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Implementacija IPv6 protokola u PPK uslugama

Hrvatska akademska i istraživačka mreža
Sasa.Macakanja@CARNet.hr

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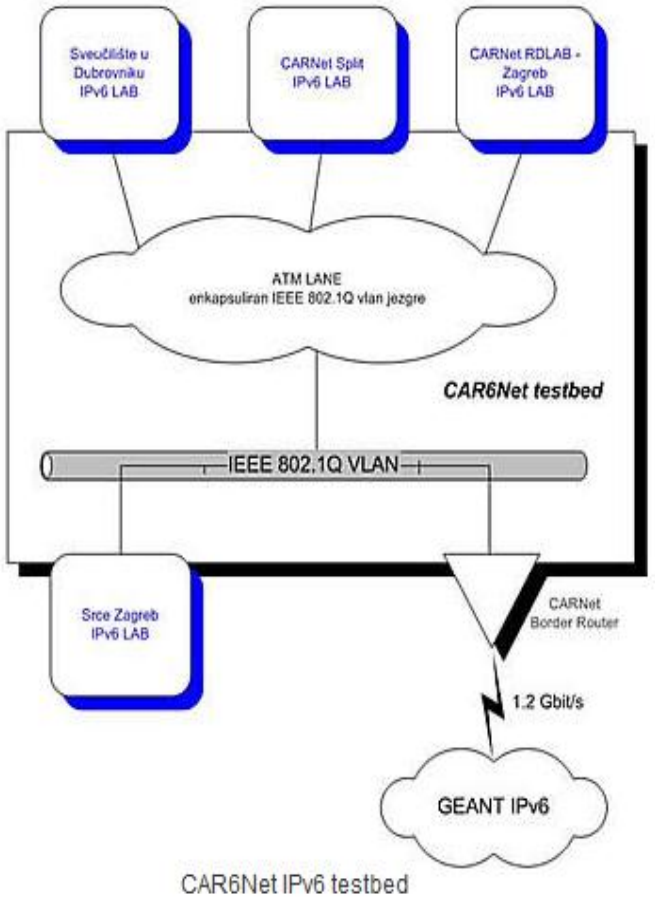
Sadržaj

- IPv6@CARNet
- Usluge pristupa Internetu (PPK)
- IPv6@PPK – tranzicija sa IPv4 protokola
- IPv6@PPK - adresni plan
- Testiranje IPv6 povezanosti

IPv6@CARNet



CAR6Net IPv6 testbed

2003. CAR6Net Prvi IPv6 projekt u CARNetu (povrh IPv4 mreže uspostavljena paralelna testna IPv6 mreža)

2004. Korištenjem BGP protokola uspostavljena prva IPv6 povezanost prema GEANT mreži i IPv6 Internetu

2008. – 2009. IPv6 protokol omogućen produkcijski. Kao traznicijski mehanizam odabran je **dual-stack** (IPv4 & IPv6).

2010. – 2011. Koristeći IPv6 protokol putem CIX-a uspostavljen je BGP peering sa četiri ISP-a

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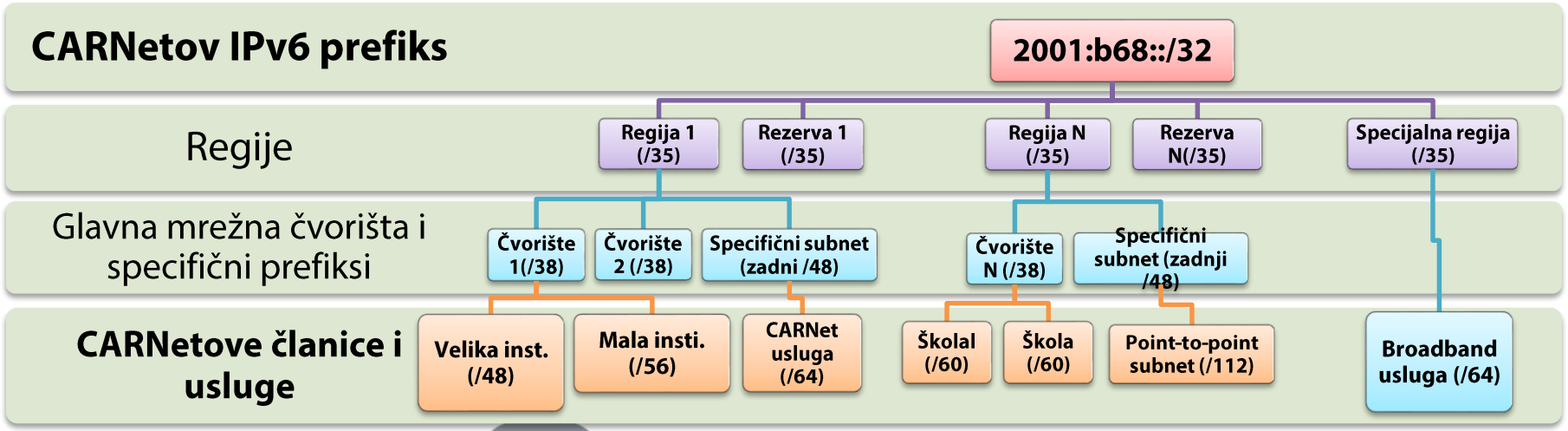
IPv6@CARNet – adresni plan

- 2008. implementiran je novi IPv6 plan adresiranja i dodjele adrese (utemeljen na preporukama međunarodnih organizacija IETF i RIPE)
- Definiran hijerarhijski i lako proširiv



