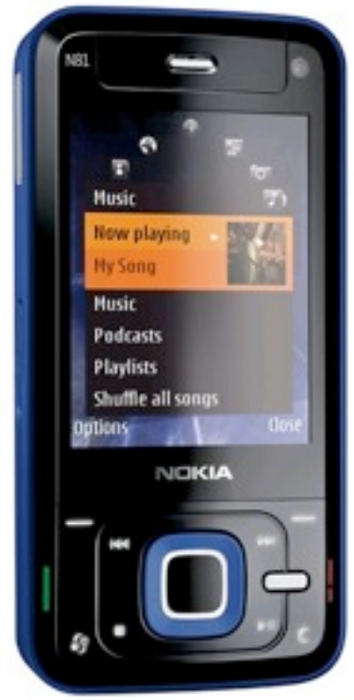
Power-Aware Gaming


9/24 12:00
SONY
UMD®
POWER
HOLD
HOME
VOL
SELECT
START


N81
Music
Now playing
My Song
Music
Podcasts
Playlists
Shuffle all songs
Options
Close
NOKIA


X
Y
A
B
START
SELECT


VAIO

major power consumers:

LCD

CPU

WNIC

e.g., on an iPAQ

LCD (~1W)

CPU (1-3W)

WNIC (1.4W)

"Integrated Power Management for Video Streaming to Mobile Handheld Devices"
Shivajit Mohapatra, Radu Cornea, Nikil Dutt, Alex Nicolau & Nalini Venkatasubramanian
ACM Multimedia 2003

how can a mult-player game reduce WNIC's power consumption?

State	Documented	Measured
WaveLAN - suspended	0W	0W
WaveLAN - receive	1.48W	1.52W
WaveLAN - transmit	3.00W	3.10W

Table 1: Power Requirements of the Lucent WaveLAN PCMCIA Wireless Ethernet card.

Power Management Techniques for Mobile Communication

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Table 1 Power characteristics of the cards used

Mode	DWA-110 802.11bg	DWL-G630 802.11g-b
Standby Mode	4.66 mA	300-300 mA
Power Save Mode	28 mA	Not supported
Receive Mode	248 mA	330-350 mA
Transmit Mode	248 mA	550-580 mA
Power Supply	5 V	3.3 V

Game Action Based Power Management for Multiplayer Online Game

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Idea: reduce transmission rate
to save power
(stay longer in receiving mode)

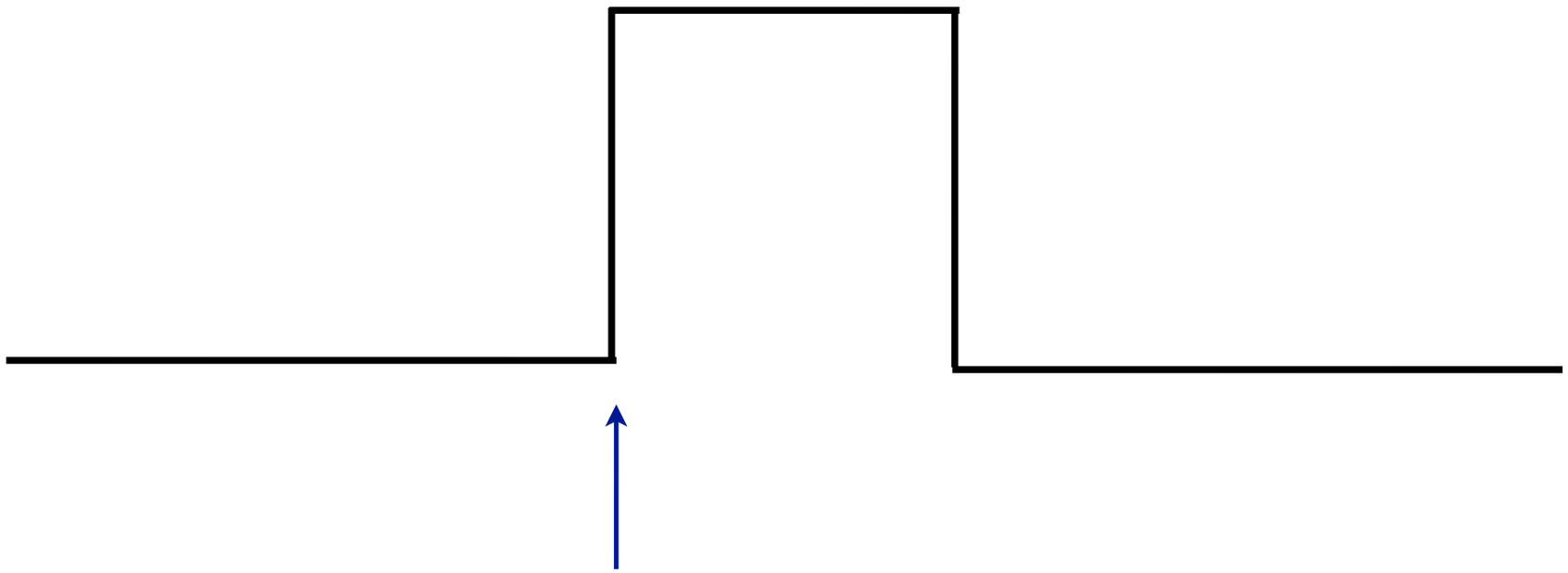
does it work?

