



THING 5 UPDATE

2013 04 08

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Institute for Modern Intelligence
& Mission Focus



MOVE IT FORWARD. MAKE IT HAPPEN.



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- **THING 5 HERITAGE**
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- CURRENT CAPABILITIES**
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BOLD VISION WICKED BARRIERS

As long as we have the courage to
“**let the data surprise us,**”

I am convinced our analysts will lead to new discoveries—and not only by NGA.
We will **enrich the analysis of others,**
especially the analysis performed by the **all source analyst.**

Letitia Long, Director, NGA



NATIONAL GEOSPATIAL-INTELLIGENCE AGENCY
Know the Earth... Show the Way... Understand the World

NGA Has a *Bold* Vision

Putting the Power of GEOINT in Your Hands



NGA Strategy

Provide online,
on-demand access
to our GEOINT
knowledge

Broaden and deepen
our analytic
expertise to produce
new value

“We will continue to deliver to our varied customer set what they need, when they need it, how they need it. But we have to be thinking about the future. We have to be continually pushing ourselves so that we do remain at the forefront.”

— Letitia A. Long, Director, NGA

Approved for Public Release – NGA Case #13-153

BARRIERS

- The Data Problem
- The Processing Problem
- The Network Effect Problem

THING 5

BREAKS THE BARRIERS



KNOW THE EARTH

MEANS KNOWING WHAT IS - The Physical & the Human terrain

FOUNDATION DATA - From imagery to custom / thematic maps

- Representing our human reality
- Telling the story of the earth and the dynamic things, natural and man-made, that operate upon it
- Foundation for analytic discourse

MAKING & MANAGING FOUNDATION DATA - Core to NGA's core domain

- Ravenous and impatient data consumer
- Starving and languishing amidst troves of data, information, and knowledge
- Something is wrong

THE DATA PROBLEM - Diversity, ambiguity, scale

- How meaning is represented - knowledge representation and semiotics
- Domain models and schemas built into every information system
- Not just more data, profoundly different - really, Really Big Data
- Inability to access, understand, manage and use our data assets as a coherent whole

