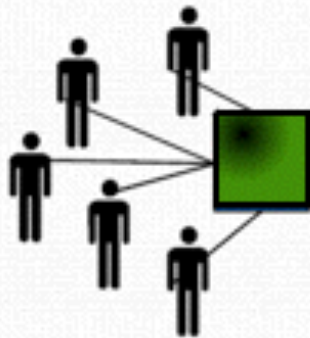


Disciplina

Sistemas de Computação

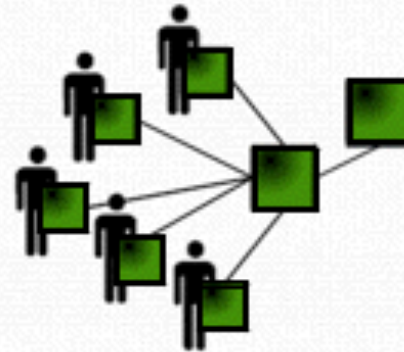
Aula 02



1950 : Mainframe



1980: Micro computer

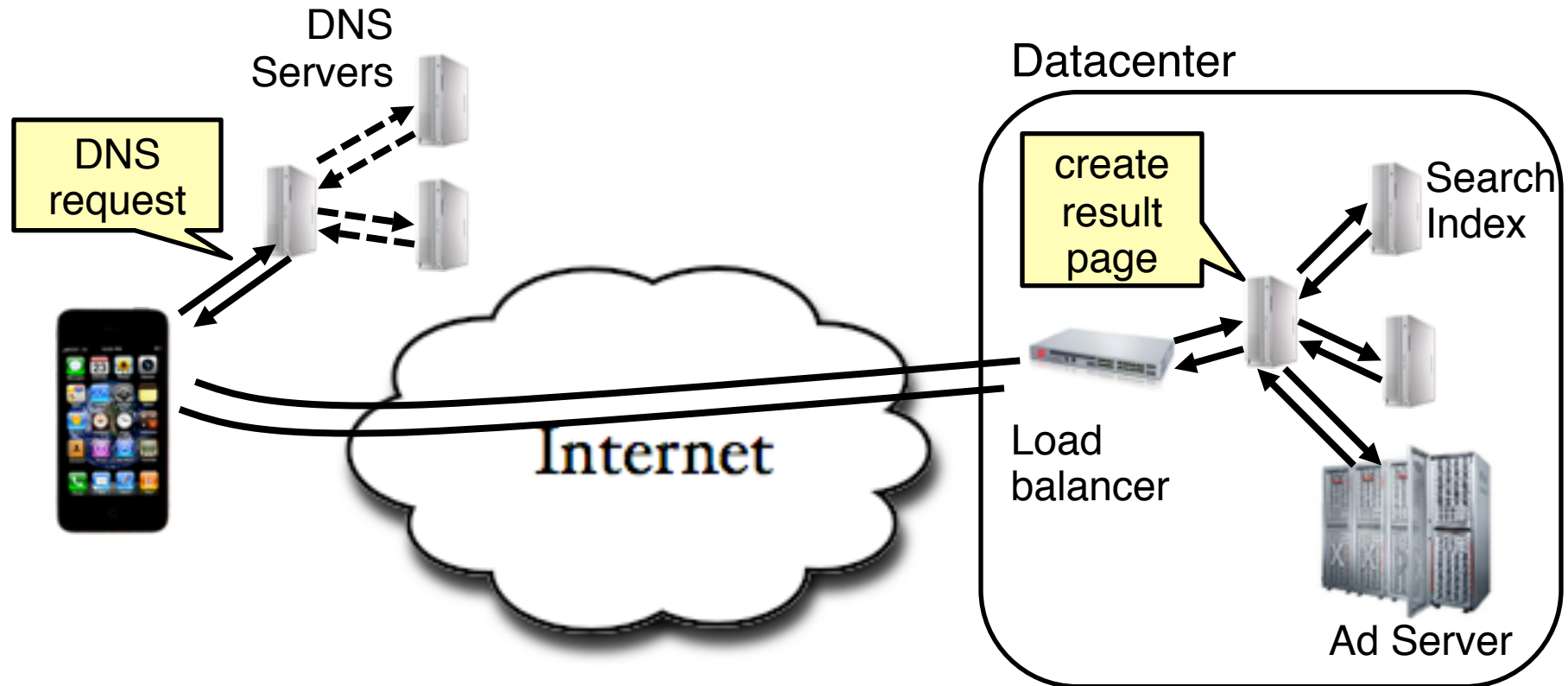


1990: Internet



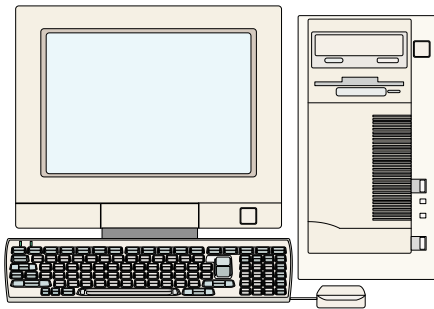
200? Diffuse IT

Exemplo: O que há por trás de uma Busca na Web?

