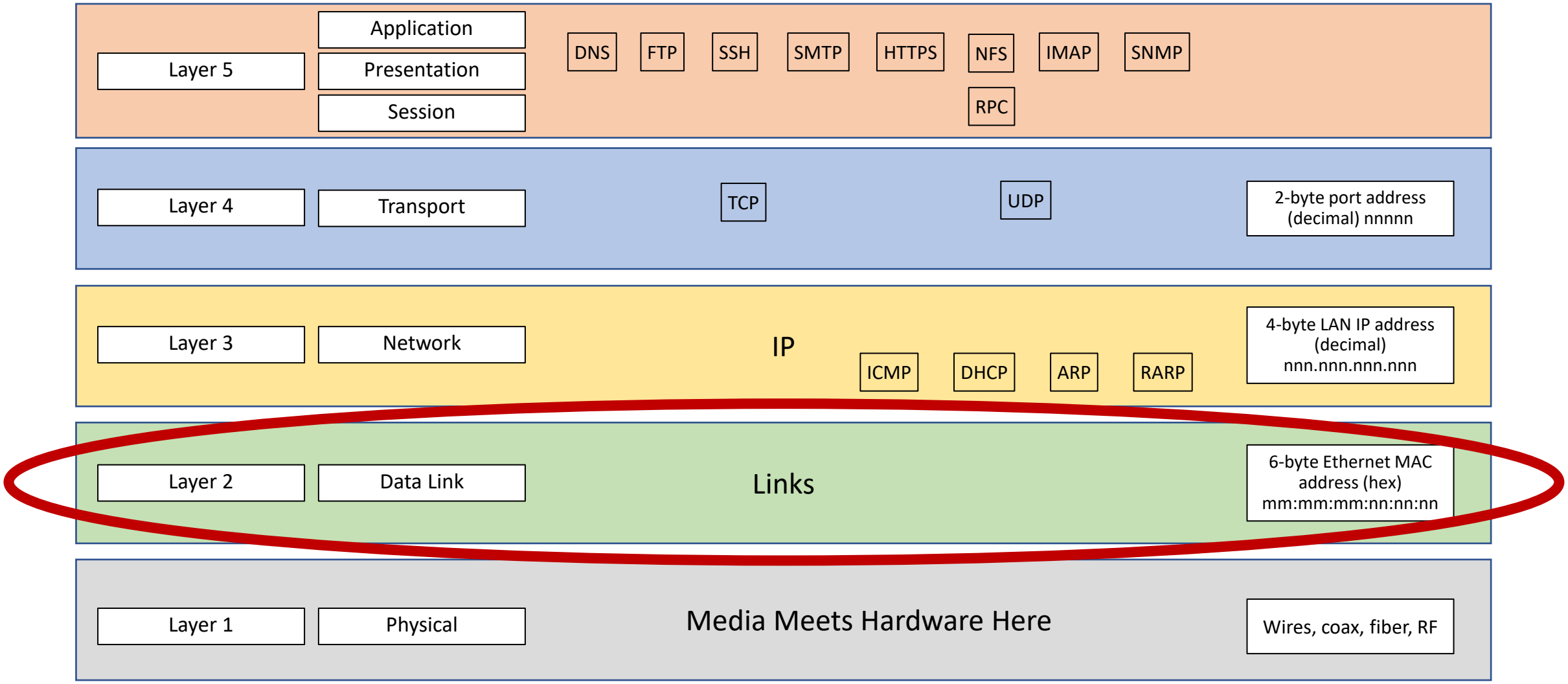
Introduction To Data Comm & Networking
Module 4 – Links
Chapter 6

http://intronetworks.cs.luc.edu/current2/html/links.html

Mr. Donald Privitera
Kennesaw State University
Marietta Campus
College of Computing and Software Engineering
IT Department
dprivit2@kennesaw.edu