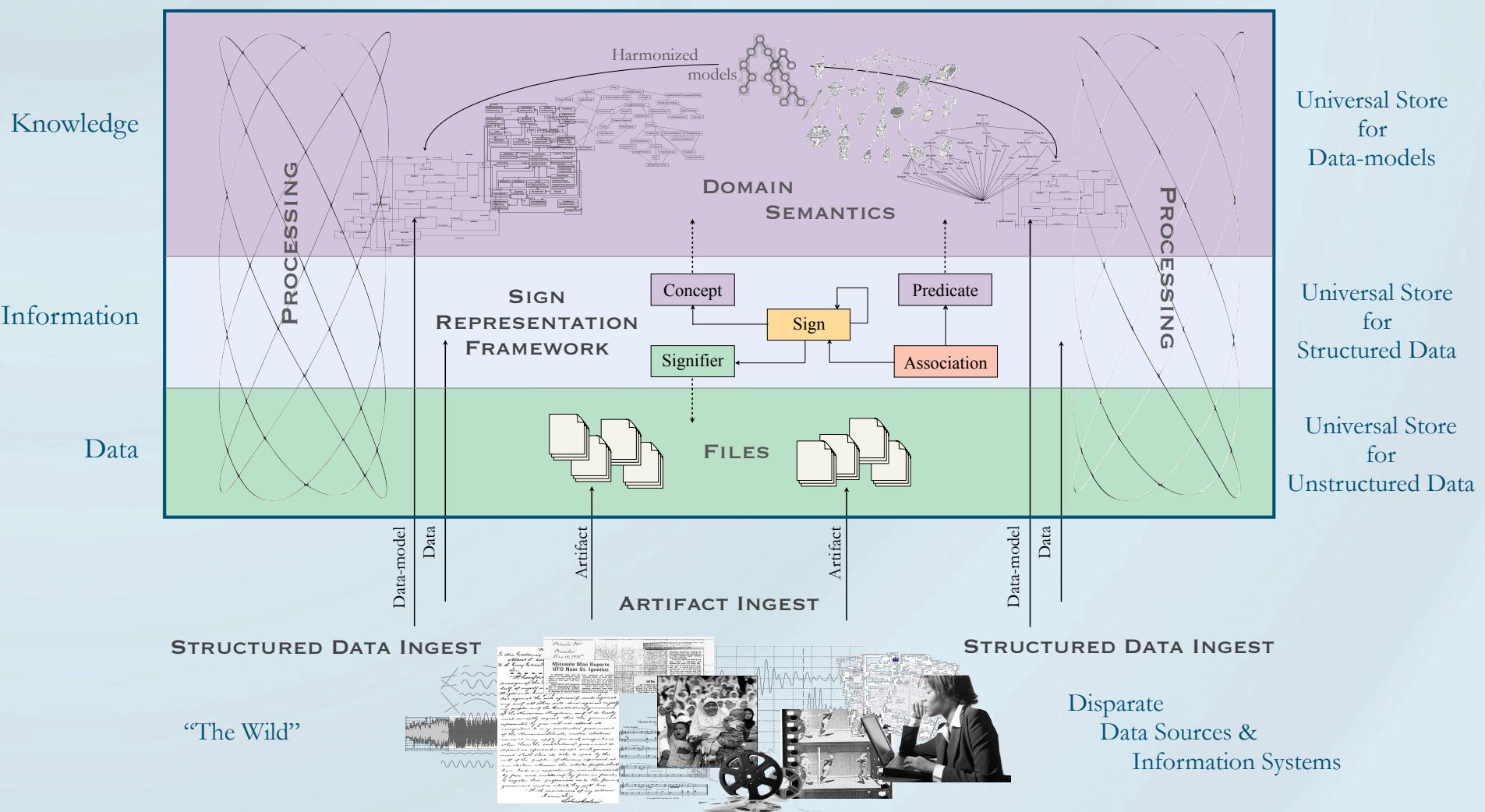
THING 5

- Accommodates diversity, reduces ambiguity, and handles scale
- Access, understand, manage and use our data assets as a coherent whole
- Feed the production chain with rich, diverse information
- Custom / thematic maps as linked data using information from any source



THING 5

A **semiotic** compute & storage apparatus,
built on an open-source **cloud** technology stack,
for the **storage** and **processing** of diverse data at scale





SHOW THE WAY

MEANS NAVIGATING THAT TERRAIN SAFELY

- ❑ Tactical level of capability that a local understanding enables

ANALYTICS

- ❑ Modeling, simulation, what-if analyses, ...
- ❑ Operationalizing the data
- ❑ Conduct of analytic discourse, a man-machine partnership

MAKING & USING ANALYTICS - Essential to NGA's core domain

- ❑ Scattered across programs and organizations
- ❑ Competing for resources and saddled with overhead
- ❑ Something is wrong

