INF3190 – Group lecture 4

L1 – The Physical Layer

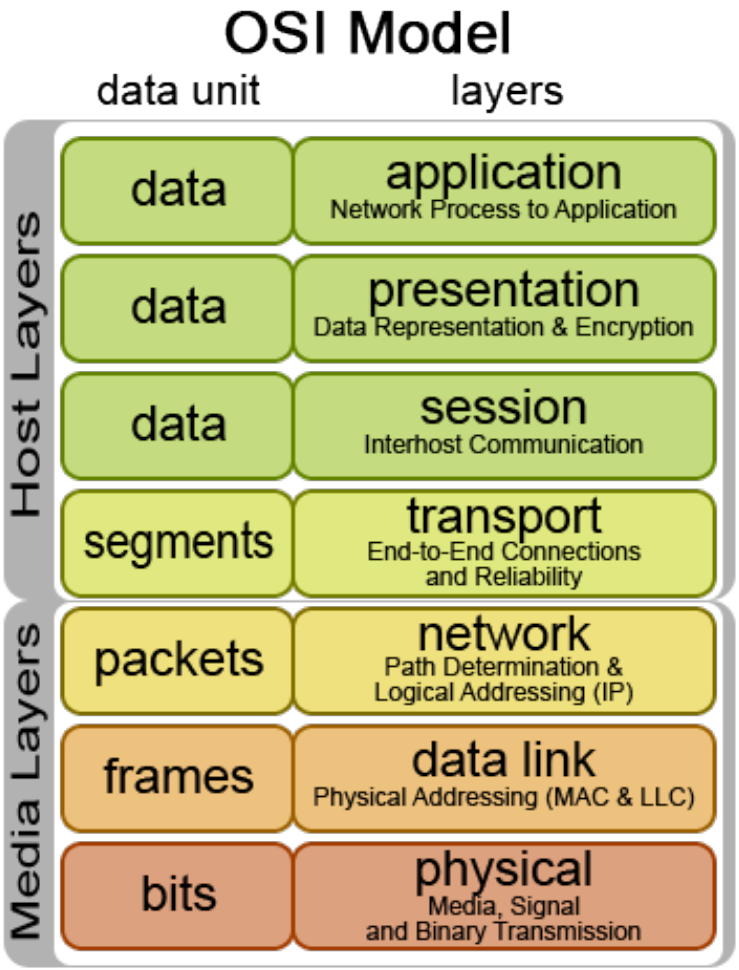
Henrik Bjørlo
henrbjor@ifi.uio.no

10 February 2014

Agenda

1. Layer 1 - The physical layer

The physical layer



From Wikimedia Commons/Dino.korah

Services

Layer 1

- The fundamental layer in the model stack
- Underlying the logical data structures of higher level functions

Service definition

Bit-by-bit transmission between directly connected nodes over a physical transmission medium.

NOTE: No mention of reliability

Bits and symbols

Layer 1

The physical world is analog - how do we transmit a digital signal?

- Waveforms
- Representing a bit (or number of bits) as a
  - Pulse (baseband)
  - Tone (passband)
- Physical symbol vs. logical bit(s)
- Rates may be different (*baud rate* vs. *bit rate*)

Digital baseband modulation (line coding)

Layer 1

Characteristics:

- AC voltage or current
- Mesuring at regular intervals (clock)
- Encoding schemes such as RZ, NRZ, Manchester etc.
- Twisted pair copper wires, optical fibres etc.

