



Global Technology Outlook (GTO)

Building Smarter Businesses

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Goals of the GTO

Early identification of significant technology trends:

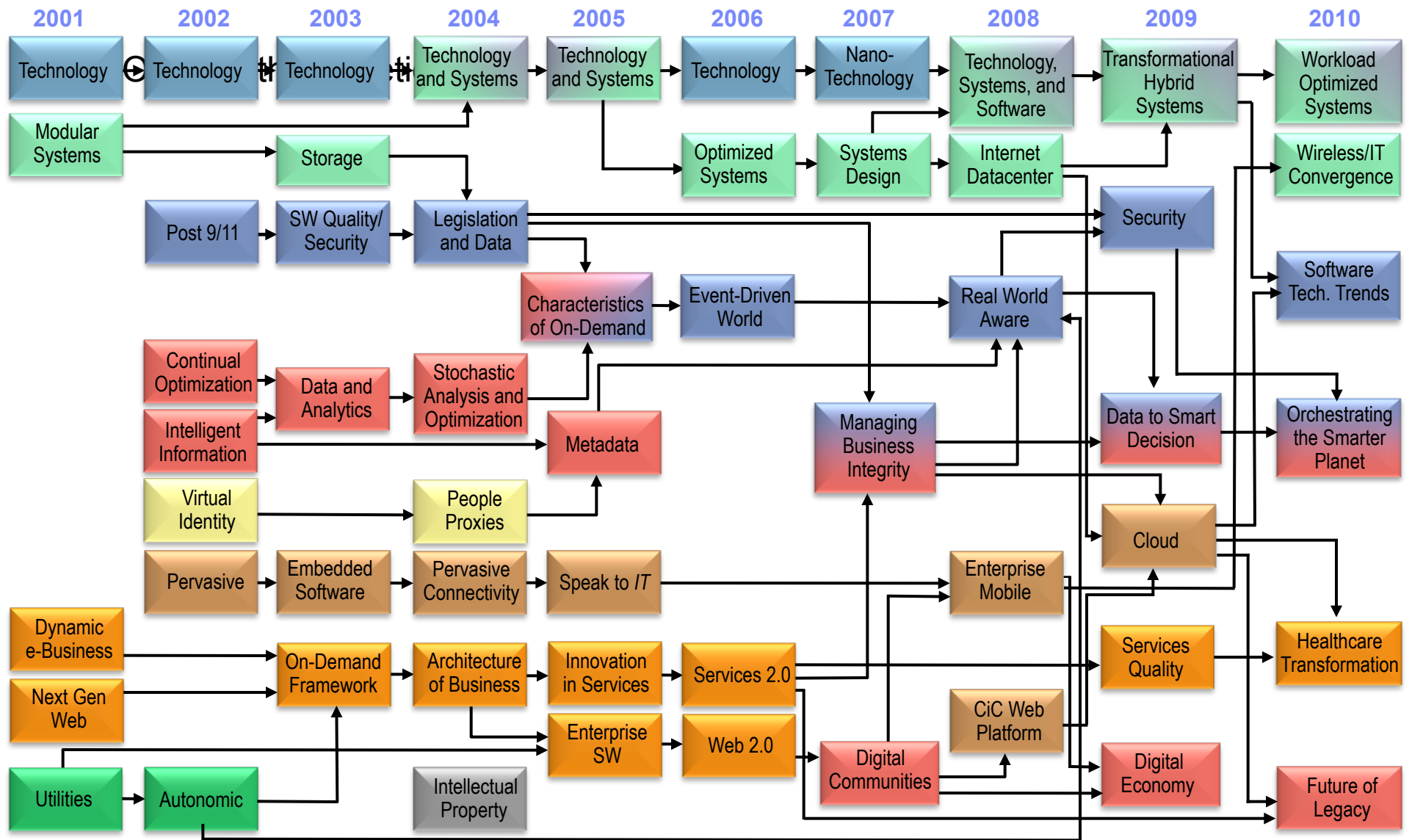
- Forward Looking (3 - 10 years out)
- High impact technologies and game changing products & services
- Disruptive changes to business / threshold crossings
- High potential to create new businesses

Work to understand how technology influences clients, businesses and industries

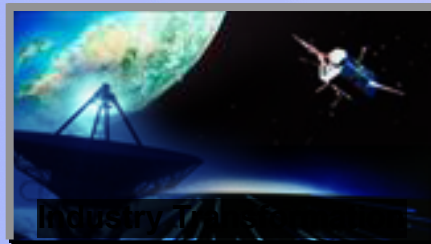
Deepen our understanding of how information technologies will evolve and how they might be exploited in the next five to ten years



The GTO has a direct impact on IBM's business and technical strategies

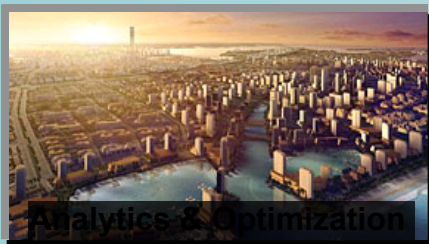


GTO 2010 chapters



1. Enabling Technologies for Healthcare Transformation

- Evidence-centric medicine, payment-for-outcomes



2. Orchestrating the Smarter Planet

- Models and model orchestration enable integrated operation and optimization



3. Software Technology Trends

- New development models, tools and methods transforming the SW industry

4. Future of Legacy

- Tools & services to "Identify, Improve and Operate" legacy



5. Convergence of IT and Wireless Infrastructure

- IT enabled wireless infrastructure optimizations

6. Workload Optimized Systems

- HW, SW co-design, integration, optimization



Resilient & intelligent technologies – including software platforms - will capture high-fidelity trusted information from the real world

Data Management, Visualization & Dynamic Control

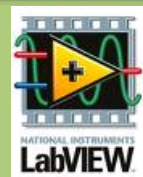
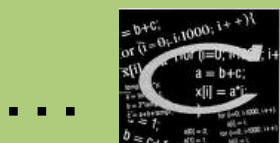
ORACLE
Sensor Edge

Windows Embedded

SAP SENSOR NETWORKS
SAP Auto-ID

IBM
WebSphere. software
Tivoli. software

Programming Environments



... **TinyOS** ...
Open-source SW

Physical Carriers

Satellites



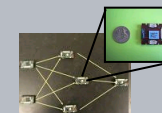
Cell phones



Measurement Instruments

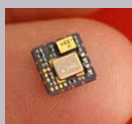


Wireless network nodes



Data Acquisition

GPS



Imaging



Standard sensors



Perceptive devices
(Self-Powered, Measure Compute, Communicate)





Real-time is a defining attribute for Smarter Planet solutions

Real-time, or progress toward real-time, is key to smart IT

"Smart computing adds to existing technologies new capabilities of real-time situational awareness and automated analysis."

– Forrester

"Operational technologies include event-driven and frequently real-time software applications for devices with embedded software."

– Gartner

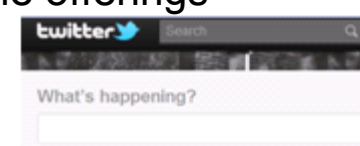
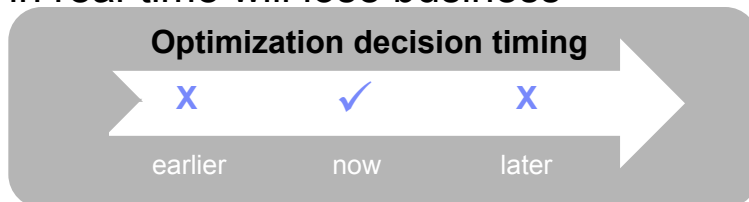
"Sophisticated analytics can substantially improve decision making... Such analytics have applications... to retailers that can use algorithms to optimize decision processes such as pricing in response to real-time in-store and online sales."

– McKinsey

Real-time will be a competitive differentiator for smart solutions in the 4th era

Companies with offers that do not operate in real-time will lose business

More and more companies have real-time offerings



Real-time is a key driver of the 4th era

The gathering, analyzing and optimal decision must all occur in real-time for Smart solution to work

Traffic optimization



Advanced flood prediction



Deep QA systems in healthcare



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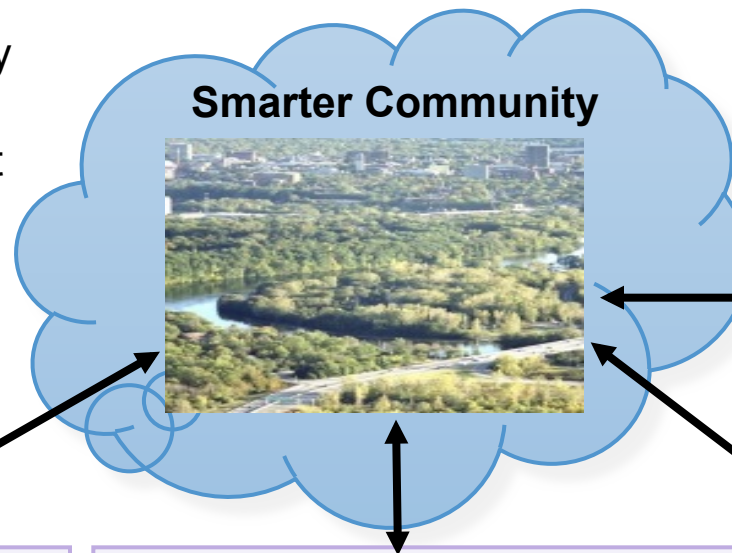
Human-assisted data capture will deliver situational intelligence & abilities for real-time interactions at the edge

Normal Situation

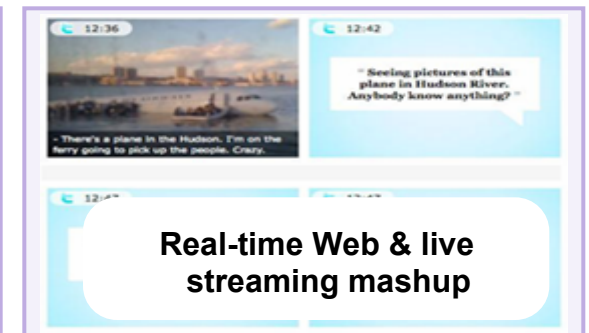
- Deploying smart sensors in public infrastructure and transportation for resiliency and daily monitoring
- Personal sensors to detect and alert on personal sensitivities or private emergency situations

