Aalto University
School of Electrical
Engineering

On doubling (or more) the internet time of smart phones

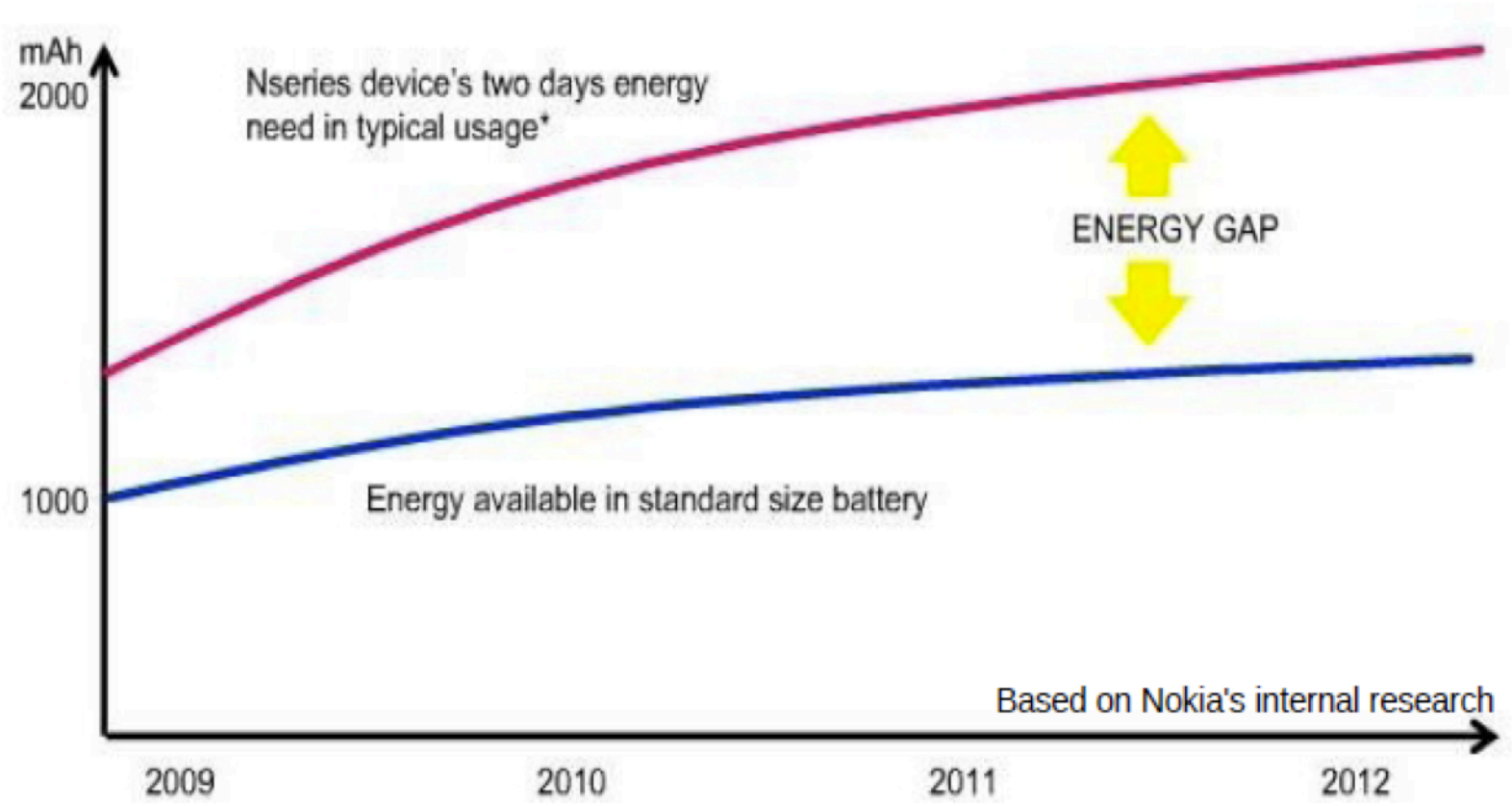
Jukka Manner
Professor, PhD. and Academic Coordinator of FI
Department of Communications and Networking

The problem

“Internet time”