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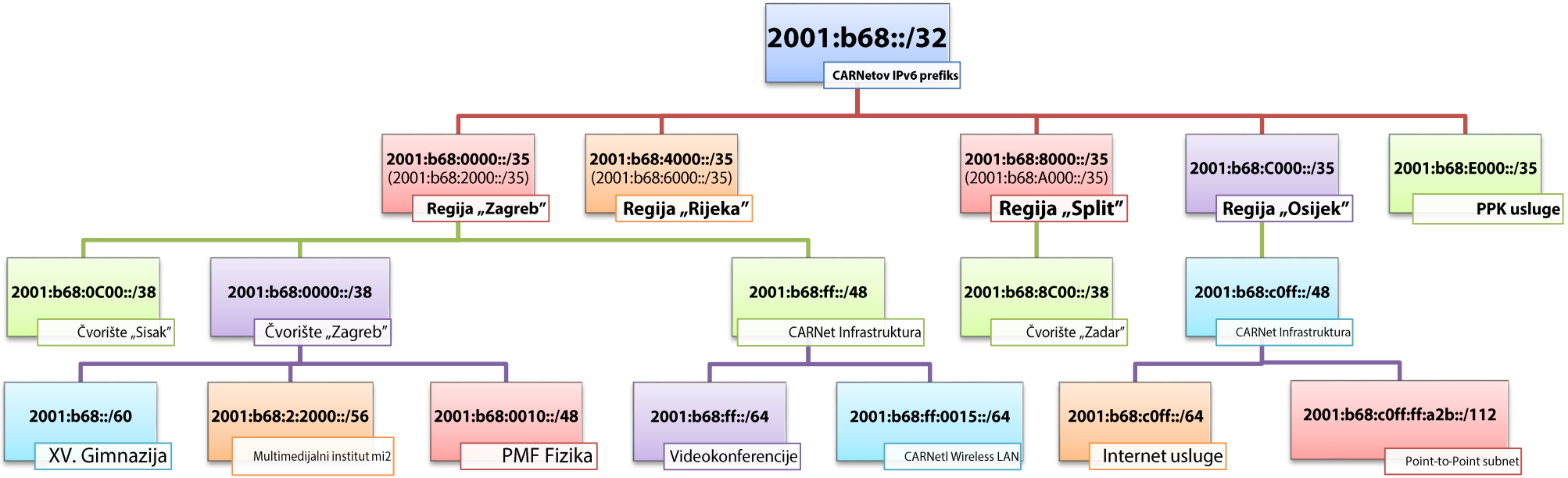
IPv6@CARNet – adresni plan (2)

- Četiri glavne IPv6 regije
- Jedna IPv6 regija za PPK



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Usluge pristupa Internetu (PPK)

- Pojedinačni širokopojasni pristup CARNet mreži

Putem infrastrukture **kabelske televizije**

- **XCARNet / 3DCARNet** (3 127 + korisnika)
- **OKCARNet** (manji broj korisnika)

Koristeći **ADSL2+** pristupnu mrežu

- **MetroCARNet** (1 149+ korisnika)
- **Duo.CARNet i Trio.CARNet** (12 695+ korisnika)
- **O2CARNet** (9 095 + korisnika)

Putem mobilnih mreža (**GPRS, EDGE, UMTS, HSDPA** infrastruktura)

- **MobileCARNet, VipmeCARNet** (14 913+ korisnika)
- **Tele2CARNet** (186 + korisnika)
- **Stick2CARNet** (10 617 + korisnika)

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Dan svjetske IPv6 aktivacije

- **6. 6. 2012** povodom Dana svjetske IPv6 aktivacije omogućeno je trajno korištenje IPv6 protokola na uslugama koje koriste PPPoE protokol:
  - **OKCARNet**
  - **Duo.CARNet i Trio.CARNet**
  - **O2CARNet**
- **20,000 +** potencijalnih korisnika IPv6 Interneta
- Korisnicima osigurana istovremena povezanost na IPv4 i IPv6 Internet

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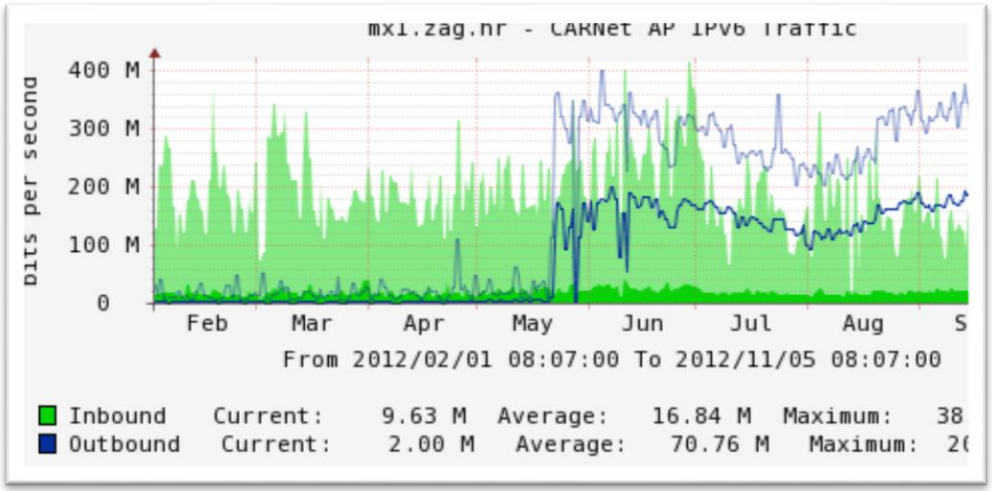
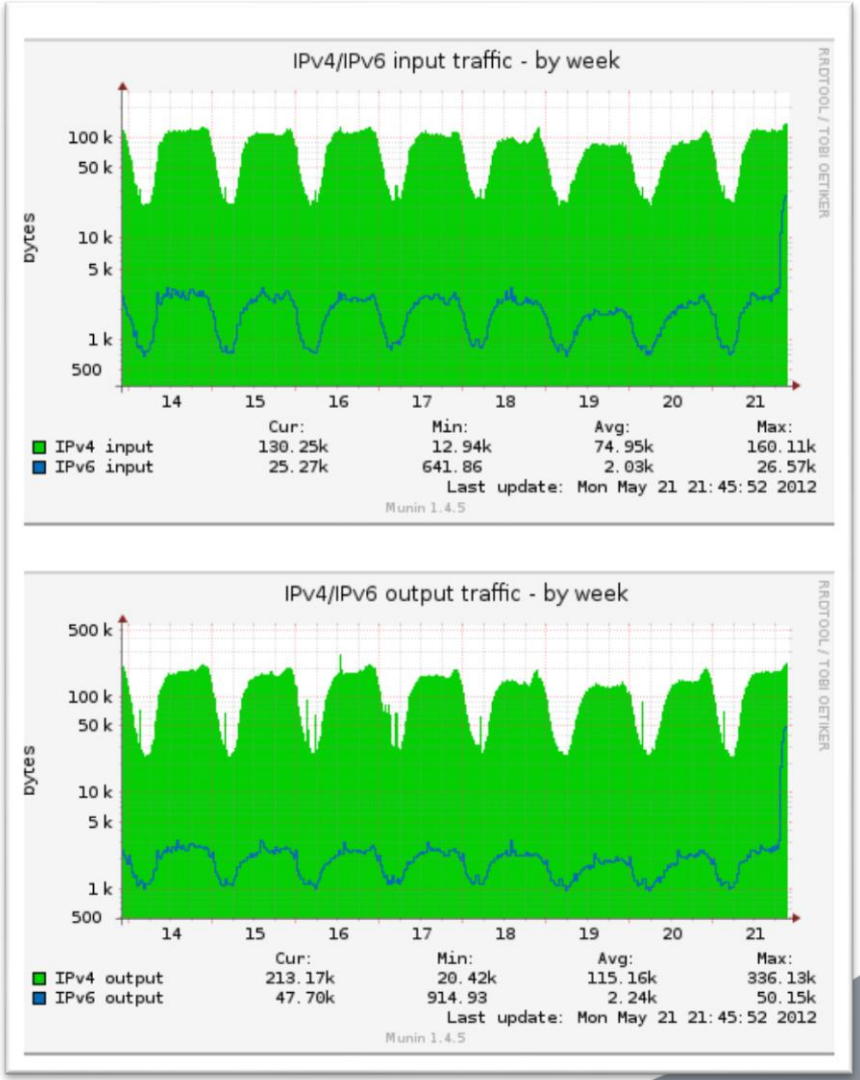
Dan svjetske IPv6 aktivacije (porast IPv6 prometa)

