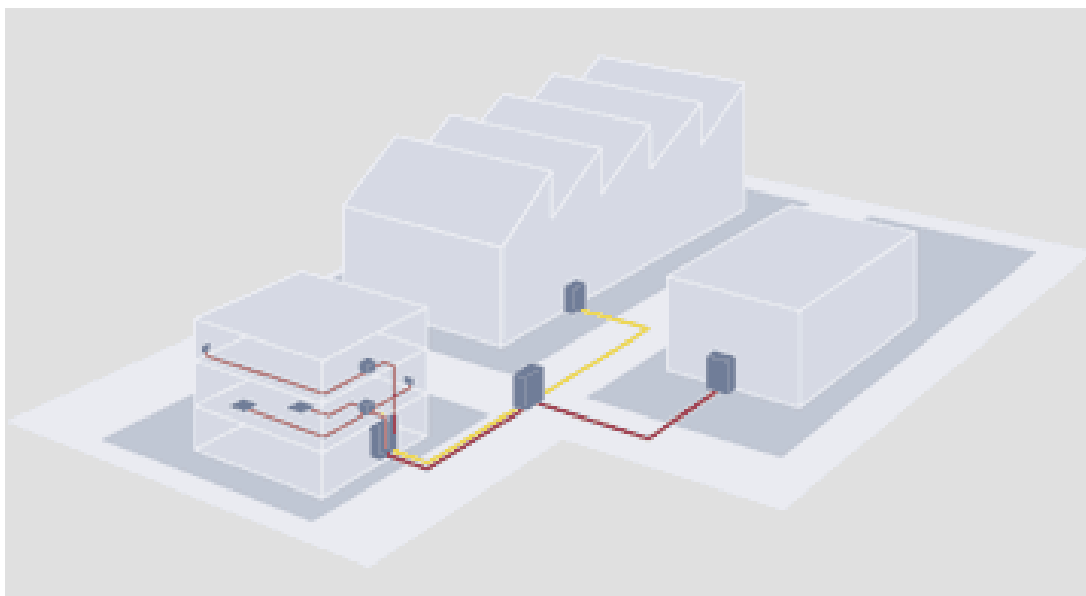


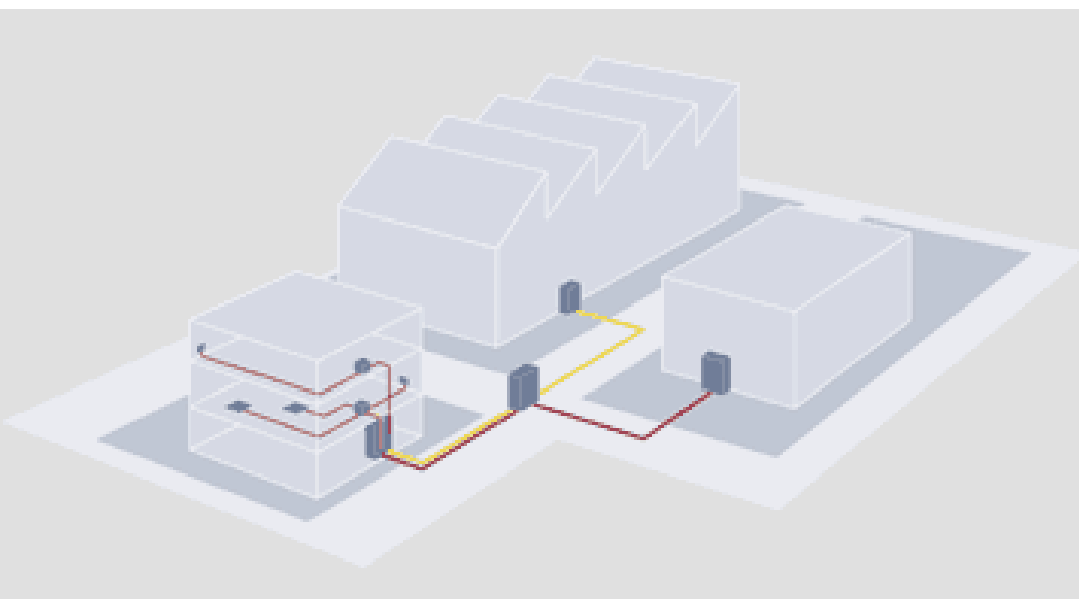
Šola Bakra

28. November, A. Z. Žagar

kabli in omrežja



kabelski standardi
mrežni standardi
gradniki
načrtovanje



ANSI/EIA/TIA-568-C

Commercial Building
Telecommunications Cabling
Standard

SIST/EN 50173 / 50174

CENELEC/EN 50173 / 50174

Informacijska tehnologija -
Splošni kabelski sistemi

ISO/IEC IS 11801

Information Technology - Generic
Cabling For Customer Premises

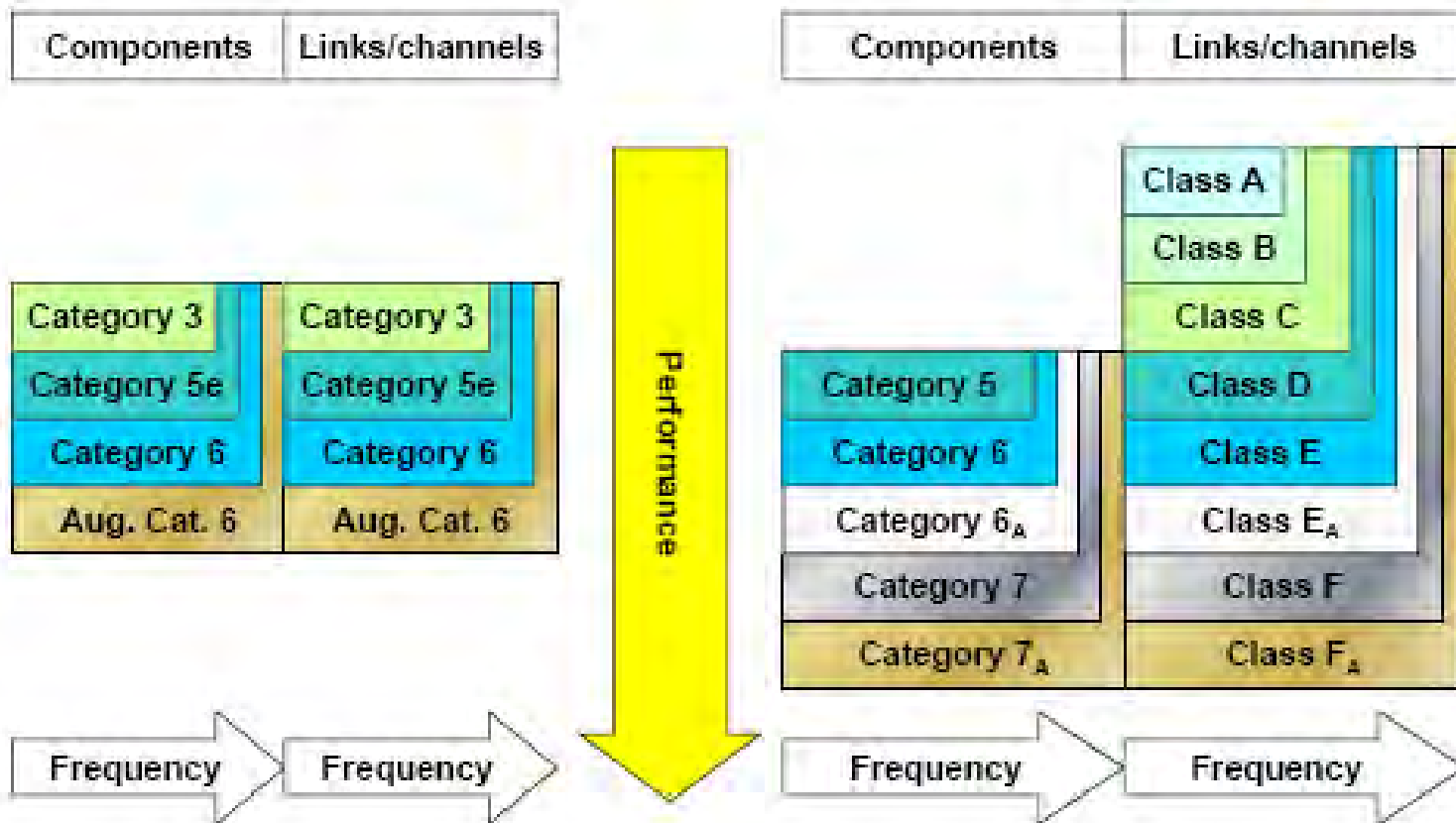


Razlike

FREQUENCY BANDWIDTH	TIA COMPONENTS)	TIA (CABLING)	ISO (COMPONENTS)	ISO (CABLING)
1 – 100 MHz	Category 5e	Category 5e	Category 5e	Class D
1 – 250 MHz	Category 6	Category 6	Category 6	Class E
1 – 500 MHz	Category 6A	Category 6A	Category 6 _A	Class E _A
1 – 600 MHz	n/s	n/s	Category 7	Class F
1 – 1,000 MHz	n/s	n/s	Category 7 _A	Class F _A



Razlike



ANSI/TIA

ANSI/TIA-568-A se razvije v **TIA-568-B** in ta v **TIA-568-C**

ANSI/TIA-568-C.0:2009

Generic Telecommunications Cabling for Customer Premises

ANSI/TIA-568-C.1:2009

Commercial Building Telecommunications Cabling Standard

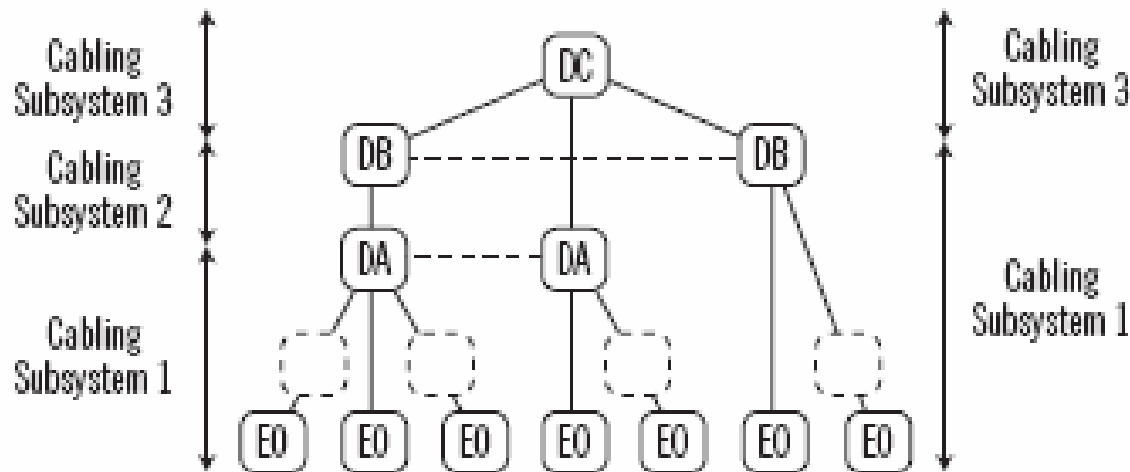
ANSI/TIA-568-C.2:2009

Balanced Twisted-Pair Telecommunications Cabling and Components Standard

ANSI/TIA-568-C.3:2009

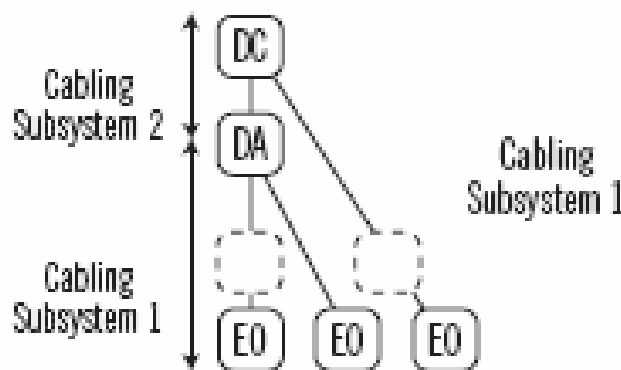
Optical Fiber Cabling Components Standard

Shema sistema

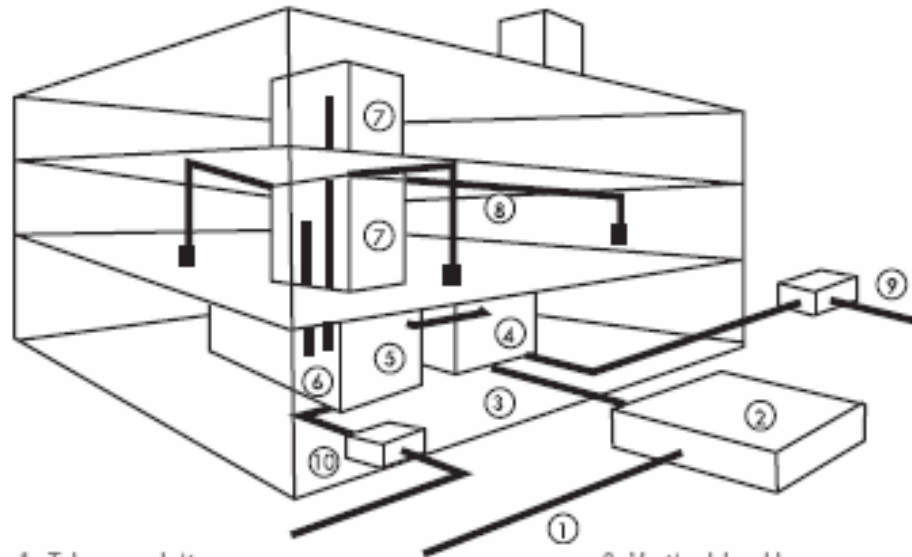


Izjemoma lahko vgradimo dodatno vmesno spojno točko (CP), vendar v razdalji najmanj 15 m proč od delovnega mesta (EO) in vozlišča ter na lahko dostopnem mestu.