Assume two modes:

active and **suspend**

Idea: suspend WNIC and suppress updates when appropriate

Recall: can suppress updates when diff in position is below threshold



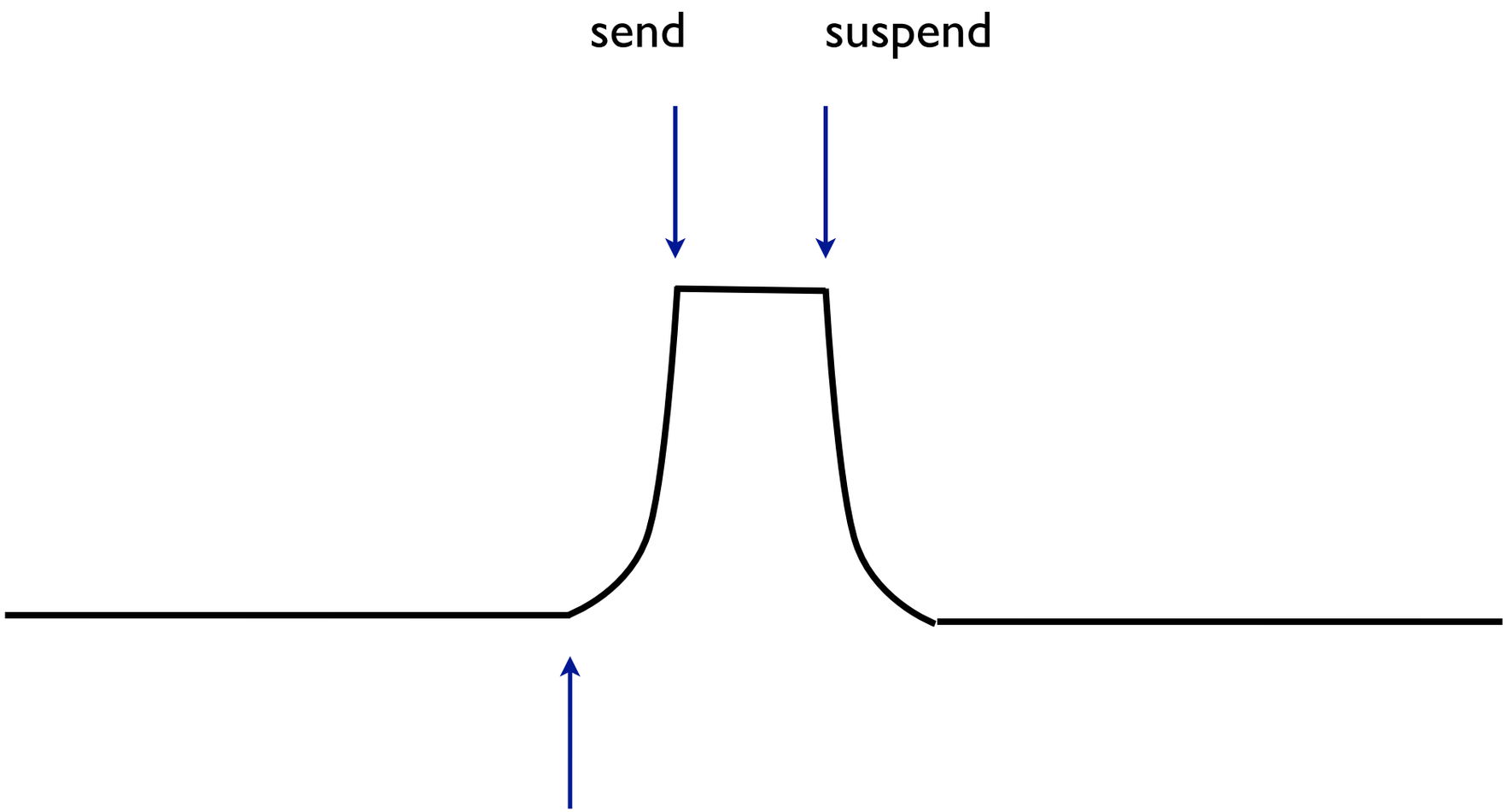
Exceed DR threshold: switch to active, send, suspend again

