Home Router Sharing based on Trust

Michael Seufert, Valentin Burger, Tobias Hoßfeld

www3.informatik.uni-wuerzburg.de

Current Trends

- Increasing amount of mobile data traffic
  - According to Cisco [1]:
    - Mobile data traffic is further increasing
    - Number of mobile-connected devices will exceed the world's population in 2013

![Graph of Global Mobile Data Traffic, 2012 to 2017](image)
Problem Statement

- Offloading to WiFi can relax the load on mobile networks
  - In 2012 already 33% of total mobile traffic was offloaded through WiFi
- Increasing number of WiFi hotspots
  - The number of public WiFi hotspots is increasing to several millions
  - Even larger amount of private WiFi hotspots
- Online social network (OSN) popularity
  - 3 of 4 Internet users are members of an OSN

- Problem:
  - Access to private WiFi hotspots is restricted.
  - Energy consumed by home routers on stand-by is wasted.

- How to make private WiFi hotspots public available?
- How to use the unutilized capacity of home routers?

HORST: HOme Router Sharing based on Trust

HORST uses information from the OSN to provide end users access to shared WiFi access points based on their trust scores, to enable content prefetching and caching, and to control an efficient content delivery overlay.
Concept

- HORST – Home Router Sharing based on Trust

- Home Router
  - Provision of private and public WiFi network
  - Usage of free space to store and deliver content

- Online Social Network
  - Sharing of WiFi access information
  - Computation of trust scores
  - Incentive mechanism
  - Social awareness for content distribution and delivery

- Mobile Device
  - App for automatic connection and offloading management (handover, transmission scheduling)
  - Device sharing for delay-tolerant mobile ad hoc network

Use Case A – Data Offloading

I want to share my Wi-Fi using HORST, to get trusted Wi-Fi connections wherever I go.
HORST guides me to trusted Wi-Fi connections and provides me access.
**Use Case B – Content Caching and Prefetching**

HORST stores content on my NaDa that might be of interest for my friends.

**Use Case C – Content Delivery**

HORST manages an efficient overlay among all resources to optimize content delivery.
Components

Mobile Device App
- Provide geo-location
- Request and access shared WiFi
- Schedule transmission for delay-tolerant content

Online Social Network App
- User and device management
- Provide social information
- Compute trust scores
  - Recommend local WiFi
  - Grant access to shared WiFi

Home Router Firmware
- Provide private and shared WiFi
- Support caching functionality (redirect requests, serve content)
- Host owner’s decision entity

Decision Entity
- Predict content specific demand
- Manage overlay and content distribution based on
  - content location, AS topology
  - Resource utilization
- Periodically update caches

Home Router Firmware

- Home router needs at least two BSSIDs to provision private and public WiFi network
- Requirements for multi BSSIDs:
  - Router hardware that supports Virtual Access Points (VAPs)
  - Firmware that implements wireless VAP support
  - Projects that currently implement VAP support are DD-WRT¹, OpenWrt² and Freetz³

- Home router can host a Nano datacenter (NaDa)
- Required functionality:
  - Cache and distribute content
  - Intercept and redirect content requests

¹ http://www.dd-wrt.com/
² https://openwrt.org/
³ http://freetz.org/
Trust Score

- Offering freely accessible WiFi connections and access to home routers opens the door for fraud users.
- **trust scores reflect** the reliability and reputation of users based on their contributions and recent cooperative behavior in the OSN.

- In P2P networks eigentrust was implemented to identify malicious peers [2]
  - Problem: global trust score might differ for individual preferences

- To cope with this problem **personal trust scores** have been introduced that rely on the transitive notion of trust [3][4]
  - Exhaustive computation of all pair trust scores is not necessary [5]
  - **Small computational effort** to calculate personalized subset with most trusted nodes

Towards Efficient Caching

- Social cohesion is defined as the ratio of the number of follower relations that exist between UGC producers of that topic and the maximum possible follower relations that could exist between them [6]

- As we move from popular to niche topics, the social cohesion values tend to increase.
- The social network of niche content producers can be used to predict users and (their) locations with high interest in the topic.
Egocentric Caching Strategy

- Cache popular content on edge caches at ISP
- Cache content of personal interest (niche content) on home router or end device

Discussion

- HORST: concept for a social aware traffic management solution which builds on home router sharing based on trust
  - to cope with increasing load of mobile data traffic and
  - unutilized resources (energy, bandwidth, storage) in home routers
- Next steps:
  - Implementation of home router firmware
  - Performance evaluation of caching strategies
- Open questions:
  - How to achieve a decent coverage of HORST access points?
  - How to obtain good incentives for WiFi sharing? (c.f. viNCENT)
  - How to calculate trust scores that allow easy access but restrict fraud users?
  - …
Thank you.

References