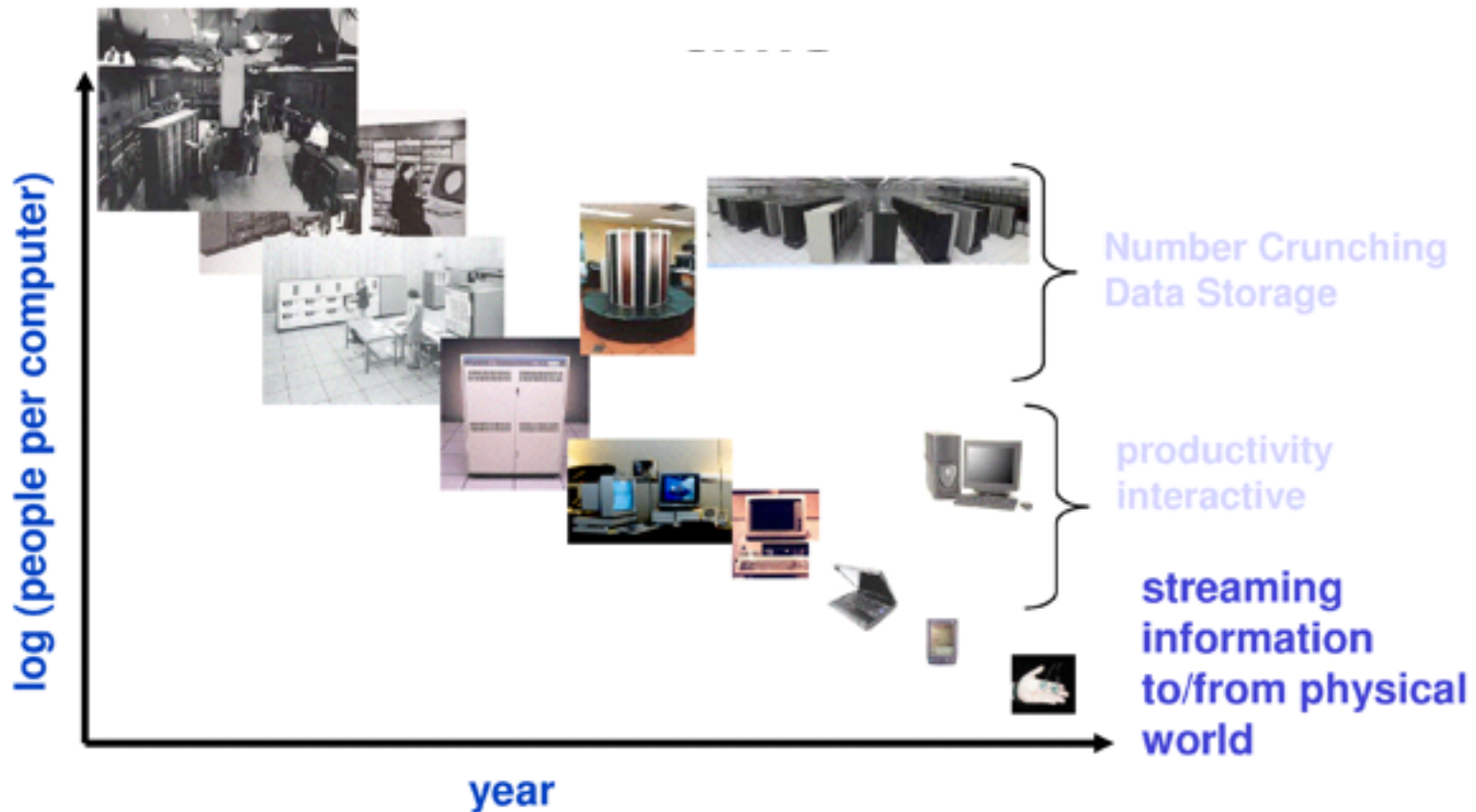


- Complexa interação de muitos componentes em múltiplos domínios administrativos

Dispositivos de Computação Estão em Toda Parte

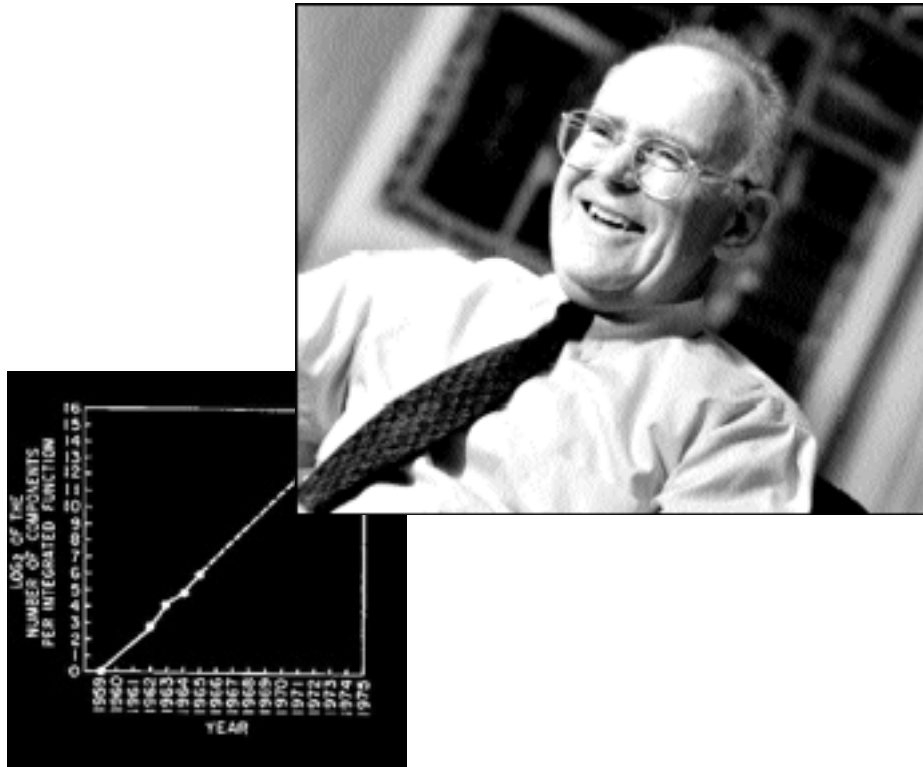


Proporção pessoas-CPU ao longo do tempo



- # de CPUs/pessoa!
