Fakulta strojní VŠB – TUO

Department of Control Systems and Instrumentation

Automatic Control Devices
2023

(Materials for write notes)

doc. Ing. Jaromír Škuta, Ph.D.

1

Fakulta strojní VŠB – TUO

Department of Control Systems and Instrumentation

Lecture No. 5

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

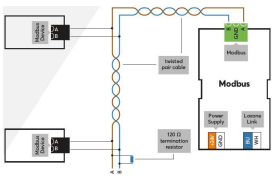
2

Fakulta strojní VŠB – TUO

Department of Control Systems and Instrumentation

What do you find out?

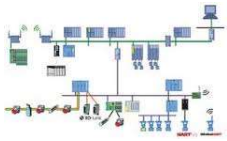
- Industrial networks
- Topology
- Protocol
- Access methods
- Confirming messages
- ...
- 7 layer model
  - physical layer
  - ...
  - application layer



3

Fakulta strojní VŠB – TUO

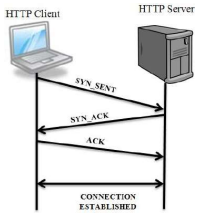
ILAN – industrial networks



4

Fakulta strojní VŠB – TUO

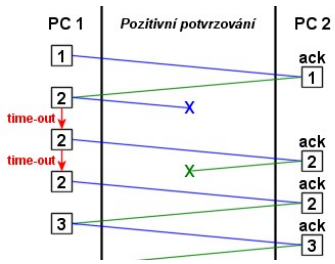
ILAN confirmation



5

Fakulta strojní VŠB – TUO

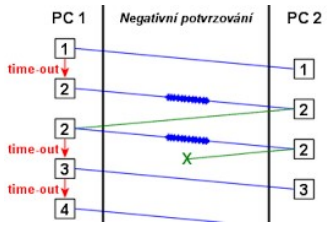
ILAN confirmation



6

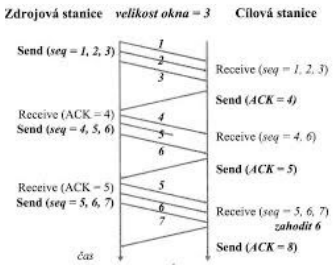
Fakulta strojní VŠB – TUO

ILAN confirmation



Fakulta strojní VŠB – TUO

ILAN confirmation

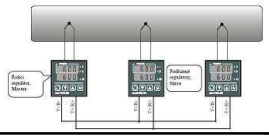


Fakulta strojní VŠB – TUO

Access to media

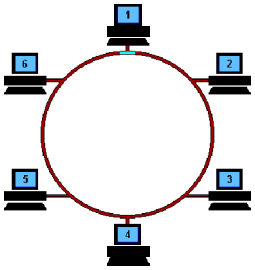
A multi-master

Master/Slave



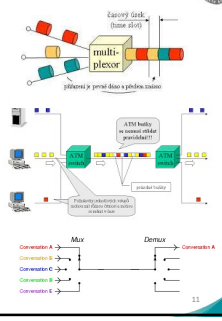
Access to media

The principle of the **Token ring** network

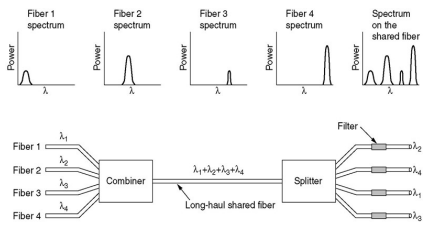


Access to media

Time division, **time multiplex** or time division multiplex (TDM



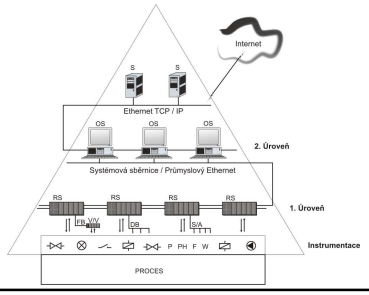
Access to media



Motto:

Industrial communication systems are not only a connecting channel between automation means in the control architecture of machines, production lines, technological, energy and transport systems, but have become not only an automation means, but also a phenomenon of automatic control.

