

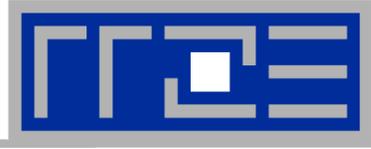
# DFN's Tools for Monitoring IP Performance Metrics Across Backbone Networks

Roland Karch

17.11.2005

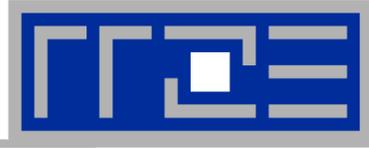


# Table of Contents



- **DFN-Labor@RRZE – who are we?**
- **IPPM-DFN Measurement System – that's what we do**
- **Examples:**
  - **G-WiN / X-WiN**
  - **6WiN**
  - **GÉANT (2)**
- **Contact**

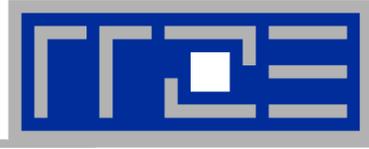
# DFN-Labor@RRZE – who we are



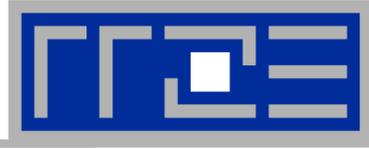
- **RRZE**
  - **Regional Computing Center Erlangen**
  - **IT service for the University Erlangen-Nürnberg**
- **DFN**
  - **German research network provider**
- **DFN-Labor@RRZE**
  - **Research project of the DFN at the RRZE**
  - **Network hardware tests**
  - **Development and operation of an IP accounting system**
  - **Quality assurance for the G-WiN SDH/WDM core network**
  - **Development and operation of an IPPM measurement system**



# IPPM-DFN Measurement System

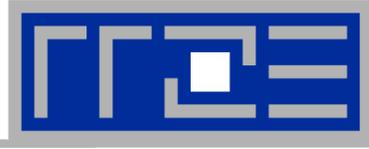


- **Intention of the measurements**
  - **Academic interest to determine the IP Quality of Service parameters**
  - **Verification of provider's network failure data**
  - **Early warning system for network failure**
  - **Correlation of QoS parameters with other network parameters**
    - **Throughput**
    - **Visual quality of video conferencing**
    - **Passive delay measurement**
  - **Analysis of customer's network performance**
    - **Collaboration with DFN video conferencing team**
    - **Mobile boxes**
    - **Second network interfaces**



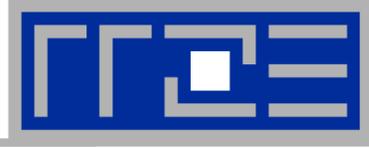
- **Alert System**
  - **Allows for surveillance of SLAs as well as early warning about network outages**
  - **Current implementation sends out alerts via mail, SNMP traps are under development**
  - **Scenarios to raise alerts:**
    - **x% packet loss (requires relatively high frequency of measurements to determine reliably)**
    - **One way delay > x ms for y s (typical end-to-end SLA)**
    - **One way delay variation > x ms for y s (sensitive parameter to most realtime network applications)**
  - **Primary target group: NOCs and network management**

# IPPM-DFN Measurement System

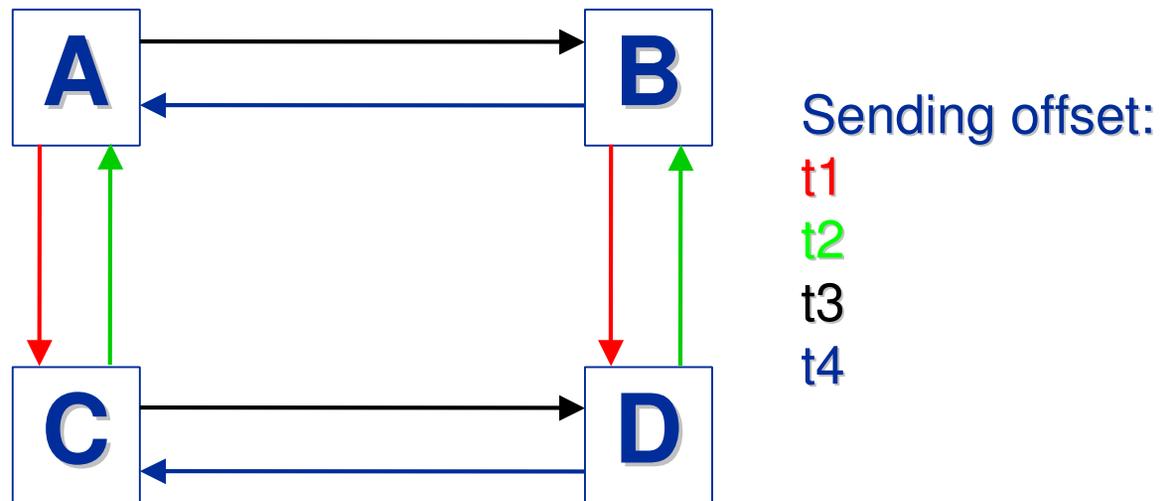


- **Active measurement**
- **UDP-Packets with timestamp**
- **Packets are sent in groups**
  - **Group median / maximum -> (no) single outliers**
- **Current configuration:**
  - **One group every 30 s**
  - **5 packets per group**
  - **Distance between packets: 20 ms**
- **Configurable:**
  - **ToS bits**
  - **Packet size**
  - **Group size, interval**
  - **Central configuration**