- The modern “smart phone” likes to use the Internet
  - Calling and SMS are not anymore the key features
- Wireless transmission and packet processing is hungry
- Today smart phones need recharging every day
  - 10 years ago a phone was recharged once a week
- One way to make the device last longer is to develop the way it uses the TCP/IP stack and Internet services

Energy gap


mAh
2000
1000
Nseries device's two days energy need in typical usage*
ENERGY GAP
Energy available in standard size battery
Based on Nokia's internal research
2009
2010
2011
2012

Break-down of energy consumption

TABLE 3: An approximate power budget for a multimedia capable mobile phone in 384 kbit/s video streaming mode.

System component	Energy consumption (mW)
RF receiver and cellular modem	1200
Application processors and memories	600
User interface (audio, display, keyboard; with backlights)	1000
Mass memories	200
Total	3000

Some solutions for mobile web access

Three groups of solutions from Comnet

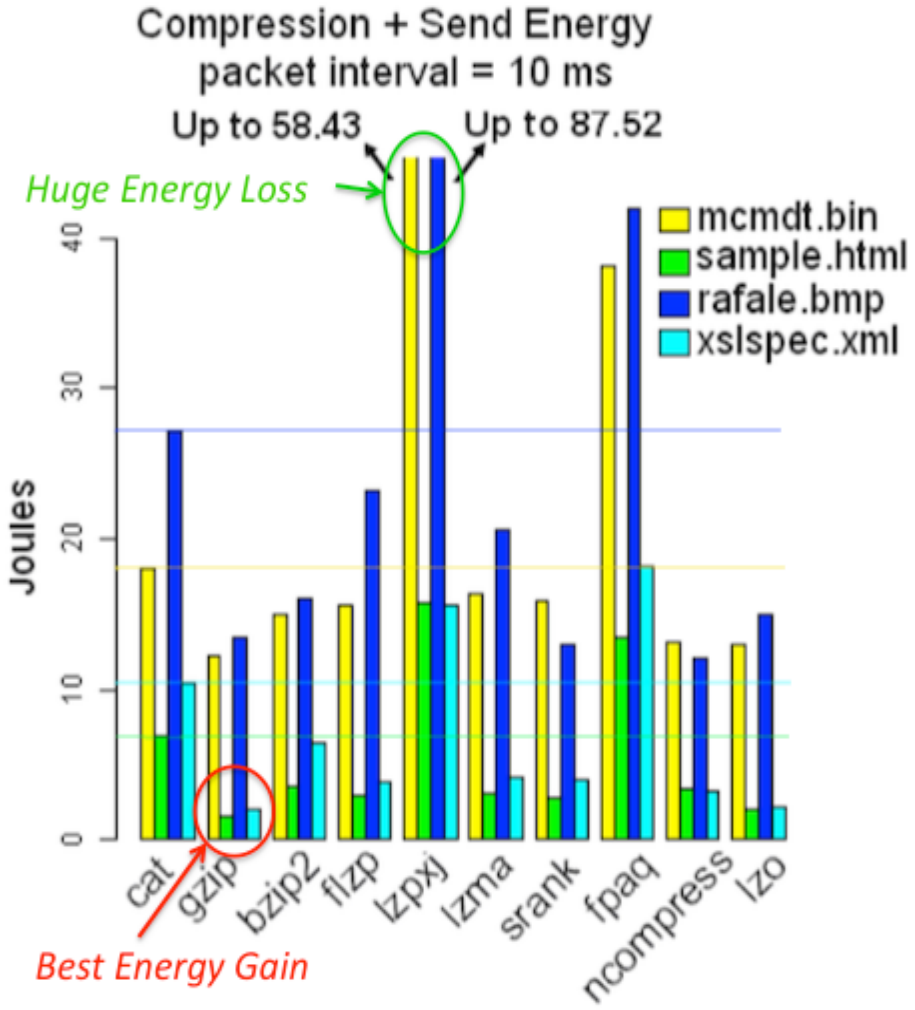
1. Compress data as much as possible
   – Optimization problem: CPU vs. transmission

