Measuring Internet Experience from Home Networks

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Internet connectivity is central in today's homes

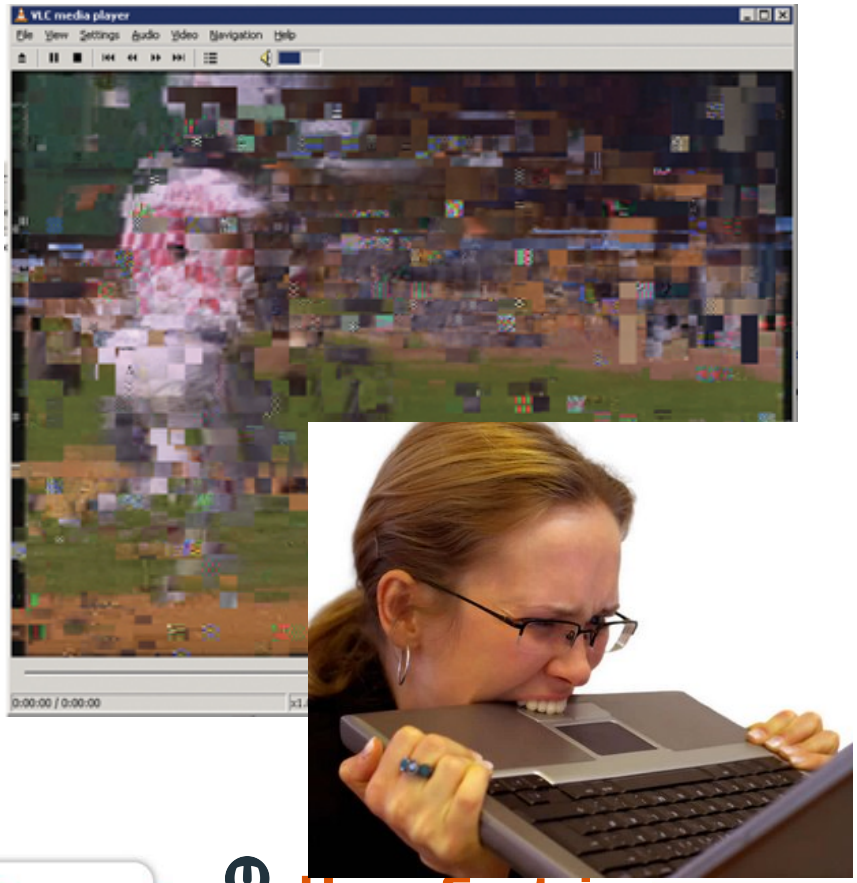
70% of broadband users under 35 get at least some of their TV from online sources

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

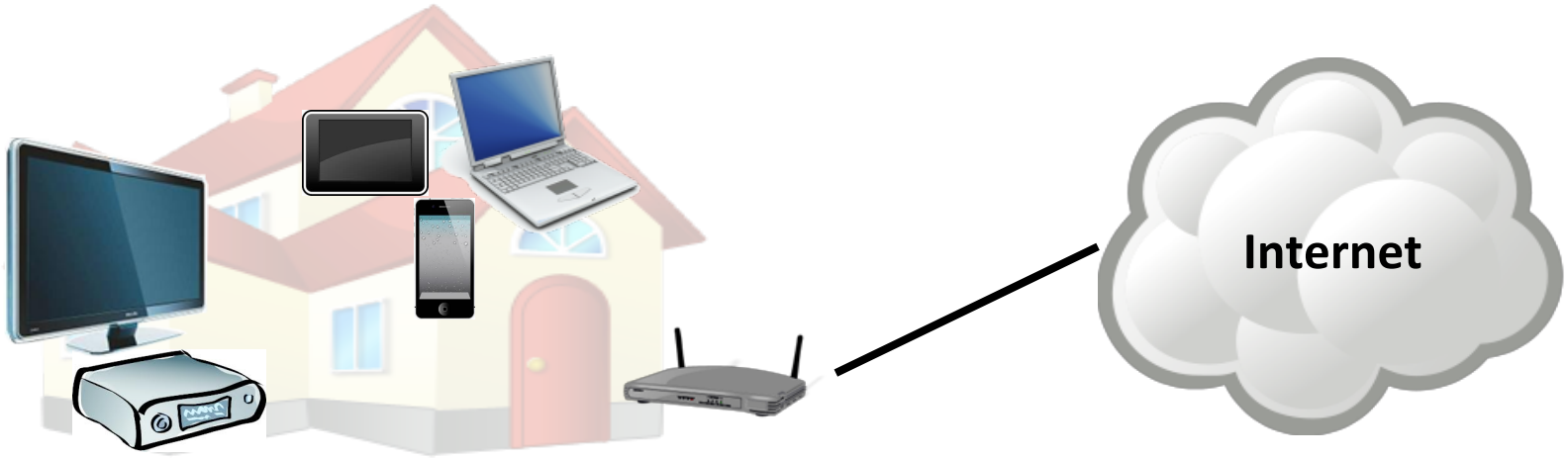
Muse's research

- 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
- fathom.sockets.*
  - 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