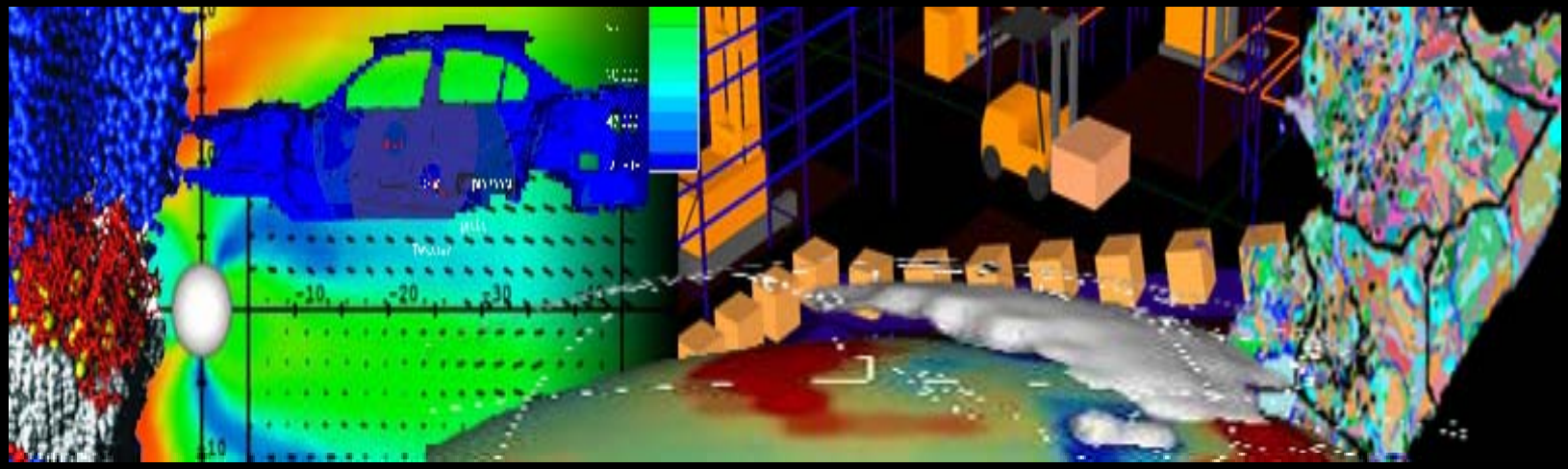
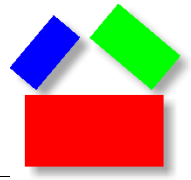

ACHVSETTS INSTITVTE OF TECHNOLOGY

Applications of the M Language in Agriculture



Edmund W. Schuster and Stuart J. Allen
The Data Center Program
Laboratory for Manufacturing and Productivity
Massachusetts Institute of Technology

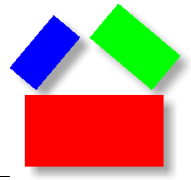


WHAT WE WILL DISCUSS TODAY

1. Managing **risk** in agriculture
2. An **introduction** to the M Language
3. A list of **applications** and projects programmed for the future
4. **Engineering Marketing Science** – The integration of marketing science, engineering technology, and supply chain management

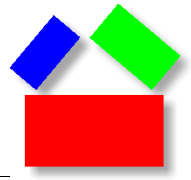
THE MIT DATA CENTER WEB SITE

www.mitdatacenter.org



An Interactive Discussion is welcome

Please feel fee to ask questions or add comments



THE GRAPE HARVEST AT WELCH'S

Allen, S.J. and E.W. Schuster, "Controlling the Risk for an Agricultural Harvest," *Manufacturing & Service Operations Management* 6:3 (2004): pp 225 – 236.

Allen, S.J. and E.W. Schuster, "Managing the Risk for the Grape Harvest at Welch's," *Production and Inventory Management Journal* 41:3. (2000): pp 31 – 36.

Schuster, E.W. and S.J. Allen, "Raw Material Management at Welch's," *Interfaces* 28:5 (1998): pp. 13 - 24.


WELCH

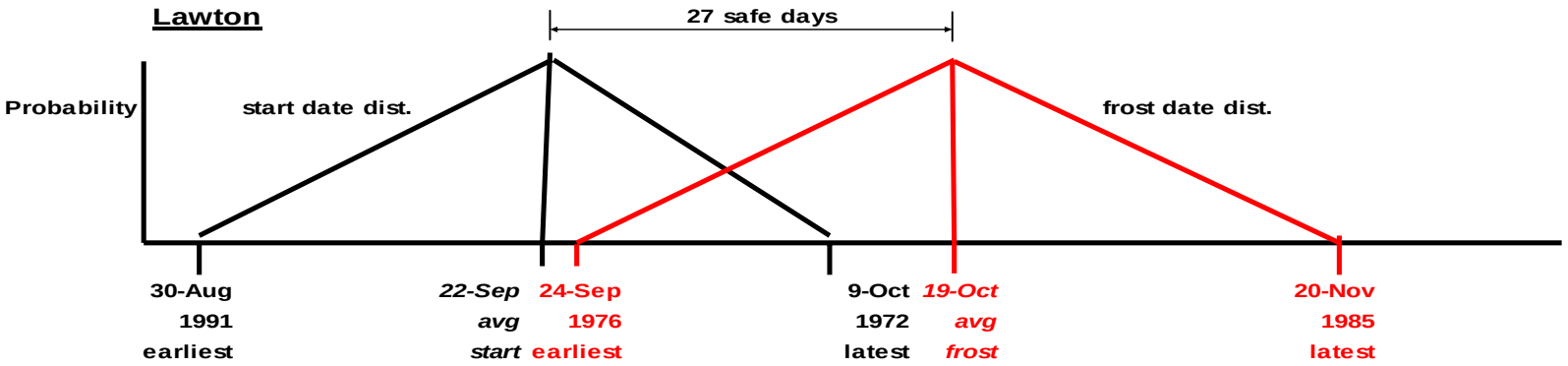
PURPOSE OF THE "HARVEST MODEL"

- Balance the growers desire to harvest all grapes before a hard frost verses capital expenditures required for maximum through-put rate.
- Historically, Welch's used a fixed-length of harvest to plan the though-put rate.
- The fixed-length of harvest method ignored the risk of a hard freeze

DEFINITION OF "POLICY"

- Take 100% of the crop, 85% of the time
- Implies a harvest rate (R) required to meet the policy
- By defining a "statistical" policy for receiving grapes we can make trade-offs between harvest capacity and investment in equipment
- We calculated a "loss function" and found the 85% policy to be optimal

Qualitative Comparison of Start Dates and First 28 Degree Day
With Estimated Triangular Distributions



Comments (a

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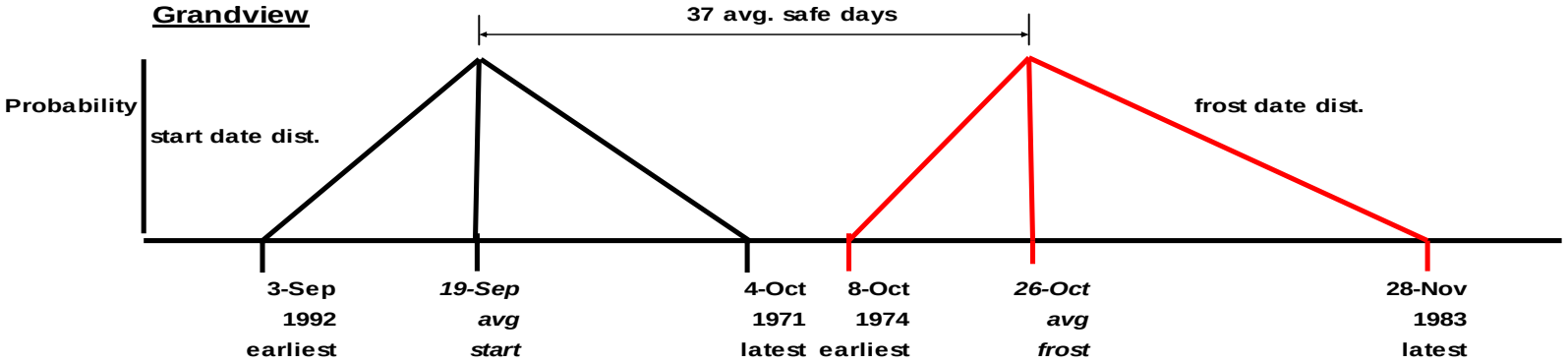
occurring

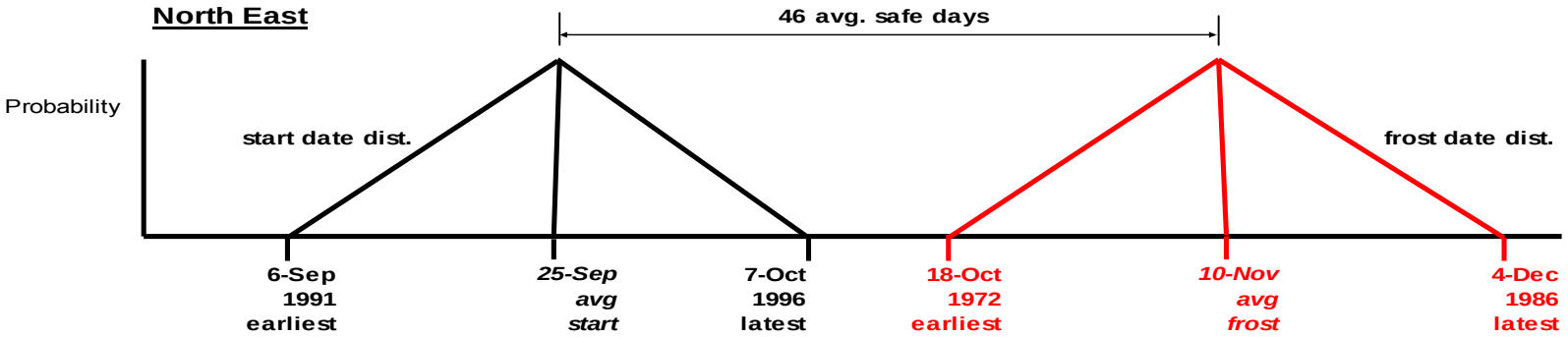
Six times du
Lawton h



Comments (a

The West ha
occurring

Over a 50%
in Octobe



Comments (a

North East h
in October

Largest am

DATA REQUIRED FOR THE HARVEST MODEL

- Harvest Size - we use the average of the LRP for Concord, for each growing area
- Historical analysis shows the harvest size to be normally distributed

DATA (continued)

- We use the "start date" and "end date" provided by National to calculate the length of season, L
- We assume the distribution of the season length to be normal (based on observations of histograms)
- L is not correlated with harvest size, H.
  - .14 correlation with significance of 53%.
- ONLY DATA AVAILABLE – POINT ESTIMATE OF TEMPERATURE
- TEMPERATURE SENSORS

M – THE BIG PICTURE

- Sensors

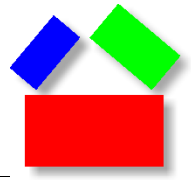
  "the number of deployed sensors will dwarf the number of personal computers by a thousand fold in 2010"

  Ferguson, Glover, Sanjay Mathur and Baiju Shah (2005), "Evolving From Information to Insight," *Sloan Management Review* 46:2, p. 52.

- A Network of Models
  - Capture 50 years of modeling
  - Something like eBay
  - The future of ERP…Packaged Software?
  - SAP and DEC, **Analog Devices**

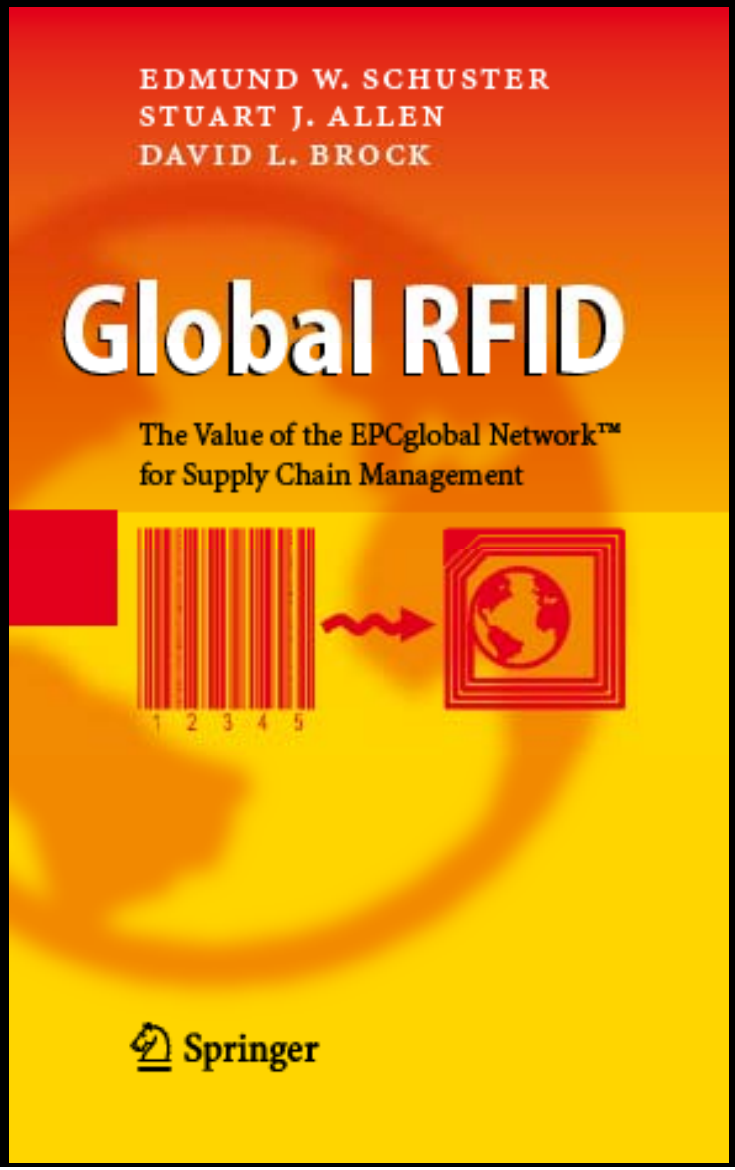
- Connect to the customer, interact

- Interoperable Data
  - Something like Adobe Acrobat



SEVERAL TYPES OF WEBS

- The Web of Information
  - –HTML and the World Wide Web
- The Web of Things
  - –Linking physical objects together using the EPCGlobal Network and RFID
- The Web of Abstractions
  - –Building a network of mathematical models
  - –Link models together
  - –Link data to models
  - –Computer languages & protocols to create a free flow of models in a network (Internet or Intranet)

