

e-business Trends and Research Challenges

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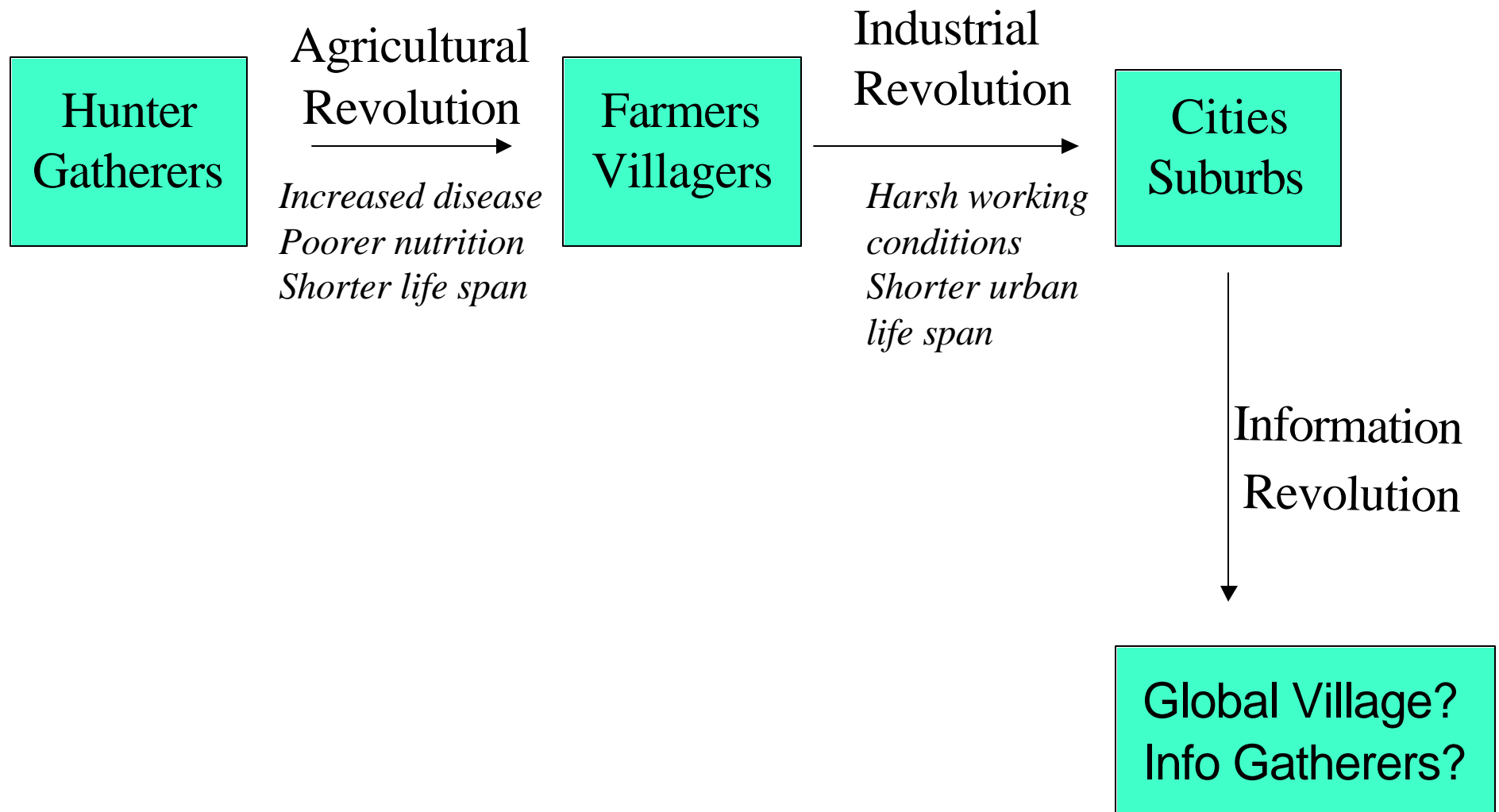
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e-business as a Research Topic

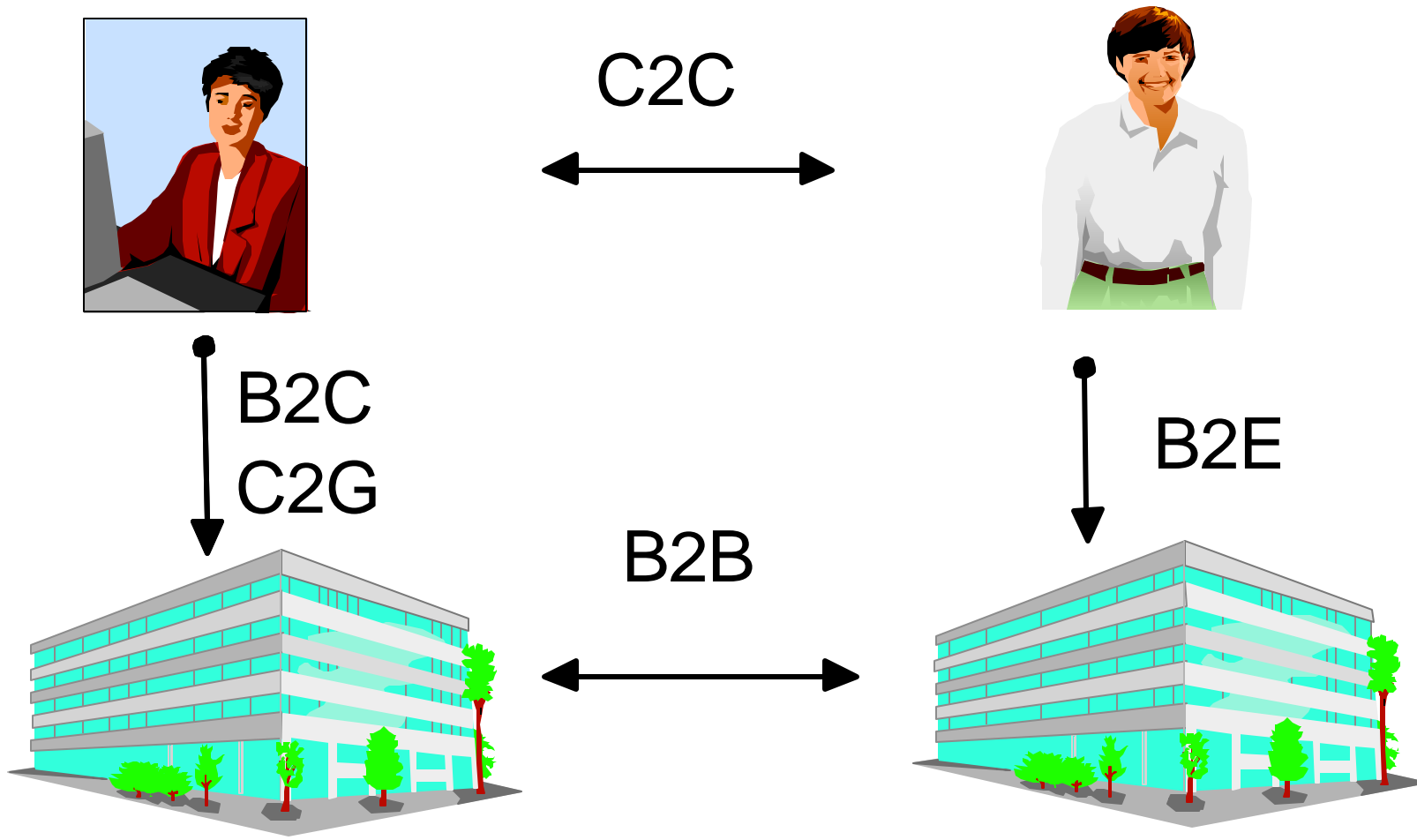
- e-business will be the main driving force for progress and deployment in IT.
 - ▶ technical computing, social uses important
- e-business will force issues of scale, scope, generality, agility, reliability
- e-business will cause significant social and economic changes that demand analysis and action
- e-business technologies will reshape directions of research institutions