Emergency responses

- Use texting, IM, Twitter, blogs, maps mashups, etc

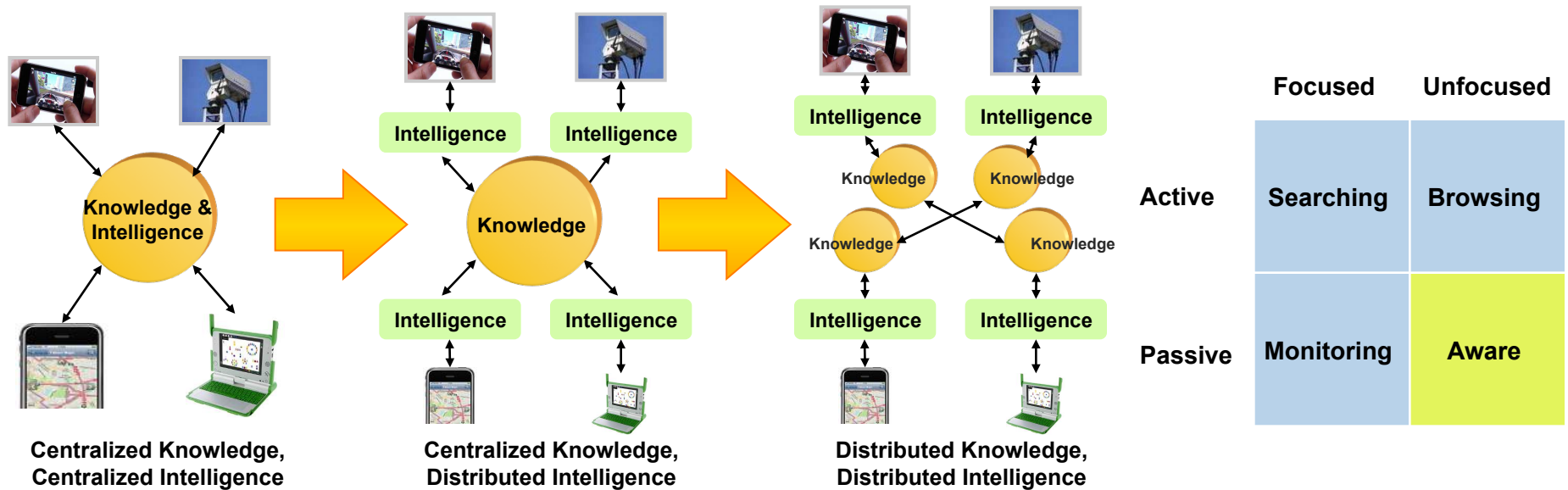


Google Maps and Twitter are essential information resource for California fires





Real-time Web -- enabling ambient awareness & situational intelligence -- has become a catalyst for smart interactions



Examples of real-time Web for smart interactions



Real-time search



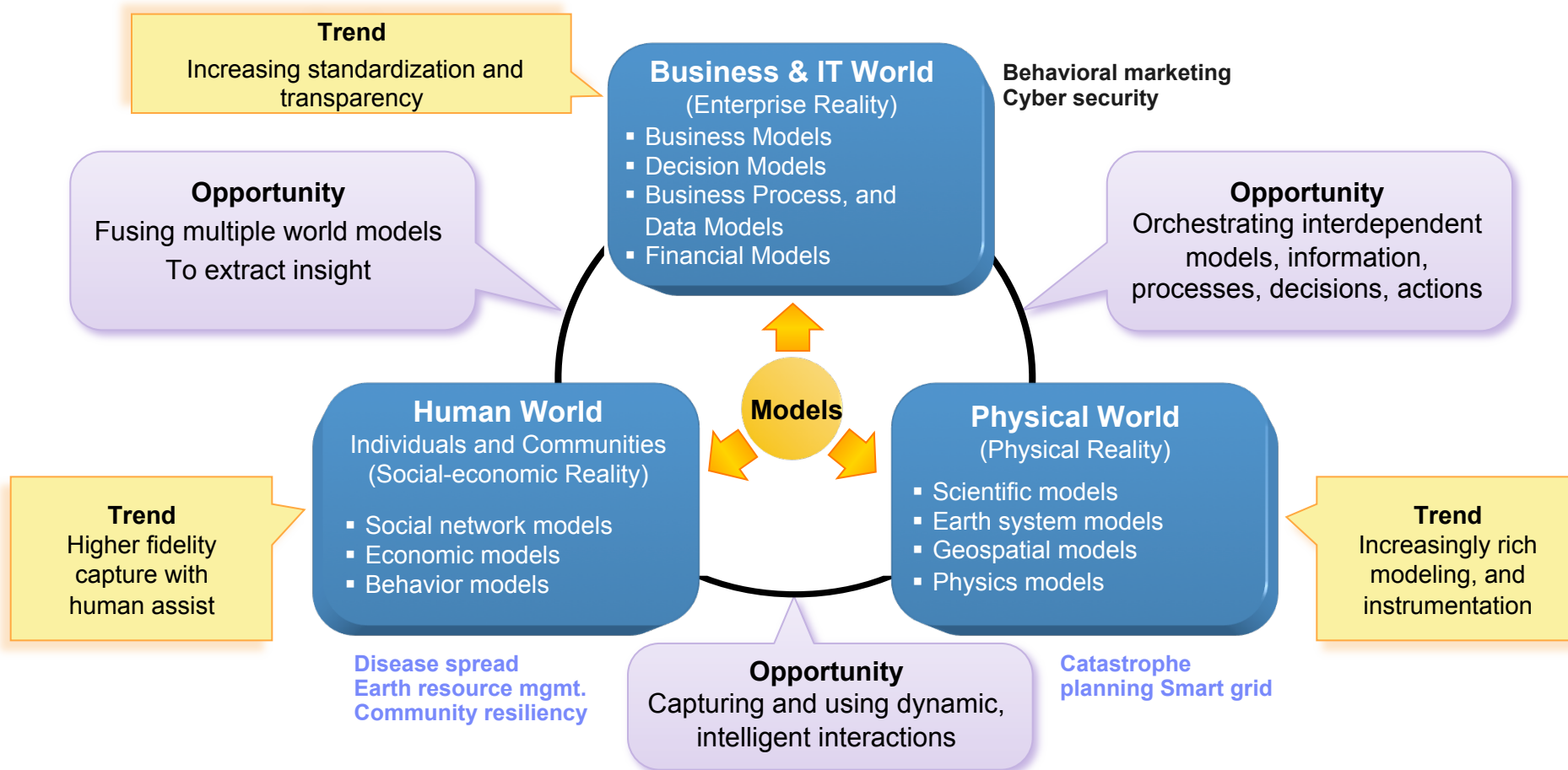
Real-time microblog



Live streaming mashup



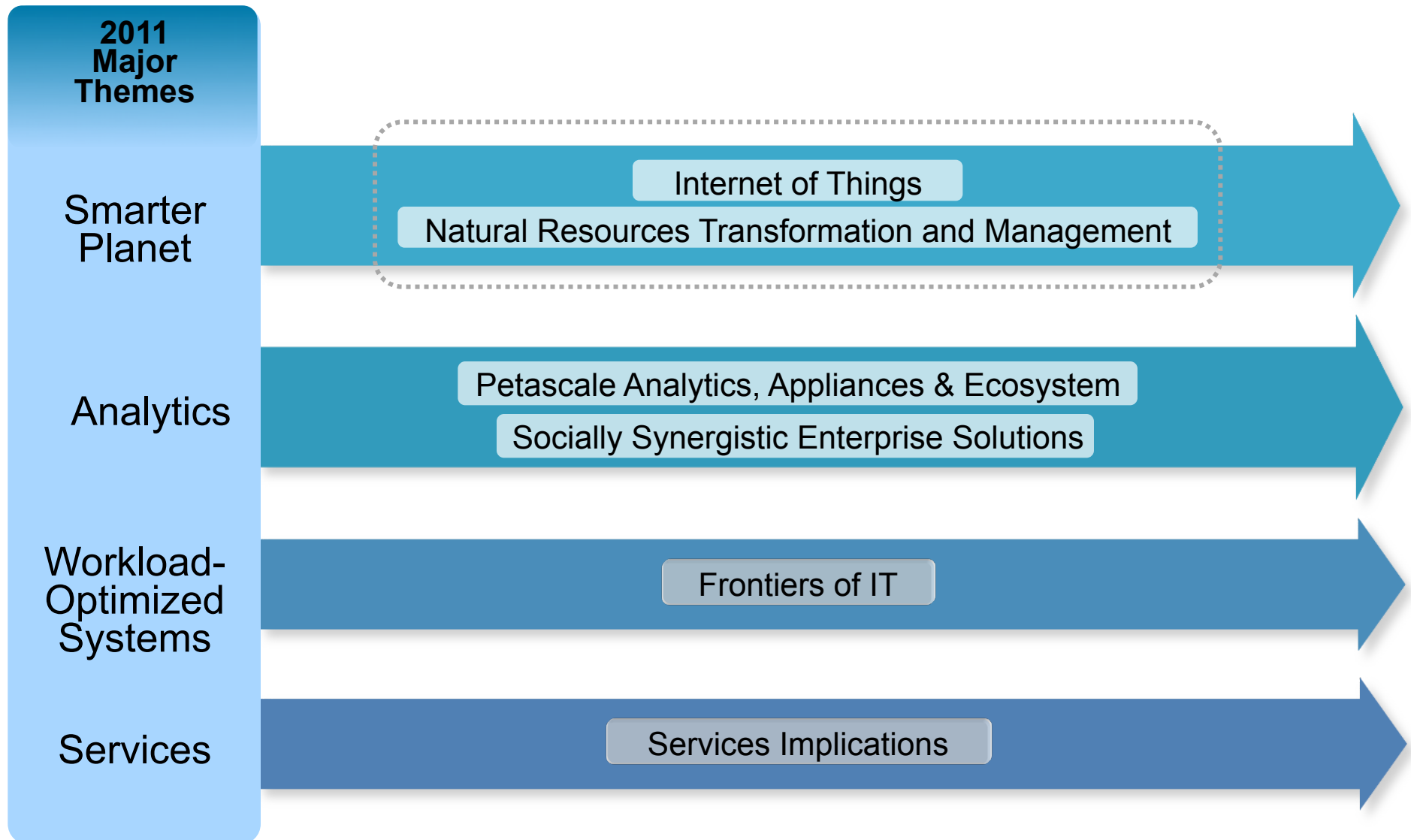
Solutions increasingly will leverage interconnected and interdependent models to represent the physical environment, business & IT, and individuals & communities



Analyzing and managing these interconnected and interdependent models creates differentiating business value for companies



Global Technology Outlook 2011





There is an explosion in data and real world events, multiple world are converging and new technology abounds

