

Sieťová a komunikačná bezpečnosť

02 Komunikácia blokmi štruktúrovaných dát

Ústav informatiky, PF UPJŠ v Košiciach



EURÓPSKA ÚNIA

Európsky sociálny fond
Európsky fond regionálneho rozvoja



OPERAČNÝ PROGRAM
ĽUDSKÉ ZDROJE

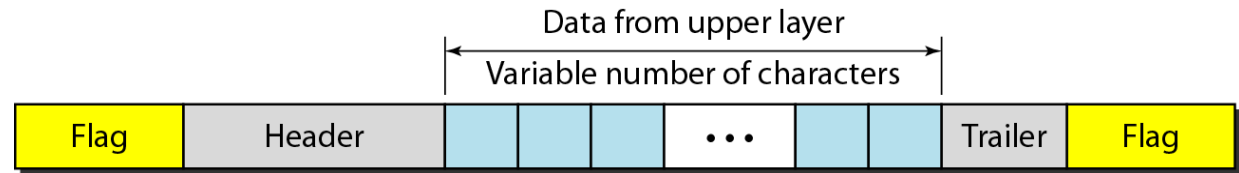


Tento projekt sa realizuje vďaka podpore z Európskeho sociálneho fondu a Európskeho fondu regionálneho rozvoja v rámci Operačného programu Ľudské zdroje

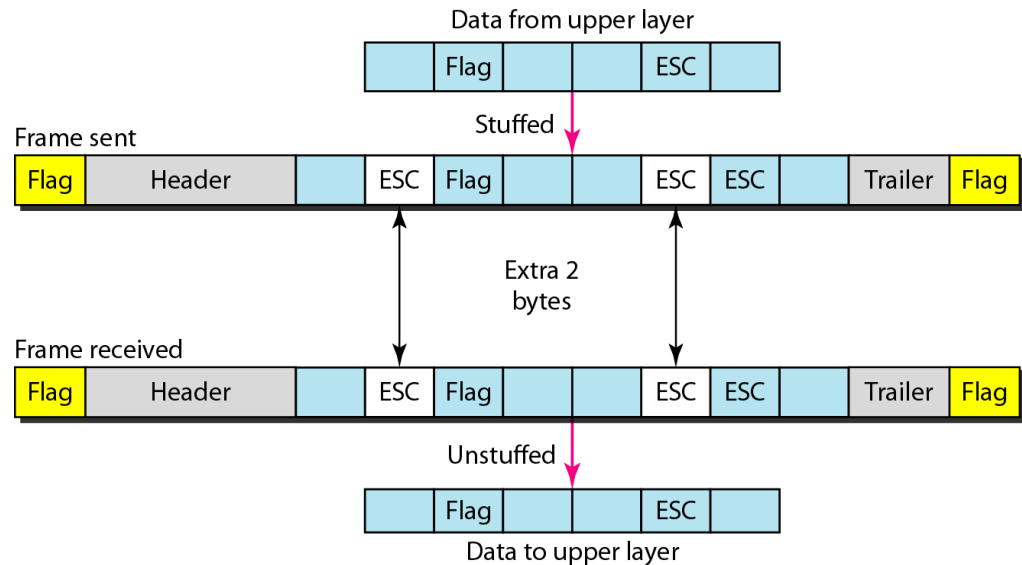
Prenos blokmi údajov spojová vrstva RM

- zabezpečuje spoľahlivosť prenosu údajov medzi susednými uzlami siete
- postupnosť bitov (bajtov) s definovaným začiatkom a koncom - **rámec** (frame) resp. **bunka** (cell)
- kontrola chýb, možnosti potvrdzovania, riadenie prístupu pre viacero používateľov spoja, riadenie toku dát (flow control) – proti zahlteniu
- jednoznačná identifikácia – fyzické adresy (MAC) (resp. identifikácia virtuálneho okruhu)

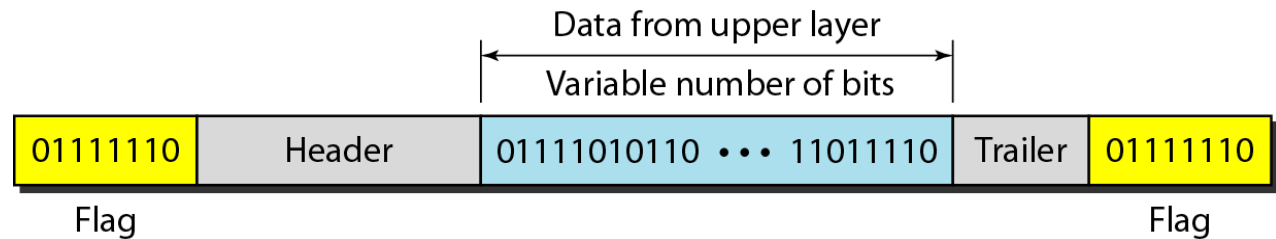
znakové (bajtové) prenosy



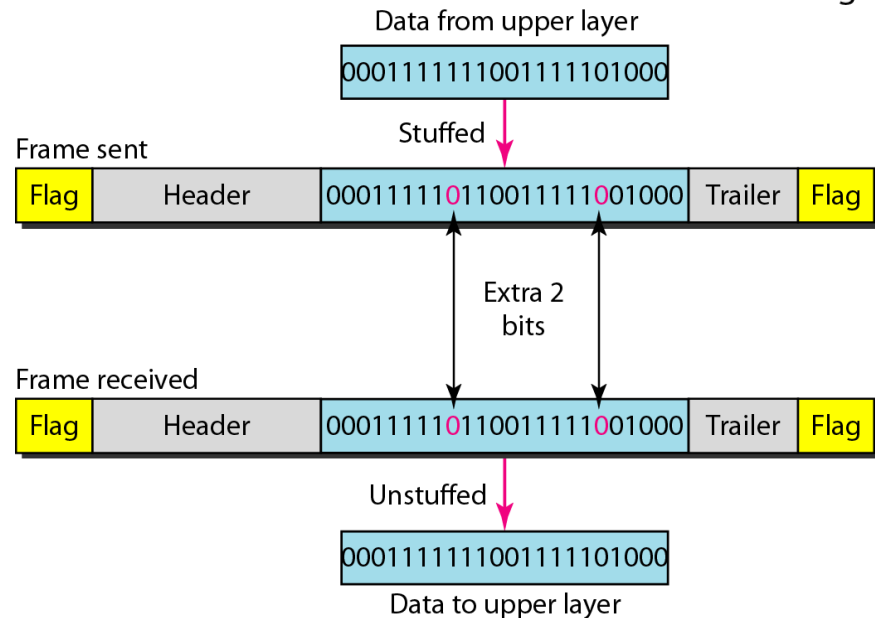
ošetrenie použitia
špeciálnych
znakov (stuffing)



bitovo orientované prenosy



krídlové postupnosti
vkladanie bitov
(bit stuffing)



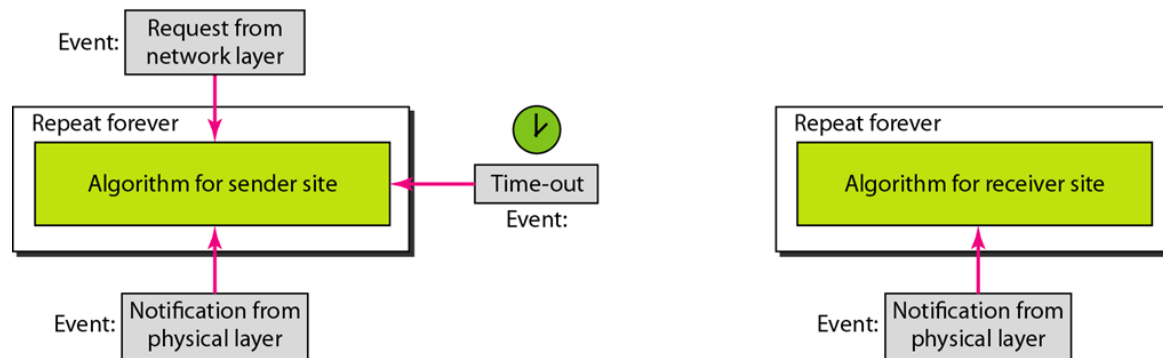
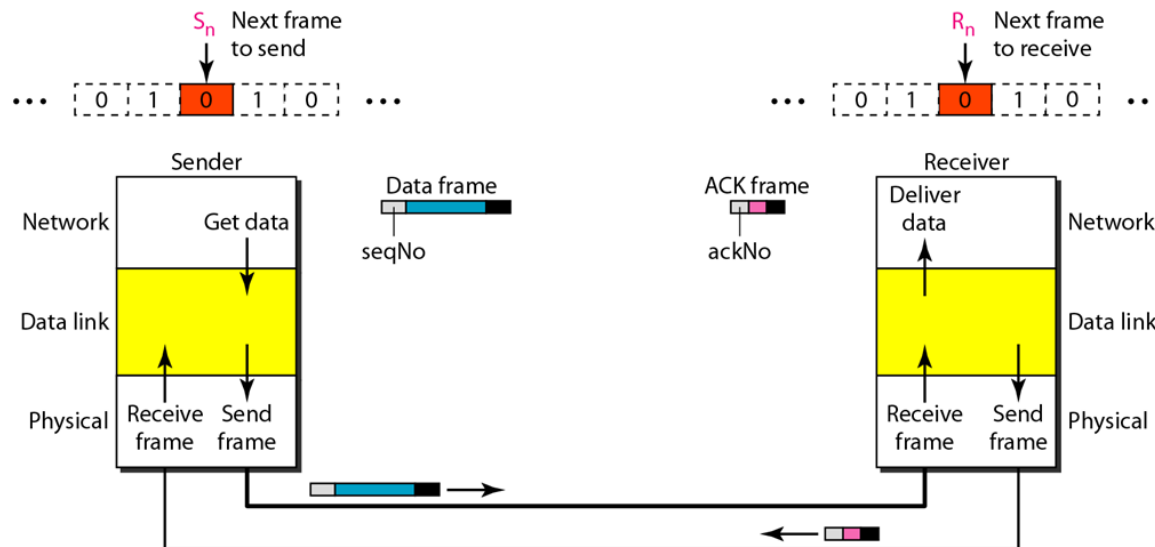
- detekcia chýb – kontrola parity resp. zvyšky po delení cyklických polynómov (CRC – cyclic redundancy check)
- riadenie toku pre bezšumové kanály
 - bez potvrdenia
 - pozitívne potvrdenie a opakovanie po uplynutí časového limitu (timeout)
- pre zašumené kanály
 - negatívne potvrdzovanie, vyžiadanie opätovného vysielania
 - Go-Back-N, Selective Repeat, Sliding Window

