ATM Networks: An Overview

Raj Jain

Raj Jain is now at Washington University in Saint Louis
Jain@cse.wustl.edu
http://www.cse.wustl.edu/~jain/
Overview

- ATM vs Phone Networks and Data Networks
- ATM Protocol Layers
- Cell Header Format, AALs
- Physical Media
- Traffic Management: ABR, UBR, GFR
ATM

- ATM Net = Data Net + Phone Net
- Combination of Internet method of communication (packet switching) and phone companies’ method (circuit switching)
ATM vs Phone Networks

- Current phone networks are synchronous (periodic). ATM = Asynchronous Transfer Mode
- Phone networks use circuit switching. ATM networks use “Packet” Switching
- In phone networks, all rates are multiple of 8 kbps. With ATM service, you can get any rate. You can vary your rate with time.
- With current phone networks, all high speed circuits are manually setup. ATM allows dialing any speed.
ATM vs Data Networks

- Signaling: Internet Protocol (IP) is connectionless. You cannot reserve bandwidth in advance.
  ATM is connection-oriented.
  You declare your needs before using the network.
- PNNI: Path based on quality of service (QoS)
- Switching: In IP, each packet is addressed and processed individually.
- Traffic Management: Loss based in IP.
  ATM has 1996 traffic management technology.
  Required for high-speed and variable demands.
- Cells: Fixed size or small size is not important
Old House vs New House

- New needs:
  - Solution 1: Fix the old house (cheaper initially)
  - Solution 2: Buy a new house (pays off over a long run)
ATM Interfaces

Computer
  Private UNI
  Private Switch
  Private UNI
  Private Switch
  Digital Service Unit
  Private UNI
  Private Switch
  Public UNI
  Public Switch
  Public UNI
  Public Switch
  Carrier
  B-ICI

Router
  DXI

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ATM Interfaces

- User to Network Interface (UNI):
  - Public UNI, Private UNI

- Network to Node Interface (NNI):
  - Private NNI (P-NNI)
  - Public NNI = Inter-Switching System Interface (ISSI)
    - Intra-LATA ISSI (Regional Bell Operating Co)
    - Inter-LATA ISSI (Inter-exchange Carriers)
      ⇒ Broadband Inter-Carrier Interface (B-ICI)

- Data Exchange Interface (DXI)
  Between routers and ATM Digital Service Units (DSU)
Protocol Layers

End System

ATM Adaptation Layer

ATM Layer

Physical Layer

Switch

ATM Layer

Physical Layer

End System

ATM Adaptation Layer

ATM Layer

Physical Layer

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Protocol Layers

- The ATM Adaptation Layer
  - How to break messages to cells
- The ATM Layer
  - Transmission/Switching/Reception
  - Congestion Control/Buffer management
  - Cell header generation/removal at source/destination
  - Cell address translation
  - Sequential delivery
Cell Header Format

- **GFC =** Generic Flow Control
  - (Was used in UNI but not in NNI)
- **VPI/VCI = 0/0 ⇒** Idle cell; 0/n ⇒ Signaling
- **HEC:** $1 + x + x^2 + x^8$

```
+--------+--------+        +--------+--------+
| GFC/VPI| VPI    |        | VPI     | VCI    |
|--------|--------+        |--------|--------|
| VPI    | VCI    |        | VCI     |
|        |        |        |        |
| VCI    |        |        |        |
|        | PTI    |        |        |
|        |        |        |        |
|        |        |        | Header Error Check (HEC) |
|        |        |        |        |
|        |        |        |        |
|        |        |        | Payload |
```
Path vs Channels

- 24/28-bit connection identifier
  First 8/12 bits: Virtual Path,
  Last 16 bits: Virtual Circuit
- VP service allows new VC's w/o orders to carriers
VP/VC Assignment/Use

<table>
<thead>
<tr>
<th>In</th>
<th>Out</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port</td>
<td>VPI/VCI</td>
</tr>
<tr>
<td>1</td>
<td>1/37</td>
</tr>
<tr>
<td>1</td>
<td>3/34</td>
</tr>
<tr>
<td>2</td>
<td>5/33</td>
</tr>
<tr>
<td>2</td>
<td>2/56</td>
</tr>
</tbody>
</table>

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## Original Classes of Traffic

<table>
<thead>
<tr>
<th></th>
<th>Class A</th>
<th>Class B</th>
<th>Class C</th>
<th>Class D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Sync</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Bit Rate</td>
<td>Constant</td>
<td>Variable</td>
<td>Variable</td>
<td>Variable</td>
</tr>
<tr>
<td>Connection-Oriented</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Examples</td>
<td>Circuit Emulation</td>
<td>Comp. Video</td>
<td>Frame Relay</td>
<td>SMDS</td>
</tr>
<tr>
<td>AAL</td>
<td>AAL1</td>
<td>AAL2</td>
<td>AAL3</td>
<td>AAL4</td>
</tr>
</tbody>
</table>
AAL 5

- Designed for data traffic
- Less overhead bits than AAL 3/4
  ⇒ Simple and Efficient AAL (SEAL)
- No per cell length field, No per cell CRC

<table>
<thead>
<tr>
<th>User Payload</th>
<th>PAD</th>
<th>Control</th>
<th>Length</th>
<th>CRC-32</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-64kB</td>
<td>0-47</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

PTI bit indicates last cell

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AAL2

- Ideal for low bit rate voice
- Variable/constant rate voice
- Multiple users per VC
- Compression and Silence suppression
- Idle channel suppression

```
Payload 1
Pkt Hdr  Payload 1  Pkt Hdr  Payload 2  Pkt Hdr  Payload 3
```

```
Cell Header
Pkt Hdr  Payload 1  Pkt Hdr  Payload 2  Pkt Hdr  Payload 3
```
Physical Media

- Multimode Fiber: 100 Mbps using 4b/5b, 155 Mbps SONET STS-3c, 155 Mbps 8b/10b
- Single-mode Fiber: 155 Mbps STS-3c, 622 Mbps
- Plastic Optical Fiber: 155 Mbps
- Shielded Twisted Pair (STP): 155 Mbps 8b/10b
- Coax: 45 Mbps, DS3, 155 Mbps
- Unshielded Twisted Pair (UTP)
  - UTP-3 (phone wire) at 25.6, 51.84, 155 Mbps
  - UTP-5 (Data grade UTP) at 155 Mbps
- DS1, DS3, STS-3c, STM-1, E1, E3, J2, n × T1
ATM Overview: History, Why and What
Protocol Layers: AAL, ATM, Physical layers, Cell format
Interfaces: PNNI, NNI, B-ICI, DXI
ABR, CBR, VBR, UBR, GFR
ATM : Key References

- For additional references, see http://www.cis.ohio-state.edu/~jain/refs/atm.refs.htm