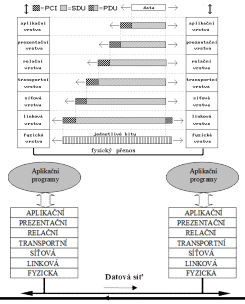
Industrial communication systems in the context of automation devices



Communication links - ISO/OSI reference model

ISO/OSI reference

Each higher layer uses the services of the lower layer.



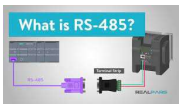
Communication links

- Individual layers can be implemented by hardware or software.

- Most ILAN networks are designed for the operation of dozens of connected stations on one transmission medium without the need for packet routing.

Physical Layer

- (Physical Layer) ensures the reception and transmission of signals via the transmission medium.



Data Link Layer

- (Data Link Layer) determines how messages are passed on the network.

Network Layer

- (Network Layer) ensures a connection that cannot be established by the line layer…

Transport Layer

(Transport Layer) ensures reliable message transmission between end stations.

Session Layer

- (Session Layer) must ensure continuous communication.
- …

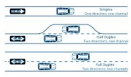
Presentation Layer

- (Presentation Layer) takes care of correct data exchange -

Application Layer

- (Application Layer) is tasked with direct application support -

Comparison of RS 485 and RS 232



- **RS 232C**
- Transmission distance: Transmission speed:
- …

Half-duplex (poloviční duplex)

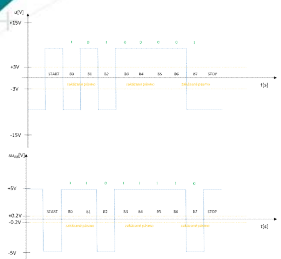
- **RS 485**
- Transmission distance: Transmission speed:
- …

Full-duplex (plný duplex)

Fakulta strojní VŠB – TUO

Physical layer

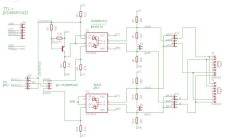
RS 232

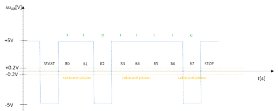


Fakulta strojní VŠB – TUO

Physical layer

RS 485





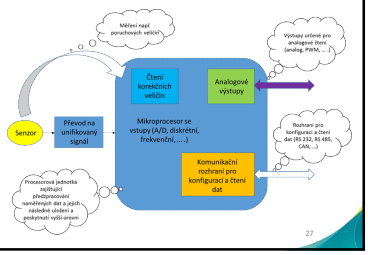
Fakulta strojní VŠB – TUO

Smart sensors

Inlet part **Inner part** **Output part**

A smart sensor can include:

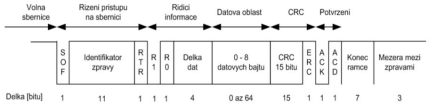
- ... .



Selected characteristics of the CAN bus

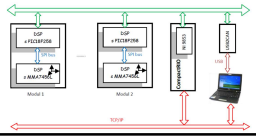
- **Two-wire serial data bus.**
- **…**

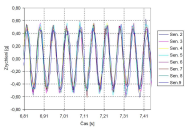
CAN bus frames



- **SOF** (Start Of Frame) –
- **Message identifier** –
- **RTR** (Remote Request) –
- **R1**(IDE) –
- **The length of the data** -
- **Data** –
- **CRC** –
- **ERC** –
- **ACK** –
- **ACD** –

Module requirements - firmware

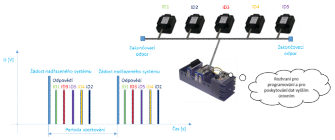




Configuration frameworks for MEMS

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							

Frames sent by MEMS



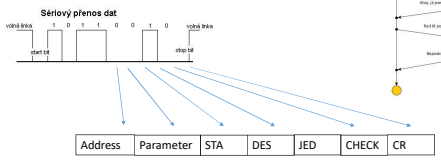
Byte	B0	B1	B2	B3	B4	B5	B6	B7
After command C1, C2								
	XL	XH	YL	YH	ZL	ZH	POC	DRDY
After command C4, C5								
	adr	hod	x	x	x	x	x	x

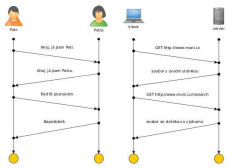
Protocol design (USART module)

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

Draft Protocol

Address	...	device address [A-Z]
Parameter	...	variable [a-z]
CHECK	....	checksum [8 bit]
STA, DES, JED	...	order [0-9]
CR	...	termination character [cr, lf]