Challenges:

- Synchronization/clock recovery
- DC buildup

Digital passband modulation

Layer 1

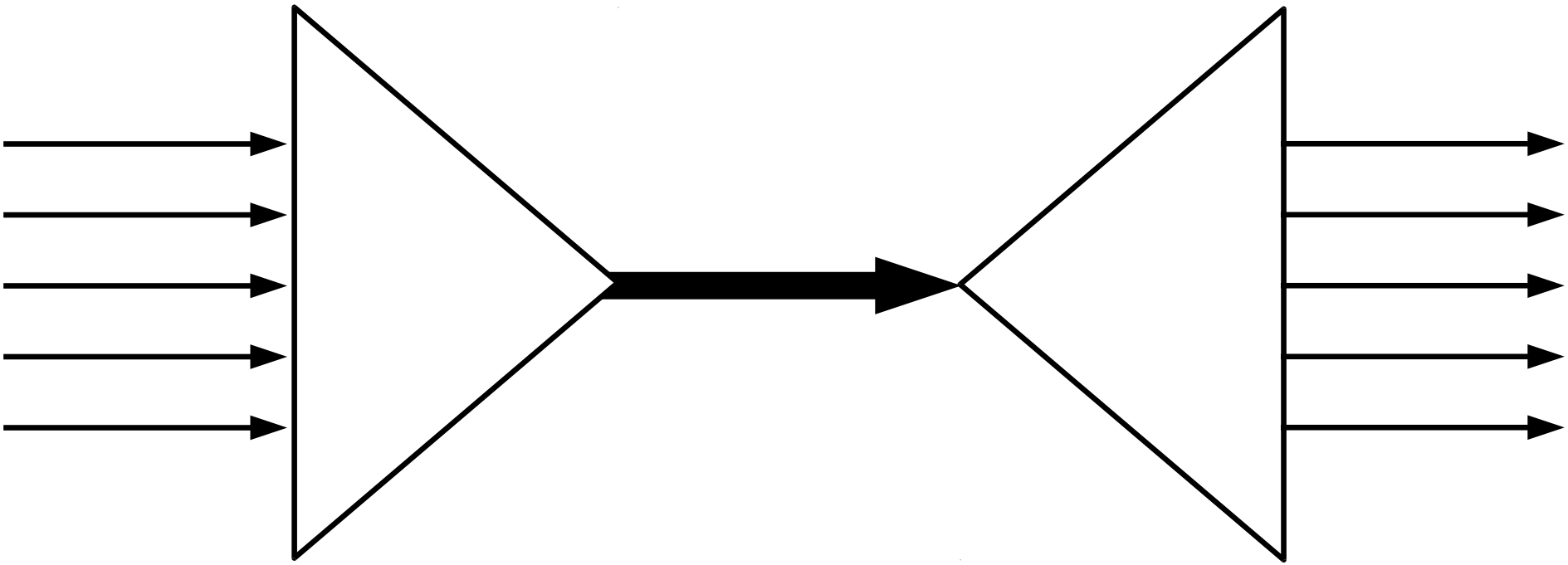
- Radio waves (Electromagnetic waves) over wireless channels
- Baseband transmission is not practical due to antenna size
- Make use of a restricted band of the frequency spectrum (*passband*)
- Interpret changes in *amplitude*, *frequency* and/or *phase*
- Frequency-division multiplexing — convey multiple signals over the same medium in parallell

Trade-off:

- Bandwidth of the passband impacts the data rate of the channel.

