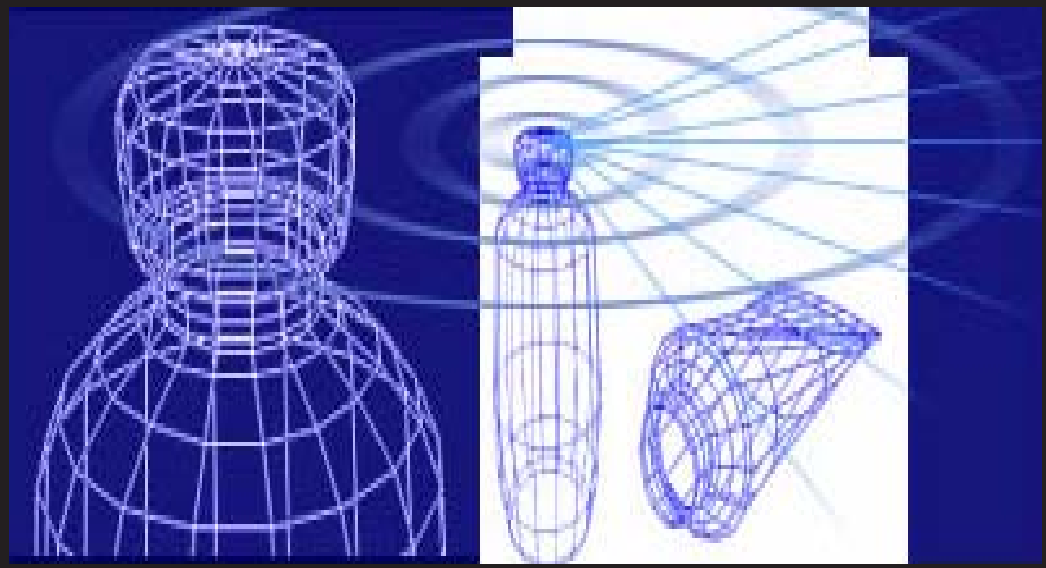
auto-id center

Auto-ID Center

Connecting the world



David Brock, Co-Founder and Director
Auto-ID Center
Massachusetts Institute of Technology

auto-id center

- **Mission**

  Merge bits and atoms

- **Task**

  Create the standards and systems to enable the *Internet of Things*

background

AUTO-ID CENTER - Founded October 1, 1999

- **US Center Headquarters at MIT, USA**
- **European Centers Cambridge University, ENGLAND**
  University of St. Galan, SWITZERLAND
- **Pacific Center University of Adelaide, AUSTRAILIA**
- **China Center Fudan University, Shanghai, CHINA**
- **Japan Center Keio University, Tokyo, JAPAN**

about the center

- **End User Sponsors**
  - **Abbott Laboratories, Ahold, Best Buy Corporation, Canon Inc., Carrerfour, Chep International, Coca-Cola, CVS, Dai Nippon Printing, Department of Defense, Ean International, Eastman Kodak, Home Depot, International Paper, Johnson & Johnson, Kellogg's, Kimberly-Clark, Kraft, Lowes Companies, Inc., Mead Westvaco, Metro, Mitsui & Co, Ltd., Nestle Purina, Pepsi Bottling Group, PepsiCo, Pfizer, Philip Morris US, Procter and Gamble Company, Sara Lee, Smurfit Stone, Target Corp., Tesco Stores Ltd., The Gillette Company, Toppan Printing, Uniform Code Council, Unilever, United States Postal Service, UPS, Visy Industries, Wal-Mart Stores Inc., Wegmans Food Markets, Inc., Yuen Foong Yu Paper Mfg. Co. LTD.**

about the center

- **Vendor Sponsors**
  - Accenture, ACNielsen, ADT/Sensormatic, Alien Technology, Avery Dennison, Applied Wireless ID, Arbitron, Avery Dennison, AWID, British Telecom, Cap Gemini Ernst & Young, Cash's, Catalina Marketing Corp, Checkpoint Systems, Inc., Composite Materials PLC, ConnecTerra, Inc., Display Edge, Ember Corporation, Embrace Networks, Flexchip AG, Flint Ink, GEA Consulting, GlobeRanger, IBM. IDTechEx, Imping Inc., Information Resources, Inc., Intel, Intermec, Invensys PLC, Ishida, KSW Manhattan Associates, Markem Corp., Matrics, Microtec AG, Morningside Technologies, NCR Corporation, Nippon Telegraph and Telephone Corporation, NTT Comware, OATSystems, Omron, Philips Semiconductors, Provia Software, PSC, Rafsec, RF Saw Components, SAMSYS, SAP, Savi Technology, Sensitech, Sensormatic Electronics Corp, Siemens Dematic Corp., STMicroelectronics, Sun Microsystems, Symbol Technologies, TAGSYS, ThingMagic, Toppan Forms, Toray International, Inc., UNISYS, Vizional Technologies, Vizional, Zebra Technologies Corporation

about the center

- **Trade Bodies**

  American Trucking Association (ATA), Association for Retail Technology Standards (ARTS) also NRF, Auto-ID Manufacturers (AIM), Canadian Council of Grocery Distributors, Consumer Electronics Association (CEA), Efficient Consumer Response Europe (ECR Europe), Electronic Commerce Council of Canada, Food Marketing Institute (FMI), Global Commerce Initiative (GCI), Grocery Manufacturers of America (GMA), Healthcare Distribution Management Association (HDMA), International Federation of Pharmaceutical Wholesalers (IFPW), International Hologram Manufactures Association (IHMA) (Reconnaissance Intl), International Mass Retail Association (IMRA), Material Handling Industry of America (MHIA), National Association of Chain Drug Stores (NACDS), National Association of Convenience Stores (NACS), National Retail Federation (NRF) also ARTS, Point of Purchasing Advertising International (POPAI), Produce Marketing Association (PMA), Uniform and Textile Services Association (UTSA)

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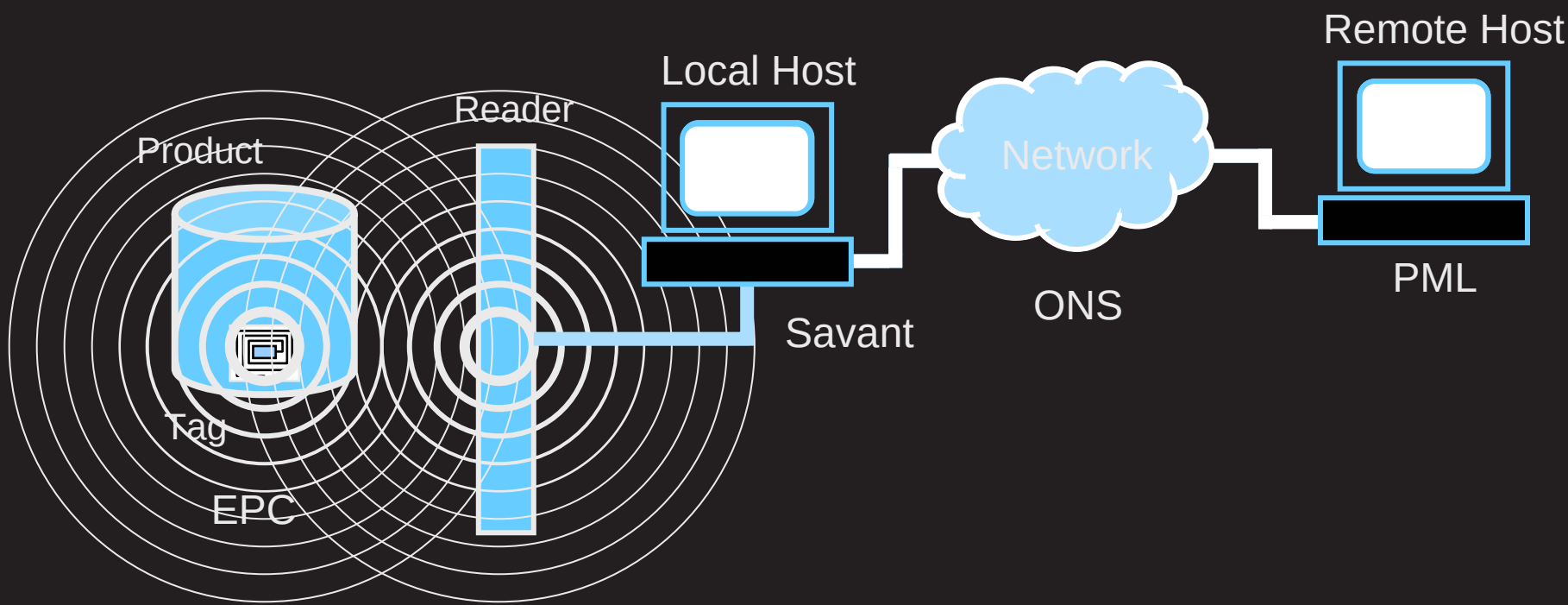
intelligent infrastructure

- **TAGS** RFID
- **EPC** Electronic Product Code
- **ONS** Object Name Service
- **PML** Physical Markup Language
- **Savant™** Distributed Operating System