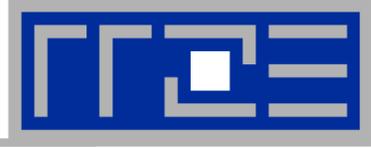
# IPPM-DFN Measurement System



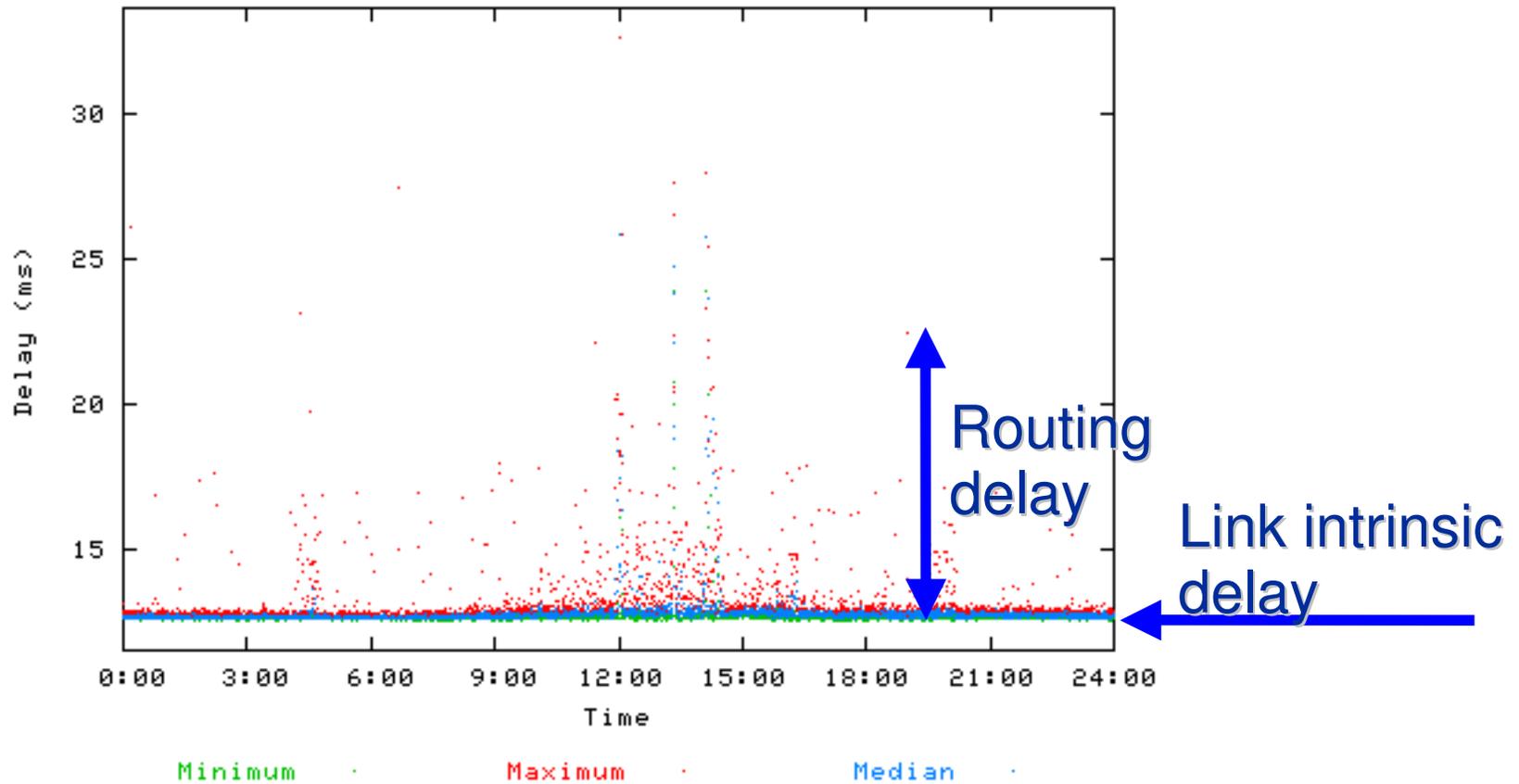
- 1 sending and 1 receiving process for every measurement connection
- Time offset between processes at every measurement PC to avoid collisions

