NETINF LIVE VIDEO STREAMING – FALUN FIELD TRIAL

Adeel Malik, **Börje Ohlman** - Ericsson

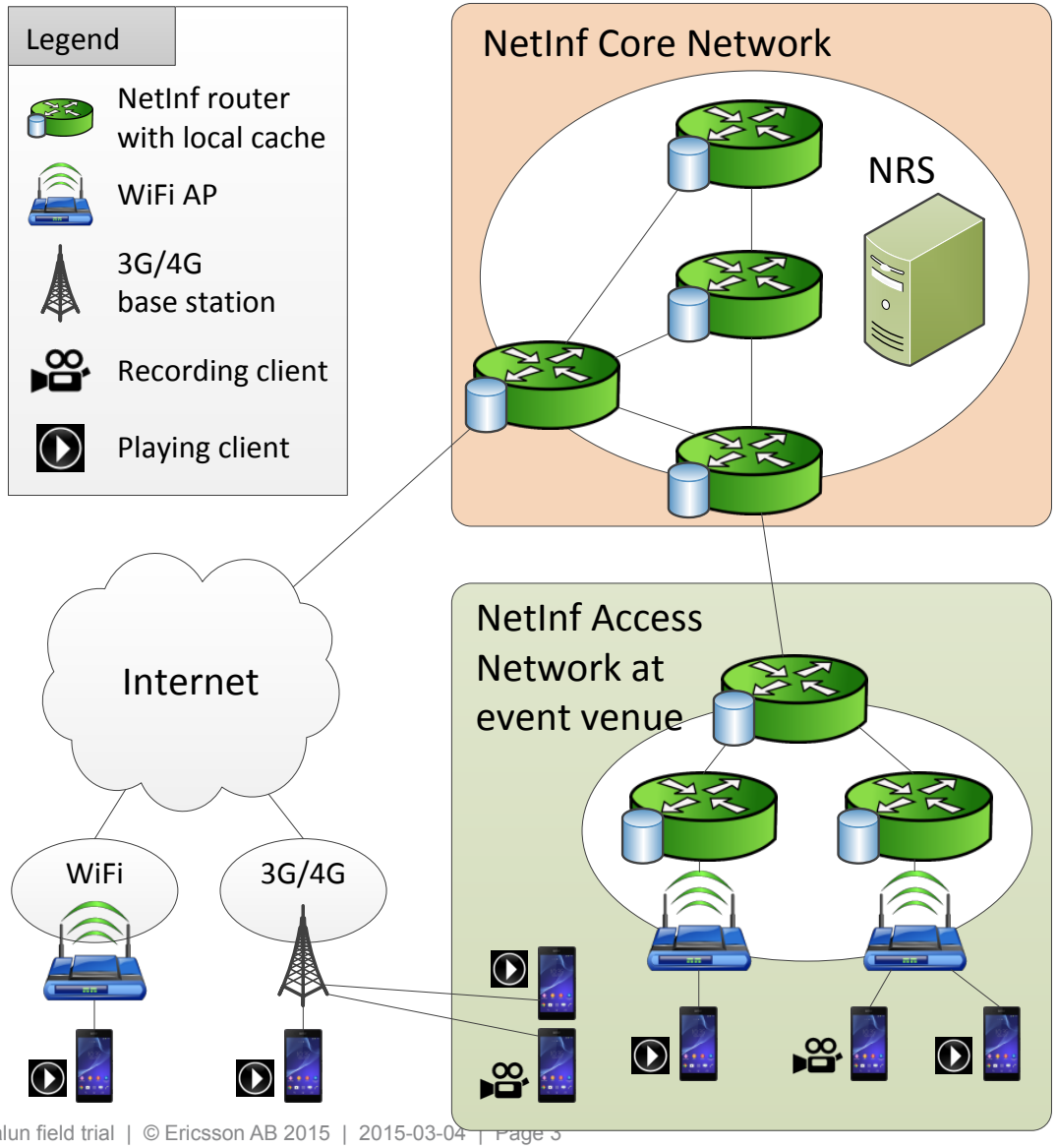
Bengt Ahlgren, Anders Lindgren – SICS

