# ATM Protocol Overview

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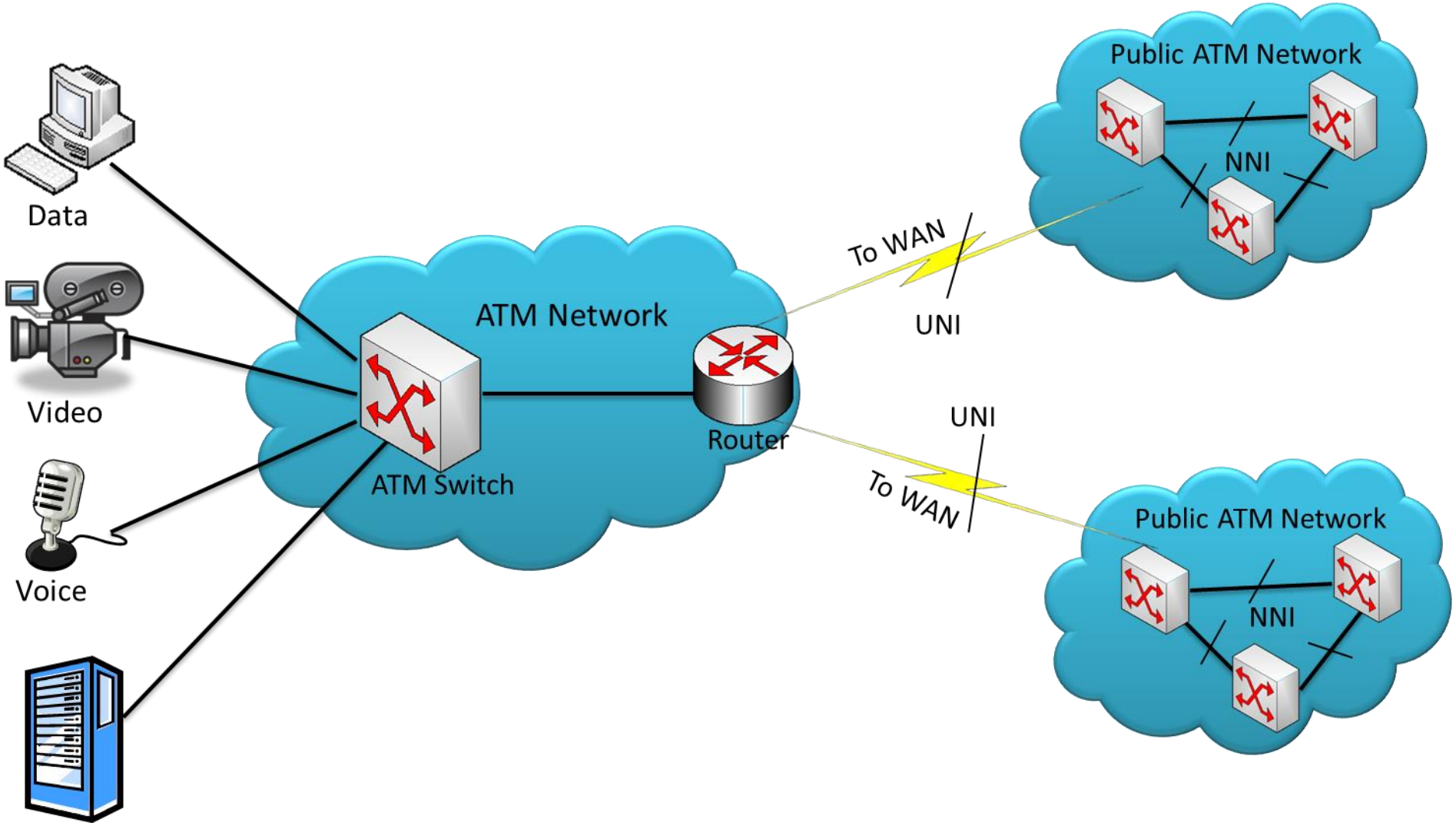
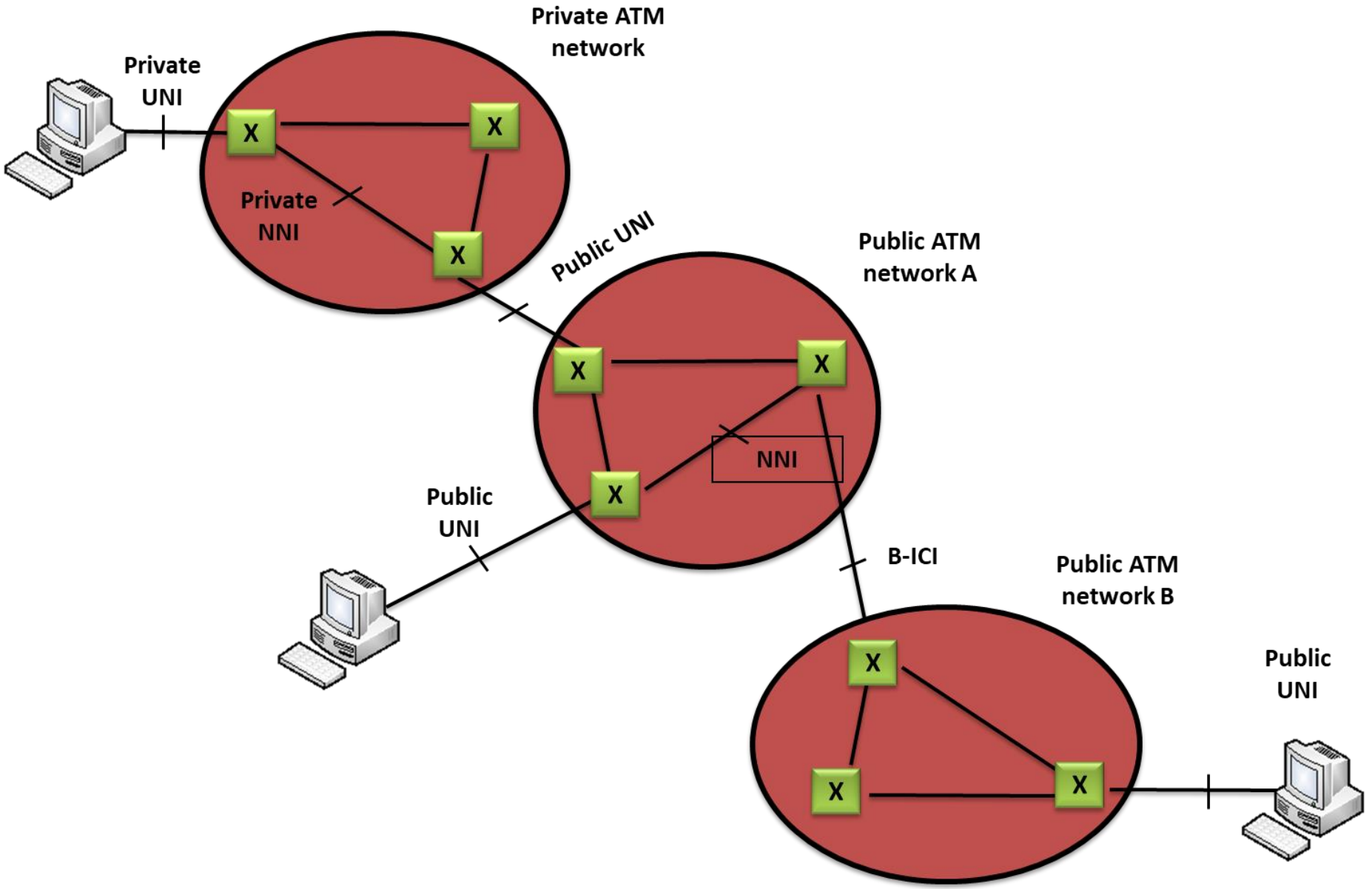
# What is ATM ?

- Asynchronous Transfer Mode (ATM) is a switching and multiplexing technology
- Flexible network that carries voice, video, and data, quickly and efficiently
- Circuit Switching and Packet Switching
- Protocol standards are developed by ITU; Consists of 3 layers – ATM Adaptation Layer (AAL), ATM layer, and Physical layer
- 2 levels – Transport and Switching; carries all traffic on a stream of fixed-size packets
- ATM is a core protocol used in SONET / SDBH backbone of the PSTN
- Support for multimedia traffic, efficient bandwidth management for burst traffic, support for LAN / WAN architecture and high performance via hardware switching

