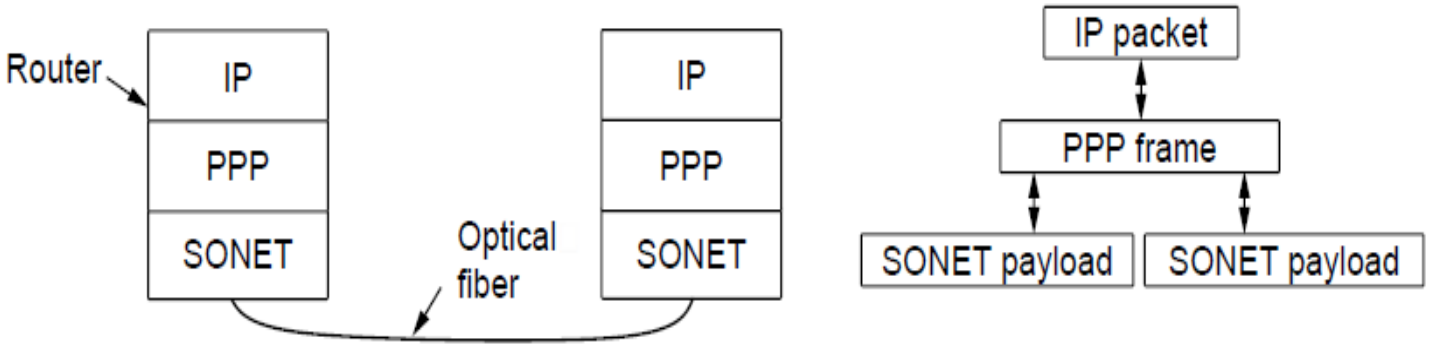
Week 4 – Data Link Layer Ends & MAC Sub-Layer Starts

COMP90007
Internet Technologies

Packet over SONET

- We saw PPP which is an old well-established protocol between router-router communication
- SONET is a physical layer protocol used on fiber optic links
- *PPP (Point-to-Point Protocol) is used on top of this for framing for example, i.e., in the backbone of Internet*



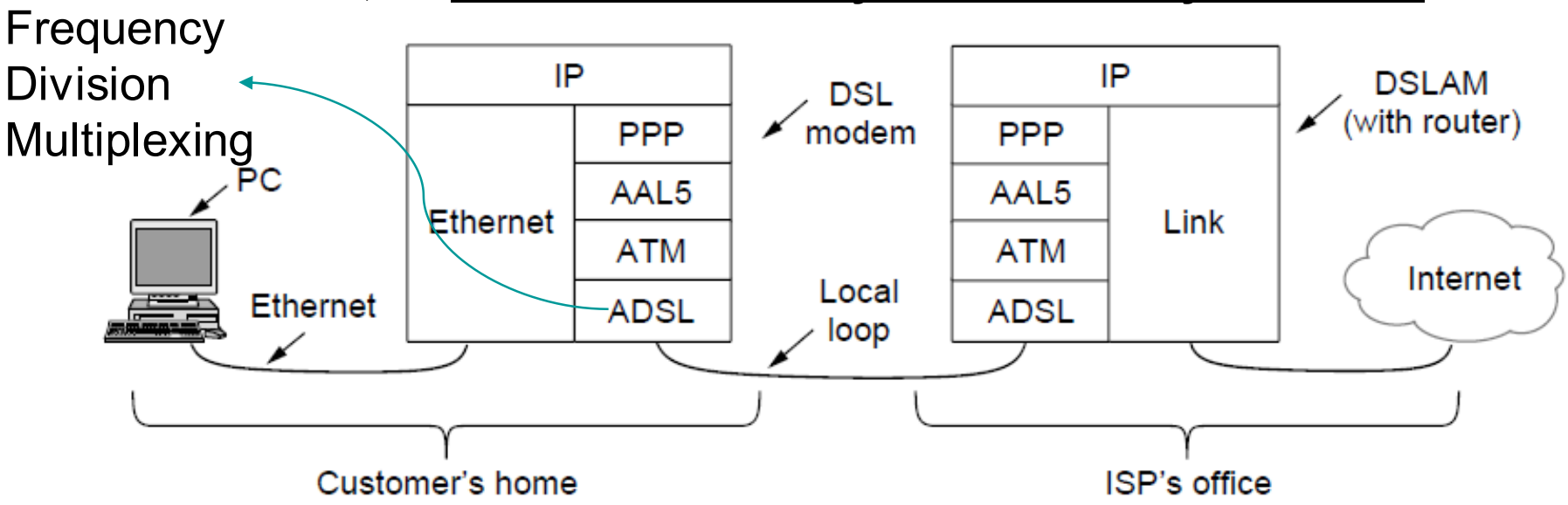
Protocol stacks

Packet over SONET

- When run over SONET, PPP has:
  - Choices made, mentioned in RFC 2615
  - 4 byte checksum and not 2
  - Payload is scrambled with an XOR function before putting on to SONET
  - …

