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NAPA WINE

# Design Considerations for a Peer-to-Peer Streaming Protocol

## draft-seedorf-ppsp-design-considerations-01

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# Introduction and Overview

- The EU Research Project NAPA-WINE has designed and implemented a network-aware P2P Live Streaming System
  - Design of Software Architecture and Chunk Scheduling Algorithms
  - Open Source Implementation (currently running large-scale trials)

**Goal of our draft:**

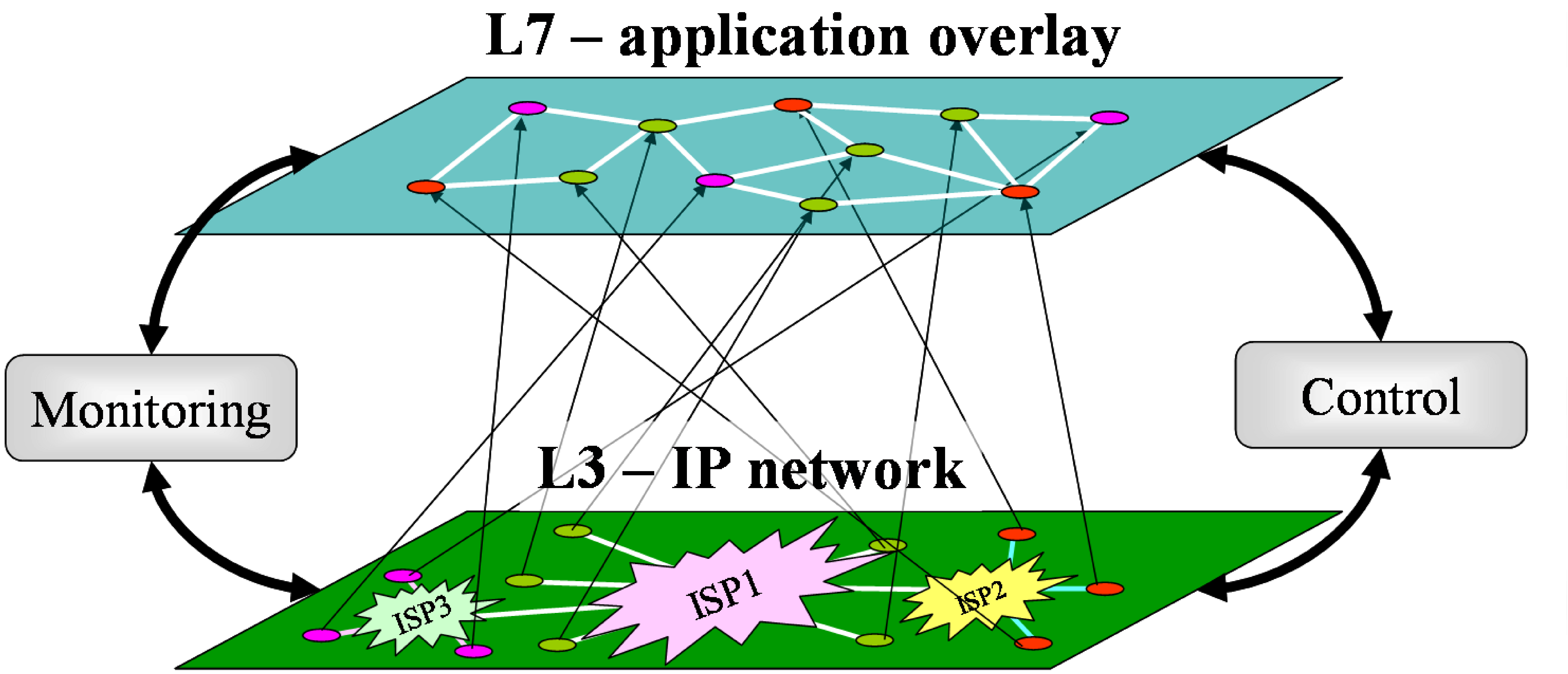
- **Derive the corresponding implications for standardizing a Peer-to-Peer streaming protocol**
  - **Based on our design and implementation experience**

# Agenda

- Background and Motivation: EU Project NAPA-WINE
- P2P Live Streaming Architecture
- Implications on Standardization

