Test-Traffic Project: Status and Plans

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Overview

- Administrative details
  - Manpower
  - Mailing lists
- Test-box installation
- Analysis
- New services
- Summary

Manpower

- Fotis Georgatos started on April 1st
  - 3rd member of the group
  - Sys-admin:
    - Configuration and installation of test-boxes
    - Day-to-day operations, user queries
    - Data quality monitoring
    - Some development or analysis work
    - ...

Mailing lists

- tt-wg@ripe.net
  - Open mailing list for this WG
- tt-host@ripe.net
  - Closed mailing list for test-box hosts
- tt-ops@ripe.net
  - Day to day operations of the test-boxes
  - Now a ticketing system

Overview

- Administrative details
- Test-box installation
  - Current Status
  - Future series of test-boxes
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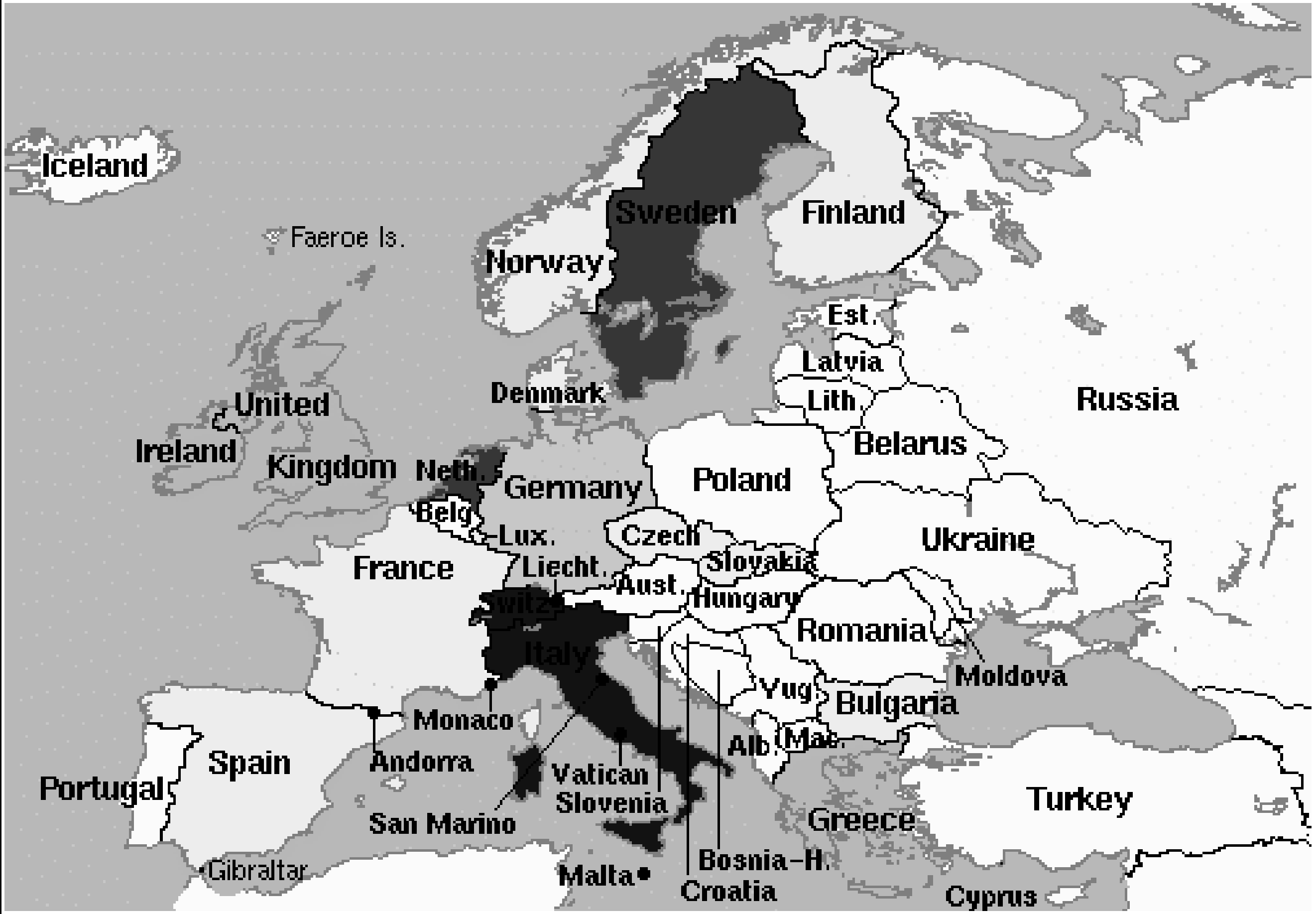
Test-box installation

- The first series of machines has been shipped
- Second series of 20 machines
  - Arrived in Amsterdam: February 1
  - Testing in February
  - Request for hosts: March 1
  - 19 sites applied/confirmed application
  - Installation started: April 1
  - First machine fully operational on April 24
  - 17 sites working on the installation of their TB

Current status

Date	30-Sep	31-Jan	1-Apr	1-May
No Host/Spare	3	0	20	1
Configure/Test @RIPE	0	3	1	4
At Remote Site	6	2	2	17
Installation Problems	3	3	4	4
Operational	12	15	16	17
No Longer Participating	0	1	0	0
Broken/Repair	0	0	1	1
Total	24	24	44	44
Unconfirmed Applications			10...20	10...20
Applied after March 20				5

Where are the boxes located?



