Energy efficiency of mobile clients in cloud computing

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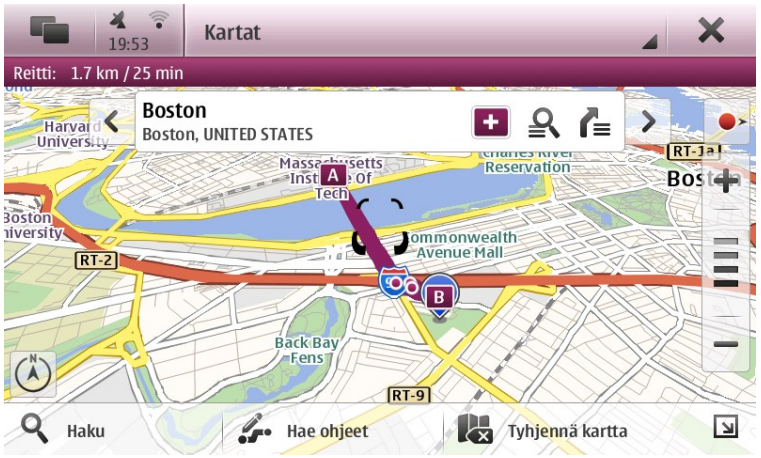
Mobile cloud computing

Local processing

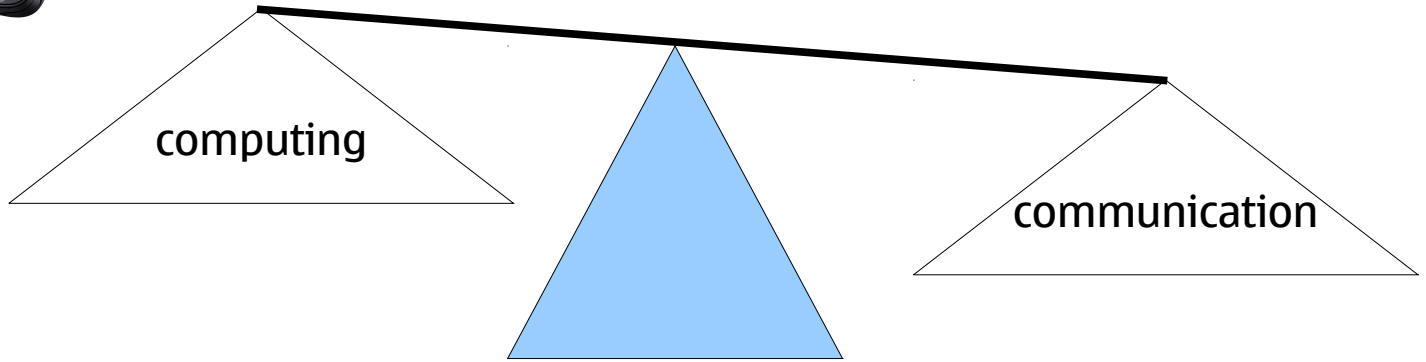


Remote processing

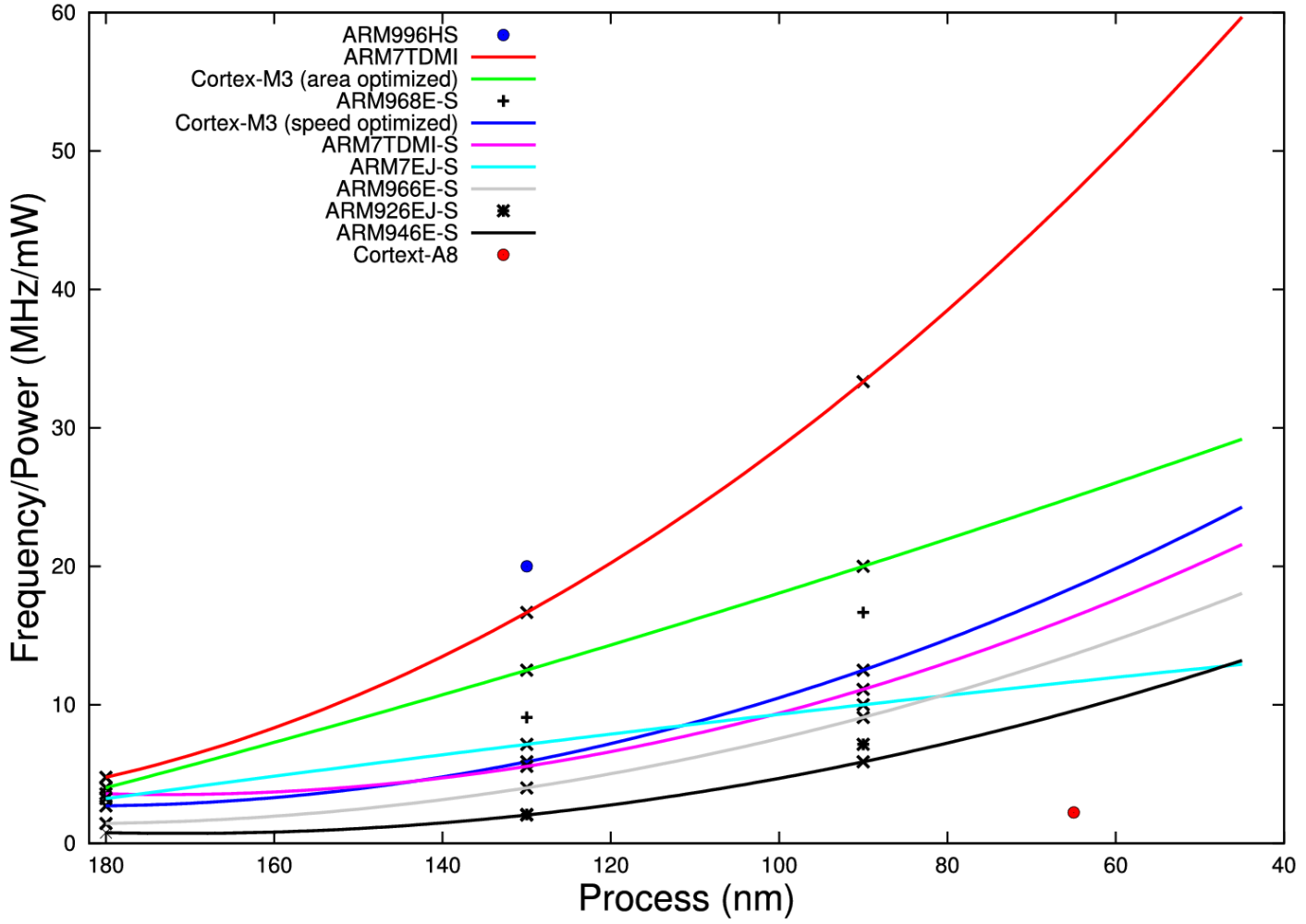
Data format? Bitmaps? Vector graphics?

Balance: computing versus communication

When is it feasible to move to cloud?

