Probe and Pray: Using UPnP for Home Network Measurements

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Measurements are going home

- Measurements from homes uncovered buffer bloat
  - Hard to know which devices to blame
- A number of efforts to measure broadband speed
  - From home gateways: more accurate
  - From hosts in the home: easier to reach more users

UPnP to the rescue

- End-host can query gateway with UPnP
  - Device name/version
  - Access link technology and synchronization rate
  - Traffic counters (packets and bytes; sent and received)

Open questions

- Do home gateways support UPnP?
- How accurate are the responses?
- How useful is it in practice?

Approach

- UPnP queries from end-hosts in home network
- Collection tools: HomeNet Profiler and Netalyzr
  - Netalyzr's bandwidth and buffer tests
  - UPnP queries
    - Gateway device model name and version
    - Gateway's WAN interface type (e.g., DSL, Cable)
    - Synchronization rate
    - Unidirectional byte/packet counters

Datasets

Dataset	Start	End	Homes	Countries	ASes
HNP	4/4/2011	15/12/2011	2,209	43	208
Netalzyr-1	23/3/2011	29/8/2011	95,417	131	1,373
Netalzyr-2	30/8/2011	15/12/2011	30,243	114	949

- Netalyzr-1 queries only gateway model and version
- HNP and Netalyzr-2 perform all queries

UPnP is not always available

Dataset	Homes	UPnP
HNP	2,209	54%
Netalzyr-1	95,417	22%
Netalzyr-2	30,243	47%

- Overall gateways in only 35% responded to UPnP
  - Some gateways do not implement UPnP
  - Some implement it, but keep UPnP disabled by default
  - Firewalls prevent query or response

UPnP answers may be incorrect

- Response to some queries only
  - 14% only gateway queries
  - 1% only wildcard queries
- Inaccurate connection type or synchronization rate
  - In SFR, 25% of gateways report Cable for of ADSL
  - Zero bps, very small values, or maximum commercial rate
- Inaccurate traffic counters
  - Available in only 22% of homes, 3% of homes hardcoded

When answers are correct…

- Synchronization rate versus measured bandwidth
- Home cross traffic
- Packet losses in home versus wide-area
- Device names with large buffers

