Industrial Technology and Strategy Review Board Meeting (Taipei, 2005 August 15-18)
The Science and Technology Advisory Group, Government of Taiwan

Strategic Policy - A I D

Agnostic Infrastructure Deployment

ENABLE CONFLUENCE OF PARTNERSHIPS TO ACCESS AVAILABLE DATA TO FACILITATE GLOBAL BUSINESS PROCESSES AND MAINTAIN GEOGRAPHIC SECURITY

RFID is neither a panacea nor a solution. RFID is an enabler. RFID technology is a century old. RFID has potential. RFID itself will change.

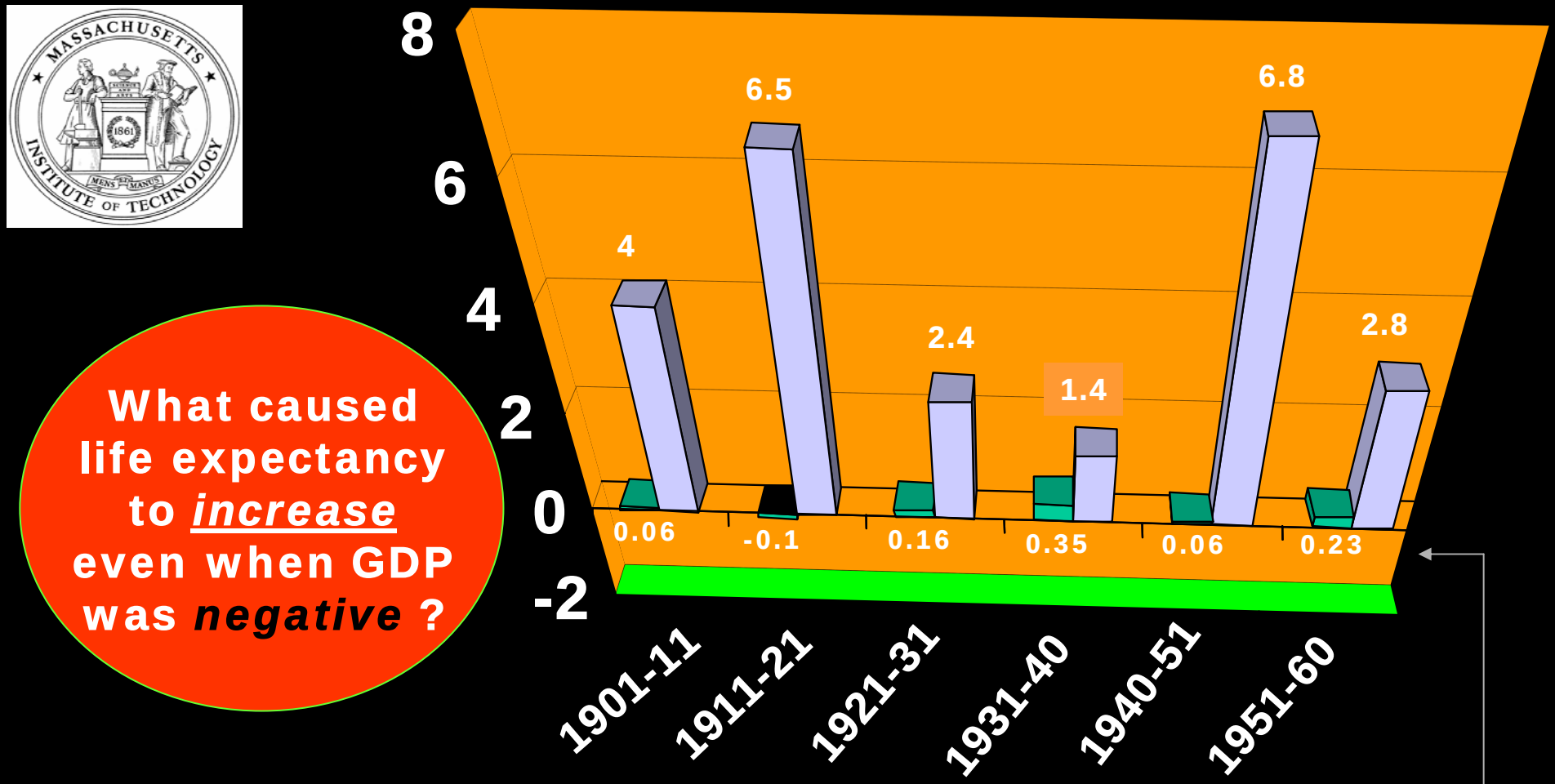
Shoumen Datta

Research Scientist, Engineering Systems Division, School of Engineering, MIT and Executive Director, MIT Forum for Supply Chain Innovation

MIT

I invented nothing new. I simply assembled into a car the discoveries of other men behind whom were centuries of work.

HENRY FORD



What caused life expectancy to *increase* even when GDP was *negative* ?

GDP

Longevity

Percentage Decadal Growth of GDP Per Capita in UK

Decadal Increases in Life Expectancy at Birth in England & Wales (Improvement in Years)

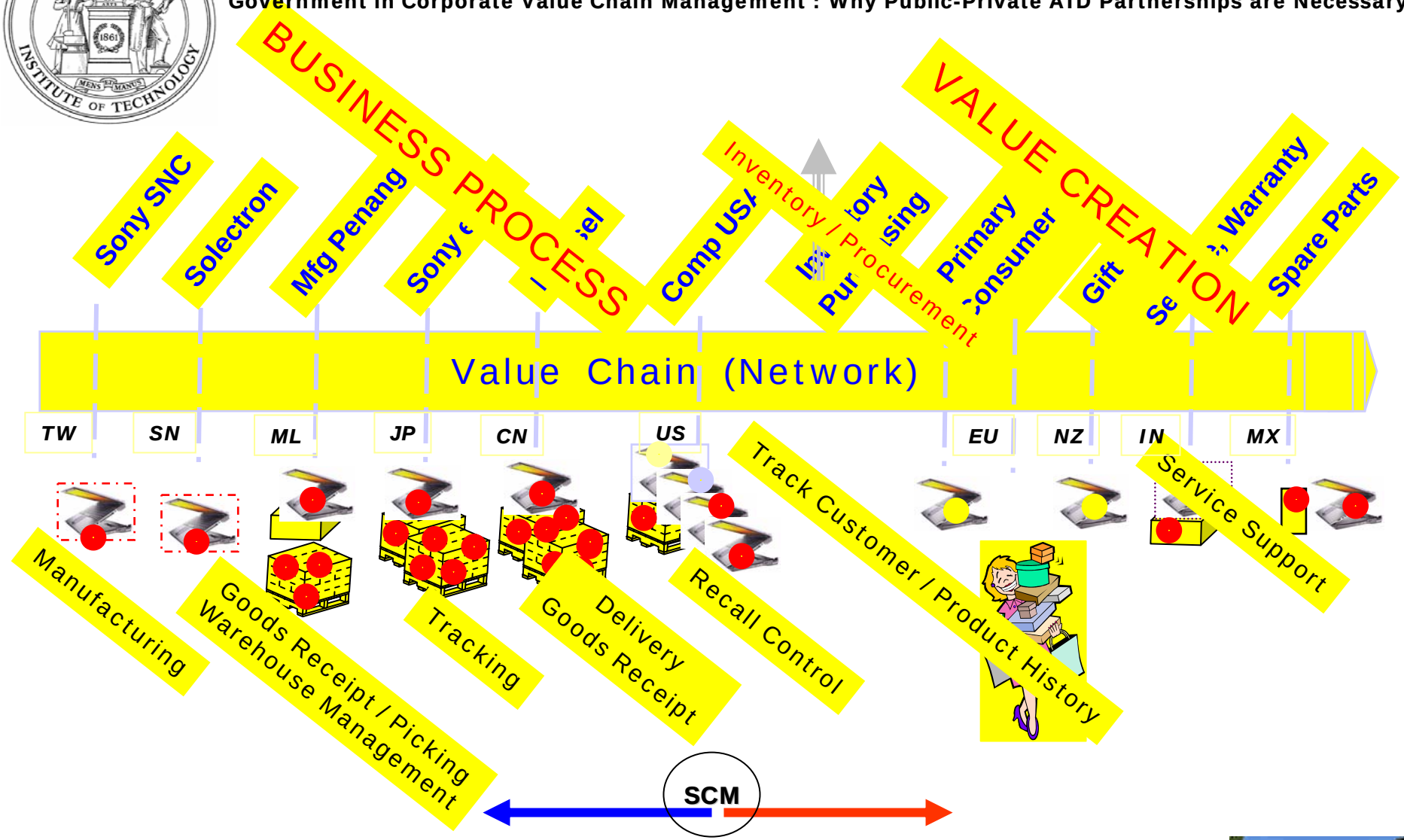
S. Preston, N. Keyfitz and R. Schoen (1992) Causes of Death: Life Tables for National Population (Seminar Press, NY)
A. Madison (1982) Phases of Capitalist Development (Oxford University Press, NY)
A. Sen (1999) Development as Freedom (Knopf, NY)

Agnostic Infrastructure Deployment [AID]:
Why AID is necessary as a national strategic policy

PROBLEM

Global Commerce: Is Policy a Facilitator or Inhibitor ?

