

Fakulta strojní VŠB – TUO

Department of Control Systems and Instrumentation

Automatic Control Devices
(Materials for write notes)

doc. Ing. Jaromír Škuta, Ph.D.

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Lecture No. 5

Industrial networks, basic types, 7 layer model, physical layer...
application layer
(18, 21).

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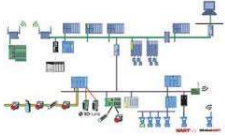
What do you find out?

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ILAN – industrial networks

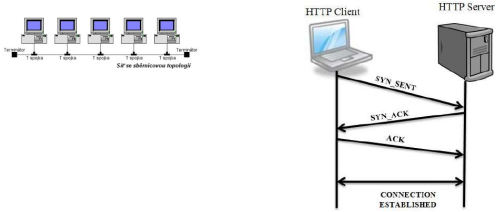
serves to transmit information in an industrial (disturbed) environment



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ILAN confirmation

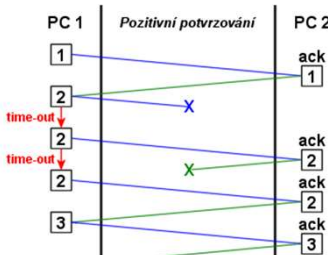


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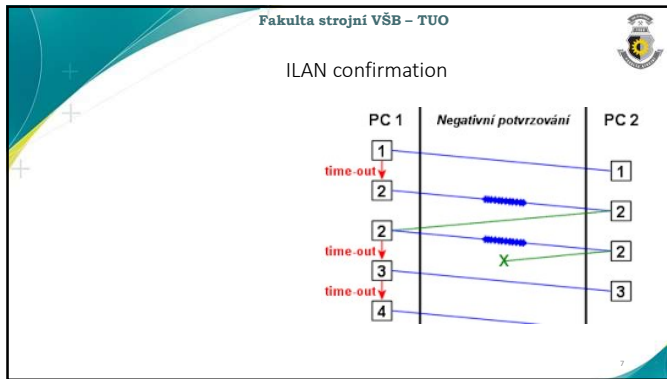
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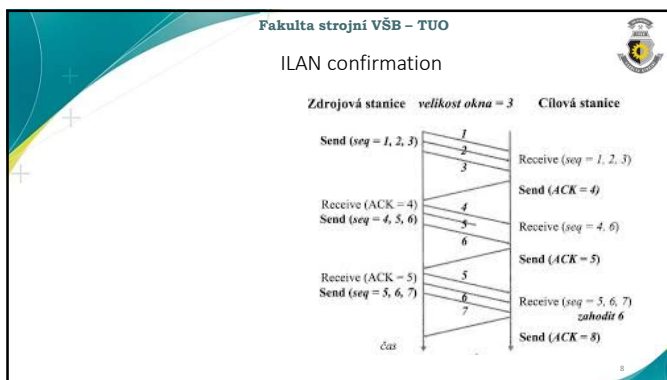
ILAN confirmation

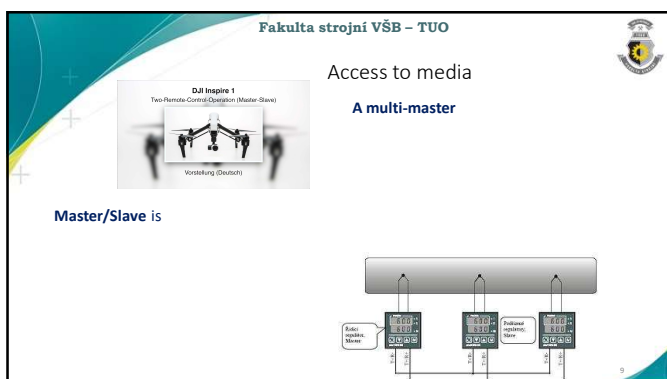
PC 1 *Pozitivní potvrzování* PC 2



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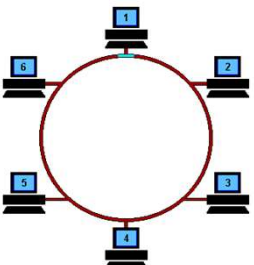




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Access to media

The principle of the **Token ring** network is

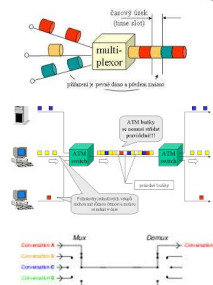


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Access to media

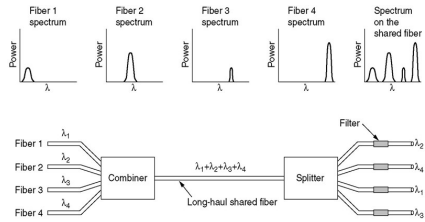
Time division, **time multiplex** or



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Access to media



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Motto:

Industrial communication systems

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[illegible]

Industriální komunikace

Industrial communication systems in the context of automation devices

Internet

S S

Ethernet TCP / IP

OS OS OS

2. Úroveň

Systémová sběrnice / Průmyslový Ethernet

RS RS RS RS

1. Úroveň

Instrumentace

PROCES

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[illegible]

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Communication links - ISO/OSI reference model

The diagram illustrates the ISO/OSI reference model, which consists of seven layers. Each layer is represented by a horizontal bar with a specific protocol or set of protocols associated with it. The layers are numbered 1 to 7 from bottom to top. The protocols are listed on the left and right sides of the diagram.

