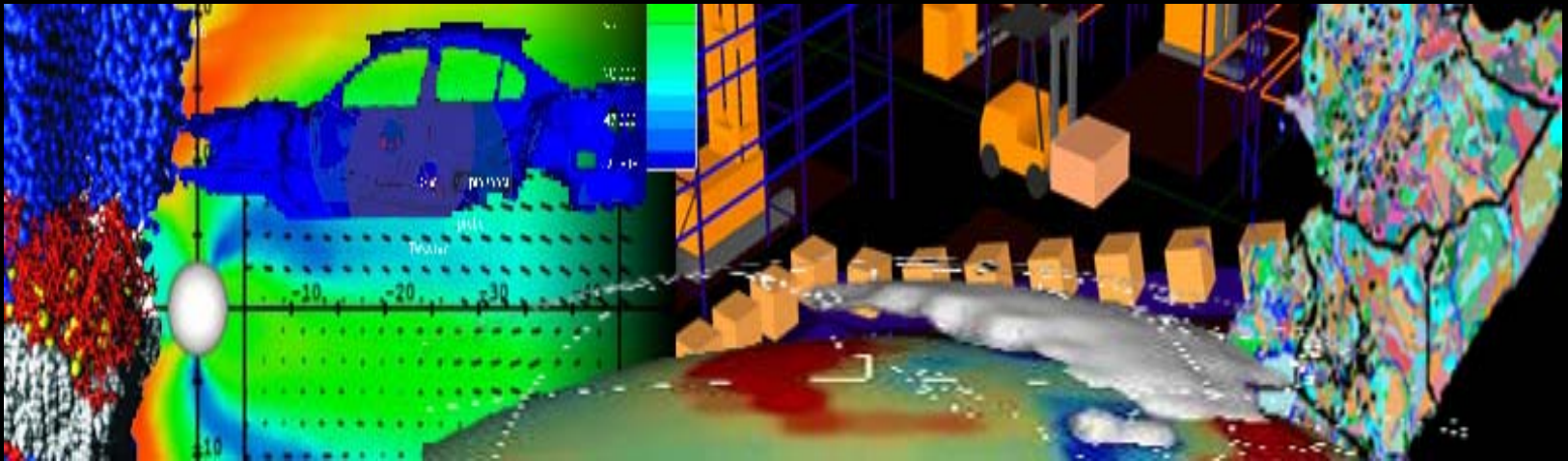


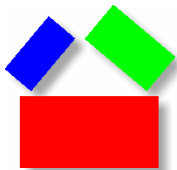
DATA CENTER

DATA CENTER

Make sense of your data

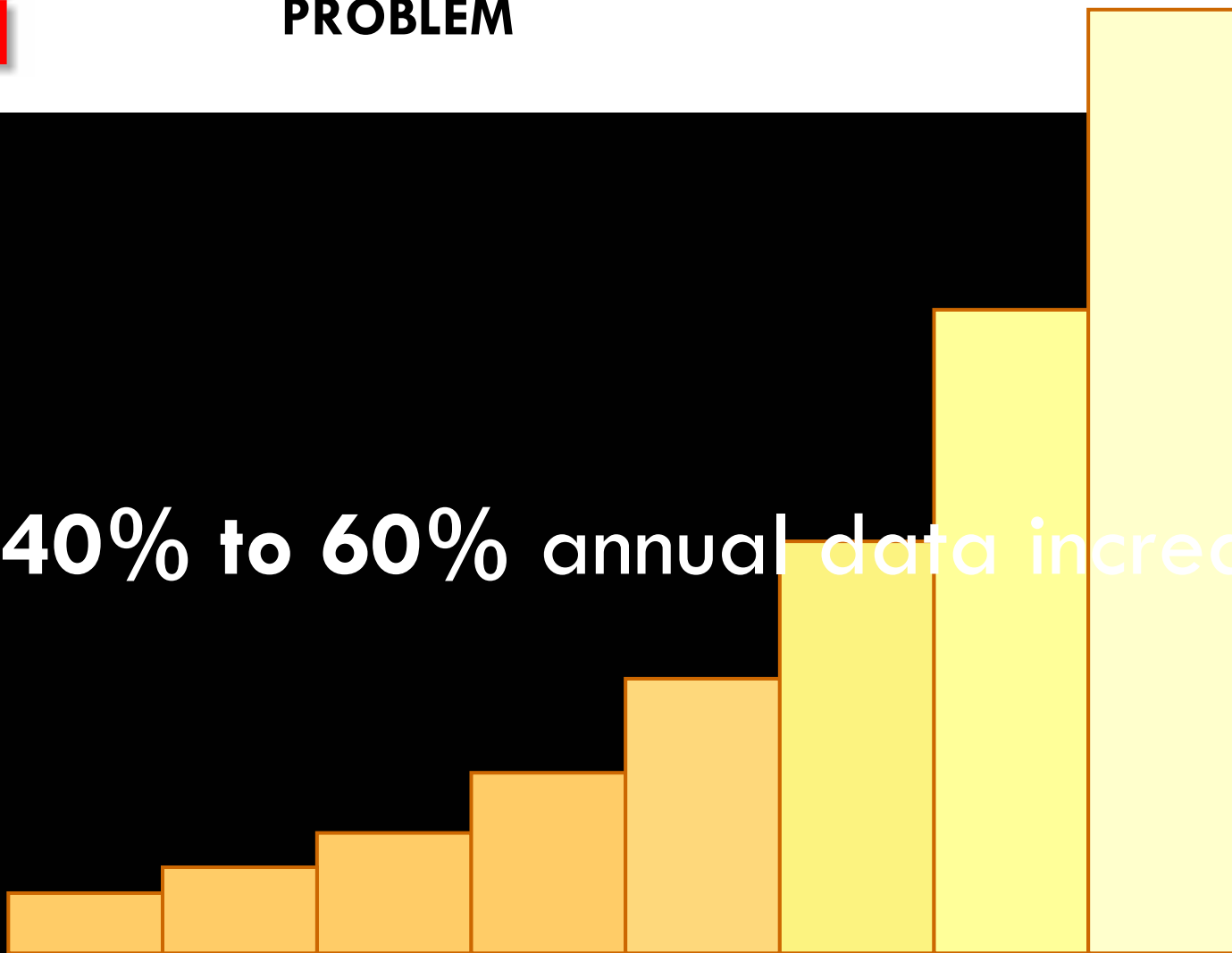


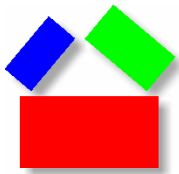
David Brock, Founder and Director
Data Center
Massachusetts Institute of Technology



PROBLEM

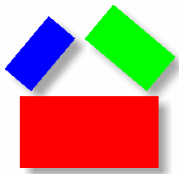
40% to 60% annual data increase





PROBLEM

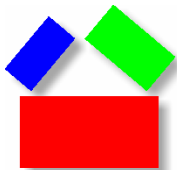
What are you going to do
with all your
Data?



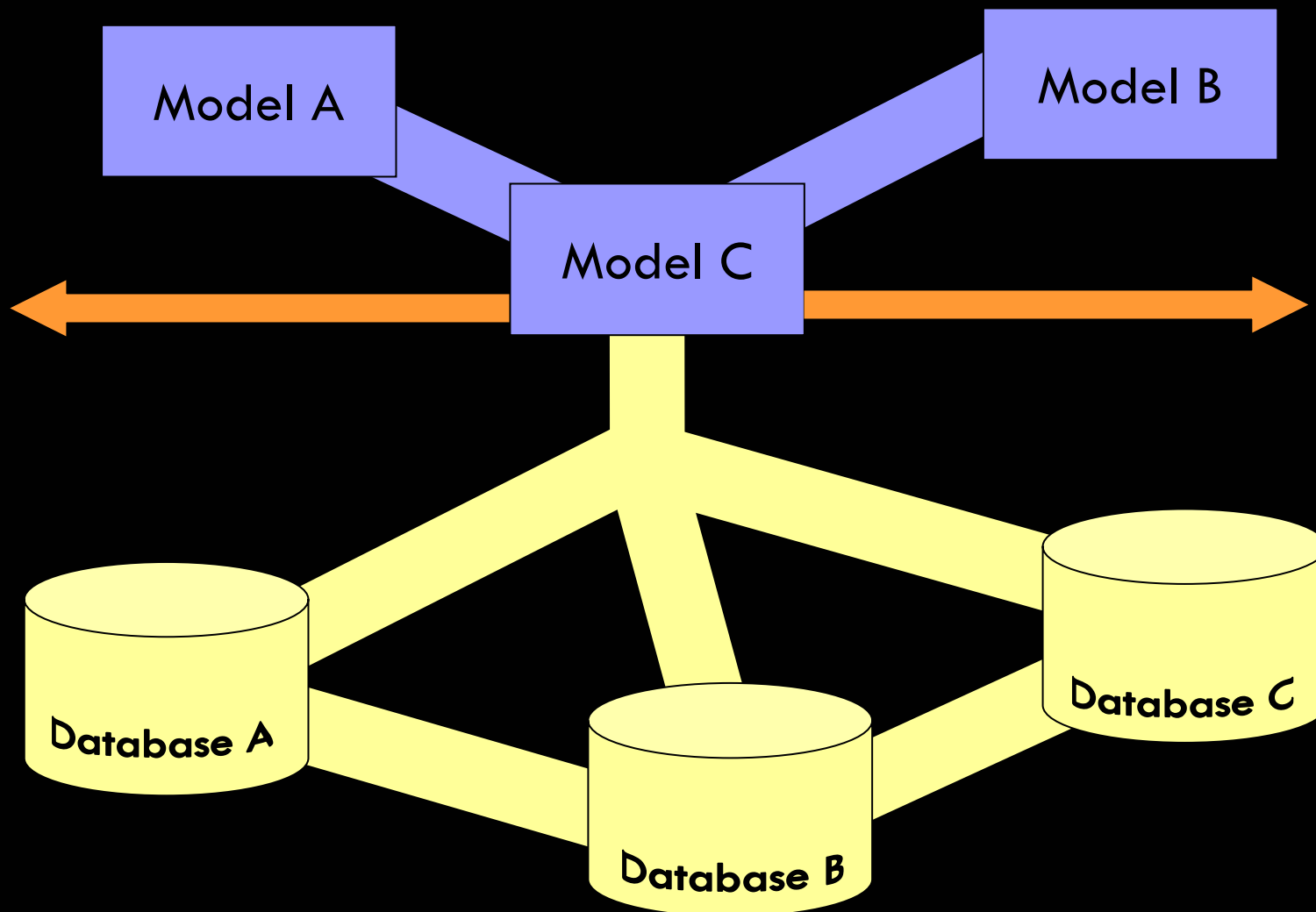
DATA CENTER

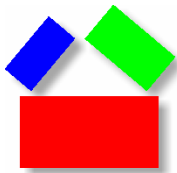
DATA CENTER

Make sense of your data

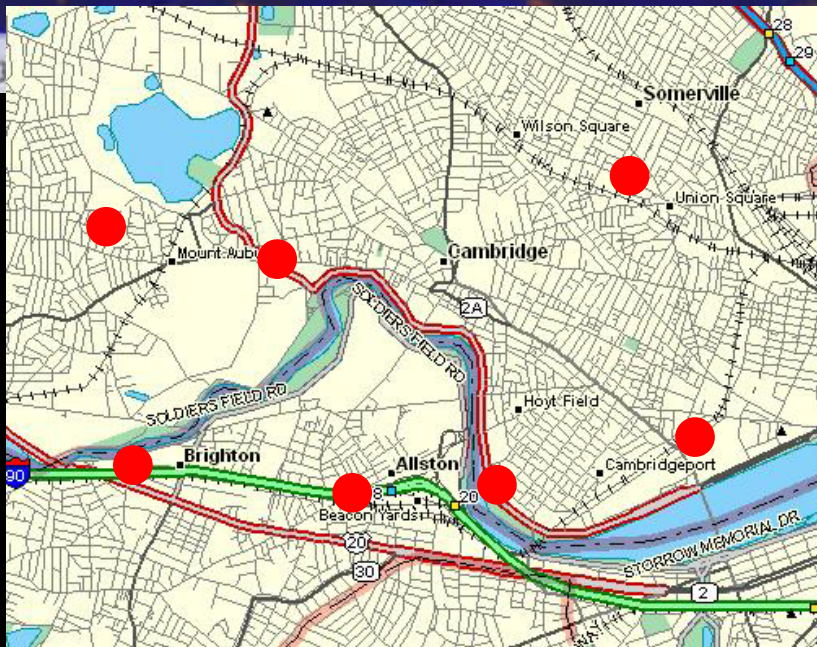
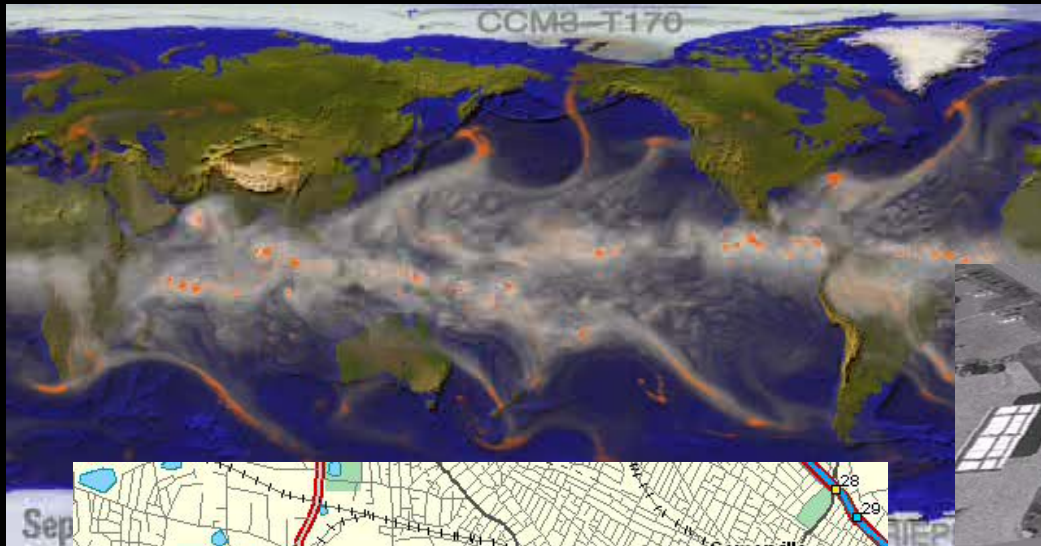


