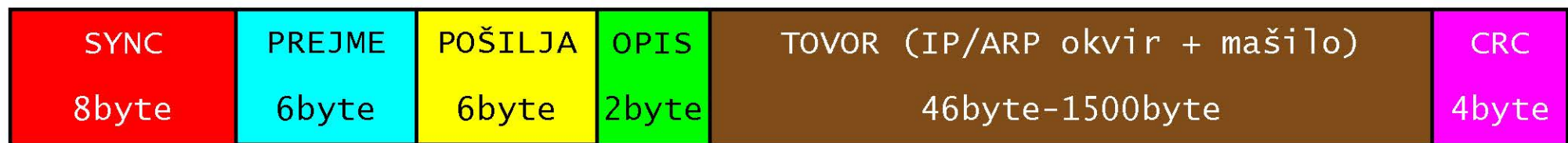


ETHERNETNI PROTOKOL

Matjaž Vidmar, S53MV

FE, Ljubljana, 14.04.2012

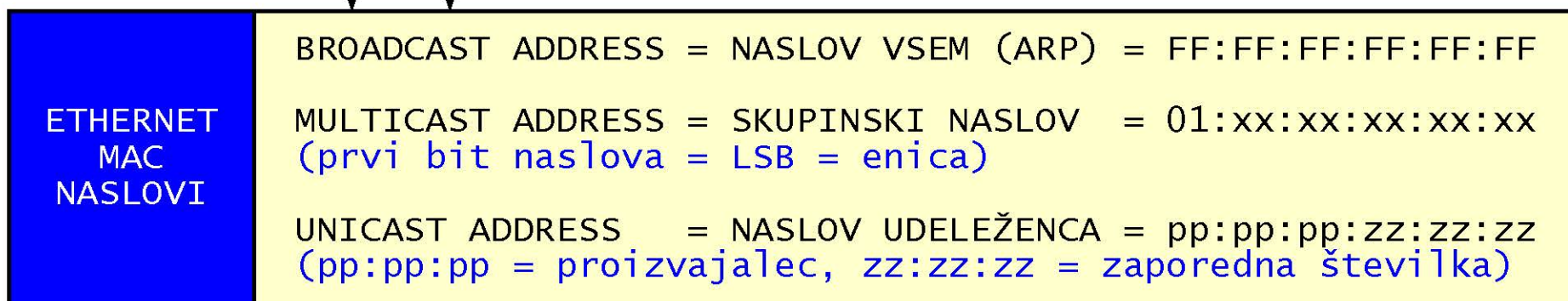
- 1973 - prvo omrežje (2.94Mbps) na skupnem prenosnem vodilu "Ether", 8-bitni naslovi, CSMA/CD sodostop (Xerox, ZDA)
- 1980 - 10Mbps, Manchester, 48-bitni MAC naslovi, 16-bitni opis vsebine (Digital, Intel, Xerox)
- 1982 - 10Mbps 10BASE5 Thick Ethernet, MAU priključek na vodilo RG8X (debel koaks) z dometom 500m
- 1985 - 10Mbps 10BASE2 Thin Ethernet, BNC priključek na vodilo RG58 (tanek koaks) z dometom 185m
- 1990 - 10Mbps 10BASE-T, dve parici (UTP), domet 100m točka-točka, omrežje zvezda do Ethernet hub
- 1995 - 100Mbps 100BASE-TX, MLT3, dve parici (UTP), domet 100m točka-točka, omrežje zvezda do Ethernet stikala (switch), full-duplex, auto-negotiation, samodejna pretvorba 10/100Mbps
- 1999 - 1Gbps 1000BASE-T, štiri parice (UTP), 100m
- 2003 - PoE (UTP) in 10Gbps ETH po svetlobnem vlaknu



10101010
10101010
10101010
10101010
10101010
10101010
10101010
10101010
10101011

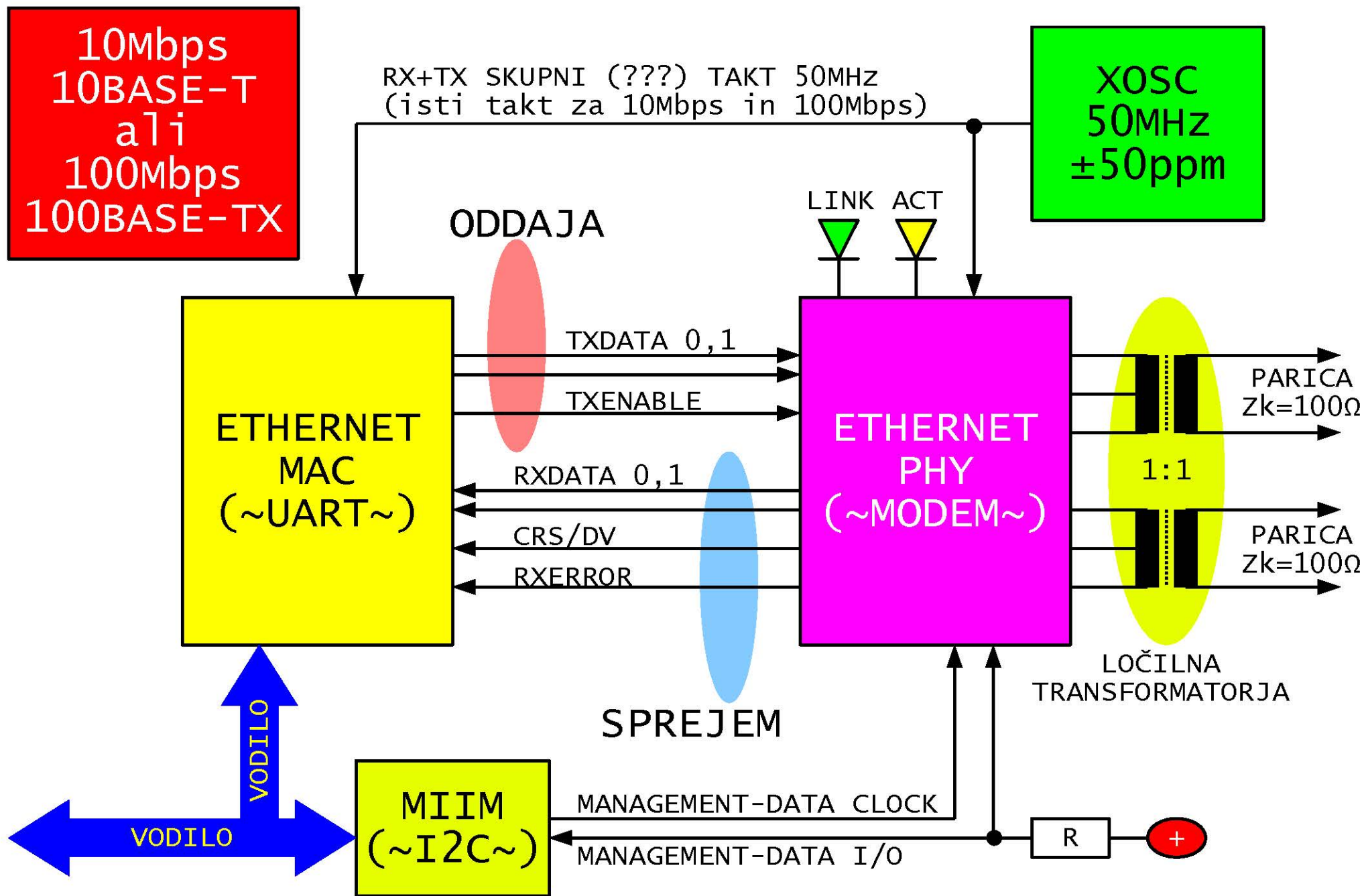
0x0800 = podatkovni okvir IP4
0x0806 = vprašanje/odgovor ARP
0x86DD = podatkovni okvir IP6
dolžina okvirja se ne uporablja!

CRC32

$$X^{32} + X^{26} + X^{23} + X^{22} + X^{16} + X^{12} + X^{11} + X^{10} + X^8 + X^7 + X^5 + X^4 + X^2 + X + 1$$


Zaporedje bitov v byte: prvi LSB, zadnji MSB (BIG ENDIAN)
Zaporedje byte v naslovih, opisu in CRC: LITTLE ENDIAN
Zaporedje byte v tovoru: običajno LITTLE ENDIAN (IP/ARP)

ZGRADBA ETHERNET OKVIRJA



VMESNIK RMII (Reduced Media-Independent Interface)

RJ-45 Wiring (TIA/EIA-568-B T568A)

Pin	Pair	Color	telephone	10BASE-T	100BASE-TX	1000BASE-T	PoE mode A	PoE mode B
1	3	 white/green	-	TX+	z	bidi	48V out	-
2	3	 green	-	TX-	z	bidi	48V out	-
3	2	 white/orange	-	RX+	z	bidi	48V return	-
4	1	 blue	ring	-	-	bidi	-	48V out
5	1	 white/blue	tip	-	-	bidi	-	48V out
6	2	 orange	-	RX-	z	bidi	48V return	-
7	4	 white/brown	-	-	-	bidi	-	48V return
8	4	 brown	-	-	-	bidi	-	48V return

(WIKIPEDIA)

ZVEZA TOČKA-TOČKA
ZAKLJUČITEV Zk=100Ω
DOMET ~100m (10/100Mbps)

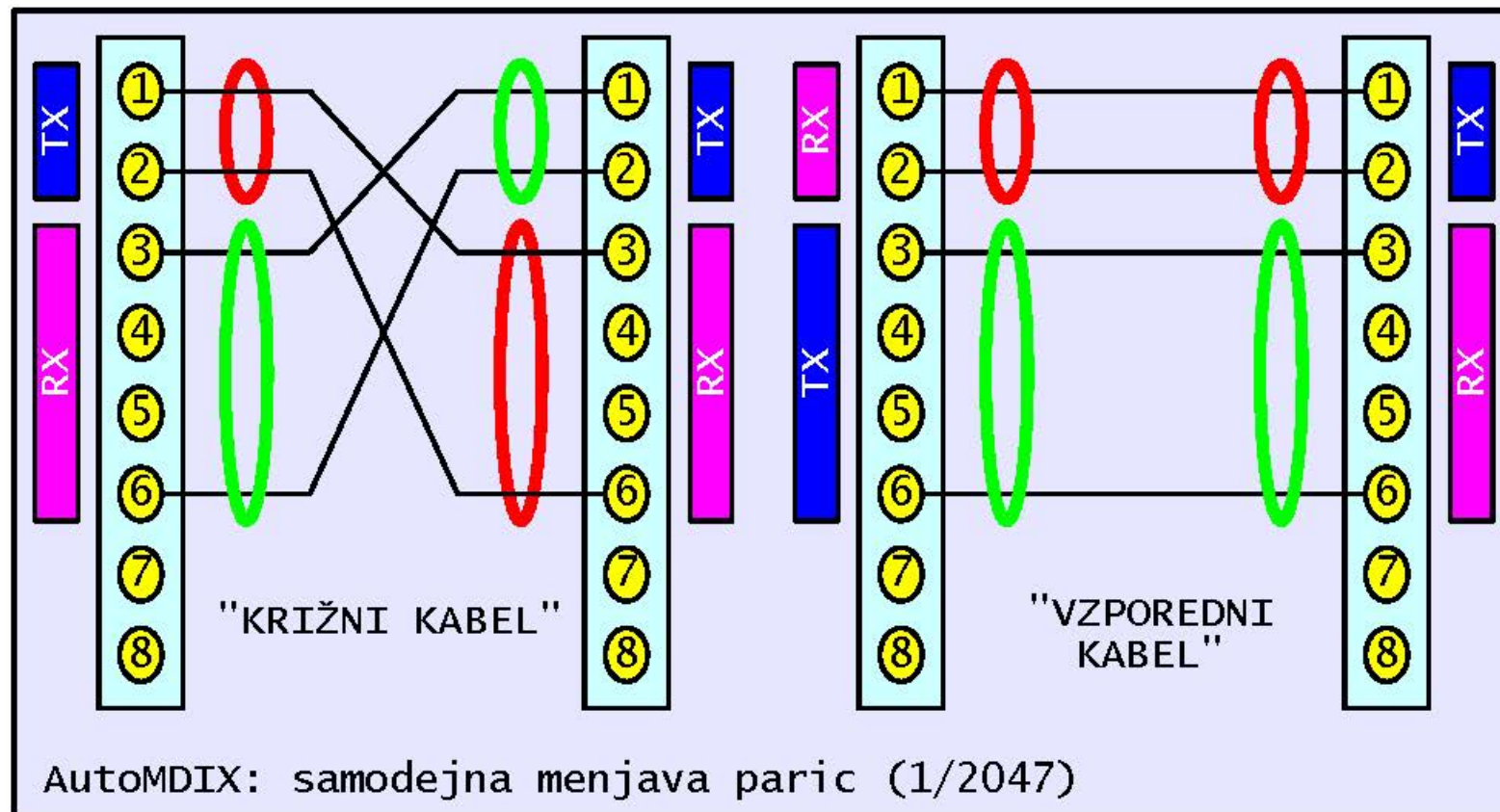
TIA/EIA-568 T568A termination

Pin	Pair	Wire	Color
1	3	tip	 white/green
2	3	ring	 green
3	2	tip	 white/orange
4	1	ring	 blue
5	1	tip	 white/blue
6	2	ring	 orange
7	4	tip	 white/brown
8	4	ring	 brown