Legend	
EO	Equipment outlet
DA	Distributor A
DB	Distributor B
DC	Distributor C
---	Optional cabling
---	Optional consolidation point



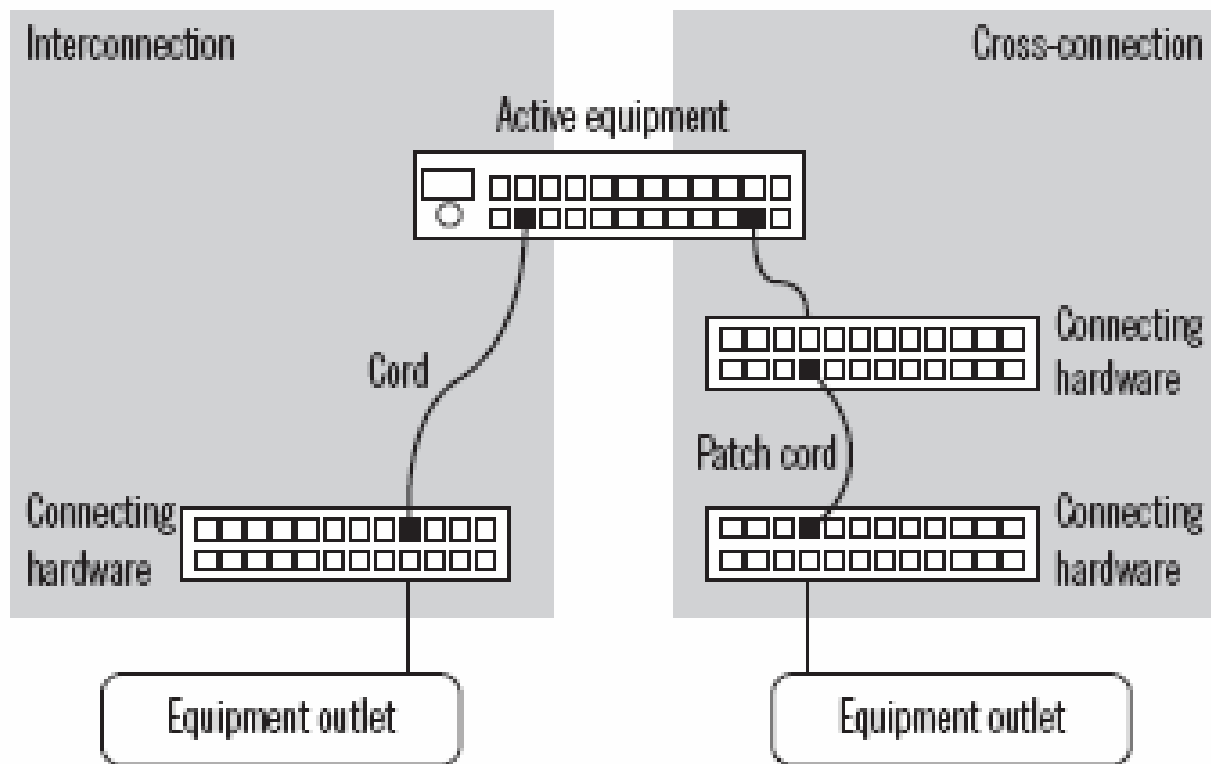
Vodoravne in navpične poti



- | | |
|--------------------------------------|----------------------------------|
| 1. Telco conduit | 6. Vertical backbone |
| 2. Telco manhole | 7. Telecommunications room |
| 3. Entrance conduit | 8. Horizontal cabling |
| 4. Telco entrance facility | 9. Interbuilding backbone |
| 5. Telecommunications equipment room | 10. Electrical entrance facility |

Tip vozlišča

Distributor A



Cabling Lengths

Razdalje

Application	Media	Distance m (ft.)	Comments
Ethernet 10BASE-T	Category 3, 5e, 6, 6A	100 (328)	
Ethernet 100BASE-TX	Category 5e, 6, 6A	100 (328)	
Ethernet 1000BASE-T	Category 5e, 6, 6A	100 (328)	
Ethernet 10GBASE-T	Category 6A	100 (328)	
ASDL	Category 3, 5e, 6, 6A	5,000 (16,404)	1.5 Mbps to 9 Mbps
VDSL	Category 3, 5e, 6, 6A	5,000 (16,404)	1,500 m (4,900 ft.) for 12.9 Mbps; 300 m (1,000 ft.) for 52.8 Mbps
Analog Phone	Category 3, 5e, 6, 6A	800 (2,625)	
FAX	Category 3, 5e, 6, 6A	5,000 (16,404)	
ATM 25.6	Category 3, 5e, 6, 6A	100 (328)	
ATM 51.84	Category 3, 5e, 6, 6A	100 (328)	
ATM 155.52	Category 5e, 6, 6A	100 (328)	
ATM 1.2G	Category 6, 6A	100 (328)	
ISDN BRI	Category 3, 5e, 6, 6A	5,000 (16,404)	128 kbps
ISDN PRI	Category 3, 5e, 6, 6A	5,000 (16,404)	1.472 Mbps

Dolžine priključnih kablov

Maximum Length of Horizontal Cables and Work Area Cords					
Length of horizontal cable	24 AWG Cords			26 AWG Cords	
	Maximum length of work area cord	Maximum combined length of work area cord, patch cords and equipment cord		Maximum length of work area cord	Maximum combined length of work area cord, patch cords and equipment cord
		W m (ft.)	C m (ft.)		
90 (295)	5 (16)	10 (33)	4 (13)	8 (26)	
85 (279)	9 (30)	14 (46)	7 (23)	11 (35)	
80 (262)	13 (44)	18 (59)	11 (35)	15 (49)	
75 (246)	17 (57)	22 (72)	14 (46)	18 (59)	
70 (230)	22 (72)	27 (89)	17 (56)	21 (70)	

ANSI/TIA, spremljajoči standardi

- ANSI/TIA-570-B:2004** Residential Telecommunications Cabling Standard
ANSI/TIA-570-B-1:2009 Add. Requirements for Broadband Coaxial Cabling
- ANSI/TIA-862:2002** Building Automation Systems Cabling Standard for Commercial Buildings
- ANSI/TIA-942: 2005** Telecommunications Infrastructure Standard for Data Centers
ANSI/TIA-942-1: 2008 Coaxial Cabling Specifications and Application Distances
- ANSI/TIA-1005: 2009** Telecommunications Infrastructure Standard for Industrial Premises

CENELEC/EN

Information technology - Cabling installation

EN 50173-1:2007	General requirements
EN 50173-1 A1:2009	Amendment 1
EN 50173-2:2007	Office premises
EN 50173-3:2007	Industrial premises
EN 50173-4:2007	Homes
EN 50173-5:2007	Data centres

CENELEC/EN

Information technology - Cabling installation

- | | |
|-----------------------------|--|
| EN 50174-1:2009 | Installation Specification and quality assurance |
| EN 50174-2:2009 | Installation planning and practices inside buildings |
| EN 50174-3:2003 | Installation planning and practices outside buildings |
| EN 50310 Ed.2:2006 | Application of Equipotential Bonding and Earthing in Buildings with Information Technology Equipment |
| EN 50346 Ed 1.1:2009 | Testing of Installed Cabling |

ISO/IEC

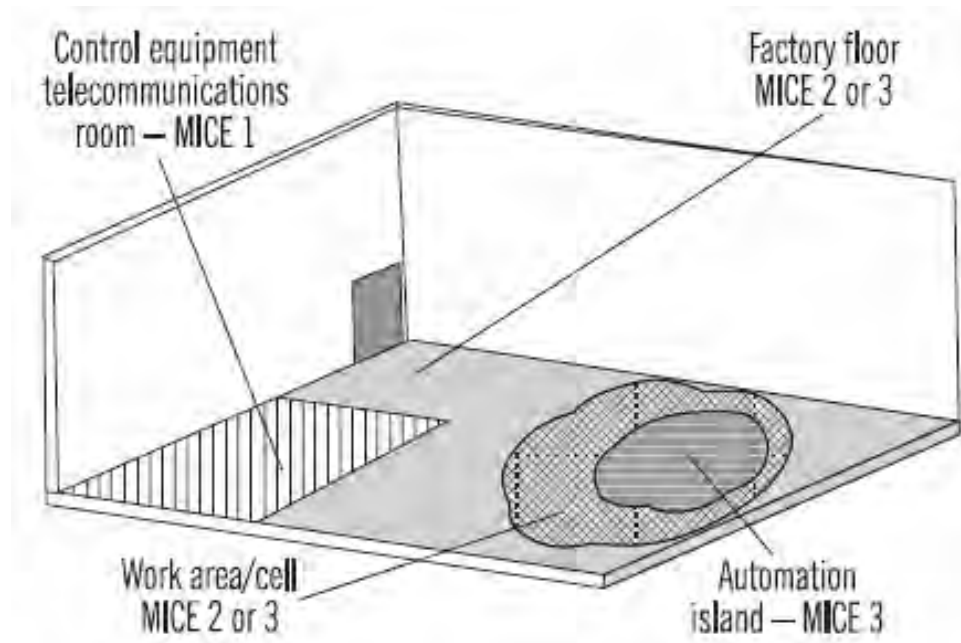
ISO/IEC 11801 Ed. 2.1: 2008	IT- Generic cabling for customer premises
ISO/IEC 15018:2004 ISO/IEC 15018 A1:2009	IT- Generic cabling for homes Amendment 1
ISO/IEC 24702:2006 ISO/IEC 24702 A1:2009	IT- Generic cabling - Industrial premises Amendment 1. Change to plastic optical fibre specifications

Dodatno določanje sistema

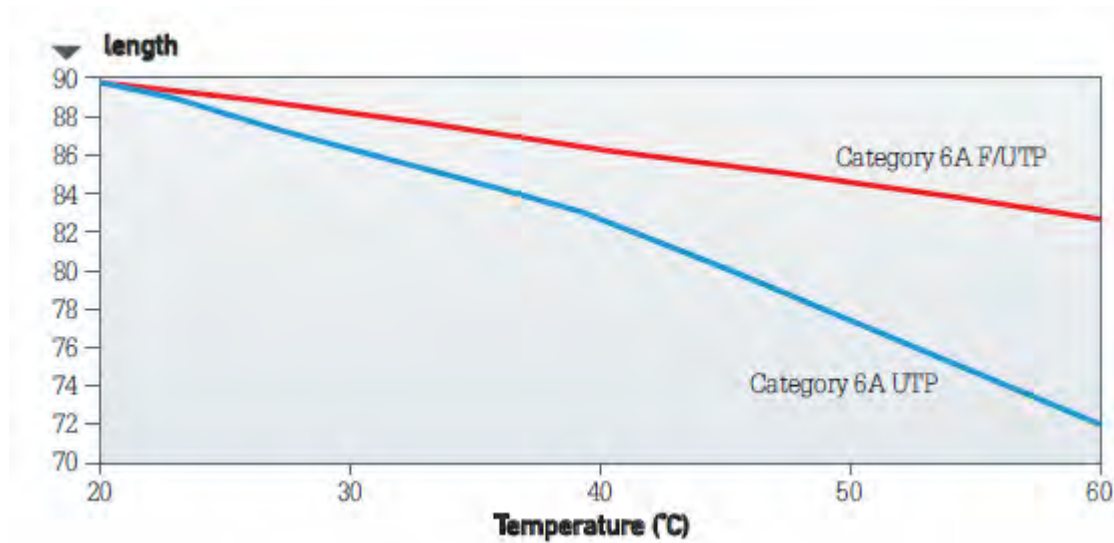
Mechanical	M₁	M₂	M₃
Ingress	I₁	I₂	I₃
Climatic	C₁	C₂	C₃
Electromagnetic	E₁	E₂	E₃
	Commercial Level 1	Light Industrial Level 2	Heavy Industrial Level 3

- M** mehanski vplivi
- I** tekočine, plini, nevarne snovi
- C** klimatske in kemijski vpliv
- E** elektromagnetni vpliv

Dodatno določanje sistema

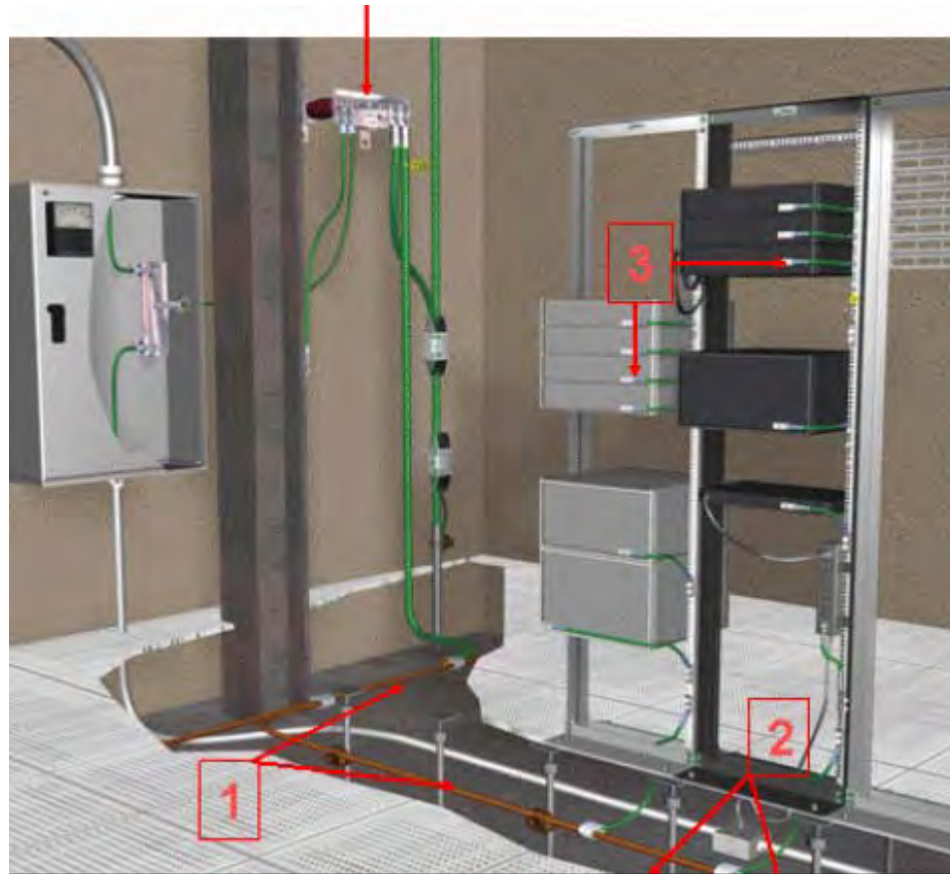


Vpliv temperature



Ozemljitev in oklopi

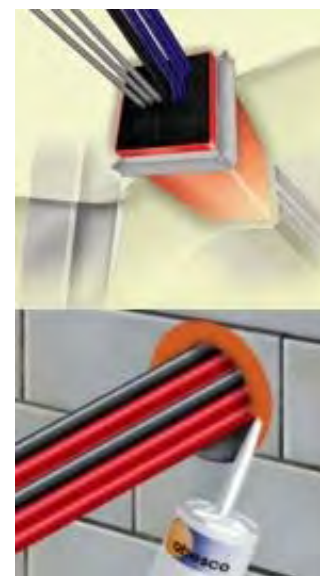
- 1
Glavna ozemljitvena mreža
- 2
Ozemljitev omare in rack-a
- 3
Ozemljitev opreme v rack-u



standardi - kabelski



Sistem za ustavitev ognja



UL 1479 F (Flame) stopnja v urah

UL 1479 T (Thermal conductivity) stopnja običajno v minutah



Industrijski kabelski sistemi



TIA-1179

standardi - kabelski

Industrijski kabelski sistemi



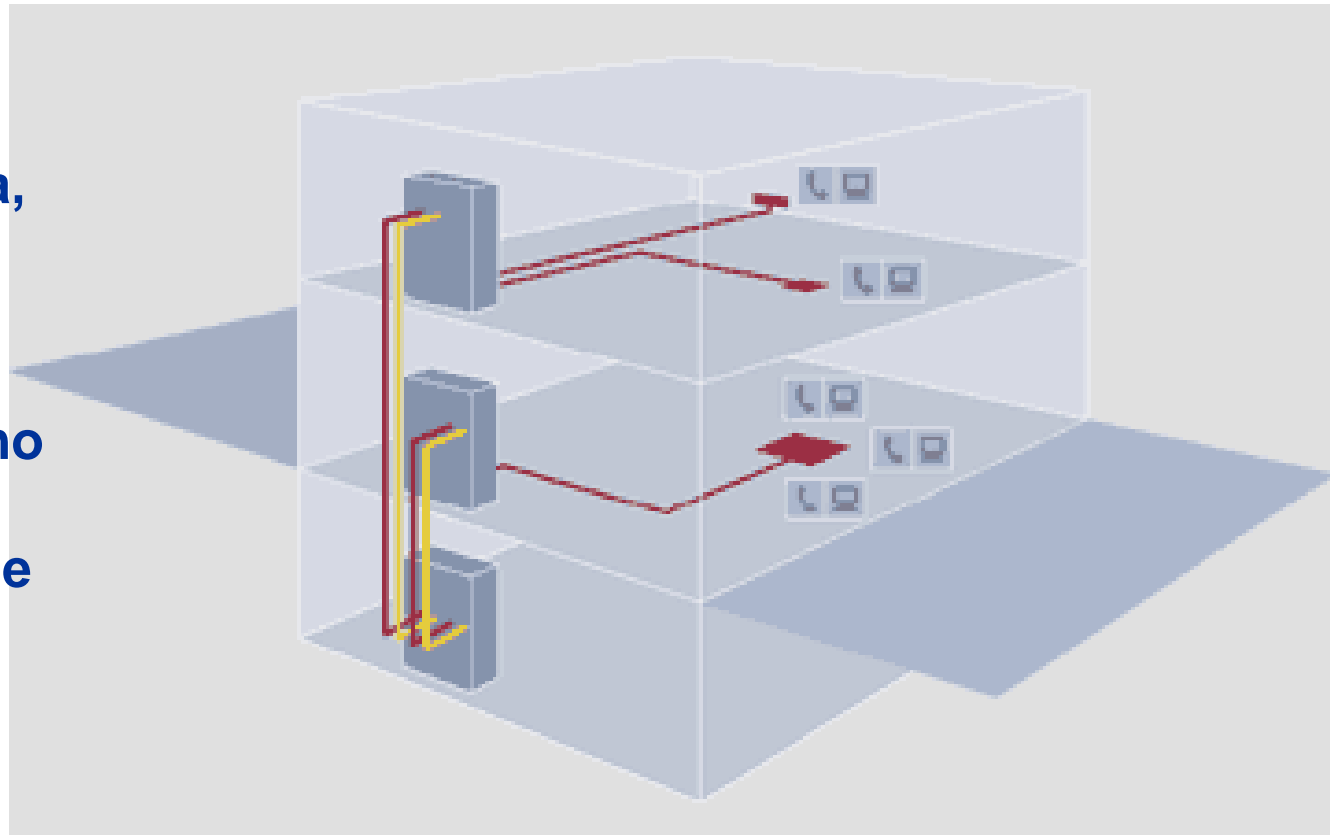
standardi - kabelski

Zgradba sistema

cilji :