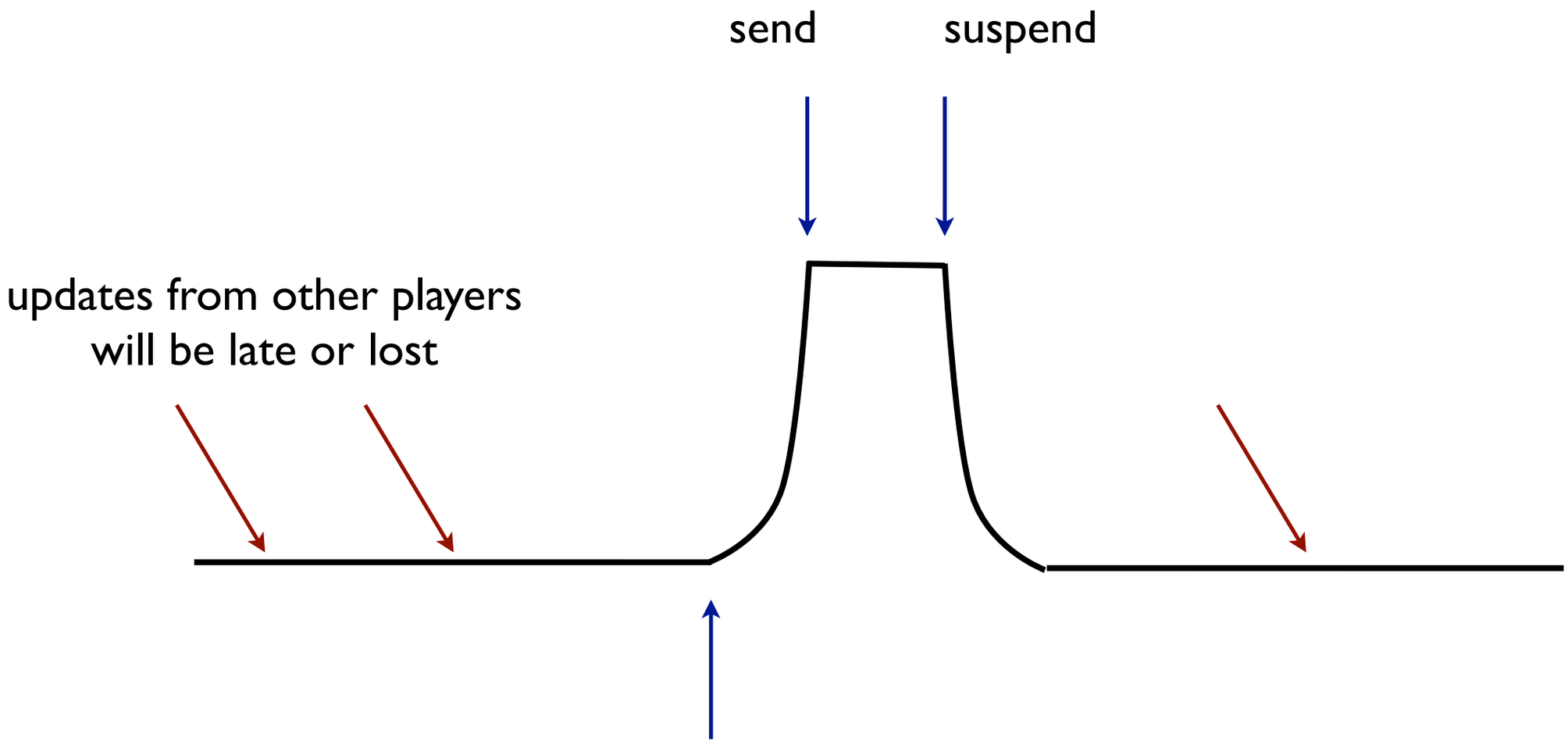
in practice, on/off switching
takes time (up to 600ms)
and consume power (350mA)

