



Frame relay



CCNP ROUTE FR review

FR vlastnosti

- FR je paketová technológia
 - Založená na Packet switching prepínaní
 - Pôvodne plánovaná ako dátové rozšírenie ISDN
 - Veľkosť rámcov do 4096 bajtov, typicky 1600B
- Pracuje na ISO OSI L2
- Vyžaduje bezporuchovosť prenosových liniek
 - Žiadny mechanizmus riadenia chýb rámcov pri prenose (retransmisia poškodených pri prenose)
 - Detekcia chýb a opravy sú ponechané na protokoly vyšších vrstiev (TCP)
 - Neobsahuje mechanizmus riadenia toku
 - Obsahuje mechanizmus riadenie zahltenia siete (drop)
- Je spojovo orientovaná
 - Medzi používateľmi prepojenými FR existuje virtuálne spojenie
 - Max teoreticky je 1024 na linku
- Ponúka rýchlosti od 64 kbps do približne 45 Mbps
 - Bandwidth je prideľovaný podľa požiadavky (štatistický MUX)
 - Typicky záujem zákazníkov je 1Mbps or 2Mbps
- Najčastejšie nasadenie
 - Bursty prevádzka
 - Prepojenie odľahlých LAN, prístup do Internetu a pod.

FR – prepojenie – Virtual Connection

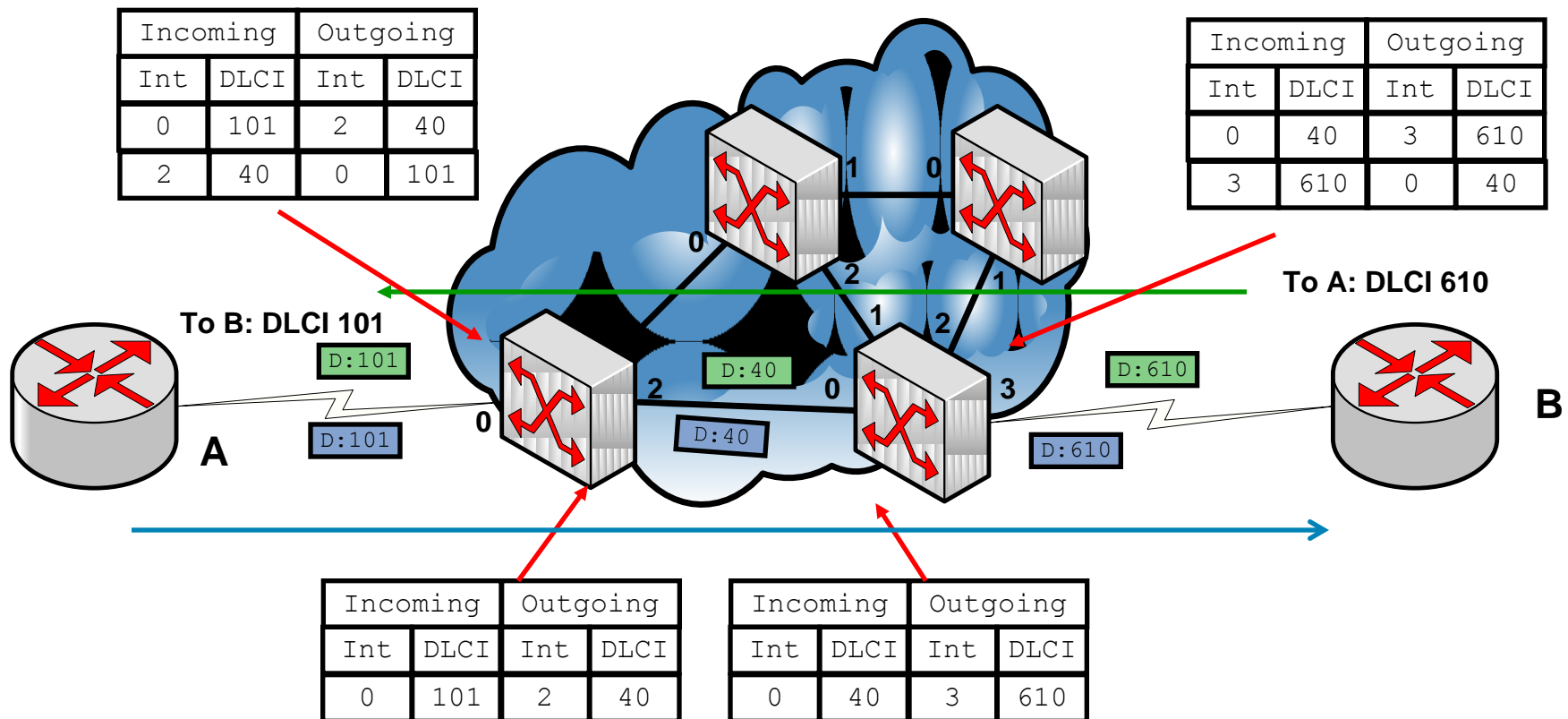
Prepojenie zákazníkov

Virtuálne okruhy (logické spojenie)

- PVC – Permanent Virtual Circuit
- SVC – Switched Virtual Circuit
 - Zostavené signalizáciou CALL SETUP, DATA TRANSFER, IDLE, CALL TERMINATION

