ATM Adaptation Layer

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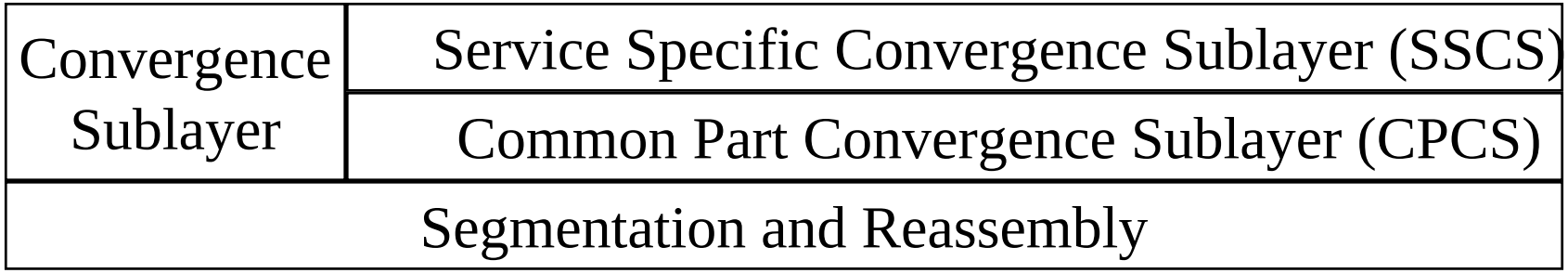
ATM Adaptation Layer

- Segmentation and Reassembly
- Convergence sublayer:
  Defines services AAL provides to higher layers.
- CS is broken into two parts:
  - Service Specific Convergence Sublayer (SSCS)
    Specific to video service, CBR, etc.

  SSCS of AAL5 is empty.
  - Common Part Convergence Sublayer (CPCS)



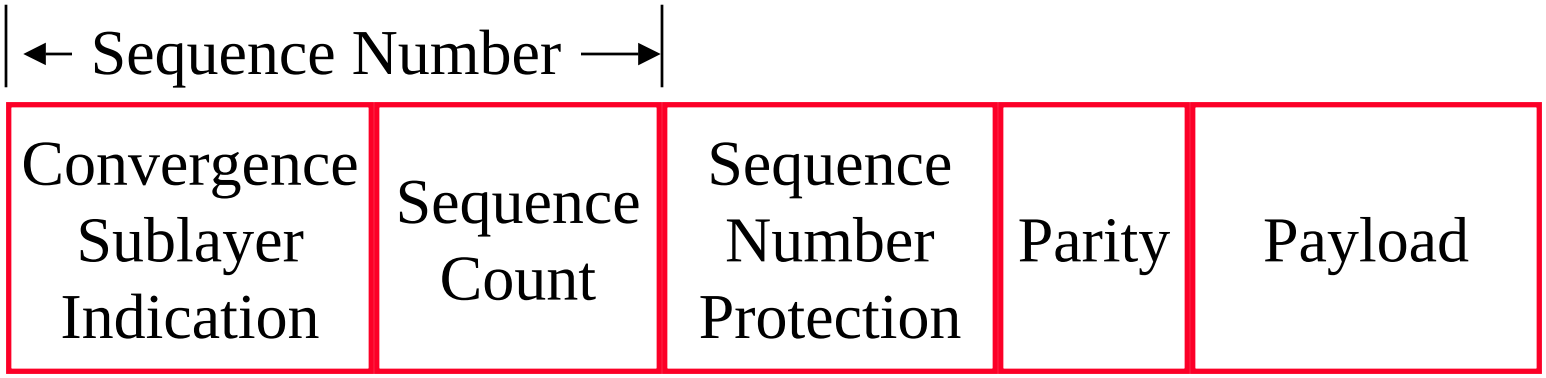
Original Classes of Traffic

	Class A	Class B	Class C	Class D
Time Synch	Required		Not Required	
Bit Rate	Constant	Variable		
Connection Mode	Connection oriented			Connectionless
AAL	AAL 1	AAL 2	AAL 3	AAL 4
Examples	Circuit emulation	Compressed Video	Frame Relay	SMDS

AAL Types

- Initially four *classes* of AALs. One for each class.
- Later four *types* $\Rightarrow$ An AAL type can service more than one class. USA wanted to use one type for both connection-oriented and connectionless data.
- AAL type 4 was based on DQDB.
- Type 4 could support both $\Rightarrow$ Type 3/4 (combined).
- AAL type 2 was meant for variable bit rate video. VBR codecs do not exist yet.
- AAL 5 Started in ITU. Completed by ATM Forum.
- AAL 0 = No AAL = Straight from application to ATM
- Signalling AAL (SAAL) uses retransmissions for guaranteed delivery

