Trying broadband characterization at home

The pros and cons of increasingly complex home networks

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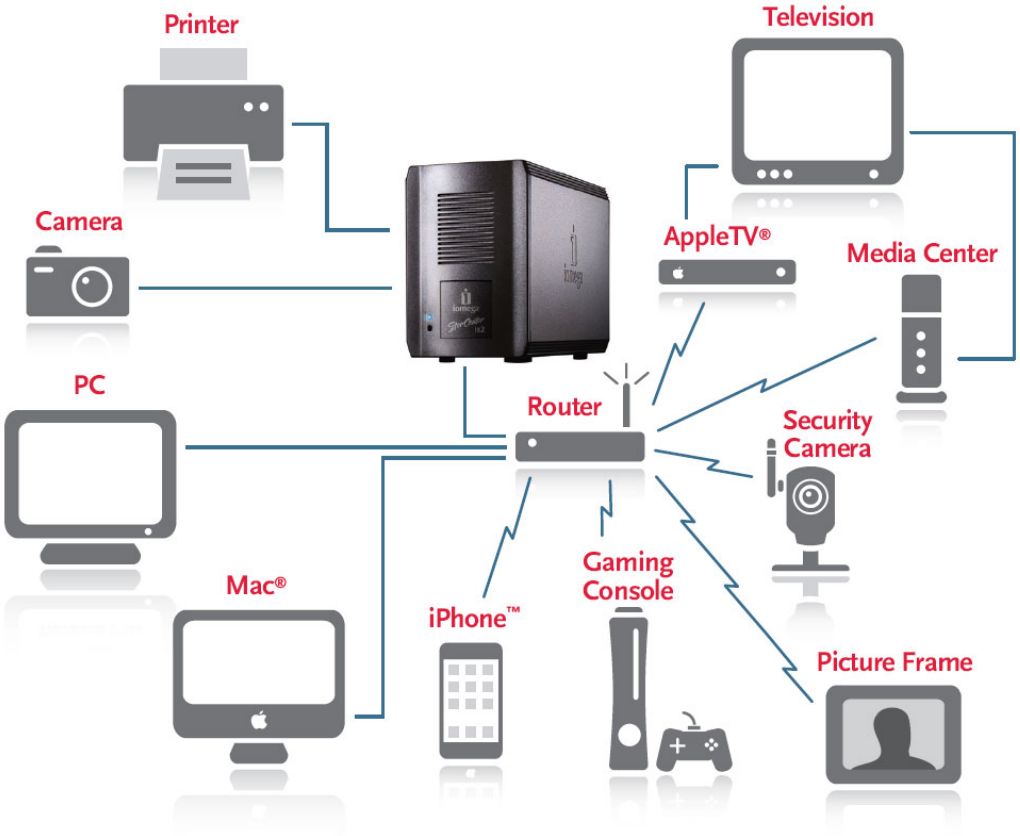
Increasingly complex home networks

- Large growth in quantity/diversity of home network devices
  - Internet-ready devices shipments will surpass **500M units by 2013!**



*iomega NEC

Increasingly complex home networks

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Increasingly complex home networks

- Challenges home network usability and resource management

- Complicates broadband characterization at the last meter (e.g., cross traffic)
  - **Dasu**, Netalyzer, Glasnost, …

Despite increasing home network complexity, we can do broadband characterization from end hosts

And the good news …

- Complexity drives Universal Plug and Play (UPnP) adoption to simplify home-network management

Press Release

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UPnP Technology Adoption Continues to Soar With New Areas of Growth

UPnP Forum's efforts in promoting device interconnectivity standards h

Beaverton, Ore, USA – 10 May 2012: The proliferation of personal com
Forum's ongoing efforts in device standardization and certification, is lea
UPnP technology. UPnP Forum is now seeing record levels of activity ir
implementations now certified as compliant with UPnP standards.

Increasing DLNA Software Certification Will Propel the Adoption and Connection of Devices within the Home Network

Scottsdale, Arizona - 24 Jan 2011

The Digital Living Network Alliance (DLNA) made some announcements at the recent CES trade show. The message was that the organization has started certifying software products as DLNA-compliant. The DLNA has been busy certifying hardware for some time; already more than 9000 consumer electronics products have received the stamp of approval. According to ABI Research data, more than 440 million DLNA-certified devices – from digital cameras to game consoles to TVs – had been installed in users' homes by the end of 2010.

- UPnP-enabled gateway can be used to infer cross-traffic

- The problem brings the solution
  - for broadband characterization at home

Roadmap

- Explore the complexity of home networks
  - Number and diversity of devices detected
- Classify devices based on likelihood of generating cross-traffic on the access-link
- Understand dynamics of home device usage
  - When devices are on/off and, if on, when do they exchange data
- Sketch an effective approach to broadband characterization*

*DiCioccio 2011

Measurement methodology

- Measure from Dasu, a platform for broadband benchmarking and network experimentation on end hosts
  - Total over 91k in over 150 countries
  - Our dataset: ≈13K home networks
  - BitTorrent
- Passive
  - Transferred bytes from host (*netstat)*
  - BitTorrent
  - Cumulative bytes transferred over the access-link (UPnP)
- Active
  - Upload/download throughput using NDT
  - Discovered devices information (UPnP): ≈4.6K home networks

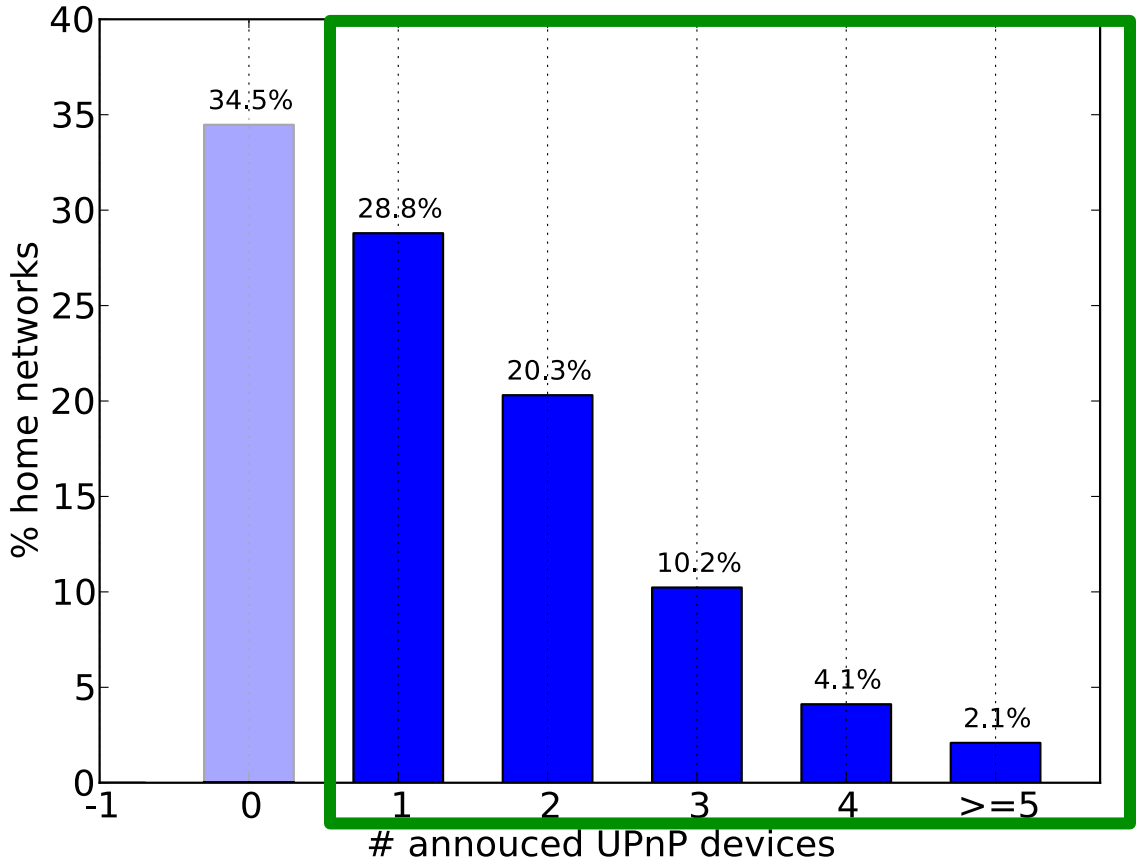
Interpreting UPnP responses…

- *If you don't respond to UPnP you don't exist*
  - These devices are not accounted for
  - But we'll know your network usage