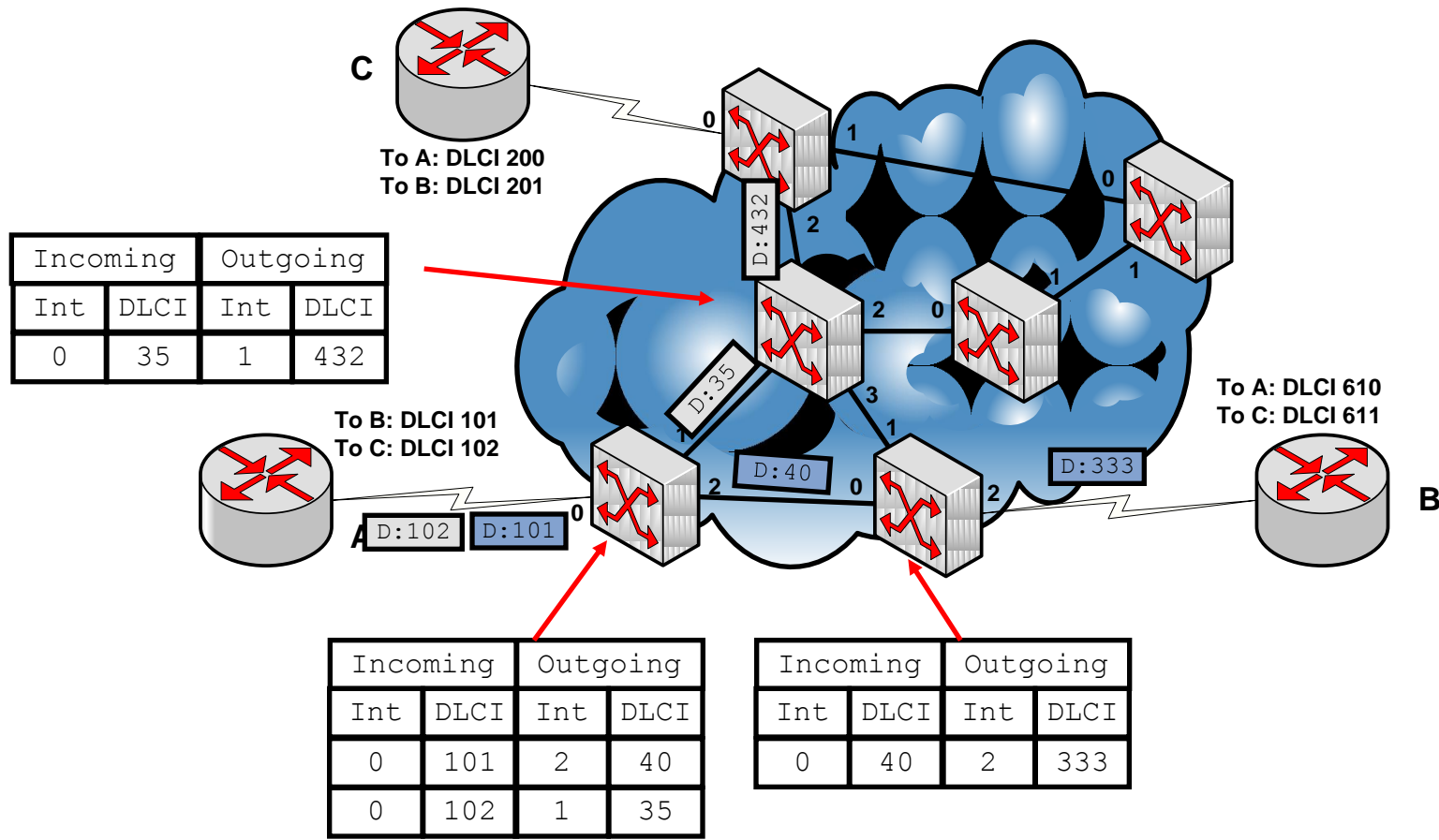
Identifikátor VC

- DLCI – Digital Line Connection Identifier
 - Len lokálny význam medzi dvomi FR zariadeniami
- Pri PVC pridelený providerom



FR – prepojenie zákazníkov - VC

- Multiplexovanie PVC cez prístupovú linku
 - Zdieľanie riešené cez štatistický multiplex
 - Odlíšenie PVC cez DLCI



Mapovanie adries susedov vo FR

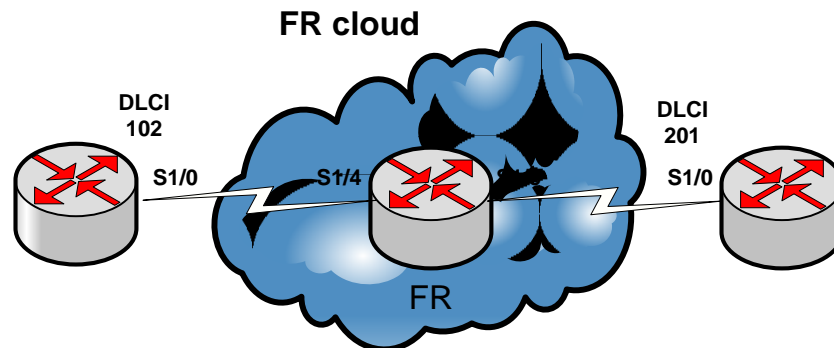
- Ak chce smerovač komunikovať s iným smerovačom cez FR
 - musí vedieť mapovanie lokálnej DLCI (L2 adresa) na L3 IP adresu suseda
- Realizácia
 - Dynamicky
 - inARP (inverse ARP)
 - Smerovač zistí IP adresu suseda z DLCI adresy VC
 - Smerovač posiela cez všetky svoje VC inARP správy
 - Z odpovedí vytvára tabuľku mapovanú L3 IP na L2 DLCI
 - LMI (Local Management Interface)
 - Cisco tu podporuje trzv. Pseudo-Broadcast fičúru
 - FR je NMBA a bcast or mcast správanie je len emulované
 - Statické mapovanie
 - Manuálne zadáme aké IP adresy mapovať do akého DLCI VC
 - Použitie:
 - Kontrola broadcastov a multicastov
 - ak smerovač na druhej strane FR mračna nepodporuje inARP
 - Pri topológii Hub and Spoke, kde smerovače nie sú priamo susedia

