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Global Technology Outlook

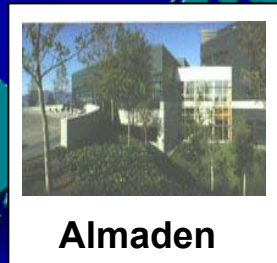
CHEP04, Interlaken

Dave McQueeney

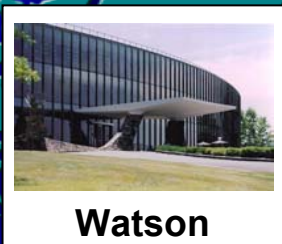
CTO, IBM US Federal

davidmcq@us.ibm.com

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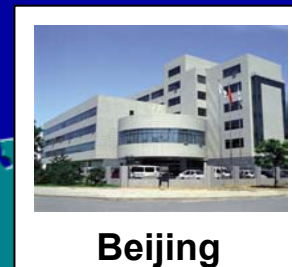
Almaden



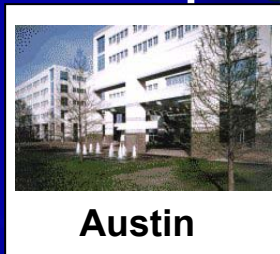
Watson



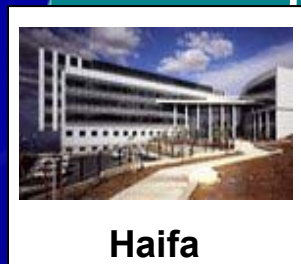
Zurich



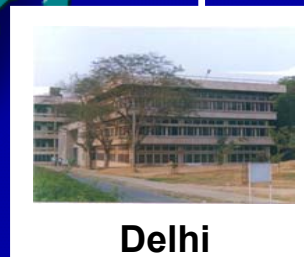
Beijing



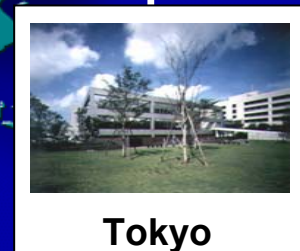
Austin



Haifa



Delhi



Tokyo

Topics: Find Disruptive Trends...

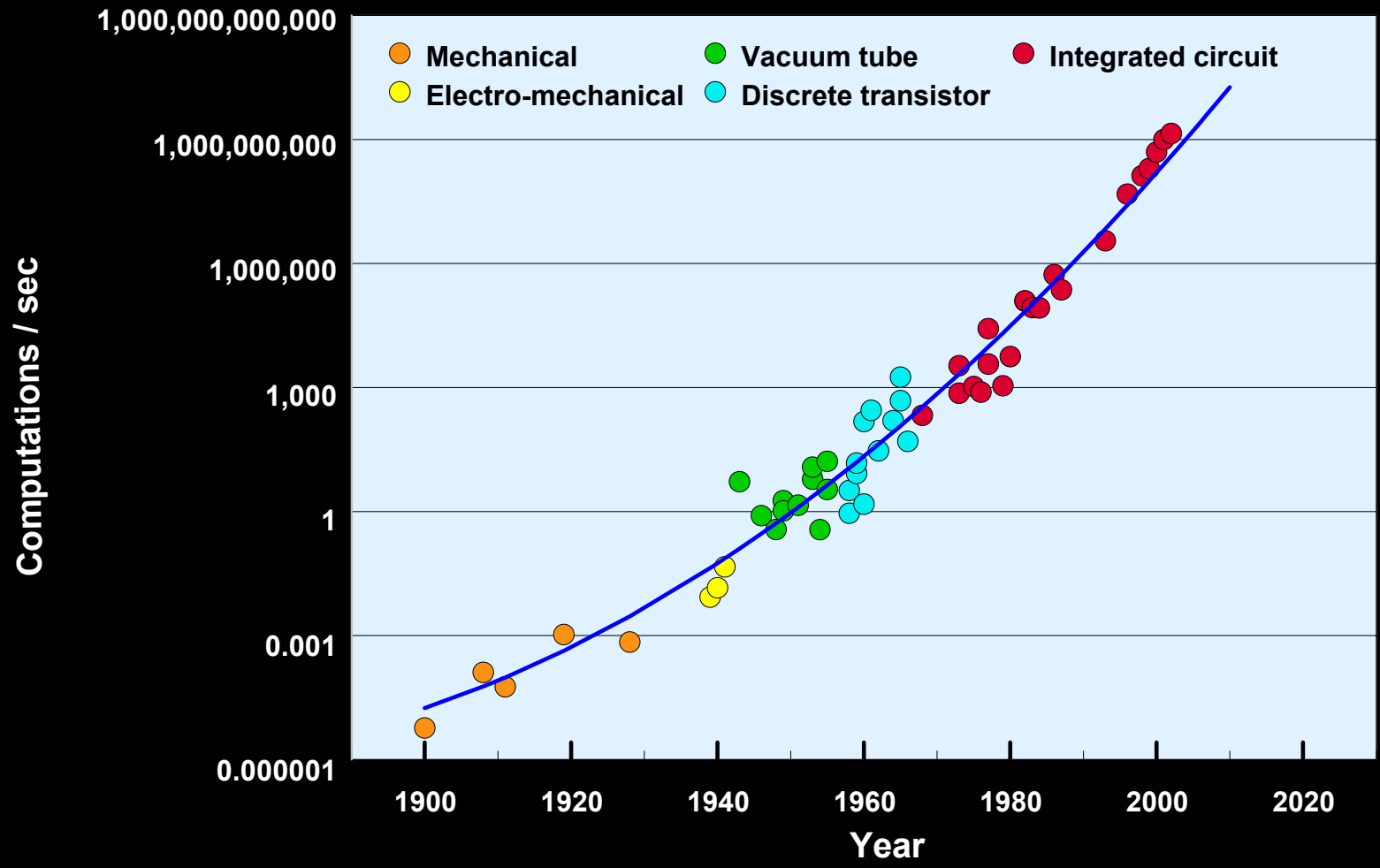
- ▶ **New log, semi-log trends...**
- ▶ **Look 2-10 years out:**
 - **Is there a really new regime?**
 - **New threshold about to be crossed**
- ▶ **What are the implications? What new applications will arise?**
- ▶ **What new innovative technologies will change our business?**

- ▶ **Technology trends: semiconductors, disks, bandwidth, etc.**
- ▶ **S/W productivity**
- ▶ **Infrastructure**
- ▶ **Size of web sites**
- ▶ **Amount of data growth**
- ▶ **Security hits**
- ▶ **others.....**

GTO Topics for Today

- **Hardware Technology and Systems**
- **Pervasive Computing**
- **The Virtual Computer and Web Services**
- **Unstructured Data Explosion**
- **Business/IT Fusion**