TCP/IP 5-Layer Network Stack



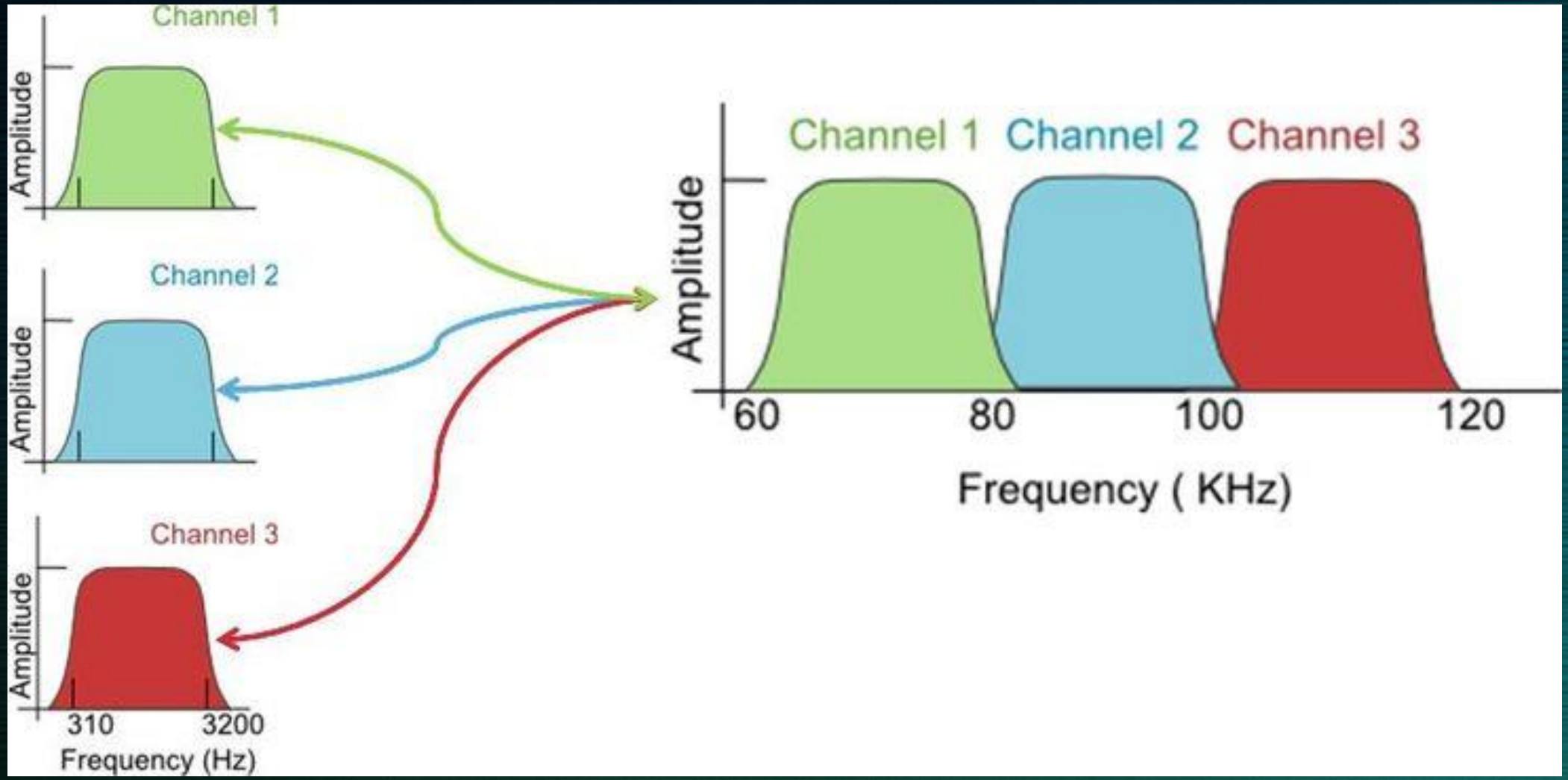
Major Modulation Schemes

- Frequency Division Multiplexing (FDM)
- Wavelength Division Mutliplexing (WDM)
- Time Division Multiplexing (TDM)

FDM (WDM)

- FDM = Frequency Division Multiplexing (rf)
- WDM = Waveform Division Multiplexing (light)
- Bandwidth is divided into discrete portions which are then allocated as channels and transmitted in parallel
- Television is an example of FDM channels
- This is the historical foundational basis for what has now recently been revitalized as OFDM.

