

Trying broadband characterization at home

*The pros and cons of increasingly complex
home networks*

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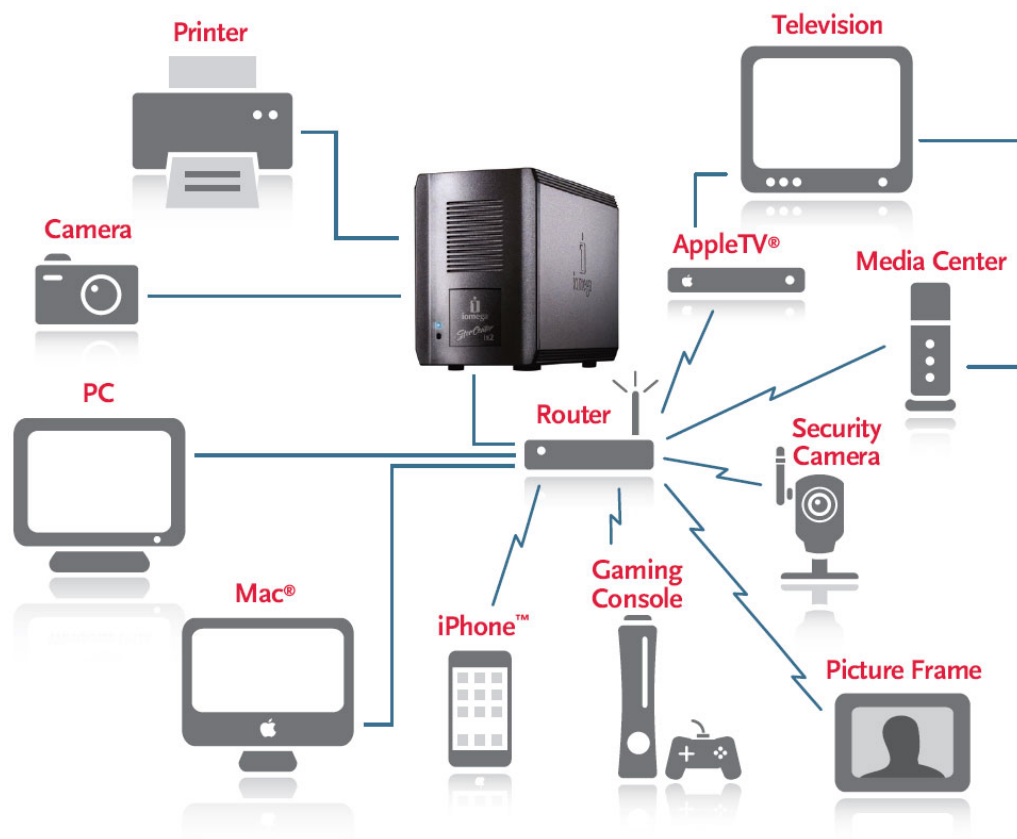
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AquaLab

Increasingly complex home networks

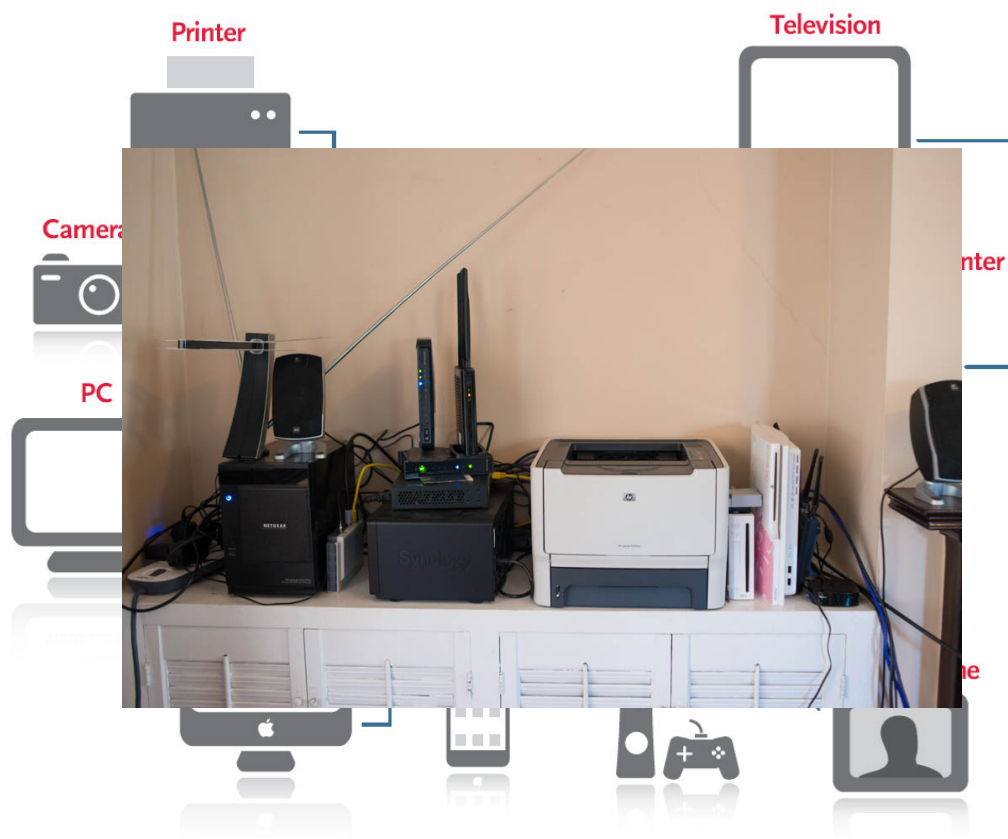
- Large growth in quantity/diversity of home network devices
 - Internet-ready devices shipments will surpass **500M units by 2013!**



*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



- 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

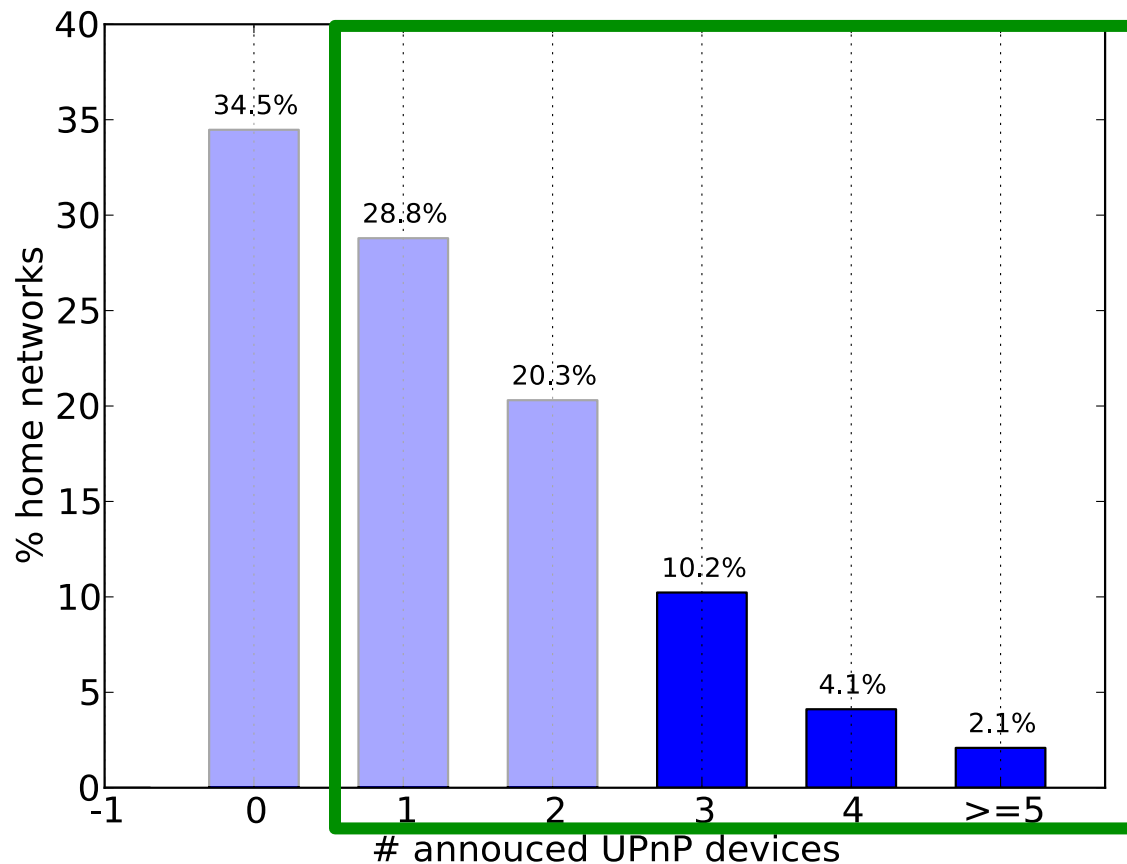
- Measure from Dasu, a platform for broadband benchmarking and network experimentation on end hosts
 - Total over 91k in over 150 countries
 - Our dataset: $\approx 13K$ home networks
 - BitTorrent
- Passive
 - Transferred bytes from host (*netstat*)
 - BitTorrent
 - Cumulative bytes transferred over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