Government in Corporate Value Chain Management : Why Public-Private AID Partnerships are Necessary



Supplier Relationship Management
Distributor Retailer Management

Decentralized Information Services
Customer Relationship Management

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Strategic Policy : A I D

- Data
- Process
- Software
- Hardware
- Technology

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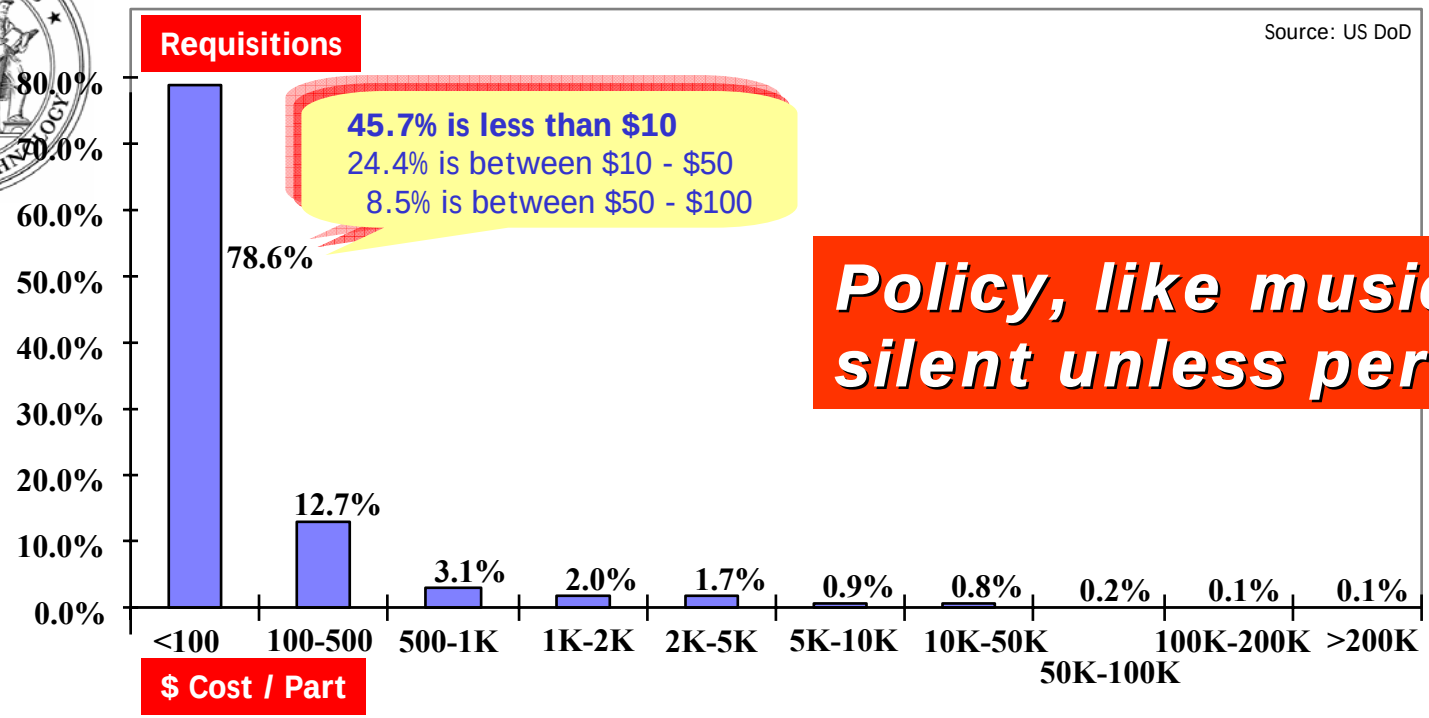
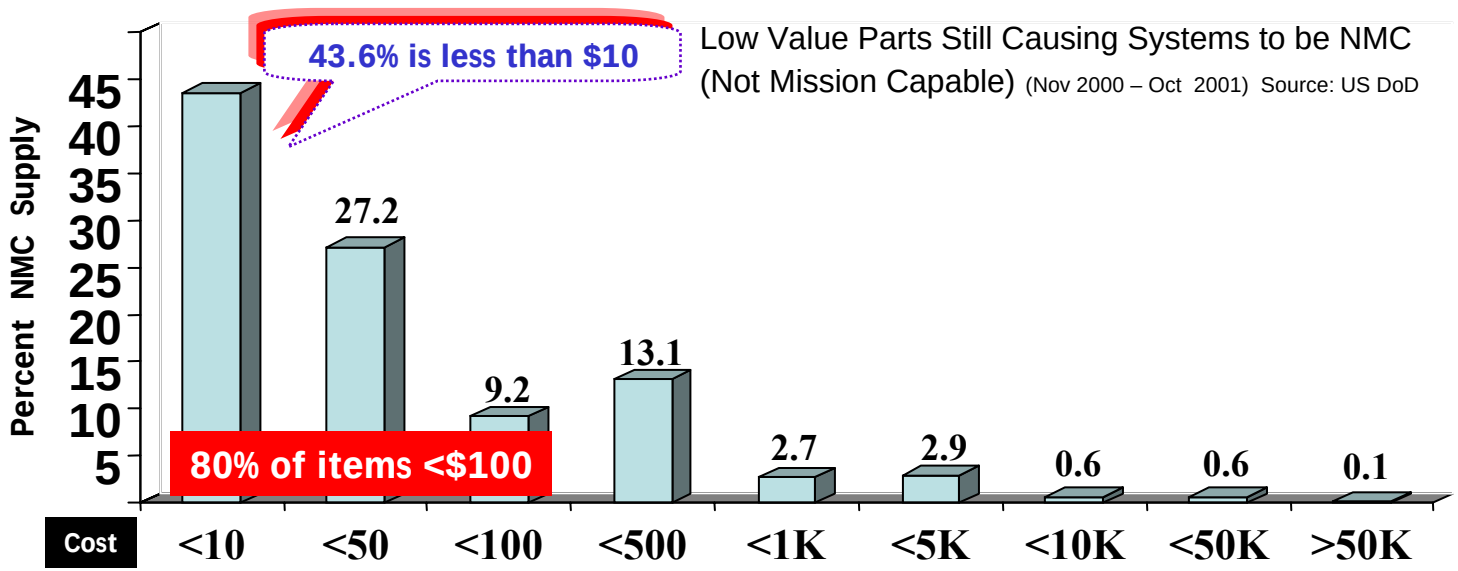
Cost of Part vs High Priority Requisitions (June 1995 – February 1996)



Policy, like music, is silent unless performed



Is A I D the PROBLEM or the SOLUTION?

Right-Time Distributed Information Management

Open Grid Services Architecture

Multi-Agent Systems

SEMANTIC WEB SERVICE

Compliance Agent

RFID, GPS, UWB

Information Agent

Policy Status

Update

Bio
Che
Mat

NORA Agents

Client

Mandates

Business Center

Transport Agent

LABOUR contractors

Business

real time inventory

Air

Land

Water

Track & Trace

Loads

Ship Order

Status

Confirmation

Global

National

Local

dMDM

Client → DC

Client → DC

Storage

Storage

Storage

Air

Land

Water

Air

Land

Water

Air

Land

Water

Handling HR Agents

Secure Goods

CUSTOMS

CLIENT

Government

Exceptions
Alerts
Warnings

Port of Entry Agent

NORA Agents

Customs Law Enforcement

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Infrastructure to facilitate decisionable information ?

Key Drivers

- Data
- Status
- Information
- Decisionable – Actionable Information
- Intelligent Information
- Services – Quality of Service (QoS)

Reality Check: Data is not Information

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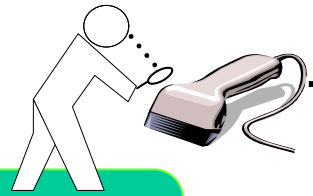
Adopt - ”the” - Standard ?

Is left-hand drive better than right-hand drive ?

Do you buy the same shoe size in the UK and the US ?