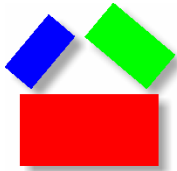
VISION





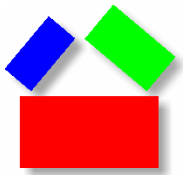
EXAMPLE - LOGISTICS





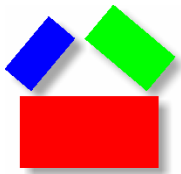
EXAMPLE - LOGISTICS





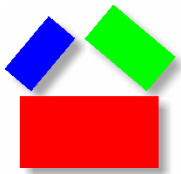
MODELS



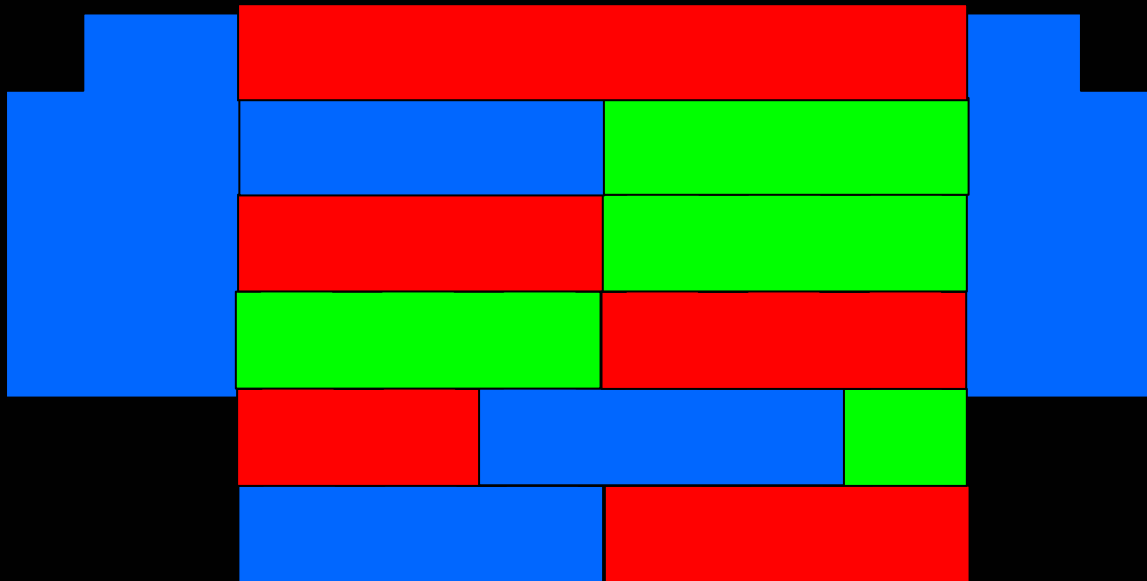


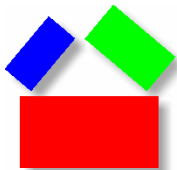
MODELS

Model

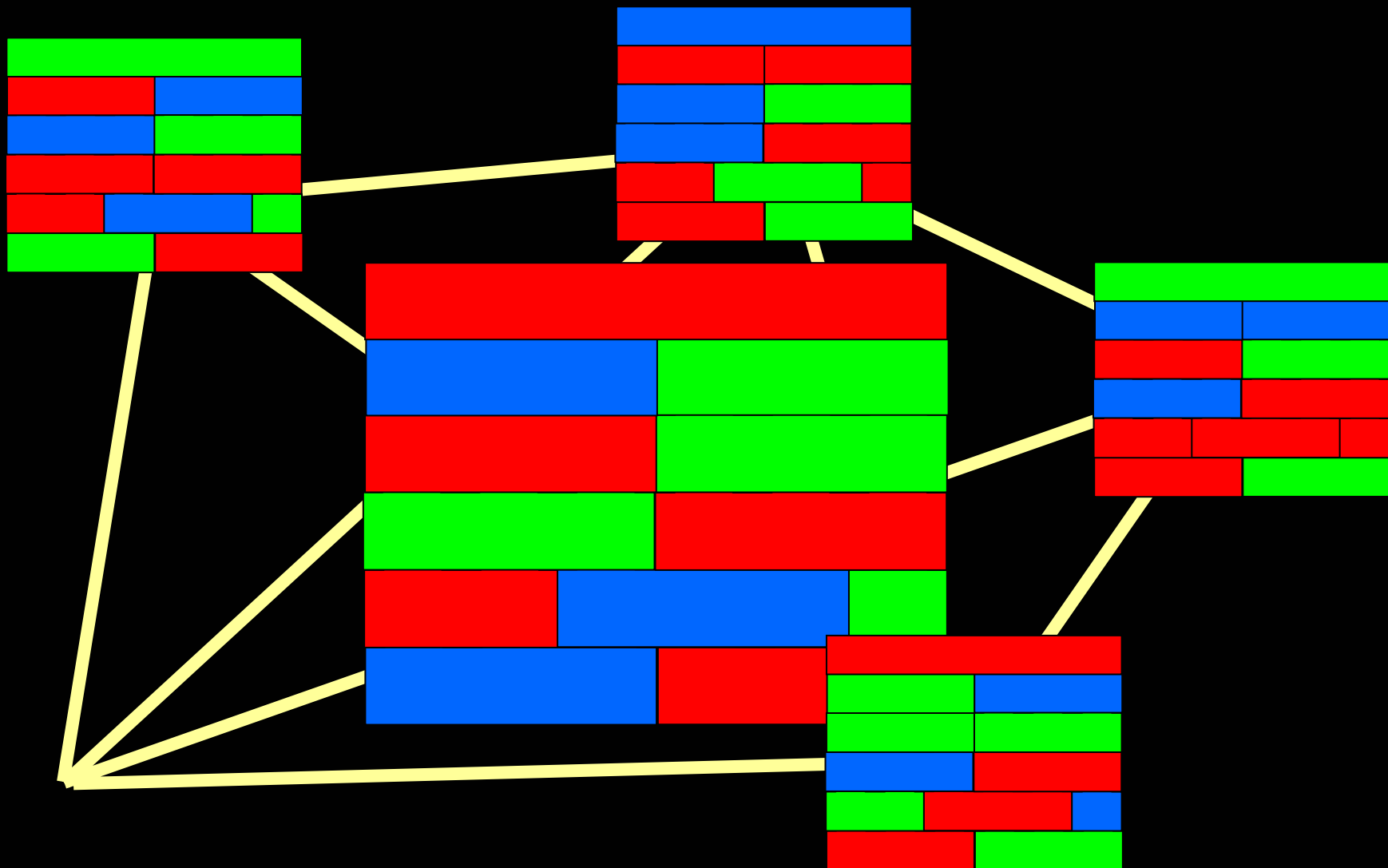


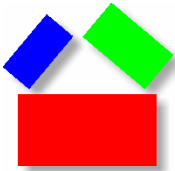
MODELS



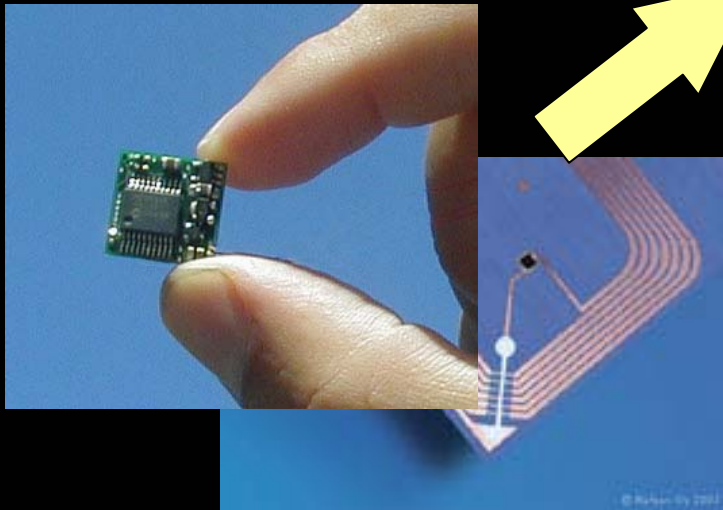
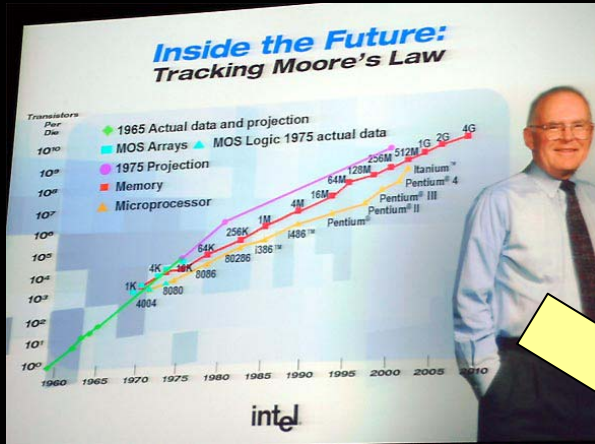


MODELS

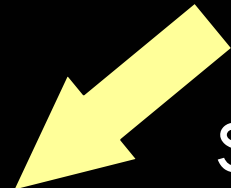




DRIVERS



XML
HTML
EPC
TCP/IP
HTTP
SOAP



U.S. Census Bureau
AMERICAN COMMUNITY SURVEY

Available in this Section

- Data Tables Main
- 2002 Data Profiles
- 2001:2002 Change Profiles
- 2002:2000 Change Profiles
- Special Tabulations
- CD-ROM Order/Details
- Detailed Tables
- 2001 Data Profiles
- 2000:2001 Change Profiles
- 2000 Data Profiles
- 1999 Data Profiles

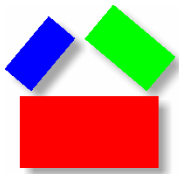
Warnings and Forecasts | Graphical Forecasts | National Maps | Radar | Rivers | Satellite

Go to State / Region | Click on Map to Zoom In

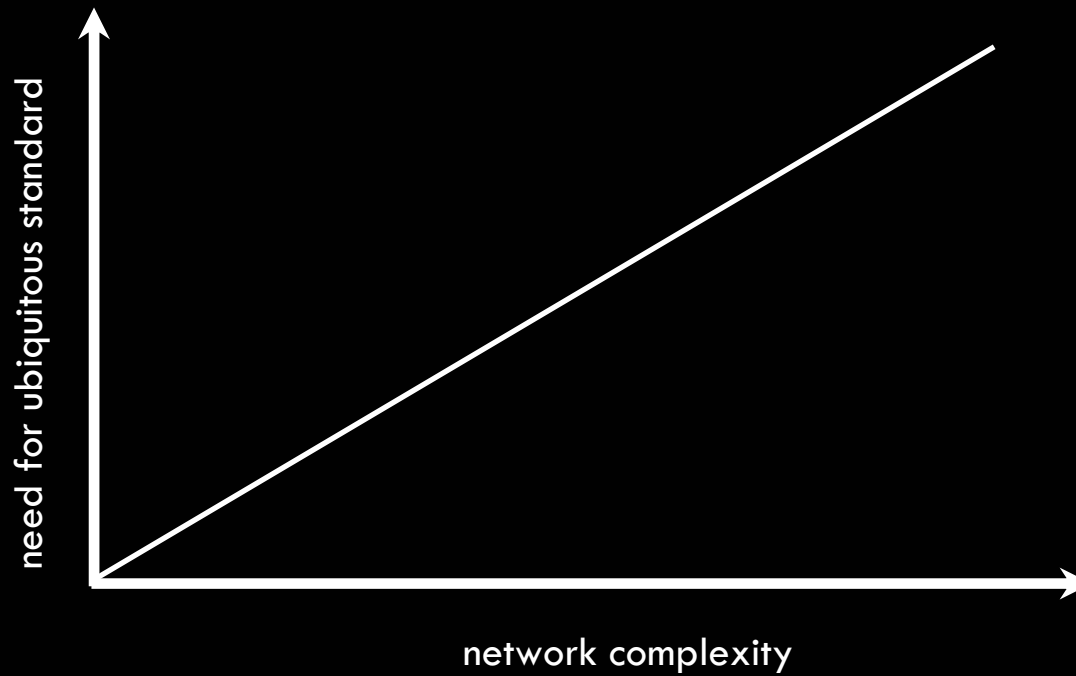
30 40 50 60 70 80 90 100 110

Low Temperature (F) Ending Tue Jul 06 2004 8AM EDT (Tue Jul 06 2004 12Z)