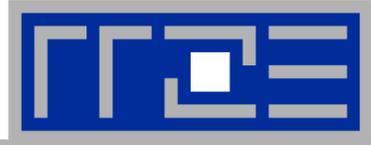


# IPPM-DFN Measurement System

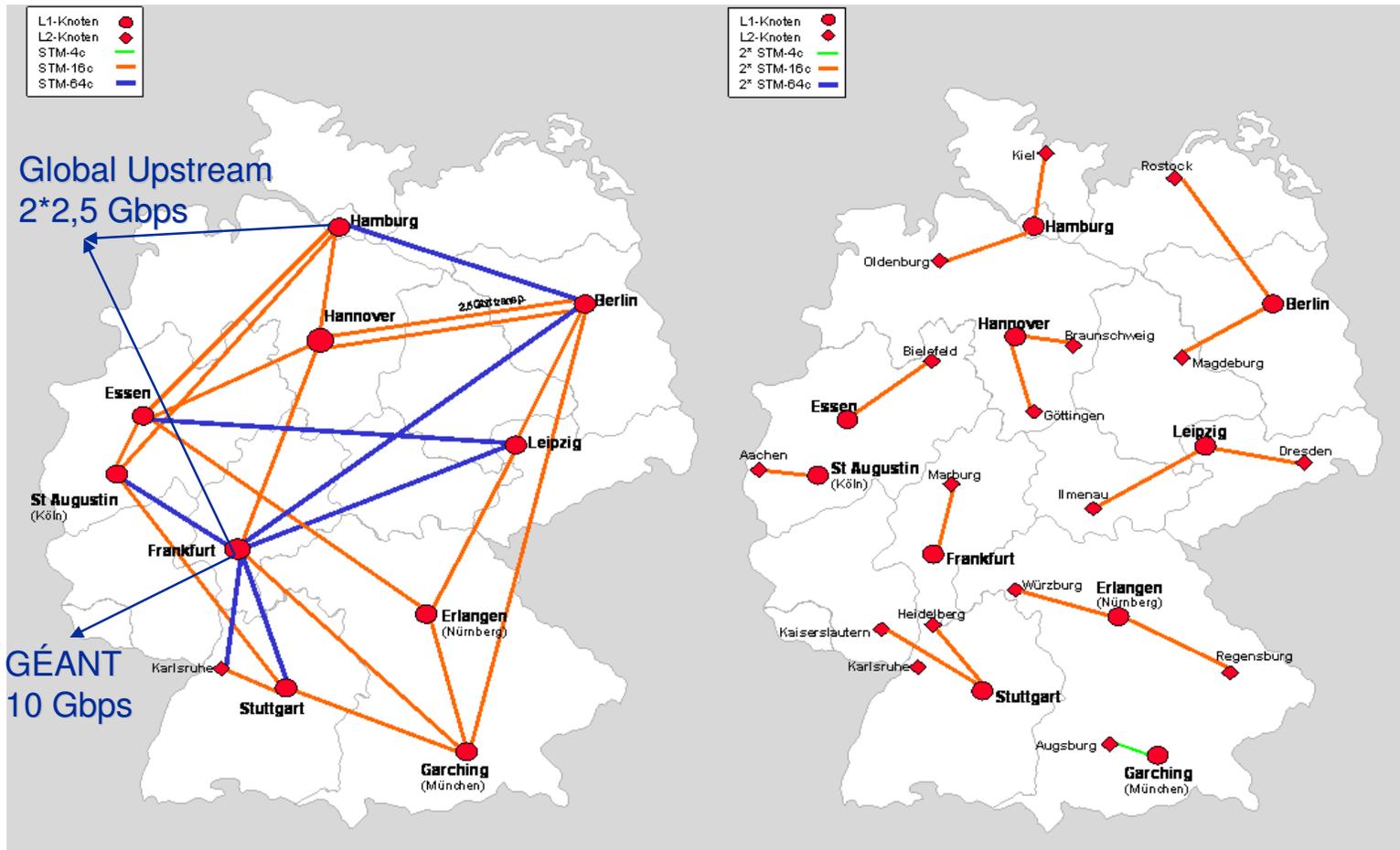


## One way delay plot

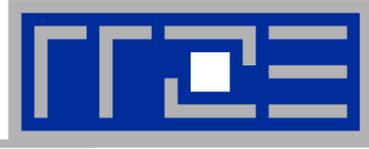




## Current G-WiN - Topology

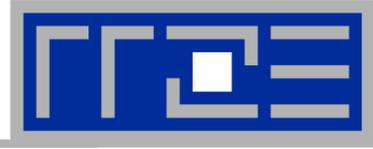


# G-WiN - Measurement



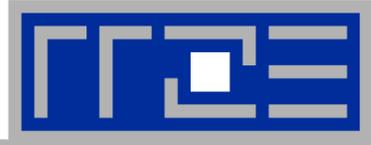
- **G-WiN: National backbone of DFN**
  - 10 level 1 sites, 17 level 2 sites
  - 7 x 10 Gbps, 31 x 2.4 Gbps, 1 x 622 Mbps
- **Current measurements**
  - 27 active Measurement Points
  - > 1200 connections in total, running 24/7 “full meshed”
  - Up to 100 connections per PC
- **Central data analysis station**
  - Fetches raw data regularly ( $\approx 200$  MB / d)
  - Computes:
    - Timestamps, delay, jitter, loss
    - Group minimum, median, maximum
    - Traceroutes
    - Stores analyzed data ( $\approx 240$  MB / d)

# G-WiN goes X-WiN

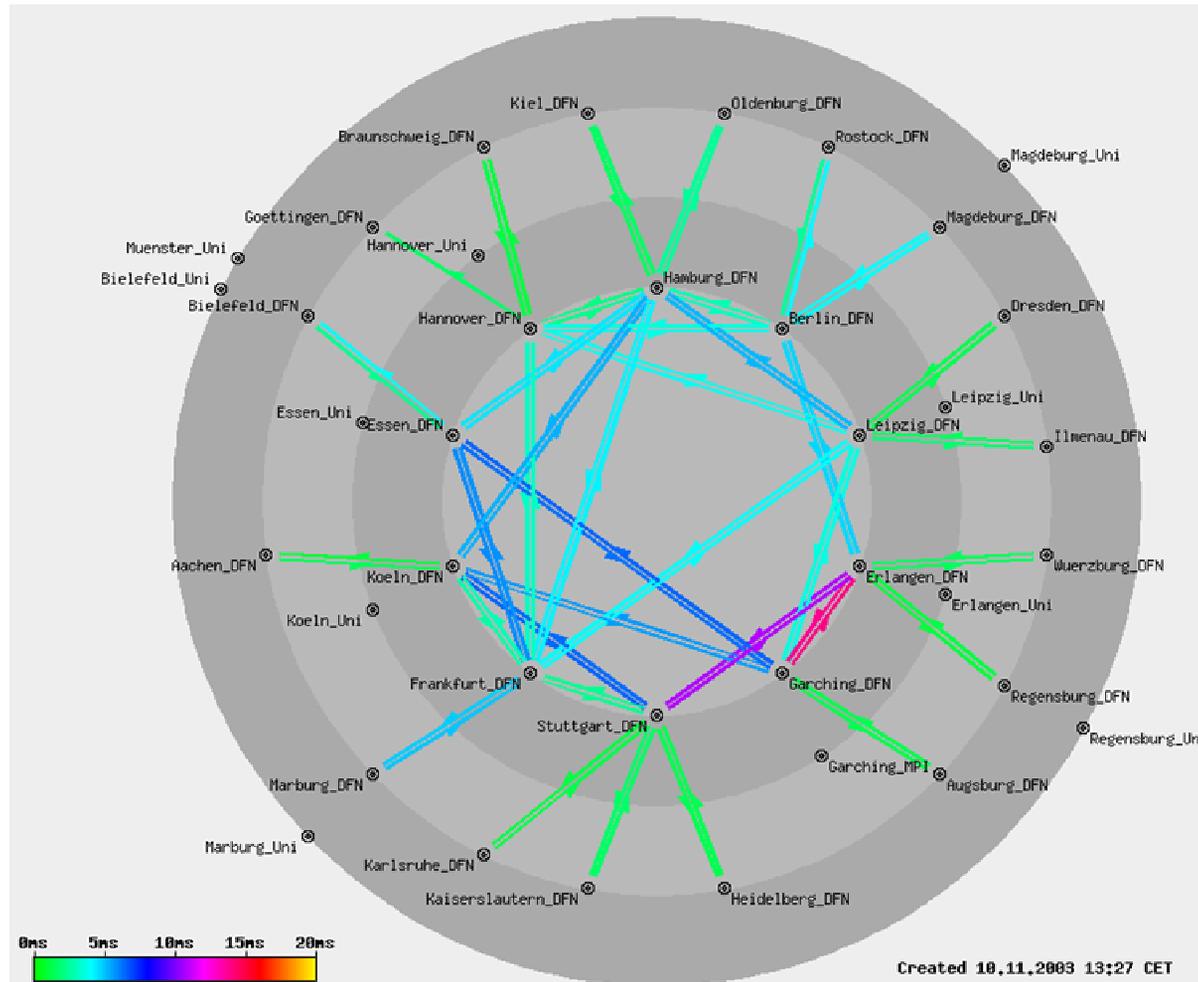


- **Old G-WiN network is running out for the end of the year**
- **Currently being replaced by the X-WiN with more PoPs**
- **13 additional measurement points, preserves the full mesh of measurements**