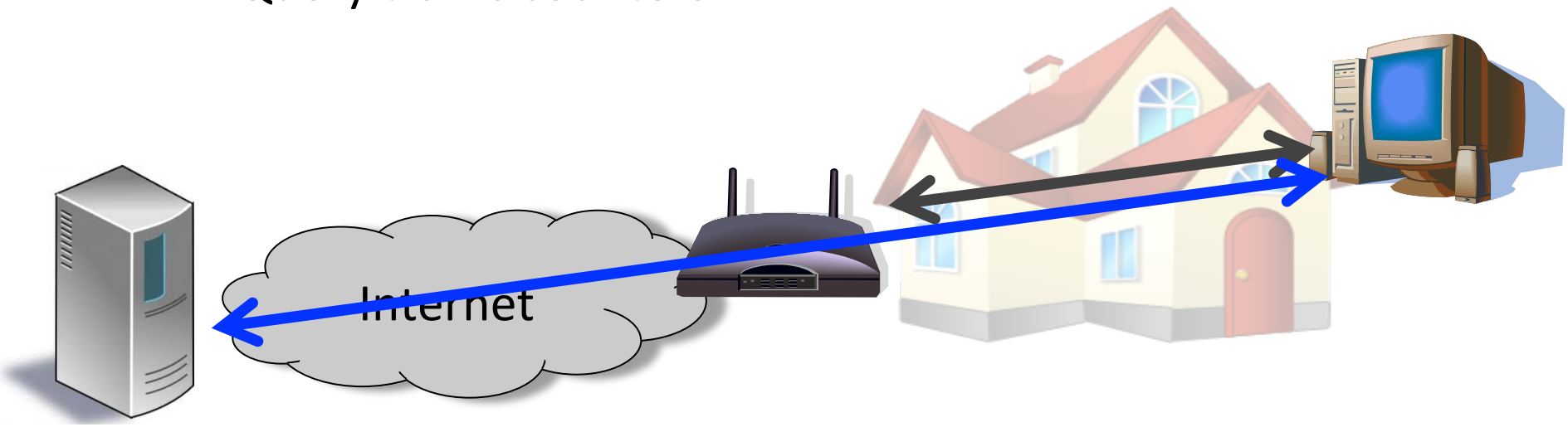
Measurement setup

1: Query sync rate

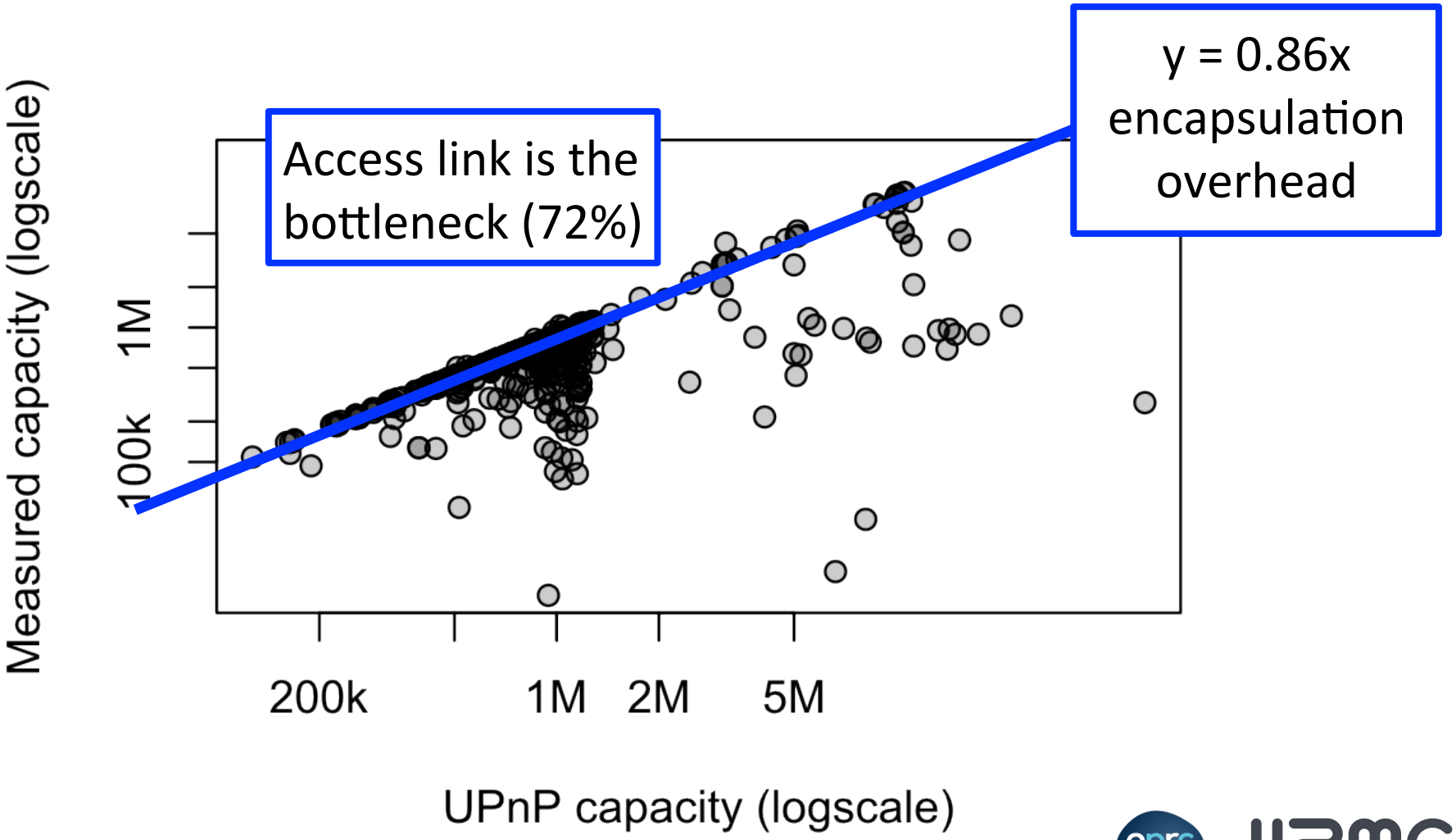
2: Query traffic counters

3: Bandwidth test

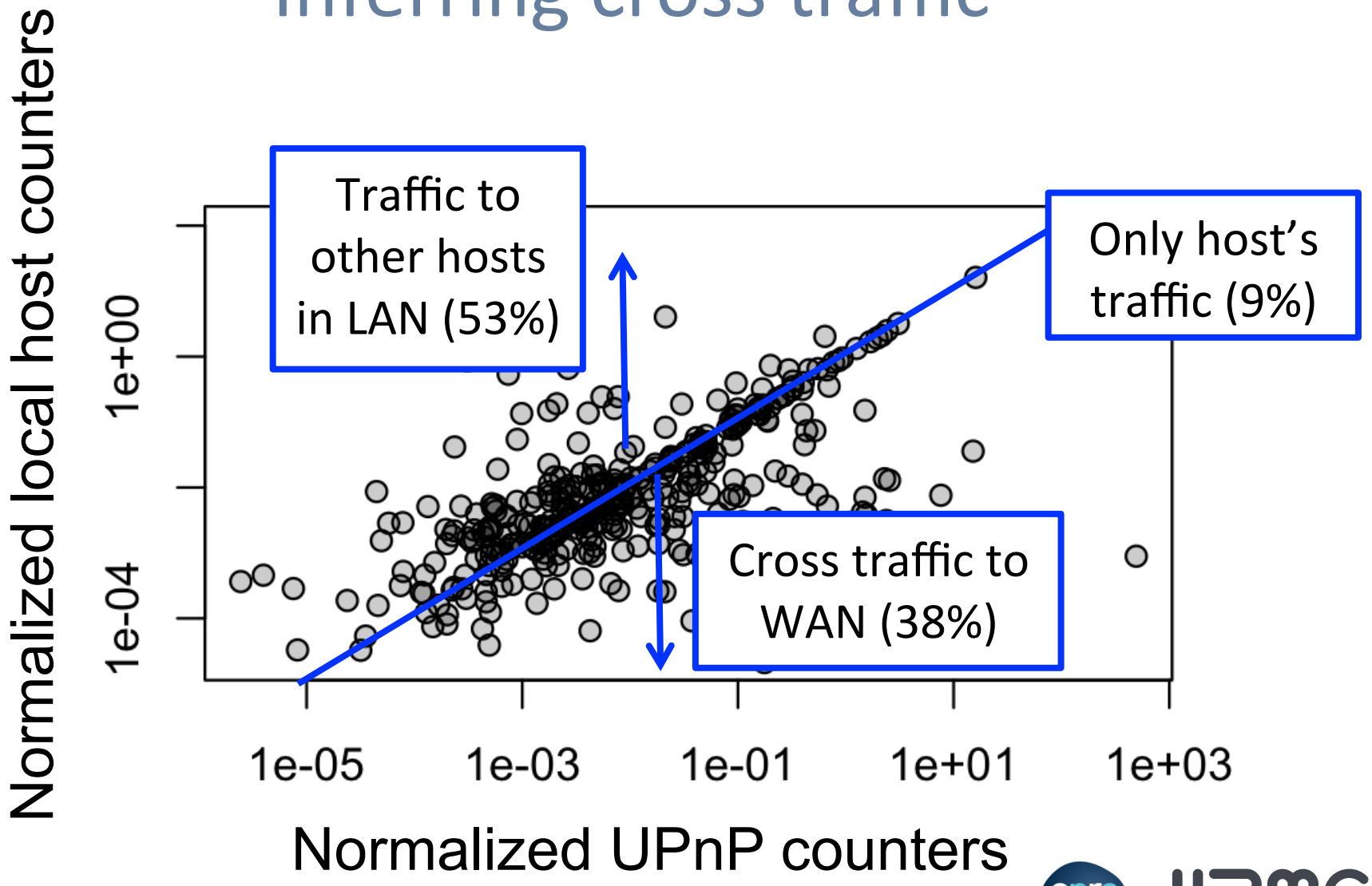
4: Query traffic counters



Sync rate vs. measured bandwidth



Inferring cross traffic

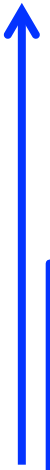


Packet losses: LAN vs. WAN

		WAN	
		No loss	Loss
LAN	No loss	2%	48%
	Loss	28%	22%

Buffers in most frequent gateways

Model	Homes	Buffer size (KB)
FRITZ Box 6360 Cable	39	365
WNDR3700 router	46	234
DIR 615	43	197
D-Link Route	91	156
WRT54G	61	159
DIR 300	51	121
FRITZ Box 7390	243	48
BRCM963xx	34	60
Thomson TG	39	22



For 1.2 Mbps uplink, more than 1 second delay under load

Conclusions

- Do home gateways support UPnP?
  - Only in about 35% of measured homes
- How accurate are the responses?
  - Not that accurate, many corner cases
- Is it useful in practice?
  - When it works, yes
    - Synchronization rate versus measured bandwidth
    - Home cross traffic
    - Packet losses in home versus wide-area
    - Device names with large buffers

Thank you!

- HomeNet Profiler
  - http://cmon.lip6.fr/hnp
- Netalyzr
  - http://netalyzr.icsi.berkeley.edu

http://www.ict-figaro.eu/