TIA/EIA-568 T568B termination

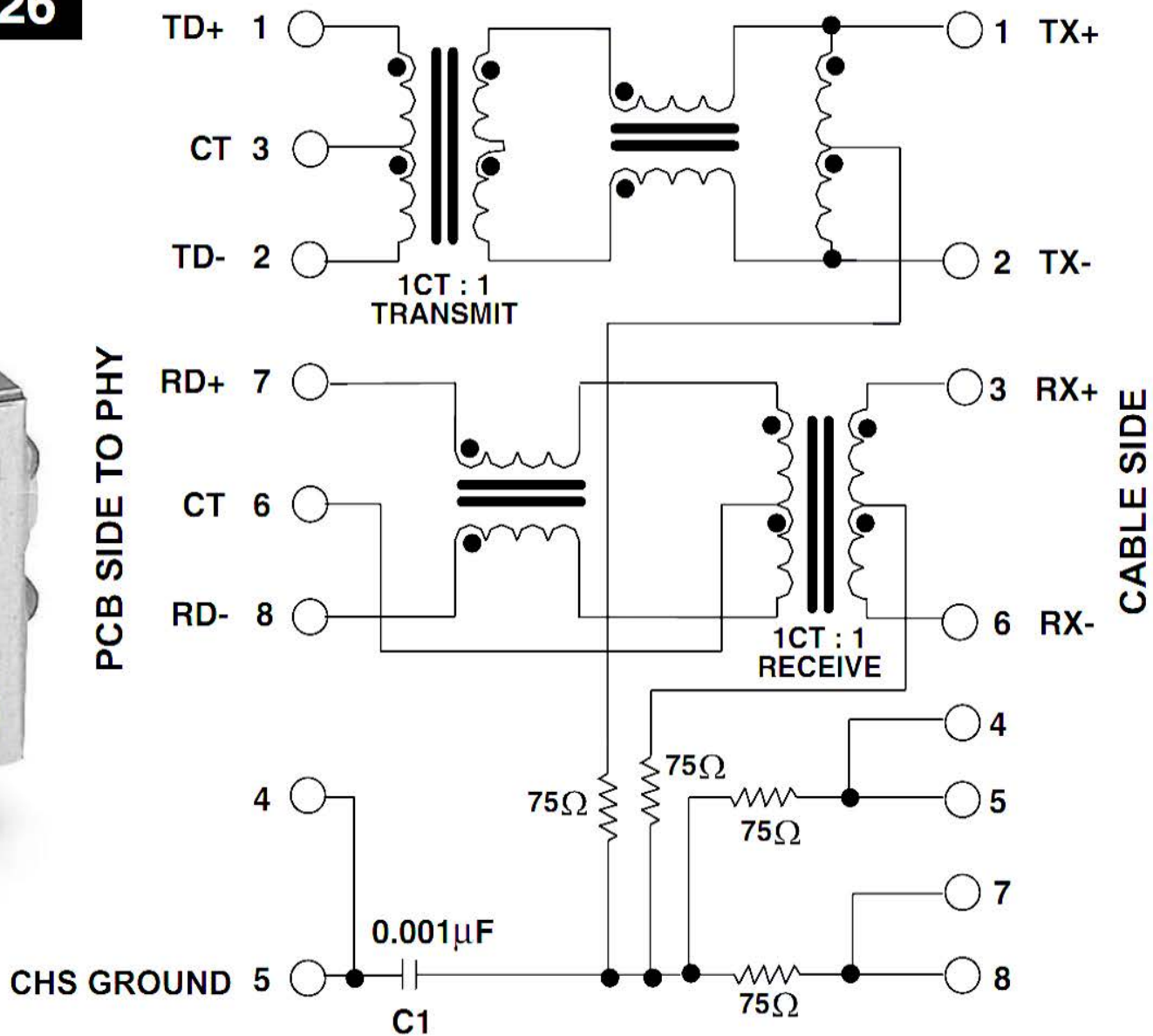
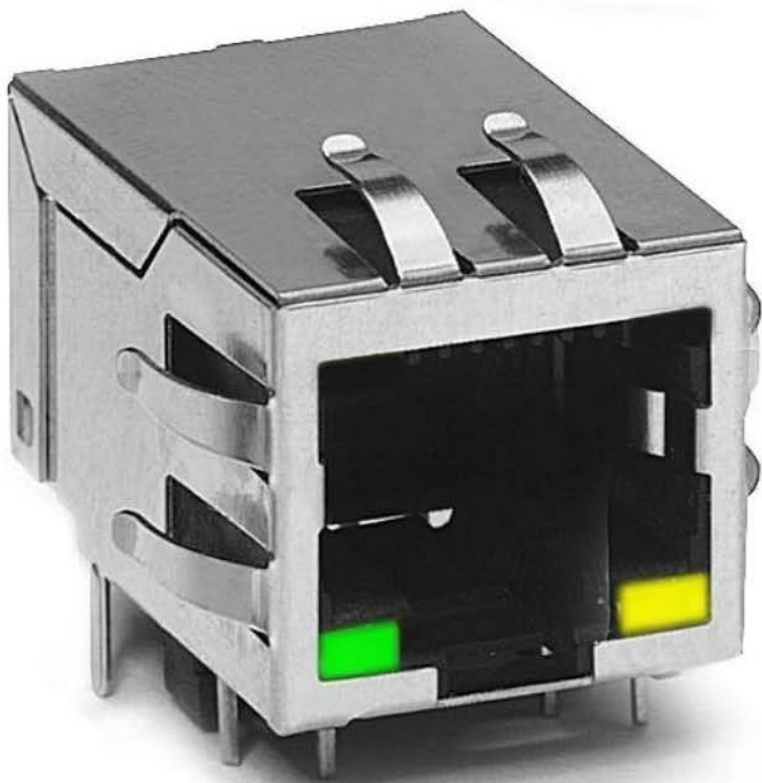
Pin	Pair	Wire	Color
1	2	tip	 white/orange
2	2	ring	 orange
3	3	tip	 white/green
4	1	ring	 blue
5	1	tip	 white/blue
6	3	ring	 green
7	4	tip	 white/brown
8	4	ring	 brown

(WIKIPEDIA)



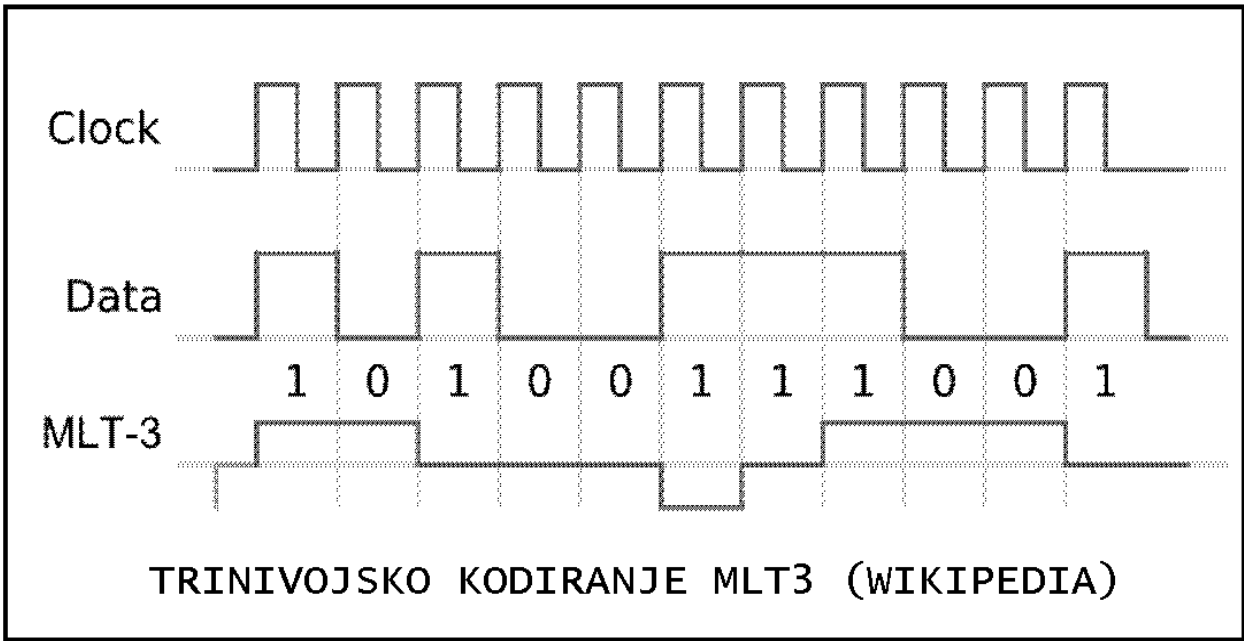
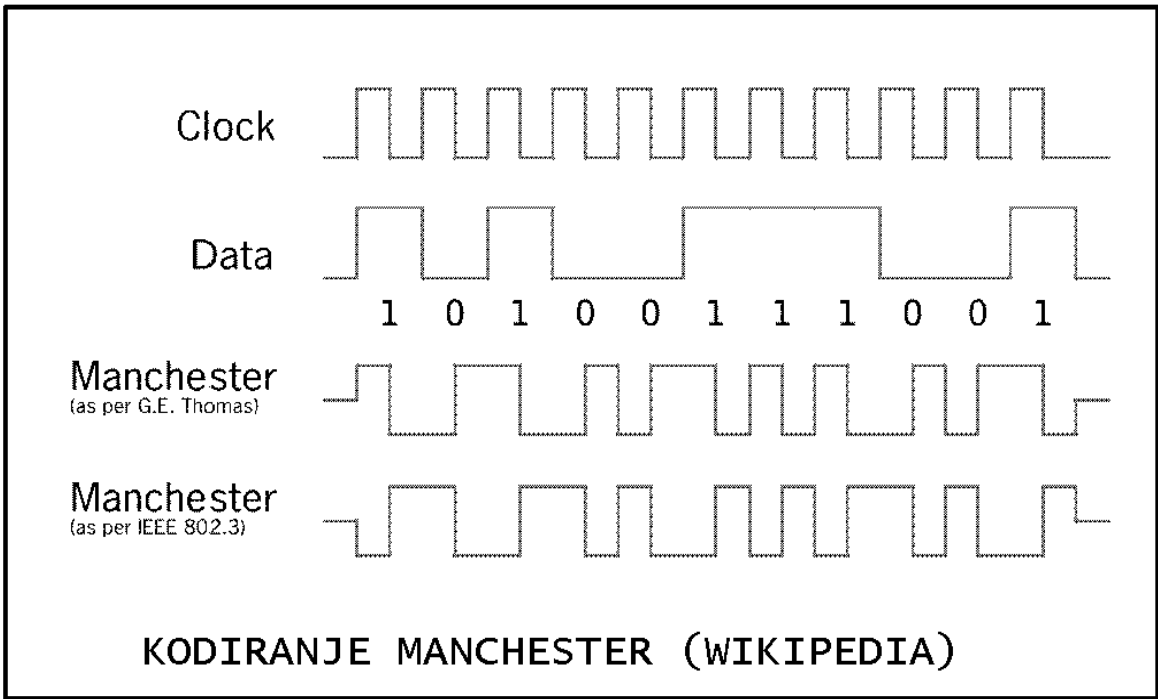
NEOKLOPLJENA SUKANA PARICA UTP

J0026



NOTE: Connect CHS GND to PCB ground.

TRAF0-VTIČNICA RJ45

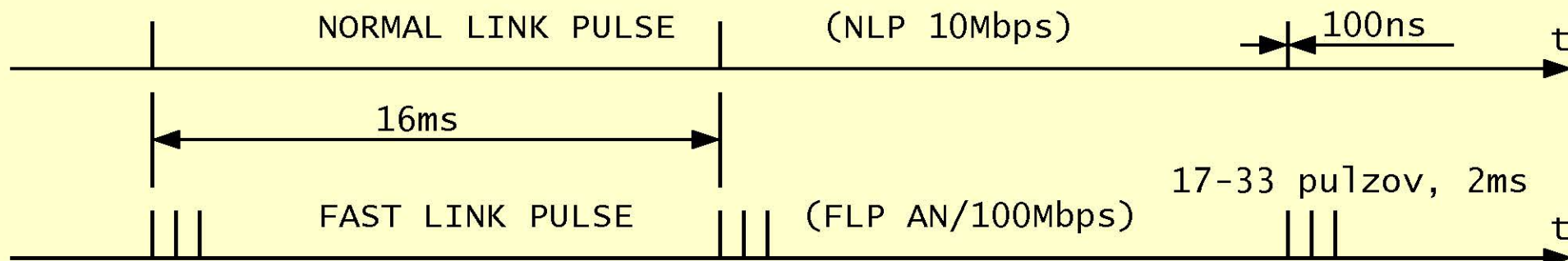


MANCHESTER, 4B5B IN MLT3

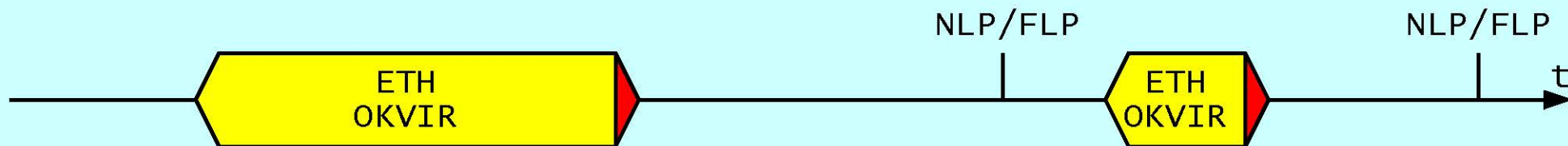
Name	4b	5b	Description
0	0000	11110	hex data 0
1	0001	01001	hex data 1
2	0010	10100	hex data 2
3	0011	10101	hex data 3
4	0100	01010	hex data 4
5	0101	01011	hex data 5
6	0110	01110	hex data 6
7	0111	01111	hex data 7
8	1000	10010	hex data 8
9	1001	10011	hex data 9
A	1010	10110	hex data A
B	1011	10111	hex data B
C	1100	11010	hex data C
D	1101	11011	hex data D
E	1110	11100	hex data E
F	1111	11101	hex data F
Q	-NONE-	00000	Quiet (signal lost)
I	-NONE-	11111	Idle
J	-NONE-	11000	Start #1
K	-NONE-	10001	Start #2
T	-NONE-	01101	End
R	-NONE-	00111	Reset
S	-NONE-	11001	Set
H	-NONE-	00100	Halt

4B5B (WIKIPEDIA)

NEPOVEZAN



10Mbps: Manchester (občutljiv na polariteto)



100Mbps: 4B5B+NRZI(1)+skrambler+MLT3

STALNA 125Mbps TRINIVOJSKA ODDAJA ~200mW/TX!!!