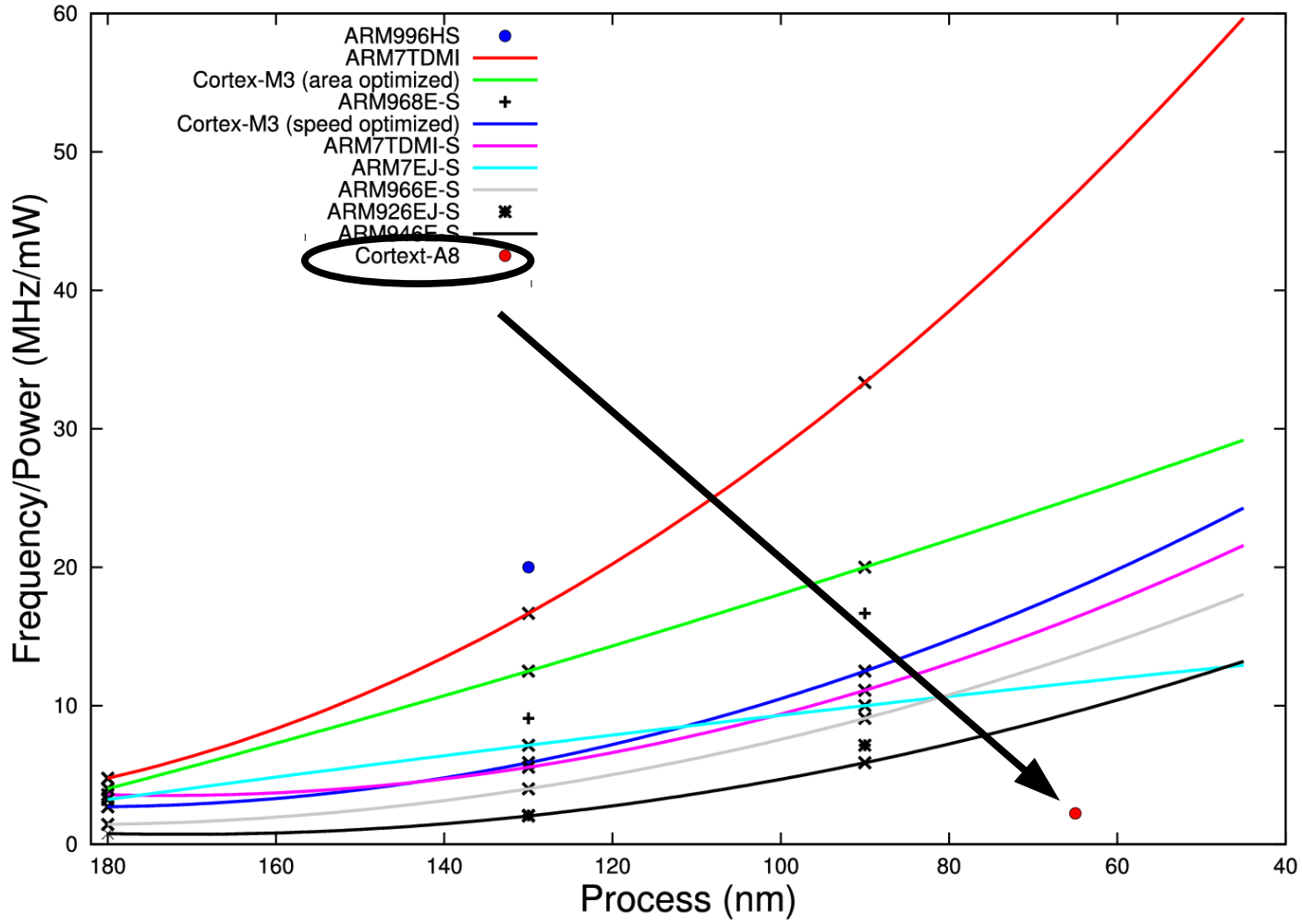


Computing: what is the energy cost?



Large variation

Computing: current mobile devices



High performance

Energy efficiency

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Computing: dynamic power management

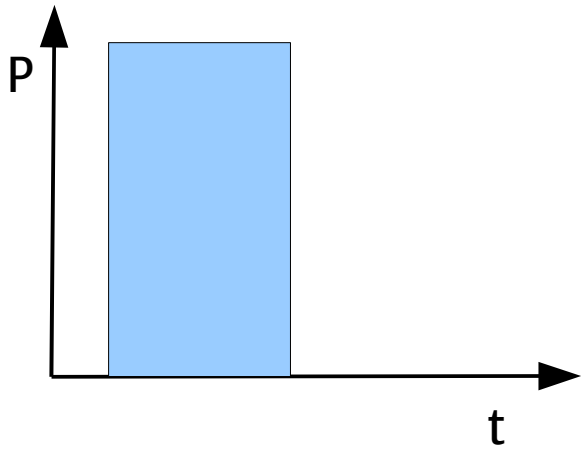
DVFS = Dynamic Voltage and Frequency Scaling