due to AP association

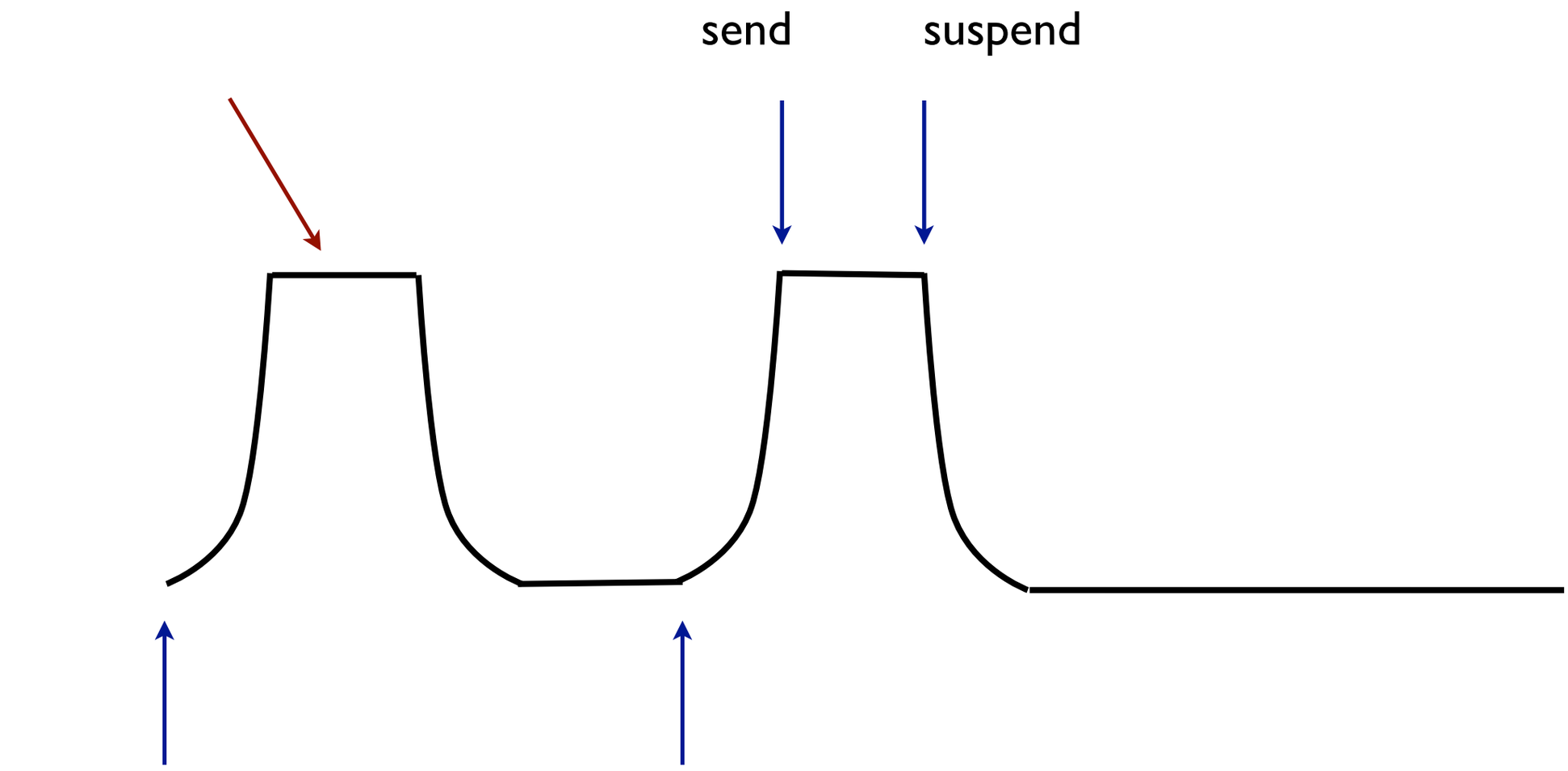
can reduce mode switch latency
if not turning off completely

To consider switching, we can switch on earlier if we predict that the DR threshold is about to be violated.




send
suspend
updates from other players
will be late or lost
Almost exceed DR threshold:
switch to active

If using a client/server model with periodic server updates, we can predict the arrival time of message. What genre of games is this more suitable for?



Open Questions:

how to predict message arrival time?

how to design game protocols with predictable message exchange?

major power consumers:

LCD

CPU

WNIC

Reducing CPU's Power Consumption

Game loop:

compute states

render scene

get input

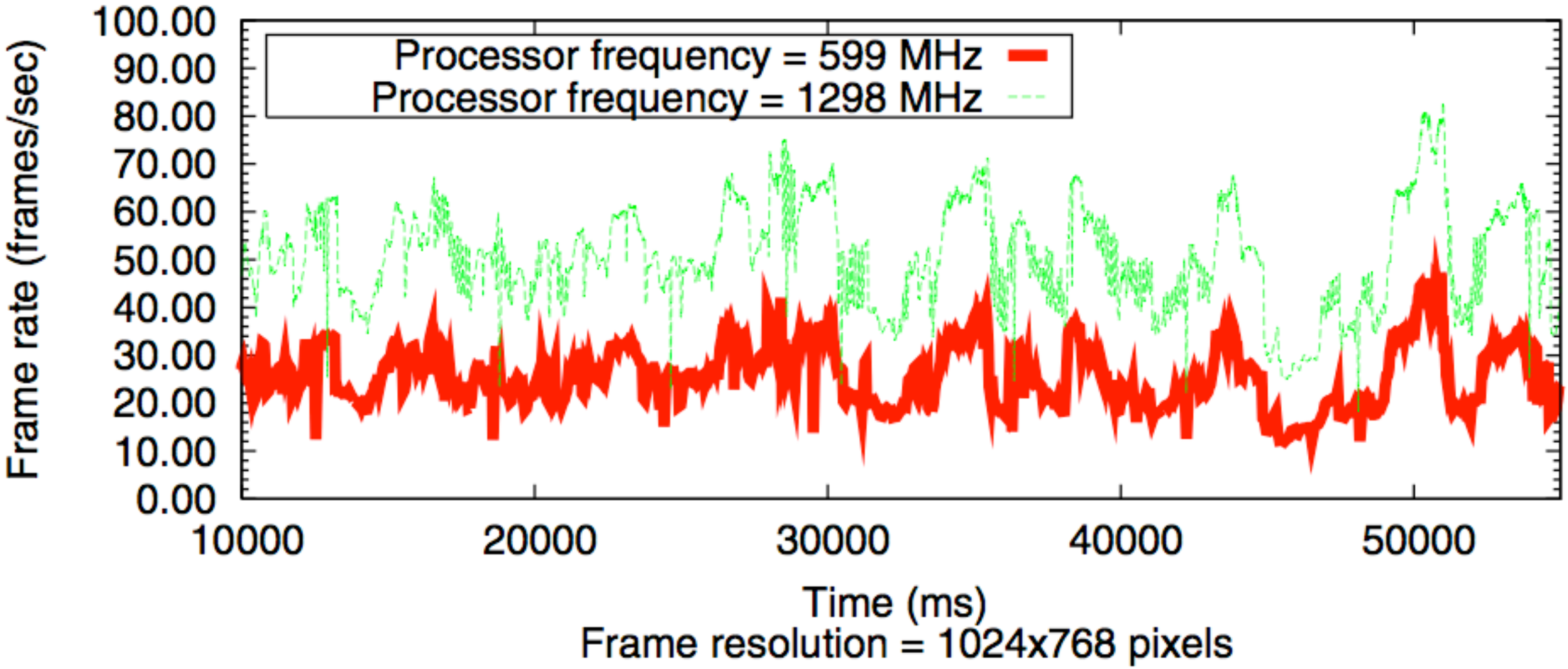
faster CPU : higher frame rate

simpler scene : higher frame rate

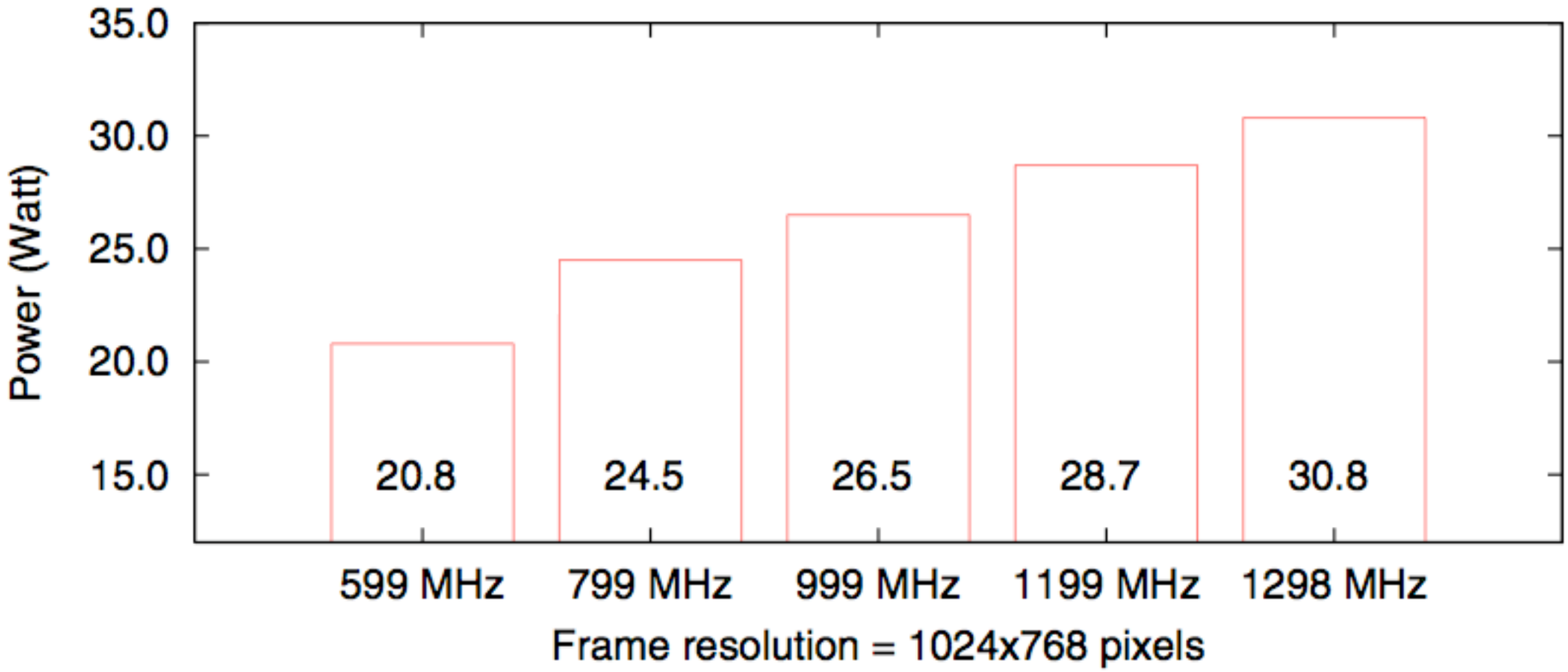
Idea: slow down CPU when scene is simpler (achieving constant frame rate)