- 7 TB’s
- 4 TB’s
- 3 TB’s
- 2 TB’s
- 1 TB’s
- Outside map: 6

Future series of test-boxes

- Installing the clock is often a problem
- Solution #1: Low loss coax cable
  - Works for up to ≈45m
  - Expensive cable, hard to install
  - Not a solution everywhere
- Solution #2: Clock in separate box
  - Use (existing) CAT-5 cable, cheap, >200m
  - January'99: Noticed clock offsets
  - Now understood, can be compensated

Solution #2

- Implementation
  - Home built box with a clock
    - Prototype exists
    - Field test soon
    - Calibration by hand
    - Have to think about automatic calibration
  - Motorola unit
    - Same idea
    - Prototype ordered
- More on this at the September meeting

Future series of test-boxes (2)

- Hosts will have to pay for the boxes:
  - Roughly • 2500/box
- Operation will be the same as the current series:
  - "Black" box
  - Measures network between host and the rest of the world
  - Hosts gets access to the data, daily plots and new services

Test-boxes for “private experiments”

- Some sites want to use test-boxes to measure their internal networks
- Buy more boxes:
  - Order an assembled box from us
  - Get the hardware specs from us, assemble one yourself, get our software
- We will (only) provide basic installation support for private experiments

The next series of boxes (4)

- Now: test clock-hardware
- Decide on implementation before RIPE-34

- However, installing more boxes is not the only thing we should do, we also have to develop services based on the TT-data.
  - More in a couple of slides

Overview

- Administrative details
- Test-box installation
- Analysis
  - DQM/Data Quality Monitoring
  - Analysis Framework
  - Comparison RIPE-NCC and Advanced data
  - Delay as a function of packet sizes
  - N^2 problem
- New services
- Summary

Data Quality Monitoring

- Has been on our list for a long time
  - Find problems with the test-boxes
  - No manpower to do this in a structured way
- Start with regular checks of
  - Antenna conditions
  - Weekly delay and loss plots
  - Report and solve problems
- Will automate and expand DQM as we go along

Analysis framework

- Hardware
  - Disk space: 90 GByte
    - 3 months of data for 100 TB's
  - Tape juke-box: 1 year of data online without changing tapes
  - CPU
- Software
  - Design exists
  - Working on implementation

Analysis framework (2)

- Main features
  - Automatic initial processing
  - Daily plots generation will move to this machine
    - Faster
    - More flexible
  - Data in ROOT: easier to test new analysis ideas
  - Easy access to the data for the hosts
- First version: end of May 1999