How many power plug adaptors do you need for global travel ?

Data Acquisition Agnostic ?



Manual Identification >> Barcode

(98) 0614141999999

Then

Belgian Waffles

Repository

Automatic Identification >> RFID

Paradigm Shift ?

01.0203D2A.916E8B.0719BAE03C

Now

Belgian Waffles

Repository

Dynamic Systems Adaptability ?

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Boston to Taipei

151.193.204.72

Which Data Standard ?

Aren't you are asking the wrong question ?

- **UCR - WCO**
- **GIAI – Global Individual Asset Identifier**
- **GLN – Global Location Number**
- **SSCC – Serialized Shipping Container Code**
- **GTIN – Global Trade Item Number**
- **GTAG**
- **Global EPC – Global Electronic Product Code**

  64 bits, 96 bits, 128 bits
- **IPv6 – Internet Protocol version 6 (128 bits)**

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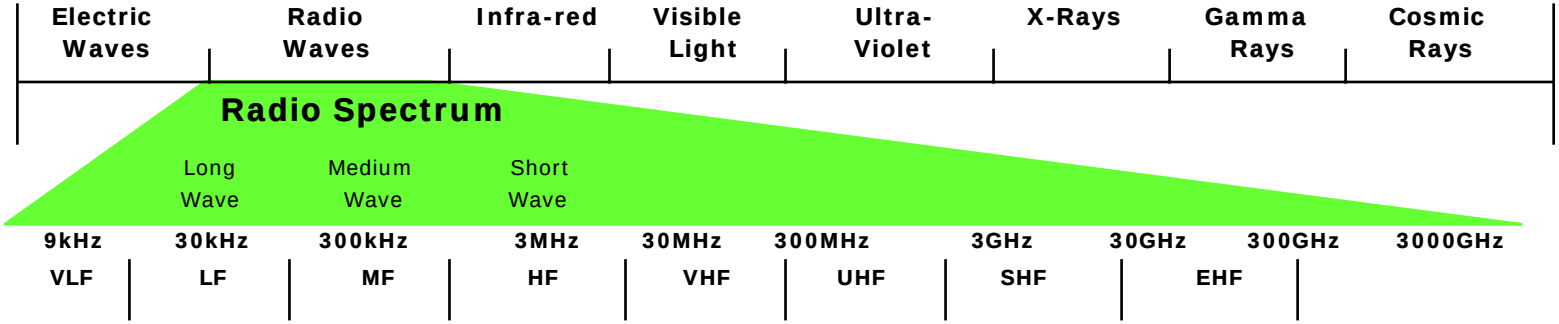
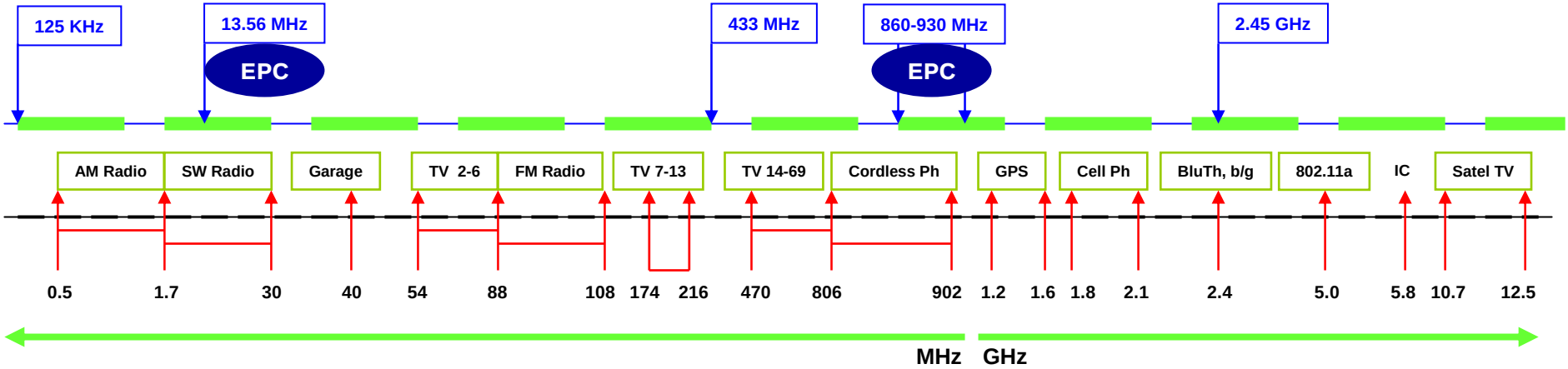
Frequency Standard !!





U L T R A W I D E B A N D

PRC 13.553 MHz to 13.567 MHz is used for micro-power (short distance) radio equipments (toys, car doors, garages, alarms, RFID).

~915 MHz is used for non-central controlling, multi-channel point-to-point system for local wireless audio or data communication for internal management (emitted power of individual devices not to exceed 3W). Band is used for GSM and unlikely to be used for RFID.

2.4 GHz to 2.4835 GHz is ISM license-free, EIRP limited to 500mW. WLAN and BlueTooth (802.11b) use this band. Available for RFID.

5.725 GHz to 5.850 GHz is ISM but authorized use, emitted power limited to 500mW and EIRP to 2W. WLAN and BlueTooth use this as expanded bands (802.11a). In China, 5.8 GHz is available for RFID.

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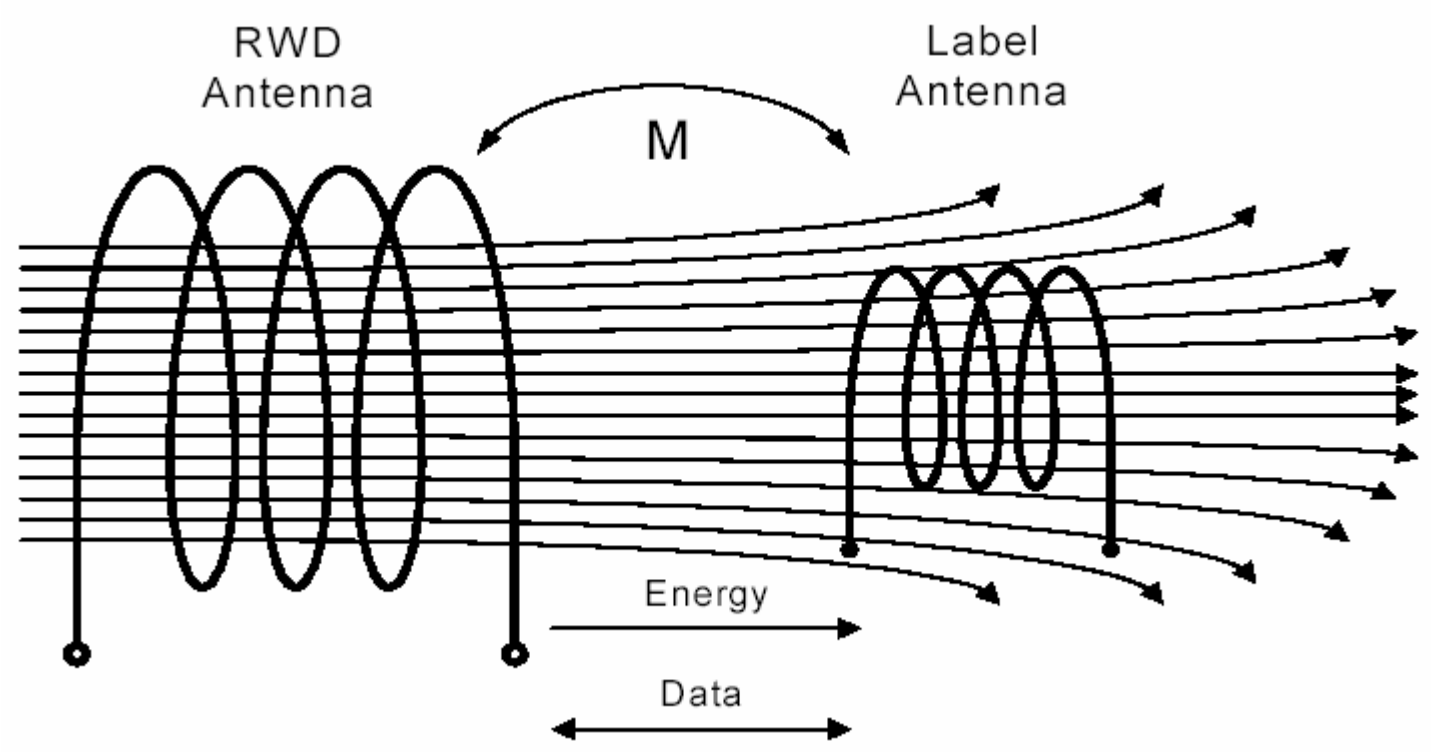
Frequency Agnostic ?