- Same device can announce several UPnP services

Complexity in number of devices

Number of networked devices found



65% of homes have at least one device

Complexity in number of devices

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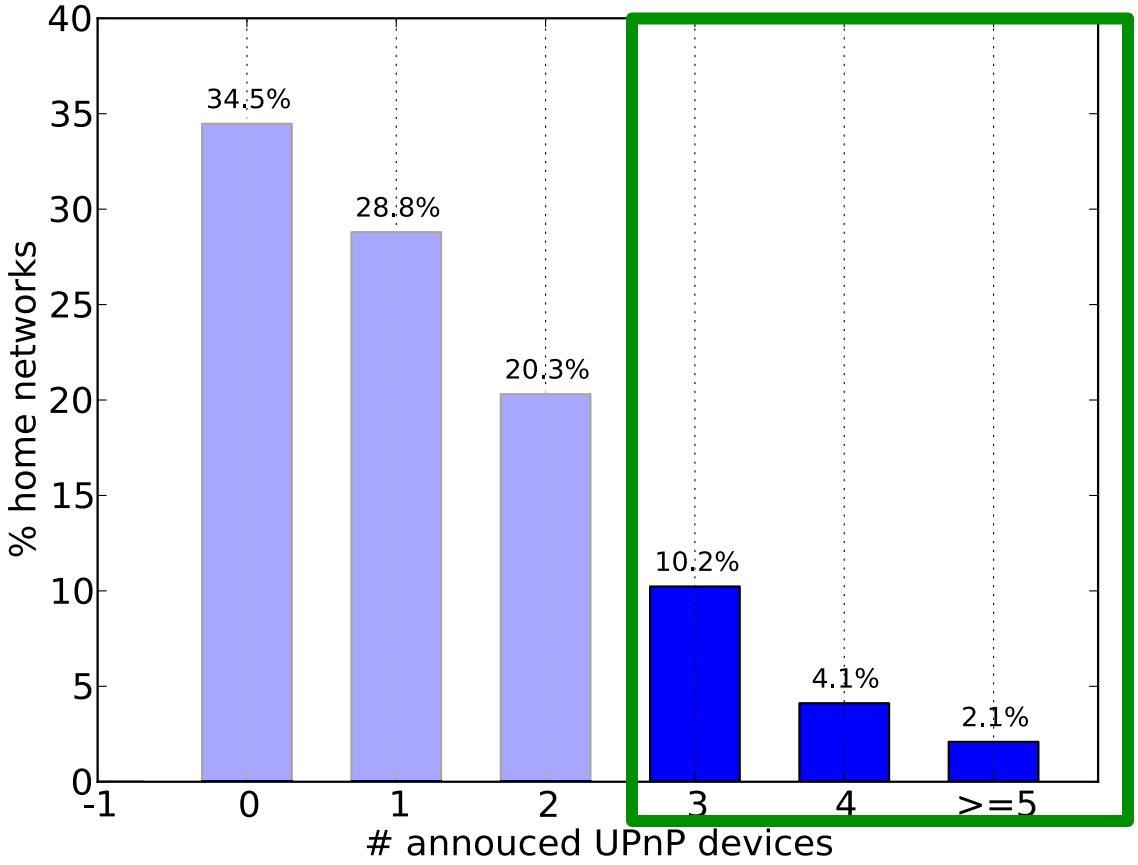
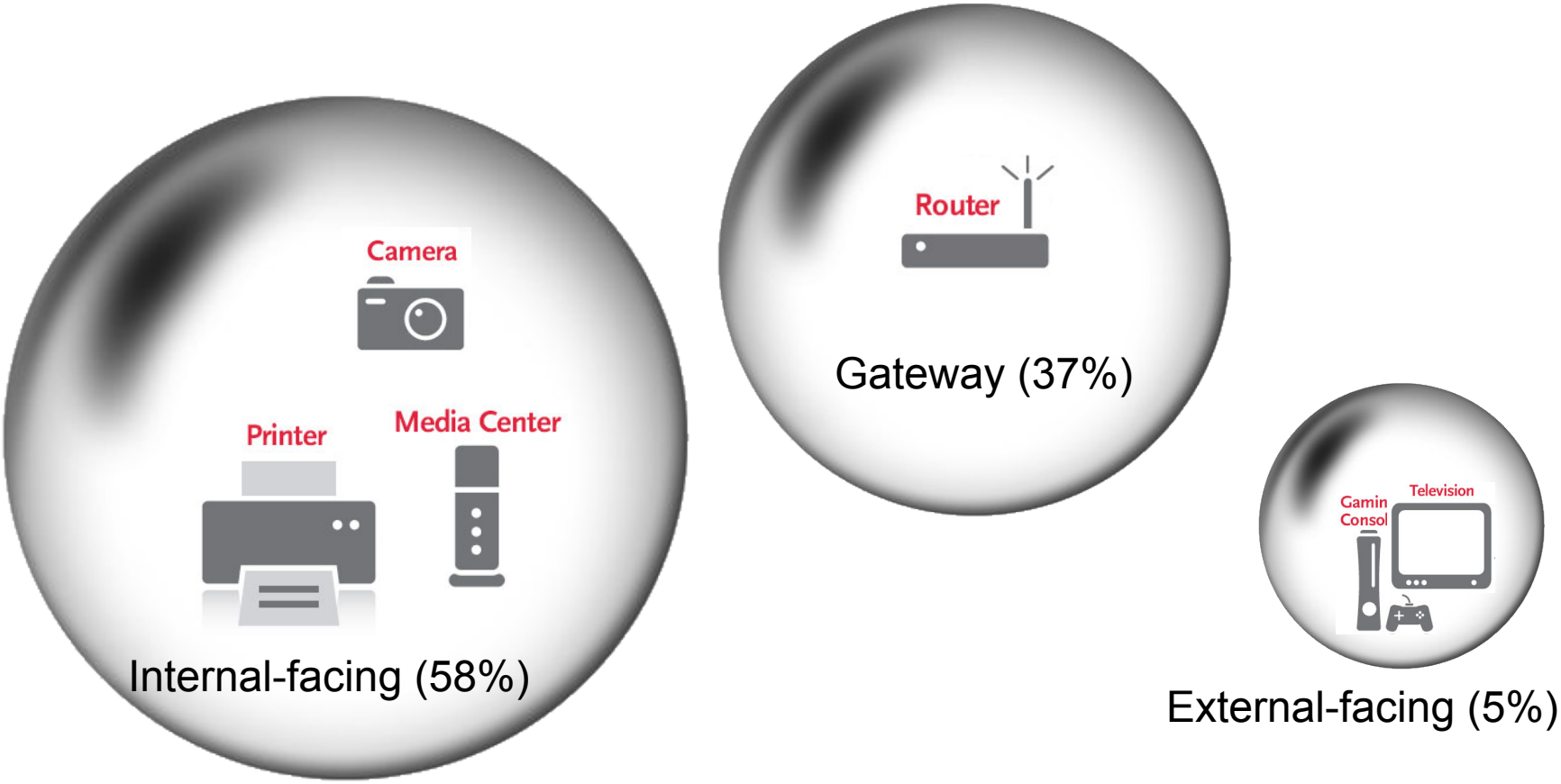