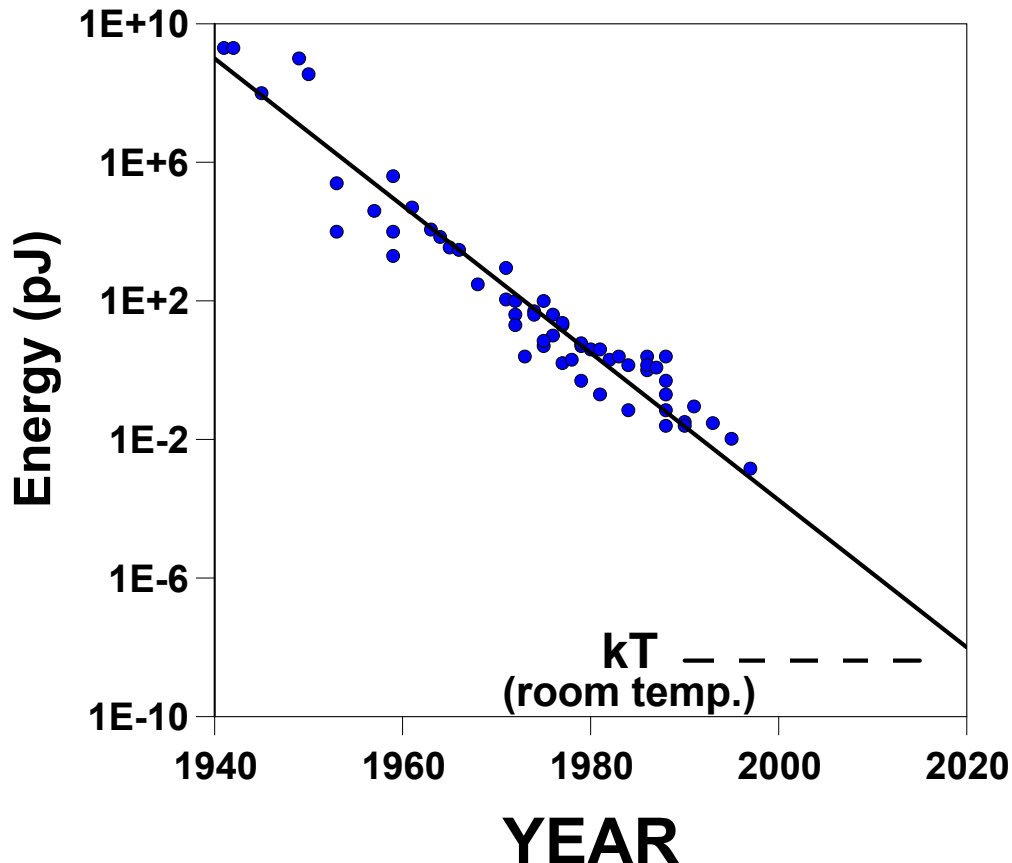
\$1000 Buys



after Kurzweil, 1999 & Moravec, 1998

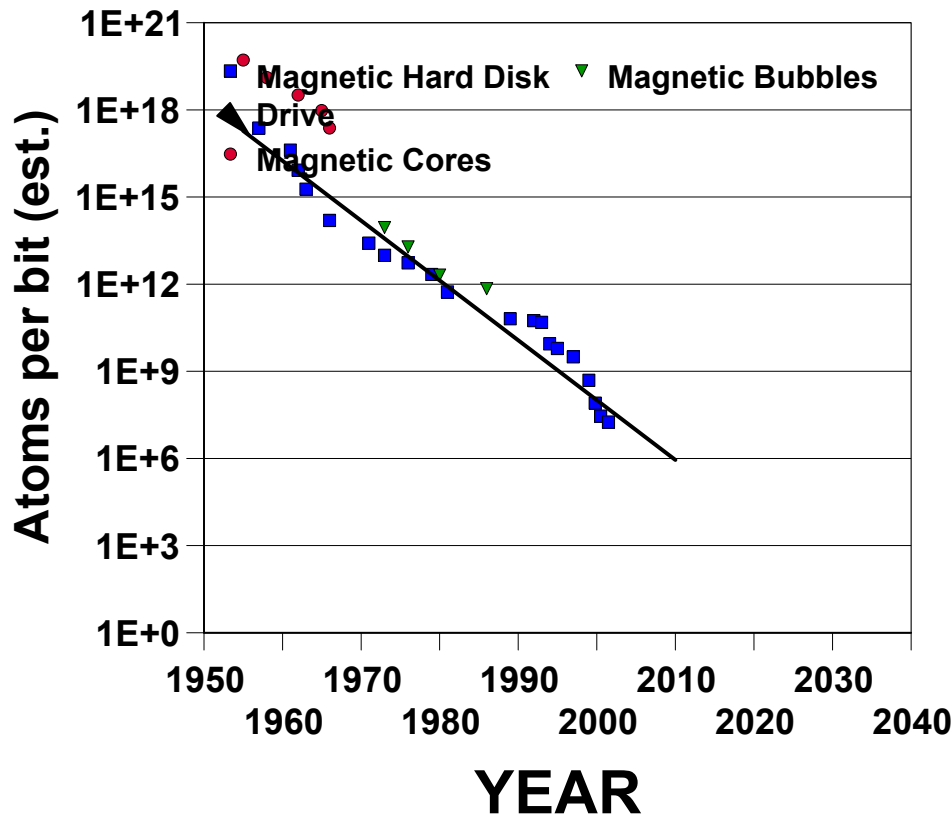
Room at the bottom? (1)

The Energy Dissipated in a Logic Operation

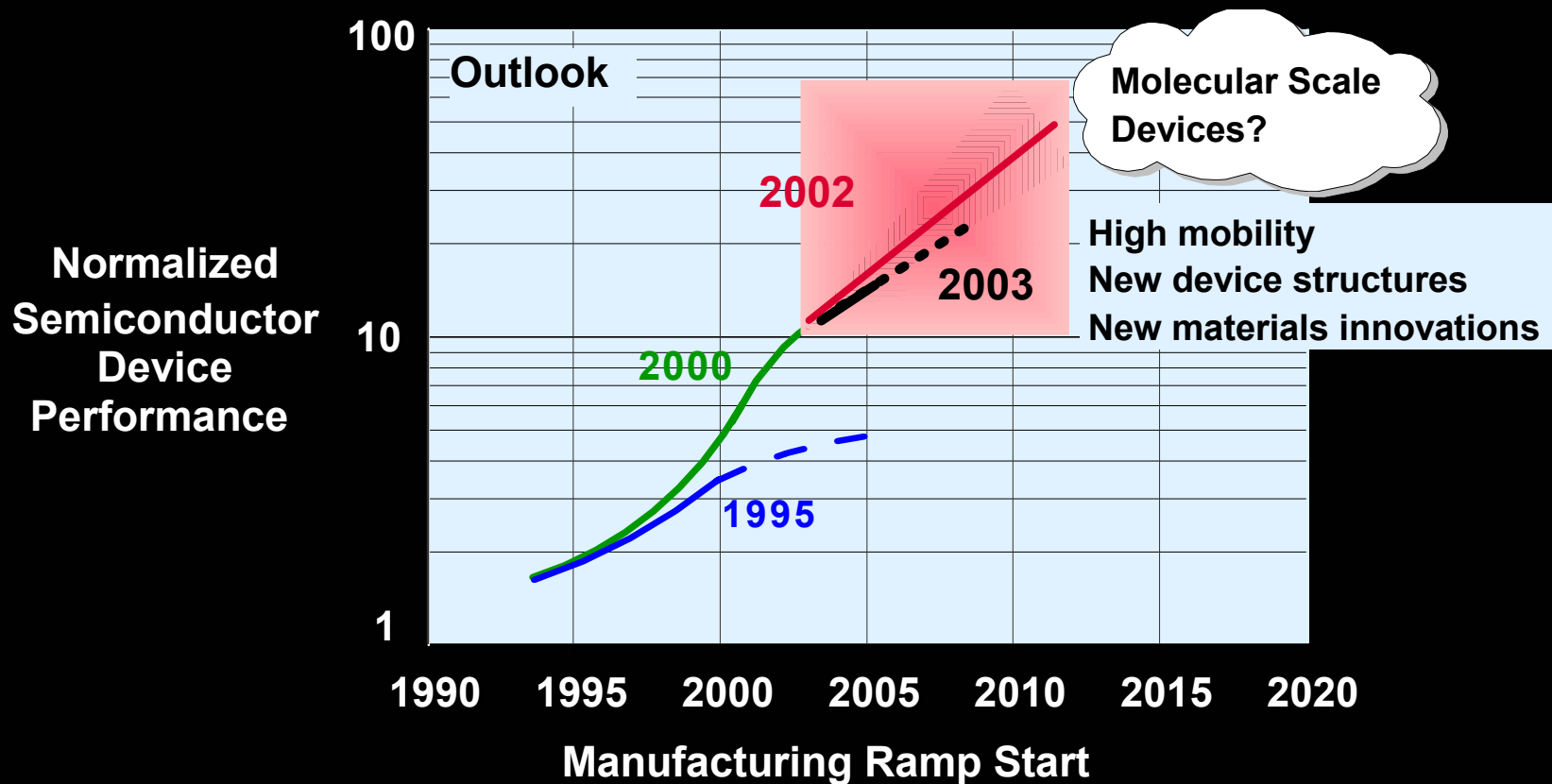


Room at the bottom? (2)