AN ≡ Auto Negotiation (10/100Mbps, half/full duplex)

AutoMDIX ≡ Auto Media-Dependent-Interface eXchange

NAČINI DELOVANJA ZVEZE PO UTP

RJ-45 Wiring (TIA/EIA-568-B T568A)

Pin	Pair	Color	telephone	10BASE-T	100BASE-TX	1000BASE-T	PoE mode A	PoE mode B
1	3	white/green	-	TX+	z	bidi	48V out	-
2	3	green	-	TX-	z	bidi	48V out	-
3	2	white/orange	-	RX+	z	bidi	48V return	-
4	1	blue	ring	-	-	bidi	-	48V out
5	1	white/blue	tip	-	-	bidi	-	48V out
6	2	orange	-	RX-	z	bidi	48V return	-
7	4	white/brown	-	-	-	bidi	-	48V return
8	4	brown	-	-	-	bidi	-	48V return

(WIKIPEDIA)

ZVEZA TOČKA-TOČKA
ZAKLJUČITEV Zk=100Ω
DOMET ~100m (10/100Mbps)

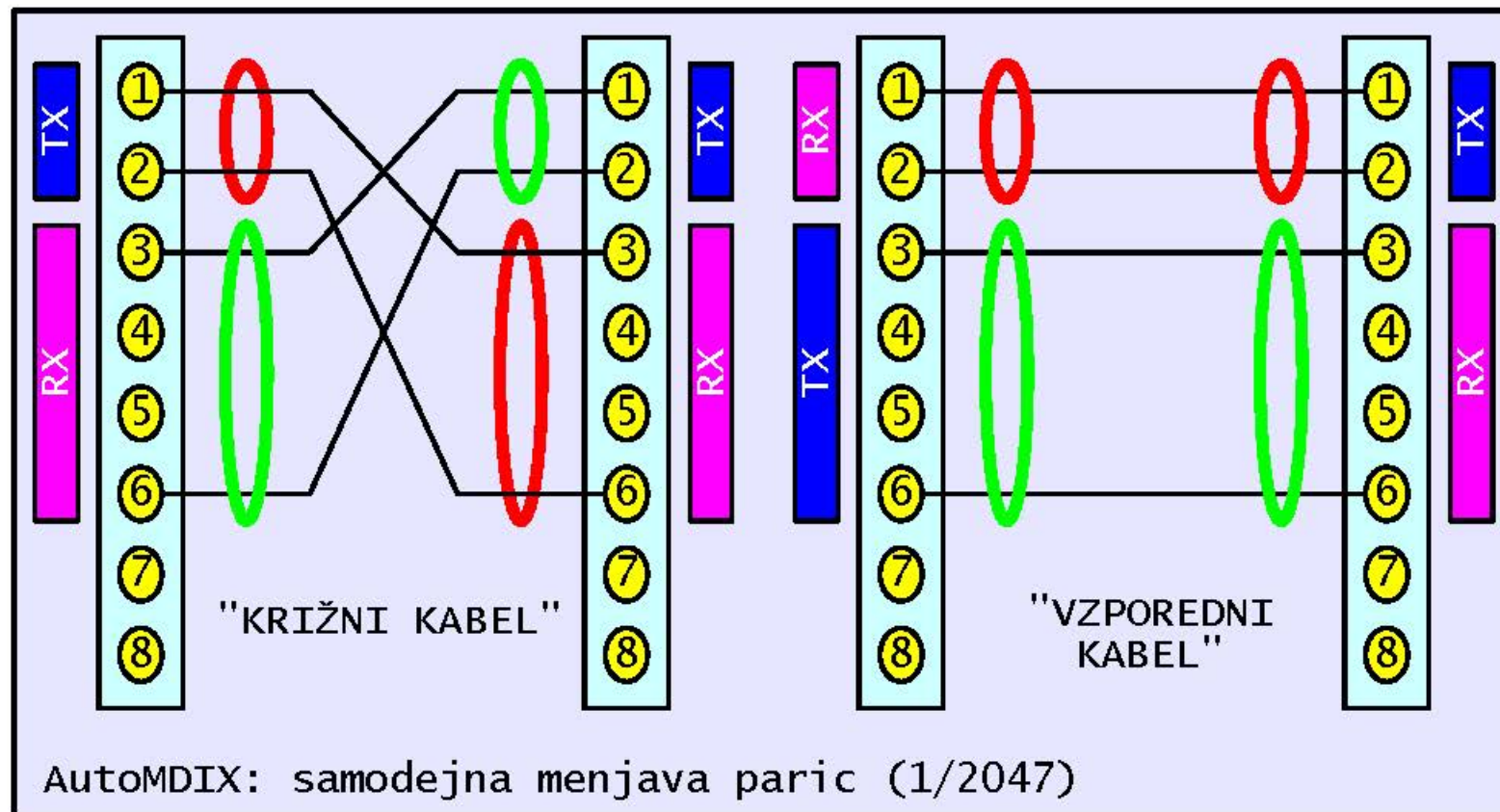
TIA/EIA-568 T568A termination

Pin	Pair	Wire	Color
1	3	tip	white/green
2	3	ring	green
3	2	tip	white/orange
4	1	ring	blue
5	1	tip	white/blue
6	2	ring	orange
7	4	tip	white/brown
8	4	ring	brown

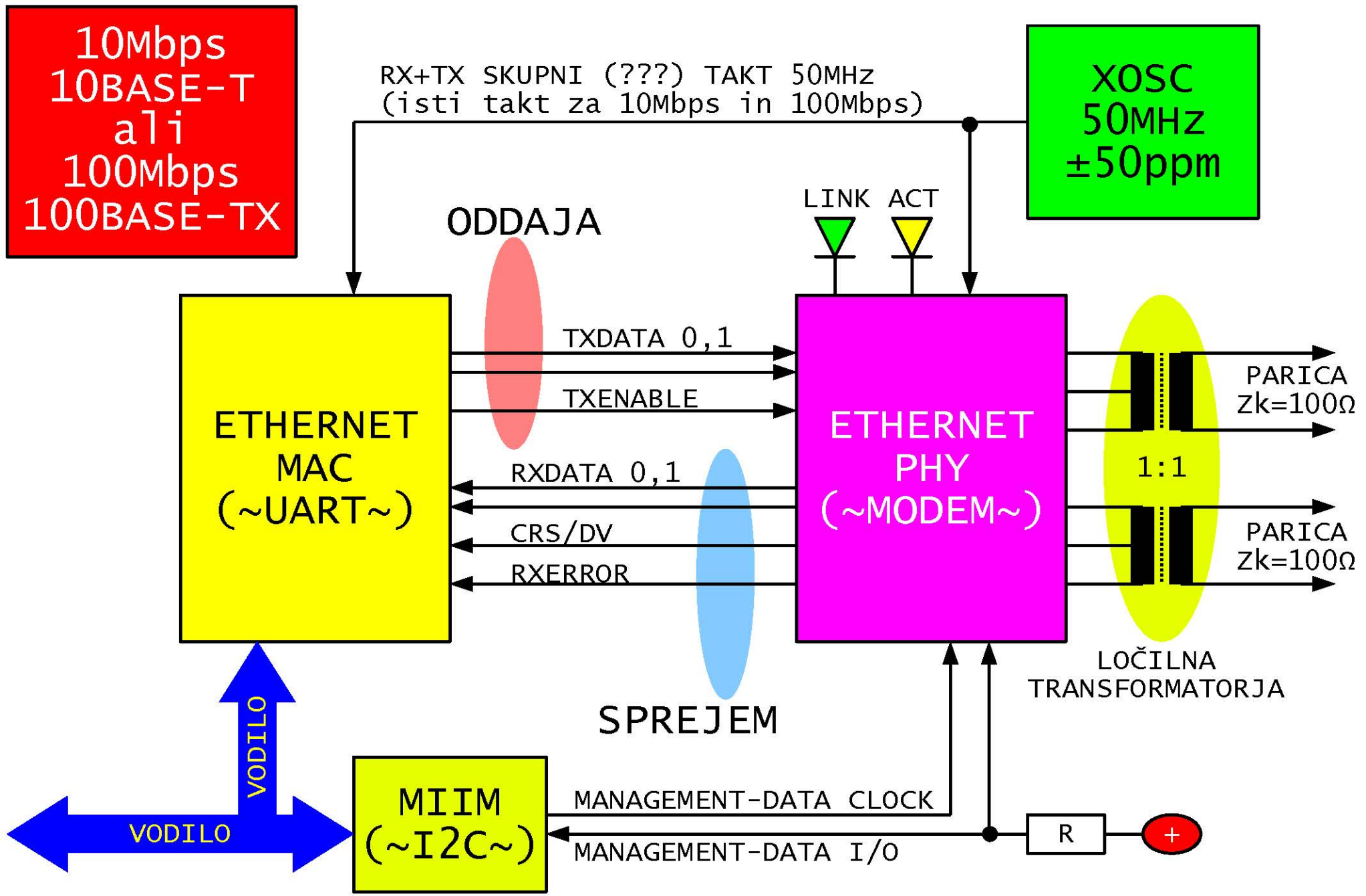
TIA/EIA-568 T568B termination

Pin	Pair	Wire	Color
1	2	tip	white/orange
2	2	ring	orange
3	3	tip	white/green
4	1	ring	blue
5	1	tip	white/blue
6	3	ring	green
7	4	tip	white/brown
8	4	ring	brown

(WIKIPEDIA)

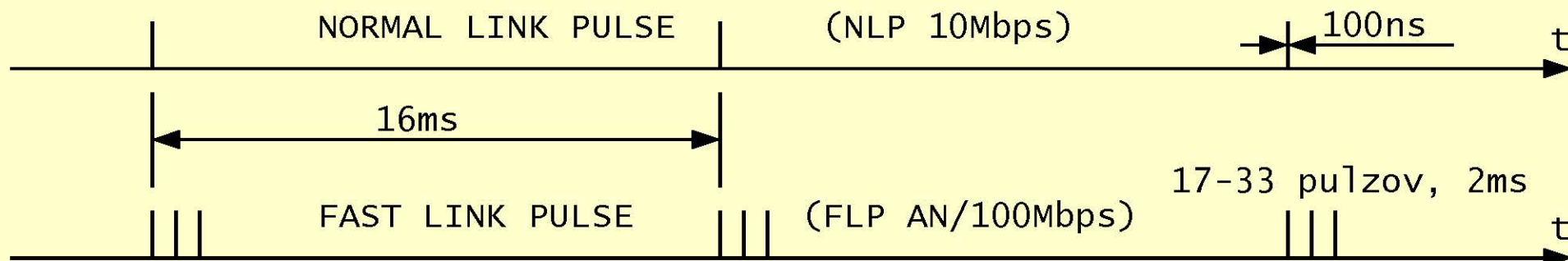


NEOKLOPLJENA SUKANA PARICA UTP

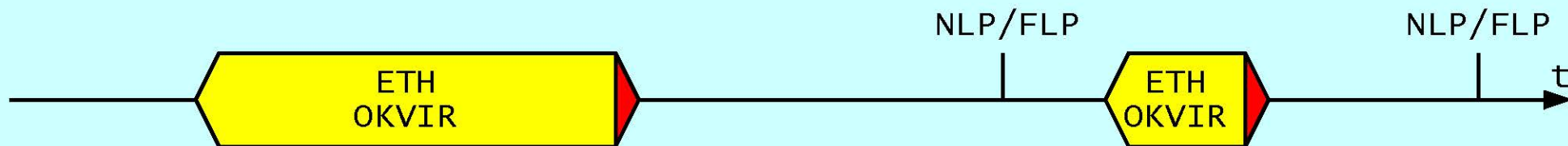


VMESNIK RMII (Reduced Media-Independent Interface)

NEPOVEZAN



10Mbps: Manchester (občutljiv na polariteto)



100Mbps: 4B5B+NRZI(1)+skrambler+MLT3

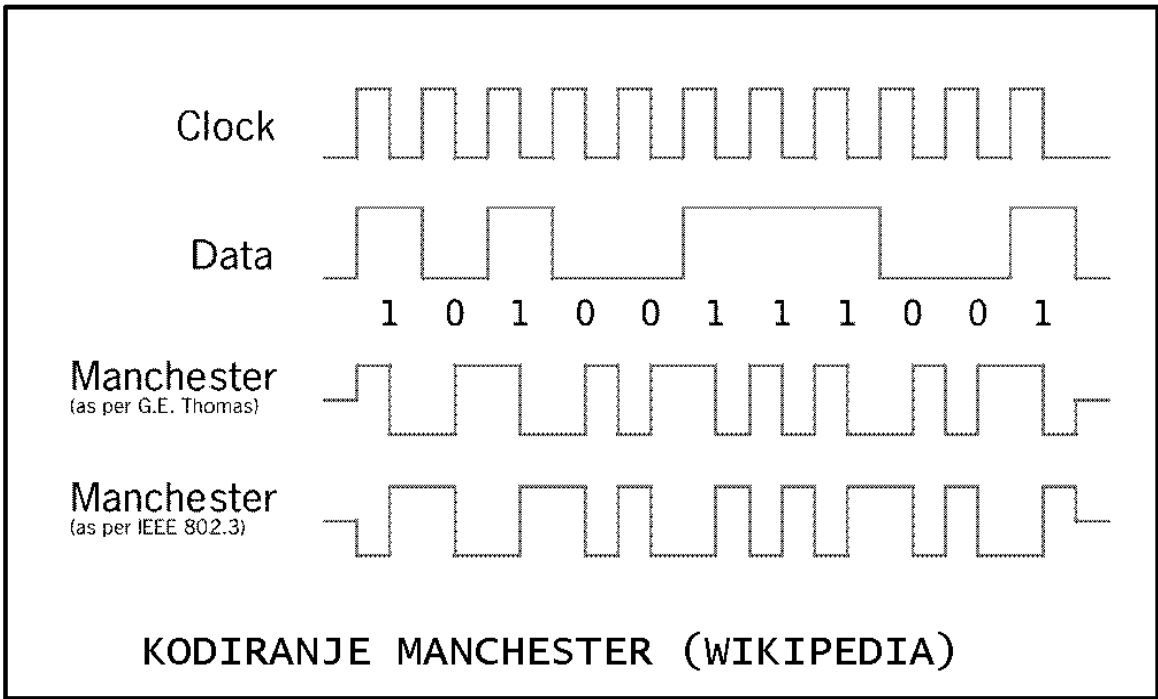
STALNA 125Mbps TRINIVOJSKA ODDAJA ~200mW/TX!!!