16% of homes have 3 or more

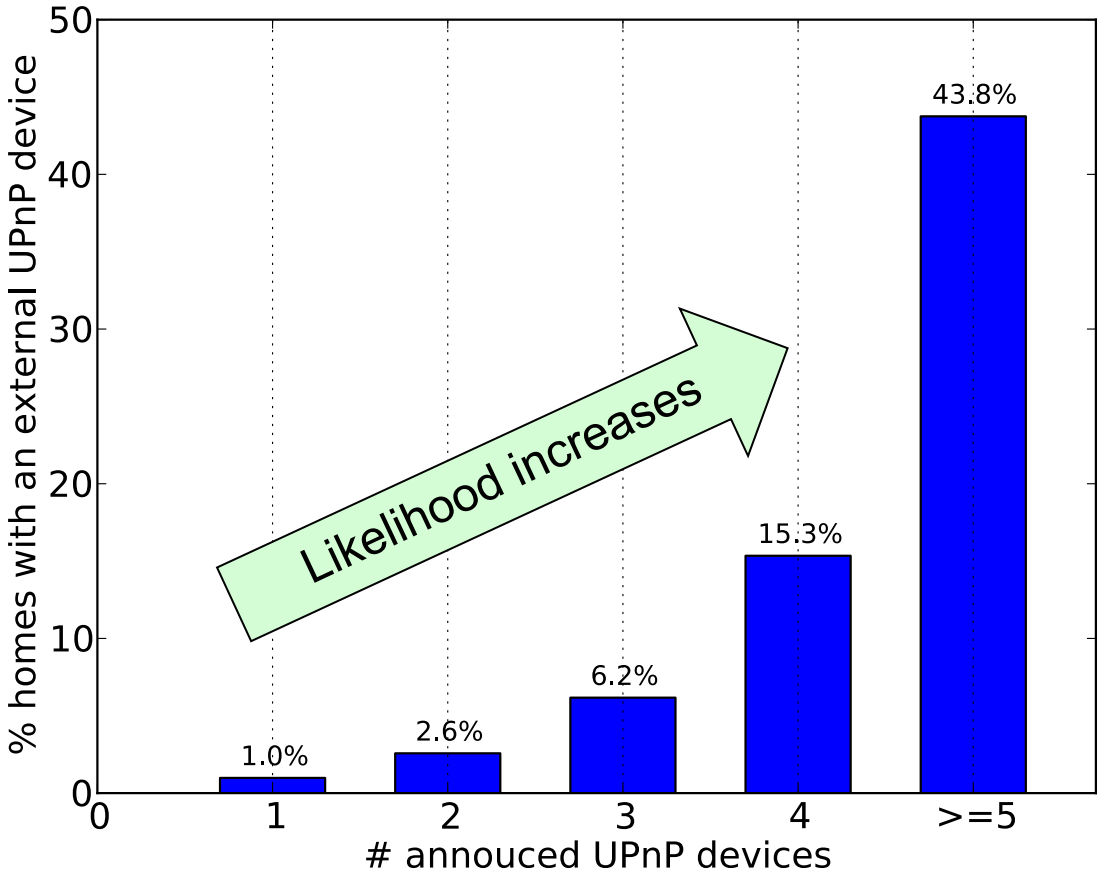
Not all devices play the same role

- Gateways
- External-facing: talks to the outside world
- Internal-facing: talks within the home network

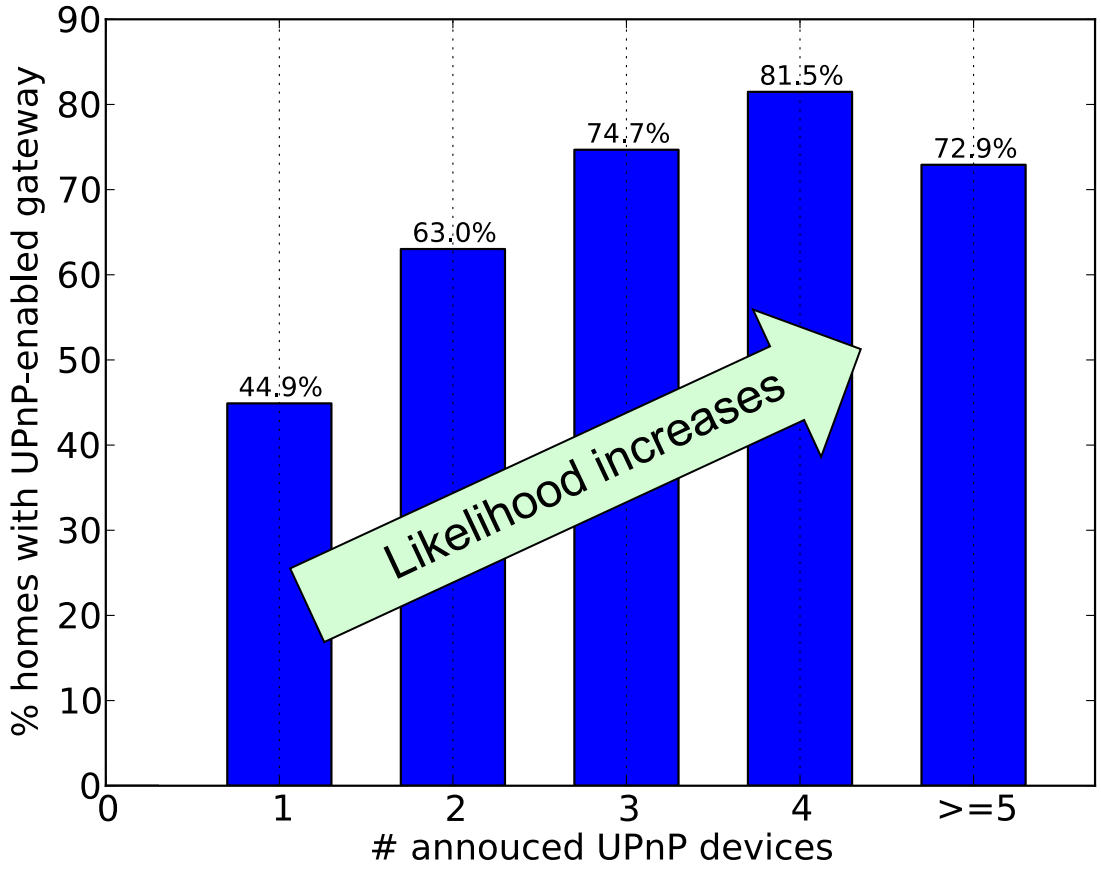


With complexity, externally-facing devices ...

