Data Communication BLM3051

Furkan ÇAKMAK

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Lecture Information Form - Weekly Subjects

BLM3051 Data Communication

Week 3

Week	Date	Subjects
1	04.10.2022	Introduction to Data Communication Standards Used on Data Communication, Architectural models
2	11.10.2022	OSI Reference Model , Layers and Their Functions
3	18.10.2022	Signaling and Signal Encoding
4	25.10.2022	Parallel and Serial Transmission, Communication Media and Their Technical Specs., Multiplexing (TDM, FDM)
5	01.11.2022	Error Detection and Error Correction Techniques
6	08.11.2022	Data Link Control Techniques, Flow Control
7	15.11.2022	Asynchronous and Synchronous Data Link Protocols (BSC, HDLC)
8	22.11.2022	1. Vize Haftası
9	29.11.2022	LAN Technologies Continued, IEEE 802.4, 802.5, 802.11
10	06.12.2022	Connectionless and Connection Oriented Services, Switching
11	13.12.2022	Wide Area Networking Technologies (X.25, ISDN, FR, ATM, xDSL.)
12	20.12.2022	Communications Equipment's, TCP/IP Model, Security Issues
13	27.12.2022	Research Presentation 1
14	03.01.2022	Research Presentation 2

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OSI Reference Model - Reminding

7	Application Layer
6	Presentation Layer
5	Session Layer
4	Transport Layer
3	Network Layer
2	Data Link Layer
1	Physical Layer

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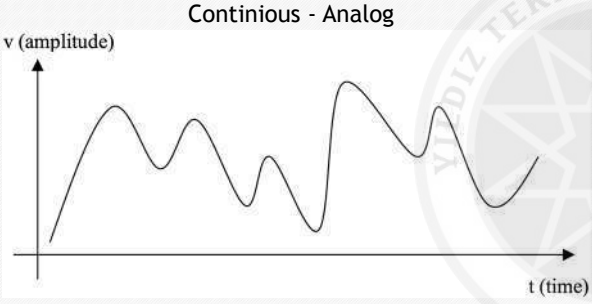
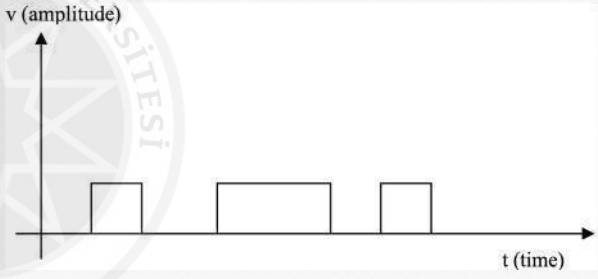
Signals

Continious - Analog



Discrete - Digital



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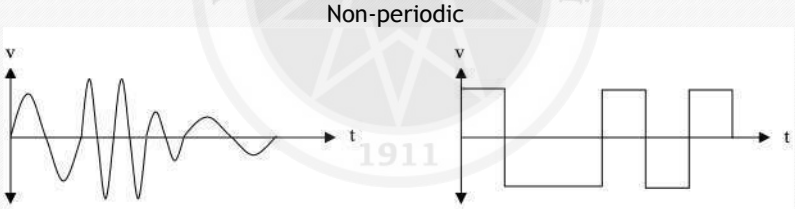
Signals – Con't

Periodic

Non-periodic



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Analog Signals

Simple Analog Signals

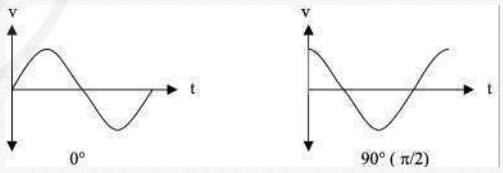
$$f(t) = A\sin(2\pi ft + \phi)$$

Complex Analogue Signals

$$f(t) = \sum_{n=1,3,5..}^{\infty} \frac{1}{n}\sin(2\pi nft)$$

- v – Amplitude
  - Volt - V
  - Amper - A
  - Watt-W
- f – Frequency
  - Cycle
  - Hertz - Hz
- ϕ - Phase
  - Degree - °
  - Radian - π

Frequency	Time
Hz	sec (second)
KHz	msec (milli second)
MHz	µsec (micro second)
GHz	nsec (nano second)
THz	psec (pico second)



