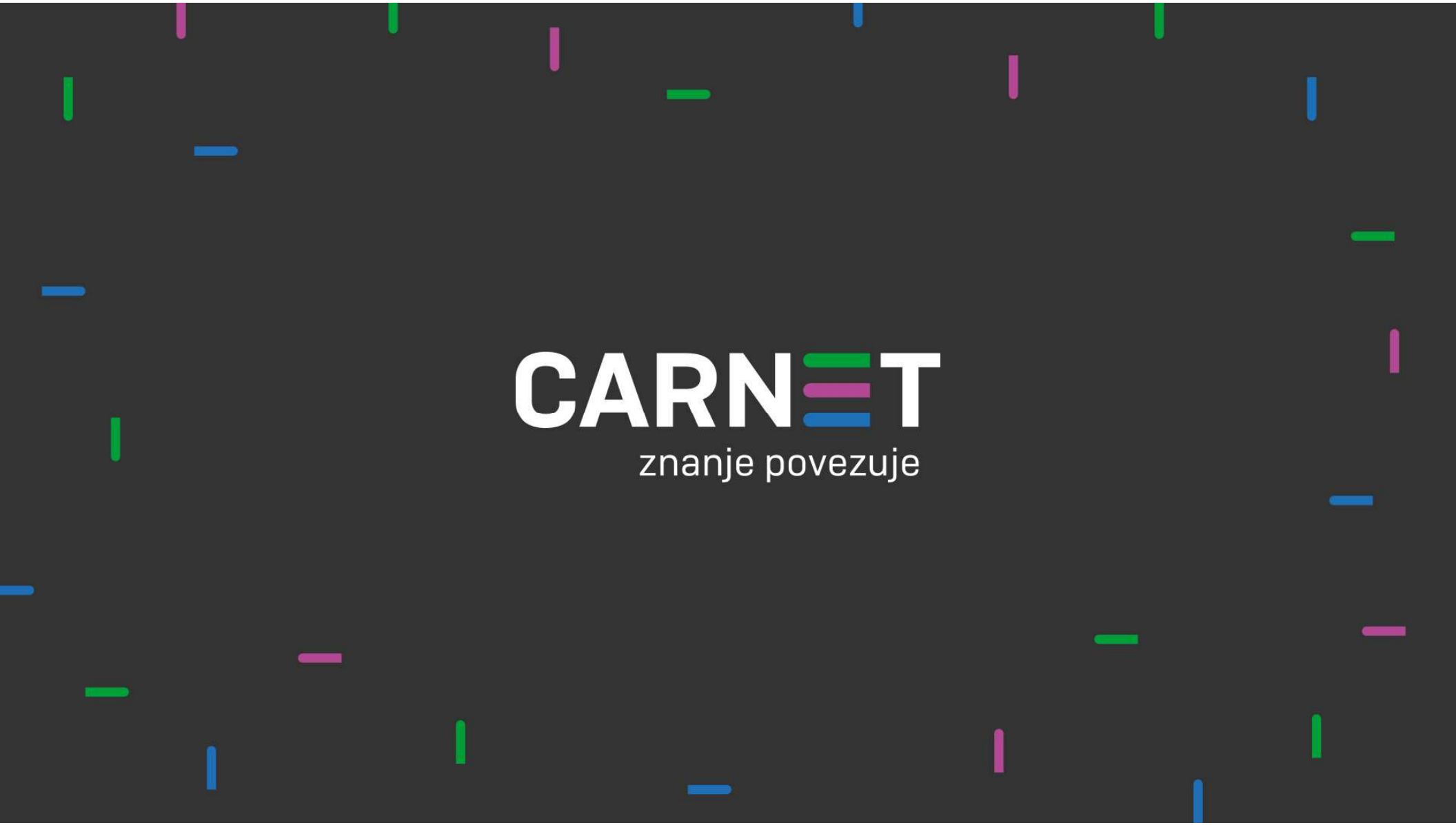
CARNET
znanje povezuje

Multikast usluga u mrežama telekom operatera

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Voditelj NOC službe
Odjel Mrežne infrastrukture

CARNET
znanje povezuje

Agenda:

- Što je multikast i zašto se koristi?
- Sparse vs. Dense (PIM-SM/SSM vs. PIM-DM)
- Multikast usluga u CARNET i Geant mrezi
- Sigurnosni problemi i IPv6 multikast u mrežama
- Pitanja i odgovori

Multikast (općenito)

- Proširenje osnovne IP usluge
- Koristi UDP protokol na transportnom sloju
- Adresni prostor (224.0.0.0 do 239.255.255.255): → Odredišna adresa
  - 224.0.0.0 – 224.0.0.255 -> rezervirano (npr. RIP, OSPF…)
  - 224.0.1.0 – 238.255.255.255 -> Globalno
    - 232.0.0.0-232.255.255.255 -> SSM (Source Specific Multicast)
    - 233.X.Y.0/24 -> GLOP Block (X,Z – AS broj, CARNET (AS: 2108): 233.**8**.**60**.0/24)
  - 239.0.0.0 – 239.255.255.255 -> local block (LAN)