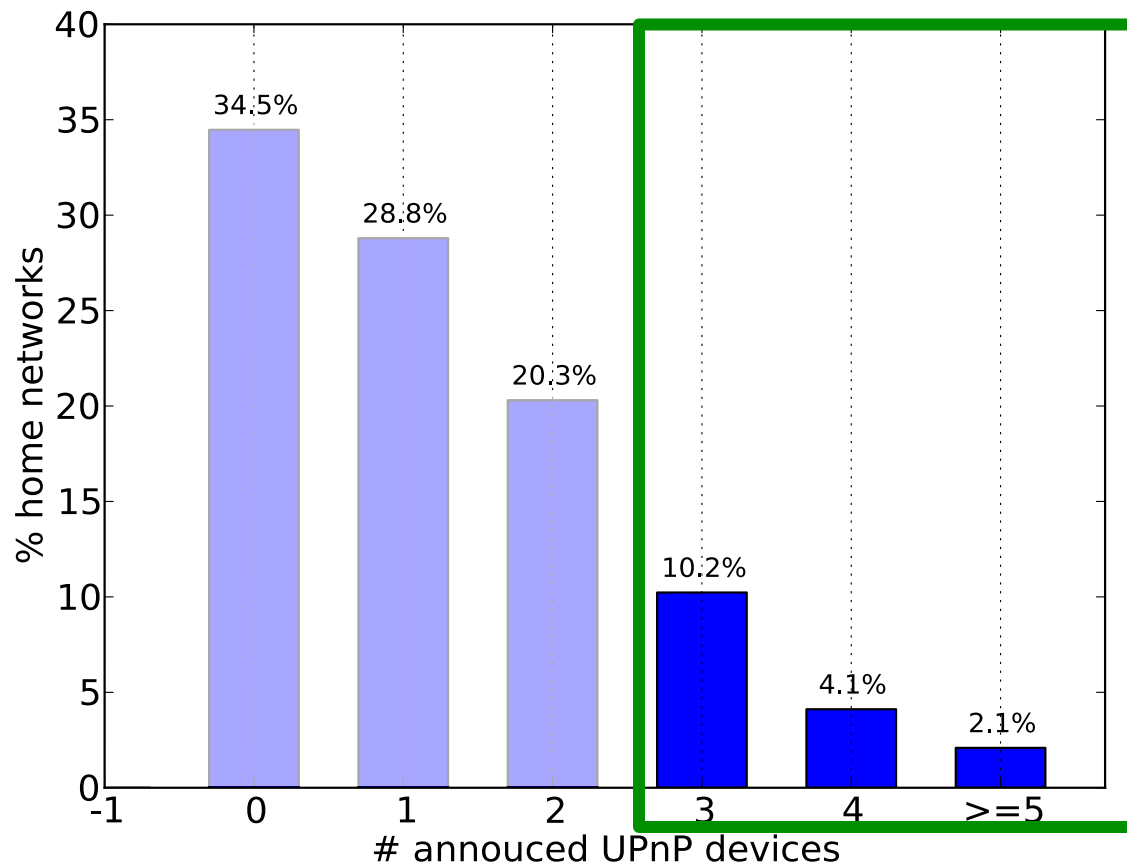
Number of networked devices found



65% of homes have at least one device

Complexity in number of devices

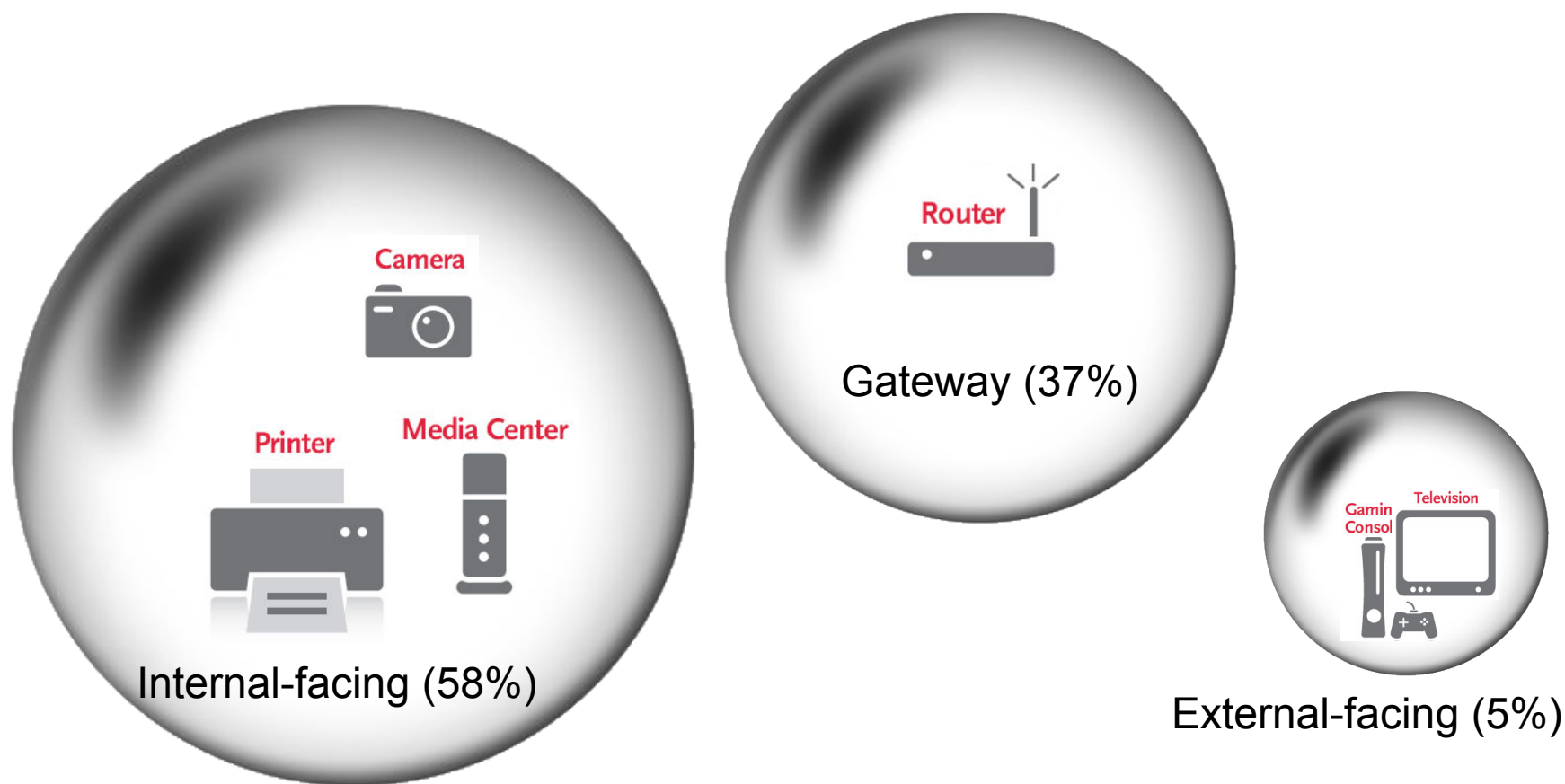
Number of networked devices found