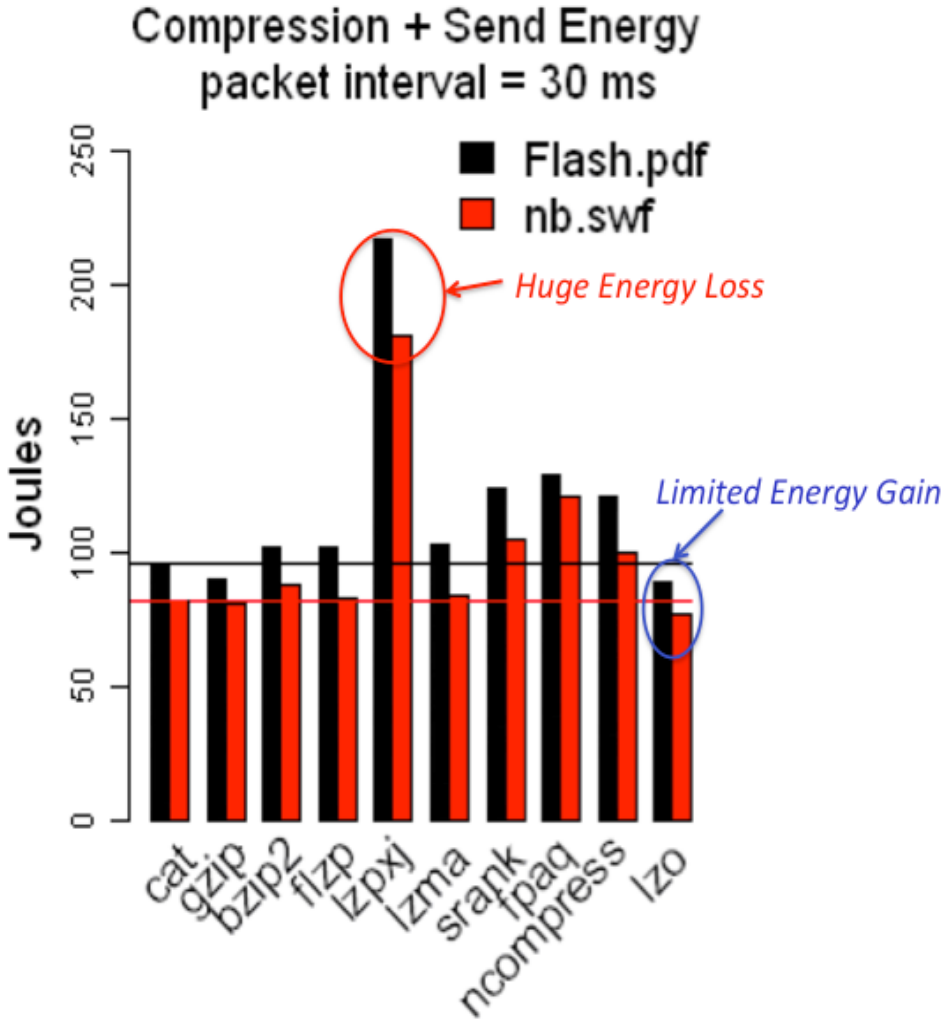
2. Optimize TCP for mobile web access
   – Access WWW content faster