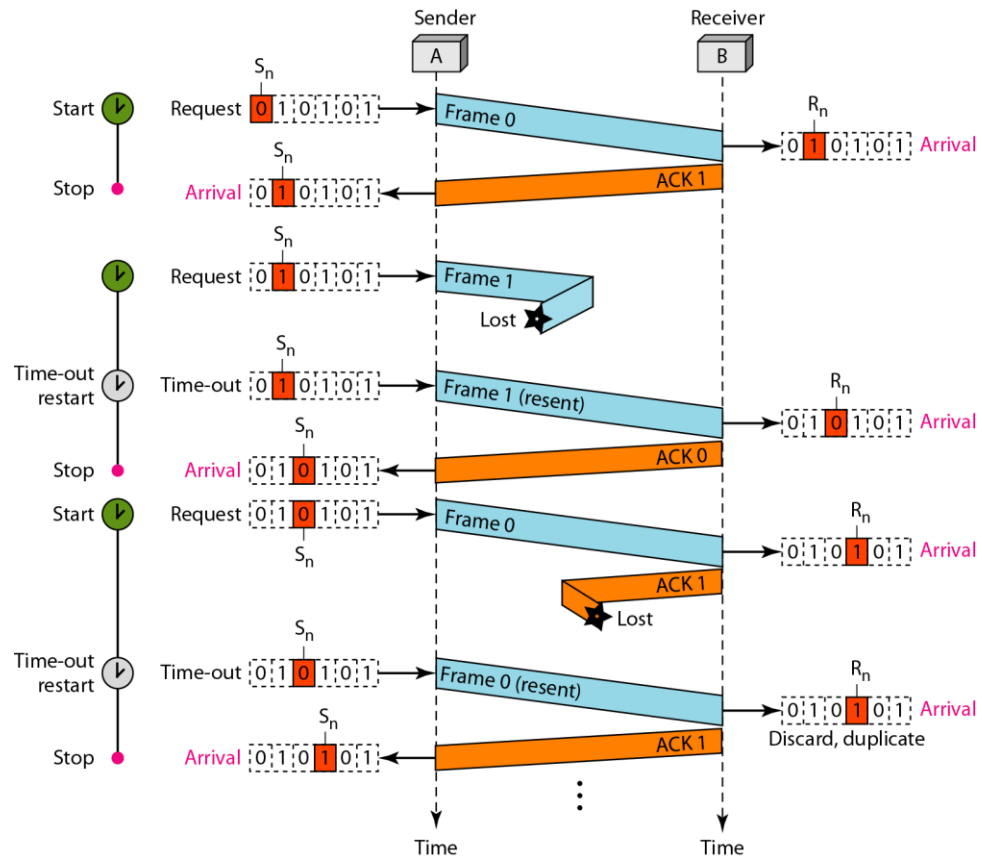


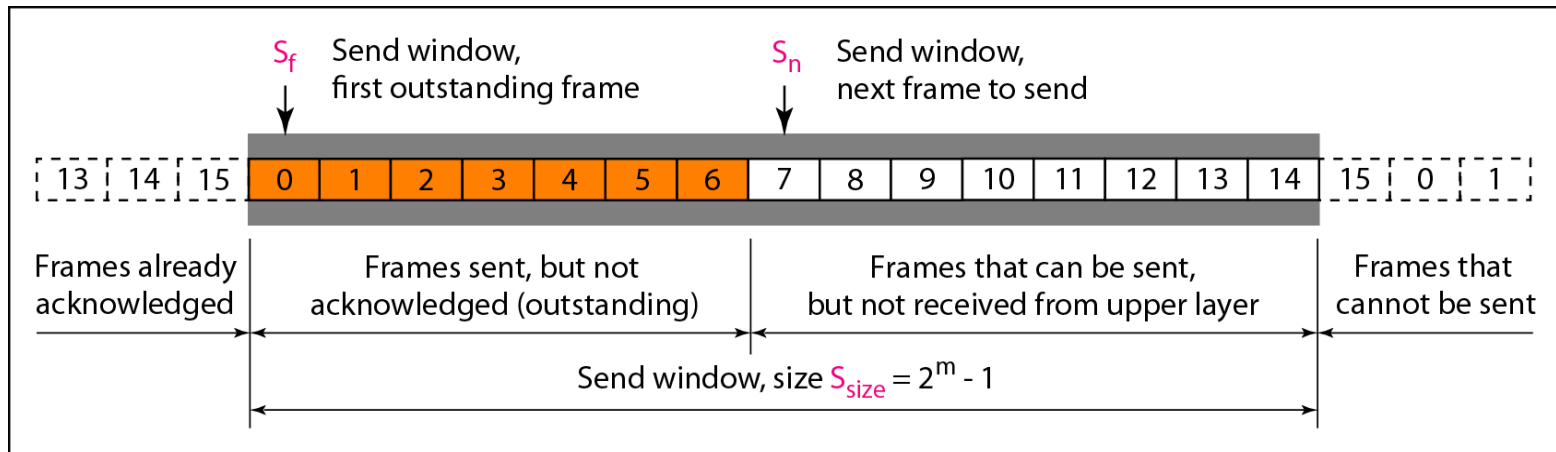
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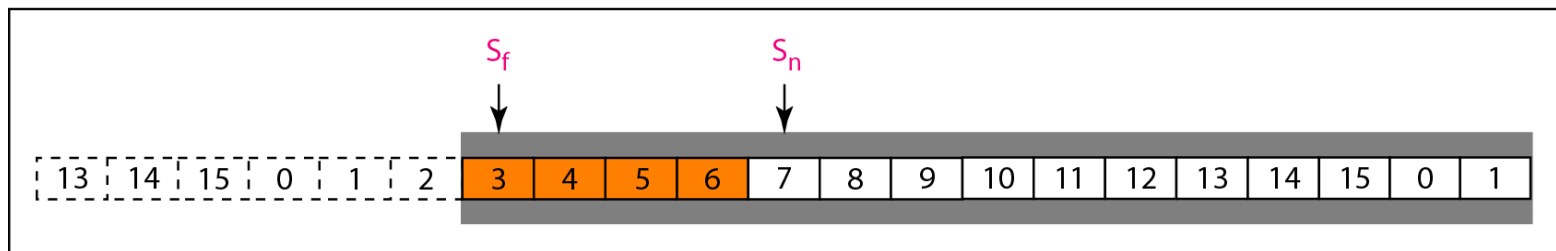
Stop-and-Wait





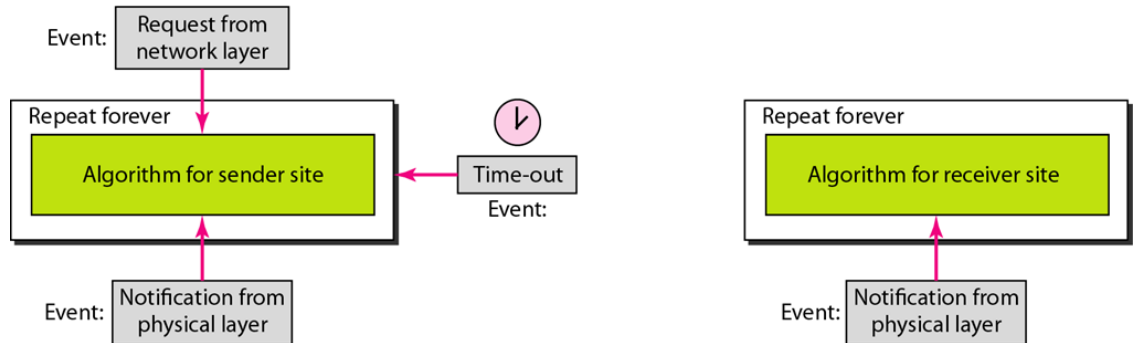
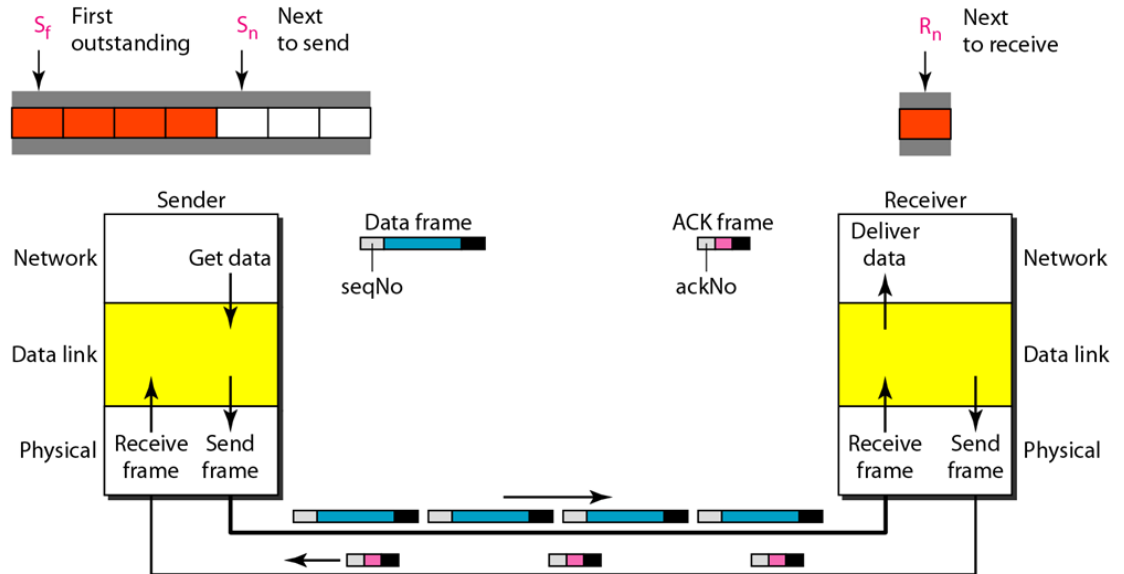