# THE NAPA-WINE VISION

# NAPA-WINE Vision

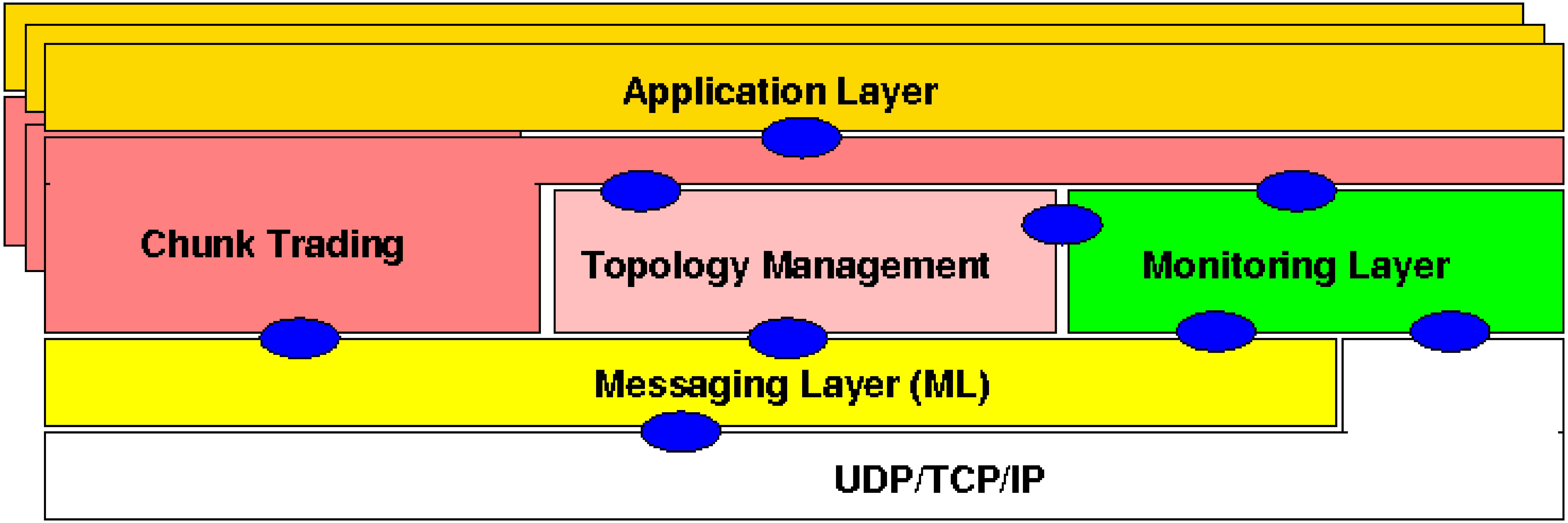


## Network-cooperative P2P architecture

- Cooperation between network providers and P2P applications
  - for P2P-TV or live-streaming in general
- Explicitly targeting the optimization of the quality perceived by the users while minimizing the impact on the underlying transport network
  - empowering future P2P High Quality TV