16% of homes have 3 or more

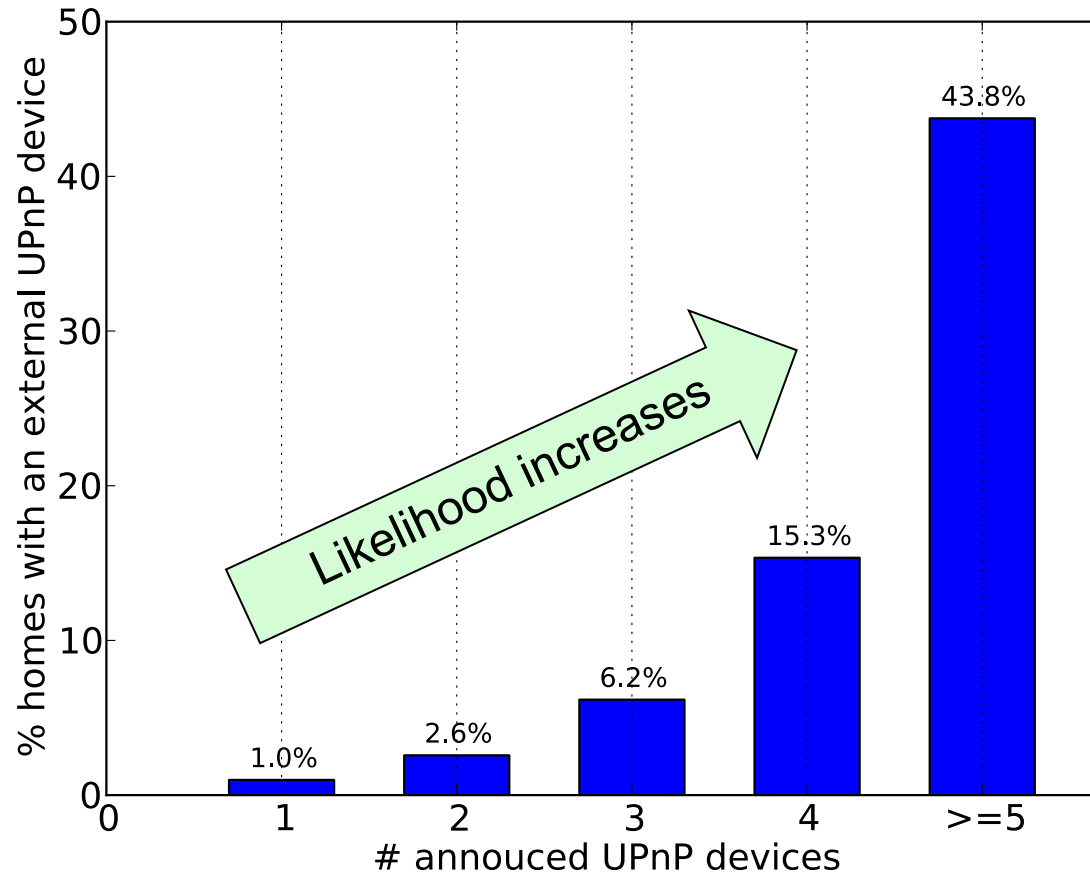
Not all devices play the same role

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

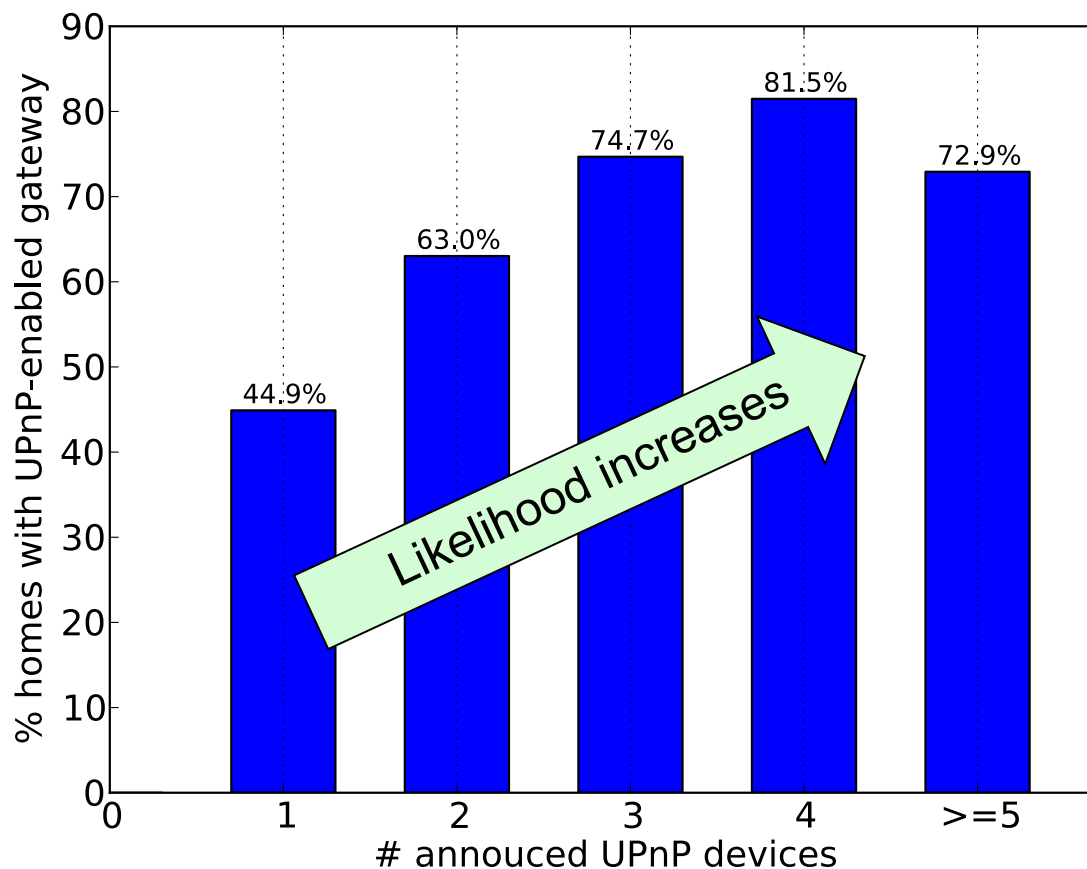


With complexity, externally-facing devices ...