a. Send window before sliding

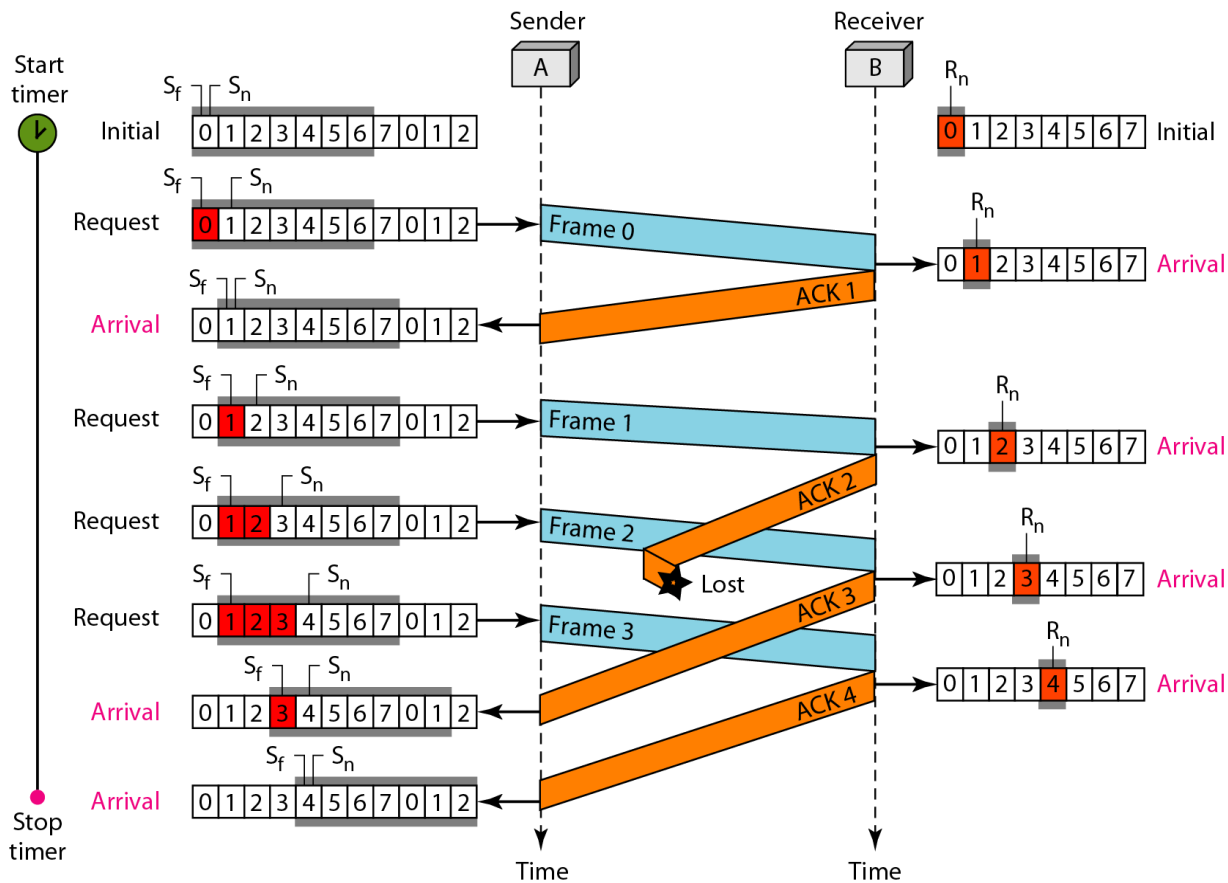


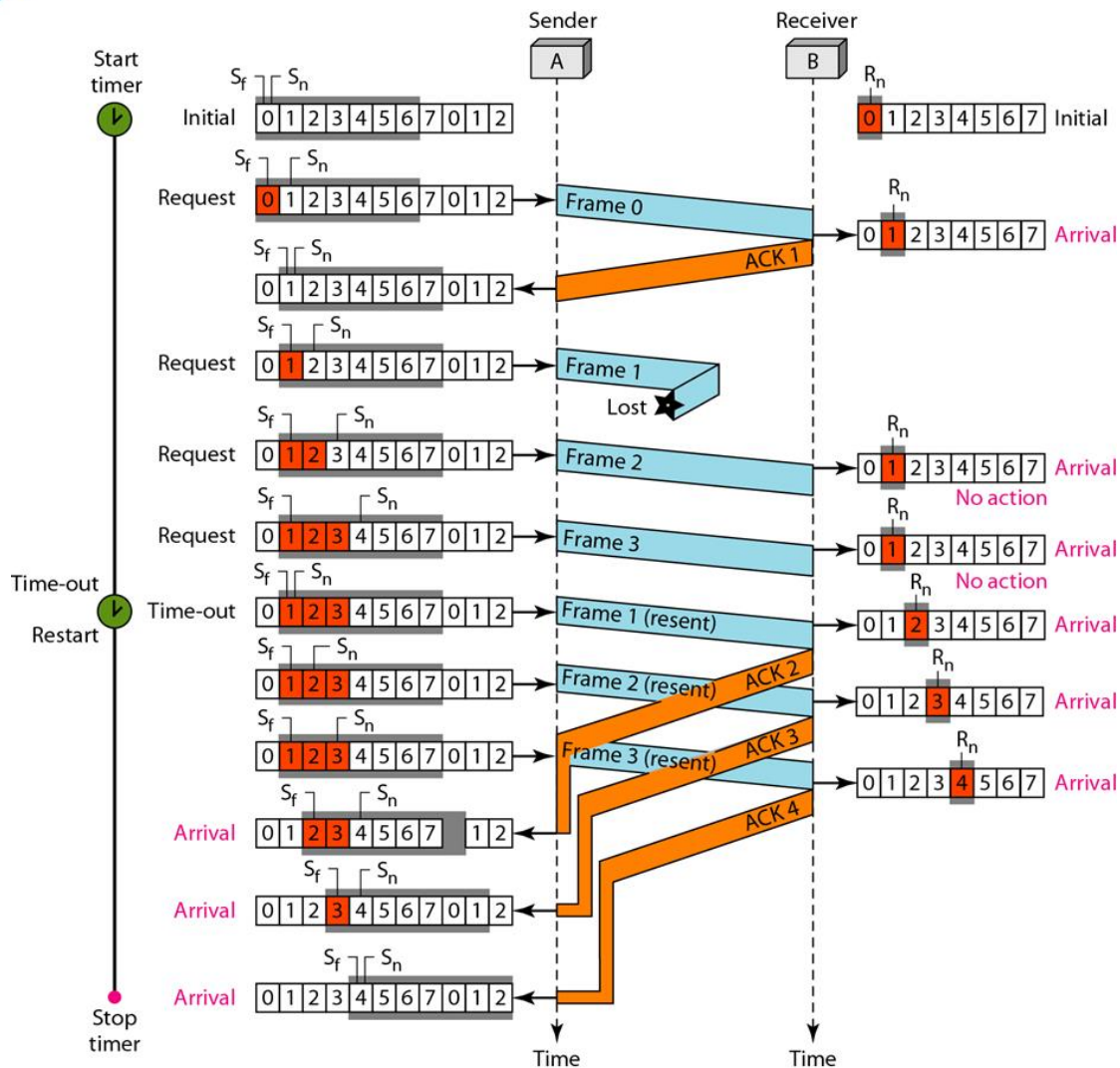
b. Send window after sliding

Go-Back-N

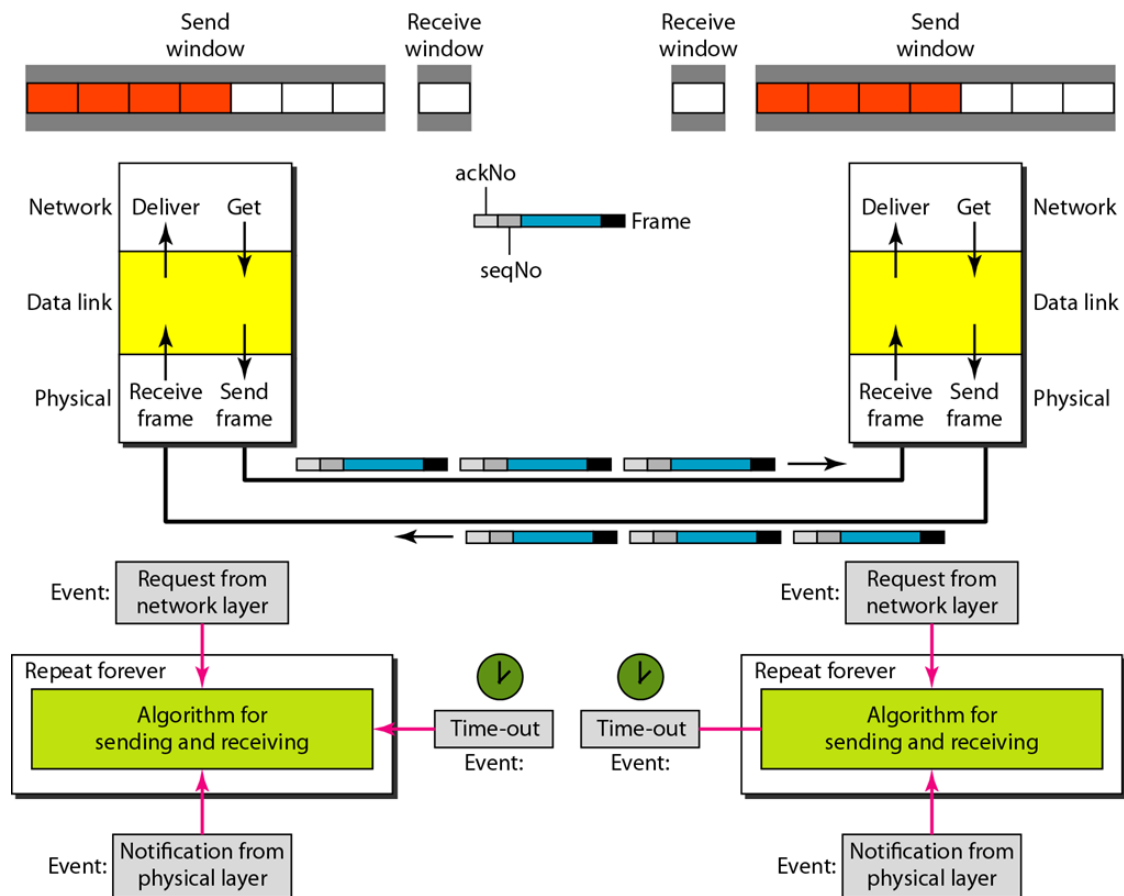


Go-Back-N flow diagram



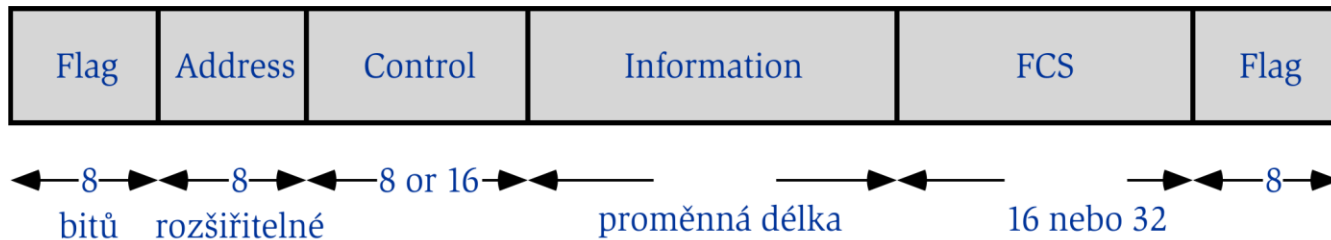


piggybacking



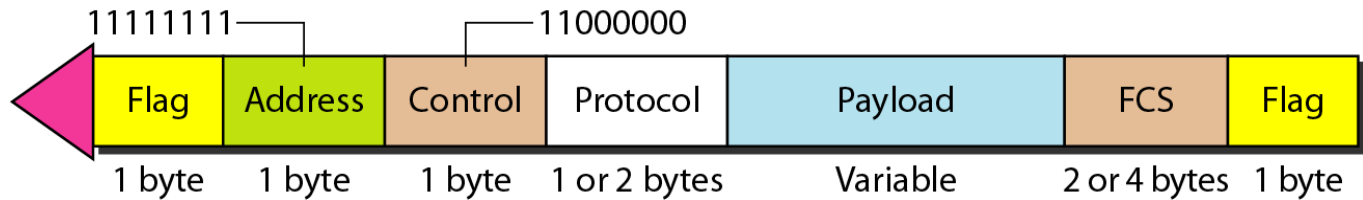
High Level Data Link Control HDLC

- bitovo orientovaný protokol
- dvojbodové aj viacbodové spojenie



- bit stuffing