AAL1



- Designed for CBR Traffic
- Misordering bad ⇒ Sequence number
- Convergence Sublayer Indication (CSI): Two uses
  - CSI bits from 4 successive cells
    = Synchronous Residual timestamp for clock recovery
  - For structured data transfers:
    - CSI = 1 ⇒ 8-bit pointer to first byte of payload,
      0 ⇒ no pointer for partially filled cells

AAL Type 2

Header	Seq #	Cell type	Payload	Length	CRC
5B	4b	4b	45B	6b	10b ← Size

- Designed for VBR Video/Audio
- Under development. One proposal above.
- CRC is used for error correction and detection

AAL 3/4

- Designed for Data (3 and 4 were merged)
- Connectionless or Connection Oriented:
  - Connectionless PDUs are handled independently
  - Connection-oriented PDUs may be multiplexed
    $\Rightarrow$ up to 2^{10} logical connections per VC
- Message or Streaming Mode:
  - Message-oriented protocols provide blocks of data
  - Stream-oriented protocols provide a continuous stream of data presented in fixed size blocks.
    Blocks may be as small as one byte. One block per cell.

AAL 3/4

- Convergence Layer PDU Format

Common Part Indicator	Begin Tag	Buffer Allocation Size	Payload	PAD	Align ment	End Tag	Len- gth
1B	1B	2B	0-9188B	0-3B	1B	1B	2B

- Cell Format

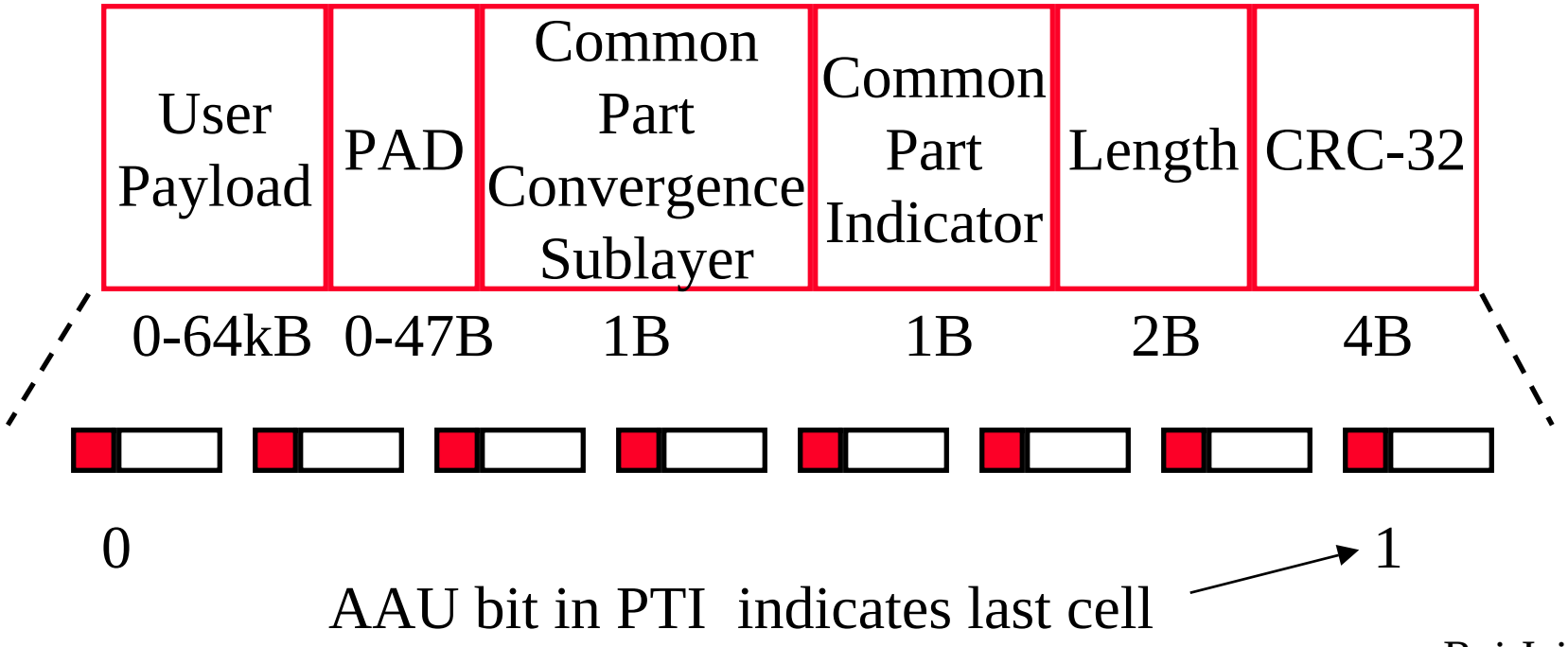
Segment Type	Seq No	Multiplexing ID	Payload	Length Indicator	CRC
2b	4b	10b	44B	6b	10b