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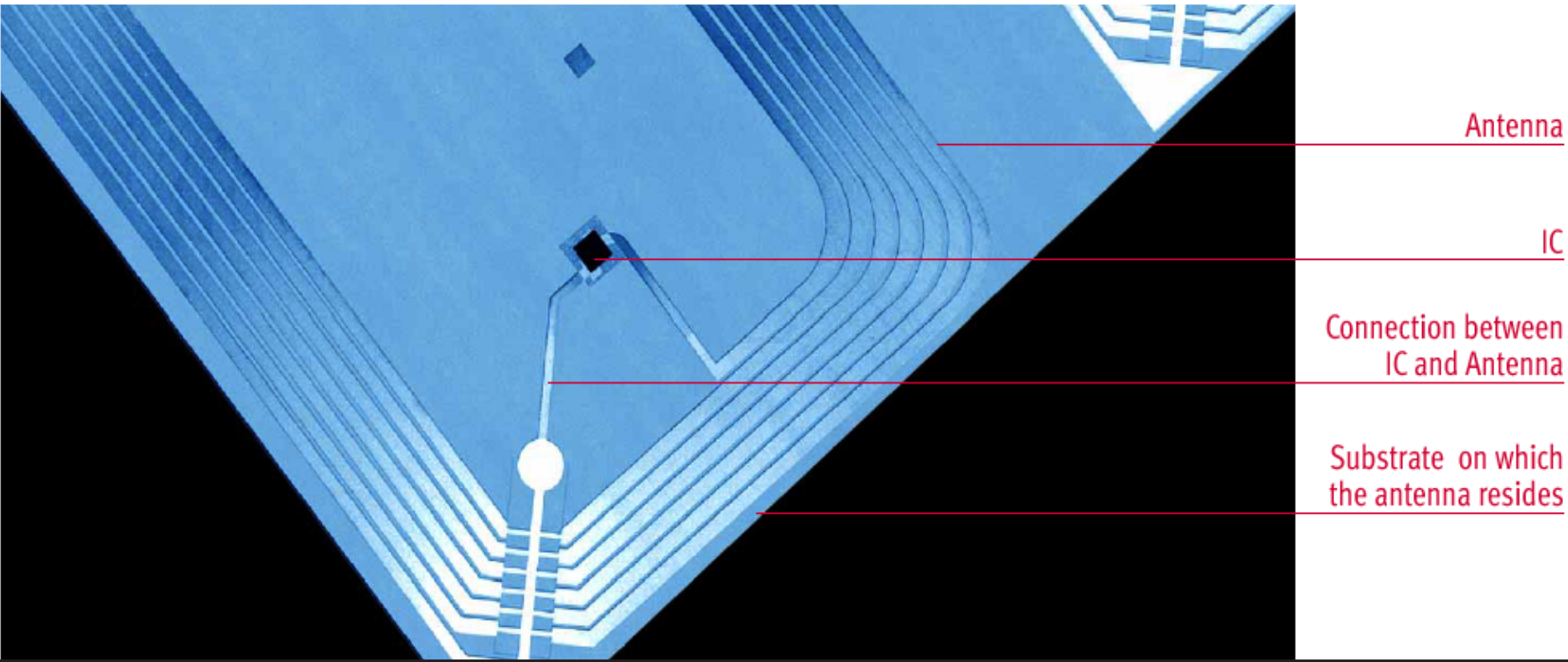
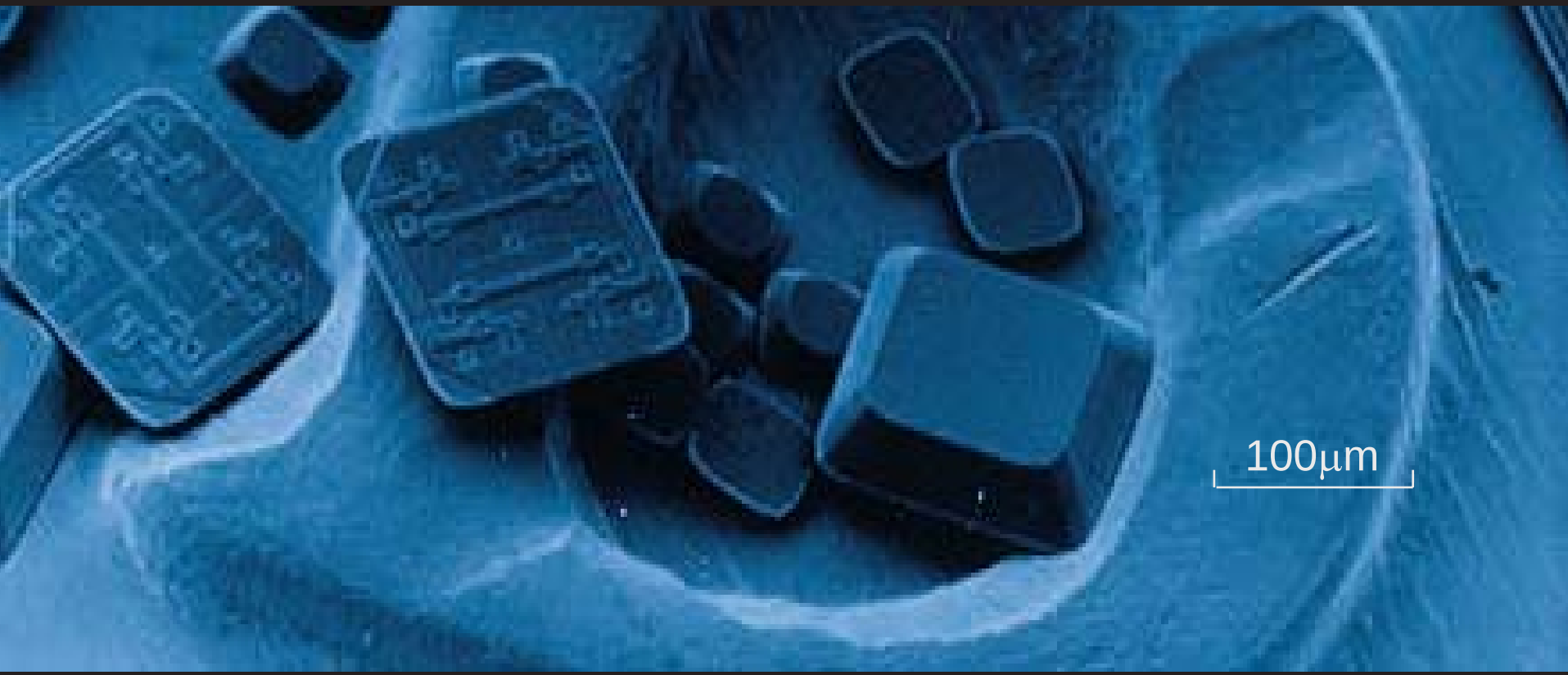
tag



AUTO-ID CENTER

tag: cheap chip



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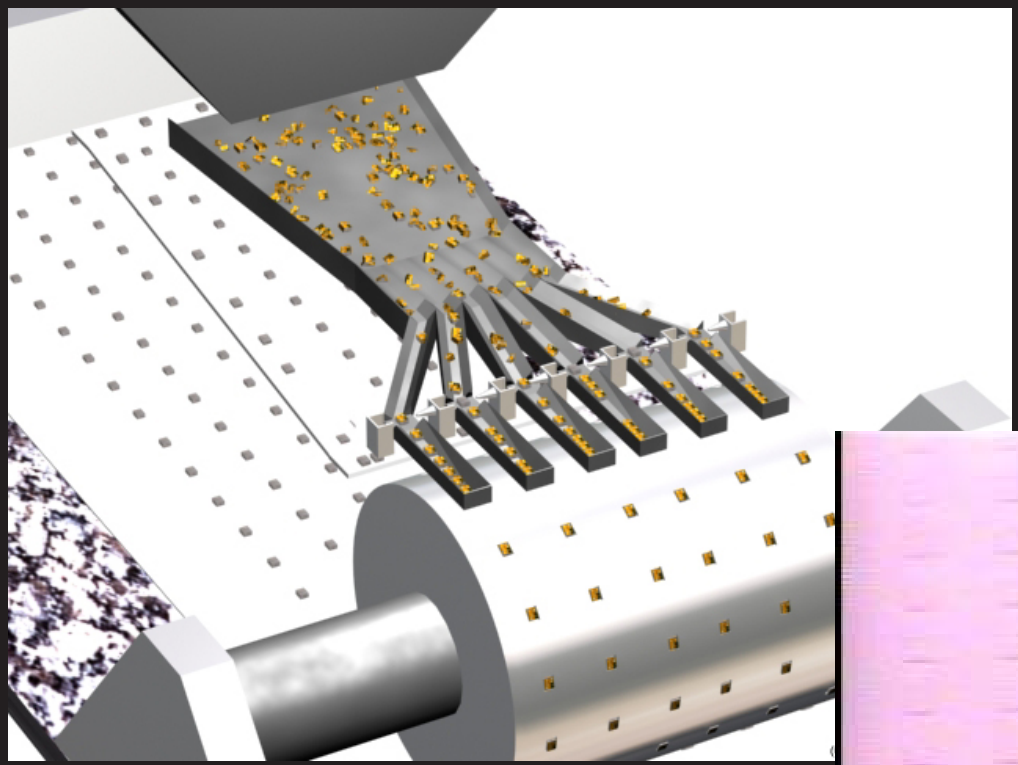
tag: cheap manufacturing



making it real

- **One dozen EPC pilot trials**
- **Gillette purchases 500 million EPC tags**
- **Wal*Mart requires top 150 suppliers to put RFID tags on shipping creates and pallets by January 2005 and all 25,000 suppliers by January 2006 – *Computer World June 16, 2003.***
- **1 Billion RFID tags with embedded Electronic Product Code (EPC) for tracking and identification of items at the individual create and pallet level – *Pam Kohn V.P. Global Supply Chain Operations Wal*Mart.***
- **United States Department of Defense (DoD) mandates RFID for higher value items.**
- **United States Food and Drug Administration (FDA) mandates RFID for pharmaceutical supply chain.**

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what can you use it for?

real-time supply chain management…

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…in the warehouse…

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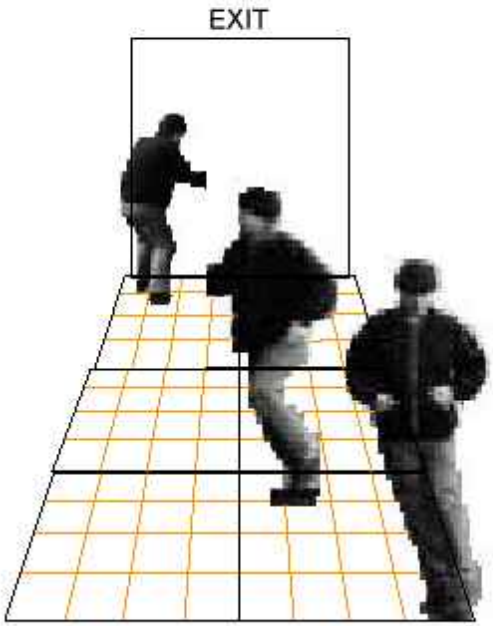
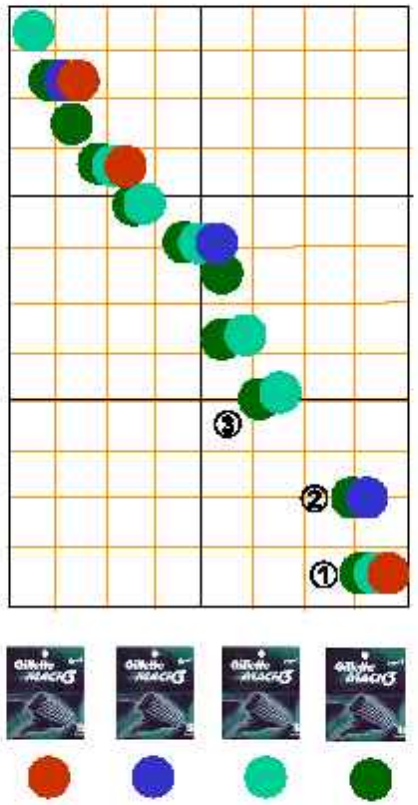
…and on the shelf

prevents theft…

What happens in store



What the system sees



What the system thinks

① Read: 3 packs Mach3

...very high risk item
...normal purchase 1-2 units
...not yet paid for
...selected 4.21 mins ago
...all removed within 34 secs

..95% risk: products together
...70% risk: theft in progress

② Read: additional pack Mach3

...not yet paid for
...selected 4.21 mins ago
...with pack from previous group

..95% risk: products together
...50% risk: moving towards exit
...75% risk: theft in progress

③ Read: 2 packs from Mach3 group

..95% risk: products together
...75% risk: moving towards exit
...85% risk: theft in progress