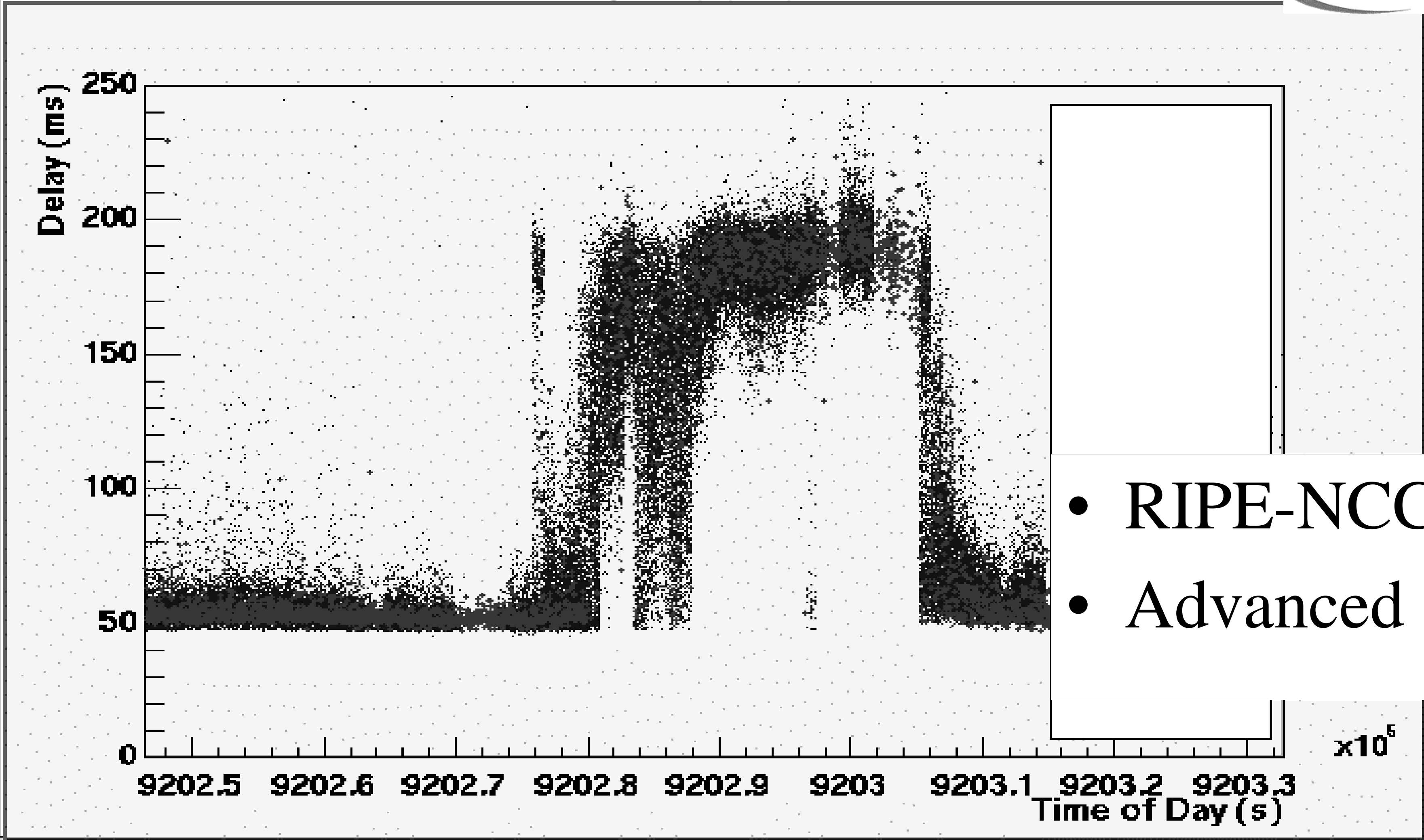
Comparison RIPE-NCC and Advanced data

- Advanced and RIPE-NCC have both implemented the 1-way-delay and loss IPPM-drafts
- When measuring delays or losses on the same path, both implementations should give the same results
- This has to be checked though
  - Summary of the slides shown at the IPPM-meeting in March

Comparison RIPE-NCC and Advanced data

- Exchanged boxes in October 1998.
- Boxes are on the same network segments at both sides
- Data taking since October 26.
- Small differences in approach
  - Packet size: 0.5ms on 50ms delays
  - Calculation of percentiles: O(1)% effect
  - Frequency of test-traffic: no measurable effect