Inductive Passive RFID 13.56 MHz and <135 KHz



Near Field
ASK, PSK

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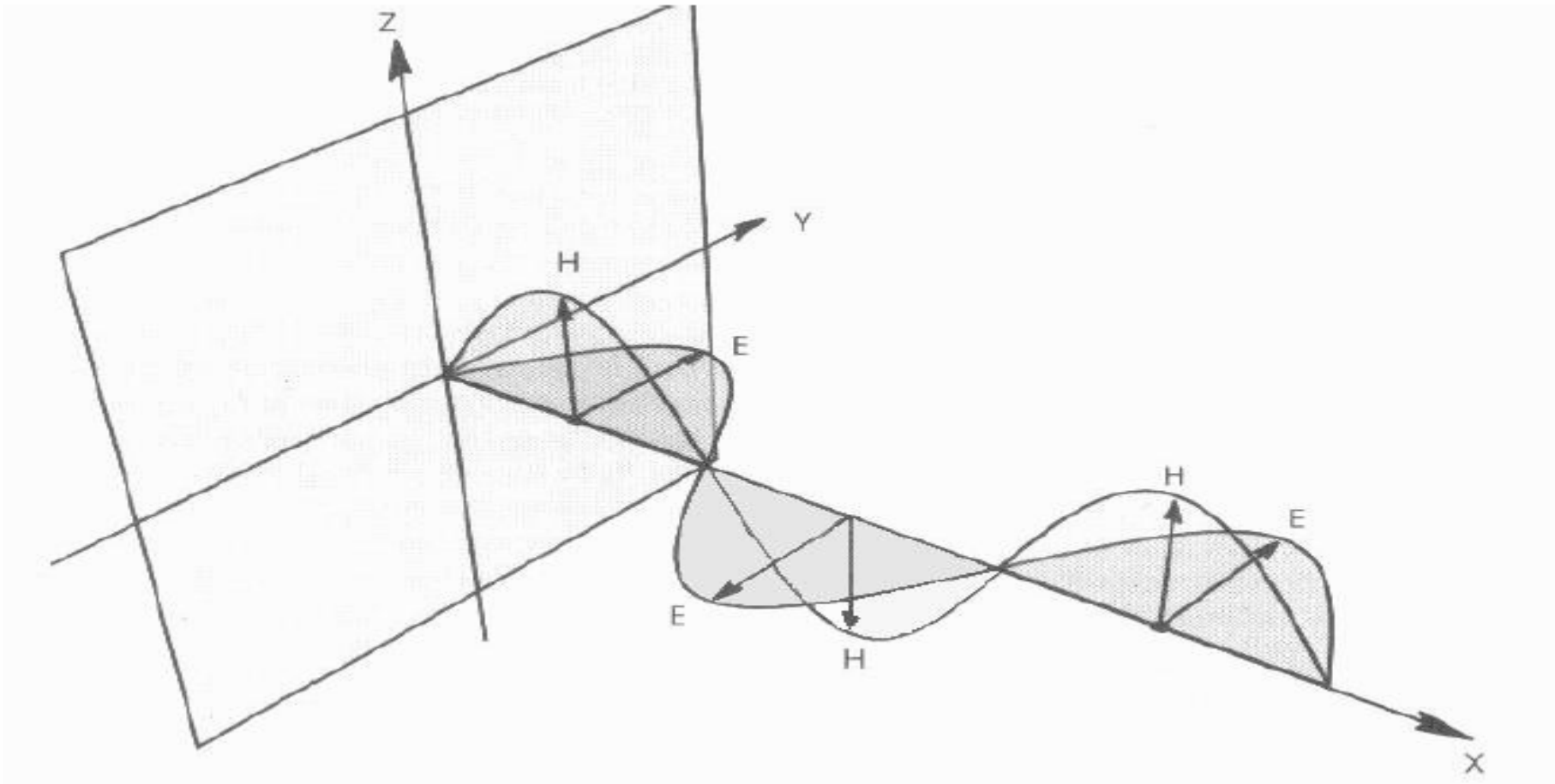
Frequency Agnostic ?

EM Field UHF RFID



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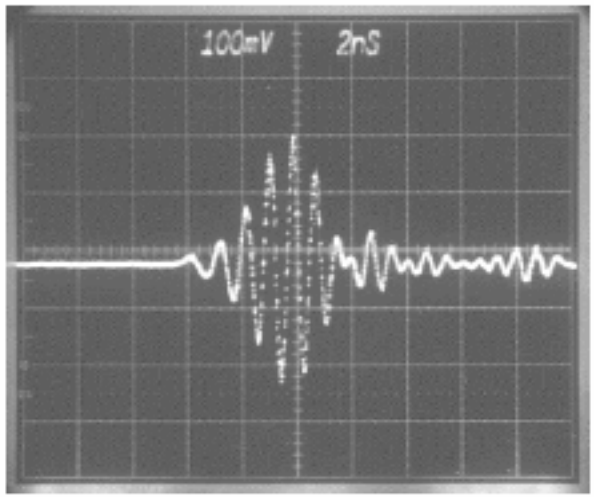
Frequency Agnostic ?

UWB – Pulse Transmission

Marconi's (1894) "Spark-Gap"



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Country Specific Power Agnostic ?

Global Power Regulation in RFID Technology Impacts Business Processes

UHF (400-1000 MHz)

Band	Region	Max. Power EIRP
433.05-434.79 MHz	Europe	25mW
865-868 MHz	Europe	4 Watts FHSS (proposed by ETSI for Europe
868-870 MHz	Europe	500mW* Still under consideration
870-875.4 MHz	Europe	4 Watts FHSS (proposed by ETSI for Europe
902-928Mhz	USA/Canada	50mV/m at 3 meters (Single freq. Systems)
	USA/Canada	4W using spread spectrum
	USA/Canada	30W FCC Part 90, LMS (3W conducted)
918-926MHz	Australia	1W all new equipment designs
915.3-915.6 MHz	South Africa	15W (5 Watt conducted)
915-921 MHz	Europe	4 Watts FHSS (proposed by ETSI for Europe

Microwave

2.4-2.4835 GHz	Europe	25 mW
	Europe	500mW spread spectrum
	USA/Canada	50mV/m at 3 meters (Single freq. Systems)

Where	Approved EIRP* Radiated Power from Reader	Distance
EU	0.5 Watt	0.7 metres
US & Canada	4.0 Watt	2.0 metres
US site license	30 Watt	5.5 metres

Data: AIM

Radiated Power ≈ Energy Field » Read Range

**** EIRP -*** effective isotropic radiated power

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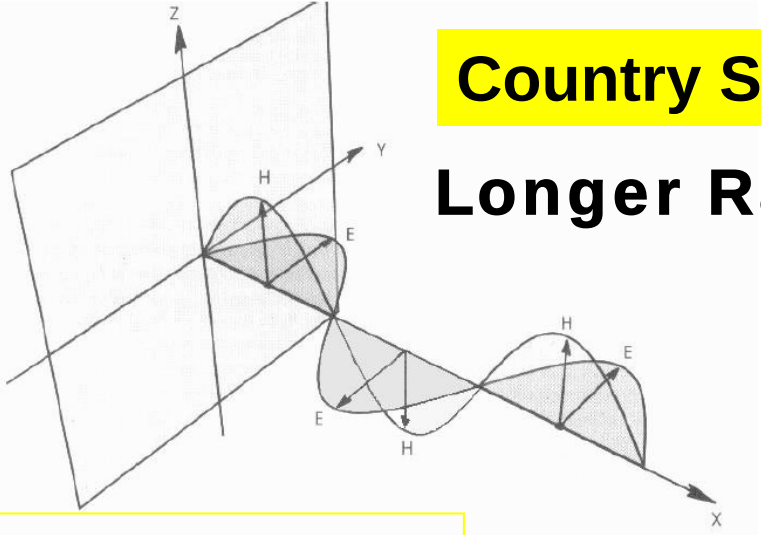
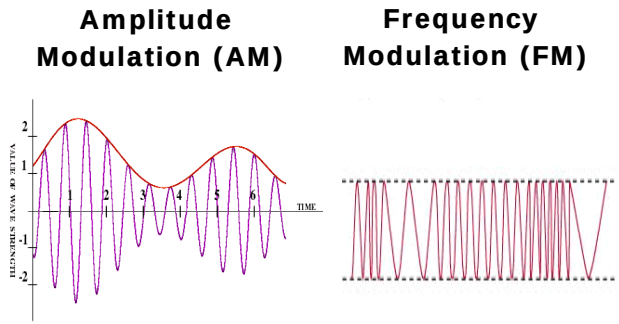
Country Specific Power Agnostic ?

