ARNES

Praktični vidiki upravljanja

Avgust Jauk,
Arnes, p.p. 7, SI - 1001 Ljubljana

Ljubljana, 3.12.2013

VSEBINA

- Izobraževalno/raziskovalna omrežja
- Omrežje ARNES
- Upravljanje omrežja ARNES
  - Kaj upravljati
  - Orodja
  - Varnost
- Diagnosticiranje

Izobraževalno/raziskovalna omrežja

- Namen
  - Kakovostne, inovativne TK storitve za R&I
  - Podpora mobilnosti
    - “Neodvisnost” od lokacije in časa
    - Študentje, profesorji, raziskovalci
  - Razvoj novih storitev
- Zaprta skupino uporabnikov

Storitve (Arnes)

- Povezljivost: IPv4, IPv6, multicast, namenske povezave
- Mobilnost: ArnesAAI, Eduroam
- Multimedija: videokonference H.232/SIP, spletne konference VOX, pretočni video, VoD
- Gostovanje:
  - e-pošta, CMS, LMS, virtualni strežniki, blog
  - Arnes oblak, Arnes shramba
- NGI: Nacionalna Grid Iniciativa
- Varnost: Si-Cert, digitalna strežniška potrdila
- Filesender, Planer, NTP, FTP, usenet news, IRC, …
- SIX, registracija domen .SI + DNS
- Podpora uporabnikom, izobraževanje, konference
- Razvoj (mednarodno sodelovanje!)

Storitve (Arnes) – za posameznike

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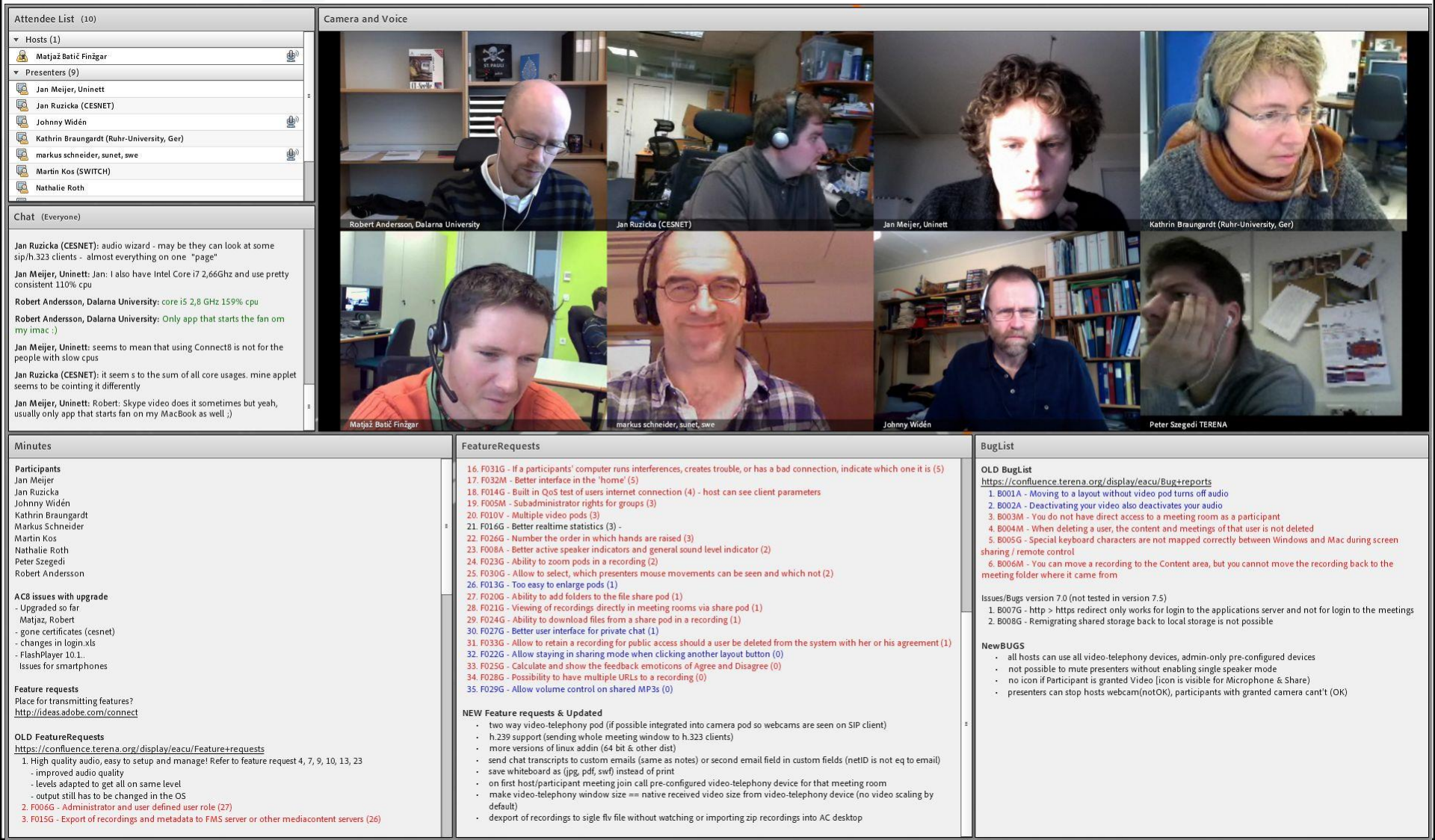
Spletne konference - VOX



Minutes

Participants
Jan Meijer
Jan Ruzicka
Johnny Widén
Kathrin Braungardt
Markus Schneider
Martin Kos
Nathalie Roth
Peter Szegedi
Robert Andersson

AC8 issues with upgrade
- Upgraded so far
  Matjaz, Robert
- gone certificates (cesnet)
- changes in login.xls
- FlashPlayer 10.1..
  Issues for smartphones

Feature requests
Place for transmitting features?
http://ideas.adobe.com/connect

OLD FeatureRequests
https://confluence.terena.org/display/eacu/Feature+requests
1. High quality audio, easy to setup and manage! Refer to feature request 4, 7, 9, 10, 13, 23
   - improved audio quality
   - levels adapted to get all on same level
   - output still has to be changed in the OS
2. F006G - Administrator and user defined user role (27)
3. F015G - Export of recordings and metadata to FMS server or other mediacontent servers (26)

FeatureRequests

16. F031G - If a participants' computer runs interferences, creates trouble, or has a bad connection, indicate which one it is (5)
17. F032M - Better interface in the 'home' (5)
18. F014G - Built in QoS test of users internet connection (4) - host can see client parameters
19. F005M - Subadministrator rights for groups (3)
20. F010V - Multiple video pods (3)
21. F016G - Better realtime statistics (3) -
22. F026G - Number the order in which hands are raised (3)
23. F008A - Better active speaker indicators and general sound level indicator (2)
24. F023G - Ability to zoom pods in a recording (2)
25. F030G - Allow to select, which presenters mouse movements can be seen and which not (2)
26. F013G - Too easy to enlarge pods (1)
27. F020G - Ability to add folders to the file share pod (1)
28. F021G - Viewing of recordings directly in meeting rooms via share pod (1)
29. F024G - Ability to download files from a share pod in a recording (1)
30. F027G - Better user interface for private chat (1)
31. F033G - Allow to retain a recording for public access should a user be deleted from the system with her or his agreement (1)
32. F022G - Allow staying in sharing mode when clicking another layout button (0)
33. F025G - Calculate and show the feedback emoticons of Agree and Disagree (0)
34. F028G - Possibility to have multiple URLs to a recording (0)
35. F029G - Allow volume control on shared MP3s (0)

NEW Feature requests & Updated
- two way video-telephony pod (if possible integrated into camera pod so webcams are seen on SIP client)
- h.239 support (sending whole meeting window to h.323 clients)
- more versions of linux addin (64 bit & other dist)
- send chat transcripts to custom emails (same as notes) or second email field in custom fields (netID is not eq to email)
- save whiteboard as (jpg, pdf, swf) instead of print
- on first host/participant meeting join call pre-configured video-telephony device for that meeting room
- make video-telephony window size == native received video size from video-telephony device (no video scaling by default)
- dexport of recordings to sigle flv file without watching or importing zip recordings into AC desktop

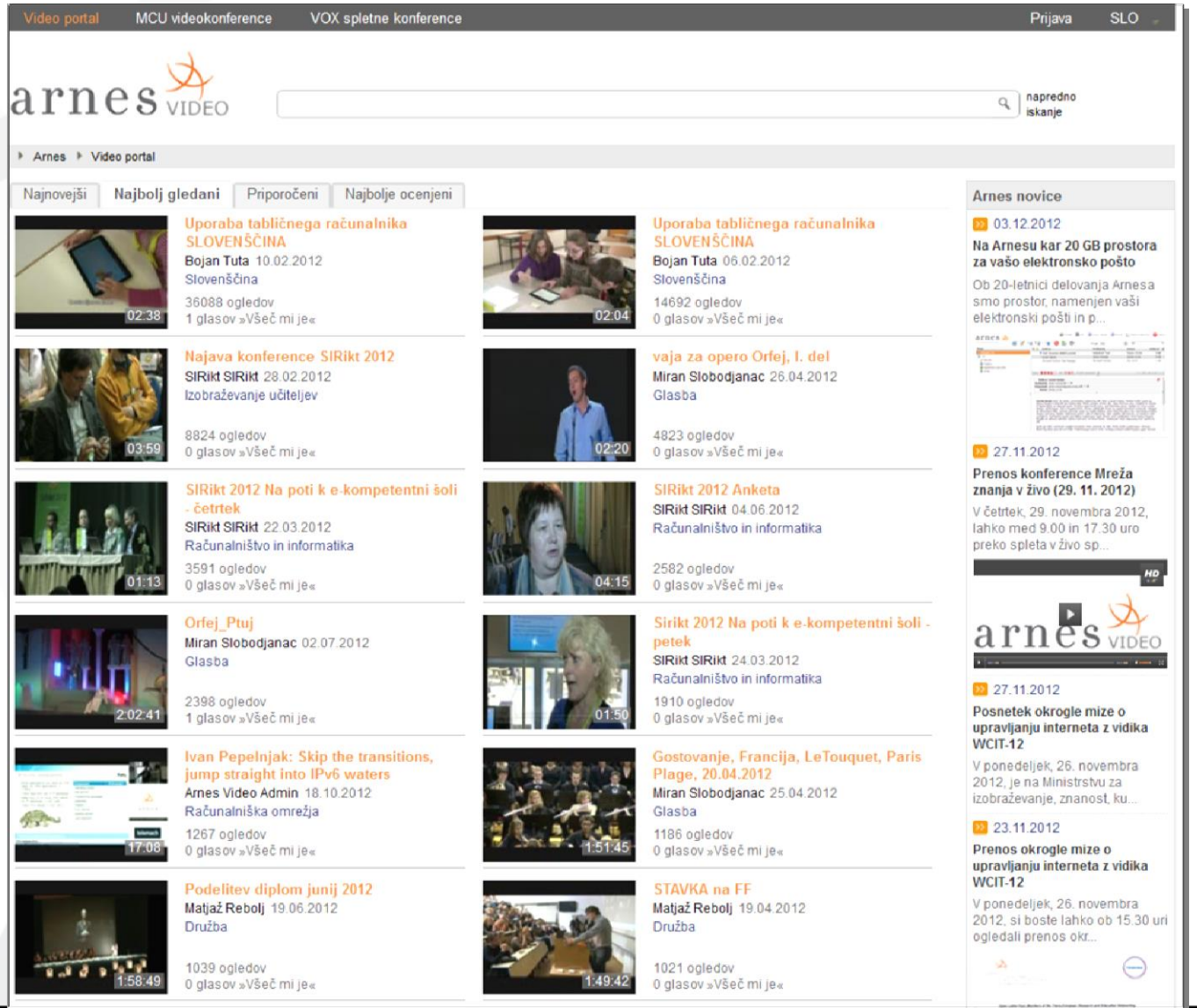
BugList

OLD BugList
https://confluence.terena.org/display/eacu/Bug+reports
1. B001A - Moving to a layout without video pod turns off audio
2. B002A - Deactivating your video also deactivates your audio
3. B003M - You do not have direct access to a meeting room as a participant
4. B004M - When deleting a user, the content and meetings of that user is not deleted
5. B005G - Special keyboard characters are not mapped correctly between Windows and Mac during screen sharing / remote control
6. B006M - You can move a recording to the Content area, but you cannot move the recording back to the meeting folder where it came from

Issues/Bugs version 7.0 (not tested in version 7.5)
1. B007G - http > https redirect only works for login to the applications server and not for login to the meetings
2. B008G - Remigrating shared storage back to local storage is not possible

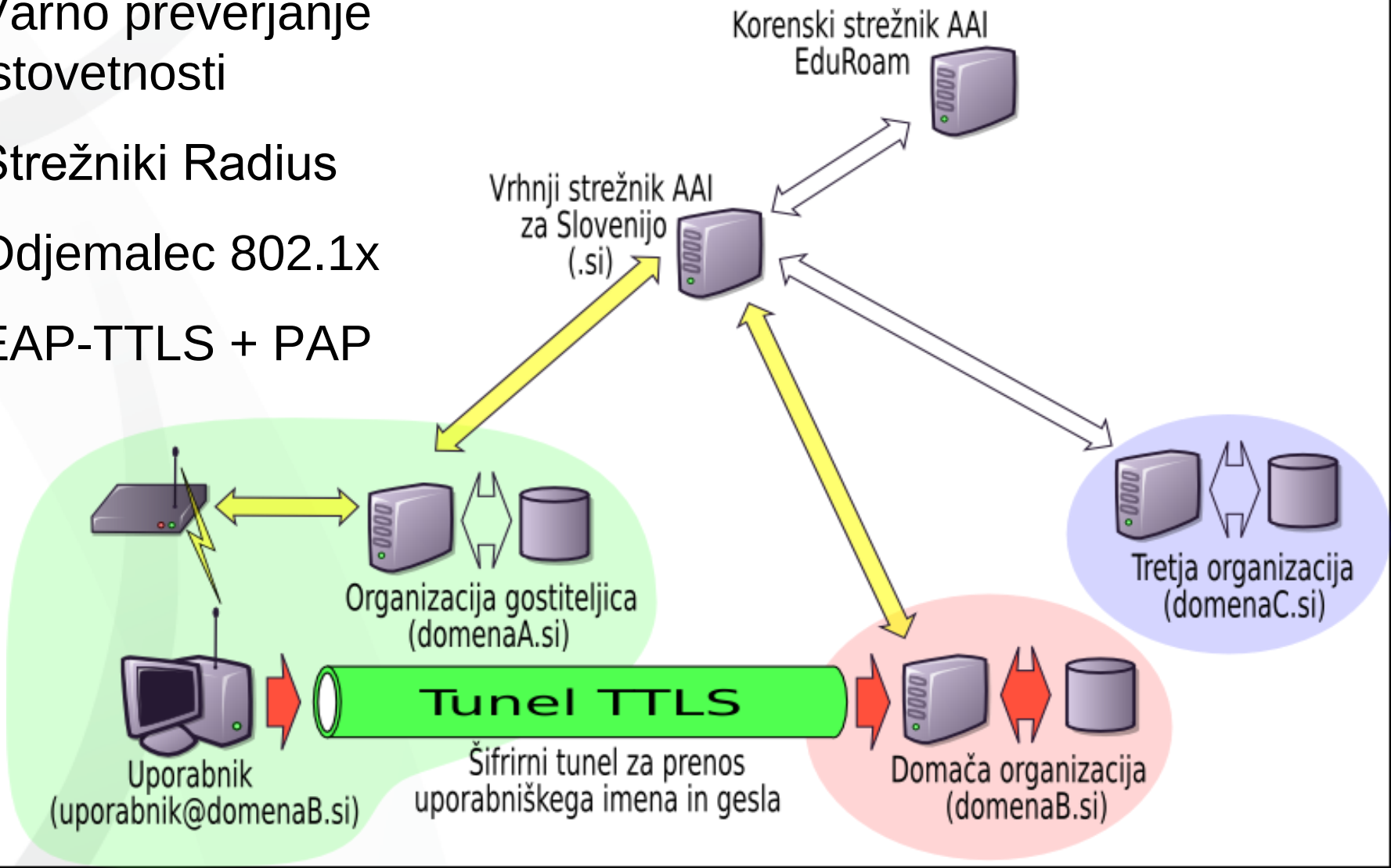
NewBUGS
- all hosts can use all video-telephony devices, admin-only pre-configured devices
- not possible to mute presenters without enabling single speaker mode
- no icon if Participant is granted Video [icon is visible for Microphone & Share)
- presenters can stop hosts webcam(notOK), participants with granted camera cant't (OK)