Multiplexing

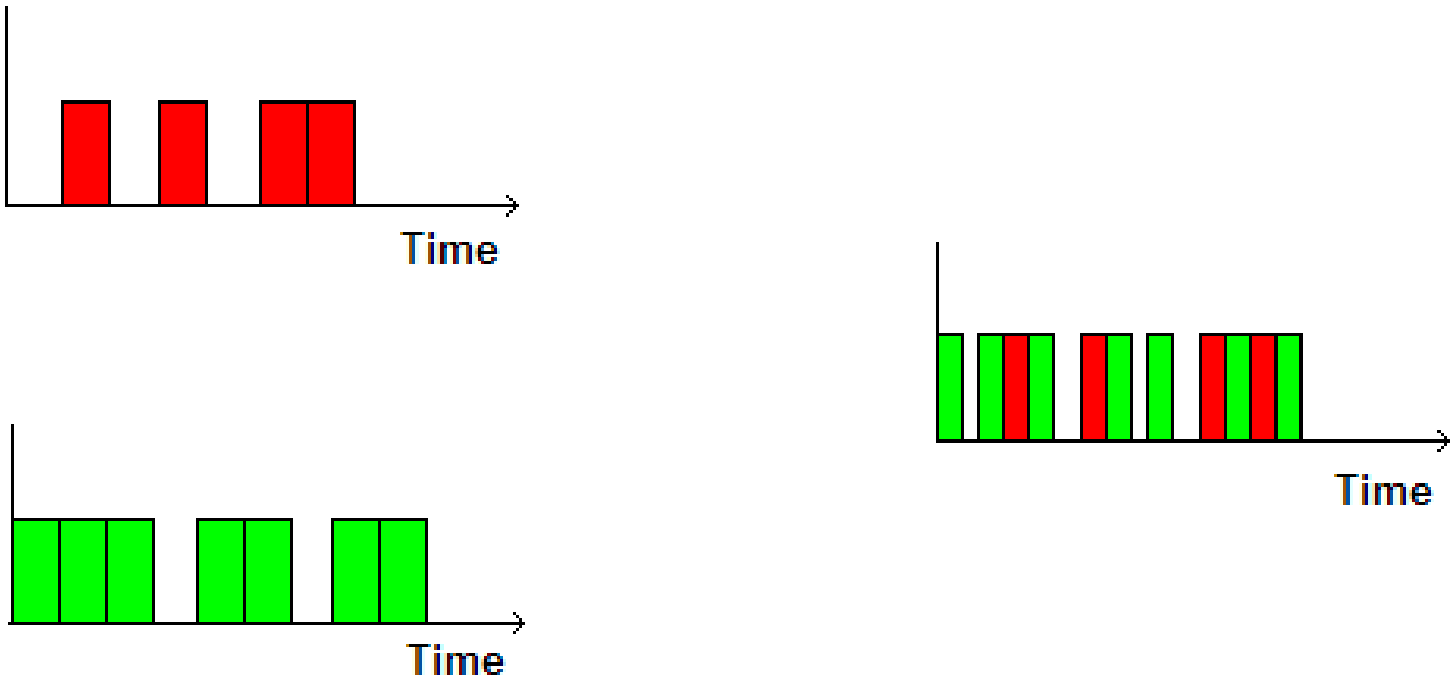
Layer 1



From Wikimedia Commons

Time-division multiplexing (TDM)