“slow down” CPU : dynamic voltage and frequency scaling

$$\text{Power} \propto V^2 f$$



Frame rate of Quake II


35.0
30.0
25.0
20.0
15.0
Power (Watt)
20.8
24.5
26.5
28.7
30.8
599 MHz
799 MHz
999 MHz
1199 MHz
1298 MHz
Frame resolution = 1024x768 pixels

let

c be the estimated cycle requirement to render a scene

f be the min acceptable frame rate

let

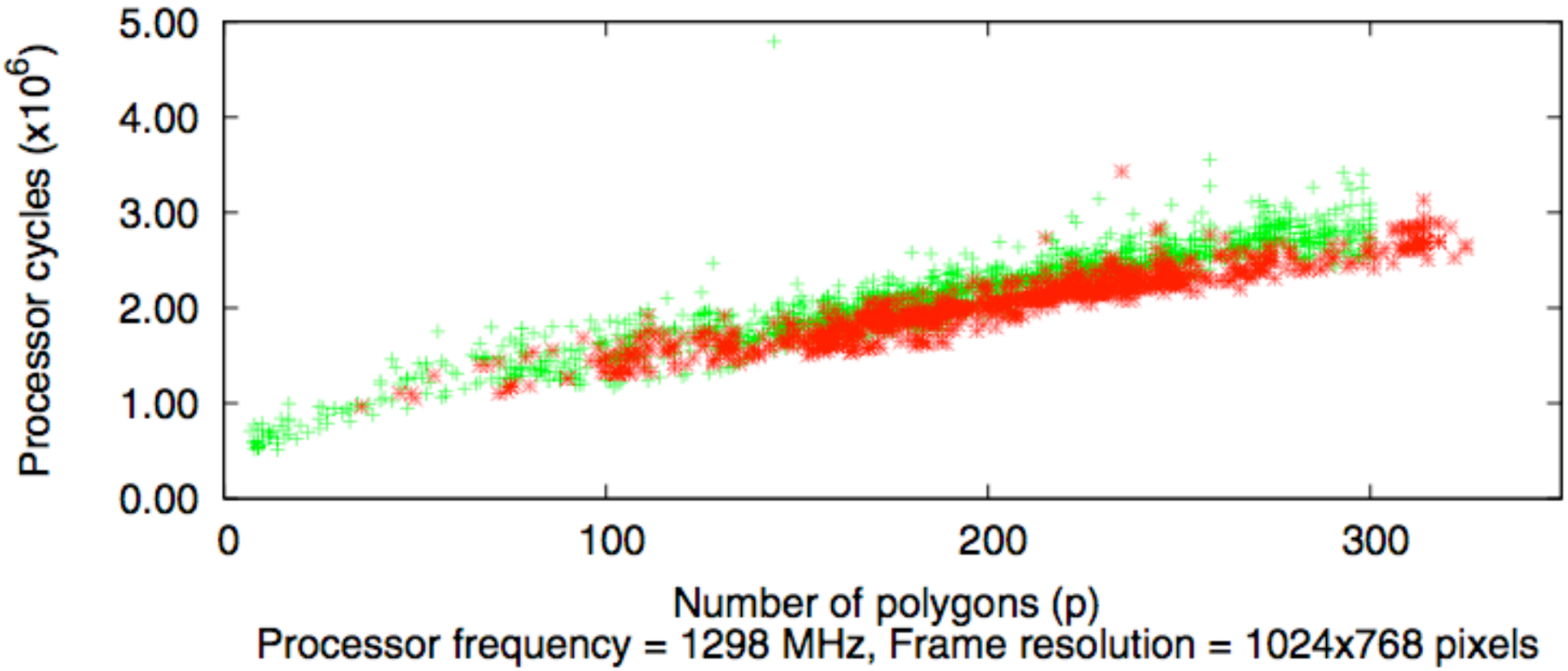
c be the estimated cycle requirement to render a scene