Address	Parameter	STA	DES	JED	CHECK	CR

Encoding (interpretation)

Dec	Hx	Oct	Char	Dec	Hx	Oct	Html	Chr	Dec	Hx	Oct	Html	Chr	Dec	Hx	Oct	Html	Chr
0	0	000	NUL (null)	32	20	040		Space	64	40	100	@	@	96	60	140	`	`
1	1	001	SOH (start of heading)	33	21	041	!	!	65	41	101	A	A	97	61	141	a	a
2	2	002	STX (start of text)	34	22	042	"	"	66	42	102	B	B	98	62	142	b	b
3	3	003	ETX (end of text)	35	23	043	#	#	67	43	103	C	C	99	63	143	c	c
4	4	004	EOT (end of transmission)	36	24	044	$	$	68	44	104	D	D	100	64	144	d	d
5	5	005	ENQ (enquiry)	37	25	045	%	%	69	45	105	E	E	101	65	145	e	e
6	6	006	ACK (acknowledge)	38	26	046	&	&	70	46	106	F	F	102	66	146	f	f
7	7	007	BEL (bell)	39	27	047	'	'	71	47	107	G	G	103	67	147	g	g
8	8	010	BS (backspace)	40	28	050	(	(	72	48	110	H	H	104	68	150	h	h
9	9	011	TAB (horizontal tab)	41	29	051	)	)	73	49	111	I	I	105	69	151	i	i
10	A	012	LF (NL line feed, new line)	42	2A	052	*	*	74	4A	112	J	J	106	6A	152	j	j
11	B	013	VT (vertical tab)	43	2B	053	+	+	75	4B	113	K	K	107	6B	153	k	k
12	C	014	FF (NP form feed, new page)	44	2C	054	,	,	76	4C	114	L	L	108	6C	154	l	l
13	D	015	CR (carriage return)	45	2D	055	-	-	77	4D	115	M	M	109	6D	155	m	m
14	E	016	SO (shift out)	46	2E	056	.	.	78	4E	116	N	N	110	6E	156	n	n
15	F	017	SI (shift in)	47	2F	057	/	/	79	4F	117	O	O	111	6F	157	o	o
16	10	020	DLE (data link escape)	48	30	060	0	0	80	50	120	P	P	112	70	160	p	p
17	11	021	DC1 (device control 1)	49	31	061	1	1	81	51	121	Q	Q	113	71	161	q	q
18	12	022	DC2 (device control 2)	50	32	062	2	2	82	52	122	R	R	114	72	162	r	r
19	13	023	DC3 (device control 3)	51	33	063	3	3	83	53	123	S	S	115	73	163	s	s
20	14	024	DC4 (device control 4)	52	34	064	4	4	84	54	124	T	T	116	74	164	t	t
21	15	025	NAK (negative acknowledge)	53	35	065	5	5	85	55	125	U	U	117	75	165	u	u
22	16	026	SYN (synchronous idle)	54	36	066	6	6	86	56	126	V	V	118	76	166	v	v
23	17	027	ETB (end of trans. block)	55	37	067	7	7	87	57	127	W	W	119	77	167	w	w
24	18	030	CAN (cancel)	56	38	070	8	8	88	58	130	X	X	120	78	170	x	x
25	19	031	EM (end of medium)	57	39	071	9	9	89	59	131	Y	Y	121	79	171	y	y
26	1A	032	SUB (substitute)	58	3A	072	:	:	90	5A	132	Z	Z	122	7A	172	z	z
27	1B	033	ESC (escape)	59	3B	073	;	;	91	5B	133	[	[	123	7B	173	{	{
28	1C	034	FS (file separator)	60	3C	074	<	<	92	5C	134	\	\	124	7C	174			|
29	1D	035	GS (group separator)	61	3D	075	=	=	93	5D	135	]	]	125	7D	175	}	}
30	1E	036	RS (record separator)	62	3E	076	>	>	94	5E	136	^	^	126	7E	176	~	~
31	1F	037	US (unit separator)	63	3F	077	?	?	95	5F	137	_	_	127	7F	177	&#127;	DEL

Source: www.LookupTables.com

Department of Control Systems and Instrumentation

What was the content of the lecture

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

Thank you for your attention …