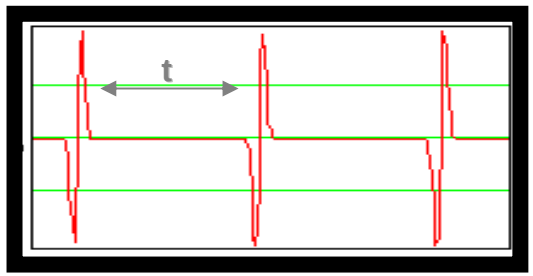
Longer Range from Less Power

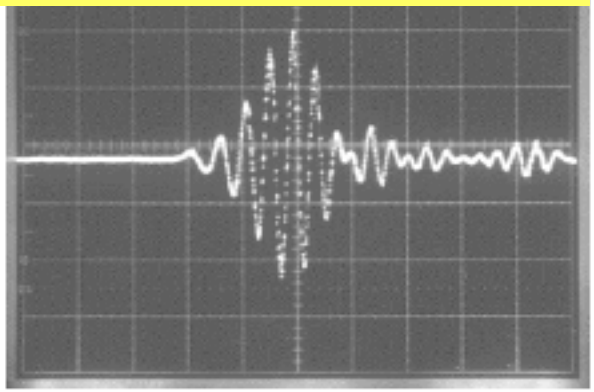


Continuous wave RF modulates data signals over carrier waves.



- UWB encodes information as pulse of RF energy
- Timing of pulses is used to relay information





Ultrawideband is carrier-less RF

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AID Strategic Policy : Balanced Oxymoron

- **Standards Compliant**
- **Standards Agnostic**
  - **Data**
  - **Software**
  - **Hardware**
  - **Infrastructure**
  - **Process**

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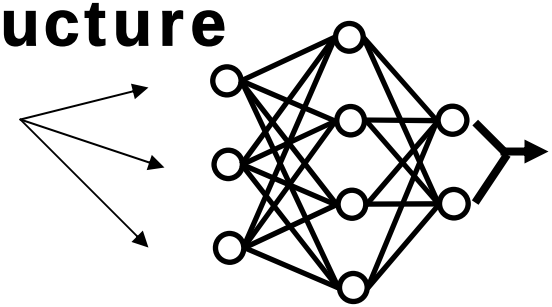
Fundamental Strategic Policy Objective: How to AID Citizens Make Better Decisions

- **Standards >> Reasonable Freedom of Choice**
  - Data
  - Software
  - Hardware
  - Infrastructure
  - Process



Information Intelligence

Better Decisions

Agnosticism = Adaptability + Productivity

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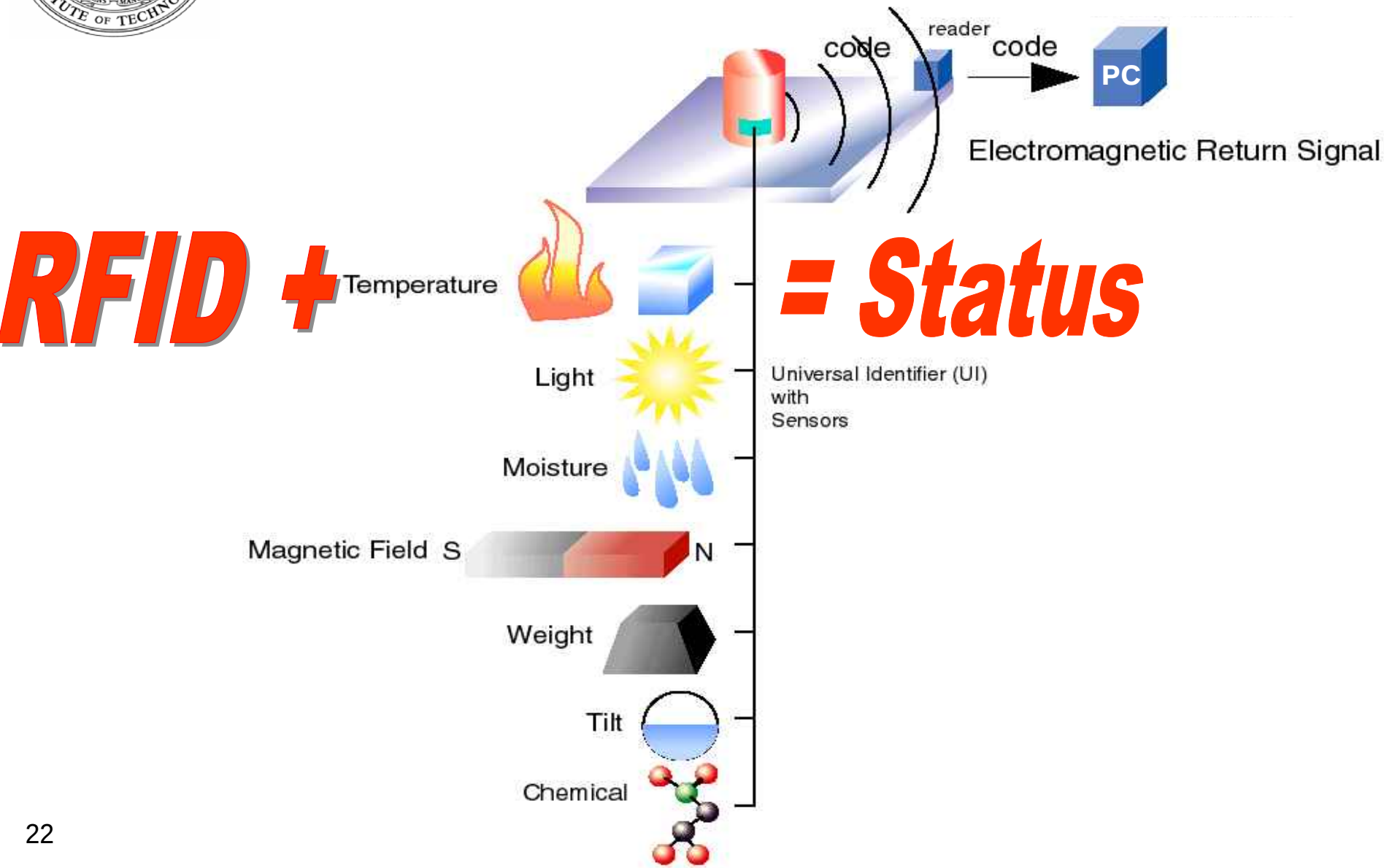
RFID >> Data
Status >> Information ?

(Data is not Information)



AID for Data vs Information Flow in Near Real-Time

Reporting

Services

Applications

MM, PP, SD

FI, CO-PA, HR

AA

S C M – A S D N P

P L M

S E M

CRM

BI

Markets

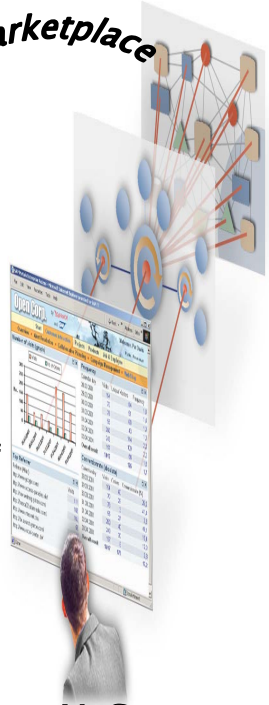
Procurement

Portals

Digital

Rights Management

Marketplace



M-Commerce

Security

Bloomberg

Reuters

?