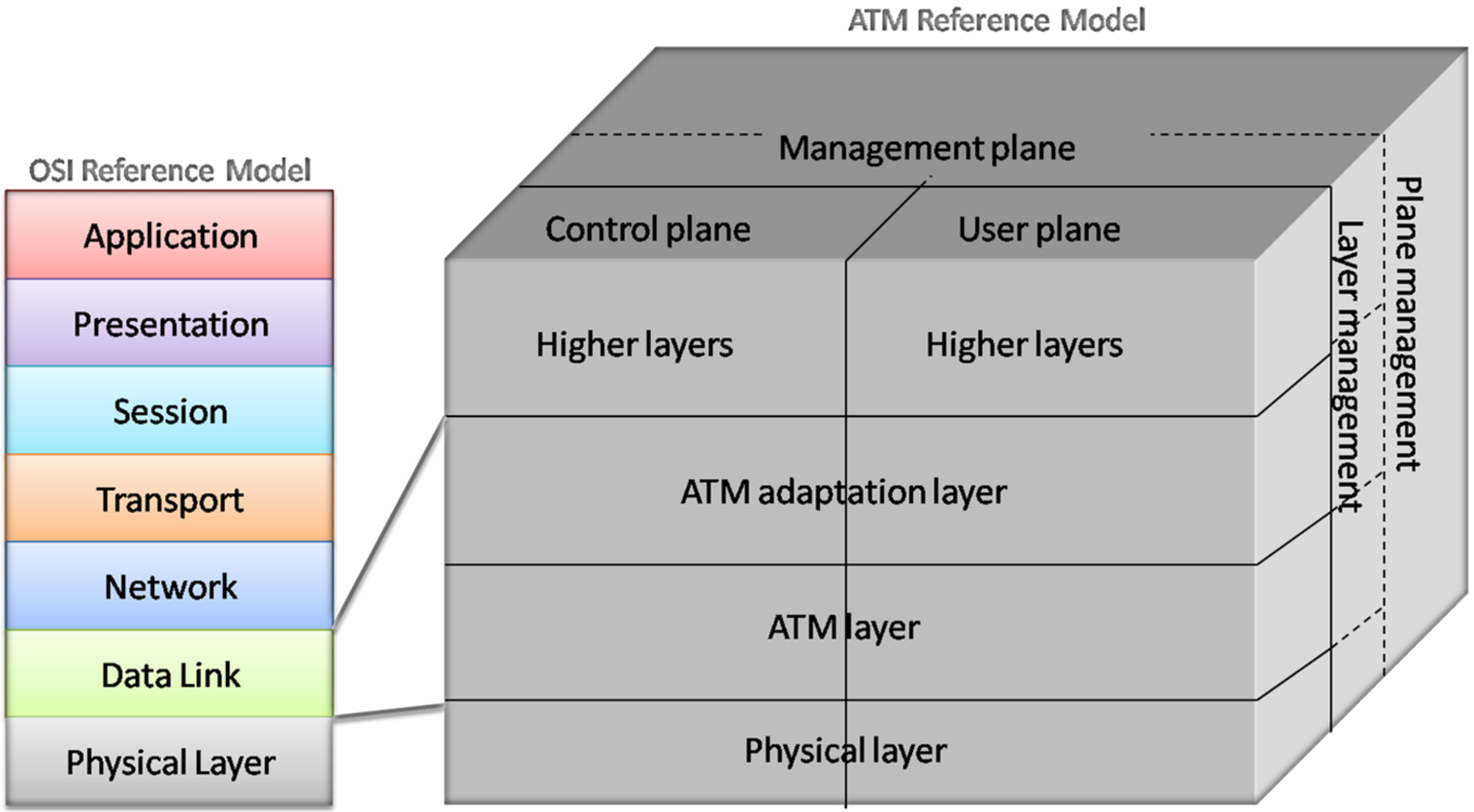
# ATM Network Model



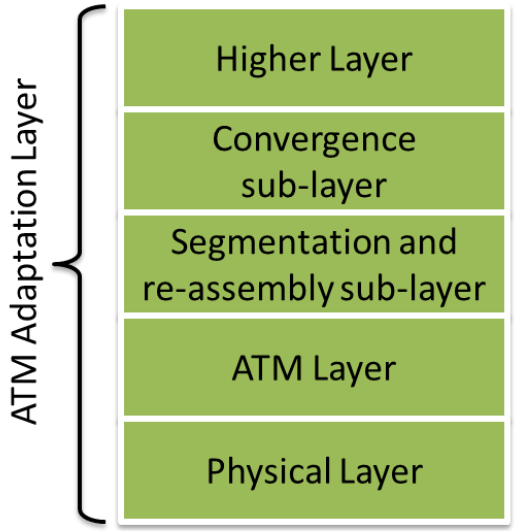
# ATM Network Interface

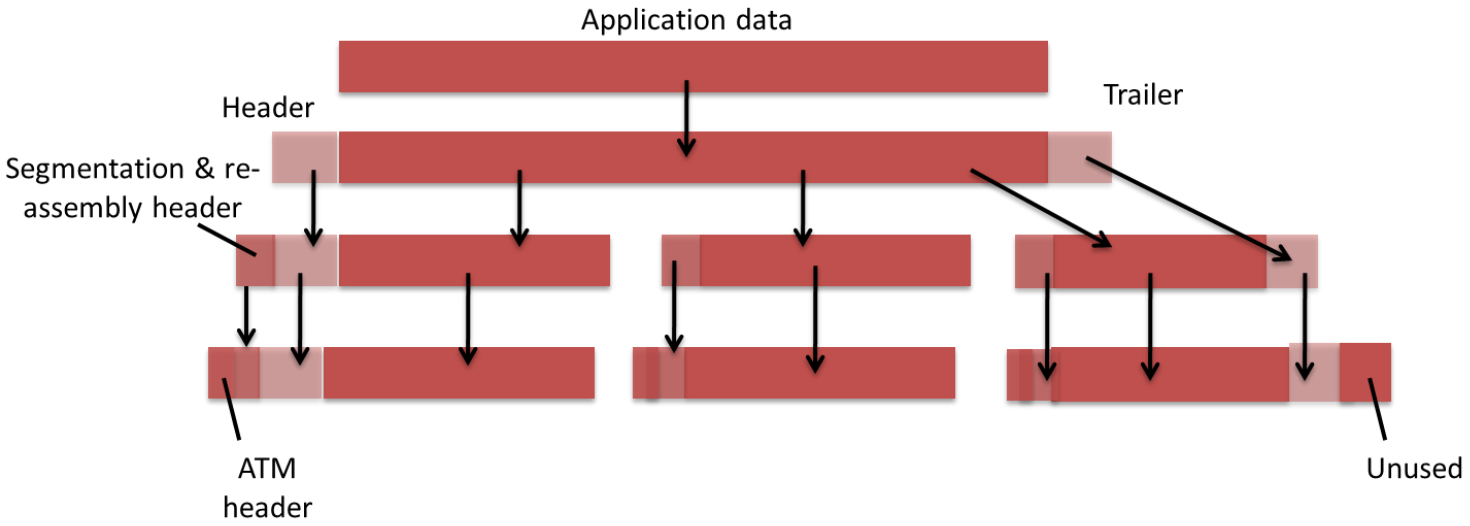


# Comparison with Basic OSI Model



# ATM Adaptation Layers (AAL)



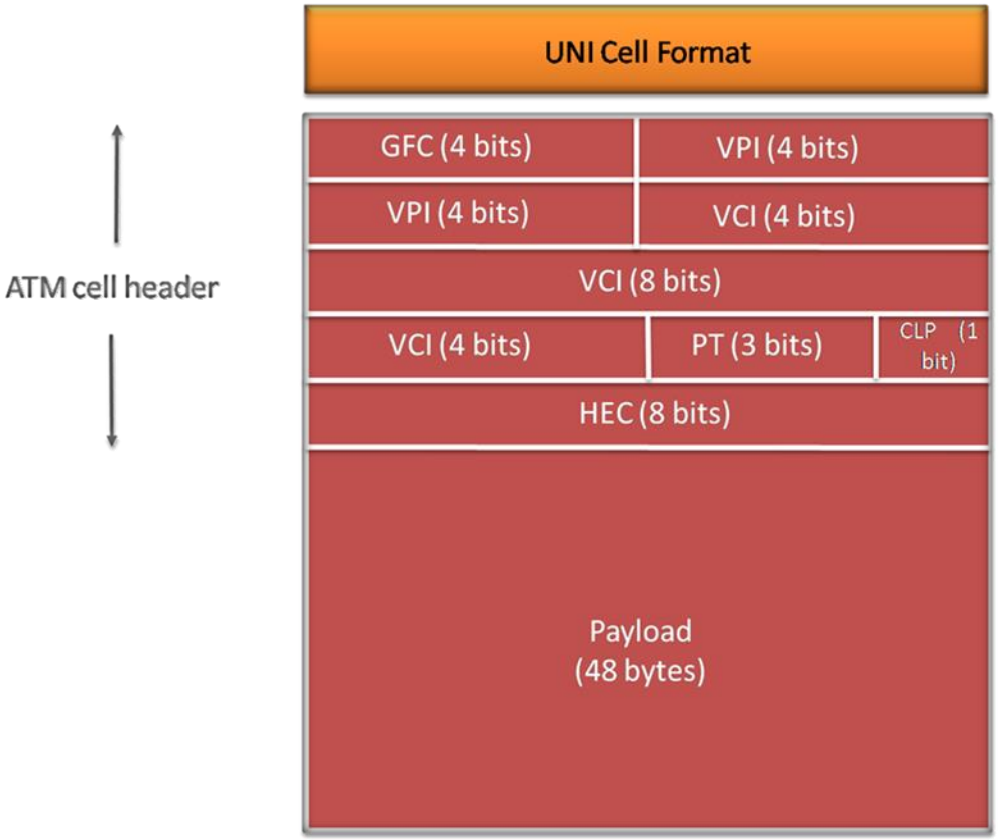

- AAL 1:- AAL1, a connection-oriented service, is suitable for handling circuit emulation and constant bit rate sources (CBR), such as voice and video conferencing
- AAL2 :- Used for variable bit rate (VBR) services, Typically includes services characterized as packetized voice or video that do not have a constant data transmission speed but that do have requirements like constant bit rate services
- AAL3/4:-Used for variable bit rate (VBR) services, Used to transmit SMDS packets over an ATM network
- AAL5:- Used to transfer most non-SMDS data, such as classical IP over ATM and LAN Emulation (LANE)

# Basic ATM Cell

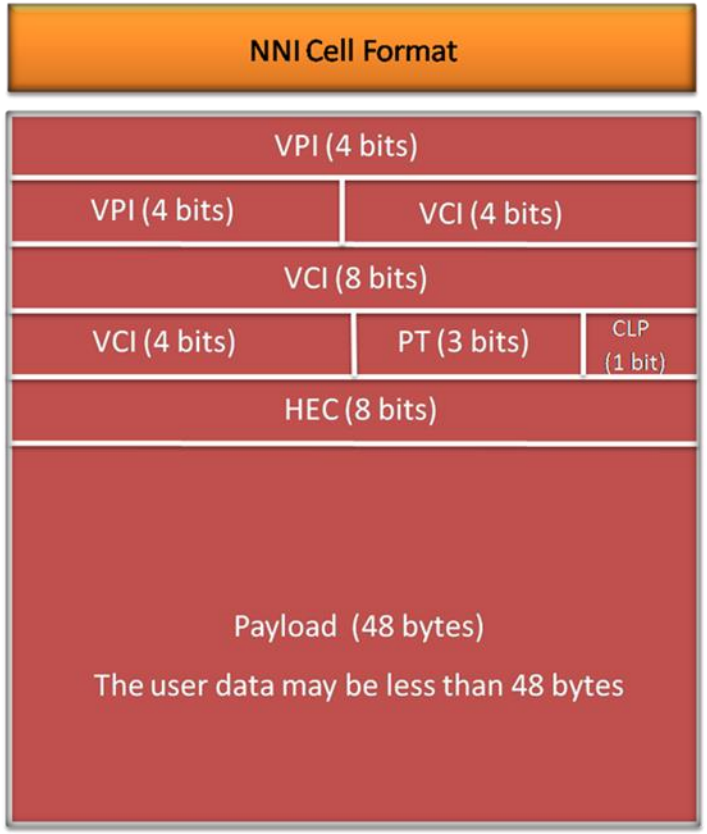
- 5 bytes reserved for Routing, addressing and flow control

# ATM Headers

**UNI (User-Network Interface)**




**NNI (Network-Network Interface)**




GFC: Generic flow control
VPI: Virtual path identifier
VCI: Virtual channel identifier
PT: Payload type
CLP: Cell loss priority
HEC: Header error control