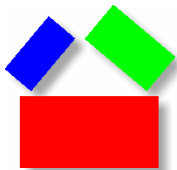
National Digital Forecast Database
Experimental graphic created 07/05/2004 11:36PM EDT



STANDARDS



The more complex the network, the more you need standards



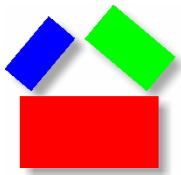
VISION

Mission

- **Make sense of your data**

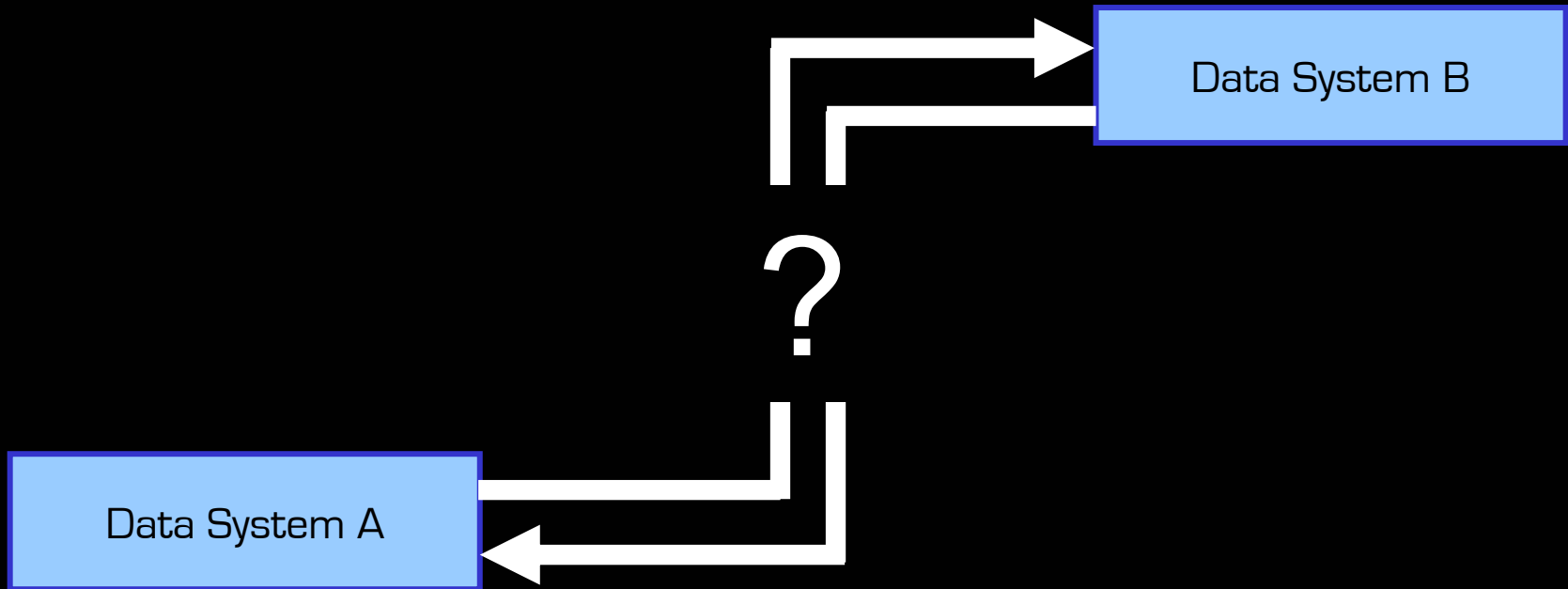
Task

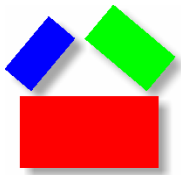
- **Create the standards and systems for interoperable data and modeling**



VISION

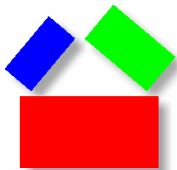
How do we synchronize data?





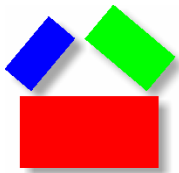
SOLUTION

XML!



PROBLEM

```
<CallsPerDay>  
    2575  
</CallsPerDay>
```

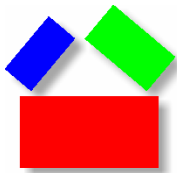


PROBLEM

`"CallsPerDay"`

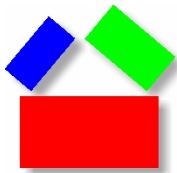
?

That's not even a word



ANOTHER PROBLEM

```
<CompanyData>
  <CompanyName>
    Fidelity Employer Services Company
  </CompanyName>
  <Location>
    Merrimack
  </location>
  <CallData>
    <RecordDate>
      Tue Aug 11, 2004
    </RecordDate>
    <CallsPerDay>
      2575
    </CallsPerDay>
  </CallData>
</CompanyData>
```

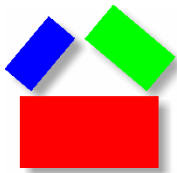


MORE PROBLEMS

```
<CompanyData>
  <CompanyName>
    Fidelity Employer
    Services Company
  </CompanyName>
  <Location>
    Merrimack
  </location>
  <CallData>
    <RecordDate>
      Tue Aug 11, 2004
    </RecordDate>
    <CallsPerDay>
      2575
    </CallsPerDay>
  </CallData>
</CompanyData>
```

?

```
<CorporateRecords>
  <Company>
    Fidelity Employer
    Services Company
  </Company>
  <Records Data= "Tue Aug
, 2004" >
    <Calls Units="PerDay">
      2575
    </Calls>
  </CorporateRecords>
```

MORE PROBLEMS

```
<CallsPerDay>  
    2575  
</CallsPerDay>
```

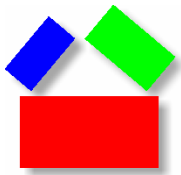
“CamelCase”

```
<Calls Units="PerDay">  
    2575  
</Calls>
```

Attributes

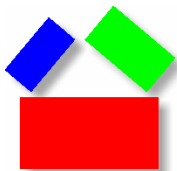
```
<Calls>  
    <Units>  
        "PerDay"  
    <Units>  
    <Value>  
        2575  
    </Value>  
</Calls>
```

Elements



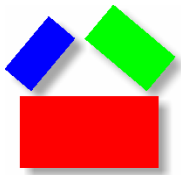
SOLUTION

Standards!



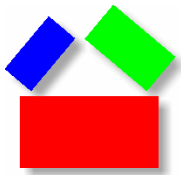
STANDARDS

4ML	ARML	BiblioML	CIDX	eBIS-XML	HTTP-DRP	MatML	ODRL	PrintTalk	SHOE	UML	XML F
5AML	ARML	BCXML	xCIL	ECML	HumanML	MathML	OeBPS	ProductionML	SIF	UBL	XML Key
6AML	ASML	BEEP	CLT	eCo	HyTime	MBAM	OFX	PSL	SMML	UCLP	XMLife
7AML	ASML	BGML	CNRP	EcoKnow	IML	MISML	OIL	PSI	SMBXML	UDDI	XML MP
8AML	ASTM	BHTML	ComicsML	edaXML	ICML	MCF	OIM	QML	SMDL	UDEF	XML News
9AML	ATML	BIBLIOML	Covad xLink	EMSA	IDE	MDDL	OLife	QAML	SDML	UIML	XML RPC
0AML	ATML	BIOML	CPL	eosML	IDML	MDSI-XML	OML	QuickData	SMIL	ULF	XML Schema
1ABML	ATML	BIPS	CP eXchange	ESML	IDWG	Metarule	ONIX DTD	RBAC	SOAP	UMLS	XML Sign
2ABML	ATML	BizCodes	CSS	ETD-ML	IEEE DTD	MFDX	OOPML	RDDI	SODL	UPnP	XML Query
3ACML	AWML	BLM XML	CVML	FieldML	IFX	MIX	OPML	RDF	SOX	URI/URL	XML P7C
4ACML	AXML	BPML	CWMI	FINML	IMPP	MMLL	OpenMath	RDL	SPML	UXF	XML TP
5ACAP	AXML	BRML	CycML	FITS	IMS Global	MML	Office XML	RecipeML	SpeechML	VML	XMLVoc
6ACS X12	AXML	BSML	DML	FIXML	InTML	MML	OPML	RELAX	SSML	vCalendar	XML XCI
7ADML	AXML	CML	DAML	FLBC	IOTP	MML	OPX	RELAX NG	STML	vCard	XAML
8AECM	BML	xCML	DaliML	FLOWML	IRML	MoDL	OSD	REXML	STEP	VCML	XACML
9AFML	BML	CaXML	DaqXML	FPML	IXML	MOS	OTA	REPML	STEPML	VHG	XBL
0AGML	BML	CaseXML	DAS	FSML	IXRetail	MPML	PML	ResumeXML	SVG	VIML	XSBEL
1AHML	BML	xCBL	DASL	GML	JabberXML	MPXML	PML	RETML	SWAP	VISA XML	XBN
2AIML	BML	CBML	DCMI	GML	JDF	MRML	PML	RFML	SWMS	VMML	XBRL
3AIML	BML	CDA	DOI	GML	JDox	MSAML	PML	RightsLang	SyncML	VocML	XCFF
4AIF	BannerML	CDF	DeltaV	GXML	JECMM	MTML	PML	RIXML	TML	VoiceXML	XCES
5AL3	BCXML	CDISC	DIG35	GAME	JLife	MTML	PML	RoadmOPS	TML	VRML	Xchart
6ANML	BEEP	CELLML	DLML	GBXML	JSML	MusicXML	PML	RosettaNet PIP	TML	WAP	Xdelta
7ANNOTE	ABGML	ChessGML	DMML	GDML	JSML	NAML	PML	RSS	TalkML	WDDX	XDF
8ANATML	BHTML	ChordML	DocBook	GEML	JScoreML	xNAL	P3P	RuleML	TaxML	WebML	XForms
9APML	BIBLIOML	ChordQL	DocScope	GEDML	KBML	NAA Ads	PDML	SML	TDL	WebDAV	XGF
0APPML	BIOML	CIM	DoD XML	GEN	LACITO	Navy DTD	PDX	SML	TDML	WellML	XGL
1AQL	BIPS	CIML	DPRL	GeoLang	LandXML	NewsML	PEF XML	SML	TEI	WeldingXML	MGML
2APPEL	BizCodes	CIDS	DRI	GIML	LEDES	NML	PetroML	SML	ThML	Wf-XML	XHTML
3ARML	BLM XML	CIDX	DSML	GXD	LegalXML	NISO DTB	PGML	SAML	TIM	WIDL	XIOP
4ARML	BPML	xCIL	DSD	GXL	Life Data	NITF	PhysicsML	SABLE	TIM	WITSML	XLF
5ASML	BRML	CLT	DXS	Hy XM	LitML	NLMXML	PICS	SAE J2008	TMML	WorldOS	XLIFF
6ASML	BSML	CNRP	EML	HITIS	LMML	NVML	PMML	SBML	TMX	WSML	XLink
7ASTM	BCXML	ComicsML	EML	HR-XML	LogML	OAGIS	PNML	Schemtron	TP	WSIA	XMI
8ARML	BEEP	CIM	DLML	HRMML	LogML	OBI	PNML	SDML	TPAML	XML	XMSG
9ARML	BGML	CIML	EAD	HTML	LTSC XML	OCF	PNG	SearchDM-XML	TREX	XML Court	XMTMP
0ASML	BHTML	CIDS	ebXML	HTTPL	MAML	ODF	PrintML	SGML	TxLife	XML EDI	XNS



PROPOSAL

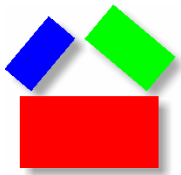
a proposal ...



