

# Intercontinental Multi-Domain Monitoring for the LHC Community

Domenico Vicinanza

perfSONAR MDM Product Manager

DANTE – Cambridge (UK)

*domenico.vicinanza@dante.net*

*CHEP2012 – New York – May 21<sup>st</sup> 2012*

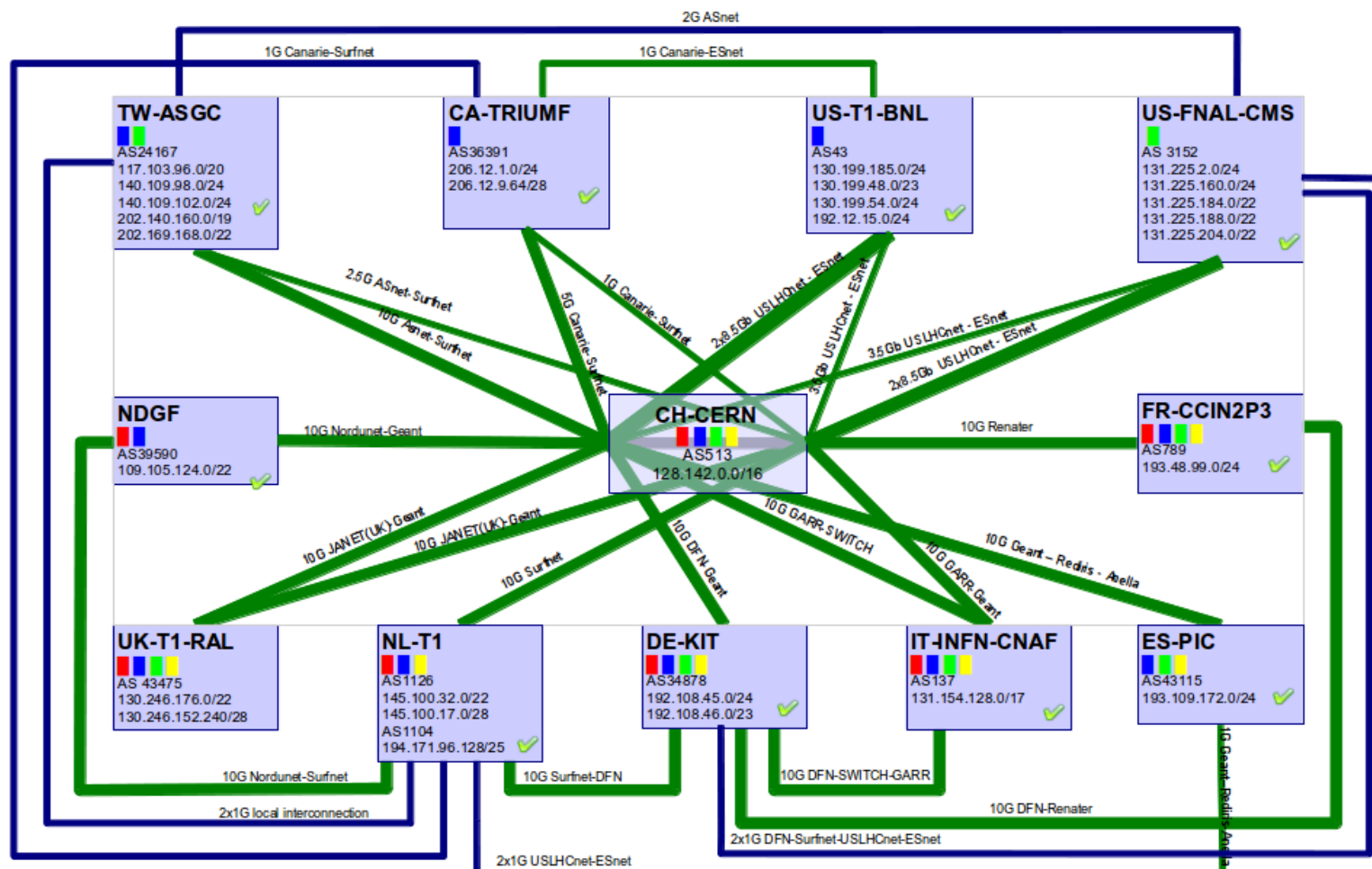
- **The situation:**

- CERN Large Hadron Collider (LHC) has really special networking and computing needs
- Computing Model is organised in tiers
  - *CERN is the Tier0 (data producer)*
  - *11 Tier1s (international big laboratories)*
  - *~120 Tier2s (university research centres and labs)*
- Data generated: 15 Petabytes/year (22 Petabytes last year)

- **The solution:**

- A special network have been built for CERN to connect it to the 11 Tier1s around the world:
  - ➔ The LHC Optical Private Network (LHCOPN)

## LHCOPN



— T0-T1 and T1-T1 traffic  
— T1-T1 traffic only  
--- Not deployed yet  
— (thick) >= 10Gbps  
— (thin) < 10Gbps  
■ = Alice ■ = Atlas  
■ = CMS ■ = LHCb  
✓ = internet backup available  
 p2p prefix: 192.16.166.0/24



- **The situation:**

- Tier2 are and will be playing a crucial role
  - *Most of the analysis will be done in Tier2 research centres and labs*
- Network is becoming an increasingly reliable resource
  - ➔ Since beginning 2011 a new network started to be designed
- Network is becoming an increasingly reliable resource
- From the new requirements (<http://bit.ly/Kj8dp5>):
  - “Data should be able to be pulled [...] from any Tier-2 or even, if possible, from several Tier-2s simultaneously in order to minimize the time to have the data locally to run the analysis task.”*

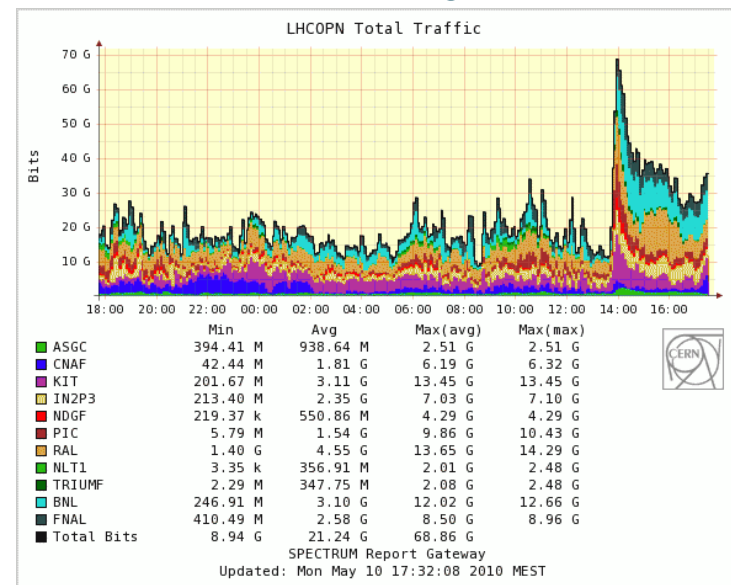
- **The answer:**

- LHC Open Network Environment
  - *L3VPN based multipoint network architecture*

# The monitoring challenge

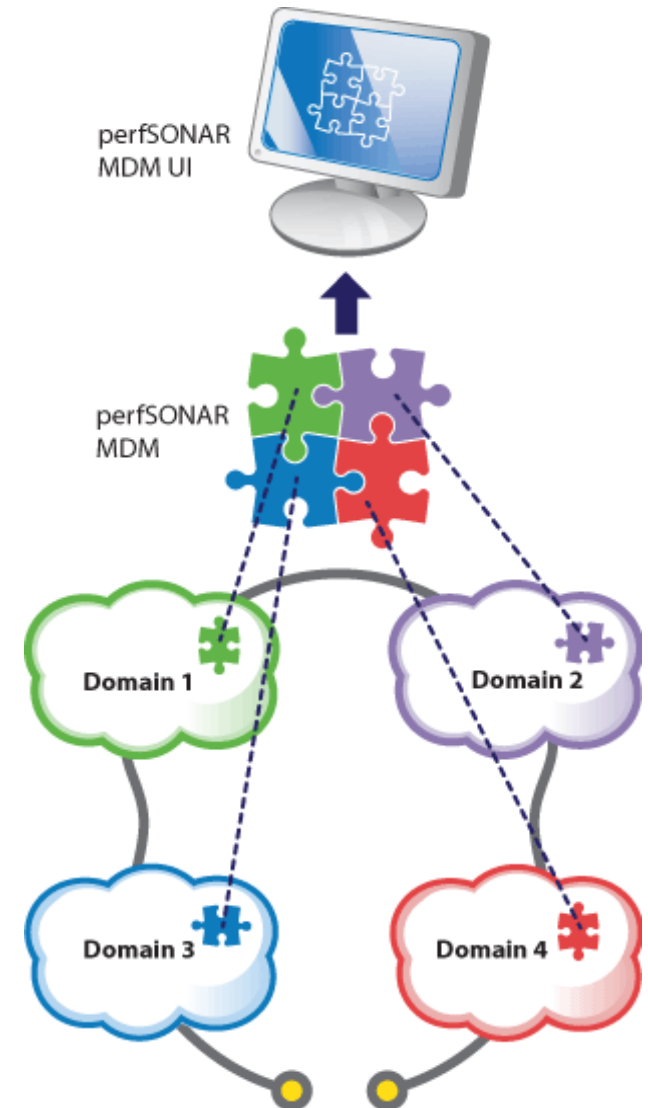


- Robust and reliable operation requires an effective monitoring of LHCOPN and LHCONE
- Monitoring solution needs to be:
  - Scalable
  - Interoperable at international level
  - Easy to deploy and manage
  - Easy to use for network engineers



- The solution chosen is based on **perfSONAR** for both LHCOPN and LHCONE

- **P**erformance focused **S**ervice **O**riented **N**etwork monitoring **A**rchitecture
- International collaboration for network monitoring
- Contributors are GÉANT, Internet2, ESnet, and RNP
- Two main implementations committed to interoperate:
  - perfSONAR MDM within GÉANT:  
<http://perfsonar.geant.net>
  - perfSONAR PS within I2/ESnet:  
<http://psps.perfsonar.net/>
- Open OGF protocol to exchange data
- Web-service based
- Design goals: flexibility, extensibility, openness, and decentralization.

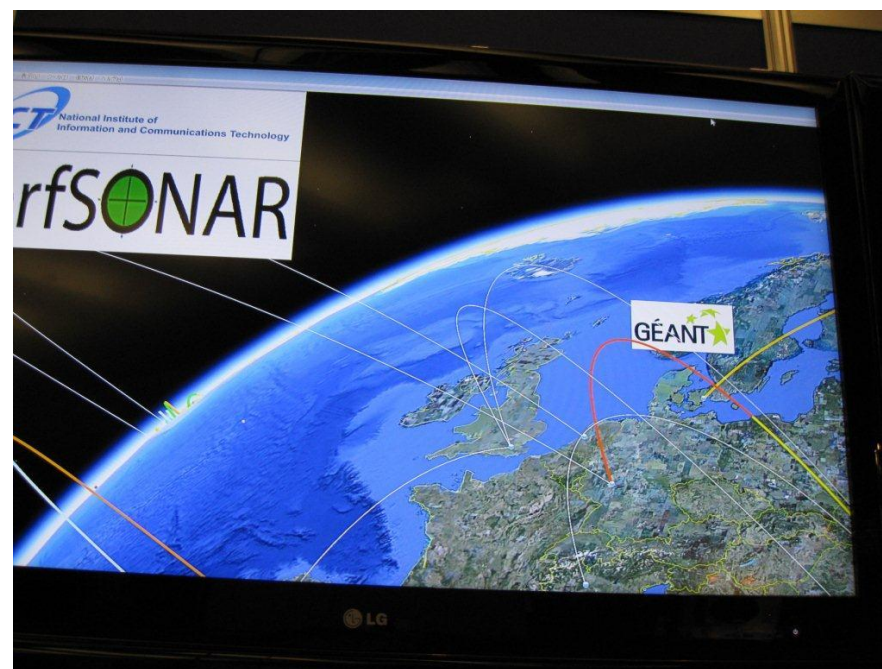
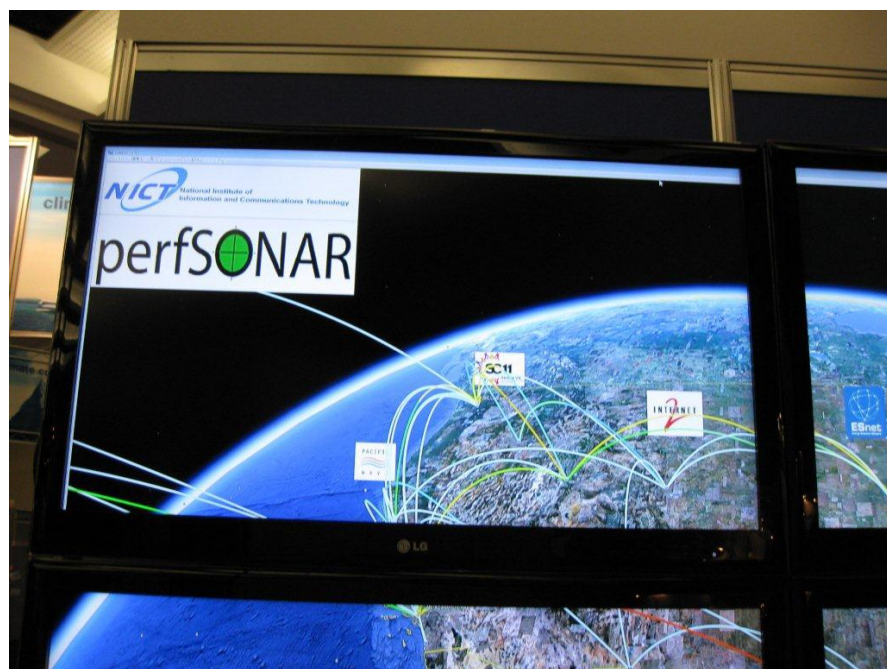