THE PROCESSING PROBLEM - The pipeline model

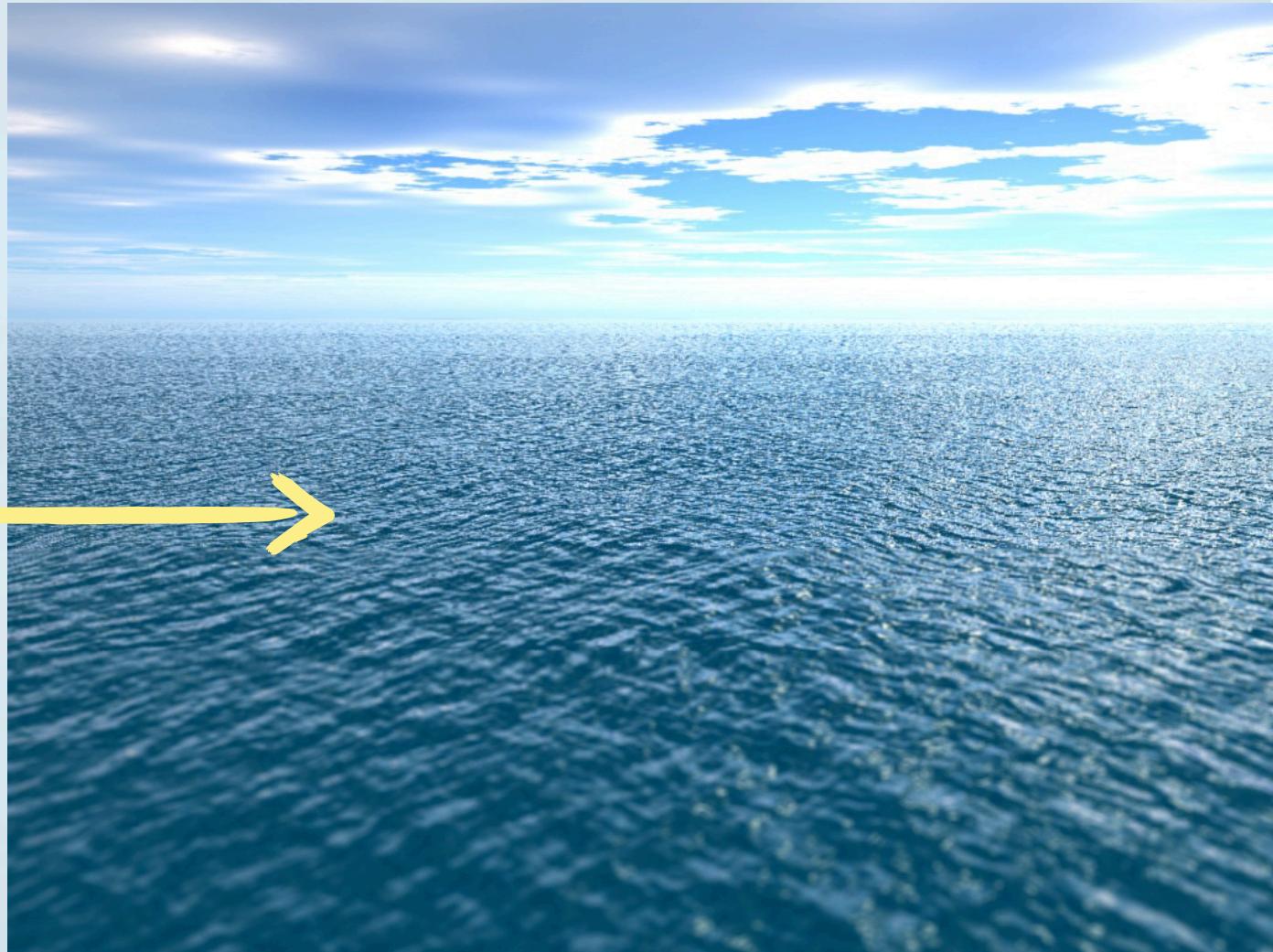
- ❑ Data flowing between processes
- ❑ Data and processing assets are different at every point in the enterprise
- ❑ Bandwidth-limited & complex
- ❑ Inability to leverage, understand, manage and apply our analytic assets as a coherent whole

THING 5

- ❑ Replaces the pipeline model with a wave model - analytic waves over data at rest
- ❑ Leverage, understand, manage and apply our analytic assets as a coherent whole
- ❑ All analytics access and enrich a shared ocean of data, information, knowledge
- ❑ Simple, robust, efficient, powerful, creative