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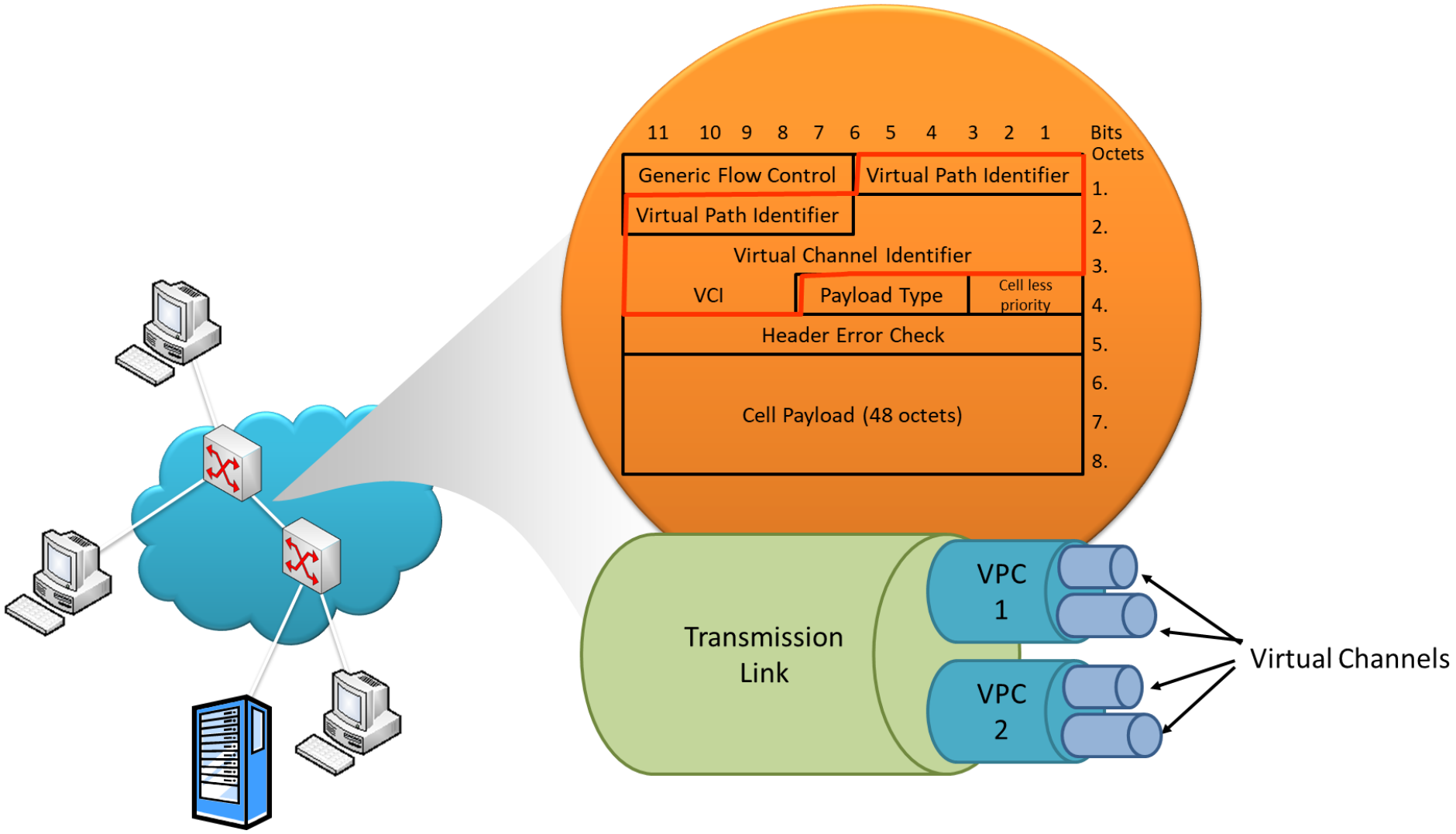
# Virtual Paths and Channels



# ATM Services

Types of services offered

- Permanent Virtual Circuit (PVC)
- Switched Virtual Circuits (SVC)

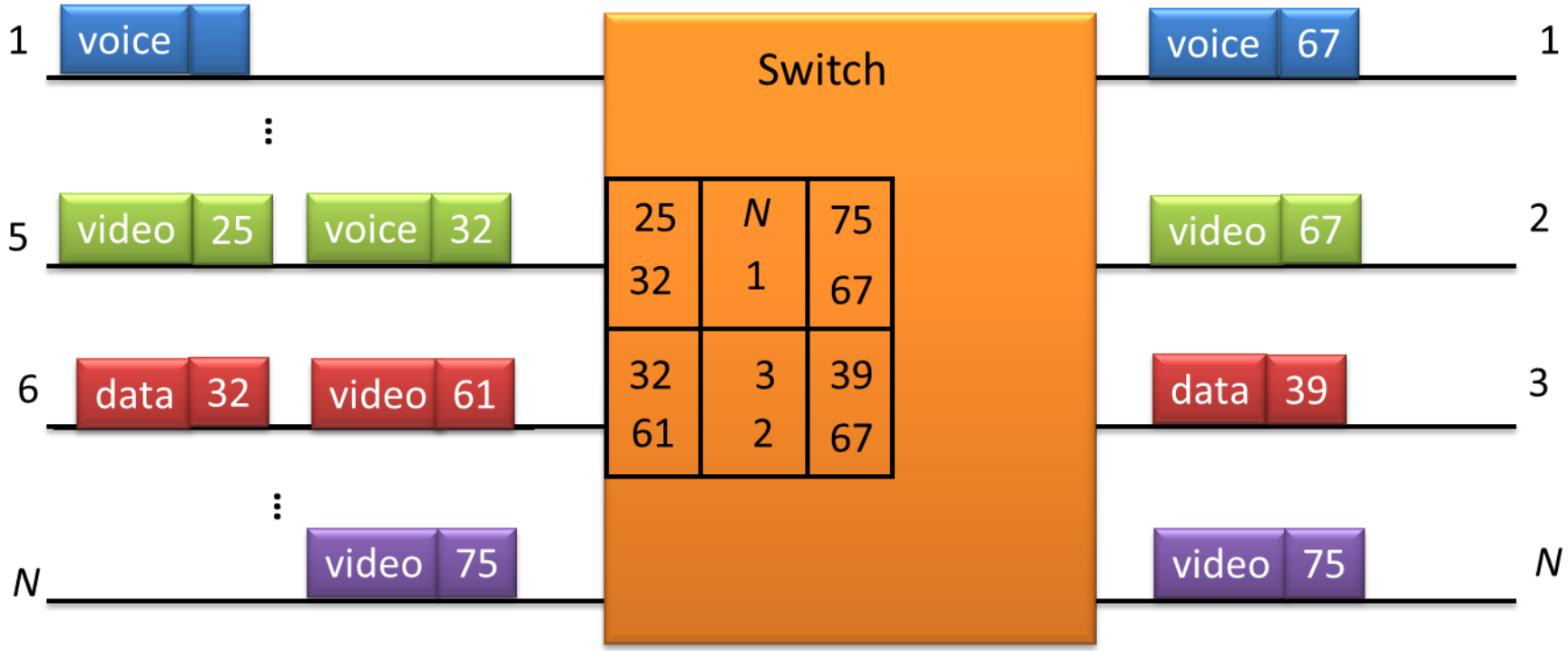
**Permanent VCs (PVCs)**

- A logical connection between two end systems which is permanent
- PVC’s are like private line services with permanent routing path and bandwidth allocated whether used or not
- Two types : Virtual Path Connections (VPC) and Virtual Channel connections (VCC)