Lukas Klingsbo, Magnus Lång, Edith Ngai – Uppsala University

OUTLINE

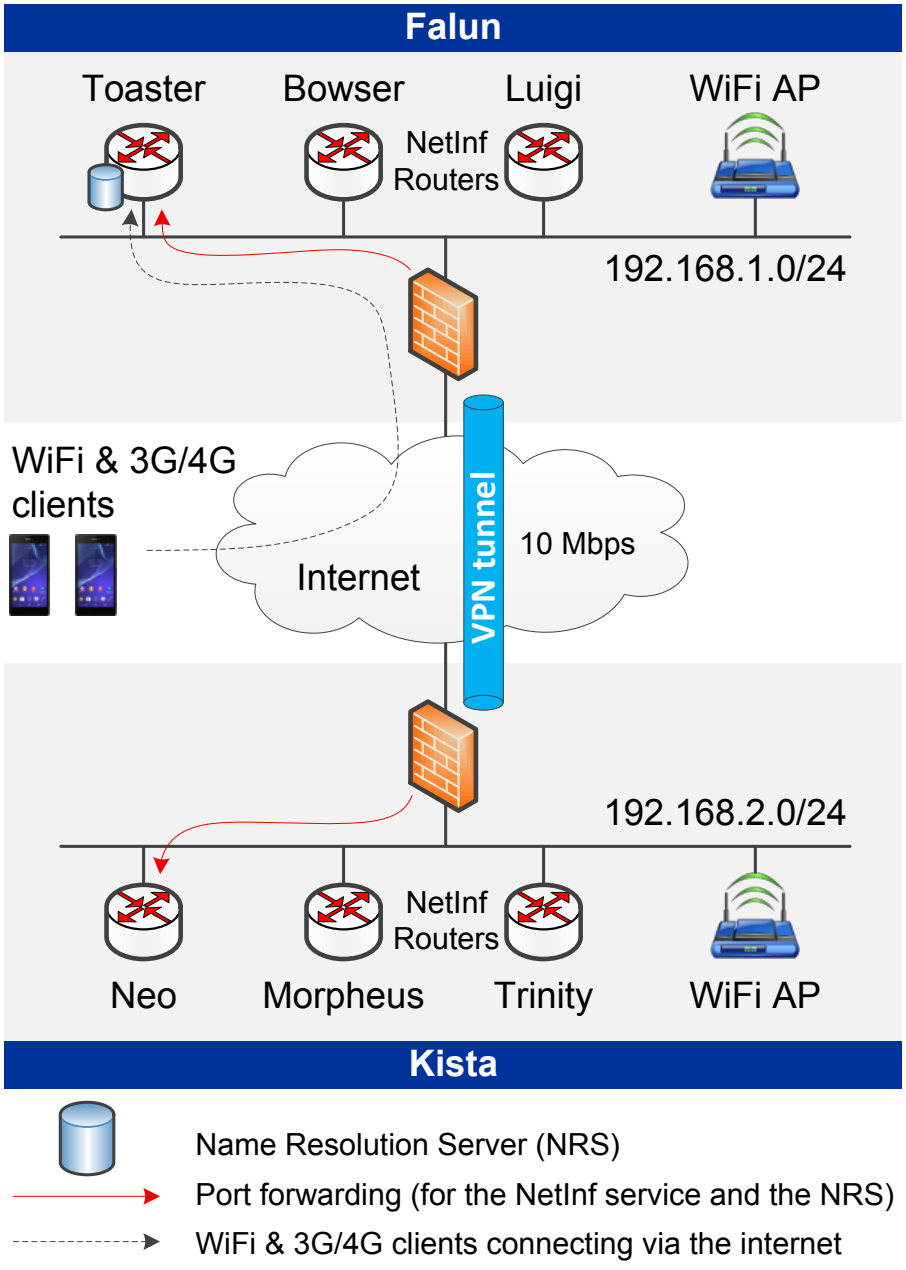
- Falun field trial
- NetInf Architecture (SPIN mechanism)
- Movie time!
- Evaluation results
- Conclusions