# Used worldwide to display network performances



- Easy to integrate into other visualisation tools
- Increasing number of organisations/events using perfSONAR to display network topology, utilisation, performances



(from the NICT booth at Supercomputing 2011, Seattle – Collaboration between GEANT and NICT)

perfSONAR

connect • communicate • collaborate

# Growing number of EU networks adopting perfSONAR MDM





# GÉANT Multi-Domain Service Desk

<http://mdsd.geant.net>



- perfSONAR MDM now officially supported by the GÉANT MDSD
- MDSD is operational from 08:00 to 17:00 UK time, Monday to Friday.
- Reachable by email [mdsd@geant.net](mailto:mdsd@geant.net) or telephone +44 1480 484697

The Multi-Domain Service Desk (MDSD) - Mozilla Firefox

http://mdsd.geant.net

http://www.geant.net/service/multidomainsupport/pages/home.aspx

Most Visited Le Monde.fr : Actualité... Rhône - Le Progrès Live Traffic perfSONAR web user i... perfSONAR web user i... VT SMGC VRC - EGIWiki

**MULTI-DOMAIN SERVICE DESK**

PART OF THE GÉANT SERVICE PORTFOLIO

SEARCH advanced search

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ABOUT MDSD USER EXPERIENCE FAQs RESOURCES ABOUT US CONTACT US

Part of the GÉANT Services Portfolio Monday 30 Jan 2012 | Time - 02 19

Do you need assistance with a multi-domain Service? Contact the Multi-Domain Service Desk

Would you like to know more about Bandwidth on Demand? Find out how Bandwidth on Demand can help you

Would you like to know more about perfSONAR MDM? Find out how perfSONAR monitoring can improve your network performance

**Multi-Domain Service Desk**

The Multi-Domain Service Desk provides a single point of contact to help NRENs involved in the delivery of multi-domain services and the deployment of multi-domain tools

The Multi-Domain Service Desk is a GÉANT service providing a single point of contact to NREN NOCs requiring assistance with multi-domain services and tools. The pilot phase for this service commences on 30th January 2012.

The MDSD provides support for:

**Service Desk Updates**

Jan 2012 The Multi-Domain Service Desk pilot will commence on 30th January 2012

Meet the Multi-Domain Service Desk team

**GÉANT News**

25 January | 2012

First intercontinental identity federation delivers easier access to resources

18 January | 2012

New release of perfSONAR MDM makes multi-domain monitoring faster than ever

• communicate • collaborate

- LHCOPN sites are all using perfSONAR since the beginning.
  - Initially only perfSONAR MDM
  - Currently both perfSONAR MDM and perfSONAR PS
- LHCONE sites are gradually installing either perfSONAR MDM or perfSONAR PS
- perfSONAR MDM deployment at LHC enables:
  - Tier1-Tier0 monitoring
  - Tier1-Tier1 monitoring
  - Tier1-Tier2 monitoring
  - Tier2-Tier2 monitoring

➔ From the same user interface

# New perfSONAR User Interface

## Comprehensive monitoring



- perfSONAR MDM has a new web interface:  
<http://orval.grid.aau.dk:8080/perfsonar-ui-lhcopn/>
  - **Comprehensive:**
    - Link utilisation, with possibility to compare two links
    - One-way delay
    - One-way delay variation
    - Packet loss
    - Hopcount (traceroute monitoring) with route comparison
    - Regularly scheduled bandwidth measurement
    - On-demand bandwidth measurement
- ➔ All accessible from one URL

# New perfSONAR UI: User-driven design



- **Built according to real user needs:**
  - Used by Network Operation Centre (NOC) engineers
  - Gradually adopted by European NOCs
  - Professionally reviewed
  - Hosted as an independent website which accesses perfSONAR data
    - *Customisable (in terms of security, access, ...)*
    - *Easy to manage*
  - Debian and Redhat packages are being prepared

# Metrics at a glance: the new web-based weathermap



- Weather map reading live perfSONAR MDM data
- Customisable coloured map
  - 19 metrics implemented
    - The actual availability depends on what it is deployed on each site*
  - Colour-coded according to the metric chosen
- Wide variety of metrics to choose, including
  - OWD
  - Jitter
  - Packet Loss
  - Bandwidth
  - Link Utilisation / Input errors / Discarded packets



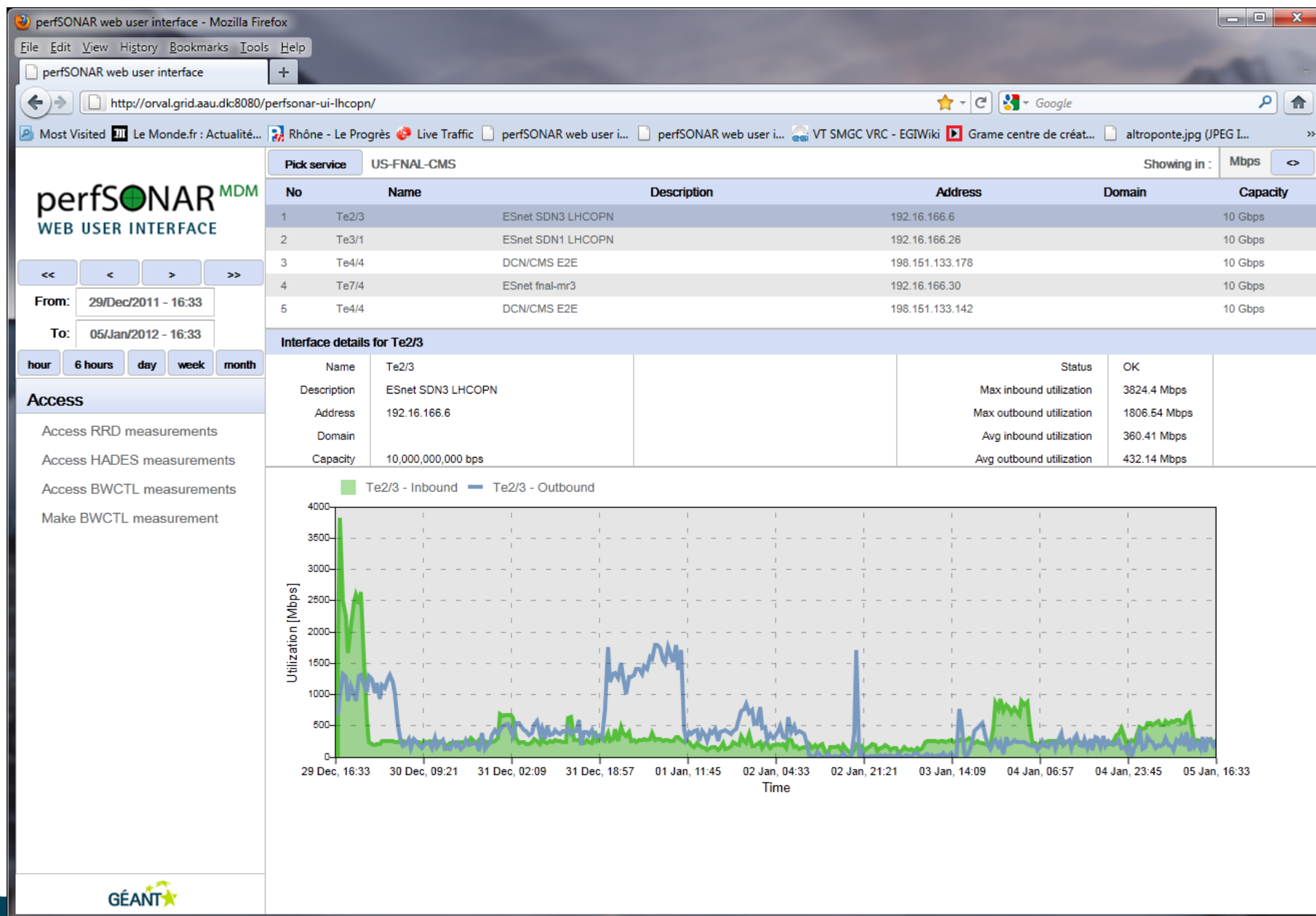
# What's new about the weathermap (cont.)



- New updated topology being implemented.
  - <http://tinyurl.com/lhcopn-weathermap>
  - Username and password created for the LHC community:
    - *User: webcnm\_lhcopn*
    - *Password: Txc5,Mb5*
- Please contact the perfSONAR MDM team if you would like your site to be included in the map!

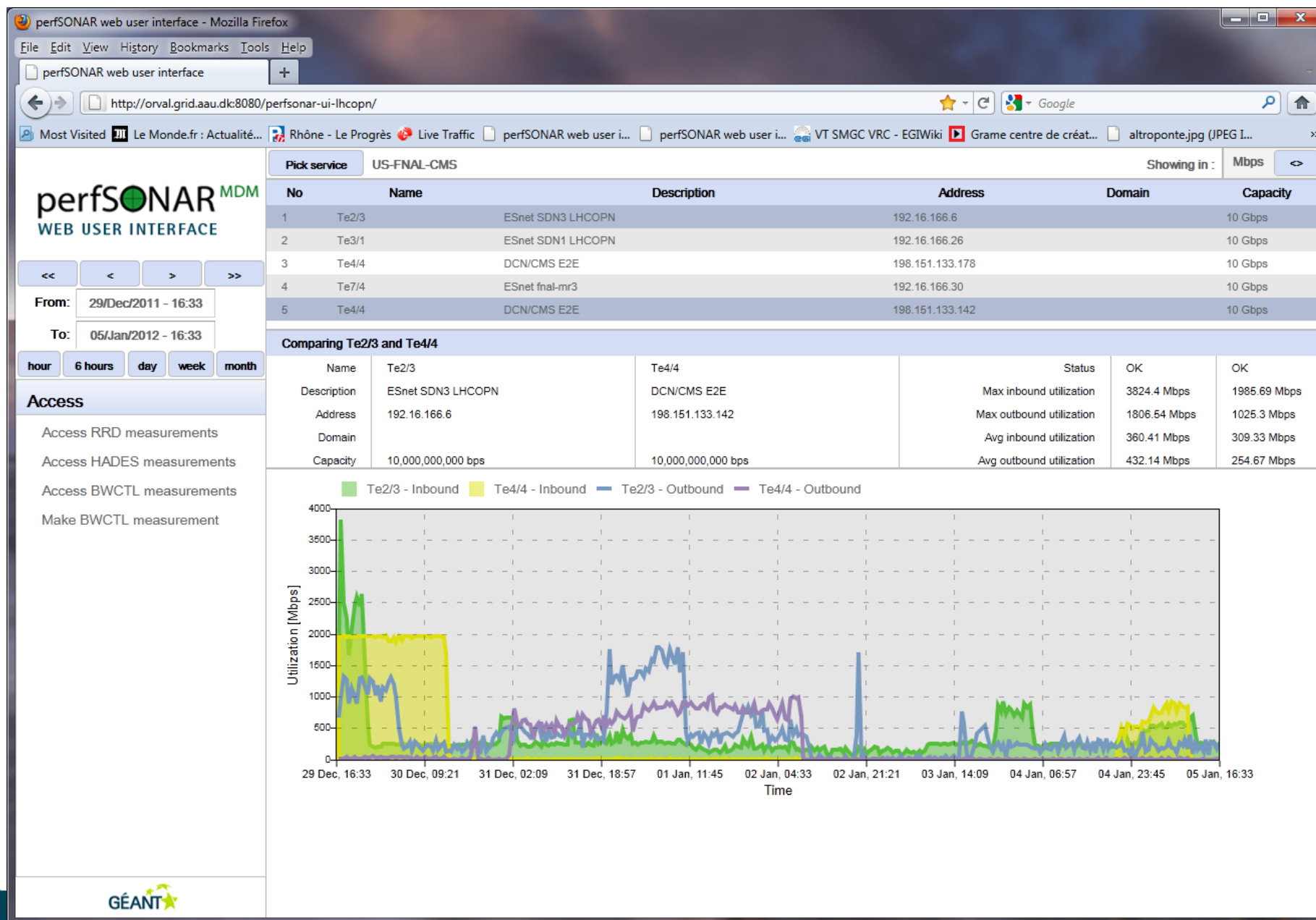
# Screenshots from the LHCOPN/LHCONE perfSONAR MDM web interface