ADSL

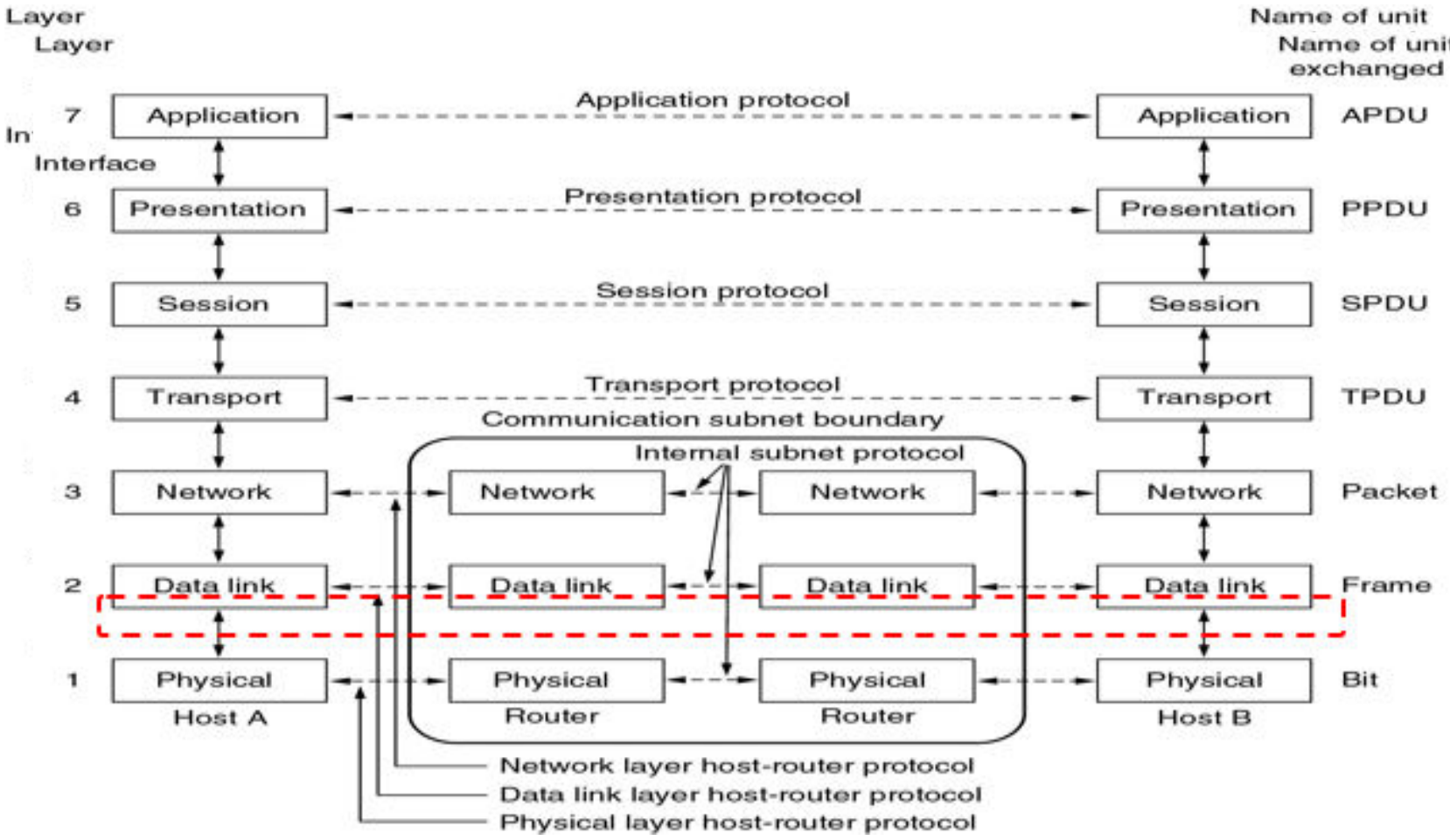
- Widely used for Internet
  - ADSL runs from modem (customer) to ISP
  - IP packets are sent using **PPP** to DSL Access Multiplexer of ISP (called DSLAM),
  - PPP here is different e.g., no CRC is needed as ADSL uses more advanced error correction codes, Reed-Solomon codes, as **ADSL is commonly on more noisy mediums**