 - Aproximando de 100

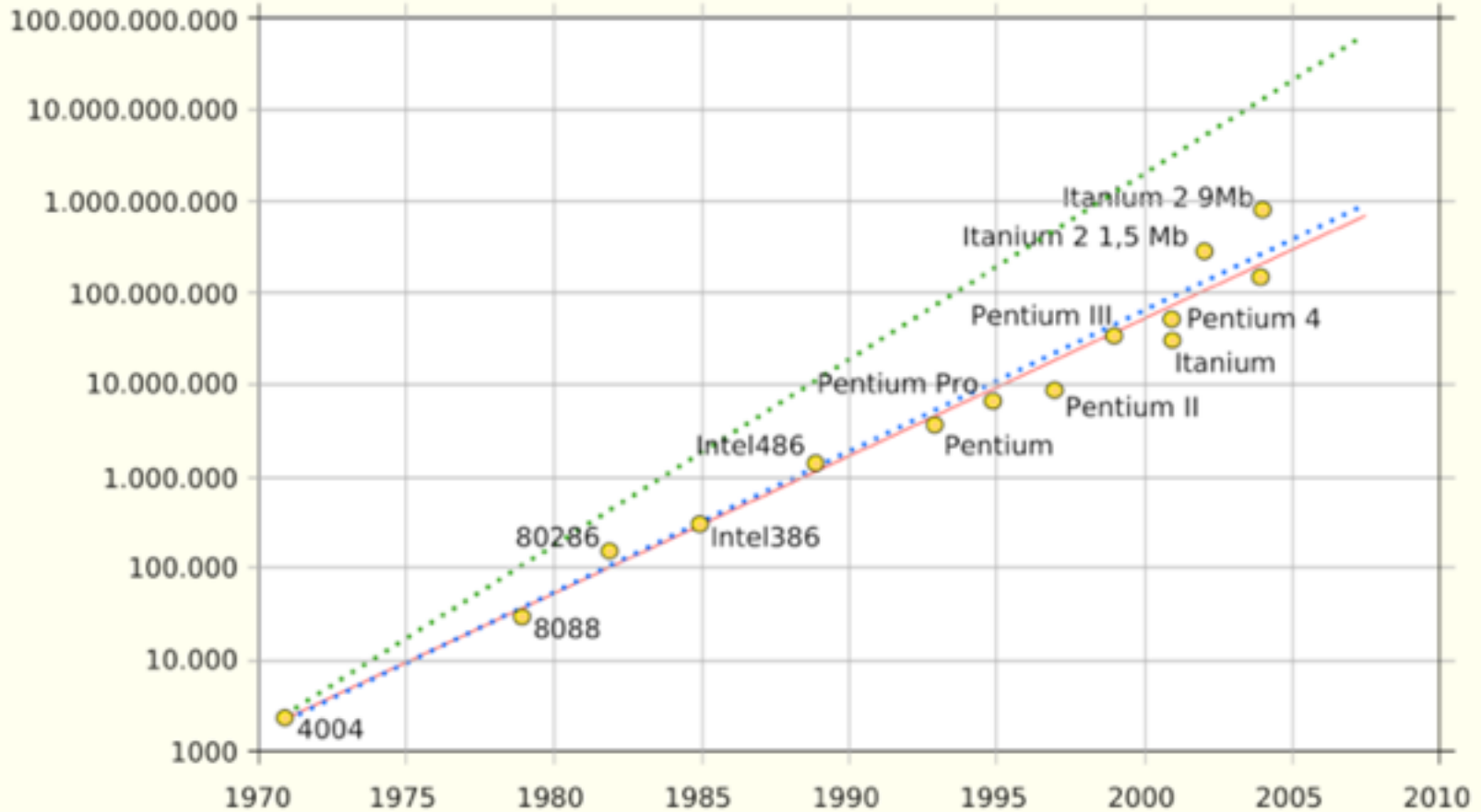
Tendências tecnológicas: Lei de Moore



Gordon Moore (co-fundador da Intel) previu em 1965 que número de transistores dos chips teria um aumento de 60%, pelo mesmo custo, a cada período de 18 meses.