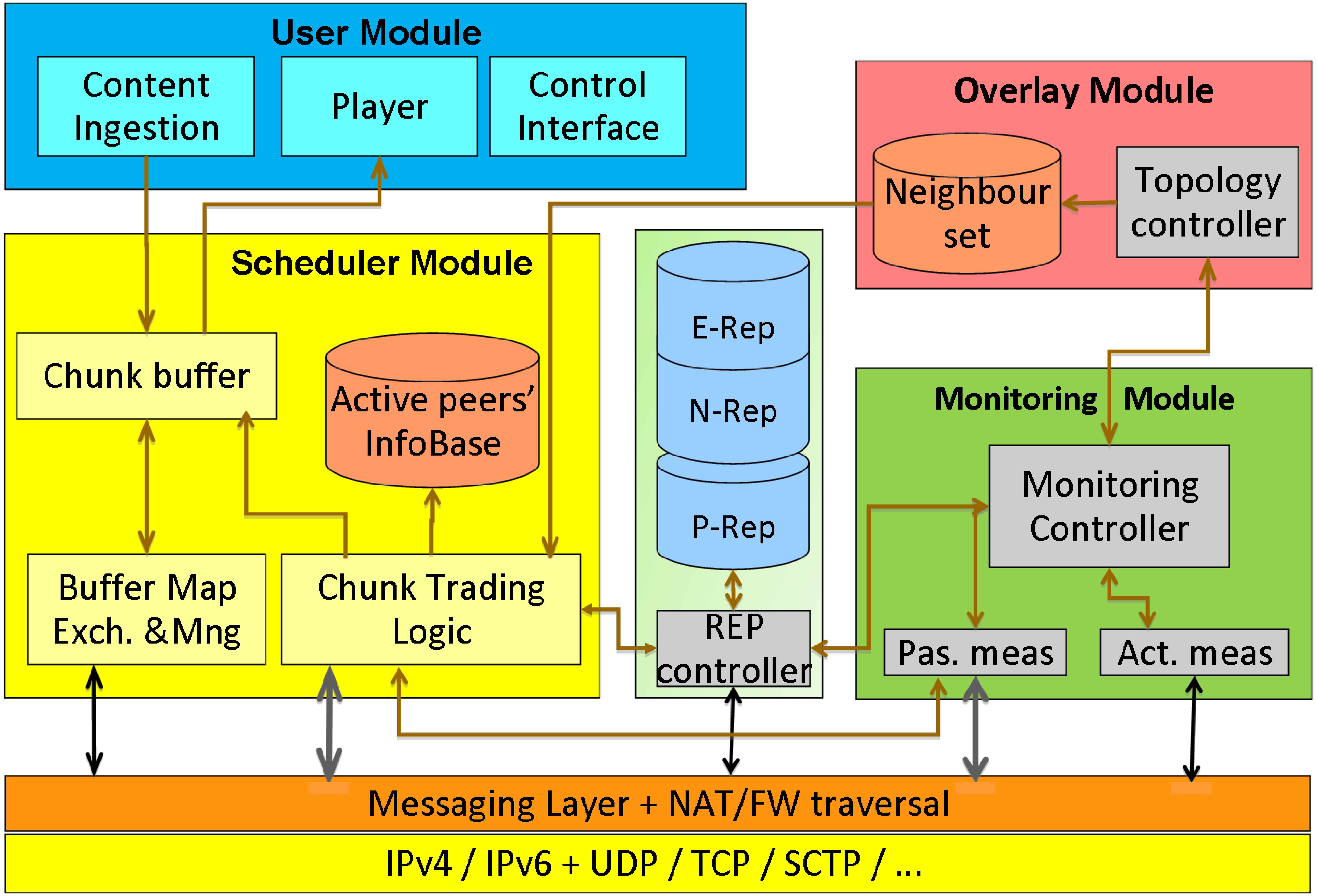
# P2P LIVE STREAMING ARCHITECTURE

# High-Level Architecture Overview



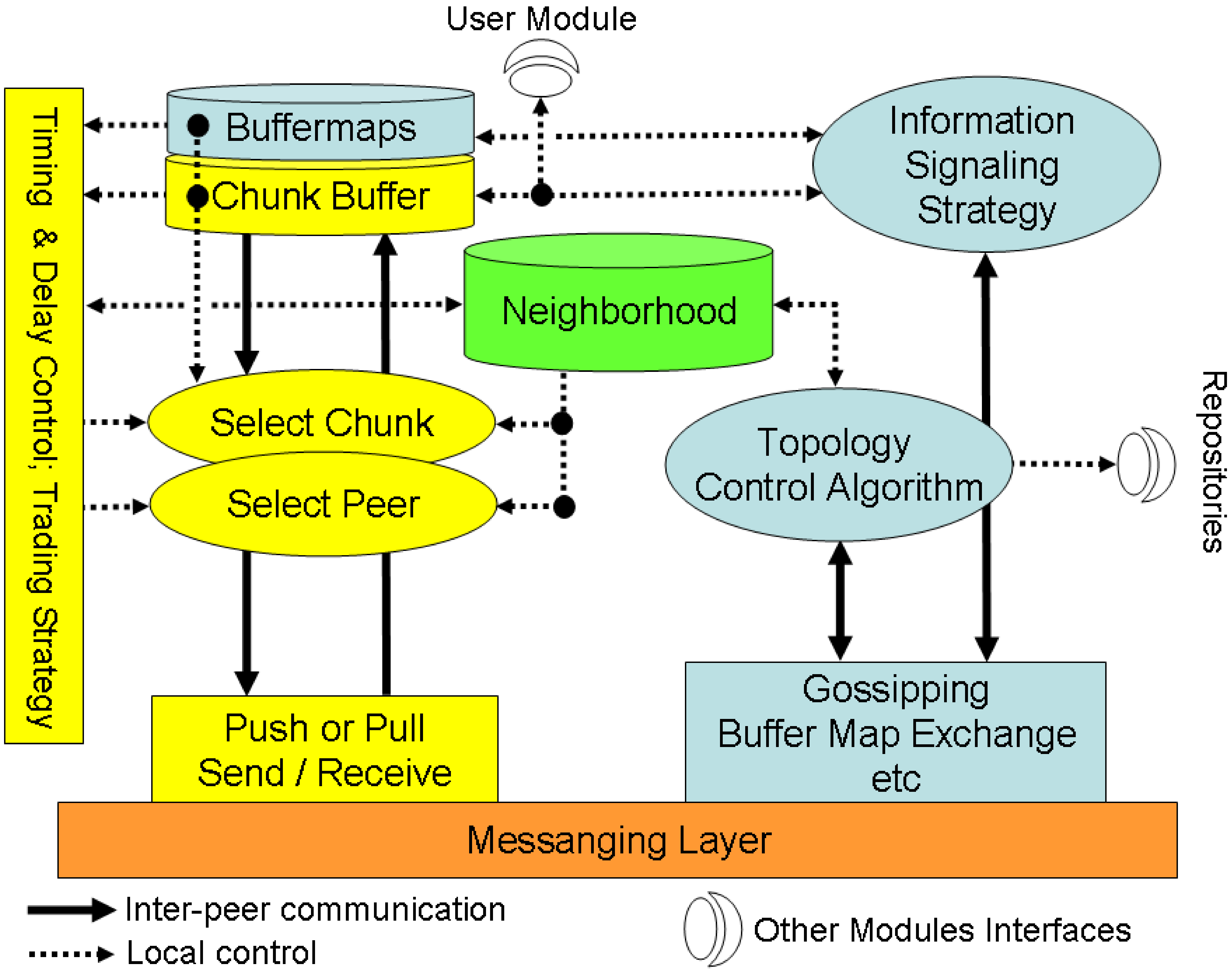
- Design of core functional blocks of a generic peer
- Distributed monitoring function
  - Allows the application to continuously gather real time information on network conditions
  - used to trigger reconfiguration of the overlay or to drive chunk scheduling

# Detailed Architecture Overview



# Topology Management and Chunk Trading

- Neighbourhood database (green)
  - Links to other peers
  - Updated dynamically
- Chunk scheduling (yellow)
  - Local chunk buffer
  - Chunk map exchange
  - Push vs. Pull
- Topology management (blue)
  - Gossiping with other peers


User Module
Buffermaps
Chunk Buffer
Information Signaling Strategy
Timing & Delay Control, Trading Strategy
Neighborhood
Select Chunk
Select Peer
Topology Control Algorithm
Repositories
Push or Pull Send / Receive
Gossipping Buffer Map Exchange etc
Messanging Layer
Inter-peer communication
Local control
Other Modules Interfaces

# Status Quo of Implementation

- All features and logical blocks have been implemented
- Development Toolkit GRAPES
  - Generic Resource Aware P2P Environment for Streaming
  - entirely written in C
    - reuse and linking with any language
- Several P2P live streamers have been implemented
  - exploring different algorithms and techniques
- For QoE evaluation, PSNR (Peak Signal to Noise Ratio) Tools have been developed

**→ www.napa-wine.eu**

# IMPLICATIONS ON STANDARDISATION

# Design Consideration for a PPSP Protocol (1)

## Topology Management

- Tracker protocol must support goals of topology management
- Standardizing topology management algorithm?
  - probably out-of-scope for PPSP
  - Definition of information about the employed topology management and the exchange may be standardized within PPSP WG

## Chunk Scheduling

- The PPSP protocol design should allow to operate either with a push or pull regime
  - Selection of push or pull being used in the PPSP system during runtime
  - probably out-of-scope for PPSP
- The PPSP protocol design should allow to employ multiple chunk scheduling algorithms with the same protocol

# Design Consideration for a PPSP Protocol (2)

## Monitoring Layer

- The PPSP protocol should allow the exchange of monitoring status information among peers

## Messaging Layer

- The PPSP protocol should allow to negotiate or select different transport protocols, e.g., between plain TCP and LEDBAT
- The PPSP protocol or framework should support peers in NAT traversal

## Interaction with ALTO

- The PPSP protocol should allow peers to interact with an ALTO server and to retrieve ALTO information
- The PPSP protocol should enable the use of ALTO information in peer selection