# Link utilisation, input errors, output drops (RRD-MA)

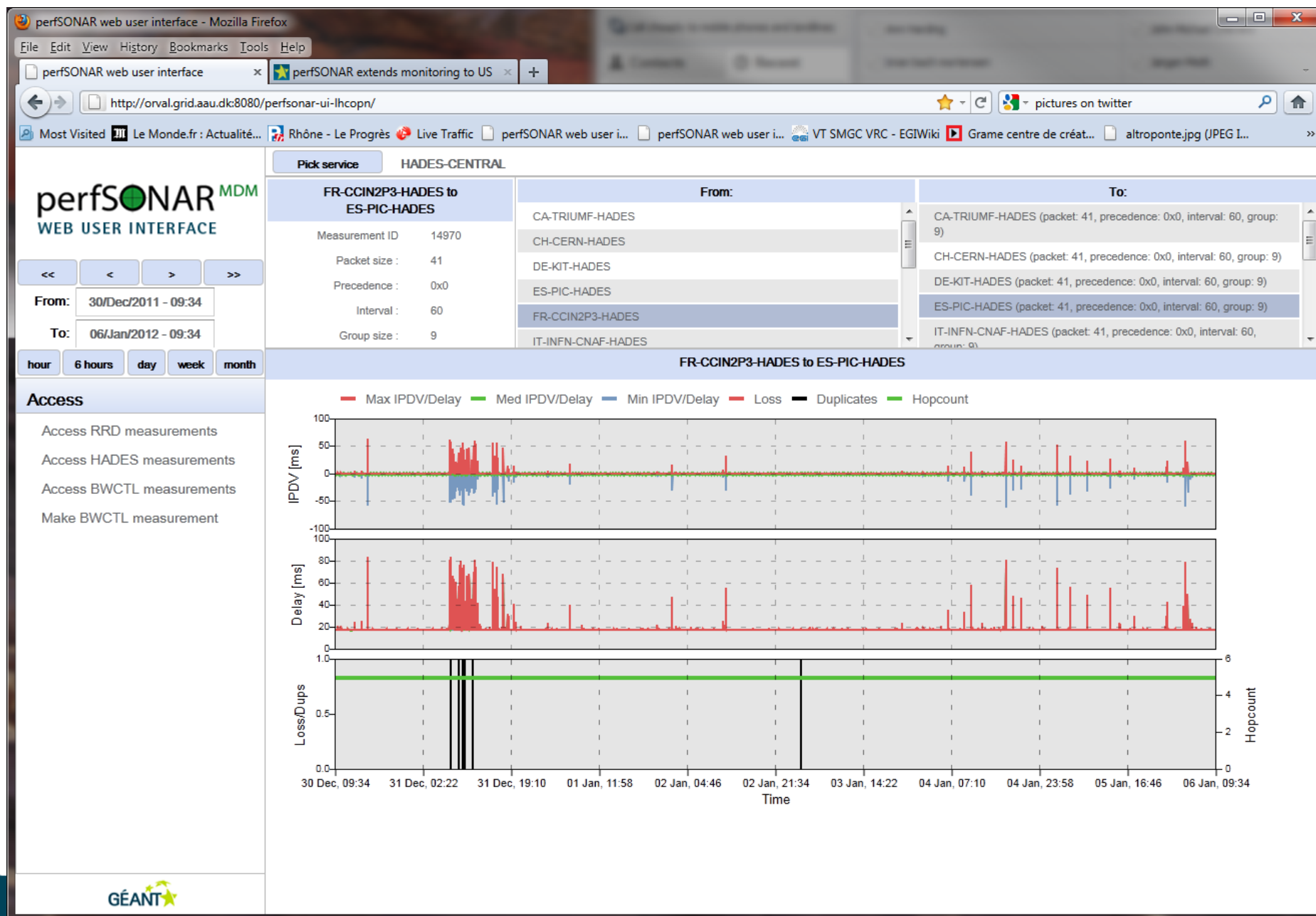


# RRD-MA

## Comparing two interfaces



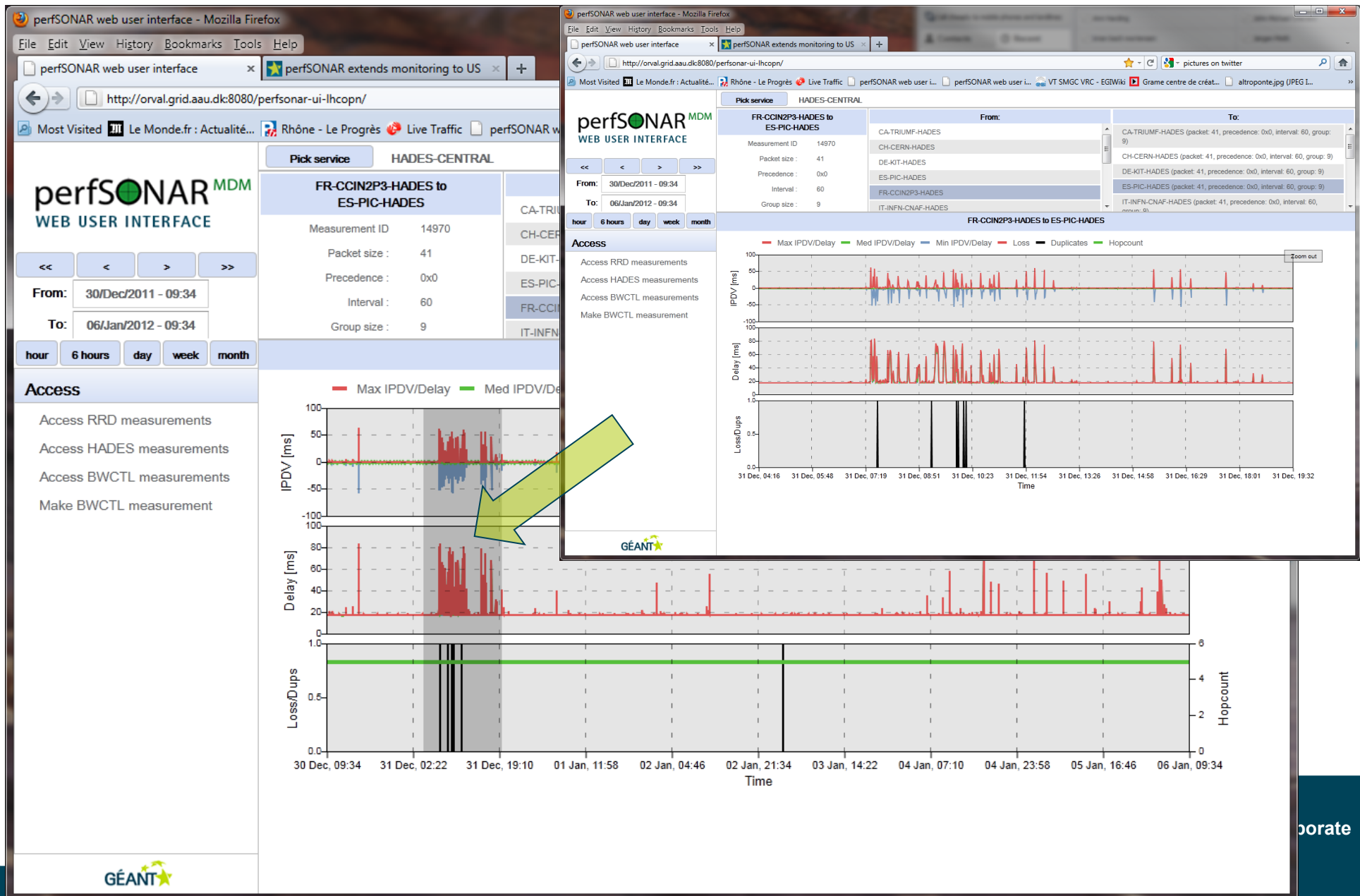
# 1Way Delay, Jitter, Packet Loss and Traceroute



rate



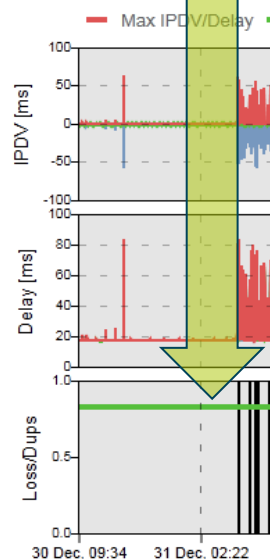
# As usual you can select and magnify



# 1Way Delay, Jitter, Packet Loss and Traceroute



Clicking on the hop counts graph you can get the traceroutes and compare them



Route 1 - from 30 Dec, 09:34

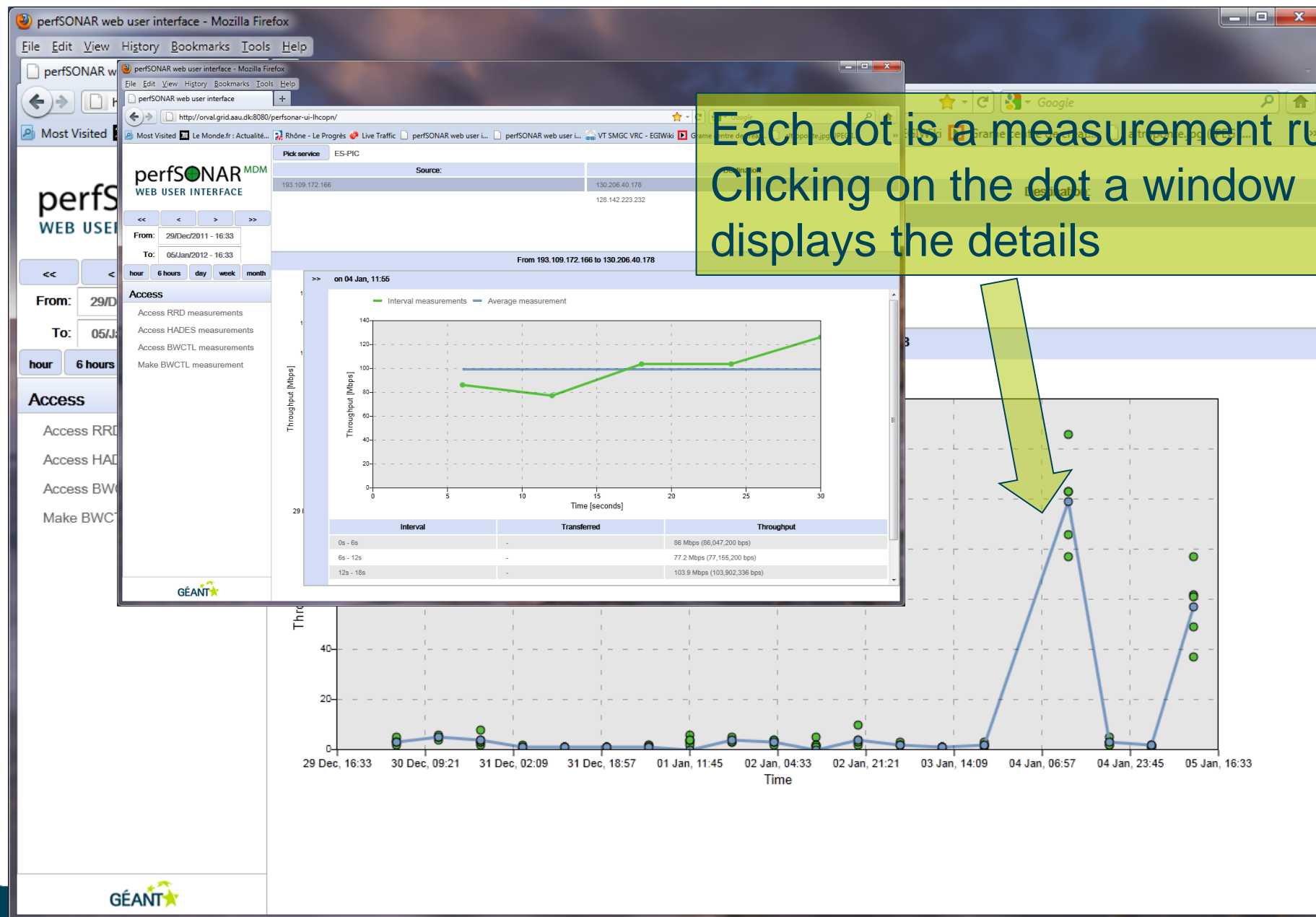
1	193.48.99.100	Lyon-OPN.in2p3.fr
2	192.16.166.41	IS13-e-rbml-2-be7.cern.ch
3	192.16.166.145	IS13-e-rbml-1-tl0.cern.ch
4	192.16.166.58	lhcopn-pic.cern.ch
5	193.109.172.165	hades-opn01.pic.es