Atoms of Magnetic Media Required to Store 1 Bit



Future CMOS Roadmap: Less Predictive

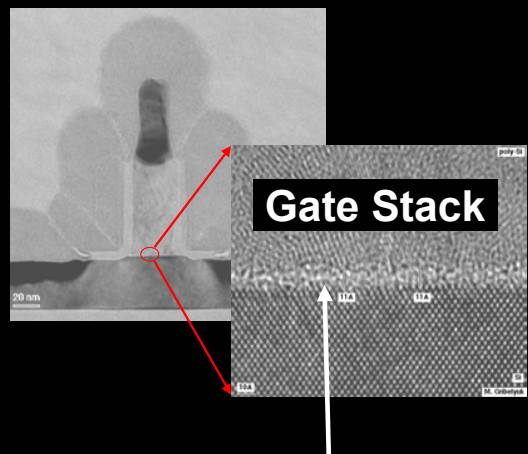
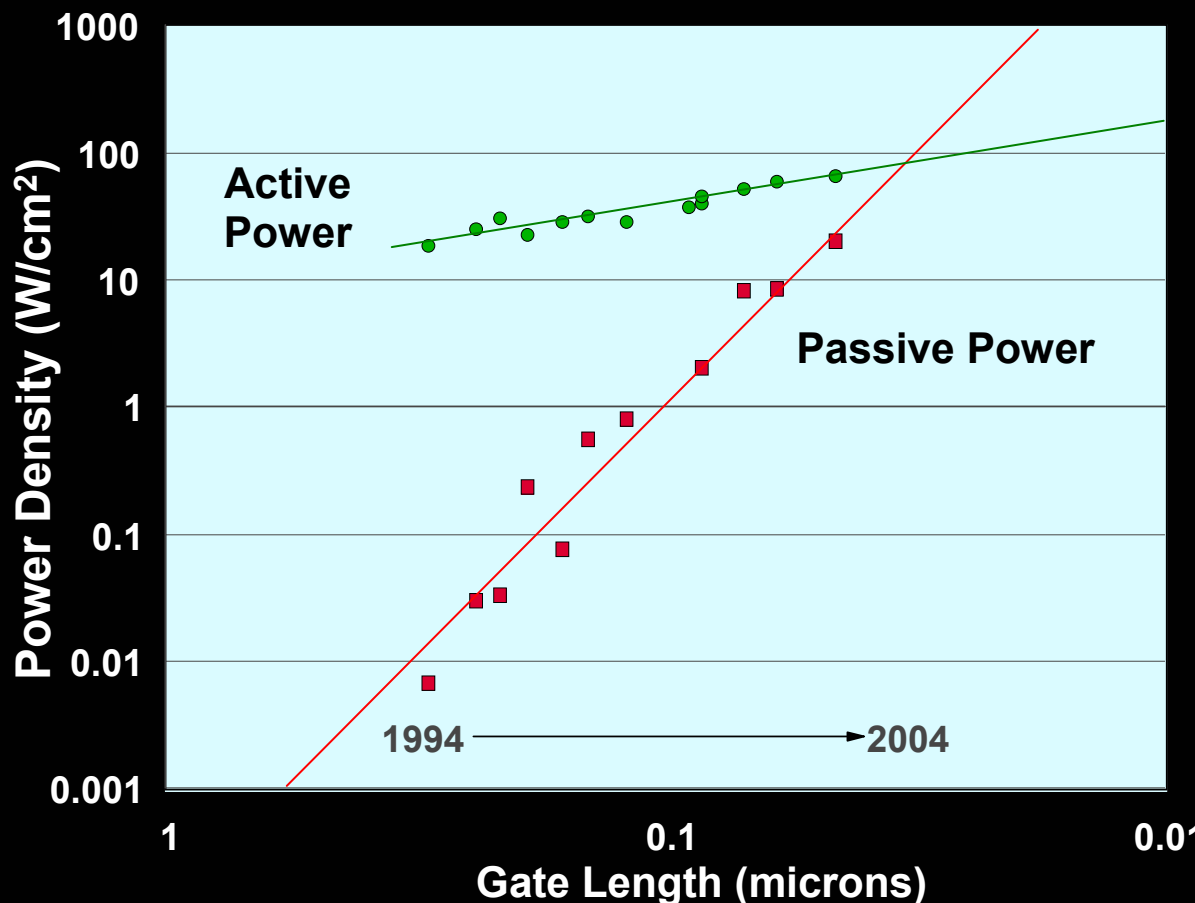


- CMOS device performance will continue to improve rapidly, but in new ways
 - The concept of a scaled technology as we know it will cease to exist
 - Innovation will continue to drive performance improvements, but timing will be harder to predict

Active vs. Passive Power

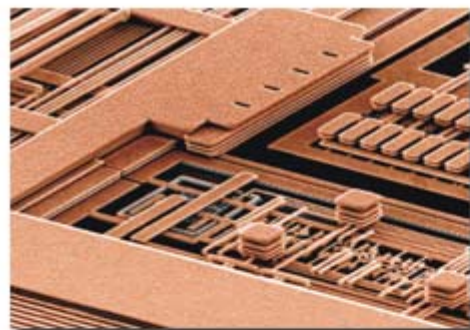
Power components:

- Active power
- Passive power
 - Gate leakage
 - Sub-threshold leakage (source-drain leakage)

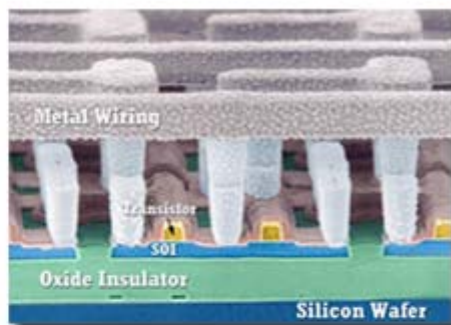


Gate dielectric approaching a fundamental limit (a few atomic layers)

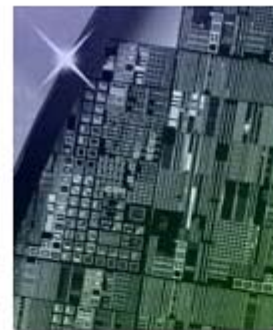
Better Performance Without Scaling



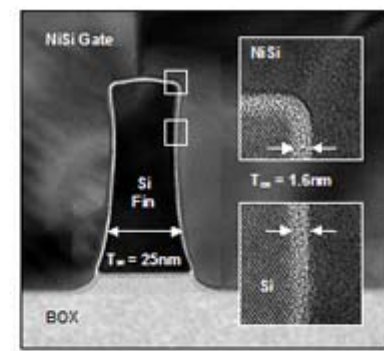
Copper



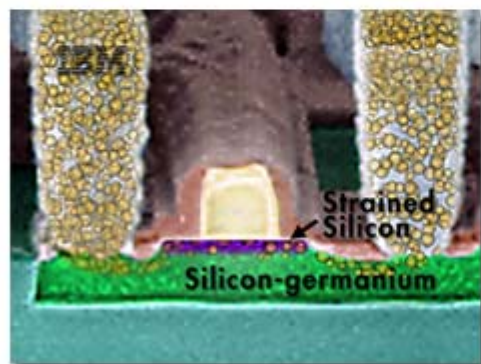
SOI
(Silicon-on-Insulator)