PIPELINES TO WAVES





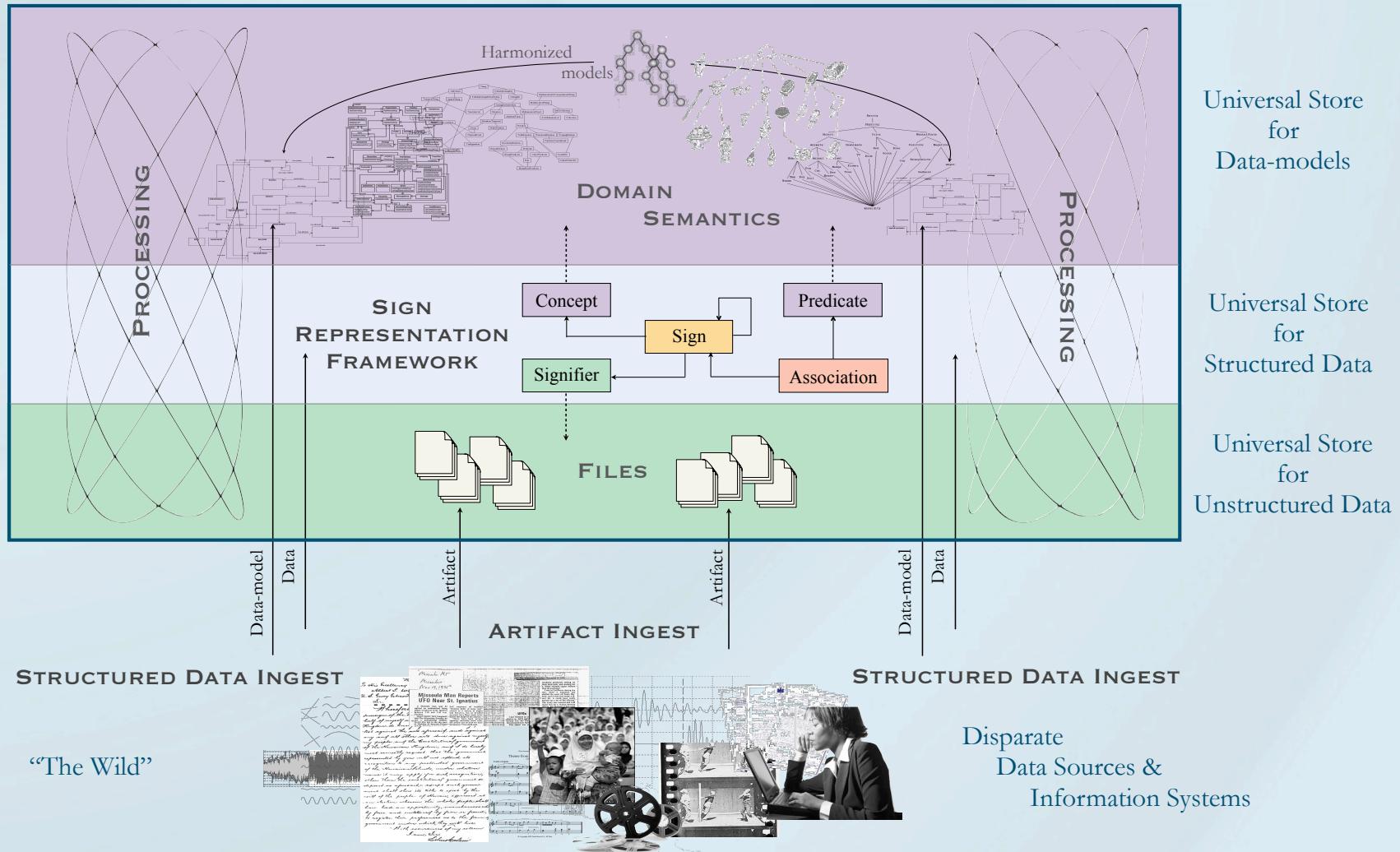
THING 5

A **semiotic** compute & storage apparatus,
built on an open-source **cloud** technology stack,
for the **storage** and **processing** of diverse data at scale

Knowledge

Information

Data





UNDERSTAND THE WORLD

MEANS KNOWING WHAT IT ALL MEANS

- A strategic level of capability that a global understanding enables

INTERCONNECTED DATA - Interconnectedness at all scales

- Putting the pieces together - a living web of information
- Sharpening the saw - adjusting data and analytic assets in anticipation
- Product of analytic discourse

MAKING & USING INTERCONNECTED DATA - Essential to NGA's core domain

- Shared objective across the IC
- Struggling despite troves of data, information, knowledge, and analytics
- Something is wrong

THE NETWORK EFFECT PROBLEM

- Not compounding (each contribution increases the value of the whole and vice versa)
- No feedback mechanism whereby output (product) enriches the input
- Inability to fully benefit from achievements and function strategically

THING 5

- A rich, living web of information naturally emerges
- Each contribution increases the value of the whole and vice versa
- Products are an enrichment of the web
- Fully implement Structured Observation Management
- Achieve and apply new levels of understanding to achieve mission objectives and make NGA better



SPACE & TIME

SPACE & TIME

- ❑ The physics that makes NGA and Thing 5 special
- ❑ The bedrock of the IC
- ❑ The unifying threads throughout our data