Select route to compare:

Route 1 (from 30 Dec, 09:34 - 5 hops)

Traceroute

# Accessing BWCTL Historic Measurements



# Making an on-demand BWCTL measurement...



perfSONAR web user interface - Mozilla Firefox

File Edit View History Bookmarks Tools Help

perfSONAR web user interface

http://orval.grid.aau.dk:8080/perfsonar-ui-lhcopn/

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**perfSONAR MDM**  
WEB USER INTERFACE

Pick source Pick destination NDGF Perform test

Protocol: TCP UDP Address type: IPv4 IPv6 Test duration (s): 30  
TCP Window size (bytes): Reporting interval (s): 6  
Type of Service bits:

Interval measurements Average measurement

From: 29/Dec/2011 - 16:33  
To: 05/Jan/2012 - 16:33  
hour 6 hours day week month

**Access**

- Access RRD measurements
- Access HADES measurements
- Access BWCTL measurements
- Make BWCTL measurement

**Please select source MP endpoint to query**

Name	URL	Type
Tier 1 - CA-TRIUMF	http://206.12.9.68:8090/services/MP/BWCTL	BWCTL_MP
Tier 1 - CH-CERN	http://128.142.223.232:8090/services/MP/BWCTL	BWCTL_MP
Tier 1 - DE-KIT	http://192.108.46.125:8090/services/MP/BWCTL	BWCTL_MP
Tier 1 - ES-PIC	http://193.109.172.166:8090/services/MP/BWCTL	BWCTL_MP
Tier 1 - FR-CCIN2P3	http://193.48.99.245:8090/services/MP/BWCTL	BWCTL_MP
Tier 1 - IT-INFN-CNAF	http://131.154.254.5:8090/services/MP/BWCTL	BWCTL_MP
Tier 1 - NDGF	http://hades-bwctl.ndgf.org:8090/services/MP/BWCTL	BWCTL_MP
Tier 1 - NL-T1	http://145.100.17.7:8090/services/MP/BWCTL	BWCTL_MP

Cancel Select

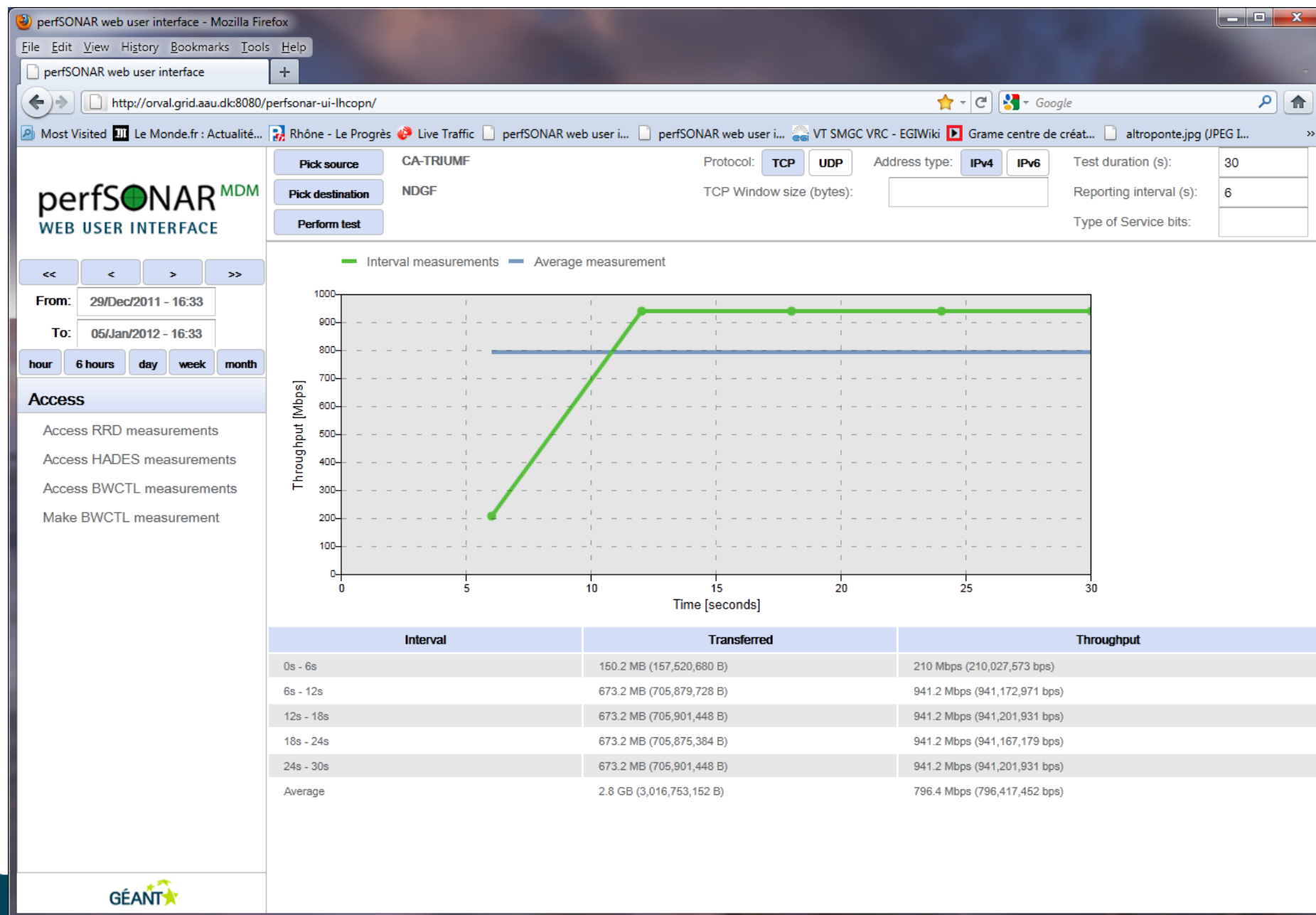
Throughput [Mbps]

Throughput

0s - 6s		3 bps)
6s - 12s		371 bps)
12s - 18s	673.2 MB (705,901,448 B)	941.2 Mbps (941,201,931 bps)
18s - 24s	673.2 MB (705,875,384 B)	941.2 Mbps (941,167,179 bps)
24s - 30s	673.2 MB (705,901,448 B)	941.2 Mbps (941,201,931 bps)
Average	2.8 GB (3,016,753,152 B)	796.4 Mbps (796,417,452 bps)