AAL 3/4

- Common Part Indicator (CPI):
  Interpretation of the PDU.
  Only one interpretation is currently defined.
- Beginning Tag (Btag): PDU sequence number modulo 256
- End Tag (ETag): Must be same as BTag. Ensures the last cell and first cell are from the same PDU.
- Buffer Allocation Size: Max buffer size for reassembly.
  = PDU size for message mode.
  $\geq$ Payload size for streaming mode.
- Pad: Allows the trailer to begin on a 32-bit boundary
- Alignment: Makes the CPCS PDU a multiple of 32-bit
- Length: Length of the payload

AAL 5

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



AAL 5

- No per cell overhead.
  AAL 3/4 uses up 4 bytes per cell for overhead
- CPCS User-to-user Indication:
  Transparently transfer user-to-user information.
- Common Part Indicator: Interpretation of the PDU.
  Only one interpretation is defined.
- Higher layers preallocate buffers ⇒ BAsize is not required
- No sequence number ⇒ Assume ordered delivery
- No MID field ⇒ no PDU multiplexing.
  End of PDU is marked by AAU bit in the header
- No LI field ⇒ pad is large enough to make PDU a multiple of 48 bytes (rather than 32-bits as in AAL 3/4)

Payload Type Field Coding

- 000 User data cell, no congestion, AAU = 0
- 001 User data cell, no congestion, AAU = 1
- 010 User data cell, congestion, AAU = 0
- 011 User data cell, congestion, AAU = 1
- 100 Segment OAM F5 cell
- 101 End-to-end OAM F5 cell
- 110 Resource management cell
- 111 Reserved

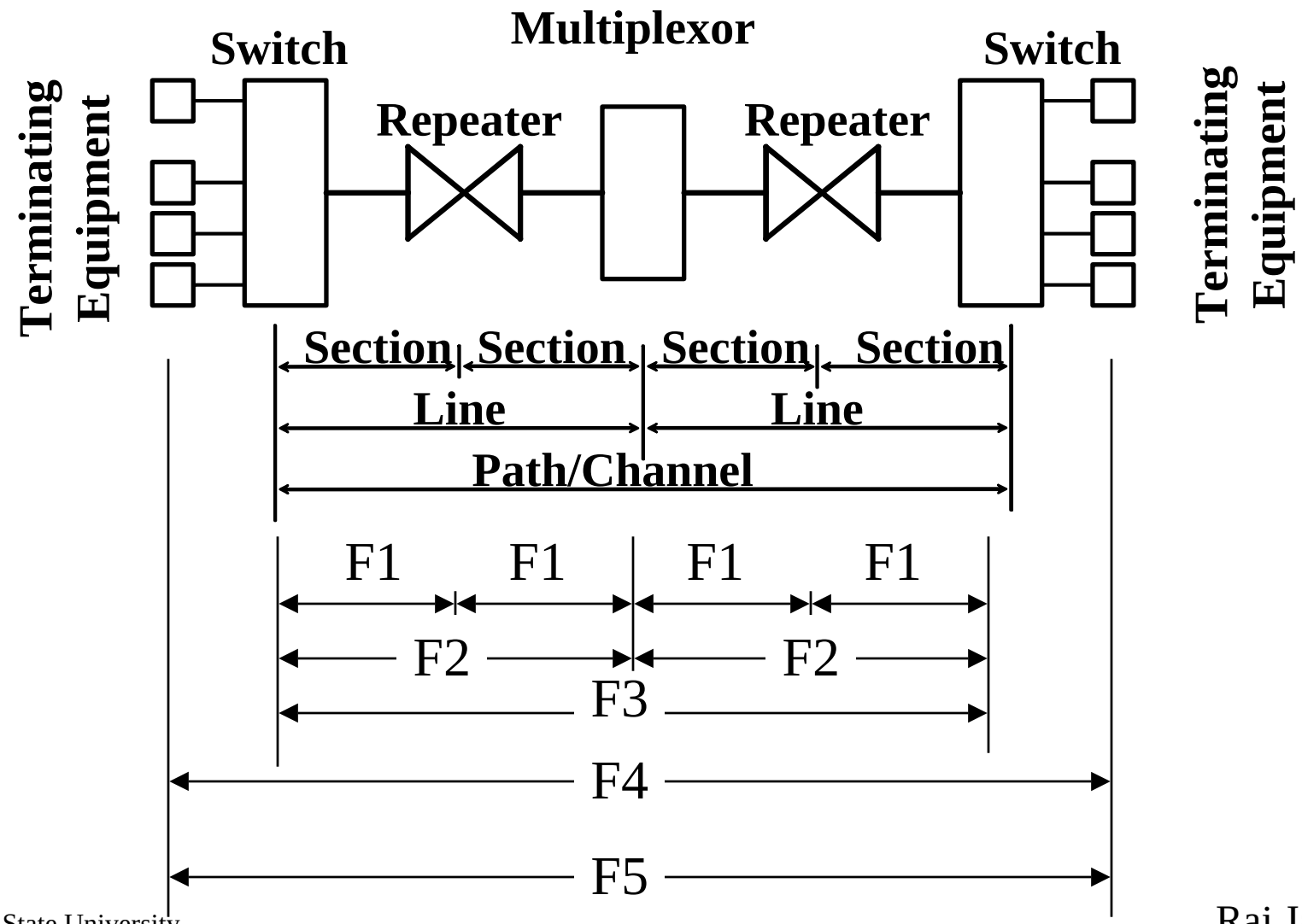
ATM-user-to-ATM-user (AAU) bit available for user-to-user indication