THING 5 CORE

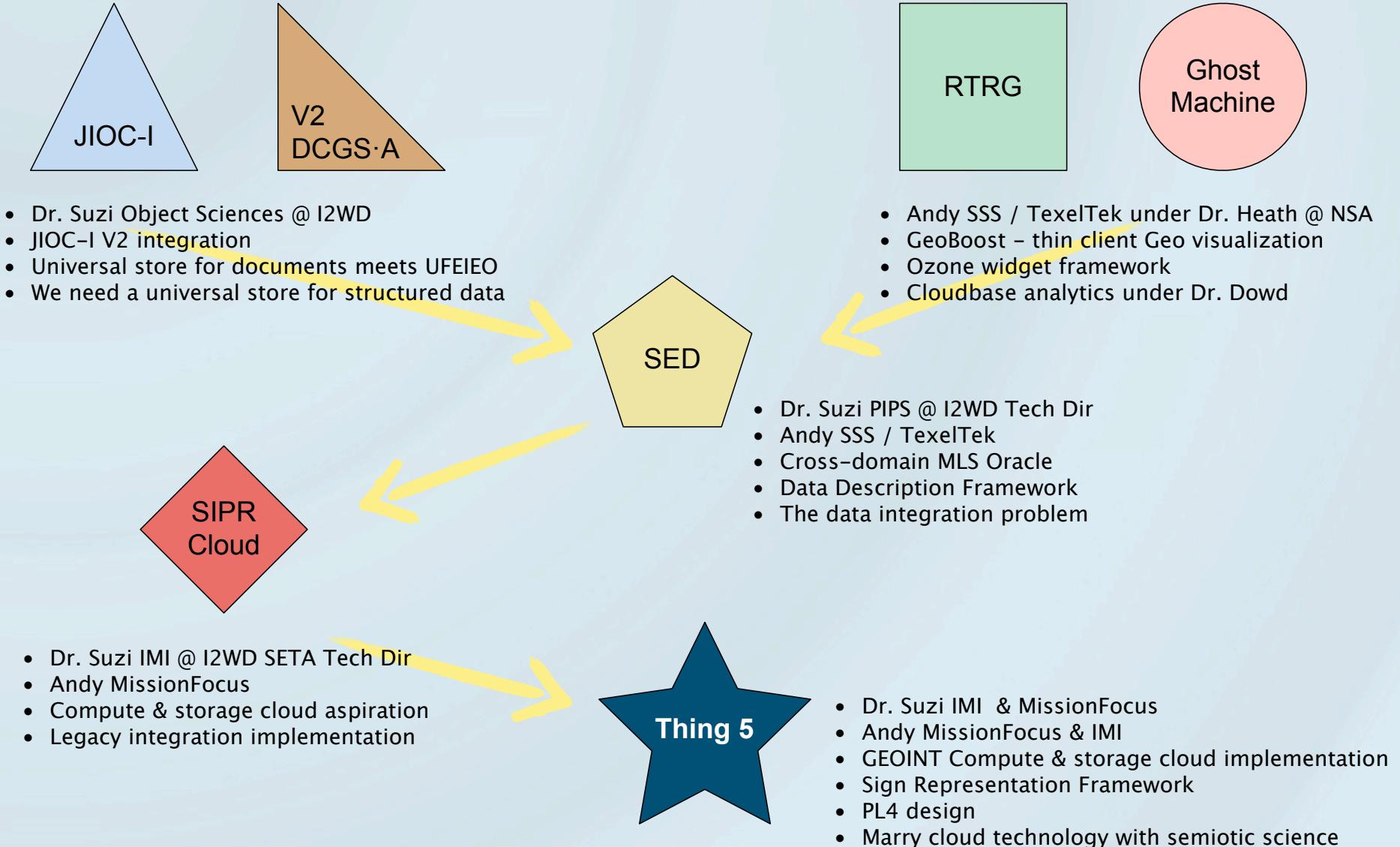
- ❑ Semantic disambiguation
 - Binding of a element of **data** (the signifier) to a **concept** (the signified)
 - Forms a Sign - the atom of semantics in Thing 5
 - e.g. [systover@imintel.org, Sender]
- ❑ Geospatial disambiguation
 - A Sign that also has a **geometry** (representing geospatial coordinates) e.g. [Nile, River, 30°10'N 031°06'E]
 - Isomorphic to a GIS feature
 - Applies to associations as well
- ❑ Temporal disambiguation
 - A sign that also has a **period** (representing temporal coordinates) e.g. [Wall Street bombing, Terrorist Act, 19200916]
 - Isomorphic to an event
 - Applies to associations as well

POWER

- ❑ Native GEOINT support
- ❑ Ideal platform for ABI
- ❑ Search, explore, discover, enrich, manage, exploit these unifying threads throughout our data
- ❑ IC solution for GEOINT storage and processing



THING 5 HERITAGE



BATTLE SCARRED AND A WHOLE LOT SMARTER



Scale changes everything

Our universe of data & processing is an Ultra-Large Scale system

Walk with your head in the clouds
and your feet in the dirt

New science waits to be discovered

Everything changes when you
deploy to a production
environment

Simple is hard

The ground state of
data is not a pure
crystalline form

Diversity gives Intel its richness

Everything changes when
you start writing the code

Every system should
have the ability to
export its data

There's More

Our data & processing assets
belong to the nation
(not the system or the contractor)

In_all_of_it_Together
Than we are getting or
could possibly get out of
All of the Parts



Be happy, write code!

