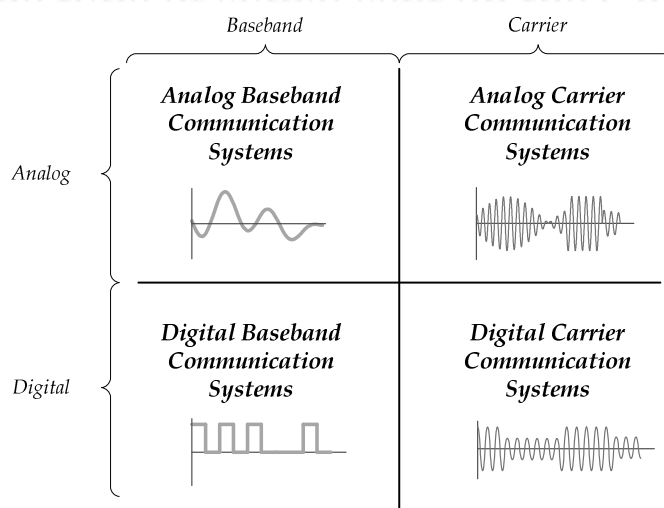


Lecture 2: Classification of Communication Systems

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EE421: Communications I

Comm Systems are classified based on the type of signal sent on the Channel



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Each system has its advantages!

Analog Baseband

- **Simplest** system to build
- **Inexpensive**

Analog Carrier

- Allows use of **Antennas**
- Allows **Multiplexing (FDM)**
- Allows **exchanging SNR for Bandwidth**

Digital Baseband

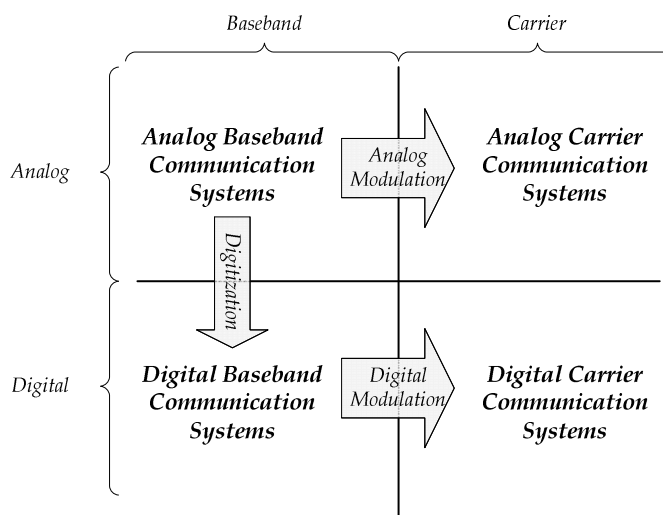
- **Immunity to Noise**
- Allows **Multiplexing at baseband level (TDM)**
- **More bandwidth efficient**
- Allows **exchanging SNR for Bandwidth**
- **For more, see Handout**

Digital Carrier

- Allows use of **Antennas**
- Allows **Multiplexing (FDM)**
- Allows **exchanging SNR for Bandwidth**
- **Also the advantages of digital baseband**

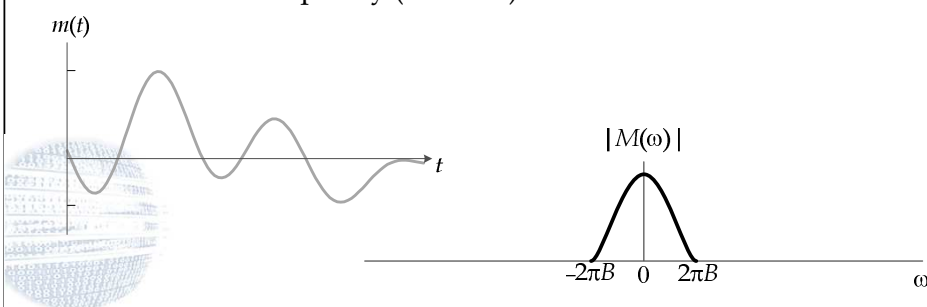


Modulation and Digitization



Analog Baseband Systems

- **Analog:** $m(t)$ can assume **any** value in a continuous range of values at **any** point in time t .
- **Digital:** $m(t)$ can assume only finite voltages or shapes and uses threshold detection.
- **Baseband:** $m(t)$ has a frequency-domain spectrum clustered around zero frequency (the base).