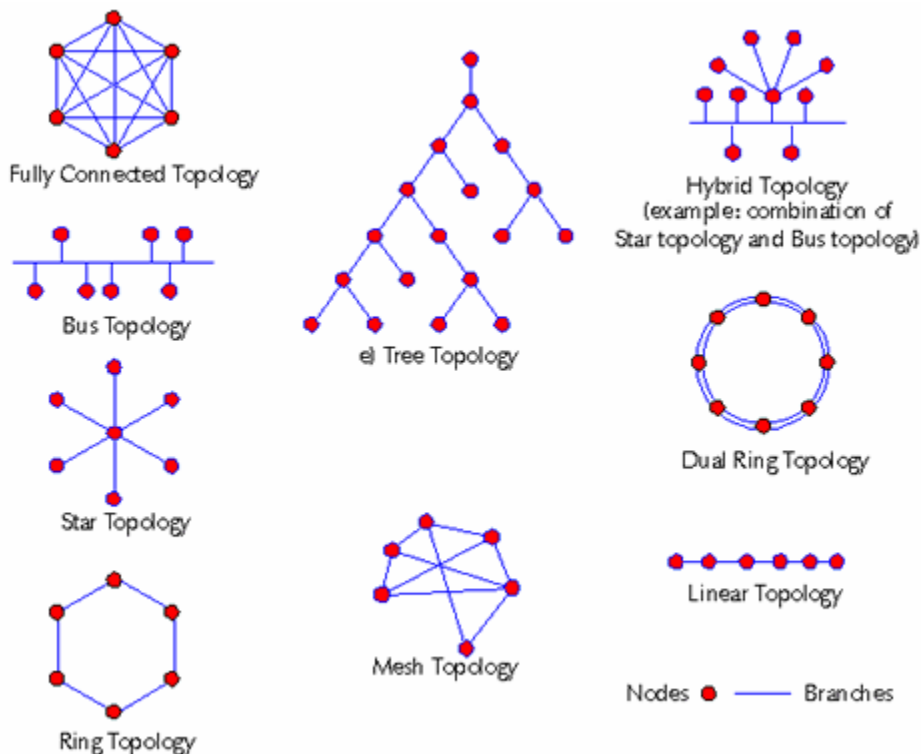
**popolna distribucija,
nadgradljivost,
modularna gradnja**

**enotno obravnavamo
podatke, telefon,
ISDN, xDSL, alarmne
signale, idr.,**

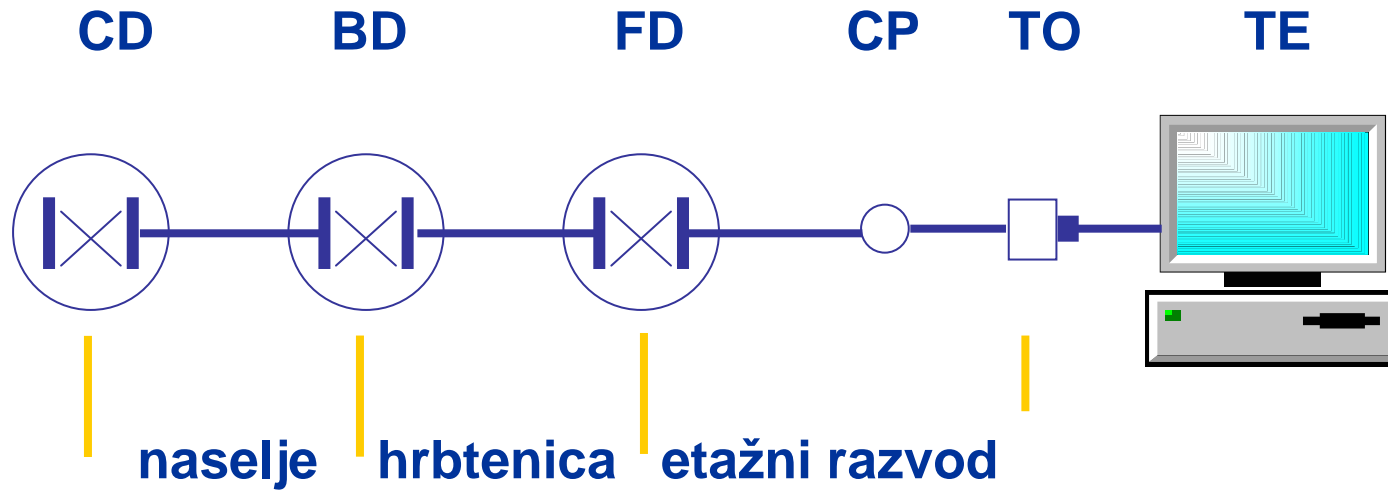


standardi - kabelski

Topologije



Pod-sistemi



CD(campus distributor) BD(building distributor) FD(floor distributor)
CP(Consolidation point) TO(Telecomm. Outlet) TE(Term. Equipment)

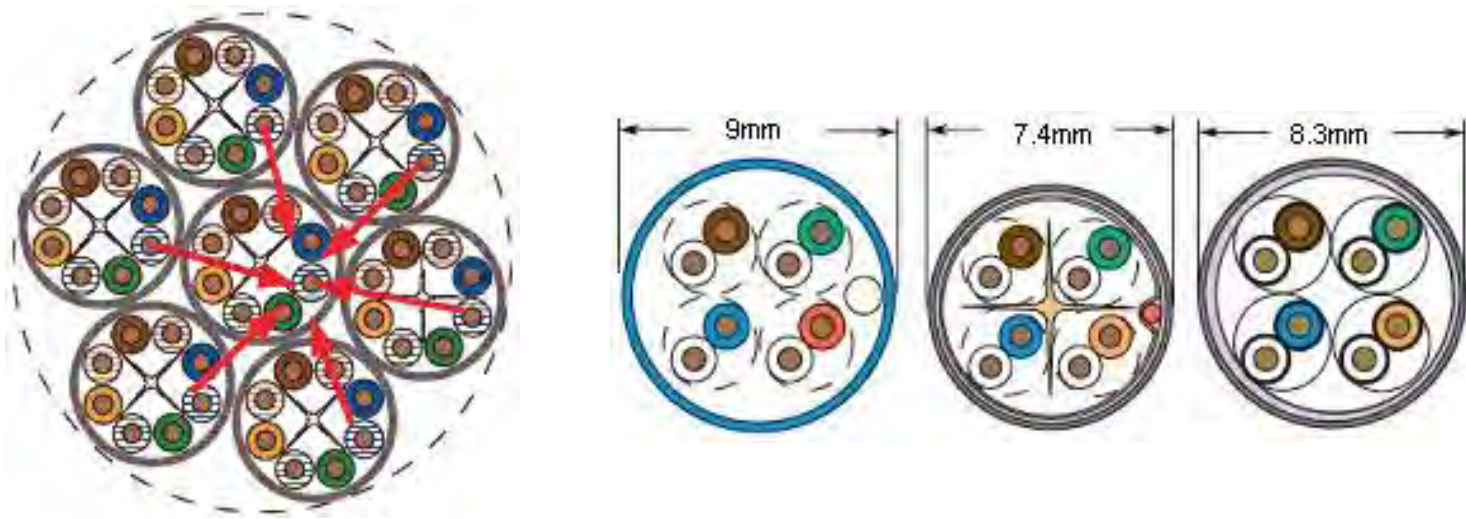
Kategorija : Razred

5e	6	6A	7	7A	OM1	OM2	OM3	OM4	OS1	OS2
D	E	EA	F	FA	OF 300	OF 500	OF 2000	OF 2000	OF 5000	OF 10000
100	250	500	600	1000	160-300	200-500	250-2000	500-4700	-	-

5-5e-6-6A / OM1-OM2-OM3-OM4 / 10/100Mb/s-1Gb/s-10Gb/s

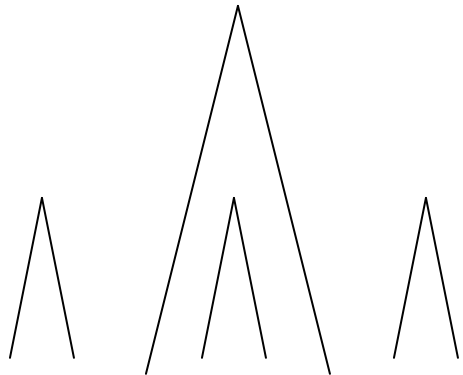
standardi - kabelski

Alien Crosstalk (AXTalk) in kat. 6A



Kategorija 6A / Razred EA (Augmented) je izboljšana Kat. 6 / Razred E, oba posebej prirejena za 10GBase-T Ethernet (IEEE 802.3an)

Konektorji kat. 7, 7A



kat. 5, 5e in kat. 6, 6A



kat. 7, 7A



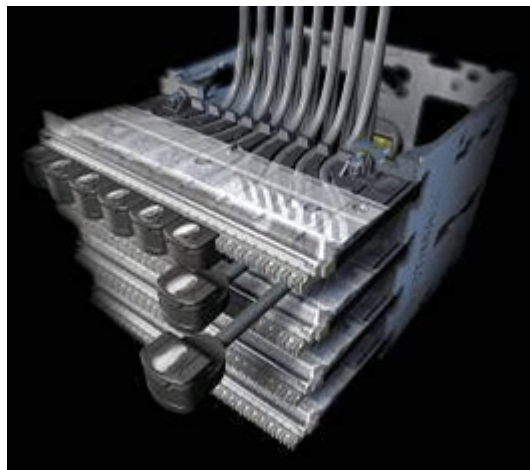
Nexans
GG45



Stewart
ARJ45

Konektorji kat. 7, 7A

visipatch



Visipatch 360

Tera



Novi standard za konektorje

RJ point five





Mrežni in kabelski standardi

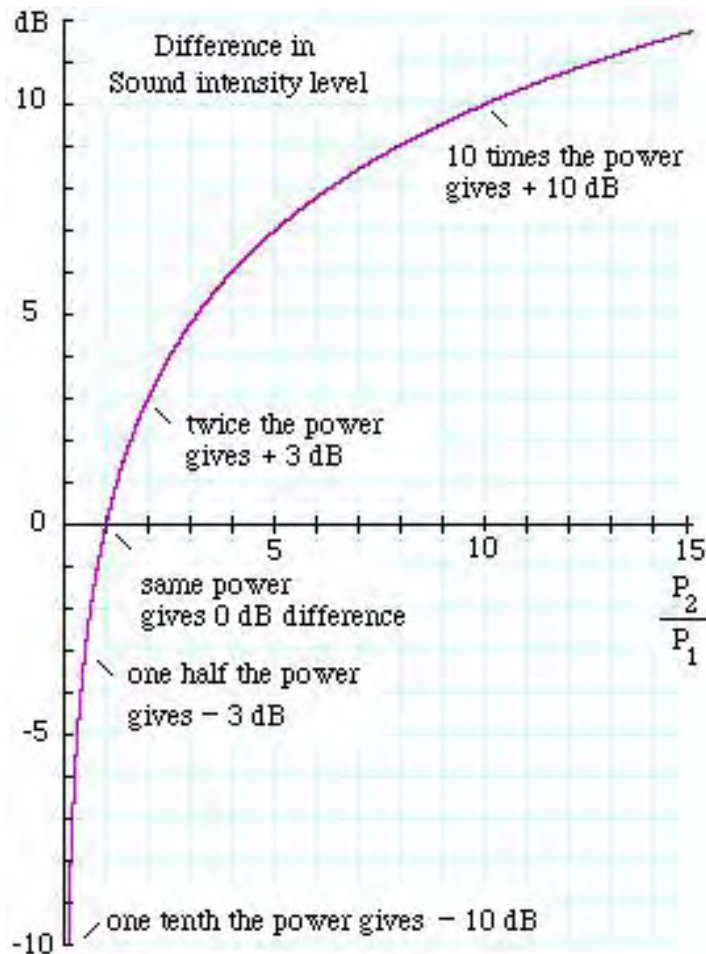
	CATEGORY 5E CLASS D	CATEGORY 6 CLASS E	CATEGORY 6A CLASS E _A	CLASS F	CLASS F _A
4/16 MBPS TOKEN RING	●	●	●	●	●
10BASE-T	●	●	●	●	●
100BASE-T4	●	●	●	●	●
155 MBPS ATM	●	●	●	●	●
1000BASE-T	●	●	●	●	●
1000BASE-TX		●	●	●	●
10GBASE-T			●	●	●
ISO/IEC 14165-144				●	●
BROADBAND CATV					●

ISO/IEC 14165-144 (Fibre Channel)

1000Base-T (vsi pari v obe smeri), 1000Base-TX (dva para za eno smer)

Kaj je dB

$10\log(P2 / P1)$ v dB



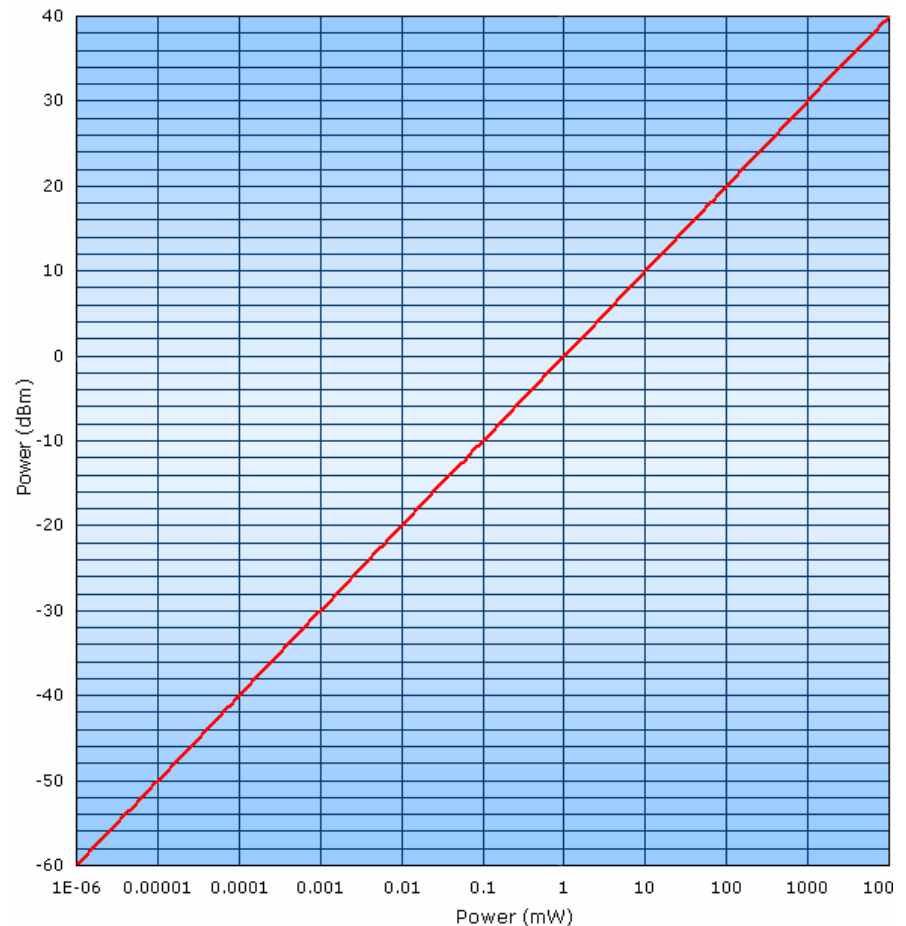
standardi - povezava

Kaj je dBm

Once you get used to it, you will never want to return to watts. Units of dBm are decibels relative to 1 mW of power, hence, 0 dBm 1 mW. 1/100 mW is -20 dBm and 100 mW is +20 dBm. Powers less than 1 mW are always negative dBm values, and powers greater than 1 mW are always positive.