FORECASTS AND TRENDS

Progress - The Long View



Forms of Commerce

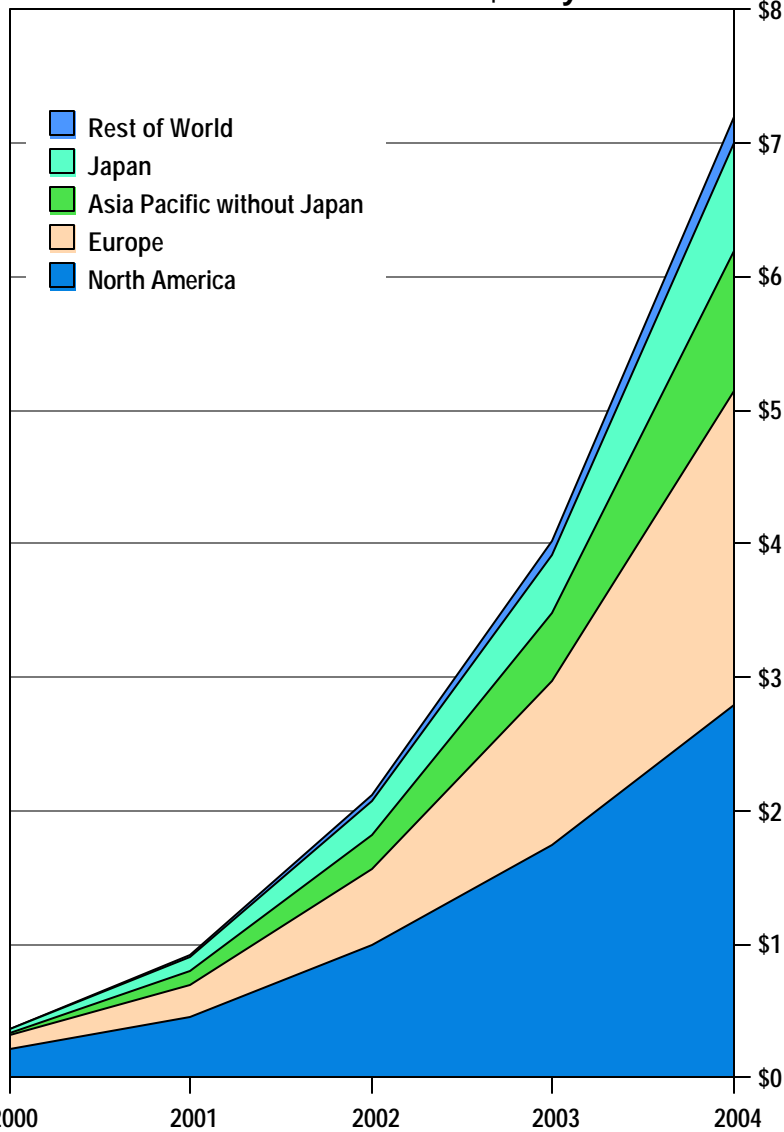


Growth Prediction Summary

- E-Commerce Growth 1995-1999:
 - ▶ CAGR=**175%** => doubling time < 9 months
- Forrester (2000) estimate: **\$6.9T** in 2004
- Jupiter (2000): **Online B2B** is likely to increase from 3% to **42% of total B2B** domestic trade over next 5 years
 - ▶ In 5 major industries over 50% of total B2B online by 2004 (aerospace&defense, chemicals, computer &telecom equipment, electronics&motor vehicles, parts)
- M-Business: number of **cellphones** able to access digital info **surpasses** number of **PCs** in 2003

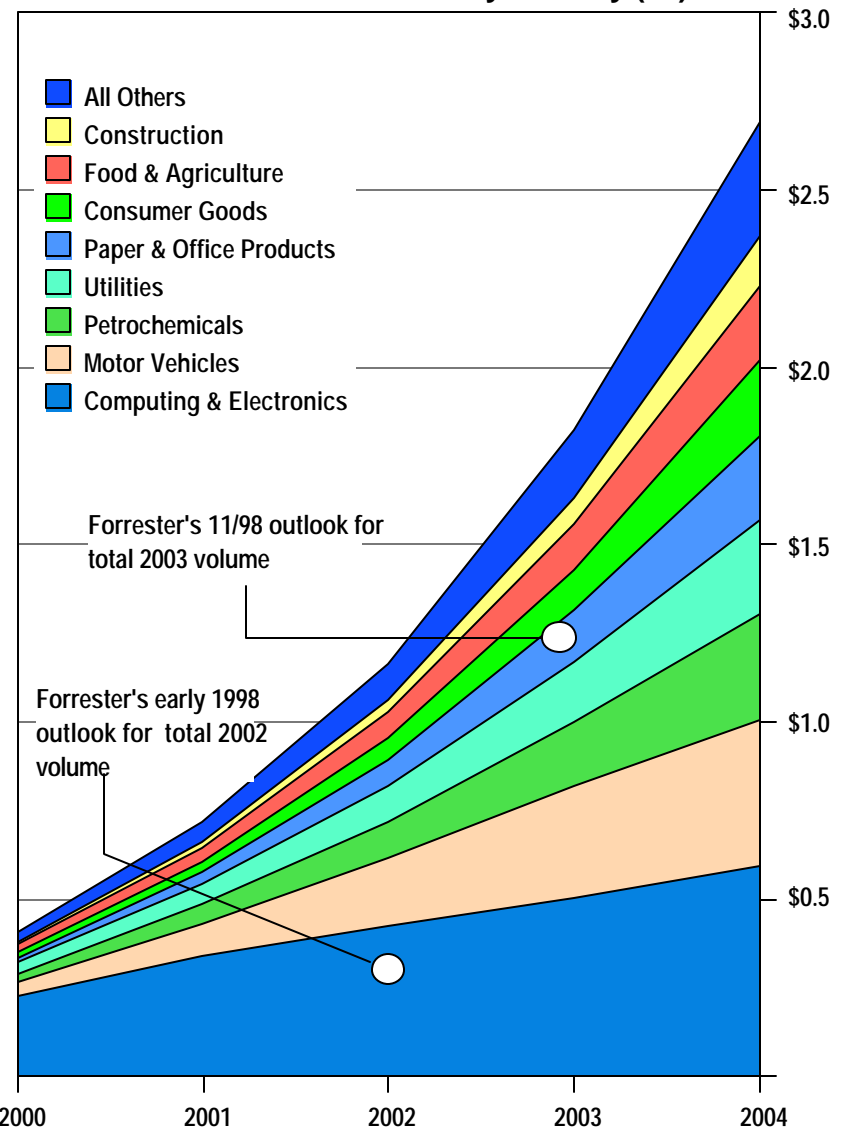
EC by Region and Industry Sector

Global B2B Trade will Reach \$7T by 2004



Source: Gartner Group, 1/31/00

US B2B e-business Growth by Industry (\$T)



Source: Forrester Research, 2/00

Some Inferences

- Exponential growth
 - ▶ errors not significant
 - if growth rate is 175%, just shift the time axis a little
 - ▶ what is the asymptote, where is the knee
 - ▶ the dot-bomb collapse only puts a kink in the curves
- Government implications
 - ▶ tax holidays won't last long
 - ▶ globalization concerns will boil over
 - ▶ "interesting" economic shifts will occur anyway
- Social implications
 - ▶ further blending of economic, political, social spheres
 - ▶ time scale ~10 years