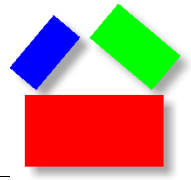

EDMUND W. SCHUSTER
STUART J. ALLEN
DAVID L. BROCK
Global RFID
The Value of the EPCglobal Network™
for Supply Chain Management
1 2 3 4 5
Springer

BOOK

- **GLOBAL RFID: The Value of the EPCglobal Network and RFID for Supply Chain Management**

  Edmund W. Schuster, Stuart J. Allen, David L. Brock

- Publisher: Springer Verlag, Manuscript = 330 pages
- 600 citations
- 41 figures and tables



GOALS IN WRITING THE BOOK

- What does the capability of unique identification mean for supply chains and business in general?
- Insight into EPCglobal, Inc.
- Targeted for a wide audience
- Focus on implementation
- The role of data, and the future (MIT Data Center and the M Language)
- Foreword written individually by Kevin Ashton and Sanjay Sarma

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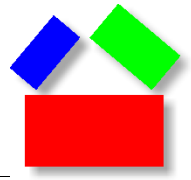
TABLE OF CONTENTS (CONTINUED)



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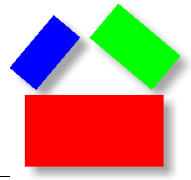

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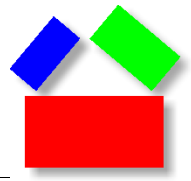
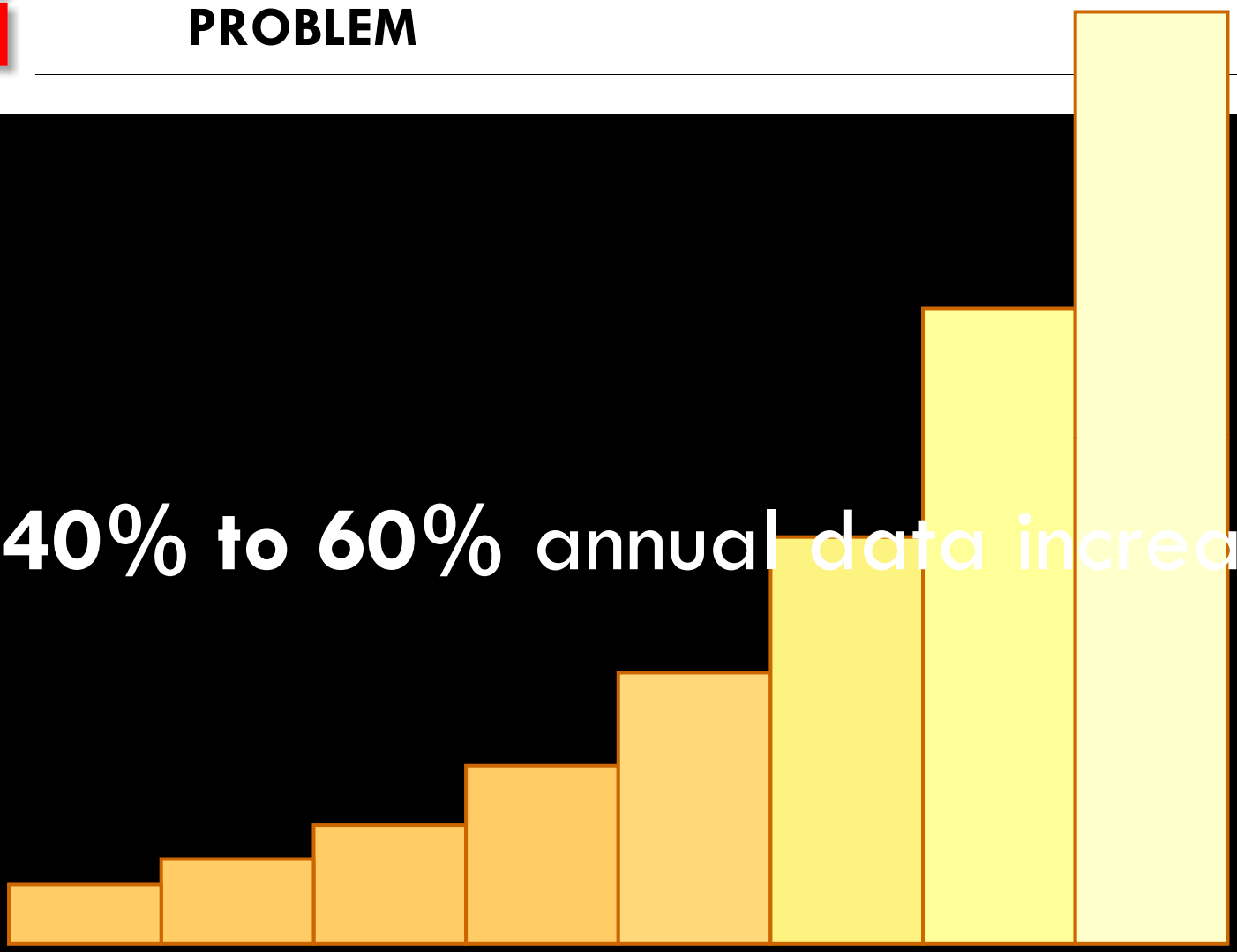
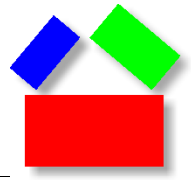


PROBLEM

40% to 60% annual data increase



From *Forbes*



PROBLEM

What are you going to do
with all your
Data?

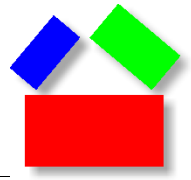
THE IMPORTANCE OF WHAT WE ARE DOING…

"Semantics is a hot industry sector right now – a $2 billion per year market and projected to grow to over $50 billion by the year 2010."

"Leading analysts have estimated that 35-65% of our System Integration costs are due to Semantic issues."

And in every sector of the market…our biggest software challenges come down to creating and resolving meaning. In other words: semantics.

2006 Semantic Technology Conference
San Jose, Ca

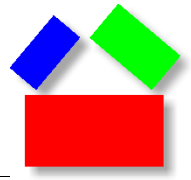


The market in semantics might be 10 times larger than RFID

This is a good area to add value, create new research, and make profits

There are many internal company benefits as well

We think the MIT Data Center might be larger than the Auto-ID effort



The market for mathematical models might be even larger

We want to become the “Henry Ford of Modeling”

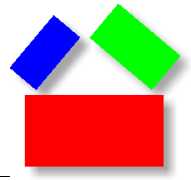
MIT DATA CENTER PROGRAM

- First work conducted in 2003
- Smartworld 2004 – over 300 attendees
- Administrative Unit within MIT 2005
- Laboratory for Manufacturing and Productivity
  - New Master of Engineering in Manufacturing
  - A number of high tech manufacturing experts
- First member, MorganFranklin Corporation, then LG, Raytheon, Siemens, and ReadyTouch

BREAK-THROUGH

- **"An Introduction to Semantic Modeling for Logistical Systems,"** D.L. Brock, E.W. Schuster, S.J. Allen and P. Kar.

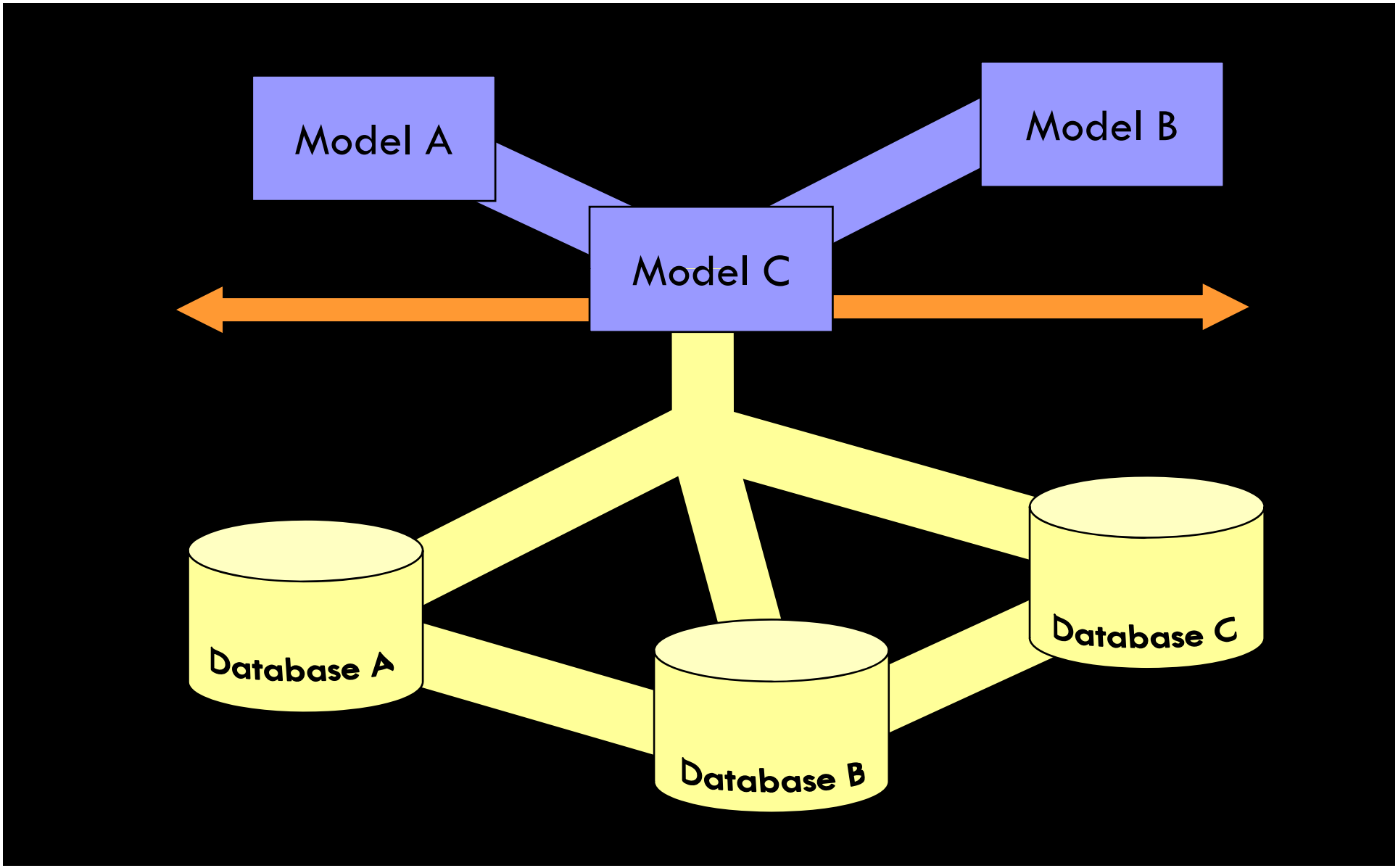
- Winner of the 2004 **E. Grosvenor Plowman Award** given by the Council of Logistics Management for best contribution to the study of logistics.



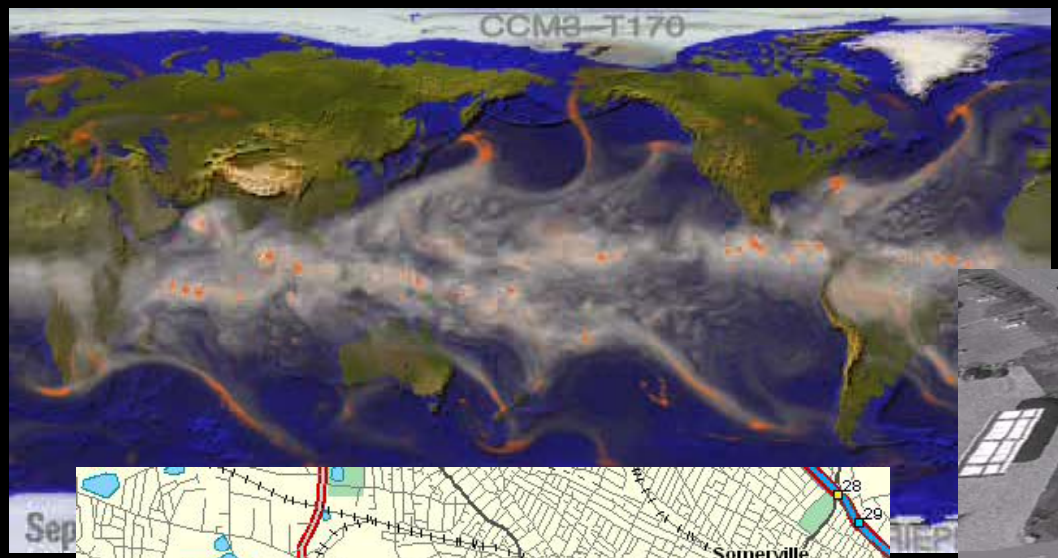
THE M LANGUAGE

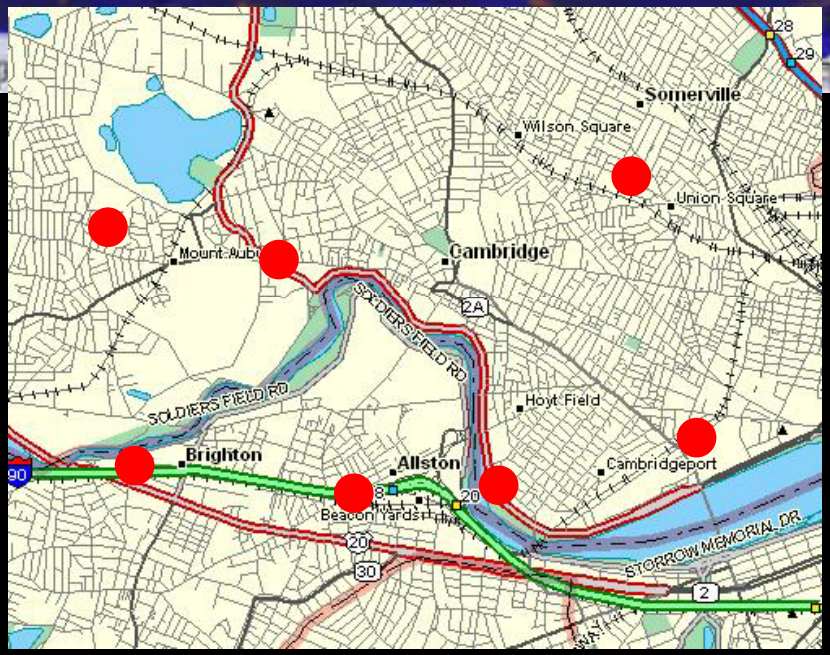
- David Brock, Chief Architect
- Initial Design – Dictionary and Rules
- A way to link data together semantically