- FCS kontrola chýb, Go-Back-N riadenie, piggybacking (potvrdenie môže byť súčasťou správy)

Point-to-Point protokol PPP



bajtové (oktetové) prenosy – ESC oktet 01111101

konfigurácia spoja, možnosť autentifikácie

- Password Authentication Protocol (PAP)
- Challenge Handshake Authentication Protocol (CHAP)

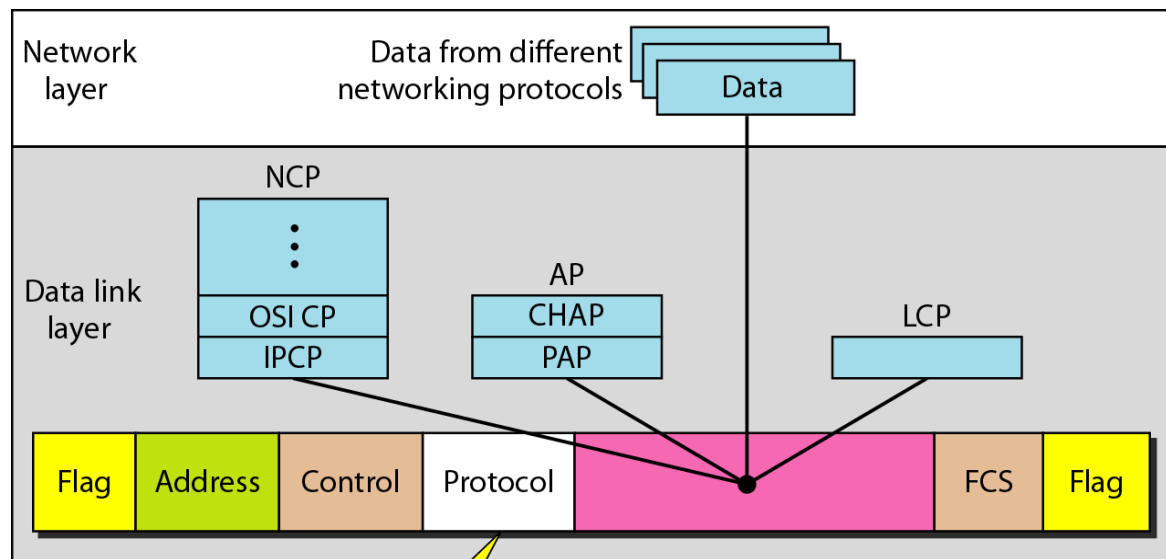


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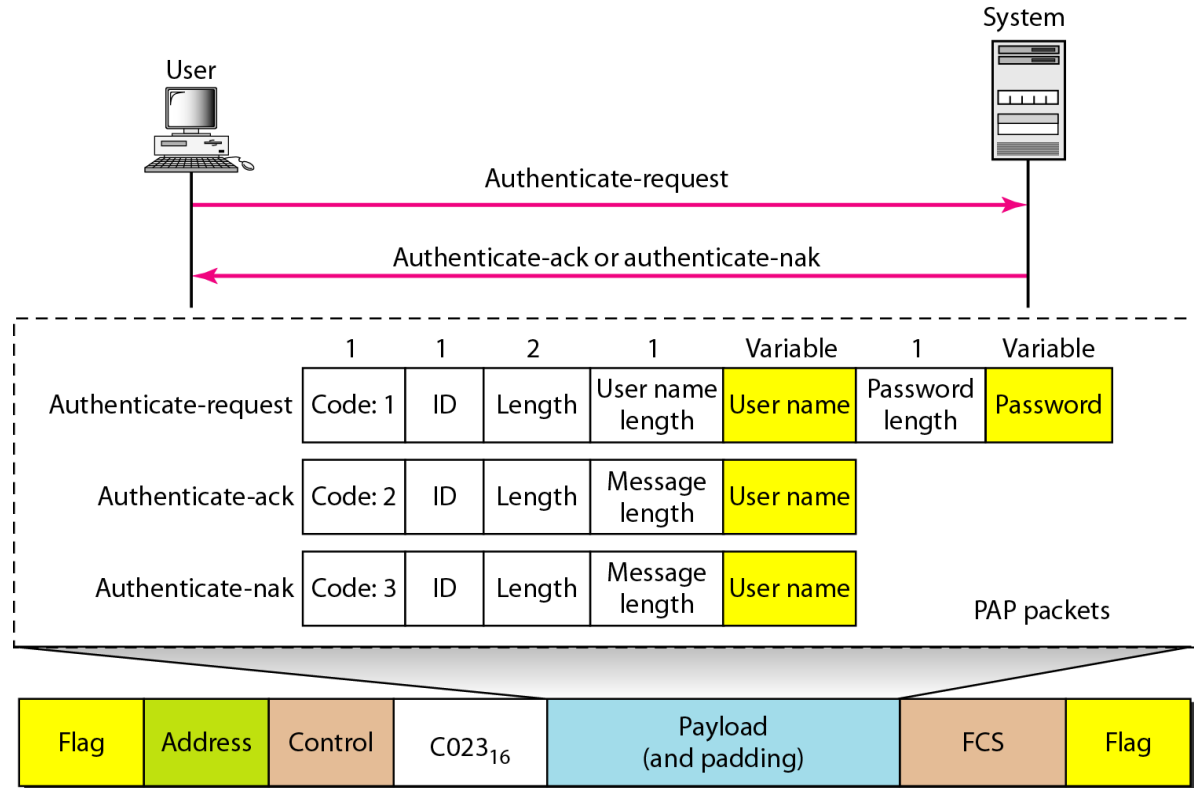