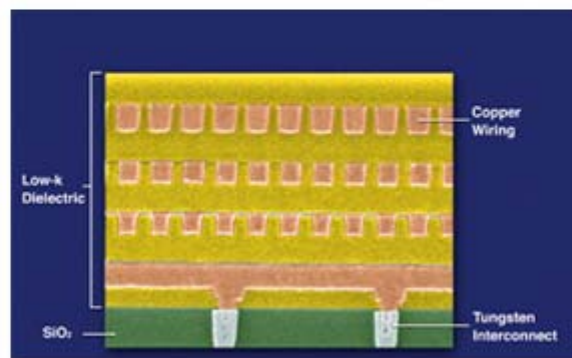
SiGe



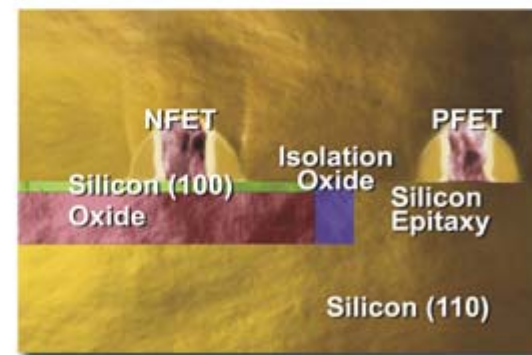
FinFET Double Gate



Strained Silicon

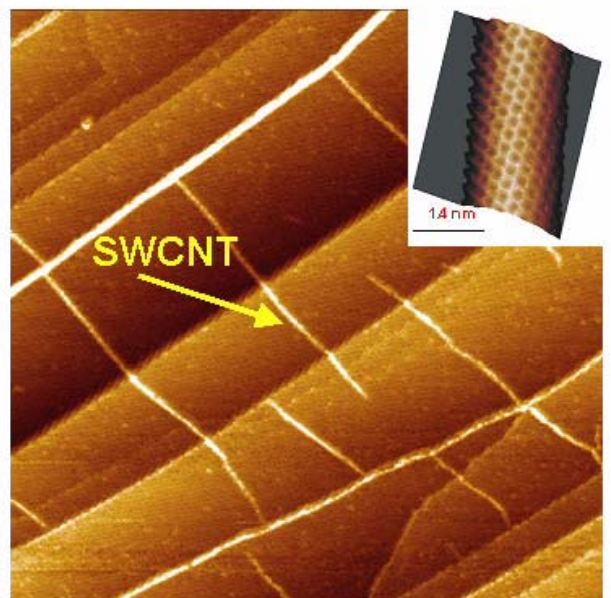


Low-k Dielectric



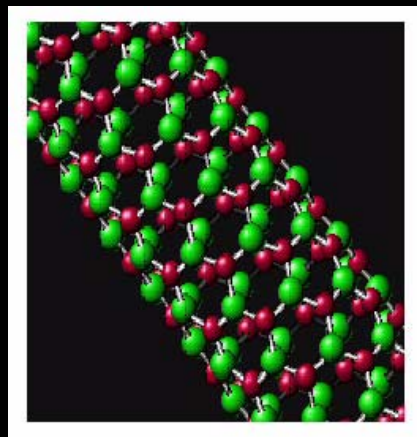
Hybrid-Orientation Technology (HOT)

Nanotechnology

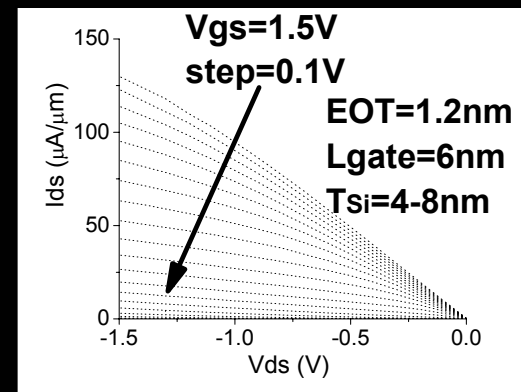
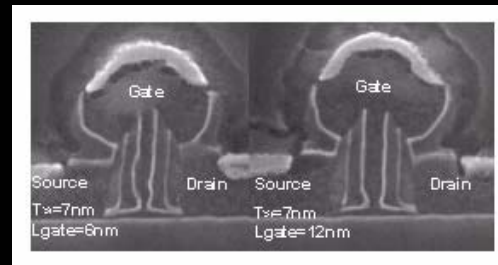


Advances in Fabrication:

- Synthesis of single-wall carbon nanotube without catalyst
- Eliminates multi-wall tubes which are not appropriate for transistors



World's first boron nitride nanotube FET

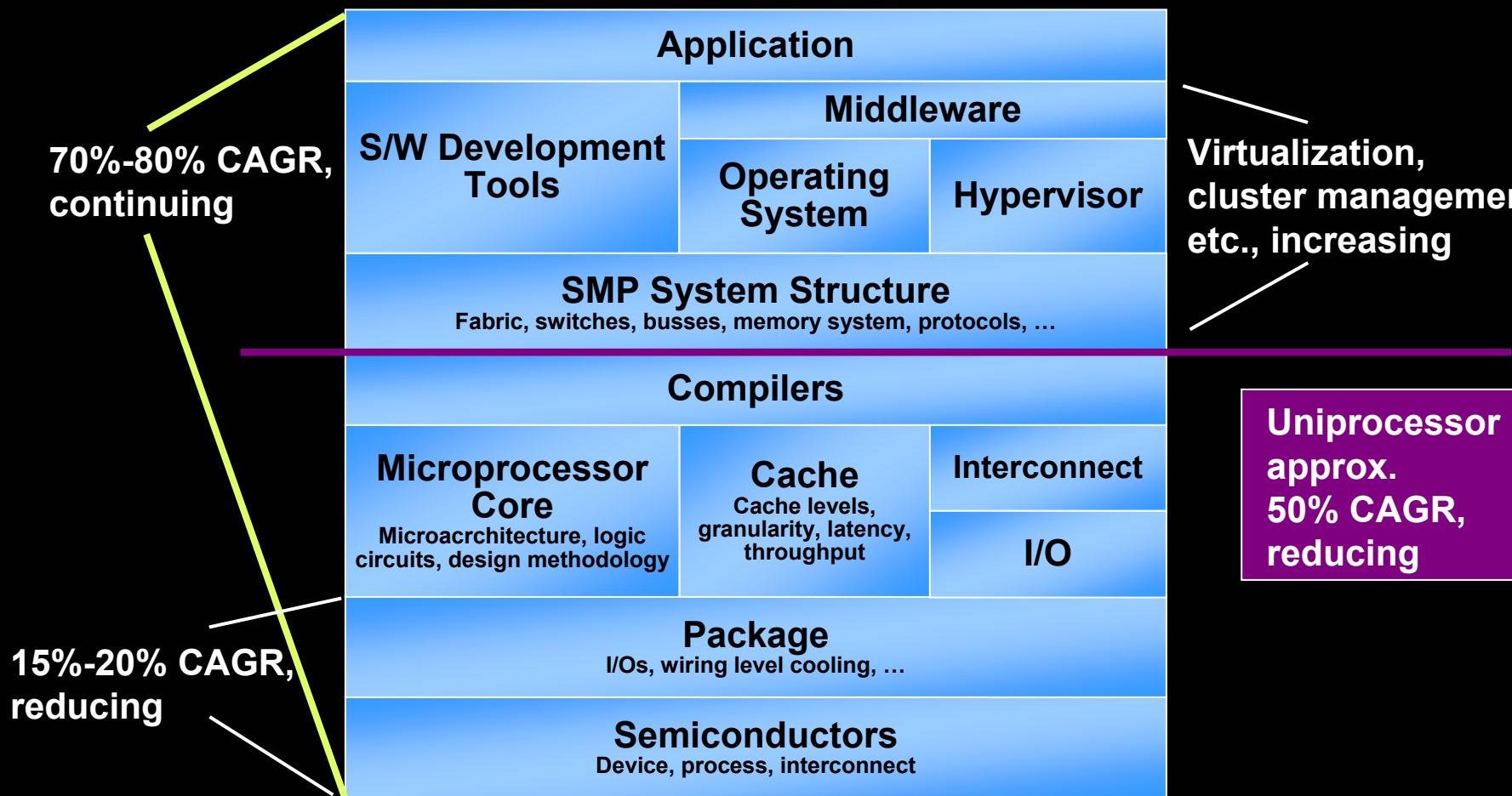


World's smallest Si FET (6 nm)