Action: ALERT SECURITY

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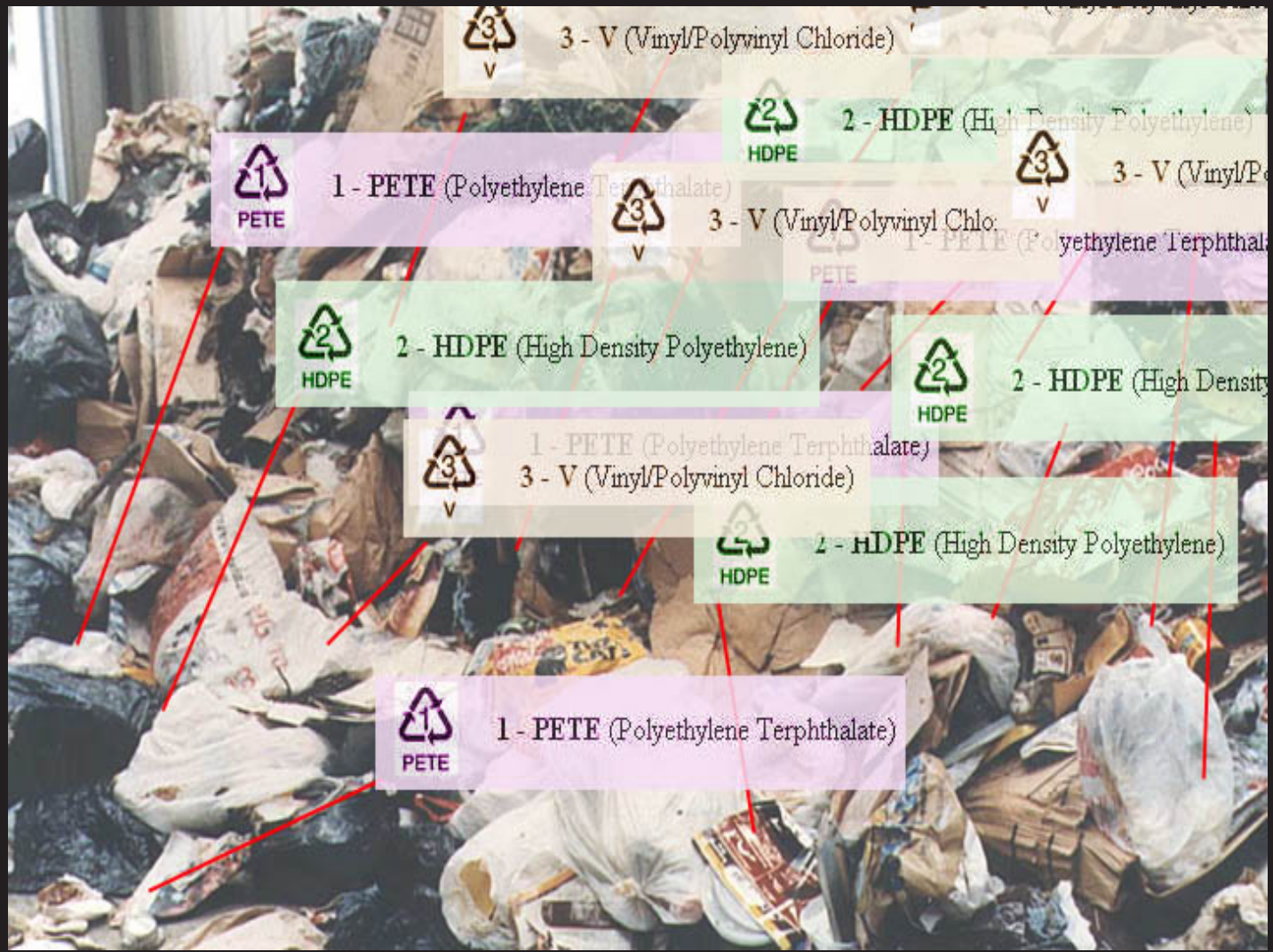
… and counterfeit products

…to disposal


3 - V (Vinyl/Polyvinyl Chloride)
2 - HDPE (High Density Polyethylene)
1 - PETE (Polyethylene Terphthalate)
3 - V (Vinyl/Polyvinyl Chloride)
2 - HDPE (High Density Polyethylene)
2 - HDPE (High Density Polyethylene)
3 - V (Vinyl/Polyvinyl Chloride)
2 - HDPE (High Density Polyethylene)
1 - PETE (Polyethylene Terphthalate)

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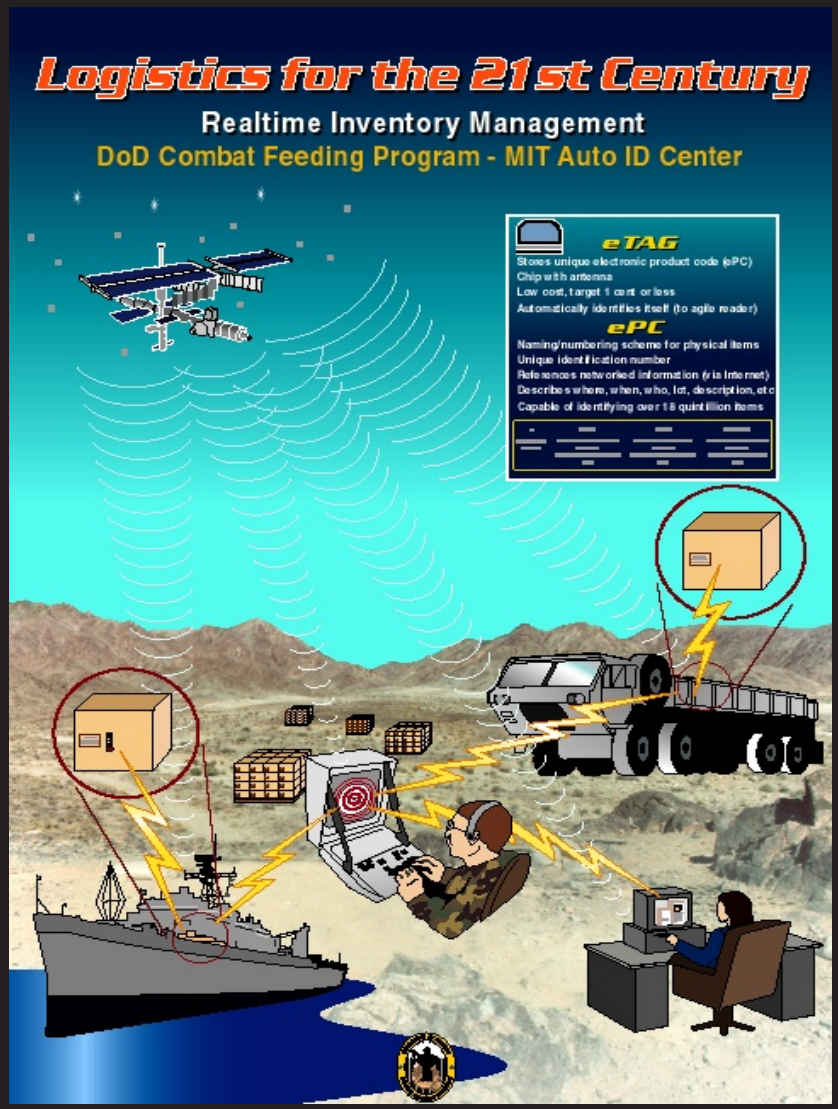
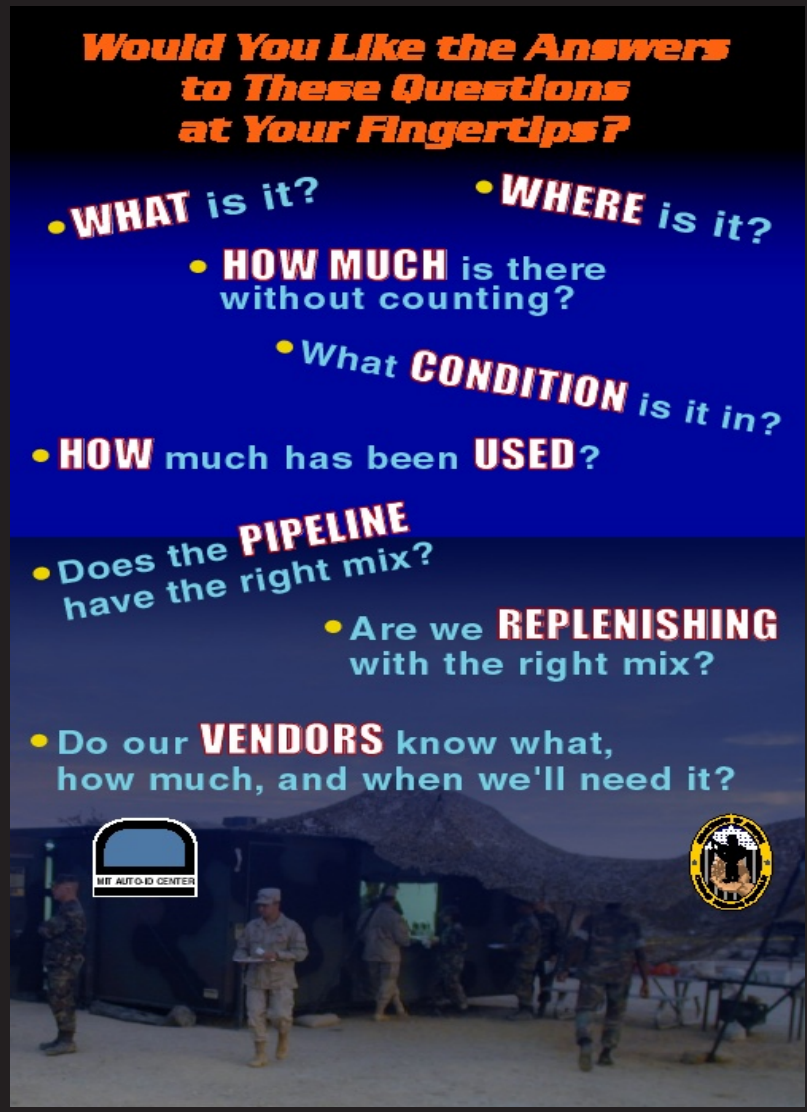
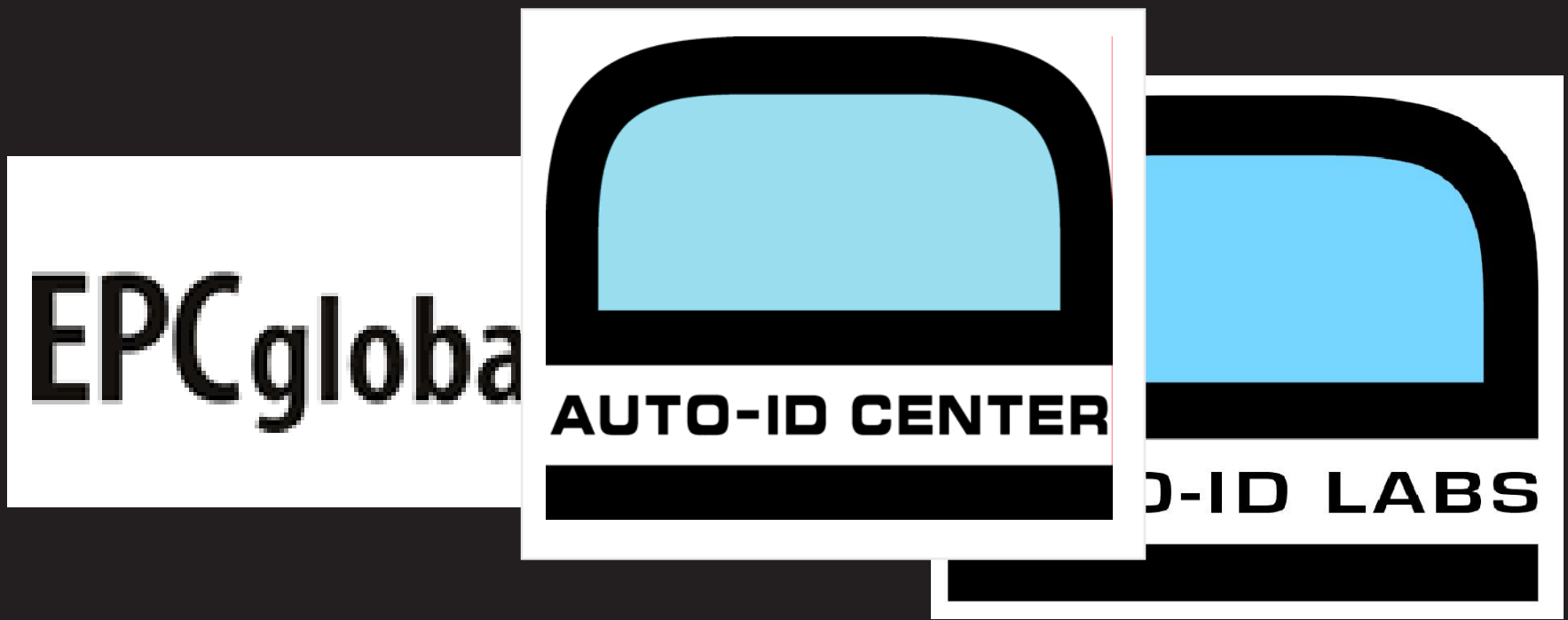
DEPARTMENT OF DEFENSE



