

Data Communication BLM3051



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Lecture Information Form - Weekly Subjects

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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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Digital Data Transmission Techniques

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- Medium specs;
 - Connector type to provide mechanical connection in the transmission medium
 - Number of wires
 - Signal type
 - Purpose
 - Frequency, amplitude and phase
- Parallel Transmission
- Serial Transmission

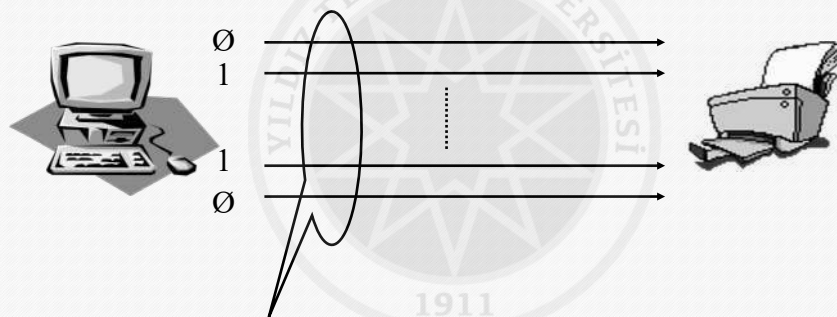
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Parallel Transmission

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N Wired Connection

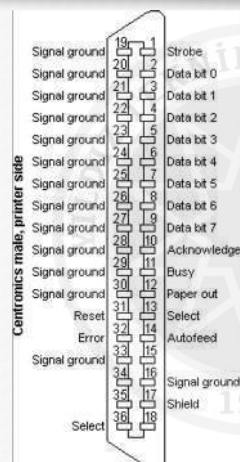
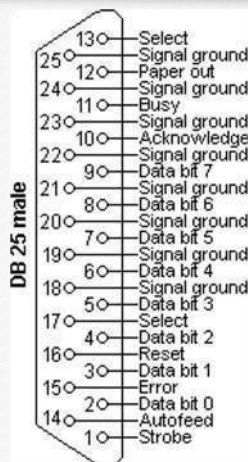
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Parallel Transmission - Con't

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- Standard Parallel Interface
 - 155 kByte/sec
- ECP/EPP (Enhanced Parallel Port/Enhanced Capability Port)
 - 3 MByte/sec
- Maximum Cable Length: 7.5m

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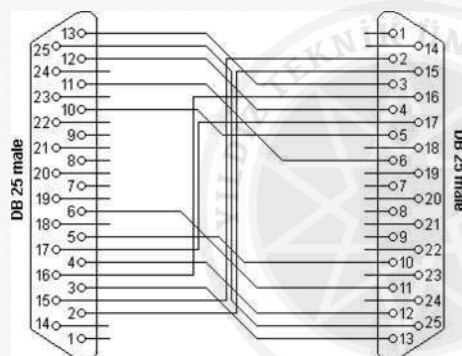
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Parallel Transmission - Con't

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- Laplink
- Interlink

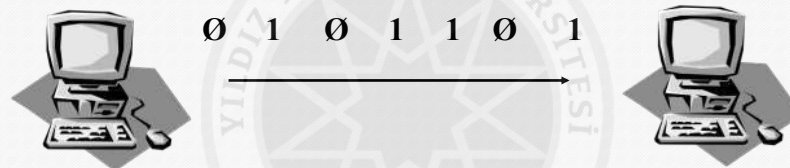


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Serial Transmission

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Serial Transmission - Con't

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- RS-232-C
 - 9 wires
 - RX
 - TX
 - GND
 - 6 x Flow Control Wire
 - 155 kbits/sec
 - 15 meters
 - NRZ-L
 - $(-15 \sim -5)V_{DC} \rightarrow 1$
 - $(+5 \sim +15)V_{DC} \rightarrow 0$
 - RS-422: 300 meters
- Asynchronous transmission in WAN
 - 2 wires
- Synchronous transmission in WAN
 - 4 wires

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Asynchronous Serial Transmission

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- Simple, Cheap
- The data arrival rhythm between the sides is not the same.
- It is not possible to tell when the incoming transmission started and when it ends
- Receiver and transmitter must agree on how long each bit will remain on the line.
- Start bit: 0, positive voltage
 - 8-N-1
 - $1 + 8 + 1 \rightarrow$ LSB
 - N: not parity bit
 - 7-E-1
 - $1 + 7 + 1$ (Even)
- Stop bit: 2-bits long