IP adrese	Rezervirano za:
224.0.0.1	**Svi sustavi u subnetu**
224.0.0.2	**Svi usmjeritelji u subnetu**
224.0.0.4	DVMRP usmjeritelji
224.0.0.5 - 224.0.0.6	**OSPF usmjeritelji**
224.0.0.9	Usmjerivači sa podignutim RIPv2 routing protokolom
224.0.0.13	**Svi PIM usmjerivači**
224.0.1.2	SGI-Dogfight (računalna igra)
224.0.1.39	cisco-rp-announce (objava rendezvous pointa)
224.0.1.40	cisco-rp-discovery (utvrđivanje tj. traženje rendezvous pointa)
224.0.18.0-224.0.18.255	Dow Jones
224.0.19.0-224.0.19.63	Walt Disney Company

Cijeli popis na: https://www.iana.org/assignments/multicast-addresses/multicast-addresses.xhtml

Tipovi usmjeravanja multikast prometa

- Tipovi/metode multikast usmjeravanja:
  - DVMRP – koristio se u testnoj MBONE mreži (1990 godine)
    - Radi paralelnu usmjerivačku tablicu sa postojećim usmjeriteljskim protokolom (2xCPU)
  - PIM - Protocol Independent Multicast
    - Ne gradi zasebnu usmjerivačku tablicu
    - Za usmjeravanje paketa koristi usmjerivačku tablicu usmjeritelja (i koristi RPF da spriječi petlju)

Dense mod vs. Sparse mod (u mrežama operatera)

- PIM metode:
  - PIM-DM – koriste ga (gotovo) SVI komercijalni telekomi koji pružaju uslugu IPTV
  - PIM-SM, PIM-SSM – primarno ga koriste akademske i istraživalačke mreže (i neki telekom operateri)

PIM Dense Mod	PIM Sparse Mod
Kako radi:	
Usmjeravanje se radi prema najboljem putu do odredišta	Gradi se stablo usmjeravanja (RP)
Koristi "flood-and-prune" - poplava (htio ili ne htio)	Usmjetitelji se dodaju u stablo samo ako ima primatelja na njima
Koristi RFP	Koristi RFP
Kada se koristi:	
Znamo gdje je izvor podataka (S,G)	Ne znamo gdje je izvor podataka (*,G)
Limitirani broj izvora podataka	Želimo znati (i kontrolirati) gdje je izvor podataka
Jako, jako veliki broj primatelja	Veliki broj primatelja
Želimo da mreža brzo konvergira	Konvergencija mreže je sporija (potrebna redundancija)
Jednostavno za implementirati	Zahtjeva dobar desing mreže i odabir usmjeritelja za RP
Implementira se unutar LAN ili VLAN mreža	Implementira se u WAN/MAN mrežama

Dense mod primjer (1)

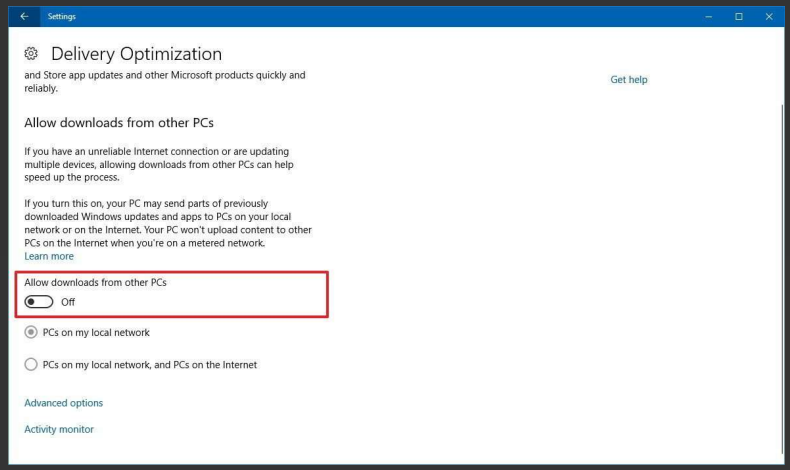
- Pružatelji IPTV usluge:
  - Kabelski operateri
  - Optički operateri
  - Svaki kanal ima svoju multikast grupu
  - Kod kuće imam mrežni usmjeritelj od operatera (Switch, VDSL, cable modem…)
  - TV kanali putuju istim VLANom

- Neimenovani pružatelji digitalne televizije (IPTV) prenosi EURO 2021:
  - 1 streaming server (*'može biti i dobar laptop'*)
  - Od 4 milijuna 2 milijuna gledatelja prima multikast promet (ostalih 50% gleda preko antene DVB-T2)
  - 10% ljudi u '.hr' ne gleda (ili prate druge kanale)…

Nedjelja, 13.6.2021, 15:00
Engleska : Hrvatska

Dense mod primjer (2)