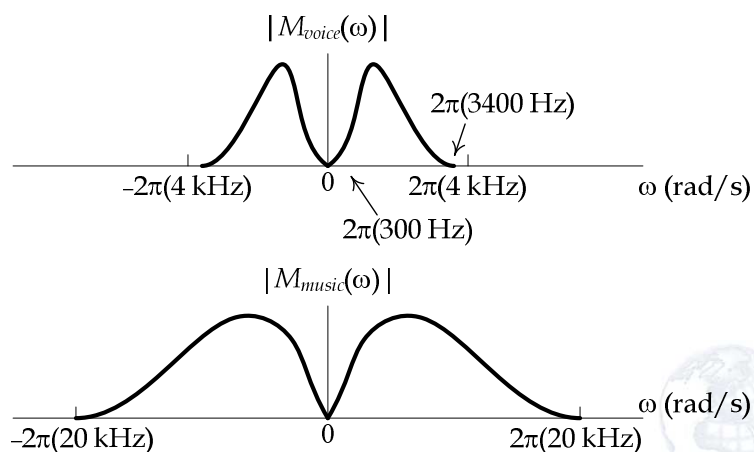


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Examples: Audio

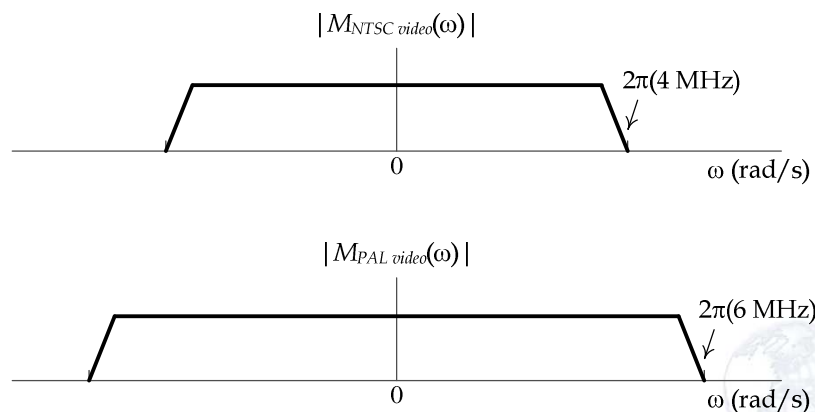


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Examples: Video



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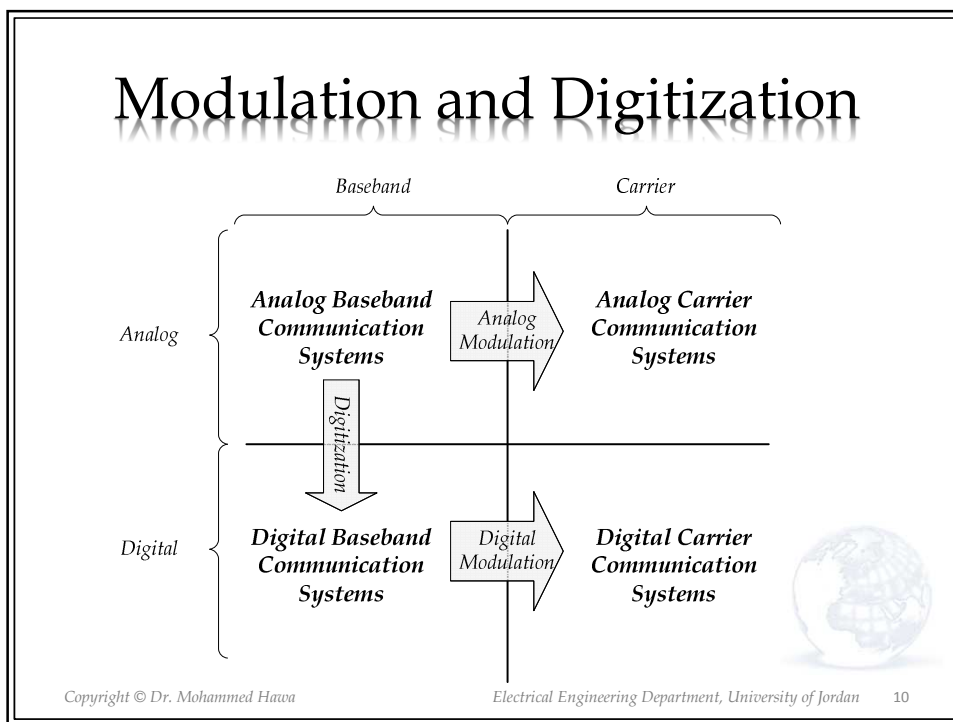