VISION

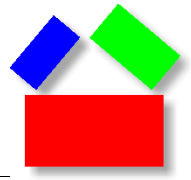


EXAMPLE - LOGISTICS



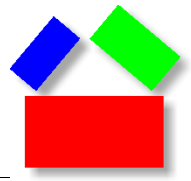


DATA

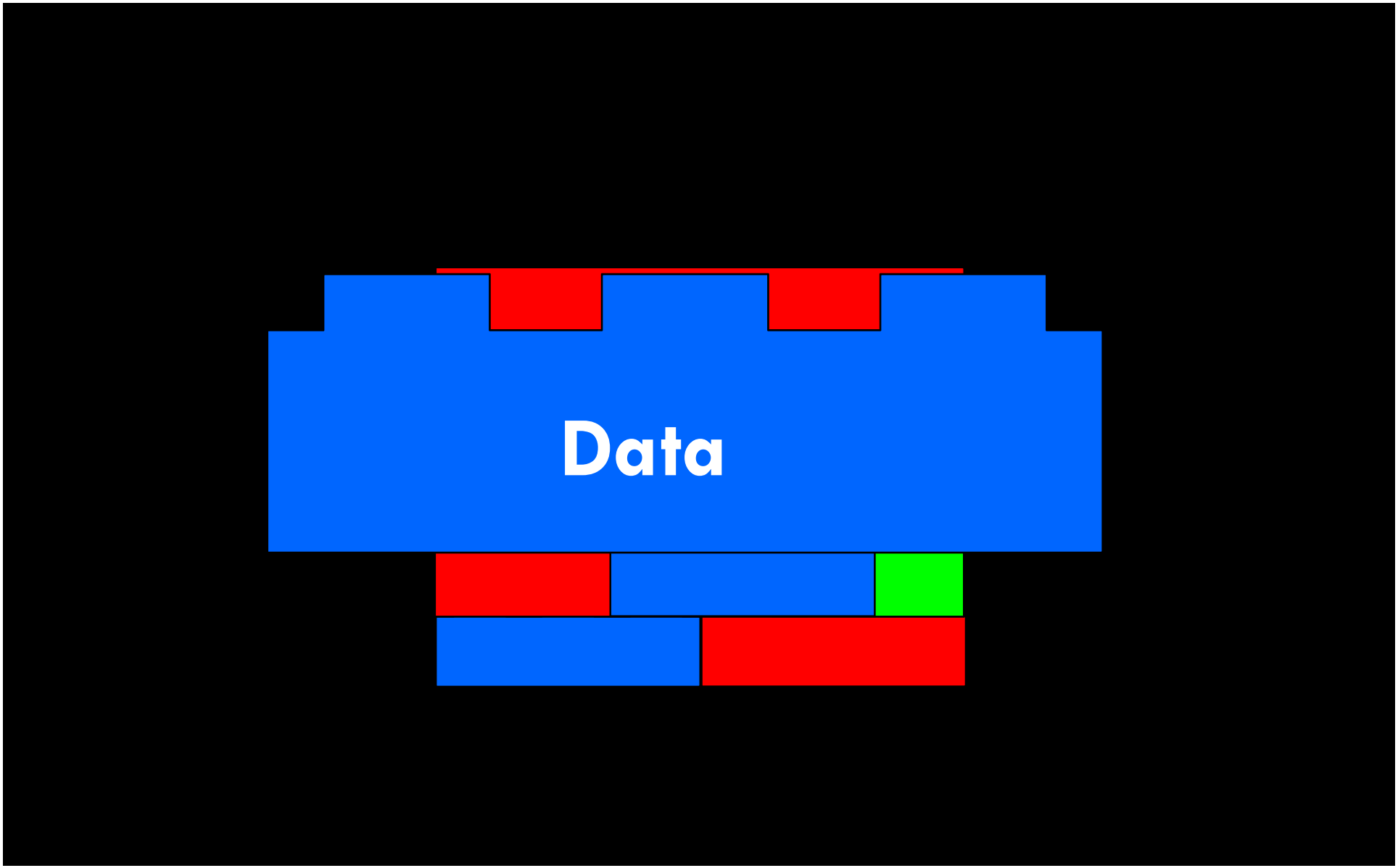


DATA

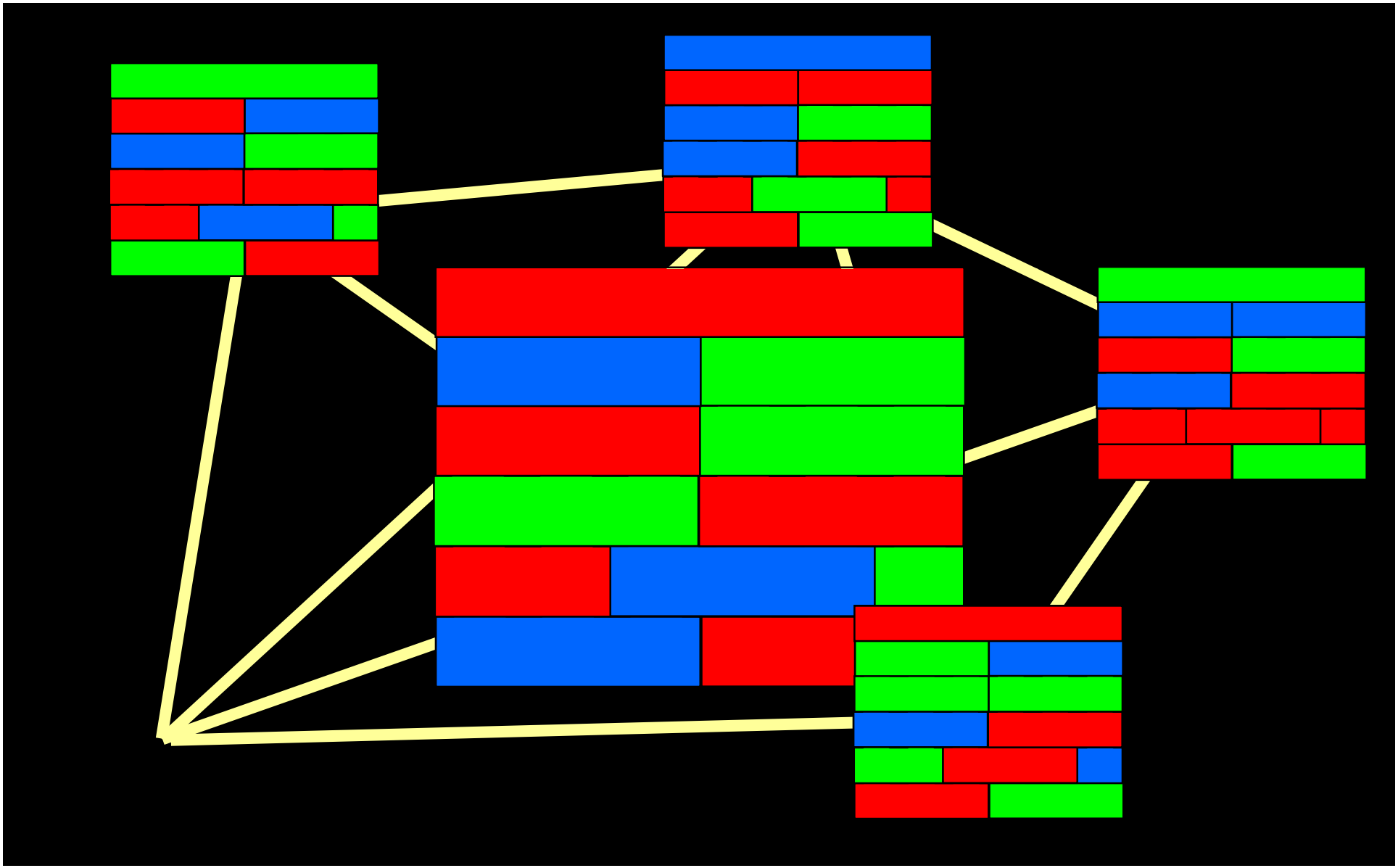
Data

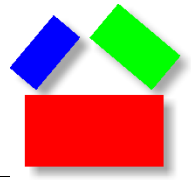


DATA



DATA NETWORK





VISION

Mission

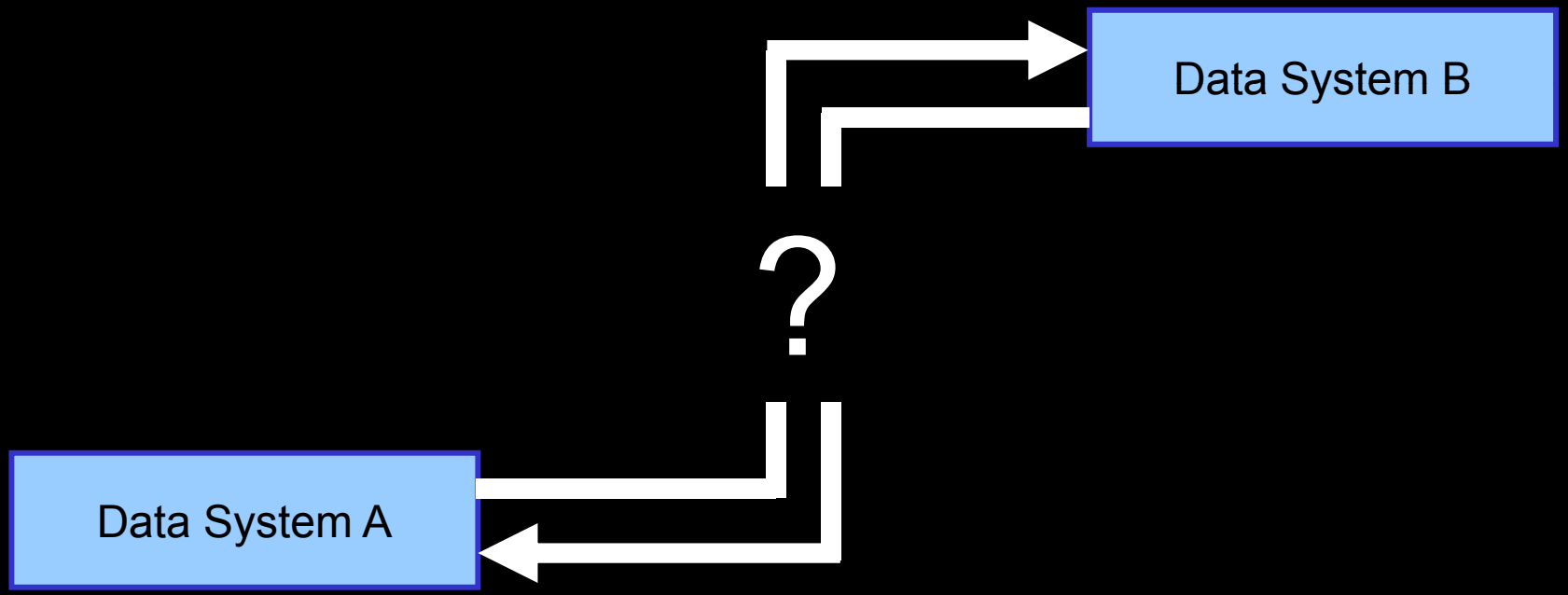
- Make sense of your data

Task

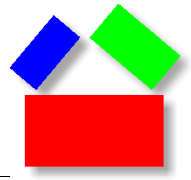
- Create the standards and systems for interoperable data and modeling

VISION

How do we synchronize data?