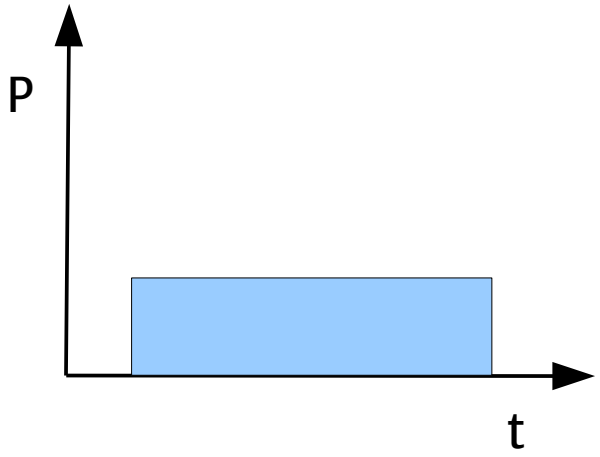
$E = Pt$

$P \sim V^2 f$

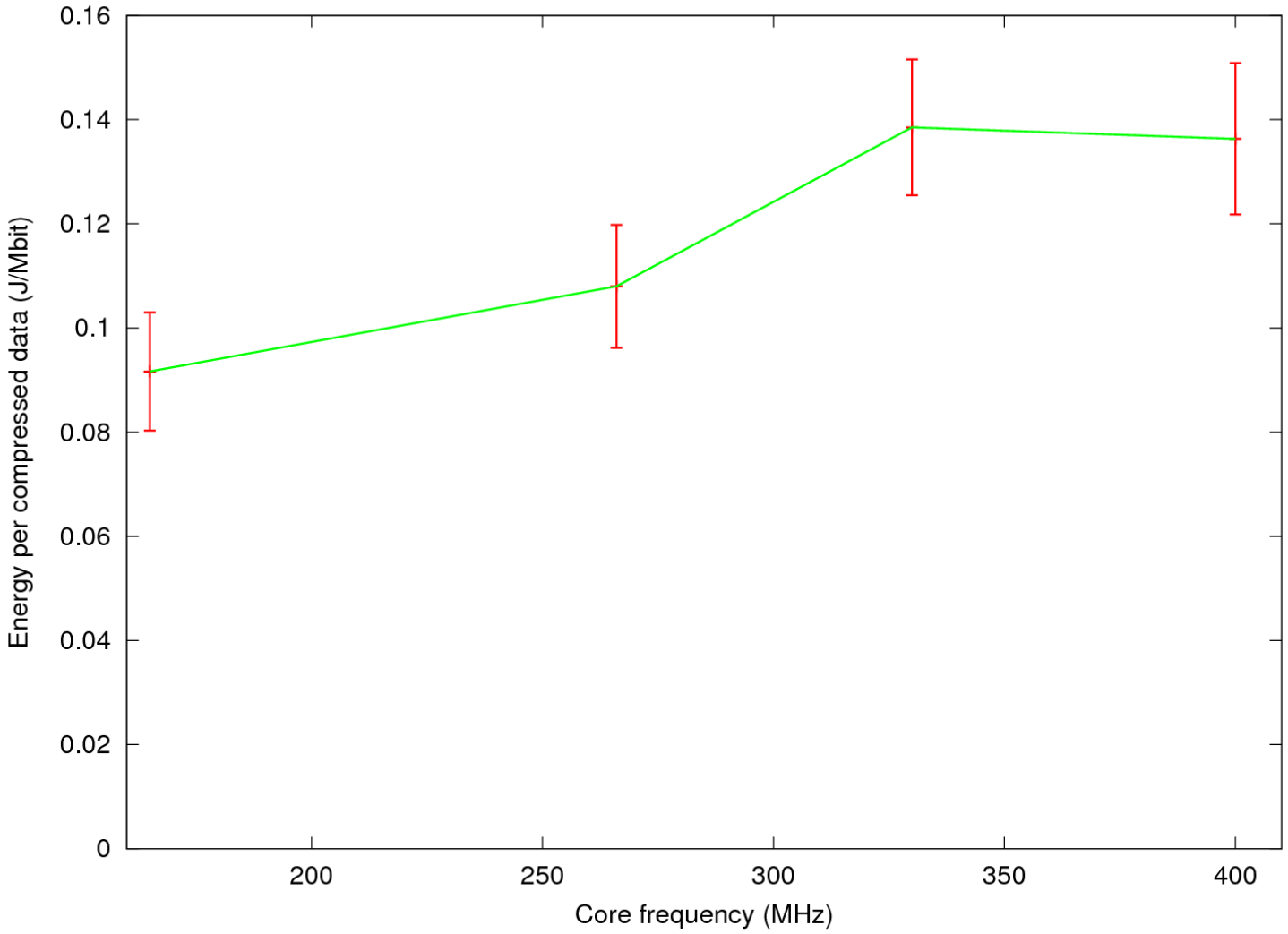
$V \sim f$

$t \sim 1/f$