- IPv6 DNS promet
- Internet IPv6 promet





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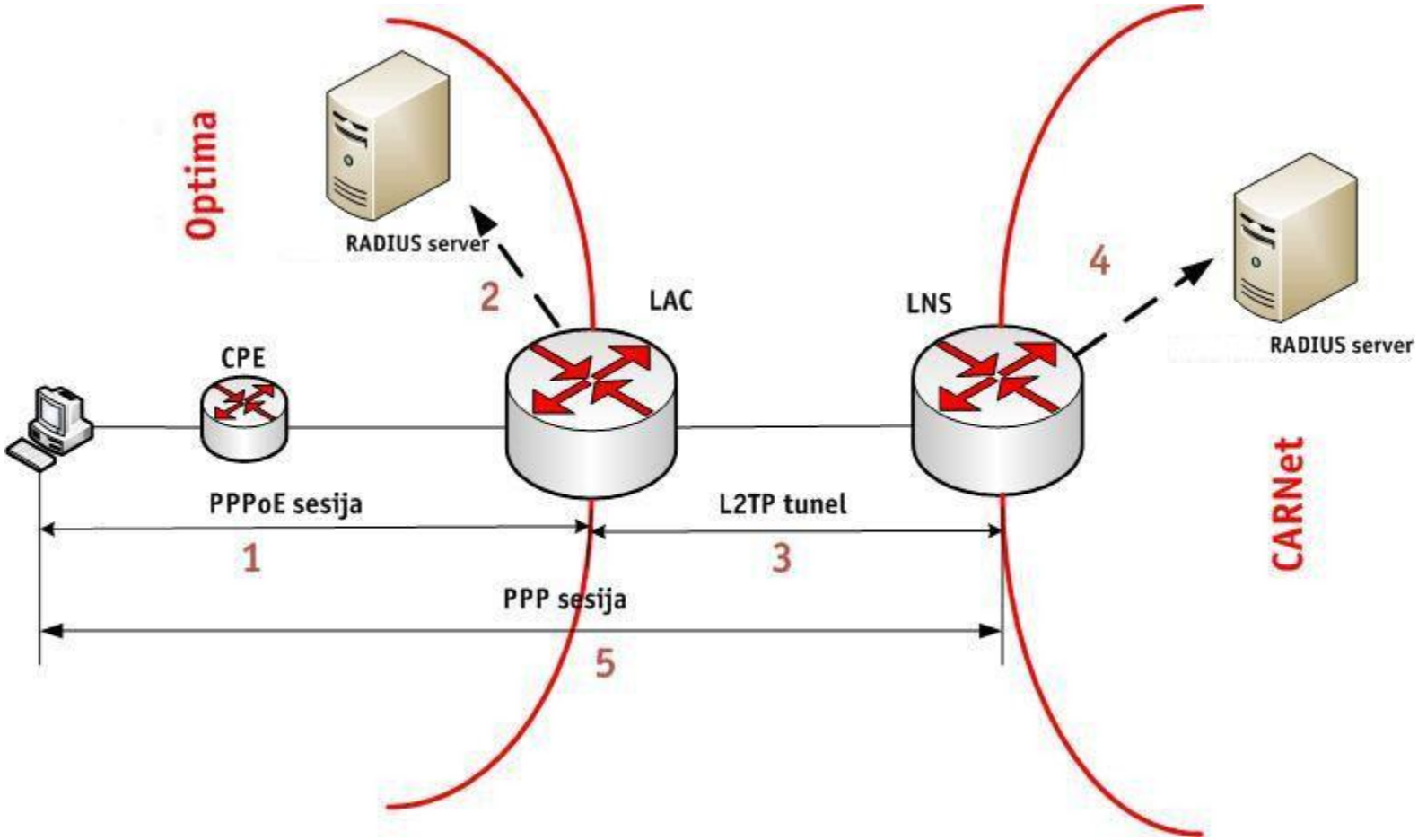
PPK usluga O2CARNet – IPv4 PPPoE



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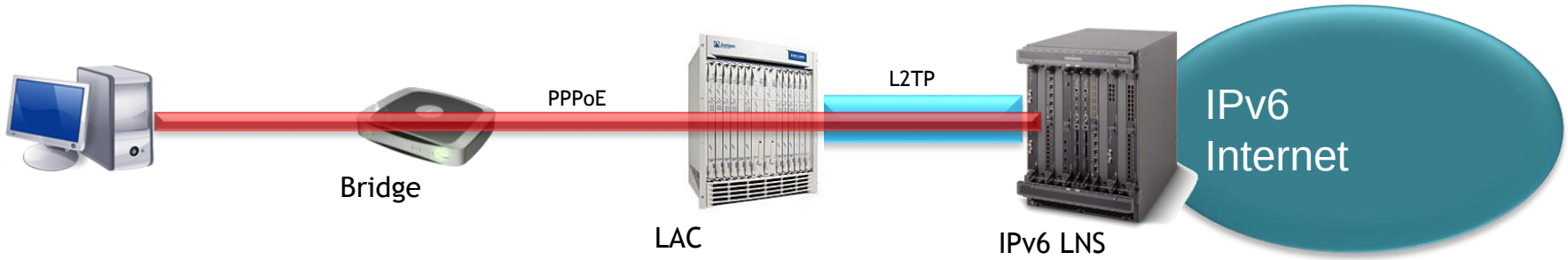
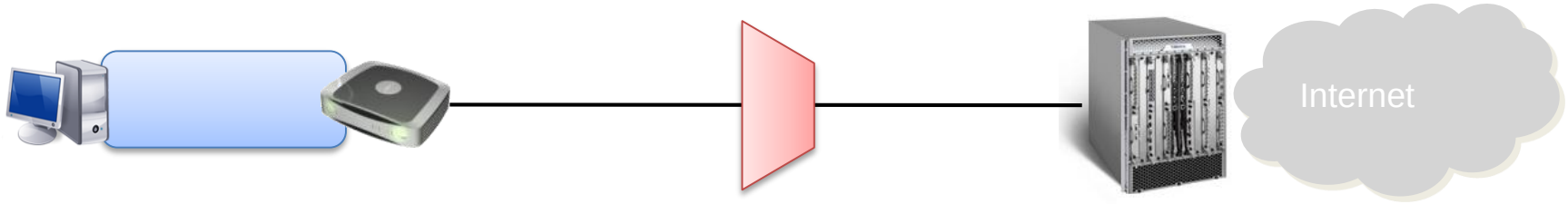
IPv6@PPK - protokoli