$$P(\text{mW}) = 10^{[P(\text{dBm})/10]}$$

$$P(\text{dBm}) = 10 \cdot \log[P(\text{mW})]$$



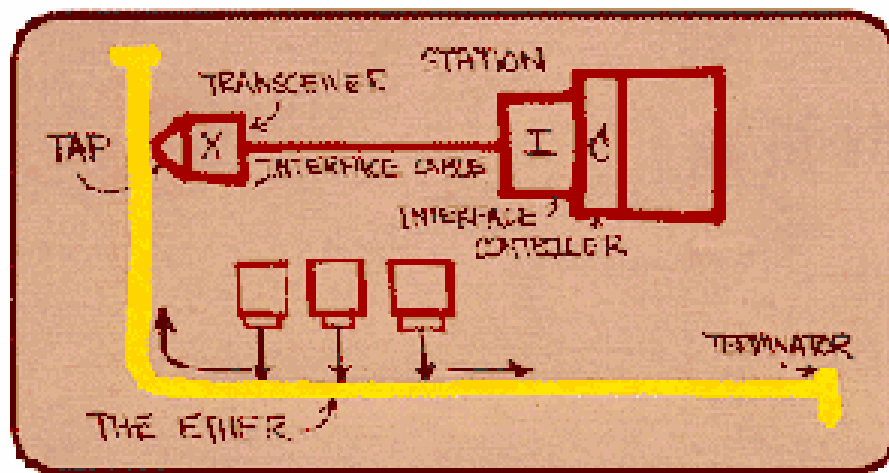
Kaj je bit in Bajt

	Bytes	Bits
1 bit =	.125 byte. =	1 bit.
1 byte =	1 byte. =	8 bits
1 kilobyte =	1024 bytes =	8192 bits
1 megabyte =	1048576 bytes =	8388608 bits
1 gigabyte =	1073741824 bytes =	8589934592 bits
1 terabyte =	1099511627776 bytes =	8796093022208 bits
1 petabyte =	1125899906842624 bytes =	9007199254740992 bits
1 exabyte =	1152921504606846976 bytes =	9223372036854775808 bits
1 zettabyte =	1180591620717411303424 bytes =	9444732965739290427392 bits
1 yottabyte =	1208925819614629174706176 bytes =	9671406556917033397649408 bits
1 xonabyte =	1237940039285380274899124224 bytes =	9903520314283042199192993792 bits
1 wekabyte =	1267650600228229401496703205376 bytes =	10141204801825835211973625643008 bits
1 vundabyte =	1298074214633706907132624082305024 bytes =	10384593717069655257060992658440192 bits

bit ali binary digit je najmanjša info enota (1, 0)

Byte je znak ali skupina dolga 8 bitov

- * 1 bit: a binary decision
- * 1 byte: a character
- * 5 Megabytes: The complete works of Shakespeare
- * 2 Gigabytes: 20 meters of shelved books
- * 10 Terabytes: The printed collection of the US Library of Congress
- * 200 Petabytes: All printed material
- * 5 Exabytes: All words ever spoken by human beings



(Dr. Robert M. Metcalfe, 1976)

vodilo → zvezda

10BaseT, 100BaseT, 1000BaseT (IEEE 802.3z), 10GBaseT (IEEE 802.3an),
EFM (IEEE 802.3ah)

1 Gb Ethernet

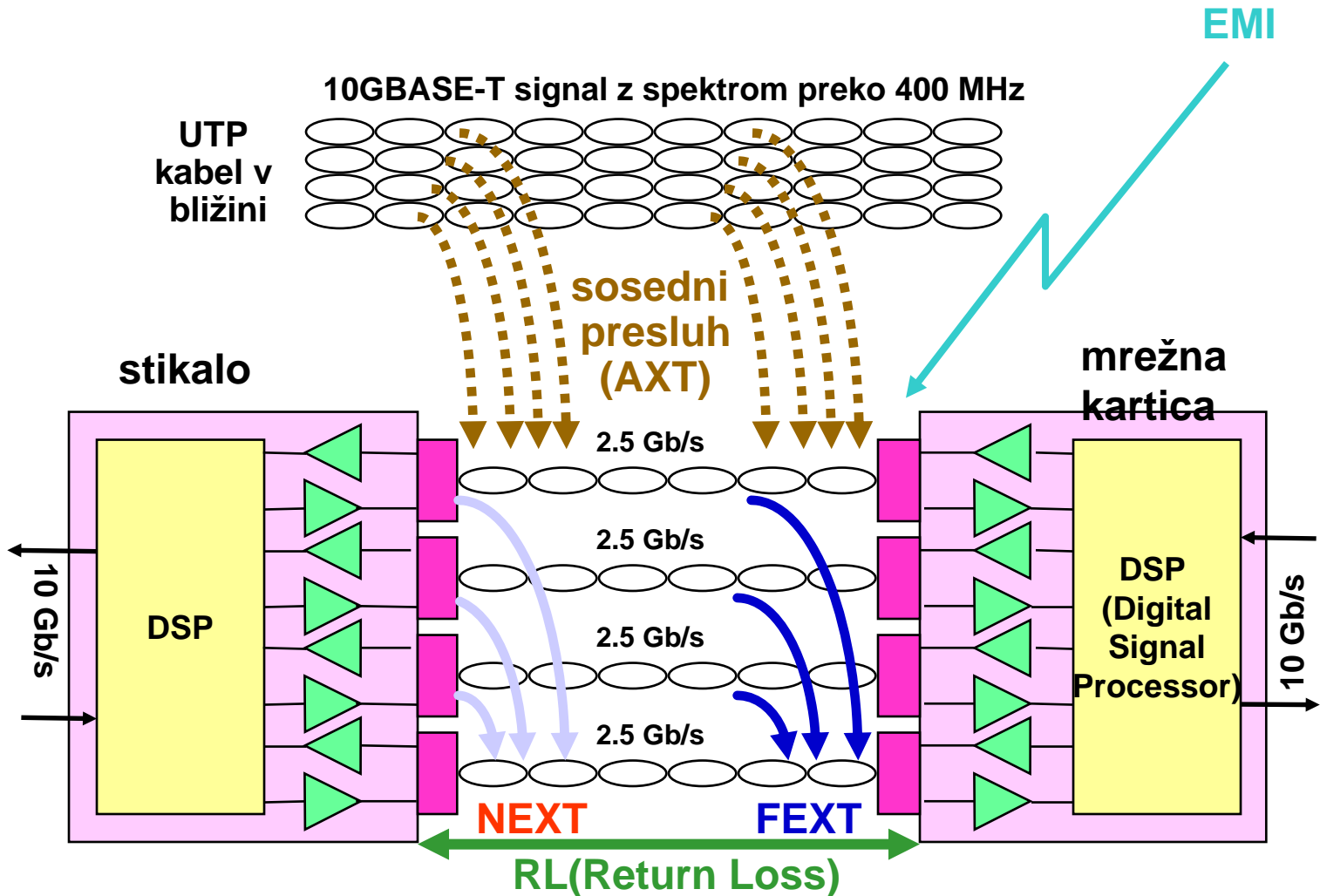
GbE UTP : 1000Base-T (IEEE 802.3z)
uporablja 4 pare, 250Mb/s na par, hkrati v obeh smereh
DSP(Digital Signal Processing)

GbE optika : 1000Base-SX in 1000Base-LX
SX, Short wave, 850 nm, 50 in 62.5 mikronska vlakna
LX, Long wave, 1300 nm, 9, 50 in 62,5 mikronska vlakna
1GbE in 10GbE delujeta po dveh vlaknih

10GBaseT (IEEE 802.3an)

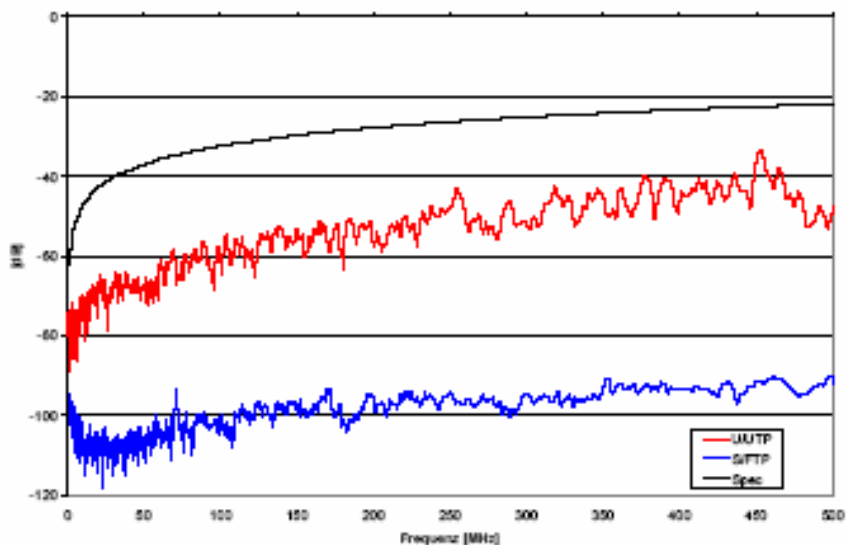
10 Giga bitov na sekundo po bakru. Z uporabo deset nivojske pulzne amplitudne modulacije PAM in drugih prijemov bo možno uporabljati 10GBaseT po bakrenih kabljih.

Polna uporaba 10 Giga-bitnega Etherneta na razdalji do 100 metrov je možna po kablju kategorije 6a, 7 in 7a, kar je še vedno cenejše kot po optiki.

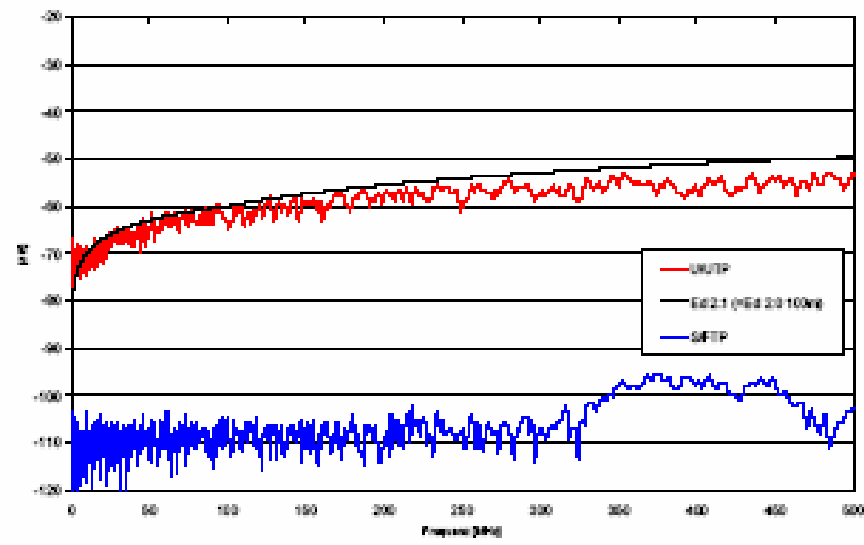


10GBaseT (IEEE 802.3an)

PS NEXT Comparison



PS ANEXT Comparison



EFM(IEEE 802.3ah)

Ethernet prve milje (EFM) ali IEEE 802.3ah GE-PON ali EPON - Gigabit Ethernet PON je širokopasovni dostop, ki lahko vključuje telefonijo, televizijo, internet in Ethernet.

Del standarda je tudi EFM po bakru, tudi EoCU ali **EFMC**.

EFM po bakru pomeni povezavo z internetom po navadni telefonski bakreni parici s pravimi Ethernet hitrostmi 10 in 100 mega bitov na sekundo. To je bistveno več kot nam ponuja ISDN ali ADSL dostop. Na področju poslovnih uporabnikov daje možnost za kvalitetne povezave znotraj skupine objektov.

EFM(IEEE 802.3ah)

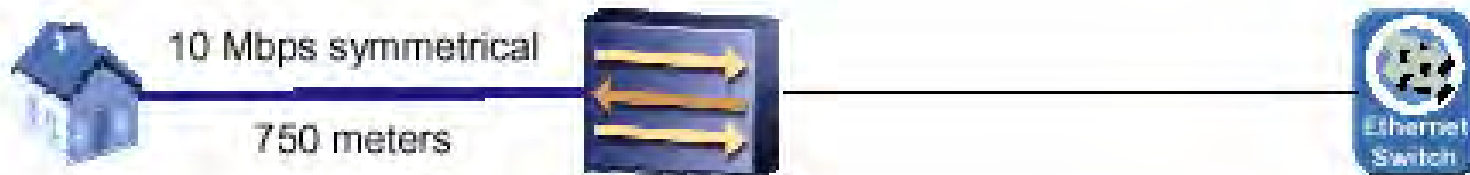
EFM po optiki (eno ali dve vlakni OS1), točka točka (P2P) za neposreden dostop

EFM po optiki (eno ali dve vlakni OS1), točka več točk (P2MP) preko pasivne optične mreže (EPON za FTTx)

EFM po bakru (EFMC), po večih paricah (SHDSL)

**EFM po bakru, po eni parici,
kot dolgi doseg za komercialno rabo (SHDSL) in
kot kratki doseg za domačo rabo (VDSL)**

EFM po bakru – kratki doseg (10PASS- TS)



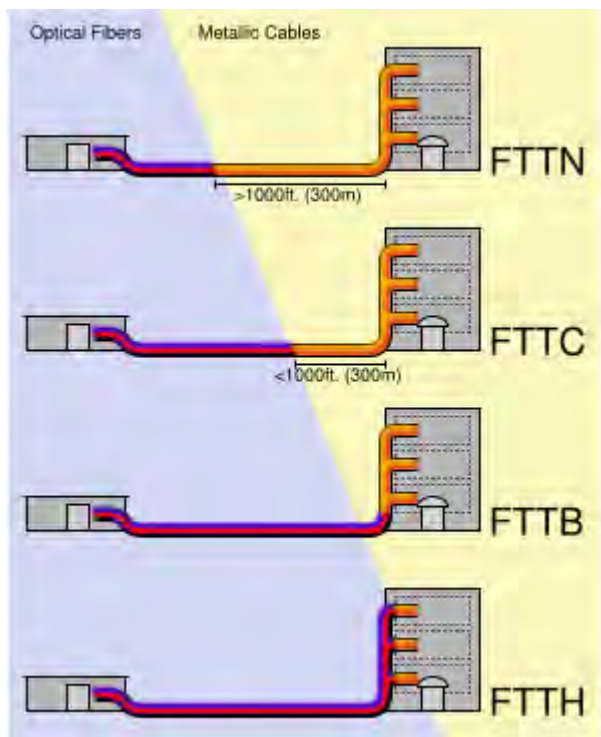
EFM po bakru – dolgi doseg (2BASE-TL)



EFMC je alternativa optiki, brez posebnih stroškov lahko deluje hkrati z ADSL, VDSL, ISDN in PSTN v istih kablji



FTTx



FTTN Node, Neighborhood ali Cabinet (FTTCab)