M

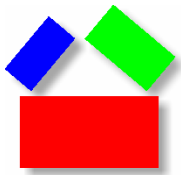
M

A Modeling Language



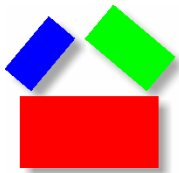
M

- Dictionary
- Grammar



DICTIONARY

Dictionary



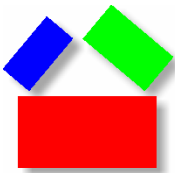
DICTIONARY ENTRY

a keyrd

call *n.*

1. A loud cry, a shout.
2. The characteristic cry of an animal.
- 3. A telephone communication or connection.**
4. Need or occasion.

call.3



DICTIONARY ENTRY – DEFINITION

key

call.5

word

call

function

n.

definition

a telephone connection.

examples

She reported several anonymous calls.

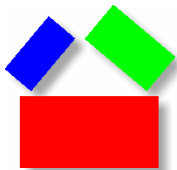
He placed a phone call to London.

He heard the phone ringing, but didn't want to take the call.

domain

agency

references



DICTIONARY ENTRY – SEMANTIC LINKS

synonyms

Syn. **phone_call.1, telephone_call.1**

antonyms

Ant.

type of

Type of. **telephone.2, telephony.1**

types

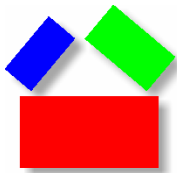
Types. **conference_call.1, long-distance_call.1**

part of (m or p)

Part of.

parts

Parts.



DICTIONARY ENTRY – SCHEMA

Data Type. one number element.

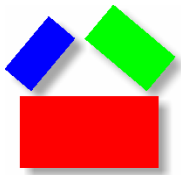
Data Description. A telephone number.

Data Example. "1-800-444-7856"

Attributes. **party.5, duration.1, telephone_number.1**

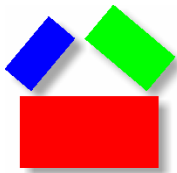
data

attributes



DEMONSTRATION

Demonstration



DICTIONARY DEVELOPMENT



Oxford
English
Dictionary
OXFORD UNIVERSITY PRESS

Oxford English Dictionary



Unified
Medical
Language
System

National Library of Medicine
Unified Medical Language System



United States Department of Defense



Princeton University, WordNet



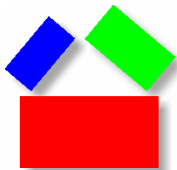
American Chemical Society
Chemical Abstracts Service



West Law Publishing
Black's Law Dictionary

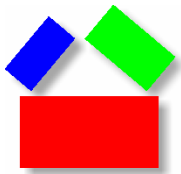


Acronym Finder
Acronym Dictionary



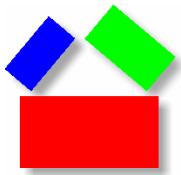
DICTIONARY DEVELOPMENT

- Web accessible
- Web editable
- Web community
- Staged approval
 - Proposal – Universal accessible and editable
 - Draft – Universal accessible and limited editable
 - Pre-approval – Universal accessible and limited comments
 - Recommendation – Universal accessible



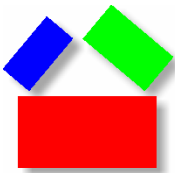
DEMONSTRATION

Demonstration

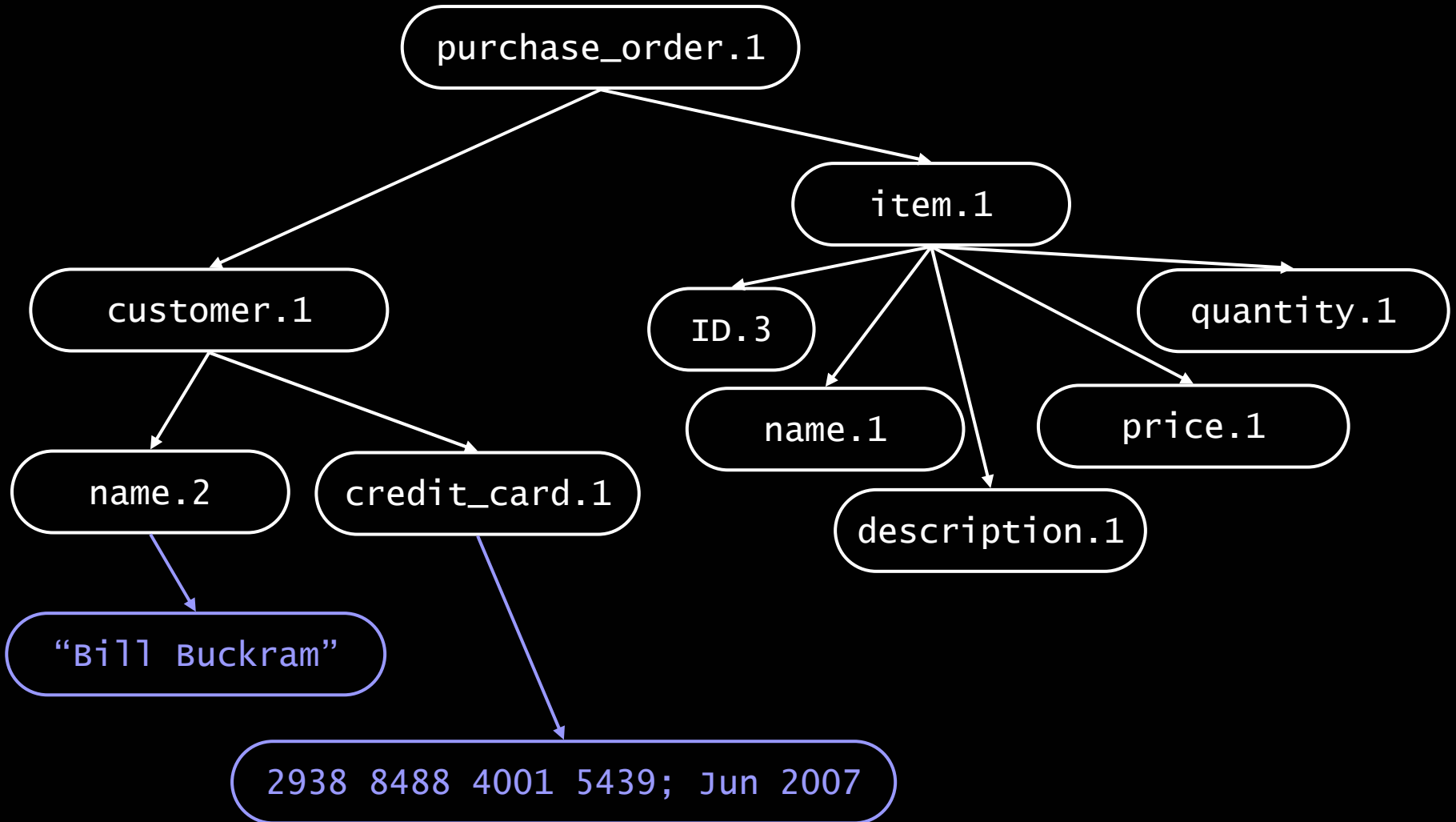


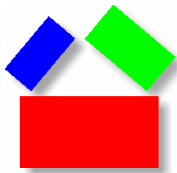
GRAMMAR

Grammar



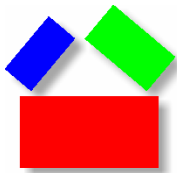
GRAMMAR





PATTERNS

1. **Noun phrases** – root words plus modifiers
2. **Key-value pairs** – tax forms, medical records, receipts, etc.
3. **Tables** – enumerations, tables, spreadsheets
4. **Generic descriptors** – ‘identification codes’,
‘date’, ‘description’, ‘title’, ‘name’, ‘information’, etc.



NOUN PHRASES

AuthorizedPricingInformation

authorized.1_pricing.1_information.1

CurrentAccountBalance

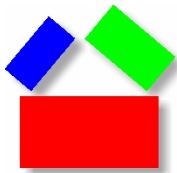
current.1_account.2_balance.6

UnitPrice

unit.1_price.2

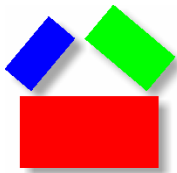
PaymentMethod

payment.2_method.2



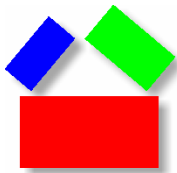
Key-value pairs

```
<customer_receipt>  
  <merchant>Core Communications</merchant>  
  <date>14-Sep-2005 09:25:35 PM</date>  
  <invoice_number>47189</invoice_number>  
  <amount2>$9.95</amount2>  
  <first_name>John</first_name>  
  <last_name>Smith</last_name>  
  <phone>978-224-9981</phone>  
</customer_receipt>
```



Key-value pairs

```
<customer_receipt>  
  <merchant>Core Communications</merchant>  
  <date>14-Sep-2005 09:25:35 PM</date>  
  <invoice_number>47189</invoice_number>  
  <amount2>$9.95</amount2>  
  <first_name>John</first_name>  
  <last_name>Smith</last_name>  
  <phone>978-224-9981</phone>  
</customer_receipt>
```

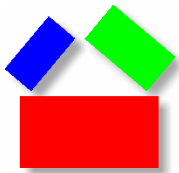


Tables

```
<EMS_Agencies_Table>
  <Agency>
    <Name>Dixie County EMS</Name>
    <County>Dixie</County>
    <DateOfLicensure>
      2/1/2002
    </DateOfLicensure>
  </Agency>
</EMS_Agencies_Table>
```

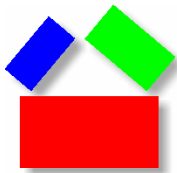
```
<Table>
  <Row>
    <Name>Edward Taylor</name>
    <Country>United Kingdom</country>
    <BirthDate>3/4/1968</BirthDate>
  </Row>
</Table>
```

```
<table>
  <title></title>
  <cols>
    <th>Name</th>
    <th>County</th>
    <th>DateOfLicensure</th>
  </cols>
  <data>
    <tr>
      <td>Edward Taylor</td>
      <td>United Kingdom</td>
      <td>3/5/1968</td>
    </tr>
  </data>
</table>
```

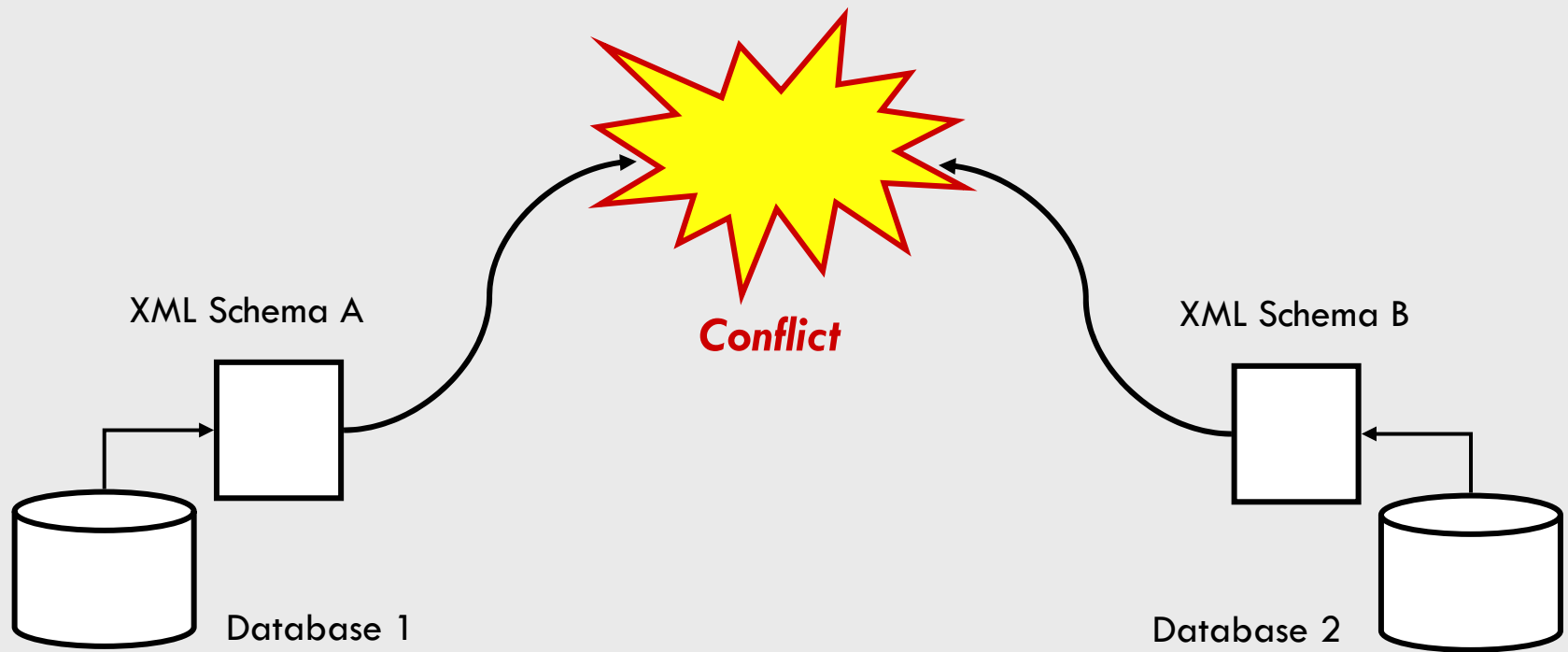


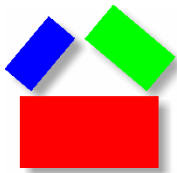
Tables

```
<table>
  <tag1>data</tag1>
  . . .
  <heading>data</heading>
  . . .
  <row>
    <column>data</column>
    . . .
  </row>
</table>
```