f be the min acceptable frame rate

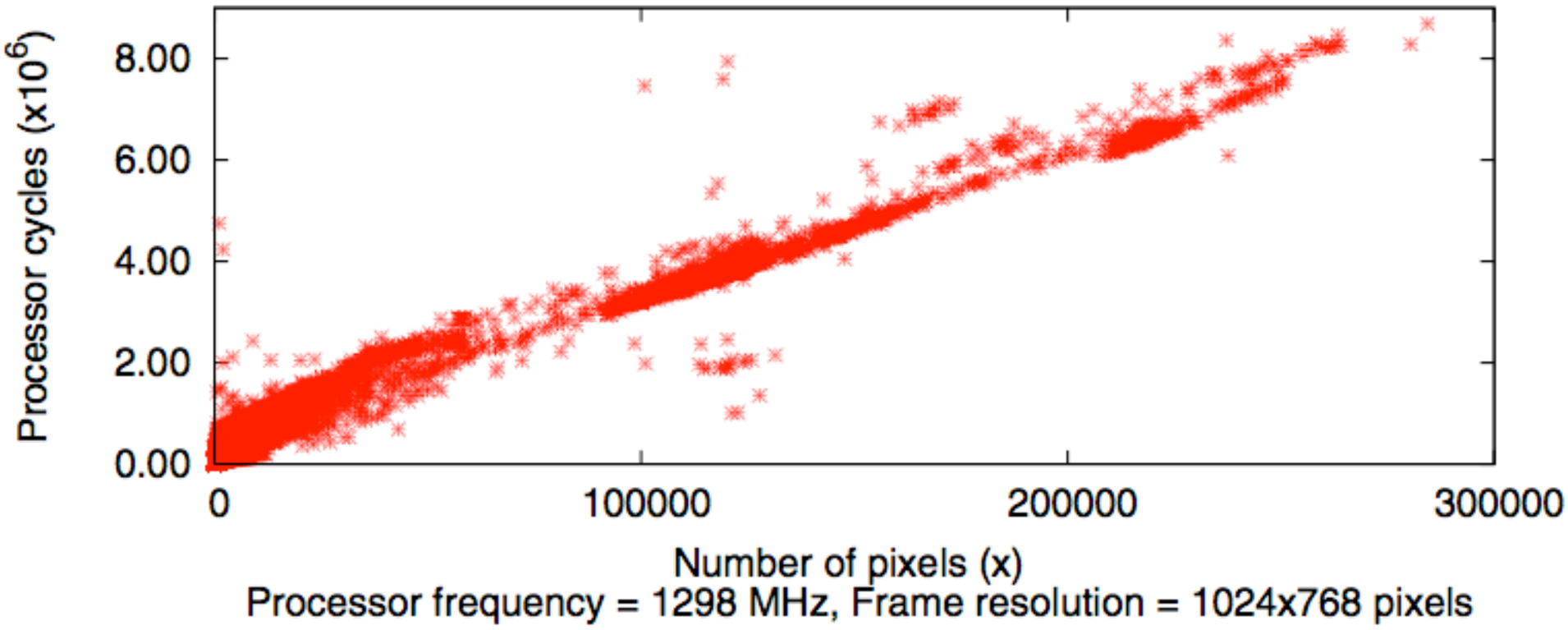
set CPU frequency to **cf** (rounded up to the nearest supported frequency)

How to estimate cycle requirement for a scene?

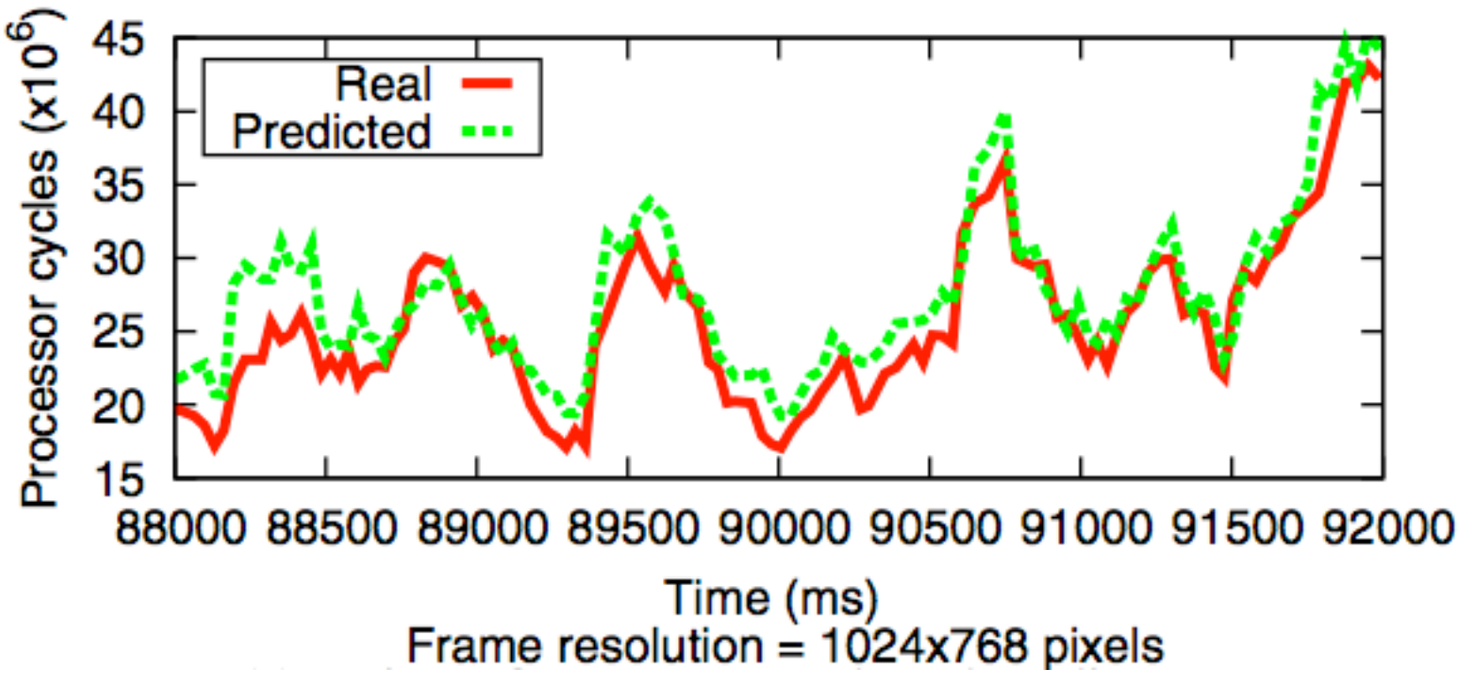
Look at the structure of a scene:
number of polygons,
number of objects ..