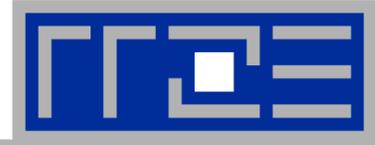
# G-WiN - Measurement



## G-WiN delay overview along SDH-paths:



# G-WiN - Measurement



## Measurement Point Selection:

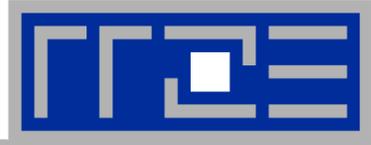
09.11.2005 - Go

< Year - < Month - < Week - Week > - Month > - Year >

**Choose node and date**

Measurement node	02.11.	03.11.	04.11.	05.11.	06.11.	07.11.	08.11.	09.11.	10.11.	11.11.	12.11.	13.11.	14.11.	15.11.	16.11.
Aachen_DFN	<input checked="" type="radio"/>														
Augsburg_DFN	<input checked="" type="radio"/>														
Berlin_DFN	<input checked="" type="radio"/>														
Bielefeld_DFN	<input checked="" type="radio"/>														
Bielefeld_Uni	<input checked="" type="radio"/>														

# G-WiN - Measurement



## Path Selection:

16.11.2005 - Go

< Year - < Month - < Day - Day > - Month > - Year >

Back to selection of measurement node

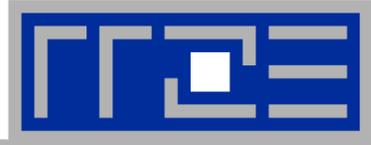
Submit

**Measurement paths for Erlangen\_DFN on 16.11.2005**

[Select all](#) - [Unselect all](#)

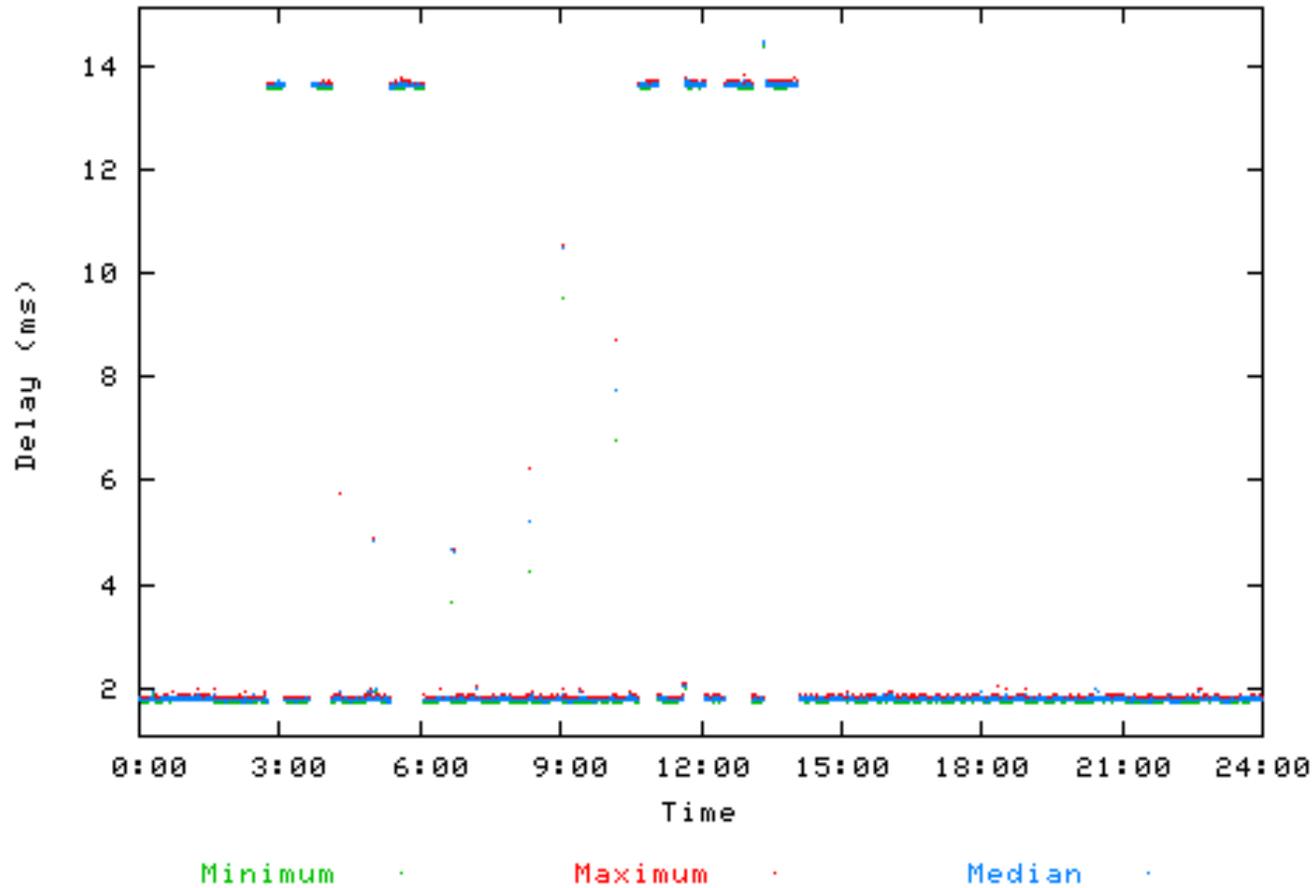
	From	To		From	To
<input checked="" type="checkbox"/>	Aachen_DFN	Erlangen_DFN	<input checked="" type="checkbox"/>	Erlangen_DFN	Aachen_DFN
<input checked="" type="checkbox"/>	Augsburg_DFN	Erlangen_DFN	<input checked="" type="checkbox"/>	Erlangen_DFN	Augsburg_DFN
<input checked="" type="checkbox"/>	Berlin_DFN	Erlangen_DFN	<input checked="" type="checkbox"/>	Erlangen_DFN	Berlin_DFN
<input checked="" type="checkbox"/>	Bielefeld_DFN	Erlangen_DFN	<input checked="" type="checkbox"/>	Erlangen_DFN	Bielefeld_DFN

