Virtual Circuits and Addressing

- Two Classes of Communications
  - Control - uses a preset circuit id
  - User Data - uses a network-assigned circuit id
- Creating circuit ids for user data
  - Static - assigned at the time of provisioning, programmed "by hand" into the equipment
  - Dynamic
    - Uses control packets for circuit setup
    - Needs a way to address virtual circuit end-points

Frame Relay

- Based on X.25
- Introduces the concept of service level agreements
  - CIR - Committed Information Rate
  - CB - Committed Burst Rate
  - Burst Excess Rate
- Circuit controls in the packet
  - Discard Eligible indicator
  - Forward and Backward congestion notifications
- Circuit IDs are called DLCI - Data Link Connection Identifier

Frame Relay Usage Example

Internet Access
ATM

- Expected to support different traffic classes
  - Constant Bit Rate (CBR)
  - Variable Bit Rate (VBR) with Quality of Service Constraints
  - Unspecified or Available Bit Rate (UBR)
  - Fixed Length Packets = “Cells”
  - Facilitate Switching
    - “Reserved” time slots for CBR

ATM Cell

- 5 Bytes
- Header Payload (48 bytes)

- UNI format; NNI bits 1-4 used for VPI

- GFC - General Flow Control, 4 bits (mostly unused)
- PT - 3 bits
  - Bit 1 - “1” = management cell
  - Bit 2 - forward congestion indication (signals that congestion was seen in in-bound cells)
  - Bit 3 - Used to signal “last in a group”
- CLP = “1”: in case of congestion, discard this cell before ones with CLP=0.
- HEC - Header Error Check (bytes 1-4 only)

Header Fields

ATM Adaptation Layers (AALs)
Adaptation Layers

- AAL 1
  - Constant bit rate over synchronous transmission
  - Each cell contains a sequence number
- AAL 2
- VBR
  - 4-byte header inside each cell
- AAL 3/4
  - Mainly used for SMDS transport
  - Each cell carries a message ID
- AAL 5 (SEAL)
  - Convergence Sub-Layer adds trailer (used to check for errors, lost, or re-ordered cells)
  - No header inside the ATM cell

ATM Addressing

- Public Addresses
  - E.164 ITU standard (international telephone numbers)
- Private Addressing
  - For use inside an organization