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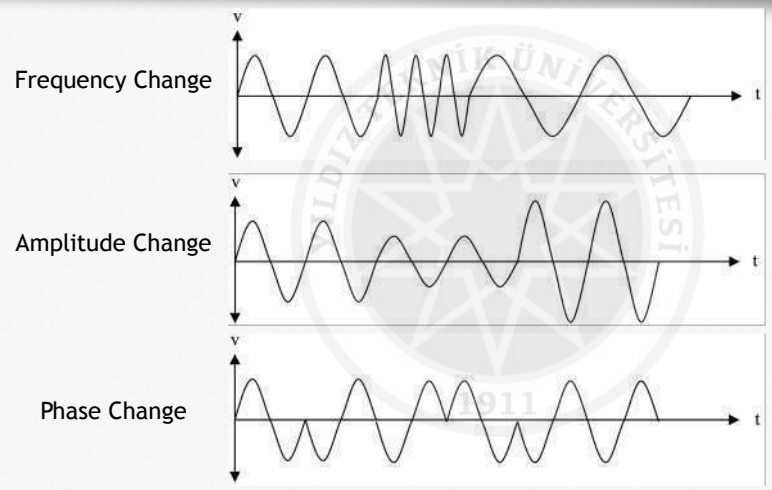
Analog Signals – Con't



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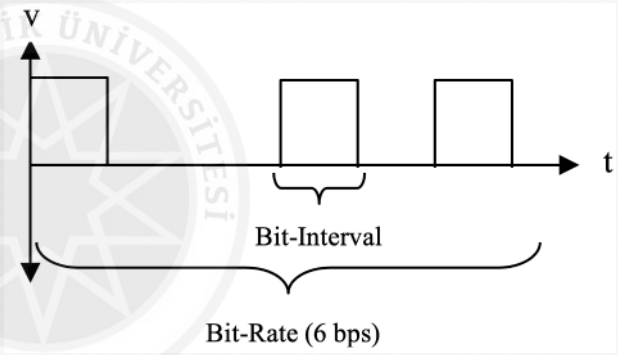
Digital Signals

- Non-periodic
- Bit-rate
  - The number of bits transferred in one second
- Bit-interval
  - The time it takes to transmit one bit (in seconds)



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Elements that Negatively Affect Communication

- Distortion
  - Attenuation
    - dB
    - Solution: Amplifying
      - Analog?
  - Noise
    - Even Idle mode
    - Thermal noise
      - Motion of atomic fragments
    - Impulse noise
      - Random electromagnetic signal
  - Cross talk
  - Delay
  - Propagation: Velocity of a sinusoidal signal in a transmission line

Data Carrying Capacity

- **Nyquist Theorem**
  - The amount of data that can be sent per unit time
  - H: Band width
  - V: Number of discrete voltages
  - Not consider the noise

$$data_{vel} = 2Hlog_2V \ \ bit/sec$$

- Noise (dB)
  - Signal strength (sent): S
  - Strength of the current noise: N

$$SNR = 10log_{10}\frac{S}{N} \ \ dB$$

Data Carrying Capacity – Con't

- **Shannon-Hartley**
  - **Data velocity with noise**

$$data_{vel} = Hlog_2(1 + \frac{S}{N})\ bit/sec$$

- **First, the highest data rate to be achieved is found according to the Shannon-Hartley formula.**
- **Then, according to the Nyquist formula, how many discrete voltage levels can be used in this bandwidth is determined.**

Example

- **Since it is known that the SNR value on a transmission channel between 3KHz-4KHz is 24dB, what is the maximum rate that can be obtained and the number of discrete levels that can be used for transmission?**

$$data_{vel} = 2Hlog_2V\ bit/sec$$

$$SNR = 10log_{10}\frac{S}{N}\ dB$$

$$data_{vel} = Hlog_2(1 + \frac{S}{N})\ bit/sec$$

$$10\log_{10}^{S/N} = 24dB$$

$$S/N = 10^{2,4} \cong 251$$

$$veri\_hizi = 1000\log_2^{(1+251)}\ bit/\sec \cong 8000bit/\sec$$

$$veri\_hizi = 8000bit/\sec = 2*1000\log_2^{v}\ bit/\sec$$

$$4 = \log_2^{v}$$

$$v = 2^4 = 16$$

Coding of Signals

- **Digital – Digital**
  - **Computer – Printer**
- **Analog – Digital**
  - **Microphone – Computer**
- **Digital – Analog**
  - **Computer – Communication Lines**
- **Analog – Analog**
  - **Radio – Radio Signal Lines**