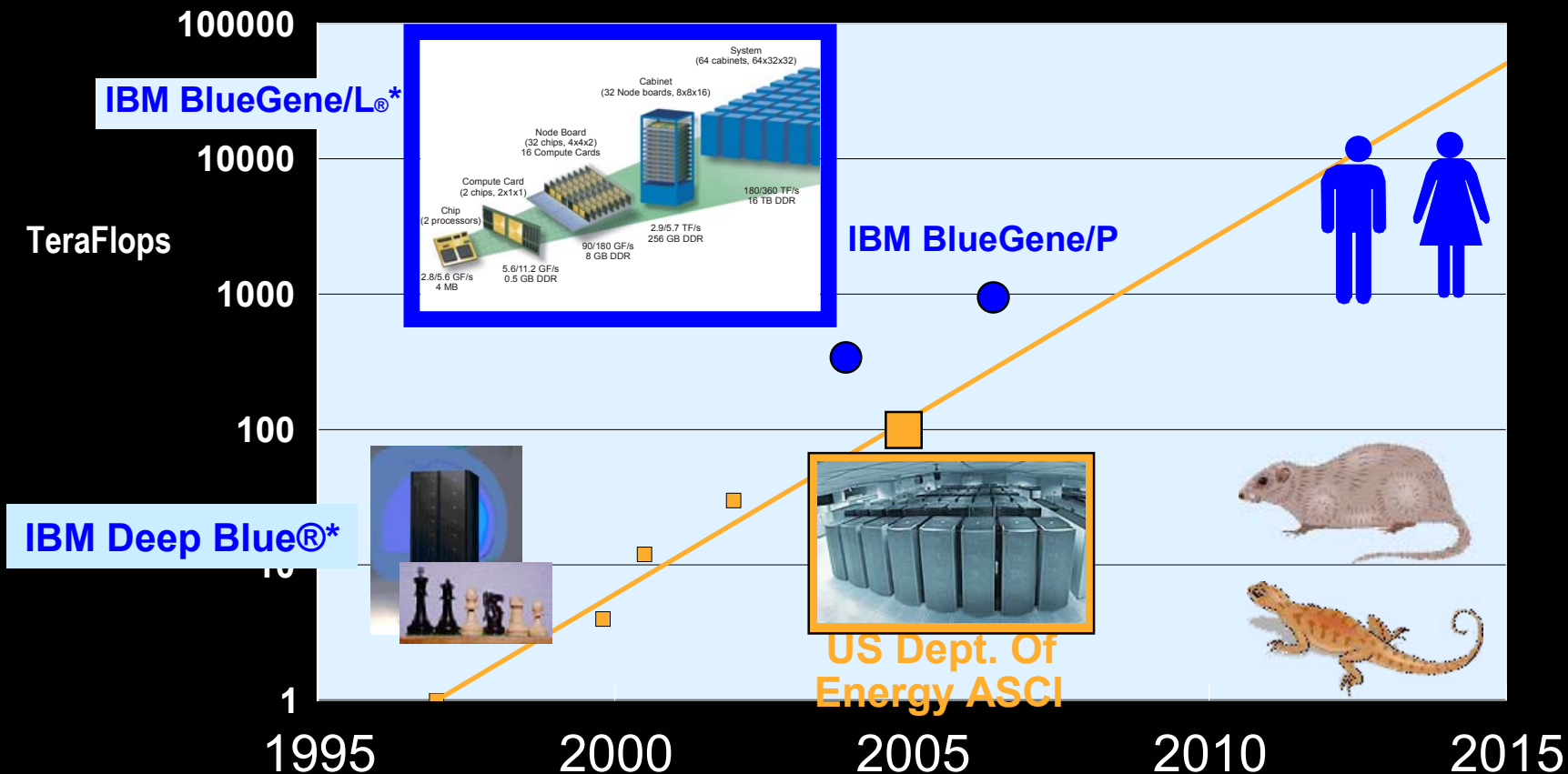
- A true nano device

System Performance Stack

Performance improvements will increasingly require system level optimization



Supercomputing Roadmap



Source: ASCI Roadmap www.llnl.gov/asci, IBM

Brain ops/sec: Kurzweil 1999, The Ace of Spiritual Machines

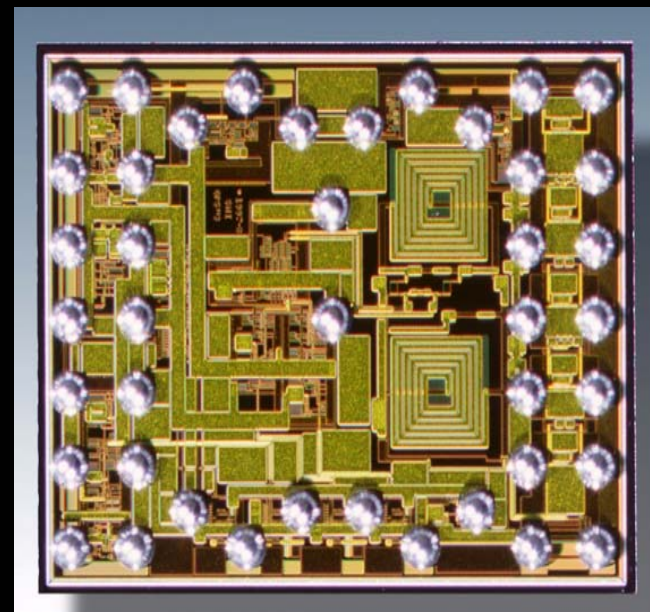
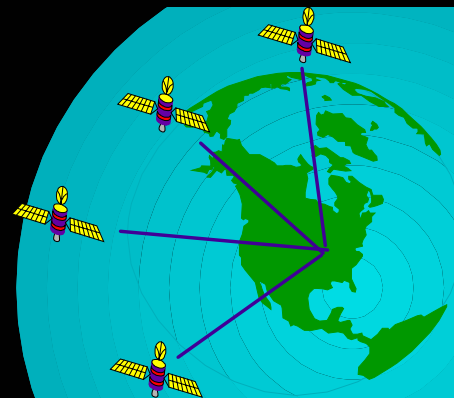
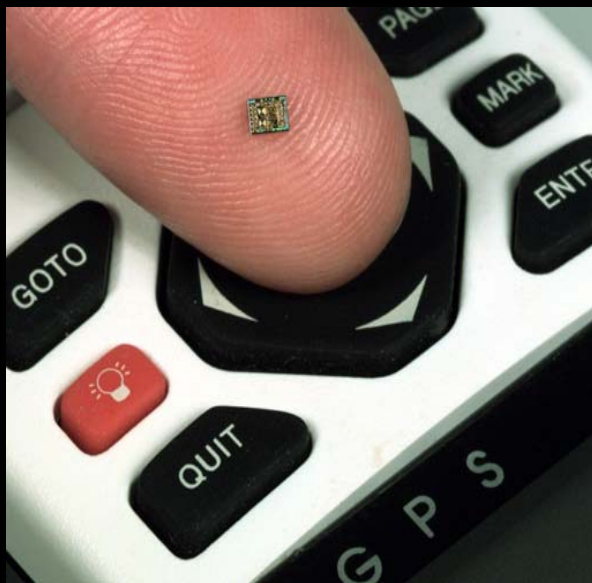
Moravec 1998, www.transhumanist.com/volume1/moravec.htm



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Pervasive Computing

Pervasive Computing – Enabled by Integration

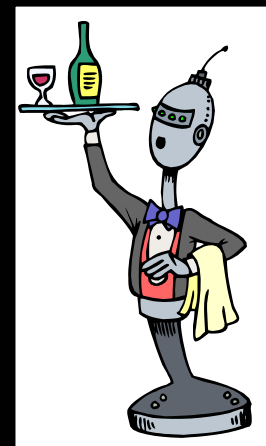
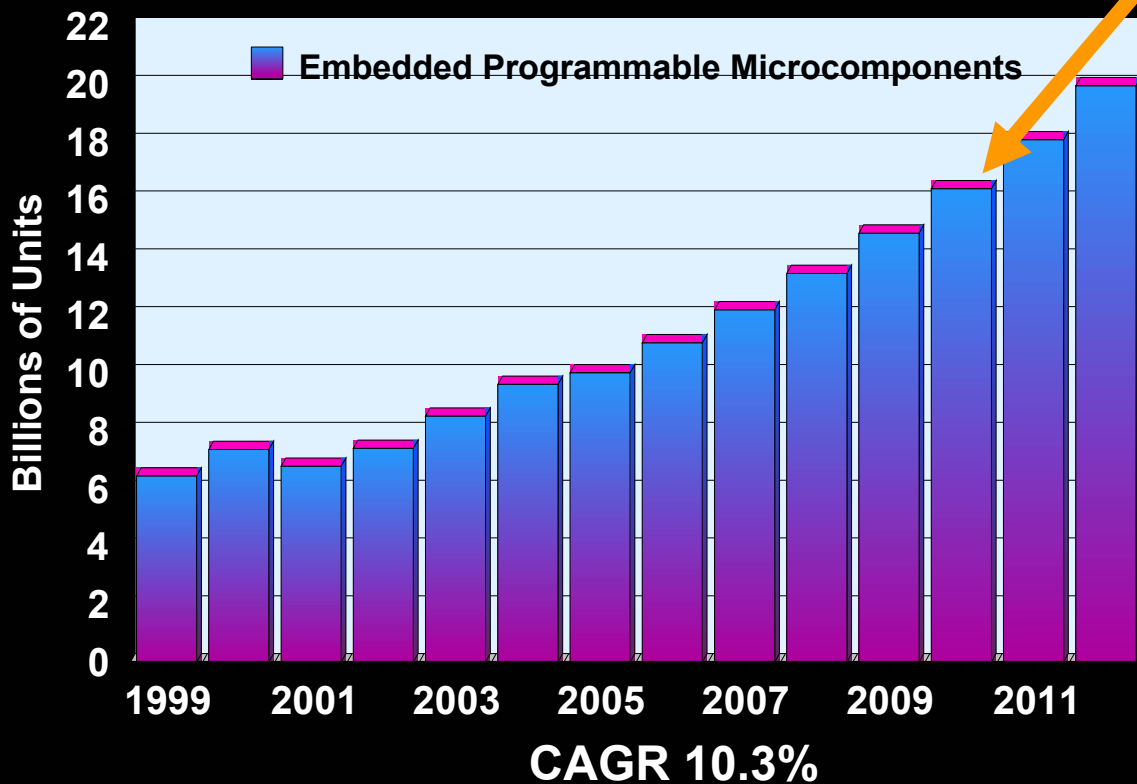