- Windows update
  - Kumulativna nadogradnja (100MB – 3,5 GB)
  - Background Intelligent Transfer service (BITS)
  - HTTP/HTTPS download sa CDNa
  - Ako je netko skinuo unutar LANa cijeli ‘update’ -> multikast dijeljenje u pozadini unutar LANa (Allow downloads from other PCs)
- My Network - 239.255.255.250 ili ff0X::c
- Windows domena
  - multicast DNS (mDNS) - 224.0.0.251
  - Link-Local Multicast Name Resolution (LLMNR) - 224.0.0.252

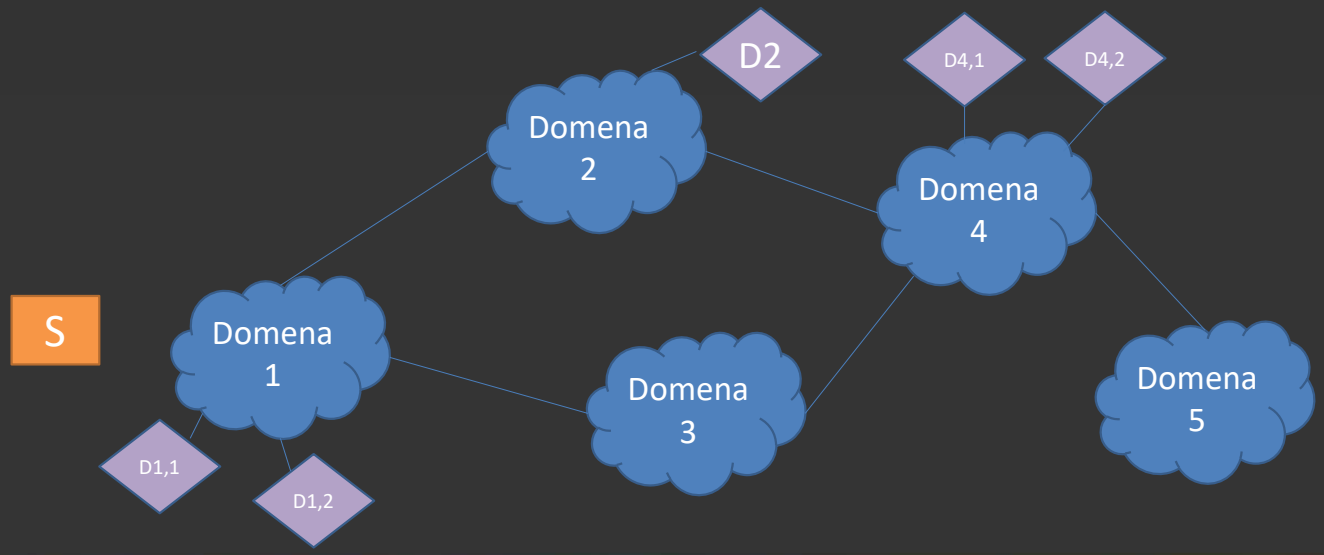


Multikast mod rada – Sparse mod (1)

- Prijenos ili primanje podataka:
  - WAN/MAN mreže
  - Između različitih administrativnih domena

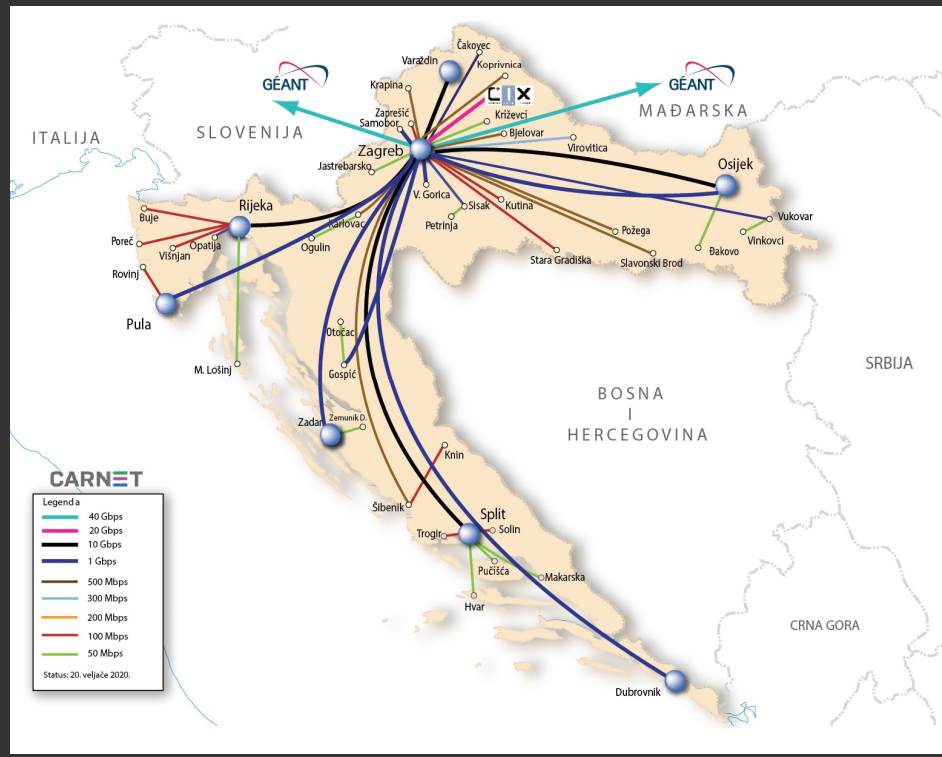
S G

Gdje je RP?