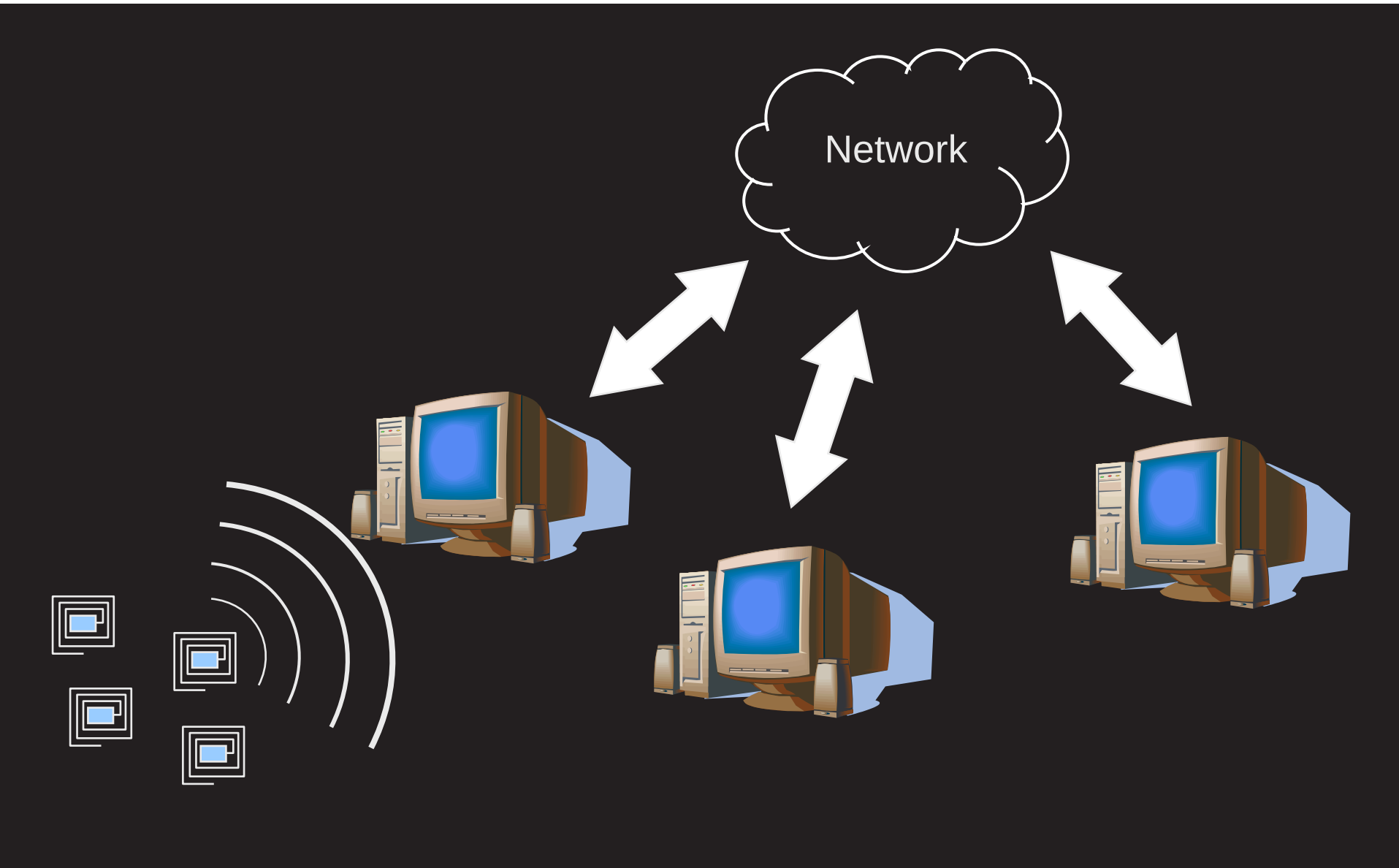


continuing the revolution…

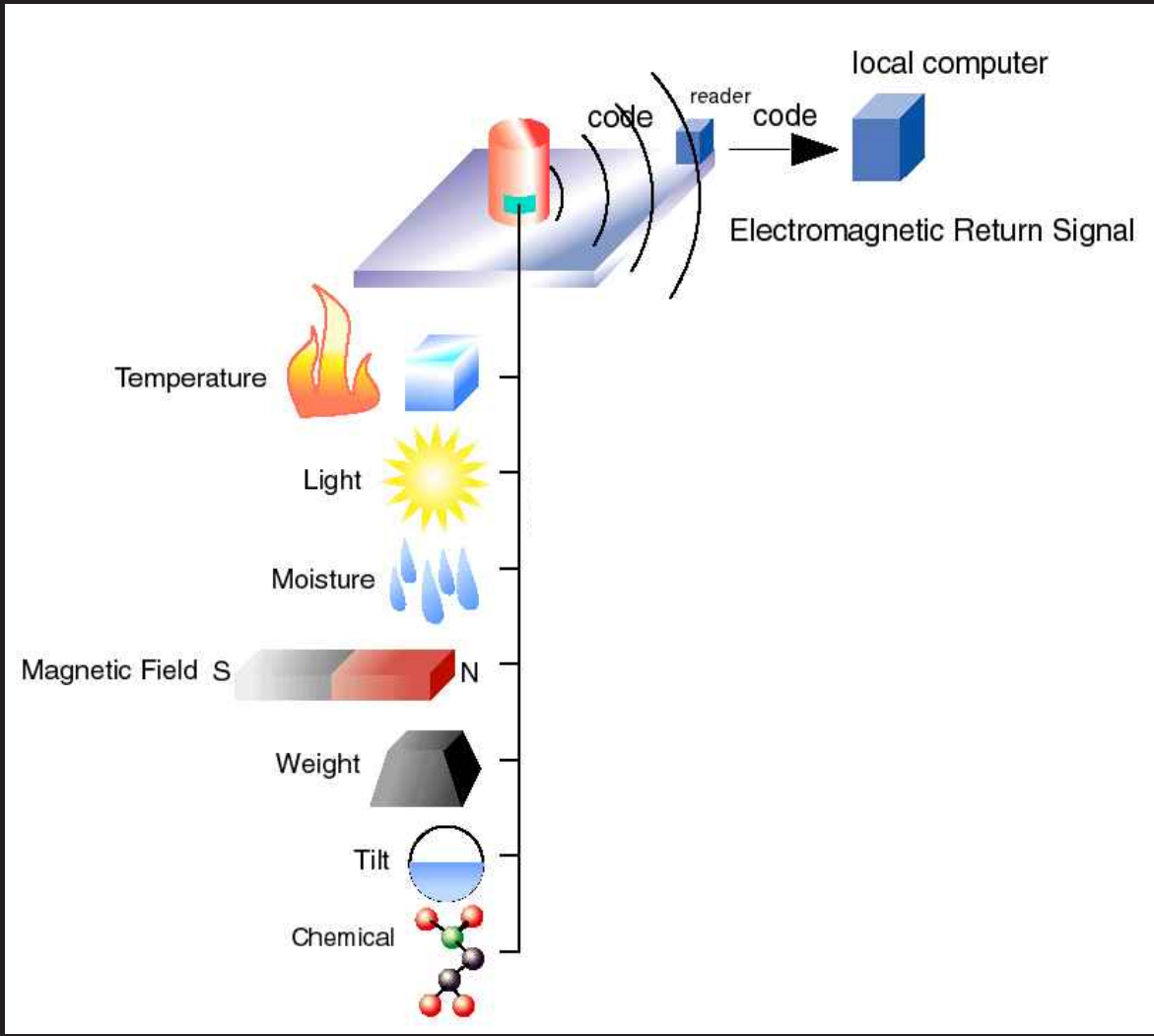


AUTO-ID LABS

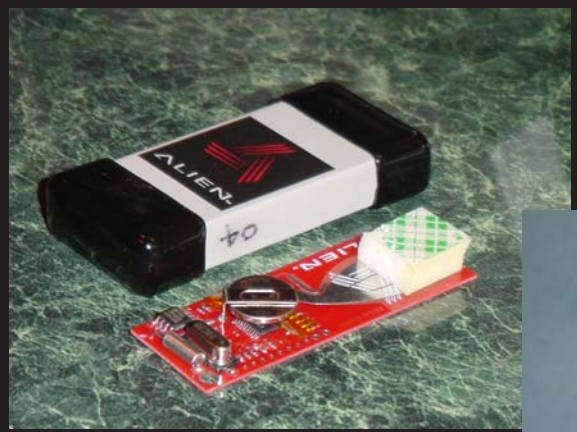
special interest group (SIG)
web services