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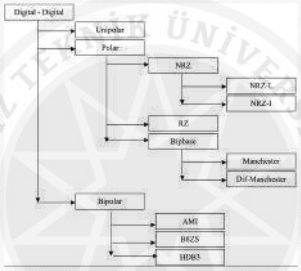
Digital – Digital Coding



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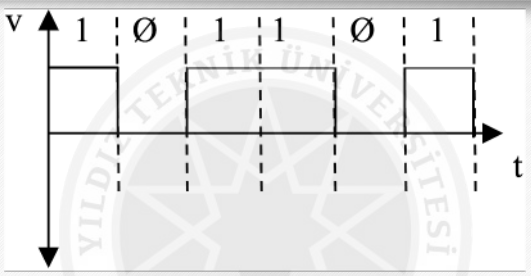
Digital2Digital – Unipolar Coding



- **2 main problems;**
  - **DC Component**
  - **Synchronization**

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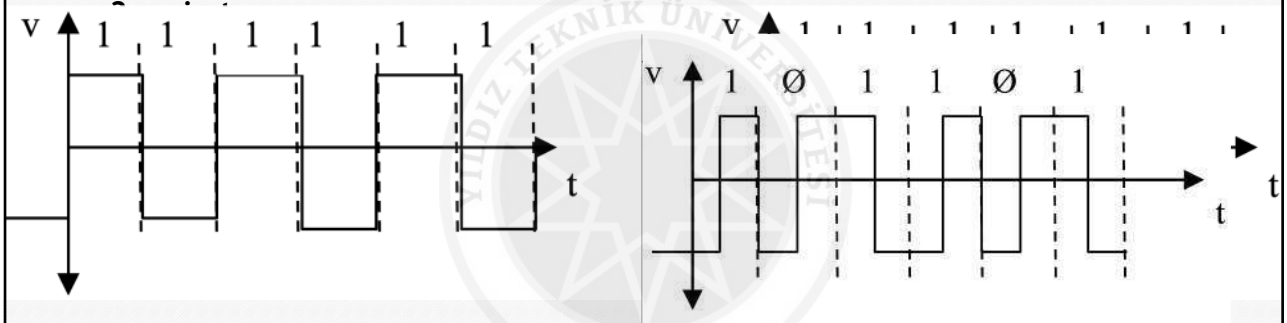
Digital2Digital – Polar Coding



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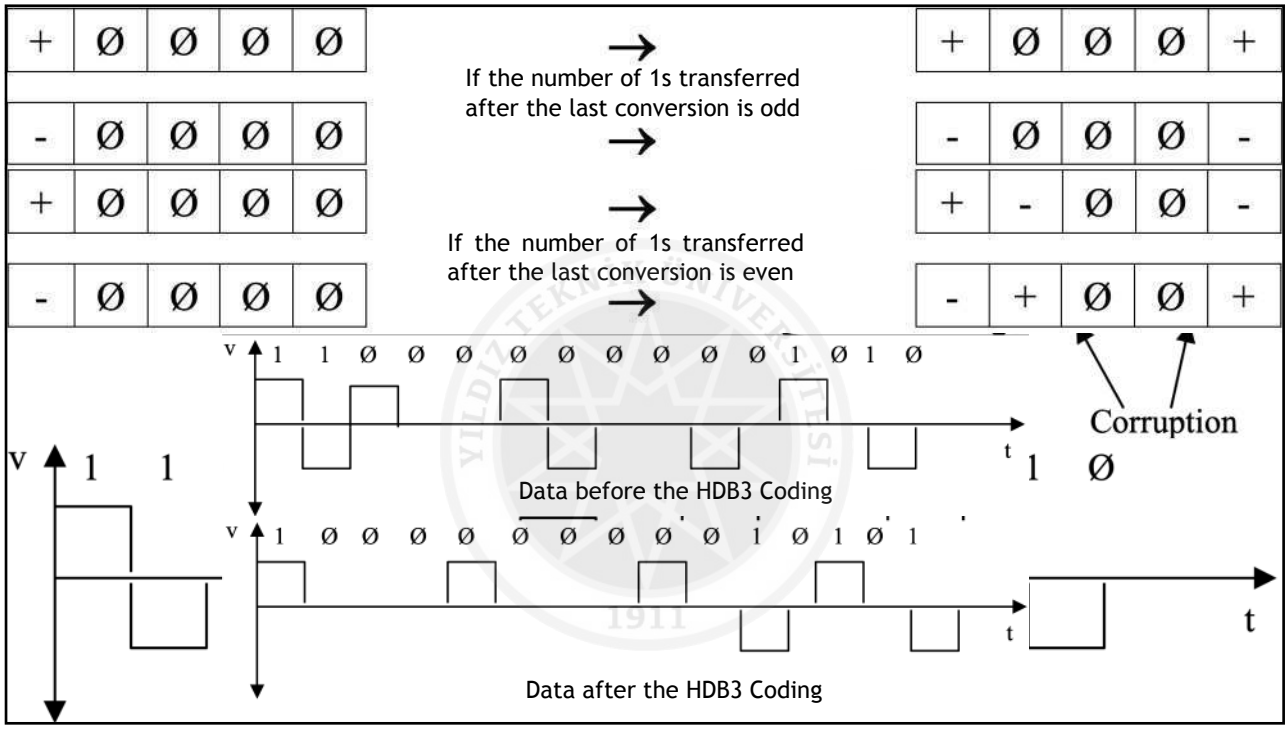

