

Computing for the Future of the Planet

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What can Computer Science do to reduce the impact of our activities on the planet?

Servers

Provide functionality to end-user machines

- Email
- Websites
- File storage and backup
- Databases
- Clock synchronization
- Authentication



Server Power Consumption

- Recently estimated to consume 1.2% of total electricity demand
 - in the U.S.
 - includes the power for cooling
 - has been growing by 15% per year

Jonathan G. Koomey, "Estimating Total Power Consumption by Servers in the US and the World", Feb 2007

Server Power Consumption

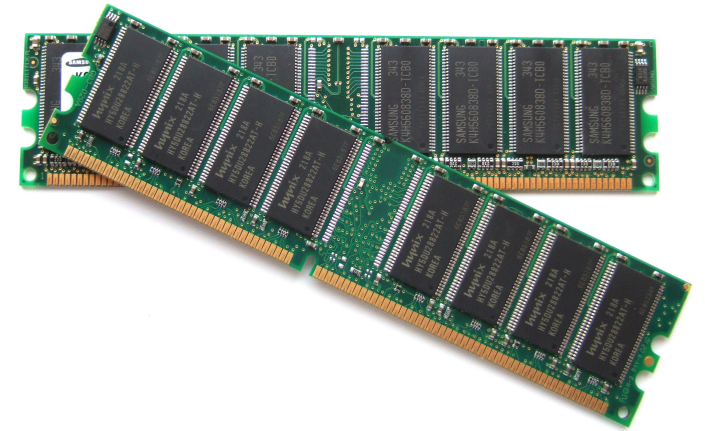
- About 50% of the total energy consumption over the machine's lifetime is in the manufacturing stage
 - assuming its left on continually for 3 years

Eric Williams, “Energy Intensity of Computer Manufacturing: Hybrid Assessment Combining Process and Economic Input—Output Methods” in *Environmental Science and Technology* 38(22) 2004

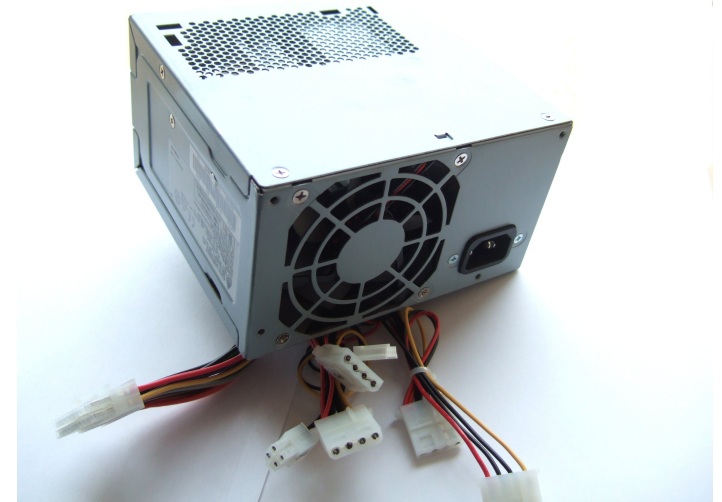
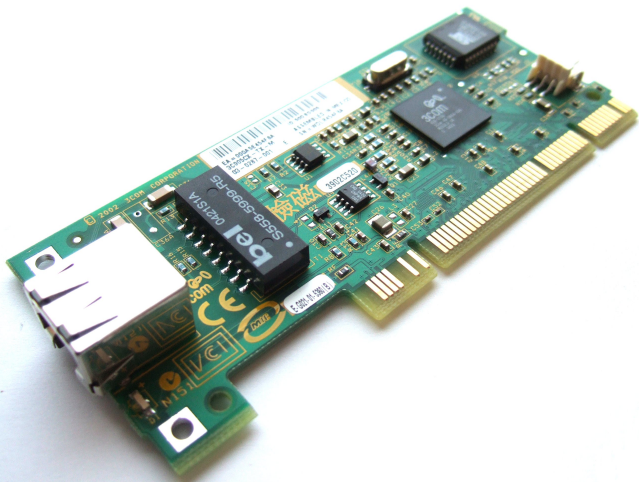
Server Power Consumption

- We need to reduce the number of servers
- We need them to last longer
- We need them to consume less power

