PAWP – A Power-Aware Web Proxy for WLAN Clients

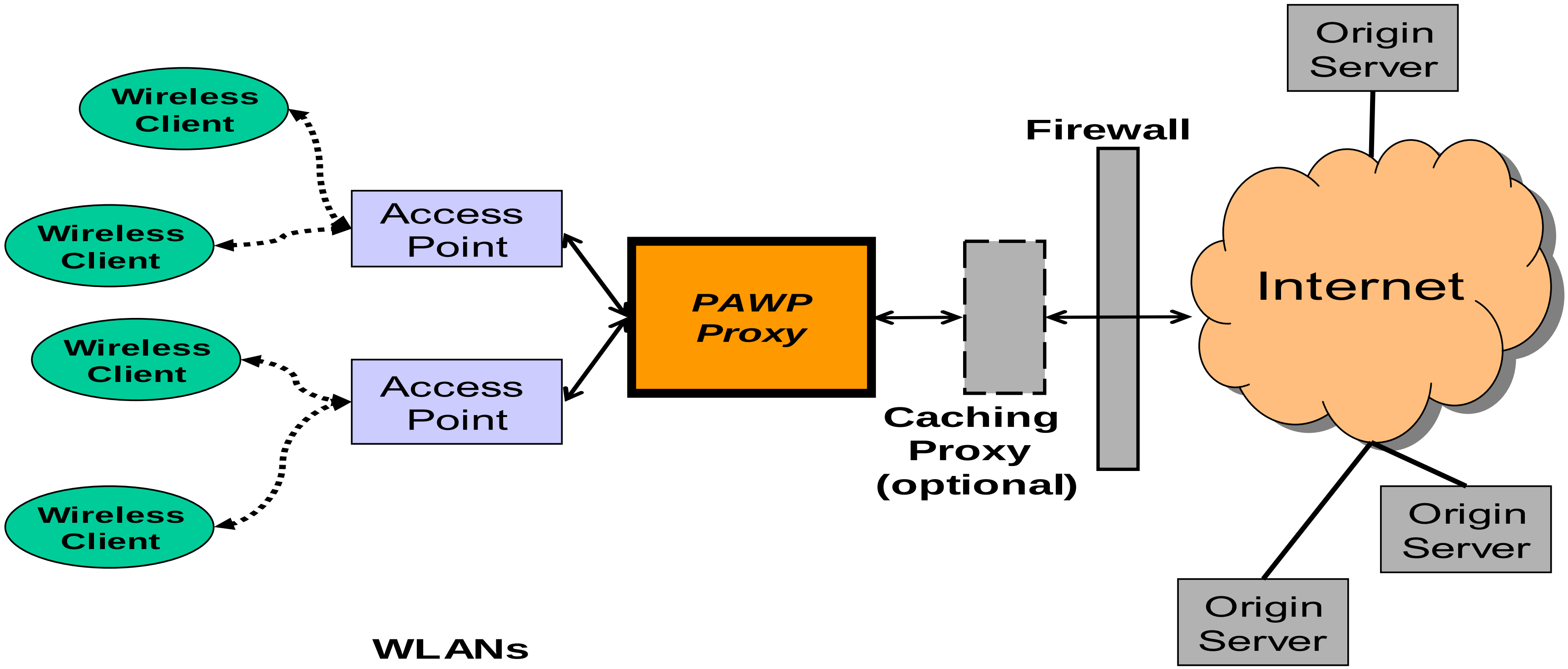
Marcel Roşu, Michael Olsen, and Chandra Narayanaswami

IBM T.J. Watson Research Center

Lu Luo

Carnegie Mellon University

Power-Aware Web Proxy Usage



Power Optimization for Wireless NIC

- Active power consumption in WLAN interface:
  - 5-10% in notebooks, 50-90% in PDAs

- Existing power-reduction approaches for WLAN clients:
  - 802.11 Power Saving Mode – limited power saving during active transmissions
  - MAC level – extending sleep time
  - Transport level – energy efficient protocols
  - <u>The unpredictability of incoming traffic causes waste of power</u>

- Our approach – Power Aware Web Proxy (PAWP), using:
  - A web proxy to shape HTTP traffic going into client's WNIC

  Based on:
  - Application domain knowledge
  - MAC level configuration
  - Network conditions