Phases of Public Excitement

- B2C
- Portals
- B2B
- e-Marketplaces
- e-business
- Pervasive e-commerce
- Service-Oriented Commerce

Phases of Public Excitement and Technical Challenges

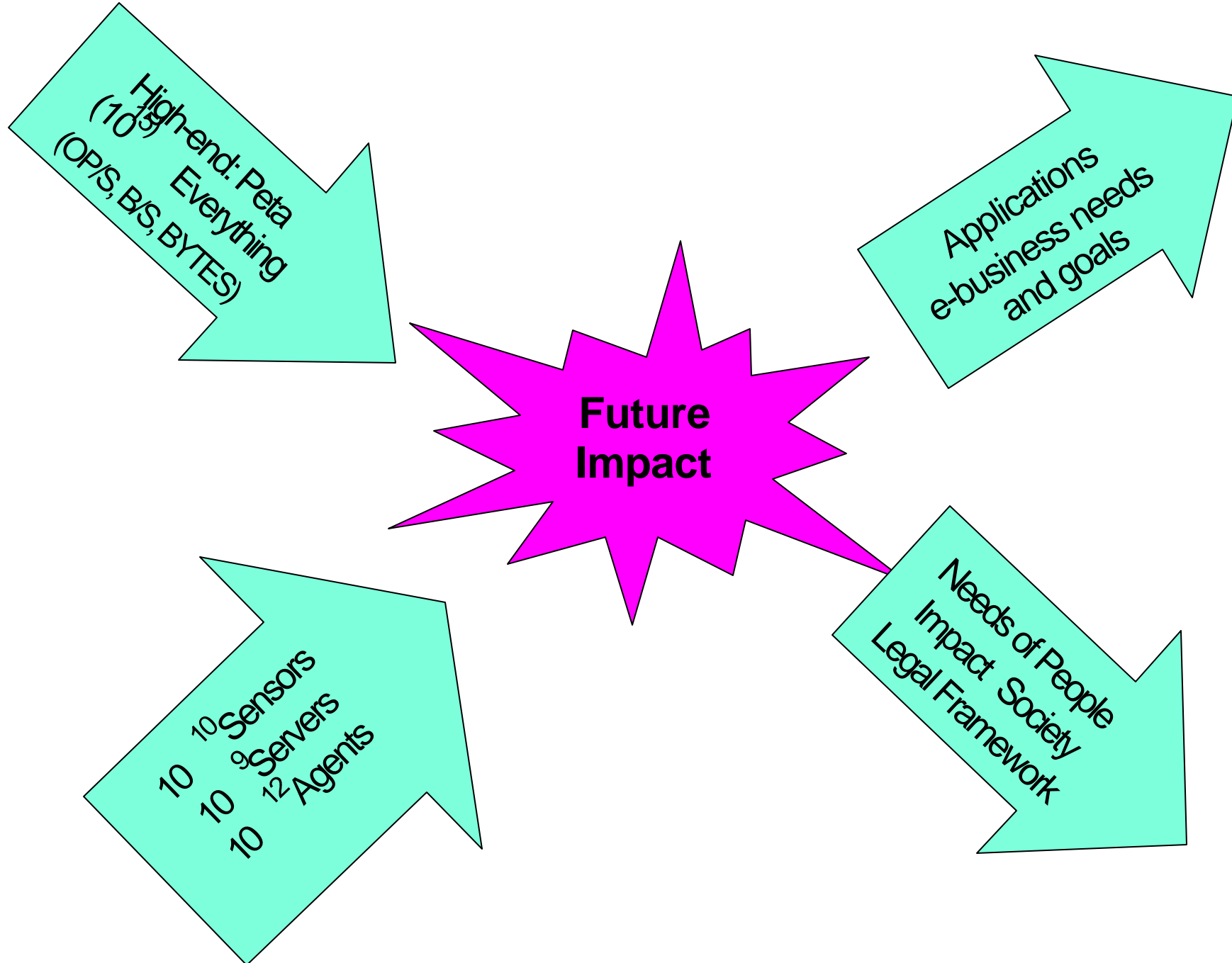
- B2C: storefront, images, payment, auction, authentication, privacy
- Portals: content, collaboration
- B2B: protocols, processes, robustness
- e-Marketplaces: negotiation, services, databases
- e-business: business process, models, stability, inter-organizational federated computing
- Pervasive e-commerce: scale, user experience, application and content adaptation
- Service-Oriented Commerce: highly distributed computing, management

COMPUTING TECHNOLOGY

PUSHES:

**Hardware, Software,
Systems, Services**

Drivers



Advancing Technology

	Typical Today	Coming Soon (2003-2005)	2010?
Access bandwidth	56 kb/s	Mb/s	100Mb/s - 1 Gb/s
Backbone b/w	155 Mb/s	622Mb/s ~ 2.5Gb/s ~ Tb/s	Pb/s
Intercontinental b/w	45 Mb/s	155Mb/s ~ 2.5Gb/s ~ 80+ Gb/s	many Tb/s
Wireless	9.6 ~ 32 kb/s	.144-2Mb/s	100 Mb/s-Gb/s
Enterprise DB size	10 TB	100 TB ~ PB	10PB +
Super computing	GIPS	3 TIPS ~ 100 TIPS ~ 1 PFLOPS	100 PFLOPS
Display	.5 Mpixel, .5 sqft	9 Mpixel, 60 sqft	more

$k=10^3$, $M=10^6$, $G=10^9$, $T=10^{12}$, $P=10^{15}$

Applications are the Driver

- In a world of plenty, some optimality concerns will be less interesting
 - ▶ wasting a factor of 2 or even 10 may be OK
 - unless it's on a tiny device
 - ▶ but orders of N will still matter
- Building applications that do what people want will be a continuing requirement
 - ▶ do the right thing
 - ▶ do it in a convenient way and place
 - ▶ do it always (24/7 the default, downtime a sin)
- Progress is captured in software
 - ▶ methodologies and code

Application Structures Will Change

- Application structures
 - ▶ Data-Centric
 - ▶ Distributed
 - ▶ Managed (with guarantees)
 - ▶ Dynamic binding
 - ▶ APIs and message protocols
 - ▶ Adaptation to usage environment (client/server, proxy/gadget, etc.)
 - ▶ Amateur programming and debugging
- Usual CS issues
 - ▶ Architecture
 - ▶ Engineering
 - ▶ Analysis
 - ▶ Tools
- DRIVEN BY THE DOMAIN
 - ▶ deep knowledge. not shallow.

Role of Software

- Traditional
 - ▶ structure of software is determined by structure of the organization that creates it

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- **New**
 - ▶ **structure of the organization is determined by structure of the software that it uses**
- ***Newer***
 - ▶ ***the businesses that an organization participates in are determined by the software and services it can use***

Business Models

- The next frontier
- Basis of an organization's entire activity
 - ▶ how it is structured
 - ▶ how it makes profit (economic, social, etc.)
- Patentability
 - ▶ and rigorous specification
- Technical "object"
 - ▶ manipulation, variation, control
 - ▶ distributed execution

Data-Centric Computing

- Bigger bit pipes
- New sources and types of data
- More information to analyze:
 - ▶ real time and historical
 - ▶ human-oriented communications
- Knowledge management as competitive tool
- Understanding and decisions

e-business PULLS: Business Evolution and Revolution

What Does Business Demand?