# Measurement Examples G-WiN

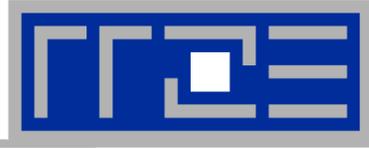


## Route flapping

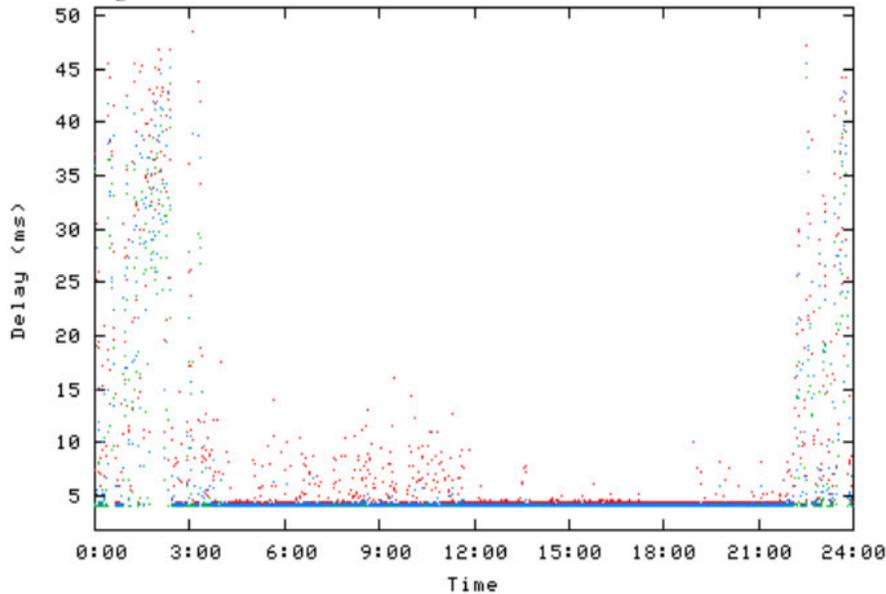
OWD from Erlangen DFN to Garching DFN  
(2003/11/10)



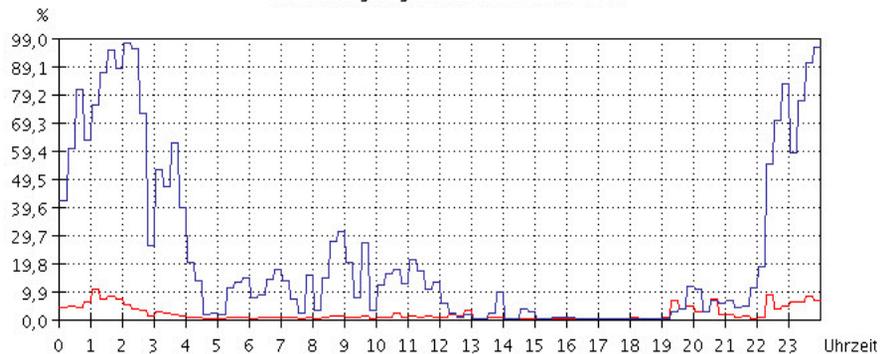
# Measurement Examples G-WiN



## Delay and network utilization



Auslastung: Tagesstatistik vom 14.3.2004



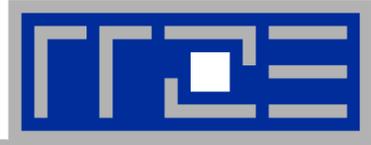
Long-time (15 min) average network load vs. delay shows at different customers either:

- Correlation
- High delay without high load
- High load without increased delay

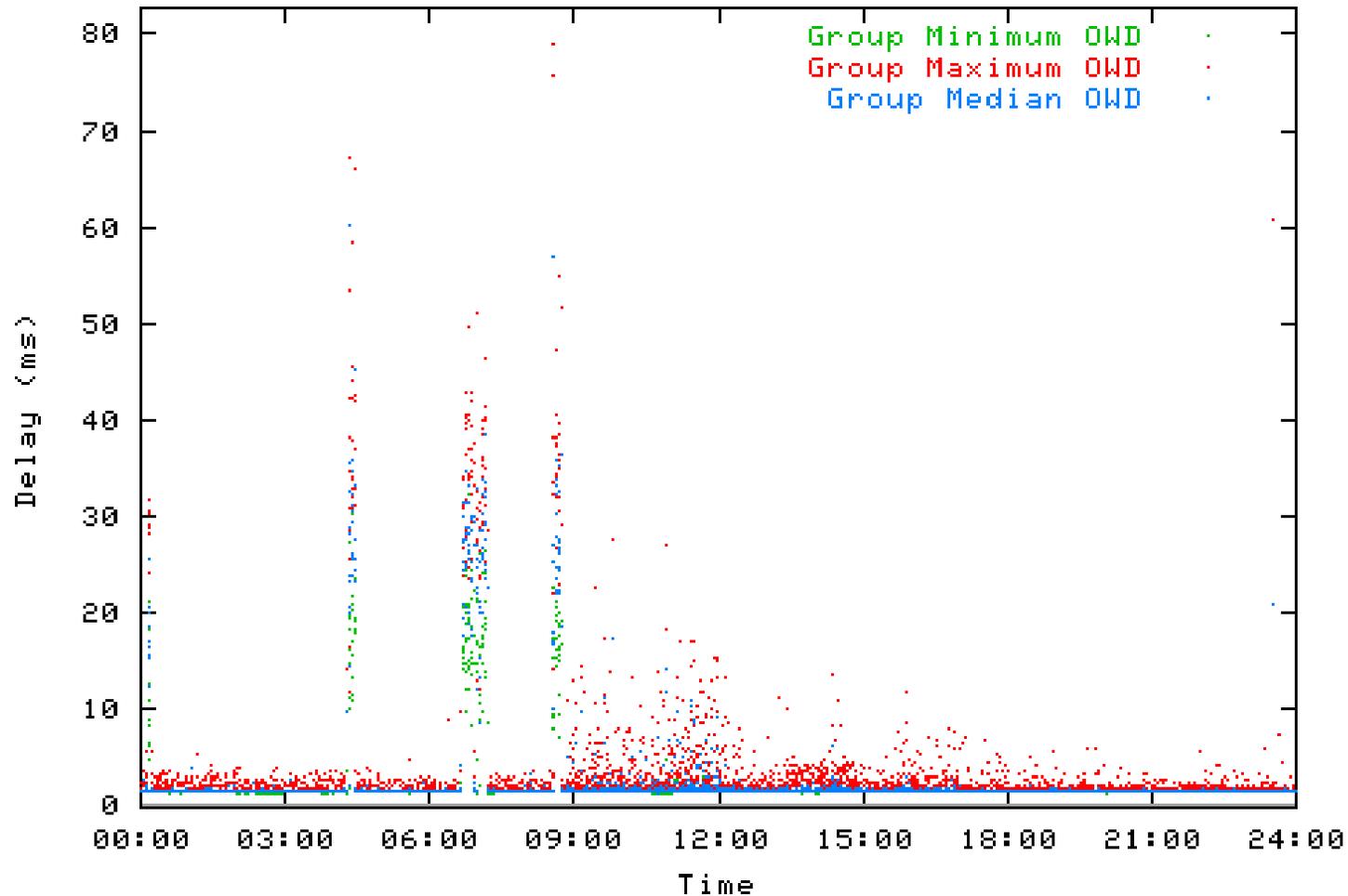
Higher time resolution of network load (< 1 s) necessary

Lab tests!