↑ devices = ↑ complexity = ↑ externally-facing devices



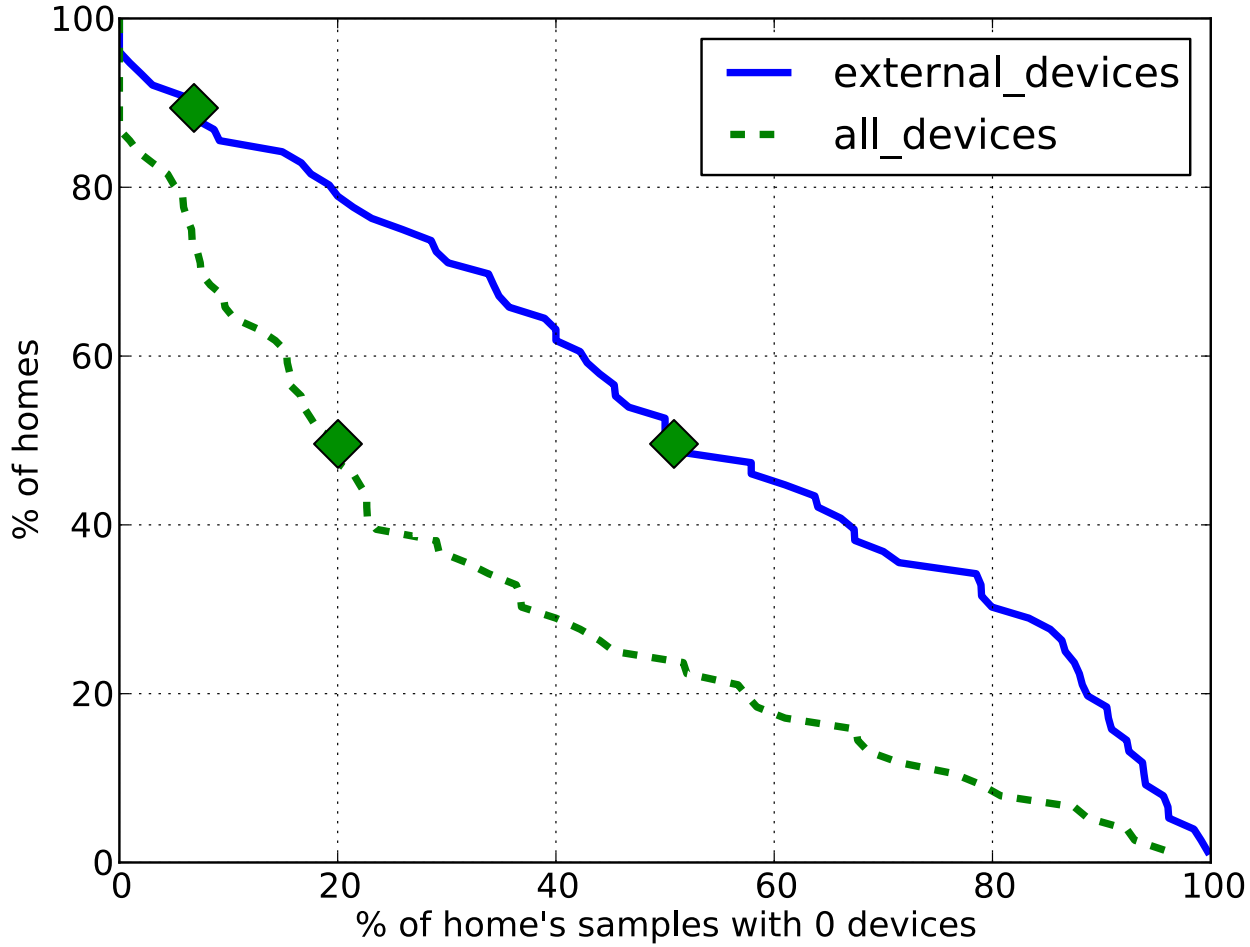
But also UPnP-enabled gateways



As # of devices increases so does the likelihood home gateway supports UPnP

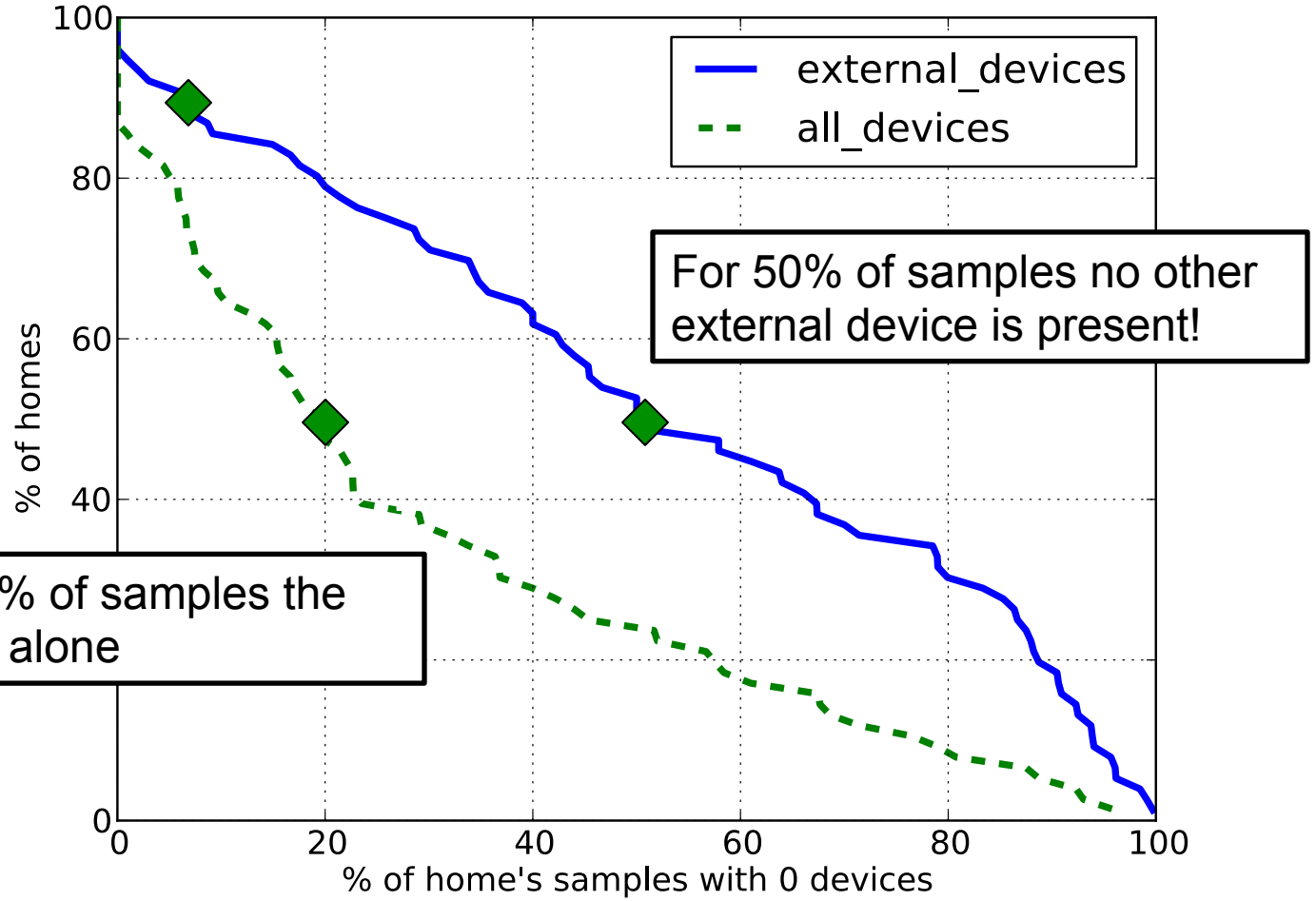
Many opportunities to measure

- “who else is out there”



Many opportunities to measure

- For 85% locations device is alone 10% of time"