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Analog – Digital Coding

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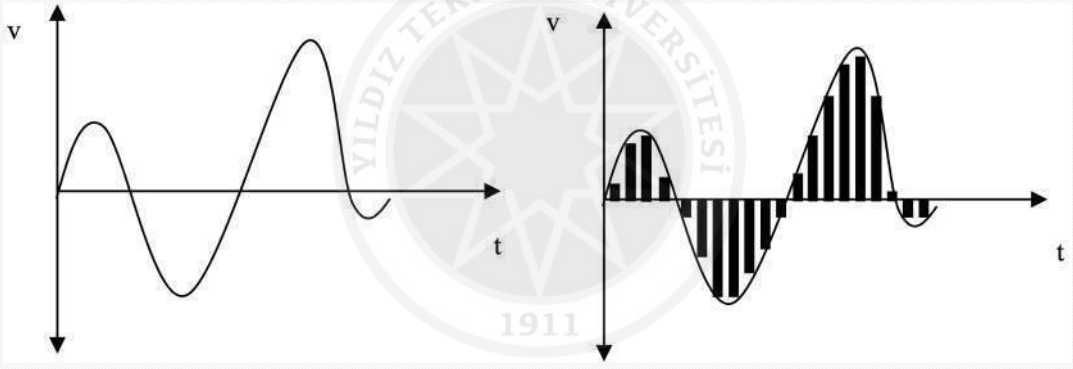
PAM (Pulse Amplitude Modulation)



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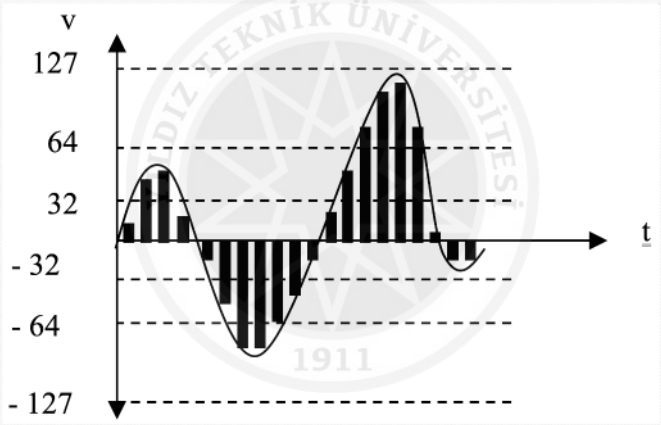
Analog – Digital Coding – Con't

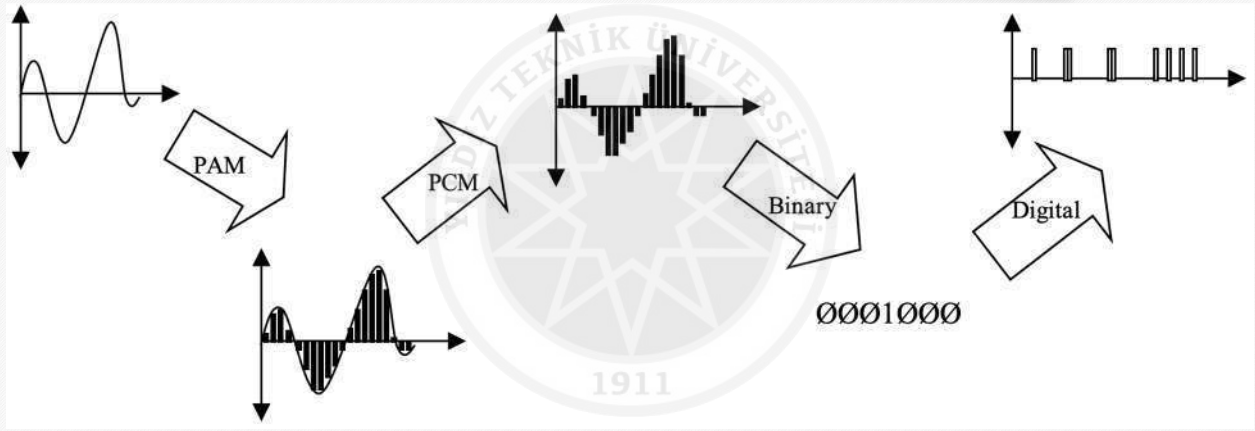
PCM (Pulse Code Modulation)