Tendências tecnológicas: Lei de Moore

Número de Transistores

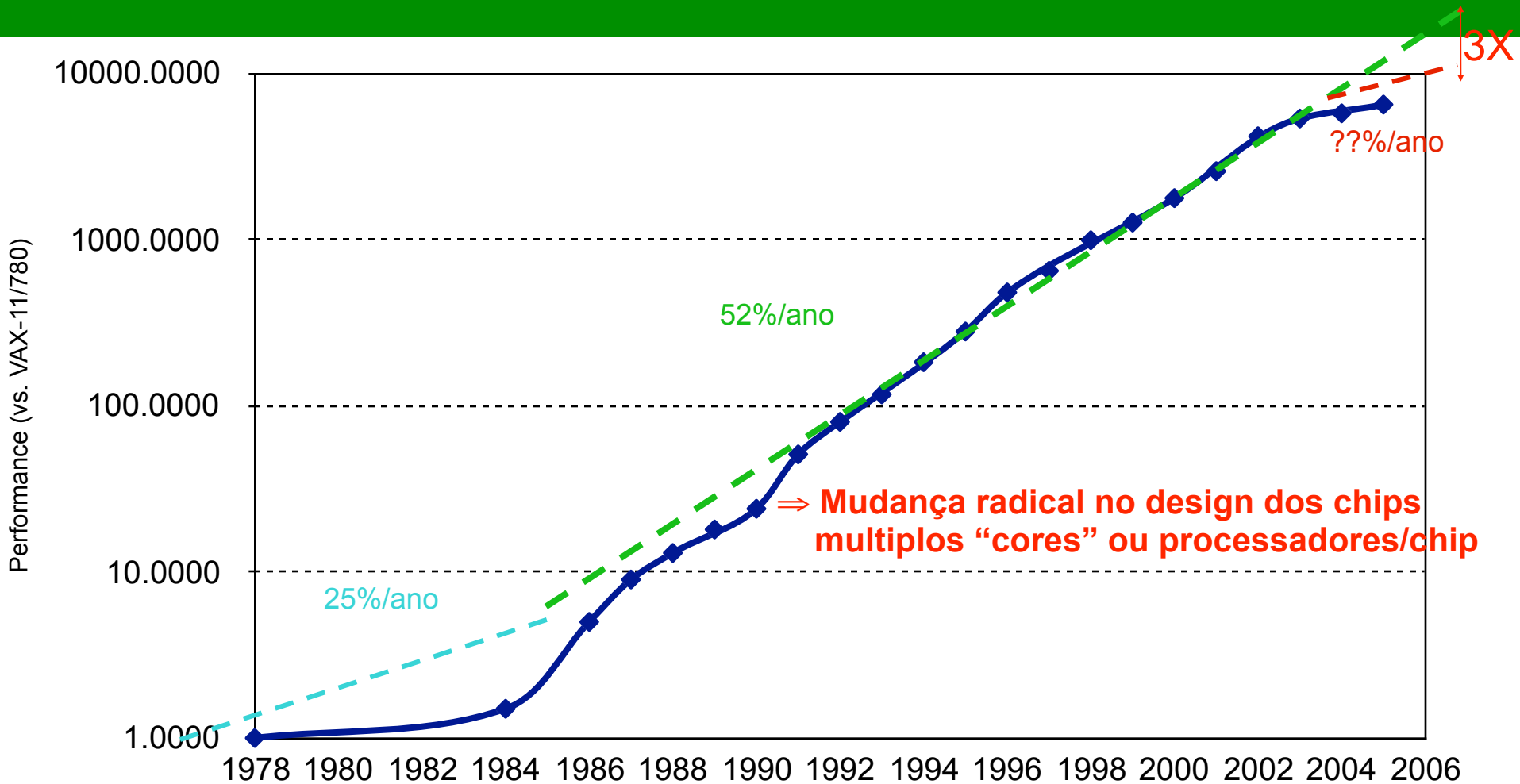


.....
Dobrando a cada 18 meses

.....
Lei de Moore

—
Processadores Intel

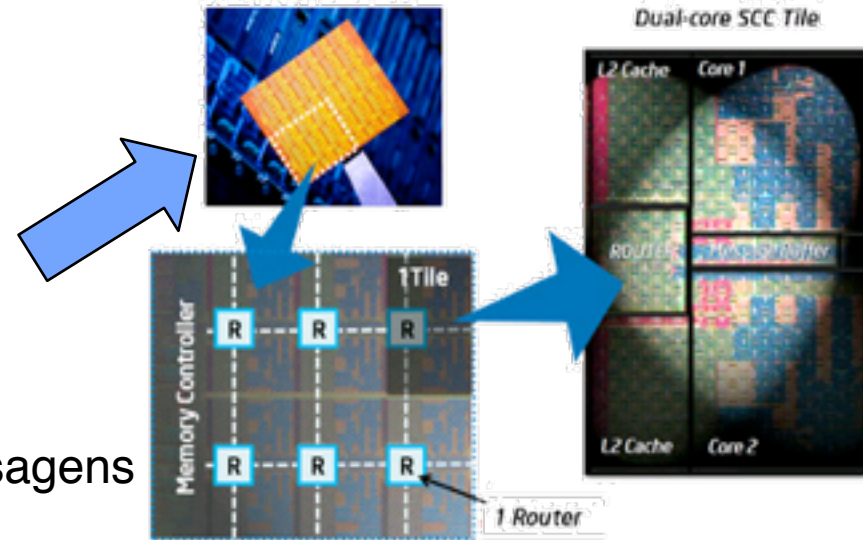
Novos Desafios



- VAX : 25%/ano 1978 a 1986
- RISC + x86: 52%/ano 1986 a 2002
- RISC + x86: ??%/ano 2002 até hoje

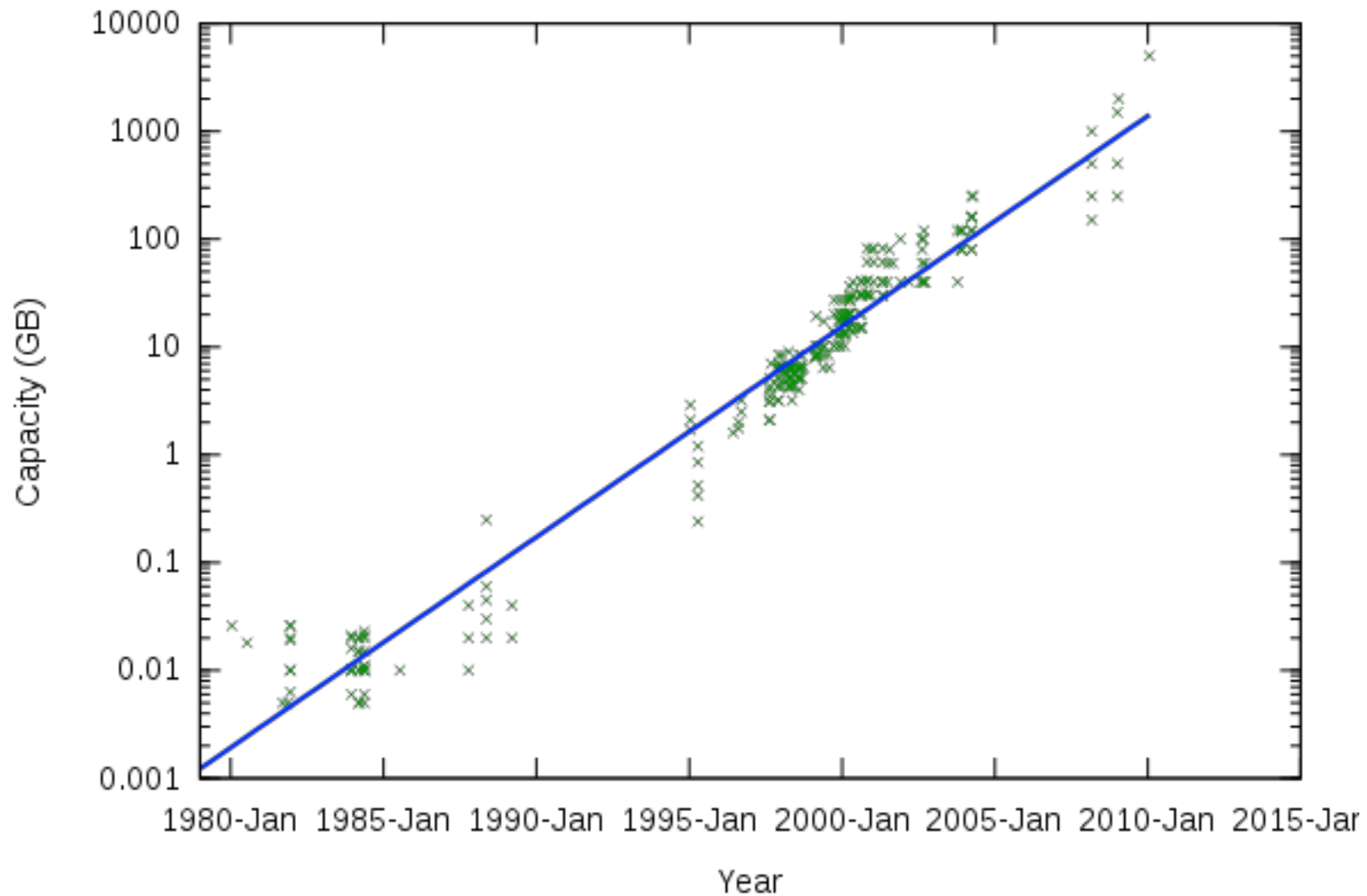
Chips Multicore: The future is here!