VoD – Video portal

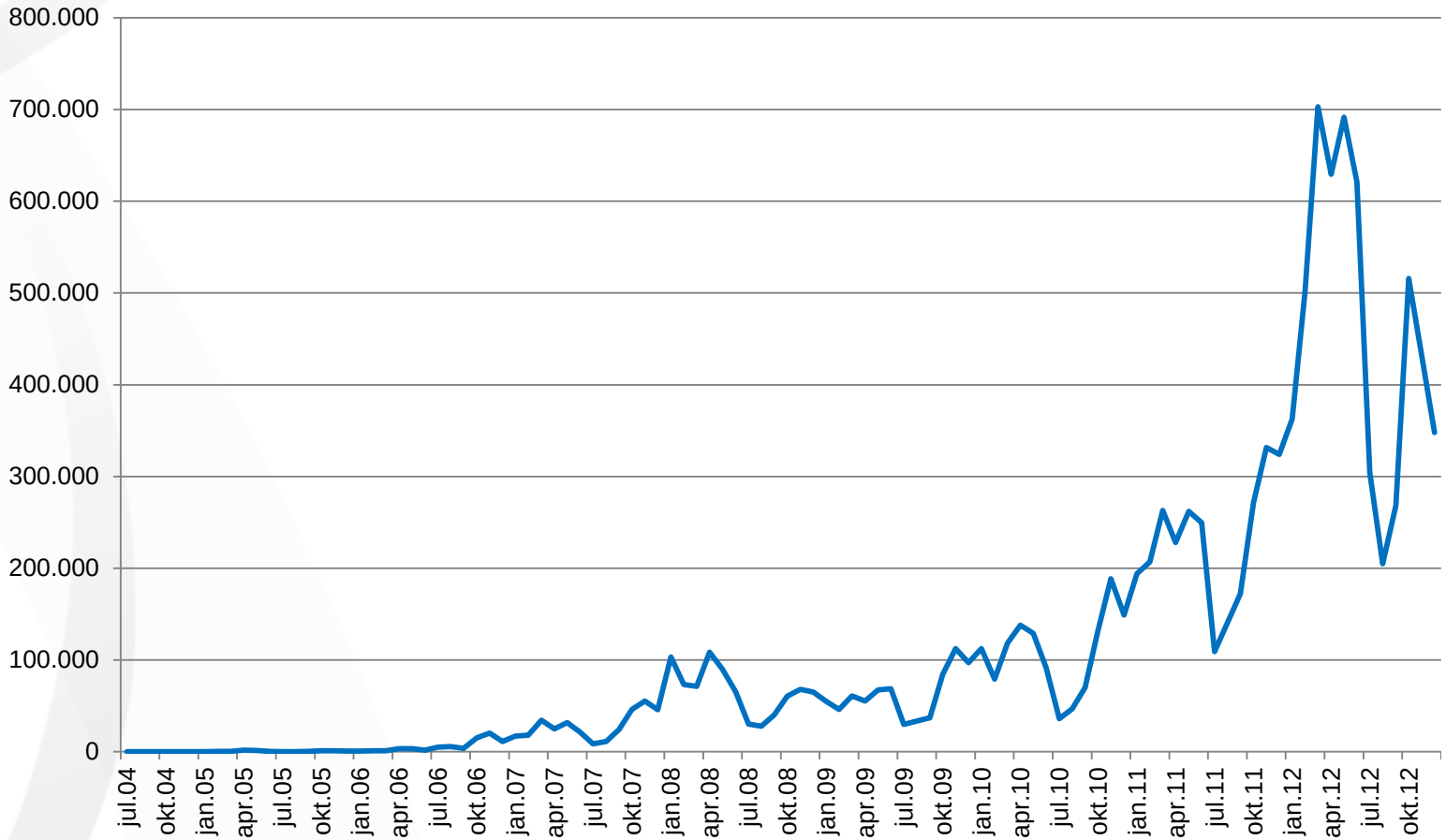


Mobilnost: WLAN

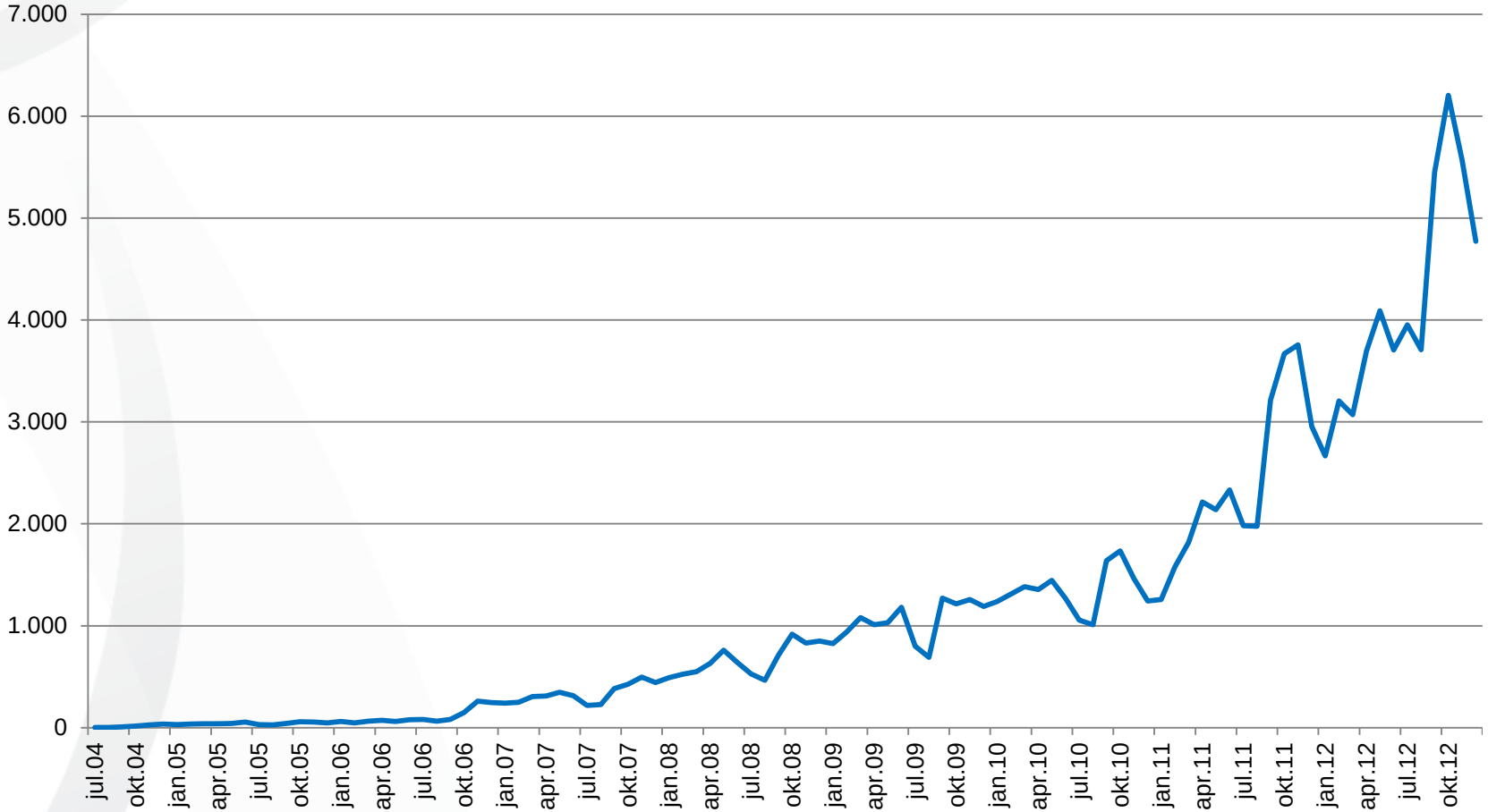
- Varno preverjanje istovetnosti
- Strežniki Radius
- Odjemalec 802.1x
- EAP-TTLS + PAP