↑ devices = ↑ complexity = ↑ externally-facing devices



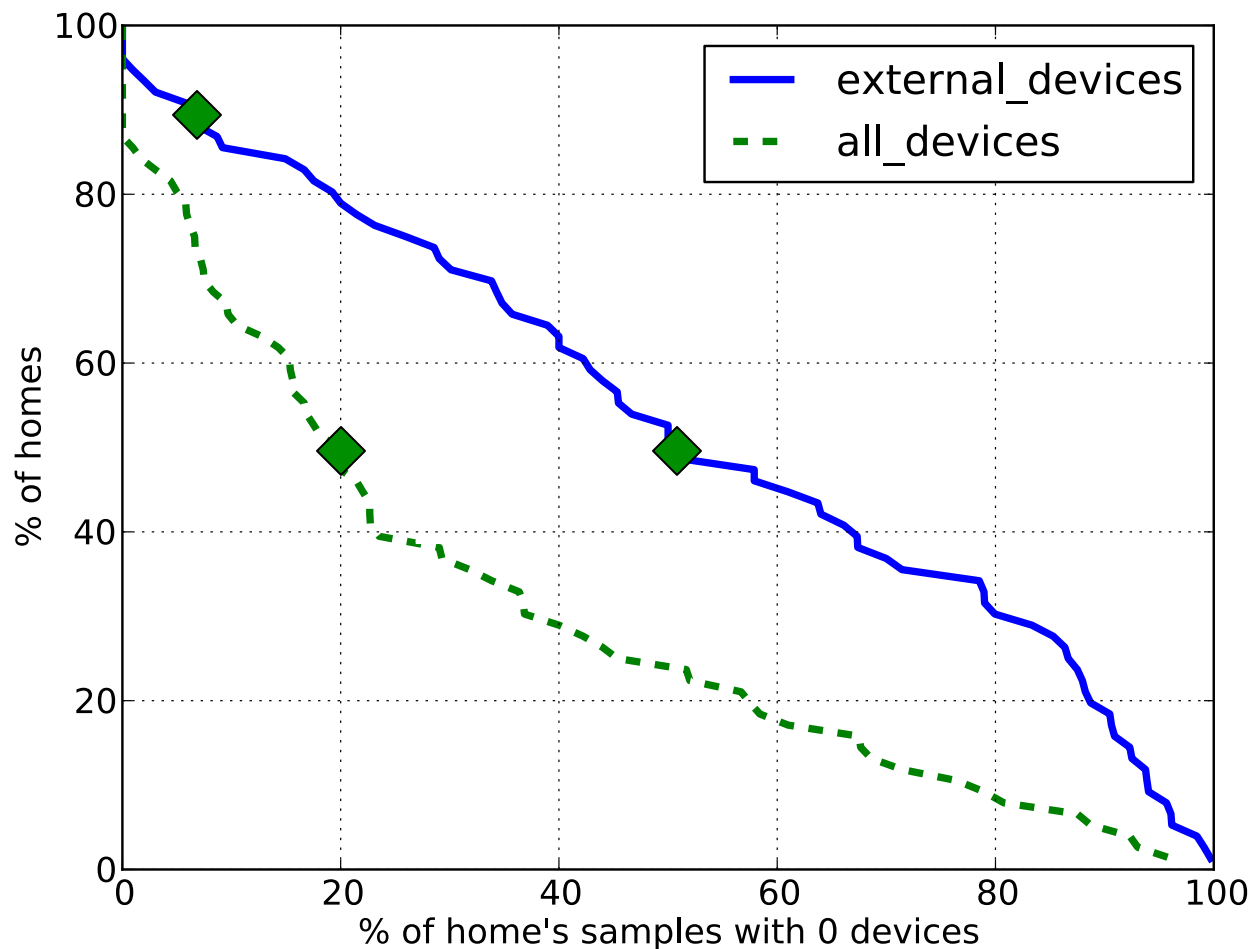
But also UPnP-enabled gateways



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

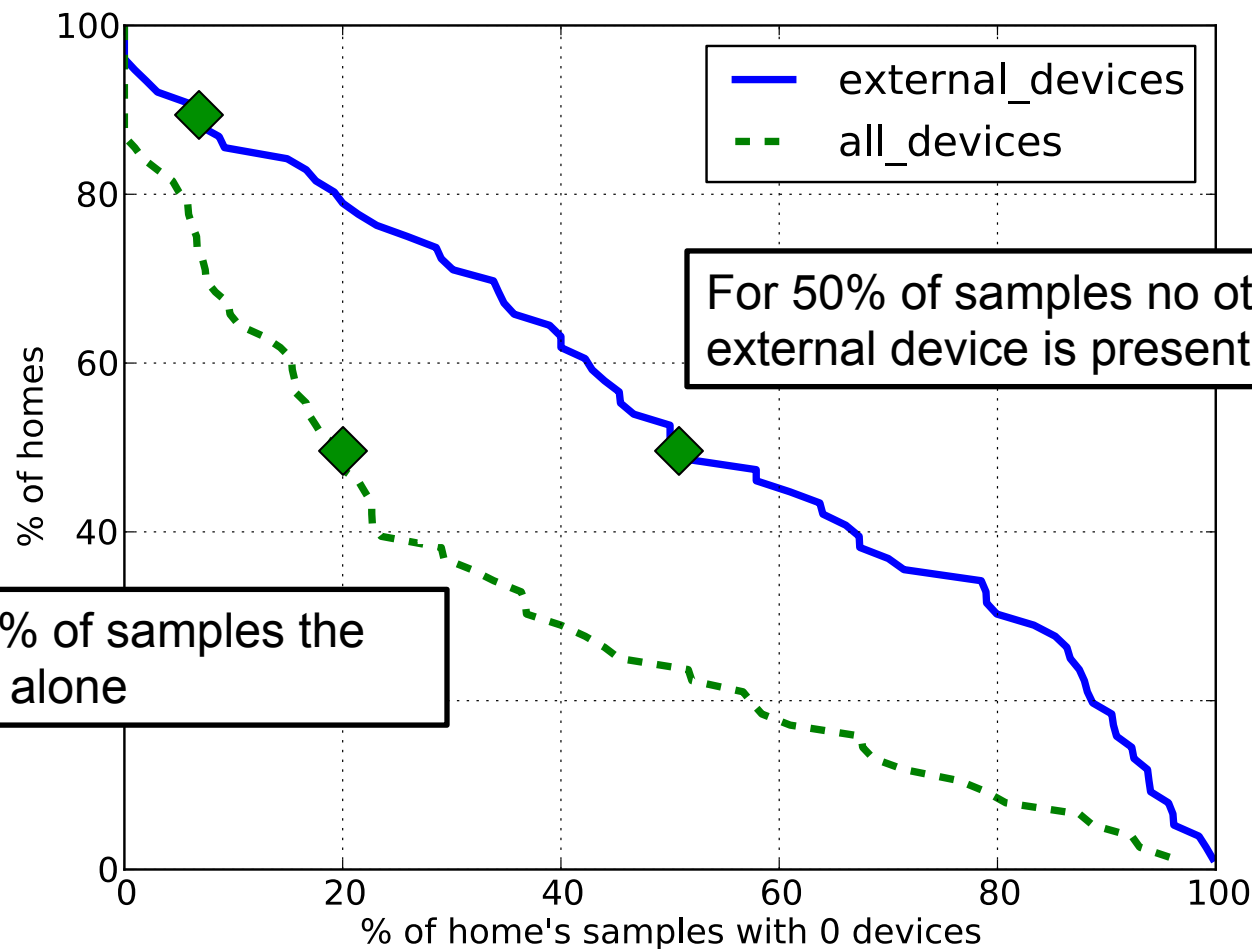
Many opportunities to measure

- “who else is out there”