- **L2TP – protokol za tuneliranje PPP sesije**
- **Dual-stack PPP (IPv4/IPv6)**
  - **IPv6CP**
- **SLAAC (RFC 2462)**
- **ICMPv6 (RFC 4443) -** Router Advertisements (RA)
- **DHCPv6 prefix delegation** – dodjela IPv6 prefiksa
- **Stateless DHCPv6** – dodjela IPv6 DNS poslužitelja

IPv6@PPK – dual-stack PPPoE – bridge mode



IPv6@PPK – dual-stack PPPoE – bridge mode



IPv4

Bridge
Ethernet
RFC 2684
ATM
DSL

Ethernet
802.1ad
Ethernet
802.3 PHY

IPv4
PPPoE
802.1ad
Ethernet
802.3 PHY

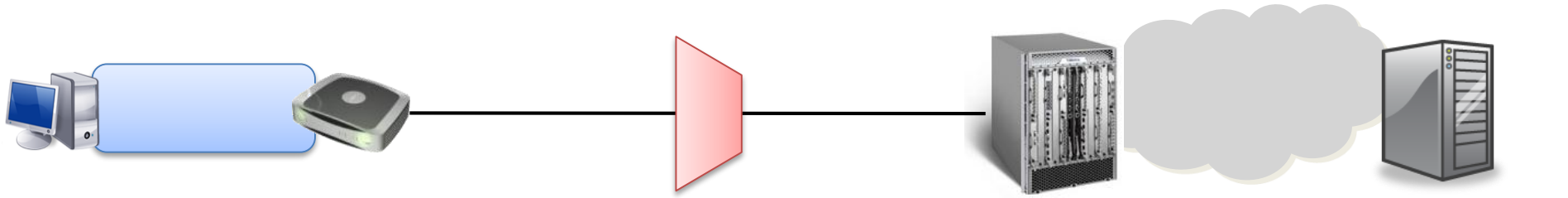
IPv6

Bridge
Ethernet
RFC 2684
ATM
DSL

Ethernet
802.1ad
Ethernet
802.3 PHY

IPv6
PPPoE
802.1ad
Ethernet
802.3 PHY

IPv6@PPK – dual-stack PPPoE – bridge mode (uspostava veze – korak 1)



PPPoE klijent | Bridge | LNS | RADIUS

PPPoE
PADI – PADO – PADR - PADS

PPP LCP ConfReq
ConfReq: MRU, Magic Number

PPP LCP ConfReq
ConfReq: MRU, Magic Number, Auth=PAP

PPP LCP ConfAck
ConfReq: MRU, Magic Number, Auth=PAP

PPP LCP ConfAck
ConfReq: MRU, Magic Number

PAP Authenticate-Request
Username (Peer-ID)+ Password

RADIUS Access-Accept
IPv6-DNS, Framed-IPv6-Prefix

RADIUS Access-Request
User-Name, Password, Service-Name VSA
Service-Type=Framed, Framed-Protocol=PPP

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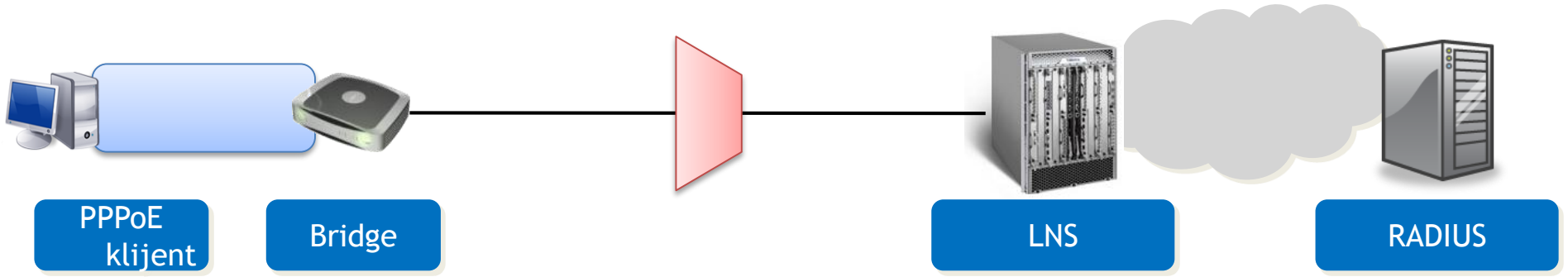
IPv6@PPK – dual-stack PPPoE – bridge mode (uspostava veze – korak 2)



PAP Authenticate-Ack

IPv6CP ConfReq
Interface-Id= *64-bit Interface ID/Client*

IPv6CP ConfAck
Interface-Id= *64-bit Interface ID/Client*

IPv6CP ConfReq
Interface-Id= *64-bit Interface ID/BNG*

IPv6CP ConfAck
Interface-Id= *64-bit Interface ID/Client*

PPP faza

RADIUS Accounting-Request
Start, User-Name, Service-Name VSA
Service-Type=Framed, Framed-Protocol=PPP