CARNET mreža

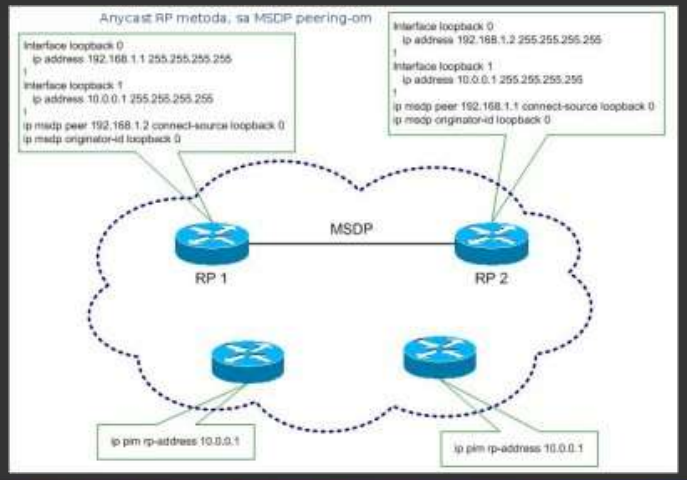
- Hrvatska akademska i istraživačka mreža – CARNET
  - Privatna mreža .hr akademske zajednice
    - Spaja sve fakultete, škole, institute
    - Sve bolnice i domove zdravlja
    - Vladine agencije (VladaRH, MZO, MINGOR, MROSP, HZMO, HZZO)
  - ~ 5000 spojenih lokacija
  - ~ 3500 mrežnih usmjeritelja
  - ~ 750.000 korisnika iz akademske zajednice
  - Top .hr domena
  - Nacionalni CERT

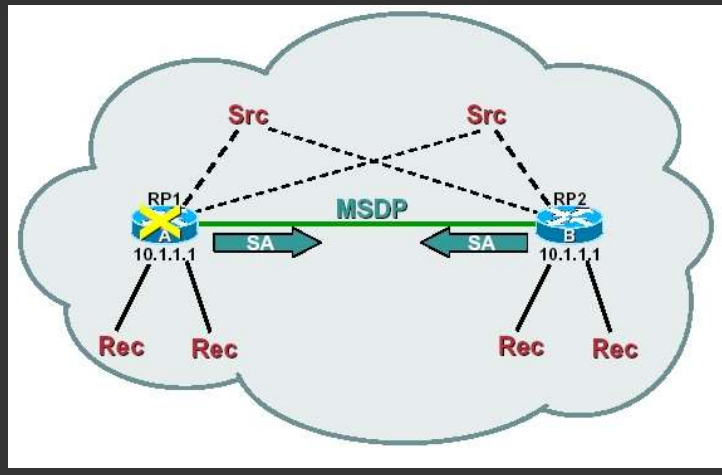


Multikast u CARNET mreži (1)

- PIM-SM
- AnycastRP – redundancija RP i ‘load balancing’
- MSDP peering (Multicast Source Discovery Protocol)
- 4x RP (Zagreb, Osijek, Split, Rijeka)

Multikast blok:	Svrha:
233.8.60.0/24	GLOP blok - izlaz iz CARNET mreže
239.192.0.0/14	Unutar CARNET mreže
239.255.0.0/16	Unutar LANa - ne propušta se u CARNET mrežu





Multikast u CARNET mreži (2)

Konfiguracija RPa:

ip multicast-routing

interface Loopback0
ip address cn-srce-ro
ip pim sparse-mode

interface Loopback1
ip address <RP IP adresa> 255.255.255.255
ip pim sparse-mode

interface <interface name>
ip address <address> <mask>
ip pim sparse-mode

ip pim rp-address <RP IP adresa>

ip msdp peer cn-unios-ro connect-source Loopback0
ip msdp mesh-group anycast cn-unios-ro
ip msdp originator-id Loopback0