GÉANT

# ...and getting the results in two clicks from the web interface





# T1-T1, T1-T2 and T2-T2 monitoring from the same interface

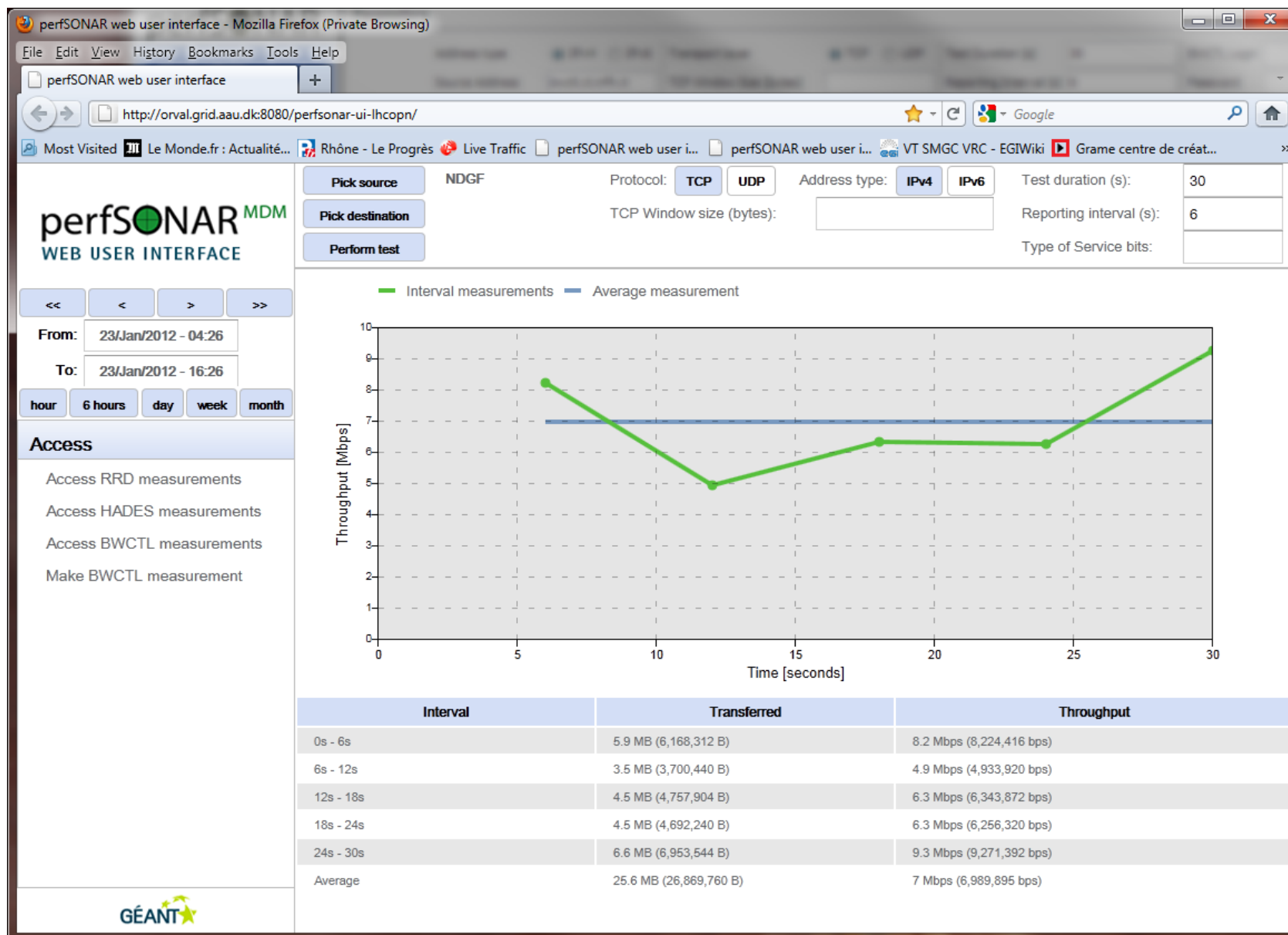


Please select source MP endpoint to query

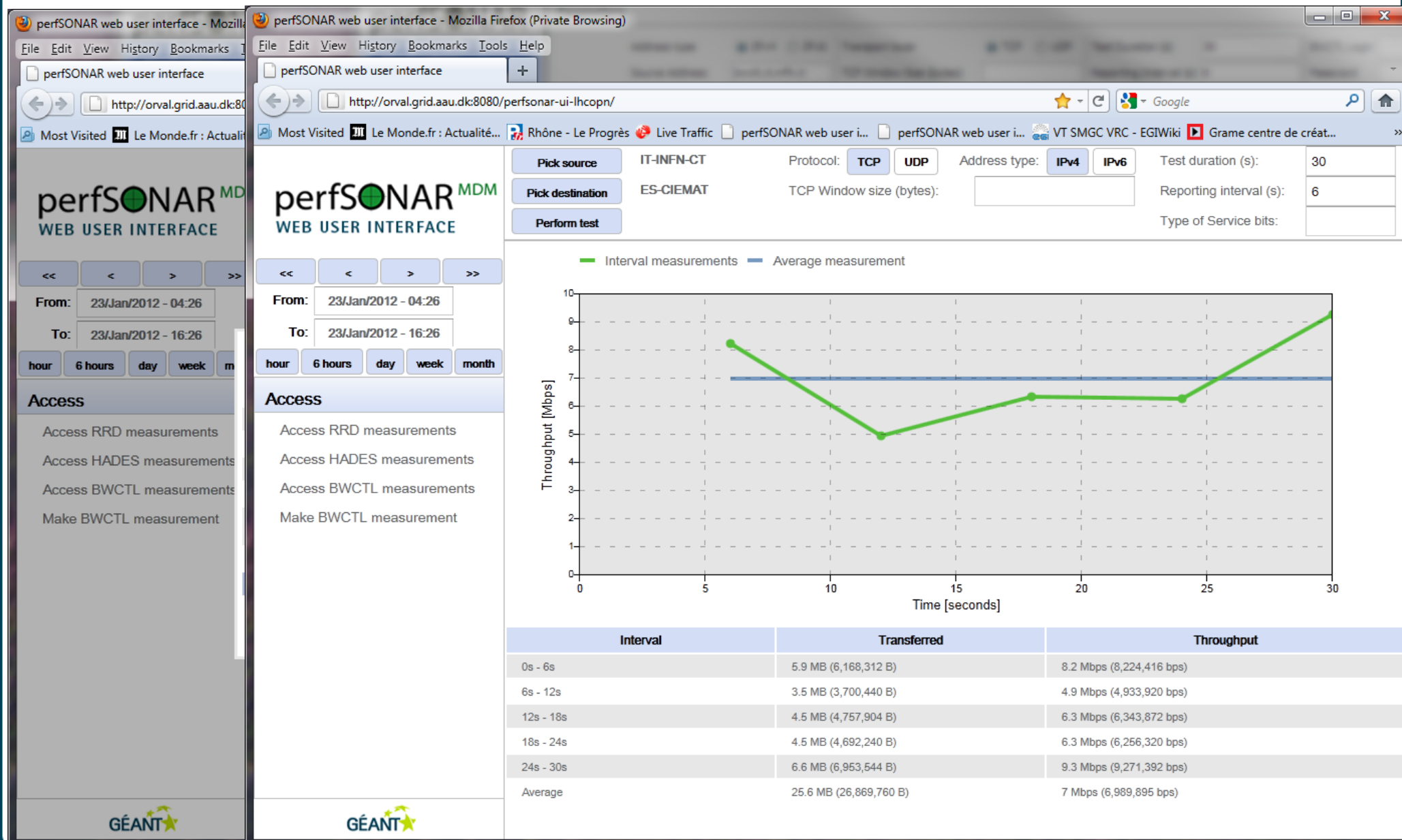
Tier 1 - IT-INFN-CNAF	http://131.154.254.5:8090/services/MP/BWCTL	BWCTL_MP
Tier 1 - NDGF	http://hades-bwctl.ndgf.org:8090/services/MP/BWCTL	BWCTL_MP
Tier 1 - NL-T1	http://145.100.17.7:8090/services/MP/BWCTL	BWCTL_MP
Tier 1 - TW-ASGC	http://117.103.105.184:8090/services/MP/BWCTL	BWCTL
Tier 1 - UK-T1-RAL	http://130.246.152.245:8090/services/MP/BWCTL	BWCTL_MP
Tier 1 - US-FNAL-CMS	http://198.49.208.19:8090/services/MP/BWCTL	BWCTL_MP
Tier 1 - US-T1-BNL	http://192.12.15.66:8090/services/MP/BWCTL	BWCTL_MP
Tier 2 - ES-CIEMAT	http://perfbw.ciemat.es:8090/services/MP/BWCTL	BWCTL_MP
Tier 2 - IT-INFN-CT	http://bwctl.ct.infn.it:8090/services/MP/BWCTL	BWCTL_MP

Cancel Select

# T1-T2 Measurements

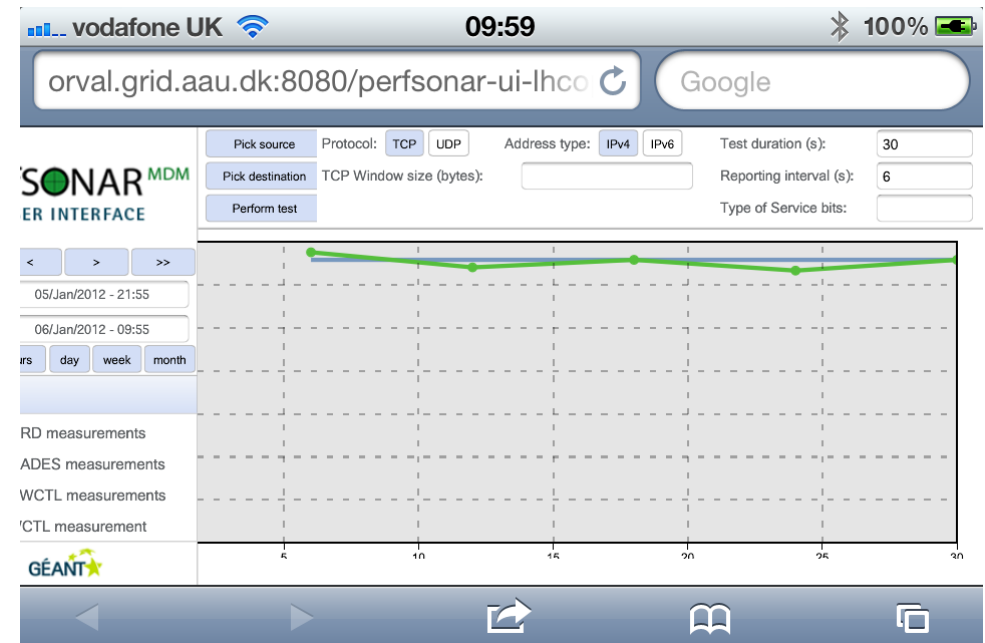


# T2-T2 Measurements



**New developments:  
Interface accessible from mobile devices**

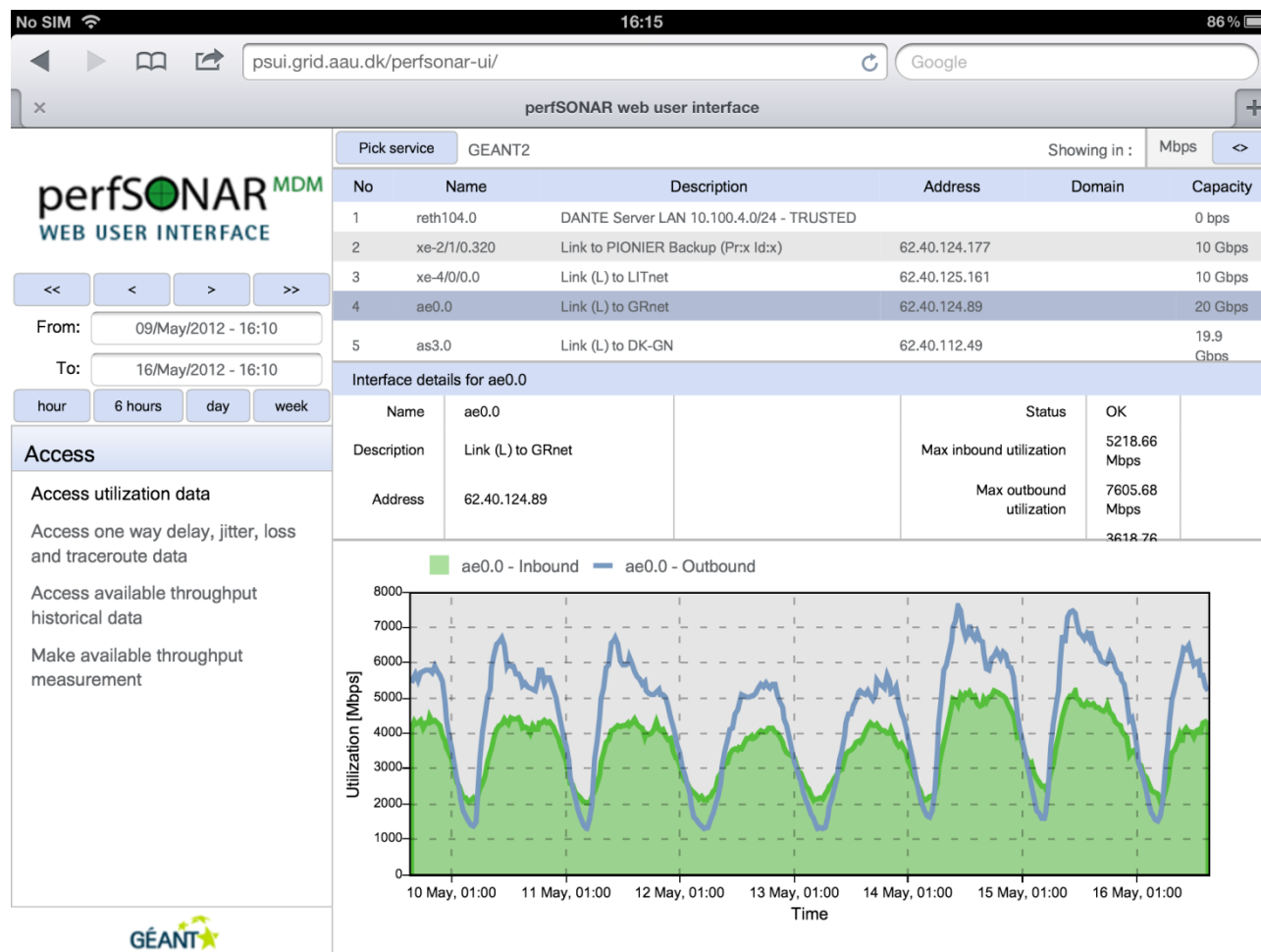
# Interface accessible from mobile devices (with on-demand capabilities)



The interface on a smartphone (Apple iPhone)