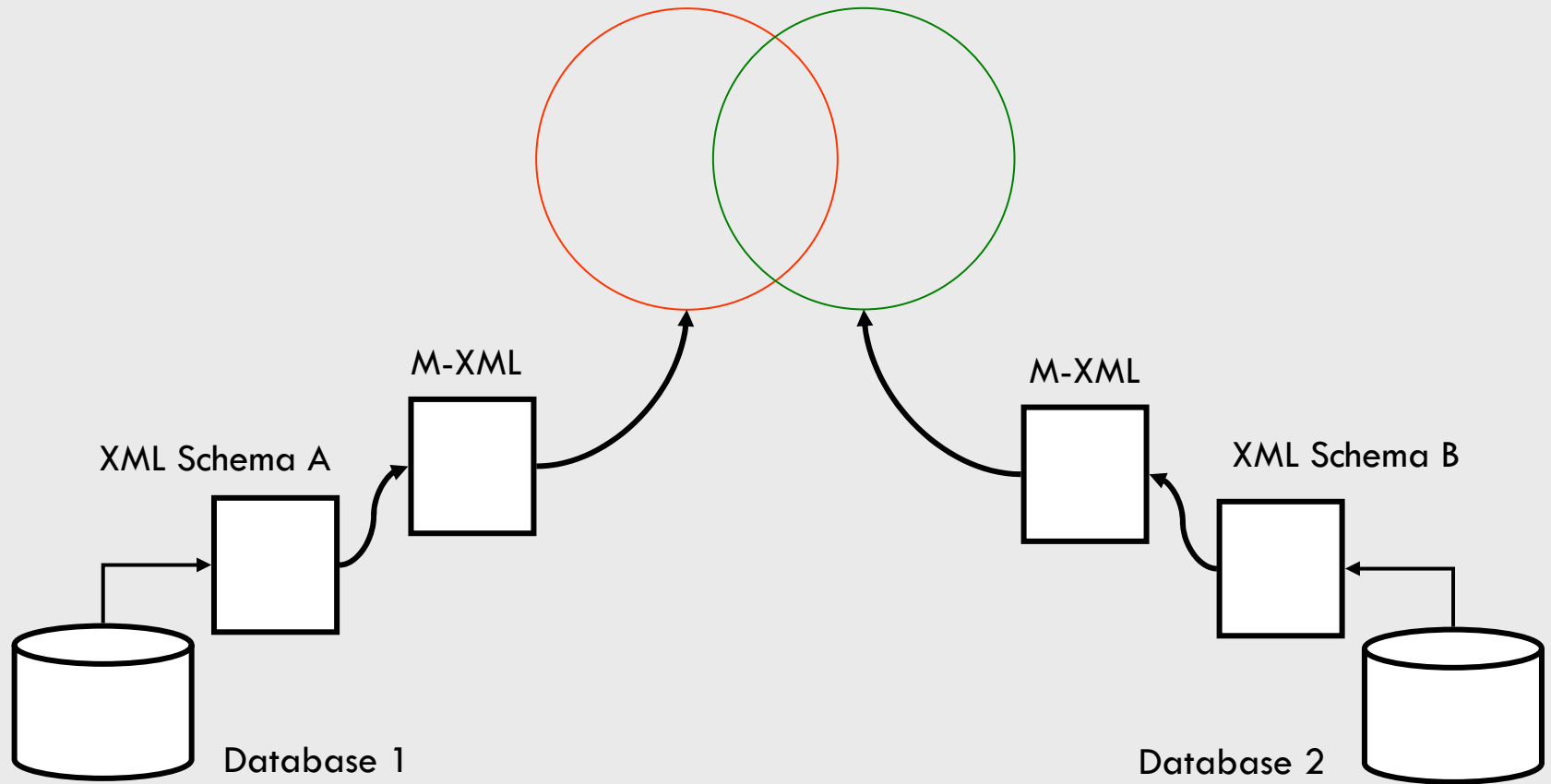


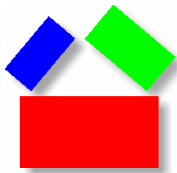
WEB SERVICE INTEGRATION



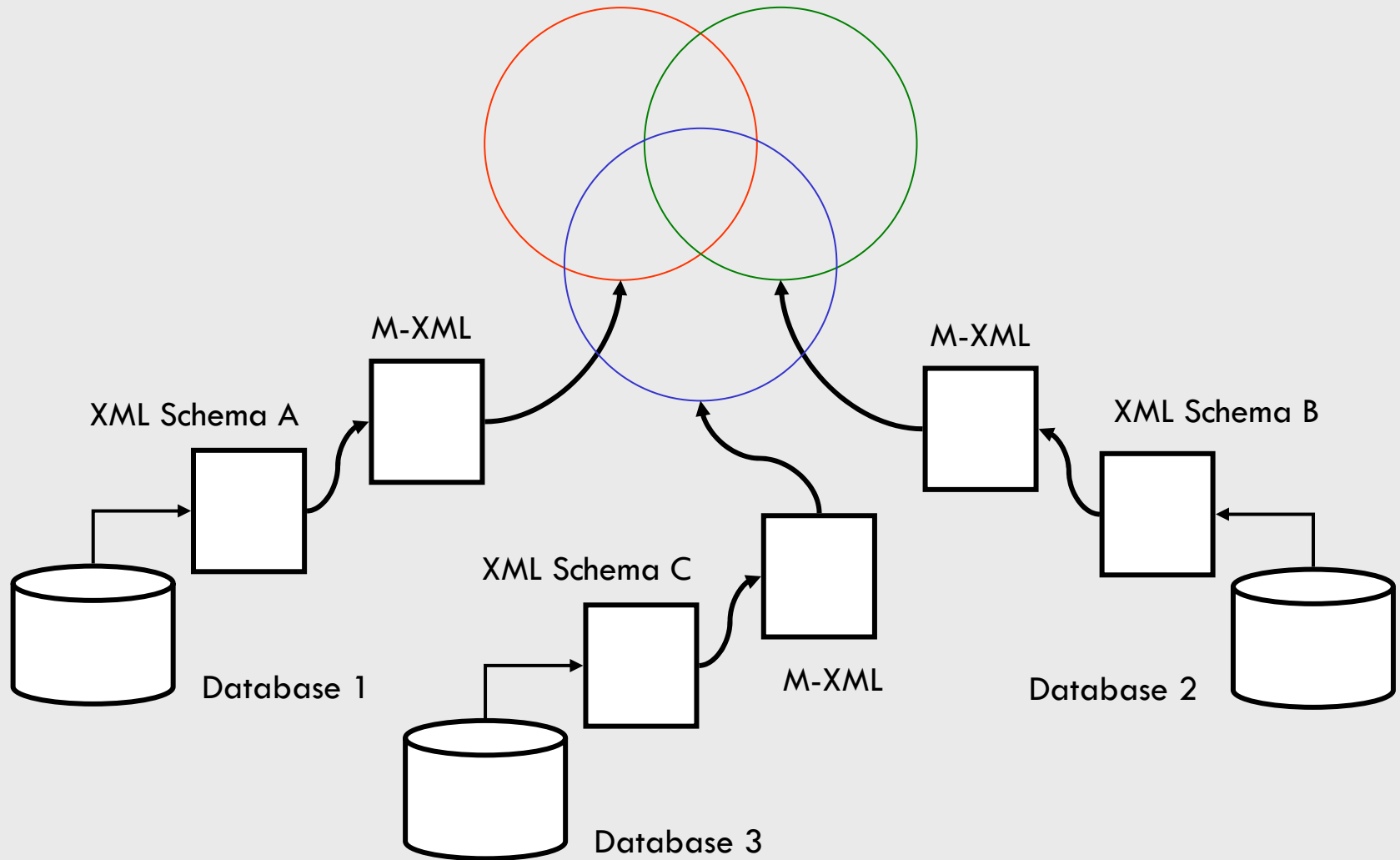


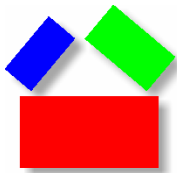
WEB SERVICE INTEGRATION



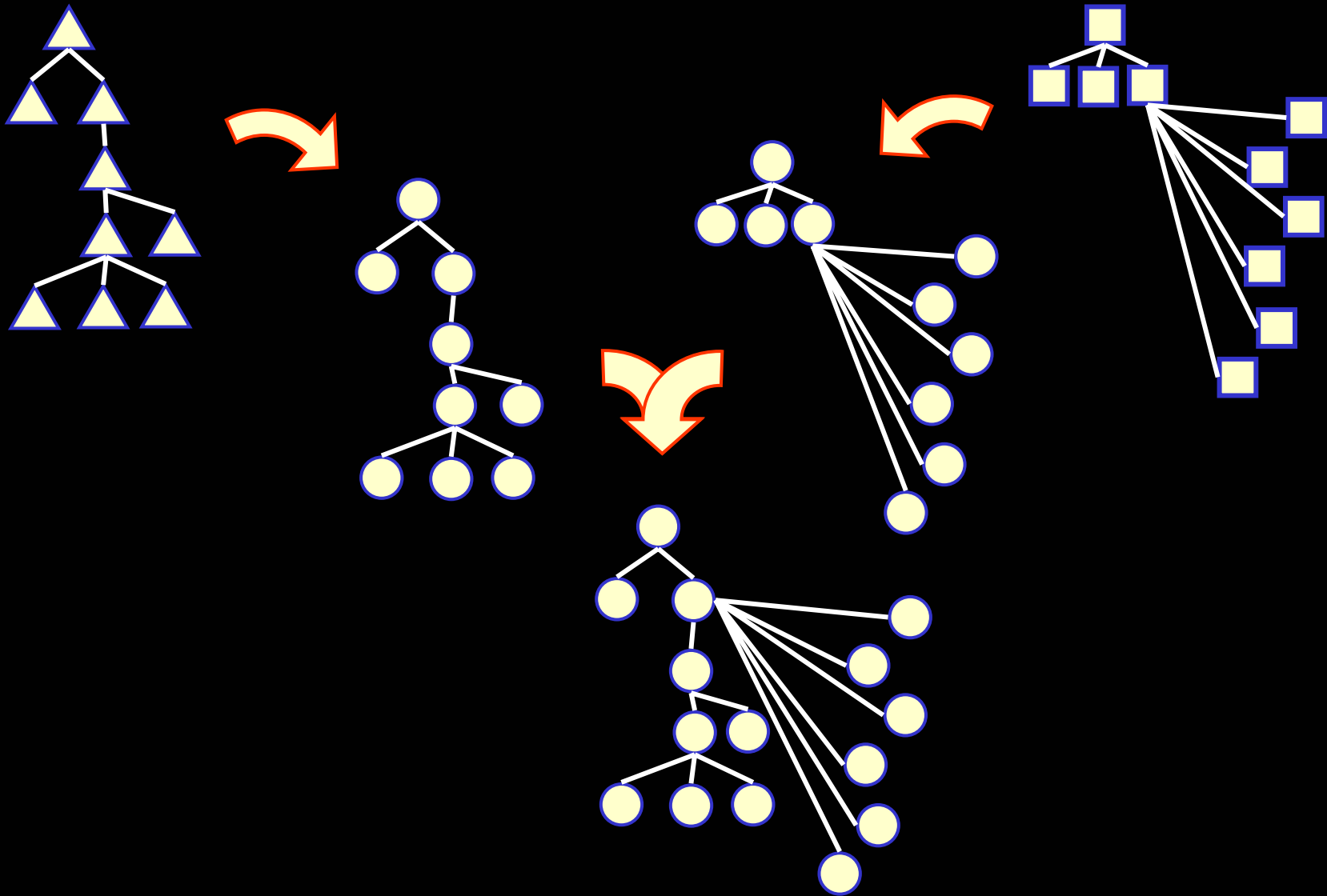


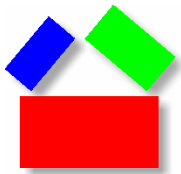
WEB SERVICE INTEGRATION





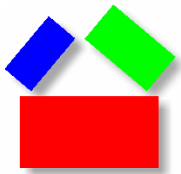
NODE TRANSLATION





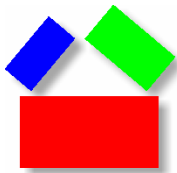
DEMONSTRATION

Demonstration



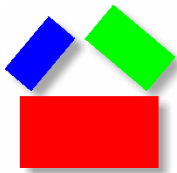
PROPOSED DELIVERABLES

Proposed Deliverables

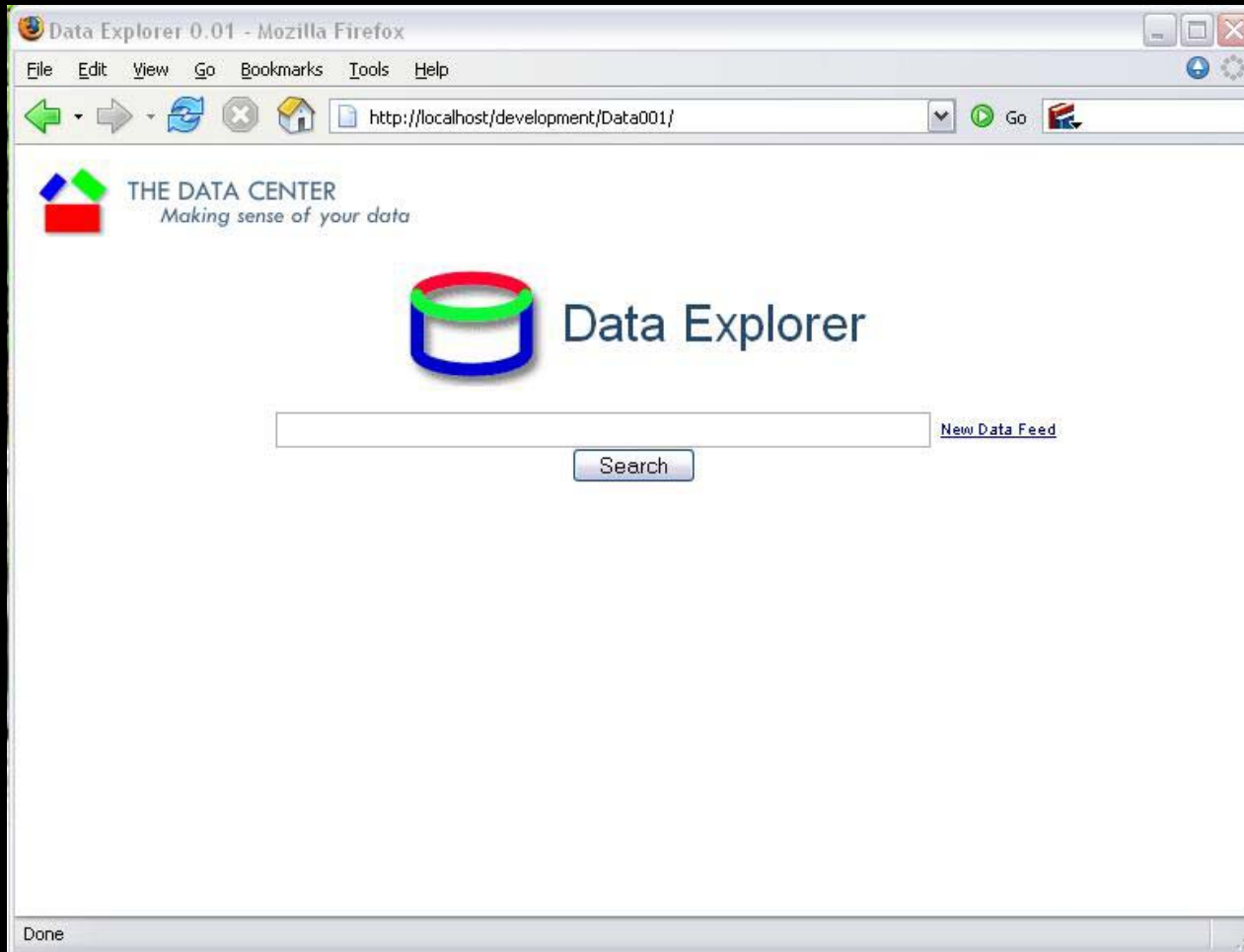


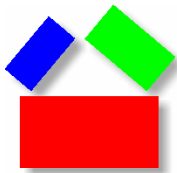
DEVELOPMENT – ‘M’ Browser

- ‘M’ Browser
 - Standard browser-based (IE6, FF1)
 - Client-side, JavaScript ‘M’ Parser
 - Asynchronous JavaScript and XML (Ajax)
 - ‘M’ names and patterns for XSLT/JavaScript
 - Dynamic Scalar Vector Graphics (dSVG - IE6, FF2)
 - Client-side charting