- **Faster**
 - ▶ tempo, time to market
- **Cheaper**
 - ▶ more efficient
- **Broader**
 - ▶ more global, more partners, suppliers, customer
- **Deeper**
 - ▶ optimization, strategy

Macro Issues

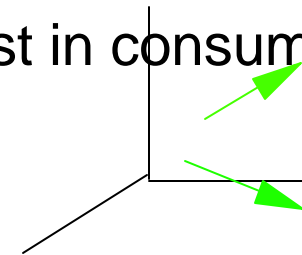
- Business will experiment and invest because
 - ▶ opportunities/greed
 - ▶ competition/fear
- Implications uncertain for society, economy, workforce, community
 - ▶ big changes in industry sectors and national positions
 - ▶ realizations will come late and reactions unpredictable
- Likely legal or political responses
 - ▶ will induce delay, cost, or circumvention
- Hard to put the genie back in the bottle

Evolutionary Trajectories

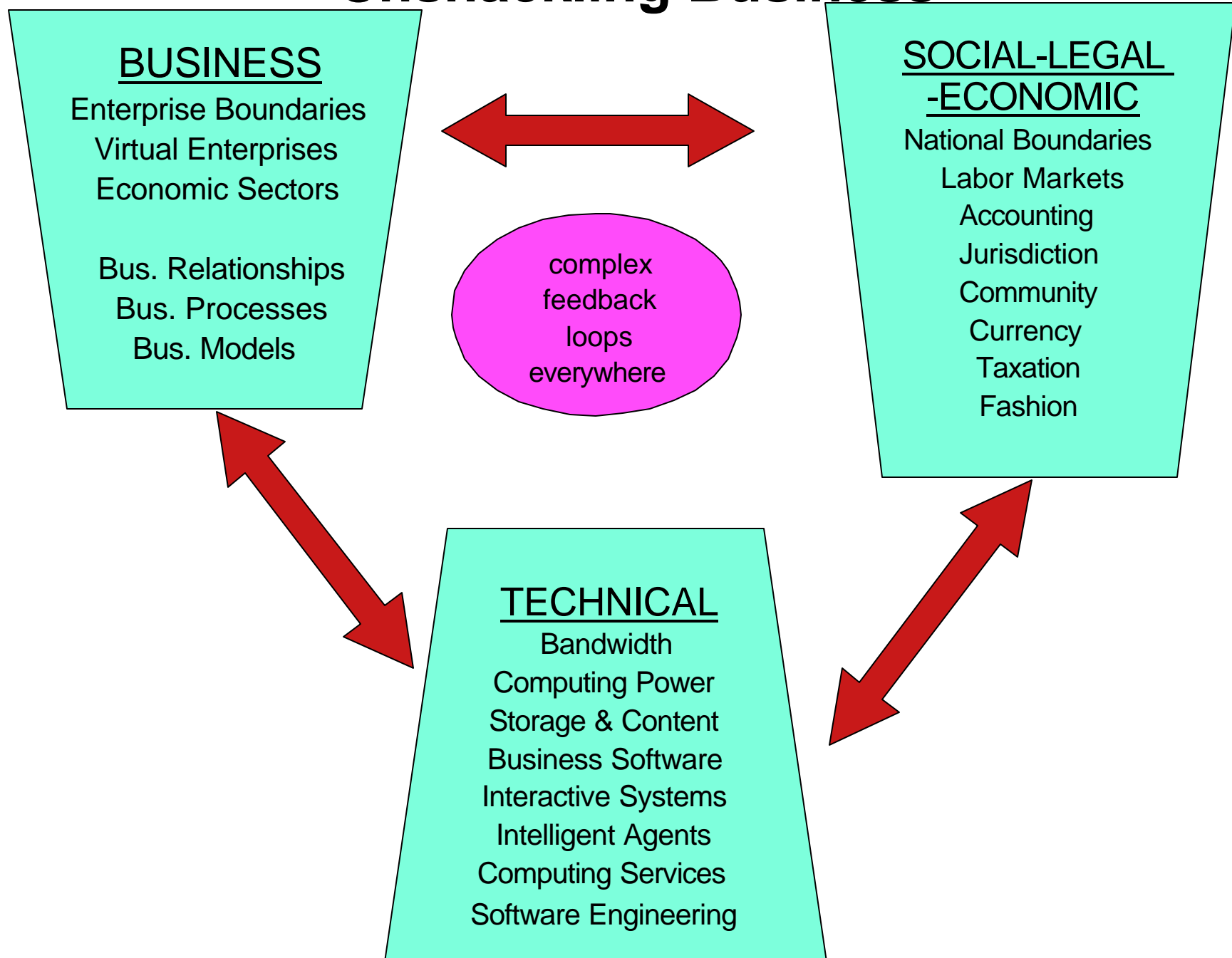
- Different paths will be followed by different
 - ▶ divisions
 - ▶ firms
 - ▶ sectors
 - ▶ nations
- Impacts will be felt by leaders in each direction
 - ▶ first mover advantage
 - ▶ but other industries can learn and follow

Evolutionary Trends of E-Commerce

1. sell ~ buy ~ trade
2. fixed price ~ auction ~ negotiate
3. location insensitive (\$\$,English) ~ localized ~ culturally sensitive
4. manual buying? ~ semiautomated ~ agent-controlled
5. standard goods ~ parametrized goods ~ ?build to order ~ ?design to order
6. 1:1 ~ n:1 ~ n:m interactions (marketplaces)
7. B2C ~ B2B ~ B2B2B, C2C, C2B (technology often first in consumer space)
8. experiment ~ business sensitive ~ core business critical
9. fixed plan ~ decision procedure ~ deep computing
10. EDI ~ Web-EDI ~ Internet EDI
11. Run it yourself ~ hosting
12. ISP ~ ASP ~ CSP
13. roll your own ~ commercial platforms ~ processes ~ externalized svcs
14. US ~ ?Europe ~ AP (but starting to change)



The Dynamo And The Internet: Unshackling Business



RESEARCH THEMES AND CHALLENGES

Some Research Challenges

- How to adapt to the world of mobile gadgets
- How to provide useful natural HCI for the billions
- How to maintain (achieve?) privacy
- How to be a dynamic e-business
- How to optimize business plans & decisions
- How to build applications that work, quickly
- How to optimize computing in a utility world
- How to structure applications for services
- How to provide access to world's information
- How to increase the world's knowledge
- How to cope with skills shortages and globalization

Some IBM Research Areas

- Institute for Advanced Commerce
- Systems technologies for manageability, availability, reliability, performance, security
- Security
- e-Utilities
- Content Management
- E-Commerce Platforms
- E-Commerce Tools and Services
- Supply Chains and Optimization
- Mobile Commerce
- Dynamic e-business
- Privacy Enabling Technologies
- Intelligent Learning Agents and 'Bots
- Experimental Economics

Institute for Advanced Commerce

- Transition to E-Commerce is a once-in-a-generation shift, not just a point technology or profitable application
 - ▶ deep issues across many scholarly topics
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CHALLENGES:

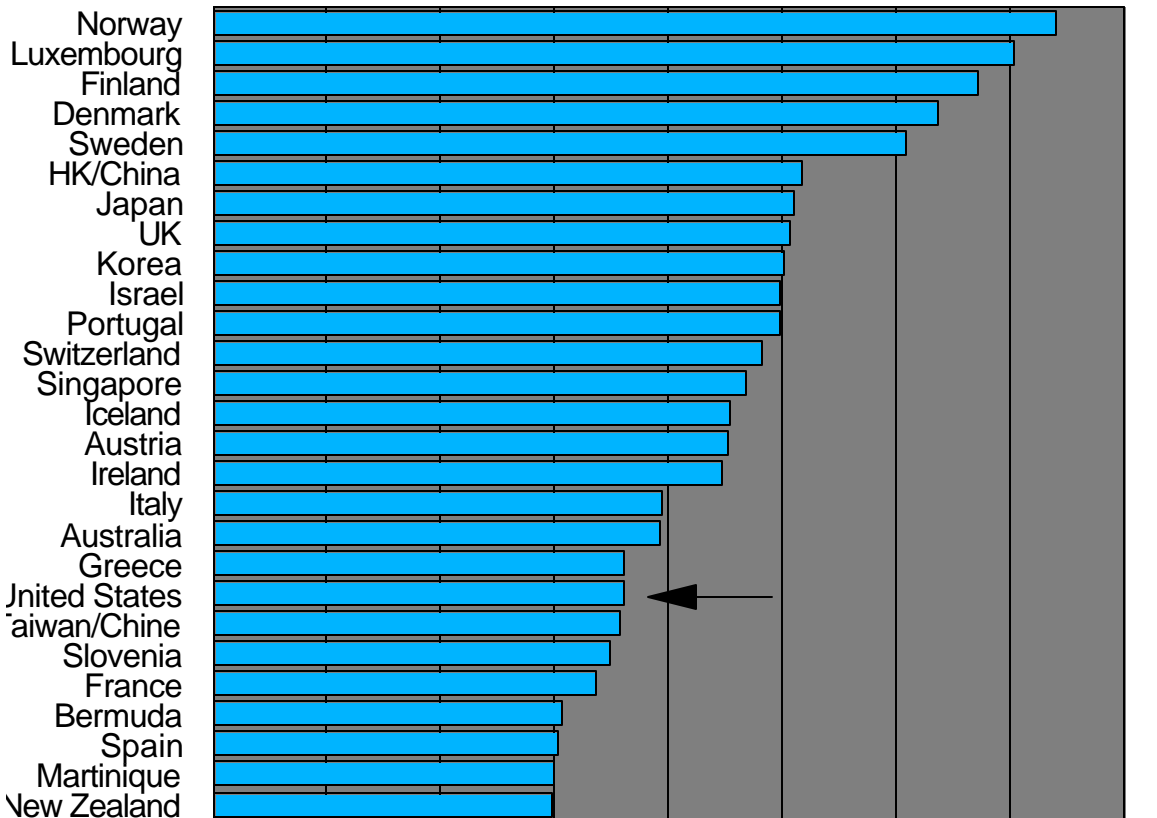
**How to adapt to the world of
mobile gadgets**

**How to provide useful natural
HCI for the billions
(Pervasive Devices and
Mobile Commerce)**

Mobile Phone Penetration

Mobile phone penetration outside NA is higher and grows faster
 due mainly to differences in existing wireline infrastructure, pricing, standards, monopolies

Penetration rates per country (as of year 2000)

