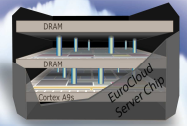


EuroCloud

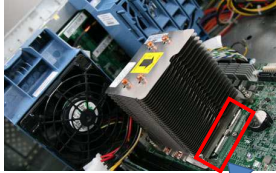


Energy-Efficient Cloud Computing Servers

Emre Özer^α, Krisztián Flautner^α, Sachin Idgunji^α, Ali Saidi^α, Yiannakis Sazeides^γ, Bushra Ahsan^γ, Nikolas Ladas^γ, Chrysostomos Nicopoulos^γ, Isidoros Sideris^γ, Babak Falsafi^β, Almutaz Adileh^β, Michael Ferdman^β, Pejman Lotfi-Kamran^β, Mika Kuulusa^δ, Pol Marchal^ε, Nikolas Minas^ε

^αARM, ^γUniversity of Cyprus, ^βEPFL, ^δNokia and ^εIMEC

Today's Computers



4x cores
~30 Watts per core
(130+ Watt CPU total)



4x 2GB DIMMs
~10 Watts per DIMM
(40+ Watt memory total)

Cores double every 24 months
DRAM capacity doubles every 18 months

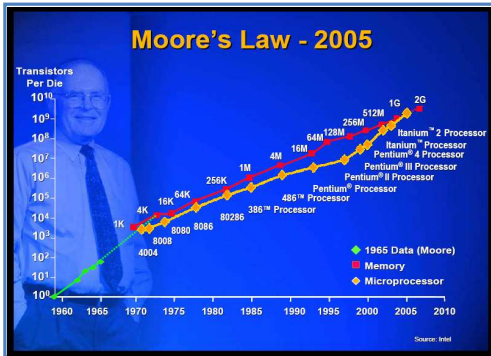
Today's Datacenters



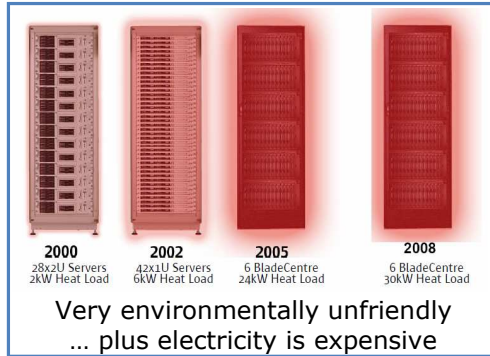
4 sockets
6 cores each
24 DIMMS

Hundreds of cabinets
Thousands of cores, Terabytes of RAM

CPU Transistors (Moore's Law)



Datacenter Meltdown?



EuroCloud Server Goals

- Maintain performance
- Meet computational demand
- Improve energy efficiency
- Reduce CPU power
- Reduce memory power

Low Power CPU?

ARM Cortex-A Processors with <500mW

Low Power Memory?

Today's Technology **Future?**

Energy wasted in "off-chip" communication

DRAMs stacked on top of processor

EuroCloud Vision

Datacenters built with mobile processors

3D-stacked memory

On-chip DRAM Stack

Through Silicon Via (TSVs)

ARM Cortex-A[™] Cores

Accelerators

Scalable Interconnection Network

Low-Power Chip for Future Datacenters

EuroCloud Server

- Many ARM Cortex-A cores
- Low per-core power
- Exploit massive server parallelism
- 3-D stacked memory
- Minimal waste in memory communication
- Nokia Ovi store applications
- Open-source server software
- LAMP (Linux, Apache, MySQL and PHP)

EuroCloud Participants

ARM Design

EPFL Architecture

Nokia Software

UCyprus Reliability

imec Manufacturing