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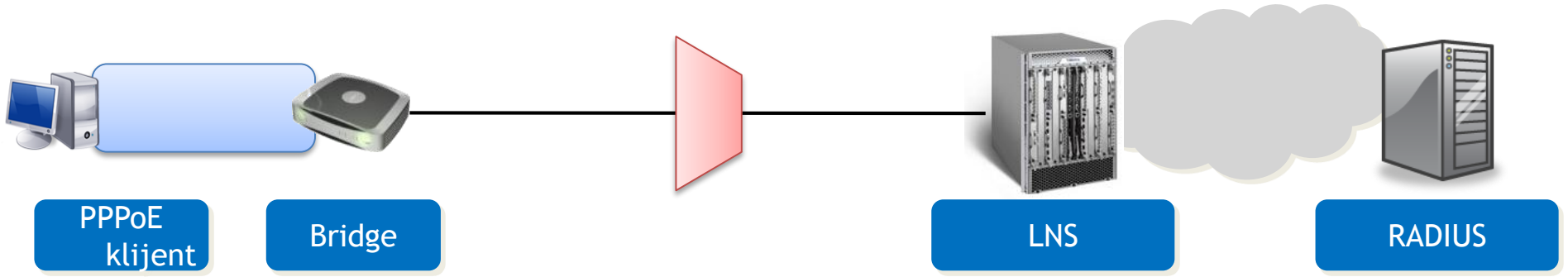
IPv6@PPK – dual-stack PPPoE – bridge mode (uspostava veze – korak 3)



Multicast Router Advertisement
M=0, O=1
Prefix Information Option: *from Framed-IPv6-Prefix*

DHCPv6 INFORMATION-REQUEST
DNS-Servers Option

DHCPv6 REPLY
DNS-Servers Option

Opcionalno DHCPv6 Stateless faza

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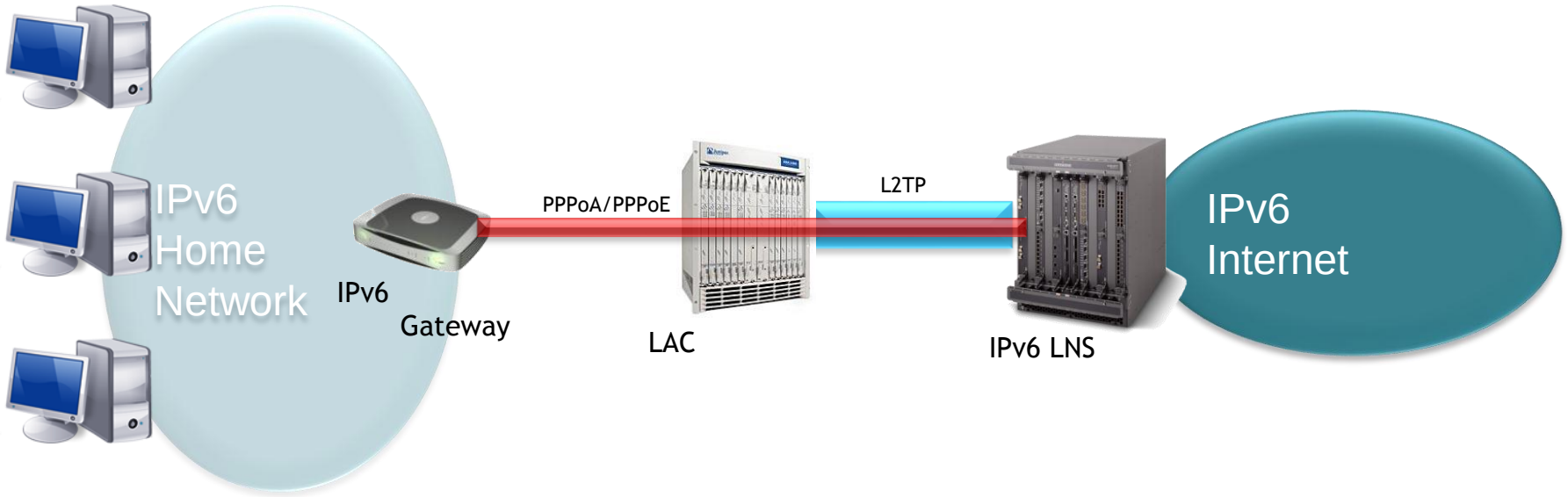
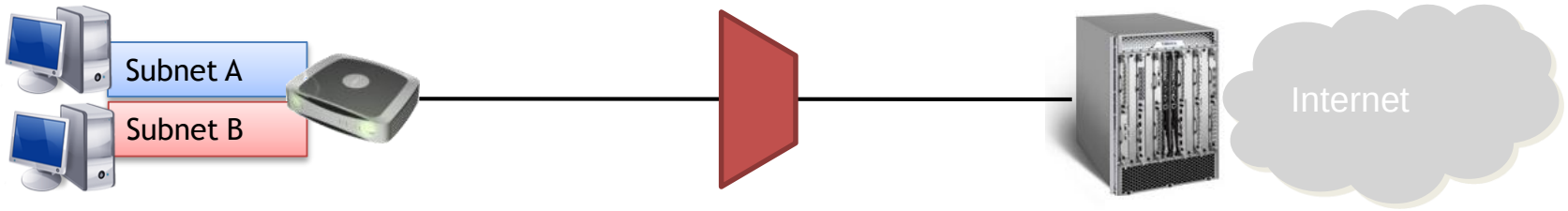
IPv6@PPK – dual-stack PPPoE – router mode



IPv6@PPK – dual-stack PPPoE – router mode



IPv4

NAT Function

UDP | TCP | TCP | UDP

Ethernet | Ethernet

RFC 2684

ATM

DSL

Ethernet | 802.1ad

Ethernet

802.3 PHY

IPv4

PPPoE

802.1ad

Ethernet

802.3 PHY

IPv6

Routing

IPv6

Ethernet | Ethernet

RFC 2684

ATM

DSL

Ethernet | 802.1ad

Ethernet

802.3 PHY

IPv6

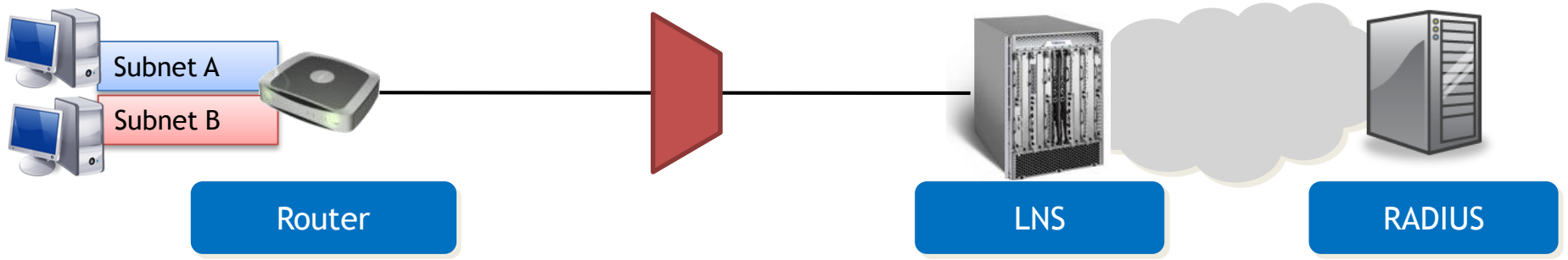
PPPoE

802.1ad

Ethernet

802.3 PHY

IPv6@PPK – dual-stack PPPoE – router mode (uspostava veze – korak 1)