Raw Data
20 hours

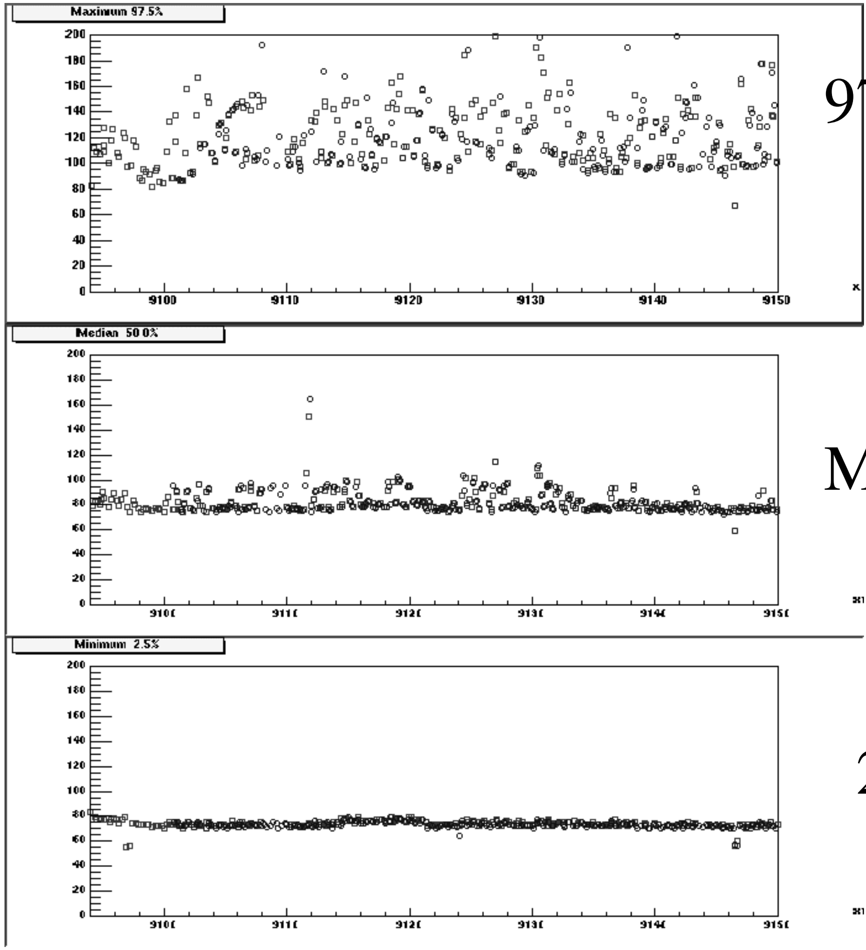


- RIPE-NCC
- Advanced

Percentile delays over a 2 month period

Advanced-data

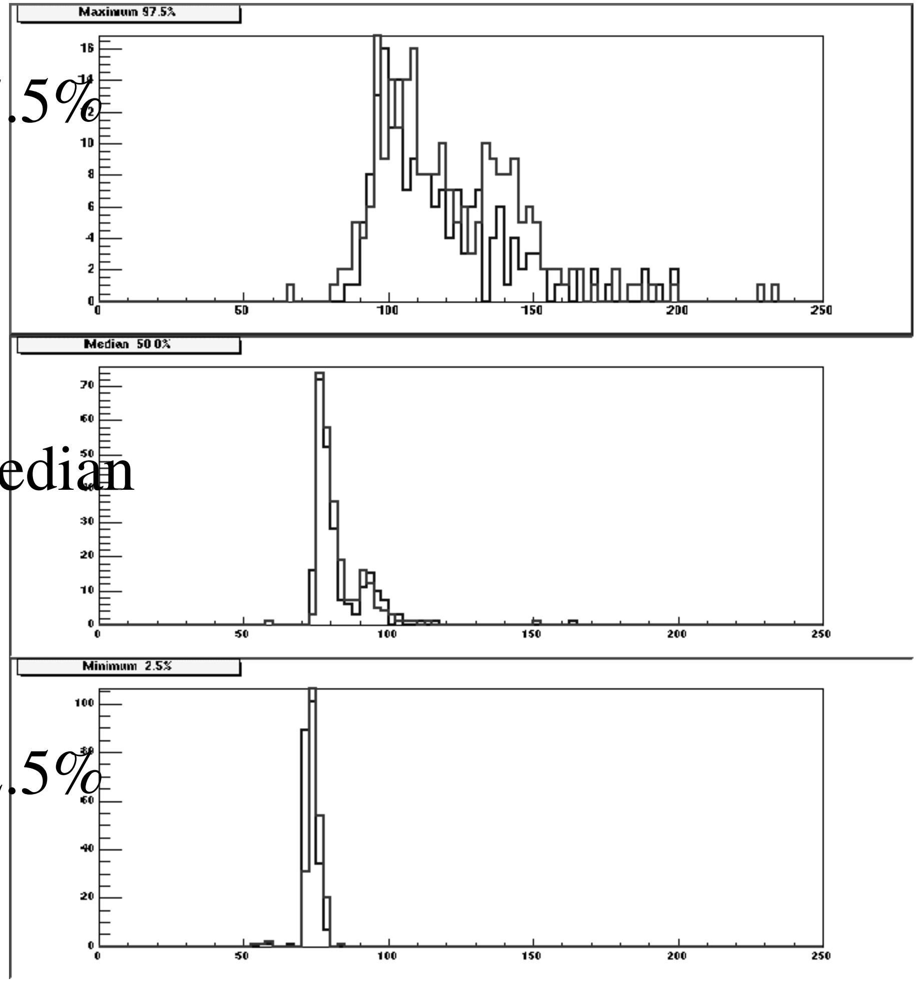
RIPE-NCC-data



97.5%

Median

2.5%



Conclusion Comparison Advanced and RIPE-NCC data

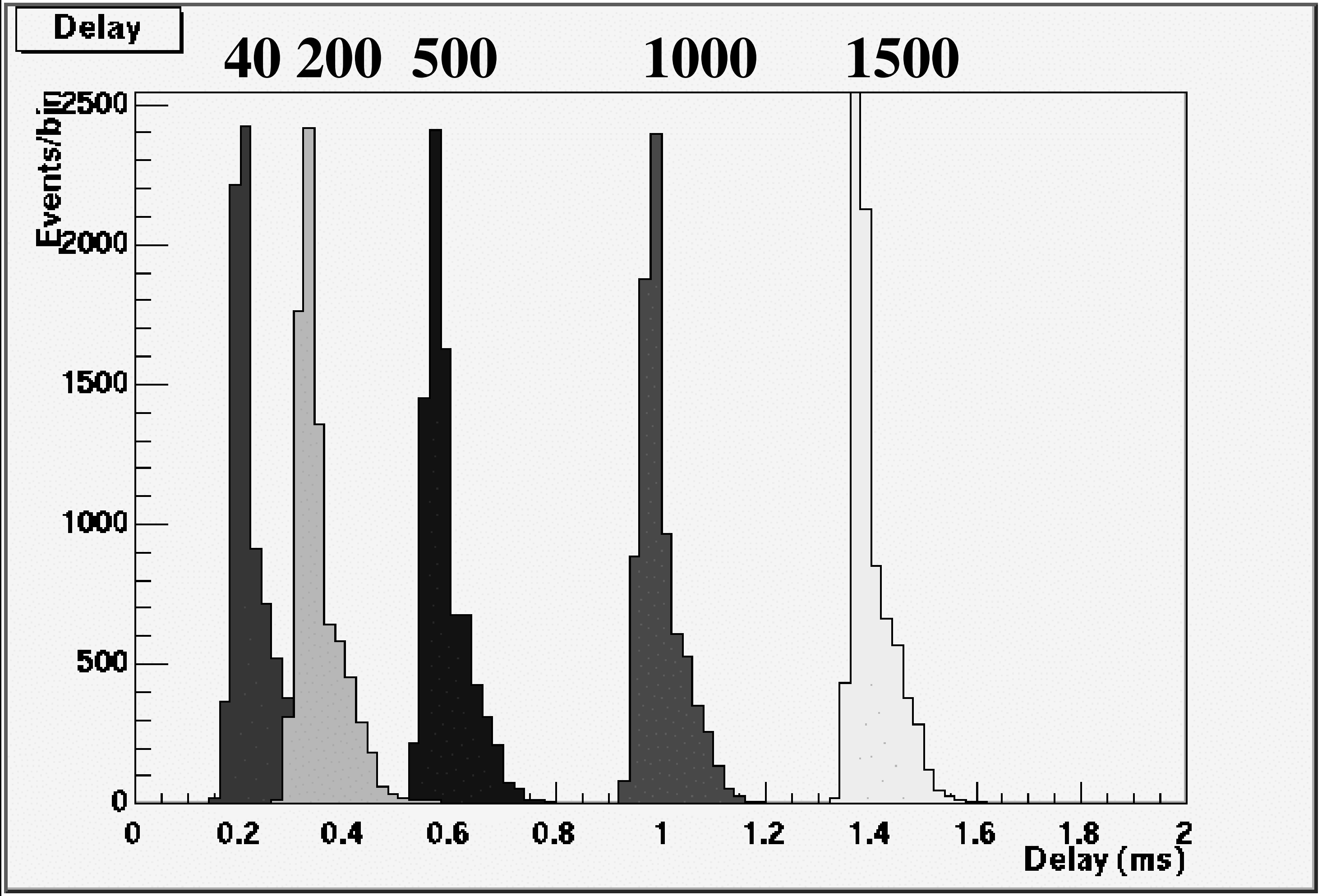
- Two independent implementations of the 1-way delay and loss drafts, measure the same effects
- Important cross-check of the results from both groups
  - Still a few details to be sorted out
  - Topic for further study