FDM (WDM)

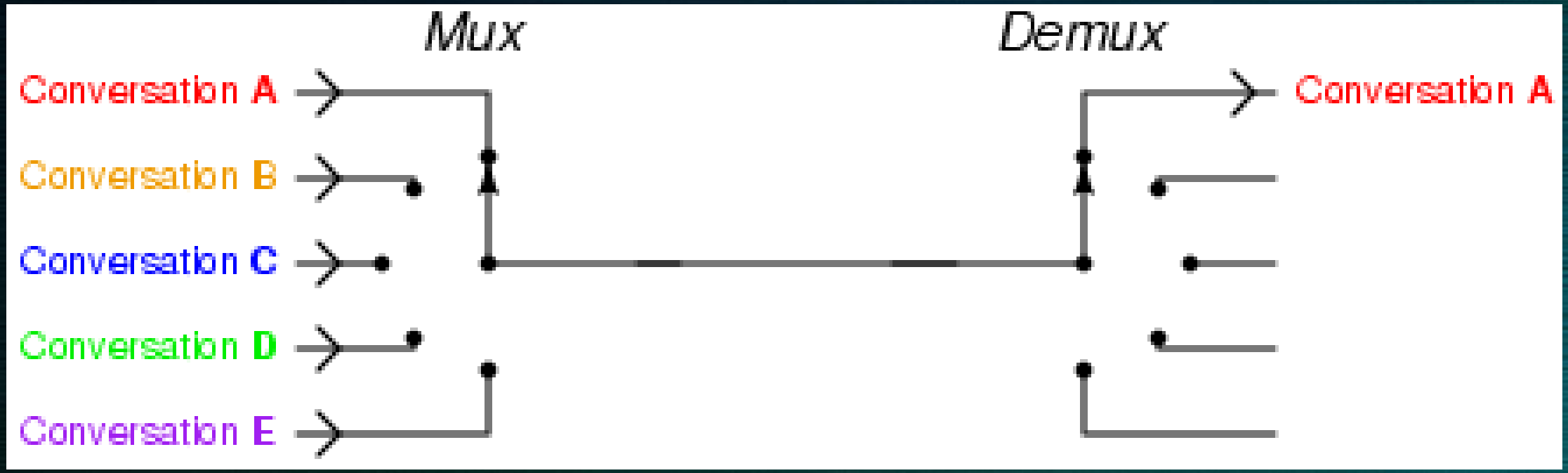


https://i.pinimg.com/736x/c3/14/b9/c314b964cfd54c4410b53bcecc4afb6e--frequency-thunder.jpg

TDM

- TDM = Time Division Multiplexing
- An alternative to dividing up channels into separate frequency bands was needed.
- Allocating very fast time slices and coordinating those as channels worked well.
- This was developed historically for telephone networks as a way to take better advantage of circuits because it was discovered that voice did not need all of the possible bandwidth of a circuit.

TDM



https://en.wikipedia.org/wiki/File:Telephony_multiplexer_system.gif

T-Carrier Lines

- A DS0 channel is an 8-bit data element sampled at 8000 times per second (8Khz) optimized for voice. 8 x 8000 = 64,000 bps maximum theoretical bandwidth.
- For comparison, CD quality sound is 16-bit @ 44Khz.
- A T1 (DS1) line carries 24 DS0 channels.
- A T3 (DS3) line carries 28 DS1 channels.