PPPoE
PADI – PADO – PADR - PADS

PPP LCP ConfReq
ConfReq: MRU, Magic Number

PPP LCP ConfReq
ConfReq: MRU, Magic Number, Auth=PAP

PPP LCP ConfAck
ConfReq: MRU, Magic Number, Auth=PAP

PPP LCP ConfAck
ConfReq: MRU, Magic Number

PAP Authenticate-Request
Username (Peer-ID)+ Password

RADIUS Access-Request
User-Name, Password, Service-Name VSA
Service-Type=Framed, Framed-Protocol=PPP

RADIUS Access-Accept
Delegated-IPv6-Prefix, IPv6-DNS,
(IPv6-Address/Framed-IPv6-Pool)

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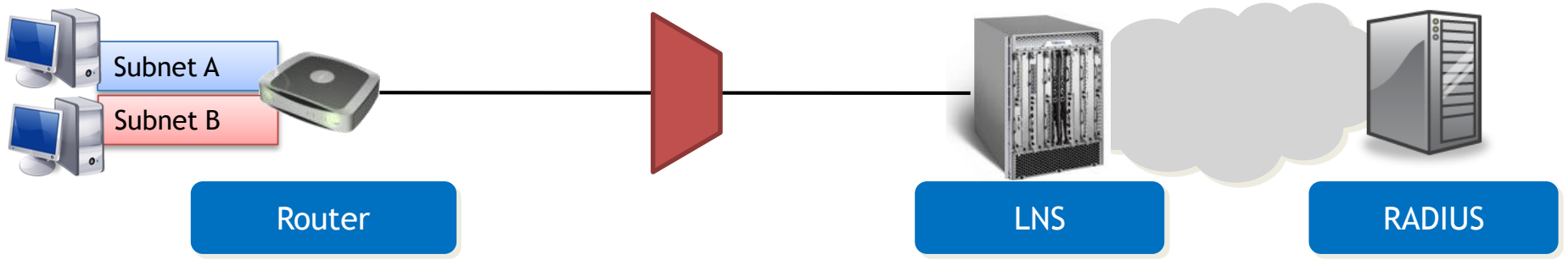
IPv6@PPK – dual-stack PPPoE – router mode (uspostava veze – korak 2)



PPP Phase

PAP Authenticate-Ack

IPv6CP ConfReq
Interface-Id= *64-bit Interface ID/Client*

IPv6CP ConfAck
Interface-Id= *64-bit Interface ID/Client*

IPv6CP ConfReq
Interface-Id= *64-bit Interface ID/BNG*

IPv6CP ConfAck
Interface-Id= *64-bit Interface ID/Client*

RADIUS Accounting-Request
Start, User-Name, Service-Name VSA
Service-Type=Framed, Framed-Protocol=PPP

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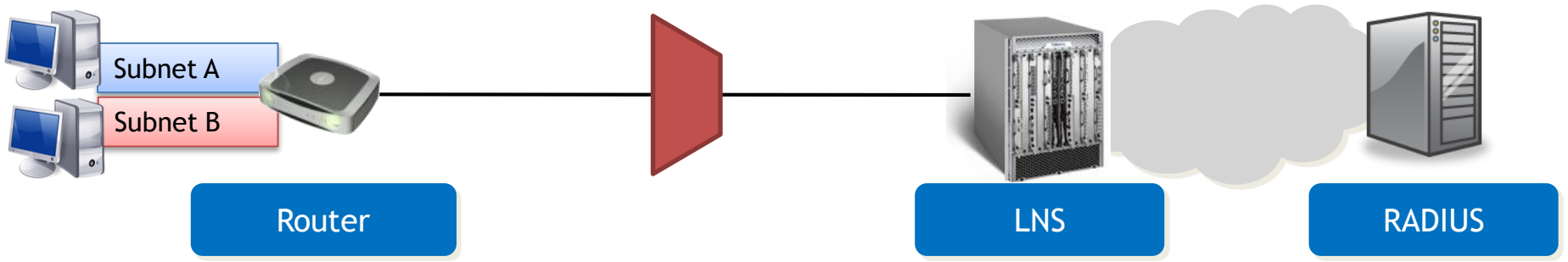
IPv6@PPK – dual-stack PPPoE – router mode (uspostava veze – korak 3)



Multicast Router Advertisement
Numbered: M=1,O=0, No PIO
Un-numbered: M=0, O=1, No PIO

DHCPv6 Phase

DHCPv6 SOLICIT
IA_PD-Option, (IA_NA-Option), DNS-Servers Option

DHCPv6 ADVERTISE
IA_PD-Option + Prefix, (IA_NA)

DHCPv6 REQUEST
IA_PD-Option, (IA_NA-Option), DNS-Servers Option

DHCPv6 REPLY
IA_PD-Option + Prefix, (IA_NA)

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IPv6@PPK - adresni plan (1)

Do **16** PPK usluga:

- Za pojedinu PPK uslugu osigurano je 2^20 ::/64 prefiksa (dovoljno za **1,048.576 pojedinačnih korisnika**)
- Korisnik u svakoj usluzi može dobiti 1x ::/64 i dodatan 1x ::/62 za lokalnu mrežu.