Delays versus packet size

- Mentioned in the design document
- Question raised in IPPM this spring

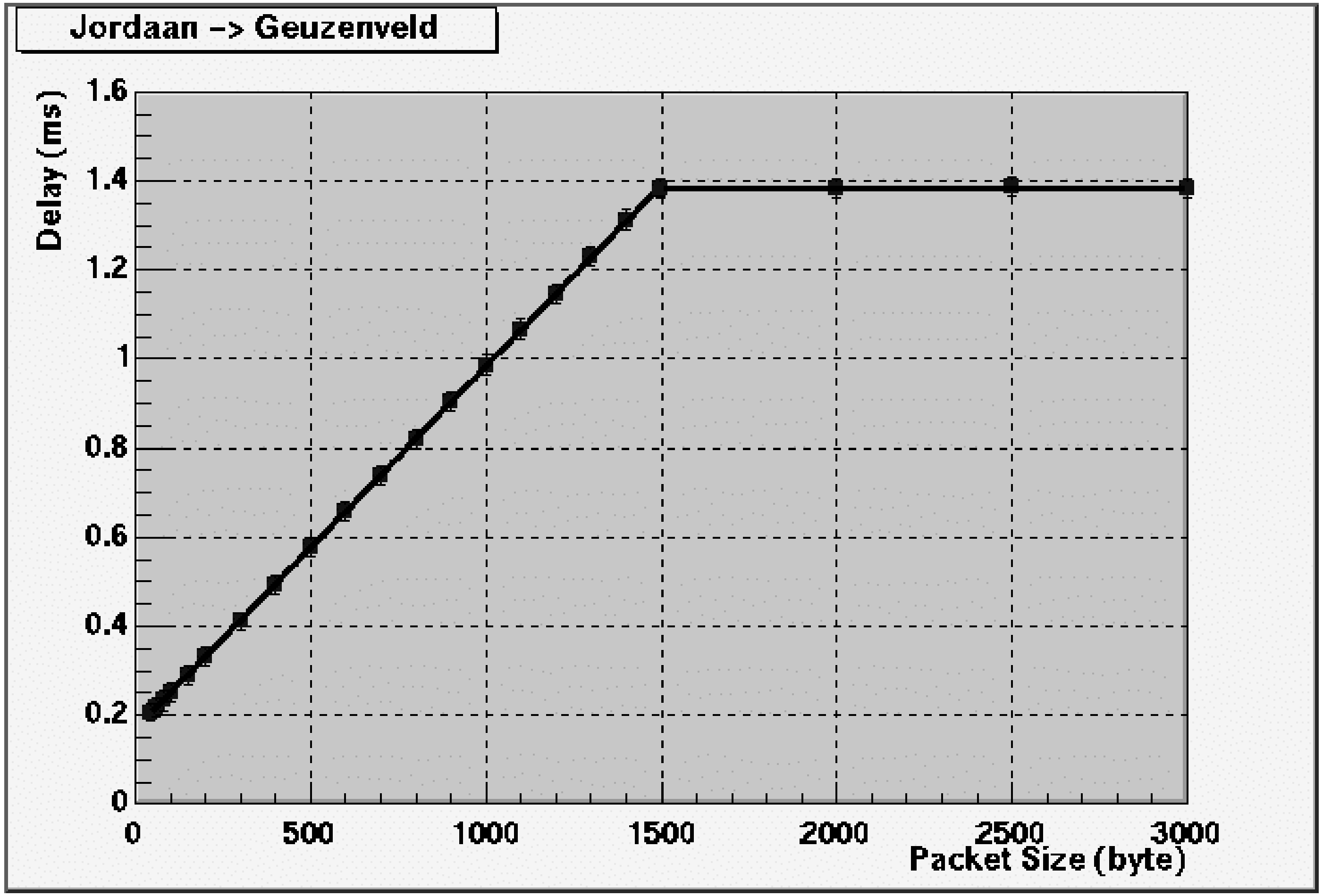
- Measure it:
  - 5 days of data
  - Removed points without valid clocks
  - Look at mean delays