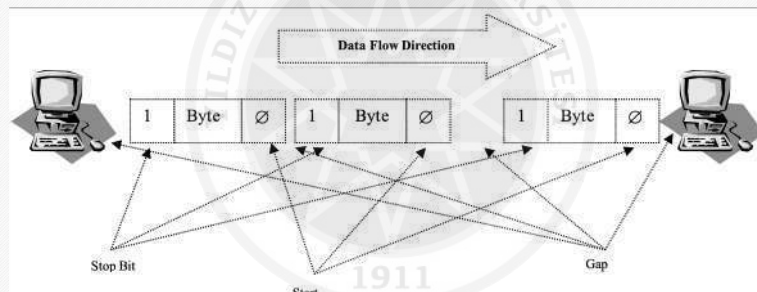
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Asynchronous Serial Transmission - Con't

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- Since the communication between the sender and receiver is not made simultaneously, there are **gaps** of variable duration between the bytes sent.



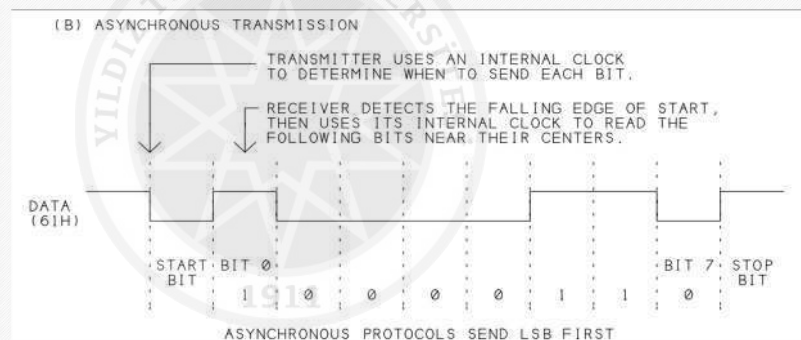
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Asynchronous Serial Transmission - Con't

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- Time skew
 - If the processing speed difference between the two sides is 5%
 - 8th -> 45%
- Dial-up
 - Carrier Signal



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Synchronous Serial Transmission

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- Much more big data transfer compare to Async within one transmission (>1000 byte)
- If there is no data transmission
 - A special bit sequence is sent in the line.
- In order for the information to be transferred properly, operations must be carried out depending on a common timing mark.
- Like an assembly line.
- Clock line: A different line
 - Clock pulse
 - Short distance transmissions

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Synchronous Serial Transmission - Con't

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- Logical Level Synchronization
 - Preamble Bit Array
 - Postamble Bit Array
 - Max 100 bits for control data.
 - HDLC (High Level Data Link Control)
 - 48 bits for control purposes.
 - Example
 - If we want to transfer 1000 characters in HDLC mode, how much bits send?
 - 1 character → 8 bit
 - 1000 characters → 1 block
 - Control data → 48-bit
 - 1 block → 8000 bit
 - $8000 + 48 \rightarrow 8048$ bits
 - Load of control data per bloc → $48 / 8048 \approx 0,6\%$

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Asynchronous ST vs Synchronous ST

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Synchronous	Asynchronous
<ul style="list-style-type: none"> + Much more efficient usage + Better error control + High transmission speed 	<ul style="list-style-type: none"> + Simple + Cheap + Additional effort required for timing + Limited speed - Limited error control mechanism (parity) - 20% loss due to start / end bits

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DTE-DCE Interfaces

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- DCE (Data Circuit-Terminating Equipment)
 - Modem
- DTE (Data Terminal Equipment)
 - Computer
 - Printer
 - Fax
 - etc.