 - Interactive charts and graphs



DEVELOPMENT – ‘M’ Data Feeds





DEVELOPMENT – ‘M’ Data Feeds

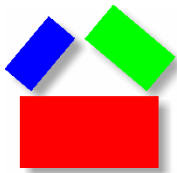
NOAA NDBC

Raw Data Feed

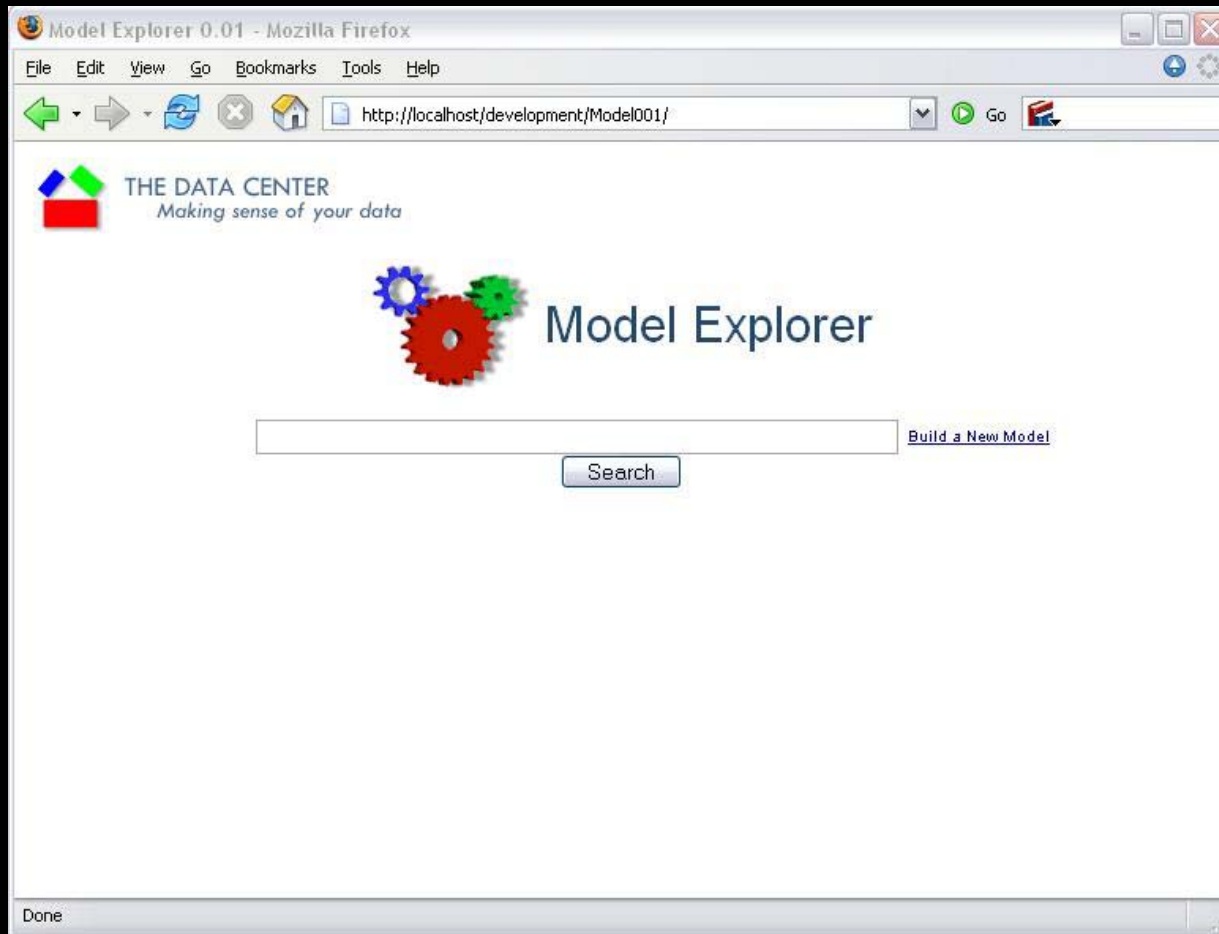
```
YYYY MM DD hh mm  WD WSPD  GST  WVHT  DPD  APD MWD  BARO  ATMP  WTMP  DEWP  VIS  PTDY  TIDE
2005 07 11 17 50  MM  MM  MM  1.2  5  MM  MM 1011.8  16.2  13.8  13.6  MM -0.7  MM
. . .
```

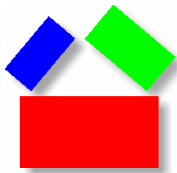
‘M’ XML Web Service

```
<timestamp.1>
  2005-07-11T17:50
</timestamp.1>
<wave.5_height.2>
  1.2
  <unit.5>foot.11</unit.5>
</wave.5_height.2>
```

DEVELOPMENT – ‘M’ Models

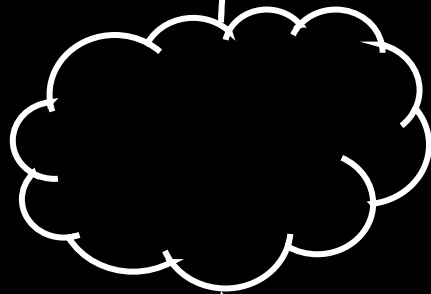




SERVICES ORIENTED ARCHITECTURE (SOA)

MODELS

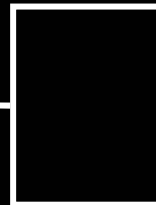
Business rules (Biz rules)
Business Intelligence (BI)
Data Mining
Analytics



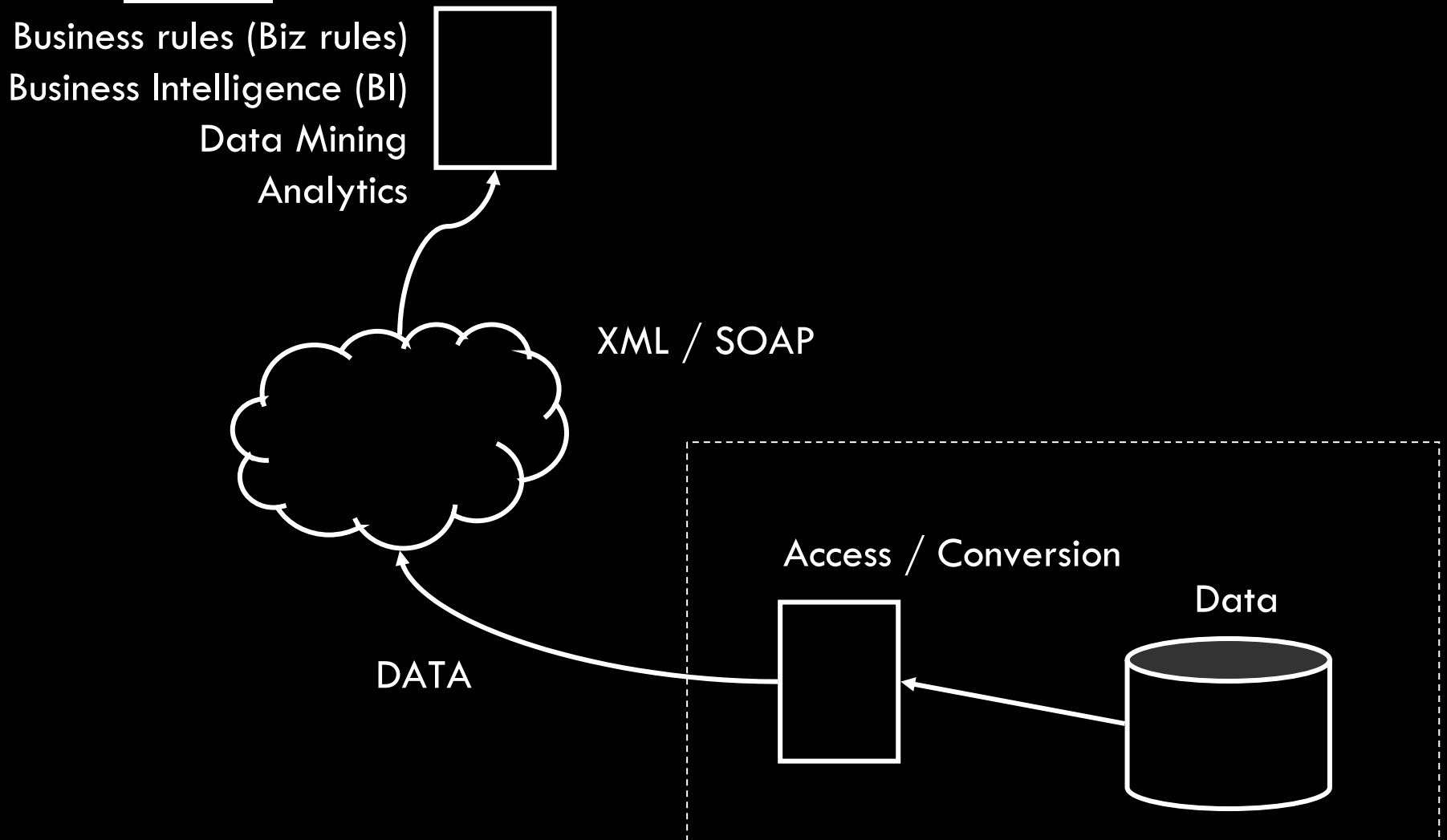
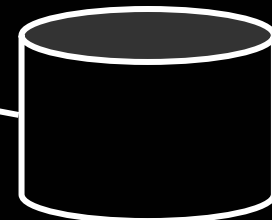
XML / SOAP