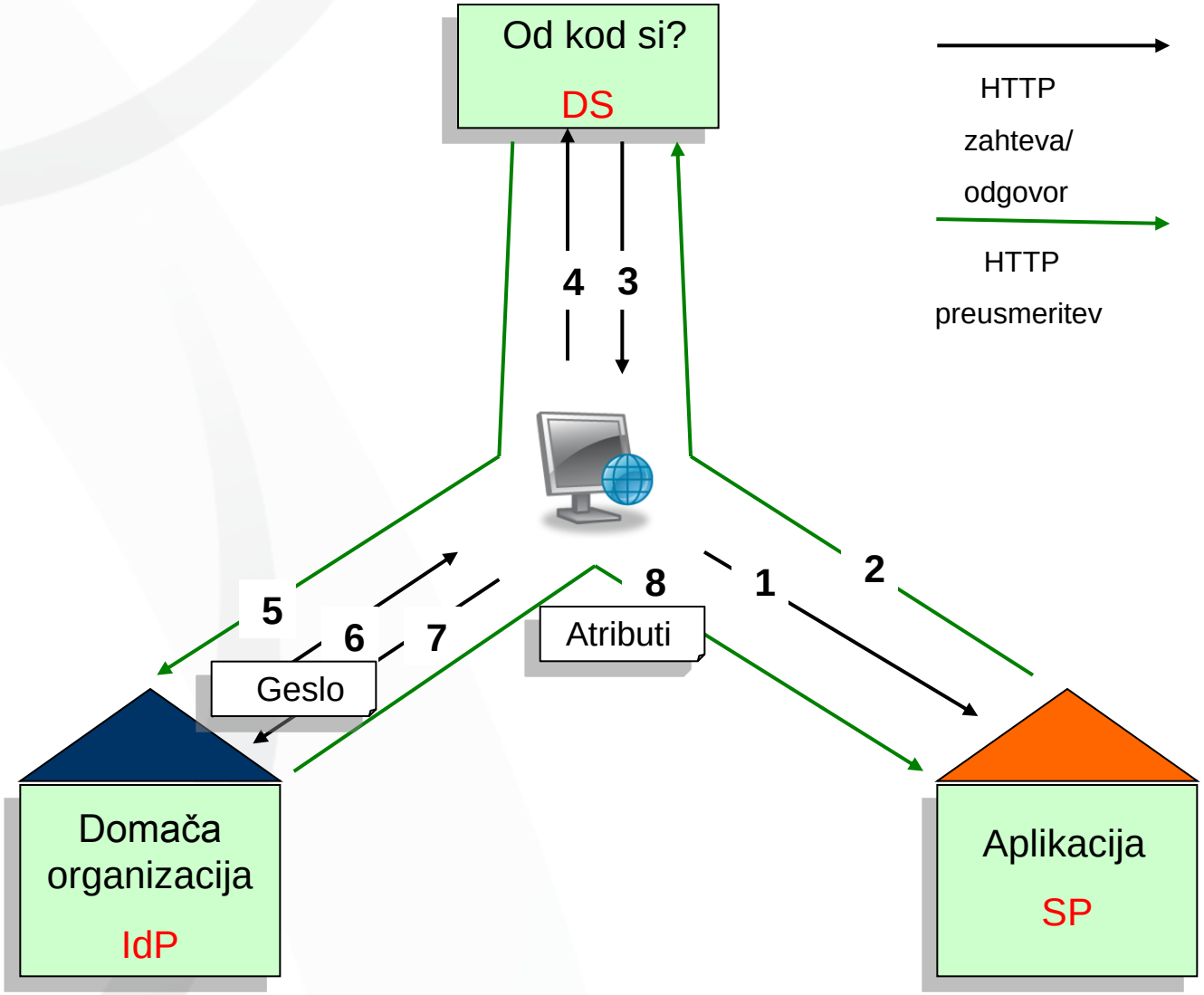
Eduroam – prijave pri gostovanju



Eduroam – št. AP pri gostovanju



Shema uporabe AAI



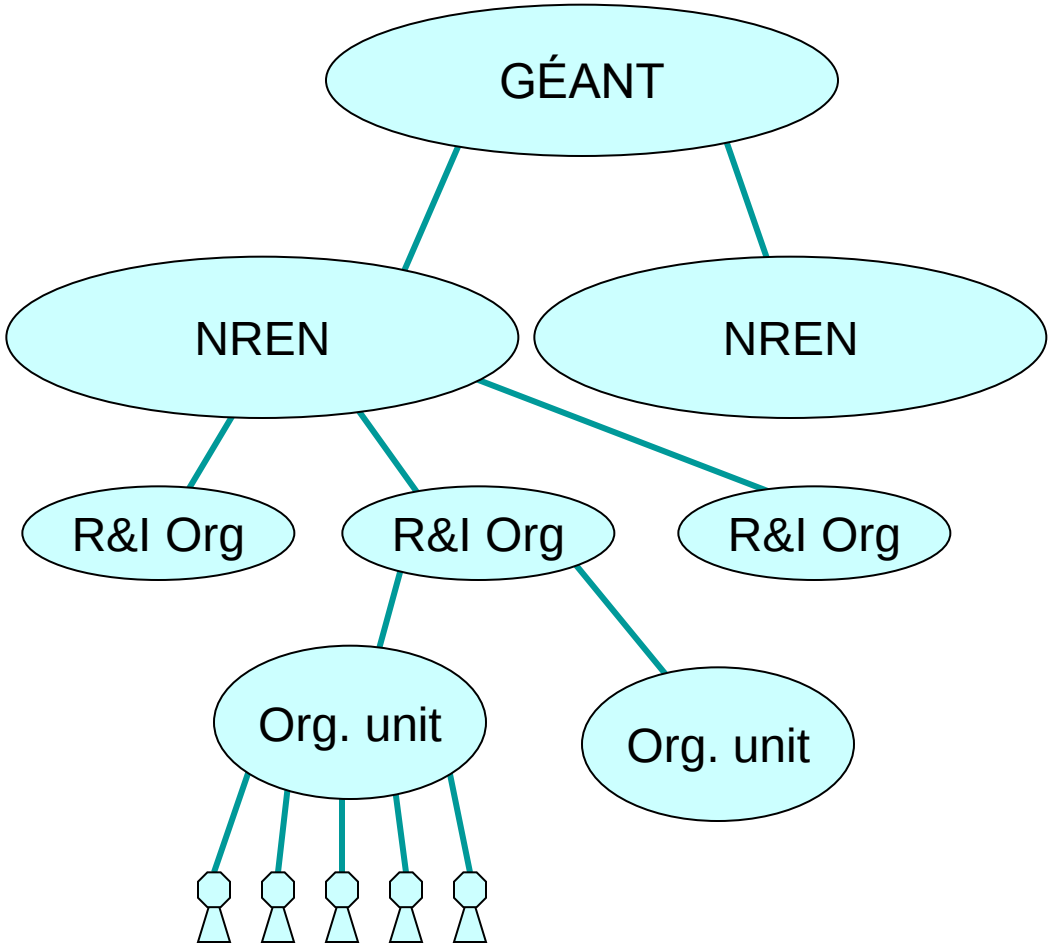
Hierarhična struktura

GÉANT

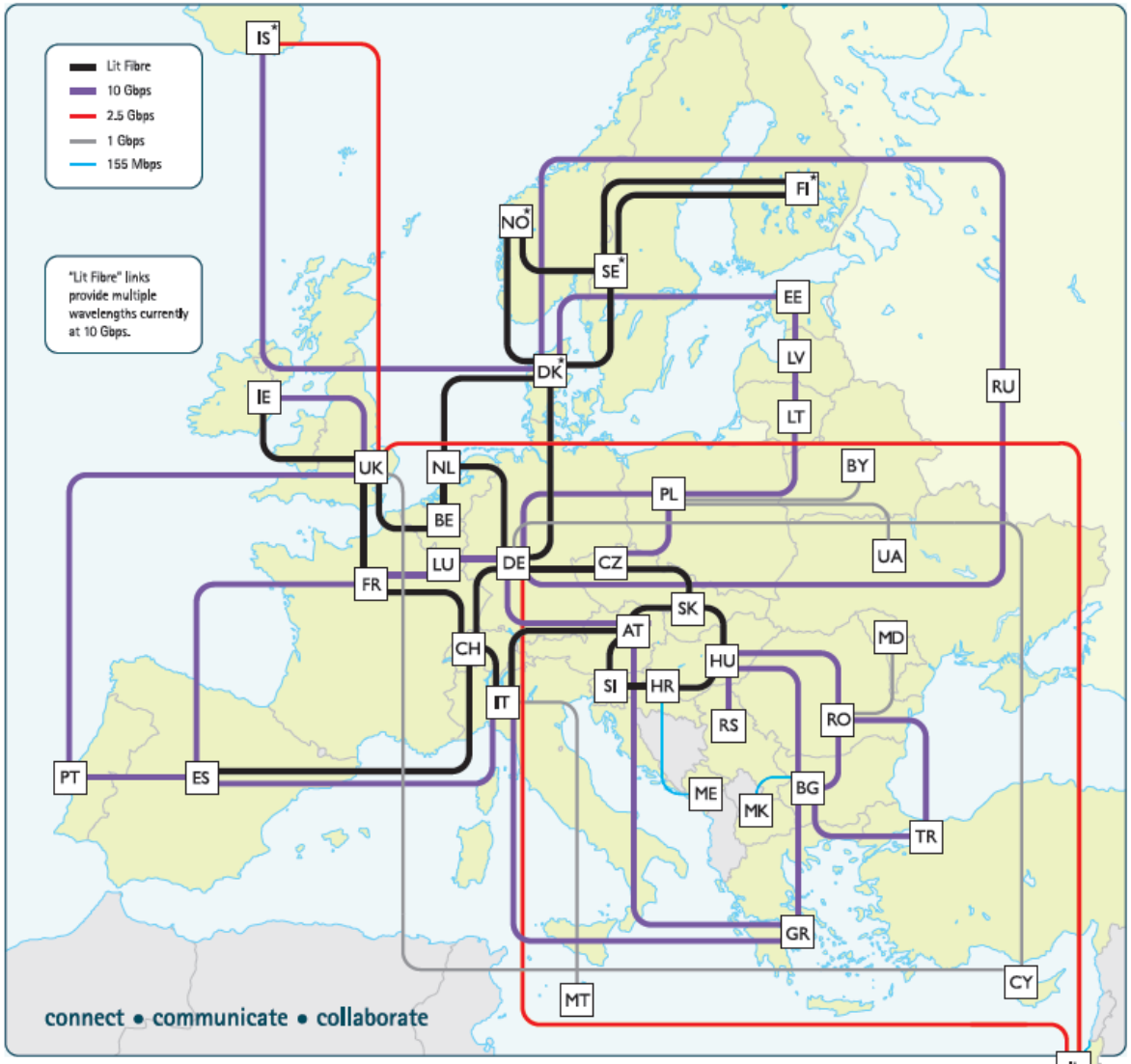
36+ NREN-ov

3.000+ raziskovalnih in izobraževalnih organizacij

40+ M uporabnikov

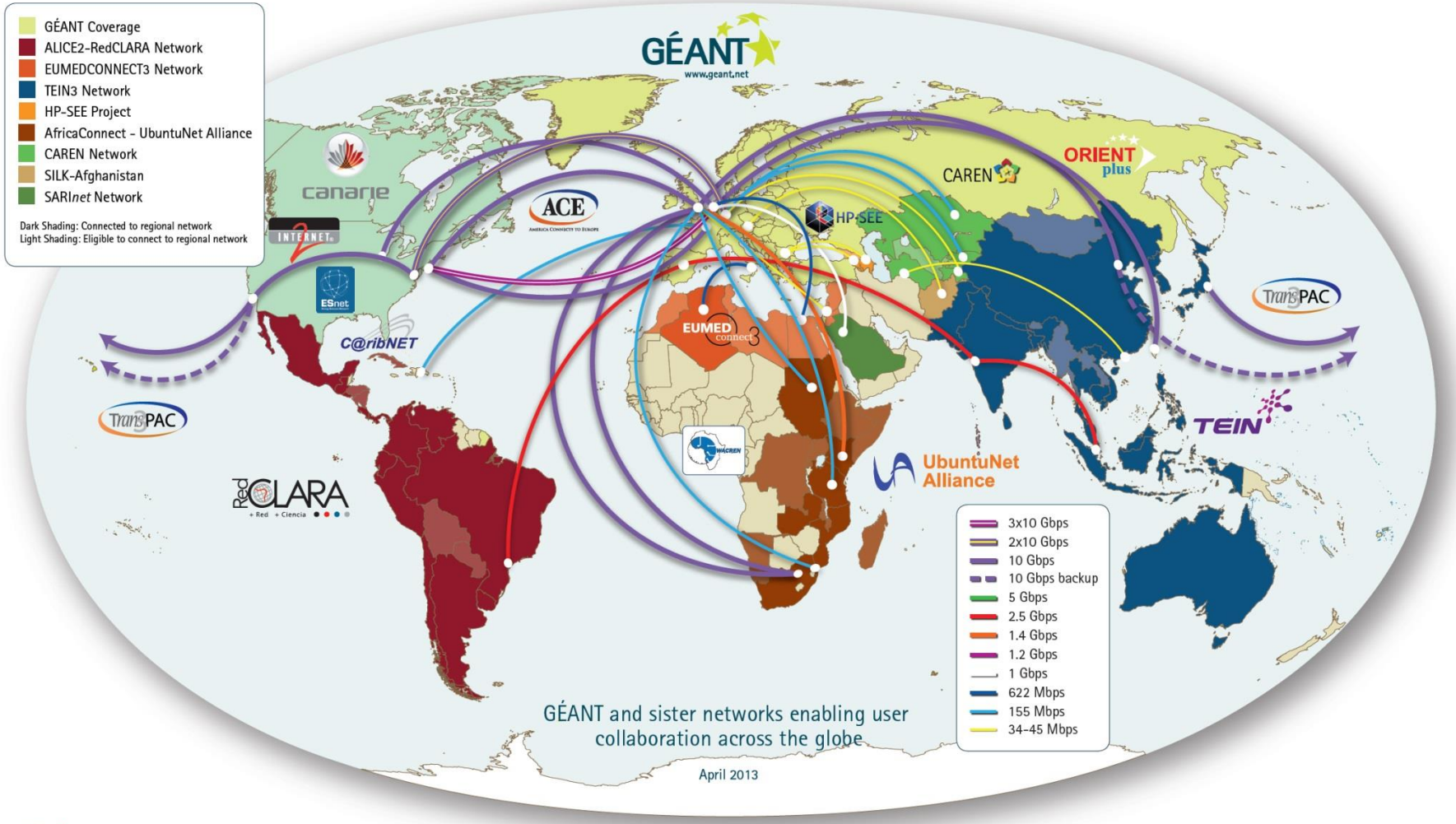


Evropsko omrežje - GÉANT



Backbone topology as at March 2012. GÉANT is operated by DANTE on behalf of Europe's NRENs.

GÉANT At the Heart of Global Research Networking



DANTE www.dante.net

GÉANT www.geant.net

connect • communicate • collaborate

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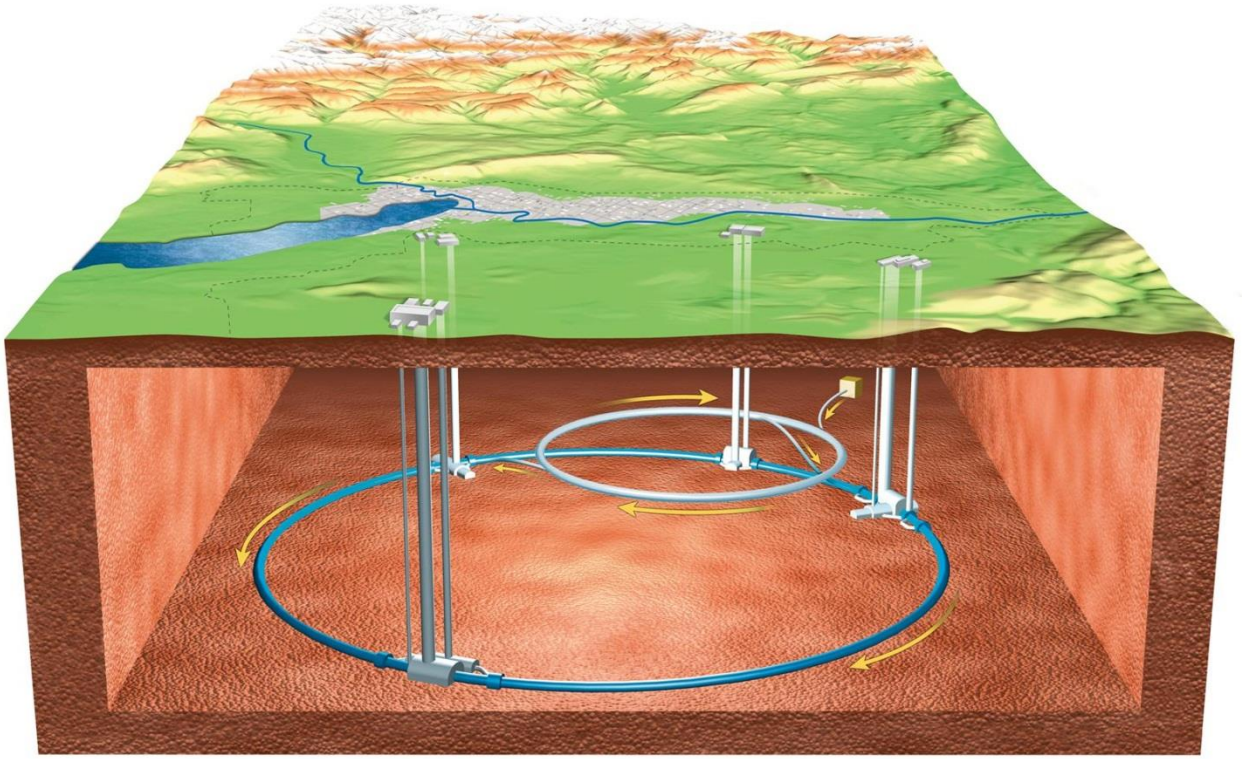
SEVENTH FRAMEWORK PROGRAMME

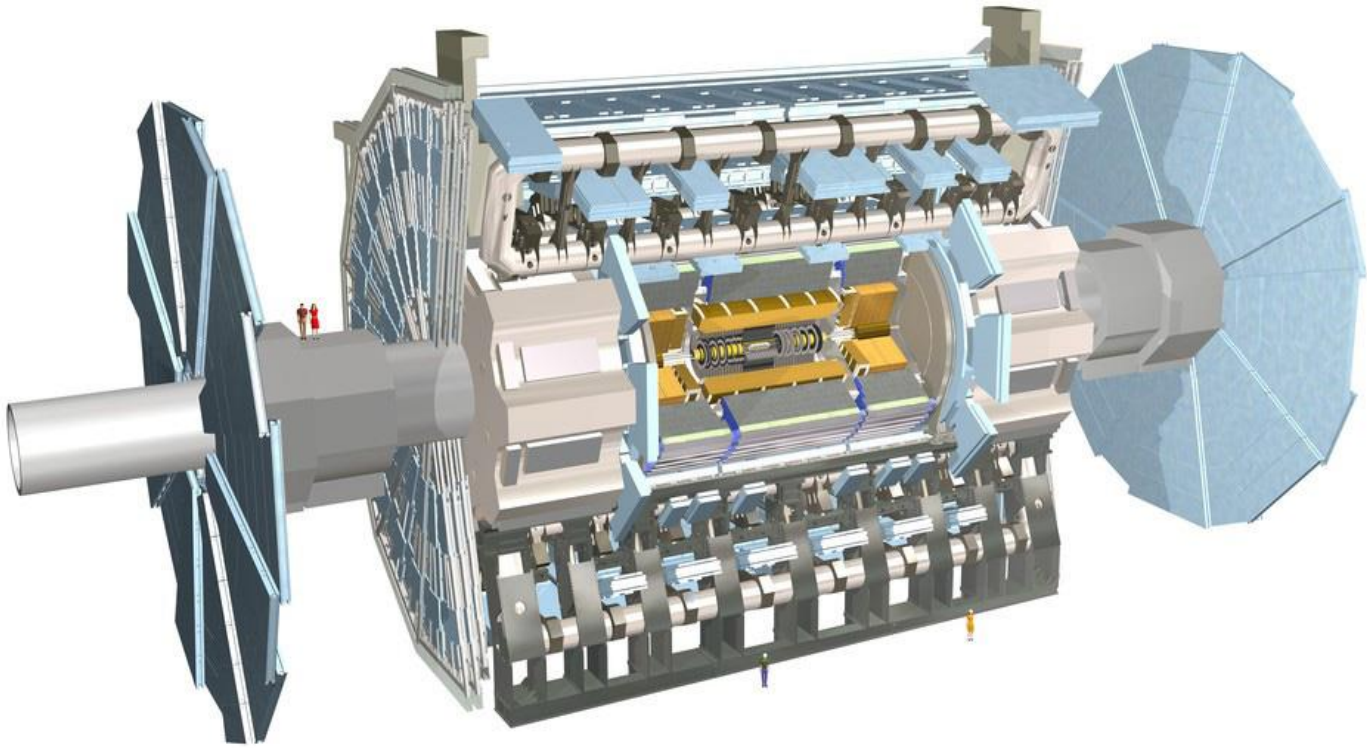
Co-funded by the European Union

Veliki hadronski trkalnik - CERN

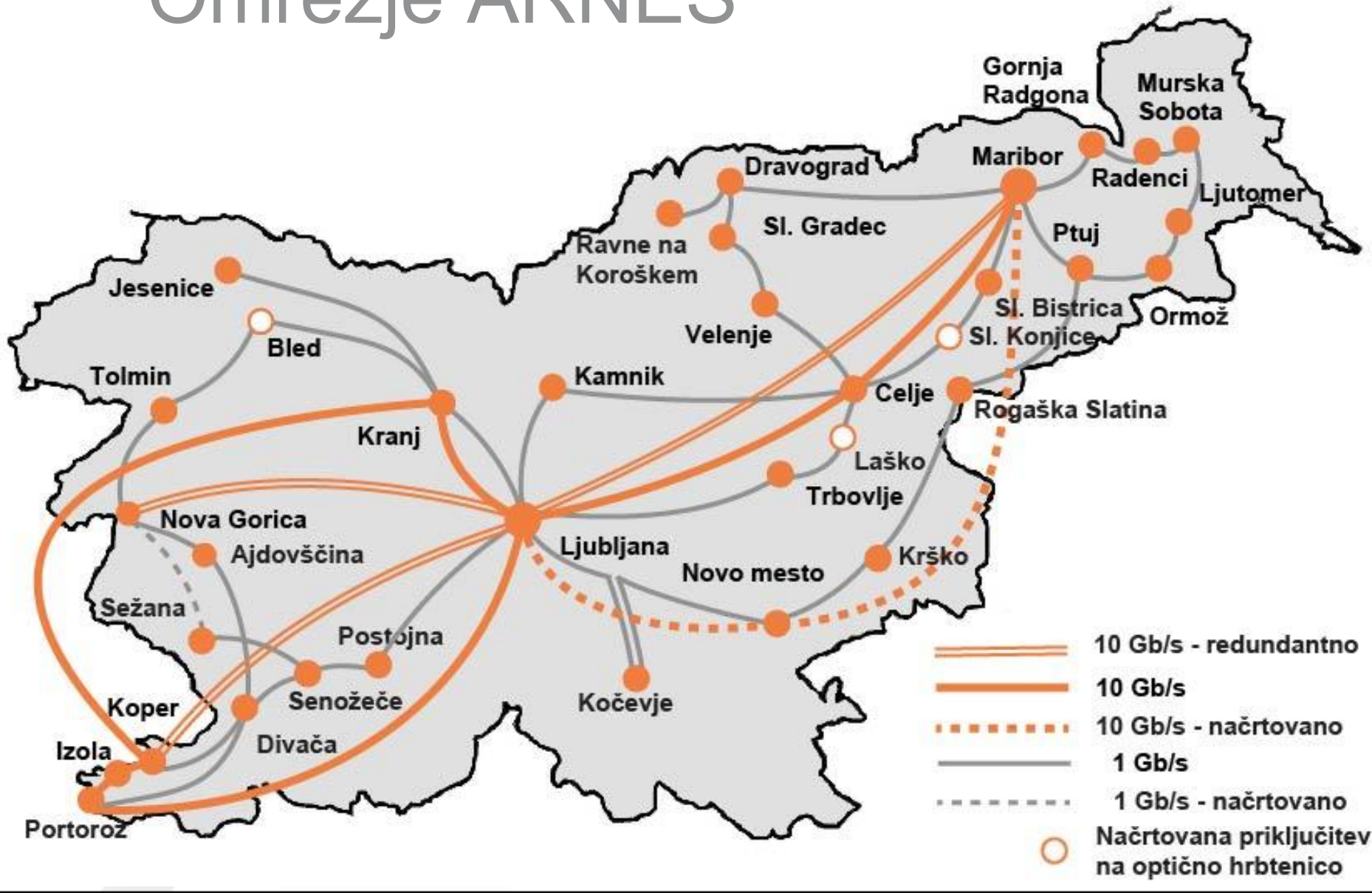


Cern – detektor Atlas

Inštrumenti bodo letno generirali 15 milijonov GB podatkov, ki se bodo obdelovali v mnogih laboratorijih po celem svetu