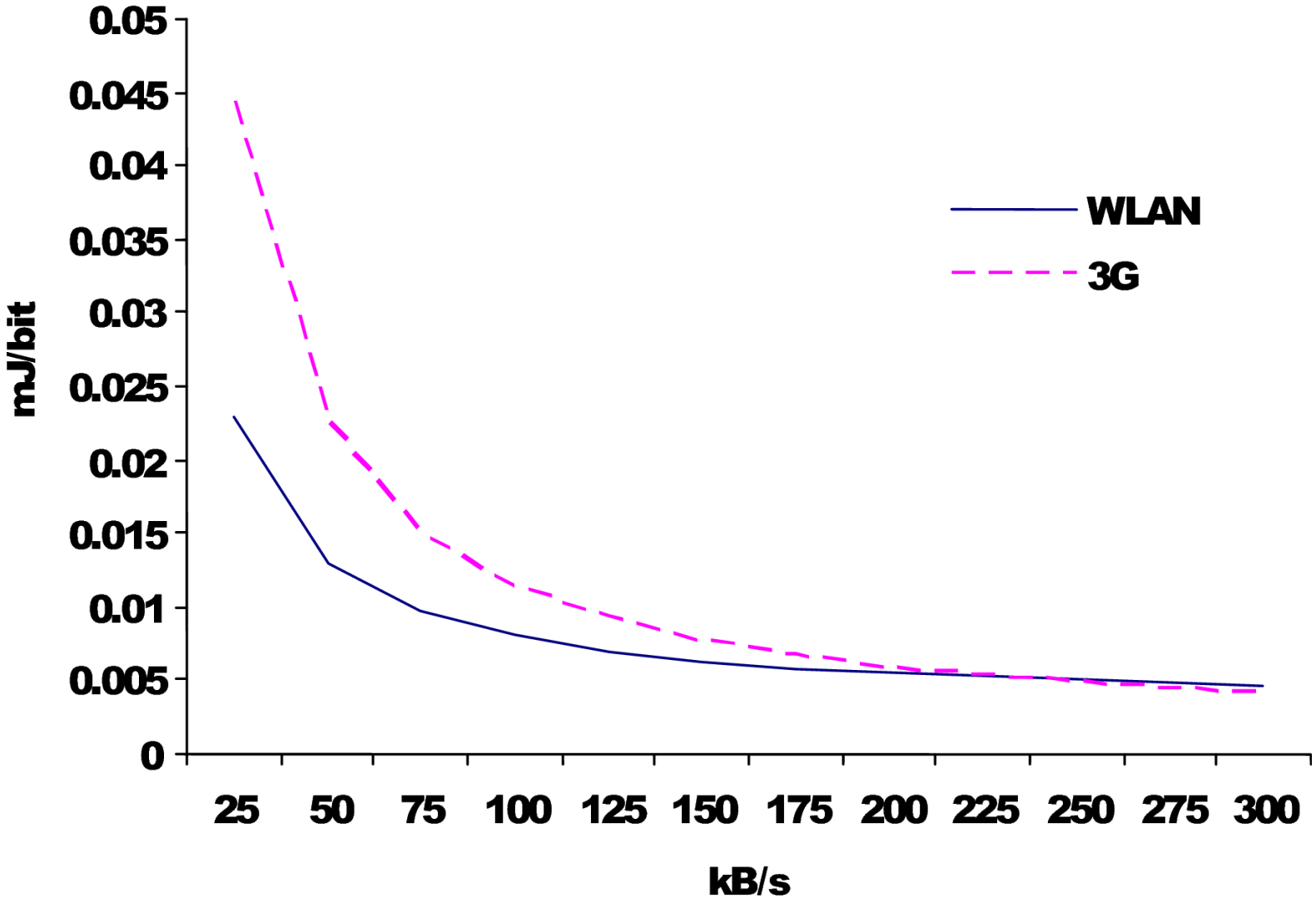




Computing: effect of dynamic power management



Communication: effect of bit-rate and technology