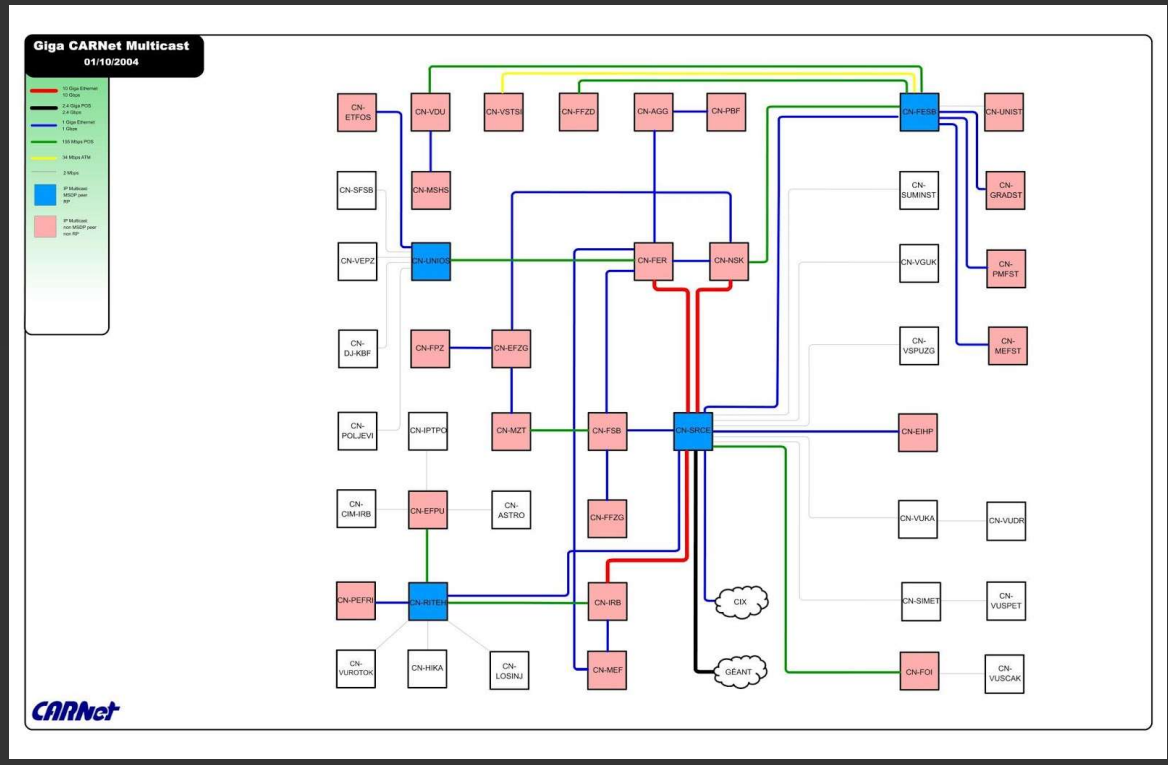
Svi ostali:

ip multicast-routing

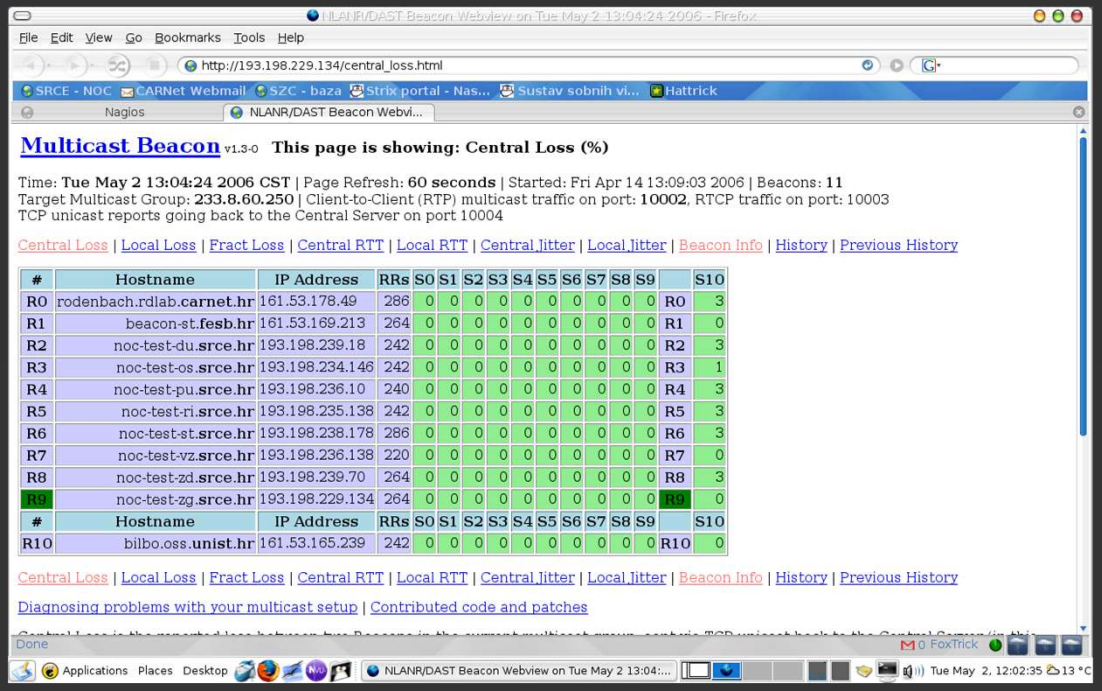
interface Loopback0
ip address cn-fesb-ro
ip pim sparse-mode

interface <interface name>
ip address <address> <mask>
ip pim sparse-mode

ip pim rp-address <RP IP adresa>



Nadzor multikast usluge u CARNET mreži



Multicast Beacon v1.3-0 **This page is showing: Central Loss (%)**

Time: **Tue May 2 13:04:24 2006 CST** | Page Refresh: **60 seconds** | Started: Fri Apr 14 13:09:03 2006 | Beacons: **11**
Target Multicast Group: **233.8.60.250** | Client-to-Client (RTP) multicast traffic on port: **10002**, RTCP traffic on port: 10003
TCP unicast reports going back to the Central Server on port 10004