1.3 Billion RFID tags in 2005

30 Billion RFID tags by 2010



Capital market data volumes grew **1,750%**, 2003-06



World Data Centre for Climate

- 220 Terabytes of Web data
- 9 Petabytes of additional data



2 Billion Internet users by 2011



4.6 Billion Mobile Phones World Wide



Twitter process **7 terabytes** of data every day



Facebook process **10 terabytes** of data every day

Internet of Things

Water Management



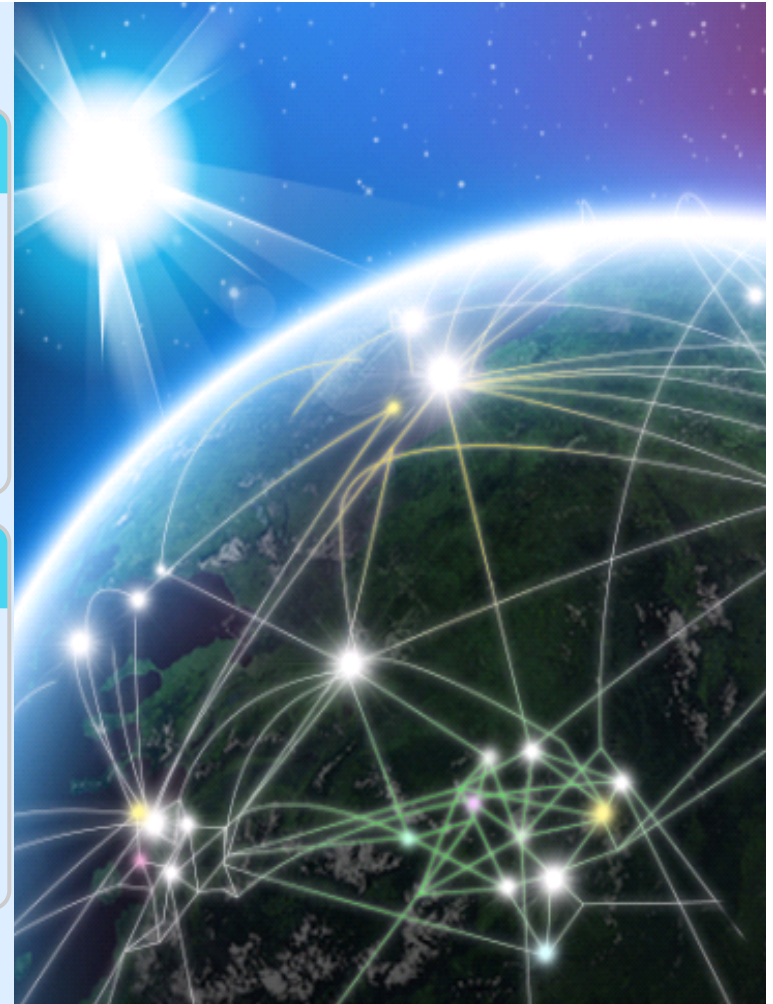
Food Safety



Home Healthcare

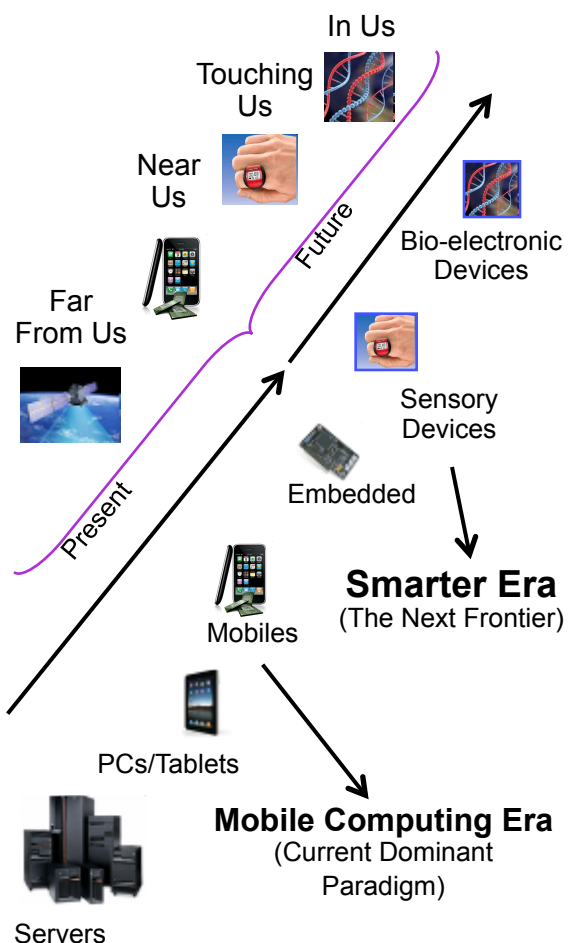


Transportation



Pulling it All Together: The Technology Frontiers

Computing Everywhere and in Everything



Natural Interfaces and Connectivity



Sensory Computing
(voice, movement, natural sensing, etc)

Touch Computing



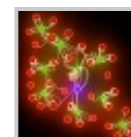
Keyboard Entry

New Computing Paradigms

Bio-Inspired Computation



Quantum Computing

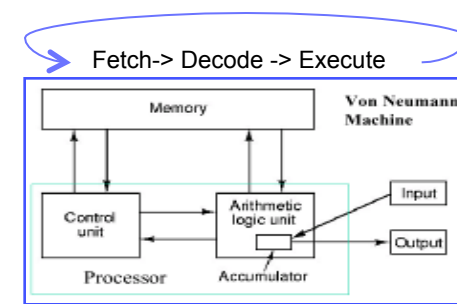


Neuromorphic and Cognitive Computing

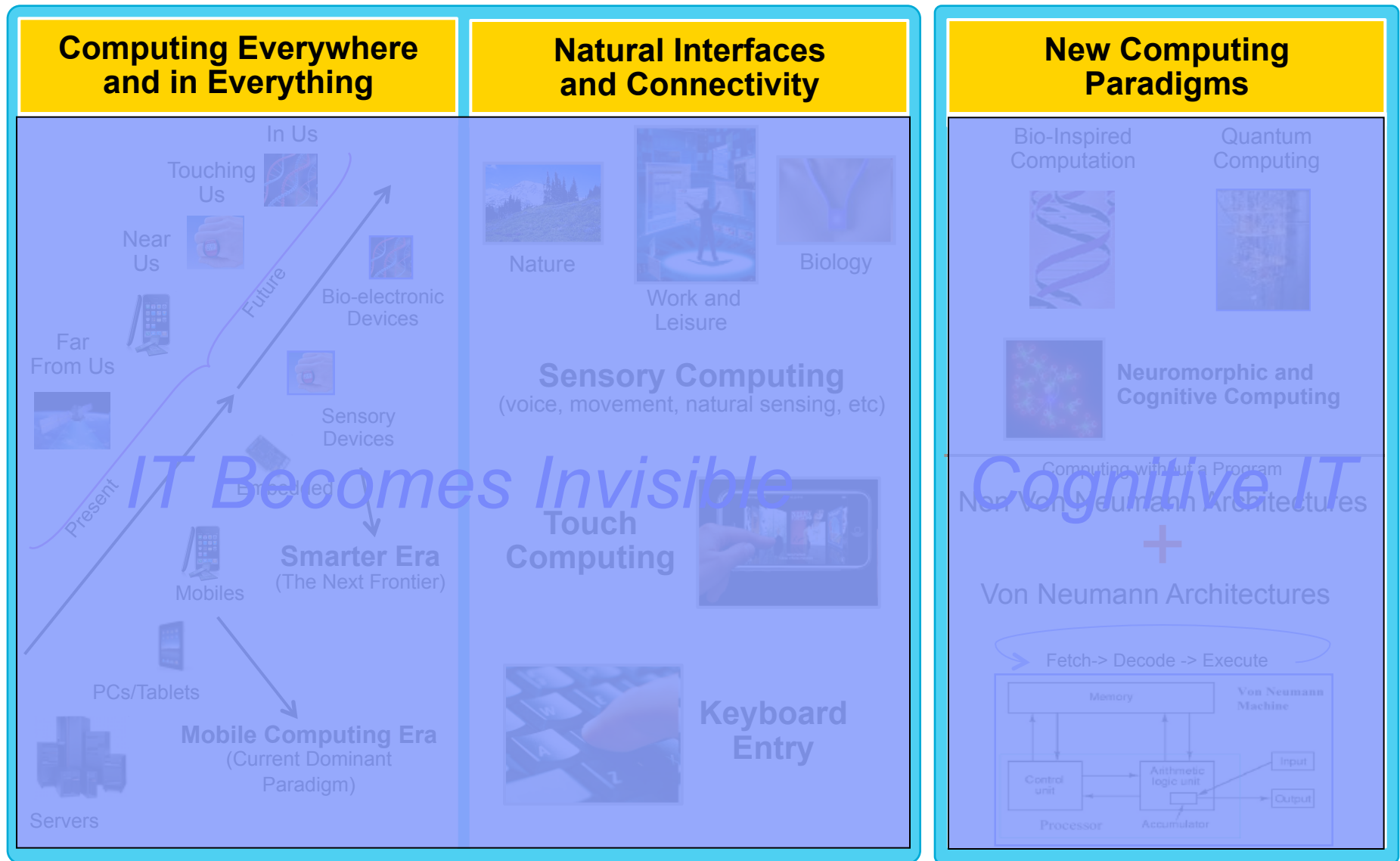
Computing without Programming
Non Von Neumann Architectures



