

A Novel Concept for Hybrid Quality Improvements in Consumer Networks

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2 Approach

- Quality of Service for LAN's
- Hybrid Personalised Recommendations
- Router

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Introduction

- Research project "Holistic Solutions for Multimedia Systems in Buildings"
 - Supported by the Federal Ministry of Economics and Technology
- Aim: providing hybrid quality improvements for home networks
- Gateway Router is being developed, targeted for the consumer market

Problem Statement

- 1 Structure of consumer's home network is chaotic and unpredictable
 - PowerLAN and Wi-Fi show performance breakdowns, when clients are streaming real-time traffic
 - QoS functionality is not established in consumer home networks

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- 1 Structure of consumer's home network is chaotic and unpredictable
 - PowerLAN and Wi-Fi show performance breakdowns, when clients are streaming real-time traffic
 - QoS functionality is not established in consumer home networks
- 2 Service offering is increasing dramatically
 - thousands of broadcast channels
 - IPTV Internet platforms offers billions of video clips

Definition

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Hybrid Quality: means on one hand the quality of digital media content delivery, called QoS, but on the other hand also the quality of multimedia content offering, called personalised recommendations.

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QoSILAN

- QoSILAN = Quality of Service for Local Area Networks
- Enables QoS for per-link resource reservation and per-flow packet prioritisation
- Router serves as QoSILAN Manager
- Works in the following 3 phases:

1. Phase

Analyze the network
and identify the
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2. Phase

Network protocol identification in real-time (SPID)

3. Phase

Bandwidth reservation and traffic shaping (NSIS)

1.Phase

- LLTD = Link Layer Topology Discovery
 - proprietary protocol from Microsoft
- Reimplemented LLTD protocol
 - Finding misconfiguration in the network
 - Helps to enable per-link reservation
- Discovers the Layer 2 topology in LANs by ARP-Spoofing
 - Host sends Ethernet packets with spoofed MAC addresses
 - Which hosts have the spoofed MAC address in his ARP table
 - Based on that we can conclude which hosts are connected to the same network segment

2.Phase: SPID

- SPID = Statistical Protocol IDentification
- Advantages:
 - No human intervention to analyse new application
 - High Accuracy and stability
- Works as follows:
 - 1 Packets grouped together to bi-directional flows
 - 2 Analysis includes 12 statistical measurements
 - 3 Identification by calculating the Kullback-Leibler divergence:

$$D(P||Q) = KL(P, Q) = \sum_{x \in X} P(x) \log_2 \frac{P(x)}{Q(x)}$$

3.Phase

- NSIS = Next Steps in Signalling
 - is the name of the working group of the IETF
- One component: NSLP-QoS (NSIS Signalling Layer Protocol for QoS)
 - RESERVE: create, update or modify QoS reservations
 - QUERY: asks information about the data path
 - RESPONSE: answer to RERERVE or QUERY
 - NOTIFY: sends information

- PPG = Personal Program Guide
- Presents linear DVB content and non-linear video clips (YouTube)
- Runs atm on a PC but in the future it can runs everywhere (TV, STB, ...)
- User profiles are saved on the novel router
- Features of the PPG included:
 - Presenting of recommendations
 - Searching related content to the actual broadcast event
 - Adding actual event to the favourites
 - Setting preferences (explicit manner)

PPG Screenshot

The screenshot displays a user interface for a TV program guide. At the top, under 'Favoriten im TV:', there is a circular navigation menu with icons for 'Callgirl Undercover', 'Soko Köln', 'Die Rosenheim Cops', and 'CSI Miami'. The 'Monk' icon is highlighted in the center. Below this, the 'YouTube:' section features five video thumbnails: 'Monk (Stottelmeyer und...', 'Mr. Monk eekelt sich am...', 'Mr. Monk macht kleinen...', 'Monk Theme song: "It's A...', and 'Funniest Moments in MO...'. The main content area shows the program 'MONK' scheduled for 22:15 - 23:15 UHR on DI 14.02.2011, with a 60-minute duration and a 'MOVIE/DRAMA' rating. The RTL logo is visible. The synopsis reads: 'MR. MONK IM UNHEIL DES VOODOOS MEHRERE OPFER MYSTERIOSER TODESFÄLLE BEKOMMEN VOR IHREM ABLEBEN VOODOOPUPPEN ZUGESCHICKT. ZAUBEREI ODER MORD? MONK (TONY SHALOU, R.) SUCHT HILFE BEIM HEXENMEISTER REVEREND JORGENSEN (GASTSTA...'. At the bottom, there are controls for 'Return/Exit', 'Suchfunktion starten', 'Long Description (OK Button)', 'Switch Sort Mode', and 'Sort by:' with options for 'Ranking' and 'Date & Time'. A 'Ranking ändern (+- Stern)' button is also present. The THM logo (Technische Hochschule Mittelhessen) is in the bottom right corner.