- Intel Single-Chip Cloud Computer (Agosto 2010)
 - 24 “tiles” com dois cores/tile
 - 24 roteadores de redes mesh
 - 4 DDR3 controladoras de memória
 - Suporte de hardware para troca de mensagens

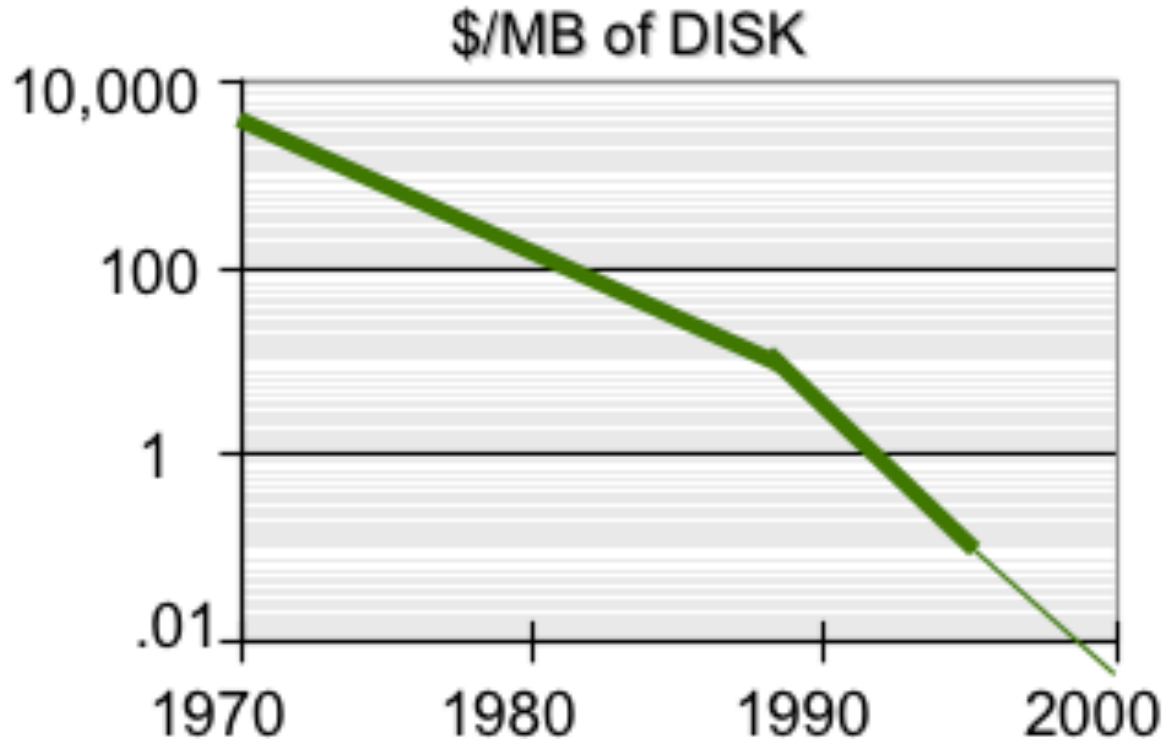


- “ManyCore” refere-se a muitos processadores/chip
 - 64? 128? Qual é o limite exato?
- Como programar eles?
 - Usa 2 CPUs para video/audio
 - Usa 1 para word, 1 para browser
 - 76 para escanear virus???
- **Paralelismo tem que ser explorado em todos os níveis**

Capacidade de armazenamento em disco



Capacidade de armazenamento em disco



- Razão \$/MB dos HDs decai vertiginosamente
 - 1965-1989: 10x/decade
 - 1989-1996: 4x/3year!
100X/decade

Utilidade das Redes: Lei de Metcalfe

Lei de Metcalfe é uma lei formulada por Robert Metcalfe, inventor do sistema Ethernet de redes locais.