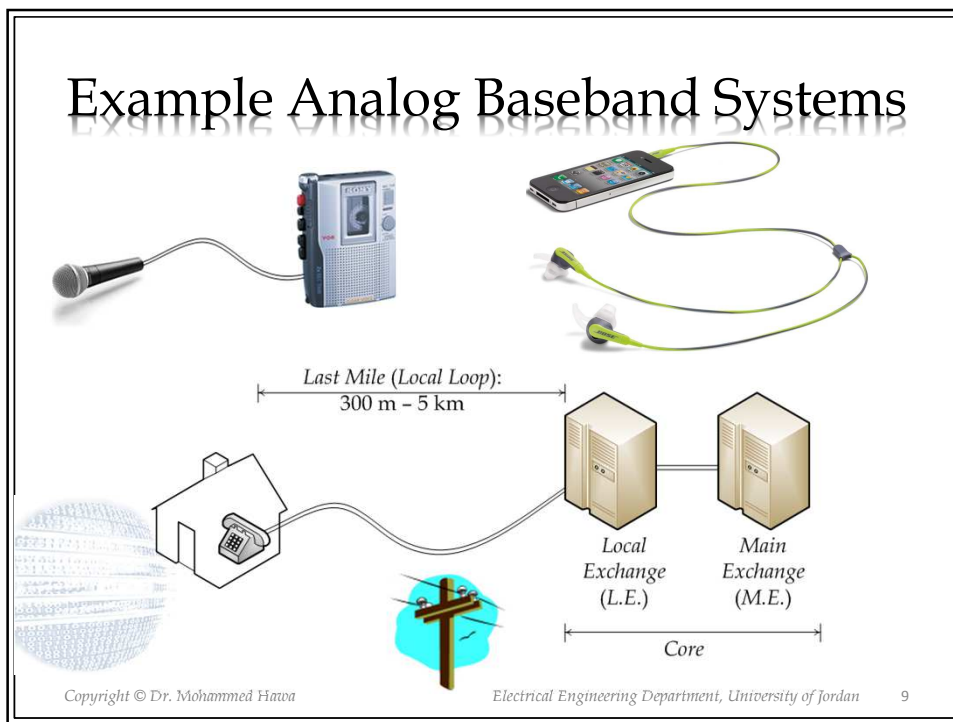
Analog Baseband Systems

- An analog baseband system sends the analog baseband signal $m(t)$ as is (without any modifications).
- Advantages:
 - Simplest possible system.
 - Inexpensive to build.
- Usually used for short-distance communications.
- Examples of such systems in the next slide.