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DTE-DCE Interfaces - Con't

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- Standards between DTE and DCE
 - EIA
 - EIA-232
 - EIA-442
 - EIA-449
 - ITU-T
 - V.24
 - V.32
 - V.32bis
 - V.34
 - X.2
 - X.24

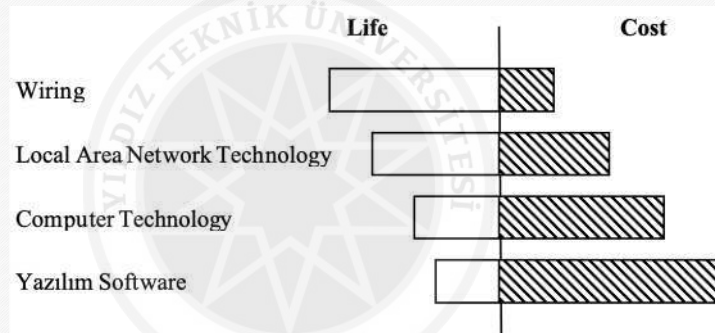
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Transmission Medium

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- Wire
- Light
- Radio Wave
- Guided and Unguided media



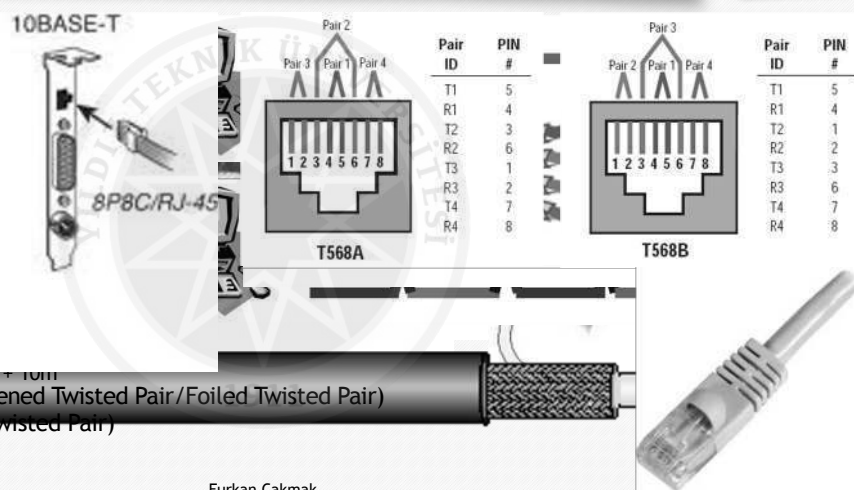
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Guided Media

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- Coaxial Cable
 - AUI (Attachement)
 - Ethernet
 - Thick: 10mm
 - Thin: 5mm
- Twisted pair
 - DGM (Data Grade)
 - CATs
 - 2-12 twist/step
 - Different Colors
 - There are 3 different types
 - UTP (Unshielded Twisted Pair)
 - 100m = 90m + 10m
 - ScTP/FTP (Screened Twisted Pair/Foiled Twisted Pair)
 - STP (Shielded Twisted Pair)



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Guided Media - Con't

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- UTP cables category criterias:

- Signal Frequency
- Wire length
- Correct connections
- Attenuation
- NEXT (Near-End Crosstalk)
- PSNEXT (Power Sum NEXT)
- FEXT (Far-End Crosstalk)
- ELFEXT (Equal Level FEXT)
- PSELFEXT (Power Sum ELFEXT)

- CAT 5e

- gigabit Ethernet
- 4 pieces of 2
- Propagation delay
 - Skew
 - Fastest - Slowest

AWG	Weight (kg/km)
22	2,895
23	2,295
24	1,820
26	1,145

Remote

RJ45 = Cat. 5e/6/6_A GG45 = Cat. 7/7_A

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Classification of UTP Cables

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Type	Usage Purpose	Freq. (MHz)	Connector Type ⁷⁴	Usage Area
Cat-1	Voice	1	6P2C / RJ-11	Voice / Phone
Cat-2	Voice - Data	4	8P8C / RJ-45	Voice / 4Mbps TokenRing / Terminal
Cat-3	Voice - Data	16	8P8C / RJ-45	Voice / 10Base-T / 25Mbps ATM
Cat-4	Data	20	8P8C / RJ-45	10Base-T / TokenRing
Cat-5	Data	100	8P8C / RJ-45	10Base-T / 100Base-T / ATM / CDDI
Cat-5e	Data	> 100	8P8C / RJ-45	100Base-T / 1000Base-T
Cat-6	Data	250	8P8C / RJ-45	1000Base-T / 10GBase-T@55m
Cat-6a ⁷⁵	Data	> 500	8P8C / RJ-45	10GBase-T
Cat-7	Data	600	8P8C / GG-45 ⁷⁶	10GBase-T
Cat-7a	Data	1000	8P8C / GG-45	40Gbps@50m / 100Gbps@15m
Cat-8	Data	> 1.200	Double Connectivity	> 40 Gbps@30-50m

