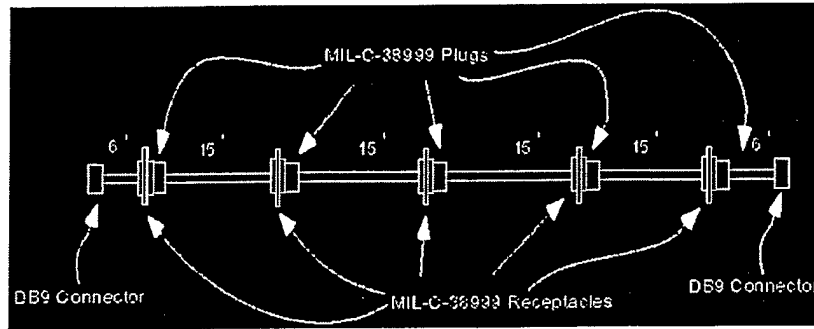


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## Demonstration Method

- Quad Cable Layout

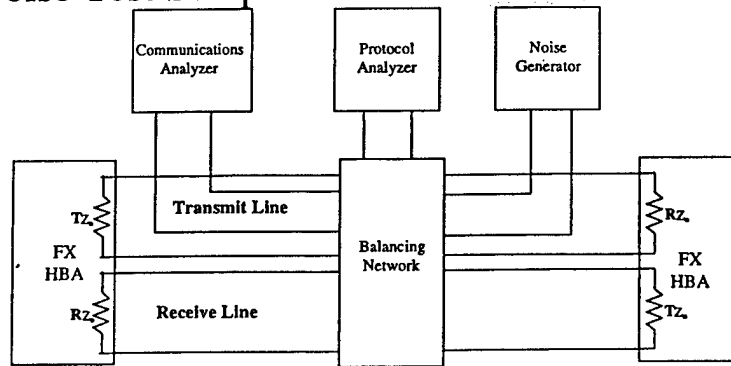


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## Demonstration Method

- Noise Test Setup



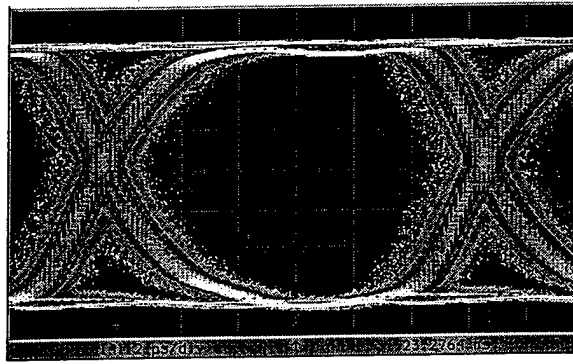
$Z_0$  = Nominal Characteristic Impedance

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# Transmit Eye Pattern

Color grade is enabled...



```

PC1063
total wfs 111.514      mask margin 48
failed wfs 2.0         total hits 11
total samples 3.4477E margin hits 11
failed samples 11      warn hits 11

```

Mask

off

Mask align

Mask edge

Mask color

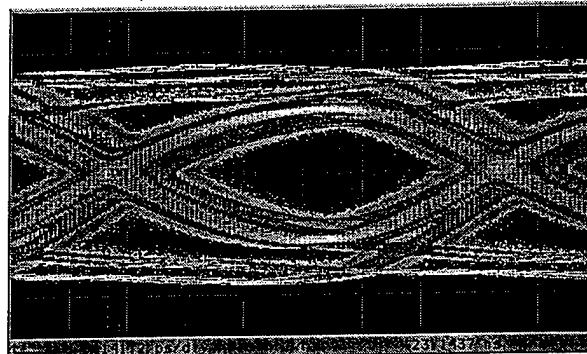
Print mask

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# Gore Quad Cable Results

Color grade is enabled...



```

PC1063
total wfs 66.000 k      mask margin -20r
failed wfs 44.566 k     total hits 62.766 r
total samples 17.937 r margin hits 61.336 r
failed samples 62.361 k warn hits 62.366 r

```

Mask

off

Mask align

Mask edge

Mask color

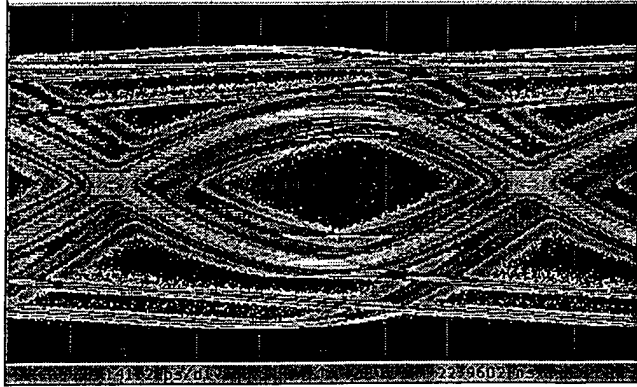
Print mask

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### RG-179 Cable Results

Color grade is enabled...



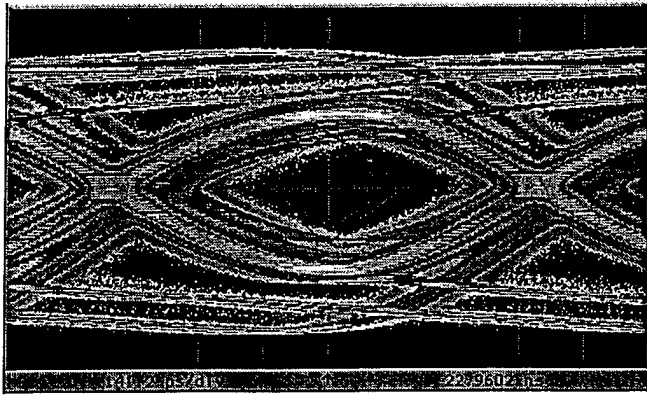
40.0 µm/div 22896021ns

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Buttons: PRINT (HP-101) GIF, Destination: disk, HP-83480, DDC: graticule (HP-83480)

### RG-302 Cable Results

Color grade is enabled...



40.0 µm/div 22896021ns

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Buttons: PRINT (HP-101) PCX, Destination: disk, HP-83480, DDC: graticule (HP-83480)



## Physical Plant Summary

Cable	Cable Loss (dB/m)	Conn. Loss (dB/Con)	Max Cable Length (m)	Trans. Rate (MB/s)	S/N Ratio
Quad	.138	.45	20	93	2.38
RG-179	.62	.50	10	90	4.25
RG-302	.288	.25	25	90	3.5

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## Close

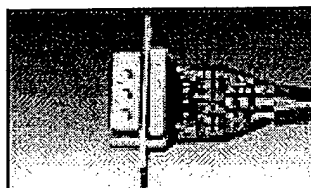
- One Giga-baud data rate with copper media
- Quad and coax cables perform well
- Quad cable has excellent signal integrity - however, highest cost
- Coax cables have good performance and low cost --- isolated grounds?
- Whats next?

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## *Why not STP?*

- standard specifies for 266Mbaud (1/4x)
- Equalization
  - for long lengths
  - fixed cable assemblies
  - solid conductor?



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