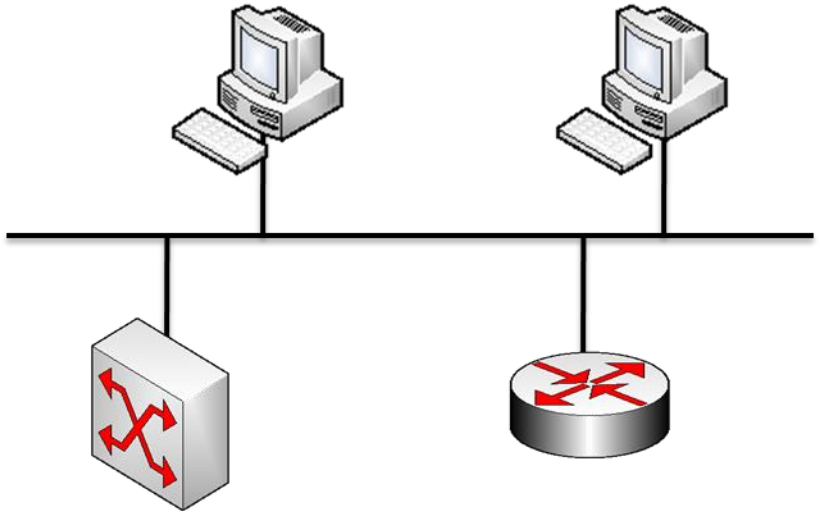
**Switched VCs (SVC):**

- Dynamically set up on per-call basis
- Routing temporary

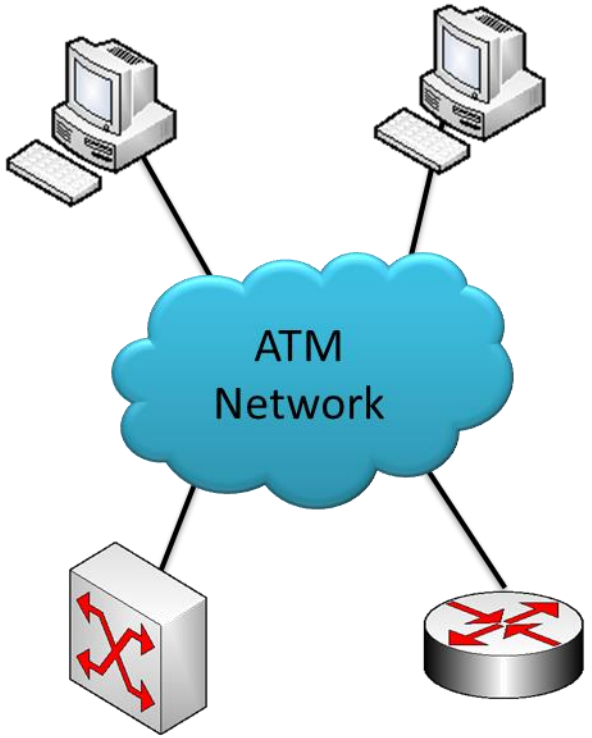
# ATM Cell Switching



# ATM Networks Emulating a Physical LAN

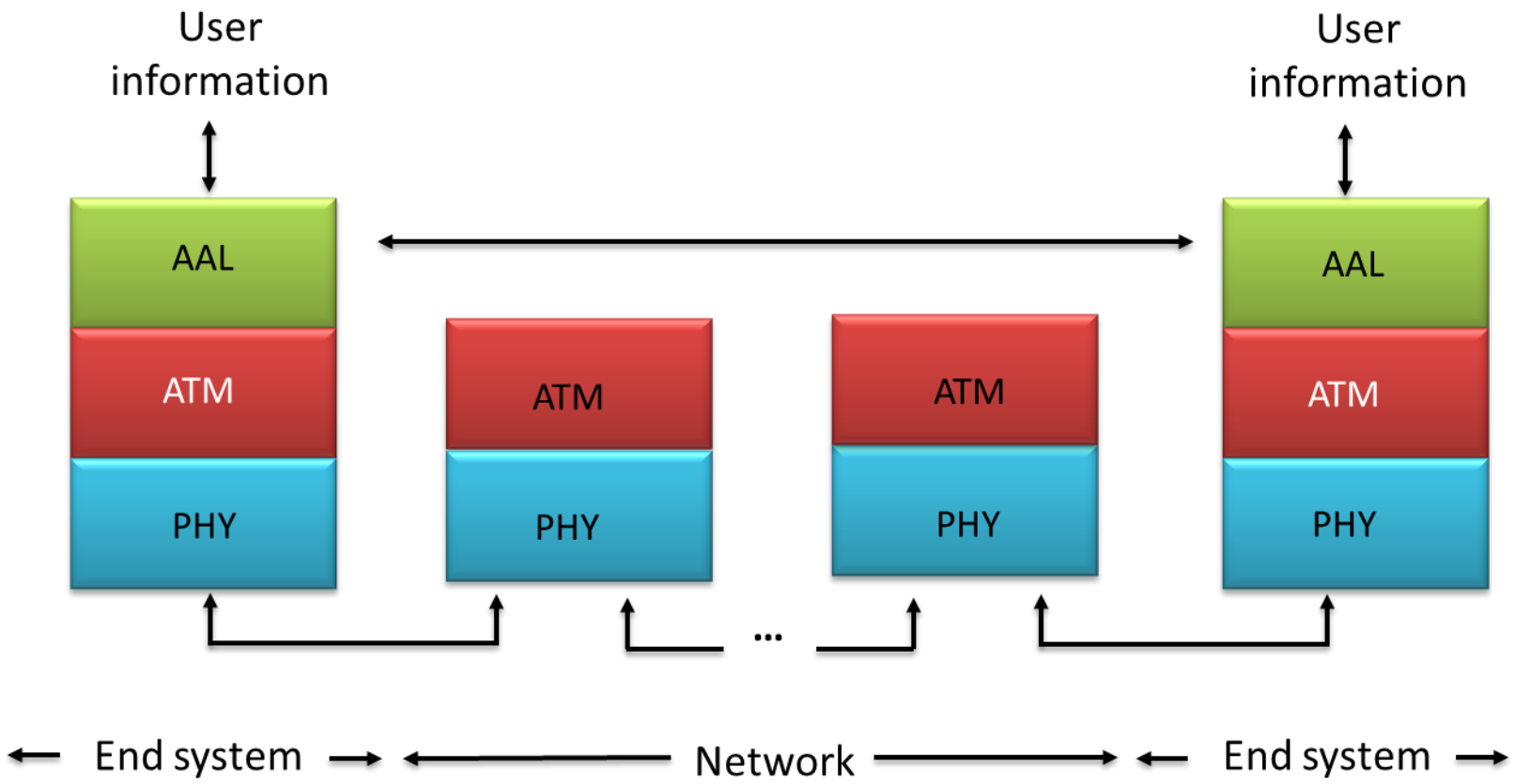


Physical LAN



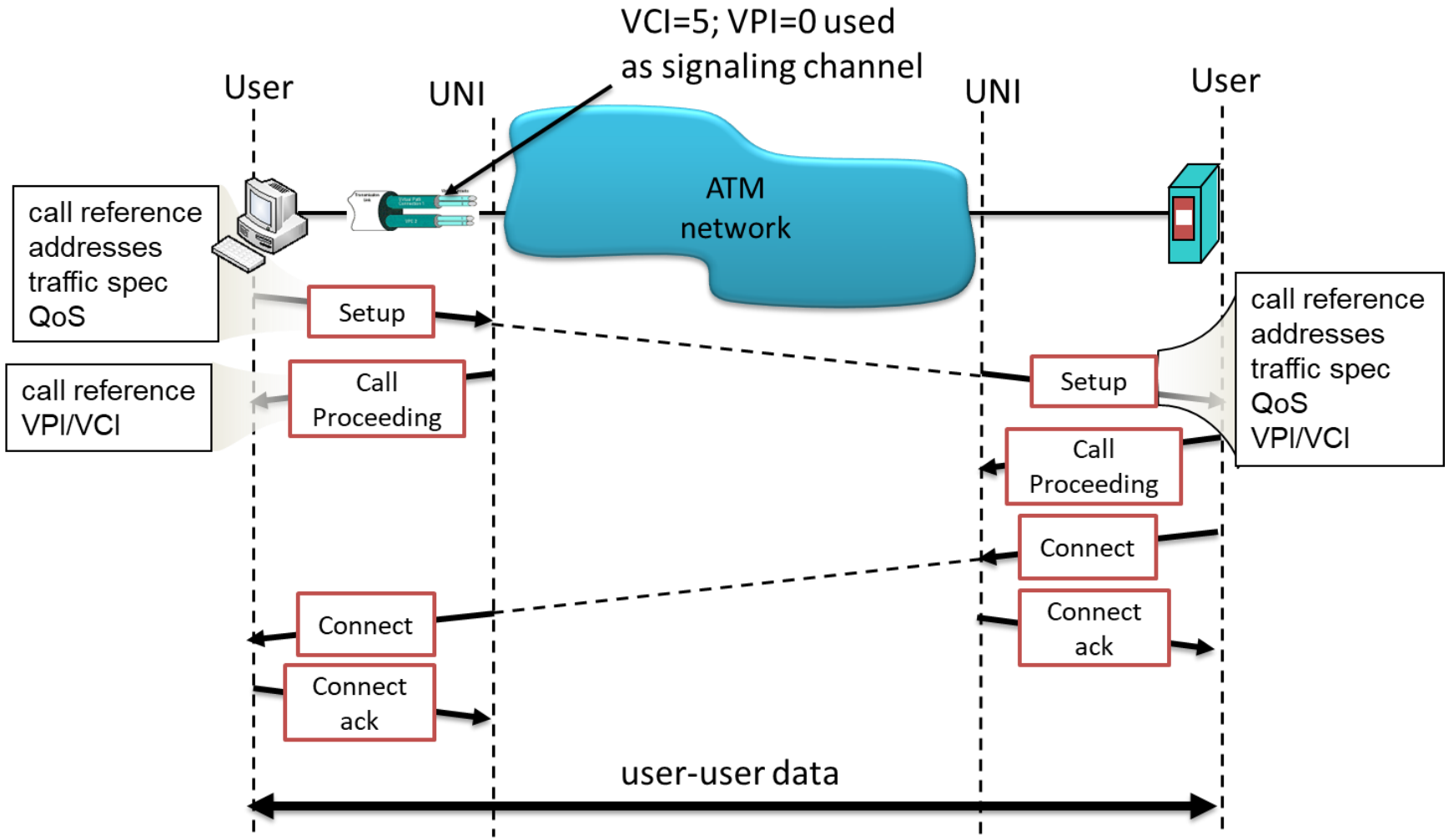

Emulated LAN

# ATM Networks Emulating a Physical LAN Protocol Architecture

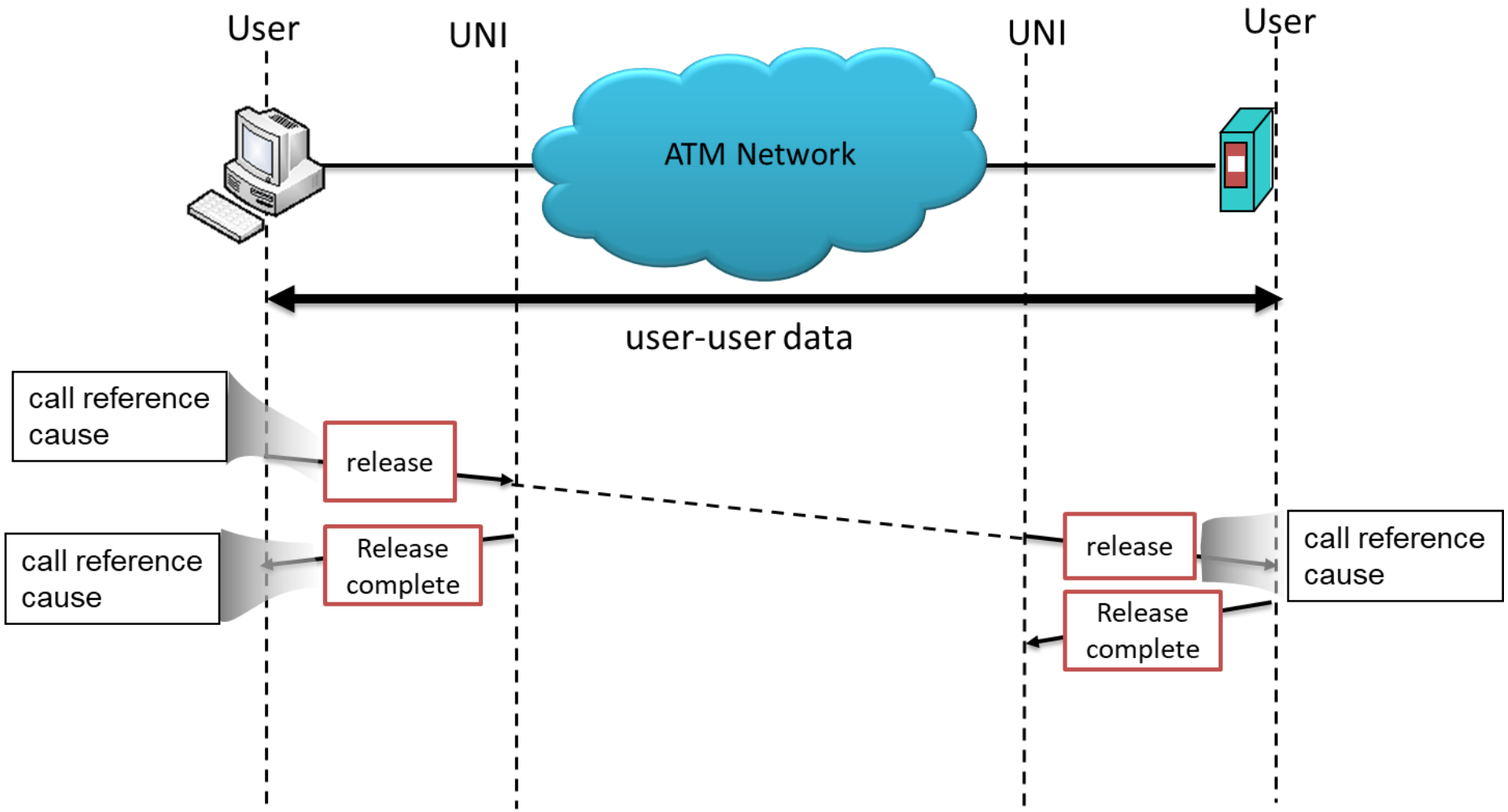


# ATM Call Setup Signaling

**Call signaling for Negotiating VPI and VCI**

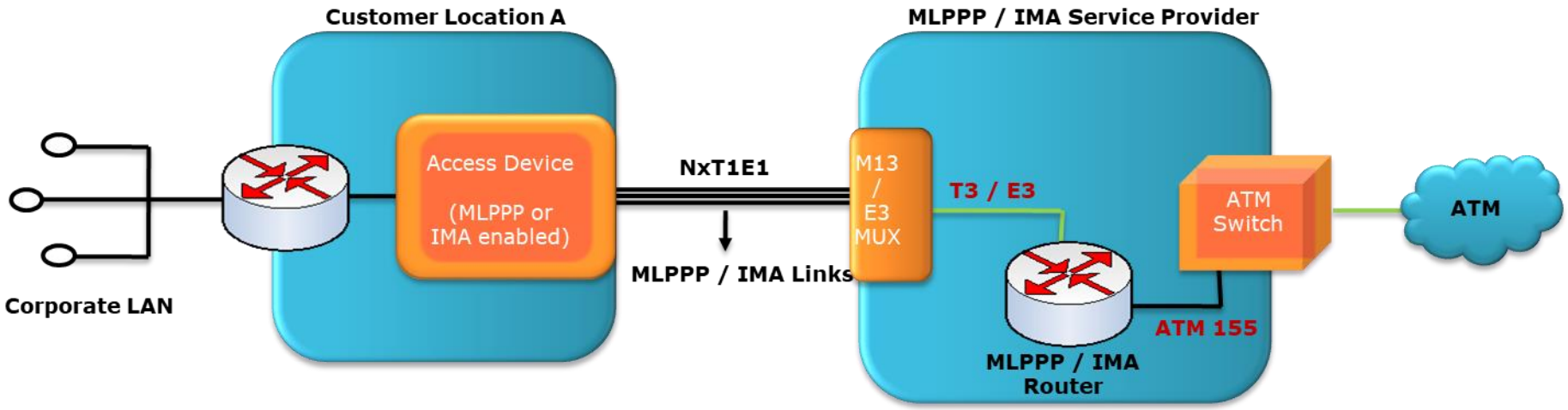


# ATM Call Release Signaling

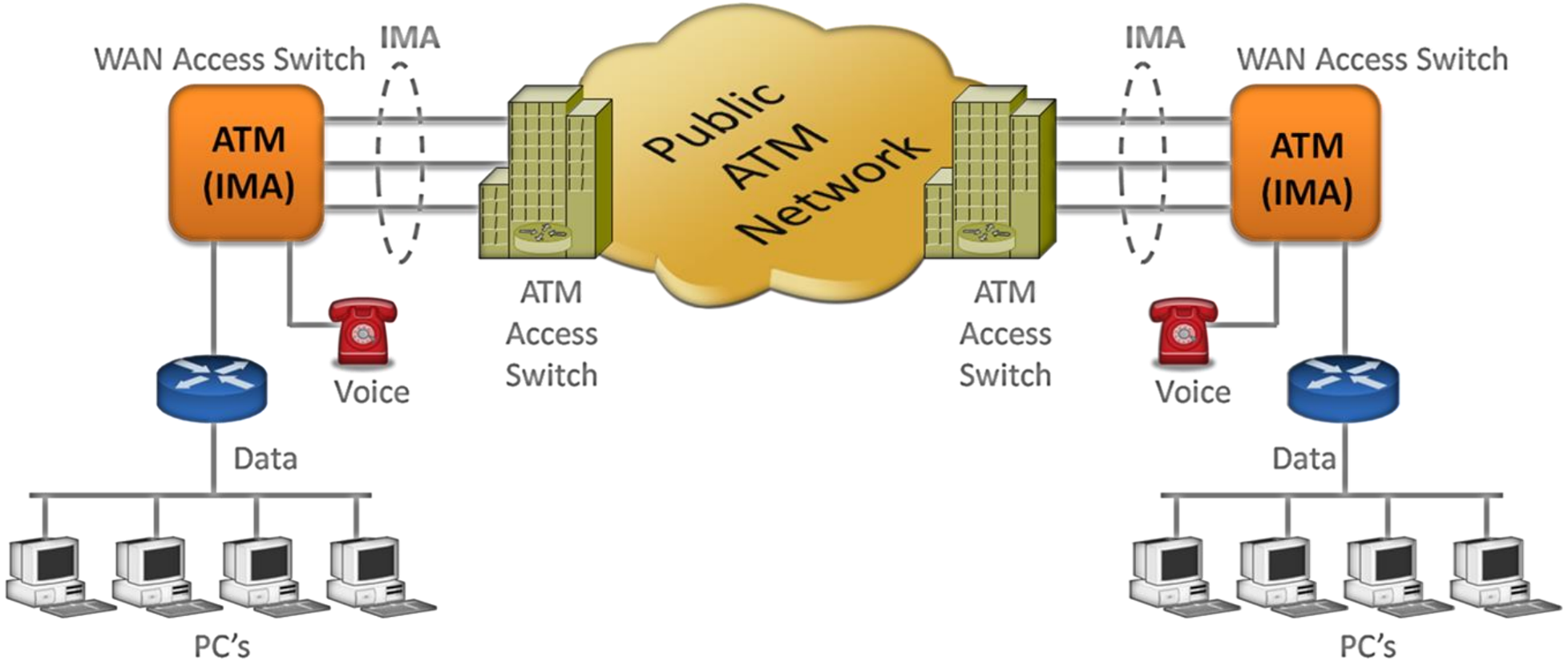


# Inverse Multiplexing over ATM (IMA)

- IMA allows some Quality of Service (QoS) capability