# Conclusion

- EU project NAPA-WINE designed and implemented a P2P Live Streaming Architecture
  - Composed of different layers with dedicated functionality
  - Overlay topology management and chunk scheduling are key components of P2P Live Streaming clients

- draft-seedorf-ppsp-design-considerations-01
  - Describes the NAPA-WINE architecture
  - Highlights key implications for standardization, based on our experience in designing and implementing a P2P live streaming system

➢ **We believe that these key design considerations we derived based on our architecture will be important input to the PPSP working group for standardizing a P2P live streaming protocol**

# ACKNOWLEDGEMENT

- This work was partially supported by NAPA-WINE, a research project supported by the European Commission under its 7th Framework Program (contract no. 214412). The views and conclusions contained herein are those of the authors and should not be interpreted as necessarily representing the official policies or endorsements, either expressed or implied, of the NAPA-WINE project or the European Commission.

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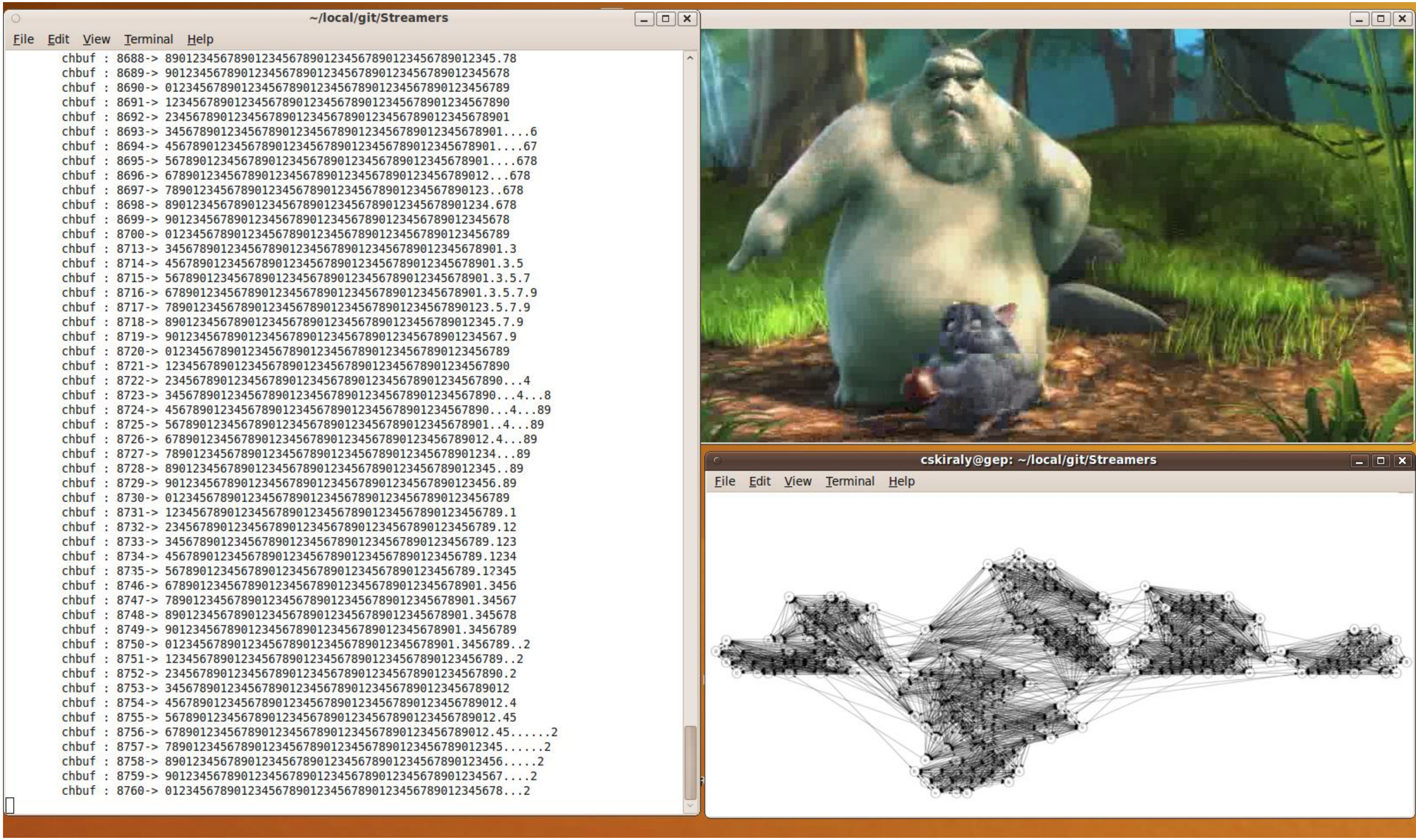
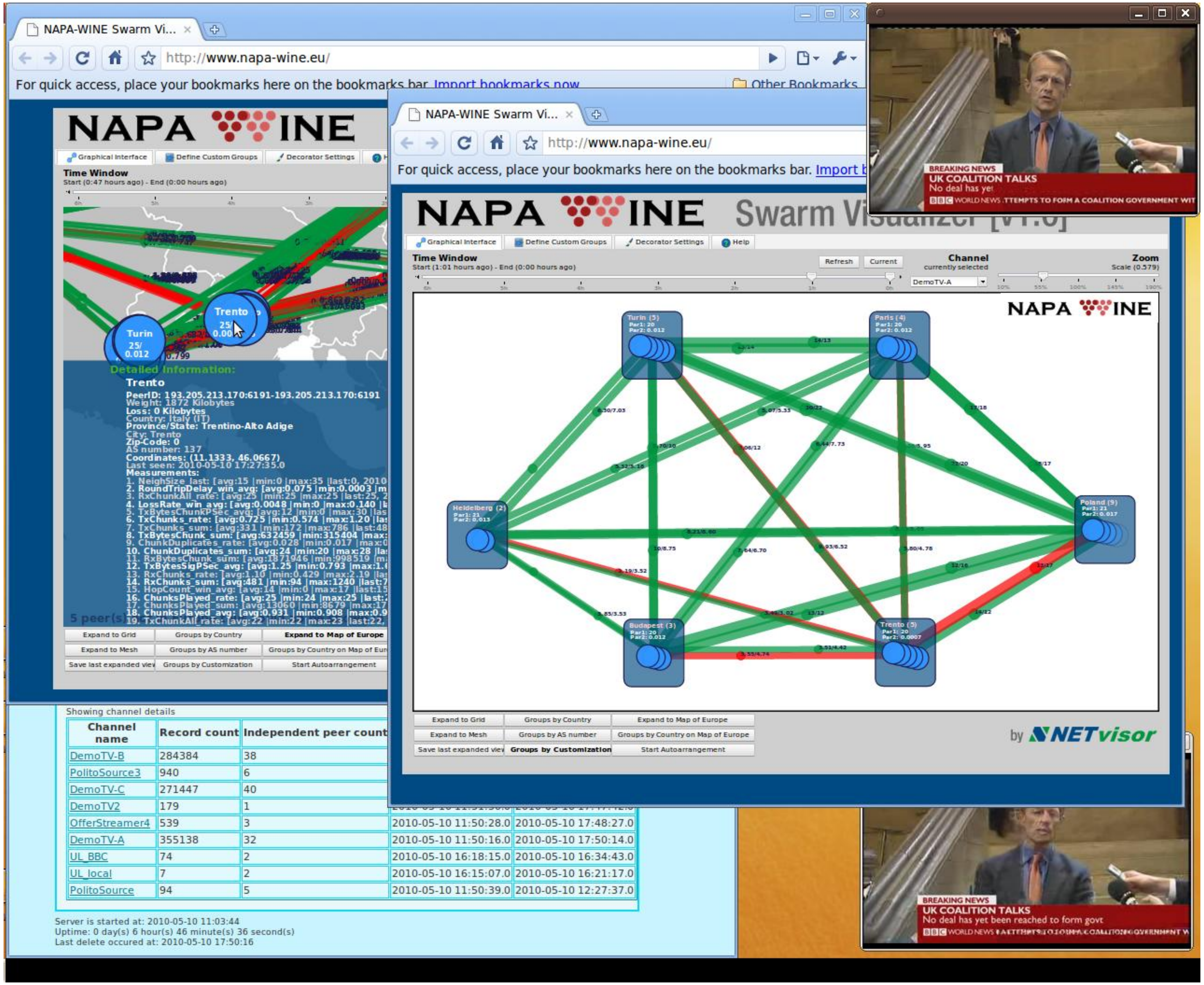
# APPENDIX: SCREENSHOTS OF THE NAPA-WINE SOFTWARE