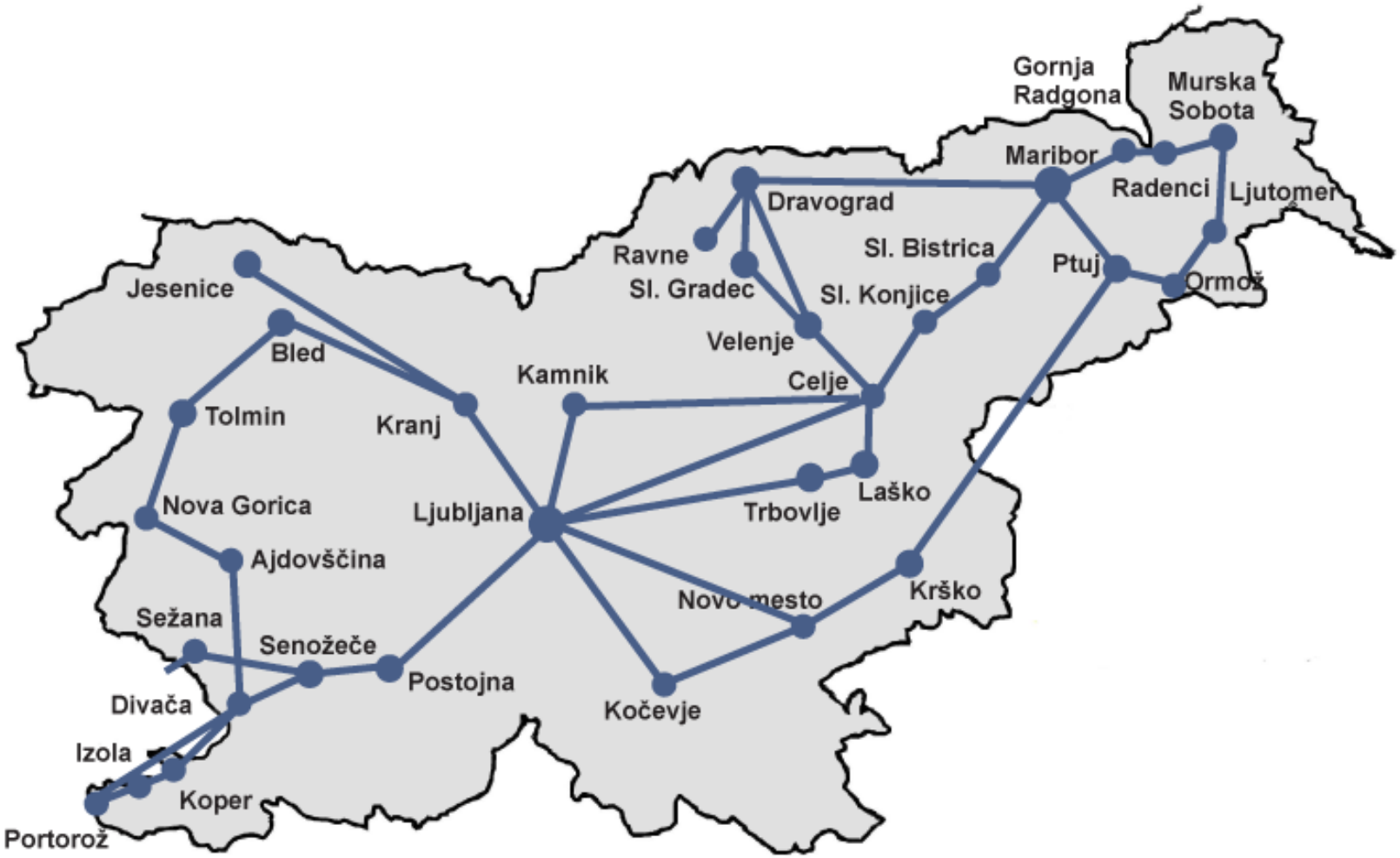
Omrežje ARNES



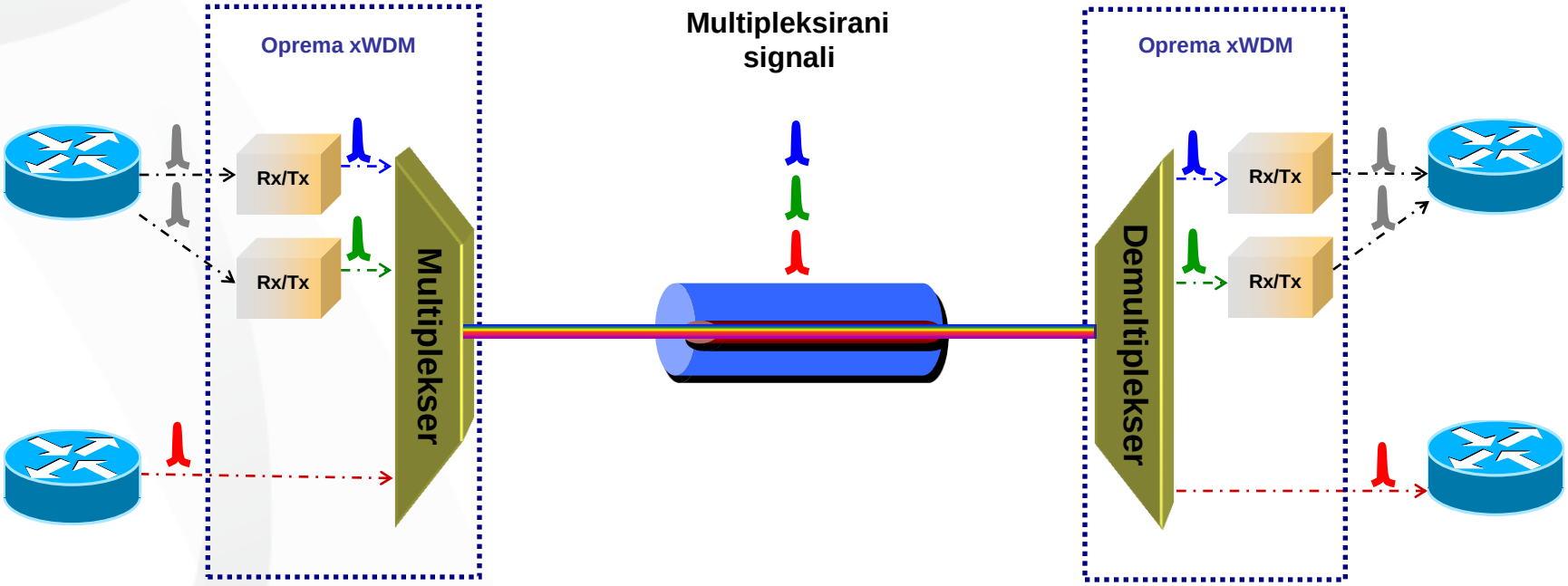
Omrežje ARNES - storitve

- Hibridni model omrežja
  - Prenos prometa IP
    - IPv4, IPv6
    - QoS (prioritete, prepustnost…), multicast…
  - Povezave točka-točka
    - zahtevni projekti: fizika (IJS, Cern), kemija, genetika, klimatologija, astronomija, medicina…
    - Povezave do redundantnih rač. centrov (IZUM, NUK...)
    - Porazdeljeno izvajanje koncertov - z več lokacij
- Slovenija, EU, svet (omrežja GÉANT, I2…)