O valor de um sistema de comunicação cresce na razão do quadrado do número de usuários do sistema

$$\frac{n(n+1)}{2}$$

Relação utilidade x conexões possíveis

1 usuário: sem utilidade

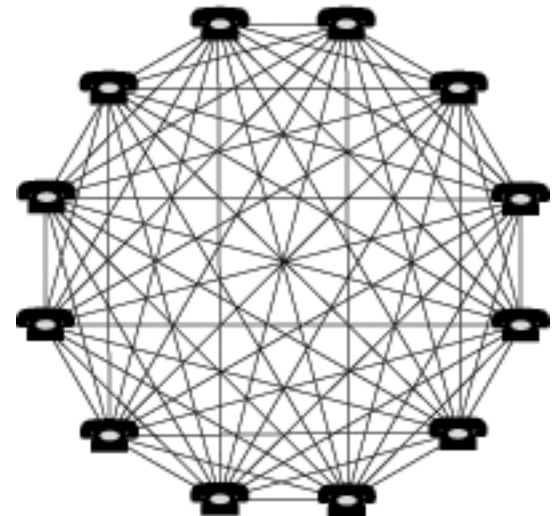
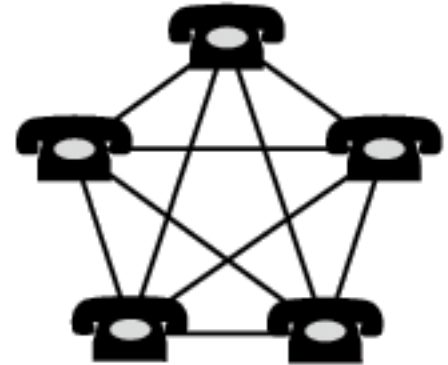
1K usuários: alguns contatos

1M usuários: muitos na rede

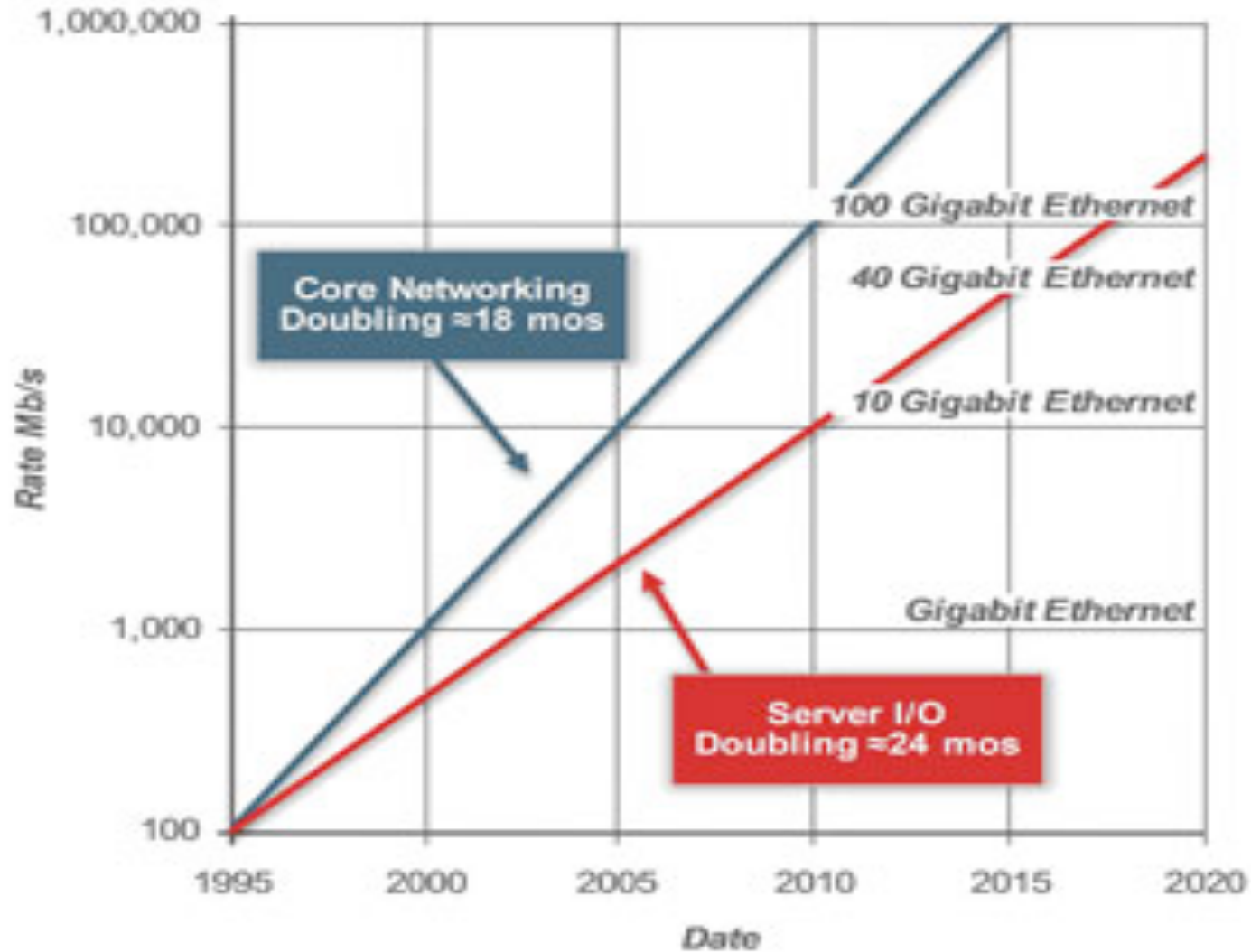
1B usuários: todo mundo na NET

Por isso que a Internet é tão “quente”

Benefício exponencial!