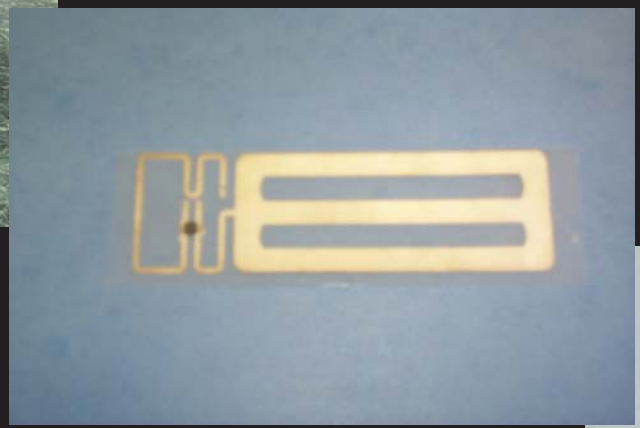
sensor data…


local computer
reader
code
code
Electromagnetic Return Signal
Temperature
Light
Moisture
Magnetic Field S
N
Weight
Tilt
Chemical

example: fresh food



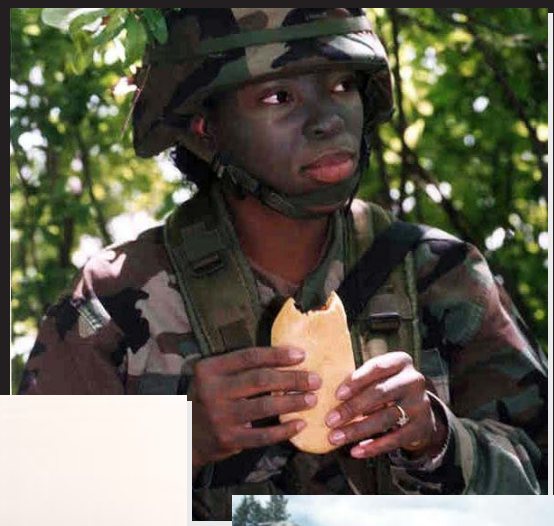
Current Type 3 Tag w/Temp Sensor



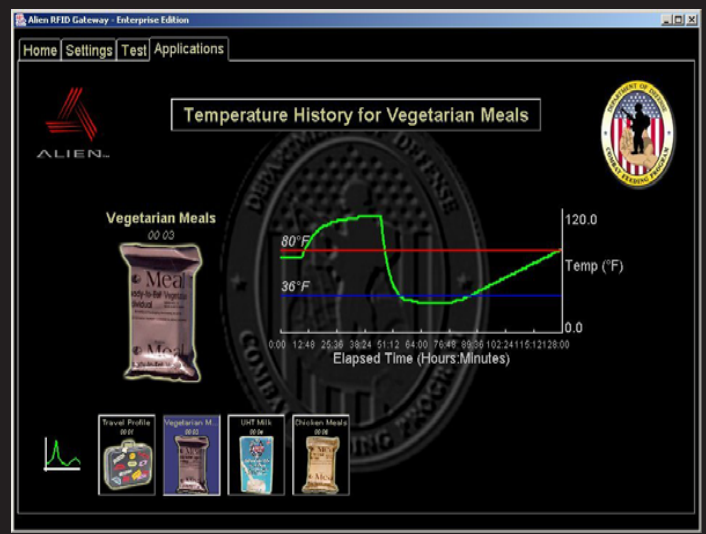
Next Generation Application Specific Integrated Circuit (ASIC)

350 Micron NanoBlock™ chips

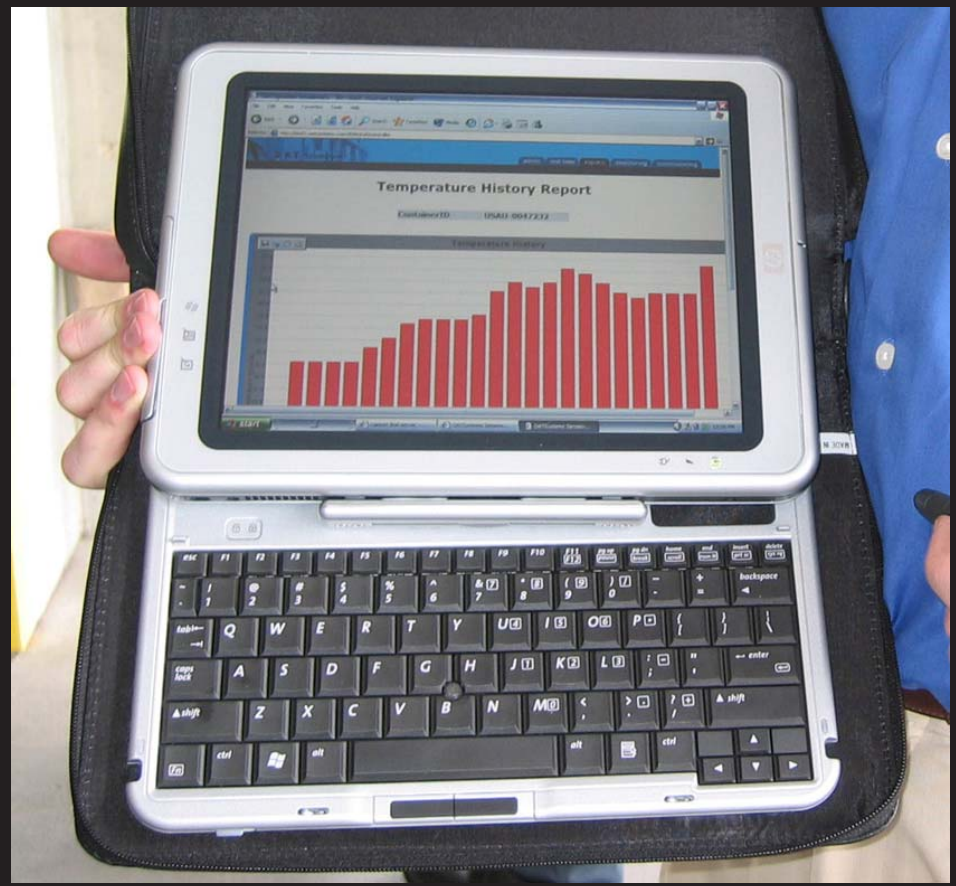
example: fresh food



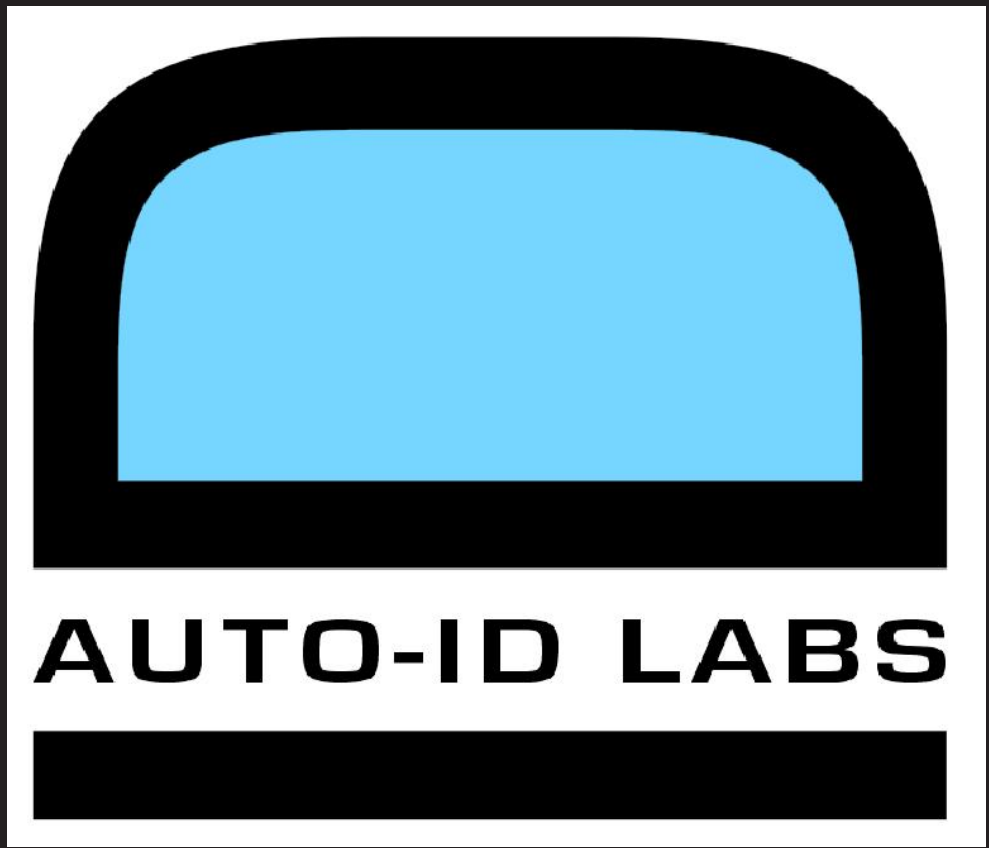
example: fresh food



EXAMPLE – SHELF LIFE



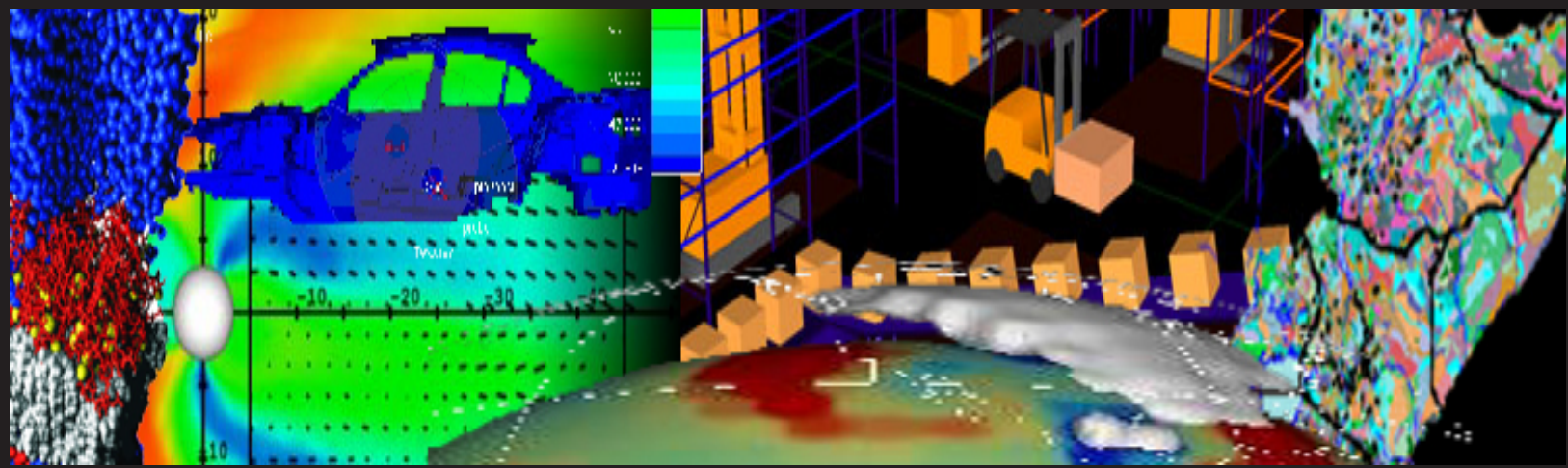
AUTO-ID LABS



What are you going to do
with all this
Data?