LCP: 0xC021
 AP: 0xC023 and 0xC223
 NCP: 0x8021 and
 Data: 0x0021 and

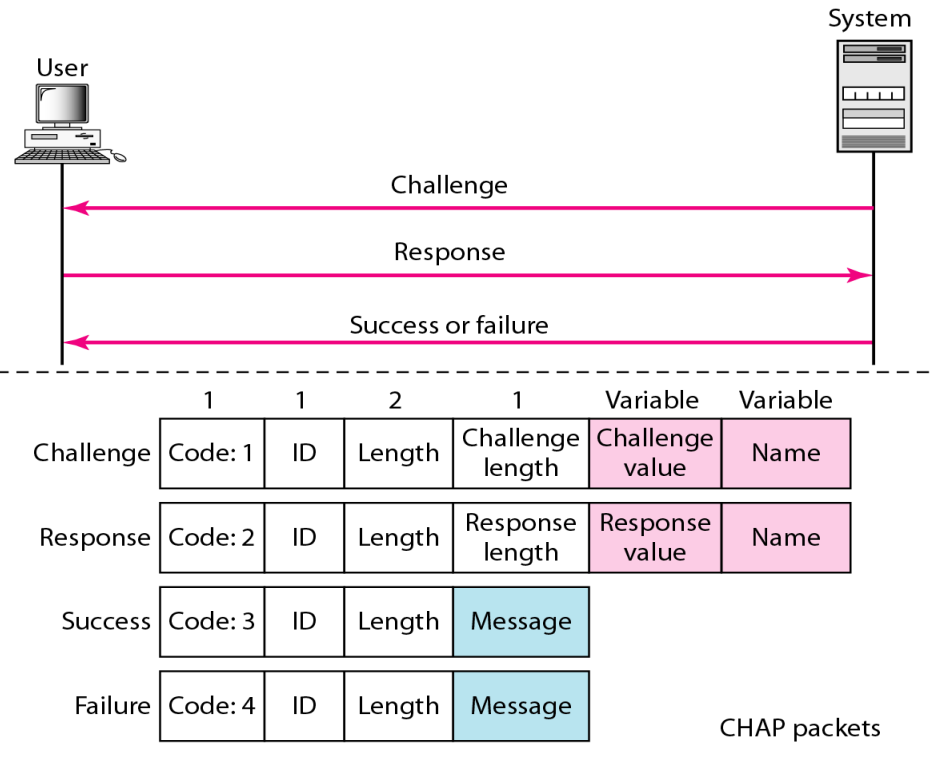
LCP: Link Control Protocol
 AP: Authentication Protocol
 NCP: Network Control Protocol

PAP autentifikácia heslom

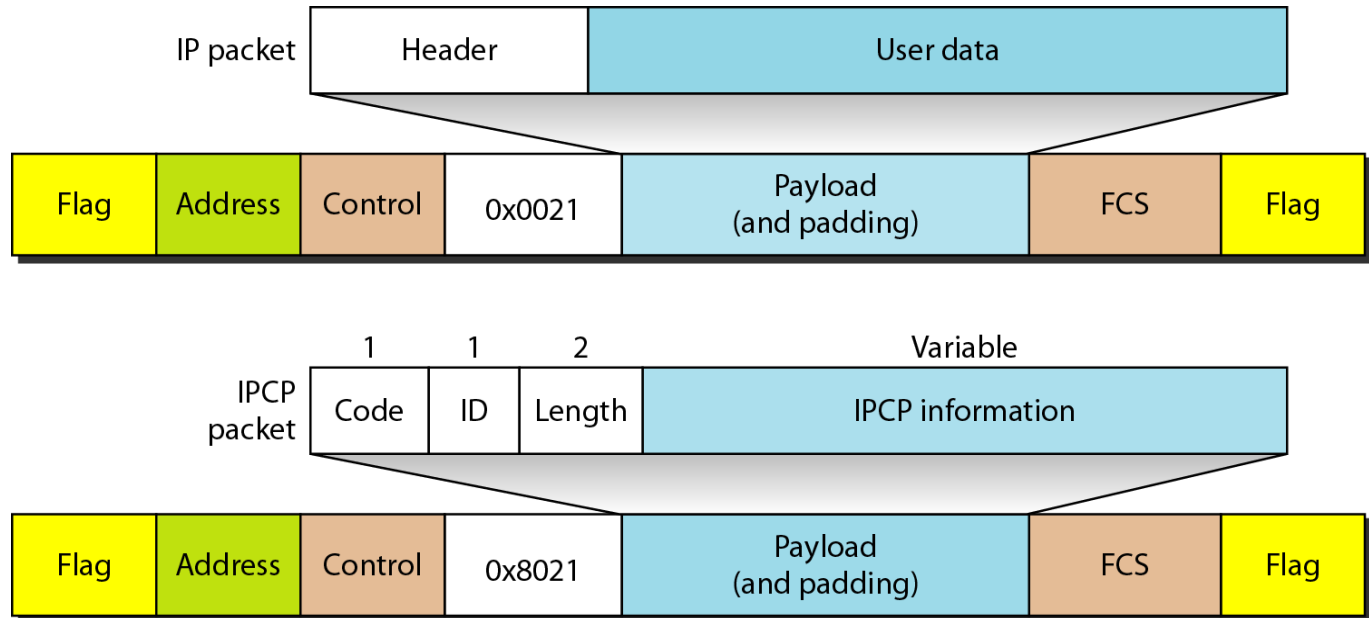


Challenge-Handshake Authentication Protocol

response
 $H(\text{ID}|\text{secret}|\text{challenge})$



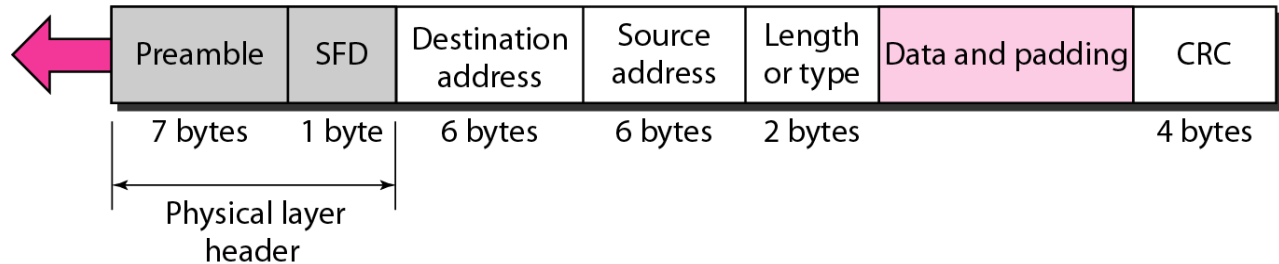
prenosy IP a IPCP paketov PPP rámcom



1976 Xerox

Preamble: 56 bits of alternating 1s and 0s.

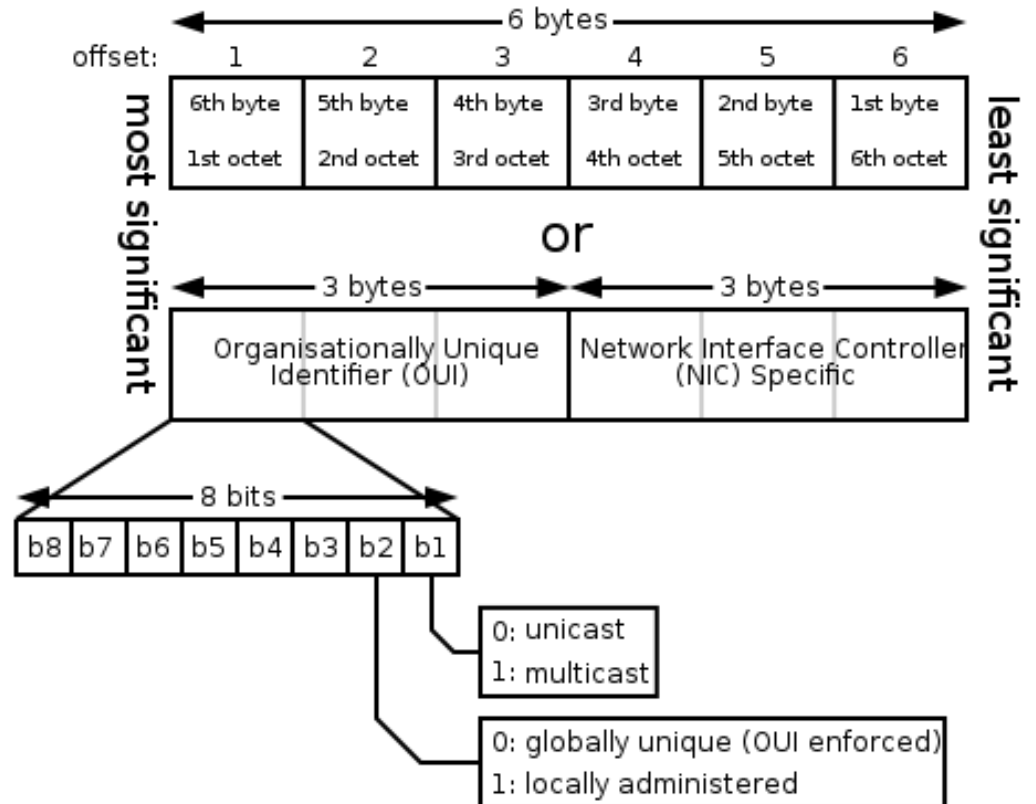
SFD: Start frame delimiter, flag (10101011)