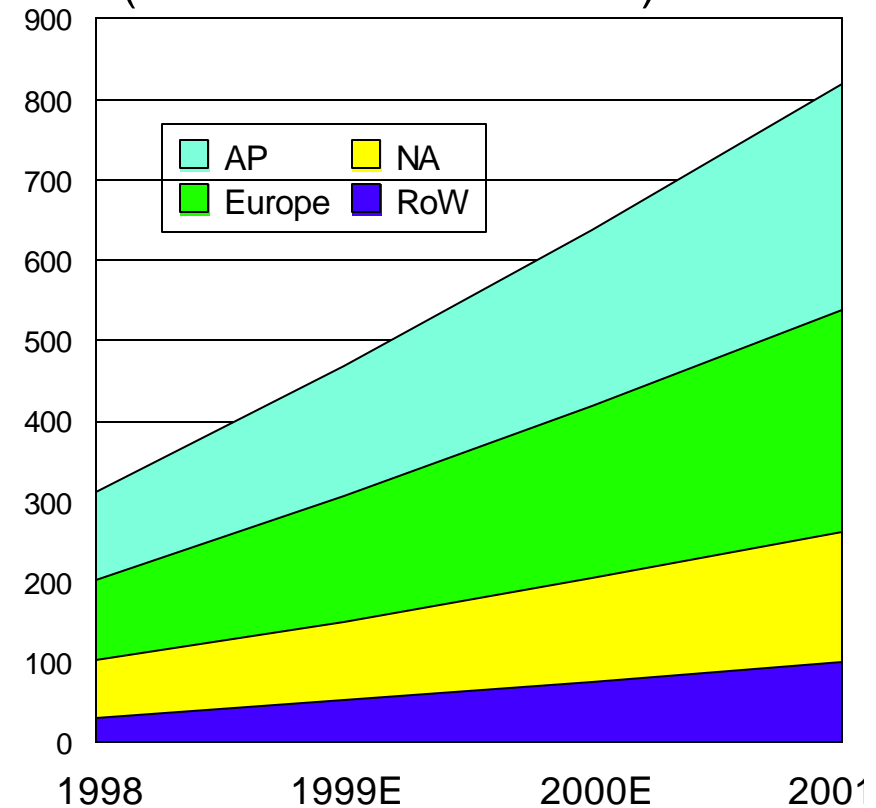


0 10 20 30 40 50 60 70 80

Source: ITU

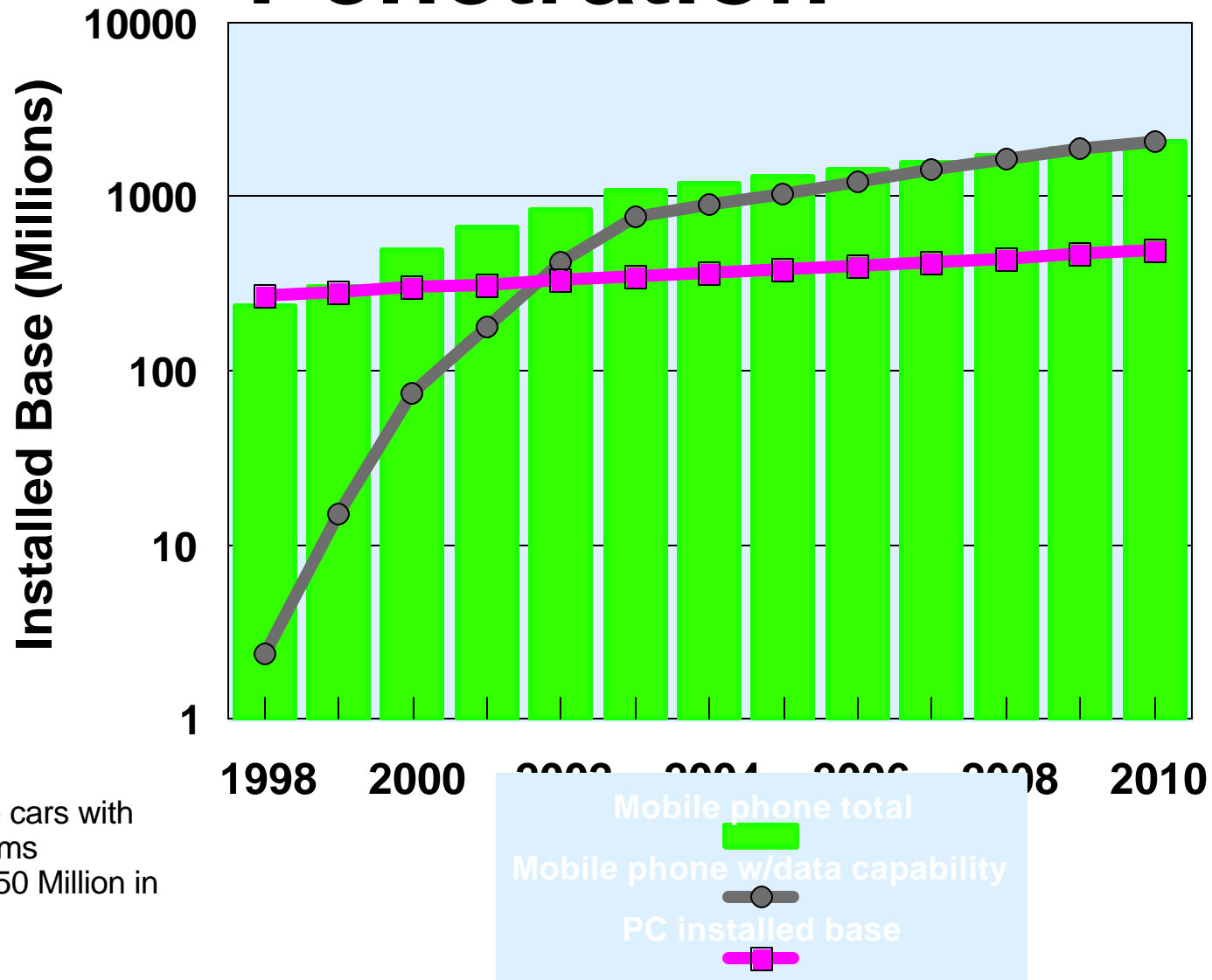
Terminals per 100 people

(millions of subscribers)



Source: Goldman Sachs

WW Mobile Phone vs. PC Penetration

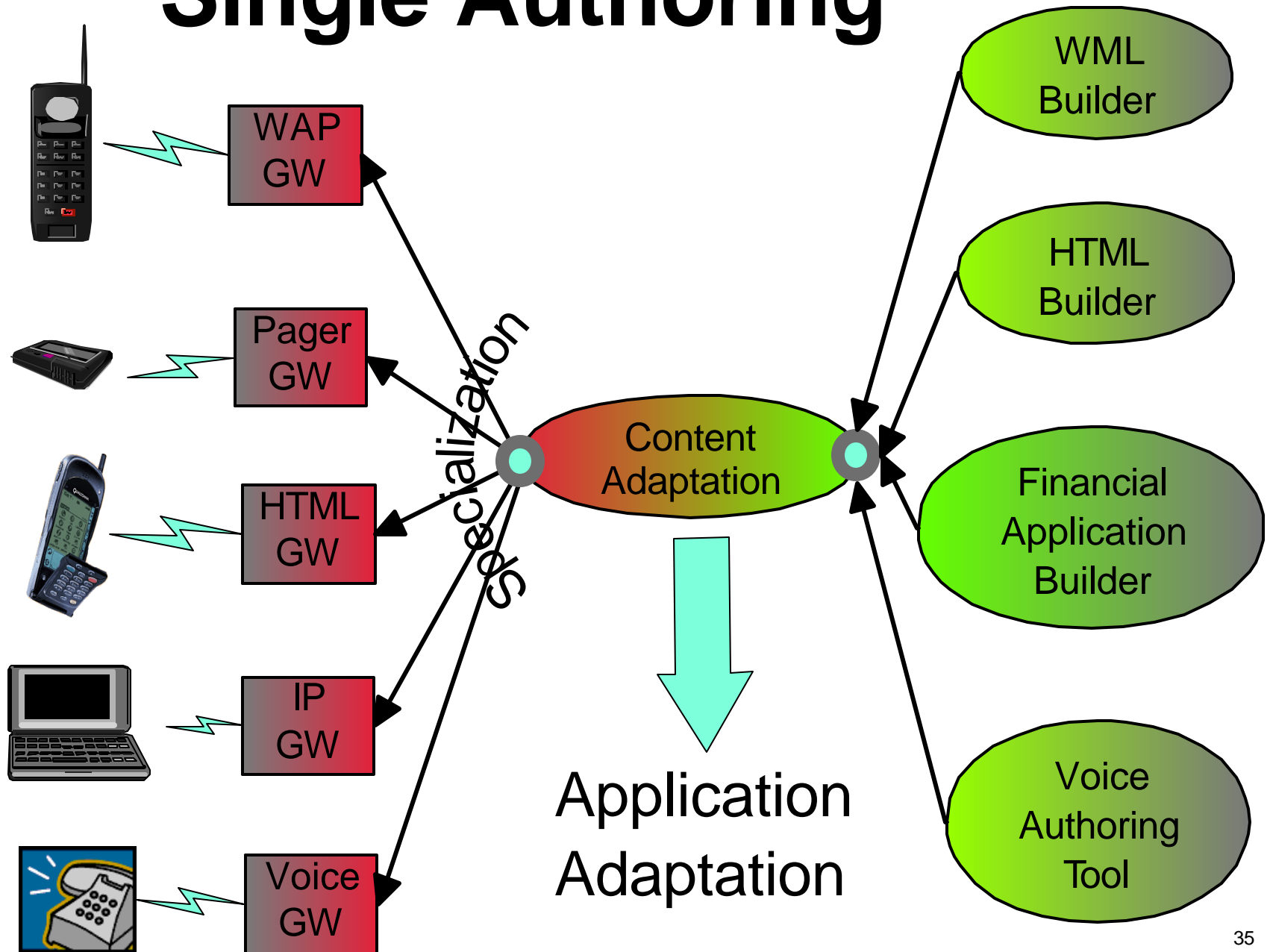


Note: Does not include cars with driver information systems (approximately 8% of 150 Million in 2006 - Jupiter)

Main Issues for M-Business

- Ubiquity
 - ▶ new demographics
- Always online
 - ▶ people available for business opportunities
- Location sensitivity
- Authentication and personalization
- Adaptation to usage environment
(client/server, proxy/gadget, etc.)

Application Development - Single Authoring



Interaction Expectations

- Multimodal
 - ▶ text, image
 - adapted for the various screens
 - ▶ spoken and understood speech
 - (it's a cellphone!)
 - ▶ video (eventually)
- Seamless transitions among them