DATA CENTER

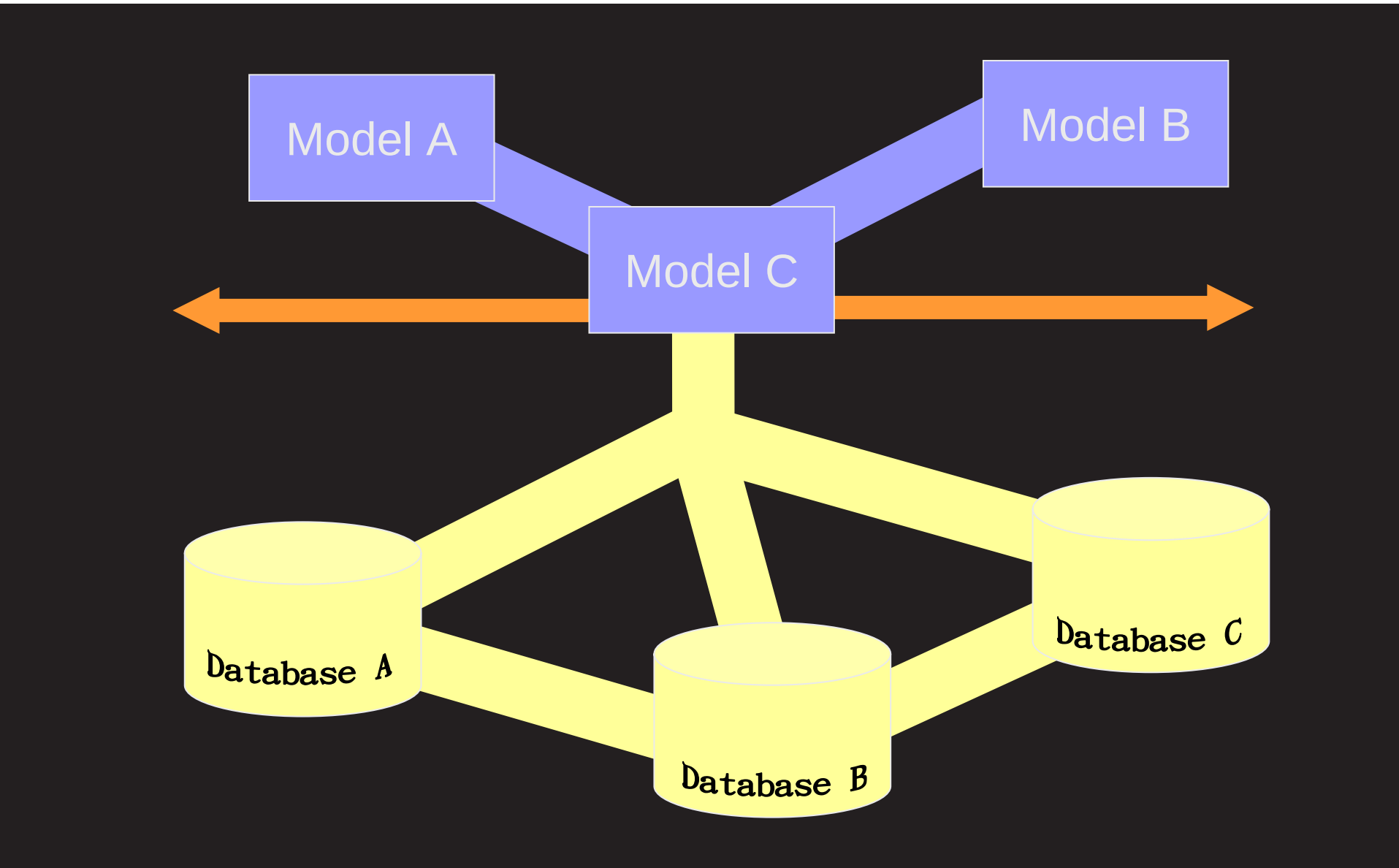
Make sense of your data



David Brock, Founder and Director
Data Center
Massachusetts Institute of Technology