Delays versus packet size Local Network



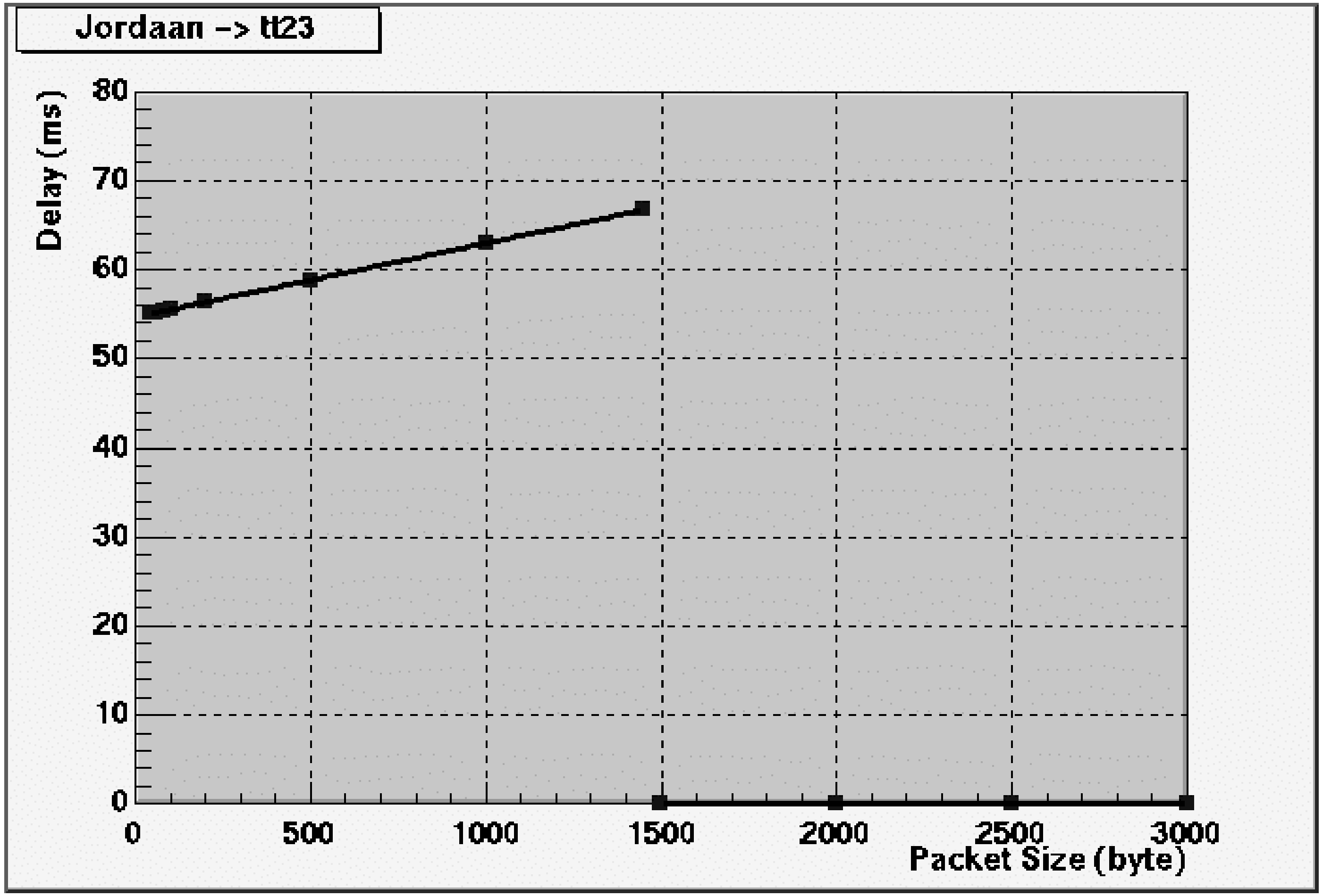
Similar shapes but shifted in time

Delays versus packet size Local Network



- Linear with packet-size up to MTU
- Then frag-mentation

Delays versus packet size Transatlantic



- Linear with packet-size up to MTU
- Larger packets are dropped

Delays versus packet-size

- Model $D = a_0 + a_1 B$, for $B < MTU$
- Local line-speed:

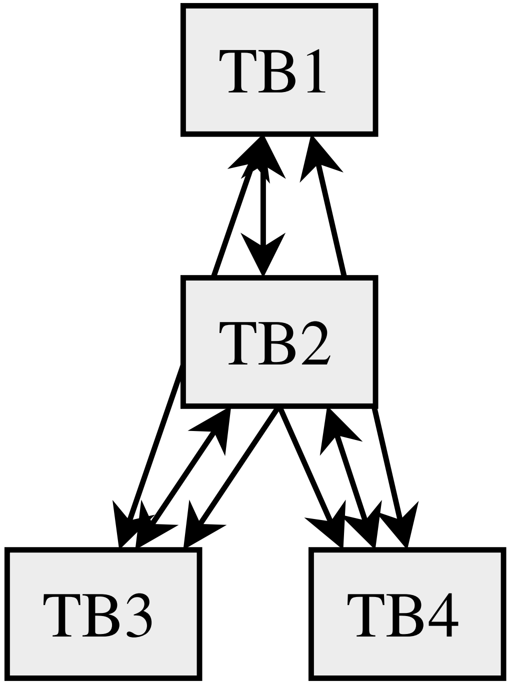
$$a_1 = (8.09 \pm 0.10)\,10^{-4}\,\text{byte/ms} \Rightarrow \text{linespeed} = (1.235 \pm 0.015)\text{Mbyte/s}$$