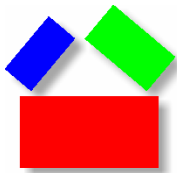
DATA

Access / Conversion



Data

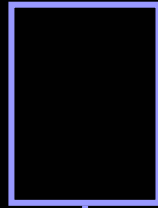




DATA CENTER VISION

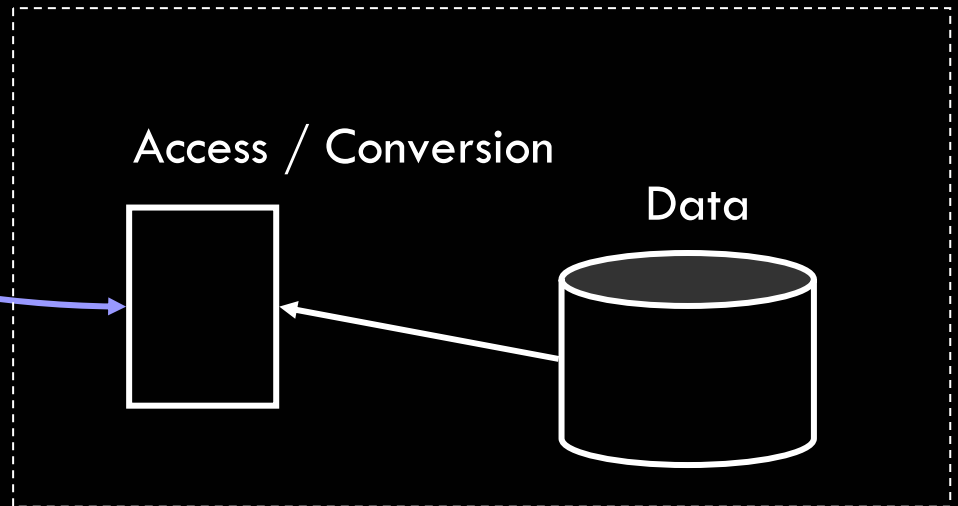
MODELS

Business rules (Biz rules)
Business Intelligence (BI)
Data Mining
Analytics



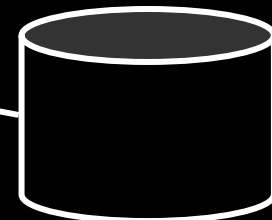
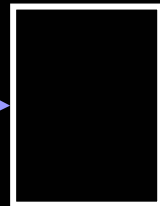
XML / SOAP

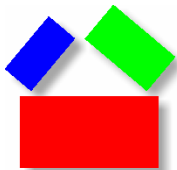
MODELS



Access / Conversion

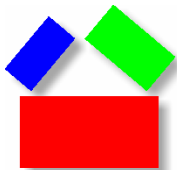
Data



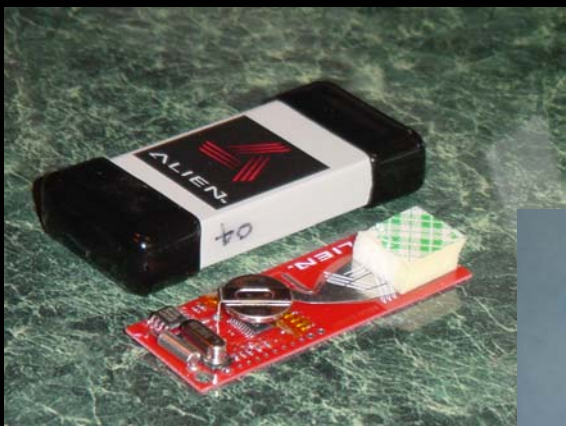


EXAMPLE – SHELF LIFE

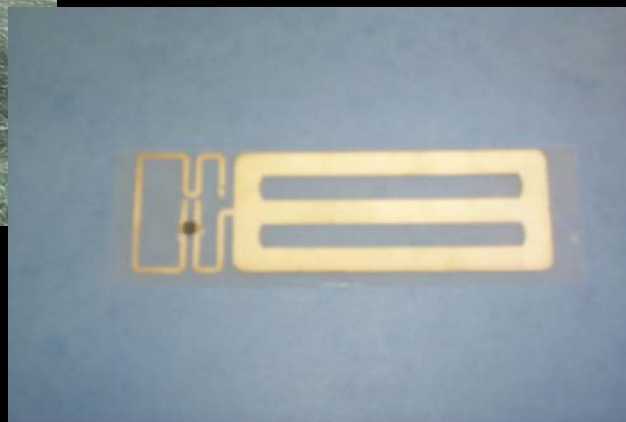




EXAMPLE – SHELF LIFE



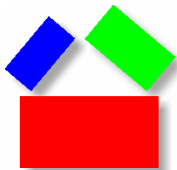
Current Type 3 Tag
w/Temp Sensor



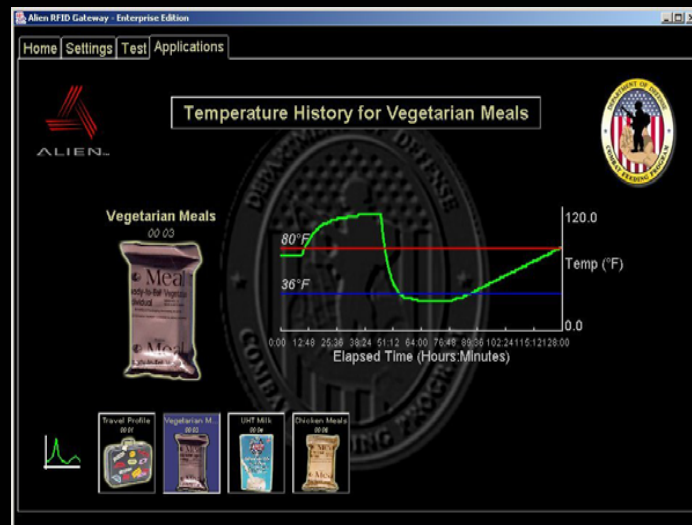
Next Generation
Application Specific
Integrated Circuit
(ASIC)

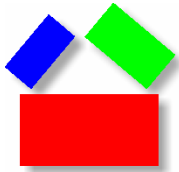


350 Micron NanoBlock™
chips

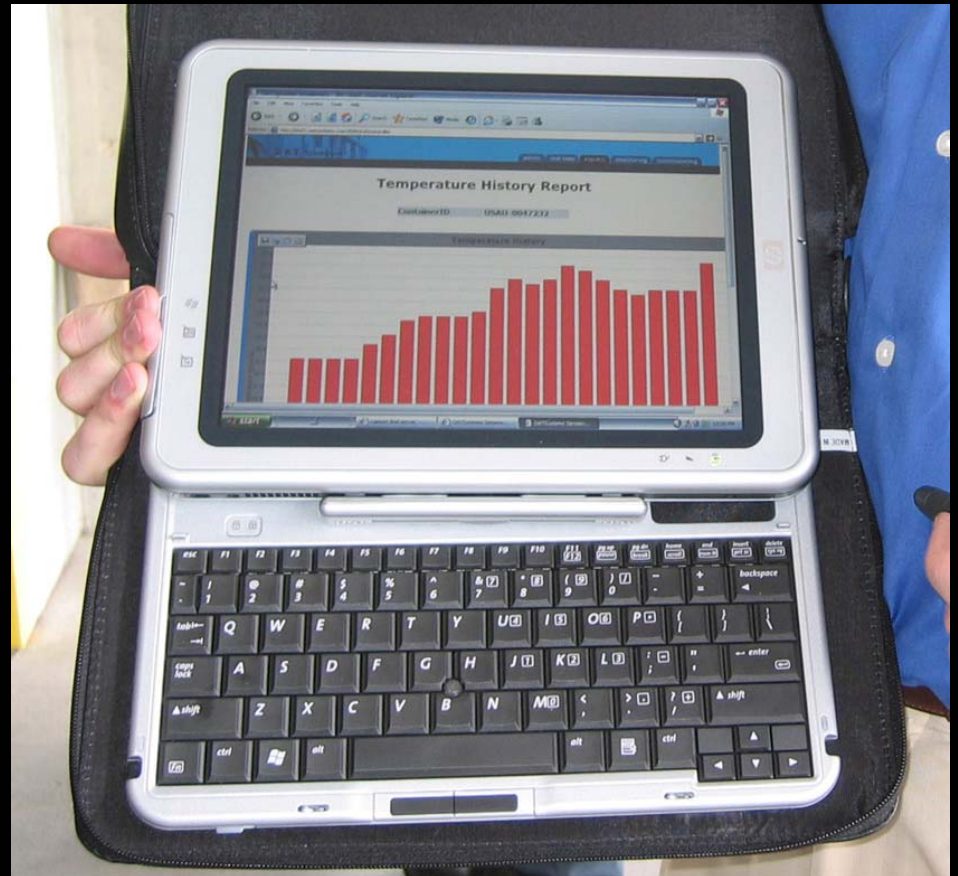


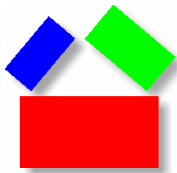
EXAMPLE – SHELF LIFE





EXAMPLE – SHELF LIFE



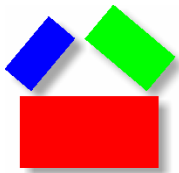


EXAMPLE – SHELF LIFE

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

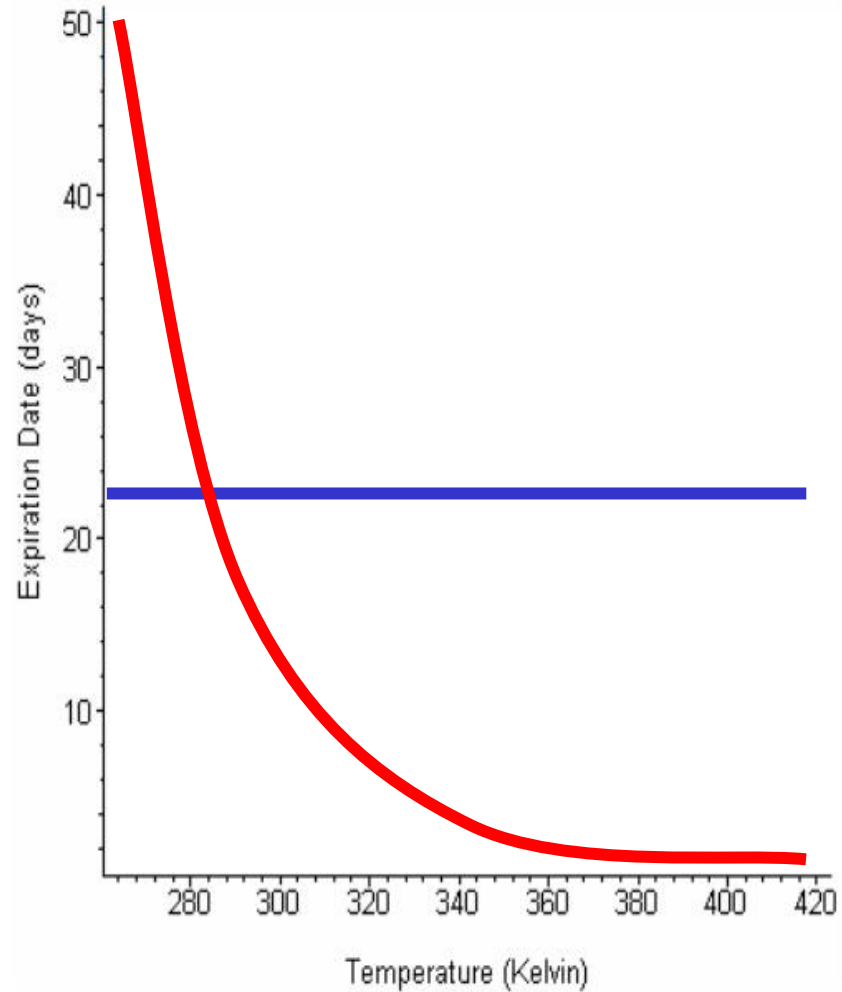
Variables

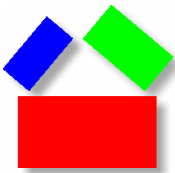
- E_a Activation energy
- k_1 Arrhenius constant
- n Order of the reaction
- T Temperature
- Q Quality
- t Time