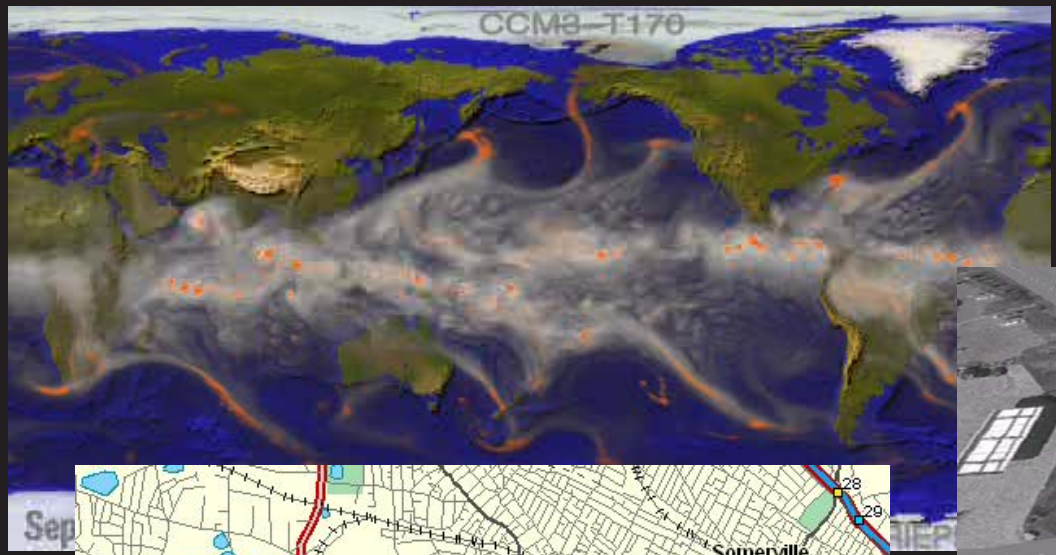
DATA CENTER

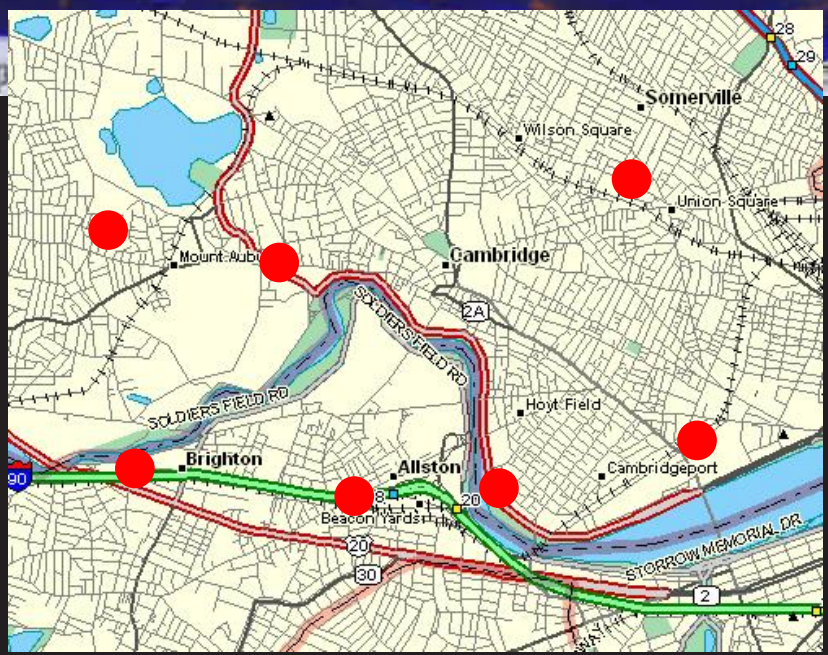
VISION



DATA CENTER

EXAMPLE - LOGISTICS





DATA CENTER

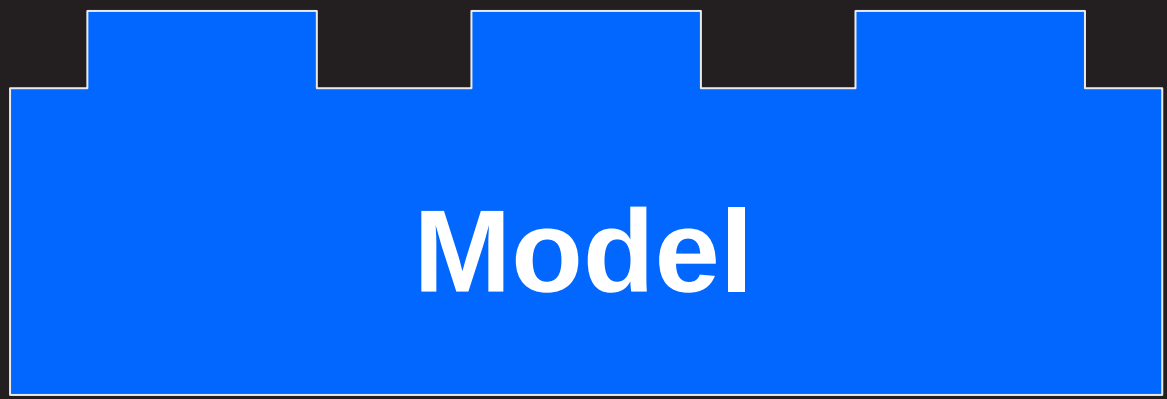
EXAMPLE - LOGISTICS

DATA CENTER

MODELS

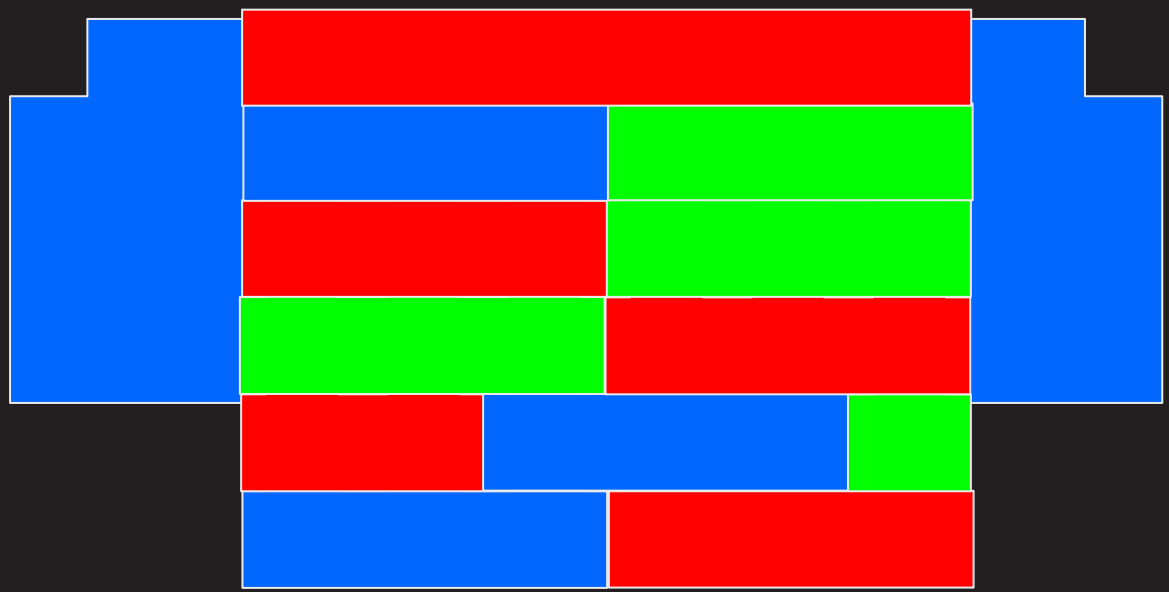
DATA CENTER

MODELS



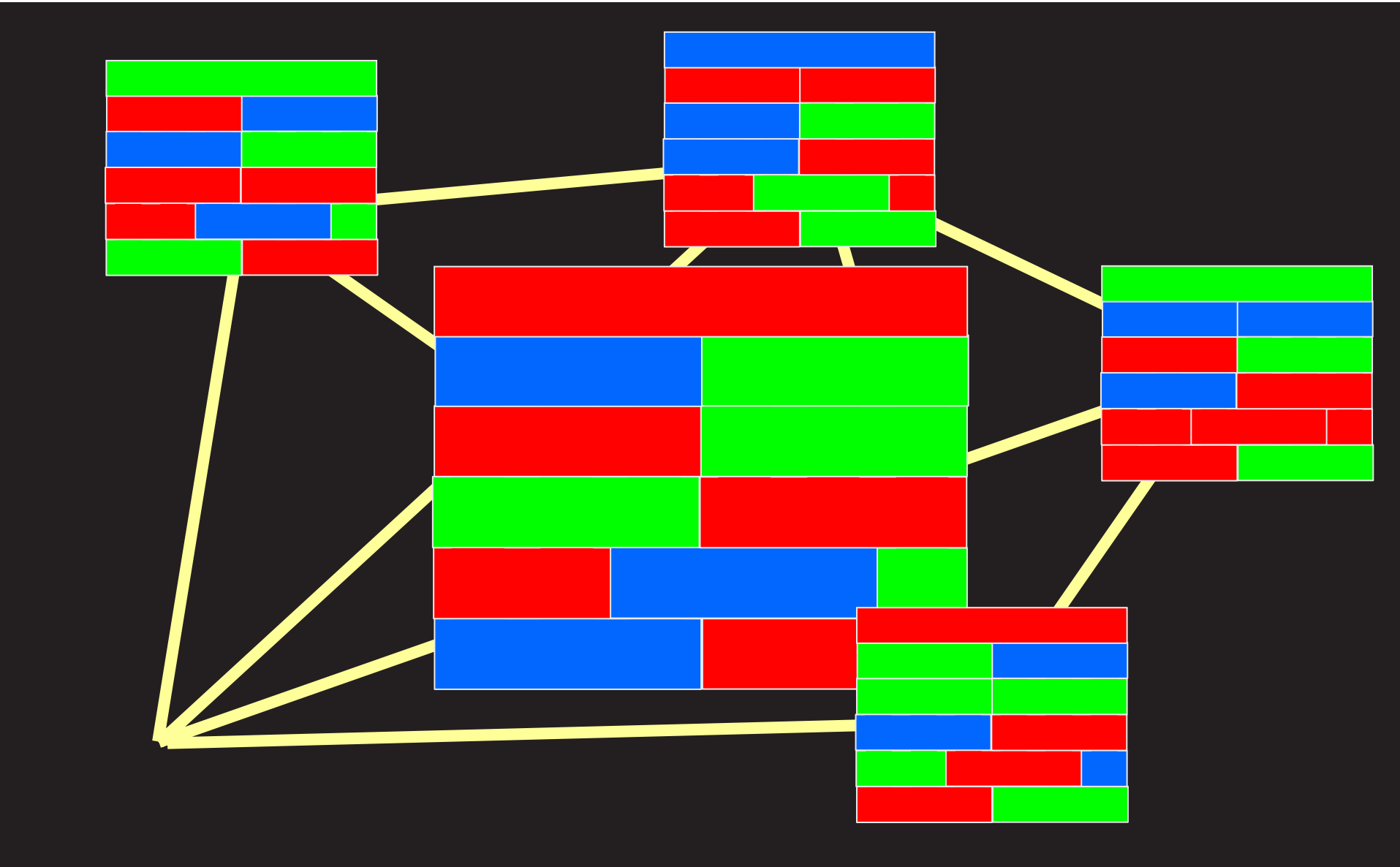
DATA CENTER

MODELS



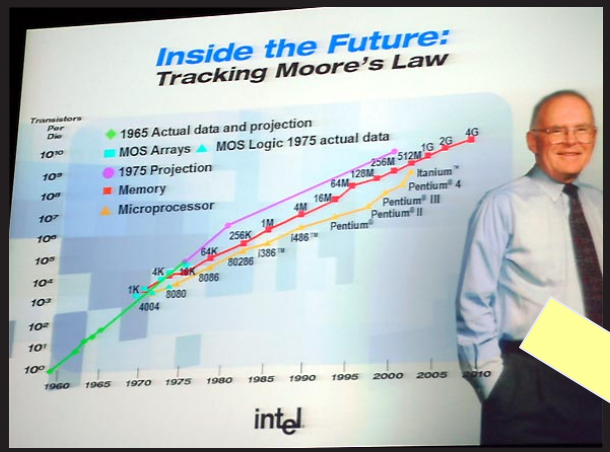
DATA CENTER

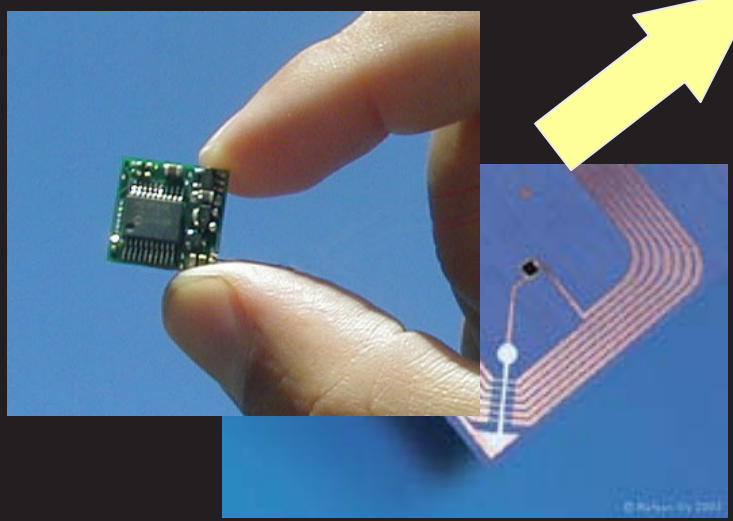
MODELS



DATA CENTER

DRIVERS





HTML

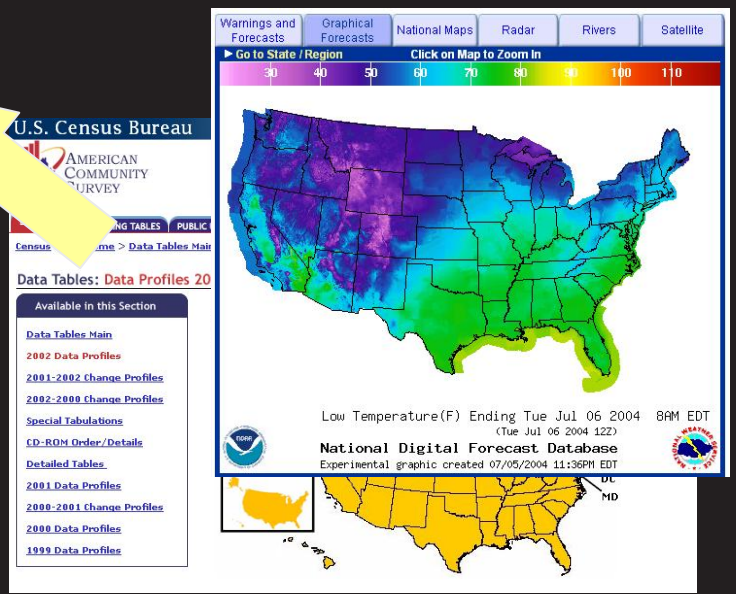
XML

EPC

TCP/IP

HTTP

SOAP



DATA CENTER

VISION

Mission

- Make sense of the data

Task

- Create the standards and systems for interoperable data and modeling

M

A Modeling Language

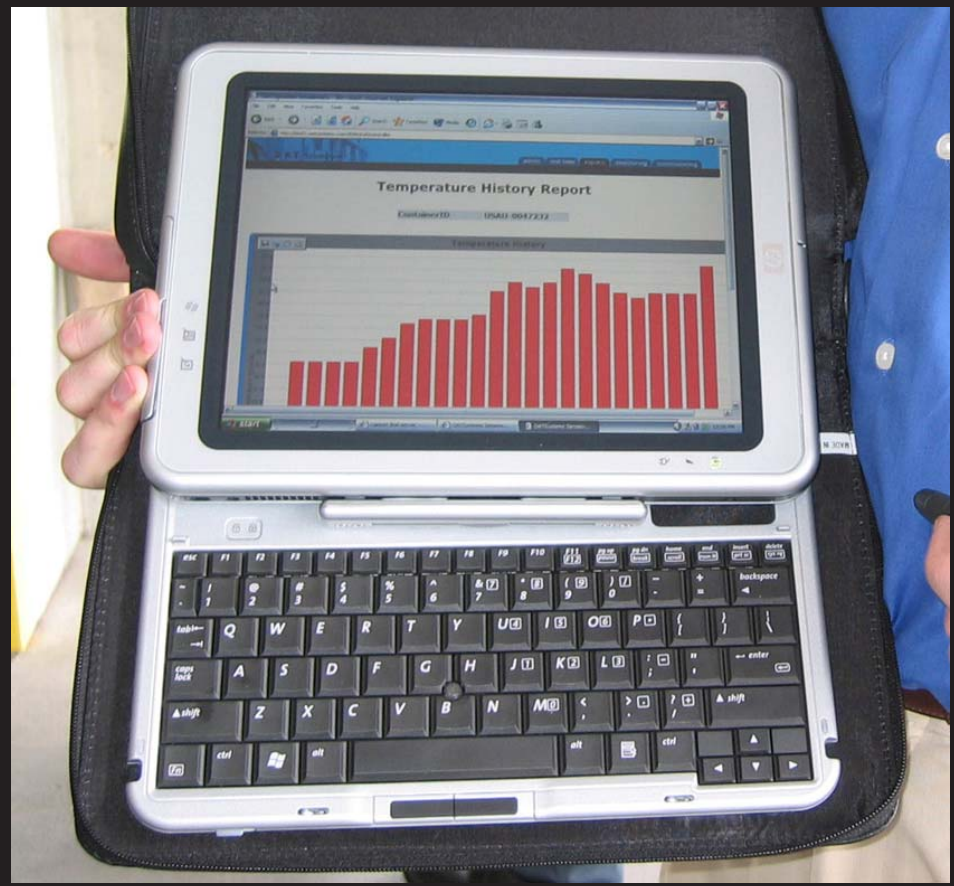
DATA CENTER

EXAMPLE

Shelf-life Example

DATA CENTER

EXAMPLE – SHELF LIFE



DATA CENTER

EXAMPLE – SHELF LIFE

$$\frac{\partial Q}{\partial t} = -k_1 \mathrm{e}^{\left[-\frac{E_a}{R_g T(t)}\right]} Q^n$$