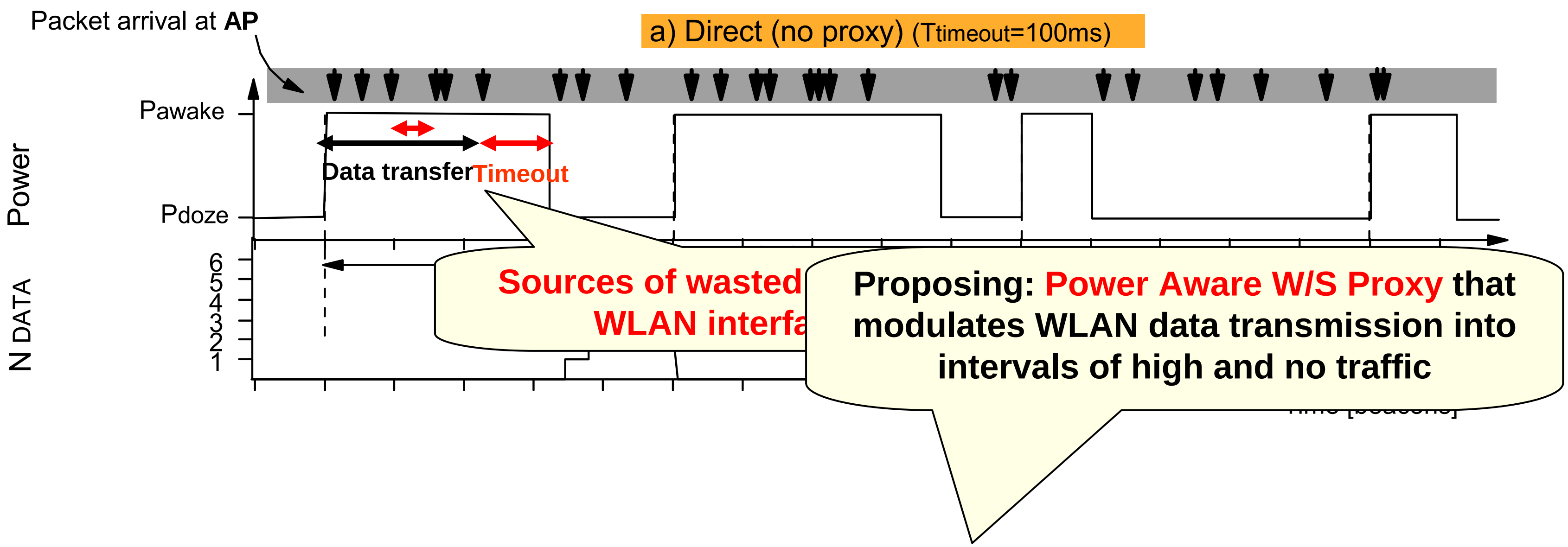
Outline

- 802.11 Power Management
  - Interactions with Incoming WLAN Traffic
- *PAWP* Architecture
  - Traffic Shaping Rules
- Experiments
  - Testbed
  - Methodology
  - Results
- Conclusions

802.11 Power Management

- Power Modes
  - Active
  - Power Save
- Power States
  - Awake (both Modes, always when listening to beacon from station)
    - PRISM3 PCMCIA card: 848mW
  - Doze (Power Save Mode)
    - PRISM3 PCMCIA card: 25mW
- Transition between modes always initiated by station
  - Frame exchange with access point
  - Active -> Power Save after idle configurable period
  - Power Save -> Active after sending/receiving frame