minimálna dĺžka – 512 b (64 B) – 46 B údajov

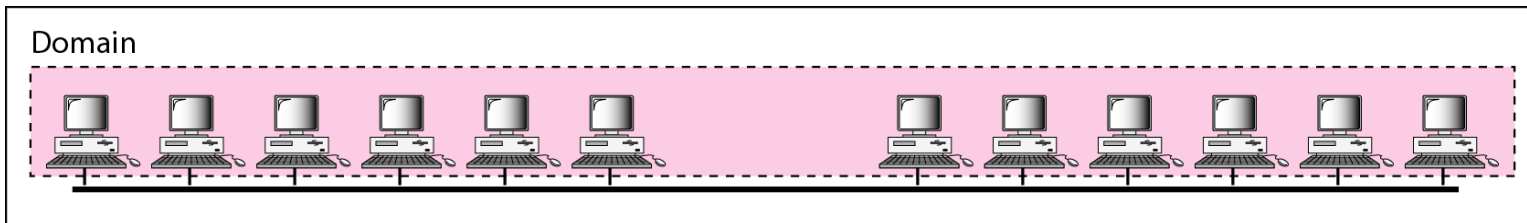
maximálna dĺžka – 12144 b (1518 B) – 1500 B údajov

6 oktetov – 48 bitov

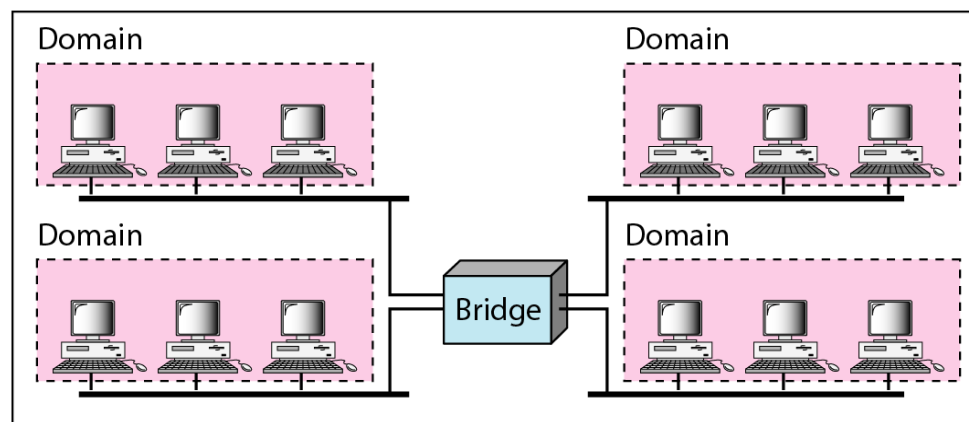


Implementácie Standard Ethernet (10 Mb/s)

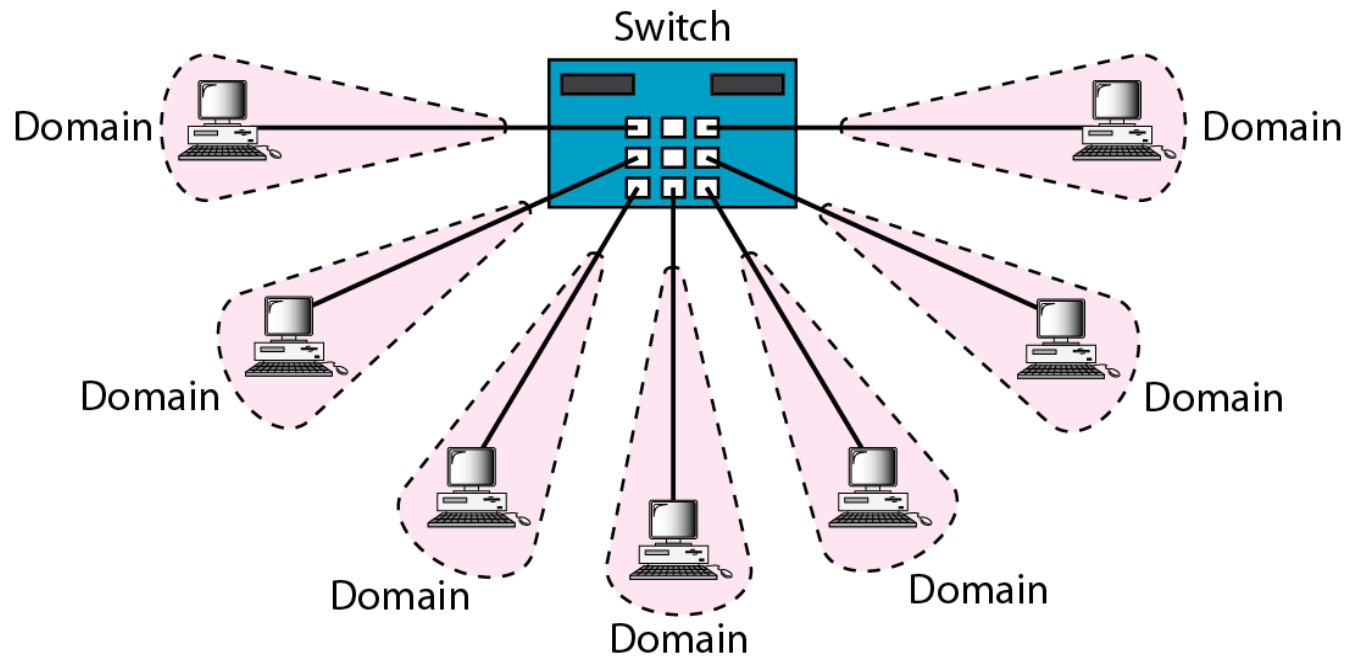
<i>Characteristics</i>	<i>10Base5</i>	<i>10Base2</i>	<i>10Base-T</i>	<i>10Base-F</i>
Media	Thick coaxial cable	Thin coaxial cable	2 UTP	2 Fiber
Maximum length	500 m	185 m	100 m	2000 m
Line encoding	Manchester	Manchester	Manchester	Manchester