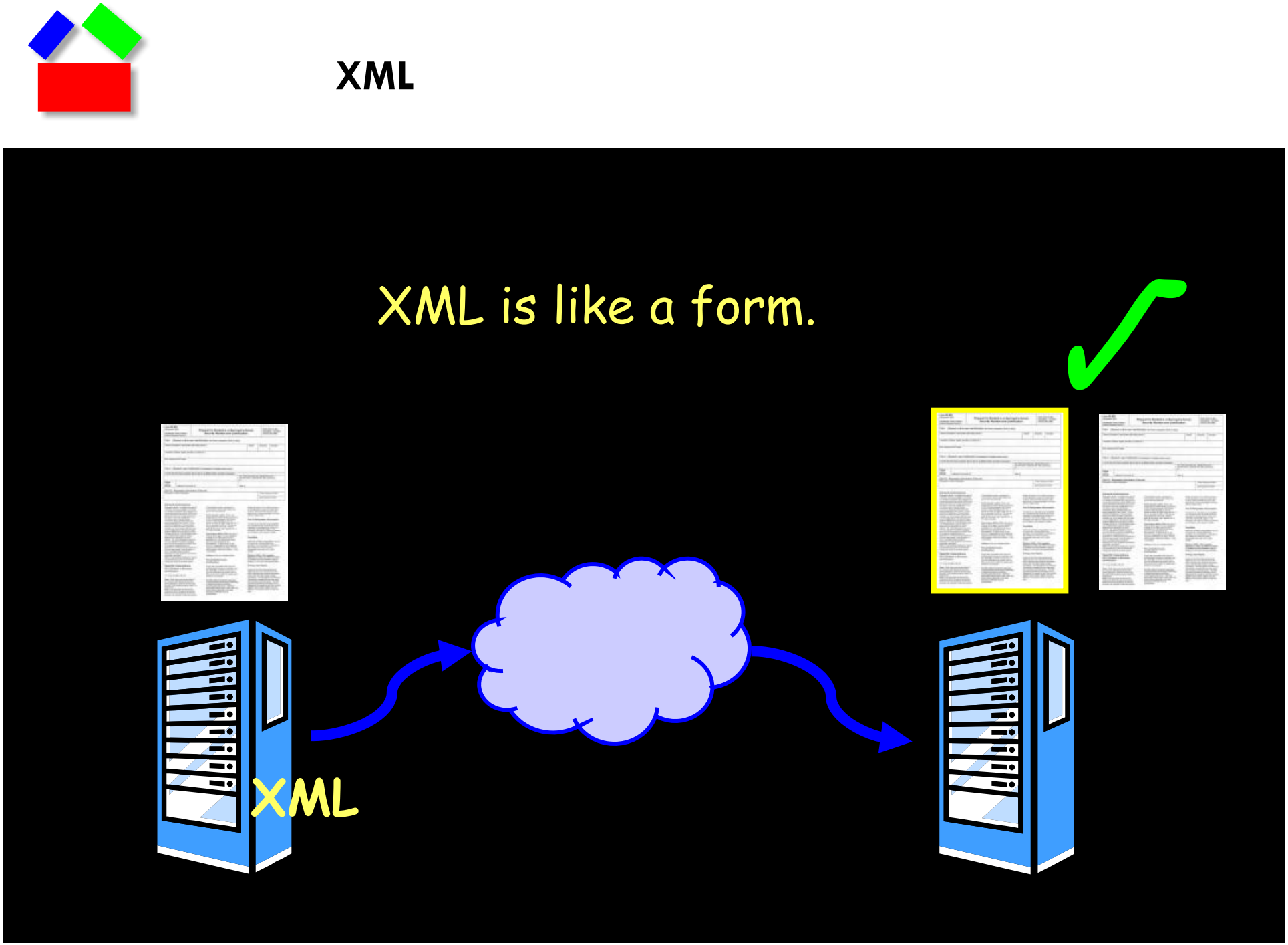
Data = Symbol CONTEXT Target: Vocabulary and Syntax



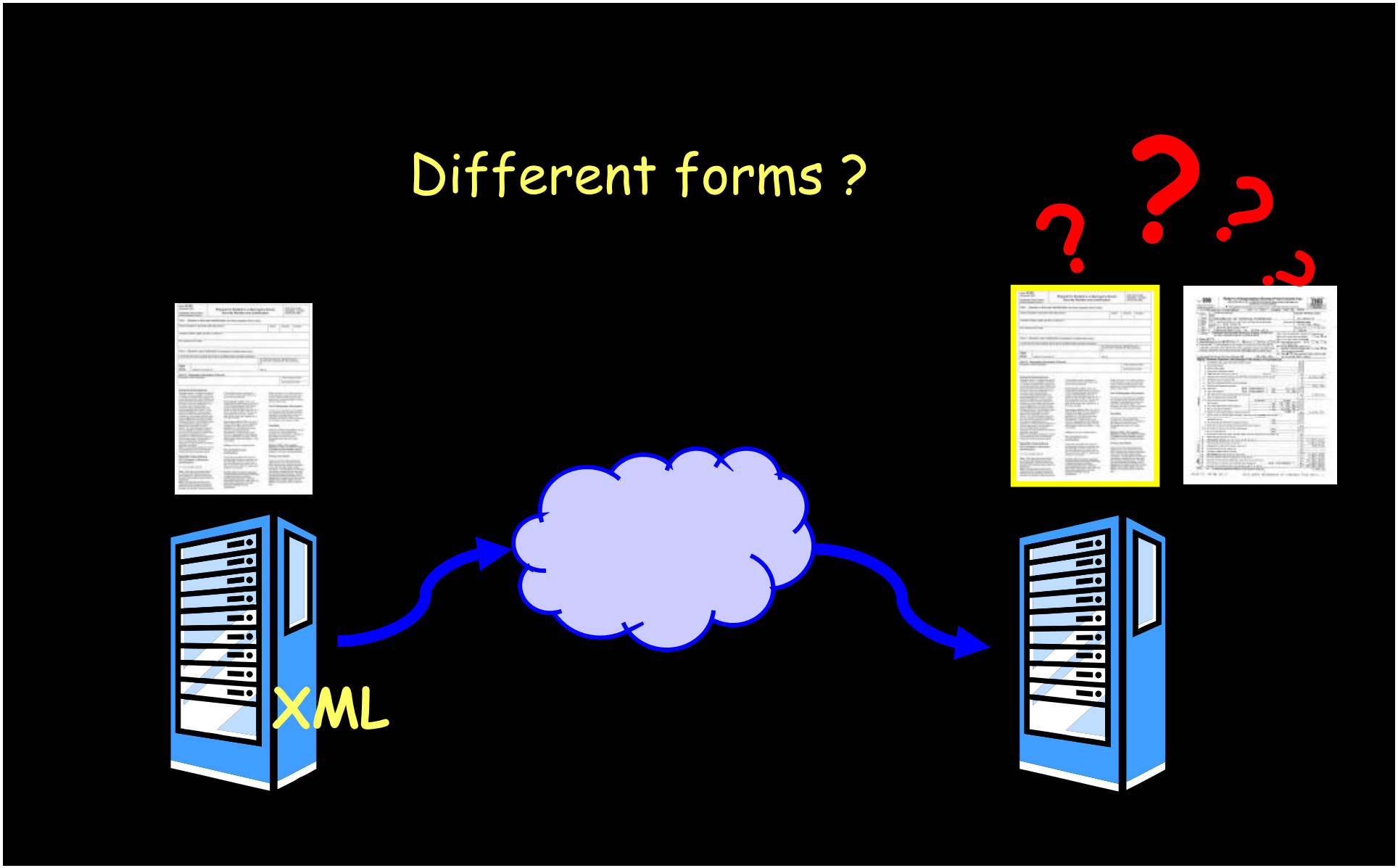
SOLUTION

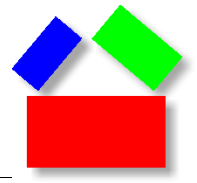
XML

Must agree on vocabulary and syntax


XML
XML is like a form.
XML

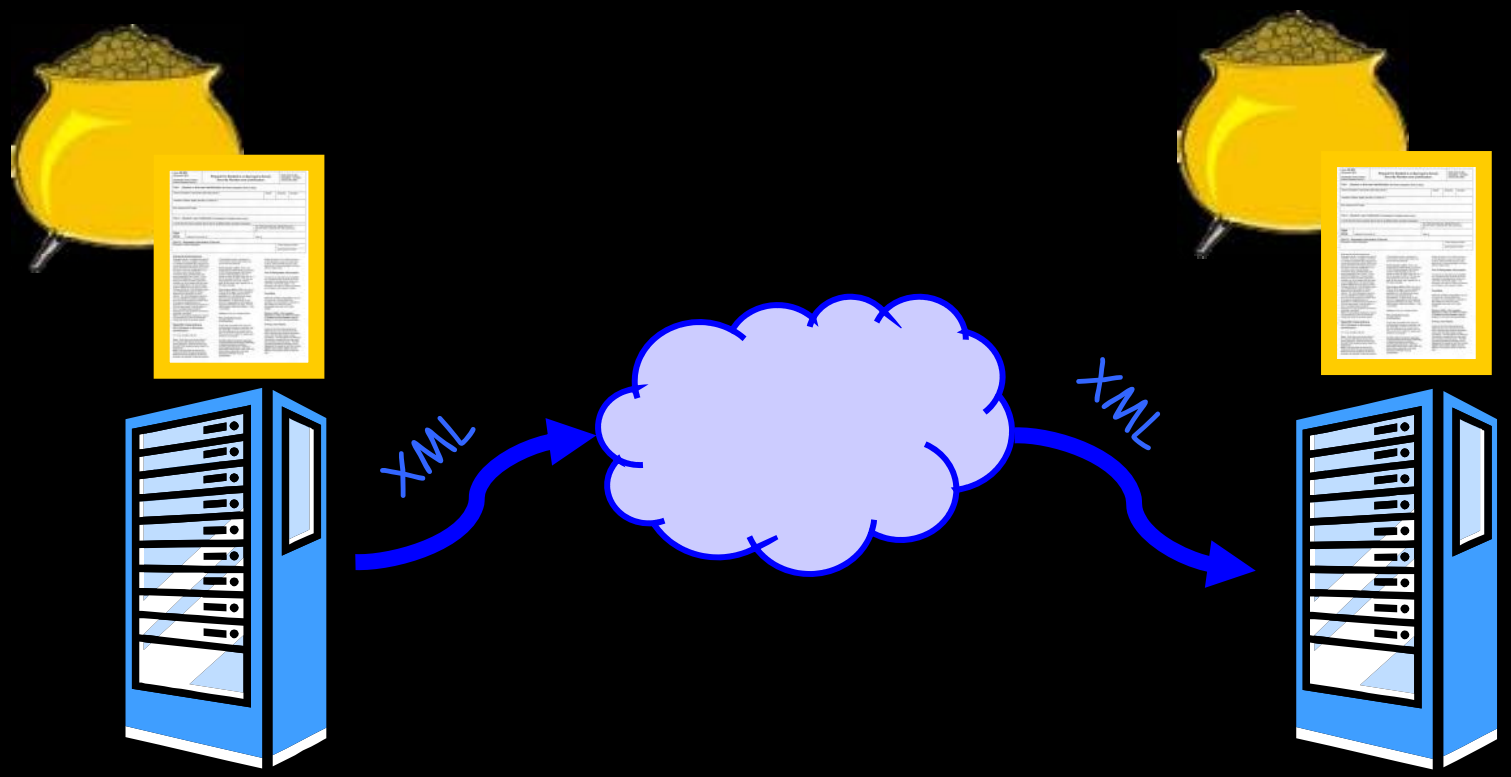
PROBLEM





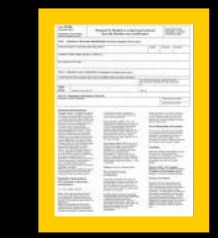
STANDARD

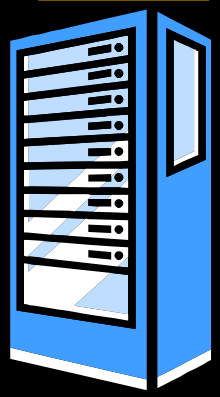
Can't we just agree on one form?



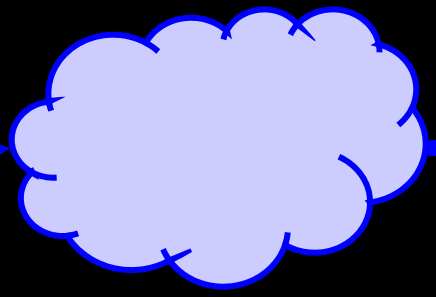
STANDARD?

Whose form?





XML



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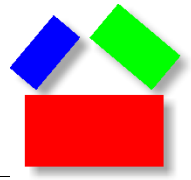

STANDARDS?

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ABML
ACML
ACML
ACAP
ACS X12
ADML
AECM
AFML
AGML
AHML
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BiblioML
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CaseXML
xCBL
CBML
CDA
CDF
CDISC
CELLML
ChessGML
ChordML
ChordQL
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CIML
CIDS
CIDX
xCIL
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ComicsML
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CIDS

CIDX
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Covad xLink
CPL
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CSS
CVML
CWMI
CycML
DML
DAML
DaliML
DaqXML
DAS
DASL
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DMML
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DocScope
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ETD-ML
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FINML
FITS
FIXML
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HTML
HTTPL

HTTP-DRP
HumanML
HyTime
IML
ICML
IDE
IDML
IDWG
IEEE DTD
IFX
IMPP
IMS Global
InTML
IOTP
IRML
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IXRetail
JabberXML
JDF
JDox
JECMM
JLife
JSML
JSML
JScoreML
KBML
LACITO
LandXML
LEDES
LegalXML
Life Data
LitML
LMML
LogML
LogML
LTSC XML
MAML

MatML
MathML
MBAM
MISML
MCF
MDDL
MDSI-XML
Metarule
MFDX
MIX
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PNML
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PNG
PrintML

PrintTalk
ProductionML
PSL
PSI
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QuickData
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RDF
RDL
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RELAX
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REXML
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RETML
RFML
RightsLang
RIXML
RoadmOPS
RosettaNet PIP
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STEP
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SyncML
TML
TML
TML
TalkML
TaxML
TDL
TDML
TEI
ThML
TIM
TIM
TMML
TMX
TP
TPAML
TREX
TxLife

UML
UBL
UCLP
UDDI
UDEF
UIML
ULF
UMLS
UPnP
URI/URL
UXF
VML
vCalendar
vCard
VCML
VHG
VIML
VISA XML
VMML
VocML
VoiceXML
VRML
WAP
WDDX
WebML
WebDAV
WellML
WeldingXML
Wf-XML
WIDL
WITSML
WorldOS
WSML
WSIA
XML
XML Court
XML EDI