Konfigurácia smerovača ako FR prepínač

```
!konfiguracia FR prepiania
FR(config)#frame-relay switching
```

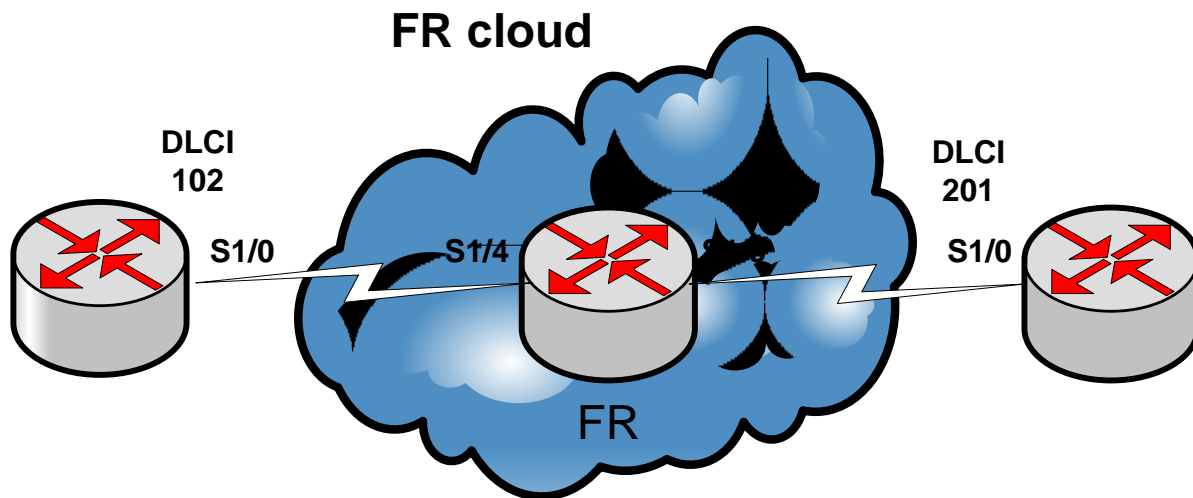
```
! Konfigurácia rozhraní
FR(config)#int s1/4
FR(config-if)#encapsulation frame-relay
FR(config-if)#frame-relay intf-type dce
FR(config-if)#clock rate 64000
FR(config-if)#no shut
FR(config-if)#int s 1/5
FR(config-if)#encapsulation frame-relay
FR(config-if)#frame-relay intf-type dce
FR(config-if)#clock rate 64000
FR(config-if)#no shut
```

```
!Konfigurácia FR prepínacej mapy
FR(config)#int s 1/4
FR(config-if)#frame-relay route 102 int s 1/5 201
FR(config-if)#int s 1/5
FR(config-if)#frame-relay route 201 interface s1/4 102
```



Incoming int	DLCI	Outgoing int	DLCI
S1/4	102	S1/5	201
S1/5	201	S1/4	102

Konfigurácia smerovačov – DTE konce



Incoming int	DLCI	Outgoing int	DLCI
S1/4	102	S1/5	201
S1/5	201	S1/4	102

```
Lavy(config)#interface Serial1/0
Lavy(config-if)# ip address 1.0.0.1 255.255.255.252
Lavy(config-if)# encapsulation frame-relay
Lavy(config-if)#no shut
```

```
Pravy(config)#interface Serial1/0
Pravy(config-if)# ip address 1.0.0.2 255.255.255.252
Pravy(config-if)# encapsulation frame-relay
Pravy(config-if)#no shut
```

Overenie konfigurácie – DTE smerovač

```
Lavy#sh frame-relay map
```

```
Serial1/0 (up): ip 1.0.0.2 dlci 102(0x66,0x1860), dynamic,  
                broadcast,, status defined, active
```

```
Lavy#sh frame-relay pvc
```

```
PVC Statistics for interface Serial1/0 (Frame Relay DTE)
```

	Active	Inactive	Deleted	Static
Local	1	0	0	0
Switched	0	0	0	0
Unused	0	0	0	0

```
DLCI = 102, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial1/0
```

```
input pkts 15          output pkts 18          in bytes 1210  
out bytes 1662         dropped pkts 0          in pkts dropped 0  
out pkts dropped 0     out bytes dropped 0  
in FECN pkts 0        in BECN pkts 0         out FECN pkts 0  
out BECN pkts 0       in DE pkts 0           out DE pkts 0  
out bcast pkts 3      out bcast bytes 102  
5 minute input rate 0 bits/sec, 0 packets/sec  
5 minute output rate 0 bits/sec, 0 packets/sec  
pvc create time 00:38:46, last time pvc status changed 00:37:46
```