NETWORK ARCHITECTURE



NETWORK ARCHITECTURE

- Experimental setup
  - NetInf routers with caches deployed at Lugnet, the ski arena in Falun
  - A similar setup in Ericsson's lab in Kista
  - Android phones with our NetInf-enabled video recording and playing app

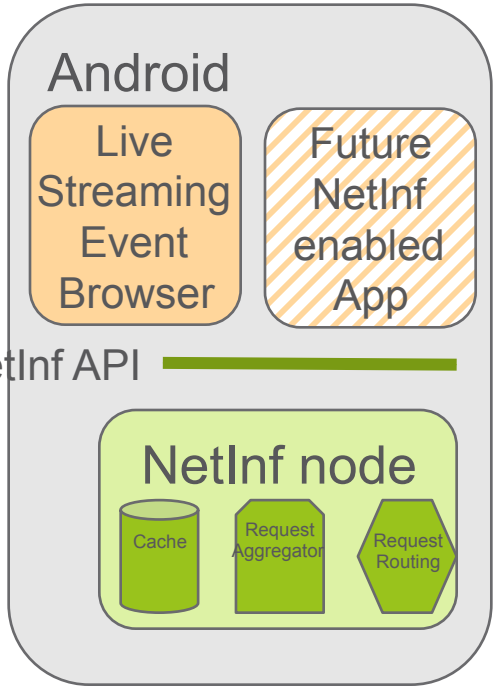


ARCHITECTURE & IMPLEMENTATION SPECIFICS

- NetInf Service Discovery
  - Clients on local WiFi use Multicast DNS (mDNS) for discovery of NetInf routers
  - Clients on the Internet use DNS resolution to discover a NetInf router
- Centralized Name Resolution Server (NRS)
  - Resolves header object and chunks names to locations
  - Stores meta-data for video streams that is used to populate the Event Browser
- Discovery of subsequent chunk names
  - Publish-Subscribe used instead of Manifest files
- Retrieval of video chunks
  - Hop-by-hop TCP connections

ARCHITECTURE & IMPLEMENTATION SPECIFICS

- Caching and Aggregation
  - On-path caching, all NetInf routers have a cache
  - Hop-by-hop Publish-Subscribe and caching enables aggregation
- Event Browser
  - Integrated in the Android Netinf live video streaming application
  - Used for video stream selection; provides a list view and a map view for selection
  - NRS periodically polled for updating the list/map view; for this a search is performed for all Header NDOs registered in the NRS
- NetInf node in Android
  - Always running, could be used by other NetInf enabled apps
- Video stream and chunks
  - Bitrate: 1 Mbps
  - H.264 encoded chunks, chunk length is 2 seconds



NDO TYPES AND METADATA

- There are two types of NDOs registered in the NRS. First the Header NDO and second the NDOs for video chunks. The two types of NDOs have the following key fields in the metadata.