# Interface accessible from mobile devices (iPad)

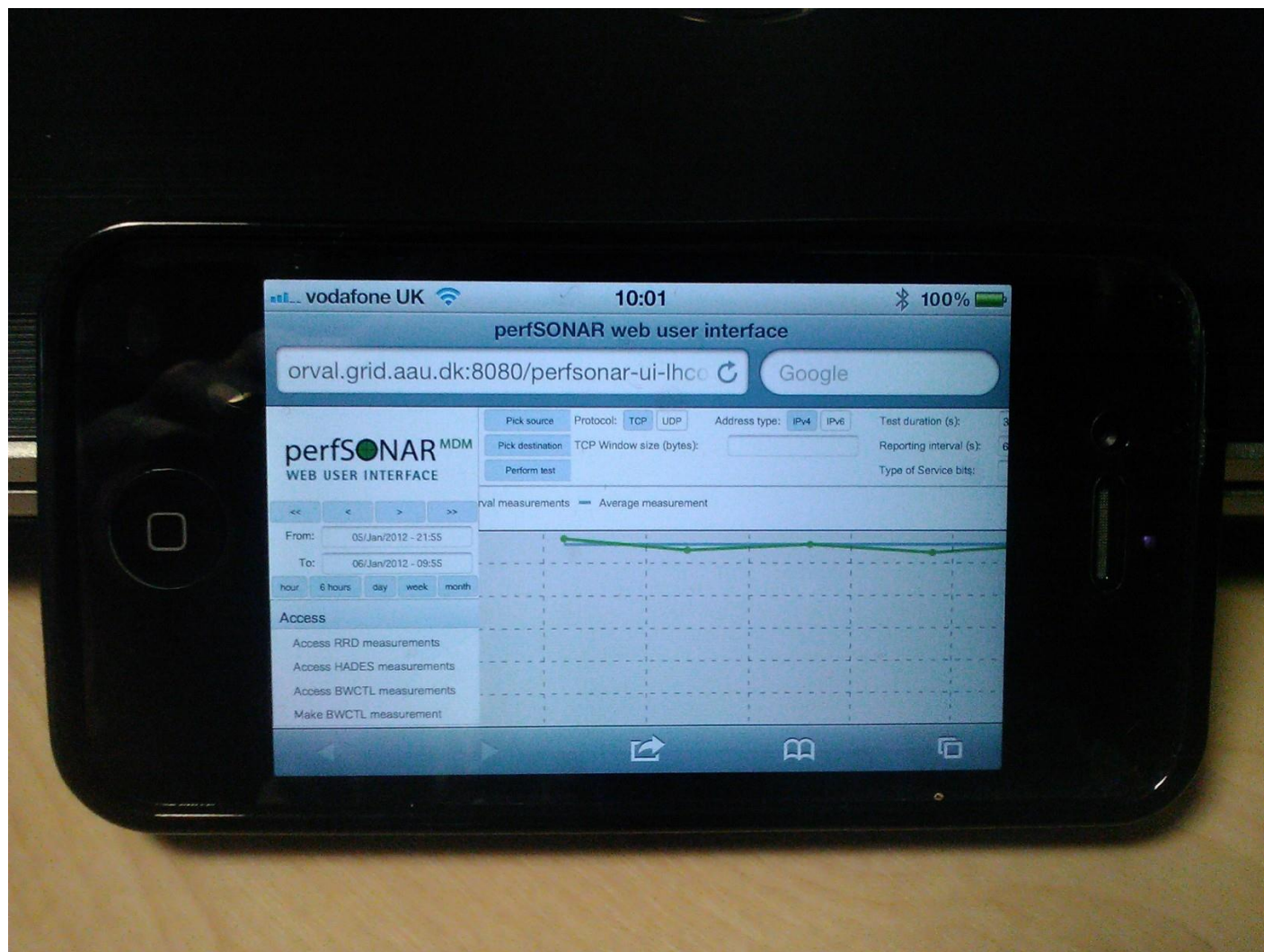


The interface on an Apple iPad

perfsONAR

connect • communicate • collaborate

# Troubleshooting on the move

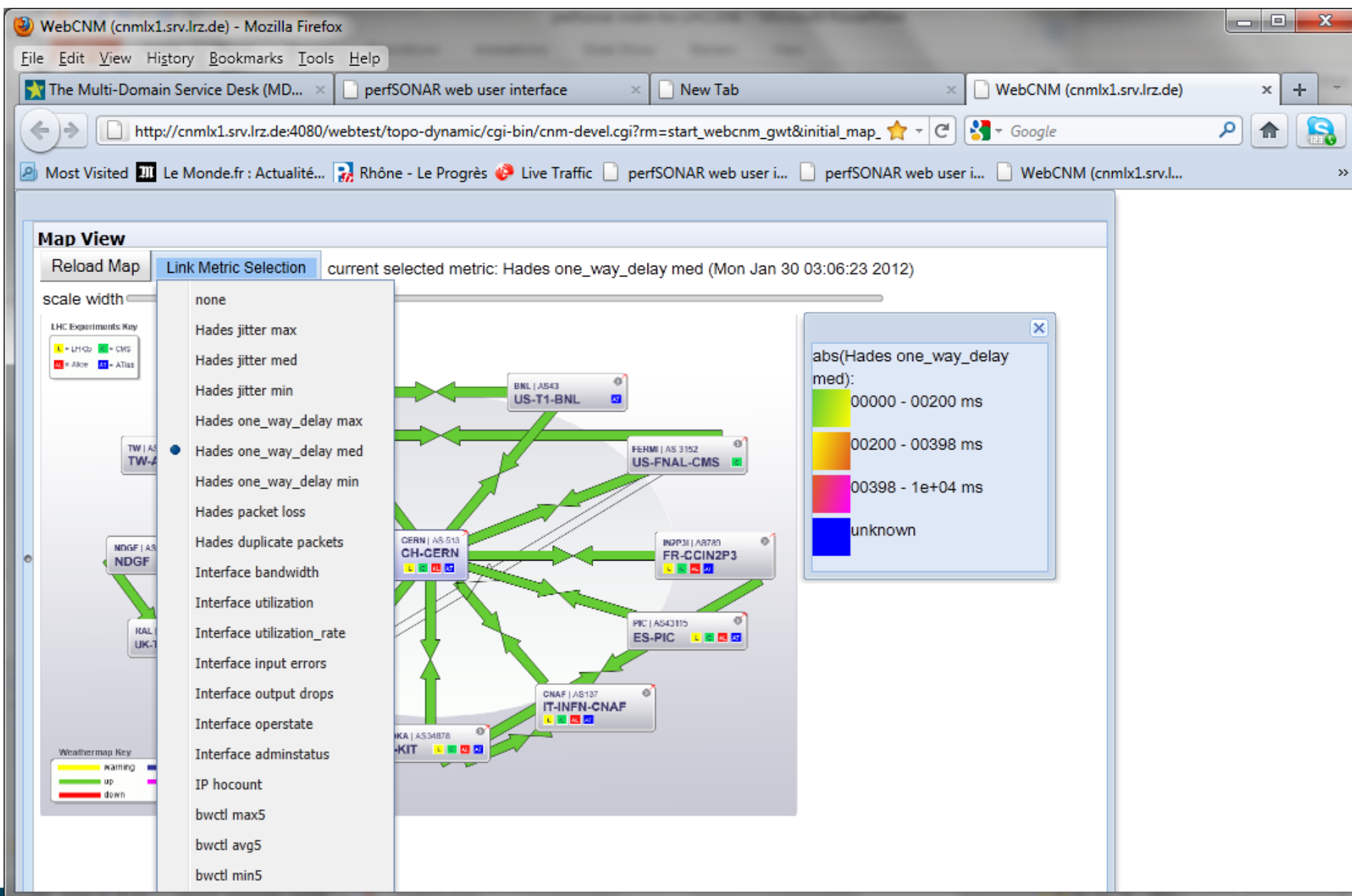


The result of an **on-demand** Bandwidth test run from an iPhone

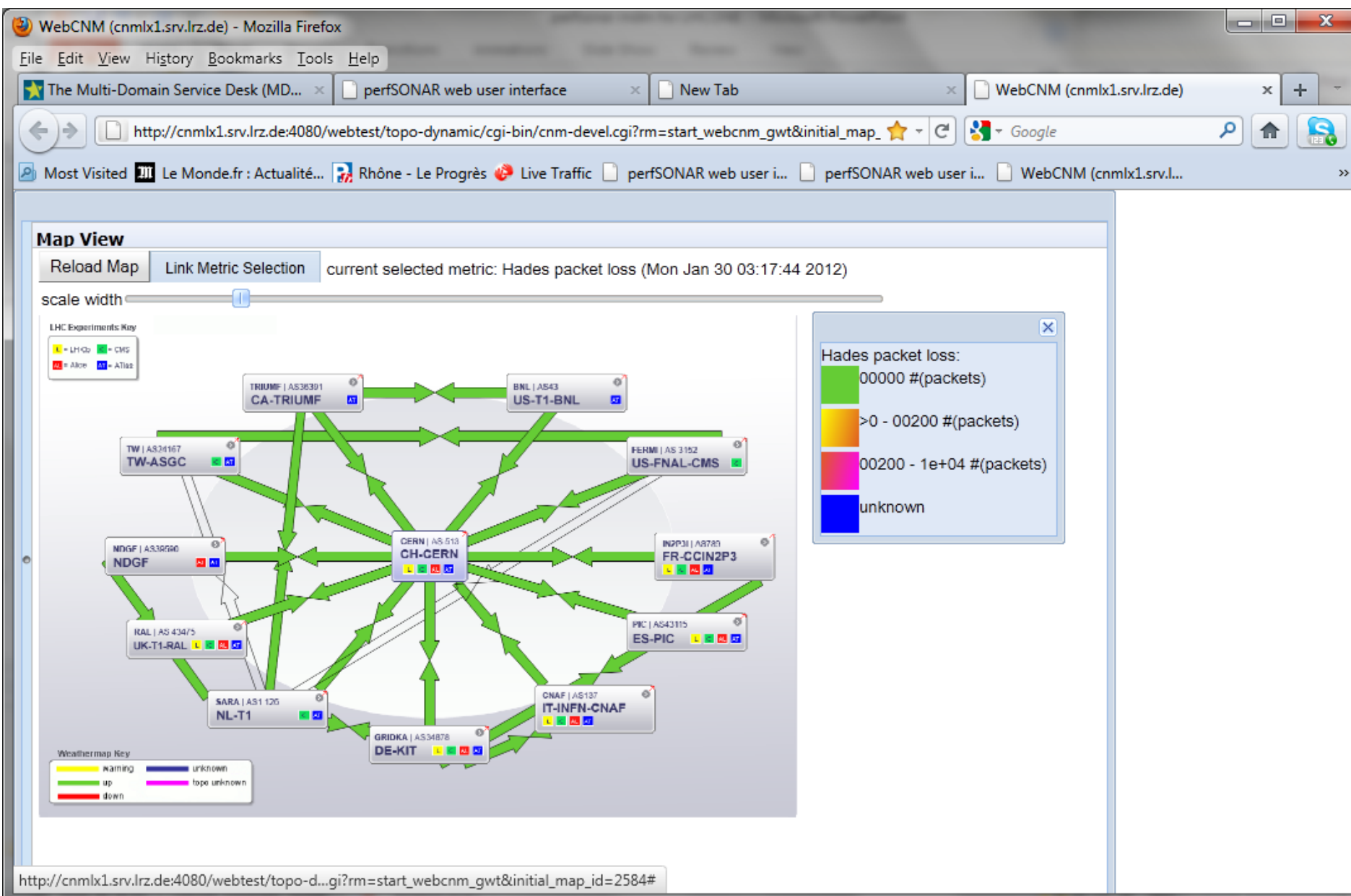
## New developments: Integration of the new weather map