AA

Intelligence

Logistics

Communication

Event Management

Filters, Continuous Query Rules, SL Tags

Adaptive Data

Manual

Keyboard

Voice

AWARE GOODS

Interrogatr Trnsceiver

Scanner

Sensors GPS/GSM

RFID, UWB

Bar Code

Others

Repository Distributed

Repository Distributed

Repository Distributed

Raw Data

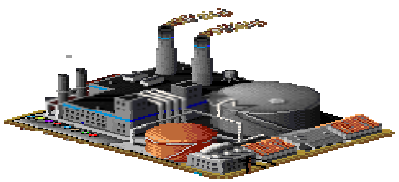
Raw Data

Raw Data

Raw Data

Raw Data

Raw Data



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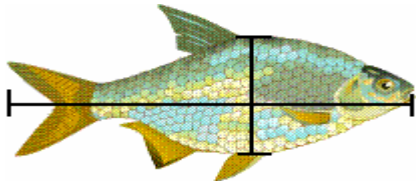
Data vs Decisionable Information

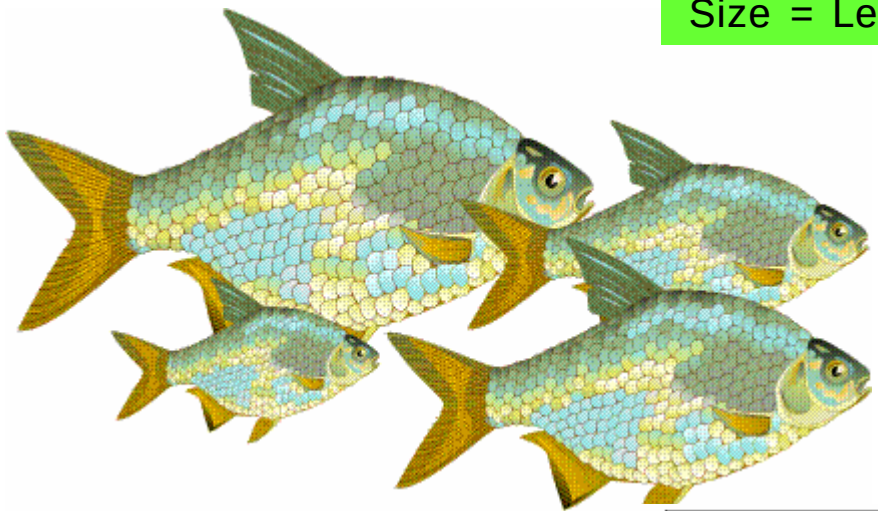
Artifacts and Inaccuracies Reduce Value of Information (not Data)

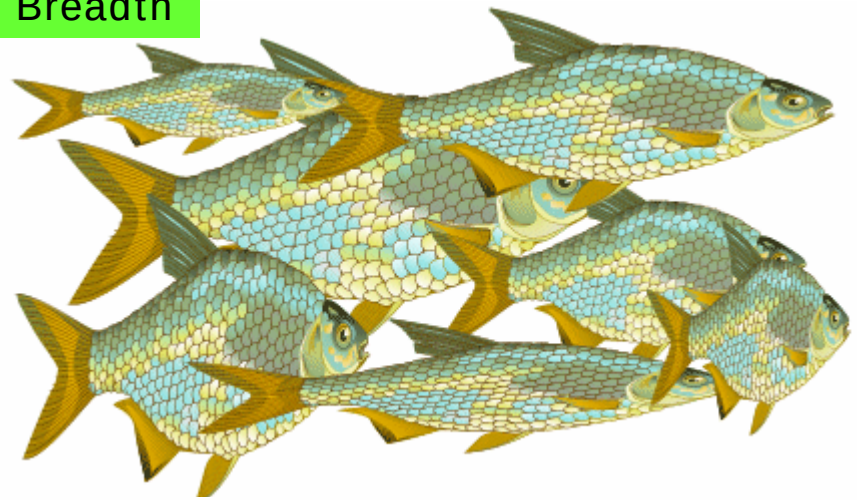


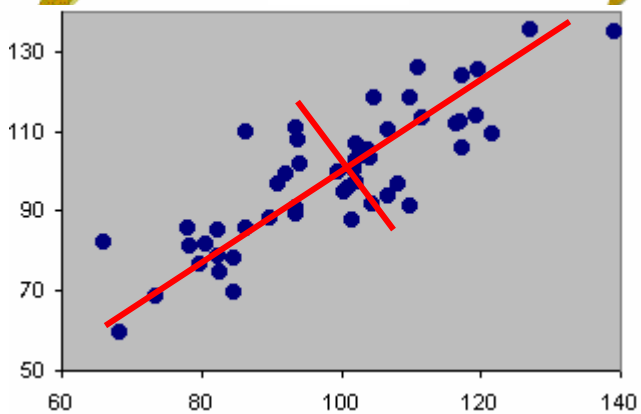
Retain 87.5% of the information

Retain 62.5% of the information

Size = Length + Breadth







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SOLUTION $\stackrel{?}{=}$ AID

Where is the ROI ?

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Data ...

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More data points …

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Data shows emerging pattern …

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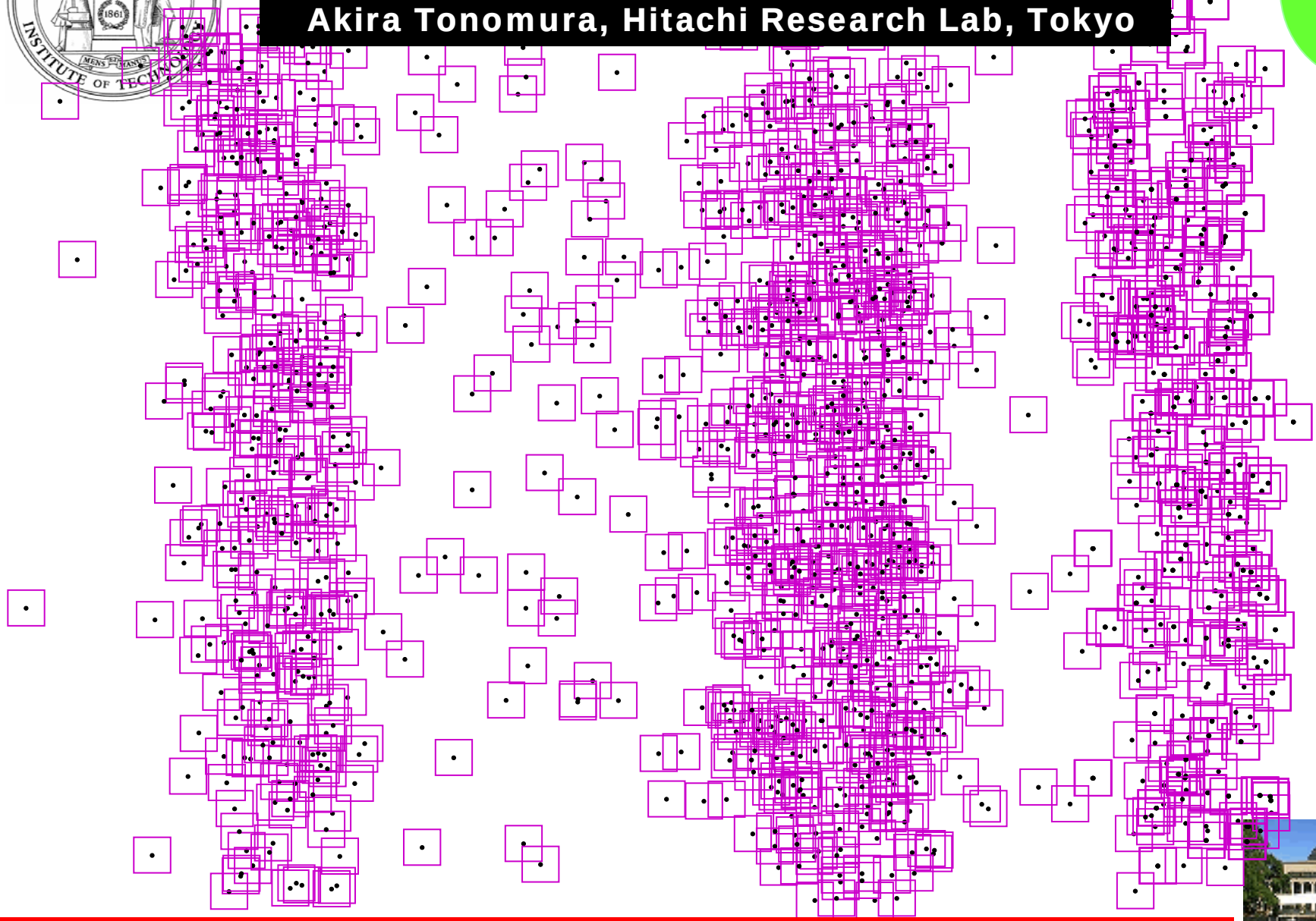
Young's Double Slit Experiment with Electrons

Akira Tonomura, Hitachi Research Lab, Tokyo

Activation Energy in Enzyme Kinetics



With enough data, patterns emerge and help optimize processes.

Where is the ROI ?