Business Process Adaptation - Changing the process based on device capabilities

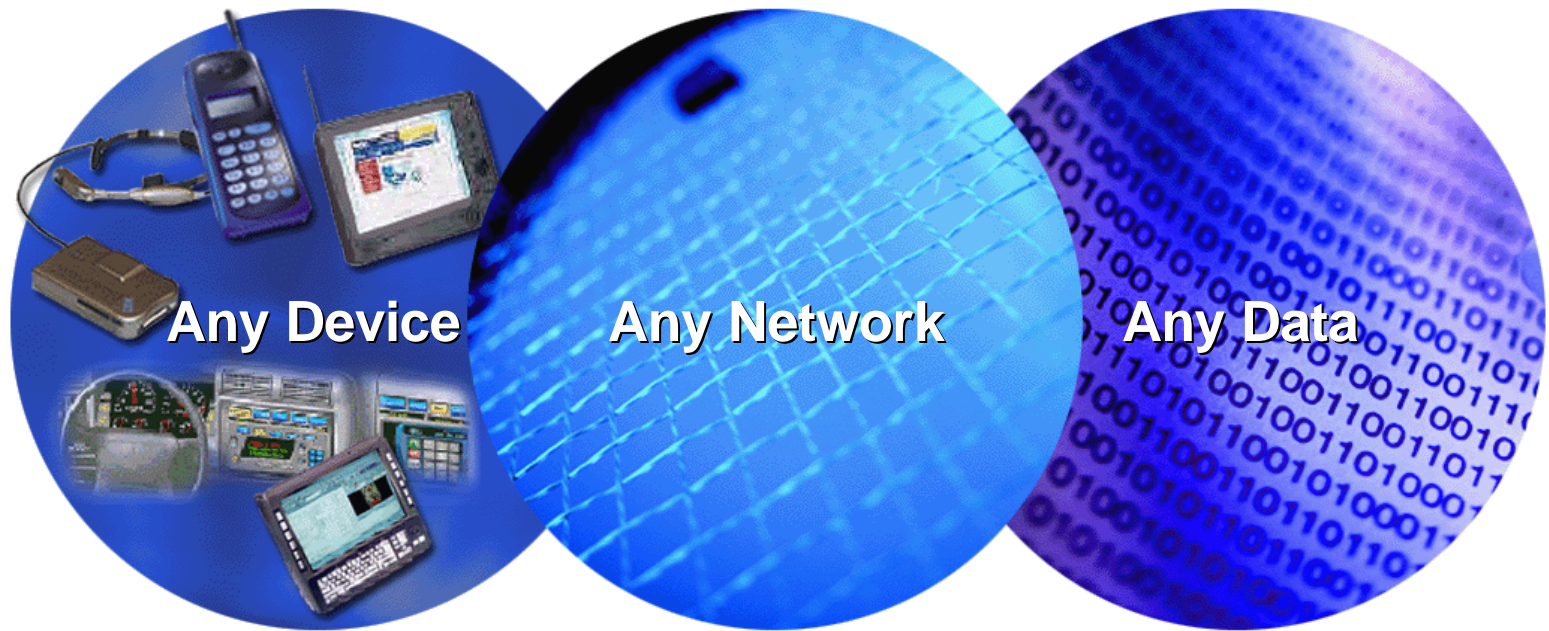
- How would you sell 50 types of socks?
 - ▶ on a high-resolution screen
 - show them all
 - ▶ on a PDA:
 - use profile, outline best 3 choices
 - ▶ over a phone
 - app asks questions, describes best sock
- How would you auction a painting?
 - ▶ on a high-resolution screen
 - pan, zoom
 - beep when outbid
 - ▶ on a PDA
 - view of signature and guarantee
 - flash when outbid
 - ▶ over a phone
 - discuss with expert
 - ring when outbid

Challenge of Demographics

Changing the User Model

- Billions of users in 2010
 - ▶ Most never saw the old Web
 - ▶ Most never heard of English
 - ▶ Many are illiterate
 - ▶ Will not be techno-tolerant
 - how explain "Bus Error Core Dumped"?
- Need multimodal interactions
 - ▶ complex user and communication models
 - ▶ application generalization
- And lots of computing

The Vision



- Useful
- Always on, always available
- Personal
- Reduced complexity
- End-to-end management
- Easy Authoring
- Secure, reliable

CHALLENGE:

**How to maintain (achieve?)
Privacy**

Privacy

- Privacy specifically deals with personal information (individual people)
 - ▶ The right to be left alone -- Louis Brandeis
 - ▶ "Get Over It" -- Scott McNealy, Sun
- Differing expectations
 - ▶ societal (rights of individual vs demands of community)
 - ▶ political
 - ▶ legal (protections, circumstances)

Privacy

- Rising social and legal concern
 - ▶ political decisions and impacts
 - ▶ who owns the information
 - personal vs human right
 - different views in Europe and US
- Technological tug of war
 - ▶ individuals can negotiate, protect selves
 - ▶ enterprises need to manage data as they agreed
 - ▶ how to ensure right thing is being done?

Privacy (*continued*)

- Technical means for assuring own privacy
 - ▶ anonymity, pseudonymity
 - ▶ randomization
 - ▶ restriction of information
- Means for an enterprise to protect privacy
 - ▶ methodological and organizational
 - ▶ technical
 - database systems, datamining approaches
 - data flow tracking, labeling
 - ▶ auditable/demonstrable/provable?

Information Management Complications

- When may a datum be used, how may it be used?
 - ▶ specific permissions
 - privacy policy tracking (what agreement made?)
 - permitted uses (statistics, marketing, sale)
 - forbidden uses (e.g., competitive info, adult products)
 - ▶ inherited permissions
 - mergers, information purchases
 - ▶ default permissions (differ by country, opt-in/opt-out)
 - ▶ lifetimes
- What does a *join* look like?
- Usage tracking for auditing and payment

CHALLENGES:

**How to be a dynamic
e-business**

**How to optimize business
plans & decisions**

Dynamic e-Business

- Requirements
 - ▶ speed (inside the decision loop)
 - ▶ automation
 - with appropriate tasks by people!
 - ▶ depth and scope of interactions
- Changes in role
 - ▶ CEO: strategy and resource decisions
 - ▶ COO: tactics and planning
 - ▶ CIO: most of the management of execution
 - ▶ partners: most of the heavy lifting

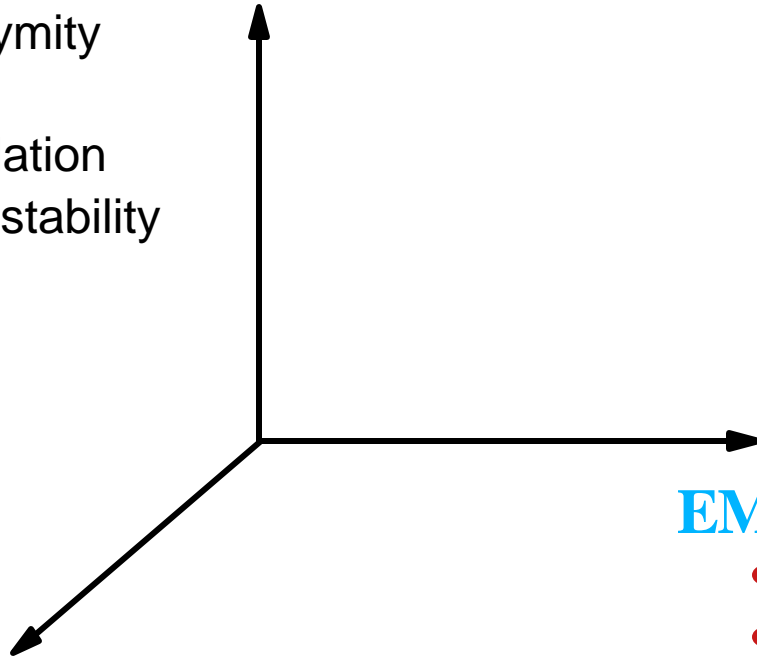
Ad Hoc Interactions

- Search and discovery
- Negotiation and agreement
 - ▶ business and technical issues Standards for interactions (EDI->ebXML)
- Legal issues
 - ▶ Business and legal contracts on demand
- Operational constraints and demands
 - ▶ New models for transactions
 - ▶ Trading partner agreements
- External services
-

What are E-Markets all about

EM Properties (Value props)

- Liquidity
- Anonymity
- Trust
- Regulation
- Price stability



EM Roles & Interactions

- Players & Protocols
 - Buyers, sellers, brokers, regulators, escrow services
- Revenue Models

EM Commerce Functions

- Organizing Inventory
- Searching
- Matchmaking
- Negotiation
- Settlement
- Fulfillment

CHALLENGES:

**How to build applications that
work, quickly**

**How to optimize computing in
a utility world**

**How to structure applications
for services**

New Service Businesses

- Assumption: the Network is here and it works
 - ▶ distributed execution is a realistic fact of life
 - ▶ can utilize distant services as easily as local ones
- Differential advantage
 - ▶ some producers of software do it better -> Independent Software Vendors
 - ▶ some producers of services do it better -> Independent Service Vendors
 - ▶ some operators of servers do it better -> outsourcing, Application Service Providers
 - ▶ some understand and implement basic business pieces better -> Business Process Outsourcers

Dynamic Interactions

- Standard syntax for interfaces
 - ▶ XML is default answer
 - ▶ but how many DTDs will there be?
- Well defined service interfaces
 - ▶ not yet - they change abruptly
 - ▶ who controls, owns, checks?
 - ▶ what to do if they do change
- Service content
 - ▶ no standard representation, description, etc.
 - ▶ DTD is just the start
- Service expectations and quality
 - ▶ SLAs (service level agreements)
 - ▶ appearance in the code?