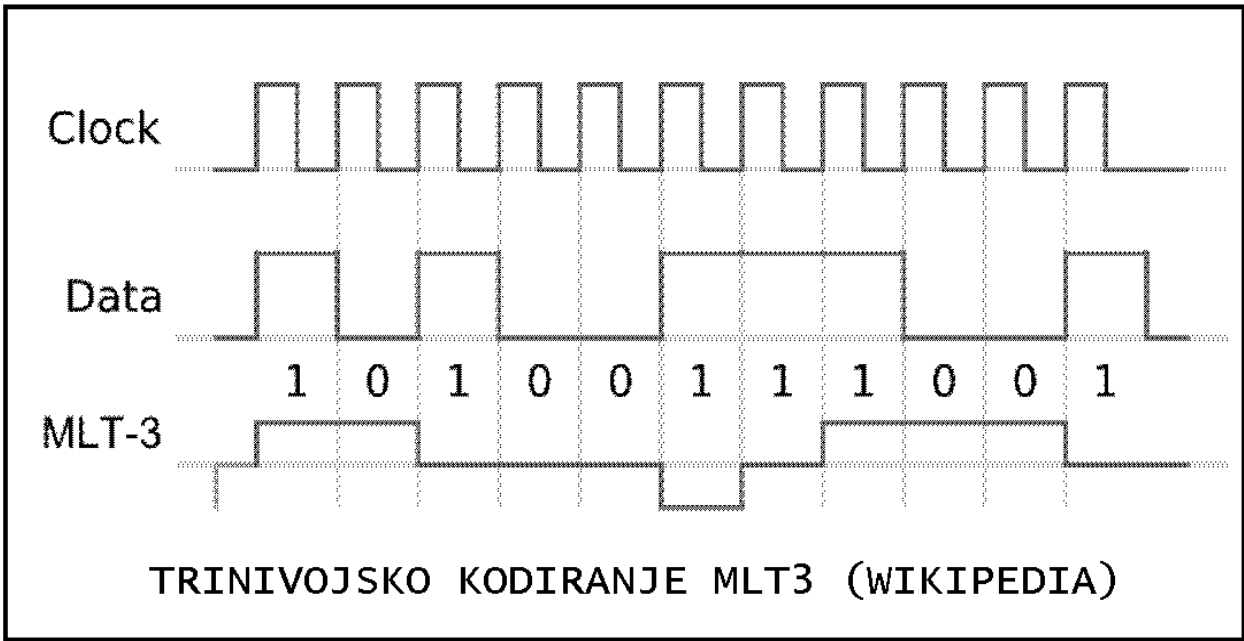
AN ≡ Auto Negotiation (10/100Mbps, half/fullduplex)

AutoMDIX ≡ Auto Media-Dependent-Interface eXchange

NAČINI DELOVANJA ZVEZE PO UTP



KODIRANJE MANCHESTER (WIKIPEDIA)



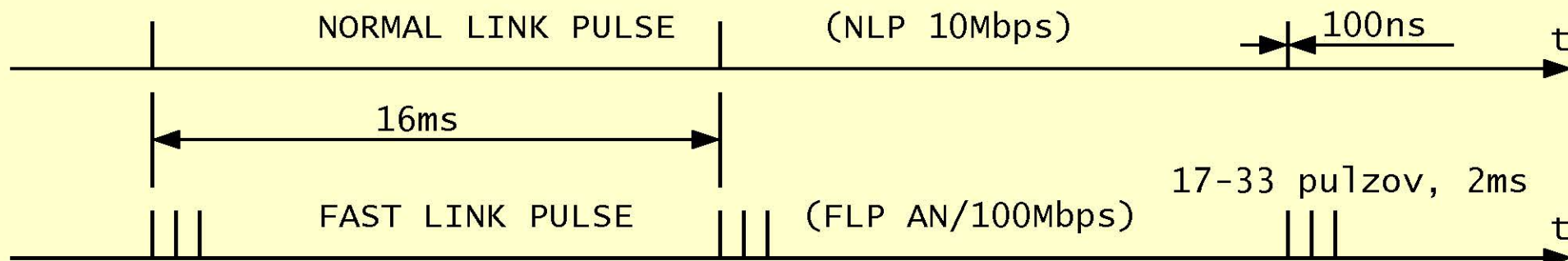
TRINIVOJSKO KODIRANJE MLT3 (WIKIPEDIA)

MANCHESTER, 4B5B IN MLT3

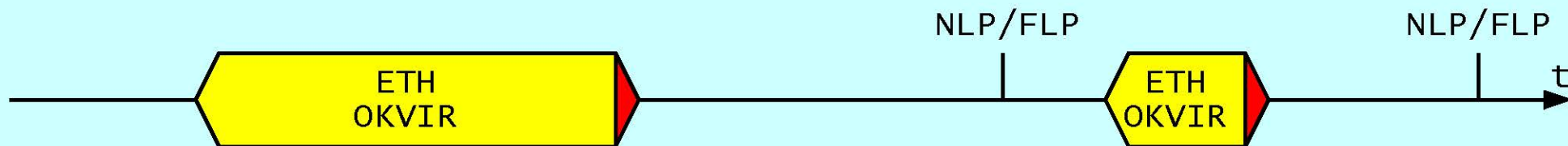
Name	4b	5b	Description
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3	0011	10101	hex data 3
4	0100	01010	hex data 4
5	0101	01011	hex data 5
6	0110	01110	hex data 6
7	0111	01111	hex data 7
8	1000	10010	hex data 8
9	1001	10011	hex data 9
A	1010	10110	hex data A
B	1011	10111	hex data B
C	1100	11010	hex data C
D	1101	11011	hex data D
E	1110	11100	hex data E
F	1111	11101	hex data F
Q	-NONE-	00000	Quiet (signal lost)
I	-NONE-	11111	Idle
J	-NONE-	11000	Start #1
K	-NONE-	10001	Start #2
T	-NONE-	01101	End
R	-NONE-	00111	Reset
S	-NONE-	11001	Set
H	-NONE-	00100	Halt

4B5B (WIKIPEDIA)

NEPOVEZAN



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100Mbps: 4B5B+NRZI(1)+skrambler+MLT3

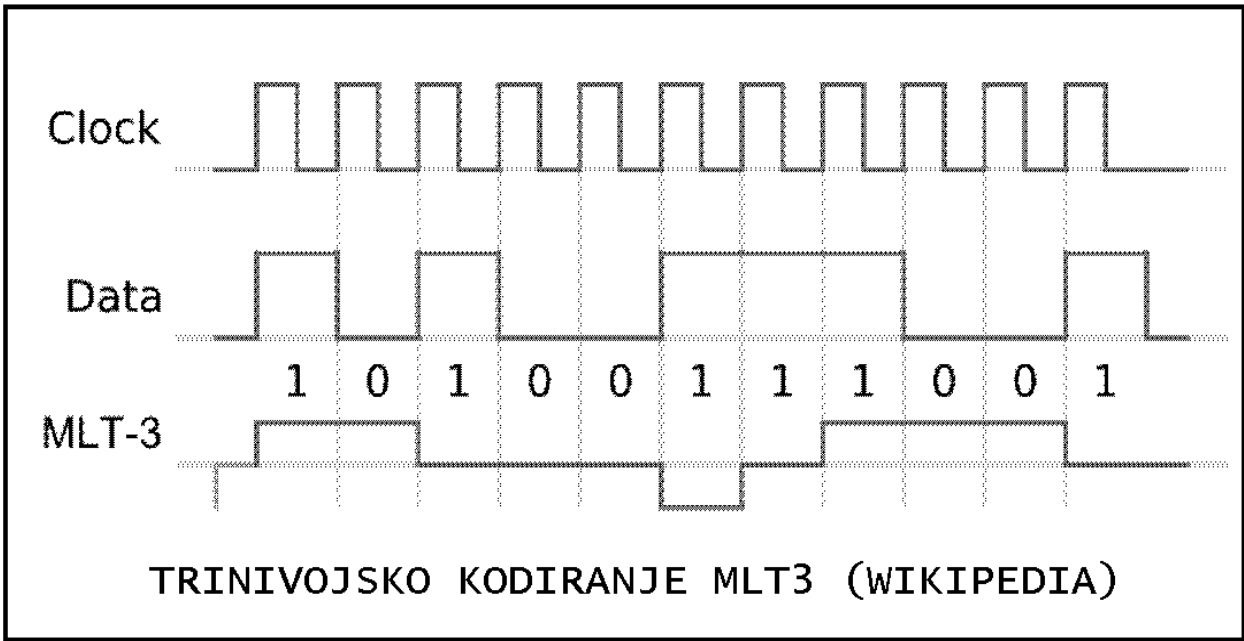
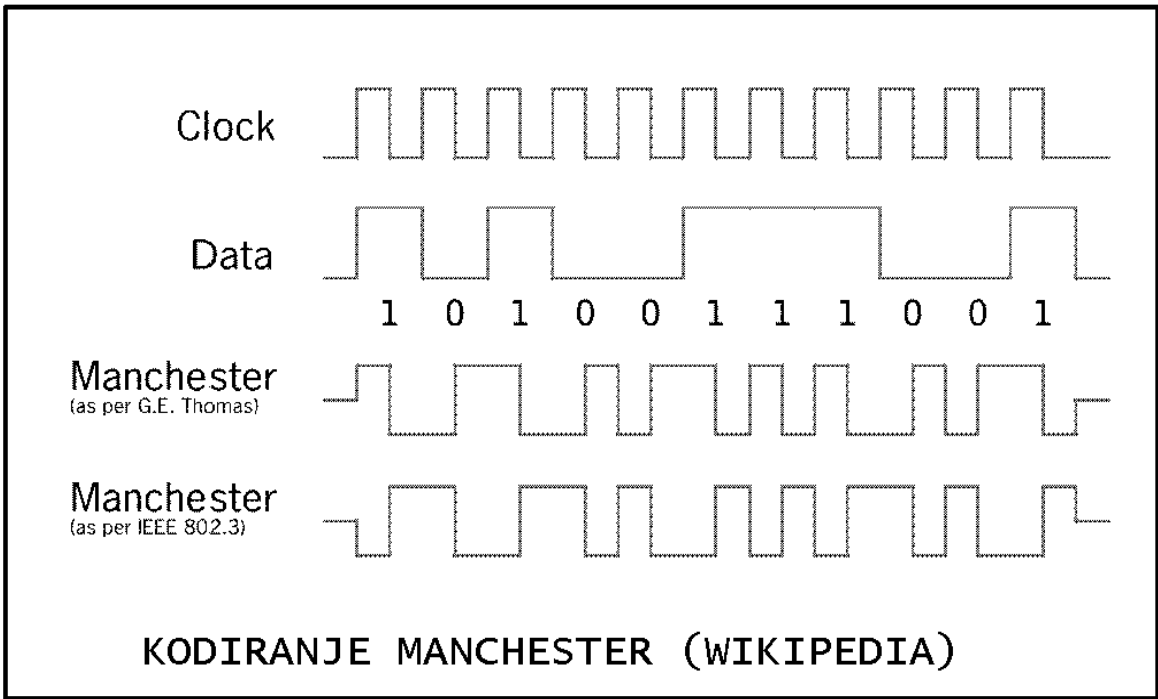
STALNA 125Mbps TRINIVOJSKA ODDAJA ~200mW/TX!!!