Von Neumann Architectures

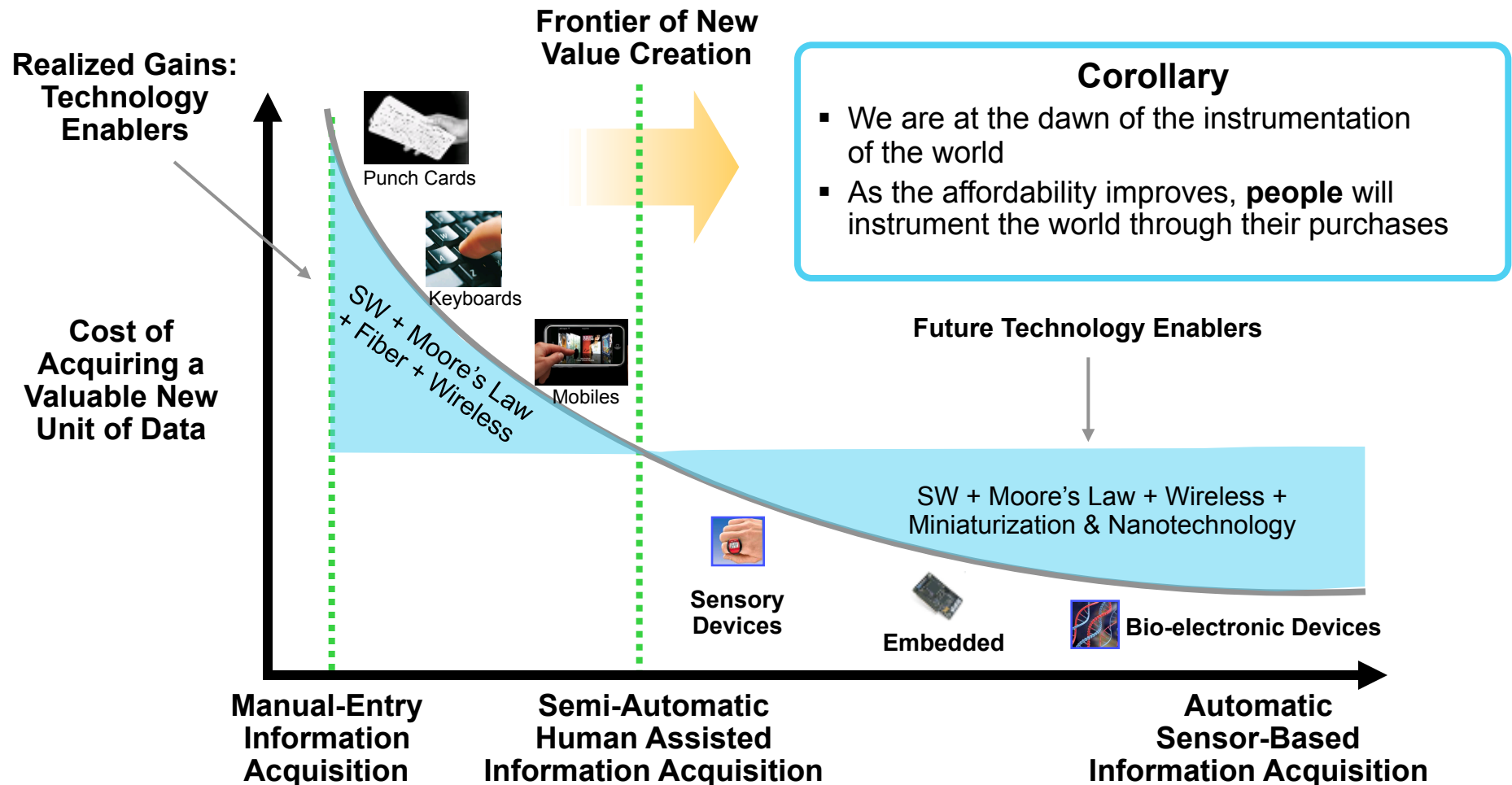


Pulling it All Together: The Technology Frontiers





Hypothesis for a New Moore's Law for the XXI Century: The Cost of Acquisition of a New Unit of Data will Fall Exponentially

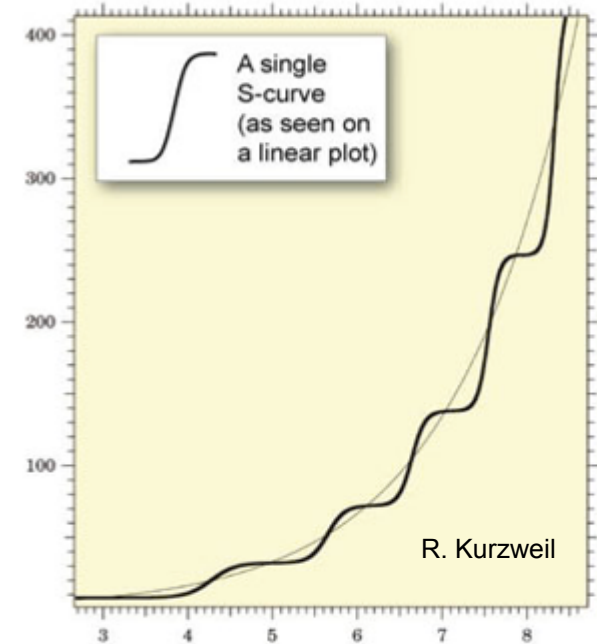




Biology and Technology

The life cycle of a paradigm:

- Slow growth, rapid growth, leveling off
- Each stage provides more powerful tools for the next
- New paradigms replace old ones
- Order and complexity increase
- Great deal of complexity from small amounts of design information



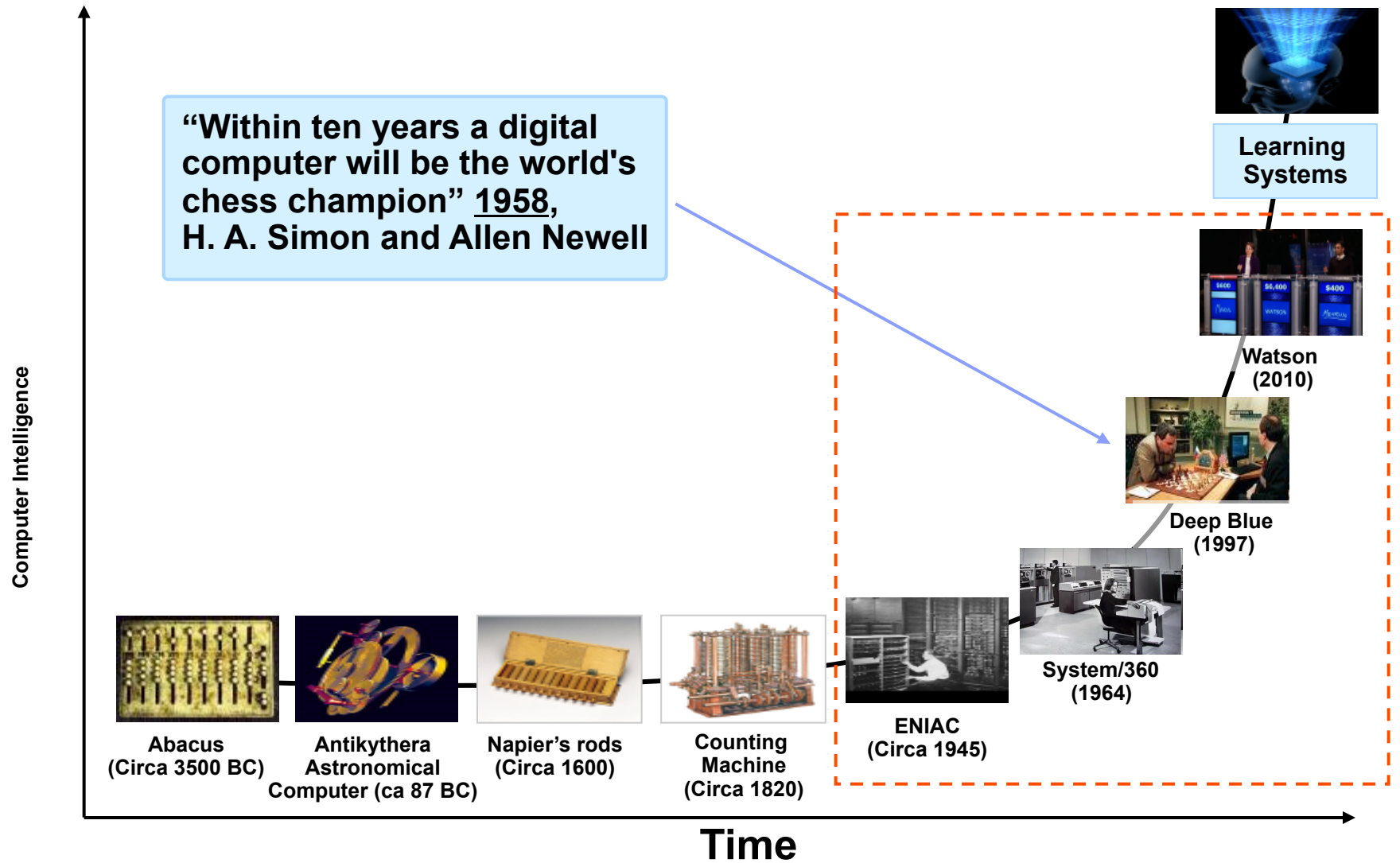
	Biology	Technology
Chaotic Environments	Mixing and matching genes	Variable market conditions
Tipping Point	Multicellular organisms	Internet connecting computers and people
Order and complexity	Genome to Humans	Thoughts and problems to computers



Probabilistic Fractals



The Evolution of Thinking Machines





Today's Systems – The Calculating Paradigm

The Calculating Paradigm



Structured Data and Text



Archives

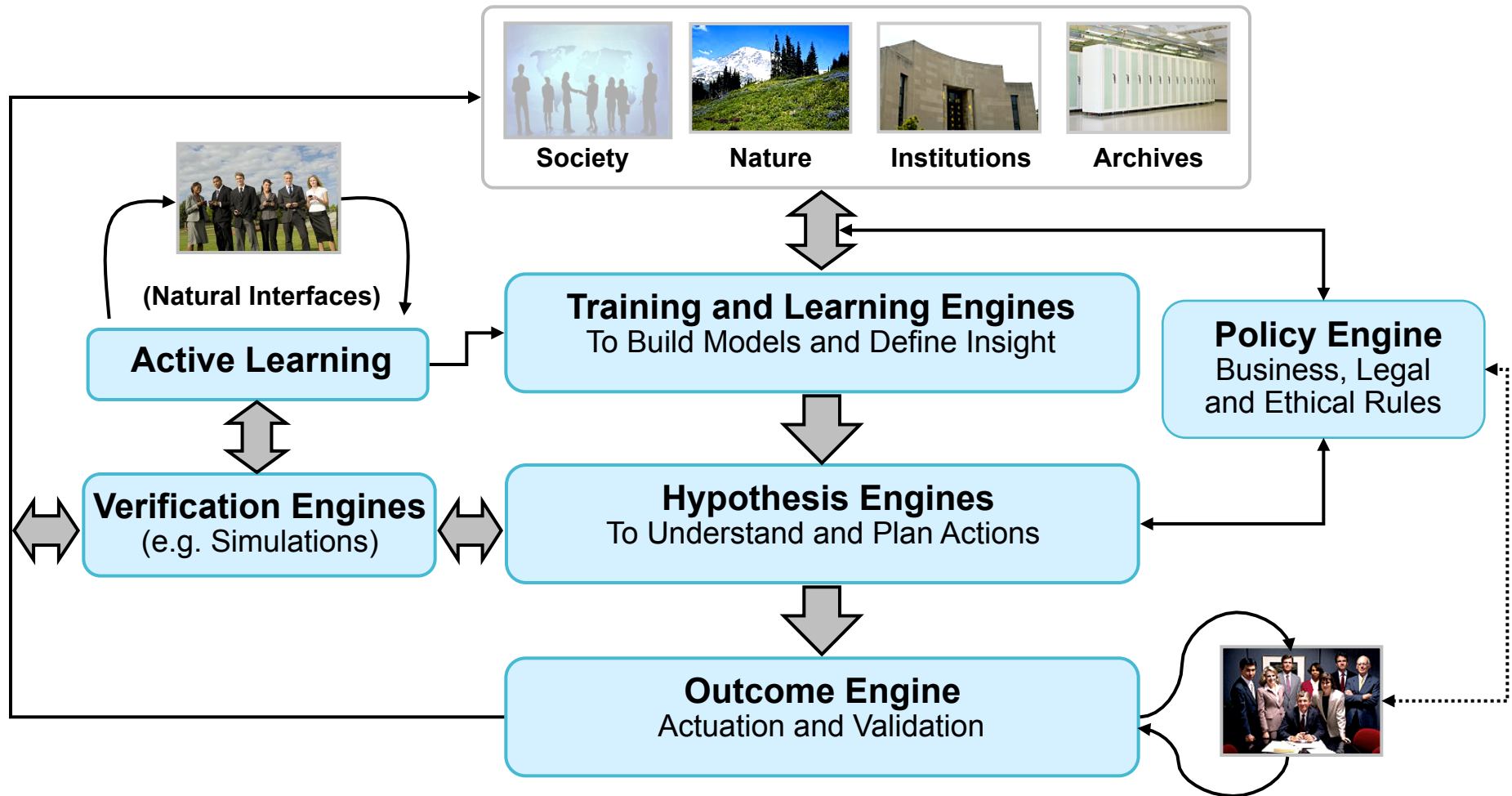
Algorithms and Applications
Static programming



People Hypothesize,
Determine “what it means”,
Run other applications...