a. Without bridging

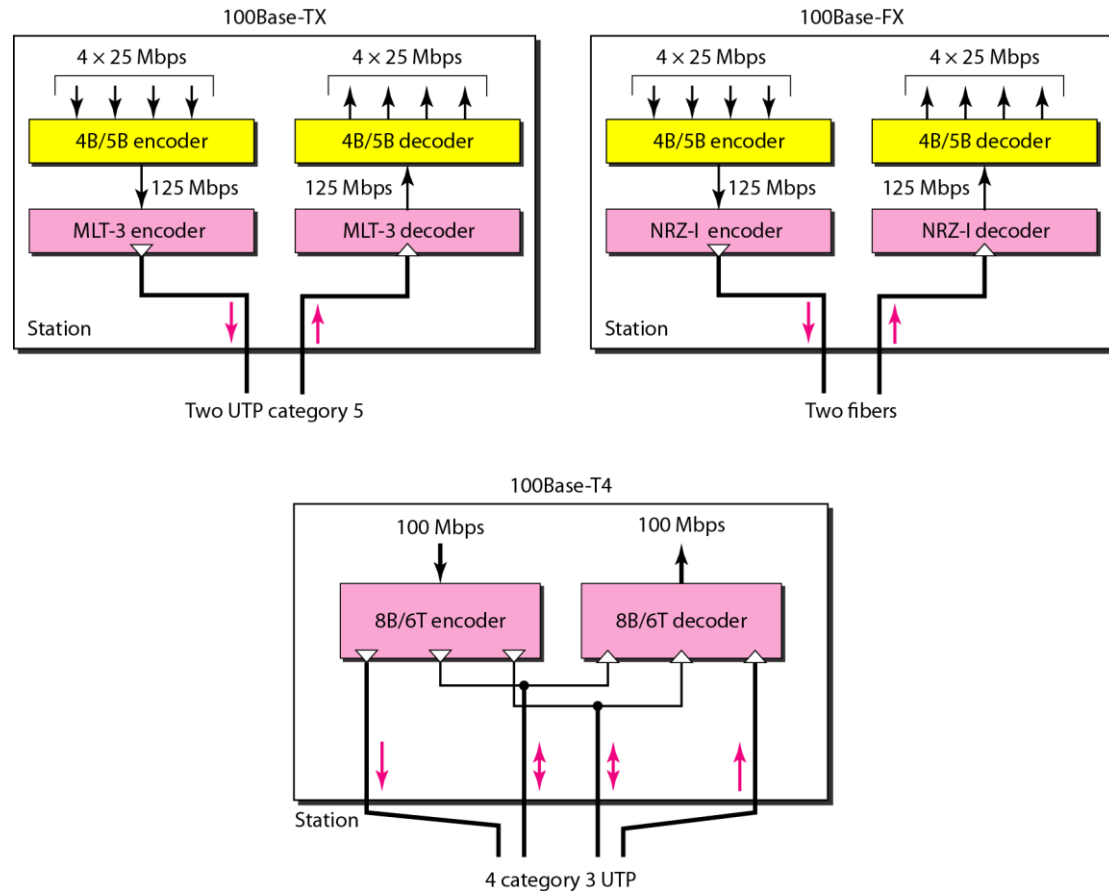


b. With bridging

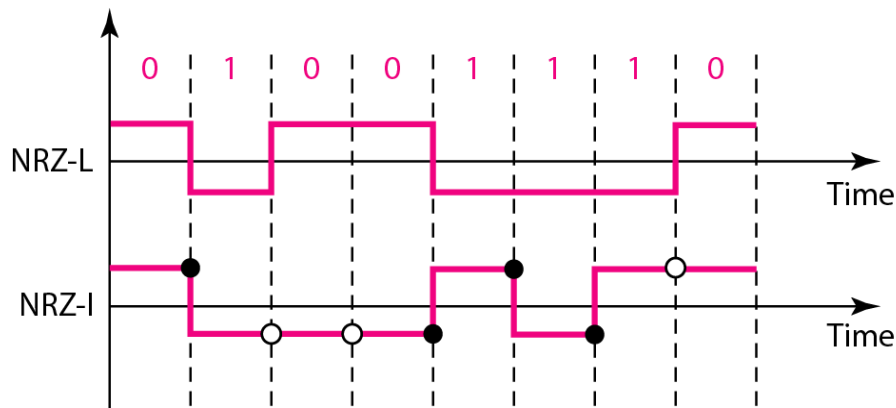


full-duplex komunikácia

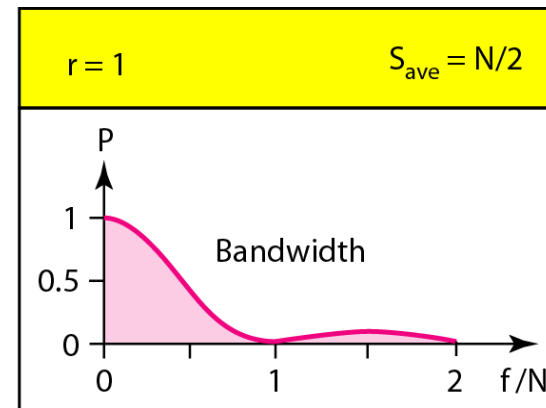
kódovanie



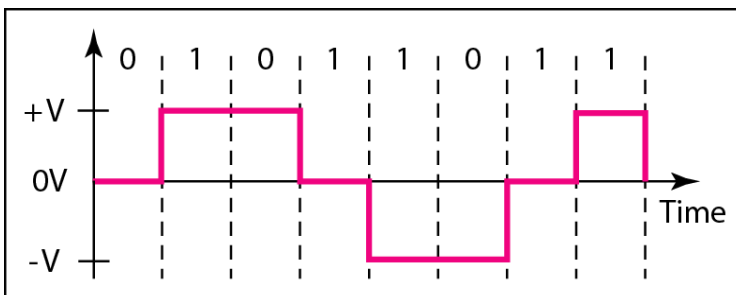
- NRZ-L – úrovňou 0 resp. 1 (problém so striedaním)
- NRZ-I – inverziou pri každej 1 (problém so skupinami núl – zariadi 4B/5B kódovanie)



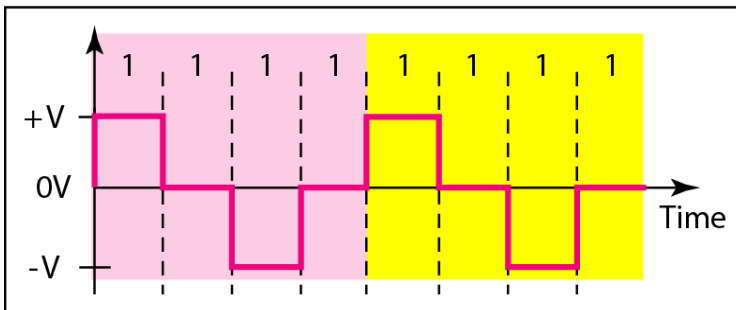
○ No inversion: Next bit is 0 ● Inversion: Next bit is 1