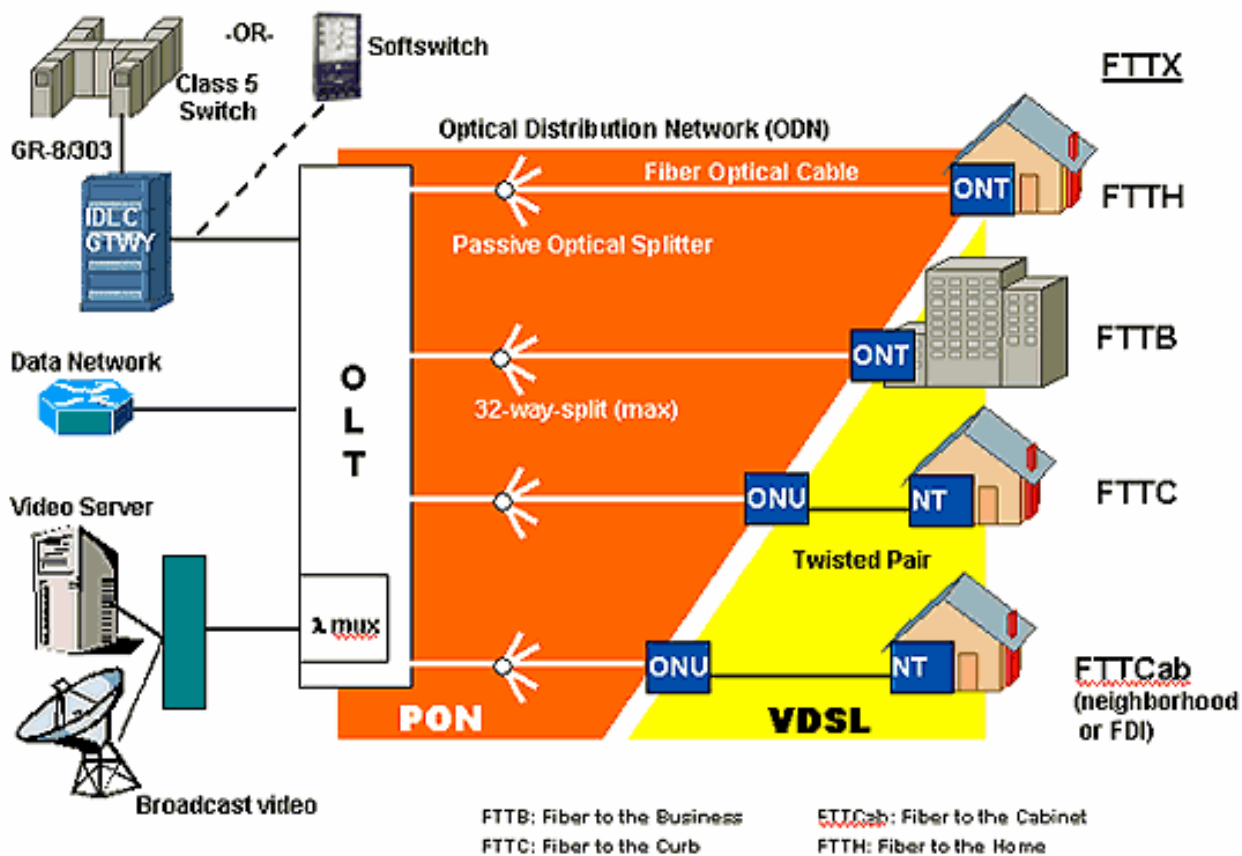
FTTC Curb ali Kerb (FTTK)

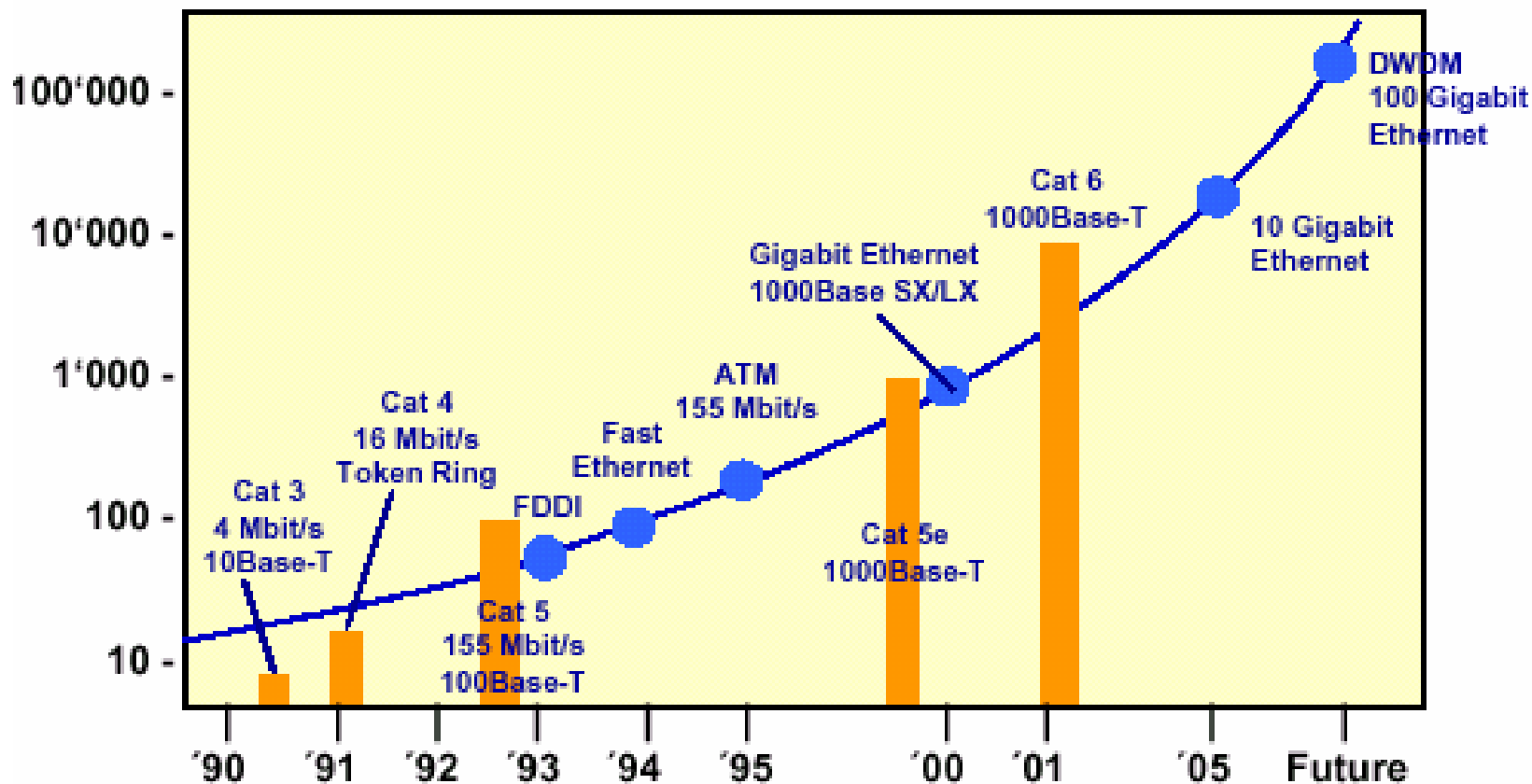
FTTB Building

FTTH Home ali Premises (FTTP)

FTTZ Zone

FTTx





(kat. 5e, 6, 6a, 7 in 7a za 1GbE, kat. 6, 6a, 7 in 7a za 10GbE)

standardi - mrežni

inštalacijski kabli

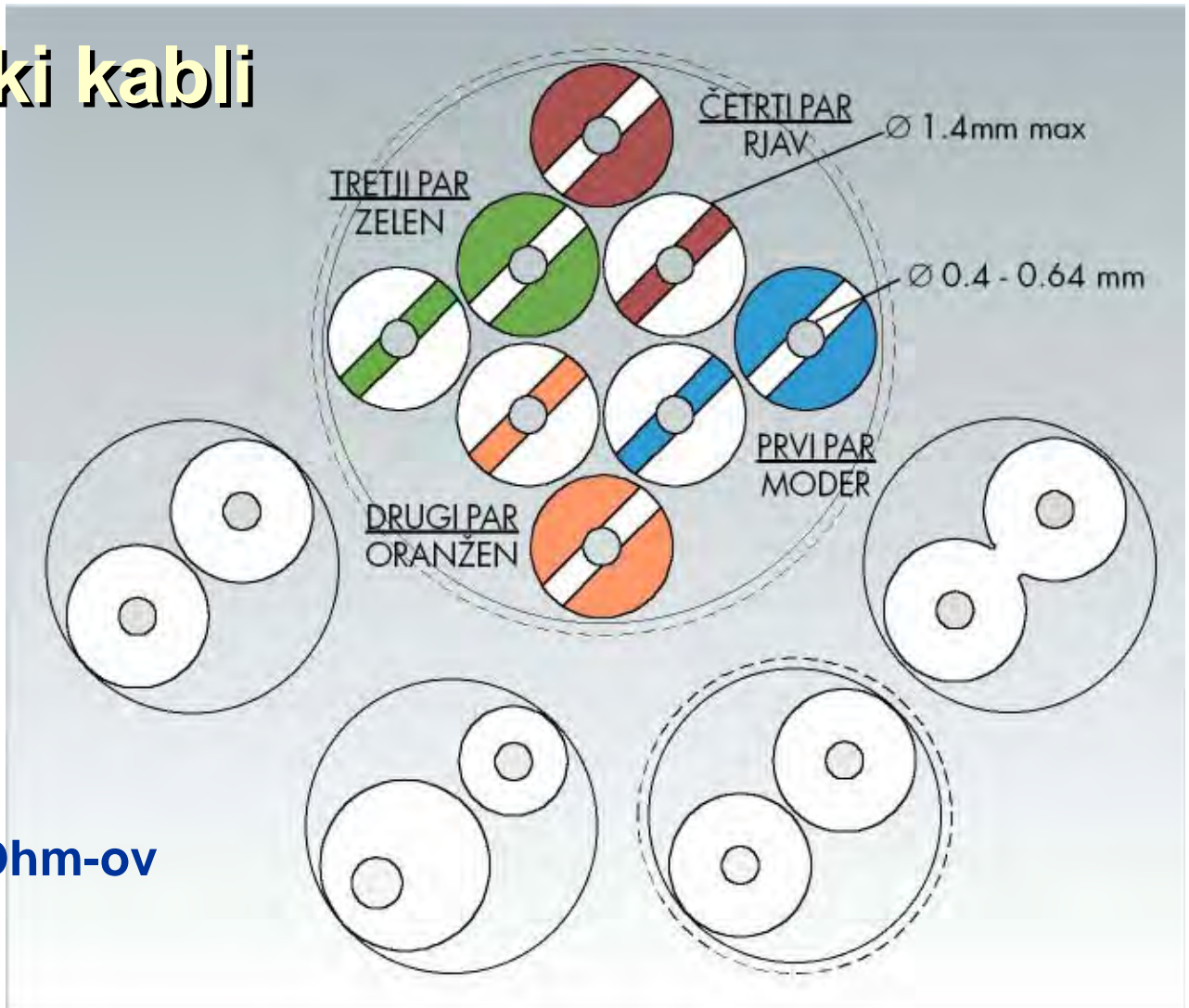
UTP, FTP, SFTP,
STP, SSTP, PiMF

nove oznake
bakrenih mrežnih
kablov :

U/UTP
U/FTP
F/FTP
S/FTP

impedanca je 100 Ohm-ov

pari so zaviti v
različnih korakih



gradniki

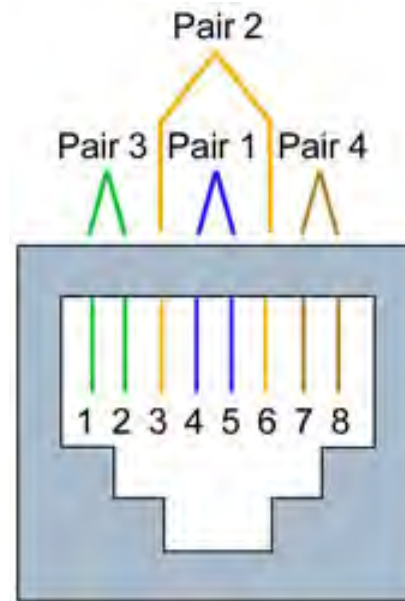
naloge parov

para 3 in 4 sta
namenjena za ATM,
155MHz

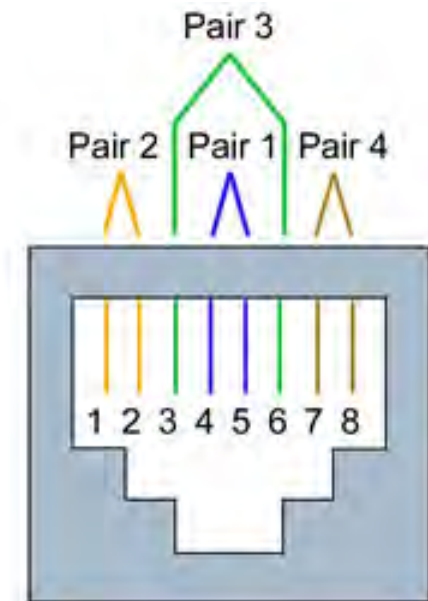
para 2 in 3 sta
namenjena za 10/100
Base T Ethernet

para 1 in 2 sta
namenjena za Token
Ring, ISDN, fax modem,
AS400, IBM 3270

vsi pari : GbE



T568A



T568B

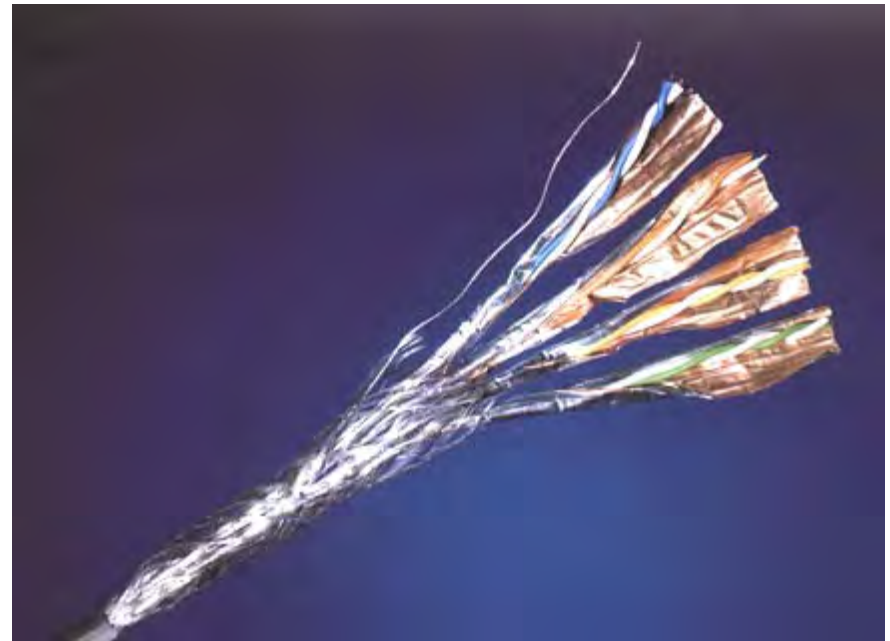
Oklop ščiti kabel pred zunanjimi vplivi, ali okolje pred sevanjem iz kabla.

Večje prenosne hitrosti - večje EMI/RFI onesnaženje.

Oklopi se ozemljijo v vsaki komunikacijski omari na rack, ki je povezan z hišno ozemljitvijo.