# Screenshots (1)


~/local/git/Streamers
File Edit View Terminal Help
cskiraly@gep: ~/local/git/Streamers
File Edit View Terminal Help

```
        chbuf : 8688-> 890123456789012345678901234567890123456789012345.78
        chbuf : 8689-> 9012345678901234567890123456789012345678901234567 8
        chbuf : 8690-> 01234567890123456789012345678901234567890123456789
        chbuf : 8691-> 12345678901234567890123456789012345678901234567890
        chbuf : 8692-> 23456789012345678901234567890123456789012345678901
        chbuf : 8693-> 34567890123456789012345678901234567890123456789 01....6
        chbuf : 8694-> 4567890123456789012345678901234567890123456789 01....67
        chbuf : 8695-> 5678901234567890123456789012345678901234567890 1....678
        chbuf : 8696-> 678901234567890123456789012345678901234567890 12...678
        chbuf : 8697-> 78901234567890123456789012345678901234567890123..678
        chbuf : 8698-> 890123456789012345678901234567890123456789 01234.678
        chbuf : 8699-> 9012345678901234567890123456789012345678901234567 8
        chbuf : 8700-> 01234567890123456789012345678901234567890123456789
        chbuf : 8713-> 34567890123456789012345678901234567890123456789 01.3
        chbuf : 8714-> 4567890123456789012345678901234567890123456789 01.3.5
        chbuf : 8715-> 5678901234567890123456789012345678901234567890 1.3.5.7
        chbuf : 8716-> 678901234567890123456789012345678901234567890 1.3.5.7.9
        chbuf : 8717-> 78901234567890123456789012345678901234567890123.5.7.9
        chbuf : 8718-> 890123456789012345678901234567890123456789012345.7.9
        chbuf : 8719-> 9012345678901234567890123456789012345678901234567.9
        chbuf : 8720-> 01234567890123456789012345678901234567890123456789
        chbuf : 8721-> 12345678901234567890123456789012345678901234567890
        chbuf : 8722-> 234567890123456789012345678901234567890123456789 0...4
        chbuf : 8723-> 34567890123456789012345678901234567890123456789 0...4...8
        chbuf : 8724-> 4567890123456789012345678901234567890123456789 0...4...89
        chbuf : 8725-> 5678901234567890123456789012345678901234567890 1..4...89
        chbuf : 8726-> 678901234567890123456789012345678901234567890 12.4...89
        chbuf : 8727-> 78901234567890123456789012345678901234567890 1234...89
        chbuf : 8728-> 890123456789012345678901234567890123456789012345..89
        chbuf : 8729-> 901234567890123456789012345678901234567890123456.89
        chbuf : 8730-> 01234567890123456789012345678901234567890123456789
        chbuf : 8731-> 123456789012345678901234567890123456789012345678 9.1
        chbuf : 8732-> 23456789012345678901234567890123456789012345678 9.12
        chbuf : 8733-> 3456789012345678901234567890123456789012345678 9.123
        chbuf : 8734-> 456789012345678901234567890123456789012345678 9.1234
        chbuf : 8735-> 56789012345678901234567890123456789012345678 9.12345
        chbuf : 8746-> 678901234567890123456789012345678901234567890 1.3456
        chbuf : 8747-> 78901234567890123456789012345678901234567890 1.34567
        chbuf : 8748-> 8901234567890123456789012345678901234567890 1.345678
        chbuf : 8749-> 901234567890123456789012345678901234567890 1.3456789
        chbuf : 8750-> 01234567890123456789012345678901234567890 1.3456789..2
        chbuf : 8751-> 123456789012345678901234567890123456789012345678 9..2
        chbuf : 8752-> 2345678901234567890123456789012345678901234567890.2
        chbuf : 8753-> 345678901234567890123456789012345678901234567890 12
        chbuf : 8754-> 45678901234567890123456789012345678901234567890 12.4
        chbuf : 8755-> 5678901234567890123456789012345678901234567890 12.45
        chbuf : 8756-> 678901234567890123456789012345678901234567890 12.45......2
        chbuf : 8757-> 7890123456789012345678901234567890123456789012345......2
        chbuf : 8758-> 89012345678901234567890123456789012345678901 23456.....2
        chbuf : 8759-> 901234567890123456789012345678901234567890 1234567....2
        chbuf : 8760-> 01234567890123456789012345678901234567890 12345678...2
```