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NAČINI DELOVANJA ZVEZE PO UTP

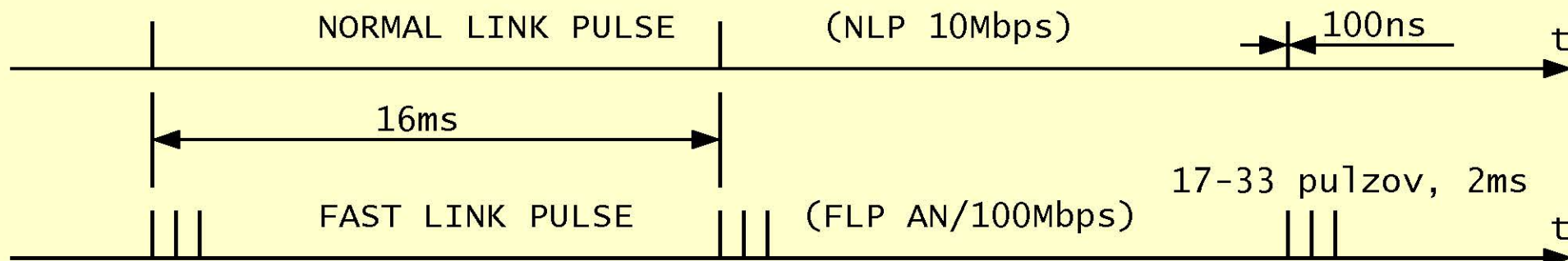


MANCHESTER, 4B5B IN MLT3

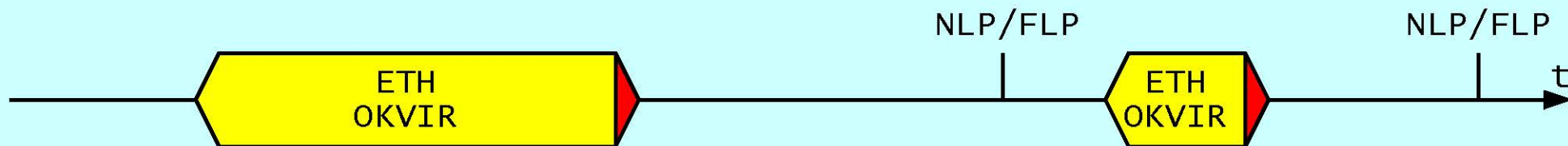
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H	-NONE-	00100	Halt

4B5B (WIKIPEDIA)

NEPOVEZAN



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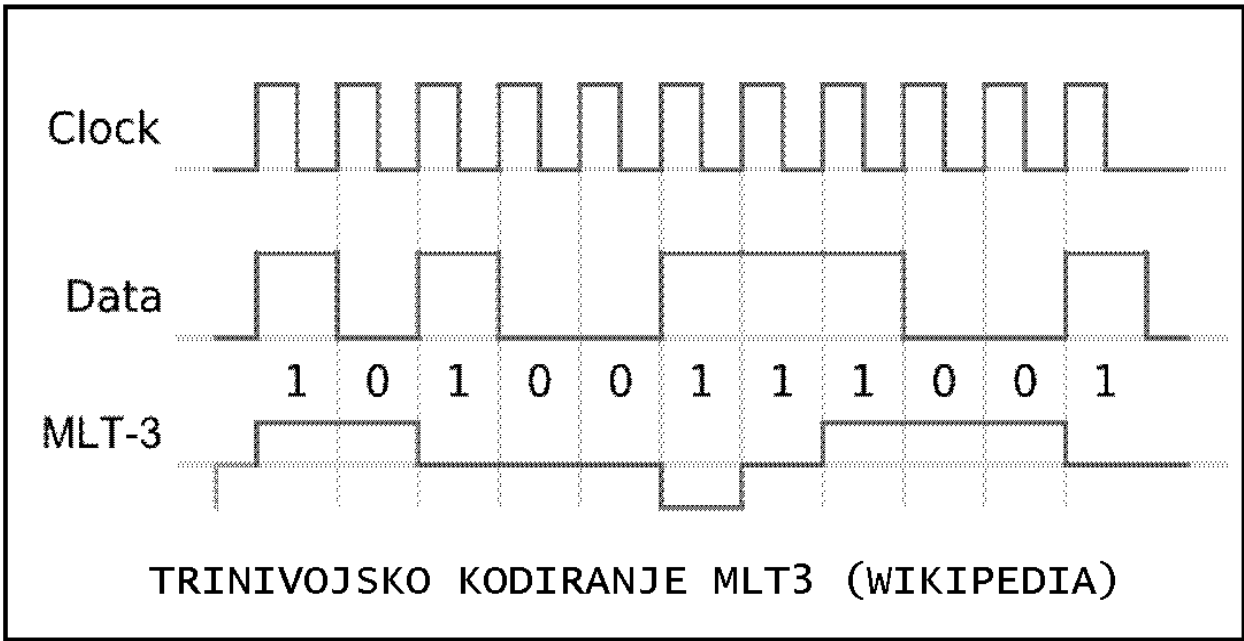
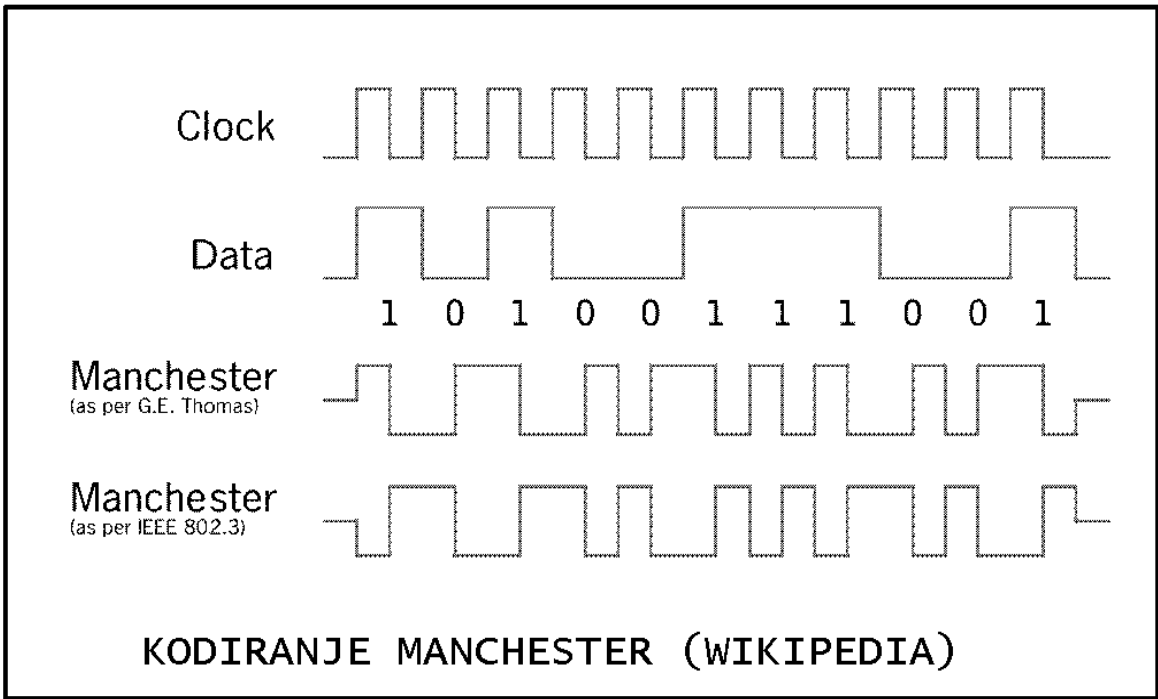
STALNA 125Mbps TRINIVOJSKA ODDAJA ~200mW/TX!!!



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NAČINI DELOVANJA ZVEZE PO UTP

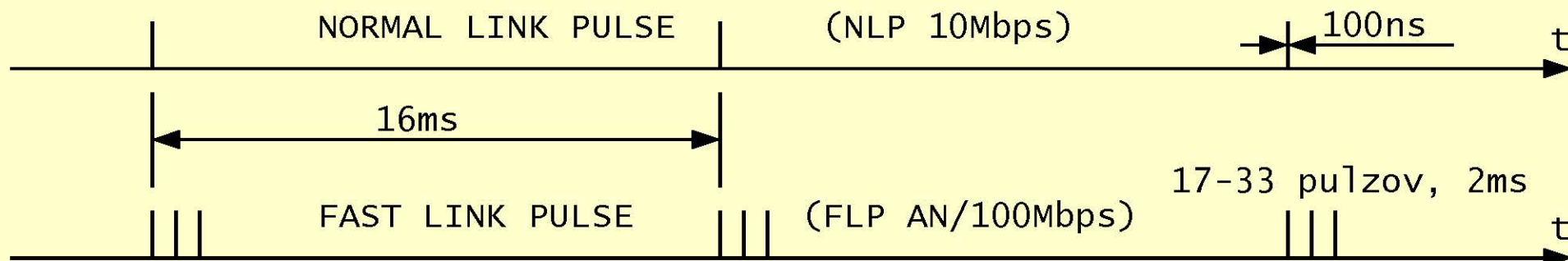


MANCHESTER, 4B5B IN MLT3

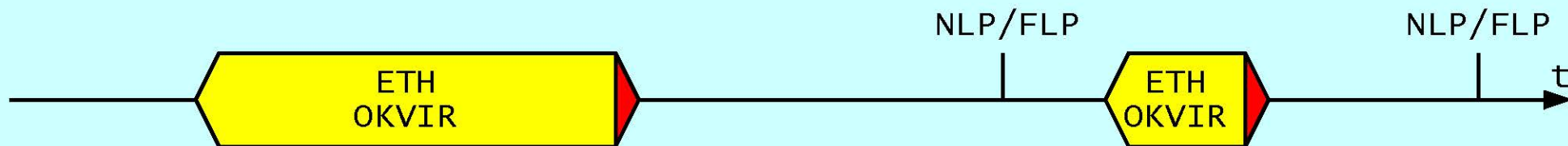
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4B5B (WIKIPEDIA)

NEPOVEZAN



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100Mbps: 4B5B+NRZI(1)+skrambler+MLT3

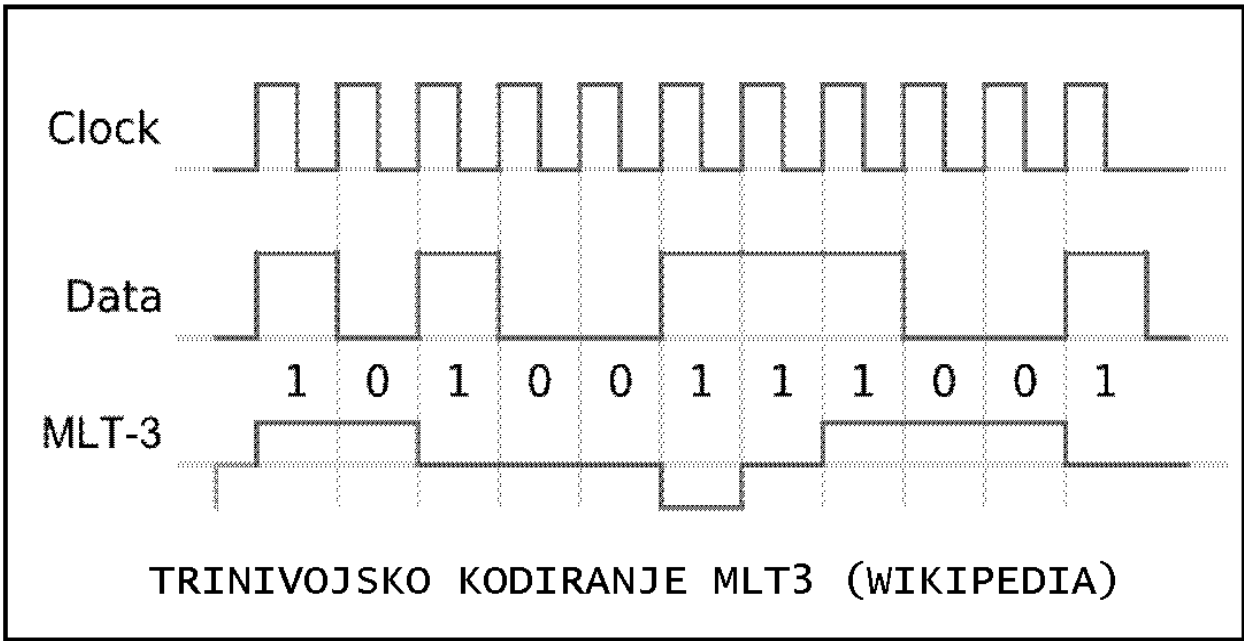
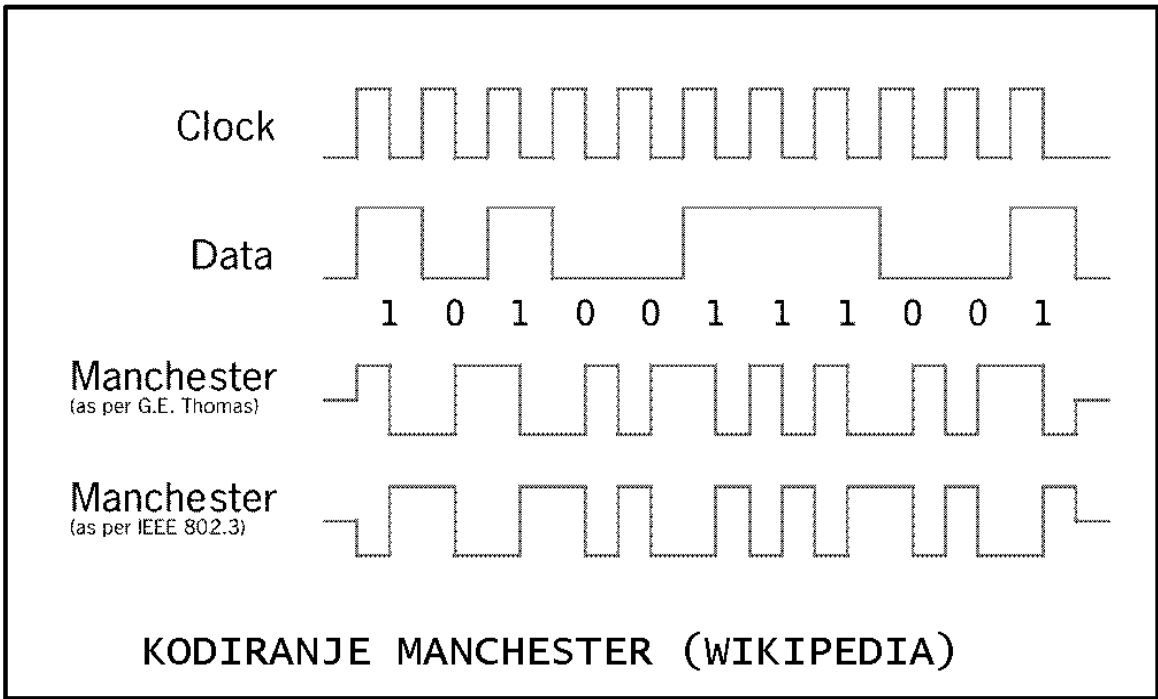
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NAČINI DELOVANJA ZVEZE PO UTP