OAM cells may be inserted in any VC $\Rightarrow$ In-band signaling

Operation Administration and Maintenance (OA&M)

- For supervision, testing, and performance monitoring
- Loopbacks for maintenance
- ITU TS standard uses CMIP
- Organized into 5 hierarchical levels
  - Virtual Channel (F5)
  - Virtual Path (F4)
  - Transmission Path (F3)
  - Digital Section (F2)
  - Regenerator Section (F1)

OAM Flows

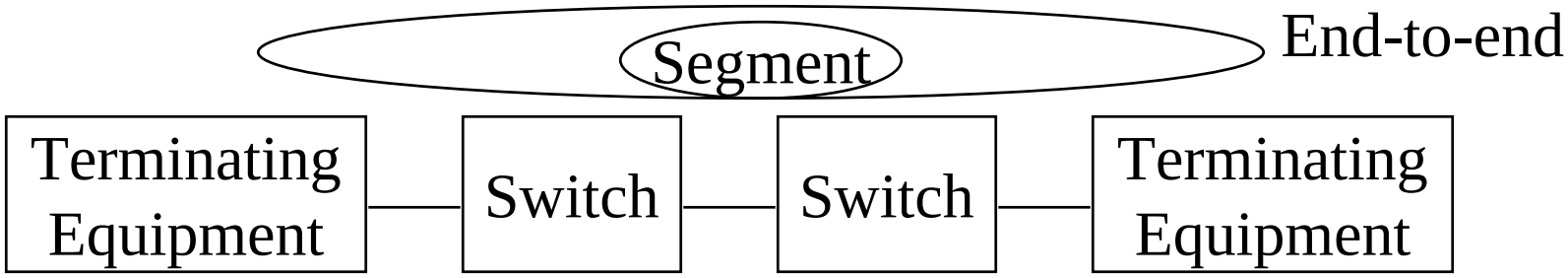

Terminating Equipment
Switch
Multiplexor
Repeater
Repeater
Switch
Terminating Equipment
Section
Section
Section
Section
Line
Line
Path/Channel
F1
F1
F1
F1
F2
F2
F3
F4
F5

OAM Flows

- **F5**: Between VC endpoints
- **F4**: Between VP endpoints
- **F3**: Between elements that perform assembling, disasembling of payload, header, or control
- **F2**: Between section end-points. Performs frame synchronization.
- **F1**: Between regeneration sections.

Segment vs End-to-End Flows

- End-to-end flows are seen by the user
- Segment flows are not seen by the user
- Segment = Single VP/VC link
  or a group of VP/VC within one network provider
- Both types of flows can be VP flows (F4) or VC flows (F5)
- F5 flows are identified by PTI = 4 or 5.
  VPI/VCI same as in user's flow.
- F4 flows are identified by VC = 3 or 4.
  VPI same as in user's flow.



Preassigned VPI/VCI Values

- 0/0 Unassigned or Idle
- 0/1 Metasignaling
- 0/3 Segment F4 Flow
- 0/4 End-to-end F4 flow
- 0/5 Signaling
- 0/15 SMDS
- 0/16 Interim Layer Management Interface (ILMI)

References

- ITU-T Recommendation I.363, “B-ISDN ATM Adaptation Layer (AAL) Specification,” March 1993.
- T. Suzuki, "ATM Adaptation Layer Protocol," IEEE Communications Magazine, April 1994.