Večji onesnaževalci so : DC in AC motorji, zatemnitvena stikala, računalniki, fluorescenčna razsvetljava, oprema v komunikacijski omari, idr...

oklop



potencialne razlike med hišnimi ozemljitvami, optika

ženski spojni elementi



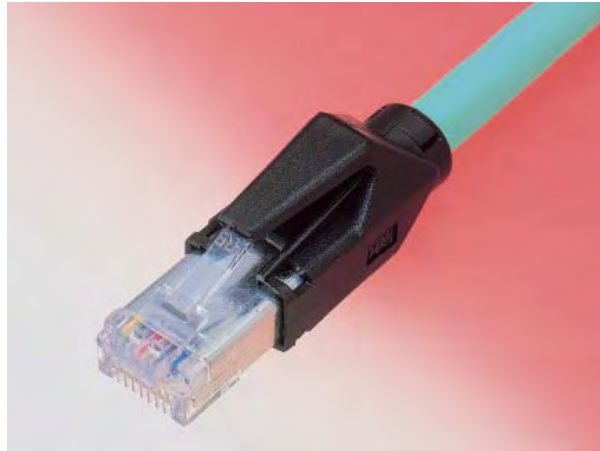
**IDC priključne letve
(Insulation Displacement
Contact)**

**110, AT&T, AMP, Krone LSA,
IBM, Panduit, Molex**

**RJ45 (ne)oklopljen
različne geometrije, patenti,
mehanski ključi**

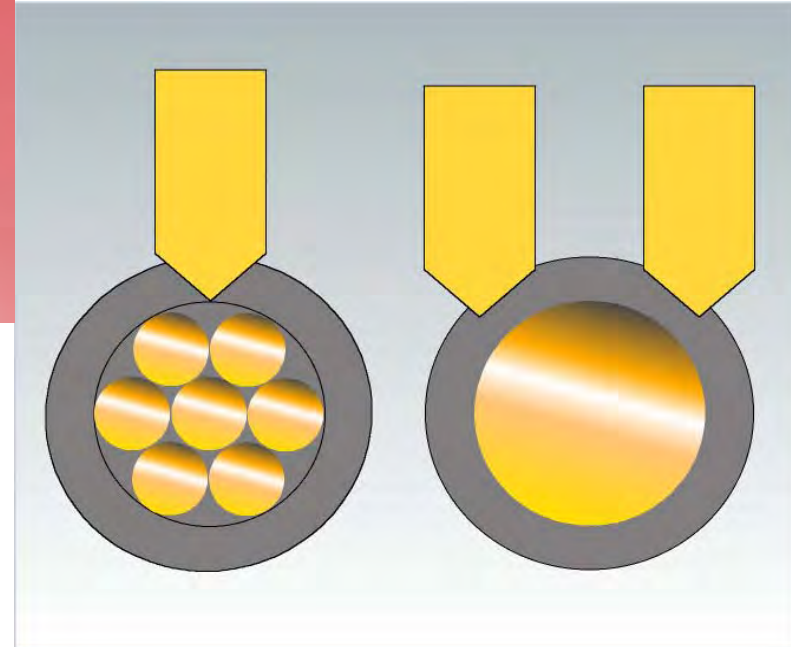
(max. dolžina odvitega para je 12,7mm)

moški spojni elementi



RJ45
(ne)oklopljen, za mehko ali
trdo žilo, za ploščati ali
okrogli kabel

IDC
AT&T, AMP, Mod Tap,
KRONE



moški spojni elementi

**RJ45 za inštalacijski kabel
kategorije 6, 6A, 7 in 7A.**

**Presek žice od AWG-27
do AWG-22**

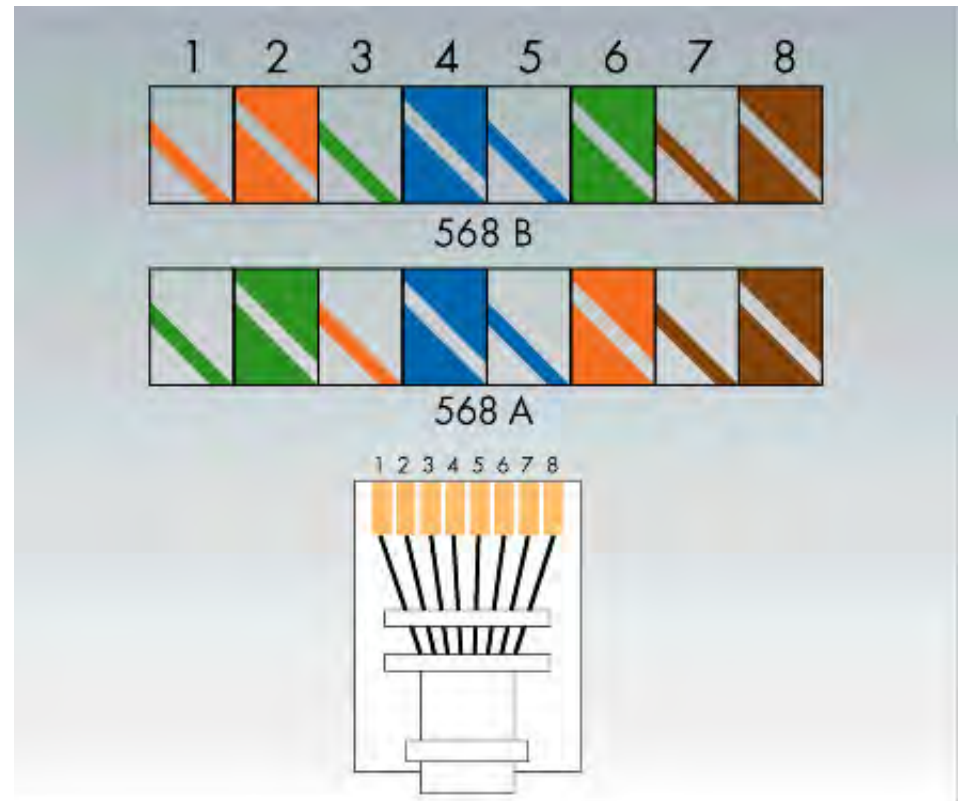


priključni kablji

**UTP, FTP, STP, FSTP, SSTP,
PiMF(Pair in Metallic Foil)**

**uporablja se mehka žila,
AWG24 ali 26, premera 0.4 do
0.51mm**

konektorji kat. 3, 5e, 6, 6a, 7



Vtičnice, delilniki



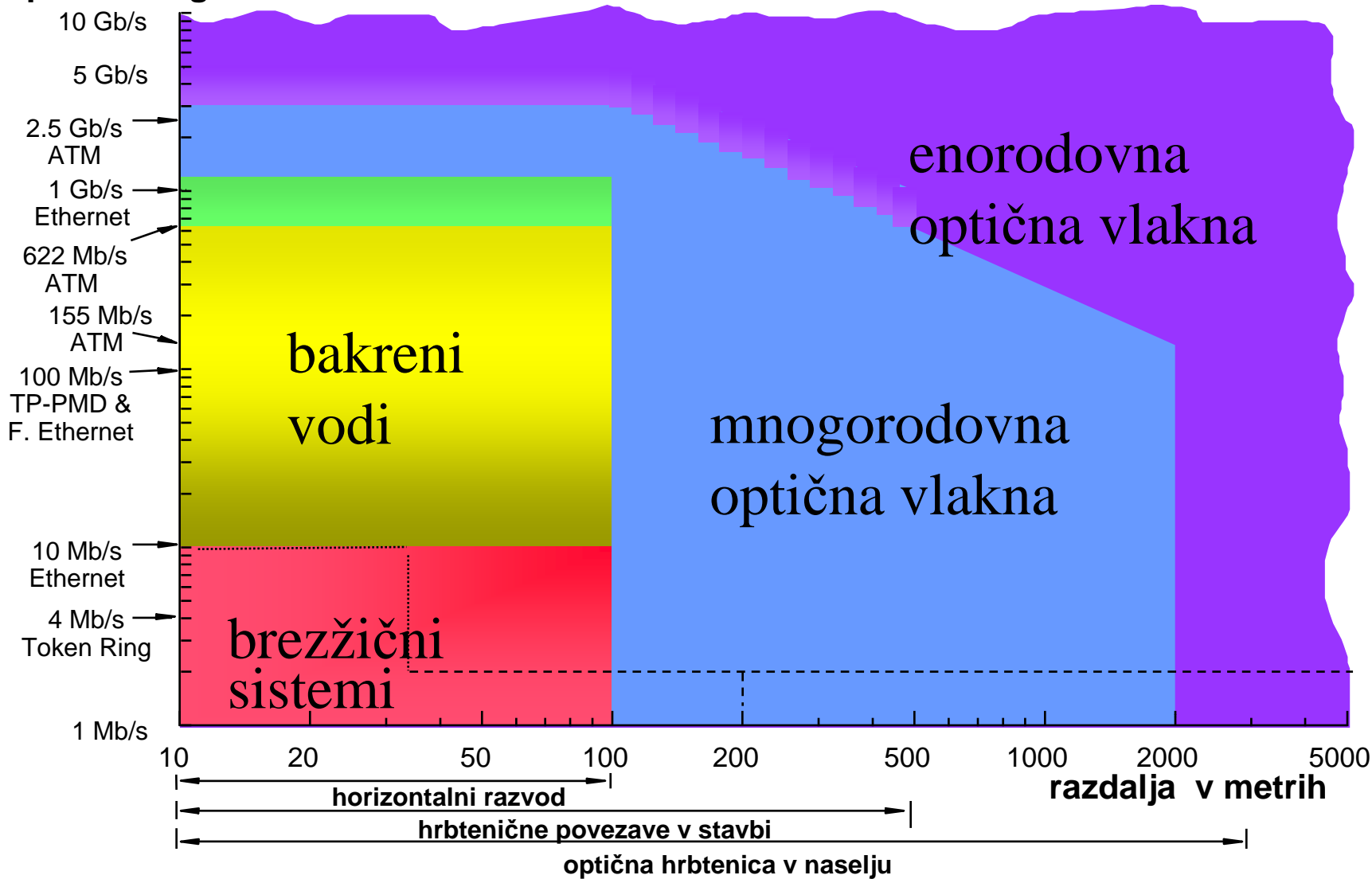
spojni elementi so osnovni sestavni del vtičnic in delilnikov

vtičnice so enojne, dvojne, trojne,.. za različne načine montaže

delilniki so 6, 8, 12, 16, 24, 32, 48 ali več delni za 10 ali 19 inčno montažo, za vgradnjo v kabelske spojke ali za prosto montažo



prenosna gostota



UTP ? ali STP ?

(na izbrani tip kabla se vežejo spojni elementi)

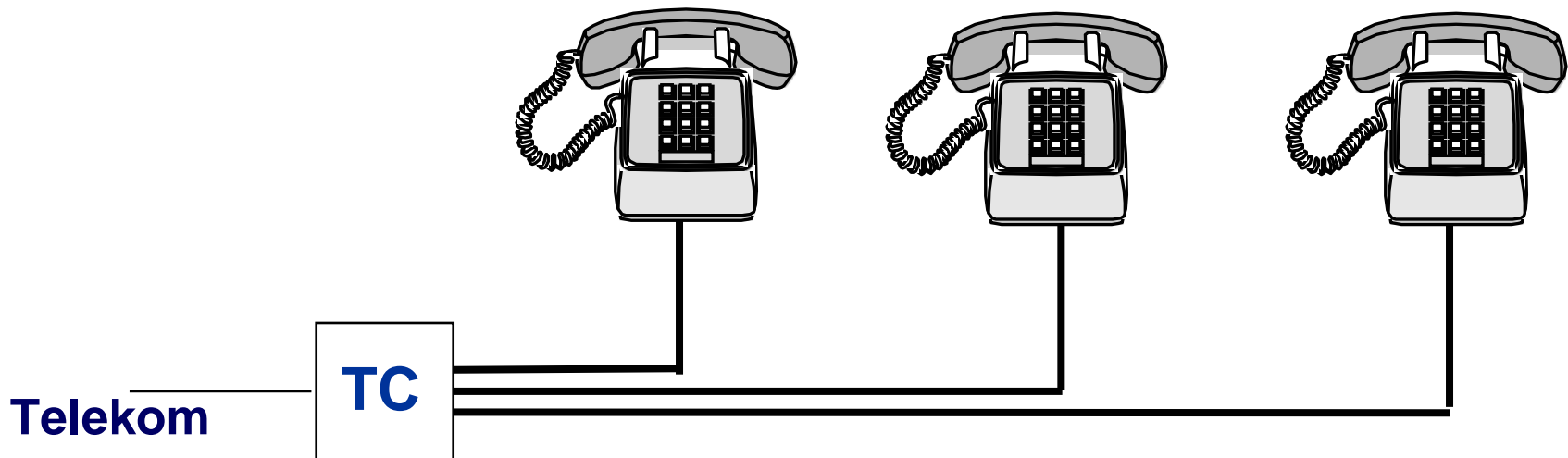
tip	UTP	FTP	SFTP	UTP	FTP	UTP	FTP	SSTP
Kat.	5e	5e	5e	6	6	6A	6A	7
EMC	nizka	srednja	visoka	nizka	srednja	srednja	visoka	visoka

EMC (Electro Magnetic Compatibility)

POTS (Plain Old Telephone Service)

dve ali štiri žične povezave

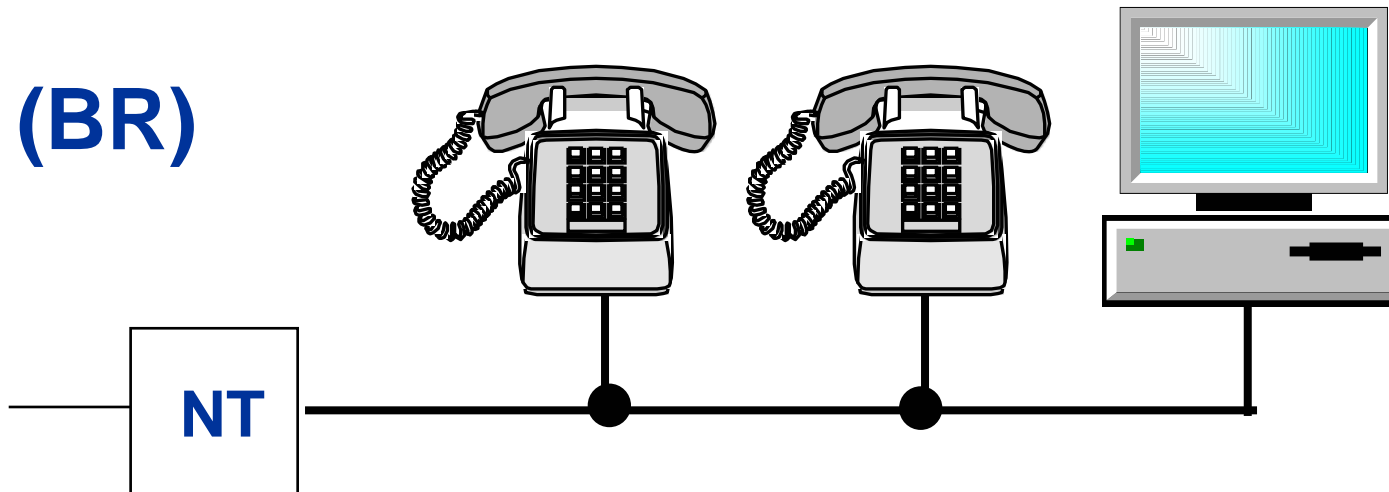
vtičnica in konektor je RJ45, izogibamo se RJ11 ali RJ12



ISDN (Integrated Service Digital Network)