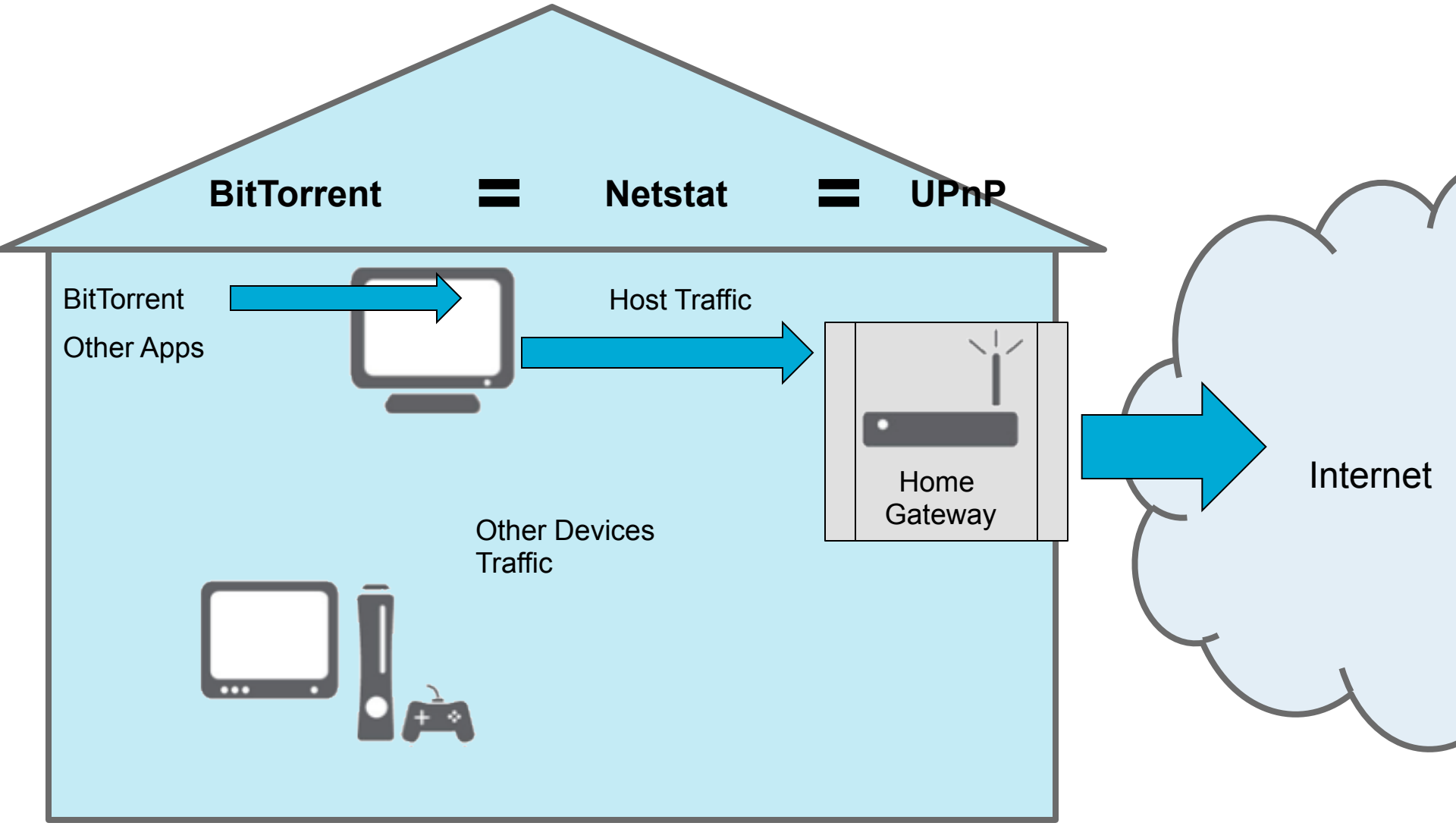
Usage rather than presence (micro dynamics)

- For broadband characterization
  - No cross-traffic
  - Local cross-traffic from other applications in the host
  - Cross-traffic from other devices

- UPnP- enabled gateways help identify different network usage scenarios inside the home network

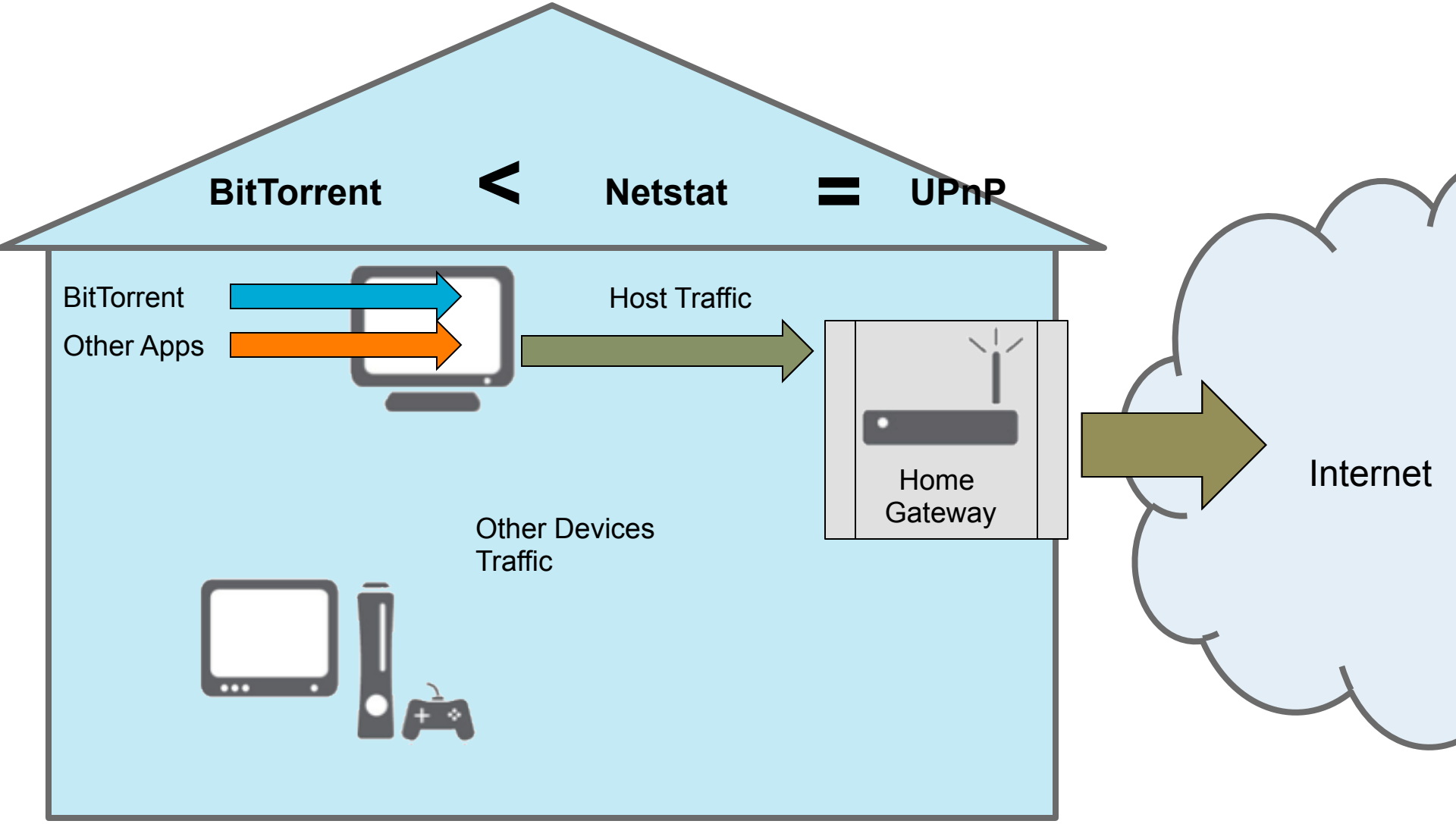
Usage rather than presence (micro dynamics)

No cross-traffic



Usage rather than presence (micro dynamics)