In Solving Problems

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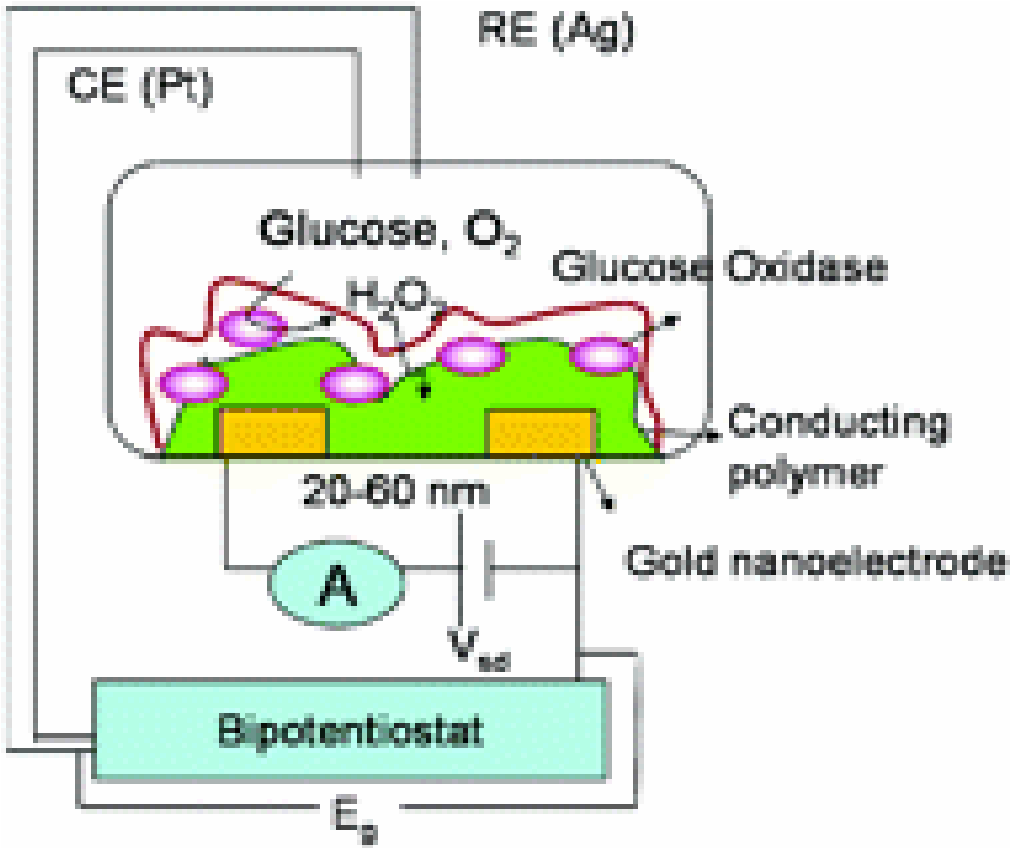
Glucose Nano-sensor



http://pubs.acs.org/cgi-bin/article.cgi/nalefd/2004/4/i09/pdf/nl049080l.pdf

NanoLetters (2004) 4 1785-1788
A Conducting Polymer Nanojunction Sensor for Glucose Detection
Erica S. Forzani, Haiqian Zhang, Larry A. Nagahara, Ishamshah Amlani, Raymond Tsui and Nongjian Tao
Department of Electrical Engineering and Center for Solid State Electronics Research
Arizona State University, Tempe, Arizona, USA
and The Microelectronics and Physical Sciences Laboratory, Motorola, Tempe, Arizona, USA

Source: UN

Growing Older > and Wiser ? or Poorer ?

	10% = 65	20% = 65	Years
France	1943	2018	**75**
Germany	1952	2009	57
Italy	1966	2006	40
USA	1972	2036	64
Japan	1985	2006	21
China	2017	2036	**19**

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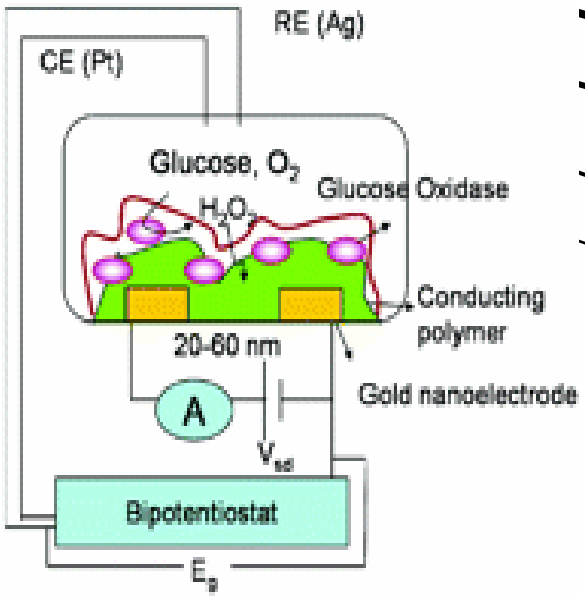
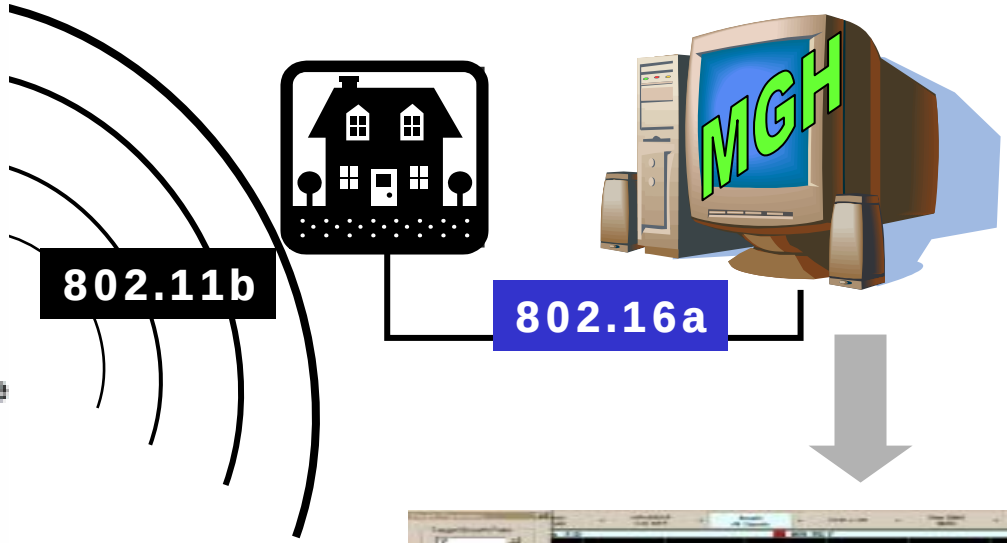
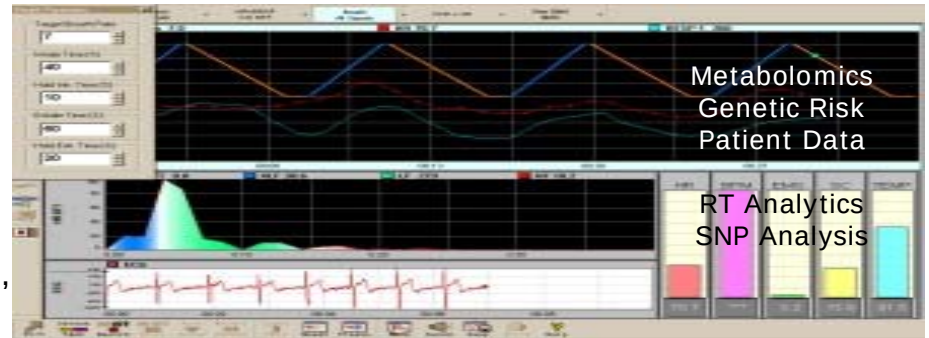
Active Aging Academics