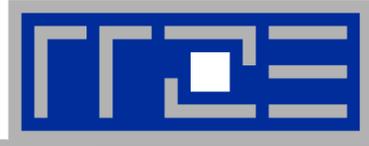
# Measurement Examples G-WiN



## Increased delay due to network equipment failure



# Measurement Examples G-WiN



- **Routing vector surveillance**
  - **Allows an interpretation of sudden jumps or just general changes of behaviour in OWD measurements**

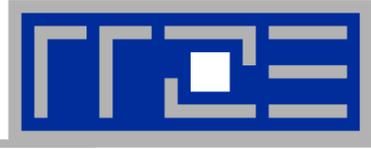
From	Till	Traceroute Log
00:03:33	07:17:42	0
07:17:42	07:20:17	1
07:20:17	07:23:41	1
07:23:41	07:32:10	0
07:32:10	22:49:28	0

---

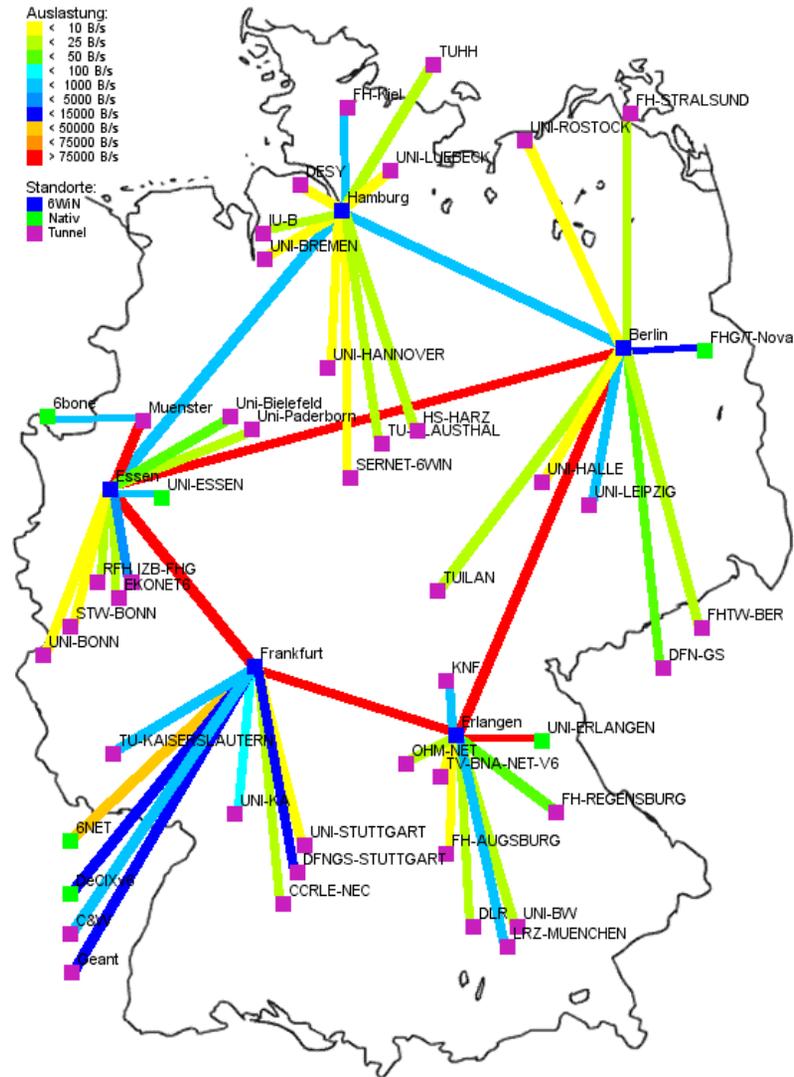
Traceroute Log 0		
0	ar-erlangen1-ge4-1-800.g-win.dfn.de	188.1.36.45
1	cr-erlangen1-ge5-0.g-win.dfn.de	188.1.72.1
2	cr-leipzig1-po9-2.g-win.dfn.de	188.1.18.46
3	cr-berlin1-po3-3.g-win.dfn.de	188.1.18.41
4	ar-berlin2-ge0-0-0-650.g-win.dfn.de	188.1.64.3
5	legolas.g-win.dfn.de	188.1.32.54

---

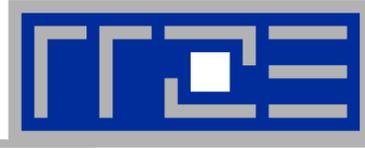
Traceroute Log 1		
0	ar-erlangen1-ge4-1-800.g-win.dfn.de	188.1.36.45
1	cr-erlangen1-ge5-1.g-win.dfn.de	188.1.72.45
2	cr-leipzig1-po9-2.g-win.dfn.de	188.1.18.46
3	cr-berlin1-po3-3.g-win.dfn.de	188.1.18.41
4	ar-berlin2-ge0-0-0-650.g-win.dfn.de	188.1.64.3
5	legolas.g-win.dfn.de	188.1.32.54