# New weather map integration

## 19 perfSONAR parameters available

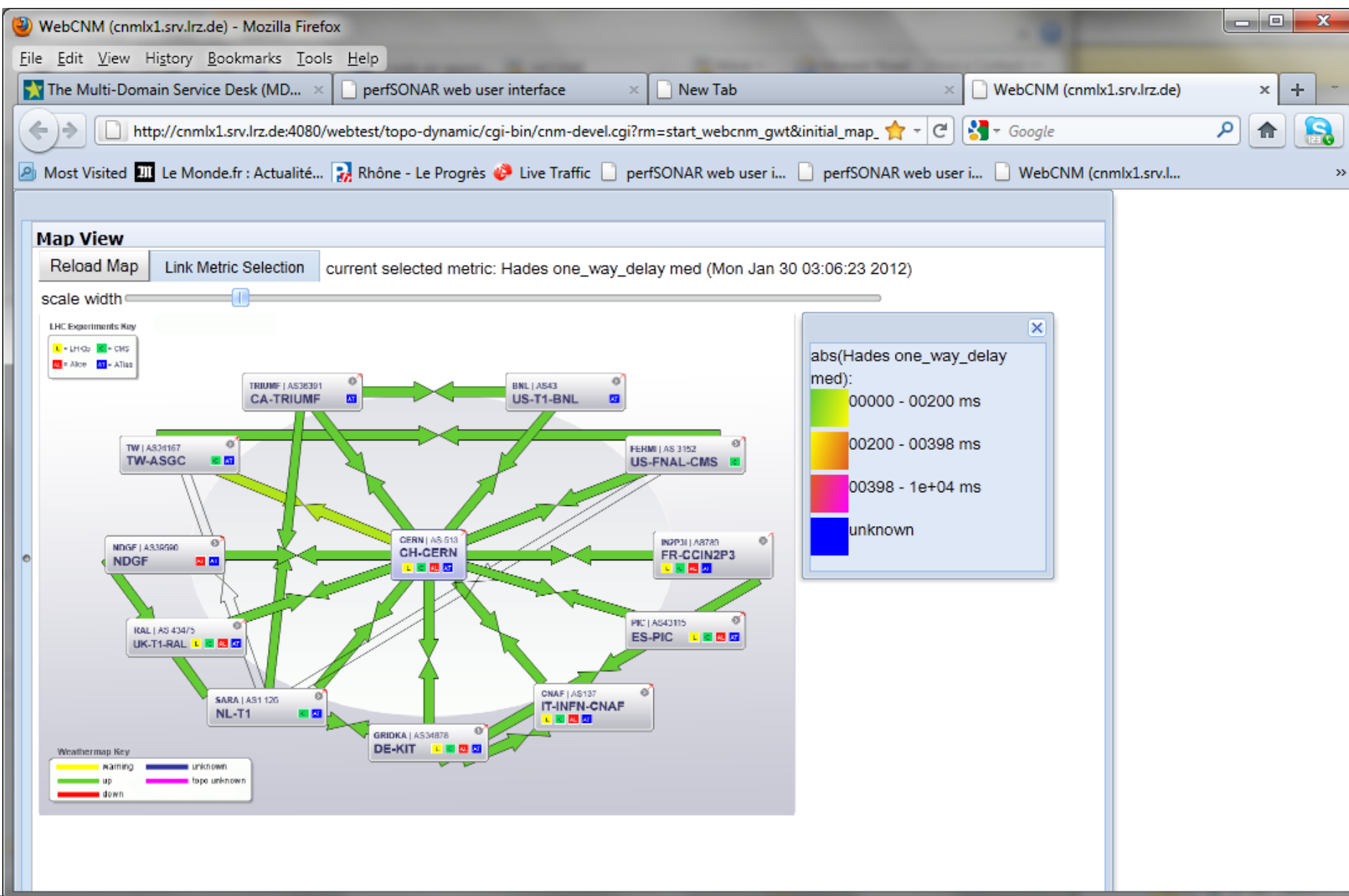


# Weather map examples (Packet loss)



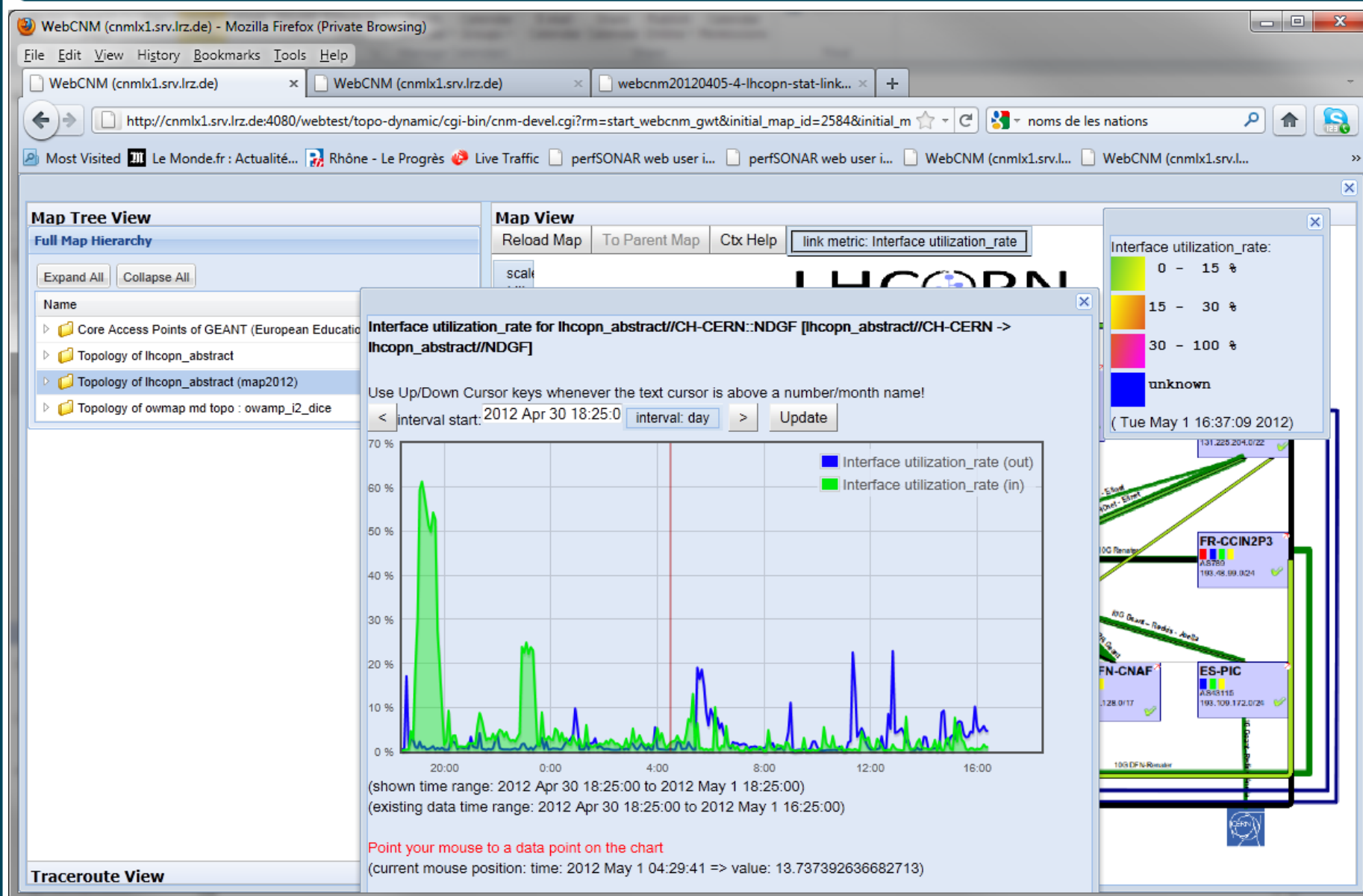


# Weather map examples (One-way delay)

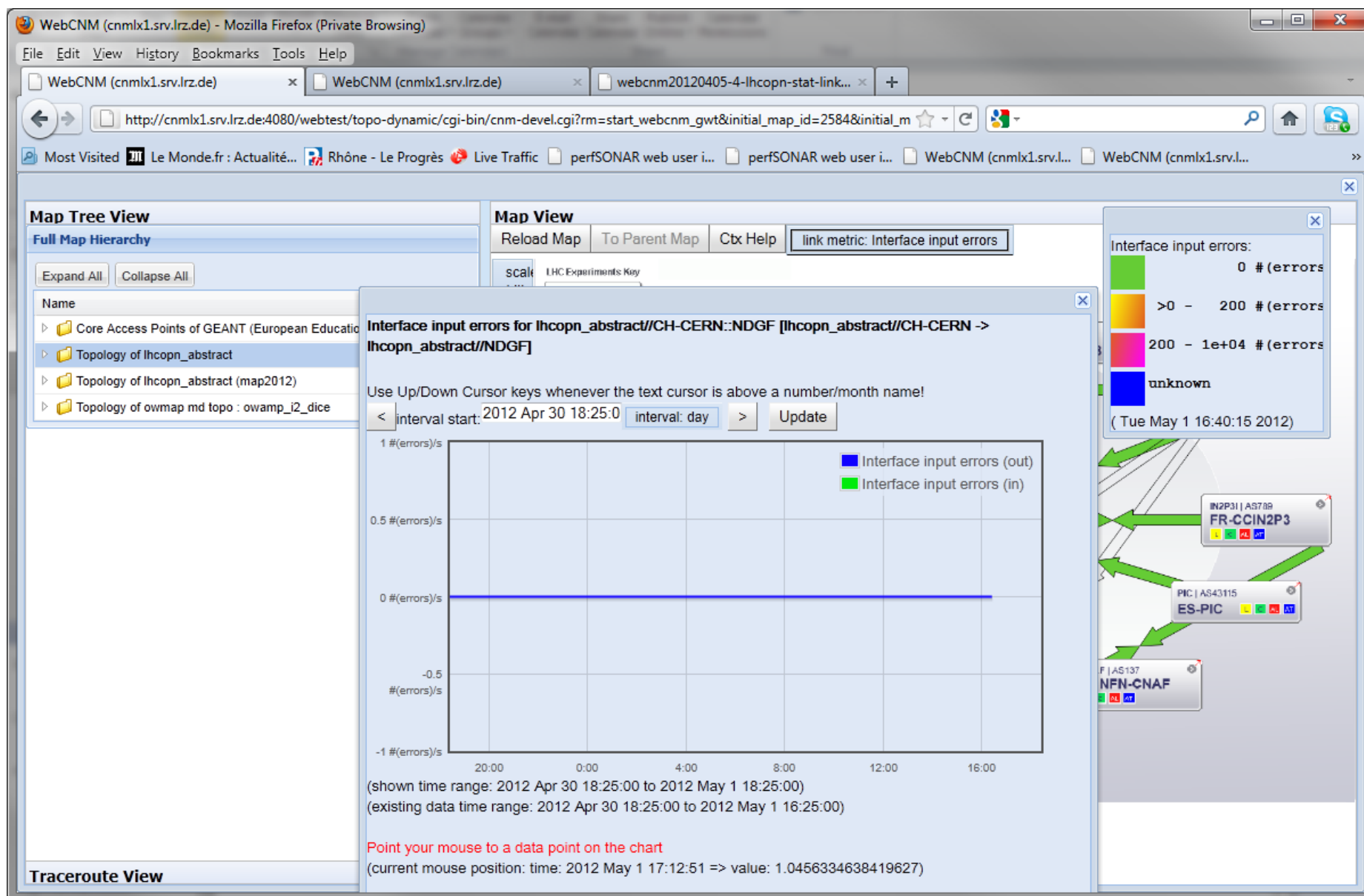




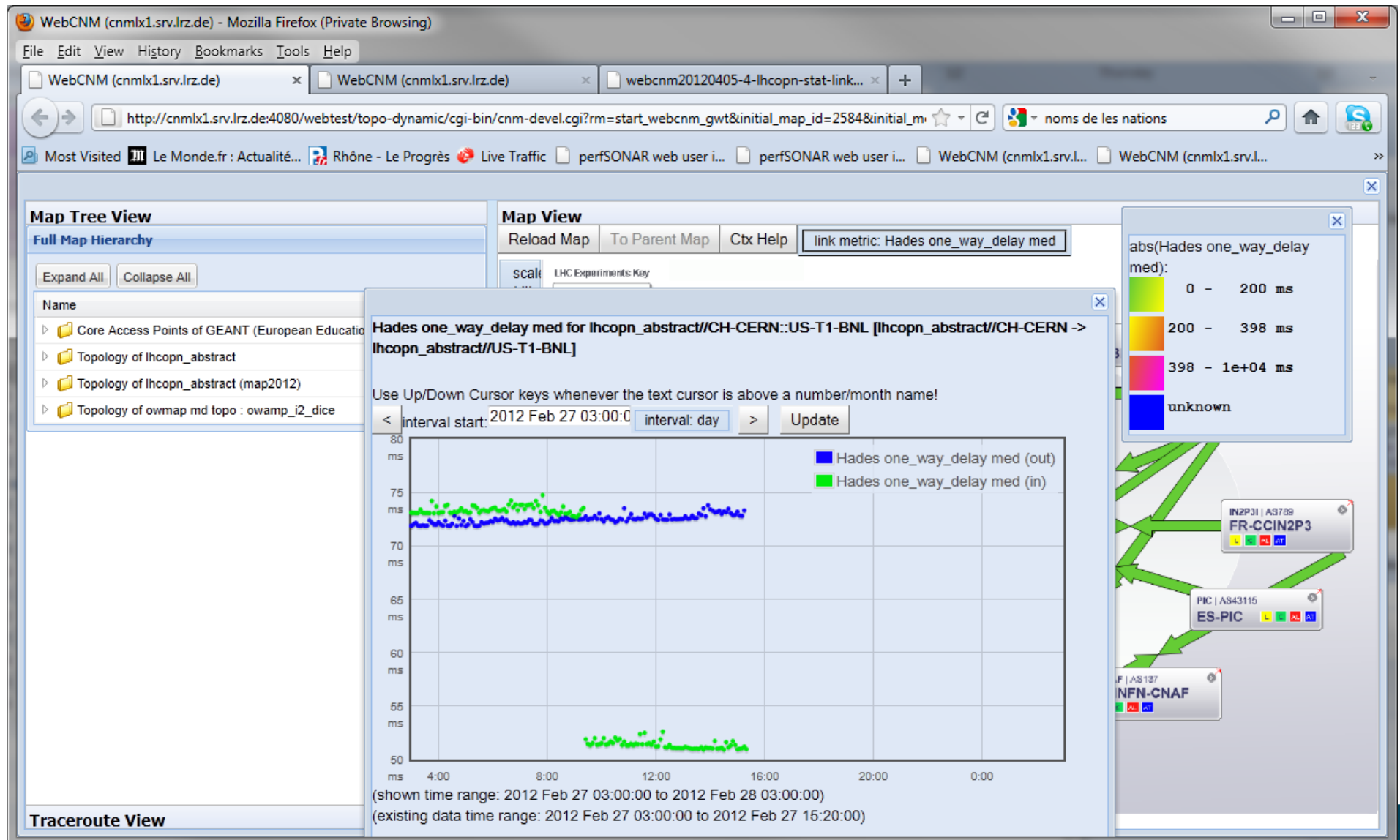
# Another example: access to interface statistics



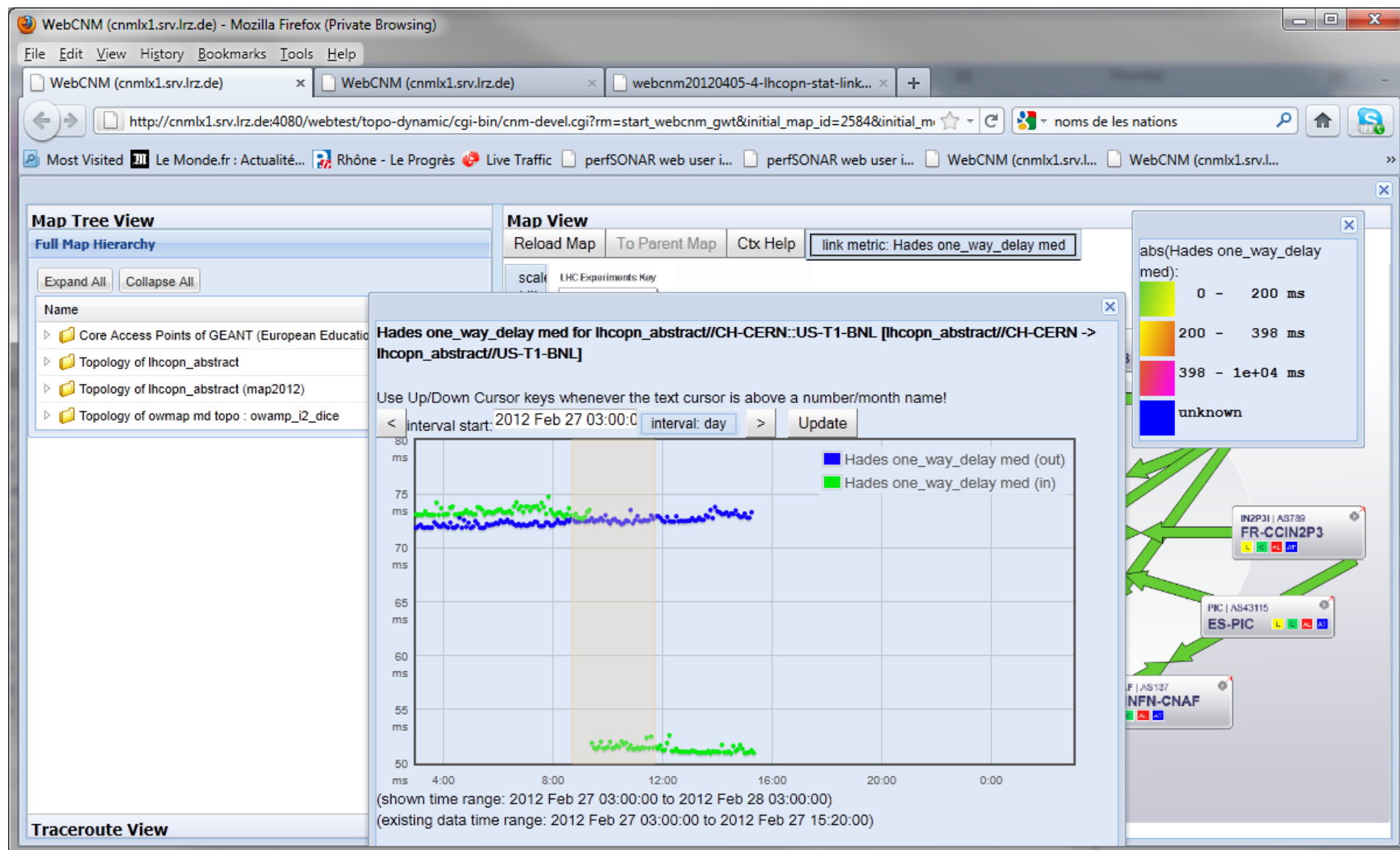
# Another example: Interface input errors