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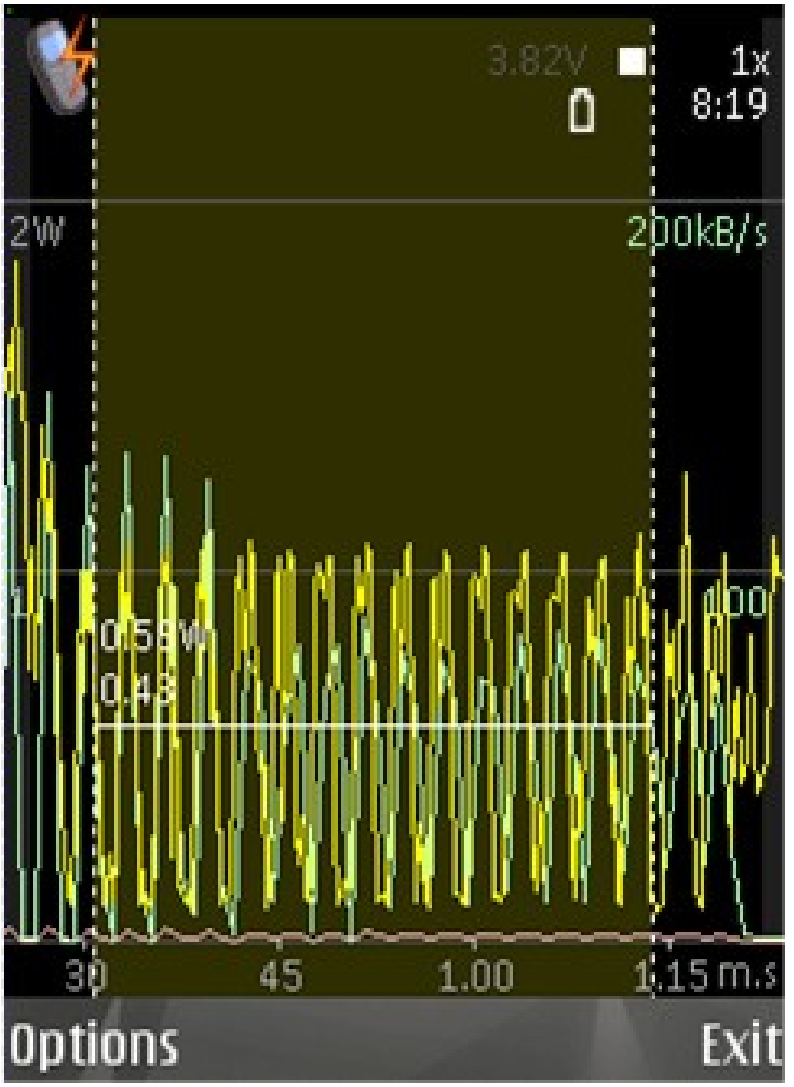
Communication: effect of traffic pattern