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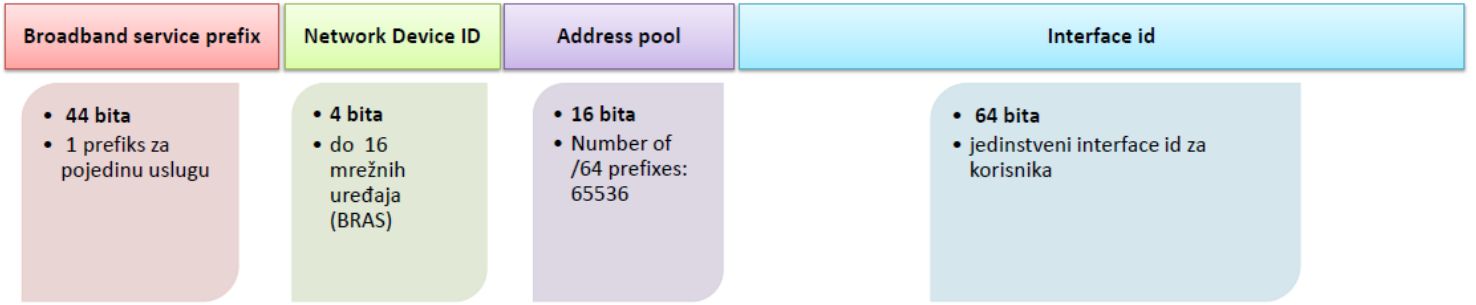
IPv6@PPK - adresni plan (2)

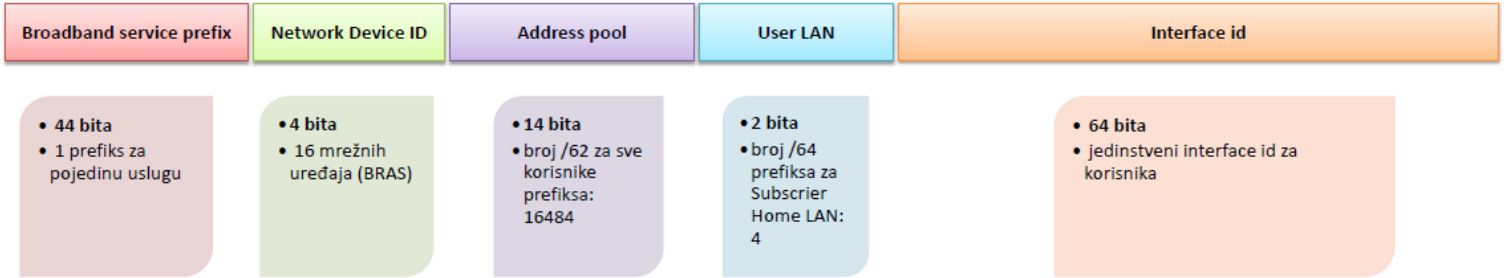
Korisnik sa jednim računalom (bridge mode):

- 1x /64 prefiks za PPP sesiju



Korisnik sa više računala u lokalnoj mreži i routerom:

- 1x /64 prefiks za PPP sesiju na WAN sučelju na routeru
- 1x /62 prefiks, odnosno 4x /64 prefiksa za LAN sučelja na routeru