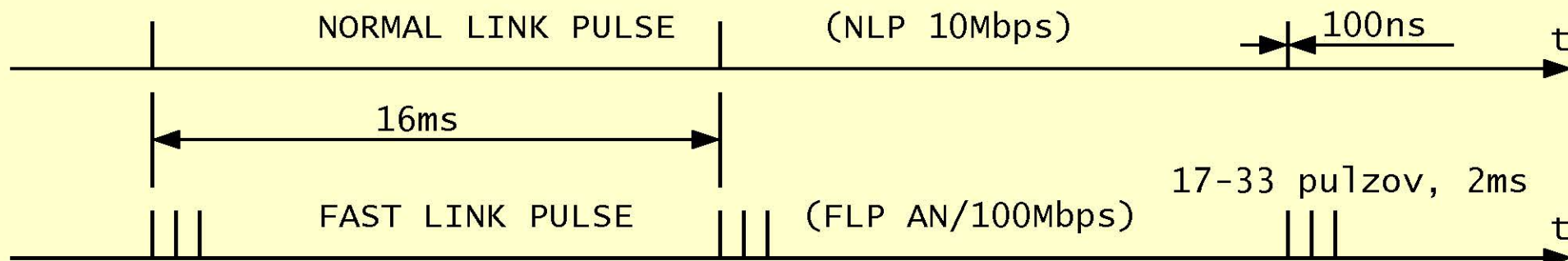


MANCHESTER, 4B5B IN MLT3

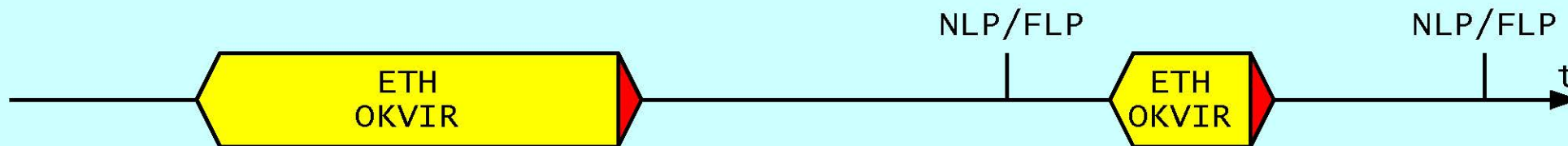
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4B5B (WIKIPEDIA)

NEPOVEZAN



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RJ-45 Wiring (TIA/EIA-568-B T568A)

Pin	Pair	Color	telephone	10BASE-T	100BASE-TX	1000BASE-T	PoE mode A	PoE mode B
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2	3	 green	-	TX-	z	bidi	48V out	-
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4	1	 blue	ring	-	-	bidi	-	48V out
5	1	 white/blue	tip	-	-	bidi	-	48V out
6	2	 orange	-	RX-	z	bidi	48V return	-
7	4	 white/brown	-	-	-	bidi	-	48V return
8	4	 brown	-	-	-	bidi	-	48V return

(WIKIPEDIA)

ZVEZA TOČKA-TOČKA
ZAKLJUČITEV Zk=100Ω
DOMET ~100m (10/100Mbps)

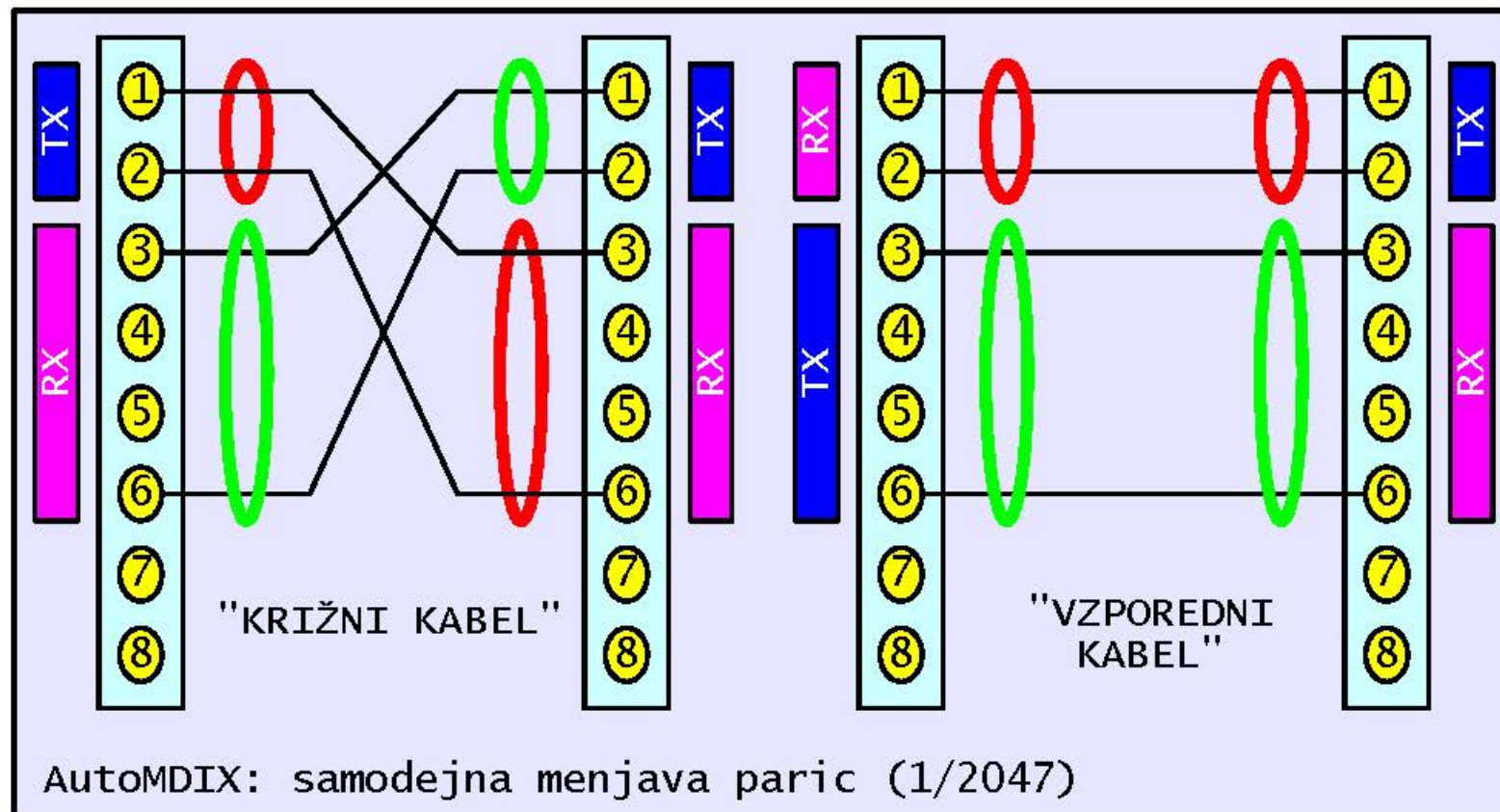
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4	1	ring	 blue
5	1	tip	 white/blue
6	2	ring	 orange
7	4	tip	 white/brown
8	4	ring	 brown

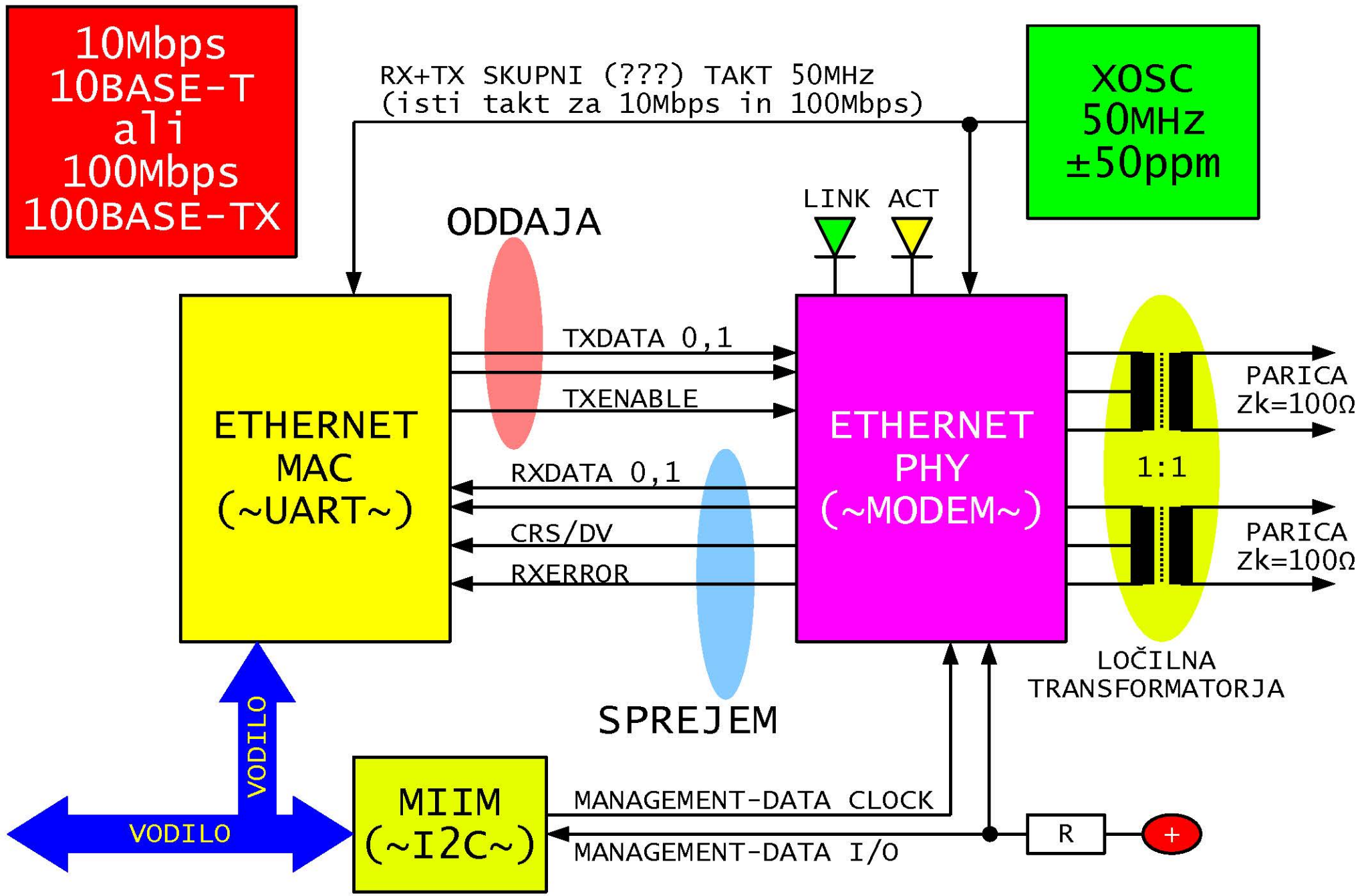
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8	4	ring	 brown

(WIKIPEDIA)



NEOKLOPLJENA SUKANA PARICA UTP



VMESNIK RMII (Reduced Media-Independent Interface)

RJ-45 Wiring (TIA/EIA-568-B T568A)

Pin	Pair	Color	telephone	10BASE-T	100BASE-TX	1000BASE-T	PoE mode A	PoE mode B
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6	2	 orange	-	RX-	z	bidi	48V return	-
7	4	 white/brown	-	-	-	bidi	-	48V return
8	4	 brown	-	-	-	bidi	-	48V return

(WIKIPEDIA)

ZVEZA TOČKA-TOČKA
ZAKLJUČITEV Zk=100Ω
DOMET ~100m (10/100Mbps)