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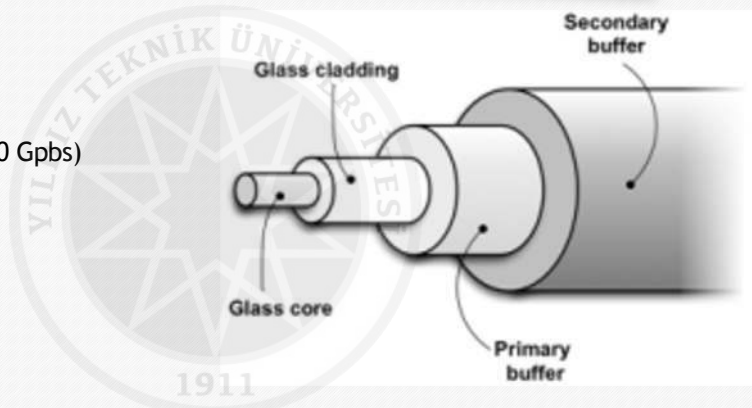
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Guided Media - Fiber Optic Cabels

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- ~~Coaxial Cables~~
- ~~Twisted Pair Cables~~
- Fiber Optic Cables
 - 300.000 km/sec
 - ≥ 100 Gbps (reached 500 Gbps)
 - Core
 - Cladding
 - Primary buffer
 - Secondary buffer
 - Armor
 - Plastic Shield
- SMF (Single Mode Fiber)
- MMF (Multi Mode Fiber)



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Guided Media - Fiber Optic Cabels - Con't

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- Single Mode Fiber (SMF)
 - Core: $9\ \mu\text{m}$
 - Light wavelength: $1.3 - 1.5\ \mu\text{m}$
 - $1.3\ \mu\text{m} \approx 9\ \mu\text{m} \rightarrow$ Transmission is carried out as a single, unbreakable beam



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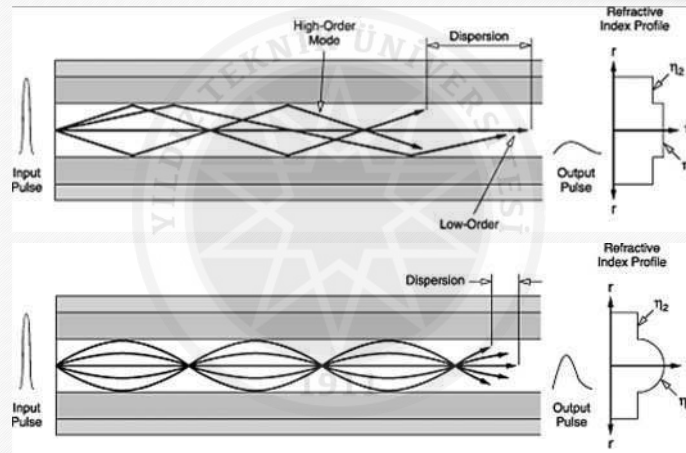
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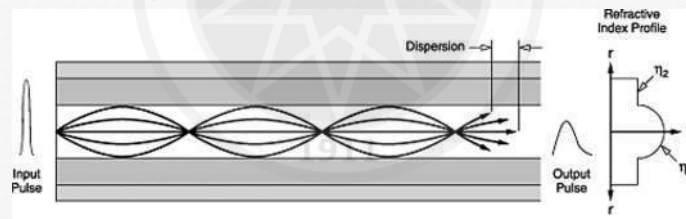
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Step Index



Grade Index



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Guided Media - Fiber Optic Cabels - Con't

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Guided Media - Fiber Optic Cabels - Con't

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- Light sources used in fiber optic media:
 - LED (Light Emitting Diode)
 - Nonfocusable
 - ILD (Injection Laser Diode)
 - Focusable
 - Receiver side: fotodiod (Photosensitive cell)
 - It is a circuit element that can generate electrical signals depending on the strength of the light falling on it.