XML F
XML Key
XMLife
XML MP
XML News
XML RPC
XML Schema
XML Sign
XML Query
XML P7C
XML TP
XMLVoc
XML XCI
XAML
XACML
XBL
XSBEL
XBN
XBRL
XCFF
XCES
Xchart
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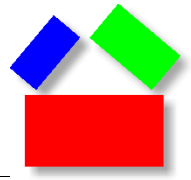
XIOP
XLF
XLIFF
XLink
XMI
XMSG
XMTP
XNS

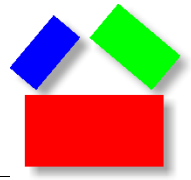


M

A Modeling Language

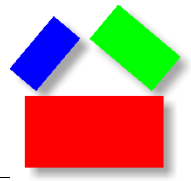
The Fundamental Idea:

Separate **vocabulary** and **grammar**

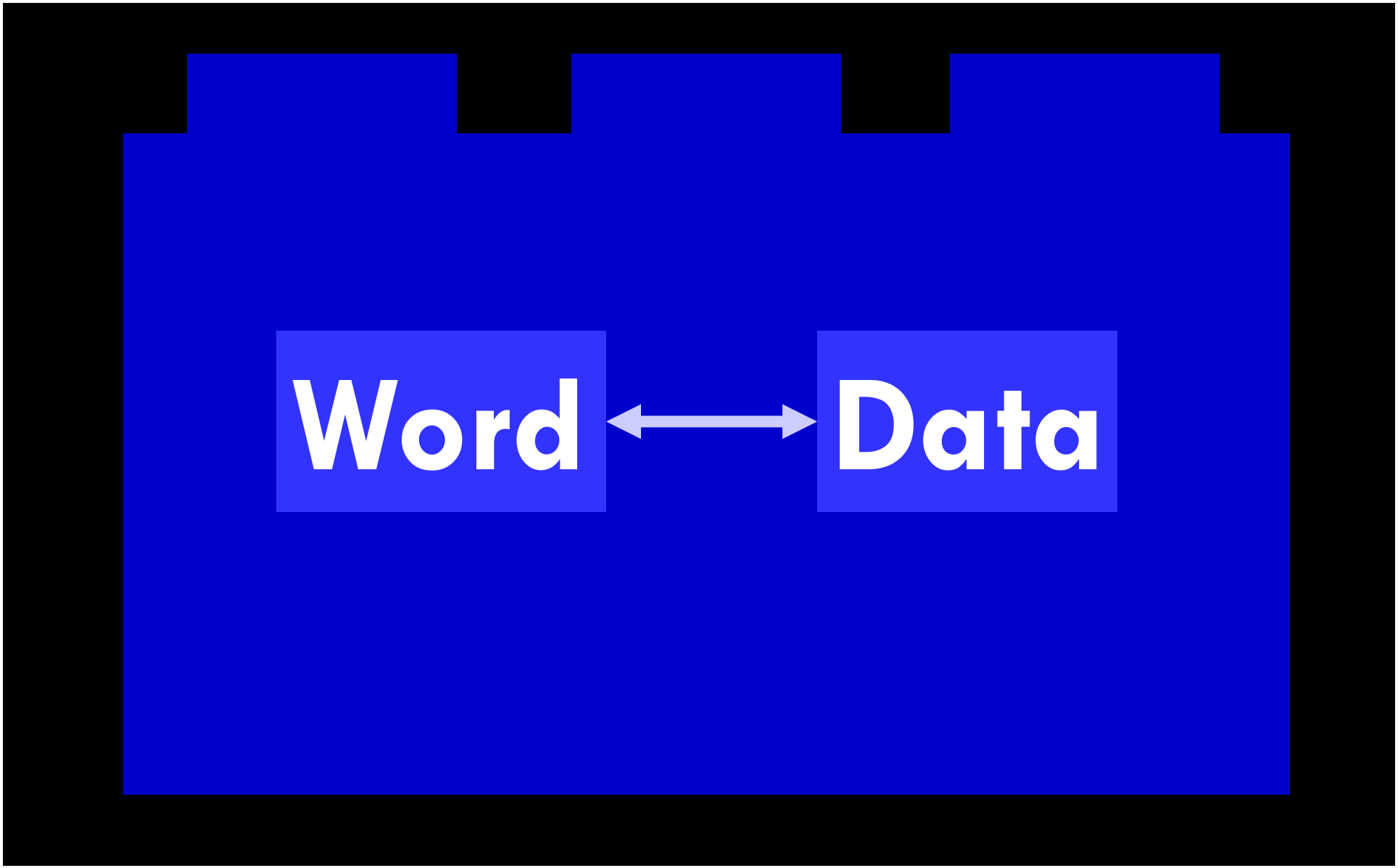


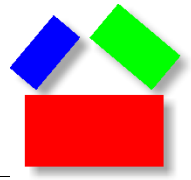
Words + **Rules**

Dictionary Grammar



DATA "BLOCK"





DICTIONARY ENTRY

WORD

call.*5*

DEFINITION

call *n.* a telephone connection.

RELATIONS

Synonyms: phone_call.1, telephone_call.1
Type of: telephone.2, telephony.1
Part of:

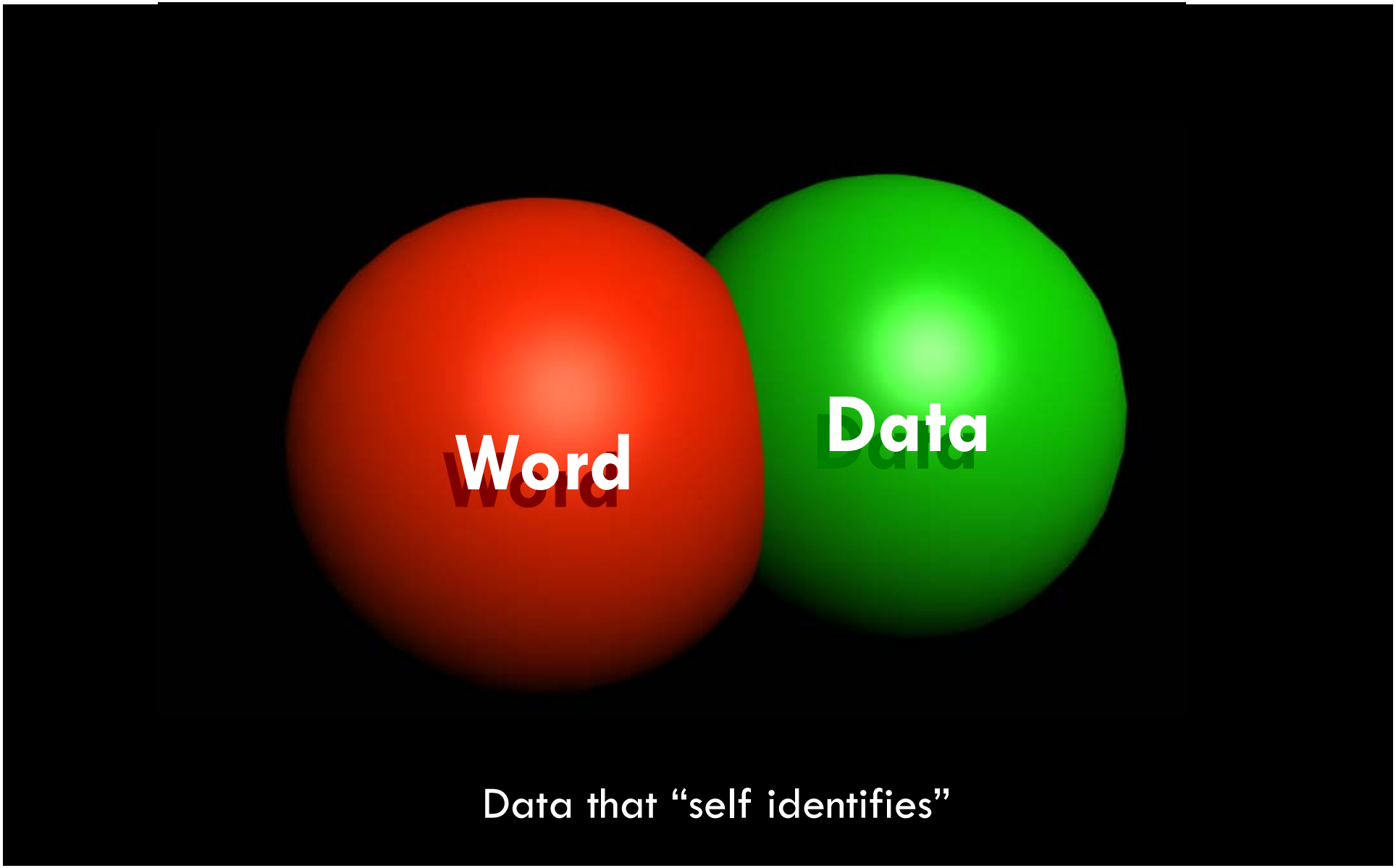
DATA

Data: ^[+][0-9]\d{2}-\d{3}-\d{4}$
Attributes: party.5, duration.1, telephone_number.1

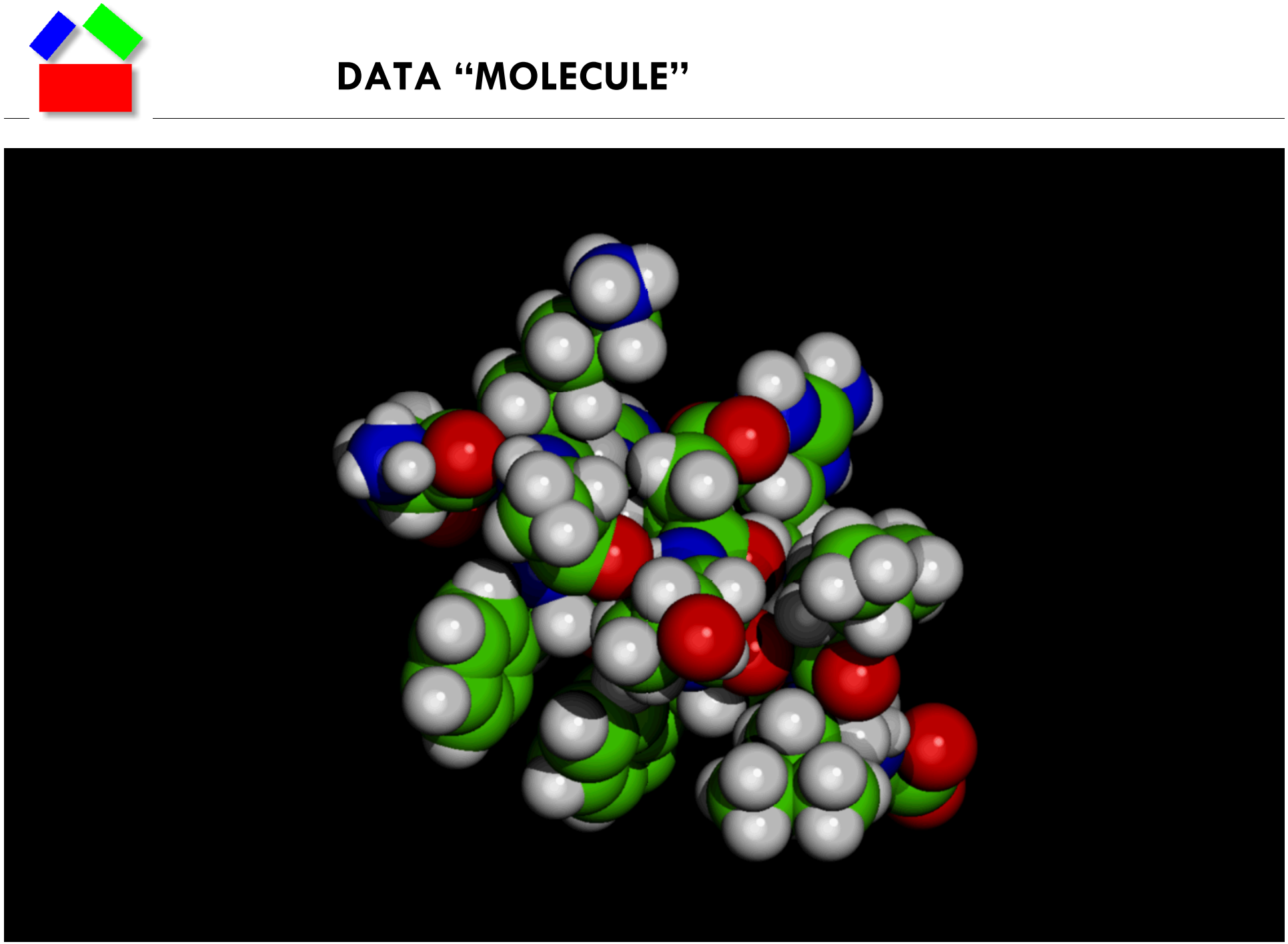
TRANSLATIONS

Data: 电话 , telefoongesprek , 전화 , телефонныйа вызов

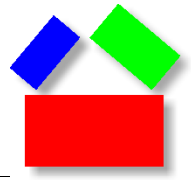
DATA "ATOM"



Data that "self identifies"

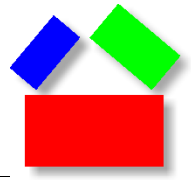


DATA “MOLECULE”



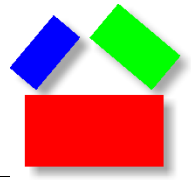
DICTIONARY AND GRAMMAR DEVELOPMENT

- Web accessible
- Web editable – A “wiki” dictionary
- 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