Local cross-traffic from other applications in the host



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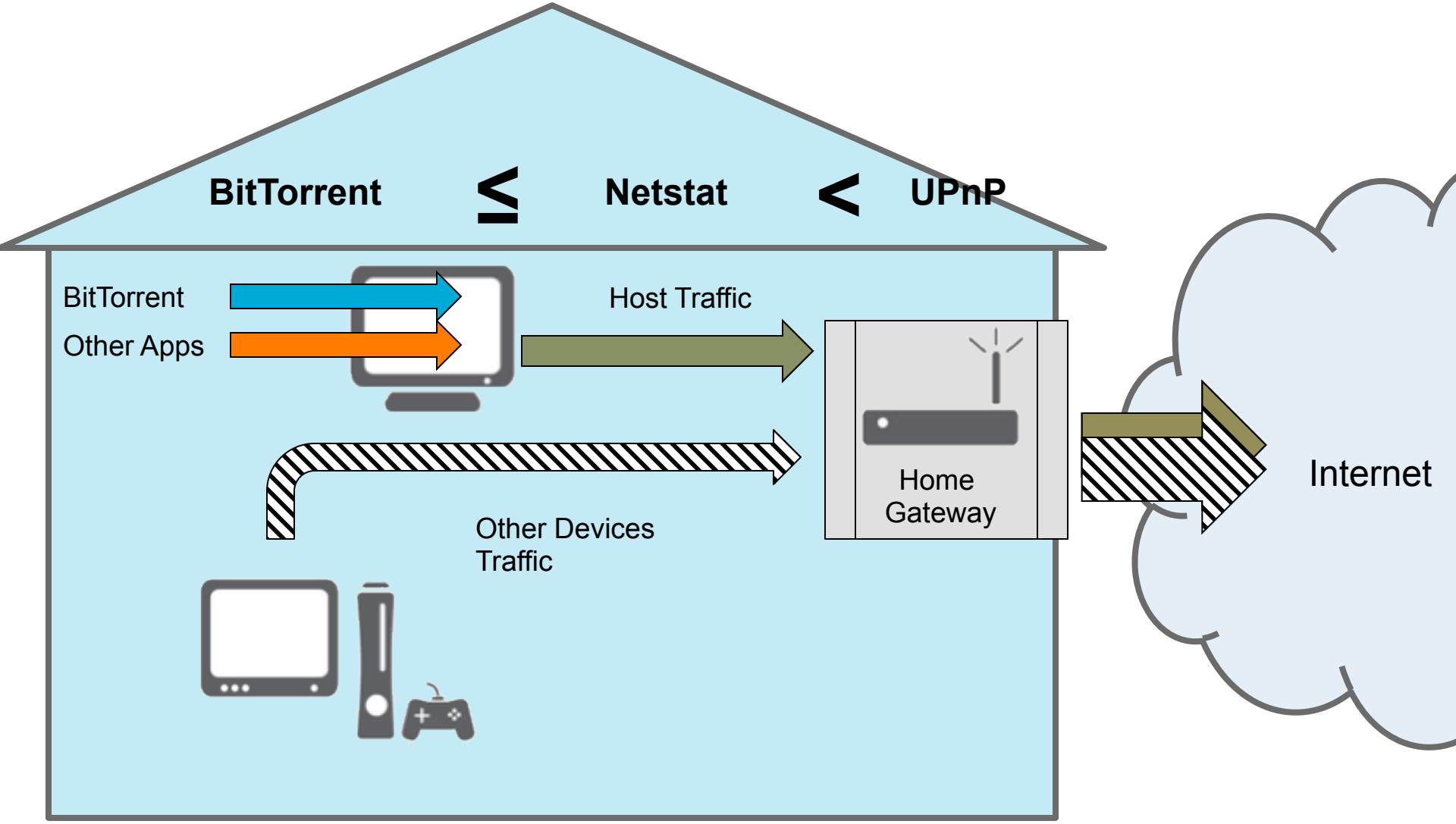
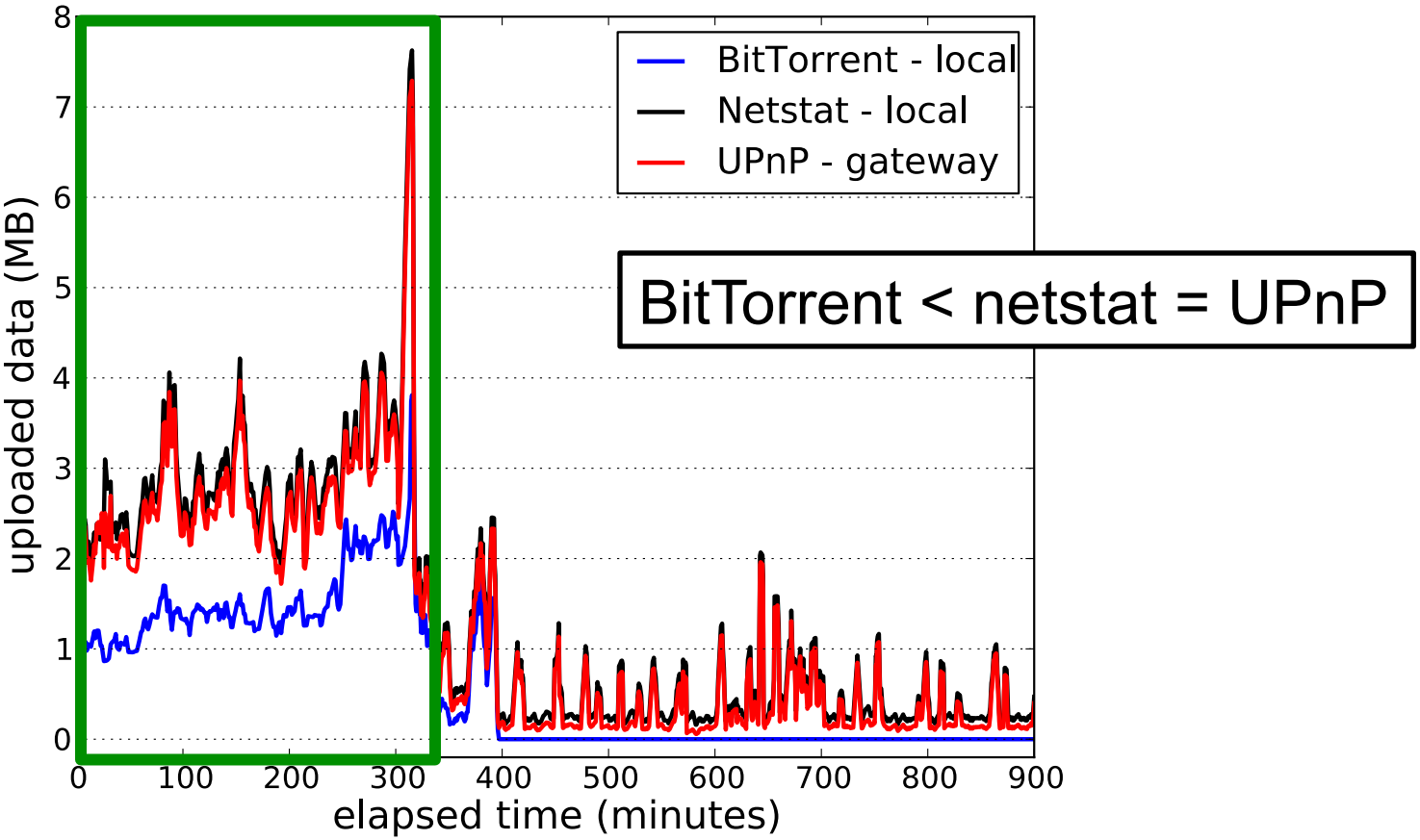
Cross-traffic from other devices