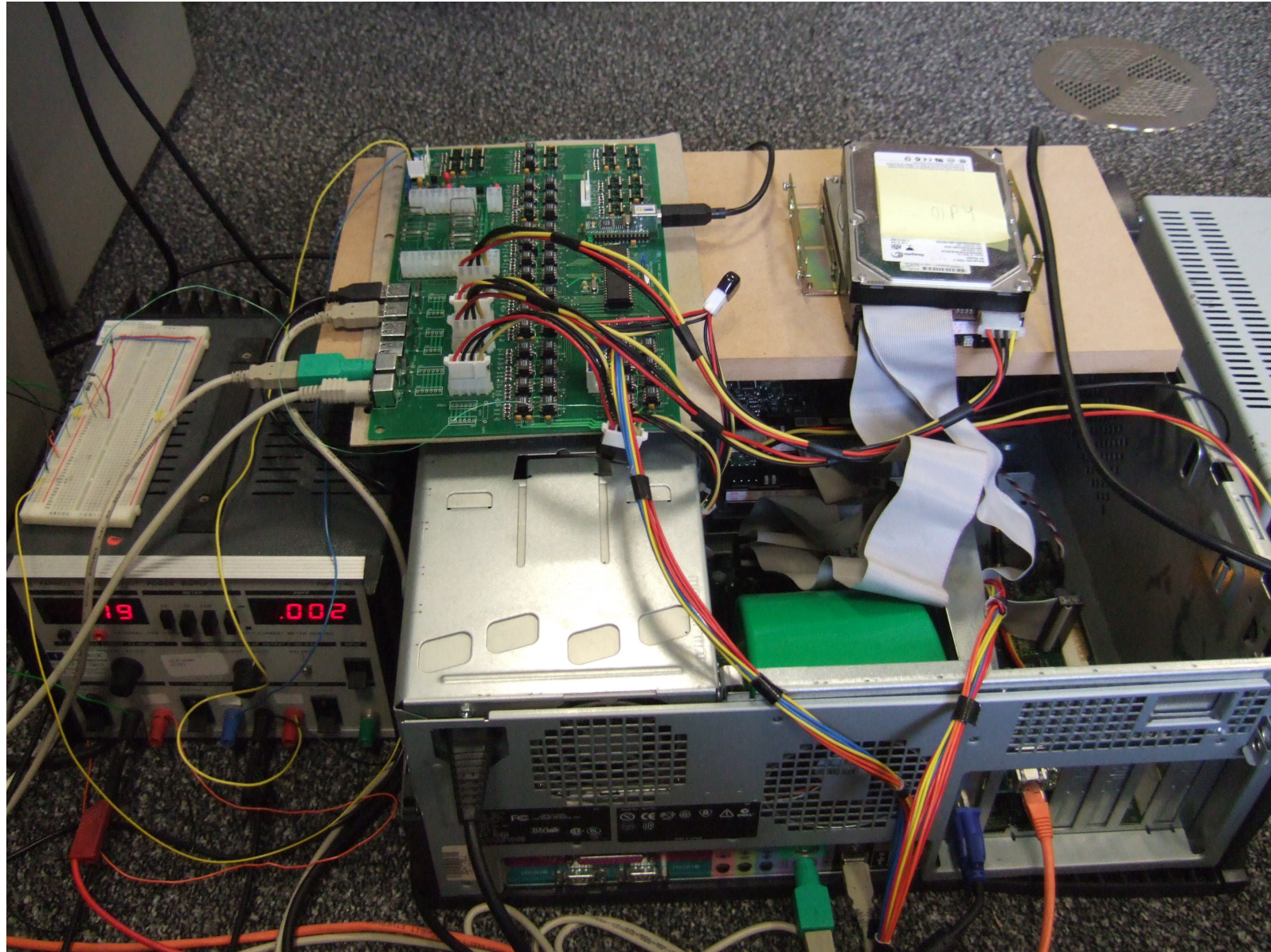
Monitoring power consumption



Collect detailed measurements at the component level



The Computer of the Future



Server Power Consumption

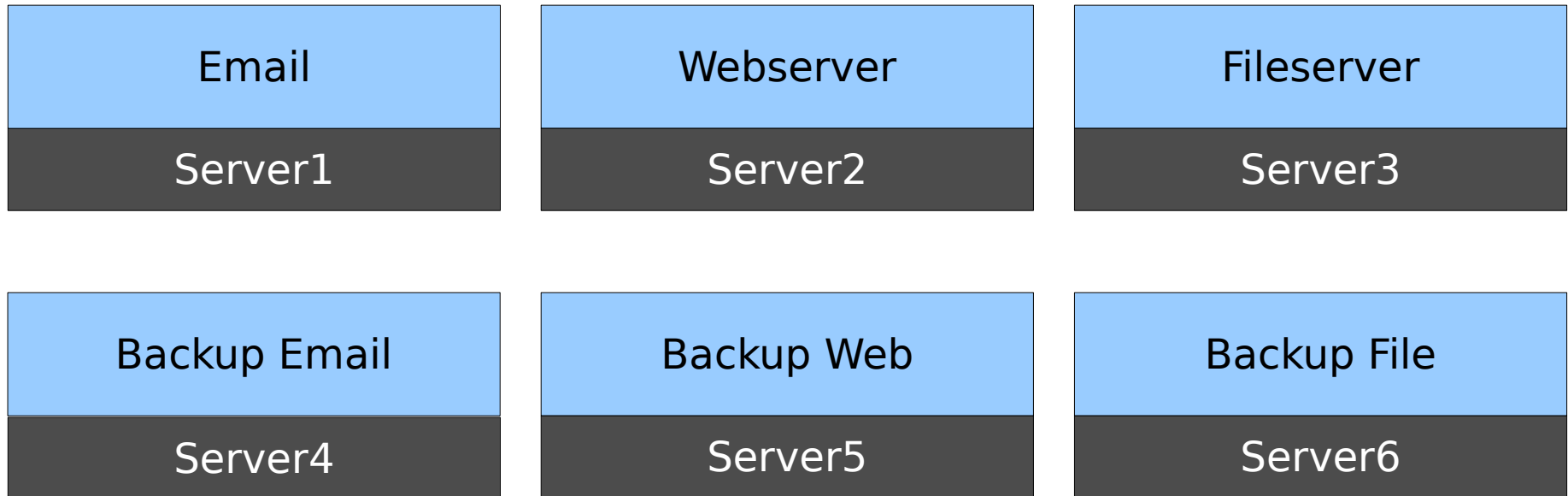
Standard practice is one service per server



This isolates services to provide easy management, support and service guarantees

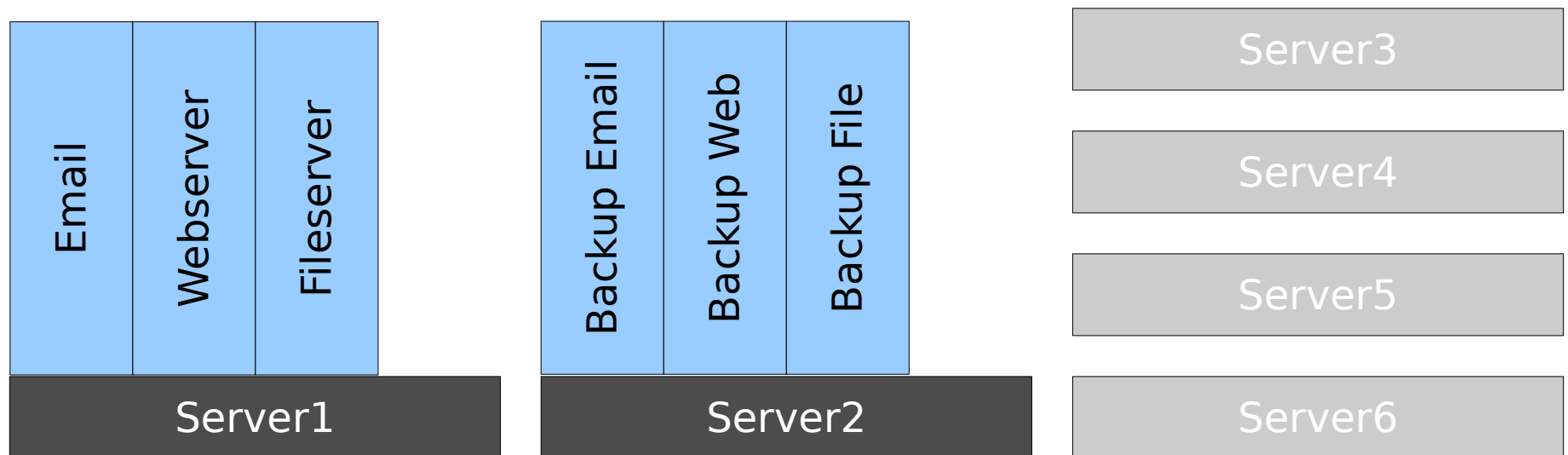
Server Power Consumption

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Virtualisation

Add a thin layer so that we run a number of virtual machines on each physical machine



For more information see the Xen project:
<http://www.cl.cam.ac.uk/research/srg/netos/xen/>
and spin-out company:
<http://www.xensource.com>

Power-Aware Virtualisation

- minimize the number of physical machines which are switched on
 - automatically switch on more if demand increases
- choose the most power efficient means support a virtual machine
 - e.g. switch off hard-disk and store data on another machine over the network

Physical to Digital



VS



VS

Guardian Unlimited network
TIMESONLINE

Inge Reichart and Roland Hirschier "The Environmental Impact of Getting the News: A Comparison of On-Line, Television, and Newspaper Information Delivery", in Journal of Industrial Ecology 2006

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