Many opportunities to measure

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

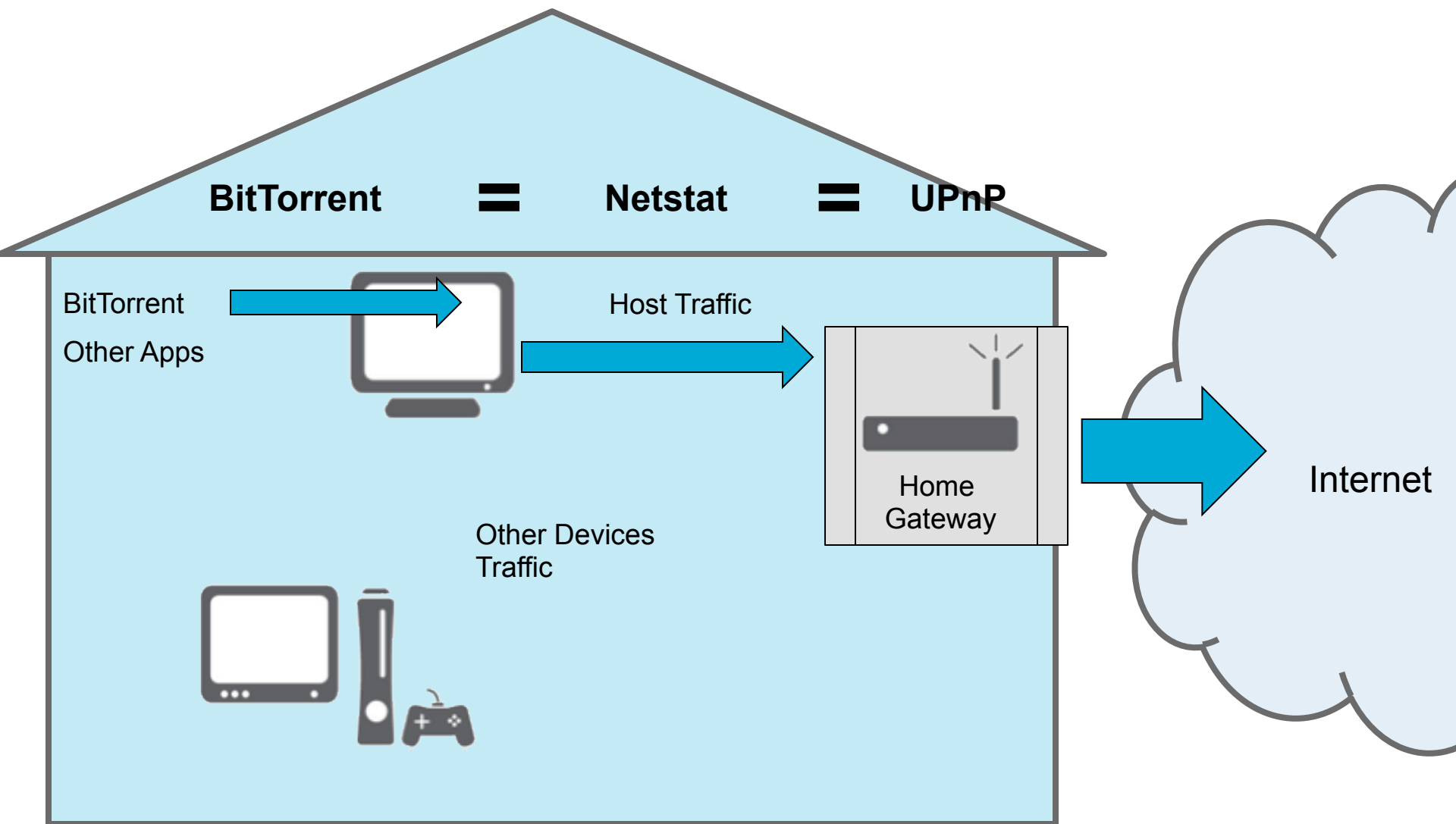


Usage rather than presence (micro dynamics)

- 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

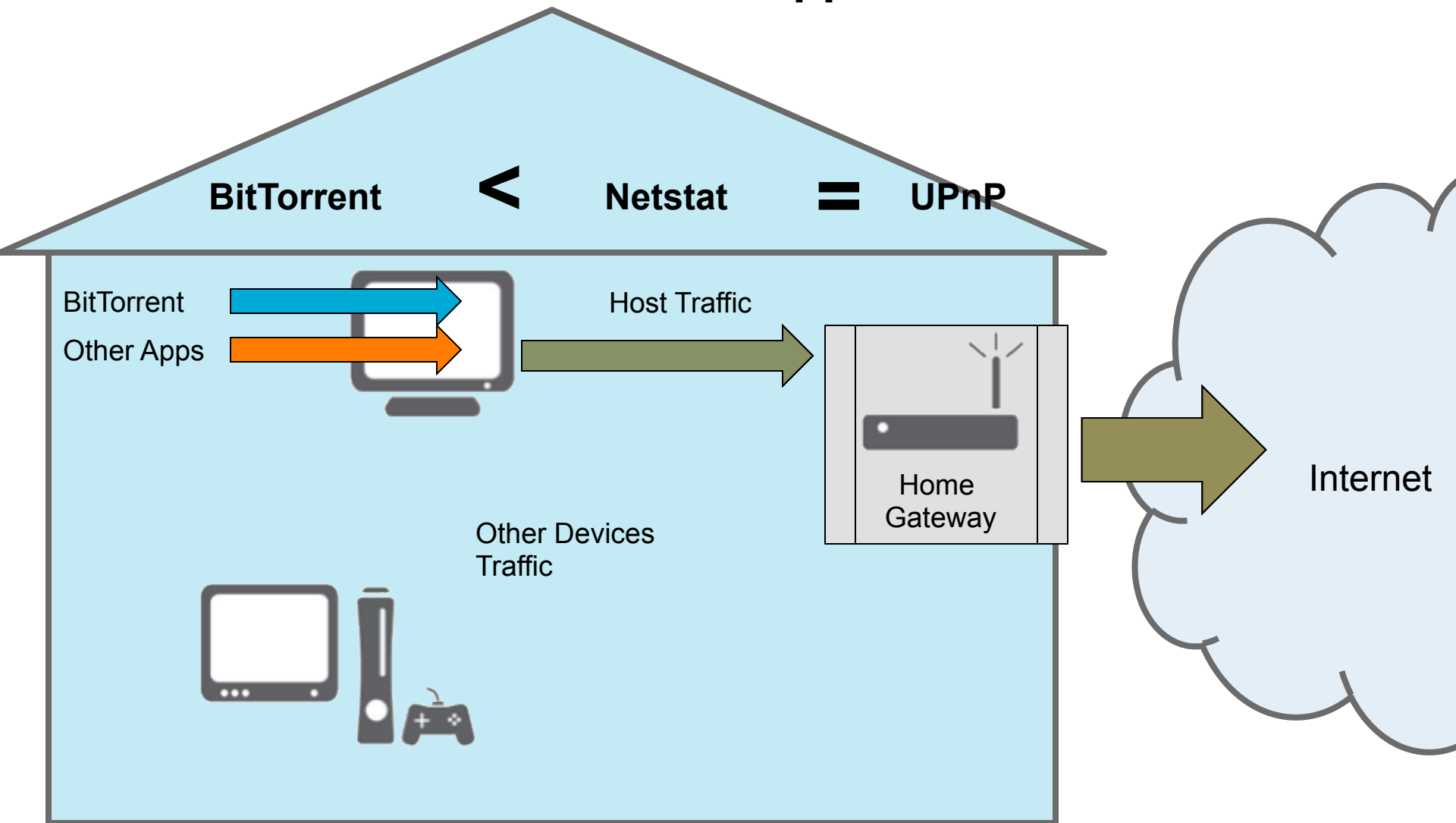
Usage rather than presence (micro dynamics)