Home alone

- Client is sole responsible for network traffic in access link



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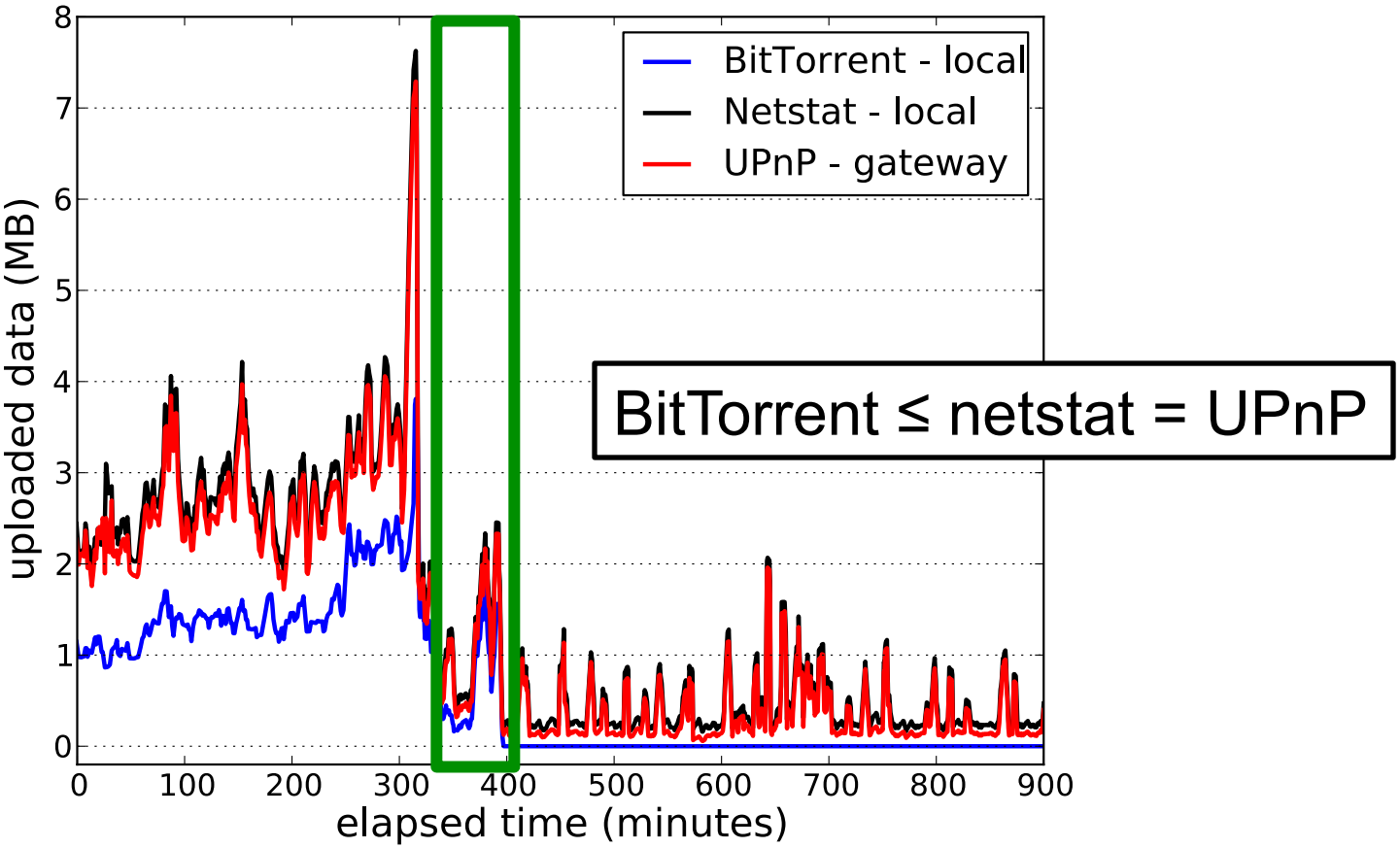

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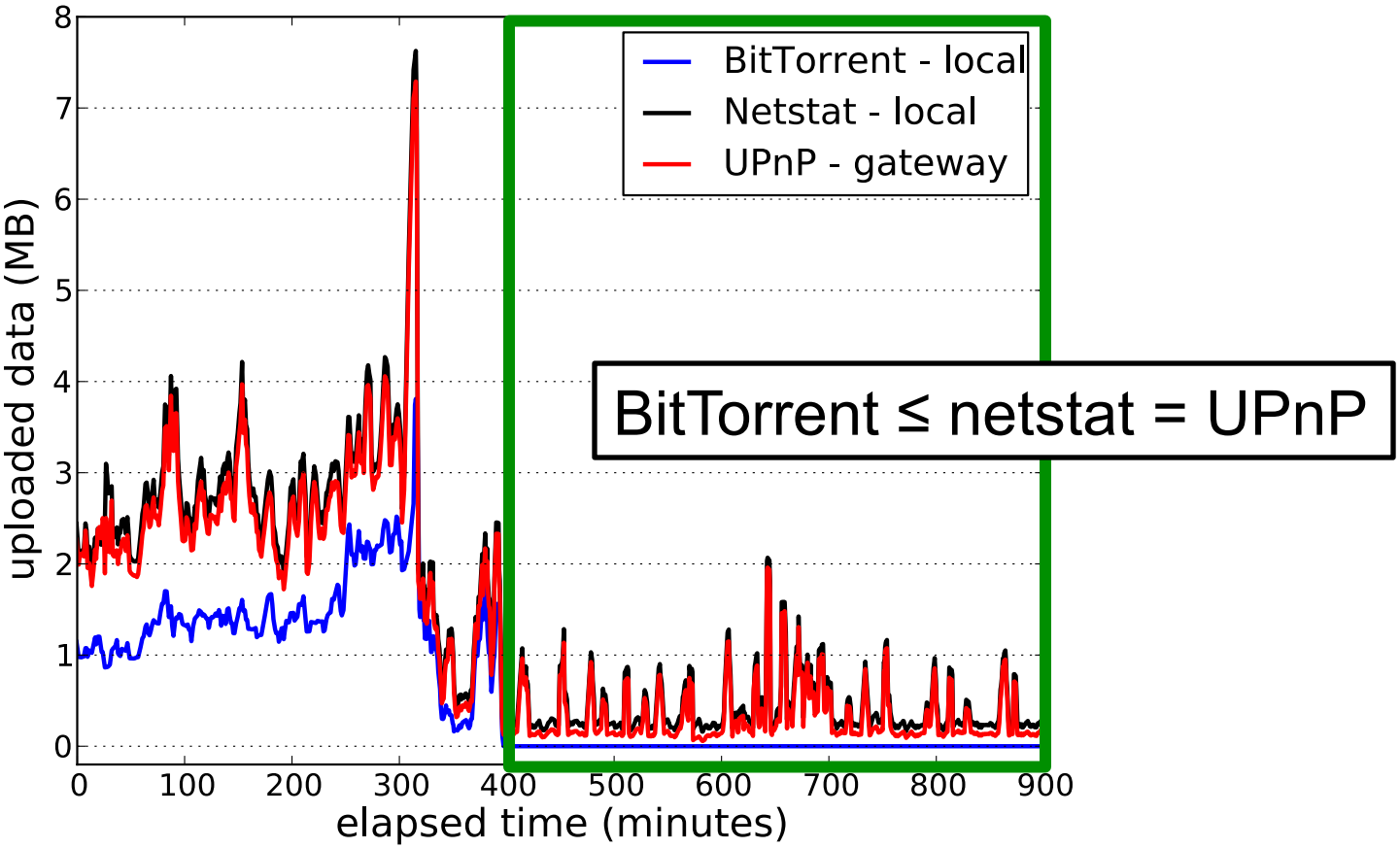
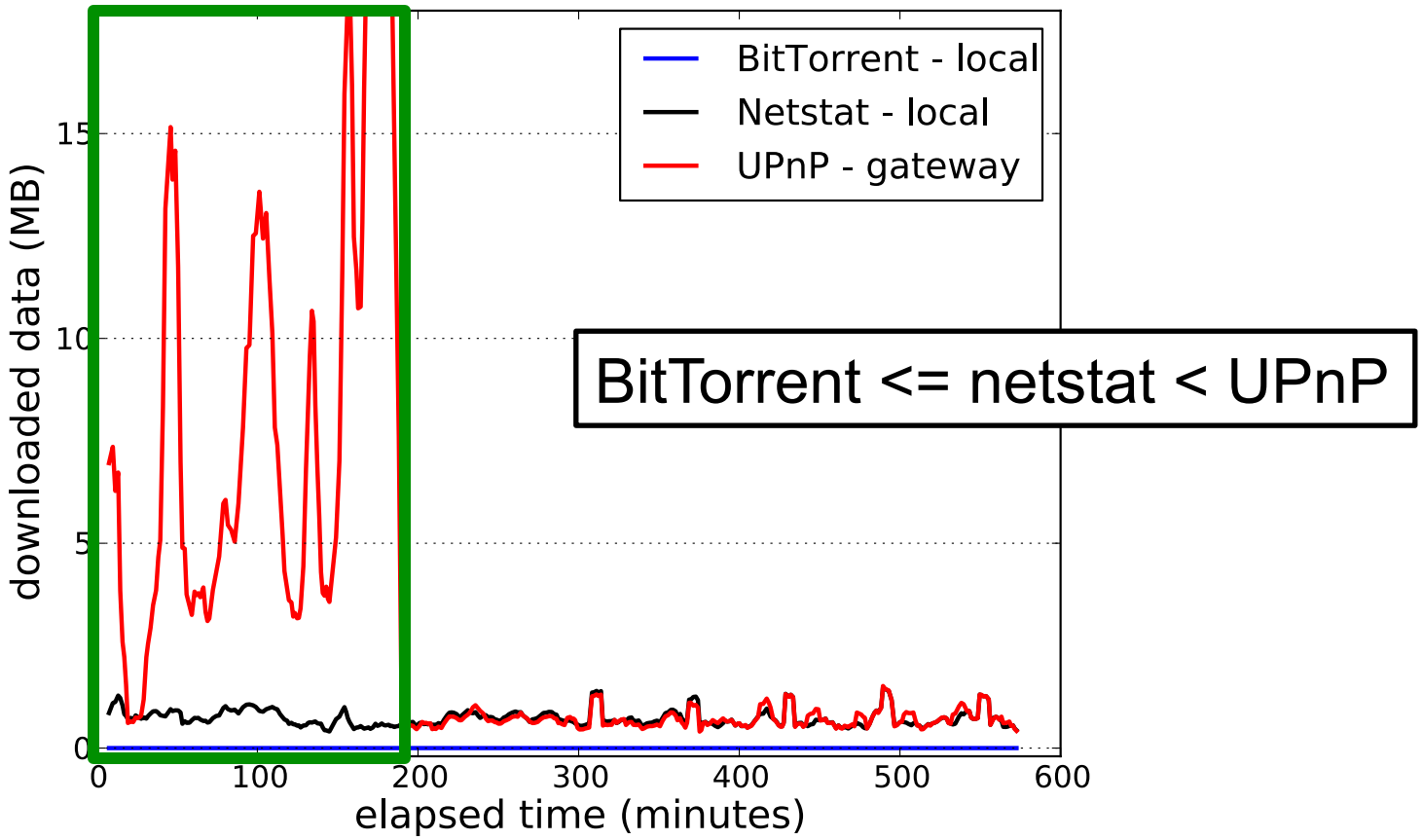