Analog – Digital Coding - Nyquist Theorem

- **Sampling at least twice the highest frequency component is required**
- **Example:**
  - **If bandwith is 1000-4000Hz, sampling fre. must be 8000**

Transmission of the Analog Signal over the Digital Network



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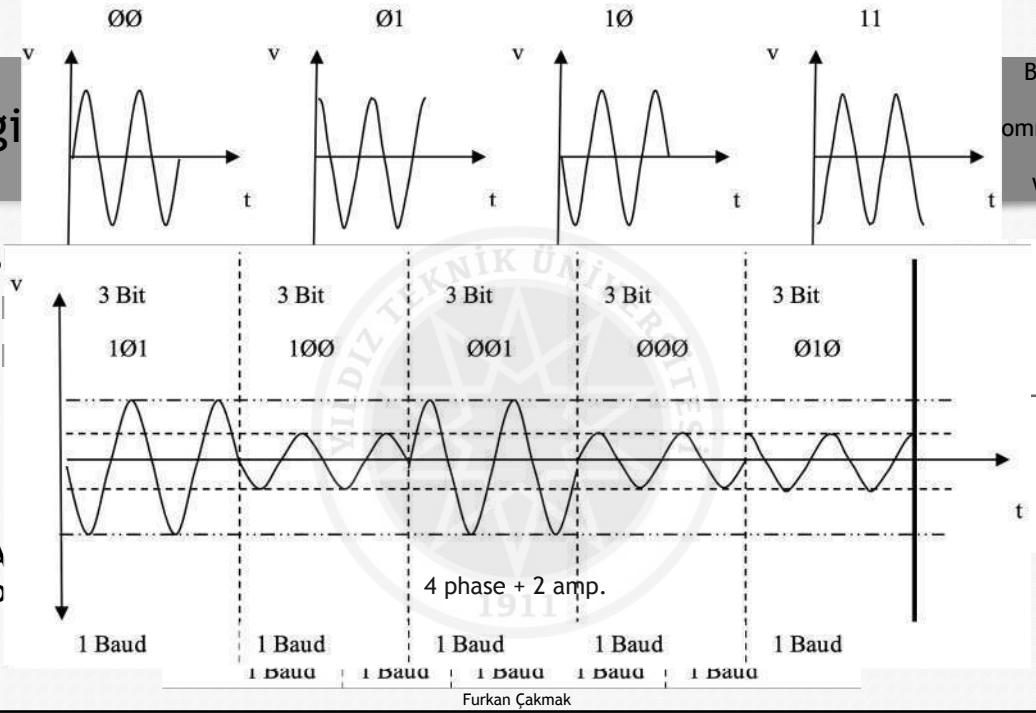
Digi

- AS
- FS
- PS
  -
- QA
  Mo
  -



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Analog – Digital Coding - Concepts

- **Carrier Signal**
- Bit and Baud Speed

Coding Technique	Unit	Baud Speed	Bit Speed	Bits / Baud
ASK, FSK,2PSK	Bit	N	N	1
4PSK, 4QAM	Dibit	N	2N	2
8PSK, 8QAM	Tribit	N	3N	3
16QAM	Quadbit	N	4N	4
32QAM	Pentabit	N	5N	5
64QAM	Hexabit	N	6N	6
128QAM	Septabit	N	7N	7
256QAM	Octabit	N	8N	8

Analog – Analog Coding

- **AM (Amplitude Modulation)**
- **FM (Frequency Modulation)**
- **PM (Phase Modulation)**

Thank you for your listening.

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