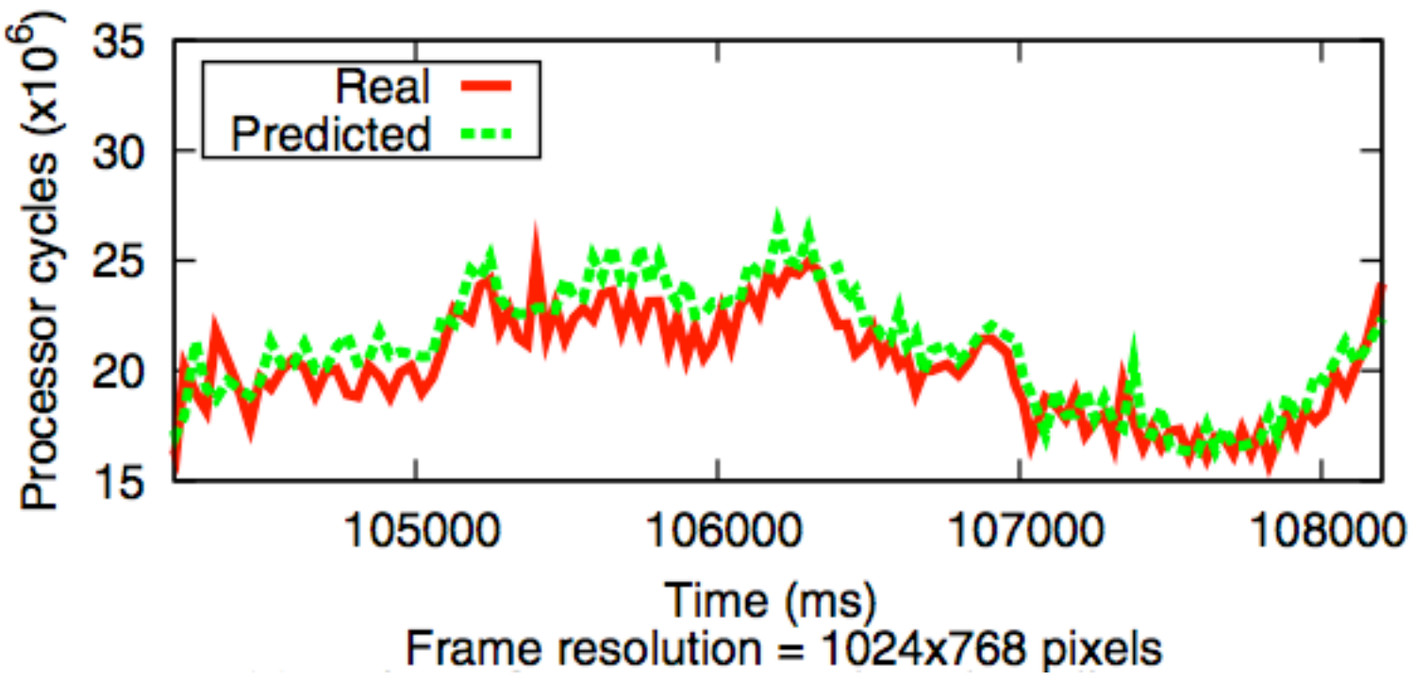


Rasterization workload for "brush model" (walls, floor, objects etc)



Rasterization workload for “alias model” (monsters, soldiers, weapon etc)


Processor cycles (x10^6)
45
40
35
30
25
20
15
Real
Predicted
88000 88500 89000 89500 90000 90500 91000 91500 92000
Time (ms)
Frame resolution = 1024x768 pixels


Processor cycles (x10^6)
35
30
25
20
15
Real
Predicted
105000
106000
107000
108000
Time (ms)
Frame resolution = 1024x768 pixels

Save power by 15% on a PDA running at 5 fps

Open Questions:

how to predict power consumed by GPU?