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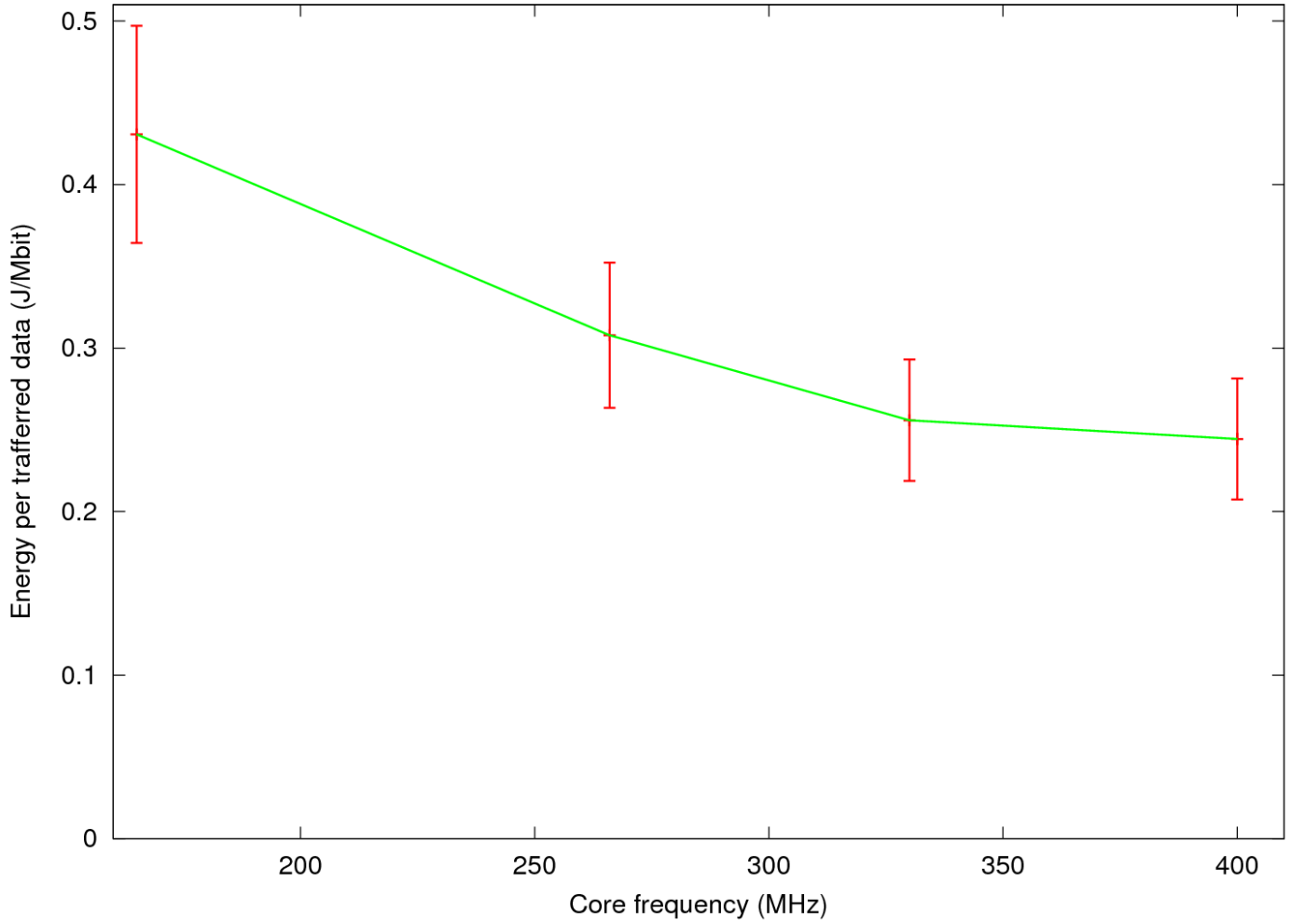