Layer	Protocol(s)
1	Physical
2	MAC, LLC
3	Network
4	Transport
5	Session
6	Presentation
7	Application

The diagram also shows the flow of data between the layers, with arrows indicating the direction of communication. The layers are interconnected, and the data flow is shown as a continuous stream from the application layer down to the physical layer and back up.

Below the main diagram, there are two additional diagrams. The left one shows the layers of the OSI model (Application, Presentation, Session, Transport, Network, Data Link, Physical) and the right one shows the layers of the TCP/IP model (Application, Transport, Network, Link, Physical). Both diagrams show the flow of data between the layers, with arrows indicating the direction of communication.

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Communication links

- Individual layers can be implemented by
- Most ILAN networks are designed for

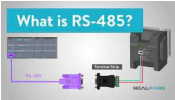
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Physical Layer

- (Physical Layer) ensures the reception and

What is RS-485?



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Data Link Layer

- (Data Link Layer) determines how messages are

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Network Layer

- (Network Layer) ensures a connection

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Transport Layer

(Transport Layer) ensures reliable message

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Session Layer

- (Session Layer) must

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Presentation Layer

- (Presentation Layer) takes care of correct

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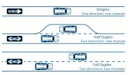
Application Layer

- (Application Layer) is

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Comparison of RS 485 and RS 232



• RS 232C	Transmission speed:	20 kbit/s
• Transmission distance:	15 m	
• RS 485	Transmission speed:	10 Mbit/s
• Transmission distance:	12 m	
	120 m	1 Mbit/s
	1200 m	100 kbit/s

Half-duplex (poloviční duplex)

Full-duplex (plný duplex)

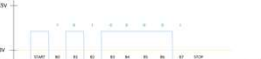
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Physical layer





RS 232




[illegible]

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Physical layer

RS 485








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Smart sensors

The diagram illustrates the architecture of a smart sensor, divided into three main sections: Inlet part, Inner part, and Output part.

- Inlet part:** A yellow circle labeled "Sensor" sends data to a blue box labeled "Převodná unifikační signál". A cloud bubble above this box contains the text: "Měření např. prostřednictvím snímačů".
- Inner part:** A large blue box labeled "Mikroprocesor se vstupny (A/D, diskretiz., frekvencí, ...)" contains two sub-components: "Číslo konverzního vstupu" (blue box) and "Analogový výstup" (green box). A cloud bubble below the main box contains the text: "Procesorová jednotka vykonává převod např. na digitální, měření výkonu a teploty, měření útlumu a posunutí vlny zvuku".
- Output part:** The "Analogový výstup" box sends data to a cloud bubble containing the text: "Výstupní signál pro analogový čítač (např. 0-10V, 0-5V, 4-20mA, ...)". Below this, a cloud bubble contains the text: "Režimový signál konfigurační a číselný (A/D, D/A, 0-10V, 0-5V, 4-20mA, ...)".

Arrows indicate the flow of data from the Inlet part to the Inner part, and from the Inner part to the Output part.

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Selected characteristics of the CAN bus

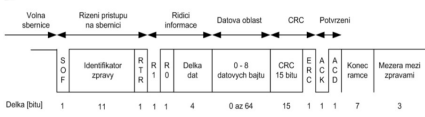
- Two-wire serial data bus.
- The transmission path used can be a twisted pair.



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CAN bus frames



Field	Length [bits]
SOF	1
Identifikátor zprávy	11
RTR	1
R0	1
Délka dat	4
0 - 8 datových bajtů	0 až 64
CRC 15 bitů	15
ERC	1
ACK	1
Konec rámce	1
Mezera mezi zprávami	7
	3

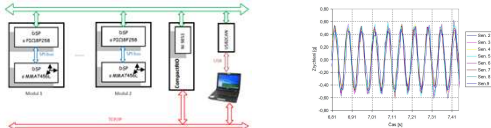
- **SOF** (Start Of Frame) – start of frame,
- **Identifikátor zprávy** – determines the priority,
- **RTR** (Remote Request) – data frame or data request,
- **R1 (IDE)** – standard or extended frame,
- **Délka dat** – values 0-8,
- **Data** – 0-8 bytes,
- **CRC** – security,
- **ERC** – separator bit,
- **ACK** – confirmation,
- **ACD** – separator.

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Module requirements - firmware

- Option to set sensor registers using the ILAN (CAN) bus.