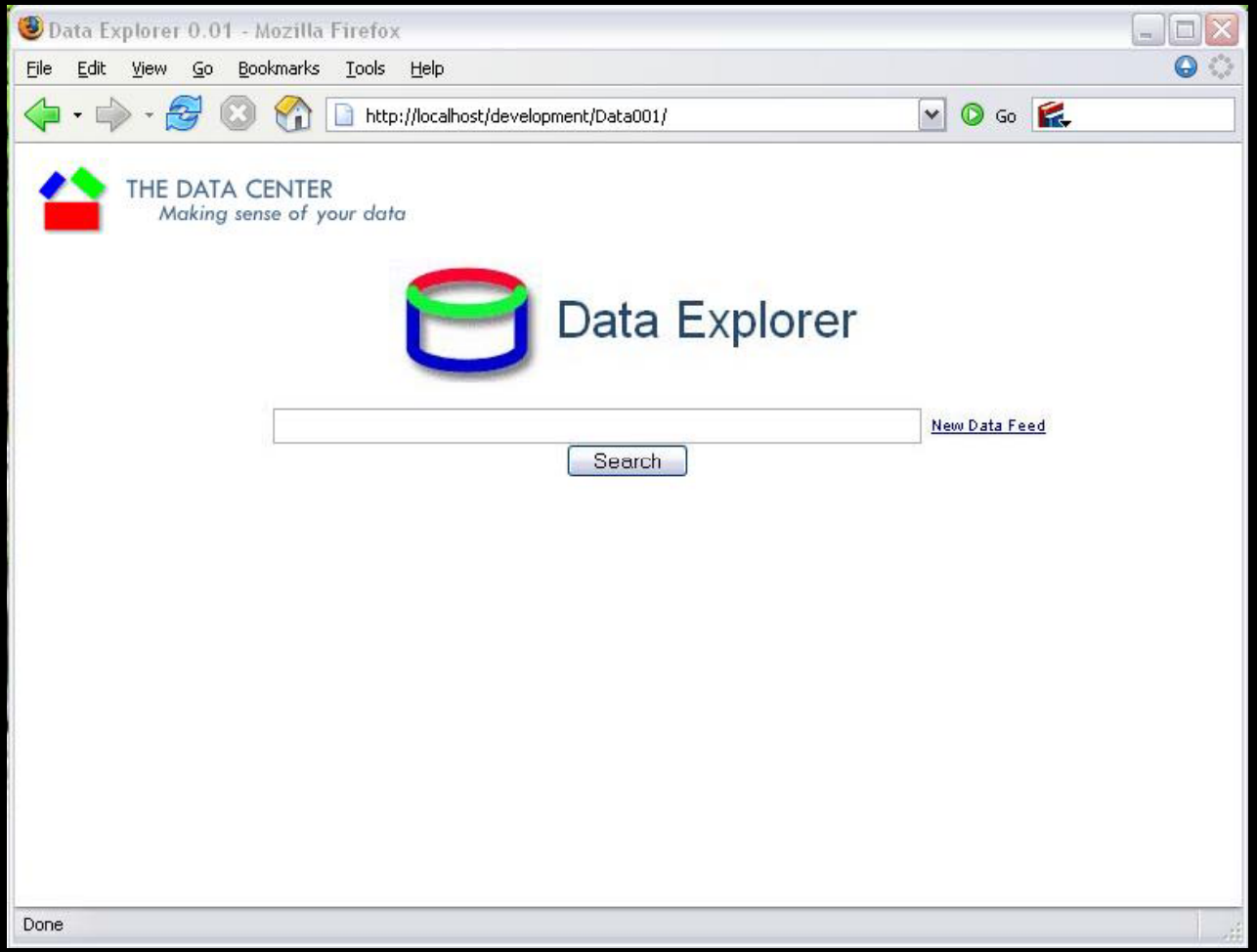
HOW DOES M COMPARE TO SEMANTIC WEB?

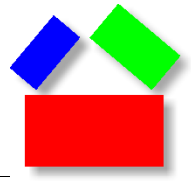
- The M Language works with W3C standards
  - XML
  - XSLT
- M focuses on atomic elements, Semantic Web focuses on creating an ontology
- M is designed for “many to many” communication, across industry disciplines
- Semantic Web plans to use some elements of Artificial Intelligence and Knowledge Management



Applications

M DATA FEEDS


Data Explorer 0.01 - Mozilla Firefox
File Edit View Go Bookmarks Tools Help
http://localhost/development/Data001/
Go
THE DATA CENTER
Making sense of your data
Data Explorer
New Data Feed
Search
Done



M NEWS FEEDS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    <title>CNN.com</title>
    <link2>http://www.cnn.com/rssclick/?section=cnn_topstories</link2>
    <description>
       CNN.com delivers up-to-the-minute news and information on the
       latest top stories, weather, entertainment, politics and
       more.
    <description>
    <language>en-us</language>
    <publication_date>Tue, 20 Sep 2005 18:01:37 EDT</publication_date>
    <managing_editor>editor@cnn.com</managing_editor>
    <webmaster>webmaster@cnn.com</webmaster>
    <item>
      <title> Rita.7 pounds.2 Florida_Keys.0 and.0 spawns.2 tornadoes.0 </title>
      <link>http://www.cnn.com/rssclick/2005/Weather/09/20/rita/
            Index.html?section=cnn_topstories
      </link>
      <description>Hurricane Rita battered South Florida and the Keys with heavy rain
and strong winds Tuesday after strengthening to a Category 2 storm. Gov. Jeb Bush warned
residents to stay vigilant as the storm -- with maximum sustained winds of 100 mph --
passed through the Straits of Florida without so far making official landfall. Radar
indicated Rita spawned tornadoes near Hollywood, Florida, and a water spout or tornado
near Islamorada, in the upper Keys.
     </description>
      <publication_date>Tue, 20 Sep 2005 16:13:49 EDT</publication_date>
    </item>
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M DATA FEEDS

NOAA NDBC

Raw Data Feed

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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' Data Feed

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  <unit.5>foot.11</unit.5>
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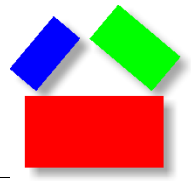
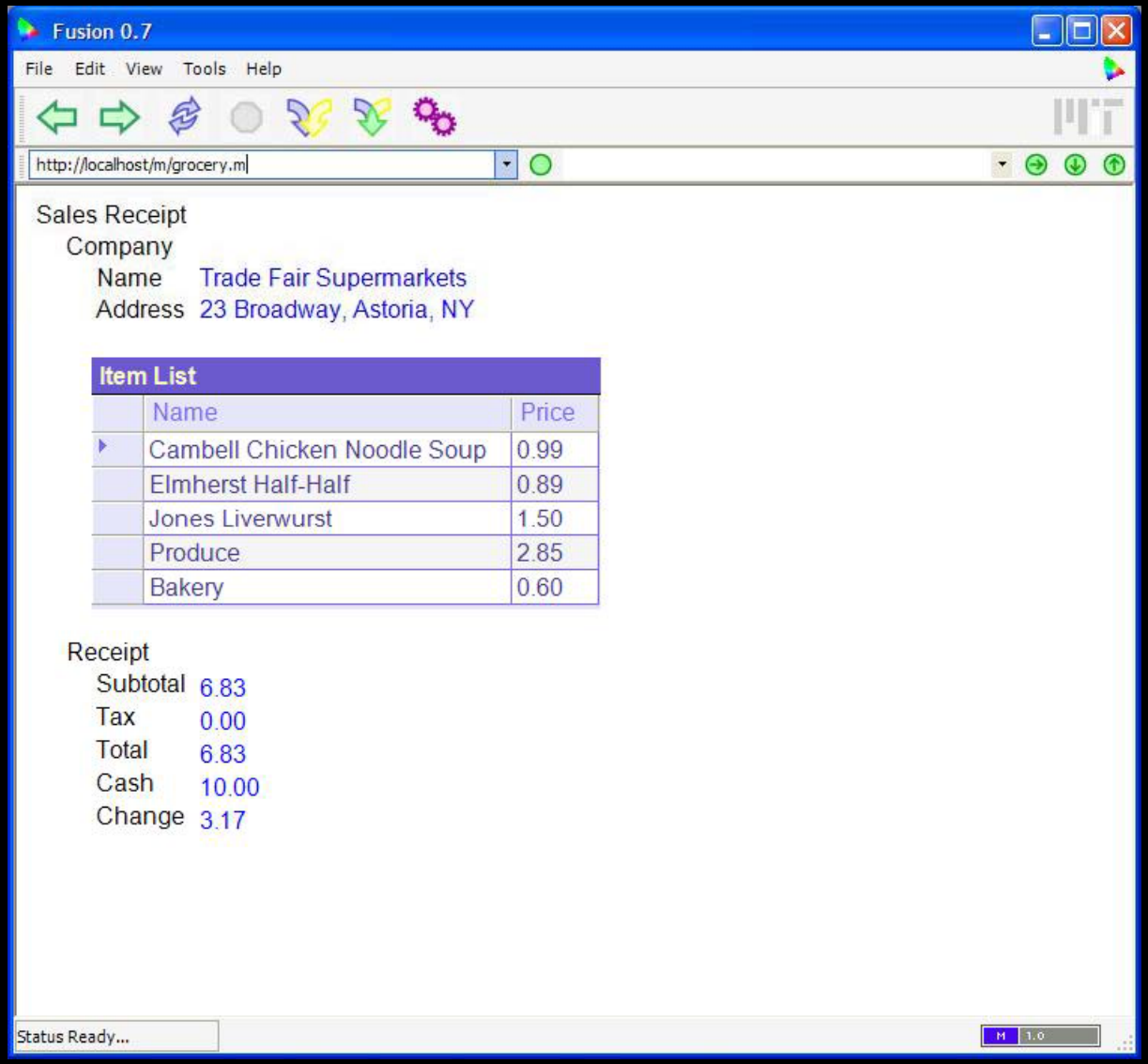
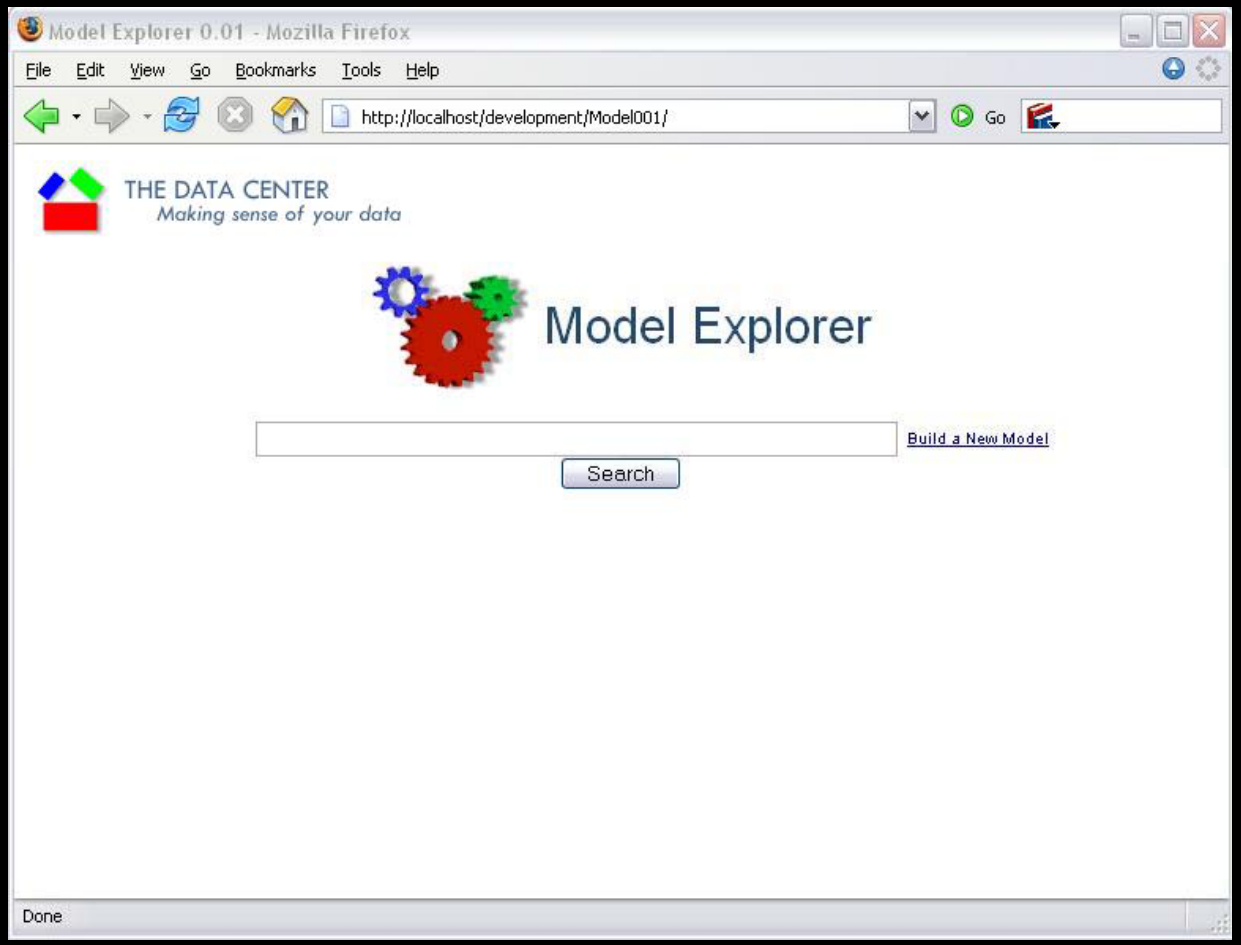
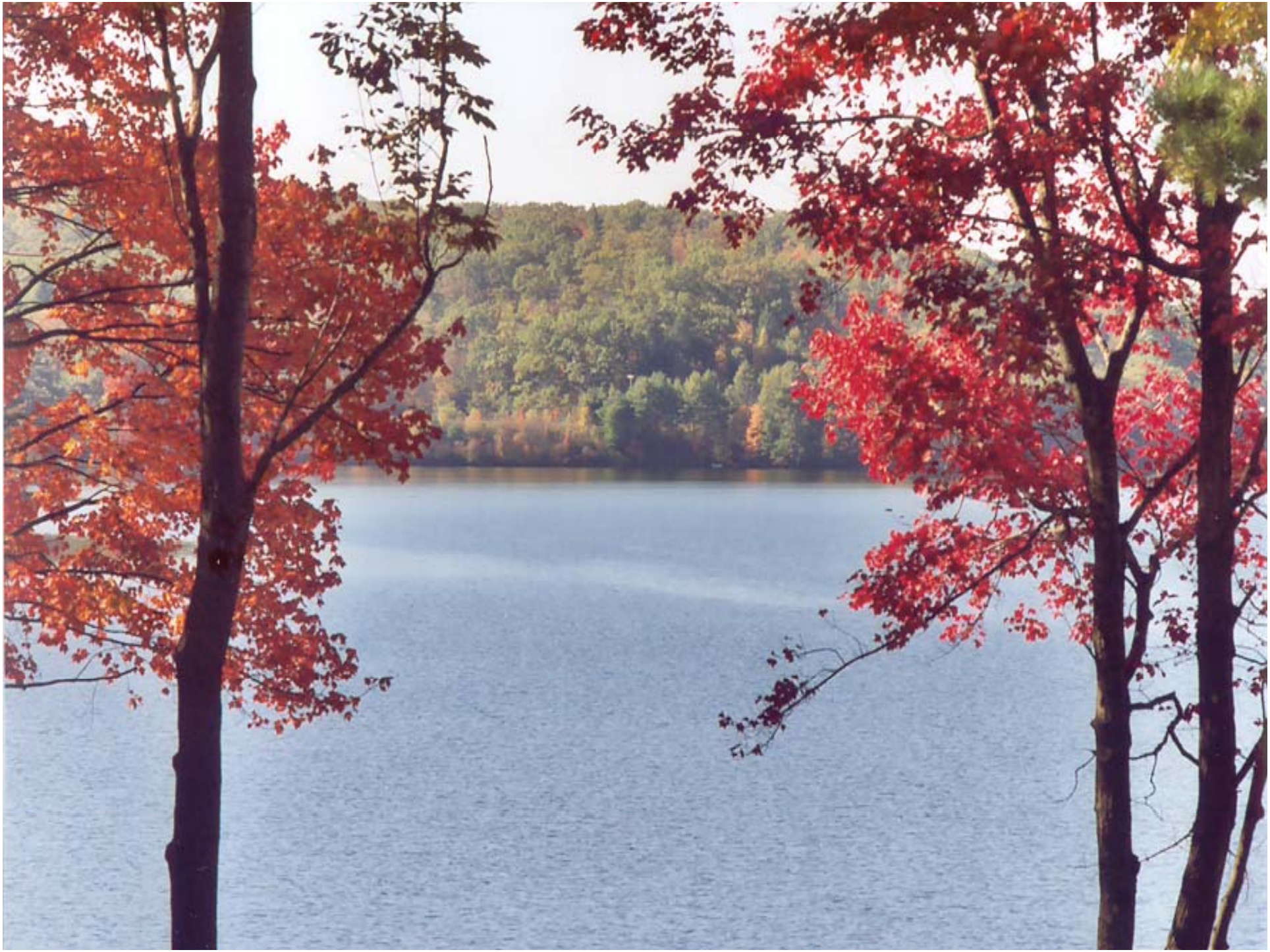