No cross-traffic



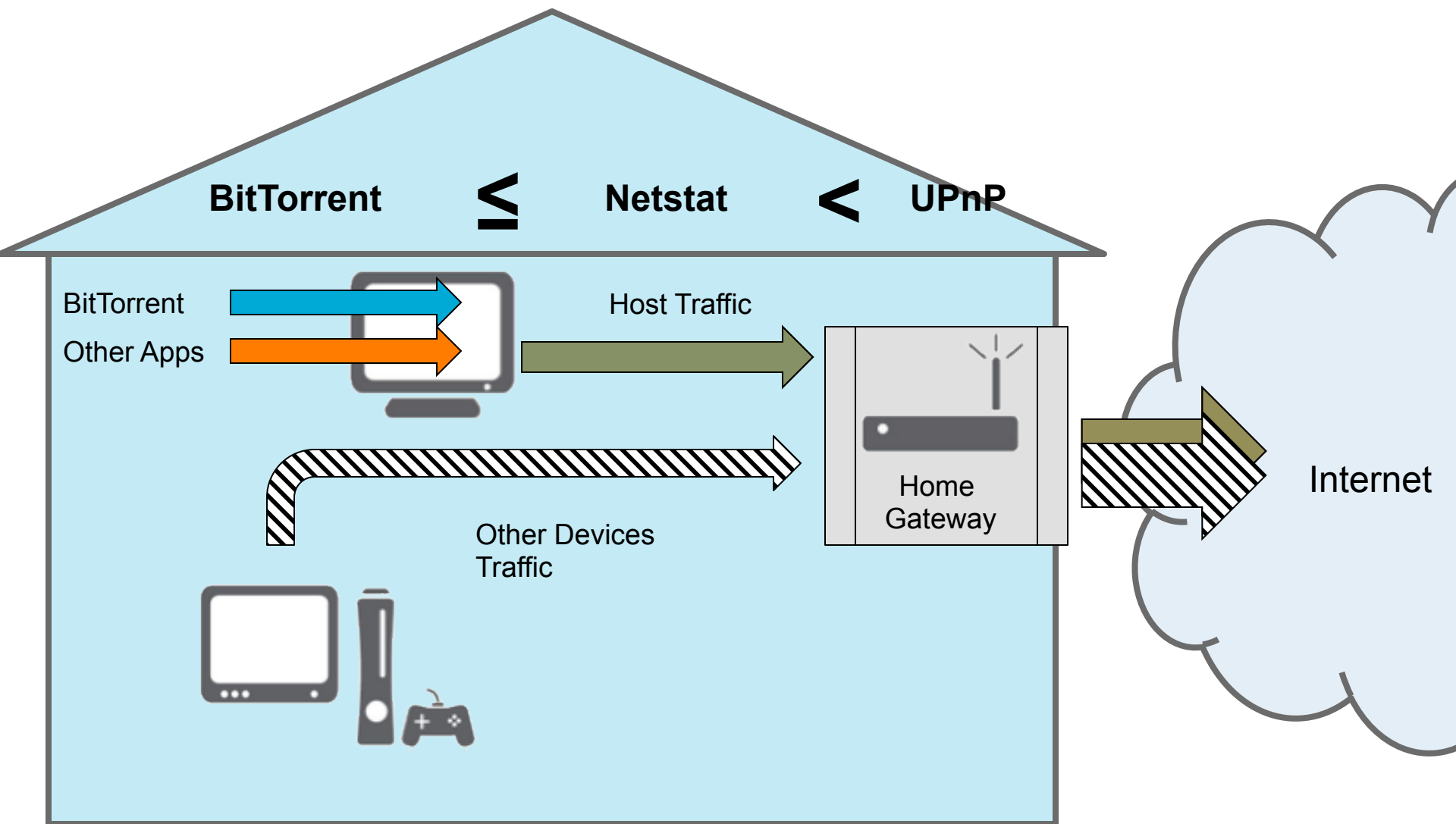
Usage rather than presence (micro dynamics)

Local cross-traffic from other applications in the host



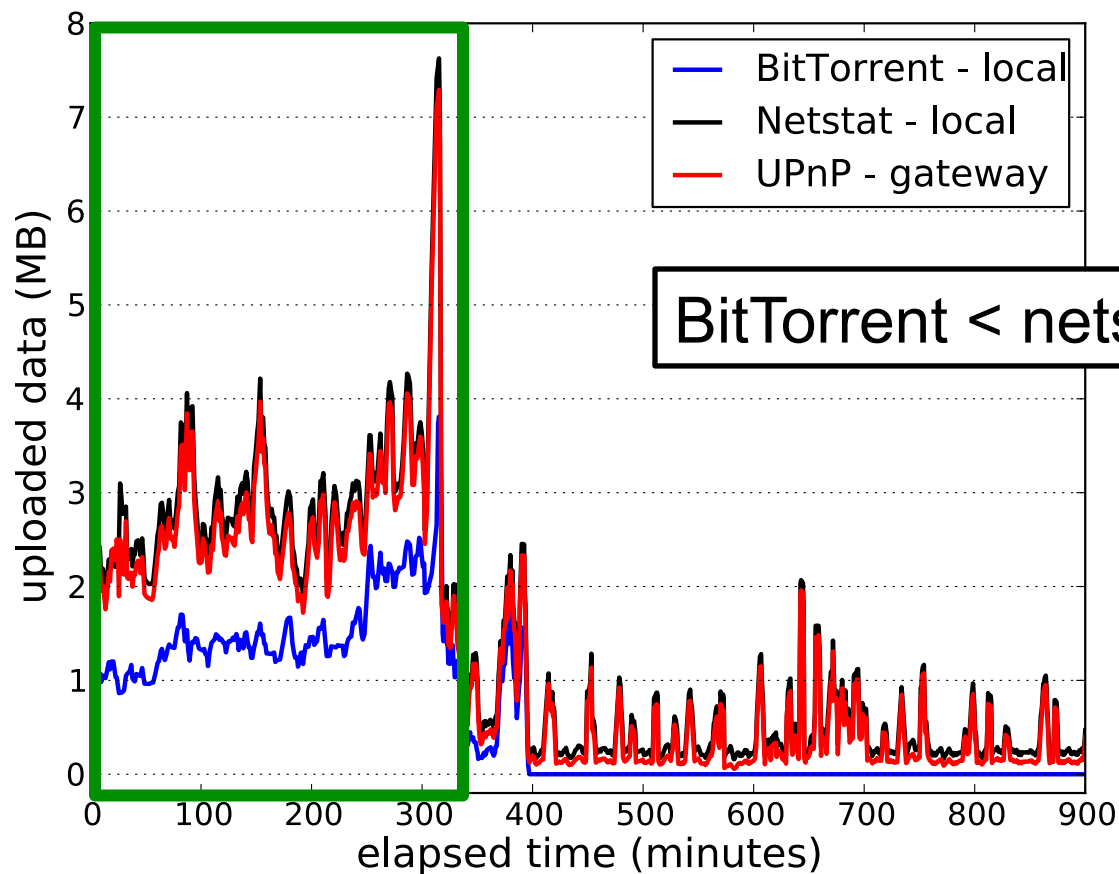
Usage rather than presence (micro dynamics)