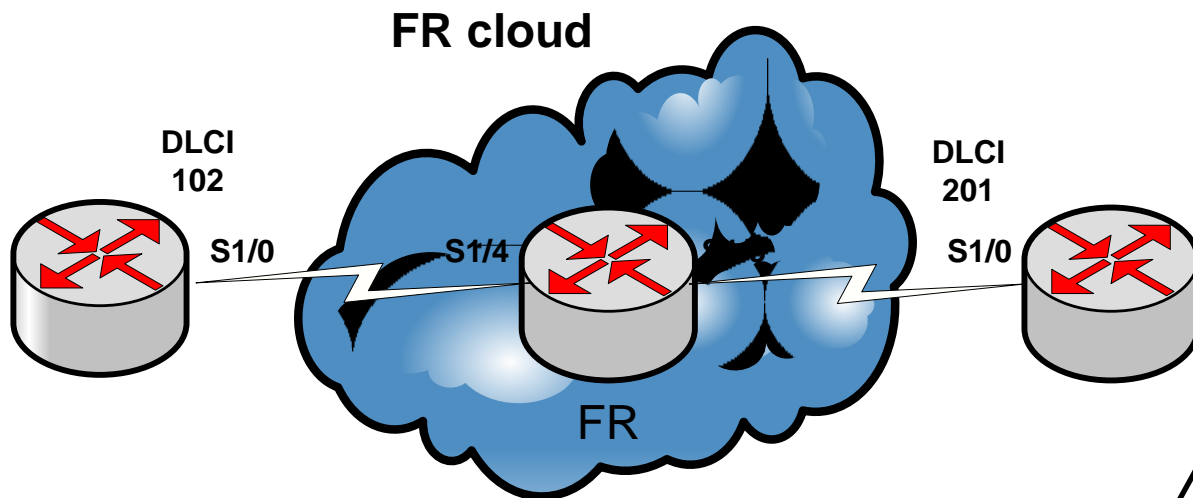



Konfigurácia statickej mapy



Vykonávame v prípade nedostupnosti inARP

Konfigurácia smerovačov – DTE konce



Incoming int	DLCI	Outgoing int	DLCI
S1/4	102	S1/5	201
S1/5	201	S1/4	102

Simulujeme
nedostupnosť
inARP tak, že ho
vypneme

```
Lavy(config)#interface Serial1/0
Lavy(config)#ip address 1.0.0.1 255.255.255.252
Lavy(config)#encapsulation frame-relay
Lavy(config)#no frame-relay inverse-arp
Lavy(config)#no shut
```

```
Pravy(config)#interface Serial1/0
Pravy(config)#ip address 1.0.0.2 255.255.255.252
Pravy(config)#encapsulation frame-relay
Pravy(config)#no frame-relay inverse-arp
Pravy(config)#no shut
```

frame-relay map

- Manuálne nastavenie mapovania.

Router(config-if) #

```
frame-relay map protocol protocol-address dlci [broadcast] [ietf |  
cisco] [payload-compress {packet-by-packet | frf9 stac}]
```

Parameter	Description
<i>protocol</i>	Defines the supported protocol, bridging, or logical link control.
<i>protocol-address</i>	Defines the network layer address of the destination router interface.
<i>dlci</i>	Defines the local DLCI that is used to connect to the remote protocol address.
broadcast	(Optional) Allows broadcasts and multicasts over the VC, permitting the use of dynamic routing protocols over the VC.
ietf cisco	Enables IETF or Cisco encapsulations.
payload-compress	(Optional) Enables payload compression.
packet-by-packet	(Optional) Enables packet-by-packet payload compression, using the Stacker method, a Cisco proprietary compression method.
frf9 stac	(Optional) Enables FRF.9 compression using the Stacker method.

Konfigurácia statickej mapy

Pridáme mapovanie IP na DLCI do oboch DTE smerovačov

```
Lavy(config)#interface Serial1/0  
Lavy(config)#frame-relay map ip 1.0.0.2 102 broadcast  
Lavy(config)#no shut
```

```
Pravy(config)#interface Serial1/0  
Pravy(config)#frame-relay map ip 1.0.0.1 201 broadcast  
Pravy(config)#no shut
```

Overenie mapovania

```
Lavy#sh frame-relay map  
Serial1/0 (up): ip 1.0.0.2 dlci 102(0x66,0x1860), static,  
                broadcast,  
                CISCO, status defined, active
```