SONET

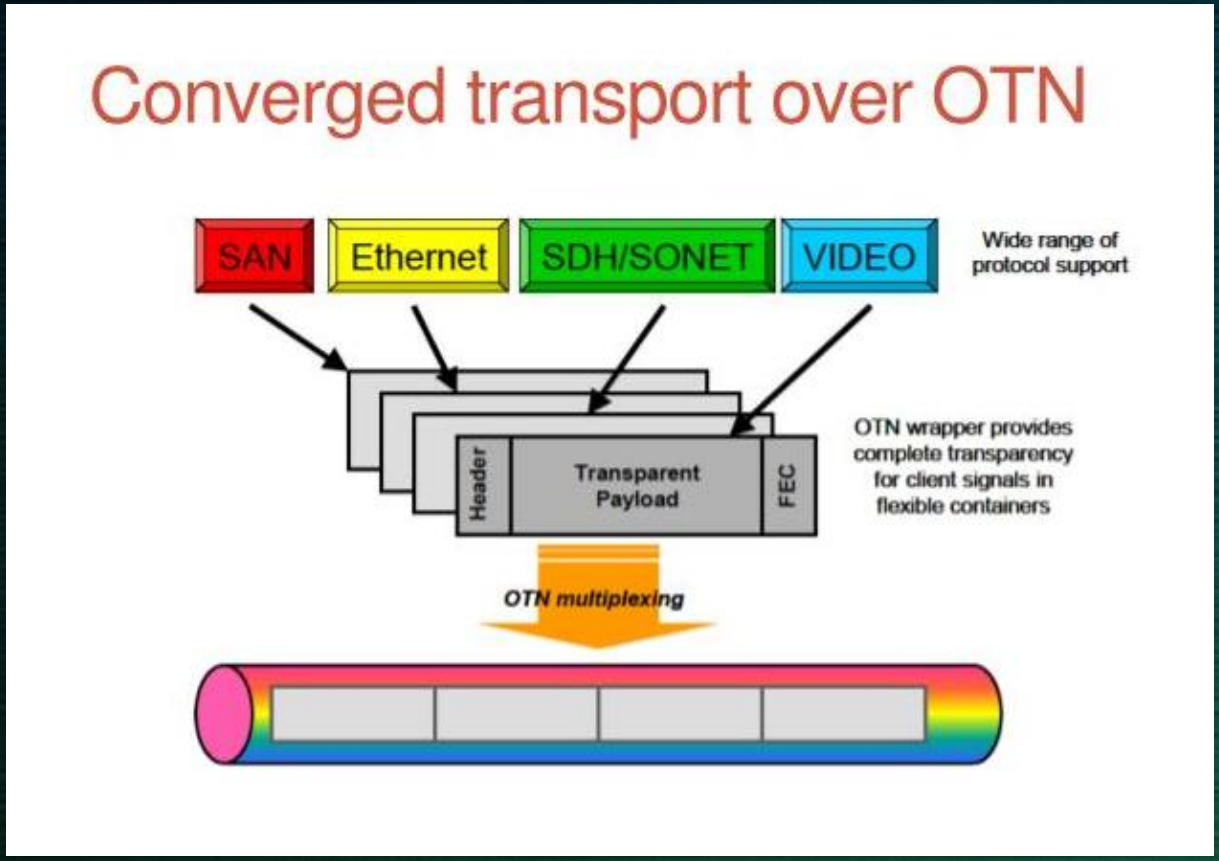
- SONET = Synchronous Optical Network
- Typically over fiber.
- Typically requires extremely accurate time synchronization using atomic clocks.
- 6 categories (STS = Optical Carrier [OC])

STS	STM	line rate
STS-1	STM-0	51.84 Mbps
STS-3	STM-1	155.52 Mbps
STS-12	STM-4	622.08 Mbps (=12*51.84, exactly)
STS-48	STM-16	2.48832 Gbps
STS-192	STM-64	9.953 Gbps
STS-768	STM-256	39.8 Gbps

http://intronetworks.cs.luc.edu/current2/html/links.html

OTN

- OTN = Optical Transport Network
- Typically for fiber
- Leverages error correction as an improvement vs SONET.



https://image2.slideserve.com/4654232/converged-transport-over-otn-n.jpg