- Transatlantic line-speed:

$$a_1 = (8.47 \pm 0.05)10^{-3}\ \text{byte/ms} \Rightarrow \text{linespeed} = (118 \pm 2)\text{kbyte/s}$$

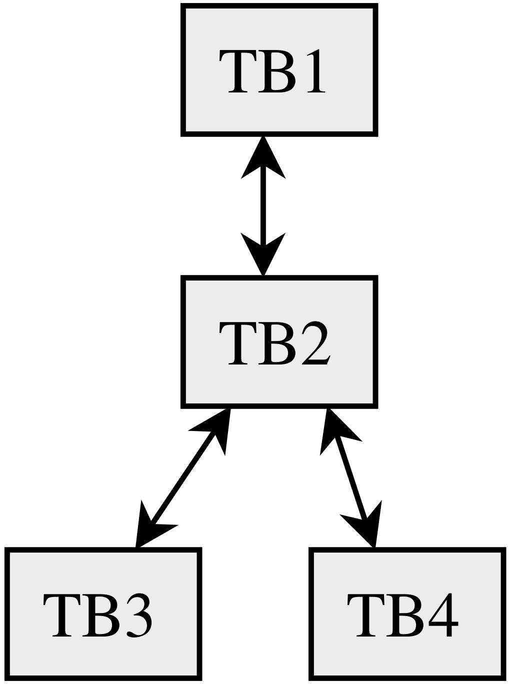
- Will add fragmentation flag to the data
- Is this a method to measure effective throughput without saturating the link?

The N^2-problem



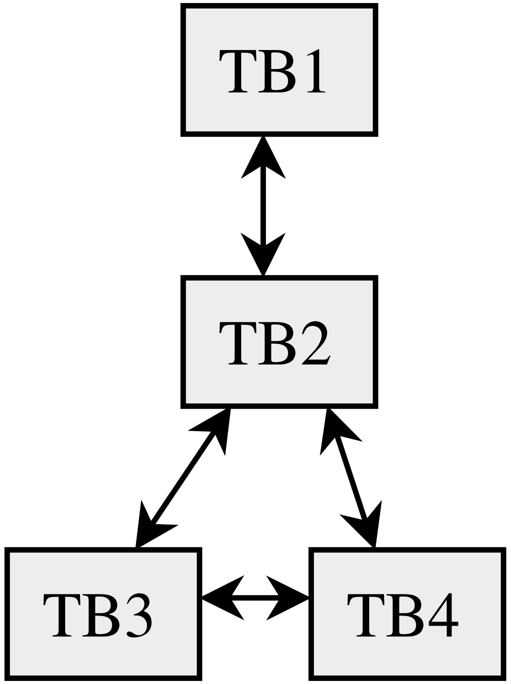
- Number of possible measurements is $N(N-1) \approx N^2$
  - Example: 12 paths
- Not all combinations are interesting:
  - Assume traffic goes via TB2
  - Red paths are the sum of black paths
  - Lots of data that does not add much

The N^2-problem



- Remove uninteresting paths
- All other delays can be derived from the 6 delays that we already measure
- Keep in mind that networks change over time

The N^2-problem



- New paths are added every day
- Dynamically update the configuration files

The N^2-problem

- Approach:
  - Always measure from any test-box to a well-defined subset
    - Test-boxes at major exchange points
    - Other test-boxes selected by the hosts
  - Develop an algorithm to dynamically add and remove other paths from the list of measurements

“Algorithm”

❶Start with all combinations

❷Measure for a while

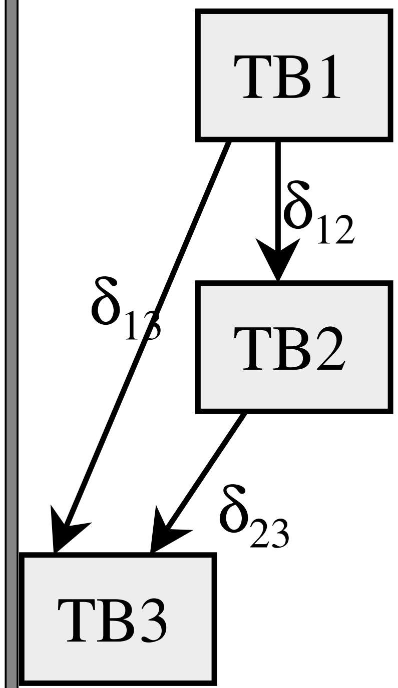
❸See which delays on long paths can be explained by the delays on shorter paths:

- Routing vectors: problematic
- Statistical methods
- De-convolute using FFT

❹Generate new setup, distribute to TB’s

❺Go back to ❷

De-convolute using FFT



- If the delay between 1 and 3 is determined by the delay between the pairs, then:

$$\delta_{13}(t) = \delta_{12}(t) * \delta_{23}(t) = \int_{-\infty}^{\infty} \delta_{12}(\tau)\delta_{23}(t-\tau)\,d\tau$$

- Simple product in the frequency domain:

$$\delta_{13}(t) = \delta_{12}(t) * \delta_{23}(t) \Leftrightarrow D_{12}(f)D_{23}(f) = D_{13}(f)$$

- Transform δ_{ij} to frequency domain, calculate D_{13}, transform back
- Compare measured and calculated delay functions δ_{13}
- How to compare distributions? IPPM!