3. Make web content retrieval smarter
   – Deliver multiple web objects faster to the device

Compressing data

Benefits of data compression





FLD-TCP

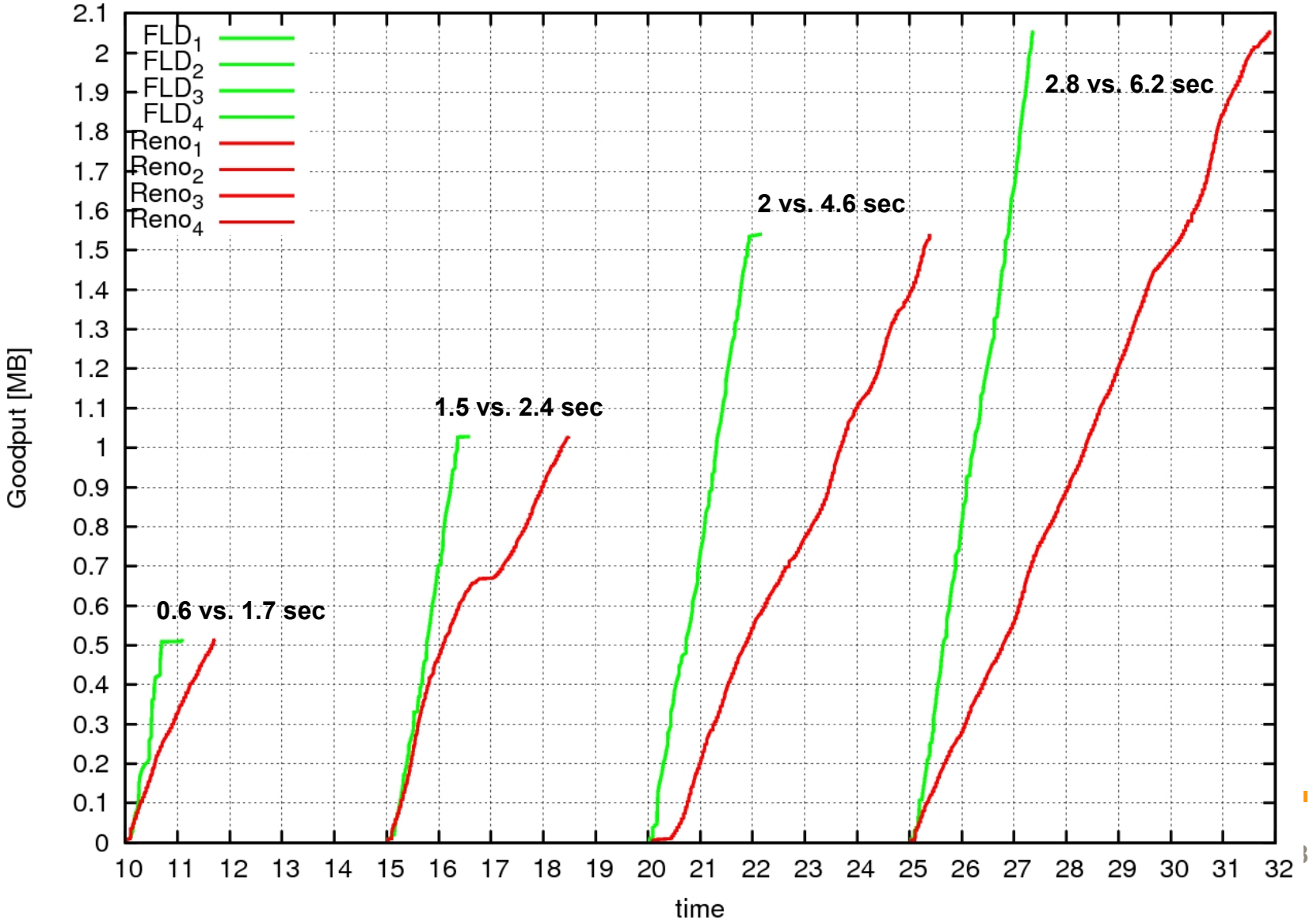
Flow Length Dependent Congestion Control

- Most Internet flows are short
  - Google statistics: average 320KB, 90-percentile 663KB
- Users perceive delay in short flow transfers more disruptive/annoying than in long flows
- For saving energy in wireless mobile devices,
  - Finish flows faster and close radio which drains significant amount of energy, and consequently
  - Improve the transfer time of short flows without affecting other (long) flows too much.

Go-Fast-Finish-Early

- Be aggressive until a certain flow length (threshold) and then be extra friendly
- Modifications in
  - TCP Initial Window,
  - Slow Start Increment and
  - use of CA algorithms with different levels of aggressiveness
- Thus,
  - short flows finish faster,
  - longer flows may take longer