Future Systems – The Learning Paradigm





Learning Systems Will Impact Key Sectors of the Economy

Financial



Fraud Prevention

Retail



Revenue Maximization

Medical



Enhanced Wellness

General Business



**Product Design, Launch and
Time to Revenue & Profit Optimization**

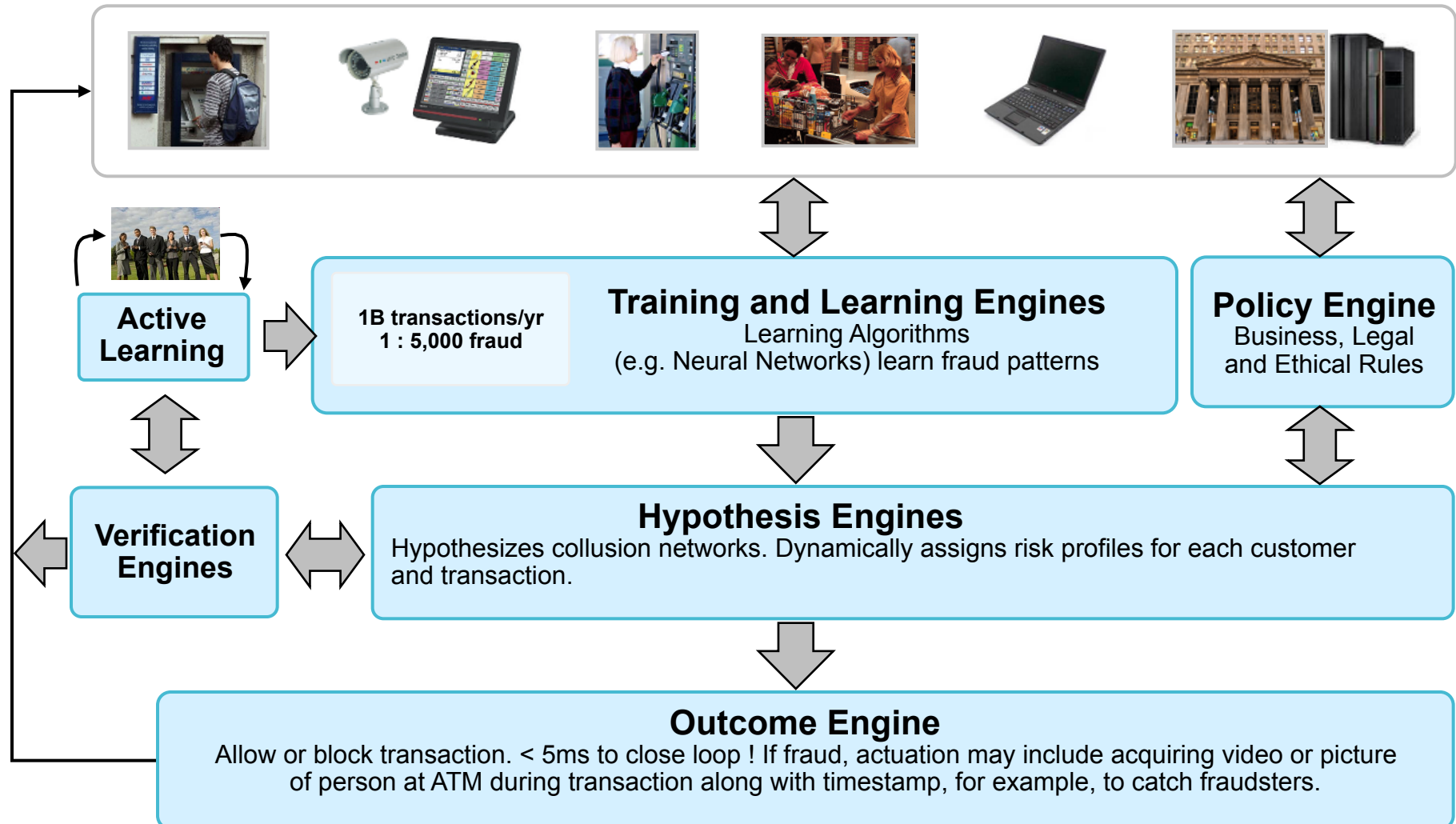
Security



Better Security in a More Complex World

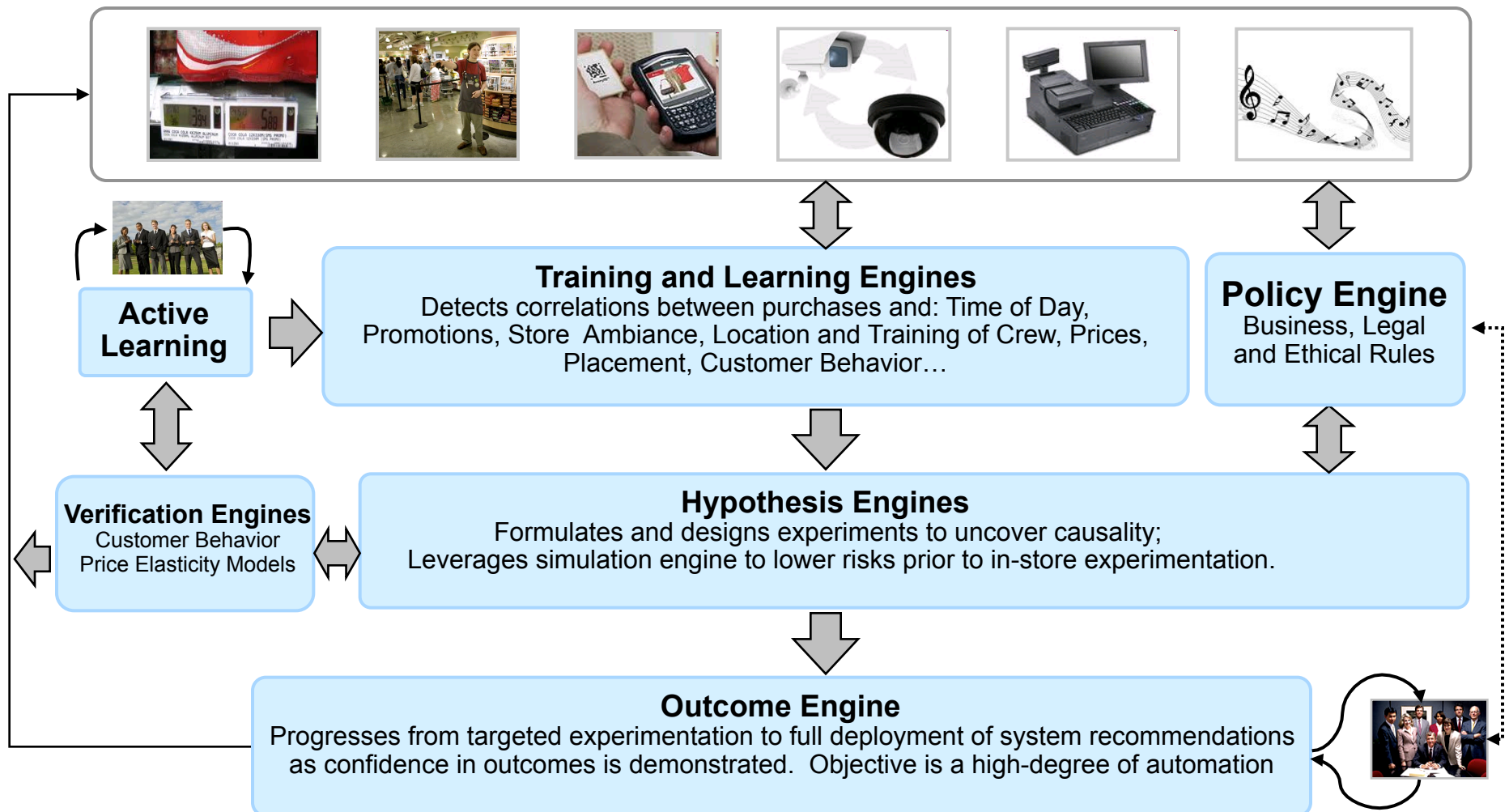


Financial Scenario: Fraud Prevention System





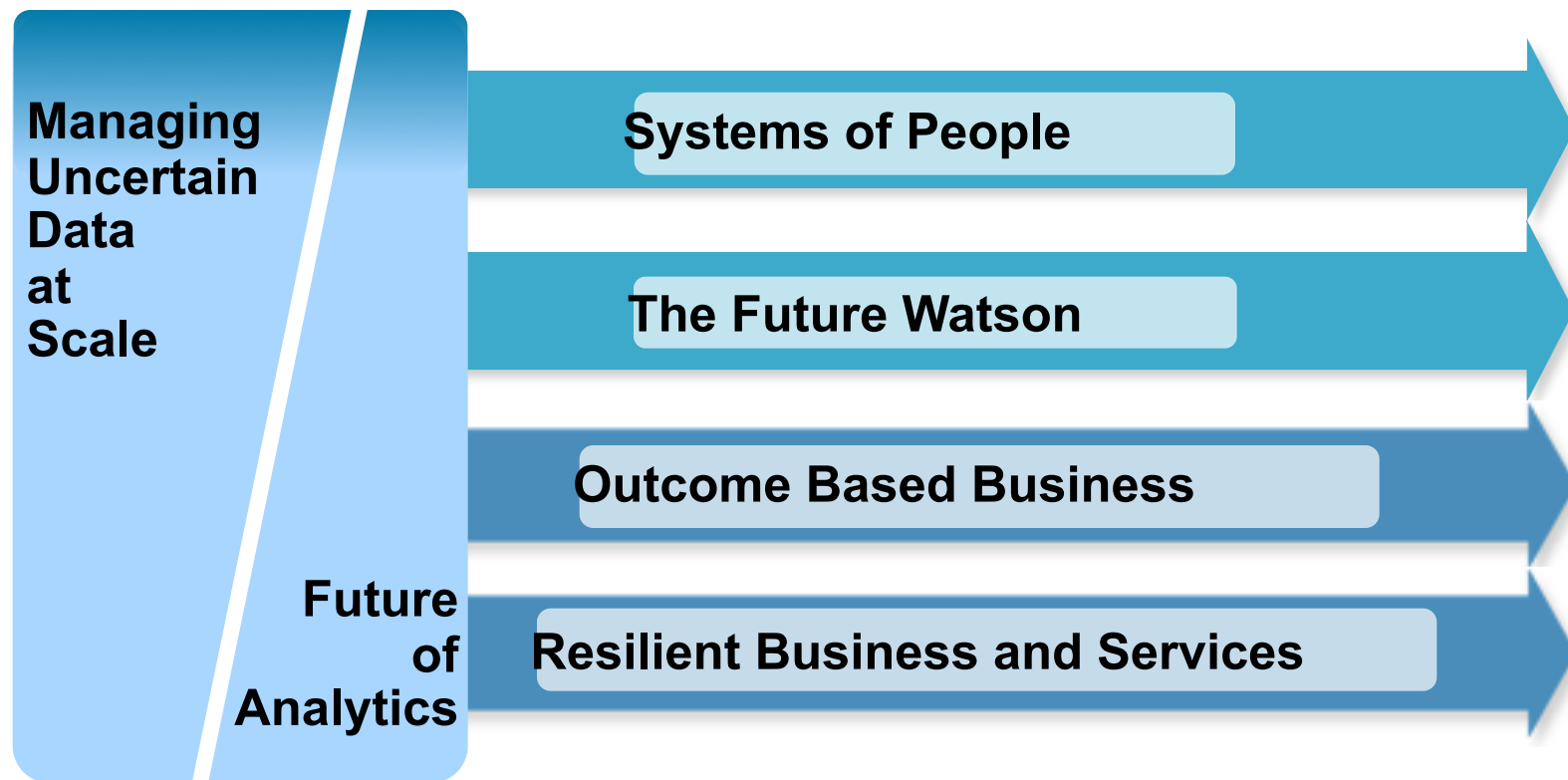
Retail Store Scenario: Revenue Maximization System





Global Technology Outlook 2012

Uncertain data and analytics are major themes





Managing Uncertain Data at Scale

Trend: Most of the world's analyzed data will be uncertain

- By 2015, 80% of the world's data will be uncertain
- Uncertain data management requires new techniques
- These techniques are necessary for real-world Big Data Analytics