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  - Delay and loss alarms
  - Long Term Trends
  - Quality of the network
  - Others?
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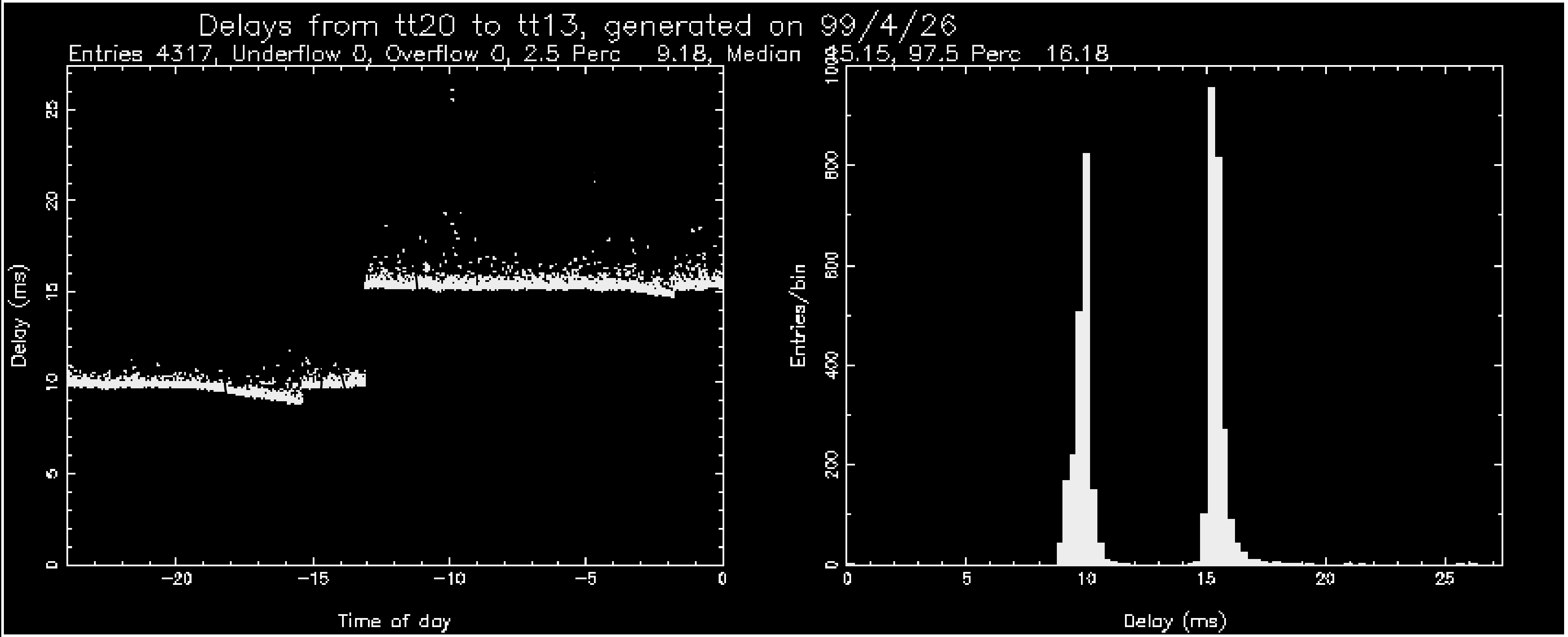
Delay and loss alarms



- Typical example
- Something changed around noon
- Inform test-box hosts

Delay and loss alarm

- Calculate mean and percentile delays for an interval
- Compare against previous intervals
  - “STA-LTA” algorithm
  - Exclude night/day effects, tune algorithm
- If the delays are outside the expected range, send alarm
  - Email (at first), SNMP (later)
- Can also be done for packet losses

Long term trends

- Question: do delays/losses change over time?
- Approach: parameterize losses/delays (following the relevant RFC's)
- Plot over time
- Look for effects

- Intended as a tool for planning

“Quality of the network”

- Summarize parameters from daily plots on a single page:
  - Both short- and long-term
  - Explain what is in the table
  - Should be scientifically defendable
  - Define some acceptable use policy
- Define derived metrics as needed
- Needs study and discussion: here, IPPM

Other ideas, Implementation

- Other services
  - We have resources to implement services based on the TT-data
  - Good idea? Let us know!
- Implementation schedule
  - No real schedule yet
  - Discuss ideas here
  - Determine schedule after RIPE-33

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Summary:

- Measurement network will be doubled in the next months
- Cross-check Advanced/RIPE-NCC data confirms the results from both groups
- Progress with the data analysis in several areas
- We will develop new services

Questions