Not alone, but you can tell

- Cross-traffic from other devices



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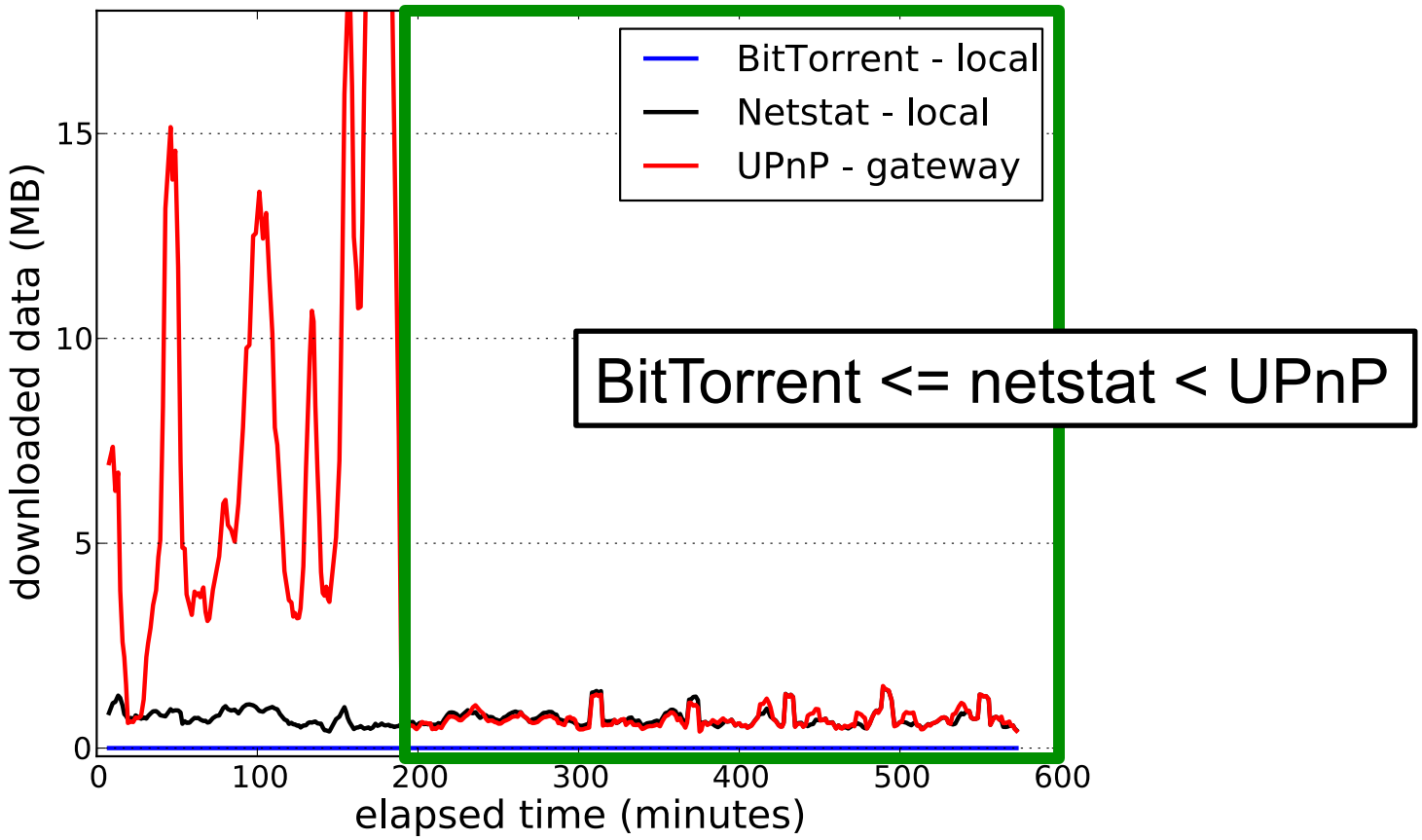

Summary

Despite complex home networks we can do broadband characterization from home

- Today's home network are a complex environments
- While # of devices in the network is high, only a few regularly connect to the Internet
- As # of devices increase, so does the likelihood home gateway supports UPnP
  - For home network management, sure
  - ***But also for broadband characterization***