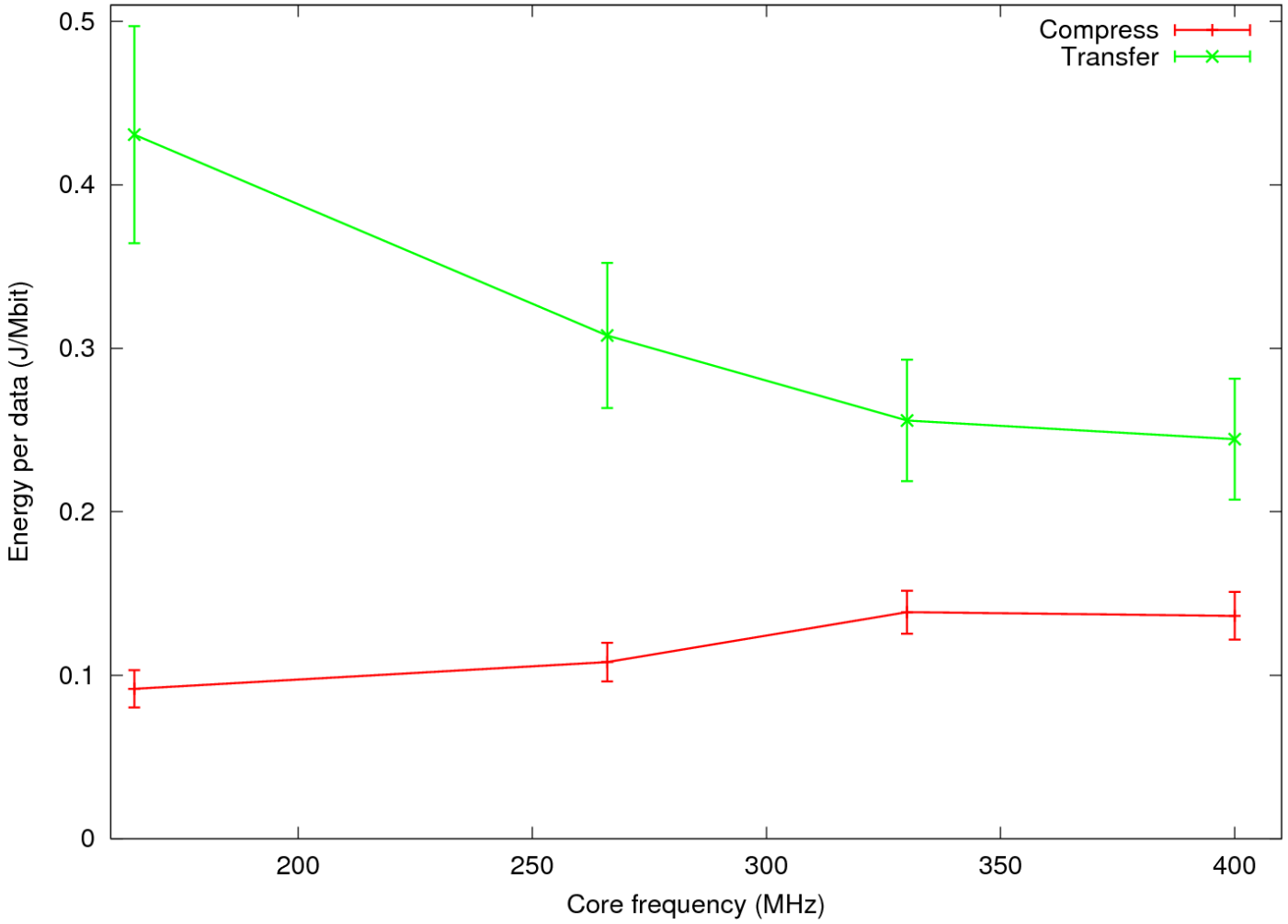
Communication: effect of DPM