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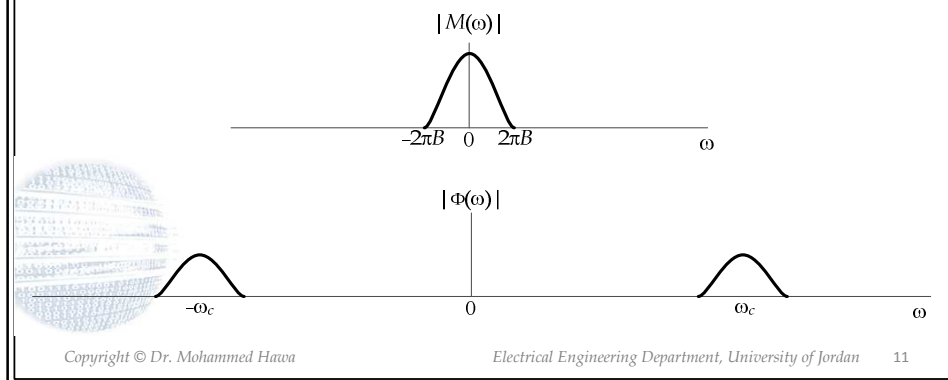
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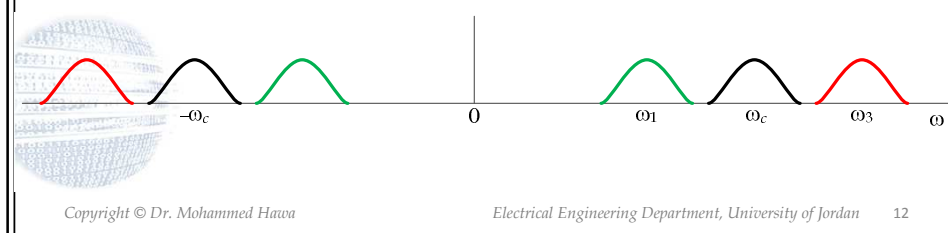
Modulation

- In modulation, the signal $m(t)$ is combined with a high-frequency signal called the carrier.
- Hence, frequencies are shifted.



Analog and Digital Carrier Systems

- Modulation (i.e., analog and digital carrier systems) advantages:
 - Allows the use of reasonable antenna lengths.
 - Allows Multiplexing (FDM). As well as CDMA and OFDMA in digital systems.
 - Allows exchanging SNR for Bandwidth.



Example Carrier Systems

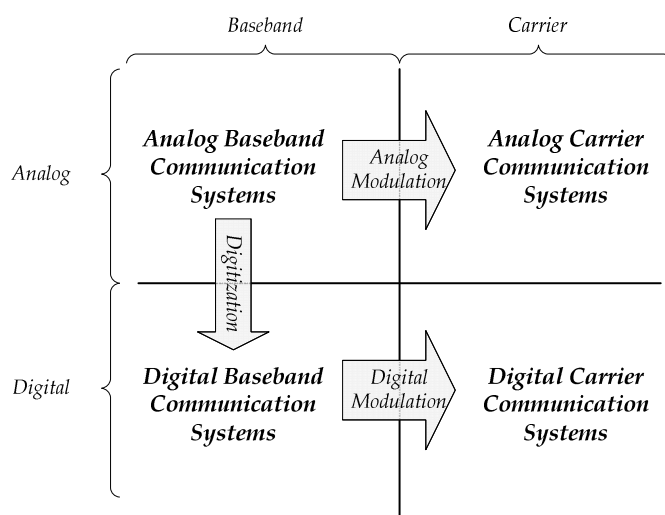
- Examples of **analog carrier** systems:
 - AM and FM radio broadcasting.
 - Analog TV broadcasting (NTSC and PAL).
- Examples of **digital carrier** systems:
 - Digital radio broadcasting (DAB).
 - Digital TV broadcasting (DVB-S, DVB-T, ATSC)
 - WiMAX metropolitan area network.
 - Wi-Fi wireless local area network.
 - Cellular Telephony (2nd, 3rd and 4th generations).
 - Bluetooth, Zigbee and NFC
 - Old dial-up modems.
 - ADSL modems.



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Modulation and Digitization



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Digitization

- To convert the analog baseband signal into a digital baseband signal :
 - Sampling.
 - Quantization.
 - Mapping.
 - Encoding (coding).
 - Pulse Shaping.
- Digital baseband Advantages:
 - Immunity to Noise.
 - Allows Multiplexing at baseband level (TDM).



Example Digital Baseband Systems

- Digital baseband Advantages (*Continue*):
 - More bandwidth efficient (compression and line coding).
 - Allows exchanging SNR for Bandwidth at the baseband level.
 - For more, see Handout.
- Examples of digital baseband systems:
 - Serial (RS-232) and USB port connections.
 - Ethernet (a popular local area network).
 - Telephony (between local exchanges), such as the T-1, T-2, ..., E1, E2, ... etc PDH carriers.



Block Diagram of a Communication System



*Impairments:
Attenuation, Distortion,
Noise, etc*



Source and Destination