# Screenshots (2)



Detailed Information:

Trento

PeerID: 193.205.213.170:6191-193.205.213.170:6191
Weight: 1872 Kilobytes
Loss: 0 Kilobytes
Country: Italy (IT)
Province/State: Trentino-Alto Adige
City: Trento
Zip-Code: 0
AS number: 137
Coordinates: (11.1333, 46.0667)
Last seen: 2010-05-10 17:27:35.0
Measurements:

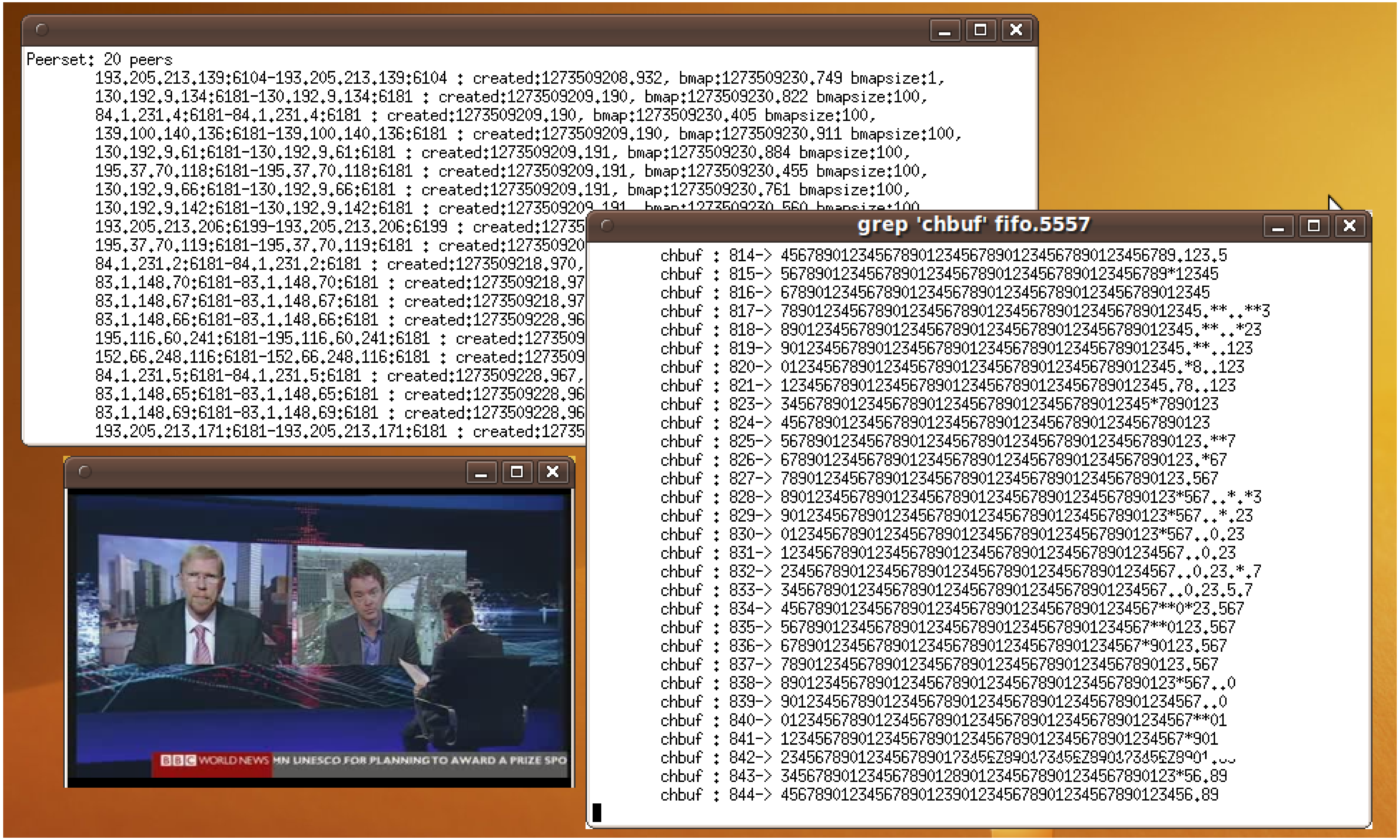
1. NeighSize_last: [avg:15 |min:0 |max:35 |last:0, 2010
2. RoundTripDelay_win_avg: [avg:0.075 |min:0.0003 |m
3. RxChunkAll_rate: [avg:25 |min:25 |max:25 |last:25, 2
4. LossRate_win_avg: [avg:0.0048 |min:0 |max:0.140 |la
5. TxBytesChunkPSec_avg: [avg:12 |min:0 |max:30 |las
6. TxChunks_rate: [avg:0.725 |min:0.574 |max:1.20 |las
7. TxChunks_sum: [avg:331 |min:172 |max:786 |last:48
8. TxBytesChunk_sum: [avg:632459 |min:315404 |max:
9. ChunkDuplicates_rate: [avg:0.028 |min:0.017 |max:0
10. ChunkDuplicates_sum: [avg:24 |min:20 |max:28 |las
11. RxBytesChunk_sum: [avg:1871946 |min:998519 |m
12. TxBytesSigPSec_avg: [avg:1.25 |min:0.793 |max:1.
13. RxChunks_rate: [avg:1.10 |min:0.429 |max:2.19 |las
14. RxChunks_sum: [avg:481 |min:94 |max:1240 |last:7
15. HopCount_win_avg: [avg:14 |min:0 |max:17 |last:15
16. ChunksPlayed_rate: [avg:25 |min:24 |max:25 |last:2
17. ChunksPlayed_sum: [avg:13060 |min:8679 |max:17
18. ChunksPlayed_avg: [avg:0.931 |min:0.908 |max:0.9
19. TxChunkAll_rate: [avg:22 |min:22 |max:23 |last:22,