- Contains some considerable overhead

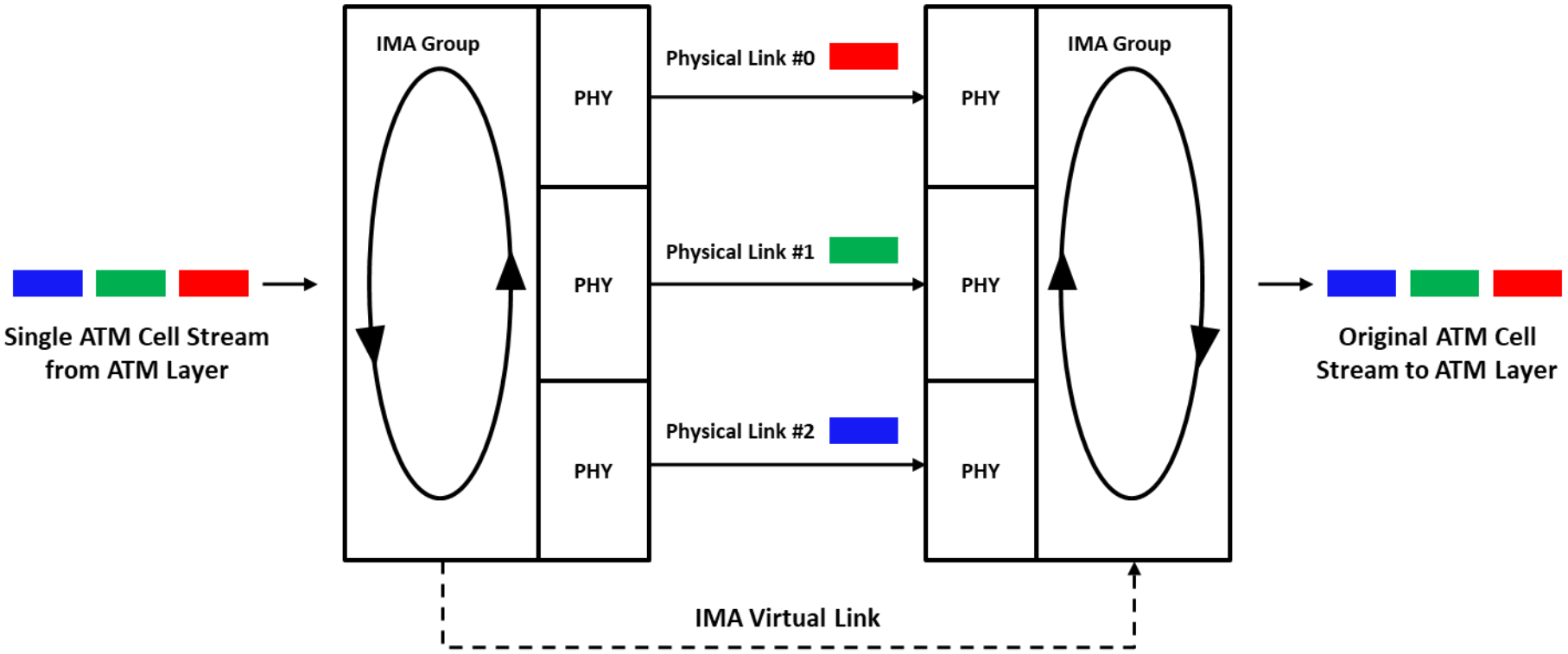


# Inverse Multiplexing over ATM (IMA) Network



# Inverse Multiplex over ATM (IMA)

- ATM Inverse Multiplexing technique involves inverse multiplexing and de-multiplexing of ATM cells in a cyclical fashion
- IMA combines multiple T1 or E1 links to form a single high-speed connection
- IMA provides flexible bandwidth options to achieve rates between the DS1/E1 and DS3/E3




Tx direction: cells distributed across links in round robin sequence
Rx direction: cells recombined into single ATM stream

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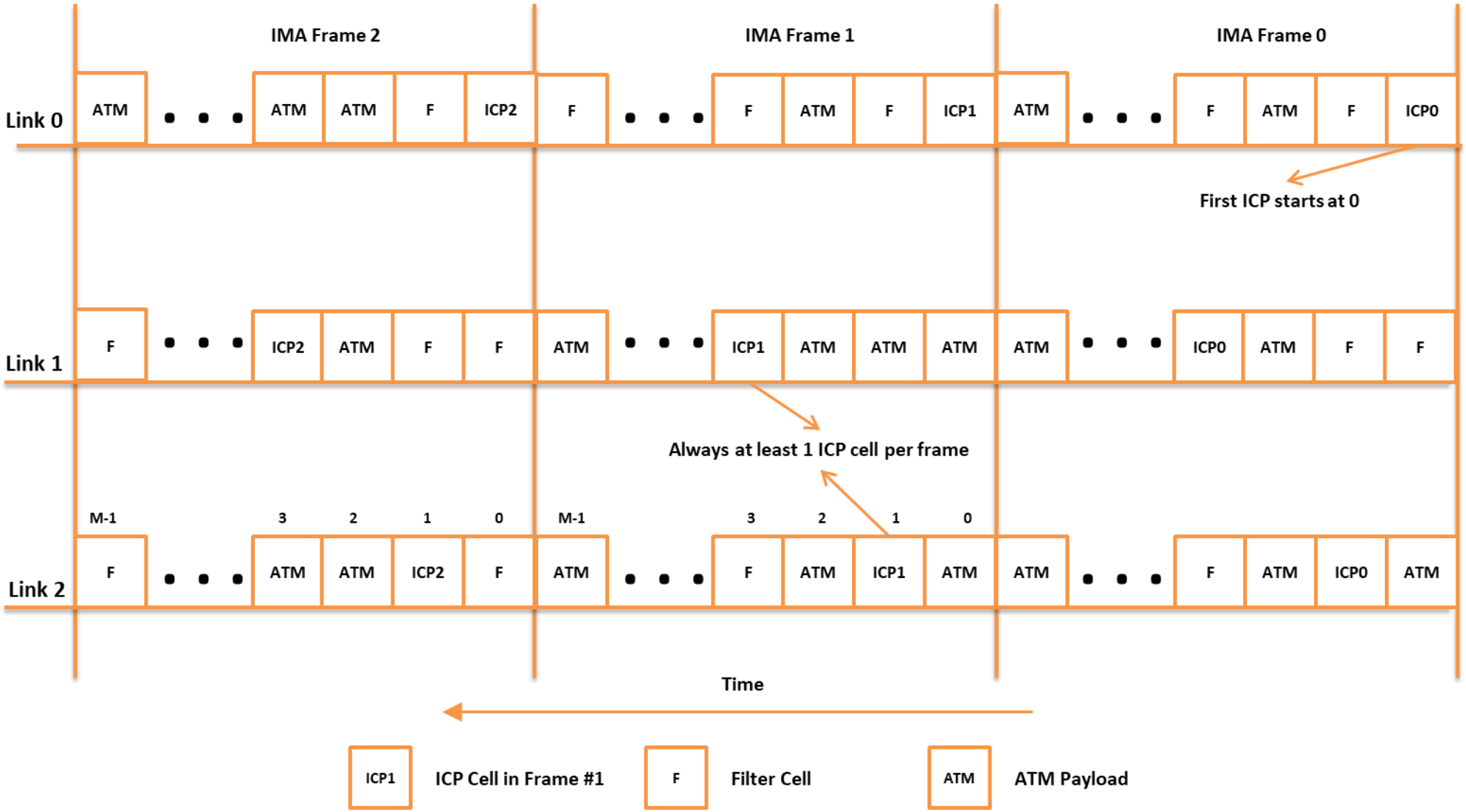
# IMA Frames