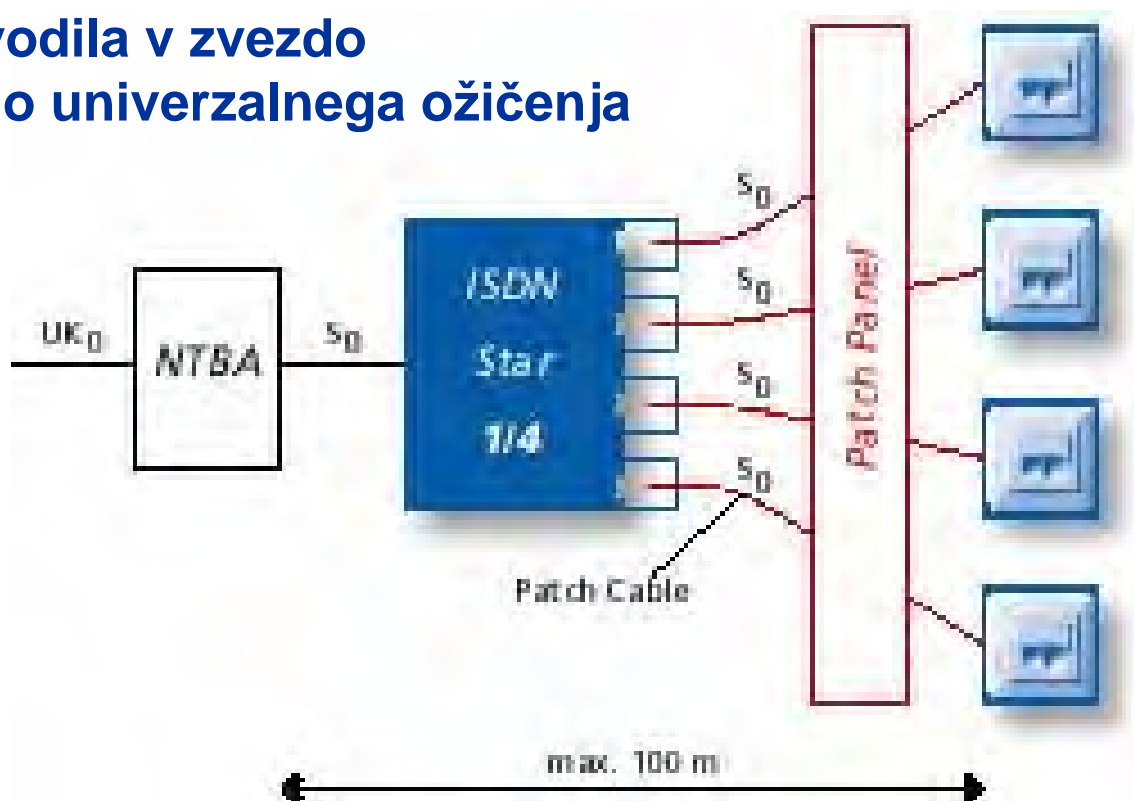
4 žične povezave
univerzalna ali ISDN vtičnica RJ45

(BR)

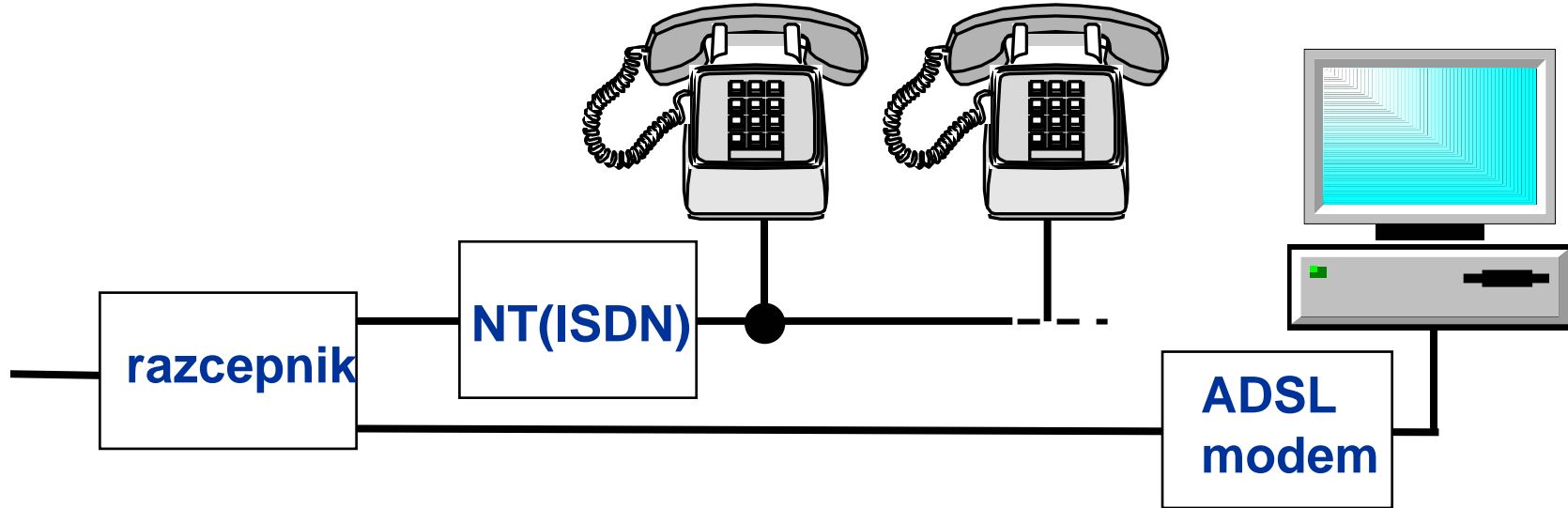


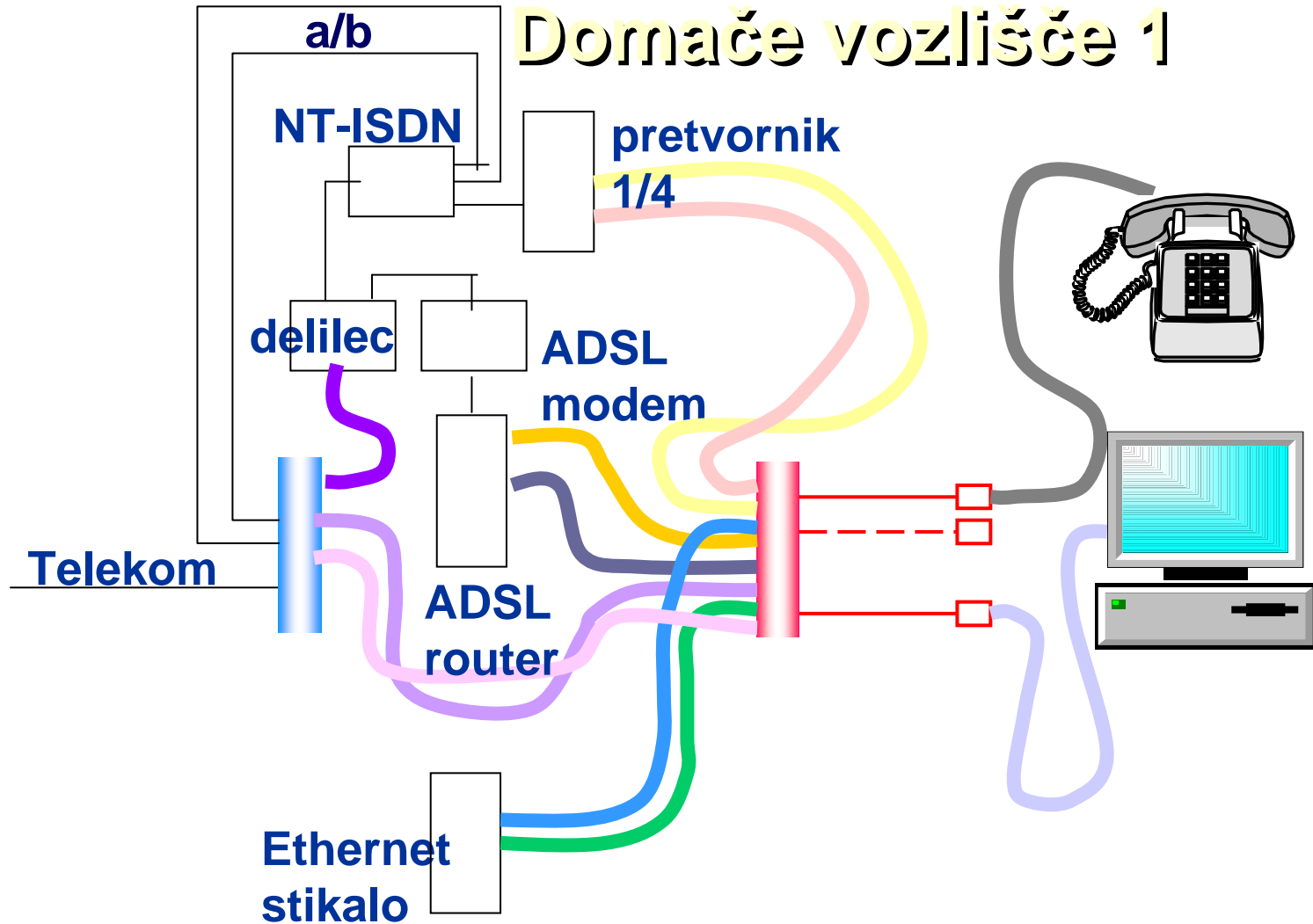
pretvornik

pretvorba vodila v zvezdo
in dostop do univerzalnega ožičenja

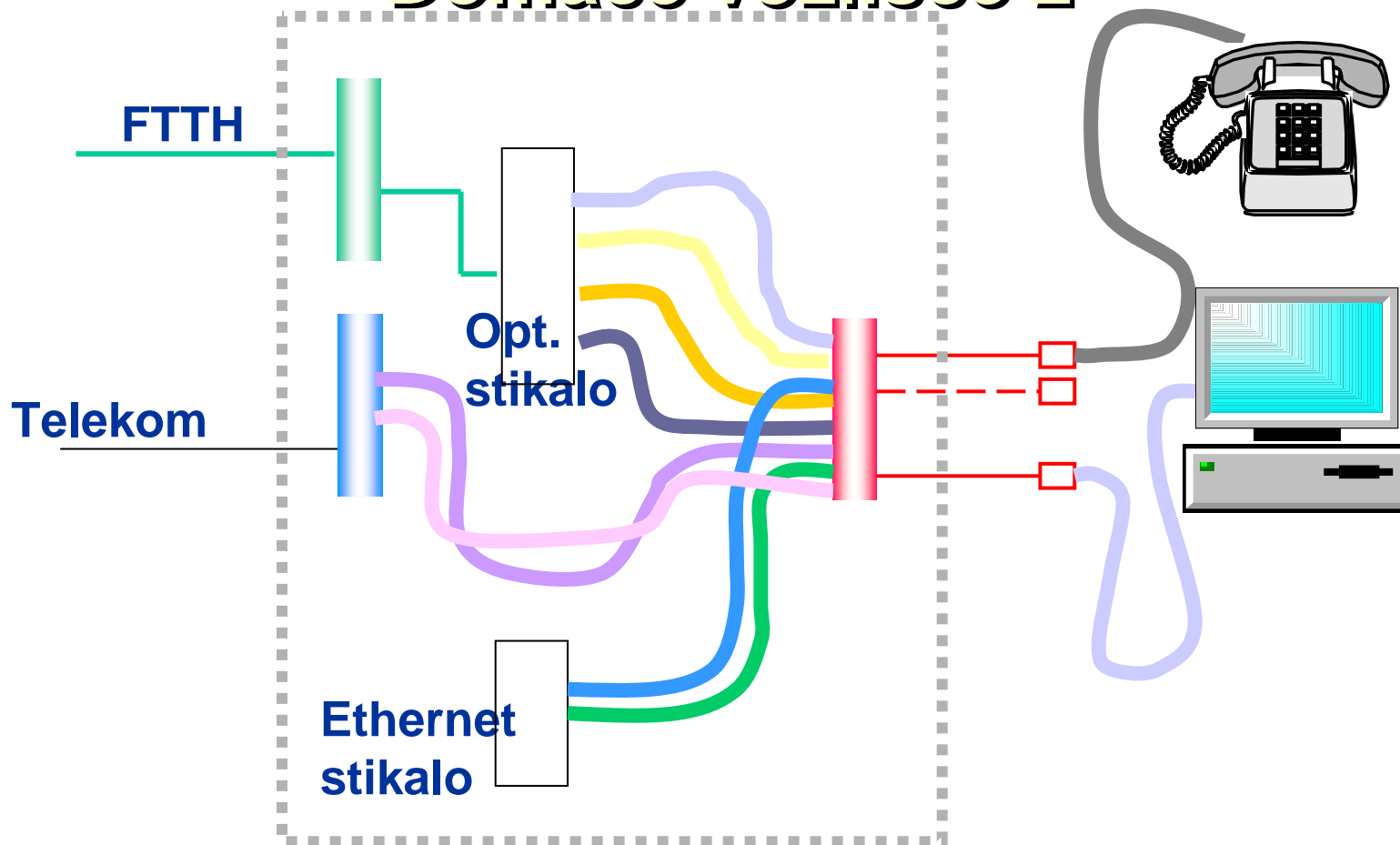


ADSL (Asymmetric Digital Subscriber Line)