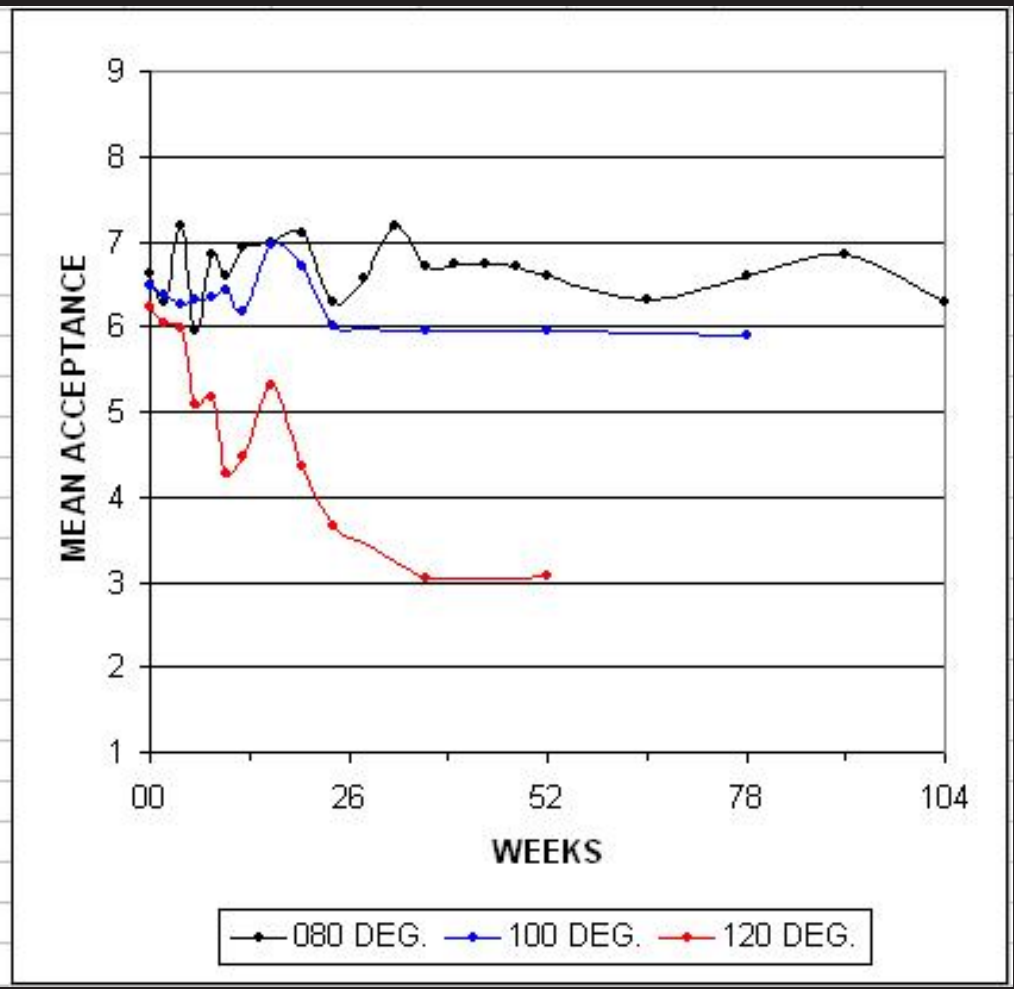
Variables

- E_a Activation energy
- k_1 Arrhenius constant
- n Order of the reaction
- T Temperature
- Q Quality
- t Time

DATA CENTER

EXAMPLE – SHELF LIFE

WKS	080 DEG.	100 DEG.	120 DEG.
00	6.622	6.486	6.243
02	6.282	6.359	6.026
04	7.194	6.250	5.972
06	5.949	6.308	5.077
08	6.850	6.350	5.175
10	6.600	6.429	4.286
12	6.944	6.167	4.472
16	7.000	6.947	5.316
20	7.111	6.694	4.361
24	6.300	6.000	3.667
28	6.579		
32	7.189		
36	6.694	5.944	3.028
40	6.730		
44	6.730		
48	6.703		
52	6.583	5.944	3.056
65	6.316		
78	6.583	5.889	
91	6.842		
104	6.300		
130			
156			



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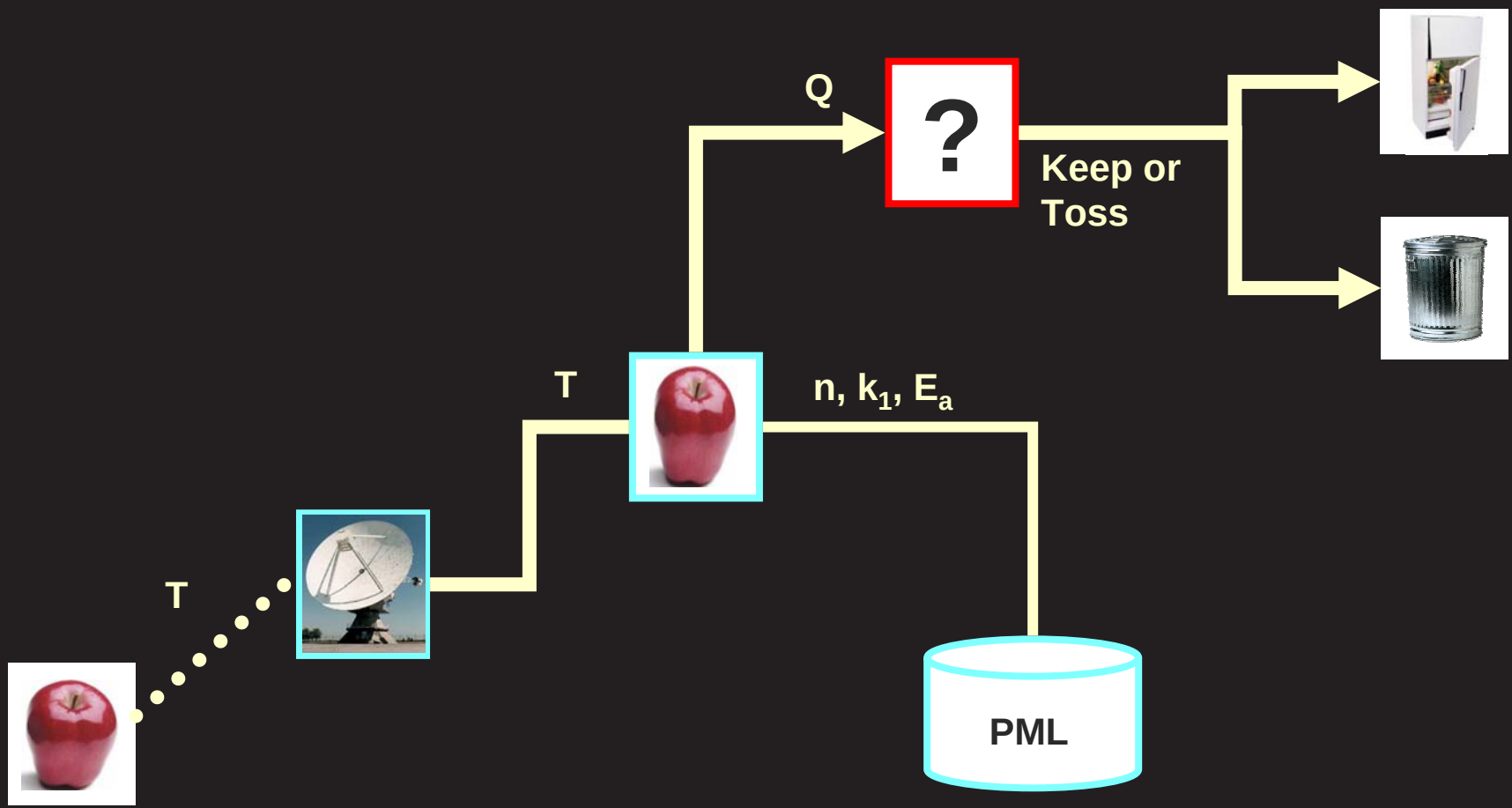

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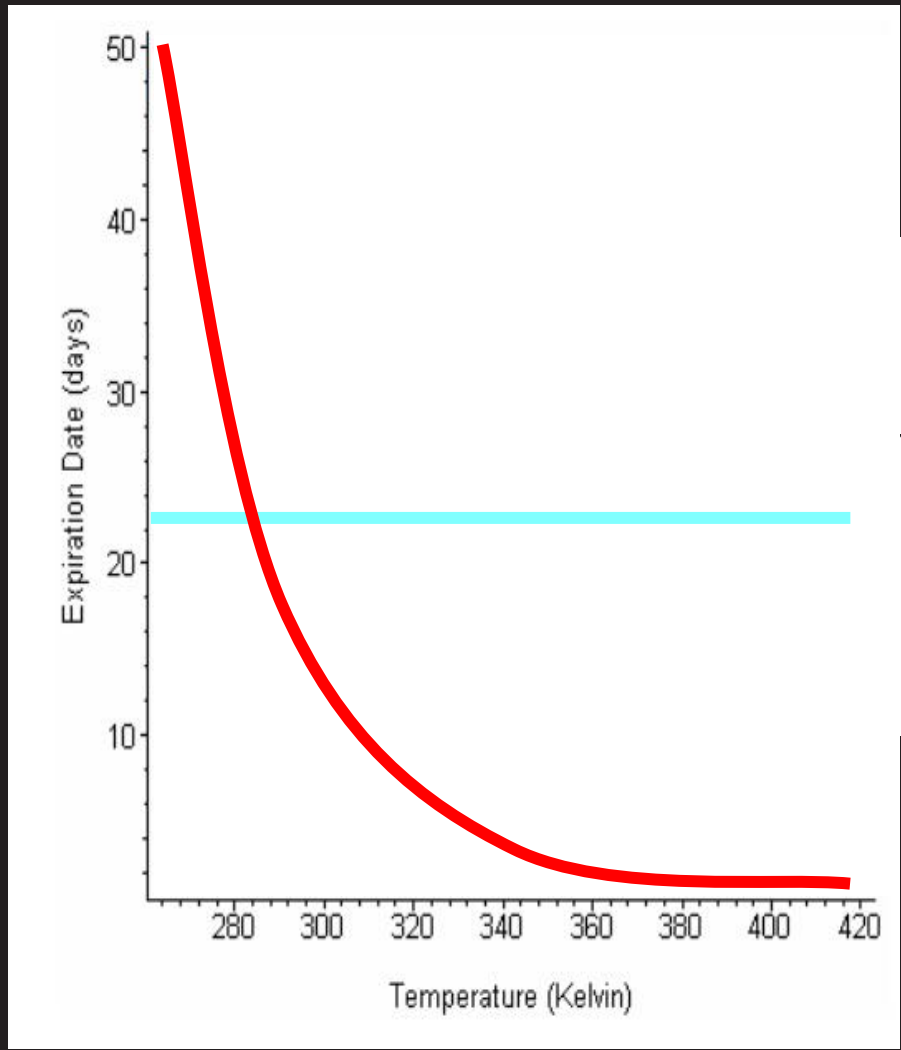

EXAMPLE – SHELF LIFE