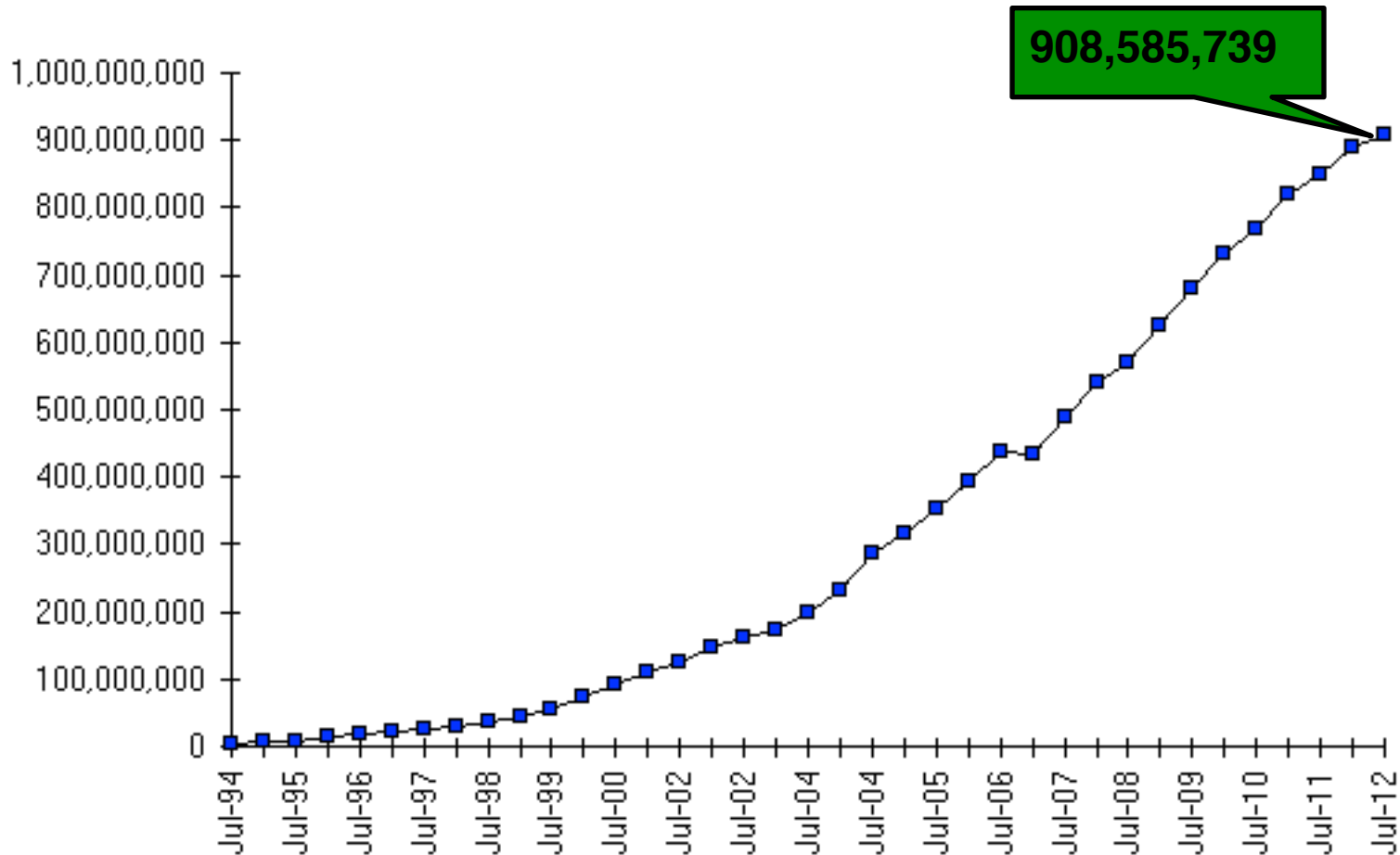


Capacidade de rede



Escalada da Internet: .91 bilhões de hosts

Internet Domain Survey Host Count



Source: Internet Systems Consortium (www.isc.org)

Escalada da Internet: .91 bilhões de hosts

WORLD INTERNET USAGE AND POPULATION STATISTICS June 30, 2012

World Regions	Population (2012 Est.)	Internet Users Dec. 31, 2000	Internet Users Latest Data	Penetration (% Population)	Growth 2000-2012	Users % of Table
Africa	1,073,380,925	4,514,400	167,335,676	15.6 %	3,606.7 %	7.0 %
Asia	3,922,066,987	114,304,000	1,076,681,059	27.5 %	841.9 %	44.8 %
Europe	820,918,446	105,096,093	518,512,109	63.2 %	393.4 %	21.5 %
Middle East	223,608,203	3,284,800	90,000,455	40.2 %	2,639.9 %	3.7 %
North America	348,280,154	108,096,800	273,785,413	78.6 %	153.3 %	11.4 %
Latin America / Caribbean	593,688,638	18,068,919	254,915,745	42.9 %	1,310.8 %	10.6 %
Oceania / Australia	35,903,569	7,620,480	24,287,919	67.6 %	218.7 %	1.0 %
WORLD TOTAL	7,017,846,922	360,985,492	2,405,518,376	34.3 %	566.4 %	100.0 %

NOTES: (1) Internet Usage and World Population Statistics are for June 30, 2012. (2) CLICK on each world region name for detailed regional usage information. (3) Demographic (Population) numbers are based on data from the [US Census Bureau](#) and local census agencies. (4) Internet usage information comes from data published by [Nielsen Online](#), by the [International Telecommunications Union](#), by [GfK](#), local ICT Regulators and other reliable sources. (5) For definitions, disclaimers, navigation help and methodology, please refer to the [Site Surfing Guide](#). (6) Information in this site may be cited, giving the due credit to www.internetworldstats.com. Copyright © 2001 - 2013, Miniwatts Marketing Group. All rights reserved worldwide.