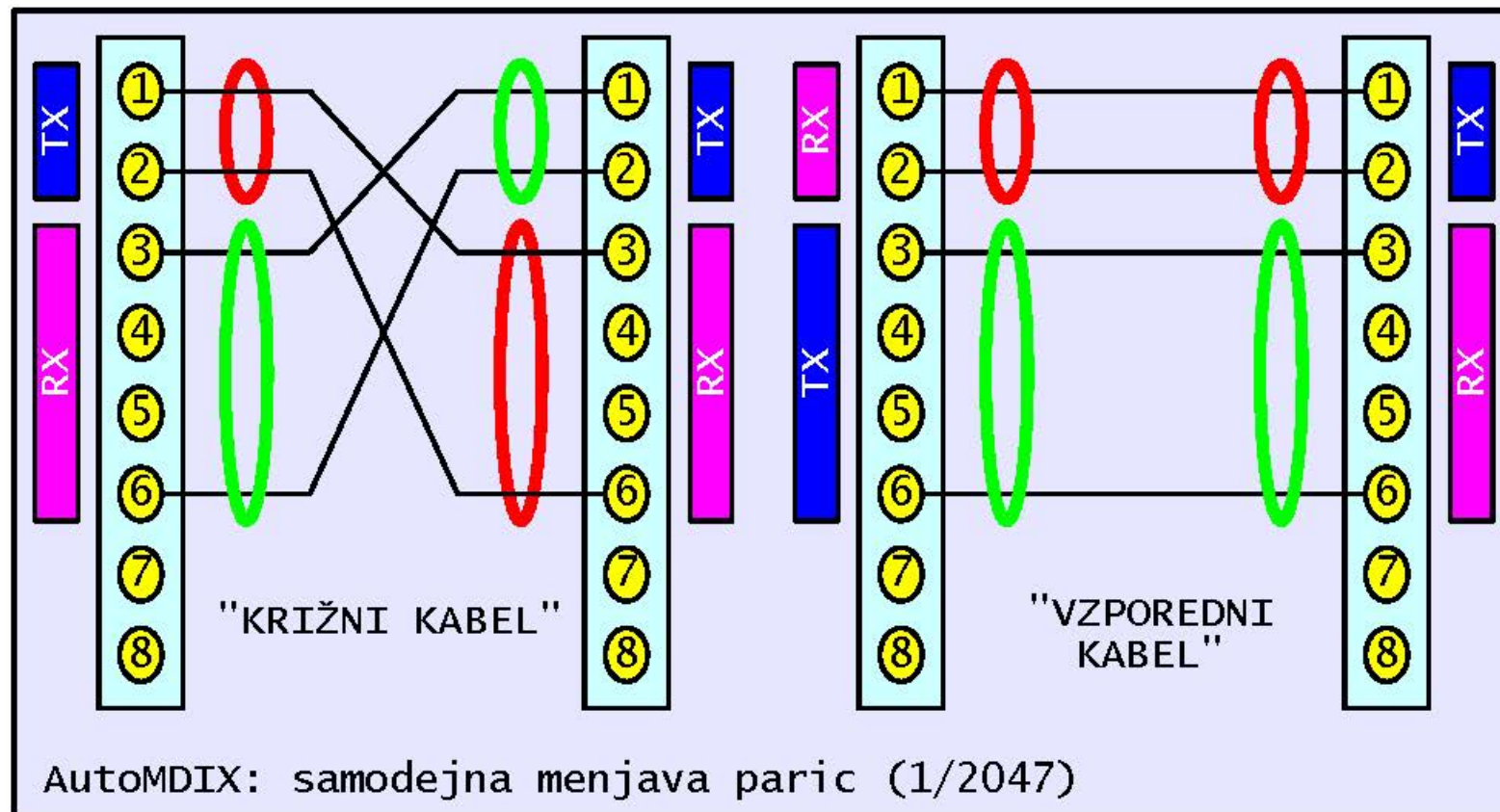
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4	1	ring	 blue
5	1	tip	 white/blue
6	2	ring	 orange
7	4	tip	 white/brown
8	4	ring	 brown

TIA/EIA-568 T568B termination

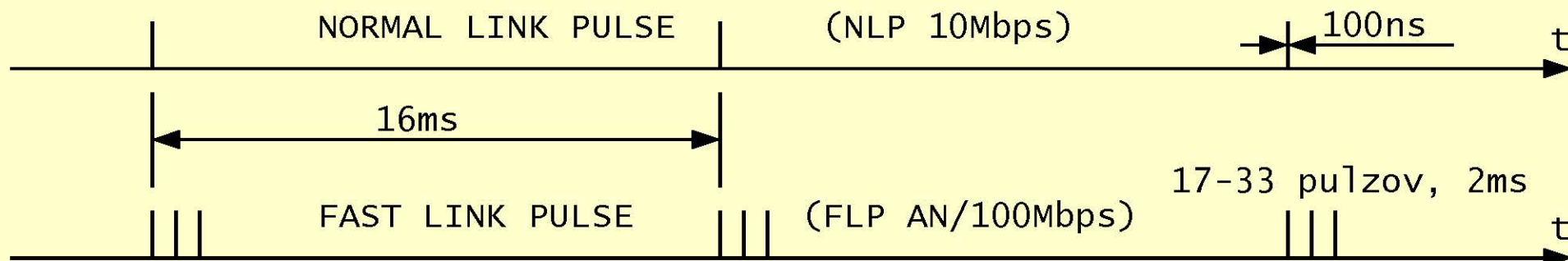
Pin	Pair	Wire	Color
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2	2	ring	 orange
3	3	tip	 white/green
4	1	ring	 blue
5	1	tip	 white/blue
6	3	ring	 green
7	4	tip	 white/brown
8	4	ring	 brown

(WIKIPEDIA)

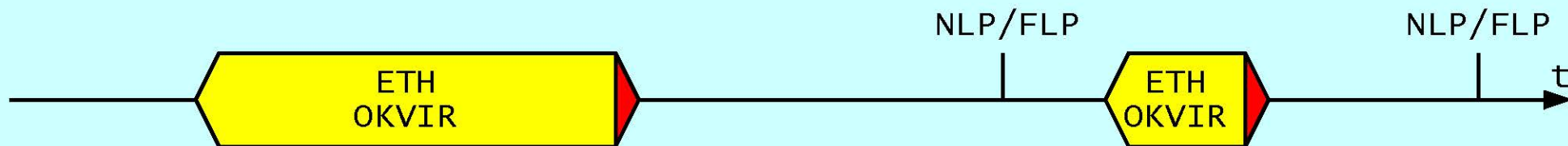


NEOKLOPLJENA SUKANA PARICA UTP

NEPOVEZAN



10Mbps: Manchester (občutljiv na polariteto)



100Mbps: 4B5B+NRZI(1)+skrambler+MLT3

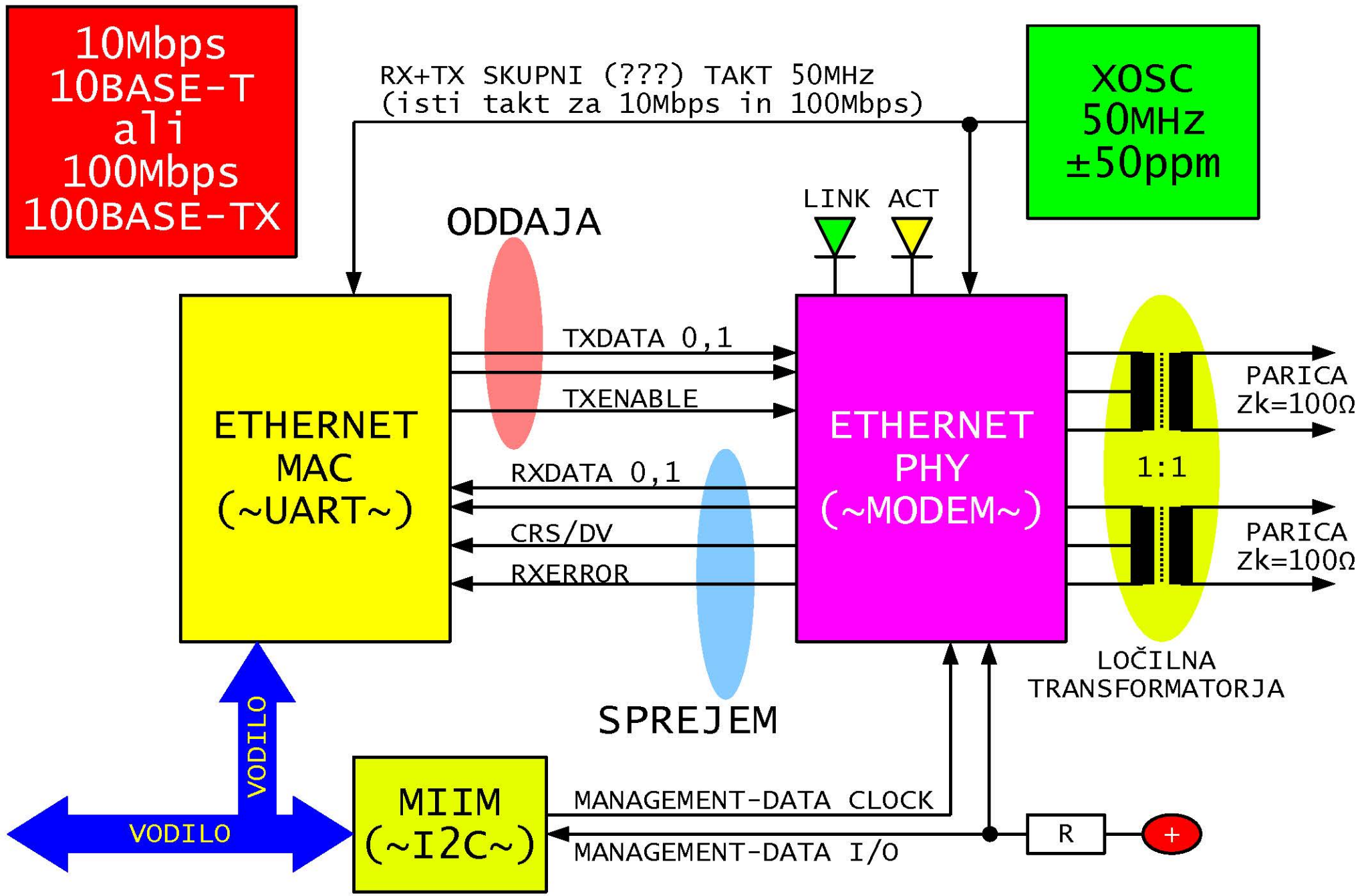
STALNA 125Mbps TRINIVOJSKA ODDAJA ~200mW/TX!!!



AN ≡ Auto Negotiation (10/100Mbps, half/fullduplex)

AutoMDIX ≡ Auto Media-Dependent-Interface eXchange

NAČINI DELOVANJA ZVEZE PO UTP



VMESNIK RMII (Reduced Media-Independent Interface)

RJ-45 Wiring (TIA/EIA-568-B T568A)

Pin	Pair	Color	telephone	10BASE-T	100BASE-TX	1000BASE-T	PoE mode A	PoE mode B
1	3	 white/green	-	TX+	z	bidi	48V out	-
2	3	 green	-	TX-	z	bidi	48V out	-
3	2	 white/orange	-	RX+	z	bidi	48V return	-
4	1	 blue	ring	-	-	bidi	-	48V out
5	1	 white/blue	tip	-	-	bidi	-	48V out
6	2	 orange	-	RX-	z	bidi	48V return	-
7	4	 white/brown	-	-	-	bidi	-	48V return
8	4	 brown	-	-	-	bidi	-	48V return

(WIKIPEDIA)

ZVEZA TOČKA-TOČKA
ZAKLJUČITEV Zk=100Ω
DOMET ~100m (10/100Mbps)

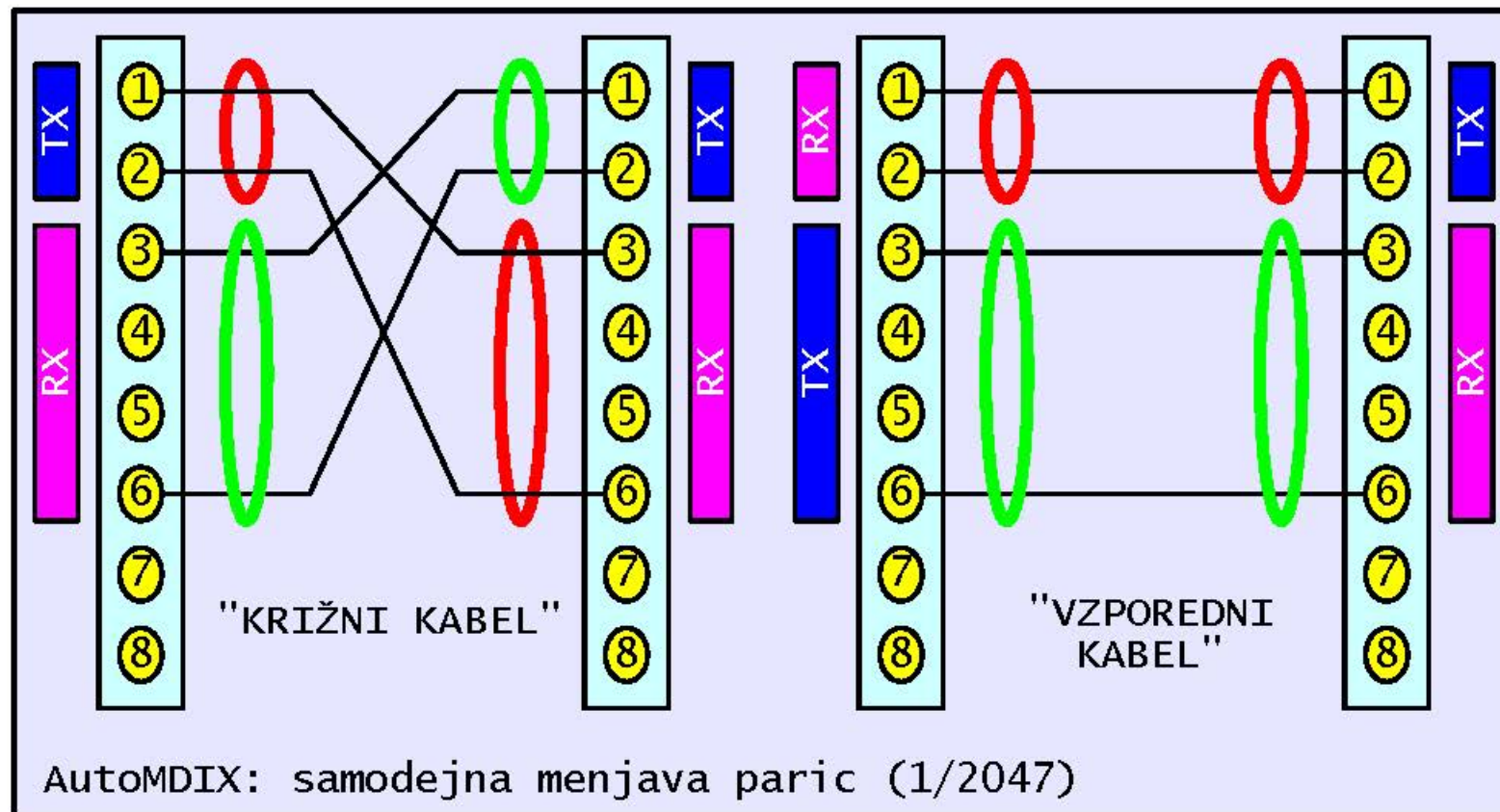
TIA/EIA-568 T568A termination

Pin	Pair	Wire	Color
1	3	tip	 white/green
2	3	ring	 green
3	2	tip	 white/orange
4	1	ring	 blue
5	1	tip	 white/blue
6	2	ring	 orange
7	4	tip	 white/brown
8	4	ring	 brown