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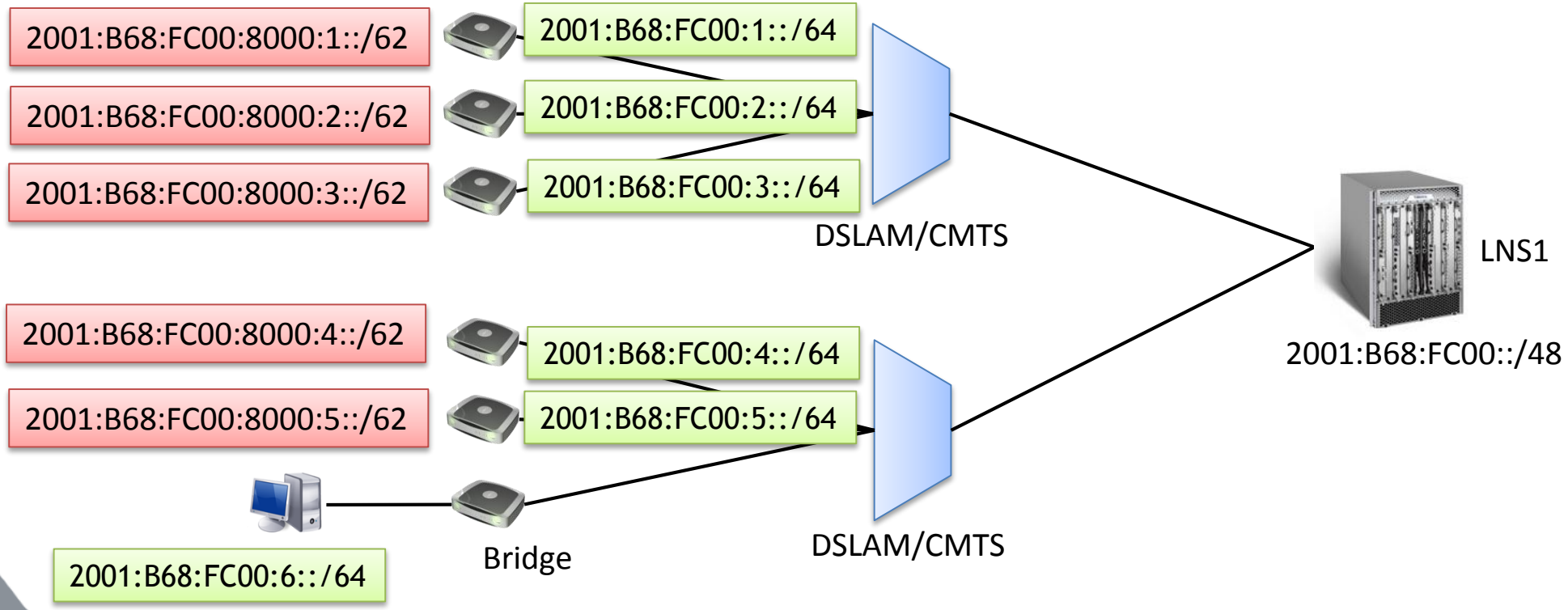
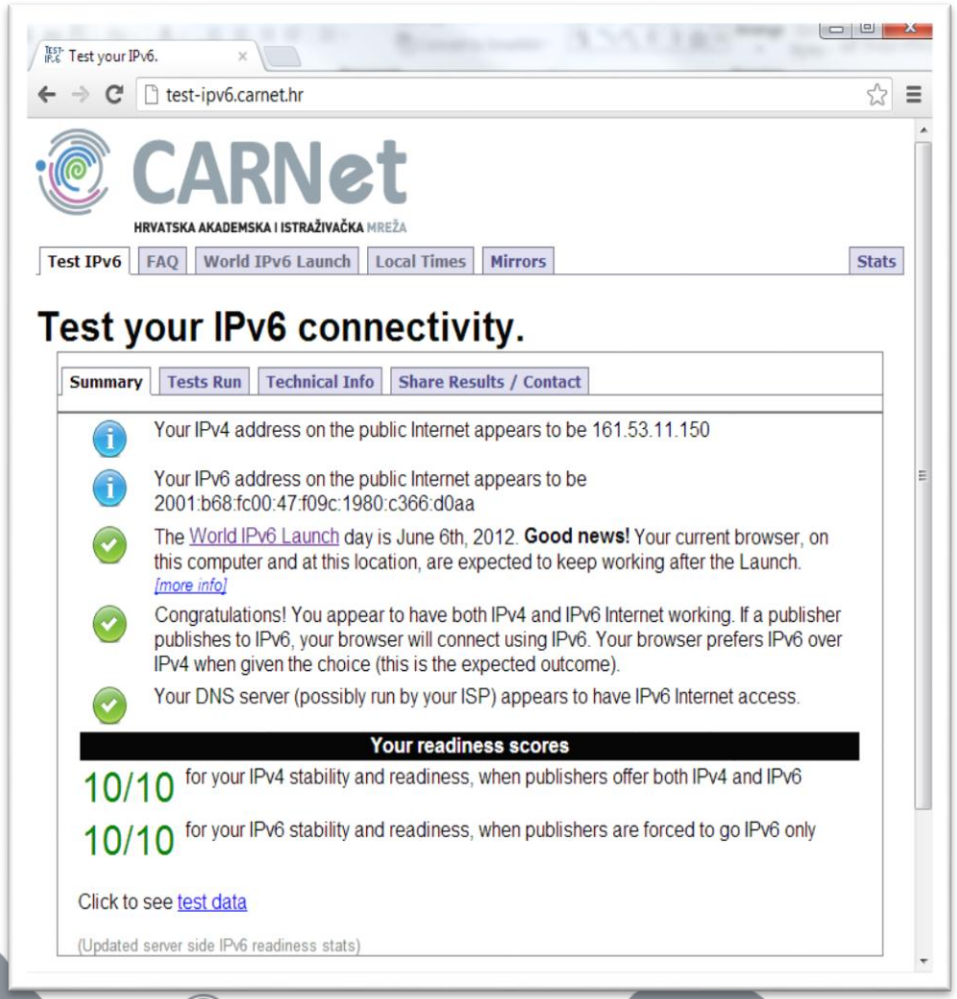
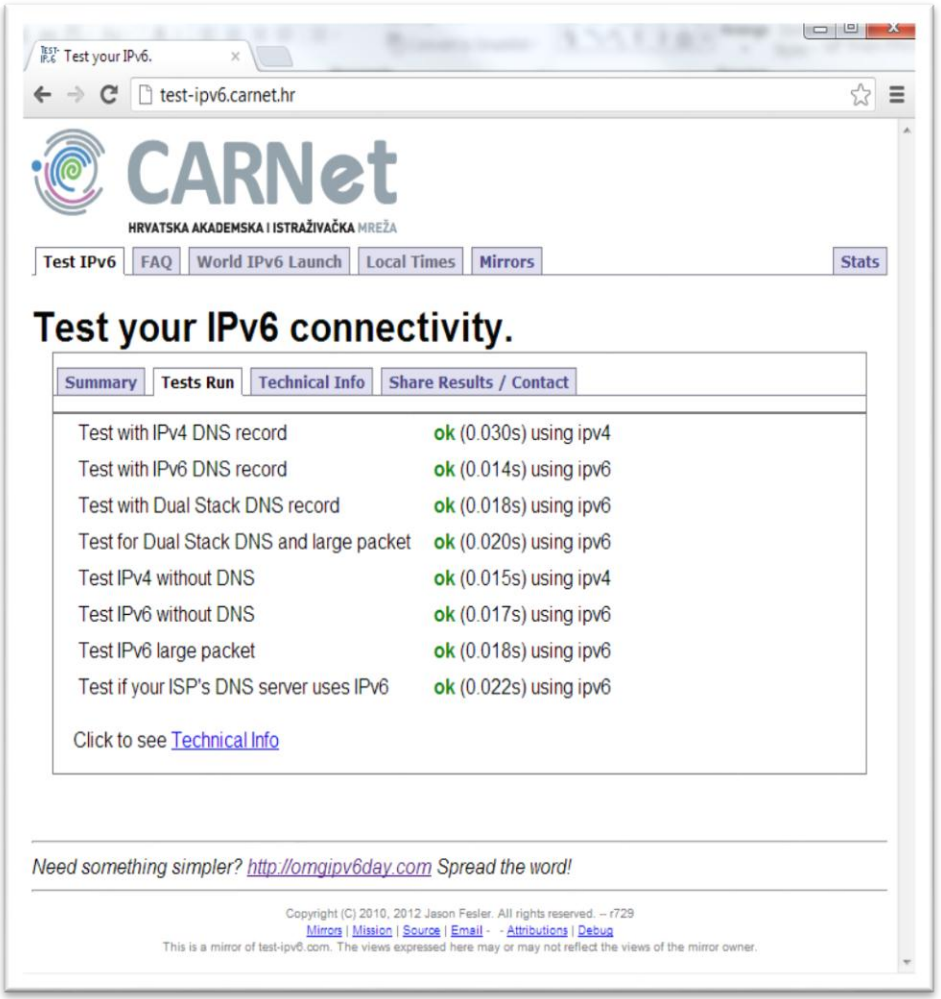
IPv6@PPK - adresni plan (3)

Primjer adresnog plana – usluga Duo.CARNet
IPv6 prefiks 2001:B68:FC00::/44



Testirajte IPv6 povezanost (http://test-ipv6.carnet.hr)





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Reference

- **[RFC 5375]** "IPv6 Unicast Address Assignment Considerations", G. Van de Velde, C. Popoviciu, T. Chown, O. Bonness, C. Hahn, prosinac 2008, http://tools.ietf.org/html/rfc5375
- [**Broadband Forum Technical Report 242 Issue 1]** "IPv6 Transition Mechanisms for Broadband Networks", Hanrahan M., Ooghe S., D. Thorne, Allan D., Cheng D., Wright S., kolovoz 2012., http://goo.gl/kk2H5
- [**Broadband Forum Technical Report 187 Issue 1]** "IPv6 for PPP Broadband Access", Hanrahan M., Ooghe S., D. Thorne, Allan D., Miles D., Townsley M., Maglione R., svibanj 2010., http://goo.gl/bbNvr

Hvala na pažnji ☺

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Pitanja ☺