Showing channel details

| Channel name | Record count | Independent peer count | | |
|---|---|---|---|---|
| DemoTV-B | 284384 | 38 | | |
| PolitoSource3 | 940 | 6 | | |
| DemoTV-C | 271447 | 40 | | |
| DemoTV2 | 179 | 1 | [illegible] | [illegible] |
| OfferStreamer4 | 539 | 3 | 2010-05-10 11:50:28.0 | 2010-05-10 17:48:27.0 |
| DemoTV-A | 355138 | 32 | 2010-05-10 11:50:16.0 | 2010-05-10 17:50:14.0 |
| UL_BBC | 74 | 2 | 2010-05-10 16:18:15.0 | 2010-05-10 16:34:43.0 |
| UL_local | 7 | 2 | 2010-05-10 16:15:07.0 | 2010-05-10 16:21:17.0 |
| PolitoSource | 94 | 5 | 2010-05-10 11:50:39.0 | 2010-05-10 12:27:37.0 |

Server is started at: 2010-05-10 11:03:44
Uptime: 0 day(s) 6 hour(s) 46 minute(s) 36 second(s)
Last delete occured at: 2010-05-10 17:50:16

# Screenshots (3)

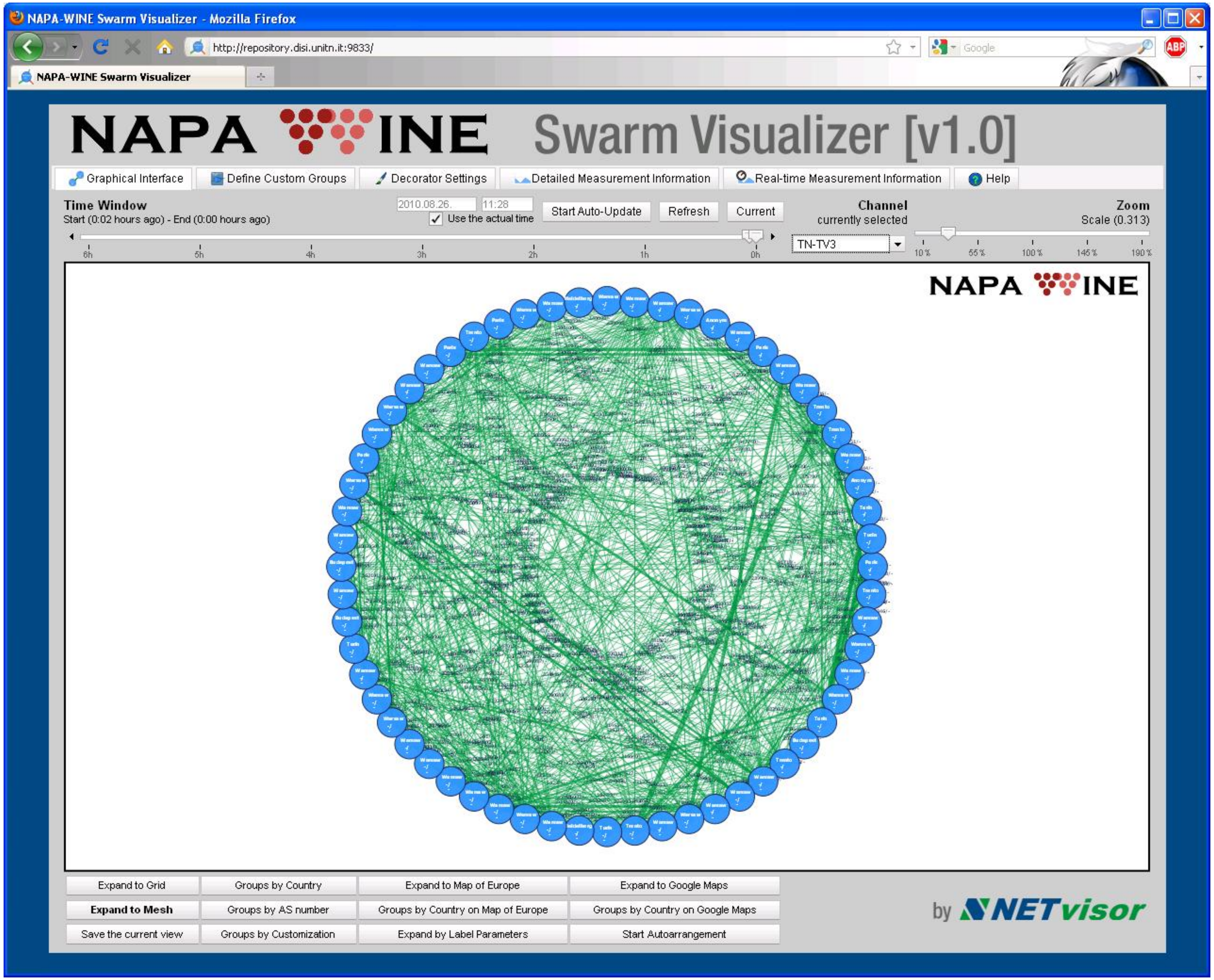


```
Peerset: 20 peers
        193.205.213.139:6104-193.205.213.139:6104 : created:1273509208.932, bmap:1273509230.749 bmapsize:1,
        130.192.9.134:6181-130.192.9.134:6181 : created:1273509209.190, bmap:1273509230.822 bmapsize:100,
        84.1.231.4:6181-84.1.231.4:6181 : created:1273509209.190, bmap:1273509230.405 bmapsize:100,
        139.100.140.136:6181-139.100.140.136:6181 : created:1273509209.190, bmap:1273509230.911 bmapsize:100,
        130.192.9.61:6181-130.192.9.61:6181 : created:1273509209.191, bmap:1273509230.884 bmapsize:100,
        195.37.70.118:6181-195.37.70.118:6181 : created:1273509209.191, bmap:1273509230.455 bmapsize:100,
        130.192.9.66:6181-130.192.9.66:6181 : created:1273509209.191, bmap:1273509230.761 bmapsize:100,
        130.192.9.142:6181-130.192.9.142:6181 : created:1273509209.191, bmap:1273509230.560 bmapsize:100
        193.205.213.206:6199-193.205.213.206:6199 : created:12735
        195.37.70.119:6181-195.37.70.119:6181 : created:127350920
        84.1.231.2:6181-84.1.231.2:6181 : created:1273509218.970,
        83.1.148.70:6181-83.1.148.70:6181 : created:1273509218.97
        83.1.148.67:6181-83.1.148.67:6181 : created:1273509218.97
        83.1.148.66:6181-83.1.148.66:6181 : created:1273509228.96
        195.116.60.241:6181-195.116.60.241:6181 : created:1273509
        152.66.248.116:6181-152.66.248.116:6181 : created:1273509
        84.1.231.5:6181-84.1.231.5:6181 : created:1273509228.967,
        83.1.148.65:6181-83.1.148.65:6181 : created:1273509228.96
        83.1.148.69:6181-83.1.148.69:6181 : created:1273509228.96
        193.205.213.171:6181-193.205.213.171:6181 : created:12735
```