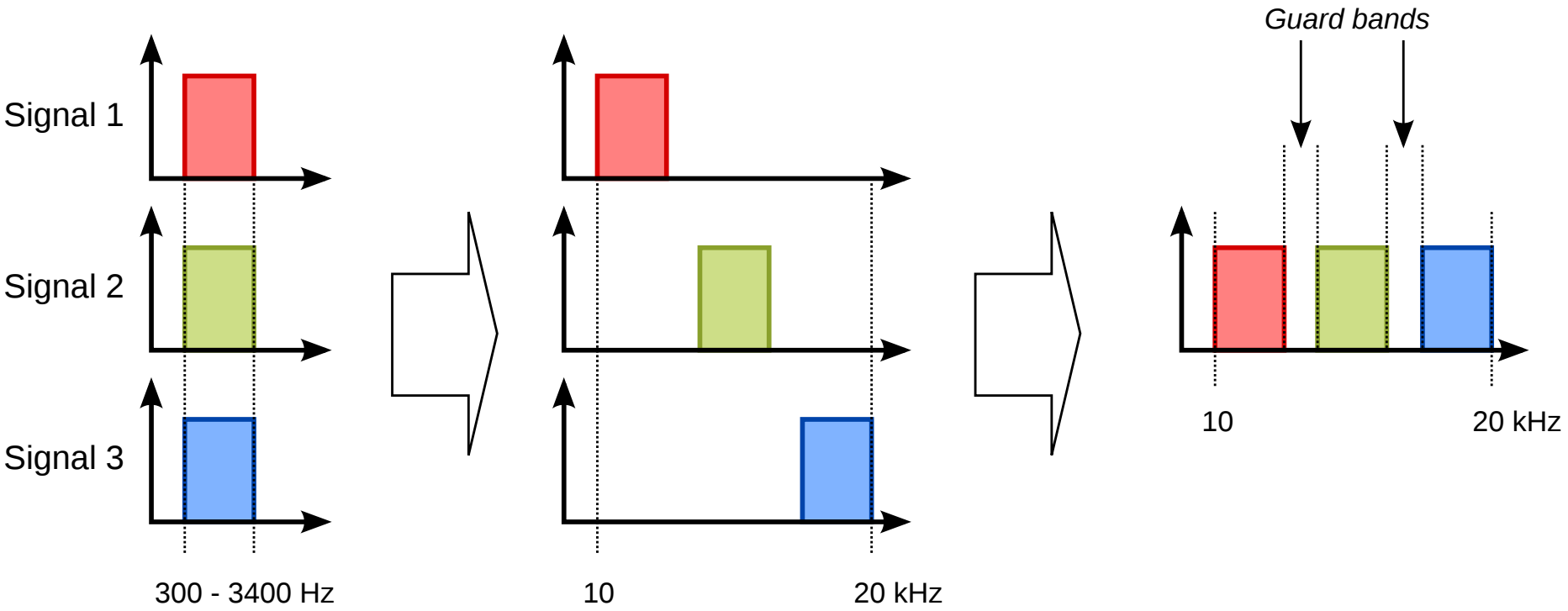
Layer 1



From Wikimedia Commons

Frequency-division multiplexing (FDM)