Introduction to MAC Sublayer

- On point to point networks, there are only singular sender and receiver pairs, eliminating transmission contention
- On broadcast networks, determining right to transmit is a complex problem
- Medium Access Control (MAC) sub-layer is used to assist in resolving transmission conflicts

The MAC Sub-layer



Types of Channel Allocation Mechanisms

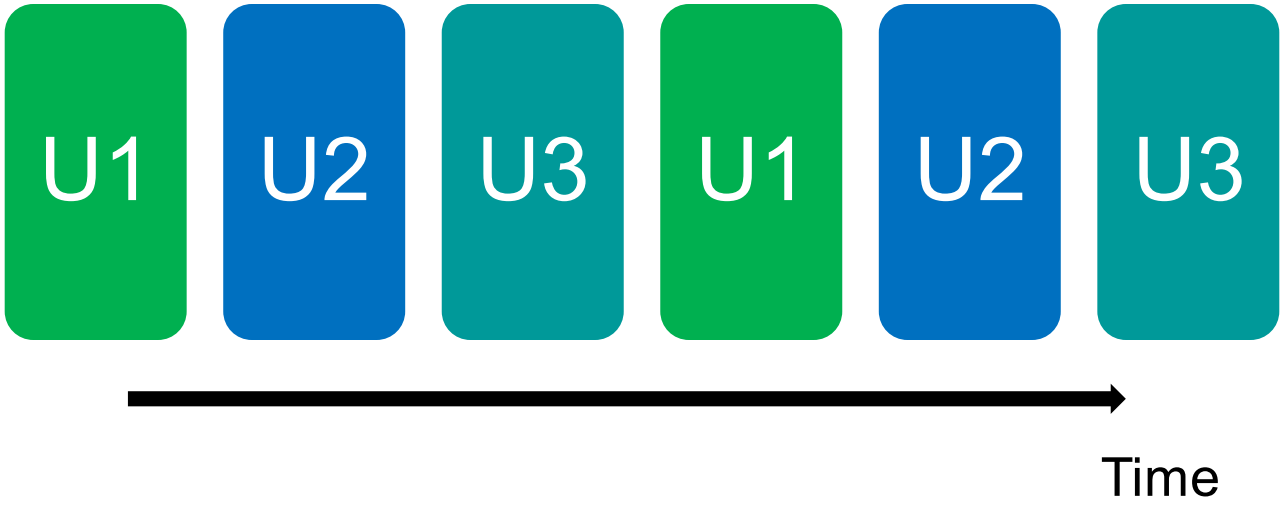
- Various methods exist for allocating a single broadcast channel amongst competing users
  - **Static Channel Allocation**
  - **Dynamic Channel Allocation**

Static Channel Allocation

- Arbitrary *division of a channel into segments and each user allocated a dedicated segment* for transmission
- Frequency Division Multiplexing (FDM) is typically used
- Significant inefficiencies arise when:
  - Number of senders > allocated segments
  - Number of senders is not static
  - Traffic is bursty