Opportunity: Business leadership using Big Data Analytics

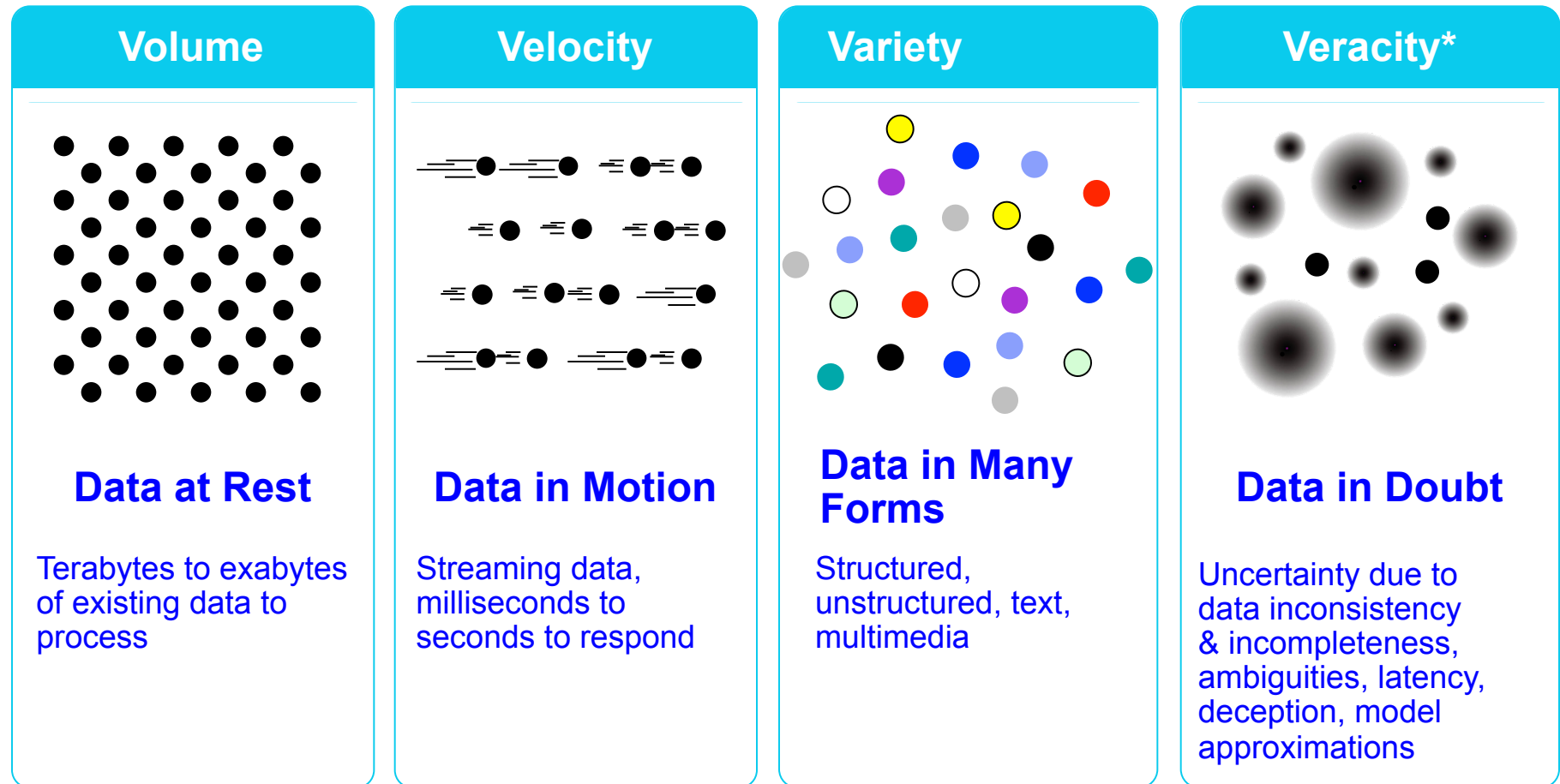
- Robust, business-aware uncertain data management
- Use analytics over uncertain web, sensor, and human-generated data
- Enable good business decisions by understanding analysis confidence

Challenge: Taking Big Data Analytics into an uncertain world

- Analysis of text is highly nuanced; sensor-based data is imprecise
- Timely business decisions require efficient large-scale analytics
- It is more difficult to obtain insight about an individual than a group, especially if the source data is uncertain



The fourth dimension of Big Data: Veracity – handling data in doubt

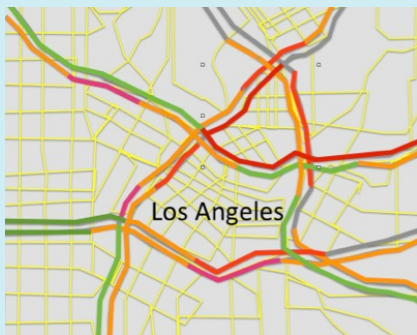


* Truthfulness, accuracy or precision, correctness

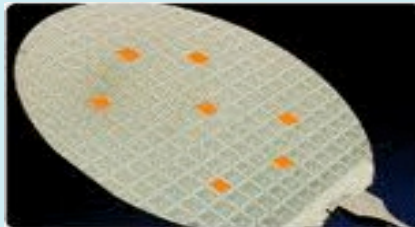
Uncertainty arises from many sources

Process Uncertainty

Processes contain
“randomness”