Predpogoj: 1600 km optičnih vlaken

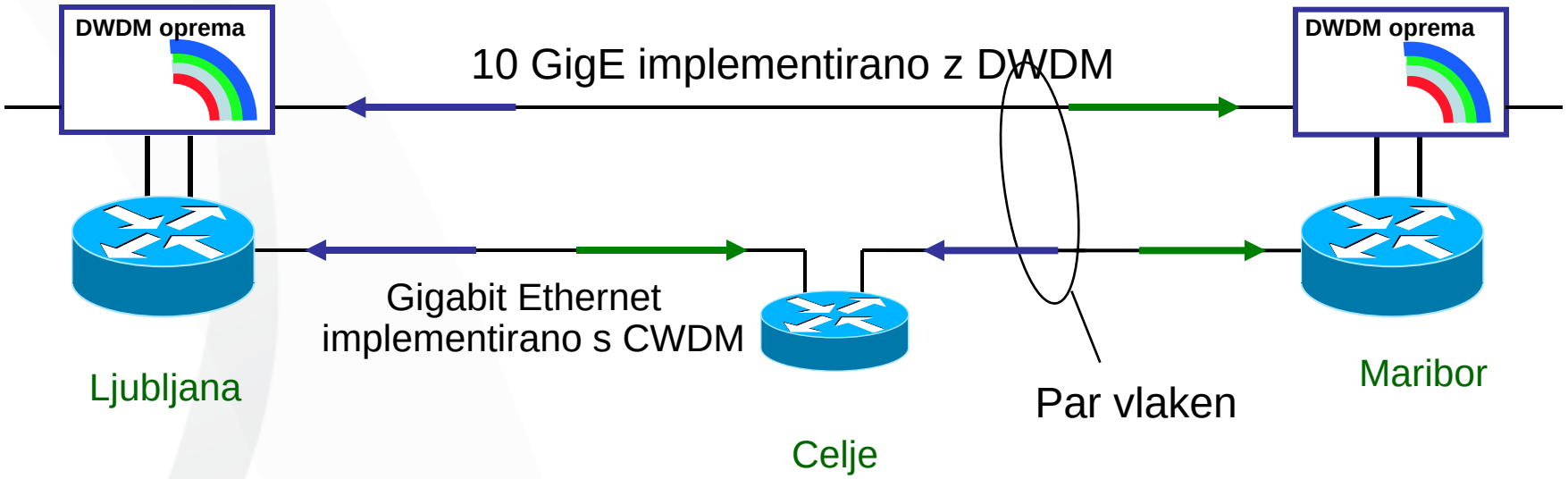


xWDM: več signalov preko enega vlakna

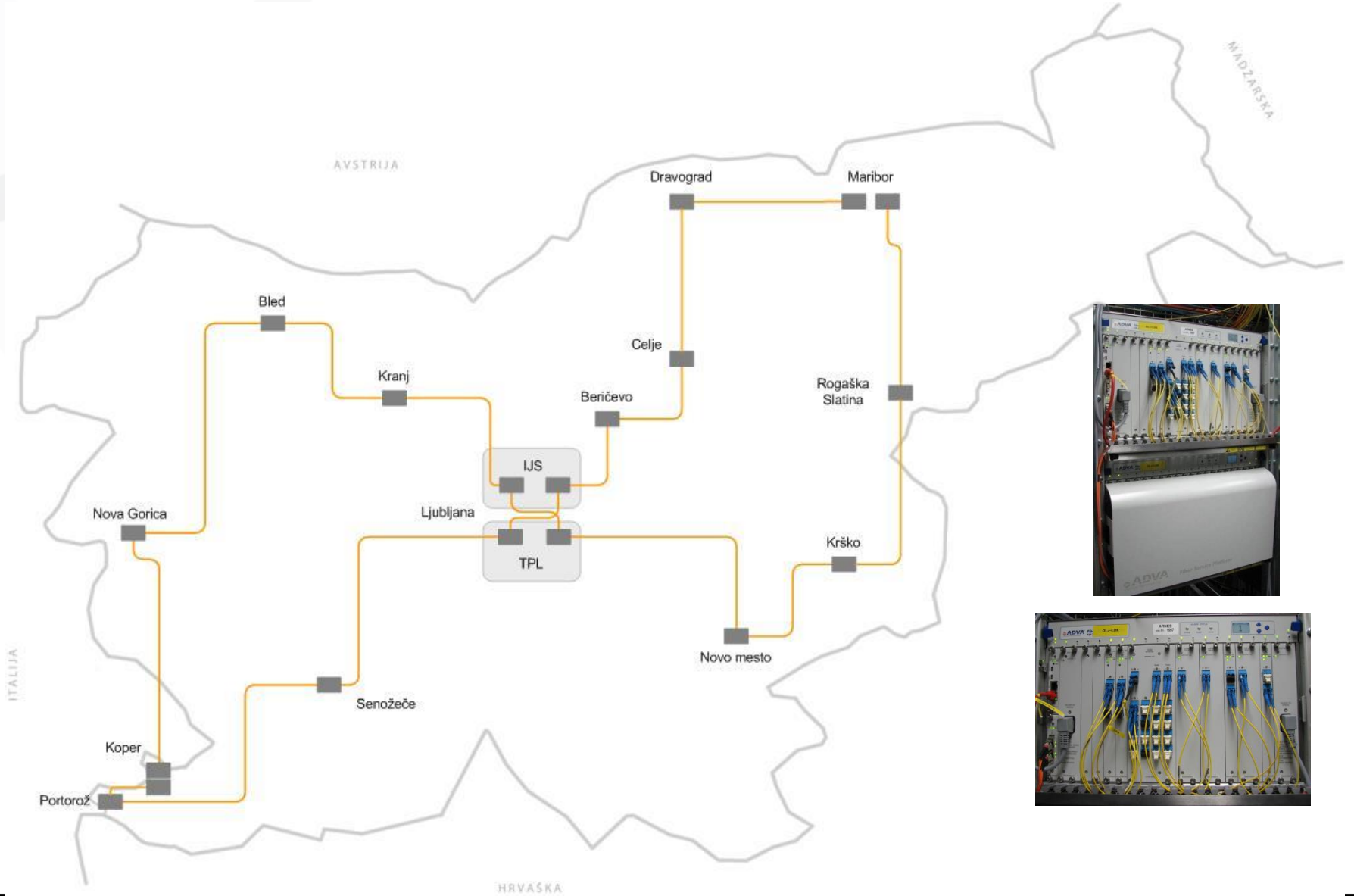


Dvosmerna uporaba optičnih vlaken

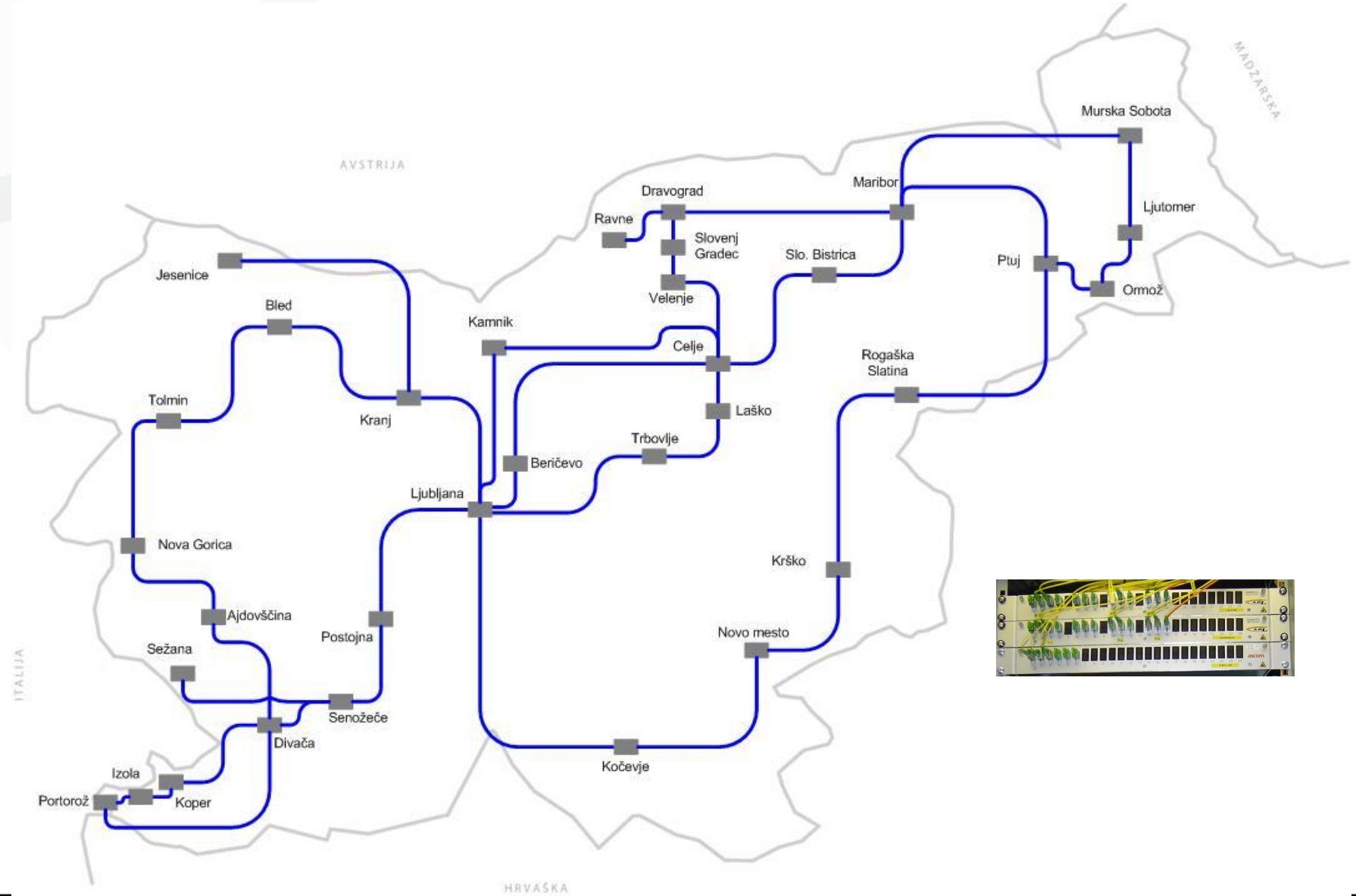
- Eno vlakno je uporabljeno za DWDM
- Drugo vlakno je uporabljeno za povezavo manjših vozlišč s poceni GigE tehnologijo in pasivnim CWDM



DWDM omrežje ARNES



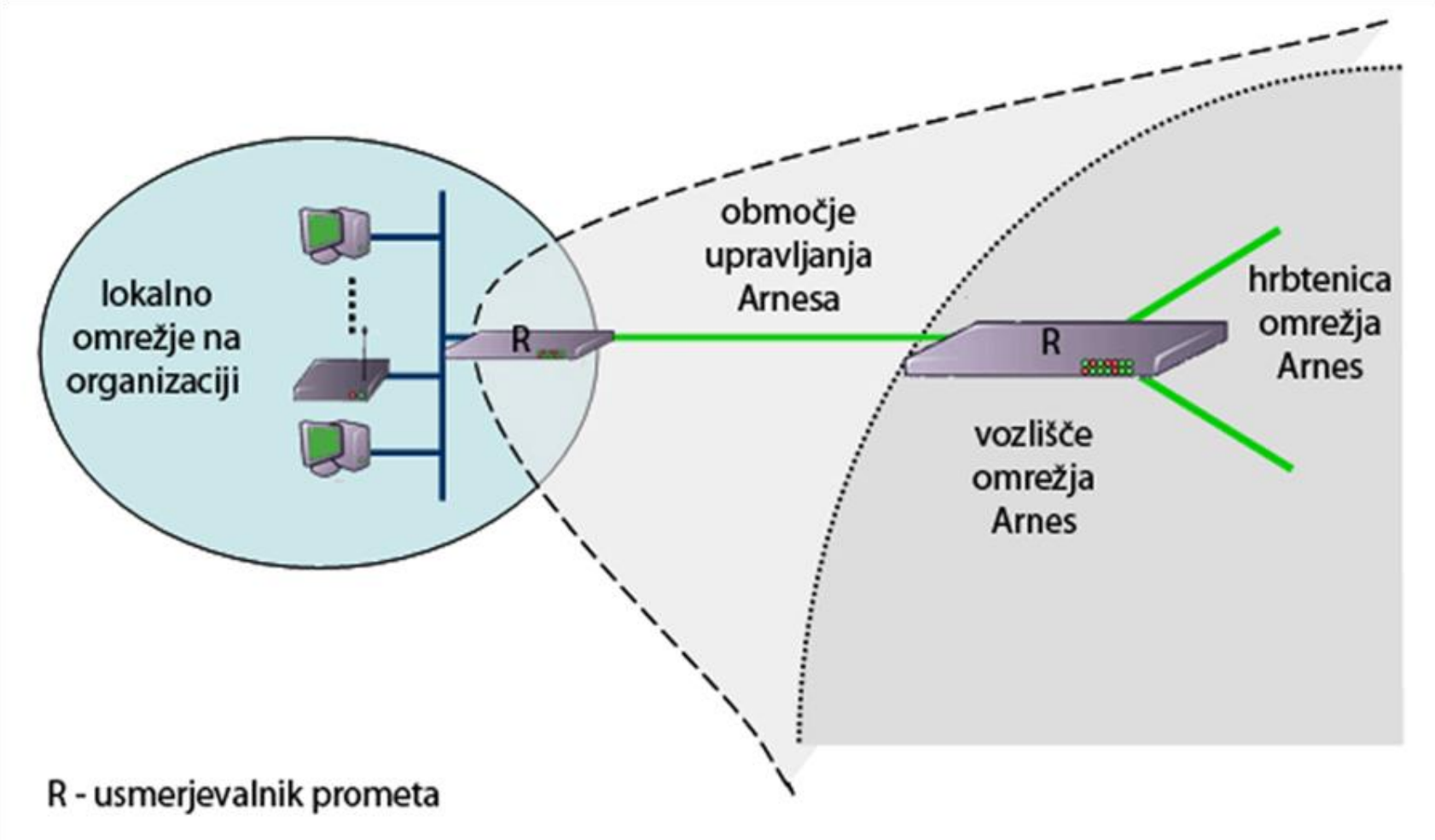
CWDM omrežje ARNES



Kaj upravljati?

- Omrežje je kompleksen sistem
  - Nekaj tisoč naprav, množica stanj
  - Velika raznolikost
    - Usmerjevalniki
    - Ethernet stikala
    - xWDM oprema
    - Sistemi za napajanje (UPS, agregat...)
    - Pretvorniki/modemi
  - Povezave med napravami

Do kod upravljati?



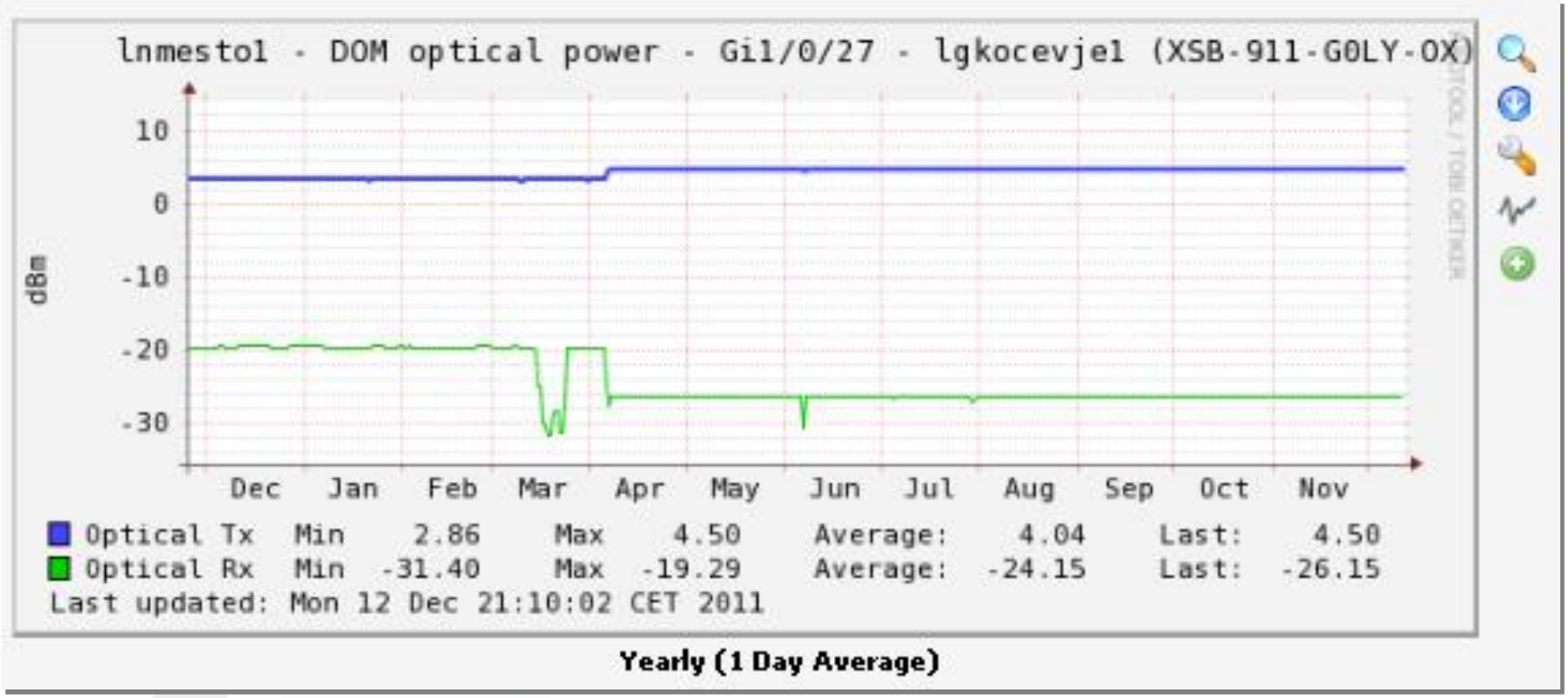
Upravljanje omrežja

- Konfiguracij omrežnih naprav
  - Priprava, vzdrževanje, shranjevanje
- Stabilnosti delovanja
  - Nadzor stanja, odprava napak…
- Varnosti
  - Kontrola dostopa, odkrivanje anomalij…
- Zmogljivosti
  - Omrežnih naprav
  - Povezav
  - Mehanizmov QoS
- Beleženja
  - Zbiranje prometnih podatkov
  - Izdelava statistik…

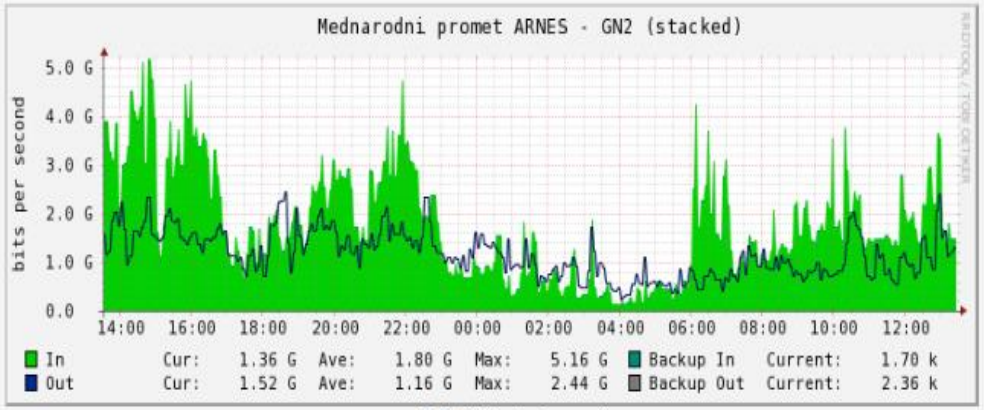
Orodja - uporaba

- Shranjujemo/spreminjamo konfiguracije
- Zajemamo podatke (promet, napake, CPU…)
- Rišemo grafe, topologijo omrežja
  - Stanje
  - Trendi
- Zaznavamo probleme
  - Ob prekoračitvi neke vrednosti
  - Ob nekem sporočilu
  - Ob nedosegljivosti naprave…
  - Avtomatsko obveščanje: email, SMS…
- Odkrivamo vzroke za probleme (debugging)

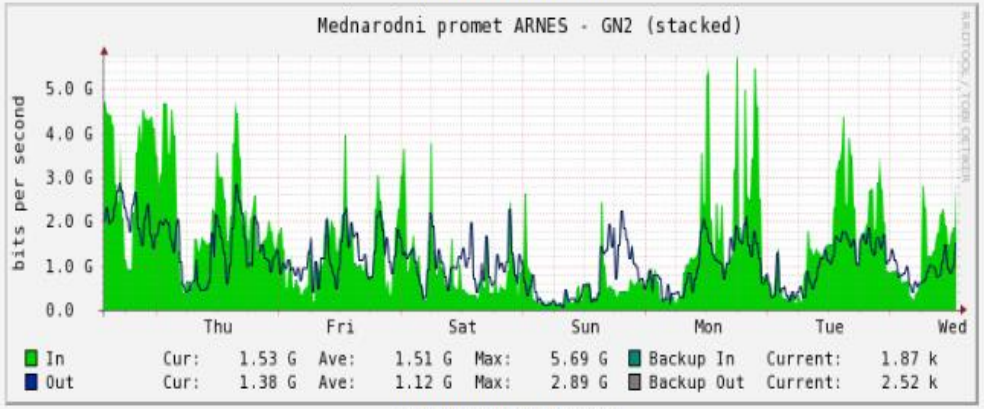
Primer: optični signal – Rx moč



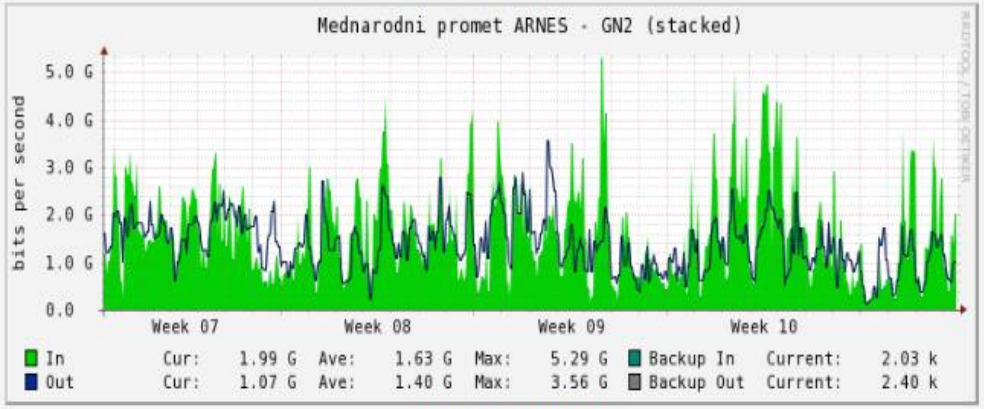
GEANT promet



Daily (5 Minute Average)