**First integration of RF front-end
And VLSI-scale logic on a single
chip**

Embedded Programmable Devices

Embedded systems will be pervasive

3 Embedded devices / person worldwide in 2010



Source: Gartner 2002: Microprocessor, Microcontroller and Digital Signal Processor Forecast Through 2005



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Data Explosion

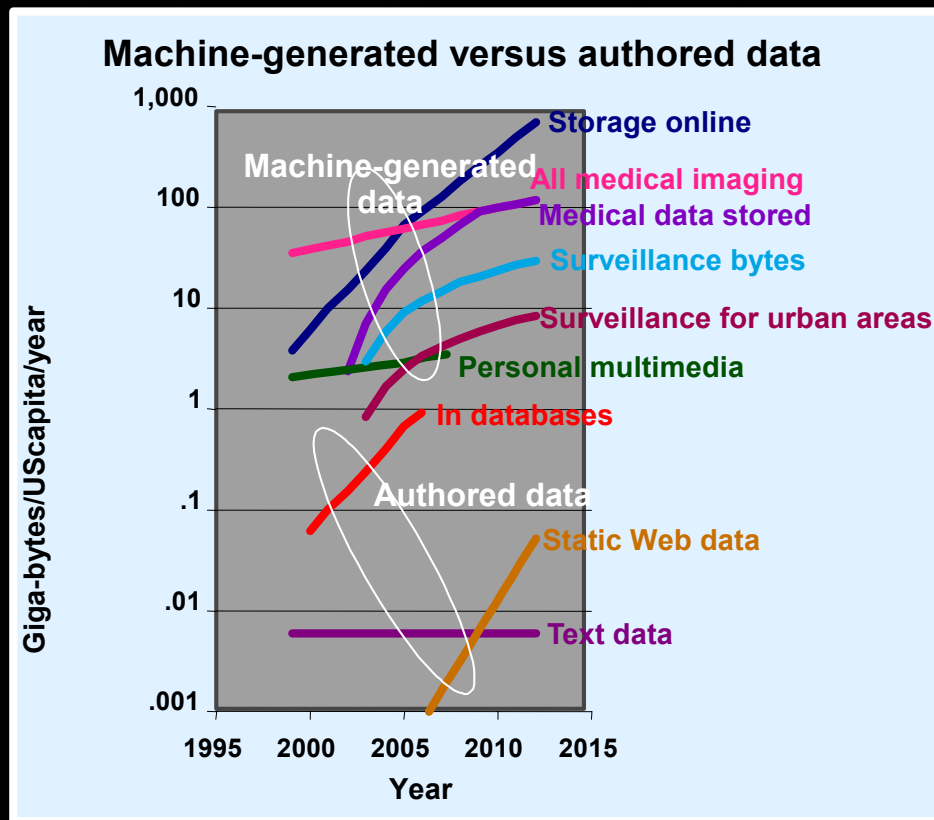
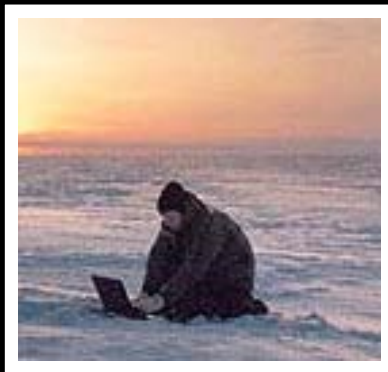
Explosion of Machine-Generated Data Causes a Data Usability Concern

Machine generated, time-based data from a variety of sources is increasing at an exponential pace

Machine-generated data



Authored Data

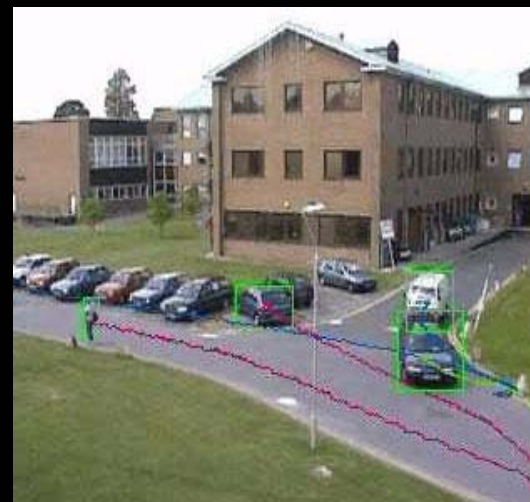


Analytics for Machine Generated Data: Surveillance Example

**Solution: Make sensors smart to reduce bandwidth of inside-out web
Data becomes more pertinent too**

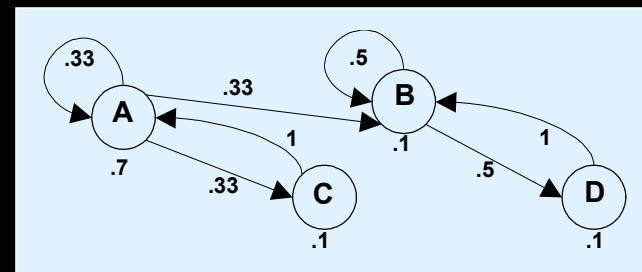
▶ Normal sensor processing chain

- Raw input (pixels)
- Remove noise and dropout
- Identify candidates (anything moving)
- Identify objects (a person)
- Identify which (person x)
- Track each object over space-time
- Track same object from one sensor to the next
- Group objects (the usual group seen before)
- Wisdom (what it means that they are together)
- Relate to past history
- Notify for plan of action about event



▶ Reduce bandwidth

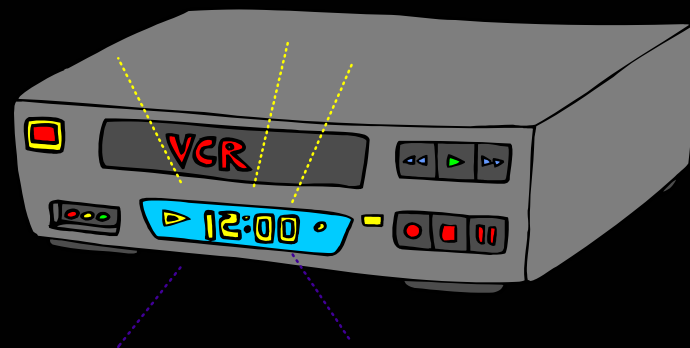
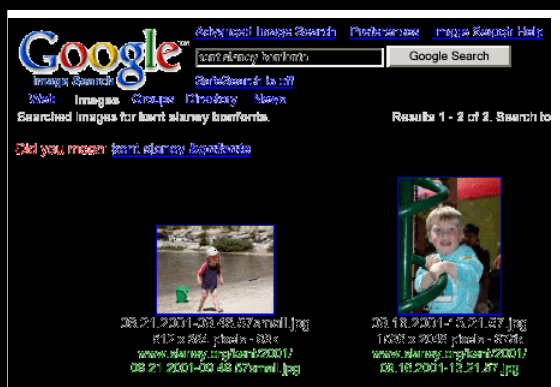
- Filter out uninteresting signals
- Find people in video
- Look for behavioral patterns
- Build temporal models



Users Now Expect the Ease of the Web Search Metaphor

The Web paradox - it is easier to (find and) access a file created by a kid in New Zealand, than to access a file created on your colleague's desktop

- The Web is pervasive



- In the light of increasing data volumes, today's hierarchical file systems have fallen below the usability threshold for finding information
- Customers will demand data retrieval that behaves like a "searchable web"