Dynamic Evolution

- We have trouble running single systems
 - ▶ now we presume to offer widely distributed generalization
- Load balance and capability sharing
 - ▶ Management of billions of distributed objects
- Evolution of capability in face of
 - ▶ ongoing search and discovery
 - ▶ business challenges and competition
 - ▶ mission creep
 - ▶ technology improvements
 - ▶ new service offerings

Distributed Businesses

- Sharing become a reality
 - ▶ geographic issues
 - ▶ separate control
 - ▶ mergers and de-mergers
 - ▶ short and long term
- Virtual enterprises
- Physically distributed firms
- Marketplaces
 - ▶ "next big thing" in E-Commerce
 - ▶ controlled shared environment with
 - shifting roles and members
 - changing services and offerings
 - competition and cooperation

Roles of Objects

- Devices are Objects
- User models are Objects
- Business Models are Objects
- Business processes are effected by changing state of such objects

Distributed Dynamic Everything Everywhere

Business Processes

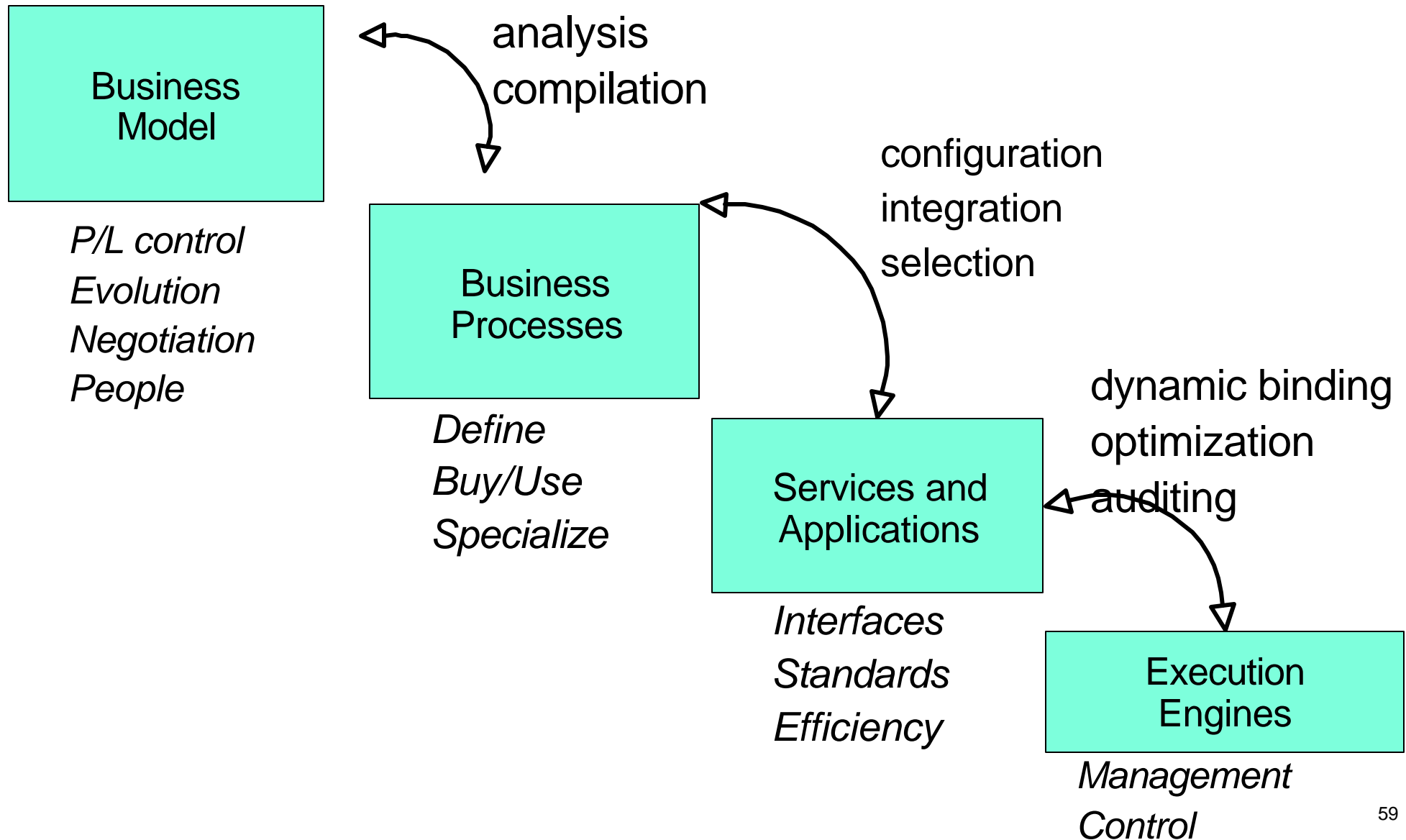
- Fundamental unit of activity
 - ▶ some quite standard
 - ▶ some specific to the business
- Mixture of automated and human activities
 - ▶ Roles and responsibilities
 - ▶ monitoring, execution, etc.
- Variants and sharing
- State and management
 - OBJECTS!

E-Utilities as Basic Infrastructure

Engineering Software to be Managed as a Service

- Need for methodologies, tools to create service-ready manageable objects

Future e-business Software - The New Waterfall Diagram



CHALLENGES:

**How to provide access to
world's information**

**How to increase the world's
knowledge**

Data Flood and Glut

■ Flood

- ▶ Online information will be measured in exabytes (10^{18} bytes)
- ▶ New data measured in terabytes/sec
- ▶ Users will be numbered in billions (10^9)

■ Search

- ▶ $O(\text{users} * \text{data}) = 10^{28} \Rightarrow$ must be smarter

Knowledge

- Creation
- Management
- Discovery

CHALLENGE:

**How to beat the skills
shortage - training,
collaboration, globally**

Skill Improvement and Displacement

- Education vs training
- Just in time teams
- Just in time training
- Collaborative technologies
 - ▶ formal methodologies and sharing
- Better tools and reuse
 - ▶ standardized paradigms

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IAC Activities

- Organizing and Sponsoring conferences
 - ▶ (Privacy, Globalization, Negotiation Technology, Master's Degrees, Marketplaces; Economics, Information Computing, Economies, etc.)
- Research support for risky projects
 - ▶ (E-Commerce Intelligence, Advanced Negotiations, Privacy, Future E-C Transactions, Secure E-C document management)
 - ▶ successful projects enrich the platform
 - ▶ work closely with lead customers
- University relations
 - ▶ Faculty Partnership research awards
 - ▶ Visits, presentations, education conferences, etc.
 - ▶ Contests for best E-Commerce PhD Thesis Proposal
- Conference presentations and journal presentations
- Presentations to customers
- Interviews with press and IT analysts
- Creation of ACM SIGecom

INSTITUTE FOR Advanced Commerce: Eight Research Themes

- Evolving Marketplace
- Privacy
- Variable Prices and Negotiated Dealings
- Direct Business to Business Interactions
- Managing the End Customer
- Impact of Globalization
- Deep Computing for Commerce
- System Foundations