Analysis of Incoming WLAN Traffic

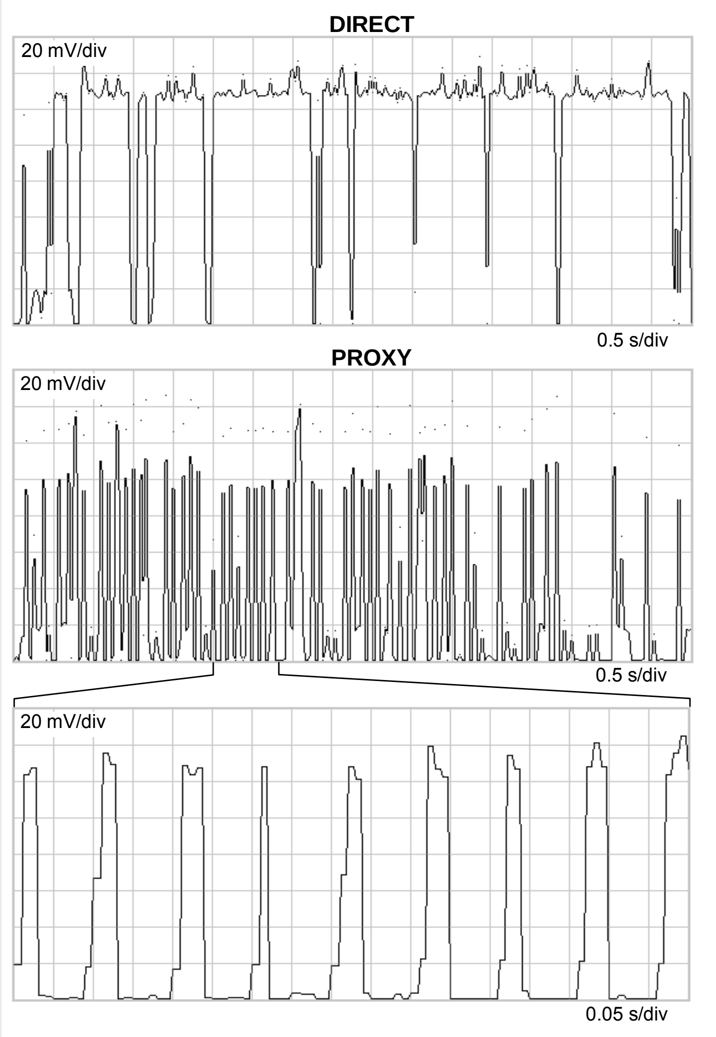


Comparison on Power Consumption

DIRECT

PROXY

ACPIspec.pdf



www.eBay.com

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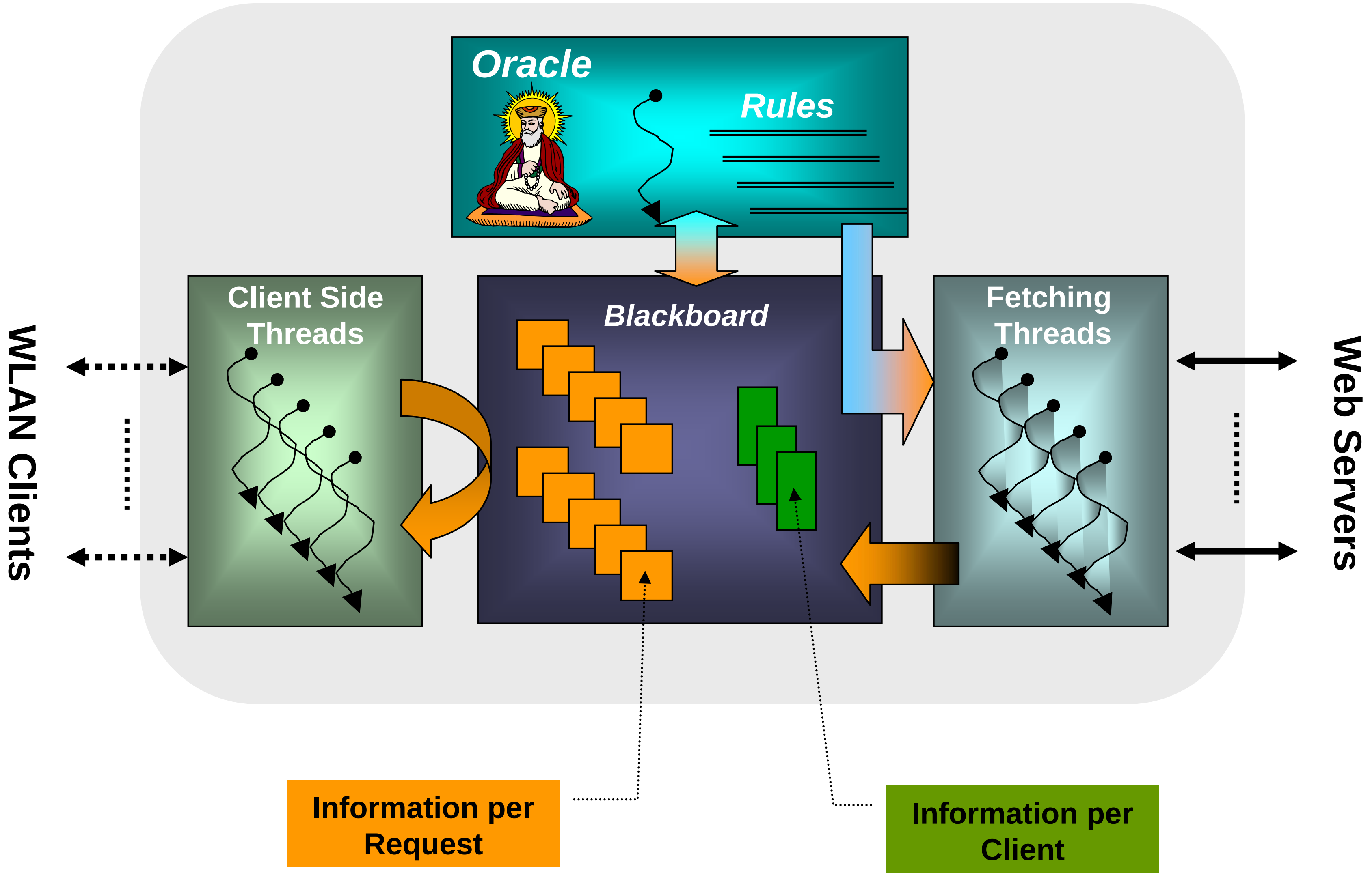
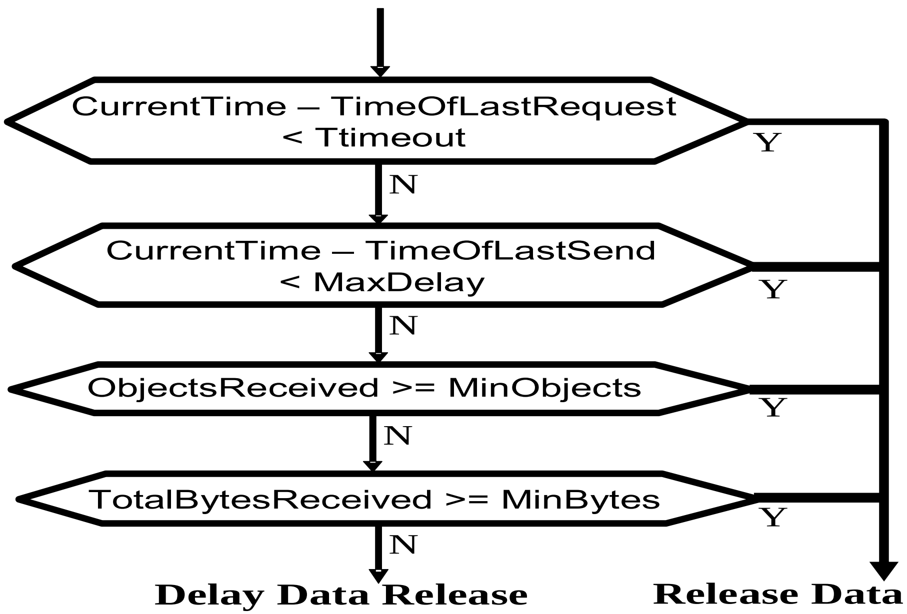
Power-Aware Web Proxy Architecture



PAWP: Compensating Content Delays

Delaying Content Release



Compensating for Delays

- Prefetch Embedded Objects
- Pipeline Requests
- Pipeline Responses
- Prioritize Tasks
- Major Challenge
  - Handling HTTP Cookies