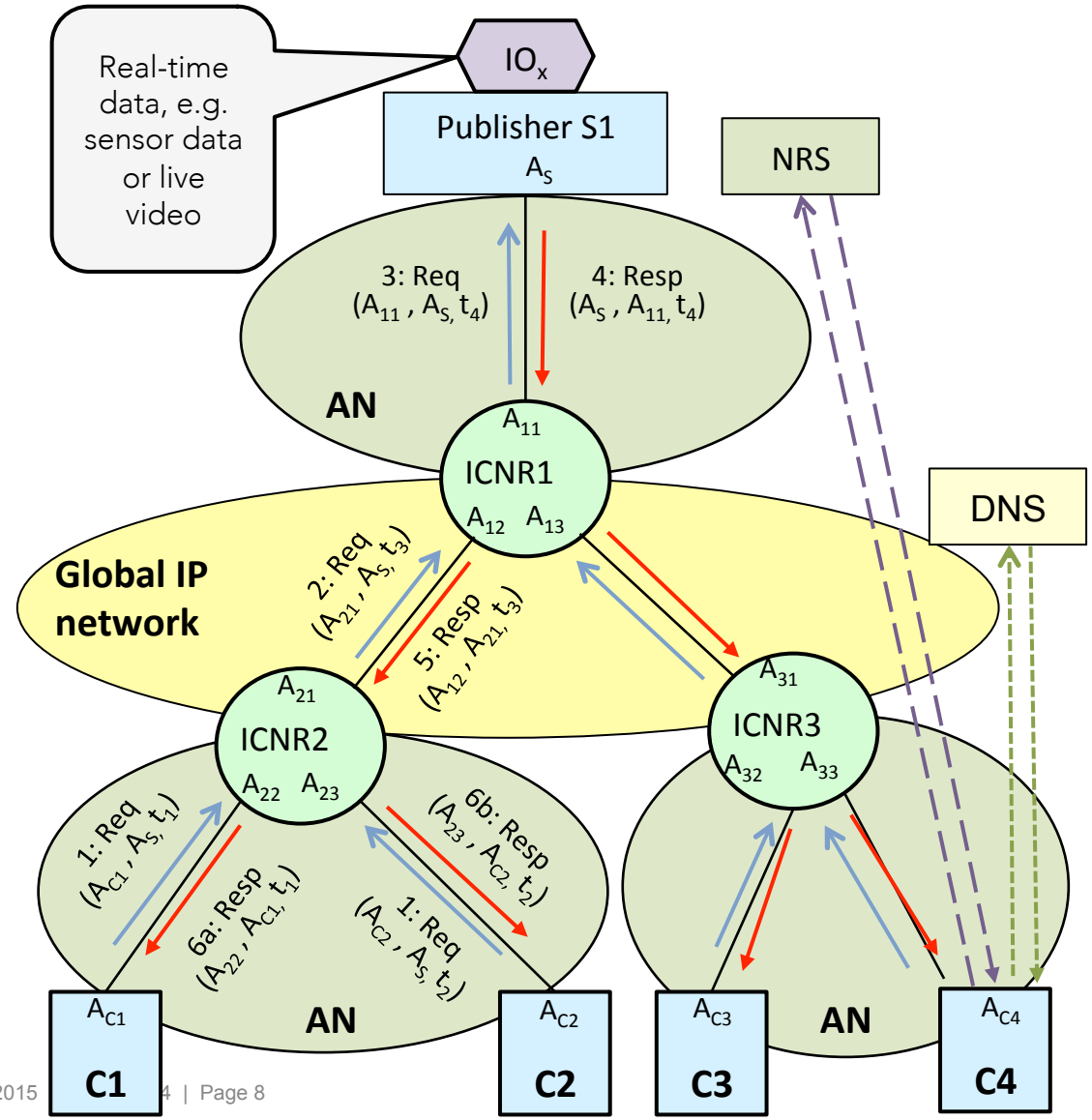
NDO type	Metadata fields
Header NDO	Video name, Video description, Video geo-location
Video chunk NDO	Header NDO name, Timestamp, Sequence number

- NRS search is used for a number of functions e.g. populating the Event Browser, retrieving video chunks when a seek is performed during video playback and retrieving video chunks for which notifications are lost.

NetInf Name Resolution and Point-to-Multipoint

NetInf - Network of Information:

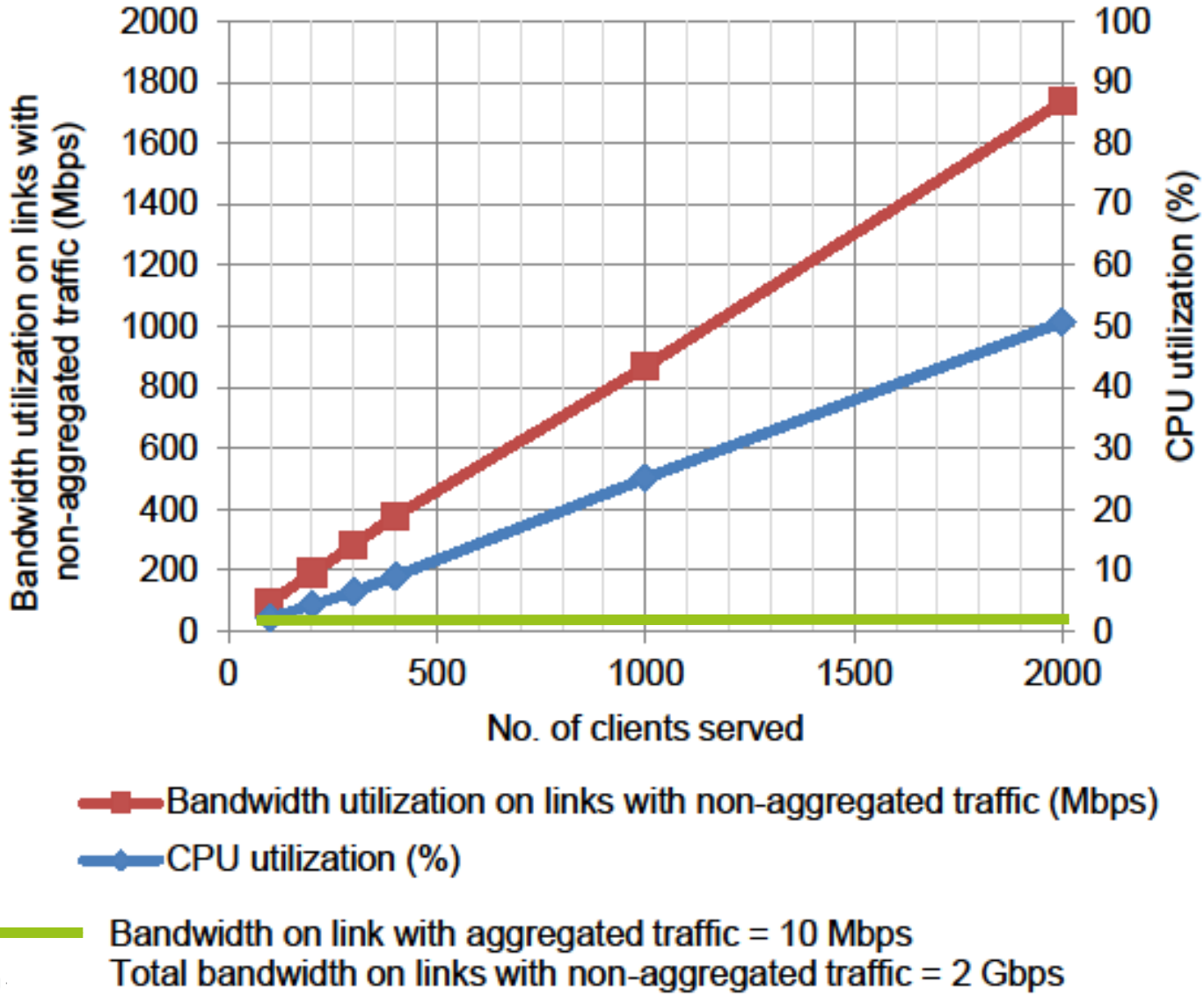
- ICN architecture developed in the 4WARD & SAIL EU projects
- Can use HTTP as transport