Overenie dostupnosti

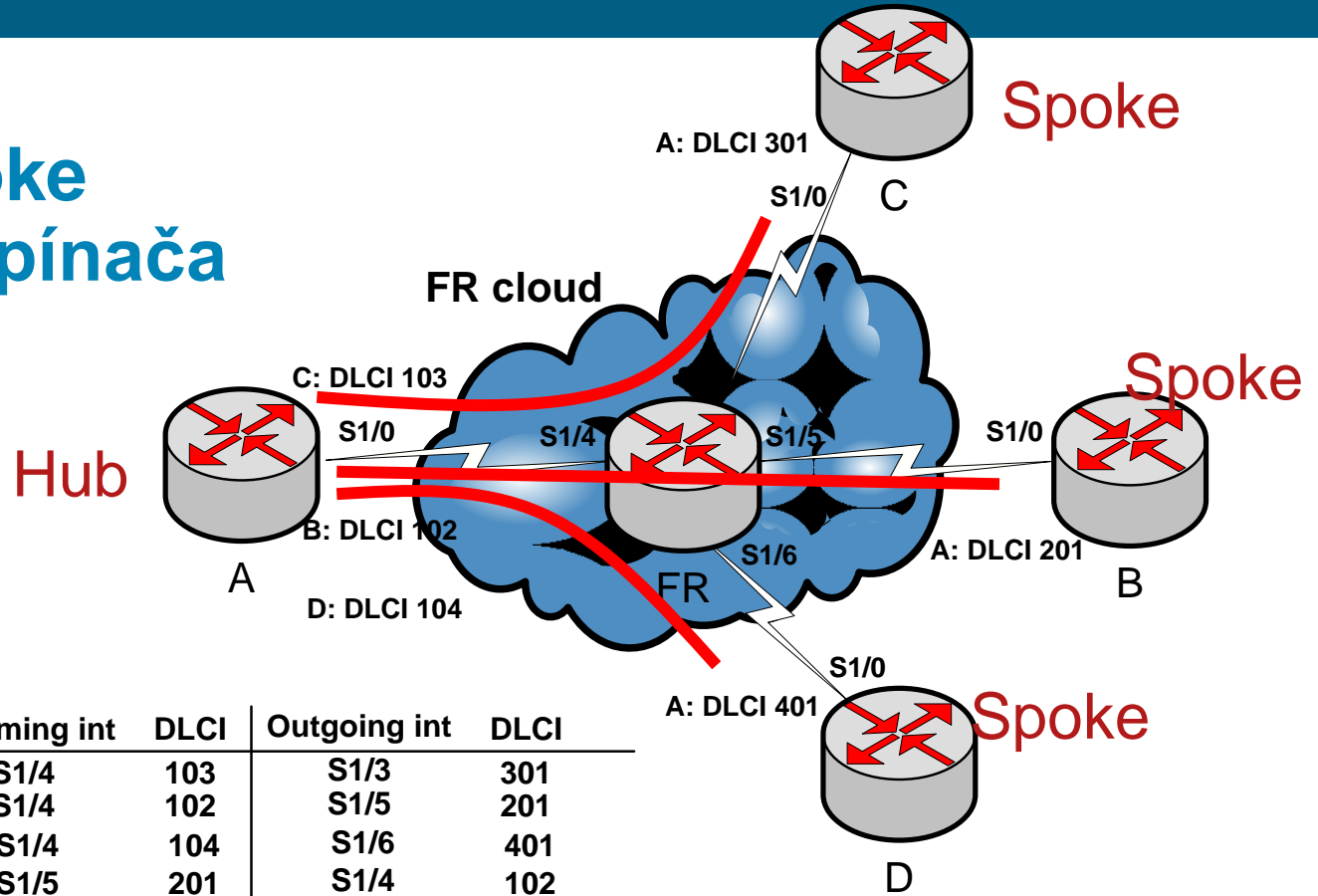
```
Lavy#ping 1.0.0.2  
Type escape sequence to abort.  
Sending 5, 100-byte ICMP Echos to 1.0.0.2, timeout is 2 seconds:  
!!!!  
Success rate is 100 percent (5/5), round-trip min/avg/max = 8/20/40 ms
```

Voľba Broadcast

```
Lavy(config)#interface Serial1/0  
Lavy(config)#frame-relay map ip 1.0.0.2 102 broadcast  
Lavy(config)#no shut
```

- FR je NBMA sieť a nepodporuje zasielanie broadcastov (aj mcastov) cez PVC
 - Niektoré smerovacie protokoly to k činnosti vyžadujú (RIP, EIGRP, OSPF)
 - Voľba **broadcast** aktivuje zasielanie bcast a mcast paketov cez PVC

- Hub and spoke
- konf. FR prepínača



Incoming int	DLCI	Outgoing int	DLCI
S1/4	103	S1/3	301
S1/4	102	S1/5	201
S1/4	104	S1/6	401
S1/5	201	S1/4	102
S1/3	301	S1/4	103
S1/6	401	S1/4	104

```
FR#sh frame-relay route
```

Input Intf	Input Dlci	Output Intf	Output Dlci	Status
Serial1/3	301	Serial1/4	103	inactive
Serial1/4	102	Serial1/5	201	inactive
Serial1/4	103	Serial1/3	301	inactive
Serial1/4	104	Serial1/6	401	inactive
Serial1/5	201	Serial1/4	102	inactive
Serial1/6	401	Serial1/4	104	inactive

Príklad 3 - Hub and spoke - konf. Spoke smerovačov

```
A(config-if)#int s 1/0
A(config-if)#encapsulation frame-relay
A(config-if)#ip add 1.0.0.1 255.255.255.0
A(config-if)#no shut
```

```
B(config)#int s 1/0
B(config-if)#encapsulation frame-relay
B(config-if)#ip add 1.0.0.2 255.255.255.0
B(config-if)#no shut
```

```
C(config)#int s 1/0
C(config-if)#encapsulation frame-relay
C(config-if)#ip add 1.0.0.3 255.255.255.0
C(config-if)#no shut
```

```
D(config)#int s 1/0
D(config-if)#encap fram
D(config-if)#ip add 1.0.0.4 255.255.255.0
D(config-if)#no shut
```