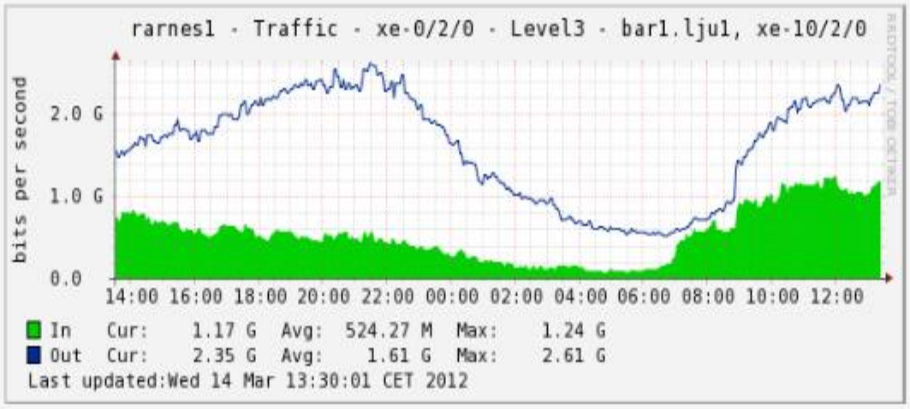


Weekly (30 Minute Average)

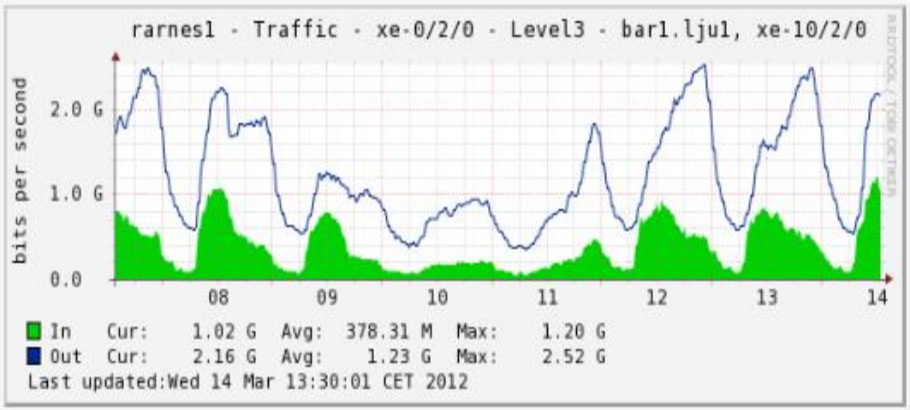


Monthly (2 Hour Average)

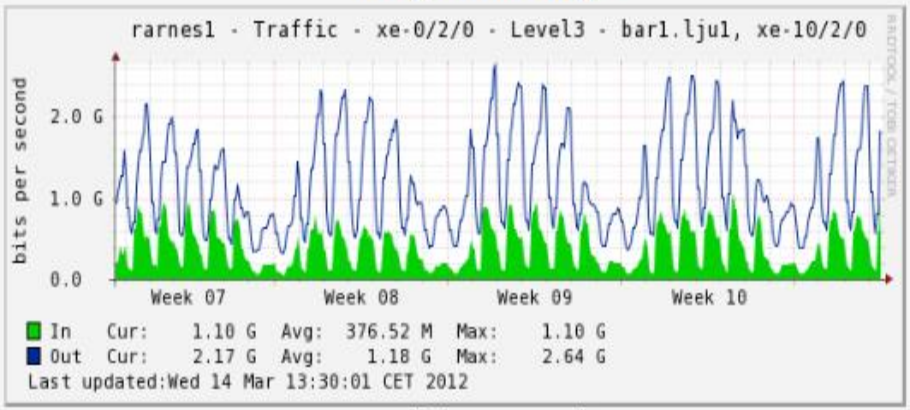
CIP promet



Daily (5 Minute Average)



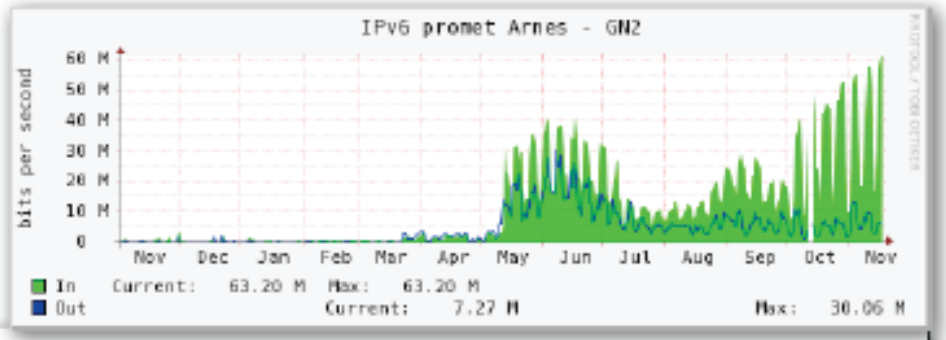
Weekly (30 Minute Average)

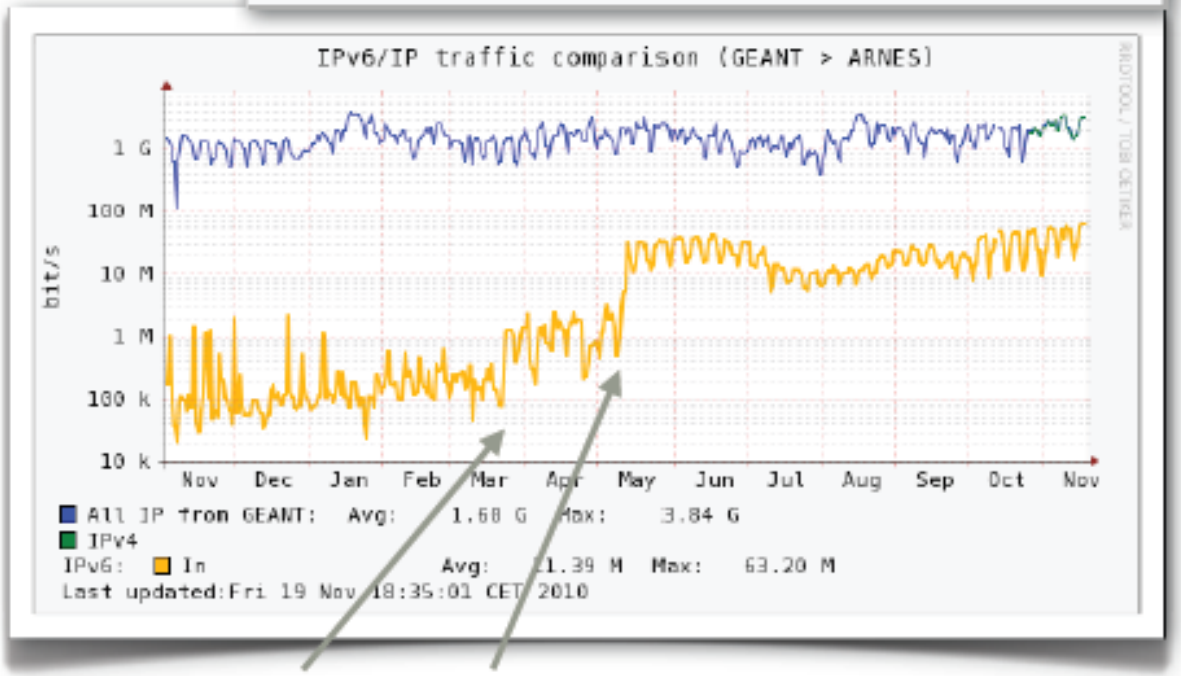


Monthly (2 Hour Average)

Primer grafa – porast prometa IPv6

- promet počasi in stalno narašča
  - pred enim letom (11/2009)
    - 1:7.000
  - danes (11/2010)
    - 1:70





Orodja - osnovna

- “Enostavna” orodja
  - Ping
  - Traceroute
- Oddaljen dostop (ssh, telnet) + CLI
- SNMP
- Syslog

Orodja - napredna

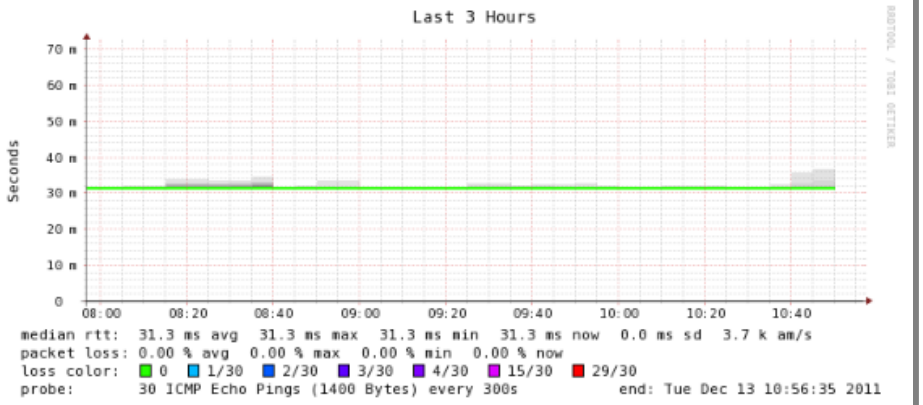
- Prosto dostopno programje
  - Rancid
  - SmokePing
  - Cacti
  - Icinga
  - Syslog-ng: naprave sporočajo dogodke
  - Netflow: nfsen, nfdump…
  - OTRS (ticketing sistem)
  - Dokumentacija (netdot, wiki, GoogleEarth…)
- Lastne skripte, aplikacije
  - Upravljanje naslovnega prostora
  - Nadzor usmerjevalnih tabel (BGP, OSPF)
  - SLA monitor
  - …

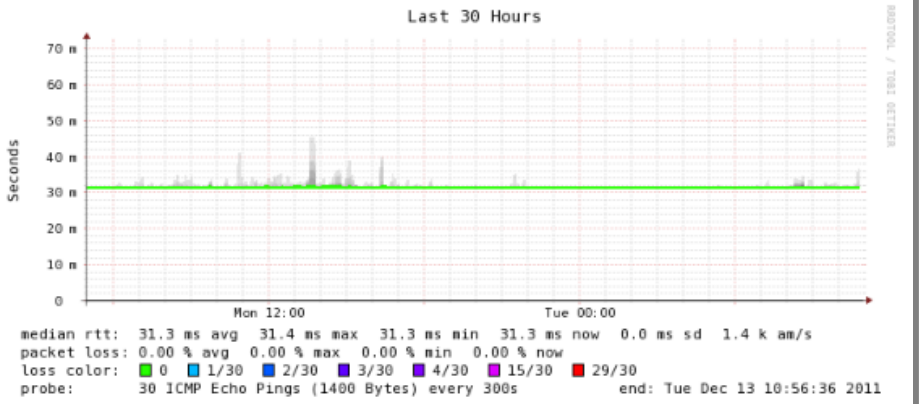
Orodja - napredna

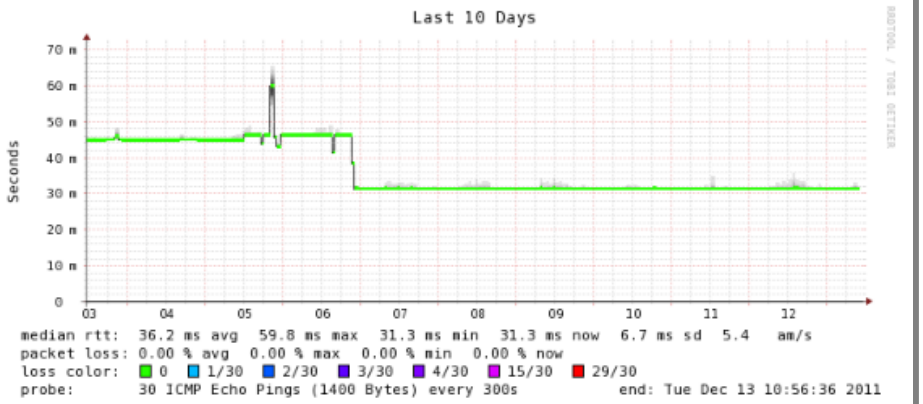
- Alternativa: komercialni produkti
  - Splunk: syslog analiza
  - Se jim izogibamo
    - Kompleksni, zmogljivi, optimizirani
    - Dragi
    - Težko obvladljivi in razširljivi

SmokePing

biblioteka.bol.bg (193.200.14.182)







Asset Inventory

By Type/Model Summary Go

Type	Model	Count
Total Assets:		2066
Chassis		**38**
	SH7HU	33
	SH9HU	5
Console Server		**10**
	ACM5004-G-E	5
	IM4232-2-DAC-X2-EU	3
	IM4232-2-DAC-X2-G-EU	2
Cooling		**12**
	ACRC103	12
DAC Cable		**34**
	DAC, 1 meter	2
	DAC, 1 meter, rev 1	7
	DAC, 1 meter, rev 3	2
	DAC, 1 meter, rev A00	12
	DAC, 3 meter, rev 2	2
	DAC, 3 meter, rev 3	3
	DAC, 5 meter, rev 1	1
	DAC, 5 meter, rev 2	2
	DAC, 5 meter, rev 3	3
Module		**630**
	10PCA-PCN-1G3+10G	7
	16CSM-#D01-#D32-SFA	9
	16CSM-#D01-#D32-SFB	9
	1CSM+#D04-E/V	3
	1CSM+#D15-E/W	4
	1CSM+#D16-E/W	4
	1CSM+#D31-E/W	4
	1CSM+#D32-E/W	4
	2BSM-#D01-#D32	21
	2BSM/P-#C1270-#C1610-DM	5
	2PCA-PCN-10G	6
	2WCC-PCN-10G	5
	3BSM-#G1310-#C1610	4
	40CSM/2HU-#D02-#D32	4
	4CSM-#C1470-#C1610	2
	4CSM-#D09-#D12	5
	4CSM-#D13-#D16	5
	4CSM-#D25-#D28	5
	4CSM-#D29-#D32	5
	4GSM-#D01-#D16	6
	4GSM-#D17-#D32	6
	4TCA-PCN-4GU+4G	4
	ASR1000-ESP40	2
	ASR1000-RP2	2
	ASR1000-SIP40	2
	ASR1004-PWR-AC	4

Device Tasks [new] [hide]

Find Devices

Name/IP/MAC:

Names within: All Zones Find

Device: **lljtpl1.arnes.si** [HTTP] [HTTPS] [refresh] [snmp-update] [delete]

Basics | Interfaces | Modules | IP info | BGP Peers | Spanning Tree | Topology | ARP | FWT | History | Access Rights | All

Device Modules (311)

Number	Name	Class	Model	Description	Asset
1	WS-C6506-E	chassis	WS-C6506-E	Cisco Systems, Inc. Catalyst 6500 6-slot Chassis System	Cisco 6506, SAL1442X7GA, 588D09EB34C0

[csv]

Show 50 items per page

Module 1 contains:

Number	Name	Class	Model	Description	Asset
2	Physical Slot 1	container		Cisco Systems, Inc. Catalyst 6500 6-slot Physical Slot	-
8	Backplane	backplane		Cisco Systems, Inc. Catalyst 6500 6-slot backplane	-
3	Physical Slot 2	container		Cisco Systems, Inc. Catalyst 6500 6-slot Physical Slot	-
4	Physical Slot 3	container		Cisco Systems, Inc. Catalyst 6500 6-slot Physical Slot	-
5	Physical Slot 4	container		Cisco Systems, Inc. Catalyst 6500 6-slot Physical Slot	-
6	Physical Slot 5	container		Cisco Systems, Inc. Catalyst 6500 6-slot Physical Slot	-
7	Physical Slot 6	container		Cisco Systems, Inc. Catalyst 6500 6-slot Physical Slot	-
13	Container of Fan FRU 1	container		Container of Fan FRU	-
15	Container of Container of Power Supply	container		Container of Container of Power Supply	-

[csv]

Show 50 items per page

Module 2 contains:

Number	Name	Class	Model	Description	Asset
4000	1	module	WS-X6704-10GE	WS-X6704-10GE CEF720 4 port 10-Gigabit Ethernet Rev. 2.6	Cisco WS-X6704-10GE, SAL11402ZXR

[csv]

Show 50 items per page

Module 4000 contains:

Number	Name	Class	Model	Description	Asset
4001	CPU of Module 1	module		CPU of Module 1	-
4002	module 1 power-output-fail Sensor	sensor		module 1 power-output-fail Sensor	-
4100	Te1/1	port		Transceiver Port Te1/1	-
4003	module 1 outlet temperature Sensor	sensor		module 1 outlet temperature Sensor	-
4101	Te1/2	port		Transceiver Port Te1/2	-
4004	module 1 inlet temperature Sensor	sensor		module 1 inlet temperature Sensor	-
4102	Te1/3	port		Transceiver Port Te1/3	-
4005	module 1 insufficient cooling Sensor	sensor		module 1 insufficient cooling Sensor	-
4103	Te1/4	port		Transceiver Port Te1/4	-
4006	EARL Switching Engine Container 1	container		Switching Engine Container 1	-

Module 4000 contains:

Number	Name	Class	Model	Description	Asset
4001	CPU of Module 1	module		CPU of Module 1	-
4002	module 1 power-output-fail Sensor	sensor		module 1 power-output-fail Sensor	-
4100	Te1/1	port		Transceiver Port Te1/1	-
4003	module 1 outlet temperature Sensor	sensor		module 1 outlet temperature Sensor	-
4101	Te1/2	port		Transceiver Port Te1/2	-
4004	module 1 inlet temperature Sensor	sensor		module 1 inlet temperature Sensor	-
4102	Te1/3	port		Transceiver Port Te1/3	-
4005	module 1 insufficient cooling Sensor	sensor		module 1 insufficient cooling Sensor	-
4103	Te1/4	port		Transceiver Port Te1/4	-
4006	EARL Switching Engine Container 1	container		Switching Engine Container 1	-

[csv]

Show 50 items per page

Module 4100 contains:

Number	Name	Class	Model	Description	Asset
4200	10-Gigabit Transceiver Port Container Te1/1	container		10-Gigabit Transceiver Port Container Te1/1	-

[csv]

Show 50 items per page

Module 4101 contains:

Number	Name	Class	Model	Description	Asset
4201	10-Gigabit Transceiver Port Container Te1/2	container		10-Gigabit Transceiver Port Container Te1/2	-

[csv]

Show 50 items per page

Module 4201 contains:

Number	Name	Class	Model	Description	Asset
4312	Transceiver Te1/2	module	XENPAK-10GB-SR	Xenpak Transceiver 10Gbase-SR Te1/2	Cisco XENPAK, SR, IJM1147M10N

[csv]

Show 50 items per page

Module 4312 contains:

Number	Name	Class	Model	Description	Asset
4313	Te1/2 Module Temperature Sensor	sensor		TenGigabitEthernet1/2 Module Temperature Sensor	-
4314	Te1/2 Supply Voltage Sensor	sensor		TenGigabitEthernet1/2 Supply Voltage Sensor	-
4315	Te1/2 Bias Current Sensor	sensor		TenGigabitEthernet1/2 Bias Current Sensor	-
4316	Te1/2 Transmit Power Sensor	sensor		TenGigabitEthernet1/2 Transmit Power Sensor	-
4317	Te1/2 Receive Power Sensor	sensor		TenGigabitEthernet1/2 Receive Power Sensor	-

[csv]

Show 50 items per page

Module 4102 contains:

Number	Name	Class	Model	Description	Asset
4202	10-Gigabit Transceiver Port Container Te1/3	container		10-Gigabit Transceiver Port Container Te1/3	-

[csv]

Show 50 items per page

[*]: **193.2.0.0/16** [refresh] [edit] [delete]

Children | Sites | Zones | Access Rights | Attributes | Comments | All

Address:	193.2.0.0/16	Used by:	Arnes [edit]
Status:	**Container**	Netmask:	255.255.0.0
Description:	SI-ARNES-193-2	Broadcast:	193.2.255.255
First Created	2013-06-18 14:47:22	Usable Addresses:	65536 (193.2.0.1 - 193.2.255.254)
Last Modified	2013-06-18 14:47:22	Address Utilization:	Used: 1178 of 65536 Available: 64358 (98%)
Owner:	Arnes [edit]	Space Allocated:	Available: 96%

Usage for 193.2.0.0/16

Legend: Available Container Static Reserved [List View] [Tree View]

Zoom: Set one row equal to /22

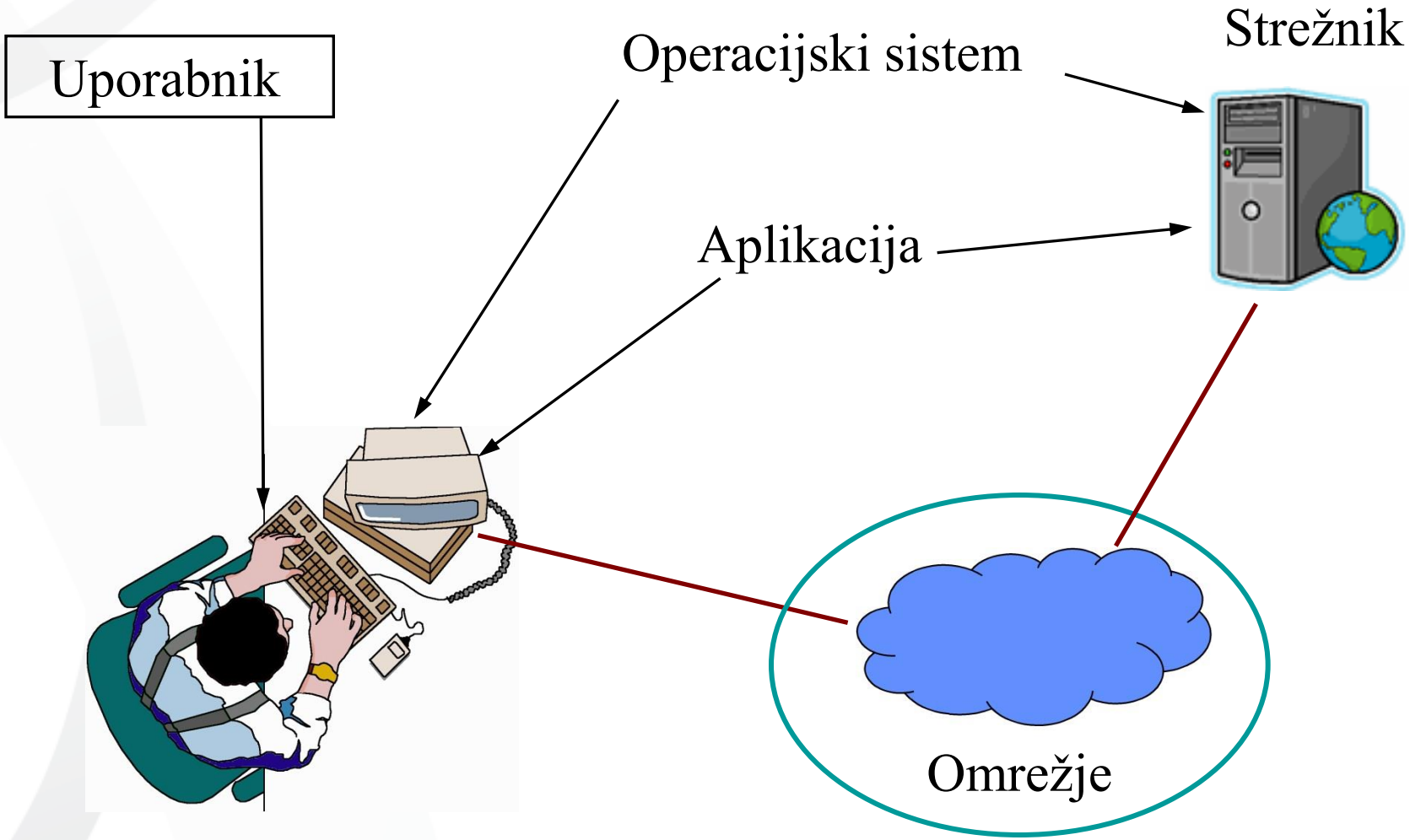
Partition: Set max free space size to unlimited

193.2.0.0
193.2.4.0
193.2.8.0
193.2.12.0
193.2.16.0
193.2.20.0
193.2.24.0
193.2.28.0
193.2.32.0
193.2.36.0
193.2.40.0
193.2.44.0
193.2.48.0
193.2.52.0
193.2.56.0
193.2.60.0
193.2.64.0
193.2.68.0
193.2.72.0
193.2.76.0
193.2.80.0
193.2.84.0
193.2.88.0
193.2.92.0
193.2.96.0
193.2.100.0
193.2.104.0
193.2.112.0
193.2.116.0
193.2.120.0
193.2.124.0
193.2.128.0
193.2.132.0
193.2.136.0
193.2.140.0
193.2.144.0
193.2.148.0
193.2.152.0
193.2.156.0
193.2.160.0

Upravljanje varnosti

- Zaščita omrežnih naprav
  - ACL, požarni zid
  - Omejitev količine prometa, ki pride do CPU
- Zaščita omrežij:
  - Lokalnega omrežja pred internetom
  - Interneta pred lokalnim omrežjem
- Pomoč - dnevniški zapisi
  - Syslog, SNMP trap…
  - Netflow (sFlow)

Diagosticiranje



Diagnosticiranje v omrežjih IP

- Lokalizacija/identifikacija razlogov za probleme v omrežju
  - Tradicionalna orodja (ping, traceroute) niso dovolj dobra.

Težave tradicionalnih orodij

```
$ ping  -s www.uni-mb.si
PING www.uni-mb.si: 56 data bytes
64 bytes from www.uni-mb.si (164.8.23.111): icmp_seq=0. time=4. ms
64 bytes from www.uni-mb.si (164.8.23.111): icmp_seq=1. time=4. ms
64 bytes from www.uni-mb.si (164.8.23.111): icmp_seq=2. time=3. ms
64 bytes from www.uni-mb.si (164.8.23.111): icmp_seq=3. time=4. ms
64 bytes from www.uni-mb.si (164.8.23.111): icmp_seq=4. time=4. ms
64 bytes from www.uni-mb.si (164.8.23.111): icmp_seq=5. time=3. ms
^C
----www.uni-mb.si PING Statistics----
6 packets transmitted, 6 packets received, 0% packet loss
round-trip (ms)  min/avg/max = 3/3/4
$
```

Težave tradicionalnih orodij

$ **ping -s www.cnn.com**

PING www.cnn.com: 56 data bytes

^C

----www.cnn.com PING Statistics----

86 packets transmitted, 0 packets received, 100% packet loss

$

Težave tradicionalnih orodij

```
$ traceroute www.cnn.com
traceroute: Warning: www.cnn.com has multiple addresses; using 157.166.255.18
traceroute to www.cnn.com (157.166.255.18), 30 hops max, 40 byte packets
 1  ojstrica.arnes.si (193.2.1.193)  1.066 ms  0.614 ms  0.596 ms
 2  rarnes13-G1-0x90.arnes.si (194.249.16.201)  1.351 ms  2.889 ms  2.330 ms
 3  larnes6-V103.arnes.si (212.235.160.237)  1.321 ms  1.387 ms  1.337 ms
 4  rarnes2-X0-0-0x102.arnes.si (212.235.160.243)  1.248 ms  4.673 ms  1.417 ms
 5  arnes-bckp.rt1.bud.hu.geant2.net (62.40.124.113)  8.571 ms  8.356 ms  8.827 ms
 6  bpt-b2-link.telia.net (80.239.134.1)  8.288 ms  8.561 ms  10.863 ms
 7  hbg-bb2-link.telia.net (80.91.250.134)  33.143 ms  30.328 ms  30.540 ms
 8  ldn-bb2-link.telia.net (80.91.250.151)  45.309 ms
    ldn-bb2-link.telia.net (80.91.254.219)  44.087 ms
    ldn-bb2-link.telia.net (80.91.250.151)  44.262 ms
 9  80.91.253.118 (80.91.253.118)  116.576 ms
     nyk-bb2-pos0-2-0.telia.net (213.248.65.94)  116.007 ms  118.039 ms
10  nyk-b5-link.telia.net (80.91.248.162)  114.598 ms
      nyk-b5-link.telia.net (80.91.248.154)  118.482 ms  147.873 ms
...
17  ae-2.ebr3.Atlanta2.Level3.net (4.69.132.85)  136.046 ms  144.237 ms  143.677 ms
18  ae-11-51.car1.Atlanta1.Level3.net (4.68.103.2)  313.401 ms  225.119 ms  237.362 ms
19  * * *
20  * * *
21  * * *
22^C
$
```

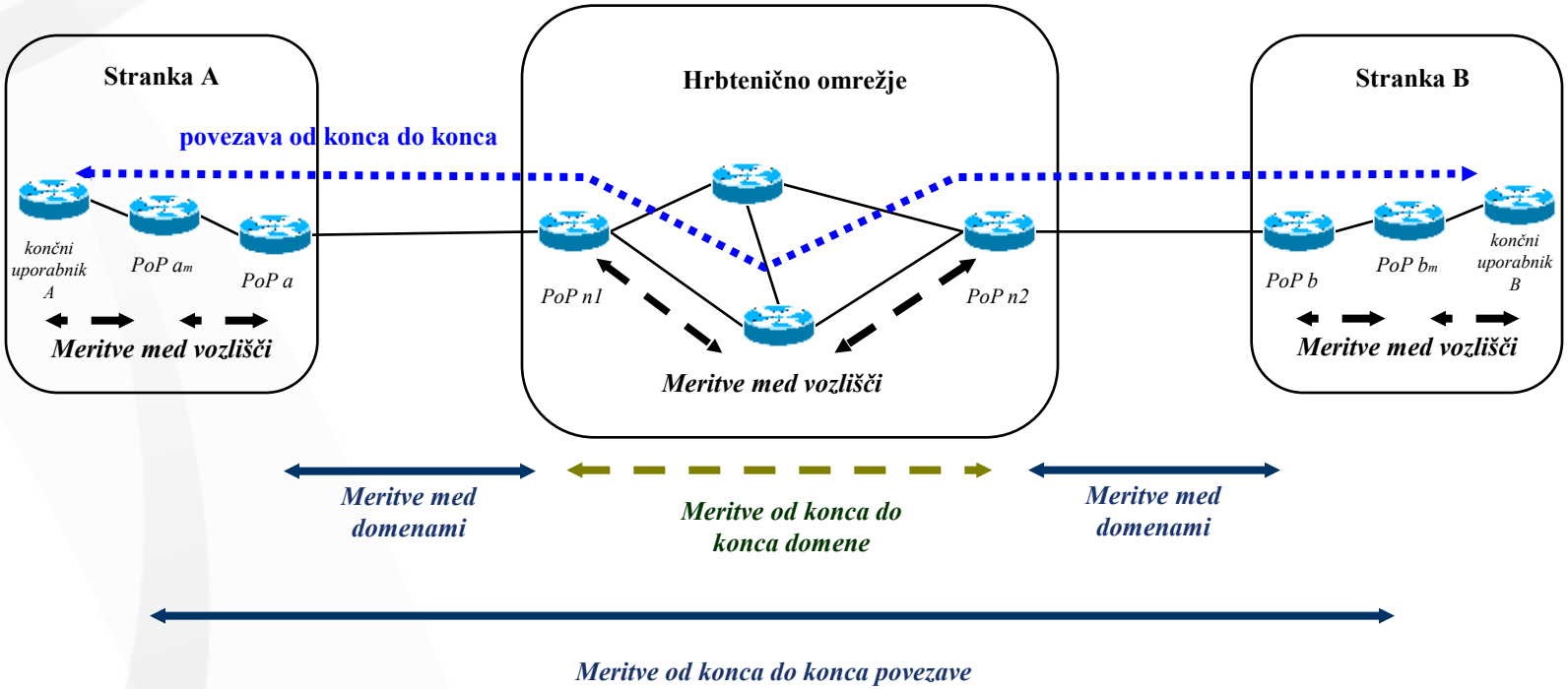
Težave tradicionalnih orodij

- Pogoj za zanesljivost rezultatov:
  - Transparentnost omrežja
  - Odzivnost omrežnih naprav
- Dejansko stanje:
  - Omrežne naprave testni promet
    - Zavračajo/se ne odzovejo?
    - Omejujejo?
    - Obravnavajo z nižjo prioriteto?
  - Zapleti ob uporabi QoS v omrežju (DSCP)
    - Kje se paketi “barvajo”?
    - Kje se izvaja omejevanje posameznih razredov prometa?
    - Se “barva” paketov ohranja na celotni poti?
    - A vsi omrežni elementi zagotavljajo ustrezen režim strežbe?

