Internet2 Spring Session
Perspectives on Rural Health Care Pilot Program

Fujitsu Network Communication
Brian Hunck
April 22, 2008
Contact Information

Brian Hunck
Planning Director – Business Access Products
Office: 972-479-6110
brian.hunck@us.fujitsu.com

Craig Healey
Sales Manager – Research & Education
Office: 972-479-3528
Cell: 972-358-8692
craig.healey@us.fujitsu.com

Jeana Cunningham
Sales Director – Research & Education
Office: 972-479-2161
jeana.cunningham@us.fujitsu.com

Manjuel Robinson
Market Development – Research & Education
Office: 972-479-2577
Cell: 214-789-6005
manjuel.robinson@us.fujitsu.com

Fujitsu Network Communication R&E Web Site:

Key Considerations

- **Network attributes needed for telemedicine applications**
  - High bandwidth
    - Interactive video conferencing
    - High resolution image transfer
    - Interactive multiple image manipulation
  - Committed bandwidth
    - Allows the telemedicine experience to be consistently repeatable
  - Low delay
    - Human experience requires low delay for full duplex communication
    - Target ~80ms for high quality interaction
    - Telemedicine workstation will account for majority of system delay due to analog/digital conversion, compression and encapsulation
    - Transport network should add as little delay as possible
  - Constant delay, not just bounded, may be needed
    - Ethernet and ATM provide a CoS with defined max delay but some variation exists
    - This may affect some telemedicine applications
      - Ex: MPEG-2 video which requires constant delay to properly receive timing information
  - Protection and high availability
    - Ensure continual availability of the system and resiliency to failures
  - Service port variety
    - Telemedicine workstations may require a variety of port interfaces for different applications
      - Ex: V.35, T1, Ethernet 10/100baseT, OC-3
Choices, Choices

Transport Options

SONET
- Provides good choice for transport layer guaranteed service parameters
- Most readily available optical high bandwidth service in most markets
- Provides for Ethernet as well as legacy TDM services to support a variety of telemedicine workstation architectures

Carrier Ethernet
- MEF service definition for Ethernet based transport but still in development
- Proposes circuit emulation for connection to TDM based workstations

ATM
- Existing option for cell based, differentiated service transport
- Extensive overhead to implement and manage
- Giving way to Carrier Ethernet

Ethernet over SONET
- GFP-F interoperability
- VT1.5 / STS VCAT
- LCAS

Ethernet Service Delivery

<table>
<thead>
<tr>
<th>MPEG 1/2</th>
<th>Uncompressed</th>
<th>JPEG</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCP</td>
<td>UDP</td>
<td>IP</td>
</tr>
<tr>
<td>AAL5</td>
<td>Ethernet</td>
<td>PPP</td>
</tr>
<tr>
<td>ATM</td>
<td>SONET</td>
<td>FIBER</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Copper</td>
</tr>
</tbody>
</table>
### Latency, Jitter, Availability – They Still Matter!

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mobile Target*</th>
<th>MEF Spec</th>
<th>TDM / SONET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delay</td>
<td>&lt;5 ms</td>
<td>&lt;25 ms</td>
<td>&lt;100 us</td>
</tr>
<tr>
<td>Jitter</td>
<td>1 ms</td>
<td>&lt;10 ms</td>
<td>&lt;3.2 us</td>
</tr>
<tr>
<td>Availability</td>
<td>99.999%</td>
<td>99.95%</td>
<td>99.999%</td>
</tr>
</tbody>
</table>

* From major wireless operator RFP for backhaul services

**Note**
- Recommended requirements for telemedicine full duplex applications
- Many “carrier grade” Ethernet platforms meeting much more stringent performance targets than MEF
SONET still best choice for DS1 transport to feed a variety of data acquisition devices at sub-rate bandwidth

DS1 circuit emulation

- Trade off between delay & efficiency
  - Packetization delay, jitter buffer delay, network delay

<table>
<thead>
<tr>
<th>Buffer Size (frames)</th>
<th>Max Ntwrk Jitter (ms)</th>
<th>Buffer Delay (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>10</td>
<td>5</td>
</tr>
</tbody>
</table>

Circuit Emulation Efficiency (typ)

<table>
<thead>
<tr>
<th>Frames</th>
<th>Efficiency</th>
<th>Bandwidth</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>24%</td>
<td>6.40 Mb/s</td>
</tr>
<tr>
<td>4</td>
<td>52%</td>
<td>2.94 Mb/s</td>
</tr>
<tr>
<td>8</td>
<td>65%</td>
<td>2.37 Mb/s</td>
</tr>
</tbody>
</table>
Regional Hospital / Clinic Access Services
DS1, DS3 & Ethernet Transport Services

FLASHWAVE 4100ES at Health Care Facility
- Universal 10/100/1000 Ethernet Service Unit
  - Offers multiple service types on a single card
  - Ethernet service delivery using standard GFP-F
- DS1 service integrates the NIU
  - Provide Visibility to the Customer demarcation point
  - 30-day binning of Performance Monitoring data
  - Integrated BERT
- DS3 service flexibility
  - DS3 or Transmux options
  - Transmux offers M13 and DS1 grooming modes
  - DS1 grooming of DS3 over OC-3/12

FLASHWAVE 4100ES at HUB Location
- Use as high density collector shelf
  - DS1, DS3 and Ethernet
Regional Hospital / Clinic Access Services
Backhaul for Remote Wireless Access

ISONET® 1500 Network Management
- NETSMART® 1500 w/ point-and-click GUI
  - Provides centralized OAM&P
  - Software Downloads & Upgrades

FLASHWAVE 4100 Extension Shelf @ Remote Sites
- DS1 & Ethernet Service Delivery
  - Low order VCAT and LCAS support
  - 10/100Base-T Copper or 100/1000Base-X Optical

- Dual OC-3 Line Interface
- Temperature hardened operation
- SNMPv2 & SNMPv3 Support
- Universal +24/-48 VDC direct input
- Compact design (footprint is at a premium)
Deployment Flexibility

- **FLASHWAVE 4100ES**
  - **SONET Delivery**
    - Well known design, reliability and maintenance methods
    - DS1, DS3, OC-n and 10/100/1000 Ethernet service delivery fully temperature hardened
  - **Native Ethernet GigE backhaul**
    - Deliver Ethernet services over Ethernet transport
    - Single FLASHWAVE 4100ES shelf for SONET/TDM and Ethernet/Ethernet
    - CPE and OSP cabinet (low cost)
FLASHWAVE 4100 Extension Shelf Provides

- A Modular Compact Platform To Address A Wide Variety Of Services
  - DS1NIU / DS3 / DS3 Transmux
  - 10/100/1000 Ethernet as per GFP-F
  - OC-3, OC-12, or OC-48 UPSR, 1+1 & 0:2
  - Universal powering at +24VDC or -48VDC

- All Industrial Grade Component Platform
  - Reduces Capital & Operational Expenses
  - Longer product life for indoor or controlled environment areas
  - Temperature hardened design eliminates special heating & cooling equipment

- Integrated DS1 NIU Minimizes Equipment & Expedites Service Turn-up

- NETSMART 1500 provides centralized management of all FLASHWAVE network elements