Akú konektivitu budeme mať?

```
A#ping 1.0.0.2
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 1.0.0.2, timeout is 2 seconds:
```

```
!!!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max = 8/16/44 ms
```

```
A#ping 1.0.0.3
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 1.0.0.3, timeout is 2 seconds:
```

```
!!!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max = 8/16/36 ms
```

```
A#ping 1.0.0.4
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 1.0.0.4, timeout is 2 seconds:
```

```
!!!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max = 8/15/40 ms
```

```
B#ping 1.0.0.1
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 1.0.0.1, timeout is 2 seconds:
```

```
!!!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max = 12/40/72 ms
```

```
B#ping 1.0.0.3
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 1.0.0.3, timeout is 2 seconds:
```

```
.....
```

```
Success rate is 0 percent (0/5)
```

```
B#ping 1.0.0.4
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 1.0.0.4, timeout is 2 seconds:
```

```
.....
```

```
Success rate is 0 percent (0/5)
```

Hub

- Konektivita s každým spoke

Spoke

- Konektivita len s Hub s inými spoke nie je

- Každý spoke

Kde je problém?

```
A#sh frame-relay map
Serial1/0 (up): ip 1.0.0.2 dlci 102(0x66,0x1860), dynamic,
                broadcast,, status defined, active
Serial1/0 (up): ip 1.0.0.3 dlci 103(0x67,0x1870), dynamic,
                broadcast,, status defined, active
Serial1/0 (up): ip 1.0.0.4 dlci 104(0x68,0x1880), dynamic,
                broadcast,, status defined, active
```

```
B#sh frame-relay map
Serial1/0 (up): ip 1.0.0.1 dlci 201(0xC9,0x3090), dynamic,
                broadcast,, status defined, active
```

```
C#sh frame-relay map
Serial1/0 (up): ip 1.0.0.1 dlci 301(0x12D,0x48D0),dynamic,
                broadcast,, status defined, active
```

```
D#sh frame-relay map
Serial1/0 (up): ip 1.0.0.1 dlci 401(0x191,0x6410),dynamic,
                broadcast,, status defined, active
```

- InARP poskytne mapovanie IP na DLCI medzi susedmi
- Spoke smerovače nie sú susedia
 - Nemám mapovanie ich IP na DLCI

Riešenie – pridať statické mapovanie na spoke smerovače

```
B(config)#int s 1/0  
B(config-if)#frame-relay map ip 1.0.0.3 201 broadcast  
B(config-if)#frame-relay map ip 1.0.0.4 201 broadcast
```

```
C(config)#int s 1/0  
C(config-if)#frame-relay map ip 1.0.0.2 301 broadcast  
C(config-if)#frame-relay map ip 1.0.0.4 301 broadcast
```

```
D(config)#int s 1/0  
D(config-if)#frame-relay map ip 1.0.0.2 401 broadcast  
D(config-if)#frame-relay map ip 1.0.0.3 401 broadcast
```

Overenie – spoke smerovač B

```
B#sh frame-relay map
Serial1/0 (up): ip 1.0.0.1 dlci 201(0xC9,0x3090), dynamic,
               broadcast,, status defined, active
Serial1/0 (up): ip 1.0.0.3 dlci 201(0xC9,0x3090), static,
               broadcast,
               CISCO, status defined, active
Serial1/0 (up): ip 1.0.0.4 dlci 201(0xC9,0x3090), static,
               broadcast,
               CISCO, status defined, active
```

```
B#ping 1.0.0.1
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 1.0.0.1, timeout is 2 seconds:
```

```
!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max = 12/26/64 ms
```

```
B#ping 1.0.0.3
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 1.0.0.3, timeout is 2 seconds:
```

```
!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max = 16/32/48 ms
```

```
B#ping 1.0.0.4
```

```
Type escape sequence to abort.
```

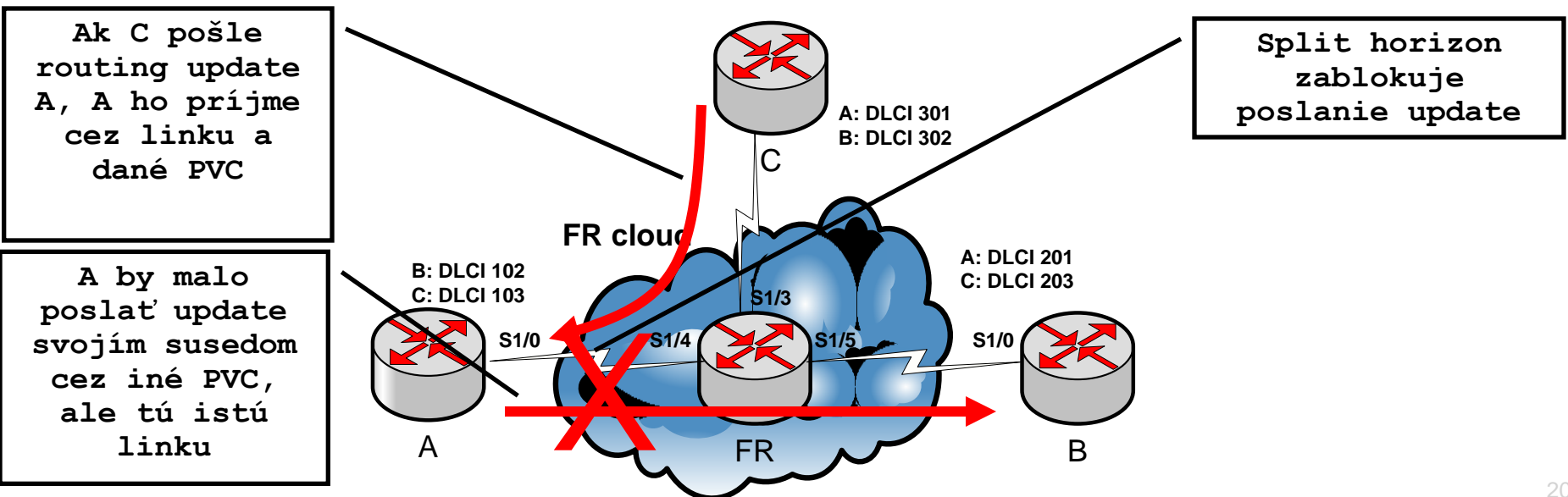
```
Sending 5, 100-byte ICMP Echos to 1.0.0.4, timeout is 2 seconds:
```

```
!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max = 12/30/92 ms
```