Computing & communication: Effect of DPM



High performance

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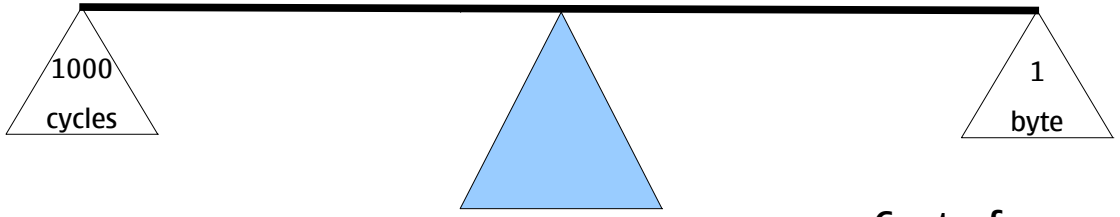
Energy efficiency

The balance – roughly

1000 cycles
versus
1 byte



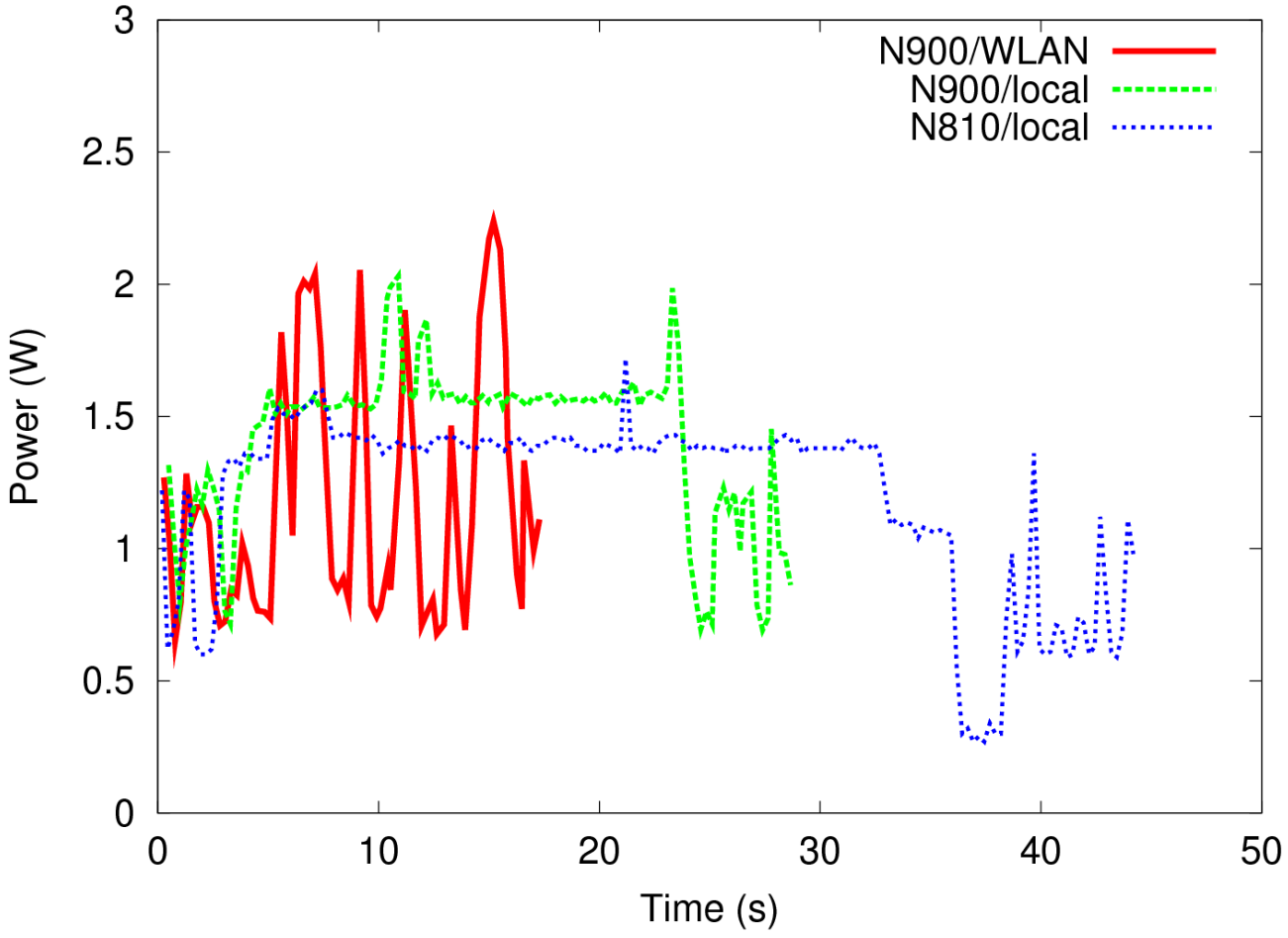
Cost of computing
is reasonably stable

Cost of communication
has large variance

Computational intensity

Workload	Cycles/byte
gzip ASCII compress	330
bzip2 ASCII compress	1080
html2text wikipedia.org	2100
html2text en.wikipedia.org	5900
pdftotext N900 datasheet	960
pdftotext E72 datasheet	8900

In practice (PDF viewer)



Energy can be saved

Performance can be improved

Fruitful area for further research

- New computationally intensive applications for mobile devices?
- Technology development?
  - Radio bit-rates versus computing efficiency?
- Tools for managing the complexity?
  - Energy aware development tools
- Energy aware middle-ware?
- Energy optimized protocols for thin clients?
- Server side technologies for optimizing client energy efficiency?

Thank You

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Coarse grain estimation can be simple