Cross-traffic from other devices



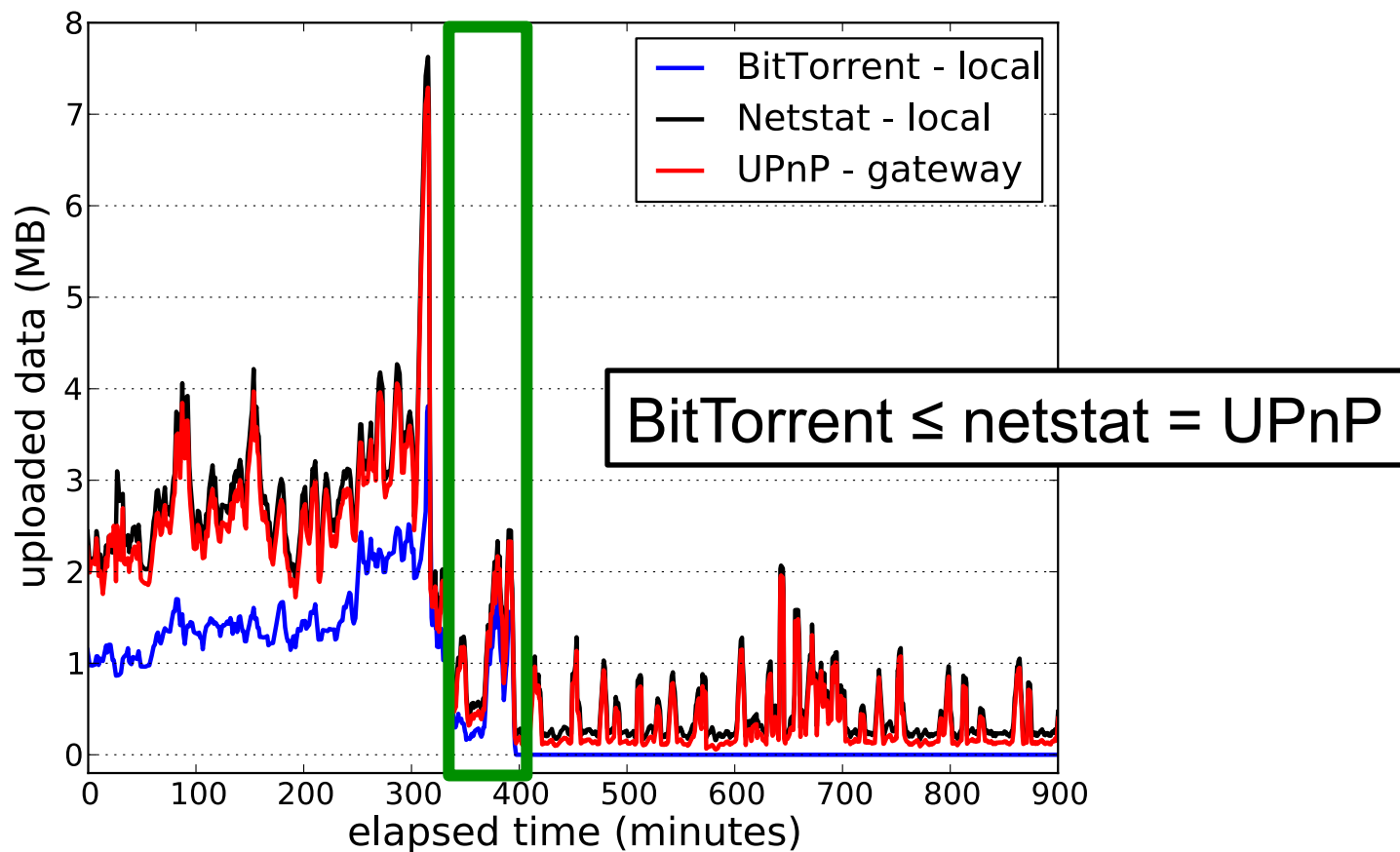
Home alone

- Client is sole responsible for network traffic in access link



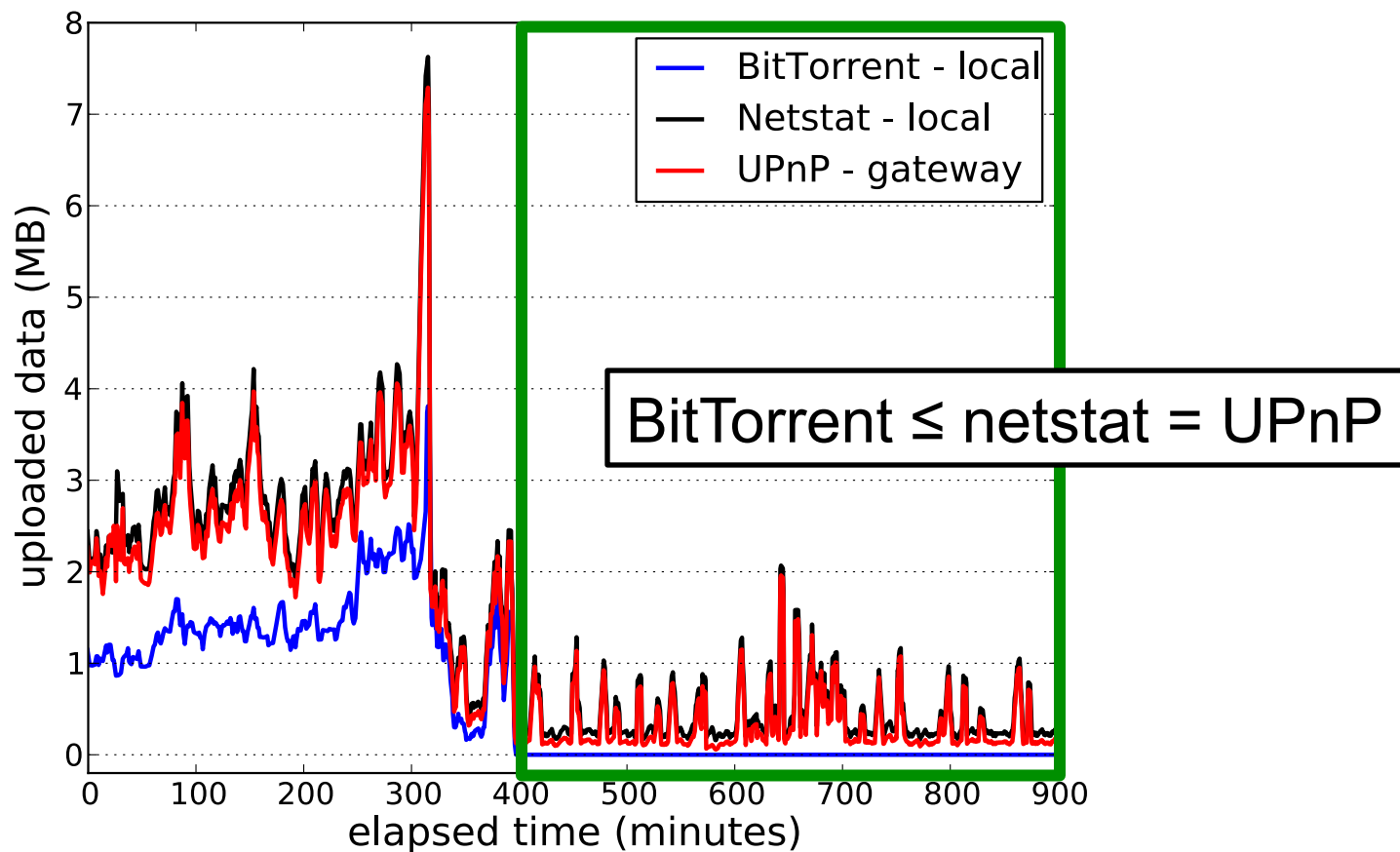
Home alone

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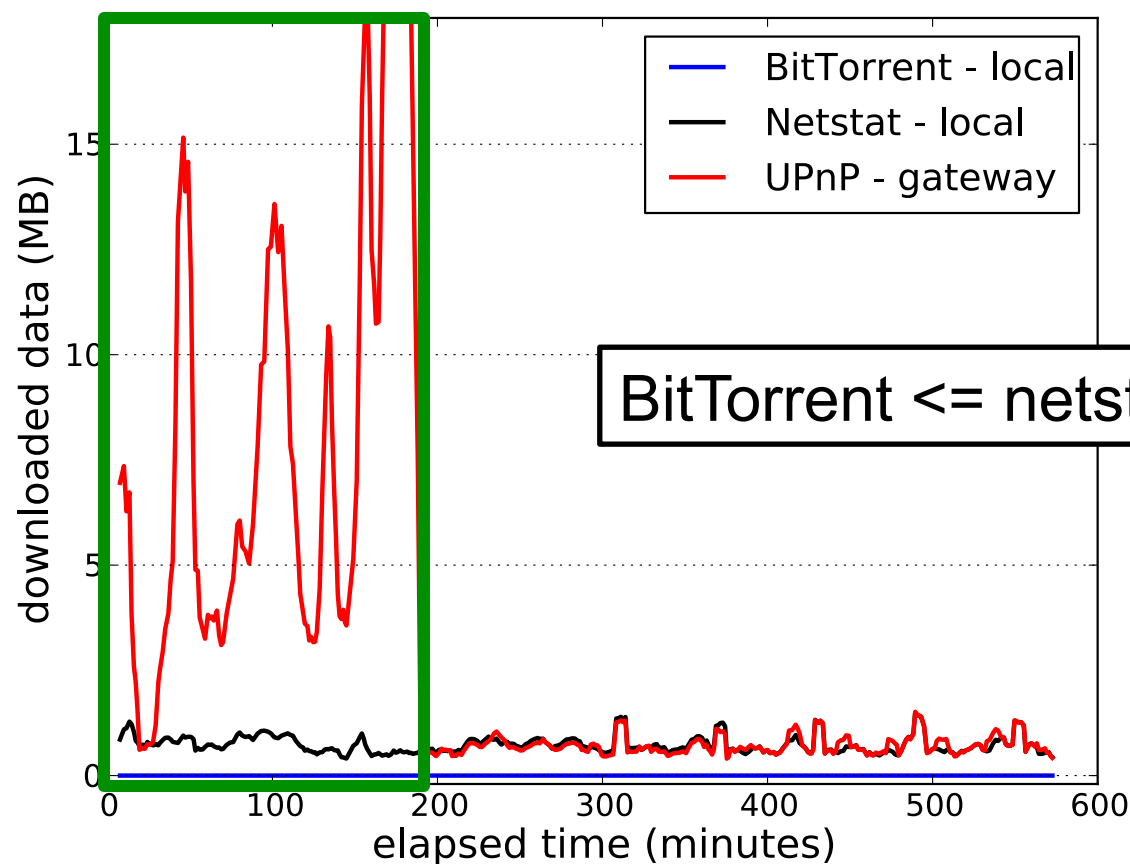