FR problémy s dostupnosťou

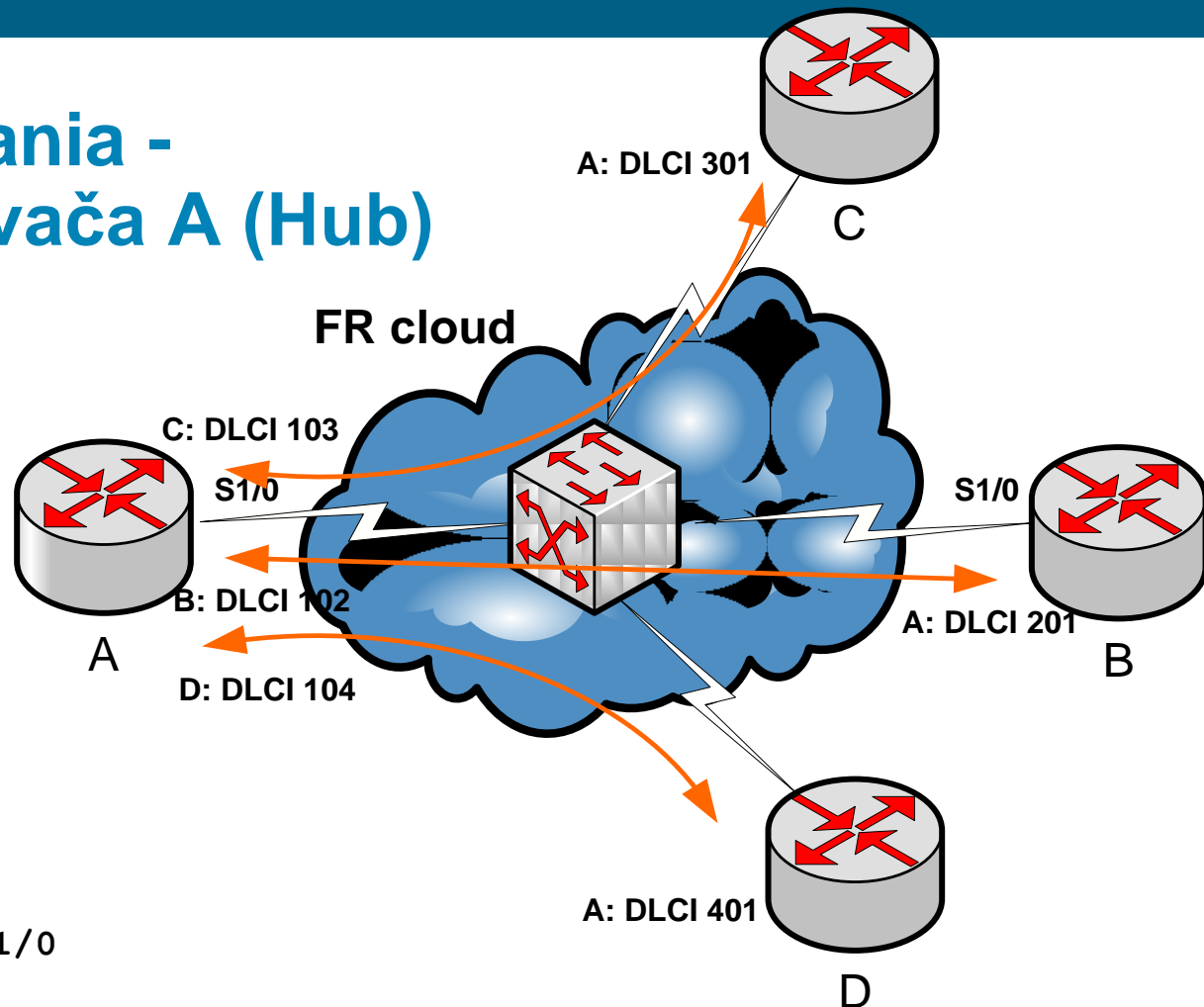
- FR je NBMA sieť
- Pri nasadení smerovacích protokolov, ktoré pracujú so Split Horizon
 - Môžeme nad FR mať problémy s dostupnosťou (Hub and Spoke topo.).
 - SPLIT zabráňuje posielanie informácií o danej sieti naučených z daného smeru späť cez to isté rozhranie