Central Loss | Local Loss | Fract Loss | Central RTT | Local RTT | Central Jitter | Local Jitter | Beacon Info | History | Previous History

#	Hostname	IP Address	RRs	S0	S1	S2	S3	S4	S5	S6	S7	S8	S9		S10
R0	rodenbach.rdlab.carnet.hr	161.53.178.49	286	0	0	0	0	0	0	0	0	0	R0	3
R1	beacon-st.fesb.hr	161.53.169.213	264	0	0	0	0	0	0	0	0	0	R1	0
R2	noc-test-du.srce.hr	193.198.239.18	242	0	0	0	0	0	0	0	0	0	R2	3
R3	noc-test-os.srce.hr	193.198.234.146	242	0	0	0	0	0	0	0	0	0	R3	1
R4	noc-test-pu.srce.hr	193.198.236.10	240	0	0	0	0	0	0	0	0	0	R4	3
R5	noc-test-ri.srce.hr	193.198.235.138	242	0	0	0	0	0	0	0	0	0	R5	3
R6	noc-test-st.srce.hr	193.198.238.178	286	0	0	0	0	0	0	0	0	0	R6	3
R7	noc-test-vz.srce.hr	193.198.236.138	220	0	0	0	0	0	0	0	0	0	R7	0
R8	noc-test-zd.srce.hr	193.198.239.70	264	0	0	0	0	0	0	0	0	0	R8	3
R9	noc-test-zg.srce.hr	193.198.229.134	264	0	0	0	0	0	0	0	0	0	R9	0
#	Hostname	IP Address	RRs	S0	S1	S2	S3	S4	S5	S6	S7	S8	S9		S10
R10	bilbo.oss.unist.hr	161.53.165.239	242	0	0	0	0	0	0	0	0	0	R10	0

Central Loss | Local Loss | Fract Loss | Central RTT | Local RTT | Central Jitter | Local Jitter | Beacon Info | History | Previous History

Diagnosing problems with your multicast setup | Contributed code and patches

Multicast beacon (G: 233.8.60.250)

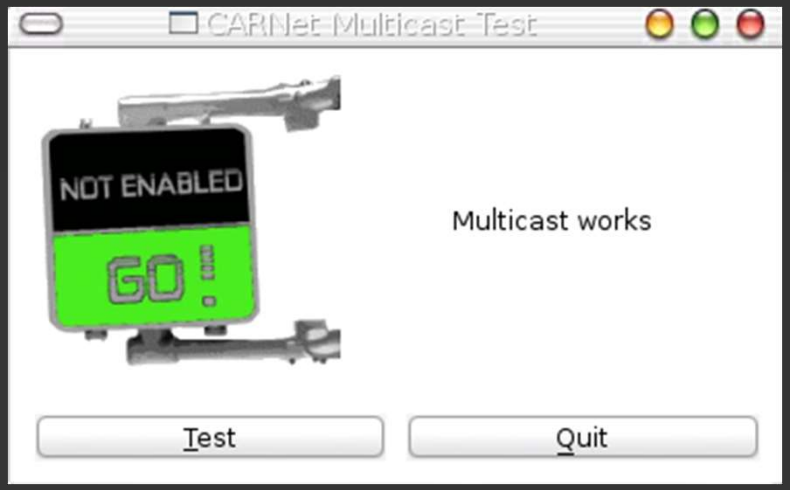
Multicast | Pregled RPs-a | Multicast grupe | **Multicast grupe (history)** | Status MSDP susjeda | Multicast topologija