Home alone

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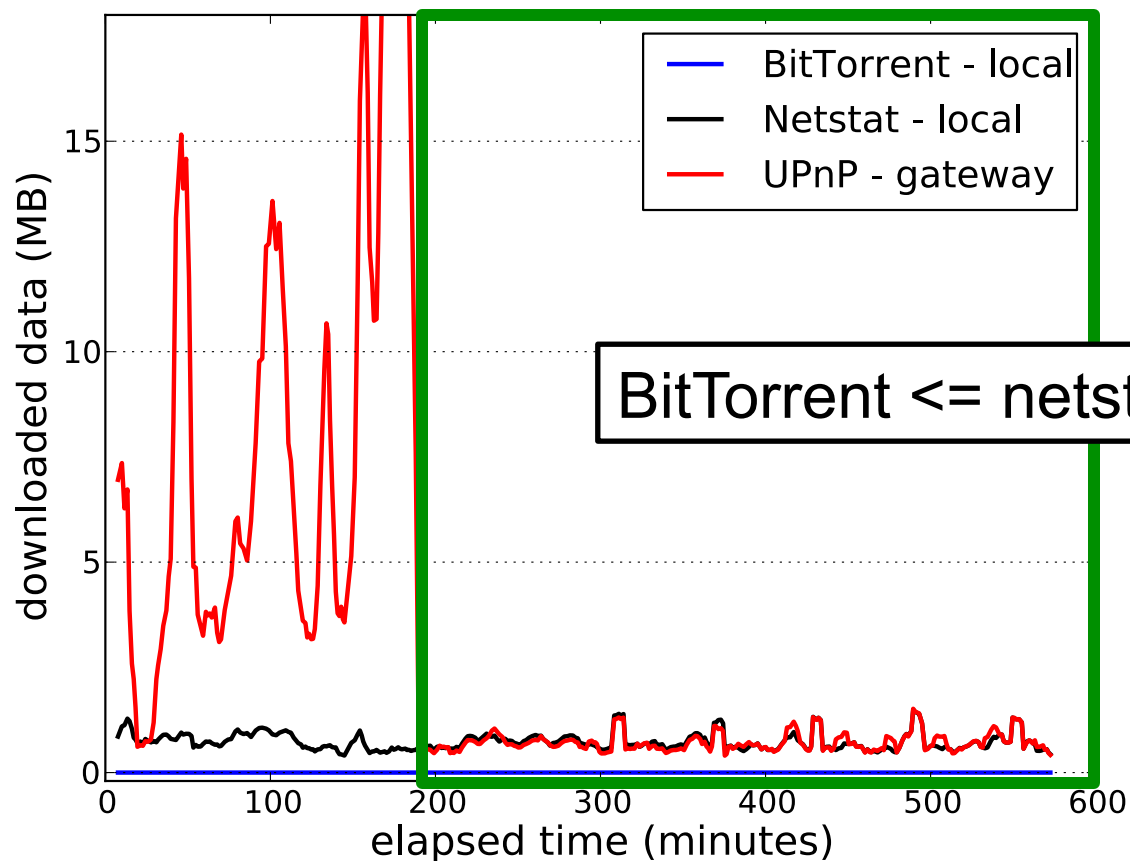
Not alone, but you can tell

- Cross-traffic from other devices



Not alone, but you can tell

- Cross-traffic from other devices



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***