PPG - Content-Based Filtering

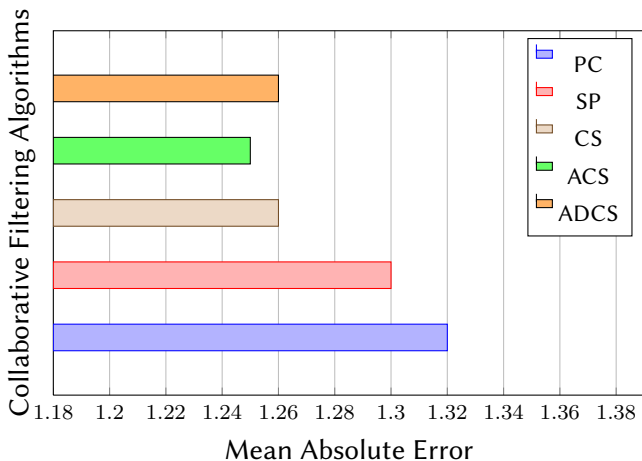
- Explicit filtering
 - Setting preferences for genres and sub-genres in form of (★★★★★)
 - Genres and sub-genres are specified by an ETSI Standard
- Implicit filtering
 - PPG logs the viewing behaviour of each individual users

PPG - Collaborative Filtering

- Uses a community for the creation of recommendations
- Example: *"Customers Who Bought This Item Also Bought ..."*
- New developed algorithm: Absolute Cosine Similarity (ACS)
 - produces a lower Mean Absolute Error (MAE)

PPG - Collaborative Filtering

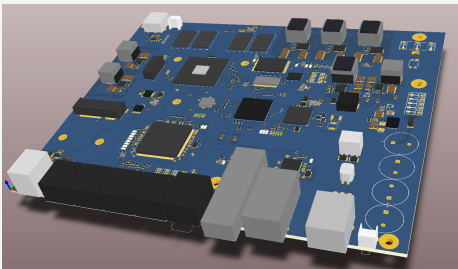
Algorithm Evaluation



- Us
- Exa
- Ne

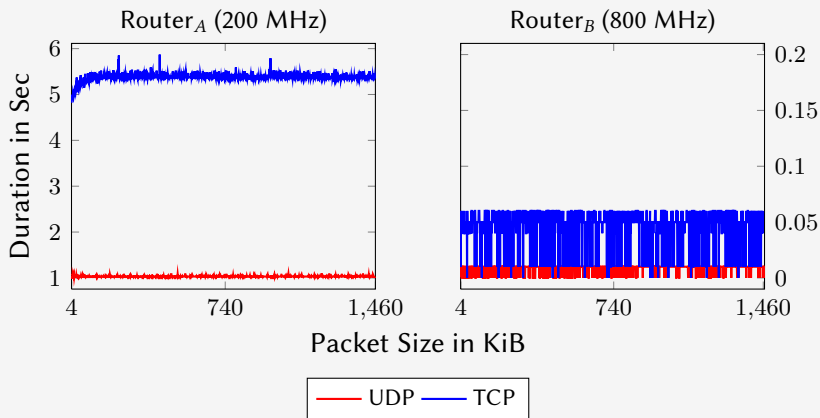
Router

- Serves as QoS/LAN manager and personalisation profile manager
- Armed with a 800 MhZ ARM CPU
- Runs with an embedded Linux OS (OpenWRT)



Performance Evaluation

- Real-time protocol identification is processor-intensive
- Question: Is 800 MHz enough to identify traffic in a home environment in real-time?



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Summary and Future Work

Future Work

- Router is not ready, yet

Conclusion

- Preliminary results are very promising
- Quality of Service
 - Router is able to provide QoS in networks where this wasn't available before
- Personalized Recommendations
 - PPG brings more quality in the consumer's user experience
 - Content of interest is now available at a glance with a very high precision

Thank You

Questions?

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