(source: <http://www.internetworldstats.com/stats.htm>)

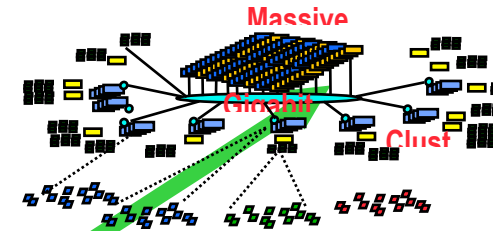
Conexões a Internet: muito além dos PCs

- Vendas de Smartphones ultrapassam de PCs!
- vendas em 2011:
 - 487M smartphones
 - 414M PCs
 - » 210M notebooks
 - » 112M desktops
 - » 63M tablets
 - 25M smart TVs
- 4 bilhões de telefones no mundo



Escala dos Sistemas de Informação

- O mundo é um sistema de larga escala
 - Microprocessadores em tudo
 - Vasta infra-estrutura por trás



Serviços escaláveis,
Confiáveis e Seguro

Internet
Connectivity



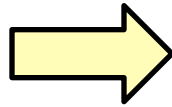
MEMS for
Sensor Nets

Challenge: Scale and Dynamic Range

- Enormous scale, heterogeneity, and dynamic range:
 - CPU: sensor motes → GPUs
 - » Cores: one → 100s [2-orders of magnitude variation]
 - » Clusters: few machines → 10,000s machines [4 orders of mag.]
 - Network: Inter-core networks → Internet
 - » Latency: nanosecs → secs (satellite) [9 orders of mag.]
 - » Bandwidth: Kbps → Gbps [6 orders of mag.]
 - » ...
 - Storage: caches → disks
 - » Size: MB → TB [6 orders of mag.]
 - » Access time: few nanosecs → millisecs [6 orders of mag.]

Compare with Cars...

- Horse Power: 50HP → 1000HP [20x times]
- Speed: 100 Km/H → 400 Km/H [4x times]
- Weight: 500 Kg → 20,000 Kg [40x times]
- Mileage: 80 MPG → 2 MPG [40x times]



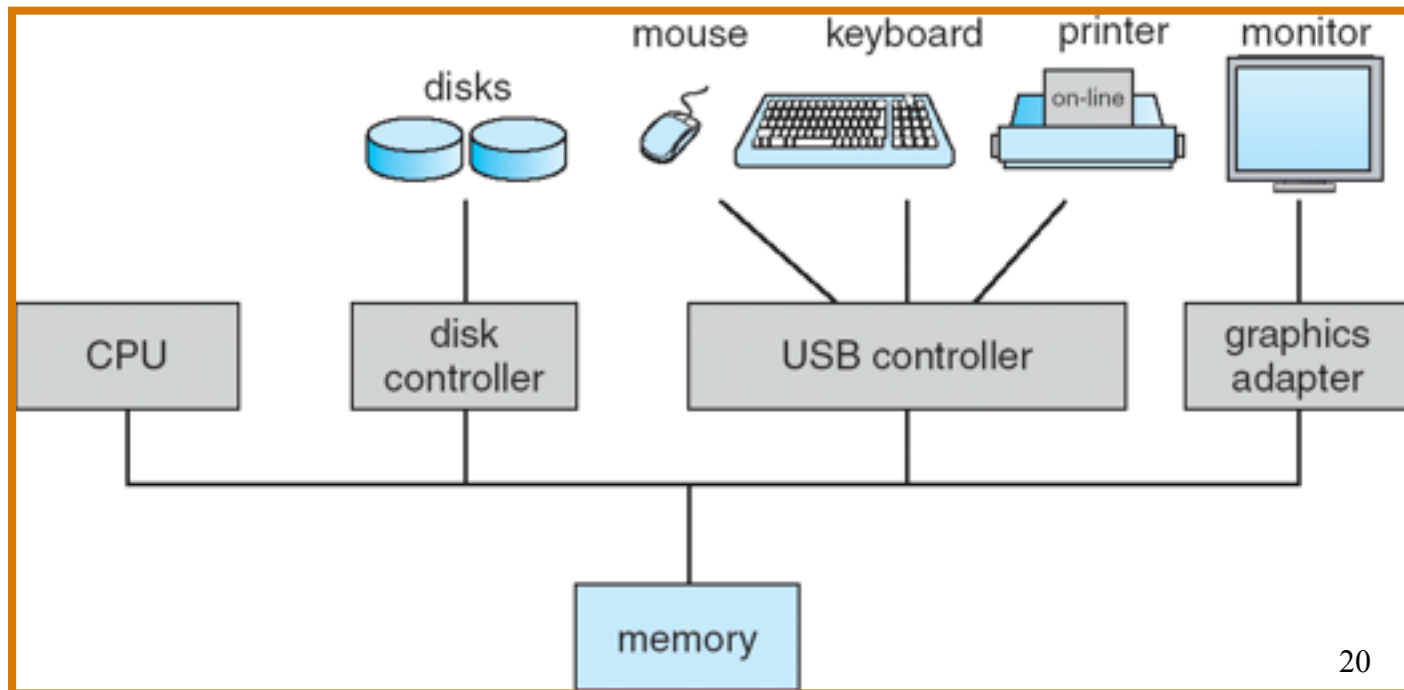
Challenge: Complexity

- Applications consisting of...
 - ... a variety of software modules that ...
 - ... run on a variety of devices (machines) that
 - » ... implement different hardware architectures
 - » ... run competing applications
 - » ... fail in unexpected ways
 - » ... can be under a variety of attacks
- Not feasible to test software for all possible environments and combinations of components and devices
 - The question is not whether there are bugs but how serious are the bugs!

Computer System Organization

- Computer-system operation

- One or more CPUs, device controllers connect through common bus providing access to shared memory
- Concurrent execution of CPUs and devices competing for memory cycles



How do We Tame Complexity?

- Every piece of computer hardware different
 - Different CPU
 - » Pentium, ARM, PowerPC, ColdFire
 - Different amounts of memory, disk, ...
 - Different types of devices
 - » Mice, keyboards, sensors, cameras, fingerprint readers, touch screen
 - Different networking environment
 - » Cable, DSL, Wireless, ...
- Questions:
 - Does the programmer need to write a single program that performs many independent activities?
 - Does every program have to be altered for every piece of hardware?
 - Does a faulty program crash everything?