Riešenie split horizon problému

- Vypnutie split horizon na rozhraní
 - Podporuje len IP protokol
 - IPX a Apple nie
 - Pre RIP je split-horizon automaticky vypnutý
- Iné riešenie
 - Rozdeliť fyzické rozhrania na viac subrozhraní
 - Subrozhrania môžu byť typu
 - **Point-to-point**
 - split horizon rieši
 - **Point-to-multipoint**
 - split horizon nerieši

FR subrozhrania - Konf. Smerovača A (Hub)

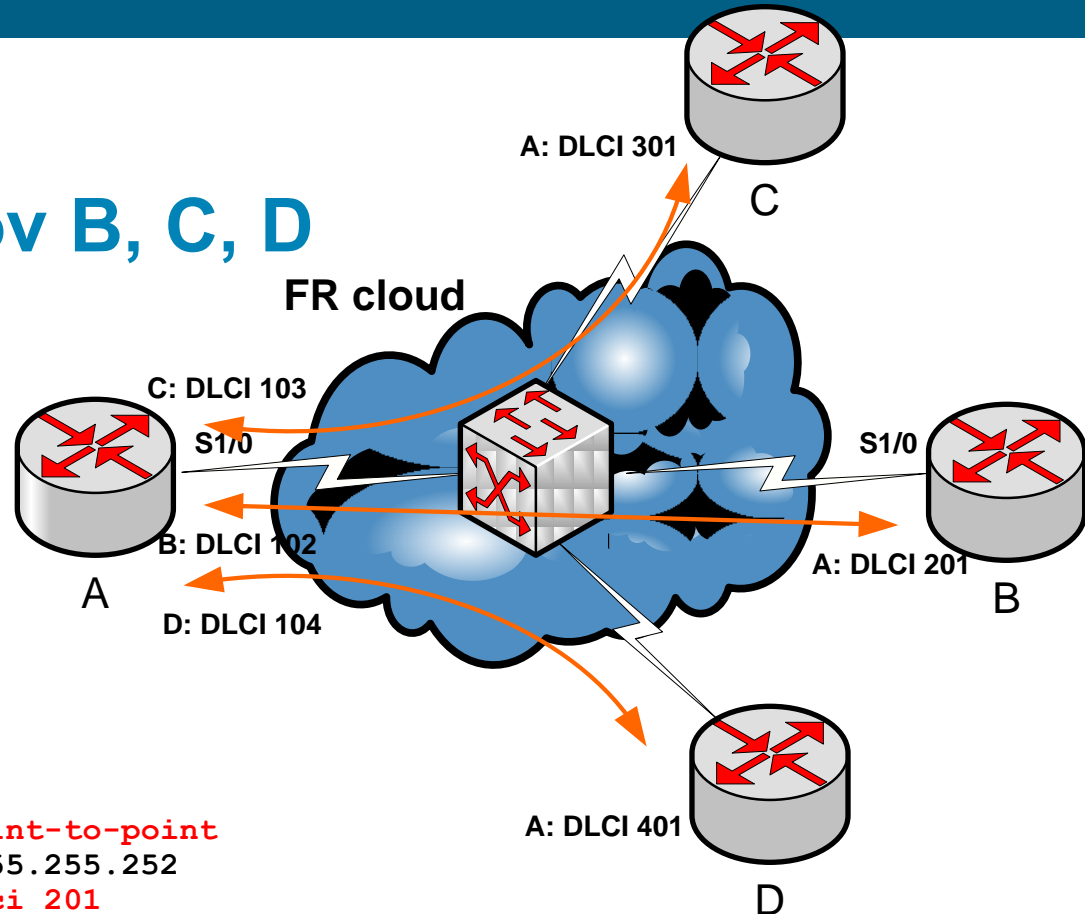


```
A(config)# interface serial 1/0
A(config-if)# no ip address
A(config-if)# encapsulation frame-relay
A(config-if)# interface serial 1/0.102 point-to-point
A(config-subif)# frame-relay interface-dlci 102
A(config-subif)# ip add 192.168.1.1 255.255.255.252
A(config-subif)# interface serial 1/0.103 point-to-point
A(config-subif)# frame-relay interface-dlci 103
A(config-subif)# ip add 192.168.2.1 255.255.255.252
A(config-subif)# interface serial 1/0.104 point-to-point
A(config-subif)# frame-relay interface-dlci 104
A(config-subif)# ip add 192.168.3.1 255.255.255.252
```

FR subrozhrania

Konf. smerovačov B, C, D

(Spoke)



```
B(config)# interface serial 1/0
B(config-if)# no ip address
B(config-if)# encapsulation frame-relay
B(config-if)# interface serial 1/0.201 point-to-point
B(config-subif)# ip add 192.168.1.2 255.255.255.252
B(config-subif)# frame-relay interface-dlci 201
```

```
C(config)# interface serial 1/0
C(config-if)# no ip address
C(config-if)# encapsulation frame-relay
C(config-if)# interface serial 1/0.301 point-to-point
C(config-subif)# ip add 192.168.2.2 255.255.255.252
C(config-subif)# frame-relay interface-dlci 301
```

```
D(config)# interface serial 1/0
D(config-if)# no ip address
D(config-if)# encapsulation frame-relay
D(config-if)# interface serial 1/0.401 point-to-point
D(config-subif)# ip add 192.168.3.2 255.255.255.252
D(config-subif)# frame-relay interface-dlci 401
```