EXAMPLE – SHELF LIFE

Q





EXAMPLE – SHELF LIFE

Name: Activation Energy

Desc

Symb

Acce

ID: E

Clas

Type

Unit

Defa

Name: Arrhenius Constant

Desc

Symb

Acce

ID: EF

Class

Type:

Unit:

Defau

Name: Temperature

Desc

Symb

Acce

ID: EF

Class

Type:

Unit:

Defau

Name: Quality

Desc

Symb

Acce

ID: E

Class

Type

Unit:

Defa

Name: Order of Reaction

Description: Order of Reaction

Symbol: *n*

Access: Read

ID: EPC: 01020084191000001289731

Class: Scalar

Type: Int

Unit:

Default: 1



Food Quality

Name: Food Quality

Description: Food Quality based Arrhenius

Developer: Natick Army Laboratories

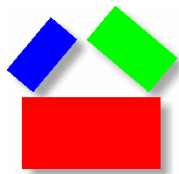
ID: EPC: 010300908808BF60000000AA

Comp: \$0.25 per month

Type: Analytic

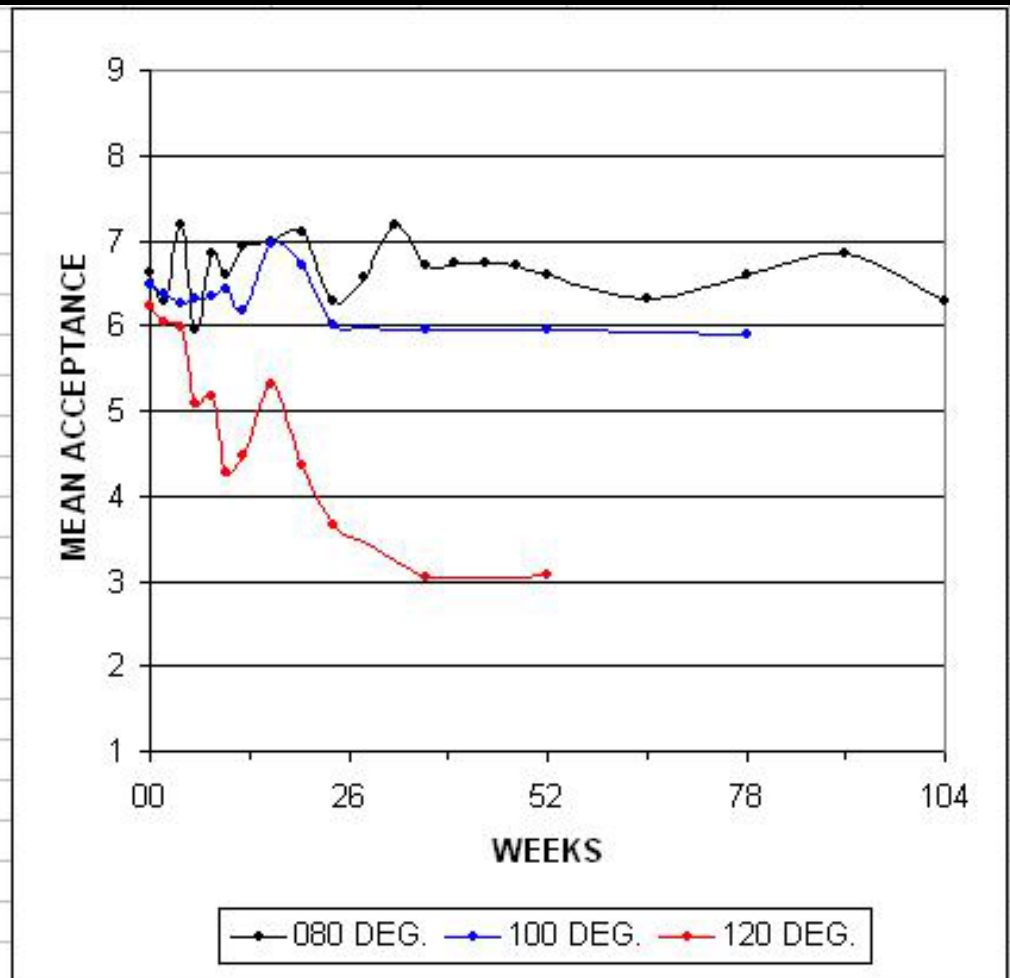
Rate: 1 to 10,000 sec

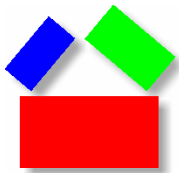
Algorithm:



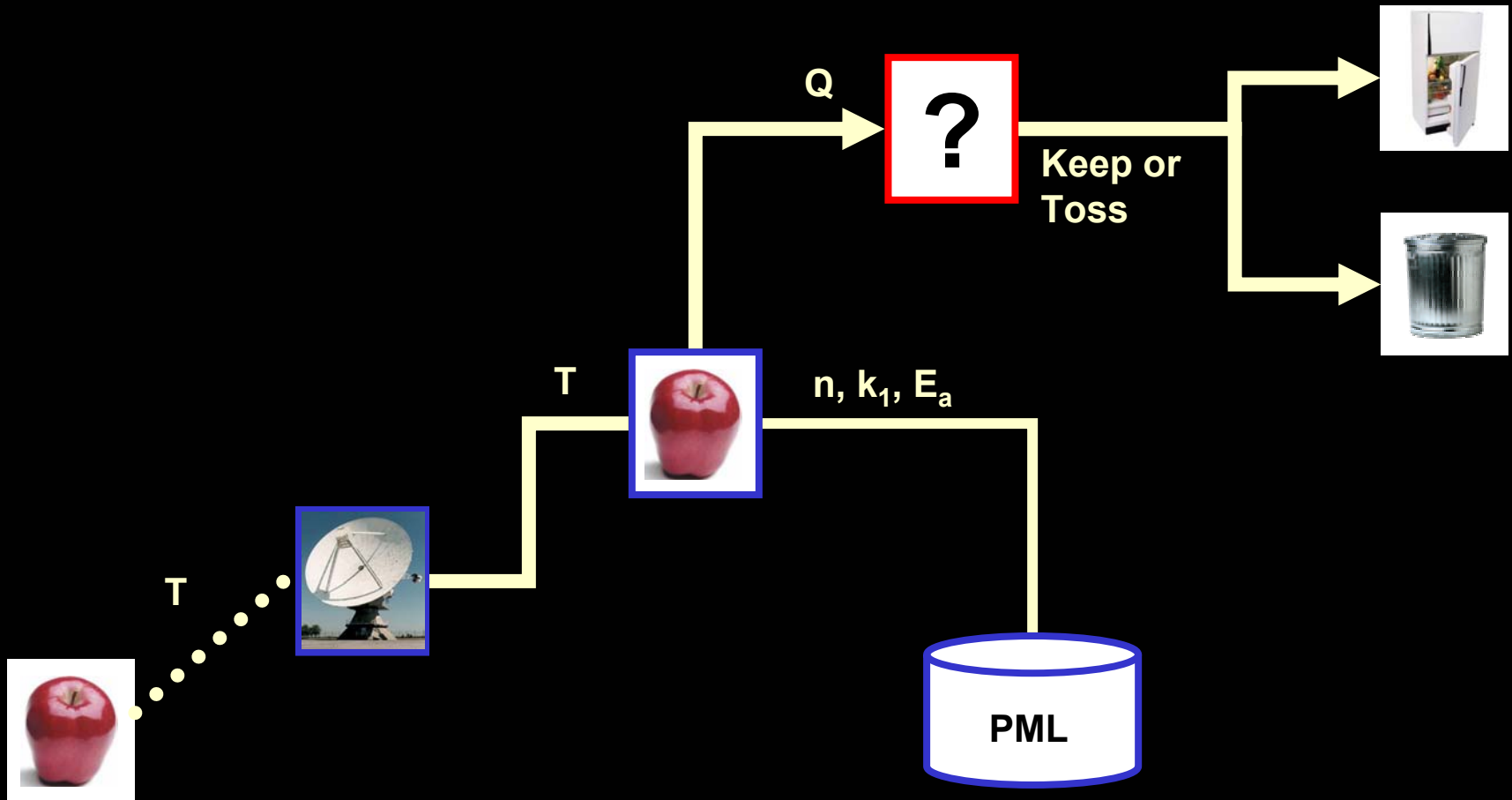
EXAMPLE – SHELF LIFE

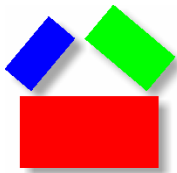
WKS	080 DEG.	100 DEG.	120 DEG.
00	6.622	6.486	6.243
02	6.282	6.359	6.026
04	7.194	6.250	5.972
06	5.949	6.308	5.077
08	6.850	6.350	5.175
10	6.600	6.429	4.286
12	6.944	6.167	4.472
16	7.000	6.947	5.316
20	7.111	6.694	4.361
24	6.300	6.000	3.667
28	6.579		
32	7.189		
36	6.694	5.944	3.028
40	6.730		
44	6.730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





EXAMPLE – SHELF LIFE





EXAMPLE – SHELF LIFE

MRE Temperature Sensor Data

Please Select an MRE:
01.0000A89.00016F.000169DC1

Start Temperature Sensor Day: Friday, May 23, 2003
Time: 11:23:07 AM
Temperature: 71

Stop Temperature Sensor

Time Temperature Chart

Time(S)	Temperature(F)
0	66
1	66
2	58
3	58
4	67
5	70
6	84
7	76
8	66
9	70
10	81
11	76
12	77
13	75
14	84
15	66
16	75
17	68
18	81
19	77
20	76
21	76
22	78
23	84
24	71

MRE Application

MRE Quality Application

Please Select an MRE:
01.0000A89.00016F.000169DC1

Quality: 50 - 100 Issue, 20 - 49 Inspect, 0 - 19 Discard

Time and Temperature Data:

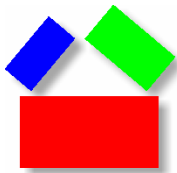
- Monday, April 28, 2003 12:17:32 PM 81
- Monday, April 28, 2003 9:44:10 PM 64
- Friday, May 23, 2003 11:18:54 AM 59
- Friday, May 23, 2003 11:18:55 AM 49
- Friday, May 23, 2003 11:18:56 AM 53
- Friday, May 23, 2003 11:18:57 AM 54
- Friday, May 23, 2003 11:18:58 AM 56
- Friday, May 23, 2003 11:18:59 AM 42
- Friday, May 23, 2003 11:19:00 AM 54
- Friday, May 23, 2003 11:19:01 AM 54
- Friday, May 23, 2003 11:19:02 AM 42

Time Quality Chart

Time(Day)	Quality
0	100
20	~70
40	~45
60	~25
80	~15
100	~10

Discard



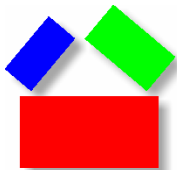


EXAMPLE – SHELF LIFE

- 76 Million cases of foodborne disease
 - 325,000 hospitalizations
 - 5000 deaths*
-
- 1.8 Million deaths from foodborne illness worldwide

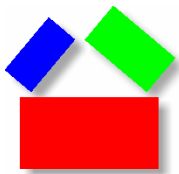
- 91 Million tons of food disposed
- Transported to landfills
- 26% of food supply*

* United States figures



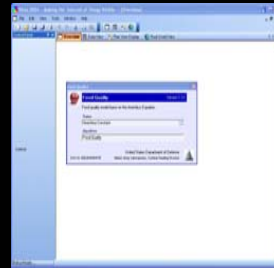
DATA CENTER

<http://www.mitdatacenter.org>



APPLICATIONS

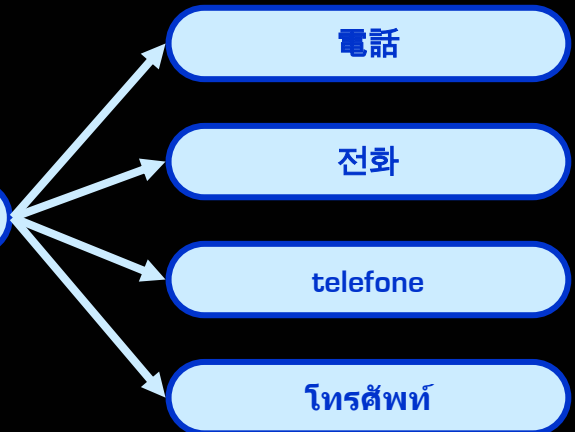
- **M Browser**



- **M News Feeds**



- **Inter-lingual M**



- **Binary M**