IMA Frame 2
IMA Frame 1
IMA Frame 0
Link 0
ATM
ATM
ATM
F
ICP2
F
F
ATM
F
ICP1
ATM
F
ATM
F
ICP0
First ICP starts at 0
Link 1
F
ICP2
ATM
F
F
ATM
ICP1
ATM
ATM
ATM
ATM
ICP0
ATM
F
F
Always at least 1 ICP cell per frame
M-1
3
2
1
0
M-1
3
2
1
0
Link 2
F
ATM
ATM
ICP2
F
ATM
F
ATM
ICP1
ATM
ATM
F
ATM
ICP0
ATM
Time
ICP1
ICP Cell in Frame #1
F
Filter Cell
ATM
ATM Payload

# IMA Frames

- IMA links transmit IMA control protocol (ICP) cells on each link in a group - once per IMA frame
- ICP cells define and separate IMA frames and enable reconstruction of the original ATM cell stream
- IMA group can have a frame size of 32, 64, 128, or 256. If an IMA frame length is of 128 cells, one out of every 128 cells on a physical link is an ICP cell
- If no ATM layer cells are being sent, then an IMA filler cell is transmitted to provide a constant stream at the physical layer. Filler cells are discarded by the receiver

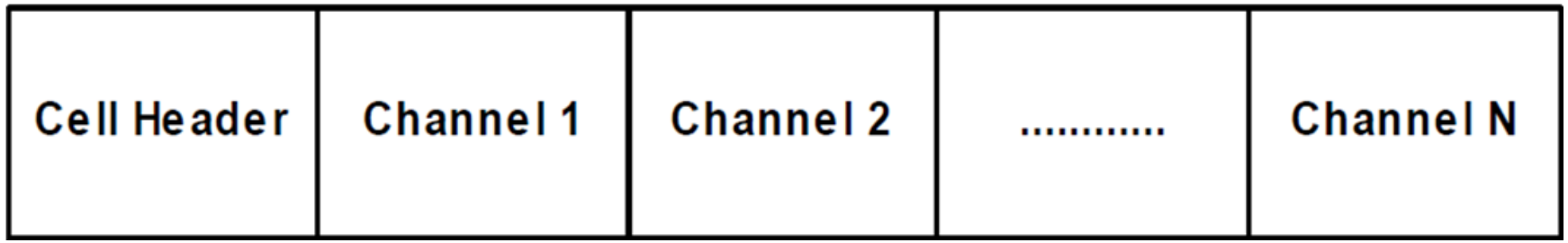
# AAL2 and AAL5 Overview

# Evolution of AAL2

- After development of AAL1, AAL3/4 and AAL5, there was a need for an AAL that could transport small packets for low-data rate applications efficiently
  - AAL1 had its inherent problems
    - High packetization delay (12ms for 32kbps and 48ms for 8kbps applications)
    - Partial-filled cell method can be used to reduce delay but are bandwidth-inefficient
  - AAL3/4 or AAL5 were suitable for busty data applications
- Another requirement was to allow multiple users to simultaneously use the channel
  - This mandated the use of some form of multiplexing identifier (like MID is there in AAL3/4)

# Evolution of AAL2 (Contd.)

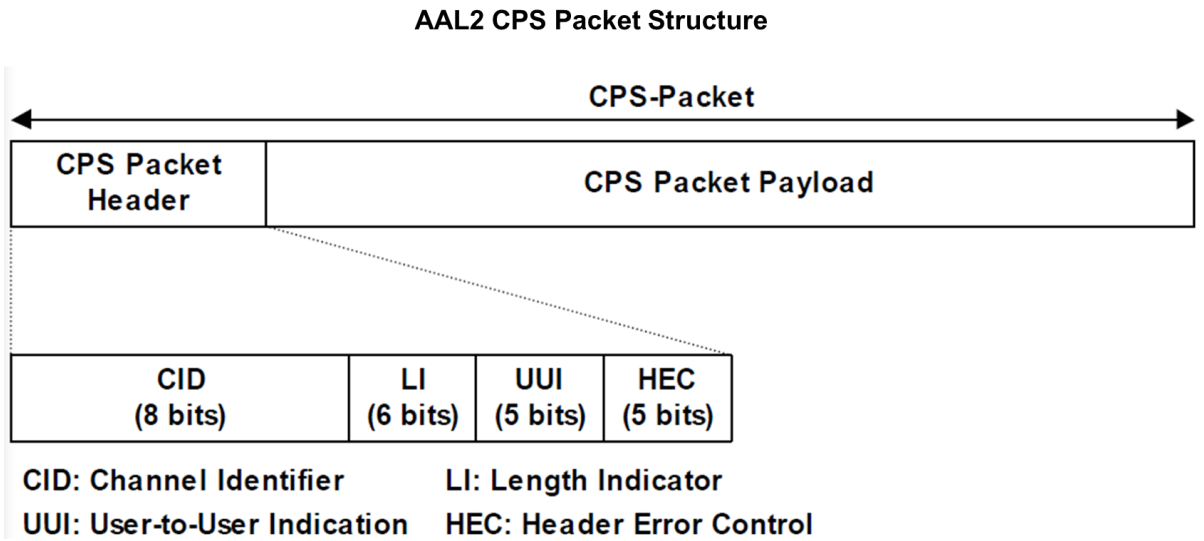
- Given this, one option is to use a fixed size channel (say 1 to 4 four bytes) and a fixed number of channels (corresponding to 48/24/16/12 channels)
- This option is not only inflexible, but also retains the inefficiency of circuit-switched networks



# Evolution of AAL2 (Contd.)

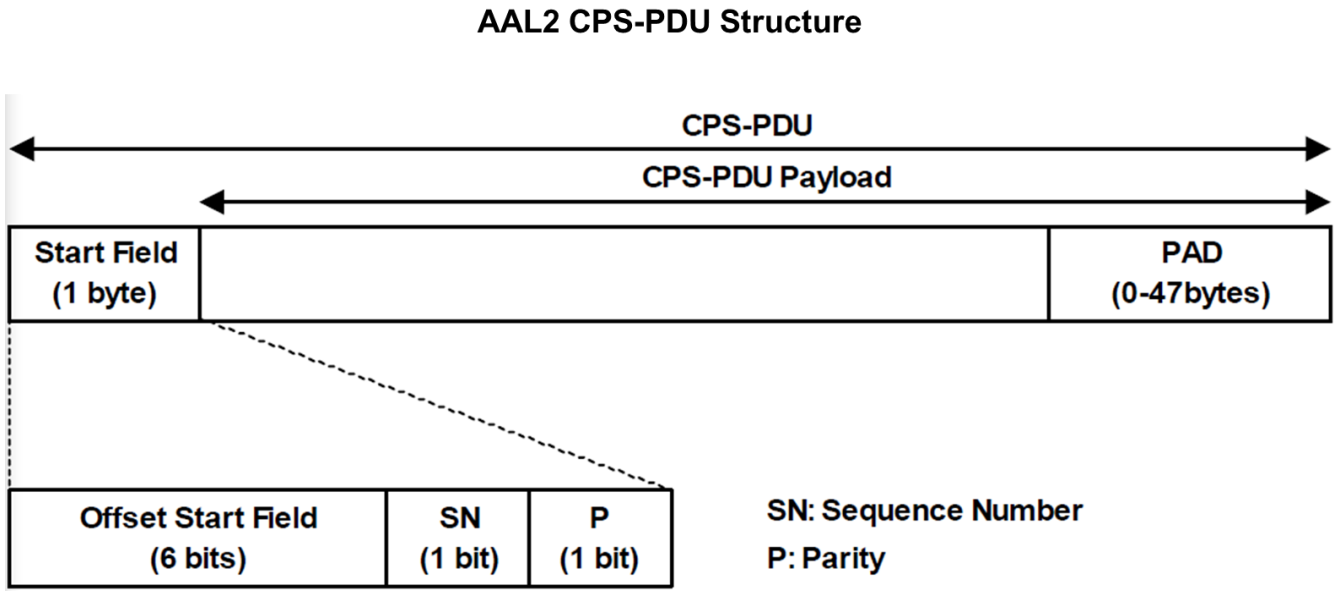
The better option is to do the following:

- Use variable sized packets instead of fixed size packets in ATM payload
- There can be one or more packets in ATM payload
- Since the packet size is variable, each packet will have its own header
- A packet is identified uniquely by an identifier called Channel Identifier (CID)
- Use a length Indicator to give the actual length of the packet



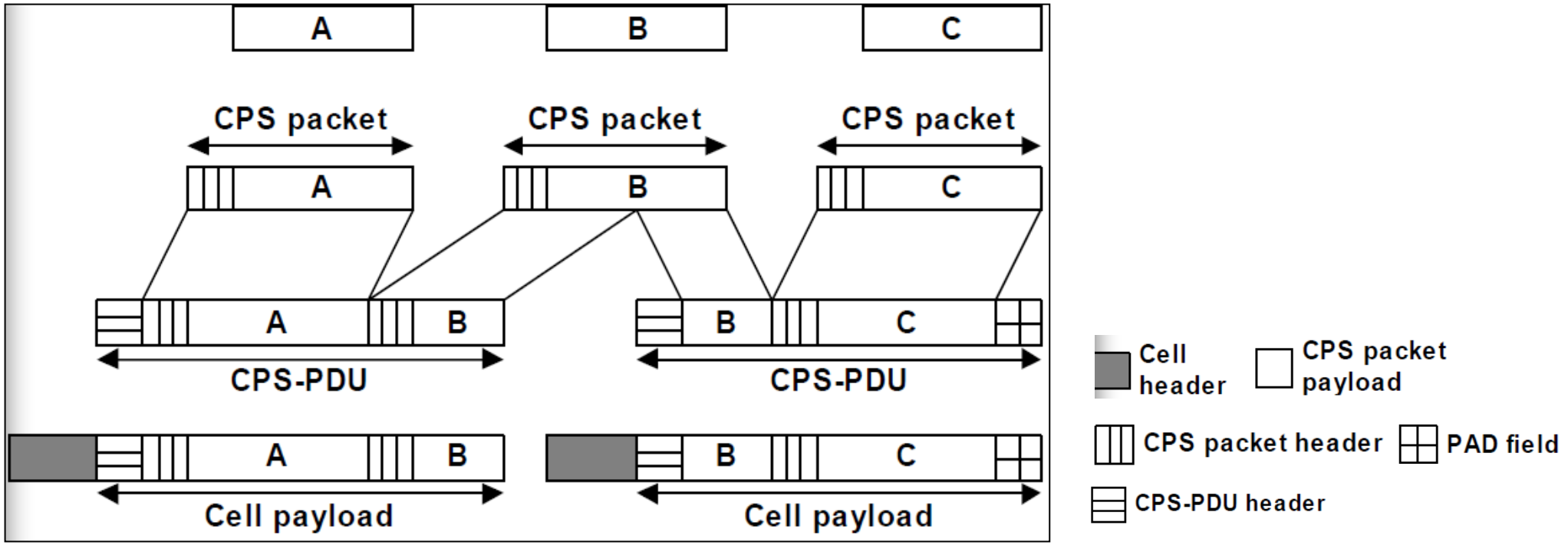
# Evolution of AAL2 (Contd.)