grep 'chbuf' fifo.5557

```
        chbuf : 814-> 4567890123456789012345678901234567890123456789.123.5
        chbuf : 815-> 5678901234567890123456789012345678901234567890*12345
        chbuf : 816-> 678901234567890123456789012345678901234567890012345
        chbuf : 817-> 78901234567890123456789012345678901234567890012345.**..**3
        chbuf : 818-> 89012345678901234567890123456789012345678901234 5.**..*23
        chbuf : 819-> 901234567890123456789012345678901234567890012345.**..123
        chbuf : 820-> 0123456789012345678901234567890123456789012345.*8..123
        chbuf : 821-> 1234567890123456789012345678901234567890012345.78..123
        chbuf : 823-> 3456789012345678901234567890123456789012345*7890123
        chbuf : 824-> 4567890123456789012345678901234567890123456789 0123
        chbuf : 825-> 5678901234567890123456789012345678901234567890123.**7
        chbuf : 826-> 6789012345678901234567890123456789012345678 90123.*67
        chbuf : 827-> 7890123456789012345678901234567890123456789 0123.567
        chbuf : 828-> 8901234567890123456789012345678901234567890123*567..*.*3
        chbuf : 829-> 9012345678901234567890123456789012345678901 23*567..*.23
        chbuf : 830-> 0123456789012345678901234567890123456789 0123*567..0.23
        chbuf : 831-> 1234567890123456789012345678901234567890 1234567..0.23
        chbuf : 832-> 2345678901234567890123456789012345678901234567..0.23.*.7
        chbuf : 833-> 3456789012345678901234567890123456789012 34567..0.23.5.7
        chbuf : 834-> 4567890123456789012345678901234567890 1234567**0*23.567
        chbuf : 835-> 5678901234567890123456789012345678901234567**0123.567
        chbuf : 836-> 6789012345678901234567890123456789012 34567*90123.567
        chbuf : 837-> 7890123456789012345678901234567890123456789 0123.567
        chbuf : 838-> 8901234567890123456789012345678901234567890123*567..0
        chbuf : 839-> 9012345678901234567890123456789012345678901234567..0
        chbuf : 840-> 0123456789012345678901234567890123456789 01234567**01
        chbuf : 841-> 1234567890123456789012345678901234567890 1234567*901
        chbuf : 842-> 23456789012345678901234567890123456789012345678901.23
        chbuf : 843-> 3456789012345678901289012345678901234567890123*56.89
        chbuf : 844-> 4567890123456789012390123456789012345678 90123456.89
```

# Screenshots (4)



NAPA-WINE Swarm Visualizer - Mozilla Firefox

http://repository.disi.unitn.it:9833/

NAPA-WINE Swarm Visualizer

NAPA WINE Swarm Visualizer [v1.0]

Time Window
Start (0:02 hours ago) - End (0:00 hours ago)

2010.08.26. 11:28
☑ Use the actual time

Channel
currently selected
TN-TV3

Zoom
Scale (0.313)