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Configuration frameworks for MEMS

Byte	B0	B1	B2	B3	B4	B5	B6	B7
C1	255	x	x	x	x	x	x	x
	reading from all connected							
C2	ID_m	128	x	x	x	x	x	x
	reading from only one board							
C3	ID_m	1	ms	us	x	x	x	x
	setting time int.							
C4	ID_m	15	Adr	Hod	x	x	x	x
	recording in sensor registers							
C5	ID_m	240	Adr	x	x	x	x	x
	reading from the sensor register							

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Frames sent by MEMS

Byte	B0	B1	B2	B3	B4	B5	B6	B7
After command C1, C2								
	XL	XH	YL	YH	ZL	ZH	POC	DRDY
After command C4, C5								
	adr	hod	x	x	x	x	x	x

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Protocol design (USART module)

- void Usart_Init(int)...MikroC
- Communication parameters:

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Draft Protocol

Seriový přenos dat

Address Parameter STA DES JED CHECK CR

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Encoding (interpretation)

Dec	Hex	Oct	Char	Dec	Hex	Oct	Char	Dec	Hex	Oct	Char	Dec	Hex	Oct	Char
0	00	00	NUL (null)	32	20	040	#32; Space	64	40	100	#64; @	96	60	140	#96; `
1	01	01	SOH (start of heading)	33	21	041	#33; !	65	41	101	#65; A	97	61	141	#97; a
2	02	02	STX (start of text)	34	22	042	#34; "	66	42	102	#66; B	98	62	142	#98; b
3	03	03	ETX (end of text)	35	23	043	#35; #	67	43	103	#67; C	99	63	143	#99; c
4	04	04	EOF (end of transmission)	36	24	044	#36; \$	68	44	104	#68; D	100	64	144	#100; d
5	05	05	ENQ (enquiry)	37	25	045	#37; %	69	45	105	#69; E	101	65	145	#101; e
6	06	06	ACK (acknowledge)	38	26	046	#38; &	70	46	106	#70; F	102	66	146	#102; f
7	07	07	DEL (delete)	39	27	047	#39; ' & #39; " & #39; #	71	47	107	#71; G	103	67	147	#103; g
8	08	08	BS (backspace)	40	28	050	#40; (	72	48	110	#72; H	104	68	150	#104; h
9	09	09	TAB (horizontal tab)	41	29	051	#41;)	73	49	111	#73; I	105	69	151	#105; i
10	A	012	LF (line feed, new line)	42	2A	052	#42; *	74	4A	112	#74; J	106	6A	152	#106; j
11	B	013	VT (vertical tab)	43	2B	053	#43; +	75	4B	113	#75; K	107	6B	153	#107; k
12	C	014	FF (form feed, new page)	44	2C	054	#44; ,	76	4C	114	#76; L	108	6C	154	#108; l
13	D	015	CR (carriage return)	45	2D	055	#45; -	77	4D	115	#77; M	109	6D	155	#109; m
14	E	016	SO (shift out)	46	2E	056	#46; .	78	4E	116	#78; N	110	6E	156	#110; n
15	F	017	SI (shift in)	47	2F	057	#47; /	79	4F	117	#79; O	111	6F	157	#111; o
16	10	020	DL (data link escape)	48	30	060	#48; 0	80	50	120	#80; P	112	70	160	#112; p
17	11	021	DC1 (device control 1)	49	31	061	#49; 1	81	51	121	#81; Q	113	71	161	#113; q
18	12	022	DC2 (device control 2)	50	32	062	#50; 2	82	52	122	#82; R	114	72	162	#114; r
19	13	023	DC3 (device control 3)	51	33	063	#51; 3	83	53	123	#83; S	115	73	163	#115; s
20	14	024	DC4 (device control 4)	52	34	064	#52; 4	84	54	124	#84; T	116	74	164	#116; t
21	15	025	NAK (negative acknowledge)	53	35	065	#53; 5	85	55	125	#85; U	117	75	165	#117; u
22	16	026	SYN (synchronous idle)	54	36	066	#54; 6	86	56	126	#86; V	118	76	166	#118; v
23	17	027	ETB (end of transmission block)	55	37	067	#55; 7	87	57	127	#87; W	119	77	167	#119; w
24	18	030	CAN (cancel)	56	38	070	#56; 8	88	58	130	#88; Y	120	78	170	#120; y
25	19	031	EM (end of medium)	57	39	071	#57; 9	89	59	131	#89; Z	121	79	171	#121; z
26	1A	032	ESC (escape)	58	3A	072	#58; :	90	5A	132	#90; [	122	7A	172	#122; {
27	1B	033	FS (file separator)	59	3B	073	#59; ;	91	5B	133	#91; \	123	7B	173	#123;
28	1C	034	GS (group separator)	60	3C	074	#60; <	92	5C	134	#92;]	124	7C	174	#124; }
29	1D	035	RS (record separator)	61	3D	075	#61; =	93	5D	135	#93; ^	125	7D	175	#125; ~
30	1E	036	IS (unit separator)	62	3E	076	#62; >	94	5E	136	#94; _	126	7E	176	#126;
31	1F	037	US (unit separator)	63	3F	077	#63; ?	95	5F	137	#95; `	127	7F	177	#127; DEL

Source: www.LinuxTales.com

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What was the content of the lecture

- Industrial networks
- Topology
- Protocol
- Access methods
- Confirming messages
- ...
- 7 layer model
 - physical layer
 - ...
 - application layer

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