Group	Source		Date/Time		Date/Time
239.192.31.11	161.53.178.36		08.04.2005 01:00:37		15.04.2005 07:51:03
239.192.31.11	0.0.0.0		08.04.2005 01:00:37		17.06.2005 06:42:13
239.192.31.11	161.53.159.24		08.04.2005 01:00:37		15.04.2005 07:51:03
239.192.31.11	161.53.160.91		08.04.2005 01:00:37		15.04.2005 07:51:03
239.192.31.11	161.53.30.15		08.04.2005 01:00:37		18.04.2005 02:33:03
239.192.31.11	161.53.159.248		08.04.2005 01:00:37		15.04.2005 07:51:03
239.192.58.47	0.0.0.0		11.04.2005 08:45:08		11.04.2005 08:57:03
239.192.33.110	0.0.0.0		18.04.2005 02:33:03		18.04.2005 02:42:03
239.193.178.2	0.0.0.0		18.04.2005 02:33:03		20.04.2005 11:42:03
239.193.178.1	0.0.0.0		18.04.2005 02:33:03		20.04.2005 11:42:03
239.193.178.4	0.0.0.0		18.04.2005 02:33:03		20.04.2005 11:42:03
224.0.1.40	0.0.0.0		28.04.2005 12:36:03		11.11.2005 01:45:44
239.192.59.237	0.0.0.0		05.05.2005 07:00:07		05.05.2005 07:03:03
239.192.6.190	0.0.0.0		05.05.2005 07:36:03		05.05.2005 07:39:03
239.193.178.1	161.53.178.50		28.05.2005 03:18:04		28.05.2005 03:21:03
239.193.178.4	161.53.178.50		28.05.2005 03:18:04		28.05.2005 03:21:03
239.193.178.2	161.53.178.50		28.05.2005 03:18:04		28.05.2005 03:21:03
239.192.63.5	0.0.0.0		13.06.2005 12:45:07		13.06.2005 12:48:03
239.192.8.130	0.0.0.0		08.11.2005 03:51:03		08.11.2005 03:54:03
239.192.9.140	0.0.0.0		08.11.2005 04:18:02		08.11.2005 04:21:04
239.192.10.7	0.0.0.0		08.11.2005 04:30:13		08.11.2005 04:36:03
239.192.1.0	0.0.0.0		10.11.2005 03:54:03		10.11.2005 03:57:03
239.192.57.162	0.0.0.0		10.11.2005 04:00:09		10.11.2005 04:03:04
233.8.60.250	0.0.0.0		10.11.2005 04:06:03		08.04.2006 09:33:03
233.8.60.250	193.198.238.178		10.11.2005 04:12:03		11.11.2005 01:45:44
233.8.60.250	193.198.229.134		10.11.2005 04:12:03		11.11.2005 01:45:44
233.8.60.250	193.198.235.138		10.11.2005 04:39:04		11.11.2005 01:45:44
233.8.60.250	161.53.178.49		10.11.2005 06:12:04		13.11.2005 09:51:04
233.8.60.250	161.53.30.15		12.11.2005 05:33:04		17.11.2005 10:24:03

SNMP multicast table

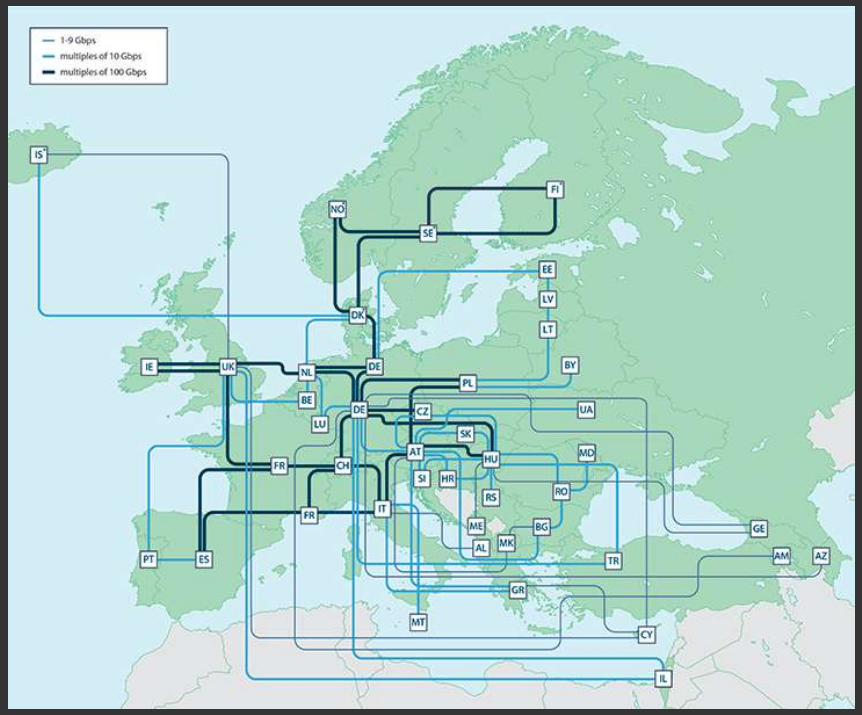
Multikast detektiv

- Da li se mogu spojiti na beacon grupu 233.8.60.250?
  - Alat više nije javno dostupan



Multikast u Geant mreži (1)

- Geant mreža spaja:
  - Sve akademske mreže u Europi
  - CERN
  - EUROATOM
  - ESA…
- CARNET spoj: 2x40Gbit/s
- CARNET djelatnici sudjeluju unutar GEANT projekta (nadogradnja mreže, razvoj nadzornih alata, OAV…)