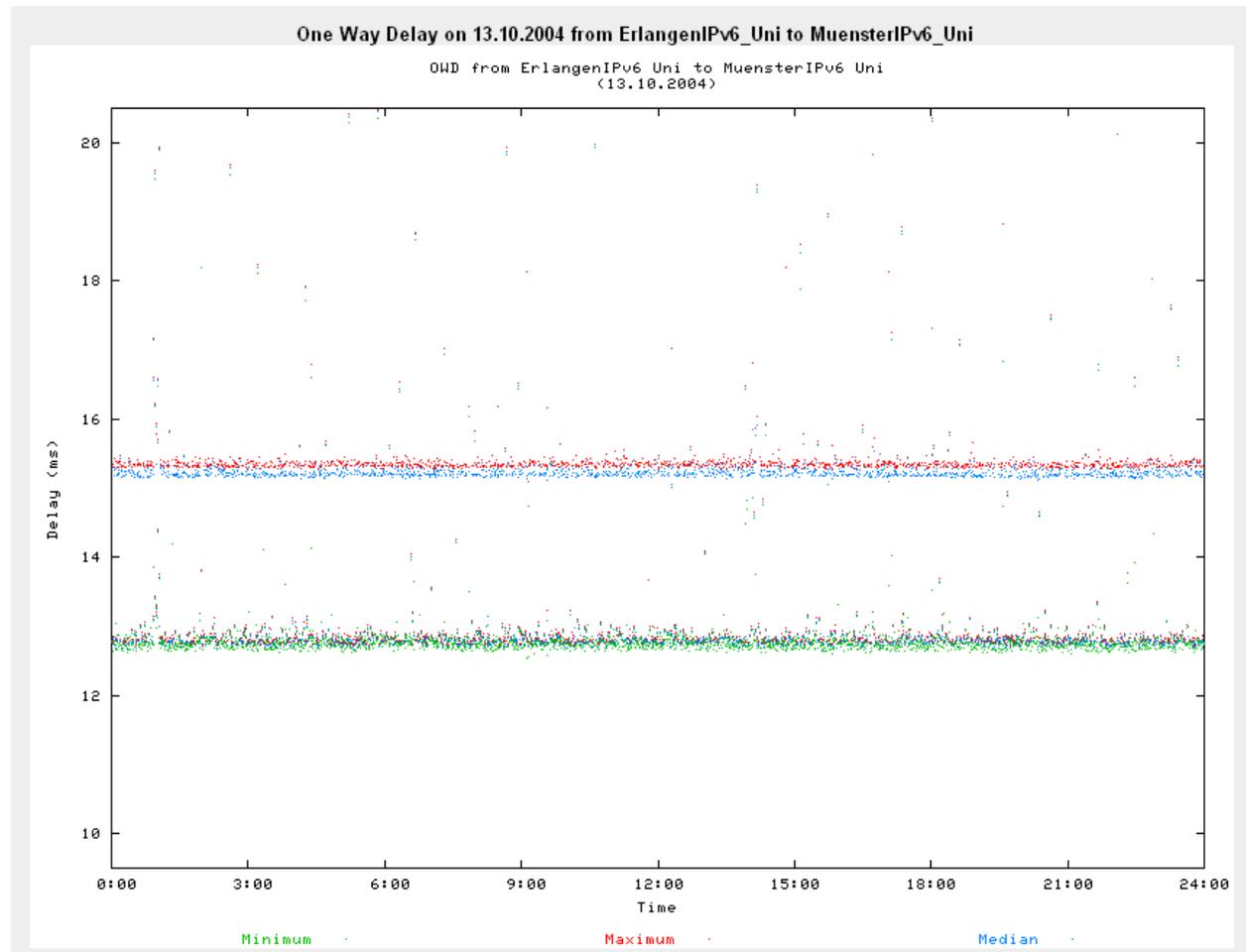
- **Native IPv6 backbone**
  - **Utilization of network during ftp download from Münster to Erlangen**
  - **Outdated, planned to be integrated into X-WiN**



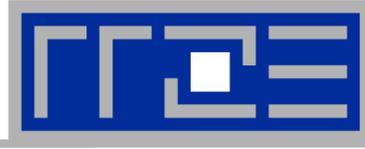
# Measurement Examples 6WiN



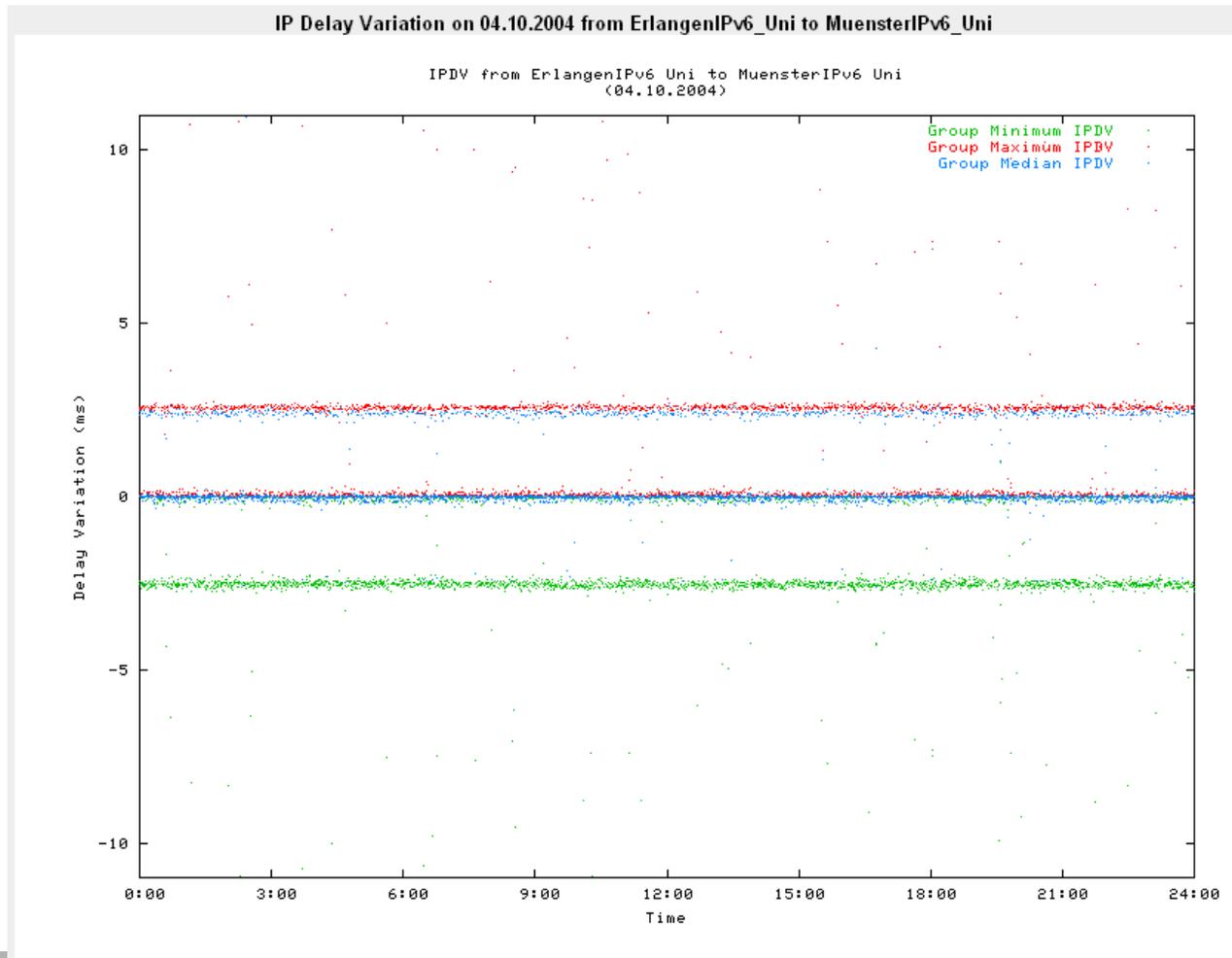
## Measurements between Erlangen and Münster (Delay)

