ATM Tutorial & Comparison with SSA

ATM History

- ATM was originally called B-ISDN
  B = Broadband = many megabits
- Began in mid-1980s by Telco's
- "guiding premise seemed to be that raw speed could replace specialization... But a funny thing happened on the way to obscurity. ATM technology was hijacked by the data communications community and given new life outside the public network sphere... being developed as a multi-purpose LAN and WAN technology... the marketplace is essentially distancing the technology from its [CCITT] origins"
**ATM cells**

- **GFC** Generic Flow Control 4 bits
  - No accepted definition, various partially thought out proposals. Used to extend VPI field in environments that don't require GFC.

- **VPI/VCI** Virtual Path/Channel Identifiers 6-12/18 bits
  - Two level hierarchical address. A virtual path encapsulates some number of virtual channels.
  - With most ATM interfaces today, VPI = 0 at end nodes, VCI designates the specific connection within an end node.

- **Type** 3 bits
  - 0ab if cell contains user data.
  - a is congestion indicator.
  - b is ATM User Indication, used by AALs.
  - 1xx if Operations and Maintenance (OAM) or Resource Management cell.

- **CLP** Cell Loss Priority 1 bit
  - Set means "discard this cell first"

- **HEC** Header Error Check 8 bits
  - Eight bit CRC calculated on header only.

---

**ATM Adaptation Layers**

- **AAL 1**: Constant Bit Rate (CBR) data, e.g. isochronous audio or video.
- **AAL 2**: Timing sensitive Variable Bit Rate (VBR) data, e.g. compressed video.
- **AAL 3/4**: Packet data, excessively complex, essentially abandoned.
- **AAL 5**: A simpler replacement for AAL 3/4. The de facto standard for packet data.
- Essentially all ATM interfaces shipping today support AAL 5 with hardware, other AALs with software.
AAL 5

- Total length is multiple of 48 bytes.
- Mapped to sequence of ATM cells, one VPI/VCI.
- ATM User Indications in cell header indicates boundaries. Set in last cell, clear in all others.
- Pad: aligns total length to multiple of 48.
- U: user field (reserved / vendor unique).
- C: common part indicator (reserved for future standardization).
- Len: payload length in bytes.
- CRC32: Autodin-II CRC (same as Ethernet™, FDDI, etc.) over payload, pad, U, C, and Len.

ATM Physical Layers

- Shipping today:
  - 100 mbits, based on FDDI PHY: optical, thinwire coax, STP
  - 155.52 mbits, based on SONET: optical, UTP-5 soon
- Shipping this year (if not today):
  - 622.08 mbits, based on SONET: optical and copper
- Highest interest within industry:
  - 51.84 mbits on UTP-3, 100 meters. Several competing proposals for signaling, each may be built by its proponents regardless of ATM Forum's decision.
### ATM vs. SSA

<table>
<thead>
<tr>
<th></th>
<th>ATM</th>
<th>SSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;cell&quot;</td>
<td>&quot;frame&quot;</td>
<td></td>
</tr>
<tr>
<td>&quot;virtual circuit&quot;</td>
<td>&quot;path&quot;</td>
<td></td>
</tr>
<tr>
<td>Cell payload</td>
<td>48 bytes</td>
<td>0-128 bytes</td>
</tr>
<tr>
<td>Path</td>
<td>8-12 bits*</td>
<td>7-28 bits</td>
</tr>
<tr>
<td>Connection</td>
<td>16 bits*</td>
<td>7-14 bits</td>
</tr>
<tr>
<td></td>
<td>*ATM path / connection bit division varies</td>
<td></td>
</tr>
<tr>
<td>Cell Format</td>
<td>fixed</td>
<td>variable</td>
</tr>
<tr>
<td>Error checks</td>
<td>separate</td>
<td>combined</td>
</tr>
<tr>
<td>Headers</td>
<td>Hop by hop</td>
<td>Hop by hop</td>
</tr>
<tr>
<td>Data</td>
<td>End to end</td>
<td>Hop by hop</td>
</tr>
<tr>
<td>Flow Control</td>
<td>Being standardized</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### Flow Control

- If both A and B try to send at full bandwidth, half the cells must be discarded. Flow control is the mechanism that tells A and B when to slow down.
- SSA flow control is called pacing, provided by RR and SAT fairness mechanisms.
ATM Flow Control

- Original feeling among B-ISDN designers: with so much bandwidth, congestion couldn't occur.
- Experience with early ATM products have demonstrated the fallacy of this assumption for LAN environments.
- Several ATM flow control schemes have been proposed and are being debated for standardization.
- Vendors are already shipping ATM products with flow control.
- Different physical links may use different schemes.

SSP Changes for ATM-SCSI

- Assume cells will not be lost due to congestion.
- Application control messages (SCSI CDBs, Data Ready, etc.):
  - SSA: 32 byte frame sent to channel 0.
  - ATM: 32 byte AAL5 packet sent to a specified channel.
- Data transfers:
  - SSA: sequence of 128 byte frames sent to a channel obtained via Data Ready.
  - ATM: sequence of 48 byte cells (comprising an AAL5 packet) sent to a channel obtained via Data Ready. Long data transfers will use several AAL5 packets.
SSP Changes for ATM-SCSI

- Payload errors or cell loss in data transfers can be recovered by re-requesting the data transfer or command.
- Payload errors or cell loss in control messages equivalent to loss of path in SSA.
  - Tbd: may need a sequence number in control messages.