- Only CPS packets alone are not sufficient
  - If one cell is lost, there must be means to identify the beginning of CPS Packet in the next cell
  - This functionality is served by CPS-PDU header of 1byte



# Evolution of AAL2: Steps

- STEP 1: Three user data frames arrive, each corresponding to a different channel
- STEP 2: For each user data frame, a CPS packet is formed by prepending a CPS header
- STEP 3: The CPS packets are concatenated to form a CPS- PDU by prepending a CPS- PDU header. One CPS packet can span multiple CPS-PDU
- STEP 4: The CPS-PDU forms the payload of an ATM cell



# SSCS Layer

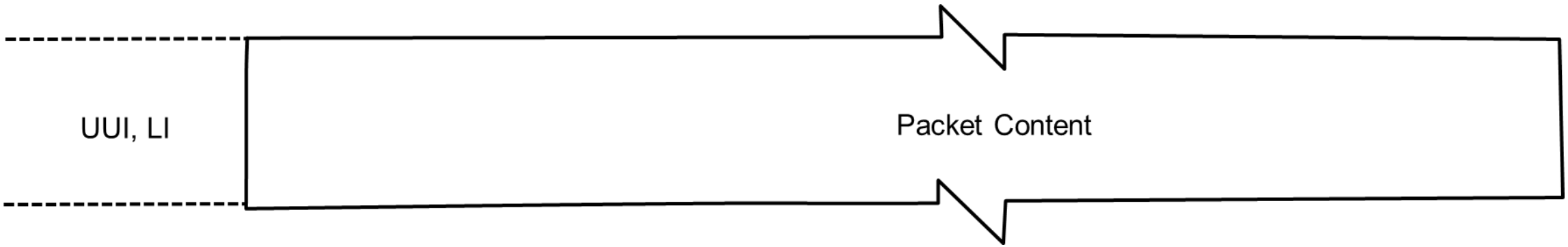
- Service Specific Convergence Sublayer that operates above the Common Part Sublayer of an AAL type 2 connection
- The purpose of the SSCS is to convey narrow-band channels consisting of voice, voiceband data, or circuit mode data
- SSCS specifies packet formats and procedures to encode the different information streams for bandwidth-efficient transport

# Packet Format Types

- Protocol data units of the SSCS are transported as CPS-Packets over one AAL type 2 connection Packet Format Types are:
  - Type 1 – Unprotected
  - Type 3 – Fully protected

# Packet Format Type 1 – Unprotected

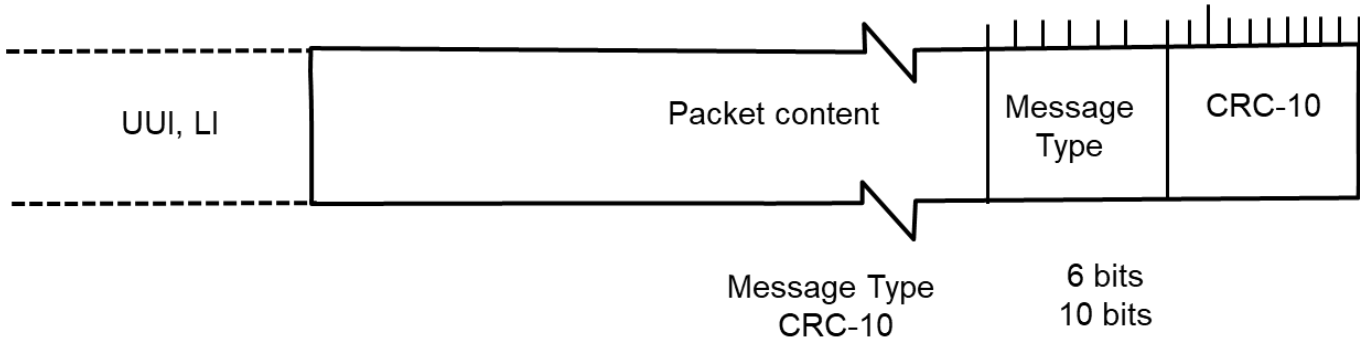
- The payload is unprotected
- This format type is used by default unless an alternative type is explicitly specified



# Packet Format Type 3 – Fully Protected

Payload is protected by a 10-bit CRC

- Type 3 packets are used for the following information streams:
  - Dialed digits
  - Channel associated signaling bits
  - Facsimile demodulation control data
  - Alarms
  - User state control operations
  - Rate control
  - Synchronization of change in SSCS operation
  - Loopback



# Message Type codes for packet format type 3

| Information stream | Message Type code | Packet format |
|---|---|---|
| Dialled digits | 000010 | Dialled digits |
| Channel associated signalling | 000011 | CAS bits |
| Facsimile demodulation control | 100000 | T.30_Preamble |
| | 100001 | EPT |
| | 100010 | Training |
| | 100011 | Fax_Idle |
| | 100100 | T.30_Data |
| OAM | 000000 | Alarm |
| | | Loopback |
| User state control | 000001 | User state control |
| Rate control | 000100 | Rate control |
| Synchronization of change in SSCS operation | 000101 | Synchronization of change in SSCS operation |

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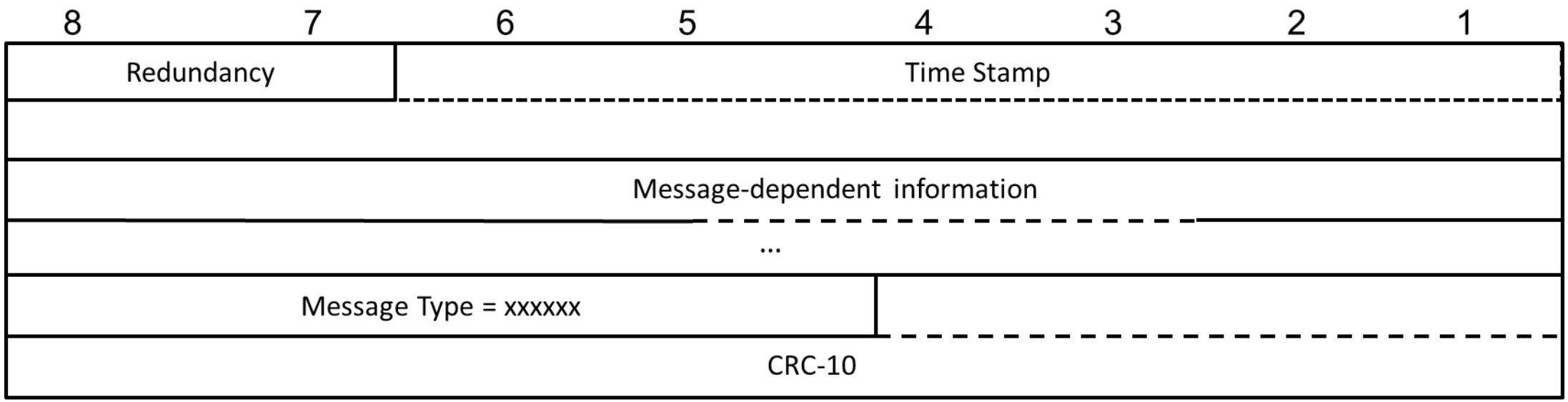
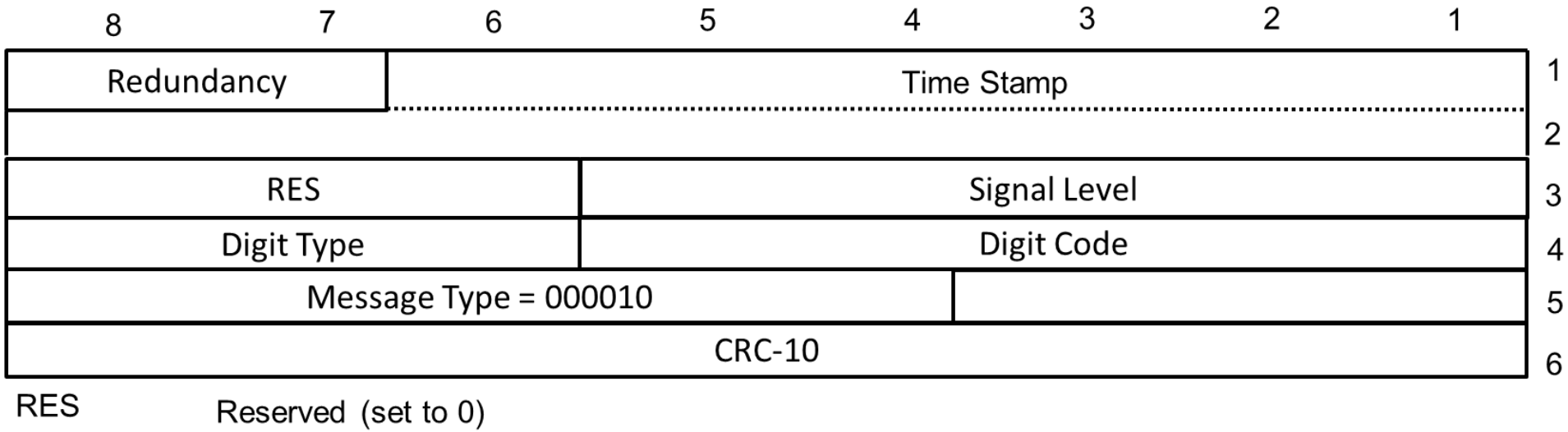
# Common facilities for type 3 packets

- It applies to dialed digits, channel-associated signaling bits, facsimile demodulation control, and user state control packets
- Alarms are patterned on OAM cells and do not use the common facilities for type 3 packets