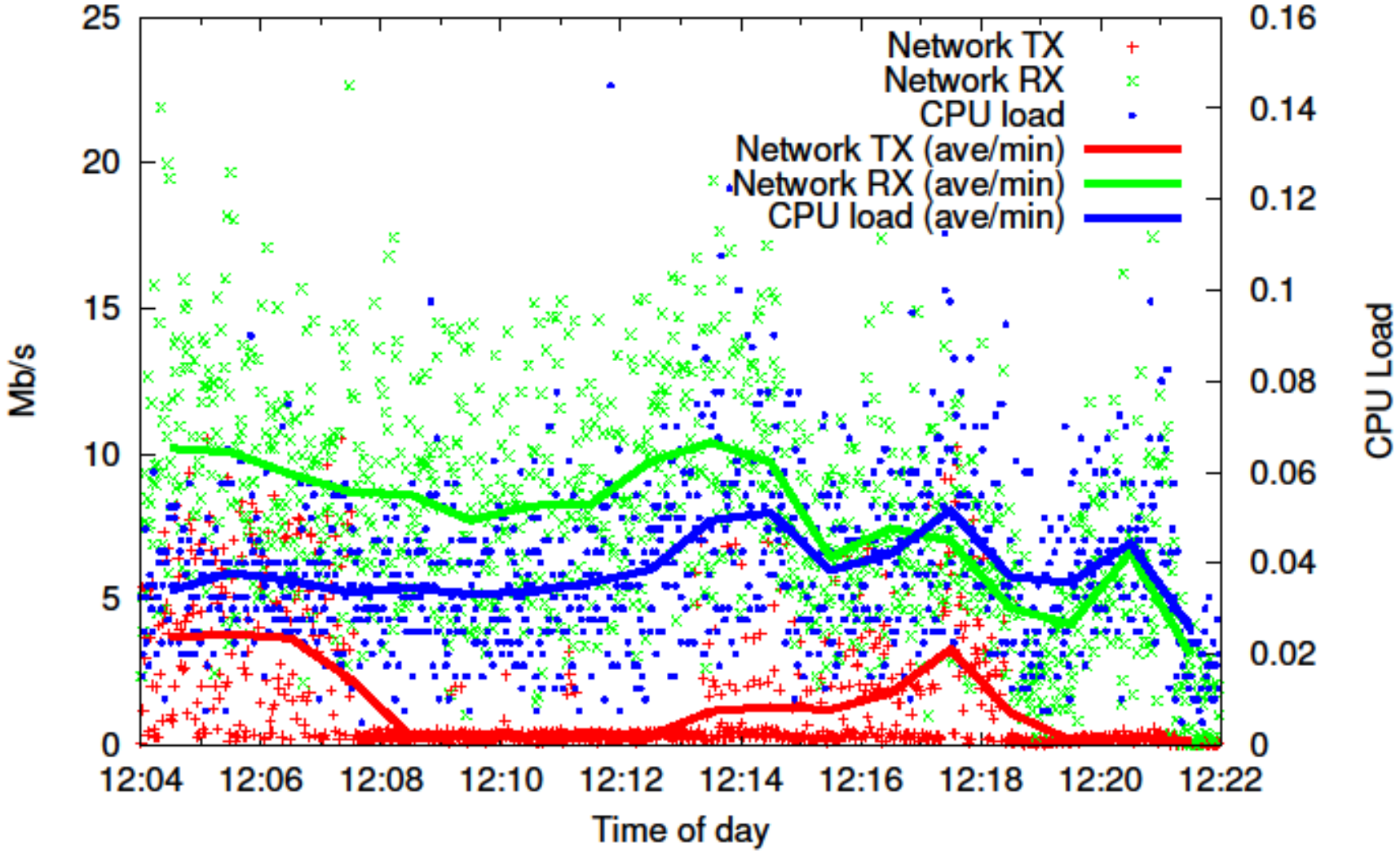
AN	Access IP Network
A_n	IP address
C	Client
IO_x	Information Object x
ICNR	Information-centric Router
S	Server
t_n	token number

Movie Time!

