Measuring Internet Experience from Home Networks

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Internet connectivity is central in today’s homes

70% of broadband users under 35 get at least some of their TV from online sources

Telecommuting in the US increased 73% from 2005 to 2011

Online video users are expected to double in 2016
Network performance disruptions are frustrating

For users

For ISPs
Problem

- The home network can disrupt networked apps
  - Multiple users/devices/apps compete for bandwidth
  - Poor WiFi increases jitter and reduces bandwidth

- Users don’t know what is happening
  - Home networks are complex
  - Most home users are not professional net admins
Muse’s research

- **Goal:** improve user online experience at home
  - Build personalized networking technology that guides network performance and diagnosis based on user

- **Networked systems at home should adapt to users**
  - Priorities, level of expertise, context

- **Approach**
  - Develop home network performance diagnosis techniques
  - Develop technique to infer of user dissatisfaction with application performance
Our research on home network diagnosis

- **Goal:** Assist users to diagnose performance problems in the home network
  - Is the problem in the ISP or the home network?
  - If the problem is in the home, what is the cause?

- **Challenges**
  - Home networks are heterogeneous
  - A number of explanations exist for a symptom
  - Output must be actionable by any user
Possible measurements points in the home

- **End-devices**
  - Observe poor user experience
  - But, have limited view of the home network and development is harder

- **Home gateway**
  - Ideally placed between home devices and Internet
  - But, have limited resources and deployment is harder
Our projects on home network diagnosis

- Monitoring and diagnosis from gateway
  - Active measurements of access link performance
  - Passive measurements to locate last-mile bottlenecks
  - Home wireless diagnosis

- The browser as a monitoring/diagnosis platform
  - Fathom: builds monitoring capability in the browser
  - Diagnosis with active measurements that leverage collaboration among devices
Fathom: A Browser-based Network Measurement Platform

with

Mohan Dhawan, Anna-Kaisa Pietilainen, Sarthak Grover,
Justin Samuel, Christian Kreibich, Mark Allman, Nicholas Weaver,
Vern Paxson
Browser as measurement platform

- **Pros**
  - Flexibility, deployability
  - Ubiquity of browser

- **Cons**
  - No proper API
  - Security model
Fathom

- Provides a programmable interface for writing and launching measurements from web pages
- Supports novel analyses via passive and active measurements
- Combines existing security primitives to safely expand capabilities of in-page JavaScript
- Current implementation: Firefox extension
Fathom API

- **fathom.system.***
  - System configuration and status, access to tools such as ping, traceroute

- **fathomsockets.***
  - TCP and UDP sockets

- **fathom.proto.***
  - Common protocol implementations (DNS, HTTP, UPnP, mDNS) using fathom sockets

- **fathom.baseline.***
  - Access continuous performance monitoring data
Fathom 2.0

- First version as a legacy overlay extension
  - Poor mobile support
  - Complex and broken support for newer Firefox versions

- New version: re-write on top of the add-on SDK
  - Mobile Firefox support (Android)
  - Simplified code-base
  - Common JS module support (leverage many existing javascript code modules)
  - SDK comes with improved development tools (e.g., packaging, unit testing)
Built-in tools

- **Debug my connection**
  - Network interface availability and configuration
  - Routing, Internet reachability
  - DNS

- **Homenet discovery**
  - Devices that respond to UPnP, mDNS
  - Pings, arppings to find other devices

- **Continuous network performance monitoring**
  - Background measurements of page load times, network cross-traffic/delays, wireless quality
Fathom for home network diagnosis

- Leverage collaboration among devices
  - Multiple Fathom-enabled devices
  - Instrumented home gateway (optionally)
    - Open source projects such as OpenWRT/BISmark

- Leverage device mobility within the home
  - Ask users to help by moving around the home

- Use cases
  - Built-in diagnosis to help users
  - Operators can point customers to diagnosis page
Next steps

- Release Fathom 2.0
  - Data collection to assist in building diagnosis tools
- Develop home network diagnosis test
  - When gateway is compatible with Fathom
  - When multiple Fathom devices
Thanks

http://muse.inria.fr/fathom
Fathom and Ark/RIPE

- **Diagnosing home network problems**
  - Ark/RIPE node in a home can collaborate with fathom
    - Request Ark/RIPE to perform specific measurements
    - Request historical data from in-home node

- **Diagnosing WAN problems**
  - Query Ark/RIPE data in real-time to help narrow down problems