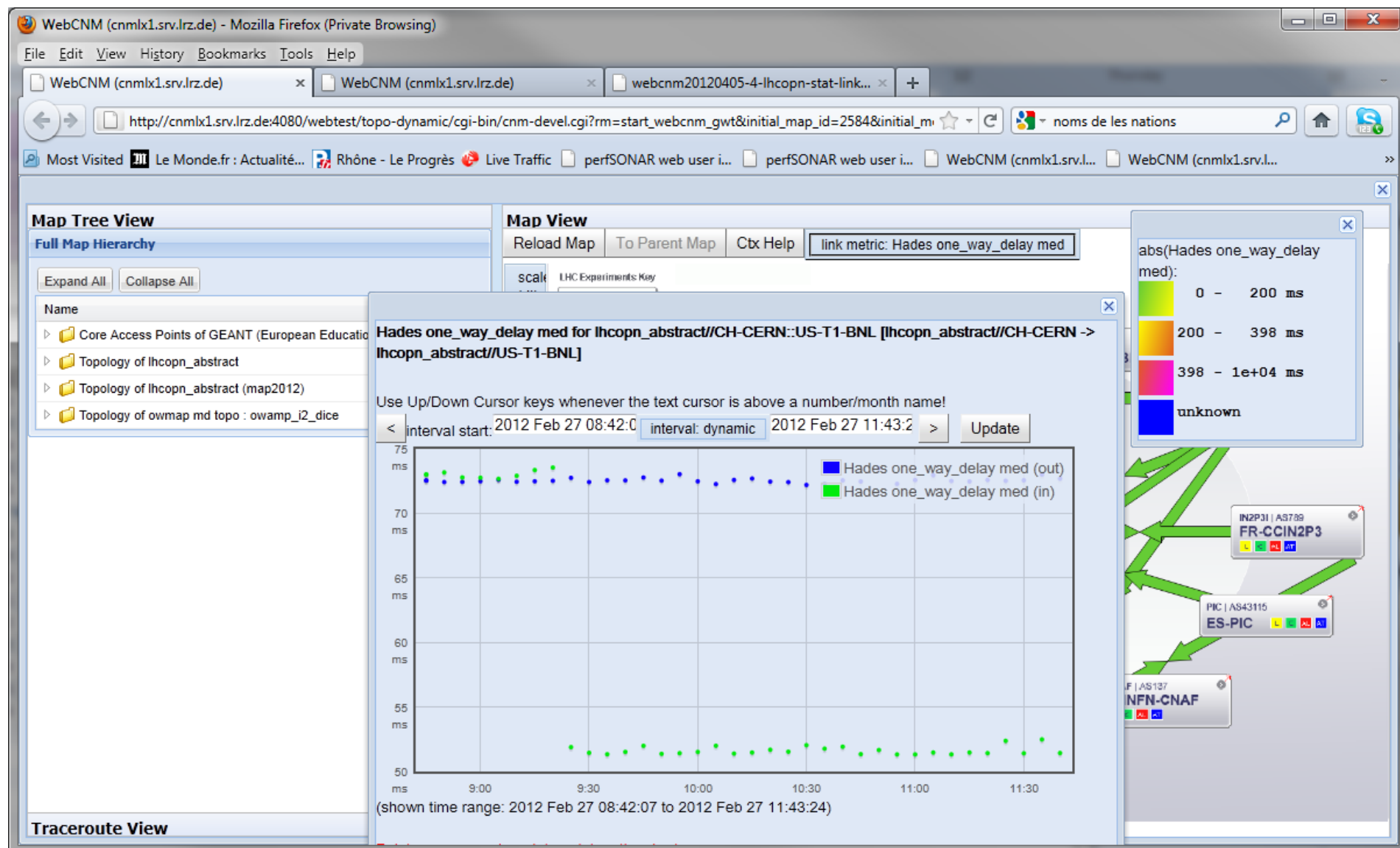
# Example: Selecting one-way delay metric and clicking on a link



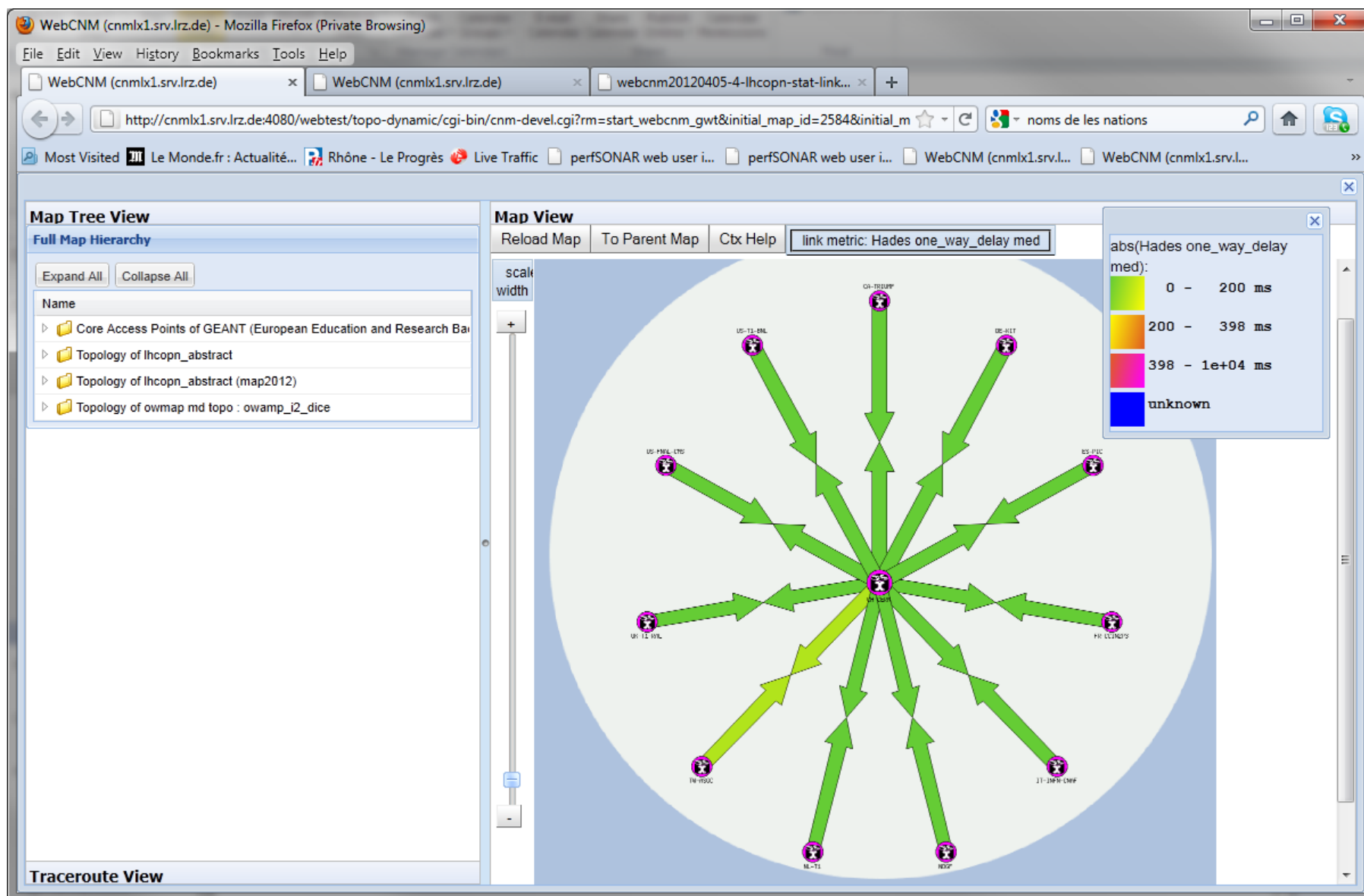
# It is possible to select an area to magnify for further inspection



# The OWD results after having magnified the area



# Site-specific star display shown when clicking on each site





**To know more about perfSONAR MDM**

# perfSONAR MDM website:

<http://perfsonar.geant.net>



Home page - Windows Internet Explorer

http://www.geant.net/service/perfsonar/pages/home.aspx

File Edit View Favorites Tools Help

Home page

SEARCH  advanced search

perfsONAR<sup>MDM</sup>

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Monday 23 May 2011 | Time - 10 57

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Find out how perfsONAR can make your life easier.

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Find out more about how perfsONAR can help you.

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Find out how perfsONAR monitoring can improve your network performance.

**perfsONAR MDM**  
The multi-domain monitoring service for the GÉANT Service Area enabling NREN NOCs and PERTs to collaborate in providing seamless network performance for their network users.

**Join the pilot phase for perfsONAR MDM - the only tool for network monitoring across multiple domains!** perfsONAR MDM is currently in a pilot phase that will last until June, with the production service planned for the autumn. DANTE and several NRENs across the GÉANT Service Area are implementing the perfsONAR MDM service for their NOCs. More NRENs are invited to join the pilot - find out how by contacting the perfsONAR team.

**perfsONAR Resources**  
| Manuals | Guides | Training | Downloads | Bug Tracking |  
click here to find out more

**perfsONAR Updates**  
Follow perfsONAR on Twitter!  
perfsONAR developers can get their hands on the latest code at **GÉANT Forge**  
The first perfsONAR **User Panel** meeting will meet at TNC for users to give feedback and look at new features.  
perfsONAR now uses the Agile/Scrum development model to ensure a more rapid development process

**GÉANT News**  
18 May | 2011  
**Russian Research Collaboration advances through high speed network connection**  
Link between GÉANT and new Russian Point of Presence brings together millions of researchers

**GÉANT Media Centre**

Deployment Status : March 2011

In trial Deployed

Internet 100%

1400 visits  
since April, from  
58 countries

## Goals:

- Single point of access for perfsONAR
- Contact points, FAQs, resources & downloads, and support
- **Host news and success stories from Users**

• communicate • collaborate

# perfSONAR Twitter: @perfSONARMDM



perfSONAR MDM (perfSONARMDM) on Twitter - Windows Internet Explorer

http://twitter.com/#!/perfSONARMDM

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perfSONAR MDM (perfSONARMDM) on Twitter

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**perfSONAR MDM**  
@perfSONARMDM Cambridge  
perfSONAR MDM (Multi-Domain-Monitoring) is the multi-domain monitoring service for the GÉANT Service Area (GSA)  
<http://perfsonar.geant.net>

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**perfSONARMDM** perfSONAR MDM  
#perfSONARMDM Correlation of existing measurements and new web-based user interface discussed with user representatives in Prague.  
39 minutes ago

**perfSONARMDM** perfSONAR MDM  
#perfSONARMDM First User Panel concluded: 18 participants from 9 NREs discussed the future direction of perfSONAR.  
41 minutes ago

**perfSONARMDM** perfSONAR MDM  
#perfSONARMDM First perfSONAR User Panel next week in Prague. Visualisation tools and circuit mon. among the topics  
<http://bit.ly/knukeQ>  
11 May

**perfSONARMDM** perfSONAR MDM  
New perfSONAR website was announced in GÉANT newsletter "Connect": <http://bit.ly/eks0VL> #perfSONARMDM  
7 Apr

**perfSONARMDM** perfSONAR MDM

About @perfSONARMDM

7 Tweets 1 Following 18 Followers 0 Listed

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Weekly tweets

Messages re-tweeted by other sister networks and organisations

Growing community of followers around the world

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MDM

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# Question?



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- Info: [domenico.vicinanza@dante.net](mailto:domenico.vicinanza@dante.net)

# Questions?



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