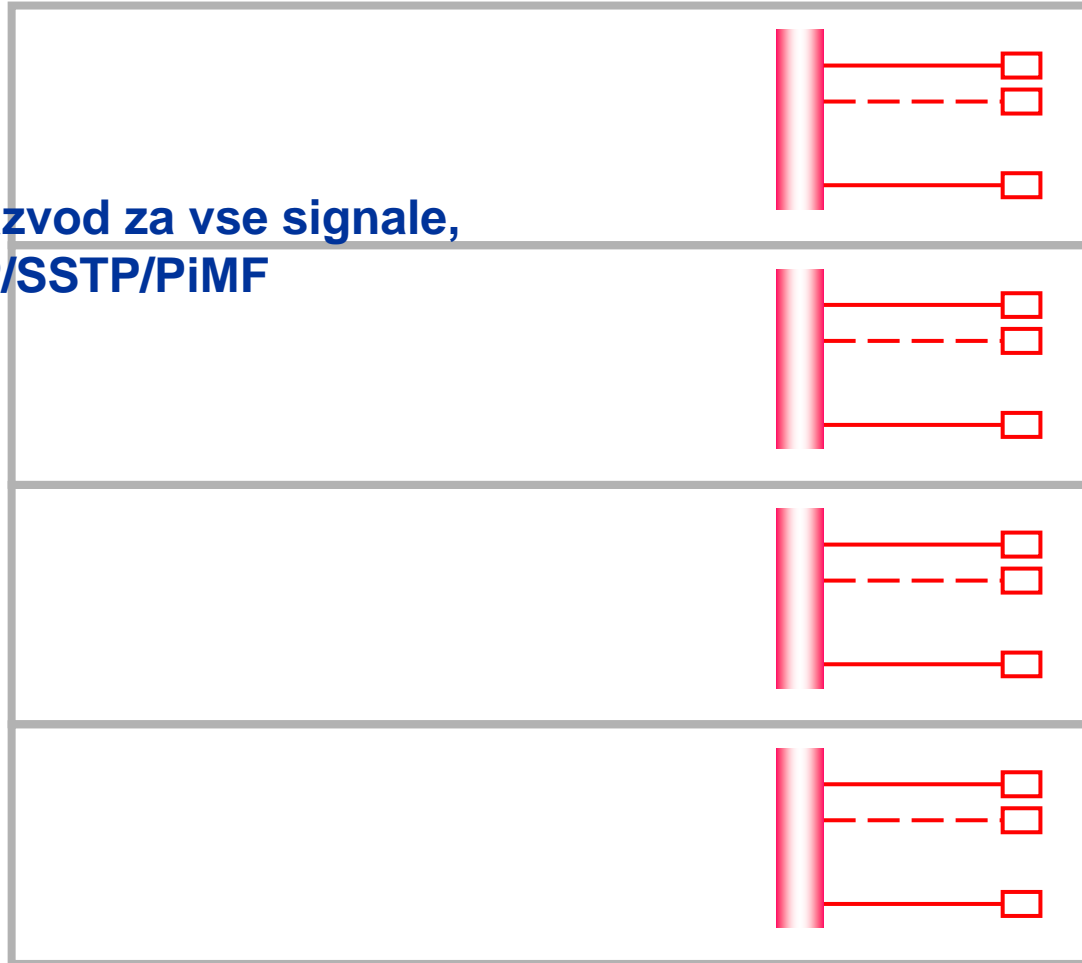


Domače vozlišče 2



D

Horizontalni razvod za vse signale,
UTP/FTP/SFTP/SSTP/PiMF



A B C D

3

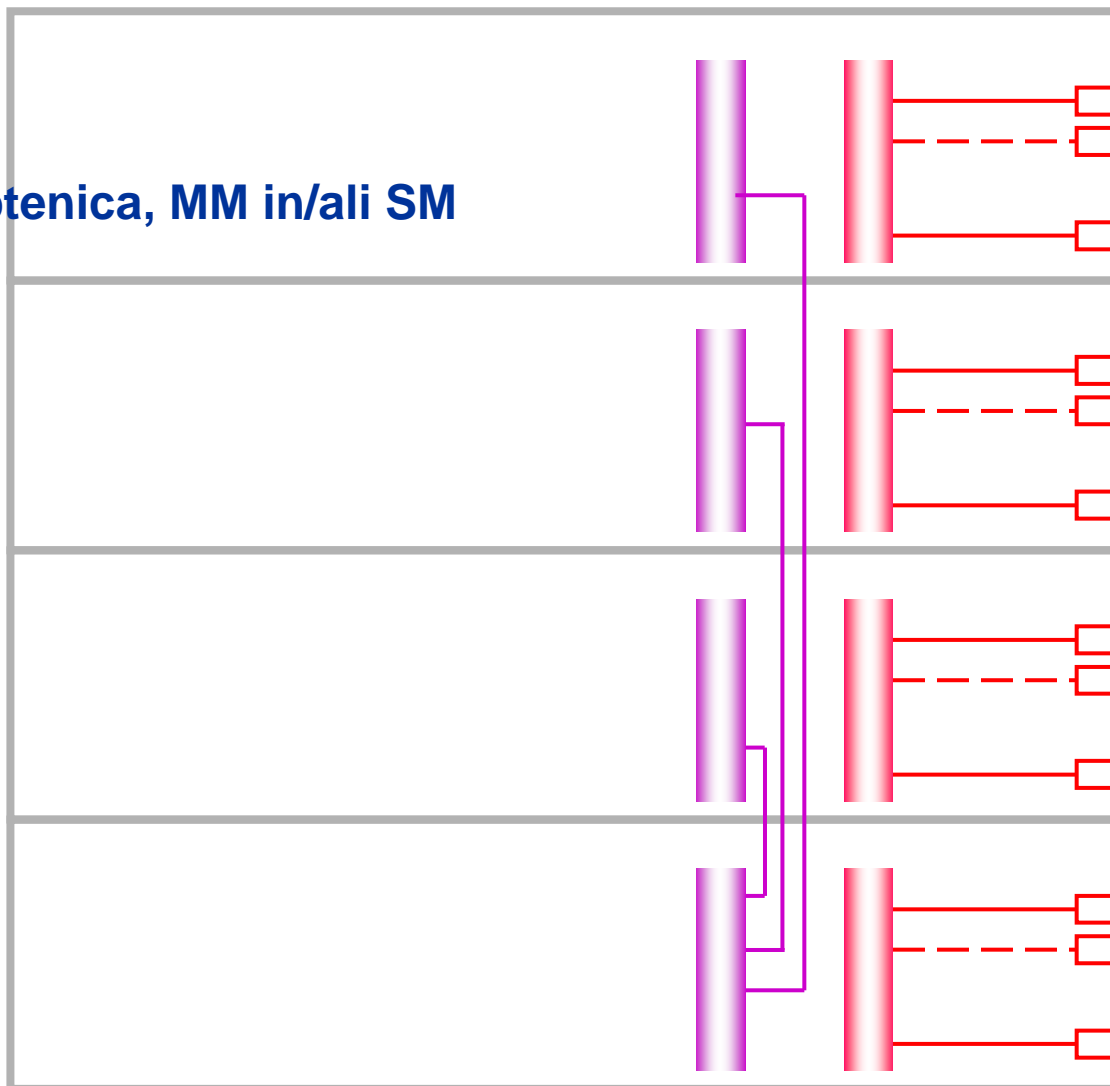
2

1

P

C

optična hrbtnica, MM in/ali SM



3

2

1

P

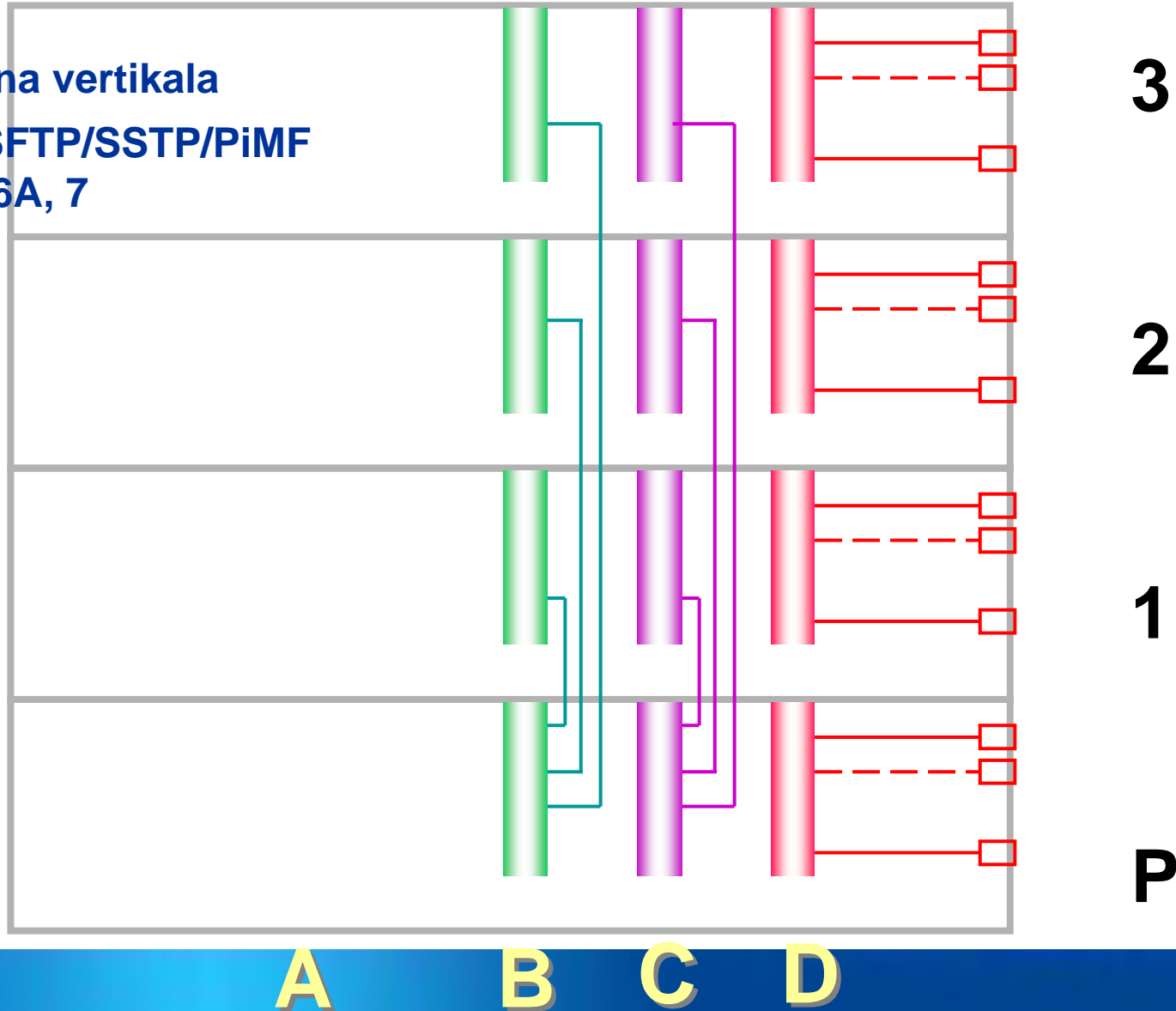
A

B

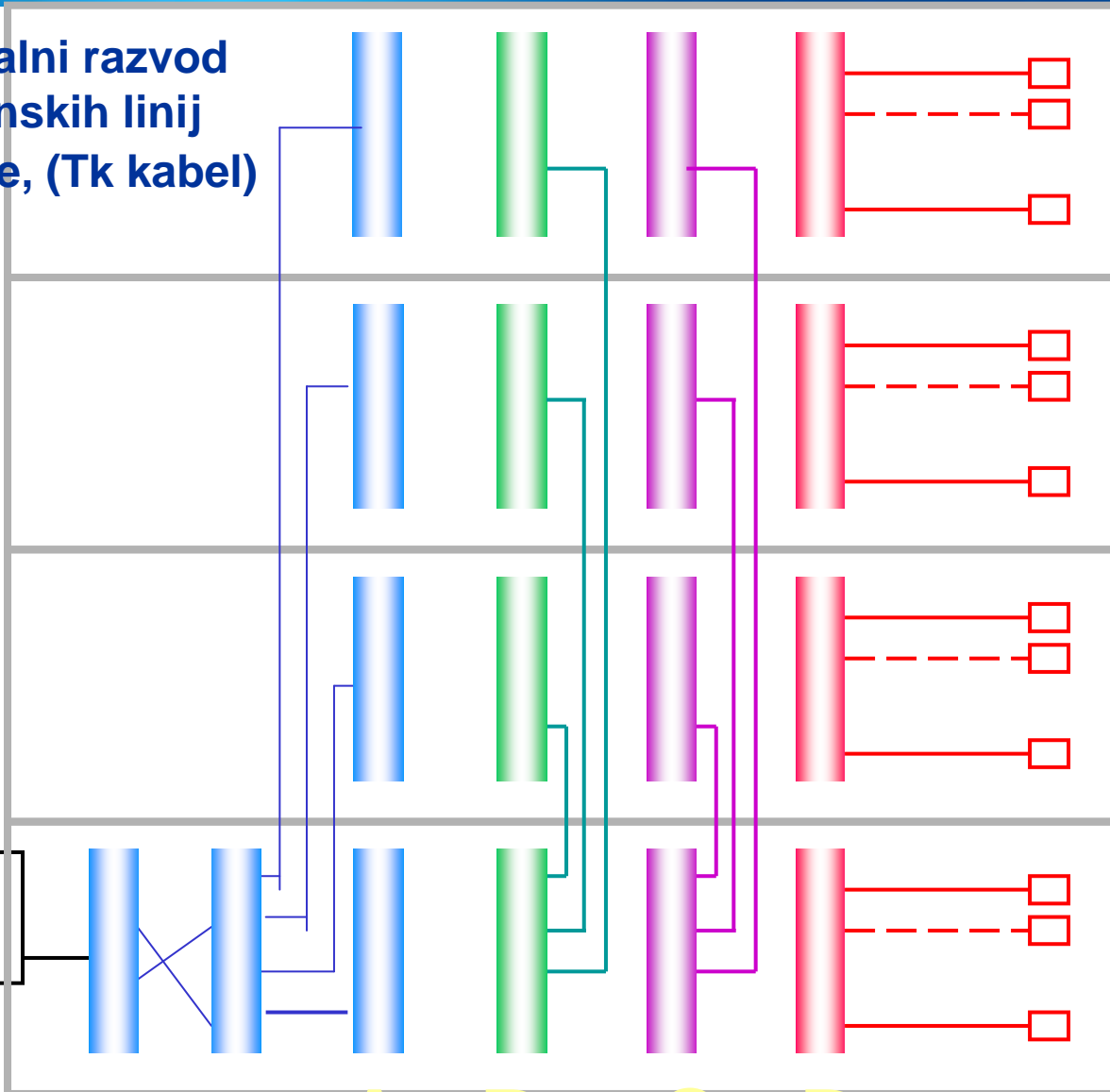
C

D

B rezervna vertikala
UTP/FTP/SFTP/SSTP/PiMF
kat. 5e, 6, 6A, 7



A vertikalni razvod telefonskih linij
UTP/FTP kat. 5e, (Tk kabel)



3

2

1

P

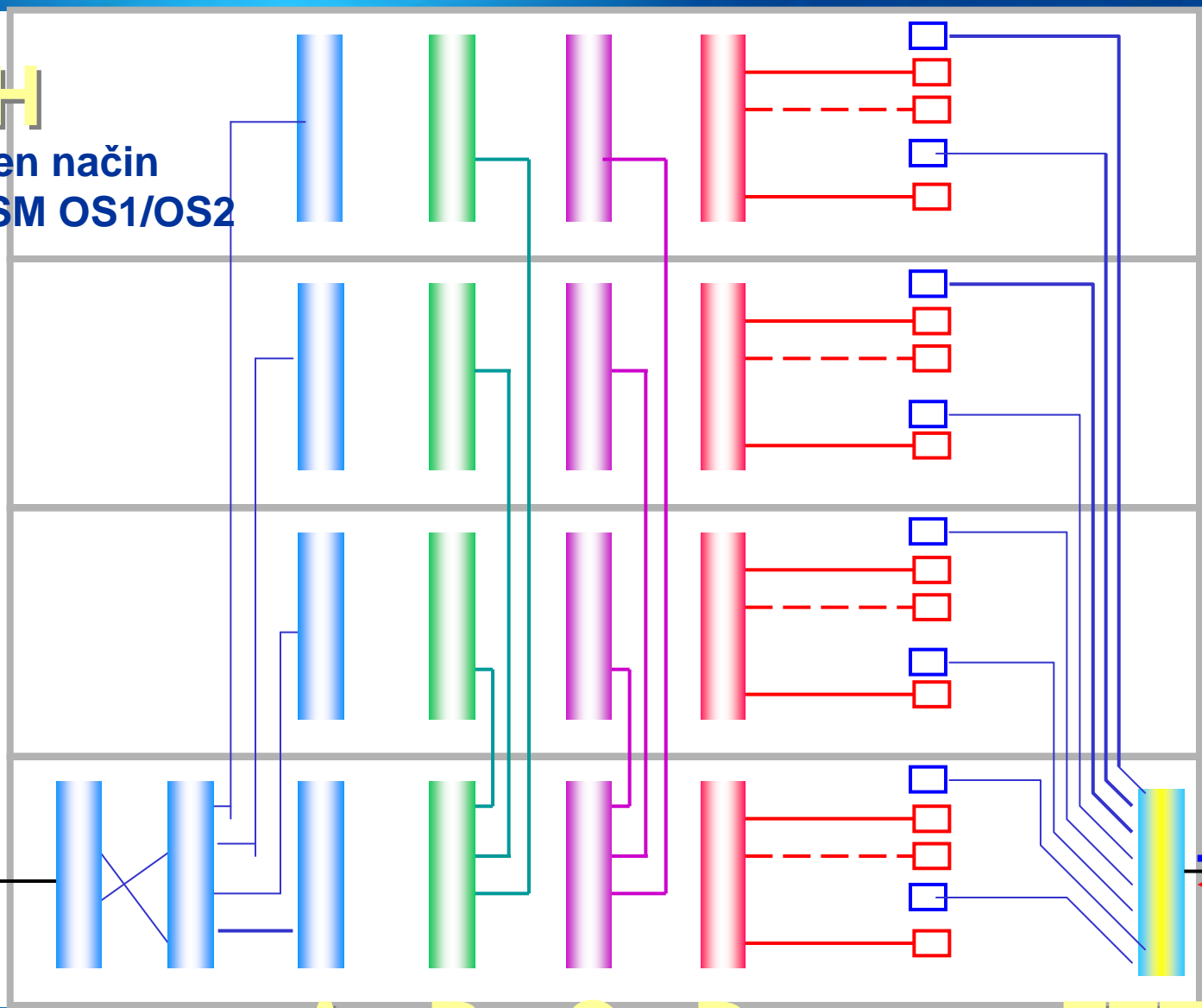
A B C D



FTTH

neposreden način razvoda, SM OS1/OS2

TC, ali Centrex



A B C D FTTH

3

2

1

P



hvala za pozornost

info@ezz.si

kabli in omrežja