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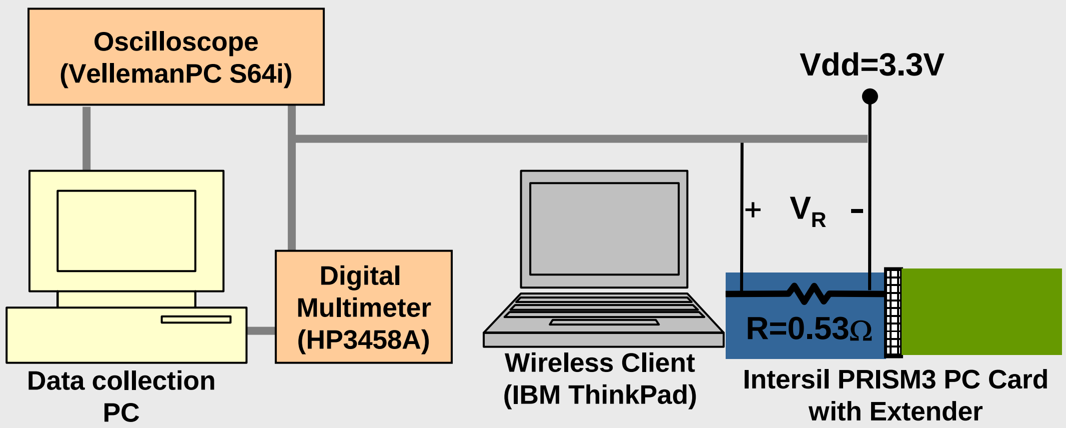
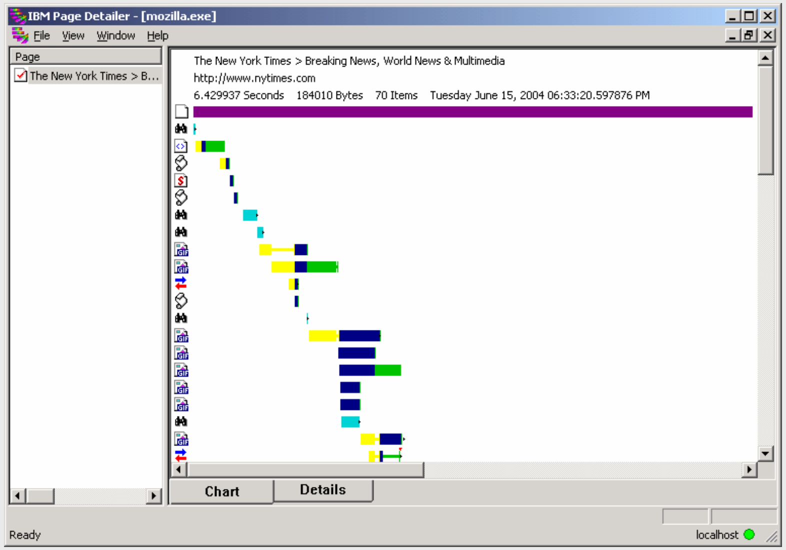
Experimental Testbed



Power measurement environment for wireless client network interface card

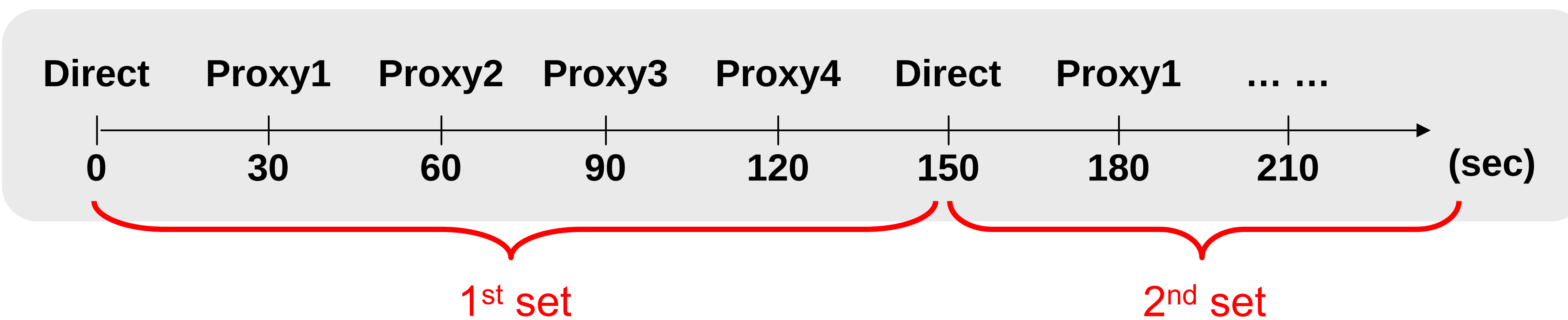
HTTP protocol trace collection using IBM PageDetailer