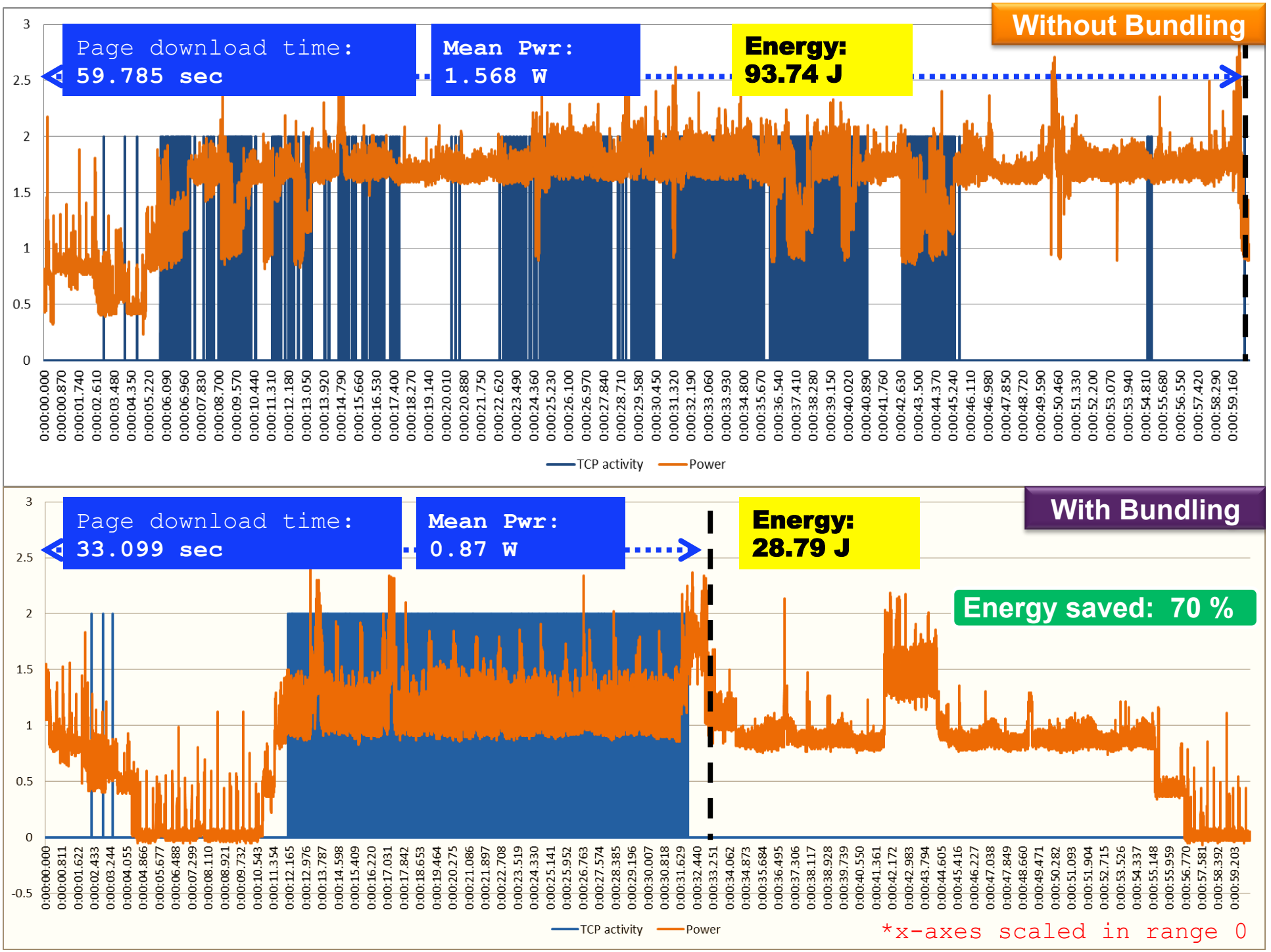
Initial results



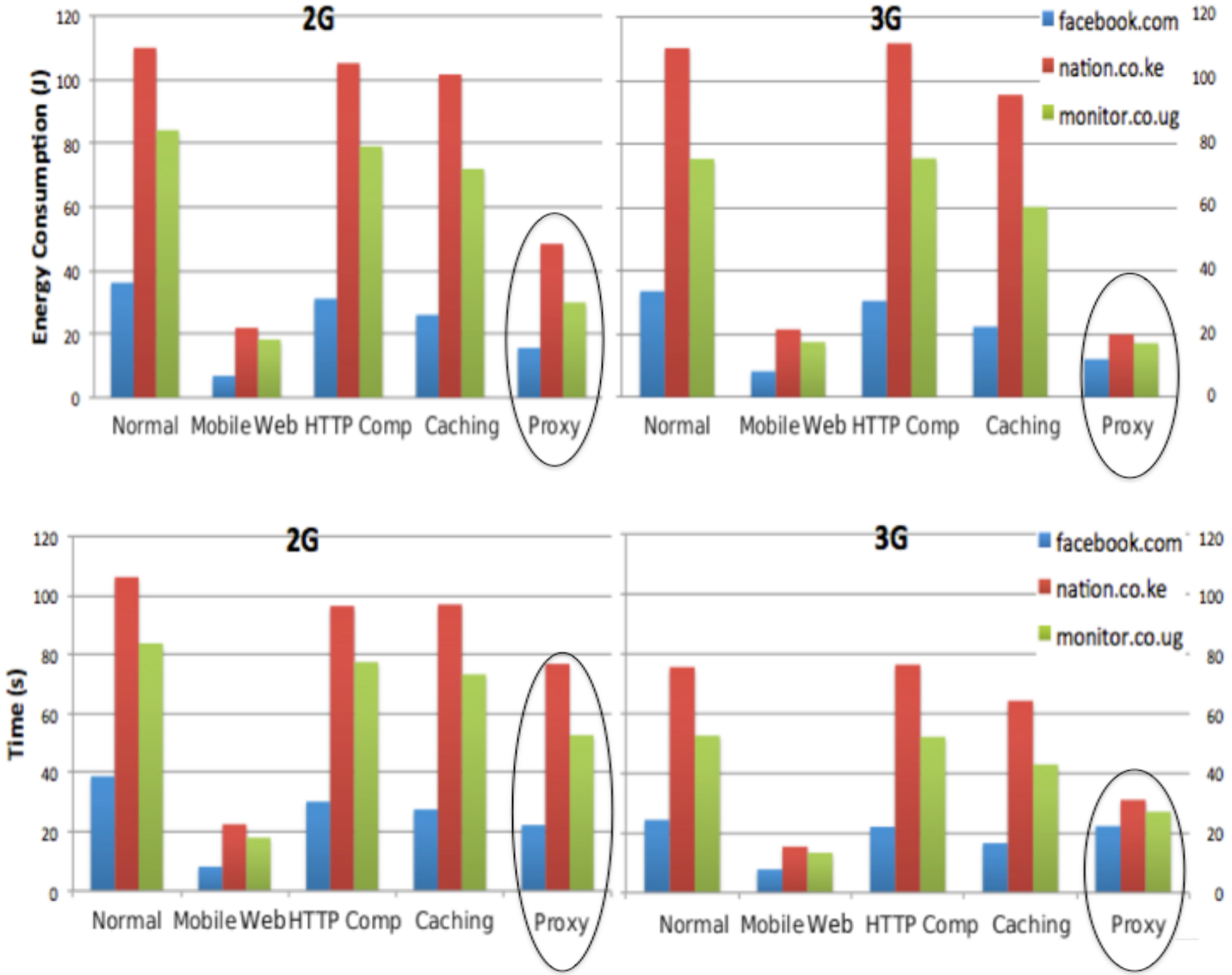
Web on steroids

Re-visiting web proxies

- Minimize web content retrieval from the mobile device
- Make proxy work on-behalf of the mobile device
- Compare different alternatives
  - Conventional web browsing
  - Mobile optimized web pages
  - HTTP Compression
  - Web caching
  - Our proxy


Without Bundling
Page download time:
59.785 sec
Mean Pwr:
1.568 W
Energy:
93.74 J
TCP activity
Power
With Bundling
Page download time:
33.099 sec
Mean Pwr:
0.87 W
Energy:
28.79 J
Energy saved: 70 %
TCP activity
Power
*x-axes scaled in range 0

Optimizing mobile access



Summary

- A smart phone needs smarter Internet access
  - We need to save the battery capacity
- Combining several techniques can lead to huge savings
  - Proxy can save up to 70% or even more
  - FLD-TCP can save 50%
- In total, these two could save 85%
- Yet, this is just the beginning of our work…