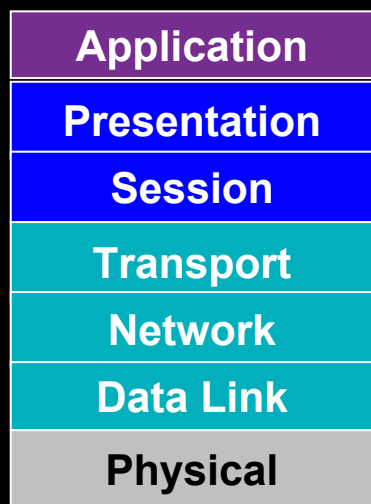
* Source: Pew Foundation Internet Study <http://www.pewinternet.org/reports/toc.asp?Report=64>



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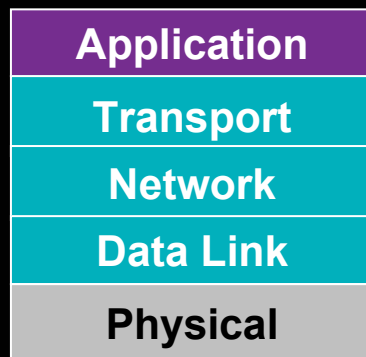
The Virtual Computer and Web Services

Web Services Completes the Internal Protocol Stack



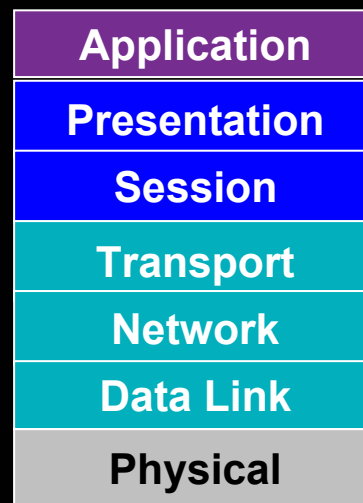
Pre-1980

Tannenbaum, 1981



1980 - 1995

Tannenbaum, 1996



1995 - 2000+

The Web Era

XML, ...
SOAP

2010+

Stack
standardization
complete

Proprietary networks

- Embodied in SNA & DECnet
- Session: long running conversations
- Presentation: interaction with user

Basic internetworking dominates:

- TCP/IP, mail ...
- Interconnect apps with byte pipes
- Early presentation & session layers
 - DCE, CORBA & DCOM

Standardized presentation layer emerged

- HTML
- Session layer returns
 - HTTP
- Web Services Formalized
 - Conversations come back with SOAP
 - Data semantics return with XML Schema

Virtual Computer Abstraction

- ▶ How others view and use the business functions
- ▶ Implements business processes and operations
- ▶ Important functions for complex apps that abstract away implementation details
- ▶ Storage/data
- ▶ Protected domains
- ▶ Manage shared resources
- ▶ Process mgmt
- ▶ Basic representation
- ▶ Computation
- ▶ State
- ▶ Communication pipes

Interfaces to users or apps, e.g., 3270

Applications using middleware

Middleware: CICS®, DB2®, WebSphere®

OS: MVS, AIX®, Windows® 2000

HW platform: S/390®, PowerPC®, or Intel®

Next Gen Interfaces

Web Services
User Interaction

Next Gen Apps

Utility Services
e.g., stock prices, airfares
Generate Customer Contract

Virtual Middleware

Business Processes Billing
Workflow Service Level Agreements
Autonomous
Self-Configuring

Virtual OS

APIs Security Resource Self-Healing
Directory/Discovery Mgmt Self-Optimizing
Grid

Virtual Engine

Communications Semantics Representation



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Business/IT Fusion

Logical Models Provide a View of Organization or Agency as Collections of Services

A componentized view yields strategic insight based on Key Performance Indicators

Transformational View

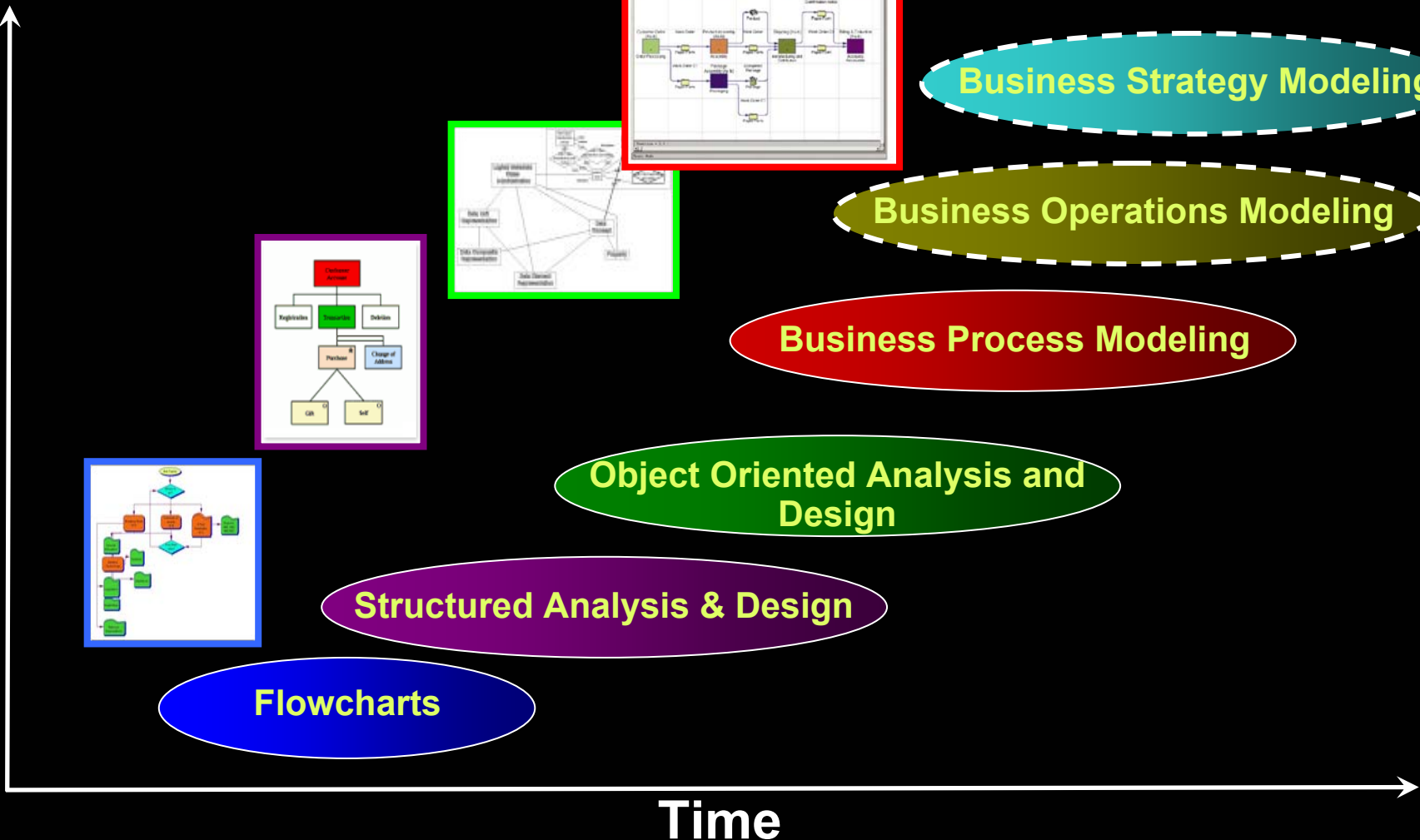
- Immediate Priority
- Medium Priority
- No Action

	Manage Customers	Merchandising	Store/Channel Operations	Supply Chain & Distribution	Finance Administration	Business Administration
Strategy	Channel, Category Strategy and Planning	Product Planning, Development & Pricing Strategies	Store/Channel Objectives & Strategy Planning	Supply Chain Strategy and Planning	Financial Management and Planning	Corp. Planning
	Customer Relationship Planning and Strategies		Store/Channel Labor Strategy			Alliance Management
Tactics	Customer Insights	Vendor Relationship Strategies	Store/Channel Design and Layout	Distribution Oversight	Market Risk Management	Line of Business Planning
	Assessing Customer Satisfaction	Matching Supply and Demand	Inventory Planning	Outbound Logistics		Business Perf. Mgmt.
	Event, Promotion Strategy and Planning	Assortment and Space Planning Management and Execution			Corporate Finance and Controls	External Market Assessment
	Order Management	Vendor and Product Performance Execution and Management	Store Operations Management	Distribution Center		Organization and Process Design
Execution	Customer Account Servicing	Item Management	Store/Off-site Services Execution	Transportation Resources	Treasury	Legal and Regulatory
	Customer Directory	Product Directory	Inventory, Product Tracking and Tracing		Operations Back Office Financial	Indirect Procurement
					Accounting and GL	Real Estate, Facilities and Equipment
						HR Administration
						Develop and Operate IT Systems