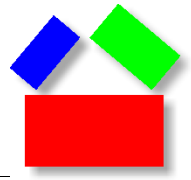
M BROWSER


Fusion 0.7
File Edit View Tools Help
http://localhost/m/grocery.m
Sales Receipt
Company
Name Trade Fair Supermarkets
Address 23 Broadway, Astoria, NY
Item List
Name
Price
Cambell Chicken Noodle Soup 0.99
Elmherst Half-Half 0.89
Jones Liverwurst 1.50
Produce 2.85
Bakery 0.60
Receipt
Subtotal 6.83
Tax 0.00
Total 6.83
Cash 10.00
Change 3.17
Status Ready...
M 1.0

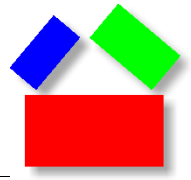
‘M’ MODEL EXPLORER







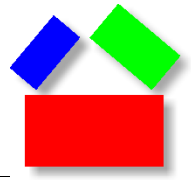
Engineering Marketing Science



Mass Advertising is taking a big hit

"Advertising is scary"

Prof. Duncan Simester
MIT Sloan School of Management



The Future…

The integration of **marketing science**, **engineering technology**, and **supply chain management**.

Supply chains that sense and respond to the physical world.

This requires an **Intelligent Infrastructure** for management, control, automation and interaction.

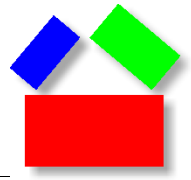
The **M Language** is an open system that will form the base.

OBJECTIVE

Develop new ways of influencing customer decision-making at the point of sale

Interactive Marketing

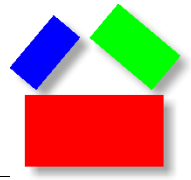
Use the M Language as the data aggregator between venders and retailers



RELEVANCE

Research Question – measuring and modeling the effect of increased amount of data at the point-of-sale.

Commercial Question – employ interactive marketing to increase sales at retail outlets.



M LANGUAGE APPLICATION

- Serve as a data aggregator
- Effective solution for the “many to many” problem
- Open source system
- Key Point – no standard exists today

In-Store Informational Kiosk

Self-service, interactive, networked terminals in the aisles for:

- *Product information*
- *Comparisons*
- *Targeted marketing*
- *Promotions*

www.readyTouch.com

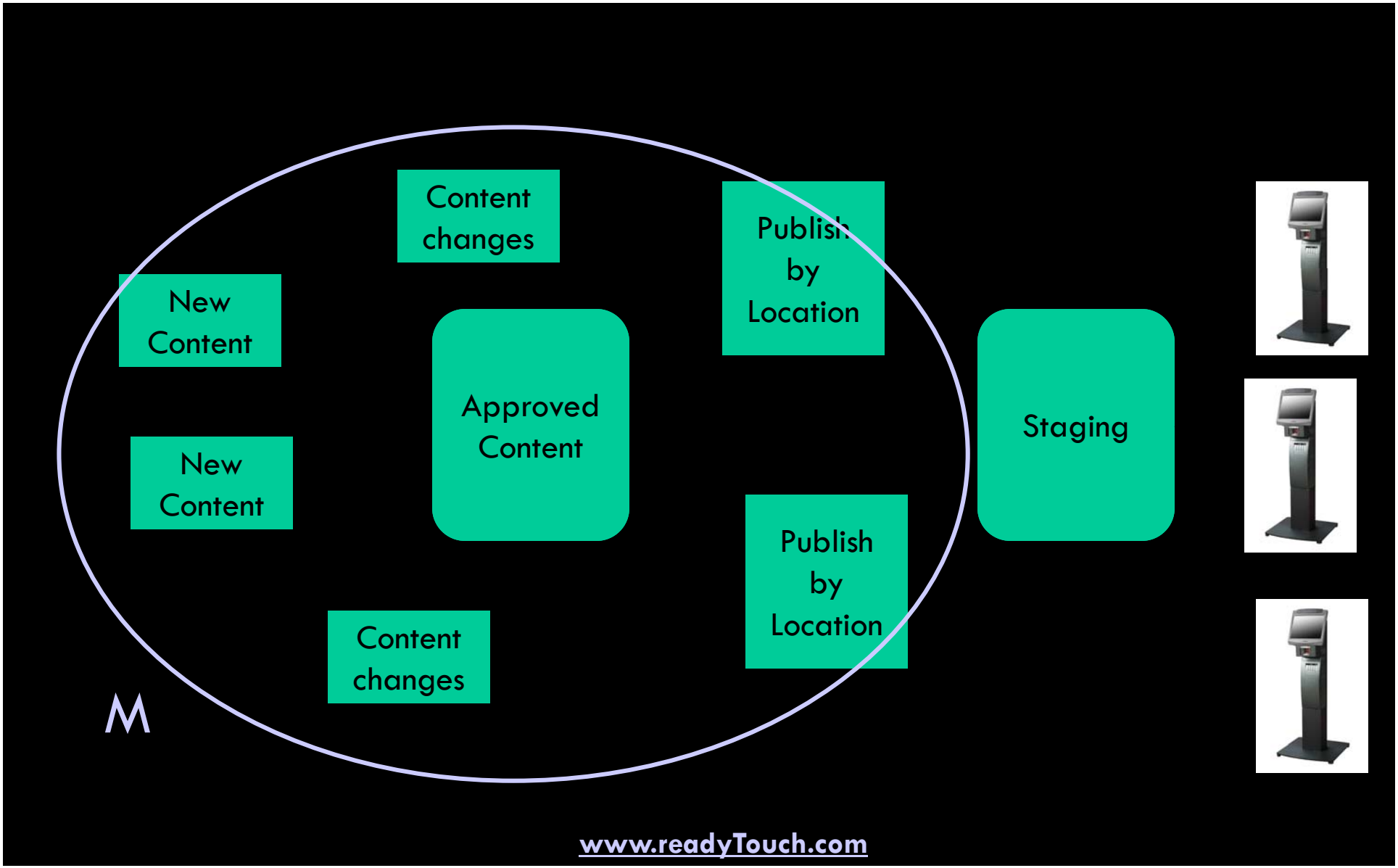
Brand Owner Benefits

- Consistent messaging
- Direct access to retail shoppers
- Access to customer shopping metrics
- Highly creative marketing options
- Deliver timely promotions

Retailer Benefits

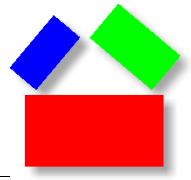
- Improve bottom line
  - More sales
  - Higher margin sales
- Improve customer service
  - More satisfied customer
- Hi-impact cross-promotions
  - Increase basket size
- Optimize staffing
  - Kiosk is product “expert”

A Supply Chain for Product Information



Expansion options

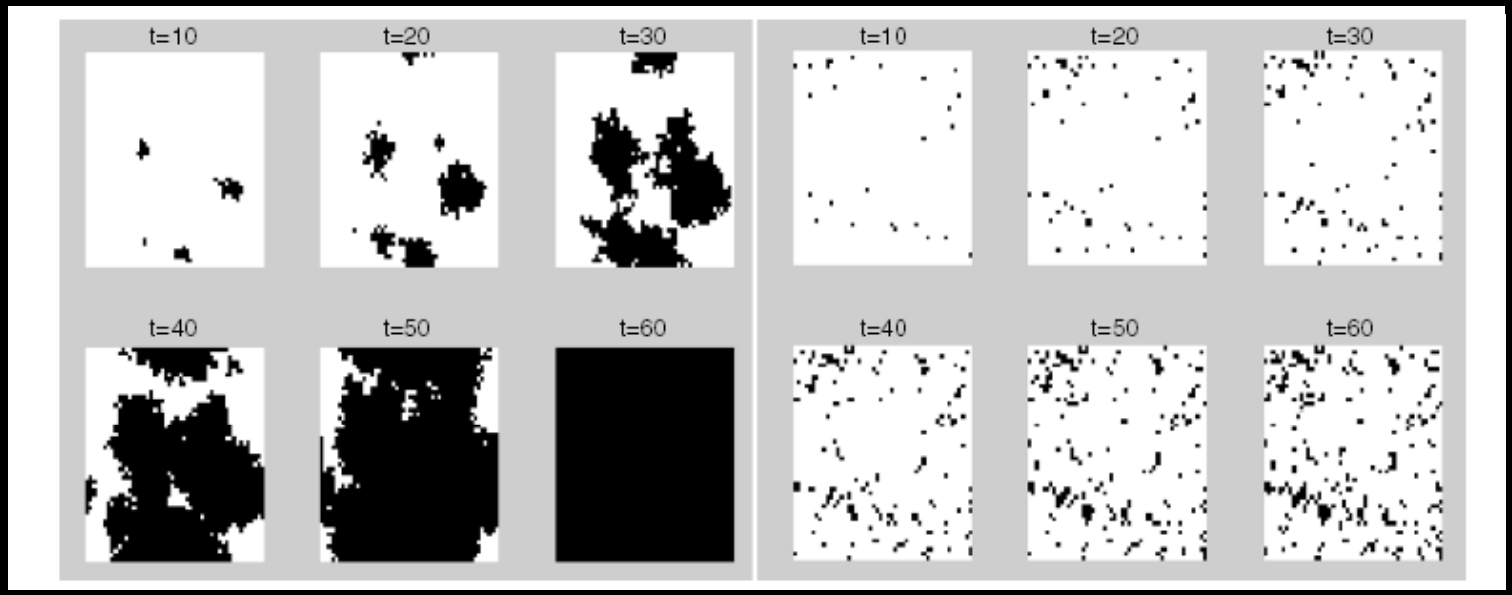
- Put the information on a cell phone
- RFID enabled devices – auto detect
- Loyalty card tie-in
- Web history tie-in
- Blogs and customer reviews
- Reporting tools to show marketing trends