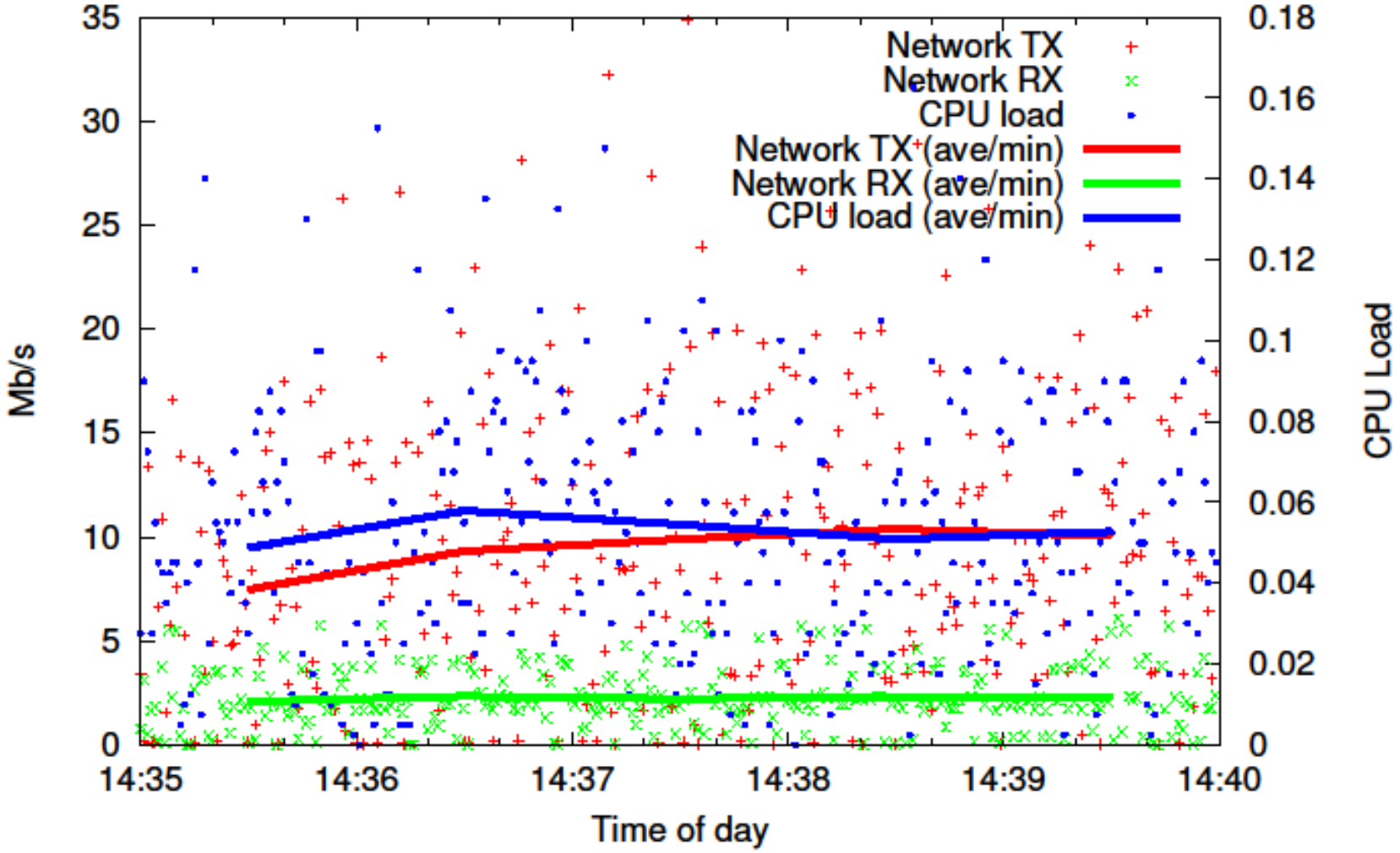
AGGREGATION EFFICIENCY OF THE NETINF ROUTER



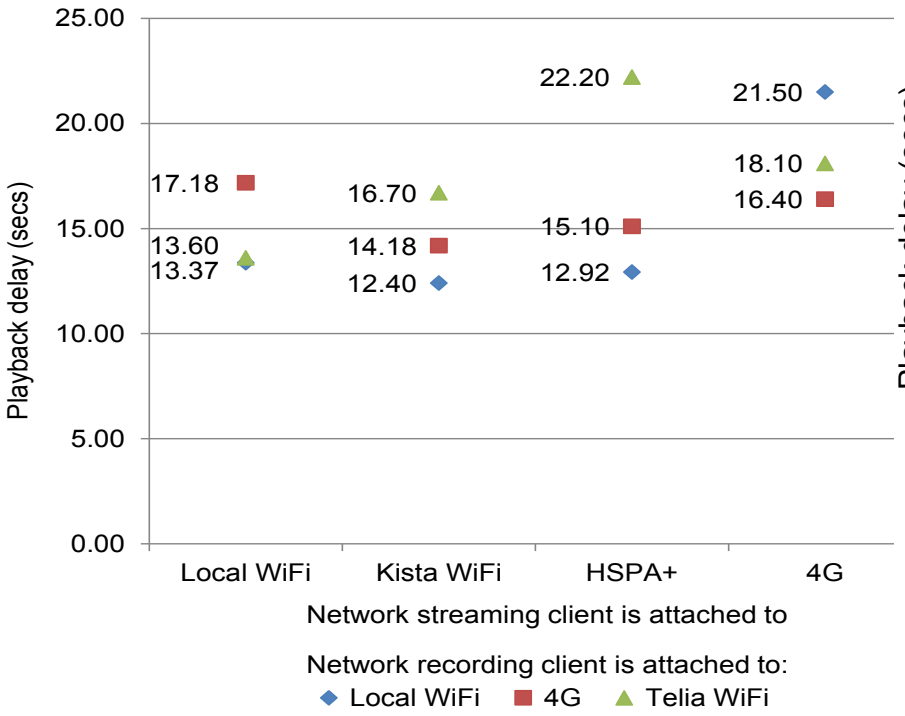
NETWORK AND CPU LOAD WITH MANY PUBLISHERS