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Advantages of Fiber Optic Cables over Copper Cables

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- Broad Bandwidth
- Immunity to Electromagnetic Interference
- Attenuation
- Insulation
- Space Saving
- Security
 - Eavesdrop

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Things to Consider When using Fiber Optic Cables

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- The core parts of the fibers used at both ends must overlap exactly.
 - Attention should be paid to dirt, oil, dust and scratches.
 - Dirt, dust, etc. should be cleaned with air gun or alcohol.
 - Scratches should be polished and rounded.
- Fiber cables are fragile like glass and must be kept gently bent.
- When not in use, fiber cables should be stored with special headers to protect them from dust and scratches.
- The laser beam at the end of the fiber optic cable is dangerous to the eyes.

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Unguided Media

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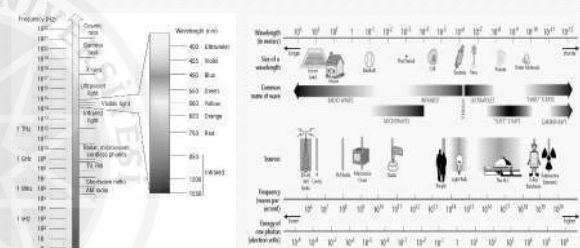
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- Technologies that aim to use the atmosphere:

- RF (Radio Frequency)
- Microwave
- IR (Infra Red)

- Ionosphere

- Ground propagation < 2 MHz
- Sky propagation 2-30 MHz
- Line of sight propagation > 30 MHz



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Unguided Media - Radio Frequency

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- 3 kHz - 1 GHz
- Television ve Radio
- Omnidirectional
- Antennas do not need to be aligned
- RF can go through the Wall.
- Obtain approval from authorities to use RF.
- Non-approval RF types:
 - Bluetooth, IEEE 802.11, etc.

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Unguided Media - Microwaves

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- 1-300 GHz
- Satellite - Ground Station
- Parabolic and horn antennas
 - Unidirectional
 - LOS - Line Of Sight
- Microwaves can not go through the Wall
- It can be harmful to the living creature between the transceiver, depending on the signal strength used.

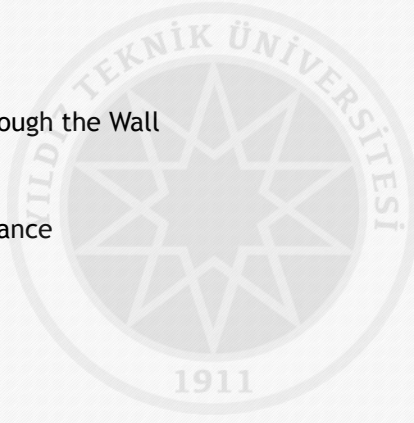
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Unguided Media - Infra Red

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- 300GHz-400THz
- Point-to-point
 - Device's remotes
- Infra Red can not go through the Wall
- Tapping-eavesdropping
- Jamming Immune
- 75 kbps in max. 8m distance
 - Top: 4 Mbps



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Comparison of Transmission Medium

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Ortam Özellik	UTP	STP	Coax	FO	RF	IR	Mikro Dalga	Uydu	Hücrel
Fiyat (\$/m)	Düşük	Orta	Orta	Yüksek	Orta	Düşük (Yüksek)	Yüksek	Yüksek	Yüksek
Hız	1 Mbps- 1 Gbps	1 Mbps- 150 Mbps	1 Mbps- 1 Gbps	10 Mbps- 10 Gbps	1 Mbps- 10 Mbps	4 Mbps (Gbps)	1 Mbps- 10 Gbps	1 Mbps- 10 Gbps	9.6 kbps- 19.2 kbps
Sinyal Zayıflaması	Yüksek	Yüksek	Orta	Düşük	Düşük- Orta	Düşük- Orta	Değişken	Değişken	Düşük
EMI	Yüksek	Orta	Orta	Düşük	Yüksek	Yüksek	Yüksek	Yüksek	Orta
Güvenlik	Düşük	Düşük	Düşük	Yüksek	Düşük	Orta- Yüksek	Orta	Orta	Düşük
Düğüm Ekleme	Kolay	Kolay	Kolay	Zor	Kolay	Kolay	Kolay	Kolay	Kolay
Mesafe	Kısa	Kısa	Orta	Uzun	Orta- Uzun	Kısa- Uzun	Uzun	Uzun	Uzun

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Thank you for your listening.

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