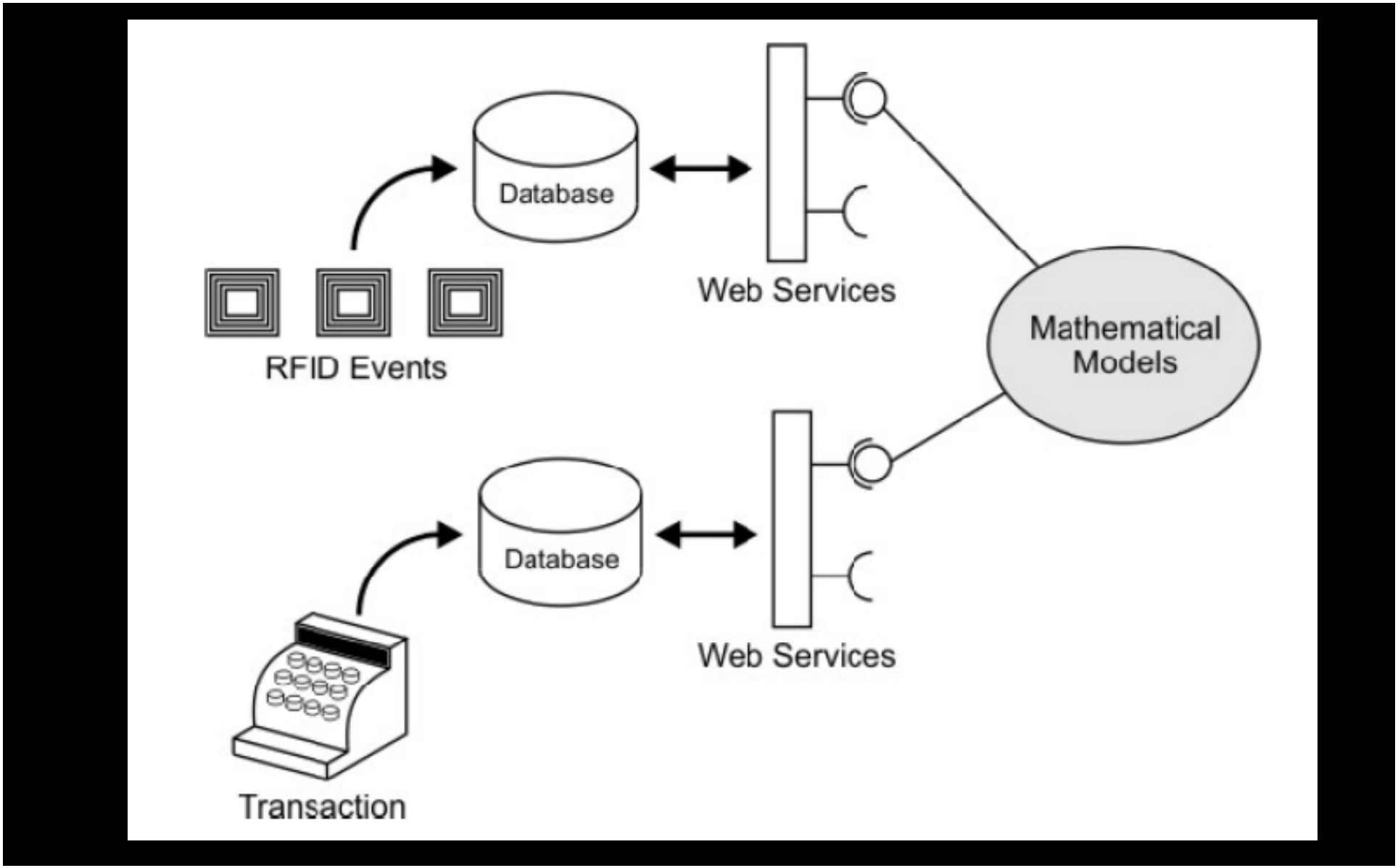
Changes in the Supply Chain

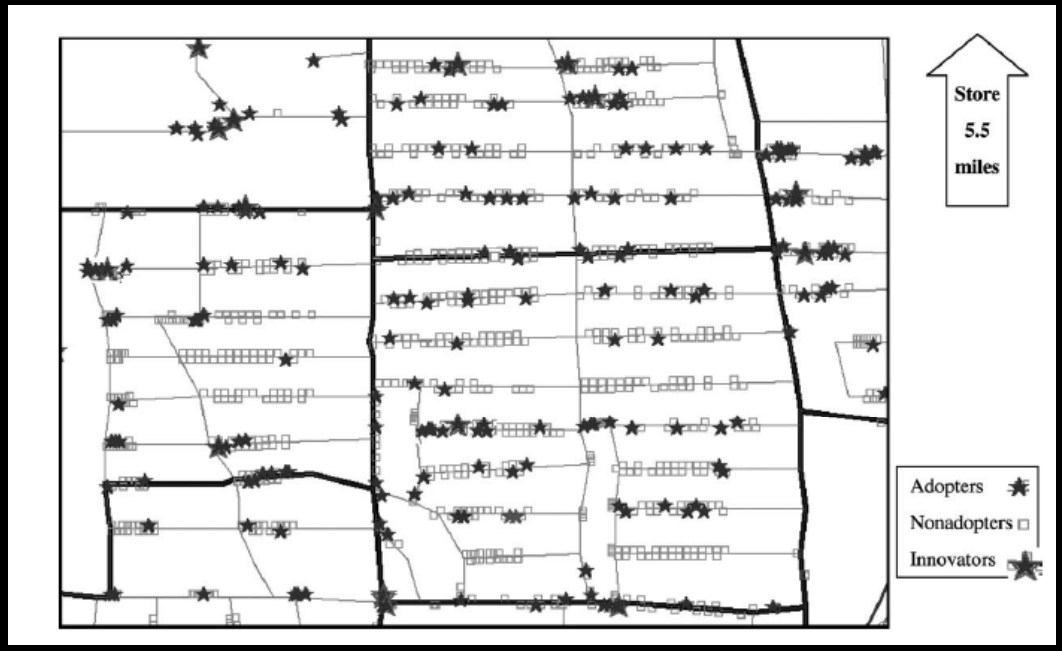
- Orientation 1 – Power to Retailer
  - Consumer has the ability to compare across brands at point of sale
- Orientation 2 – Power to Manufacturer
  - Control information flow about a brand
- Orientation 3 – Marketing Research Tool
  - Gain store level data on customer behavior

Marketing Spatial Diffusion

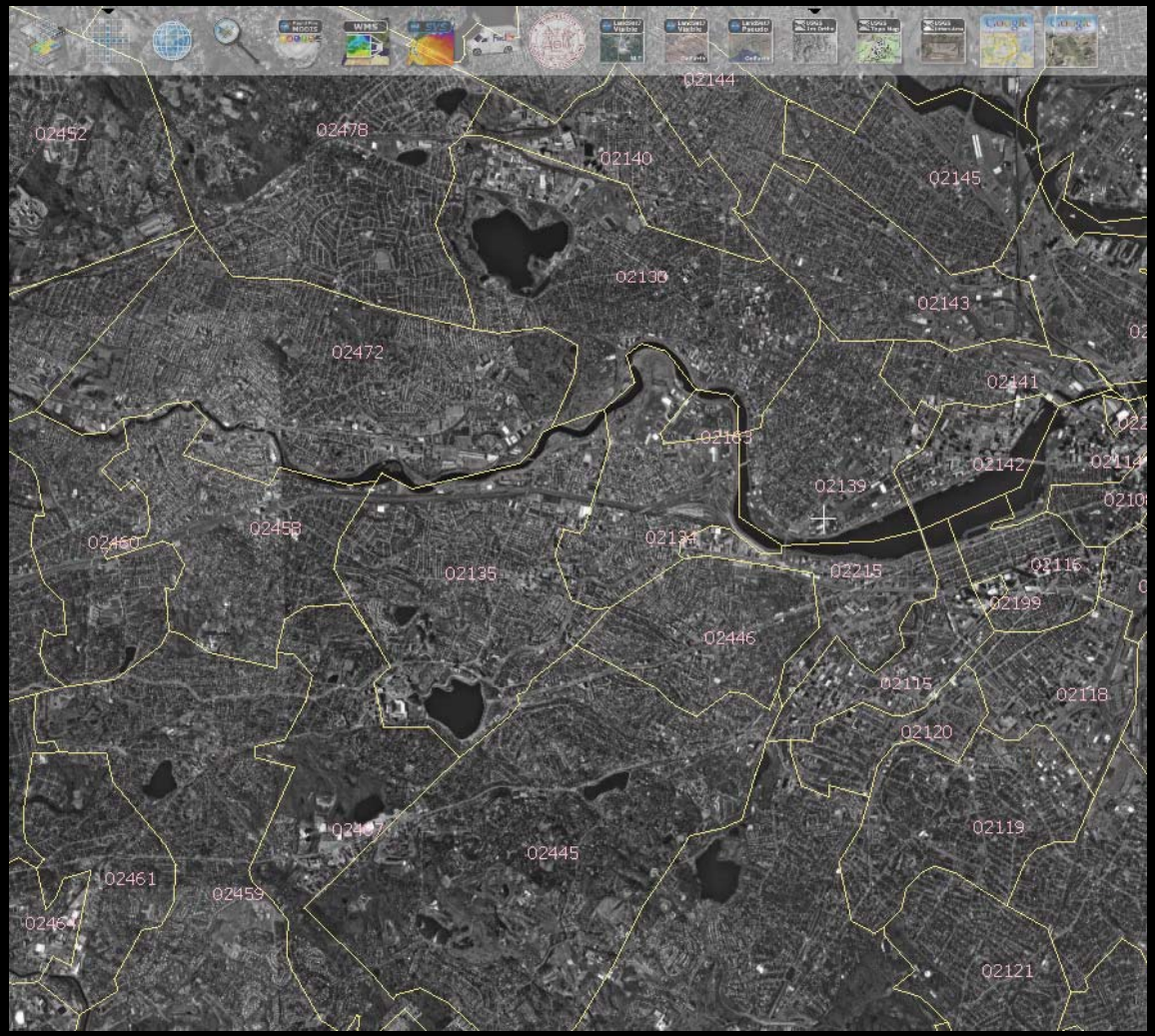


Garber, Tal, Jacob Goldenberg, Barak Libai, and Eitan Muller (2004), "From Density to Destiny: Using Spatial Dimension of Sales Data for Early Prediction of New Product Success," *Marketing Science*, Vol. 23, No. 3, pp. 419-428.


Database
Web Services
RFID Events
Mathematical Models
Database
Web Services
Transaction



Allaway, Arthur W., David Berkowitz and Giles D'Souza (2003), "Spatial Diffusion of a New Loyalty Program Through a Retail Market," *Journal of Retailing*, Vol. 79, pp 137 – 151.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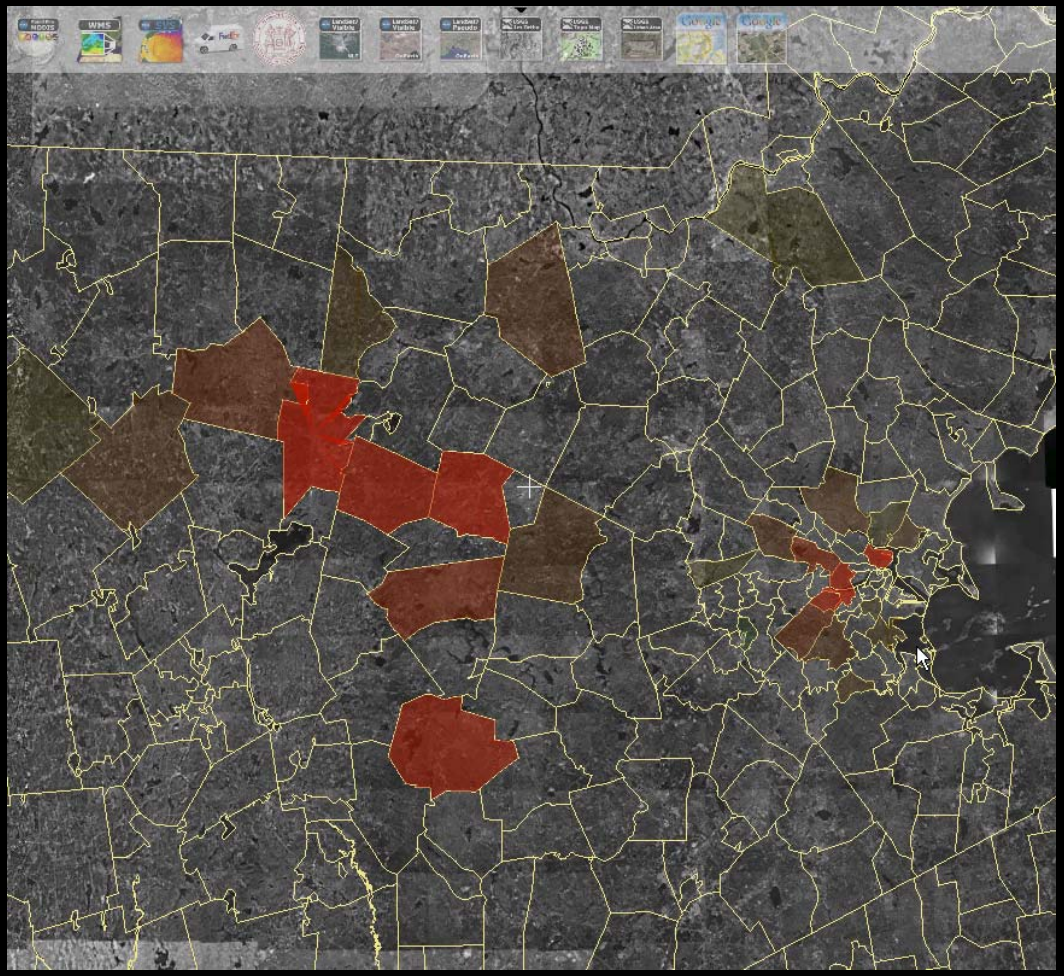
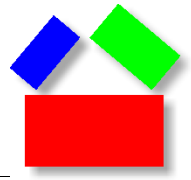




IMPLEMENTATION

- You can use the M Language now!
- We are refining the Dictionary, Browser, and Rules
- Distributed dictionary approach
- Controlled “wiki” process
- Industry leaders of the MIT Data Center Program drive use and control future direction

M Language – Manufacturing and SCM

1. Building an intelligent network that links **models to data** (Alternative to ERP)

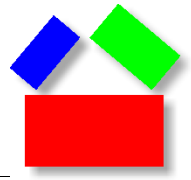
2. Translating data at the **edge** of computing systems (Data integration in supply chains)

3. Internet Search tool that uses the **definition** of the word (common understanding within MFG. organizations)

4. Various forms of **visualization** of data through a tangible user interface

M Language – Application Goals (continued)

5. A Standard for **Spatial** Data (impact of weather on logistical systems)
6. **Data Aggregation** (tech. manuals, maint. records)
7. **Human** Language Translation (SCM documents)
8. A standard for **sensors** (capital equipment)
9. A standard for **location** (general supply chain)
10. Improve data **quality** (general supply chain)



www.mitdatacenter.org