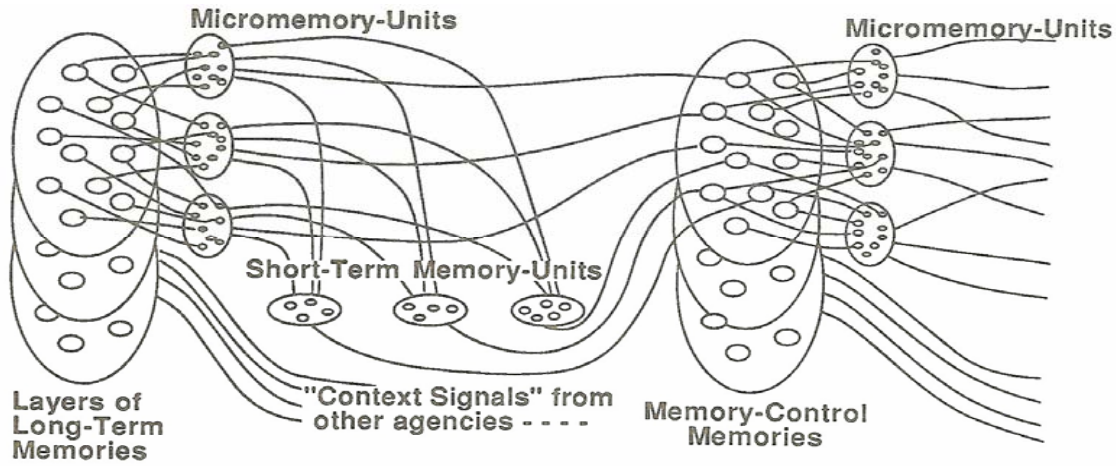


Blood Glucose Nano-sensors



Source: From Neurons to the Brain

Basic Neural Circuits



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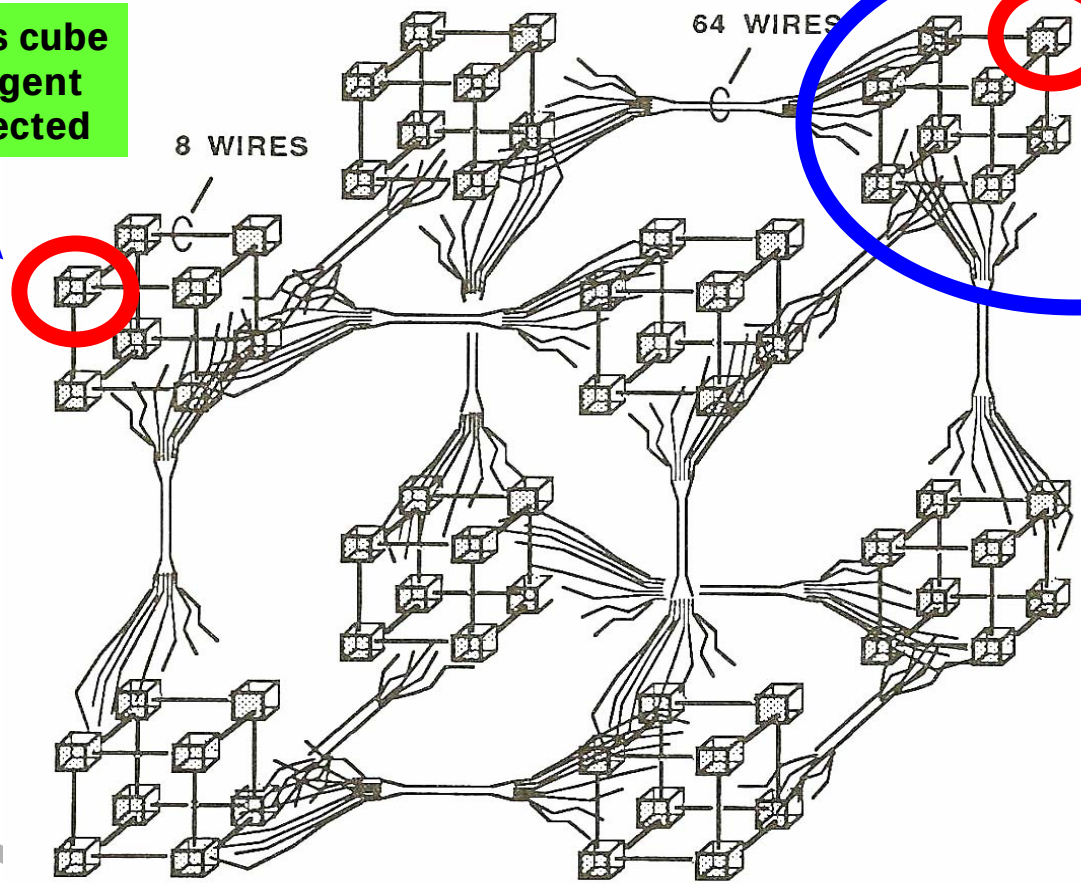
Cube-on-Cube

Cube-on-Cube

8 corners of larger cube
8 Agents repeated 8 times

64

8 corners of this cube
1 corner = 1 Agent
8 Agents connected



= 512

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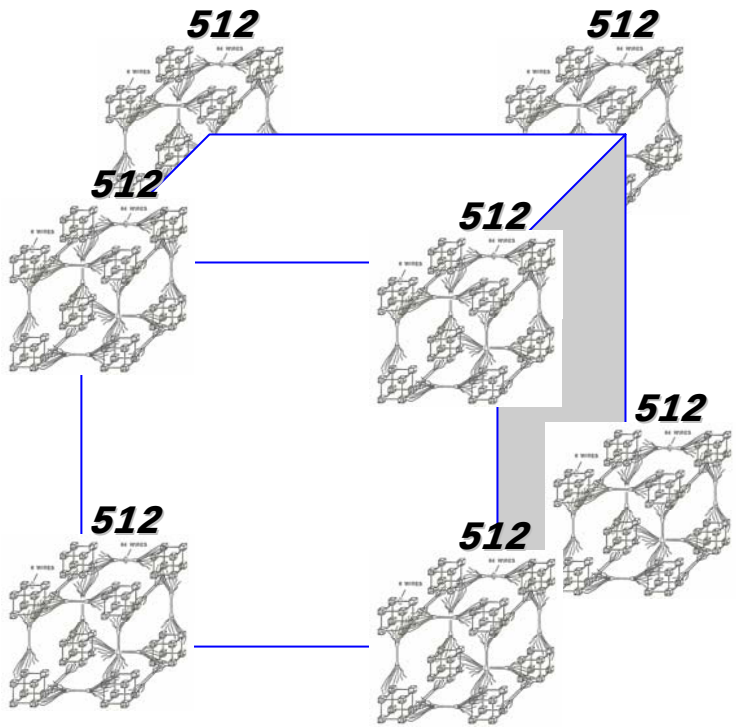
Cube-on-Cube: Step 4



Agents interconnected

8 X 512 = 4096

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Cube-on-Cube: Step 10

Cube-on-Cube: Step 10

Repeat this cube-on-cube pattern 10 times (10 steps).

Supercube (8^{10} = 1, 073,741,824) will contain over 1 billion Agents.

Each Agent in the original smallest cube (of 8 Agents) can communicate with 1 billion Agents (sources, variables) in 10 steps.

Link each Agent to 50 other Agents:
Each Agent communicates with >15 billion Agents in 6 steps (50^6).

CocaCola can monitor nearly *each RFID tagged unit case* of its product. Real-time data can be collected by an Agent (Agency) in mere 6 steps for analysis (inventory, distribution, storage, transit, temperature). In 2004, CocaCola produced 19.8 billion unit cases.

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Bio, Info, Nano = Technologies

Healthcare QoS = Problem

Problem of 200 outpatient visits

2 patients in need of attention

Renato Dulbecco

25,000 genes in Cancer ?

1 gene in Cancer

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More Innovation, Less Regulation » AID for Transparency

SYNTACTIC WEB

Dumb browsers

Are you still stuck here?

Internet 0
Internet 1
Internet 2

Internet of Things
Internet of Devices

InterDev

IPv6 *

Bits, Atoms, Decisions

Right-Time Analytics

Smart services

AGENTS

Web Services

Service Supply Chain

SECURITY

SEMANTIC GRID Web Portal

MEMS / NEMS
SENSOR NETS
Intel Motes, Crossbow
Ember, Millennial Net

D2B / RFID / UWB
Object Oriented Hardware

FINANCIAL
Supply Chain

CUSTOMS
FDA, EPA

Remote Monitoring HEALTHCARE

dERP

E-Government Utilities, Pension

Real Time Data
Streaming Data - Continuous Query

From Taipei, TW you log on a Software Defined Radio reader in a LAX warehouse to check if a shipment arrived. It did and cleared customs. You also see that your distributor in Santiago, Chile and Nordic retailer in Espoo, Finland also checked the distribution status, moments before you logged on.

* *Data Interrogators as Ubiquitous Internet of Devices*

Source:
The Economist, April 24th, 2004

"Likewise, in the past few decades most of the companies that have created truly extraordinary amounts of wealth have done so by inventing great processes, not great products (technology). Dell, Toyota and Wal*Mart, for example, have risen to the top of their respective industries by coming up with amazingly efficient ways of getting quite ordinary products into the hands of consumers more cheaply than their rivals."

Do you have the human capital competency to ascend the value chain from components manufacturing to providing global solutions?

Policy : Milk or Butter ?

AID Pilots & Proof of Concept

shoumen@mit.edu

Thank you