Illustrative Retail Client

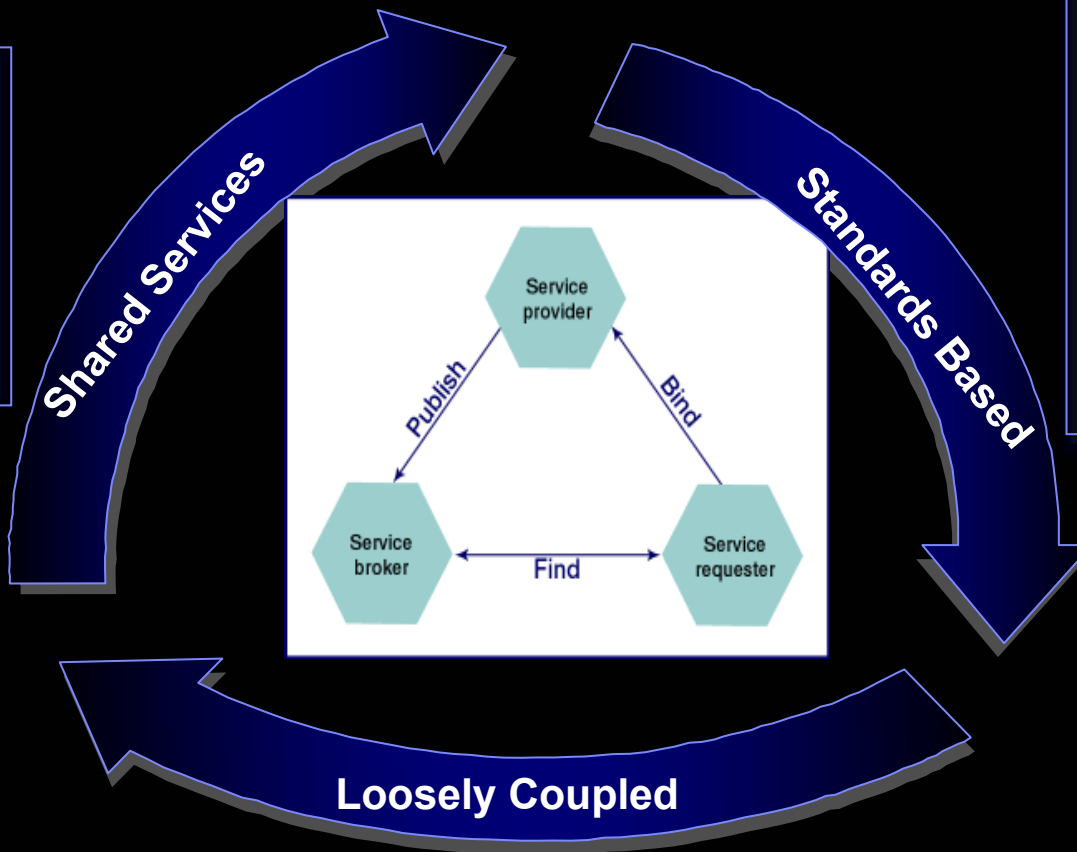
Evolution of Software Modeling

Business Semantics



Web Services Accelerates the Move Towards Service-Oriented Architectures

Allows individual software assets to become reusable building blocks



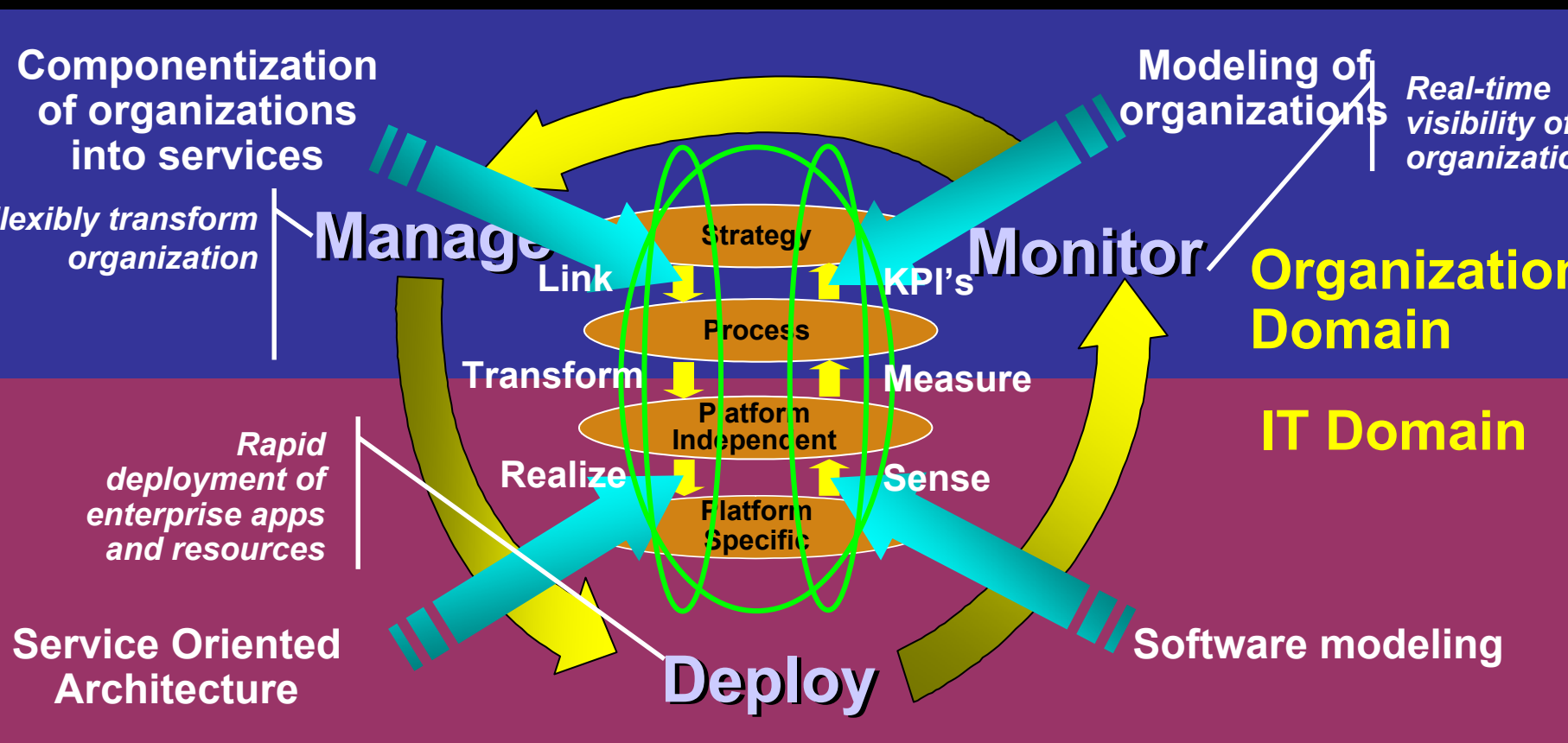
Leverages open standards to represent software assets as services

- XML
- SOAP
- WSDL
- UDDI

Optimize interdependence between services components

Convergence of the Trends

Applications will be deployed, monitored and managed through the manipulation of multi-level models



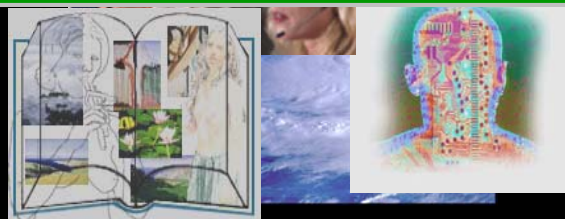
Accurately and reliably capture and translate organization intent into IT solutions (**Business / IT fusion**)

Information Technology



Value Enablement

Growing impact on people and businesses



Getting intelligent

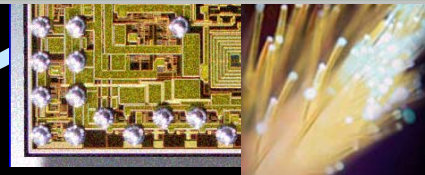
Core Technology



Better, faster, cheaper !



Infrastructure



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