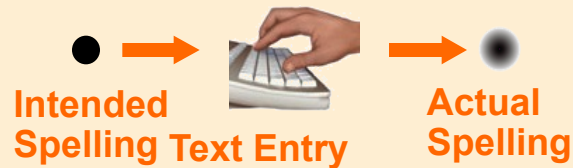
Uncertain travel times



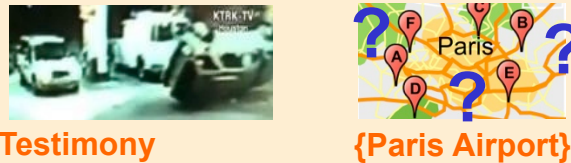
Semiconductor yield

Data Uncertainty

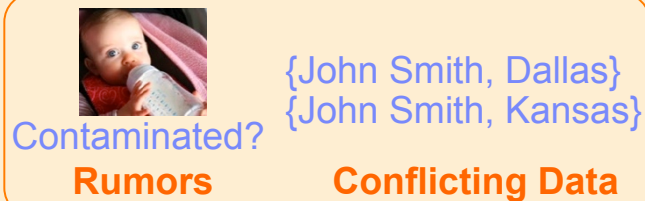
Data input is uncertain



GPS Uncertainty

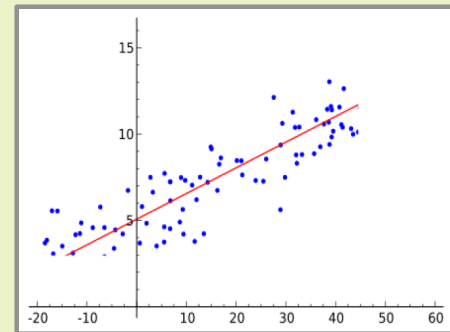


Ambiguity

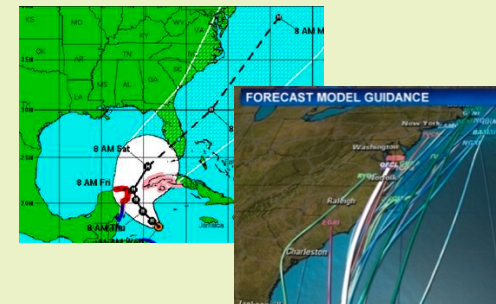


Model Uncertainty

All modeling is approximate



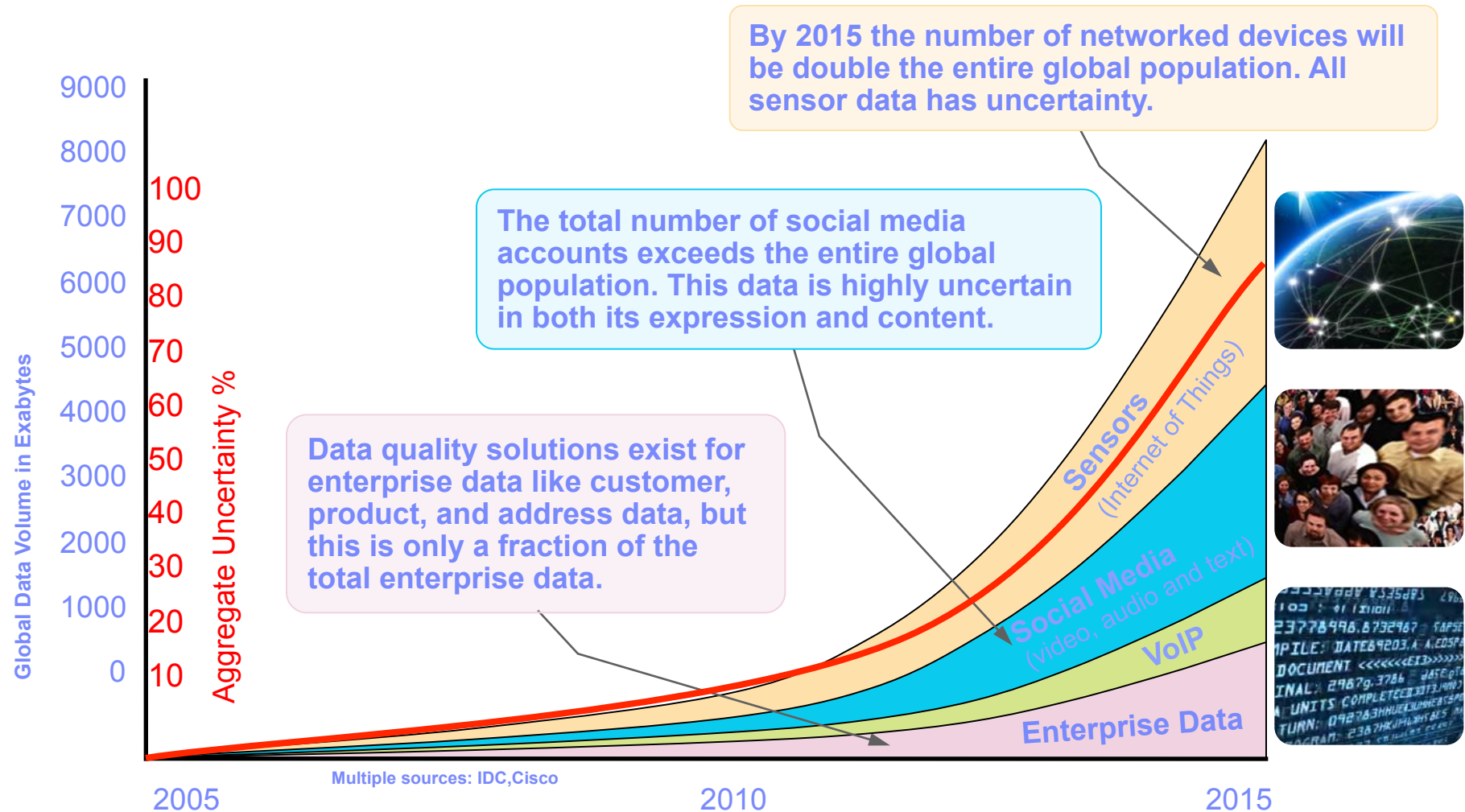
Fitting a curve to data



Forecasting a hurricane
(www.noaa.gov)



By 2015, 80% of all available data will be uncertain





Examples: Uncertainty management presents many opportunities

Smarter Planet

System analytics predict maintenance

- Downtime costs \$M in income loss
- Equipment maintenance needs unpredictable
- Customer contracts impose penalties

Energy 5% more oil platform production
 30% less maintenance cost

Improvements obtained using statistical modeling that combine equipment sensor data with performance history to predict corrective maintenance activities

360° customer view

Creating profiles from many sources

- Many inconsistent data sources
- Intent hidden within social media
- Geospatial data is imprecise

Auto 35% more satisfied customers
 by analyzing agent notes

Telco 35% better churn prediction using
 customer SMS messages



Reduced time to determine lending risk
 from weeks to minutes

Supply chain

Process and forecast uncertainty

Modeling Uncertainties

- Demand, sales, production, shipment

Shipping Uncertainties

- Goods damaged
- Mistakes in shipped goods



80% lower price protection costs
 30% less channel inventory
 50% fewer returns

Reductions obtained using inventory replenishment model that accounts for uncertain price protection

Healthcare

More data from physician notes and tests

Structured medical records are incomplete

- “Golden” text notes must be interpreted
- Drug names
- Relationship types (mtr, sibs, m, paunt)
- Uncertainty in images



Healthcare

Able to identify:

- 40% more smokers found
- 15% more disease history

Mitral stenosis:

- 50% more diagnoses
- 35% misdiagnoses



Systems of People

A shift in value from process optimization to people-centric processes

- Organizations have extracted most of the efficiencies from traditional process automation
- IT enablement opportunities are shifting to Line of Business

A new set of data is made possible by exploiting social business

- Social business drives new efficiencies and value from people-centric processes
- An opportunity to instrument people-processes
- Provides the basis for addressing diverse set of problems

A new IT market is emerging

- **Adaptive** social platforms **instrumented** with knowledge capture, **interconnected** with enterprise data and processes, and made **intelligent** through differentiating analytics will transform business



People-centric processes are at the core of a broad range of issues



Differentiate for Growth

Create winning products, fast, by having the best and most productive knowledge workers



Drive Sales Productivity

Create superior sales force, drive sales enablement and seller/client alignment



Grow in Emerging Markets

Re-create organizational footprint in global markets

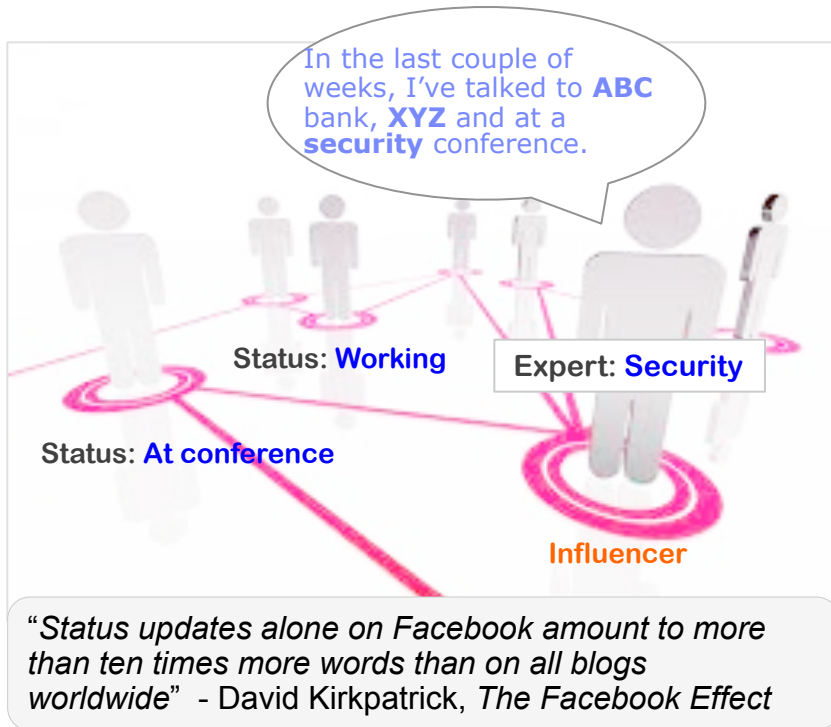


Transform Service Delivery

Further grow productivity and enable new delivery models



Optimizing people-centric processes is not the same as optimizing supply chains



- Rich information (e.g. expertise, work patterns, response to incentives, digital reputation) is flowing through on-line collaboration and enterprise systems
- Capturing this information enables analytics to be applied to people-centric processes

Strength of Sales Force Index is an example of what is possible with a rich representation of people



TODAY

- Years selling
- Job change
- Salary band
- PBC

FUTURE

- True skills and expertise
- Disciplines
- Clients served
- Products sold
- Team experiences
- Connections
- Incentives and responses
- Career path
- ...

- SSFI mines sales force data to understand which attributes of a seller (e.g. skills, experiences), sales team (e.g. team composition, territories) or sales process (e.g. incentives, coverage model) are driving sales performance (quota attainment, win rates, productivity)
- SSFI identifies:
 - Reasons for performance disparities (at individual or group level), and the best set of actions to drive performance

“Why is our sales force in Region X not performing at par with other regions or competition?”

“What actions can we take to improve sales performance?”

“What are the incentives that truly drive performance?”



Social Business is an evolutionary foundation for **Systems of People**

Systems of People (SoP)

- Adaptive social platforms **interconnected** with enterprise data and processes, **instrumented** with knowledge capture, and made **intelligent** through differentiating analytics



Social Business



Social Apps



Social Networks



ERP



A new way of enabling global workforces

PEOPLE
ENABLEMENT



A new data set is being created

PEOPLE
CONTENT



A new way of using analytics is emerging

PEOPLE
ANALYTICS



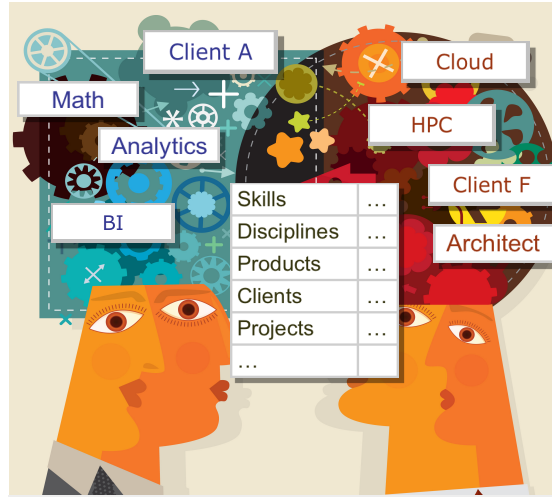
Executing on SoP vision depends on three key capabilities



Incorporate capabilities that **adapt content** for situations and needs, and enhance communication **over many devices, across diverse pools of talent**

context-aware
cognitive load management
translation, transcription
text-to-speech, voice...

PEOPLE ENABLEMENT



Develop capabilities to **create a representation** of a person's skills, experiences, preferences, digital reputation...