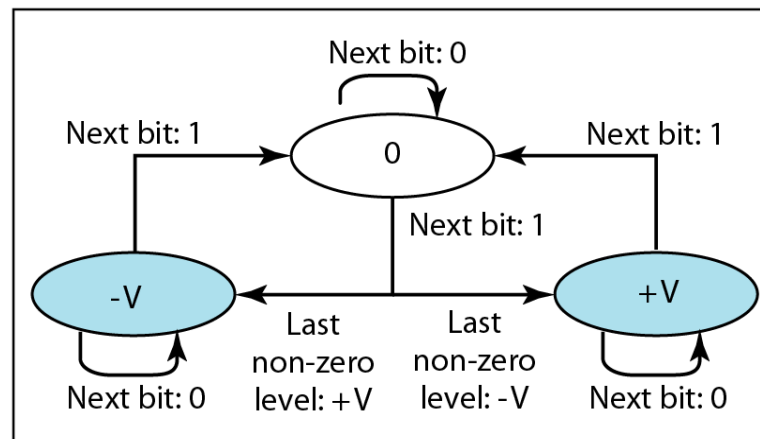
Multi-Level Transmit - MLT3 kódovanie



a. Typical case

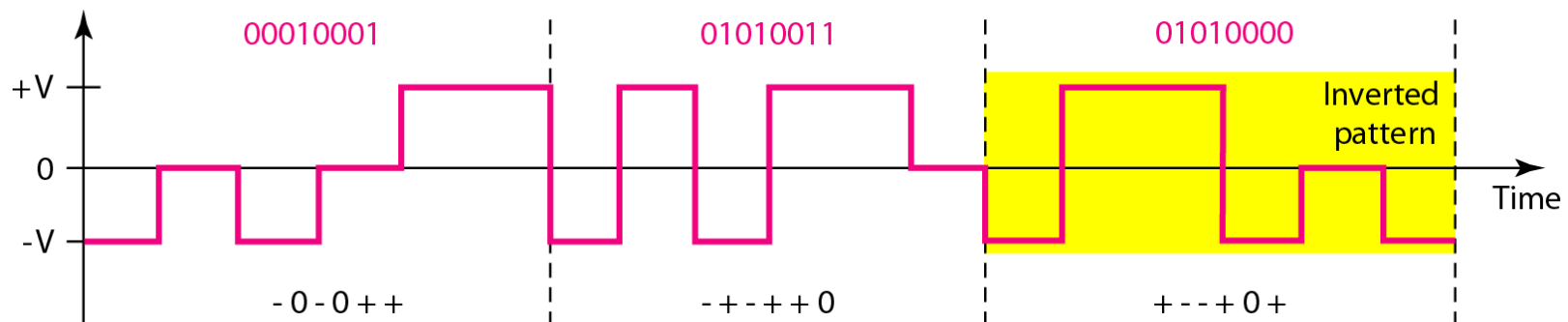


b. Worse case



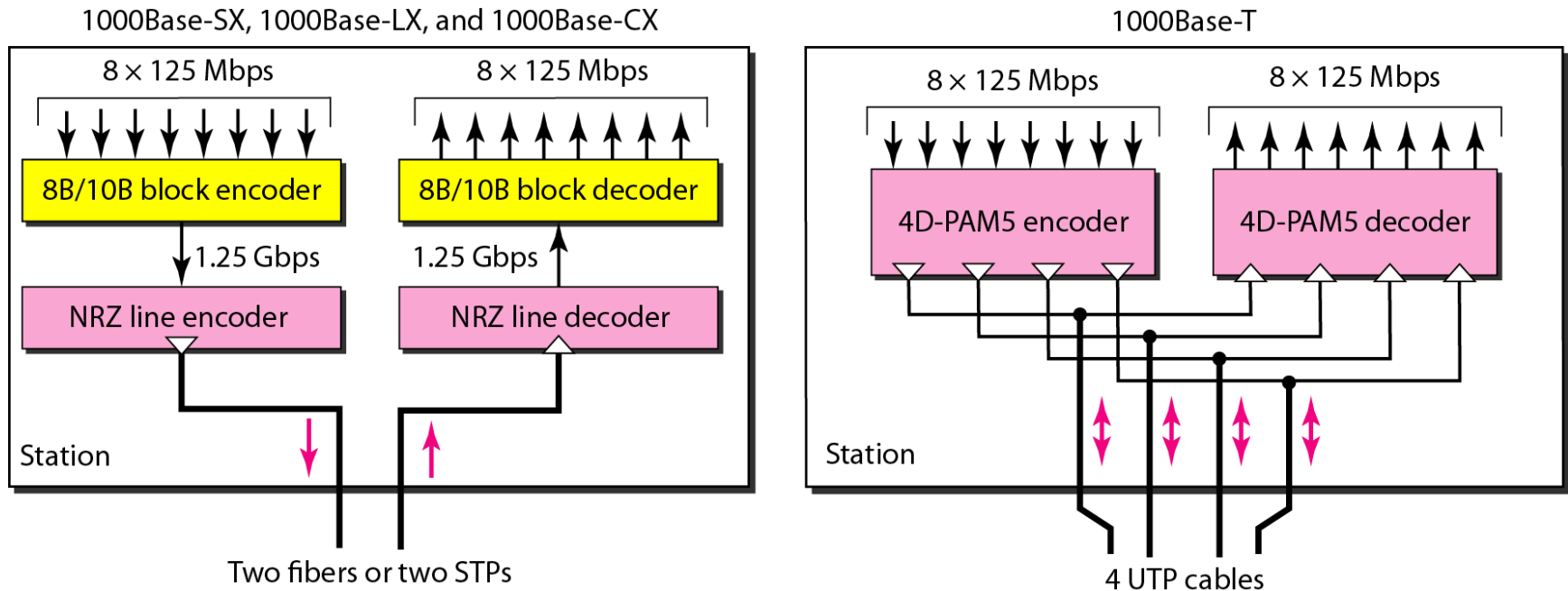
c. Transition states

- 8 bitov na 6 ternárnych úrovní (+0-) so zabezpečením striedania



<i>Characteristics</i>	<i>100Base-TX</i>	<i>100Base-FX</i>	<i>100Base-T4</i>
Media	Cat 5 UTP or STP	Fiber	Cat 4 UTP
Number of wires	2	2	4
Maximum length	100 m	100 m	100 m
Block encoding	4B/5B	4B/5B	
Line encoding	MLT-3	NRZ-I	8B/6T

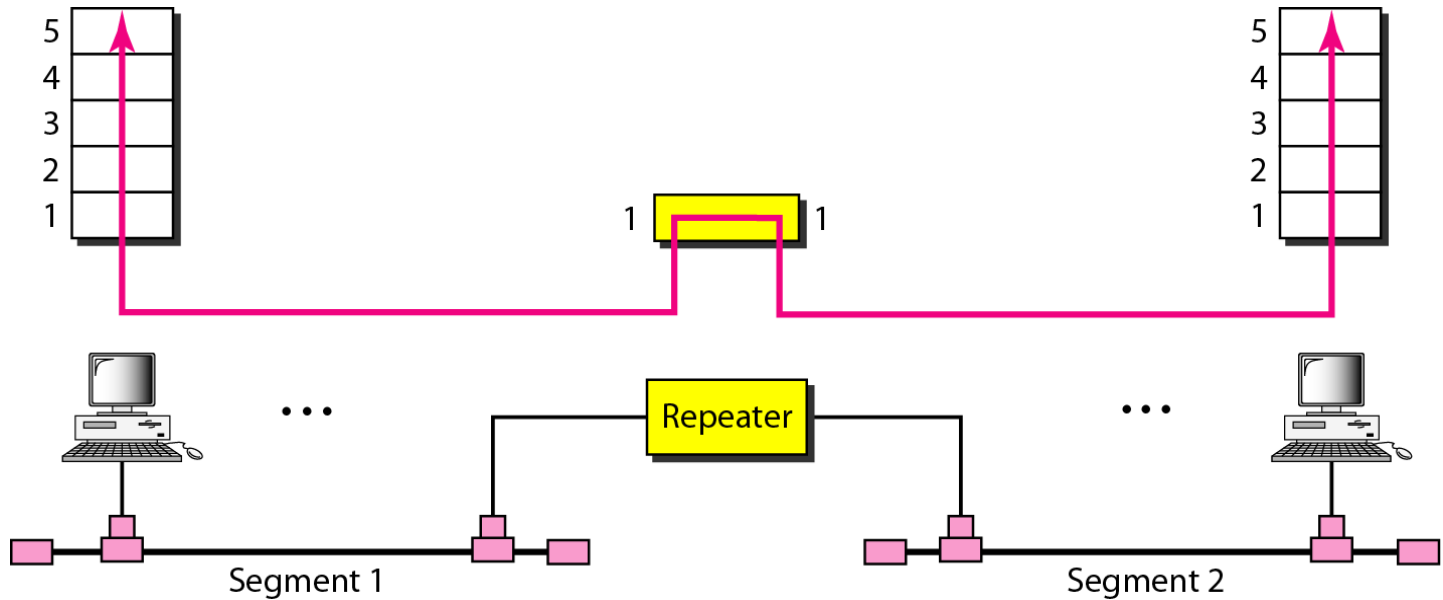
kódovanie PAM s 5 úrovňami súčasne po 4 kábloch



<i>Characteristics</i>	<i>1000Base-SX</i>	<i>1000Base-LX</i>	<i>1000Base-CX</i>	<i>1000Base-T</i>
Media	Fiber short-wave	Fiber long-wave	STP	Cat 5 UTP
Number of wires	2	2	2	4
Maximum length	550 m	5000 m	25 m	100 m
Block encoding	8B/10B	8B/10B	8B/10B	
Line encoding	NRZ	NRZ	NRZ	4D-PAM5

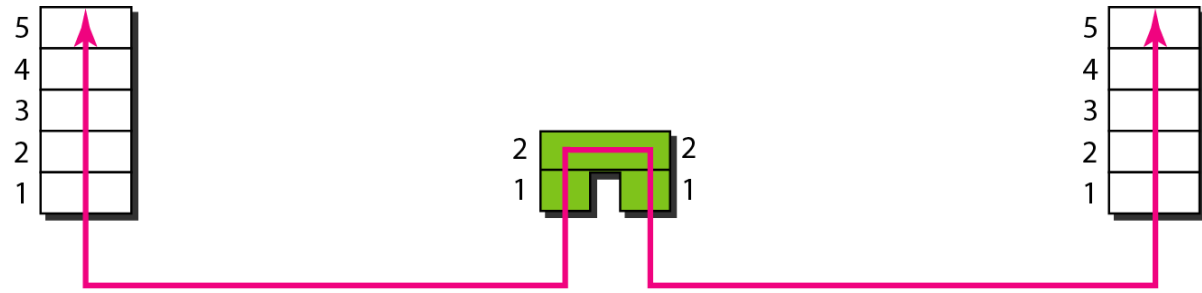
<i>Characteristics</i>	<i>10GBase-S</i>	<i>10GBase-L</i>	<i>10GBase-E</i>
Media	Short-wave 850-nm multimode	Long-wave 1310-nm single mode	Extended 1550-nm single mode
Maximum length	300 m	10 km	40 km

prepojenie segmentov – opakovač



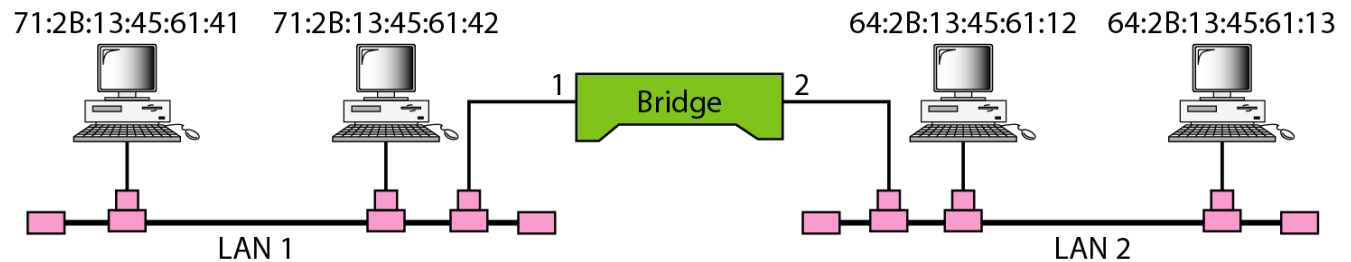
regenerácia signálu, nefiltruje komunikáciu

prepojenie kolíznych domén mostom

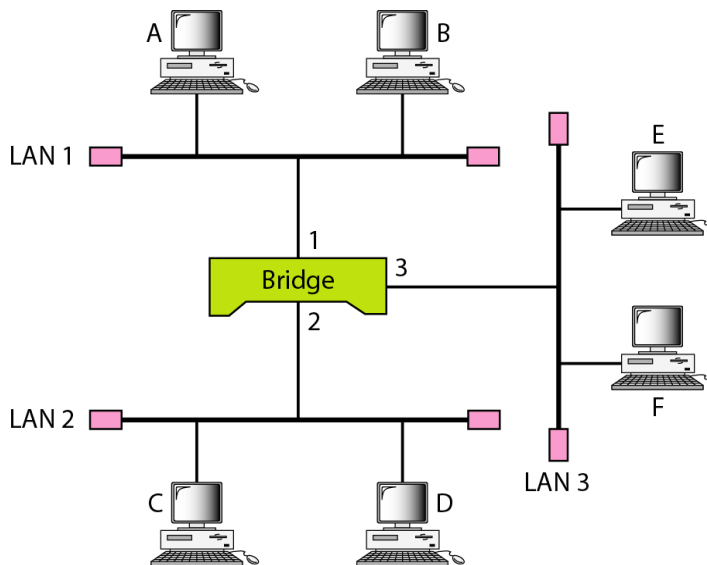


Address	Port
71:2B:13:45:61:41	1
71:2B:13:45:61:42	1
64:2B:13:45:61:12	2
64:2B:13:45:61:13	2

Bridge Table



proces učenia adries (learning bridge)



Address	Port

a. Original

Address	Port
A	1

b. After A sends a frame to D

Address	Port
A	1
E	3

c. After E sends a frame to A

Address	Port
A	1
E	3
B	1

d. After B sends a frame to C