Kako iz težav?

- Potrebujemo več podatkov:
  - Delež izgubljenih paketov, duplikati
  - Zakasnitev paketov pri prenosu (v eno smer)
  - Nihanje zakasnitve
  - Spreminjanje vrstnega reda paketov
  - Zasedenost povezav
  - Razpoložljiva pasovna širina
  - Vrednost števcev na omrežnih napravah
- Meritve po segmentih omrežja
  - Na zahtevo/periodične
  - Aktivne/pasivne

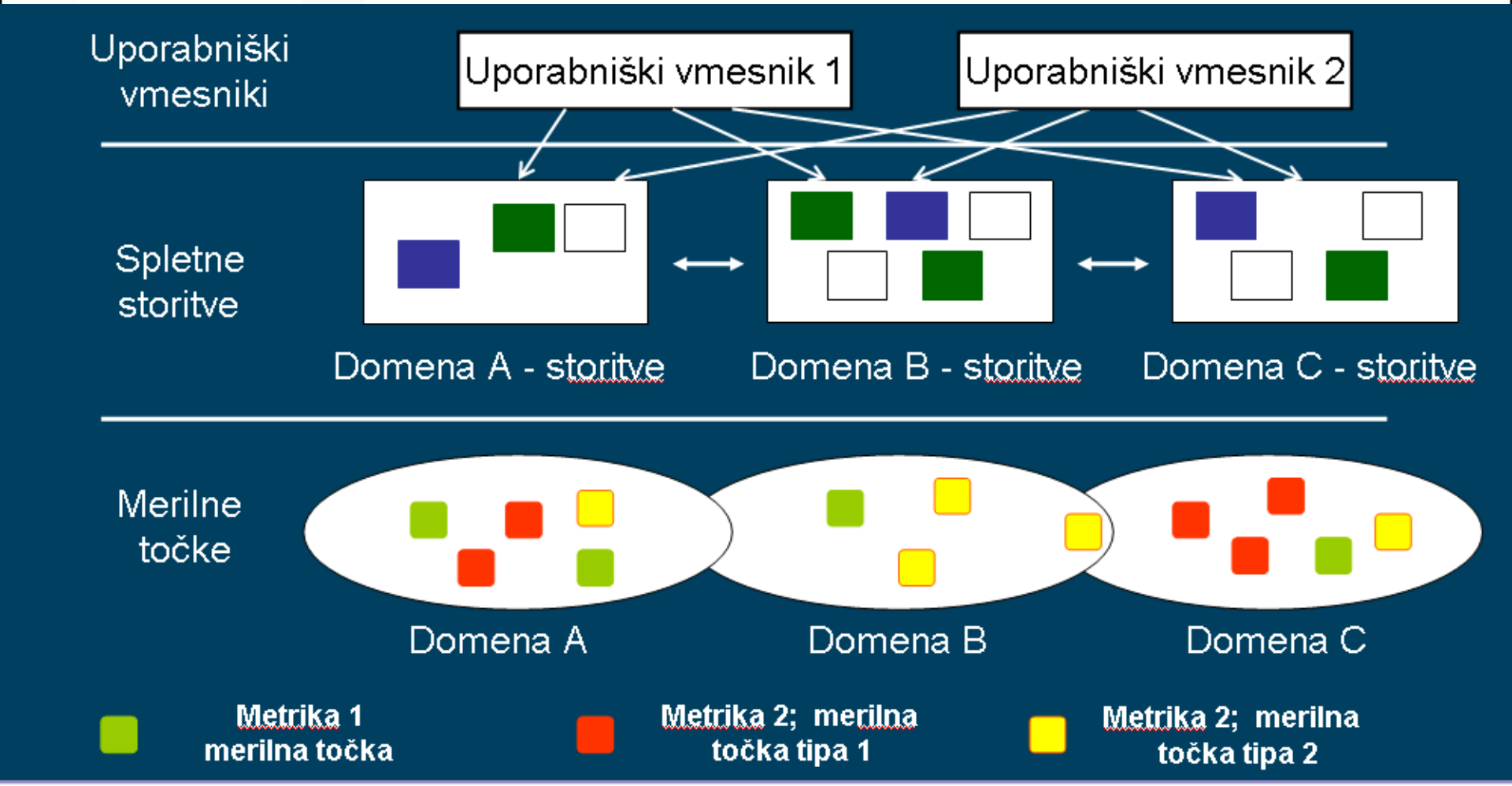
Potrebne meritve



Problematika večoperaterskega okolja

- Večino meritev lahko izvaja le operater omrežja
  - Dostop do omrežnih elementov
  - Poznavanje topologije omrežja
  - NOC (Network Operations Center)
- Povezava preko omrežij več operaterjev?
  - Vpletenih več NOC-ov
  - Potrebna koordinacija pri diagnosticiranju napake
  - Ni ustreznih orodij
  - Zavračanje “krivde”
  - Dolgotrajni postopki

Perfsonar - arhitektura



GEANT2

PerfsonarUI-v0.10

File Interfaces Circuits Playground Help

Interfaces | Circuits | Playground

perfSONAR

Query & search options

Service addresses
Time options

Execute query

Retrieve all
Clear
Refresh

Interface details

ISTF-J

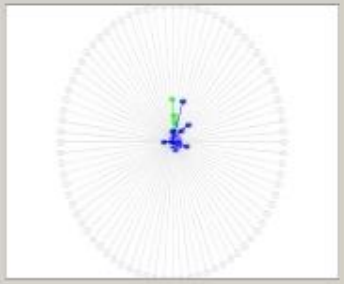
Hostname	PoP-SOF
IP Address	195.251.4.61
Interface name	PO2/1
Interface descrip...	SEEREN-SOF==...
Capacity	155000000
Resolution	300
Key	localhost.3b5eba...

Search by interface IP

```
1 swiBE2-G2-3.switch.ch (130.59.36.114) 0 msec 0 msec
  2 swiBE1-G2-4.switch.ch (130.59.36.197) 0 msec 4 ms
  3 swiCE2-G3-1.switch.ch (130.59.36.109) 4 msec 4 ms
  4 switch.rt1.gen.ch.geant2.net (62.40.124.21) [AS 2
  5 so-2-0-0.rt1.mil.it.geant2.net (62.40.112.34) [AS
  6 garr-gw.rt1.mil.it.geant2.net (62.40.124.130) [AS
  7 rt1-mi1-rt-mi2.mi2.garr.net (193.206.134.190) [AS
```

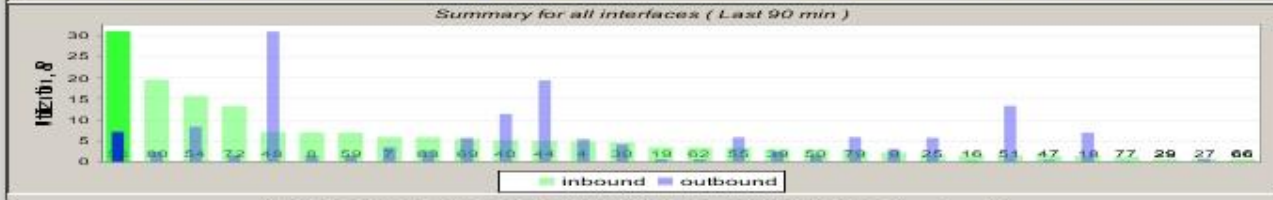
File | Paste | Search | Traceroute & Search

Summary

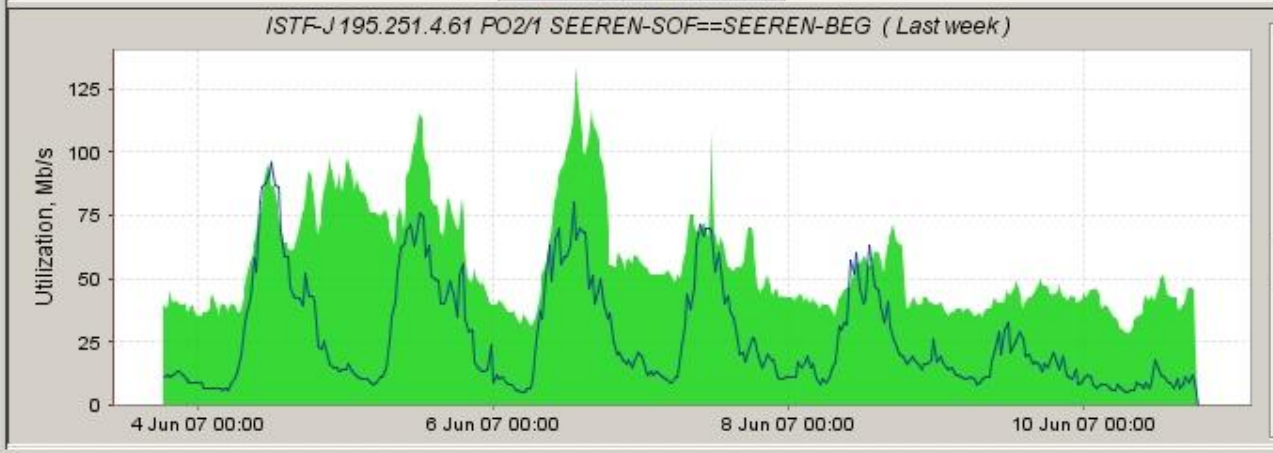


Select Interface

No.	hostName	ifAddress	ifName	ifDescription	Capacity, ...	Inbound u...	Outbound ...	Inbound u...	Outbound ...	Domain
58	PoP-SOF	195.251.4.61	PO2/1	SEEREN-S...	155,000,000	31.02	7.119	48,081,112	11,034,101	ISTF-J
80	PoP-VAR	194.141.2...	Fa0/1.1120	PoP-VAR=...	100,000,000	19.505	2.463	19,505,018	2,462,671	ISTF-J
54	PoP-VTR	194.141.2...	Fa0/0.3	PoP-VTR=...	100,000,000	15.6	8.334	15,599,902	8,334,186	ISTF-J
72	Acc-UNWE-...	192.168.1...	Gi0/1	Acc-UNWE-...	100,000,000	13.353	1.693	13,353,364	1,692,847	ISTF-J
48	PoP-SOF	195.251.4.42	PO2/0	SEEREN-S...	155,000,000	7.103	30.985	11,009,532	48,027,048	ISTF-J
8	Acc-MU-Ple...	194.141.67.1	Fa0/1	Acc-MU-Ple...	100,000,000	6.956	1.511	6,956,410	1,510,502	ISTF-J



Page
1 / 3
1-30
First | Prev | Next | Last



Time
Last 90 min
Last 8 hours
Last 24 hours
Last 3 days
Last week
Last month
Last 3 months
Last year

Completed.

PerfsonarUI-v0.10

File Interfaces Circuits Playground Help

Interfaces | Circuits | Playground

perfSONAR

Query options

Service addresses

Execute query

Retrieve all
Clear

Probe data

GEANT

Sender	Amsterdam_SUR...
Receiver	Athens_GRNET6
Sender IP address	2001:610:1:80a...
Receiver IP addr...	2001:648:2ffc:1...
Measurement ide...	0
Packet size	41
Group size	9
Sending interval	60
Precedence	0x0

June 2007

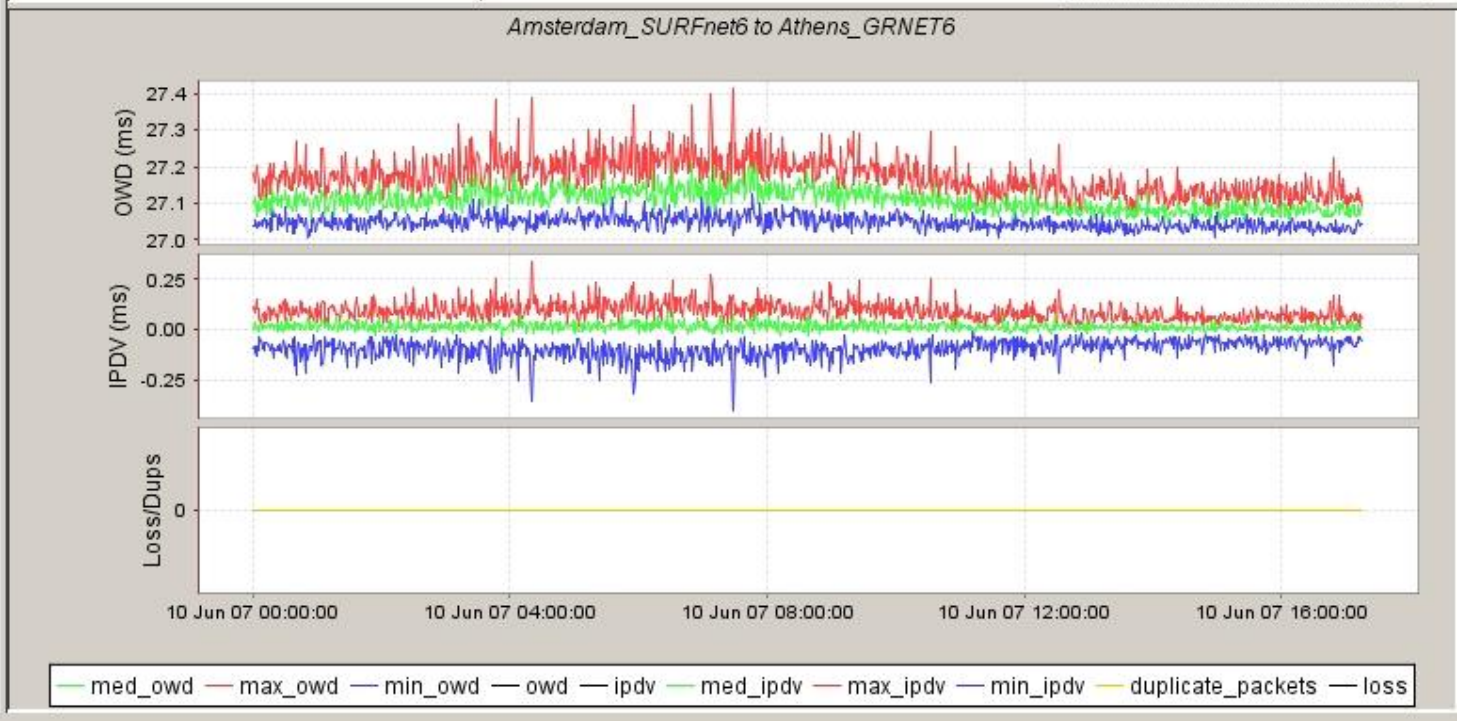
Sun	Mon	Tue	Wed	Thu	Fri	Sat
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

GEANT

Measurement ide...	N/A
Packet size	N/A
Group size	N/A
Sending interval	N/A
Precedence	N/A

Available measurements for Sun, Jun 10, 2007

#	Source
1	Amsterdam_GEANT
2	Amsterdam_SURFnet
3	Amsterdam_SURFnet6
4	Athens_GRNET
5	Athens_GRNET6
6	Bologna_GARR
7	Budapest_GEANT
8	Budapest_HUNGARNET
9	Budapest_HUNGARNET6
10	Copenhagen_GEANT
11	Frankfurt_DFN
12	Geneva_GEANT
13	Gent_BELNET
14	Kaunas_GEANT
15	Lisbon_FCCN



Completed.

Kadri – potrebno znanje

- Telekomunikacije
  - Internetne tehnologije (IP, DNS, ping, traceroute…)
  - Optične komunikacije (vlakna, ojačevalniki, filtri…)
  - Omrežne tehnologije (ethernet, MPLS…)
  - Nadzor in upravljanje omrežij
- Računalništvo
  - Sistemska podpora (strežniki, diskovni sistemi, SAN…)
  - Programerji (Java, PHP, Perl…)
- Vodenje projektov, timsko delo…
- Angleški jezik
- “Common sense”

Hvala za pozornost