- Downloading time distribution
- Information on web objects
- HTTP headers



Complete, Across-The-Board Experiments

- Based on the new experimental testbed
  - Experiments on each proxy configuration can be done in < 30 sec
  - Quick, automatic switching between configurations
  - Measurements in each set are close in time – avoided deviation



Experimental Results (1)

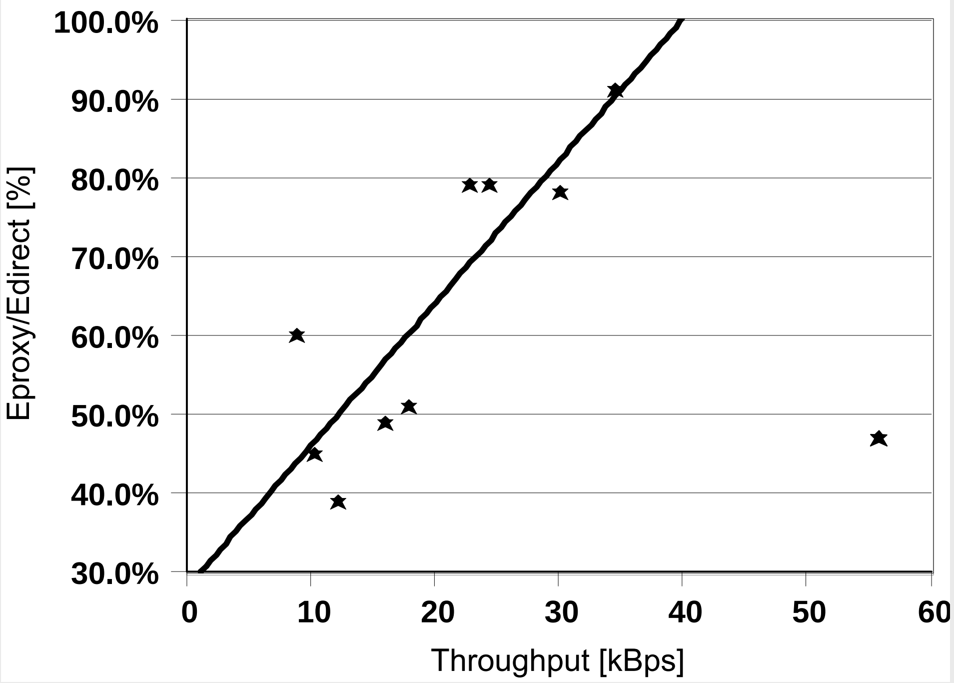
	Website Size [kB] / Num of Objects	Connection Type	Download Energy [J]	Download Time [s]	Throughput [kB/s]
Internet Explorer	cnn 281kB/84	Direct Proxy	2.47 2.25 (-9%)	8.13 7.33 (-10%)	34.6
	nytimes 253kB/76	Direct Proxy	2.36 1.89 (-22%)	8.17 5.78 (-29%)	30.1
	washingtonpost 535kB/73	Direct Proxy	6.14 2.83 (-54%)	9.08 8.58 (-6%)	56.0
	bbc 61kB/31	Direct Proxy	2.10 1.05 (-50%)	3.56 3.37 (-5%)	17.1
Mozilla	cnn 252kB/84	Direct Proxy	3.30 1.37 (-59%)	4.63 3.88 (-16%)	54.3
	nytimes 190kB/45	Direct Proxy	3.29 1.11 (-66%)	6.85 3.20 (-53%)	23.3
	washingtonpost 504kB/67	Direct Proxy	4.99 2.20 (-56%)	7.34 7.01 (-5%)	44.4

Experimental Results (2)

Cost and Benefits of Proxy Features

NY Times (www.nytimes.com) 240kB/77	Download Energy [s]	Download Time [s]
Direct (no proxy)	2.70	8.75
Proxy: all features disabled	2.46	8.95
Proxy: scheduling, prefetching	2.38	8.05
Proxy: scheduling, prefetching, request & response pipelining	2.15	7.54
Proxy: all features on	1.94	6.99

Relative energy consumption with Proxy vs. Direct case throughput



Conclusions

- *PAWP* challenges
  - No client modifications
  - Visible to clients
  - Invisible to servers
  - Don't over-shape traffic
    - Avoid increasing download times
- Lessons learned
  - Page design matters (cookies)
- HTTP usage is increasing
  - *PA**x**P* extends savings beyond Web browsing

Questions?