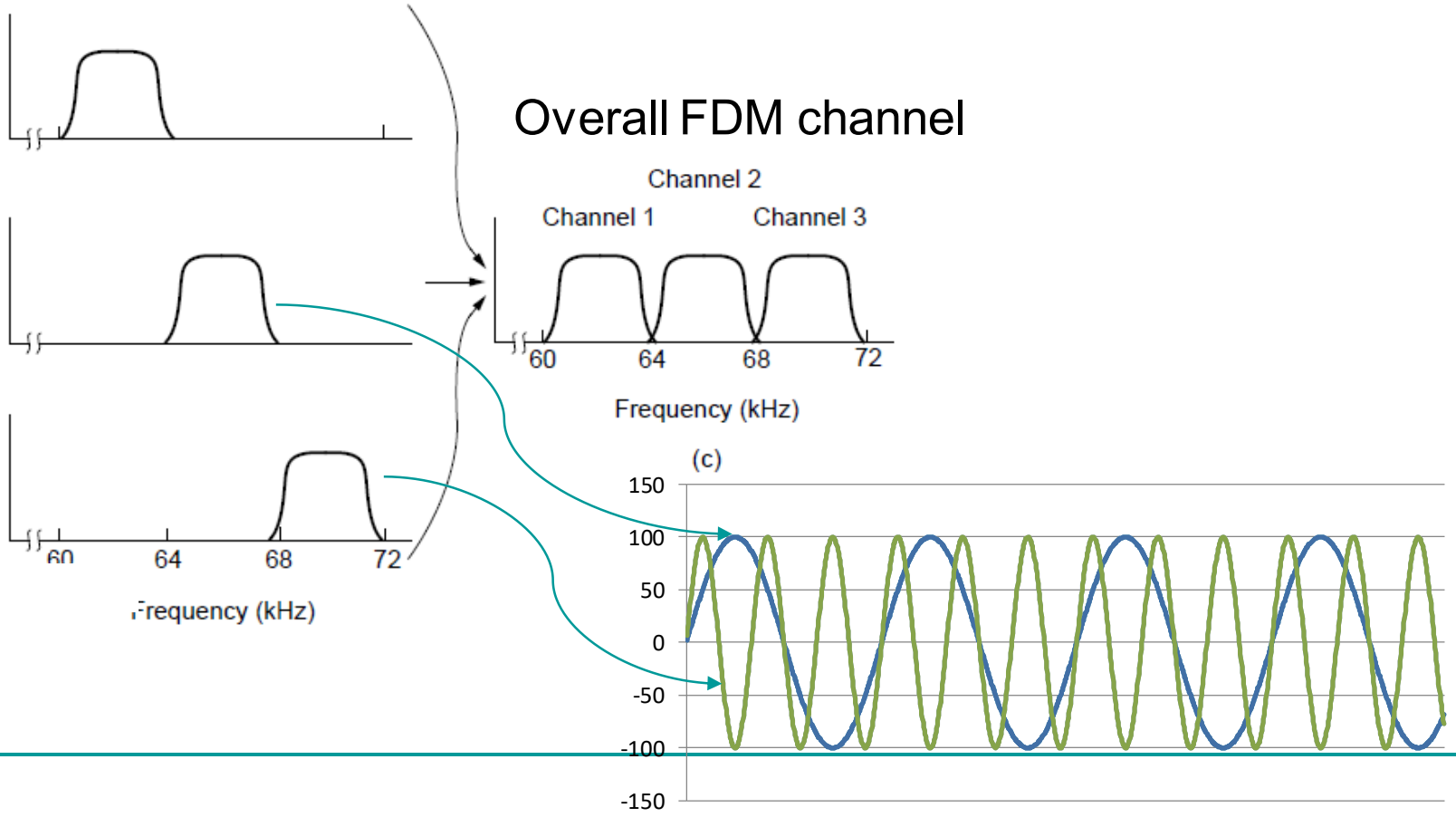
Time Division Multiplexing

Users take turns on a fixed schedule



Frequency Division Multiplexing

FDM (Frequency Division Multiplexing) shares the channel by placing users on different frequencies:



Downfalls

- Usually *good for fixed number of users*
- Network traffic is bursty
  - TDM and FDM try to give consistent access to the network leading to *inefficiency in the use of network resources*
- Where:
  - TV and Radio (FDM)
  - 2G used TDM

Dynamic Channel Allocation

- Channel segmentation is dynamic, segment allocation is dynamic
- Assumptions for dynamic channel allocation:
  - Independent transmission stations
  - Single channel for all communication
  - Simultaneous transmission results in damaged frames
- Time
  - Transmission can begin at any time
  - Transmission can begin only within discrete intervals
- Carrier Sense
  - Detection of channel use prior to transmission
  - No detection of channel use prior to transmission

Multiple Access Protocols

- ALOHA
- Carrier Sense Multiple Access
- Collision Free
- Limited Contention
- MACA/MACAW (for Wireless LANs)

ALOHA

- Users **transmit frames whenever they have data**; users **retry after a random time if there are collisions** (or no Ack is arrived)
- Requires **no central control mechanism**
- **Efficient under low load** but inefficient under high traffic loads
- **Slotted ALOHA**: Allows the users to start sending only at the beginning of defined slots. Increase efficiency of pure ALOHA by reducing possibility of collisions.

Carrier Sense Multiple Access (CSMA) Protocols

- In networks which **require/has transmission state detection** to determine transmission rights dynamically, there are specific protocols which are used
  - Persistent and Non-Persistent CSMA
  - CSMA with Collision Detection