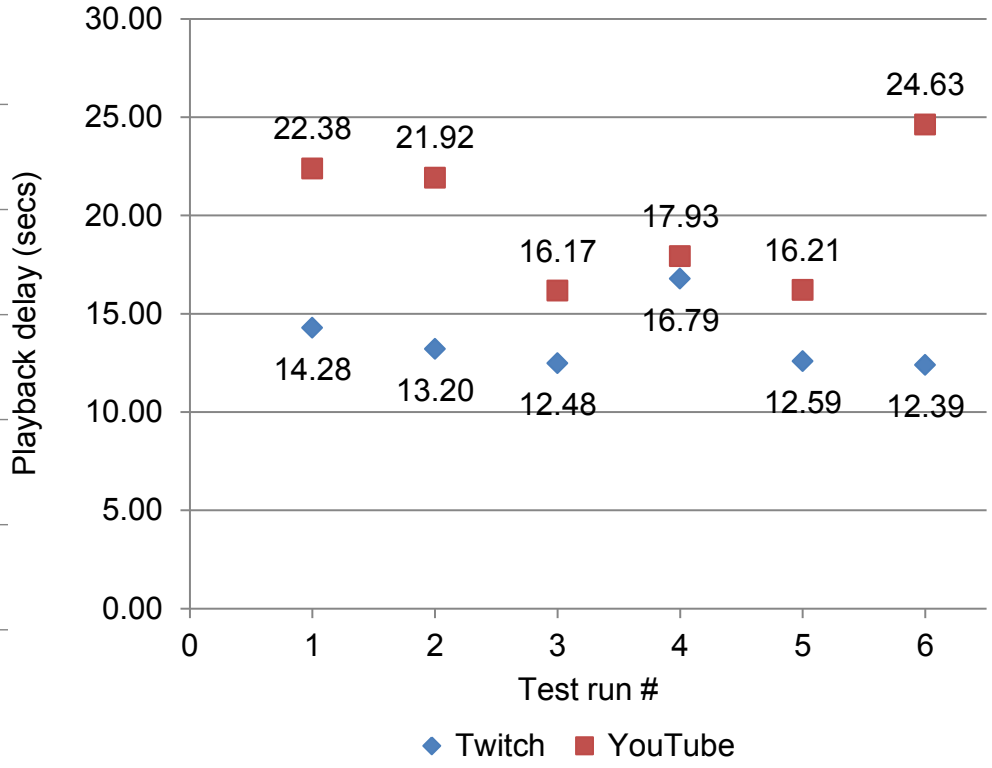


NETWORK AND CPU LOAD WITH MANY VIEWERS



DELAY COMPARISONS WITH YOUTUBE AND TWITCH





EXPERIENCE & RESULTS

- Largely worked as expected with no major issues!
- Live delay measurements
  - Delay in the range 12-25 seconds, similar to Twitch and Youtube
  - Major delay sources are video chunk size and client playback buffering
- Aggregation router performance
  - Generally low CPU load
- Scalability experiment
  - Up to 4000 clients on a single aggregation router

FUTURE WORK

- Investigate reasons for delay deviation
  - Interference in WiFi channels? Implementation?
  - More logging: when are notifications received, when are video chunks retrieved etc.
- Improve implementation to reduce delay
- Content retrieval from off-path caches; this will increase the chances of accessing content from the local network and save precious bandwidth on the backbone links
- Improve usability of the Android app e.g. add features like video ratings, trending videos etc.