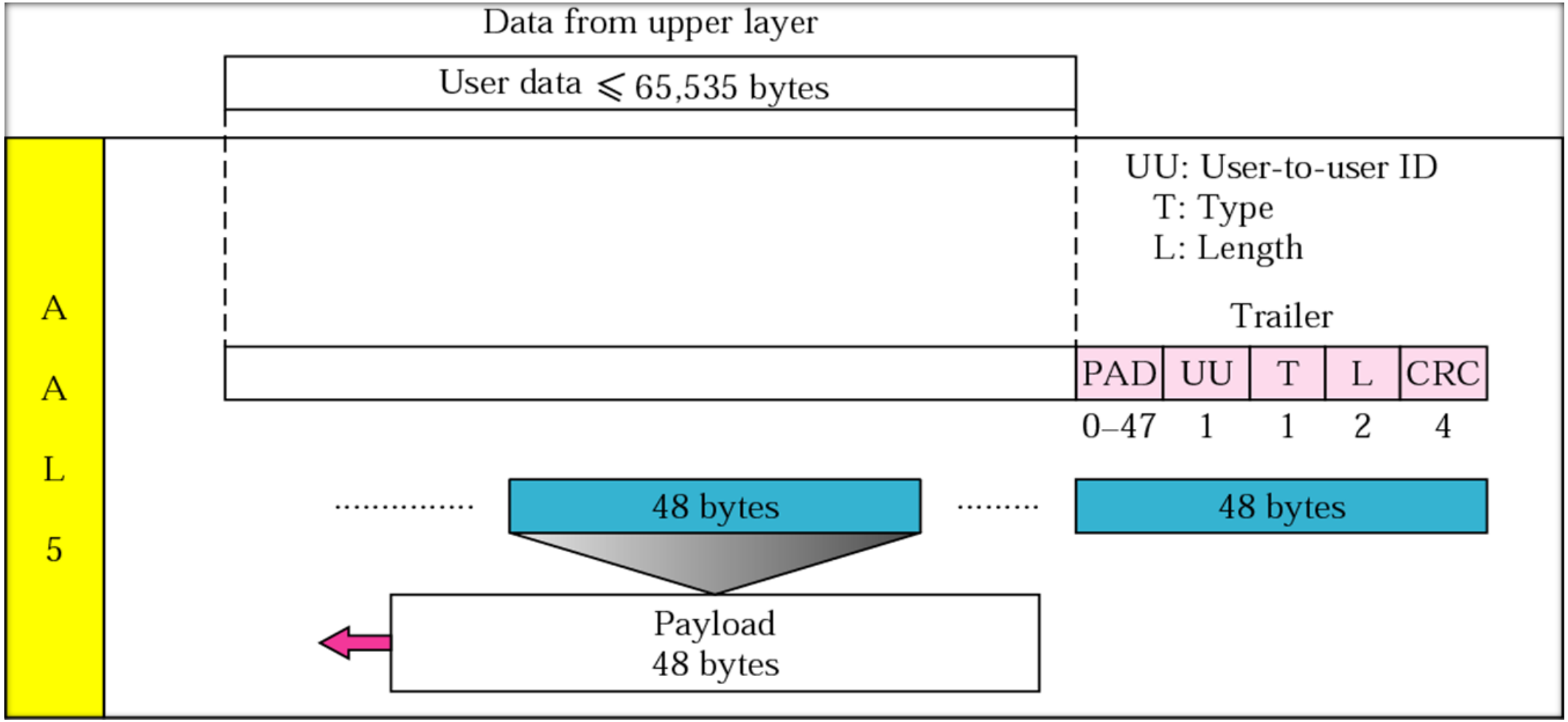
# Example: Dialed Digits Packet Format

- Dialed digit packets are format type 3 and benefit from CRC-10 error detection
- They make use of the common facilities for type 3 packets including triple redundancy

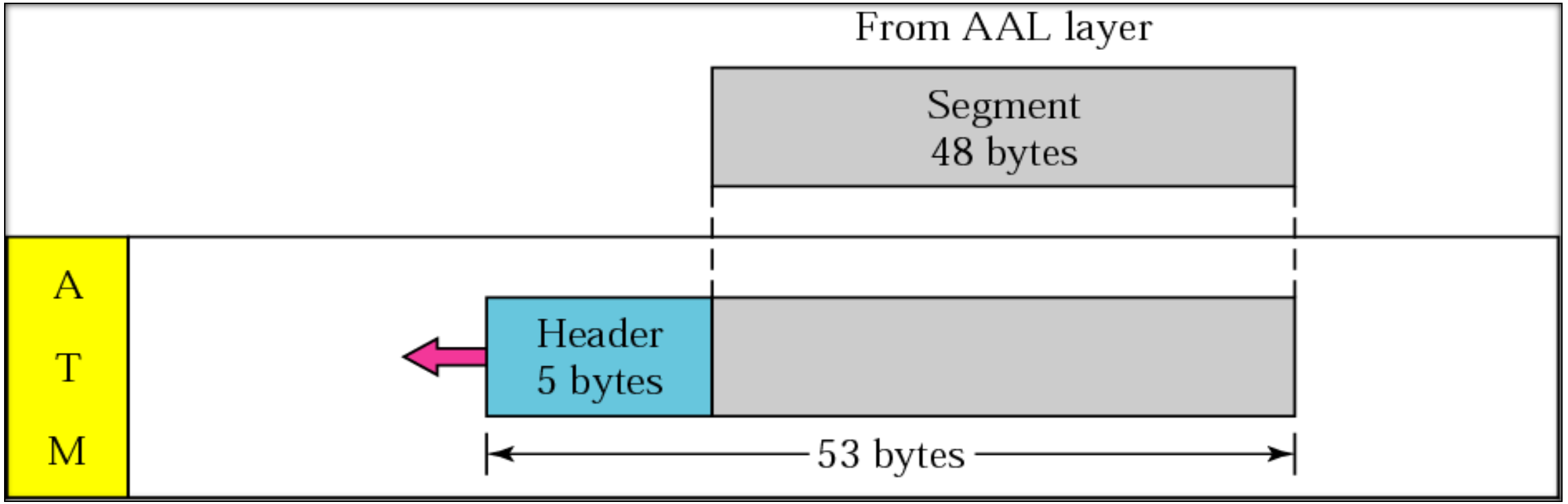


# AAL5

- The AAL layer used by the IP protocol is AAL5



# ATM Layer



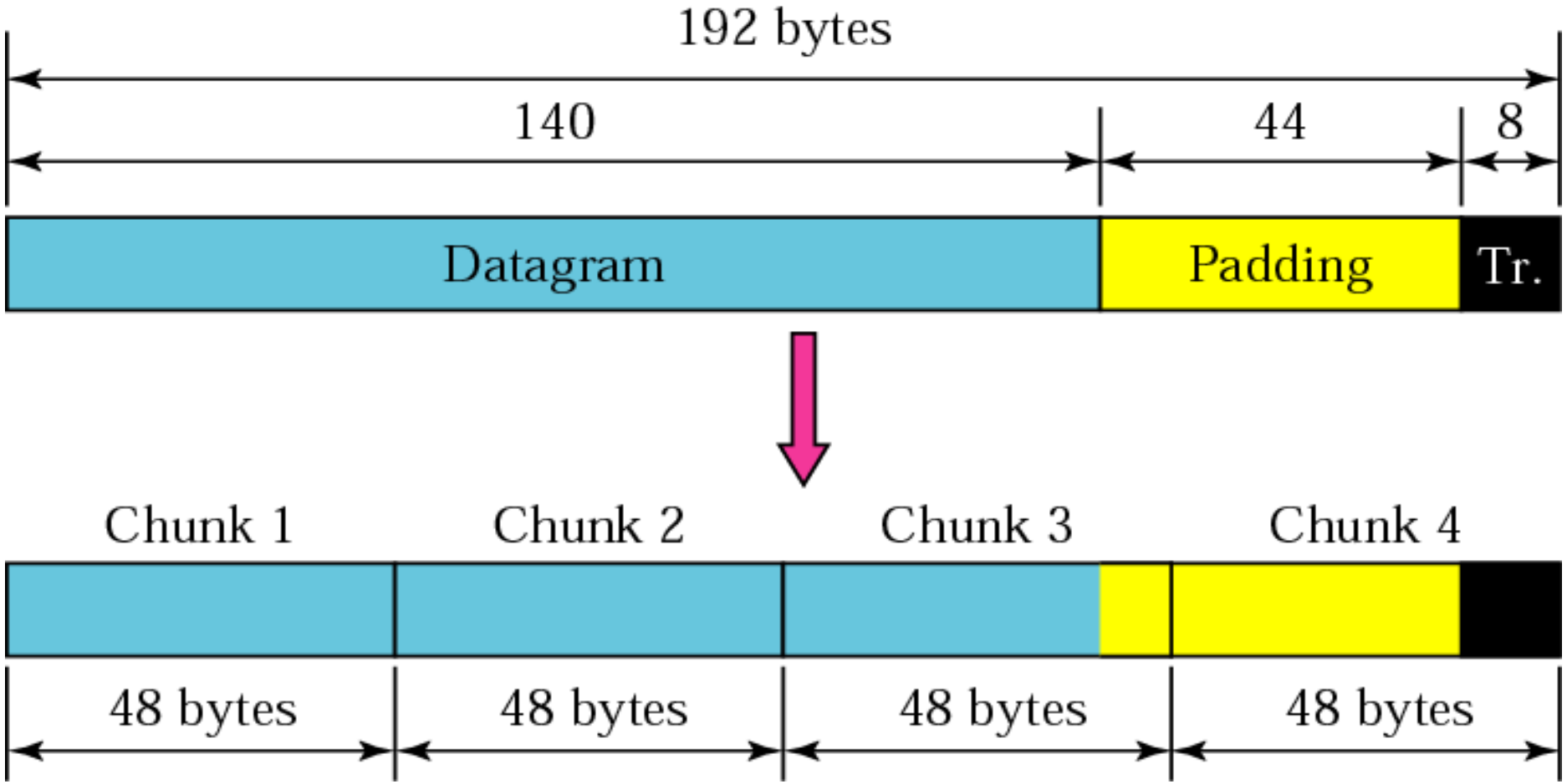
# Carrying A Datagram in Cells

Why Use AAL5?

- We show how an example of a datagram is encapsulated in four cells and transmitted through an ATM network

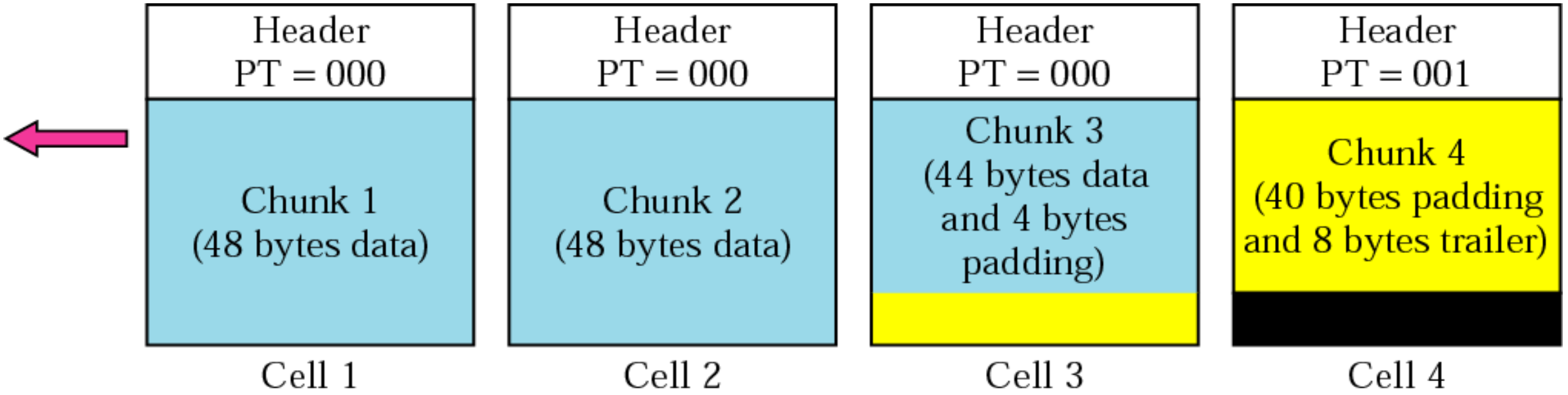
# Fragmentation

- Only the last cell carries the 8-byte trailer added to the IP datagram
- Padding can be added only to the last cell or the last two cells



# ATM Cells

- The value of the PT field is 000 in all cells carrying an IP datagram fragment except for the last cell; the value is 001 in the last cell



# Thank you