In a **structured and organized way**, so it can be used **for the purpose of running a business**

PEOPLE CONTENT



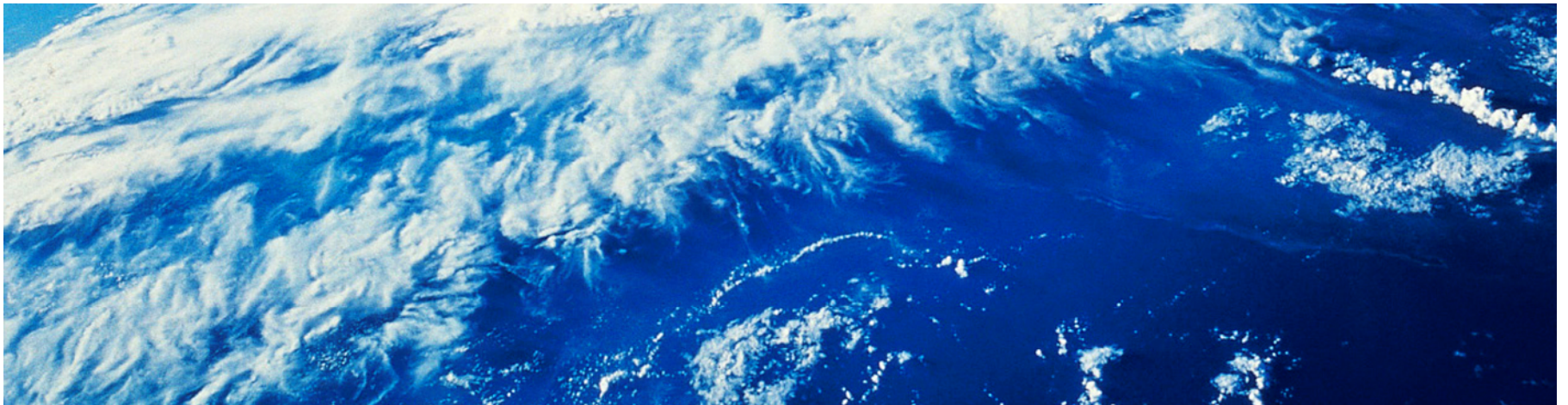
Implement capabilities for people-centric process optimization **within an analytics platform for rapid, on-demand deployment**

matching, talent cloud
crowdsourcing, predictive markets
simulation of workforce trends
performance analytics
behavior modeling...

PEOPLE ANALYTICS

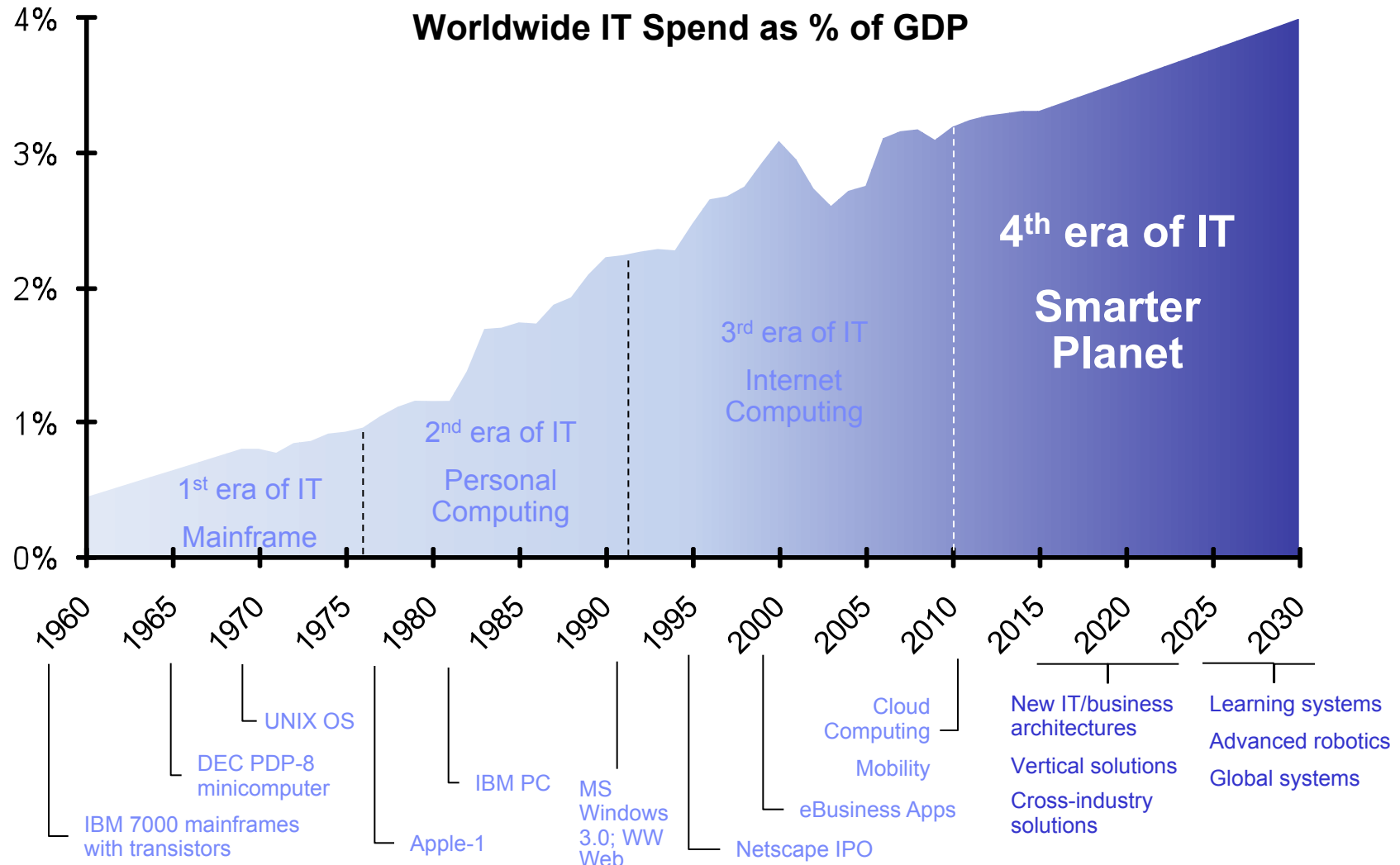


Final Thoughts





All of these technologies are the catalyst of a 4th era of computing is upon us



Source: IBM Market Analysis extrapolated from IDC Black Book for IT and IBM Corp Finance for N-GDP, Forrester Research "Next Wave of IT Investment is Smart Computing" Jan 2010, IBM Research GTO 2011 "Frontiers of IT" © 2012 IBM Corporation



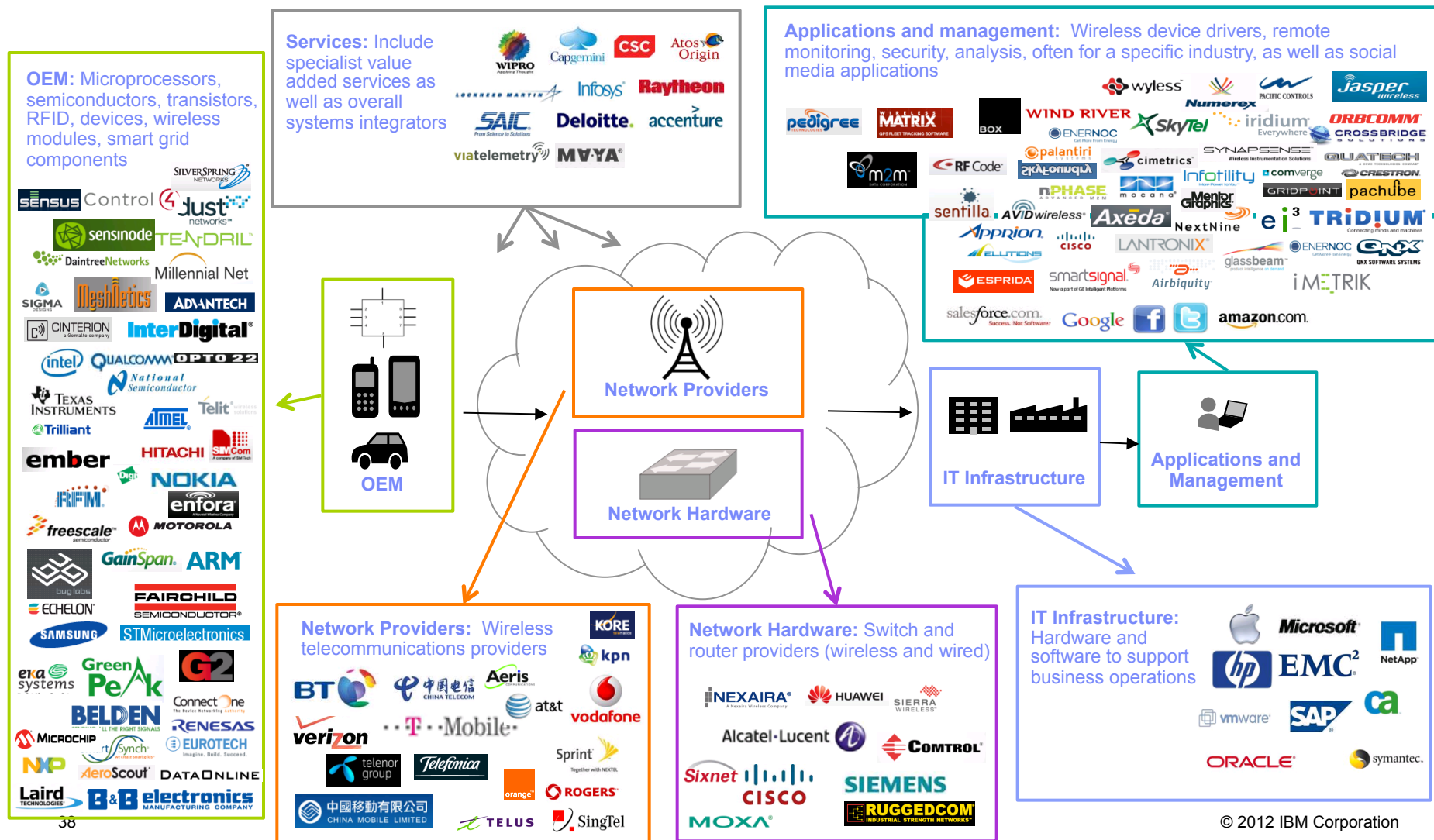
The 4th era extends the historic value created during the previous eras of IT

Each era uses IT to solve challenges, creating historic value...

	Business challenge solved	Historic value created
1st era	Mainframe automates high frequency transactions	Scales back-office functions, making possible modern corporation
2nd era	PC's automate individual transactions	Revolutionizes individual capability and productivity, re-engineering the corporation
3rd era	Internet automates connections	Transforms business models, accelerating the global economy
4th era	Solutions automate decisions in exponentially growing networks	Transforms and converges industries and public sectors, delivering sustainability



Investment occurring across a new eco system of smart





The era of Smarter Planet will give rise to game changing technology and significant new opportunities

Initial Stages in the 4th era

- Emerging architectures
 - cloud computing
 - mobility
 - social business
 - Big Data
- Vertical solutions
 - static learning systems
 - transformational industry-specific solutions
- Cross-industry solutions
 - **advanced analytics**

Later in the 4th era

- Learning systems
 - dynamic and autonomous systems
 - conversational language solutions
 - self-optimizing software
- Advanced robotics
 - self-navigating robots with speech capabilities
- Global systems
 - new industries emerge as a result of cross-industry systems



Questions? :

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ClientSOA](http://www-03.ibm.com/developerworks/blogs/page/ClientSOA)*