Layer 1



From Wikimedia Commons/Matthias Bock

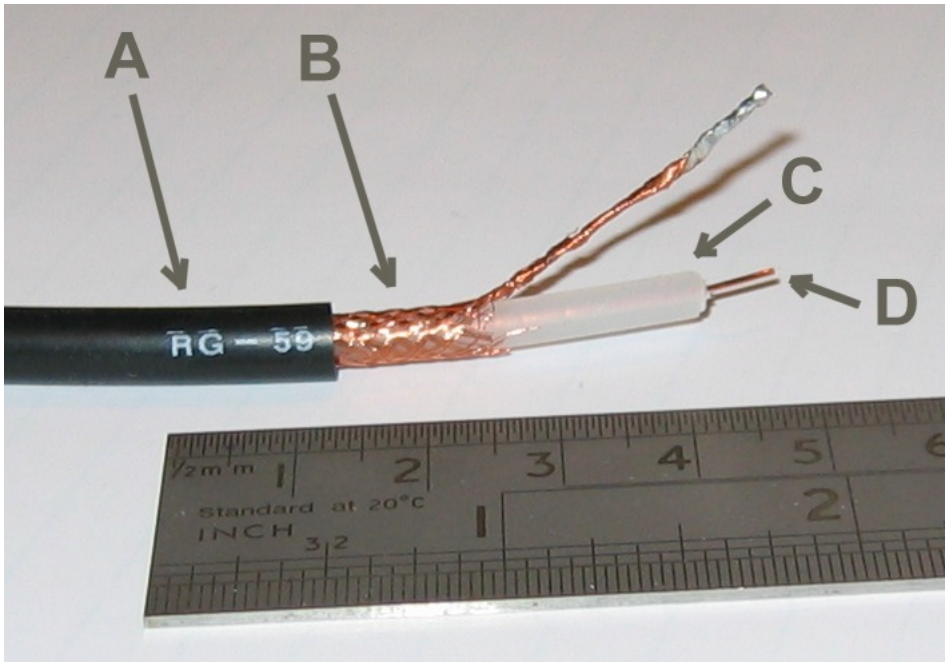
Copper cable

Layer 1

Twisted pair

From Wikimedia Commons

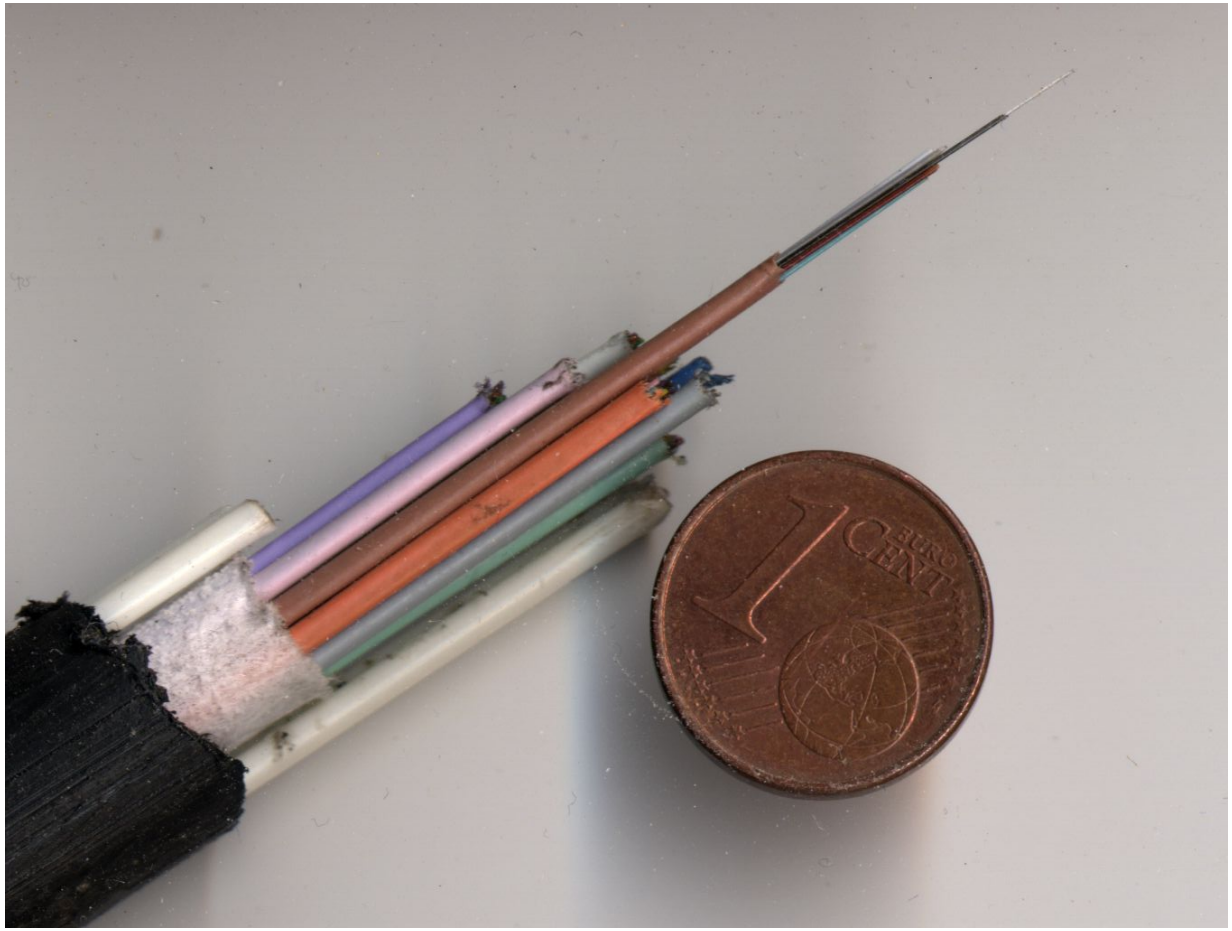
Coaxial



From Wikimedia Commons

Fiber optic cable

Layer 1



From Wikimedia Commons