TIA/EIA-568 T568B termination

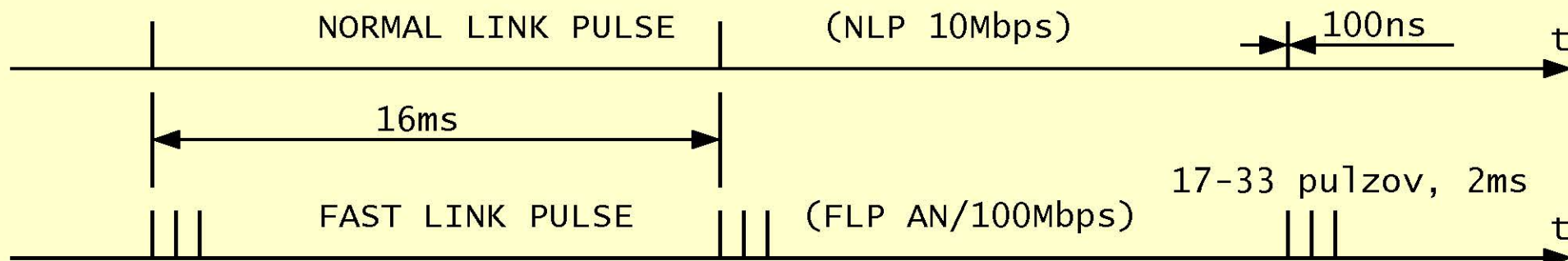
Pin	Pair	Wire	Color
1	2	tip	 white/orange
2	2	ring	 orange
3	3	tip	 white/green
4	1	ring	 blue
5	1	tip	 white/blue
6	3	ring	 green
7	4	tip	 white/brown
8	4	ring	 brown

(WIKIPEDIA)

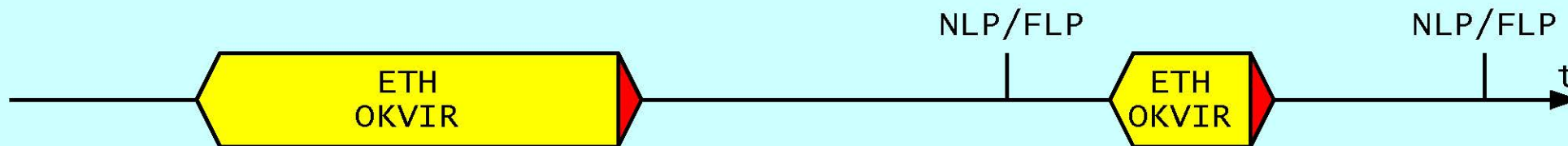


NEOKLOPLJENA SUKANA PARICA UTP

NEPOVEZAN



10Mbps: Manchester (občutljiv na polariteto)



100Mbps: 4B5B+NRZI(1)+skrambler+MLT3

STALNA 125Mbps TRINIVOJSKA ODDAJA ~200mW/TX!!!

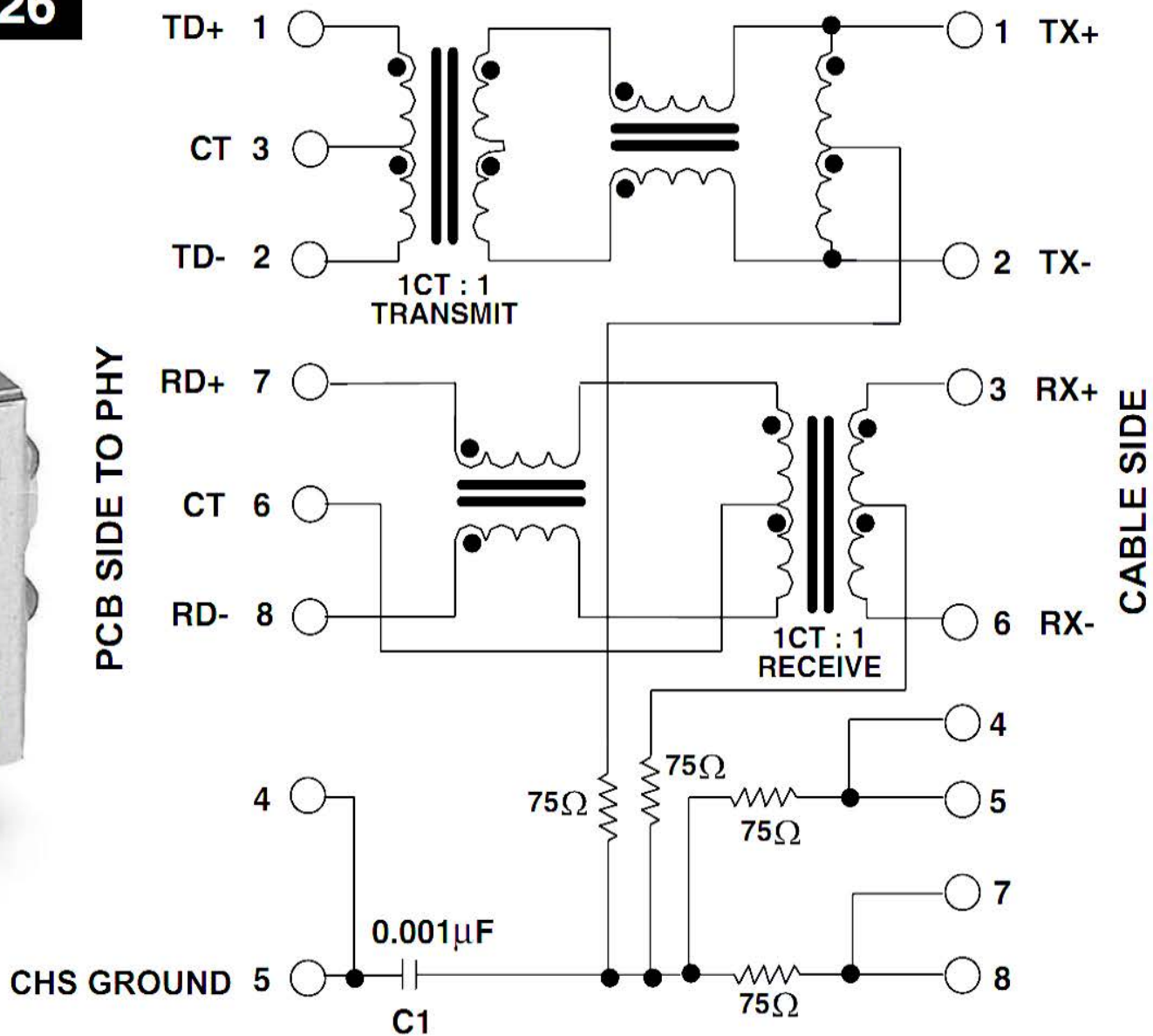
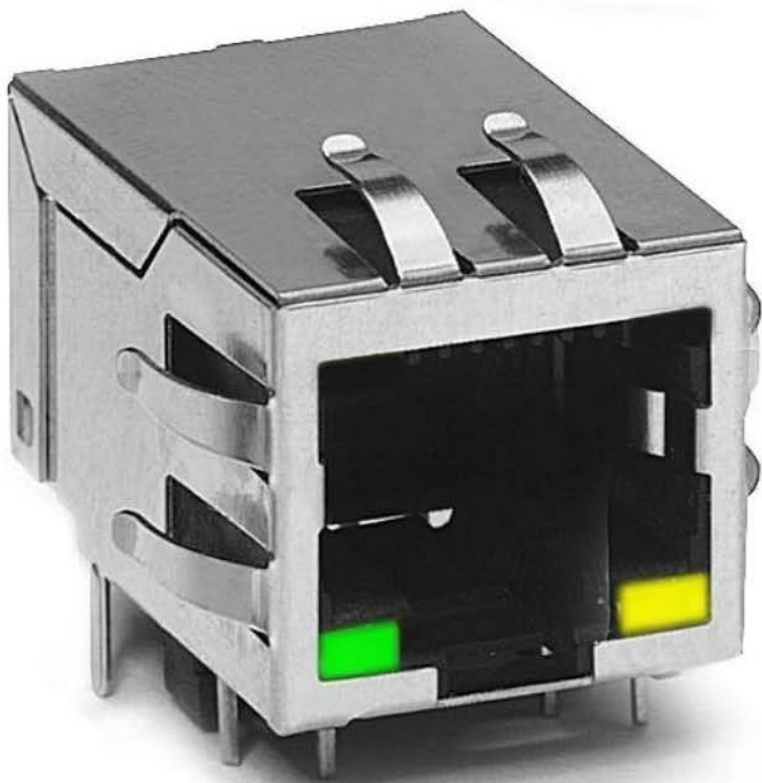


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AutoMDIX ≡ Auto Media-Dependent-Interface eXchange

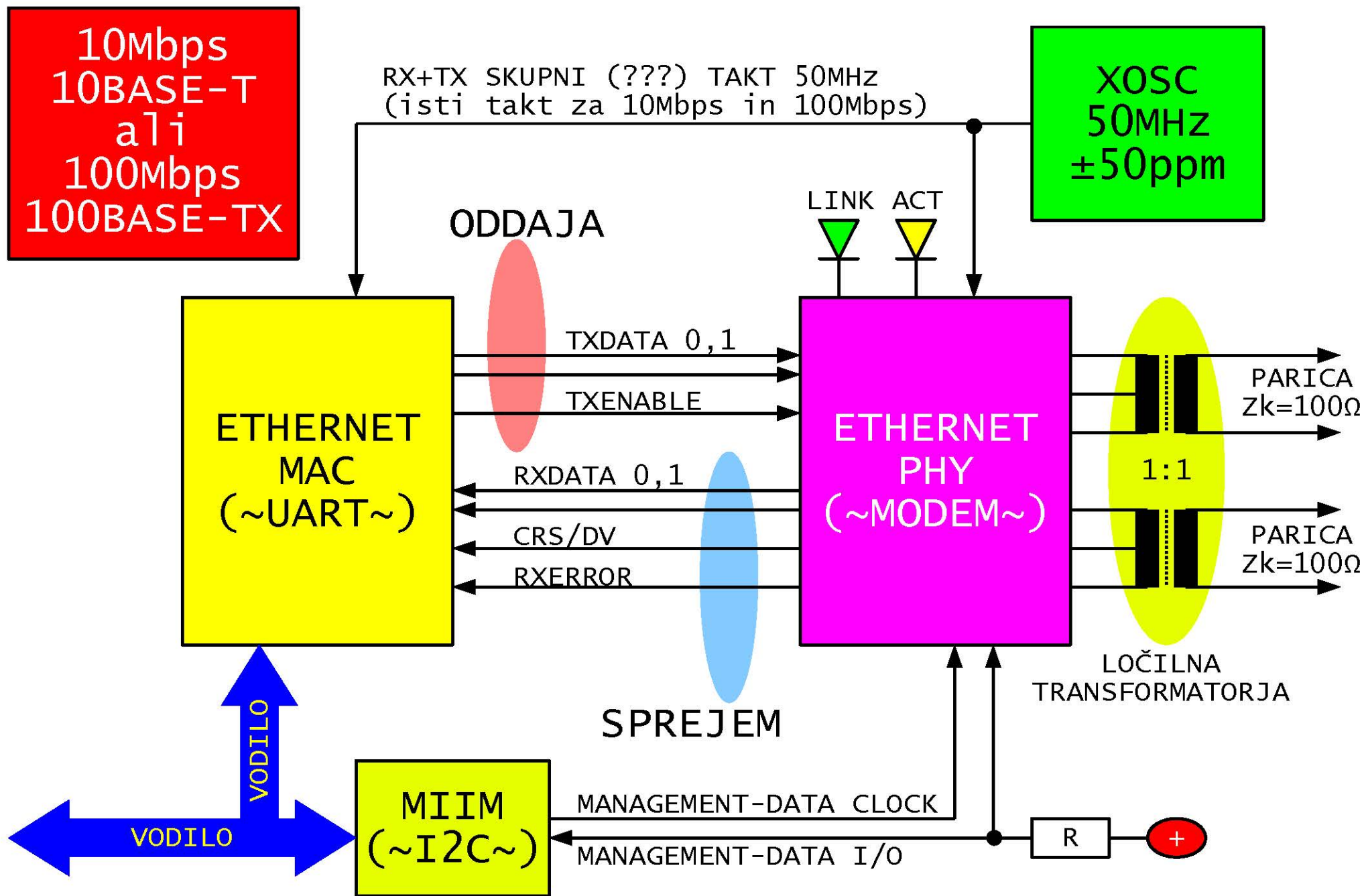
NAČINI DELOVANJA ZVEZE PO UTP

J0026



NOTE: Connect CHS GND to PCB ground.

TRAF0-VTIČNICA RJ45



VMESNIK RMII (Reduced Media-Independent Interface)