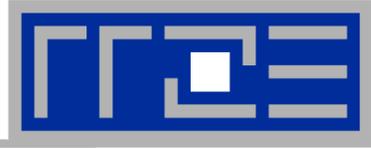


# Measurement Examples 6WiN

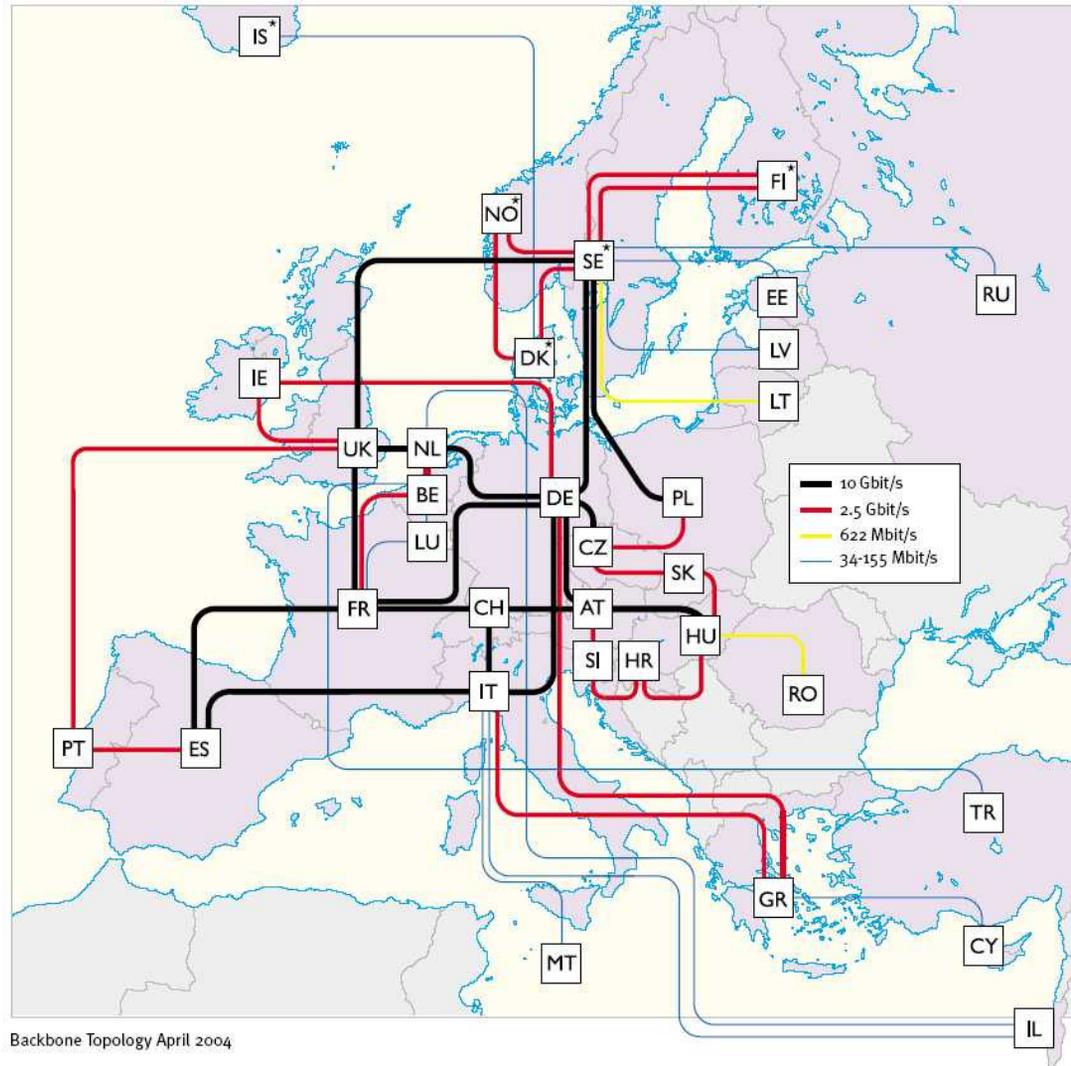


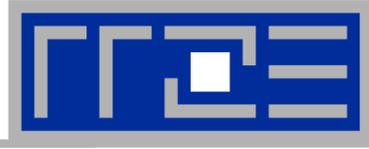
## Measurements between Erlangen and Münster (Delay Variation)





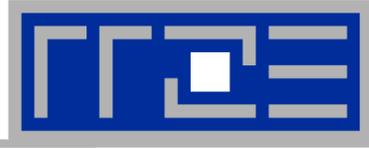
## ■ Topology





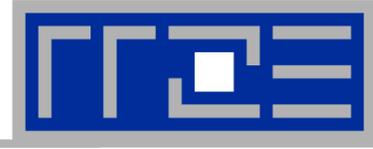
## Current Activities

- **Currently, nine Measurement Nodes installed and running**
  - **Athens, Frankfurt, Paris, Poznan, Rome, Sofia, Tel Aviv, Thessaloniki, Zagreb**
  - **<http://www.win-labor.dfn.de/cgi-bin/ipqos/select.pl?config=geant>**
  - **IPv4 measurements running, IPv6 up in four locations**
- **Ongoing development**
  - **Make IPPM conform to One Way Active Measurement protocol (OWAMP)**
  - **Traceroute**
  - **Throughput / bandwidth**
  - **Interface to raw / analyzed data (PerfSONAR)**
  - **More user interaction**
  - **Mobile boxes**



- **Network Monitoring Activity JRA1**
  - In GÉANT2 (four years project, started sep. 2004) there is a whole research activity (JRA1) on network monitoring;
  - JRA1 focuses not only on enhancing existing tools but also on integrating them in a coherent architecture
  - This architecture should be multi-domain and allow users to access measurement services and measurement results over well defined interfaces
  - There is an ongoing coordination with Internet 2, ESNET and other third parties to reach an aligned design of this monitoring architecture
- **Future of IPPM-DFN**
  - IPPM as activity within GÉANT2
  - Measurements in the European research networks (approx. 20-30 nodes)

# Contact



- **Internet:**
  - <http://www.win-labor.dfn.de/>
- **email:**
  - [WiN-Labor@dfn.de](mailto:WiN-Labor@dfn.de)
- **phone:**
  - **+49 9131 85-28800**

