**REPORT DOCUMENTATION PAGE**

<table>
<thead>
<tr>
<th>1. REPORT DATE</th>
<th>2. REPORT TYPE</th>
<th>3. DATES COVERED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Viewgraphs</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4. TITLE AND SUBTITLE</th>
<th>5a. CONTRACT NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>NexGenBas Testing Brief (Viewgraphs)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6. AUTHOR(S)</th>
<th>5b. GRANT NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sid Jones</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5c. PROGRAM ELEMENT NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5d. PROJECT NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5e. TASK NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5f. WORK UNIT NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)</th>
<th>8. PERFORMING ORGANIZATION REPORT NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naval Air Warfare Center Aircraft Division</td>
<td></td>
</tr>
<tr>
<td>22347 Cedar Point Road, Unit #6</td>
<td></td>
</tr>
<tr>
<td>Patuxent River, Maryland 20670-1161</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)</th>
<th>10. SPONSOR/MONITOR'S ACRONYM(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naval Air Systems Command</td>
<td></td>
</tr>
<tr>
<td>47123 Buse Road Unit IPT</td>
<td></td>
</tr>
<tr>
<td>Patuxent River, Maryland 20670-1547</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>11. SPONSOR/MONITOR'S REPORT NUMBER(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>12. DISTRIBUTION/AVAILABILITY STATEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approved for public release: distribution is unlimited.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>13. SUPPLEMENTARY NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>14. ABSTRACT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>15. SUBJECT TERMS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>16. SECURITY CLASSIFICATION OF:</th>
<th>17. LIMITATION OF ABSTRACT</th>
<th>18. NUMBER OF PAGES</th>
<th>19a. NAME OF RESPONSIBLE PERSON</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. REPORT</td>
<td>b. ABSTRACT</td>
<td>c. THIS PAGE</td>
<td>Unclassified</td>
</tr>
<tr>
<td>Unclassified</td>
<td>Unclassified</td>
<td>Unclassified</td>
<td>Unclassified 14</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>19b. TELEPHONE NUMBER (include area code)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(301) 342-1601</td>
</tr>
</tbody>
</table>
NexGenBus

Fibre Channel
Test and Evaluation

Approach

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

- Methods:
  - Analysis
  - Demonstration
  - Simulation
Methods

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

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
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

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
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

Analysis Results

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

Analysis Results

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

Demonstration Method

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

Typical Eye Pattern

Eye Response

Time

Demonstration Method

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

Demonstration Method

- General Test Setup
Demonstration Method

- Quad Cable Layout

![Quad Cable Layout Diagram]

Demonstration Method

- Noise Test Setup

![Noise Test Setup Diagram]

\[ Z_0 = \text{Nominal Characteristic Impedance} \]
Noise Results

Physical Plant Summary

- Summary table
  - dB loss per meter
  - dB loss per connector
  - Maximum Lengths
  - Transmission Rate performance
  - Noise Rejection performance
Physical Plant Summary

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

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?
Why not STP?

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