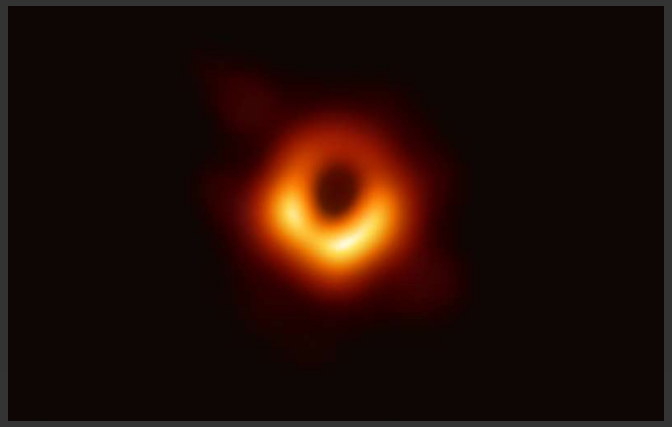


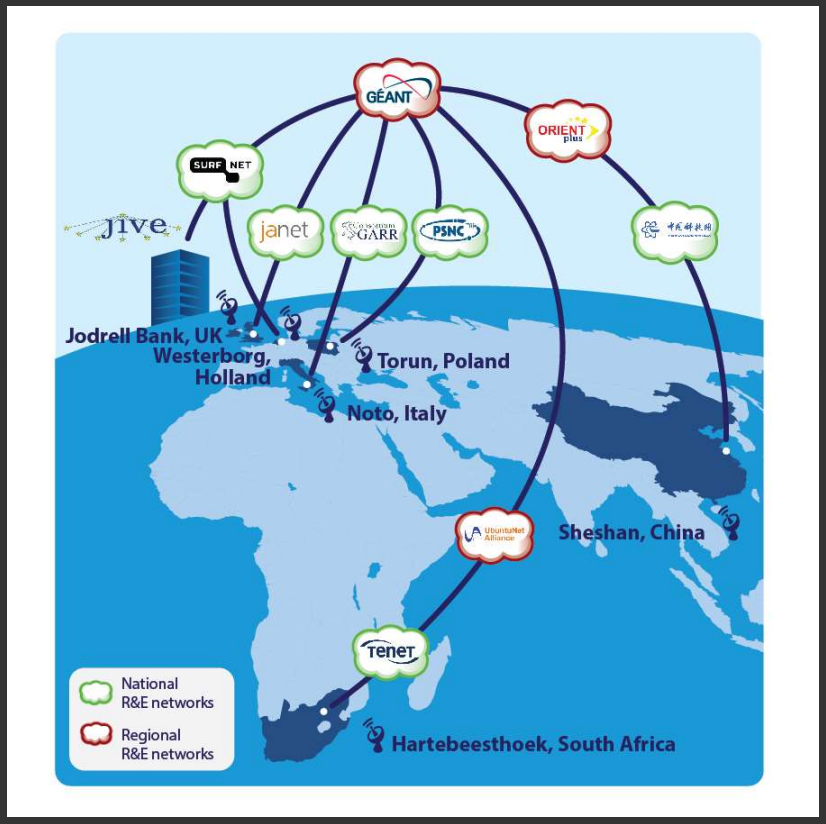
https://map.geant.org/

Multikast u Geant mreži (2)

- Istraživački centri generiraju veliku količinu podataka (BIG Data)
- Multikast projekti:
  - EDUMED (slanje vremenskih satelitskih karti - DHMZ)
  - Astronomi (atomski satovi sinkronizacija, slanje nekompresiranih radio slika za obradu)
  - NGI Grid (povezana super računala – SRCE/600 procesorskih jezgri i 150 TB podatkovnog spremišta)
  - Projekt LOLA (low latency multicast service)…

Multikast u Geant mreži (3)





Sigurnosni problemi multikast usmjeravanja

- DDoS napadi
  - Volumetrijski (npr. generiranje 500Mbit/s prometa na neku grupu)
  - Flood attack – SAP storm kod PIM-SSM

- Jako je važno znati tko je izvor podataka (S,G) – *RP filtering*
- Pridržavati se adresnog plana (promet se inače 'DROP'-a)
- U CARNET mreži je mali broj korisnika multikast prometa (kojima je ista omogućena usluga), ali generiraju velike količine podatka, pa smo sigurni…

IPv6 multikast

- Koristi se kao i IPv6
  - U svijetu je manjak IPv4 adresa
- MLD, PIM-SSM, IGMPv3
- CARNET ima implementiranu IPV6 mrežu ali ne i IPv6 multikast mrežu (*nema zahtjeva*)

PITANJA?

Damir Regvart (damir.regvart@carnet.hr)

CARNET
znanje povezuje

Genetiranje multikast sadržaja @home (1)

https://peakdrive.com/how-to-use-vlc-media-player-to-stream-multicast-video/

VLC settings:

1. In the Media menu, choose “Stream”

2. In the Open Media dialog file tab, click “add” and choose the file or device you want to stream and click “Open”

3. At the bottom, click the “Stream” button

4. This opens the “Stream Output” dialog showing the source file you have chosen. Click Next to set destination.

5. In “Destinations”, choose “RTP /MPEG Transport Stream” and click the “Add” button

6. In the “Address” box, enter the required multicast address (enpr. 239.255.0.1) and set the port (or leave default at 5004)

7. In transcoding options, choose the appropriate settings for your video and PC’s codecs

8. Once the options are set, click “Save”. Then click Next for “Option Setup” and select “Stream all elementary streams” then click stream.

Genetiranje multikast sadržaja @home (2)

To view the stream, open another instance of VLC media player (try it on the same PC before trying it over the network)

1. Choose Media/Open Network Stream

2. In address, enter rtp://@239.255.0.1:5004 – choose the correct address and port you entered when setting up the stream. Don't forget to enter the "@" symbol after "rtp://" and before the multicast ip address!

3. Click "Play"