What you don't have
in your head, you gotta
have in your feet

Godspeed

The sink is not a
repository for dirty dishes

Don't sell yourself short (the rest of the world will do it for you soon enough)



APPENDIX



MOVE IT FORWARD. MAKE IT HAPPEN.

CURRENT CAPABILITIES



MOVE IT FORWARD. MAKE IT HAPPEN.

CAPABILITIES - DATA

■ INGEST

- ALL UNSTRUCTURED / SEMI-STRUCTURED FILE TYPES
 - E.G. NITF, MP2TS (VIDEO), EMAIL, IRC, XLS, PPT, DOC ...
- ENDPOINT TYPES: FILE SYSTEM, JMS TOPIC / QUEUE, (S)FTP,
- MULTI-CAST / UNI-CAST STREAM
- STRUCTURED DATA & ASSOCIATED DATA MODELS
 - SHAPE FILES
 - DATA MODELS EXPRESSED IN OWL

■ ASSERT, RETRIEVE, DELETE, EXISTS, TALLY

- ARTIFACTS OF ANY TYPE AND MODALITY
- SIGNS & ASSOCIATIONS
- DOMAIN MODELS
- SYSTEM ACTORS
- PROCESS ELEMENTS

■ INDEX

- TEXT INDEX: ARTIFACTS, SIGNS, CONCEPTS
- SIGN INDEX: SIGNIFIER, CONCEPT
- GEOSPATIAL INDEX: SIGNS & ASSOCIATIONS
- TEMPORAL INDEX: SIGNS & ASSOCIATIONS

■ QUERY

- TEXT
- SEMANTIC (SIGNIFIER, CONCEPT)
- GEOSPATIAL
- TEMPORAL



CAPABILITIES - PROCESS

- PROCESS WAVES INFRASTRUCTURE
- SEMAPP MAP-REDUCE PROCESS FRAMEWORK
- PARALLEL PROCESSES

- PARSE > 36 DOCUMENT, AUDIO, VIDEO, & IMAGE FILE TYPES
- EXTRACT & EXPOSE PLACE NAMES FROM ARTIFACT TEXT
- VERIFY NITF STANDARD COMPLIANCE
- EXTRACT & EXPOSE SEMANTIC ELEMENTS FROM EMAIL, NITF, IRC, & MP2TS
- EXTRACT & EXPOSE NITF IMAGE THUMBNAILS
- EXTRACT & EXPOSE NITF IMAGES AS ARTIFACTS
- EXTRACT & APPLY SECURITY MARKINGS FROM NITF & MP2TS
- EXTRACT & EXPOSE VIDEO COLLECTION FOOTPRINT FROM MP2TS, KML FLY-OVER DISPLAY
- EXTRACT & EXPOSE EMAIL ATTACHMENTS AS ARTIFACTS
- FIND SHORTEST PATH BETWEEN 2 SEMANTIC ELEMENTS
- EXTRACT & EXPOSE SHAPE-FILE FEATURES AND ATTRIBUTES
- GATHER INTERNAL ARTIFACT STATISTICS
- INDEX INTEGRITY





PROCESS WAVES

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■ PROCESS WAVES AND THEIR DEPENDENCIES

- ARTIFACT INGEST WORKS THE SAME REGARDLESS OF THE FILE TYPE
- PROCESSES TEND TO FORM CHAINS AROUND A **FILE STANDARD** (E.G NITF)
- * ⇒ UNIFIED PROCESS
 - DESIGNED TO ACCOMMODATE ALL FILE STANDARDS
 - DYNAMICALLY SELECTS AN ENGINE APPROPRIATE TO THE STANDARD

Ingest*	NITF	Marking Extraction	Ruminate*	Digest*
			Image Extraction	
			Proofer	
			Text Index*	
	email	Ruminate*	Text Index	
			Digest*	
	Chat	Ruminate*	Text Index	
			Digest	
MP2TS	MP2TS	Marking Extraction	Ruminate*	Digest*
				Footprint Extraction
	Shape	Digest*		
	all-parsables	Text Index*		
...	...	Artifact Statistics		
		Index Integrity		

CAPABILITIES - APPLICATION

■ USER APPLICATIONS

- SEARCH - SURF WEB APPLICATION

■ PRIVILEGED USER APPLICATIONS

■ PROCESS MANAGER

- SCHEDULE AND EXECUTE PROCESSES
- BROWSE PROCESS ISSUES

■ SYSTEM ACTOR MANAGER

- BROWSE & MANAGE ENTITIES KNOWN TO THE SYSTEM

■ UNIFIED INGEST

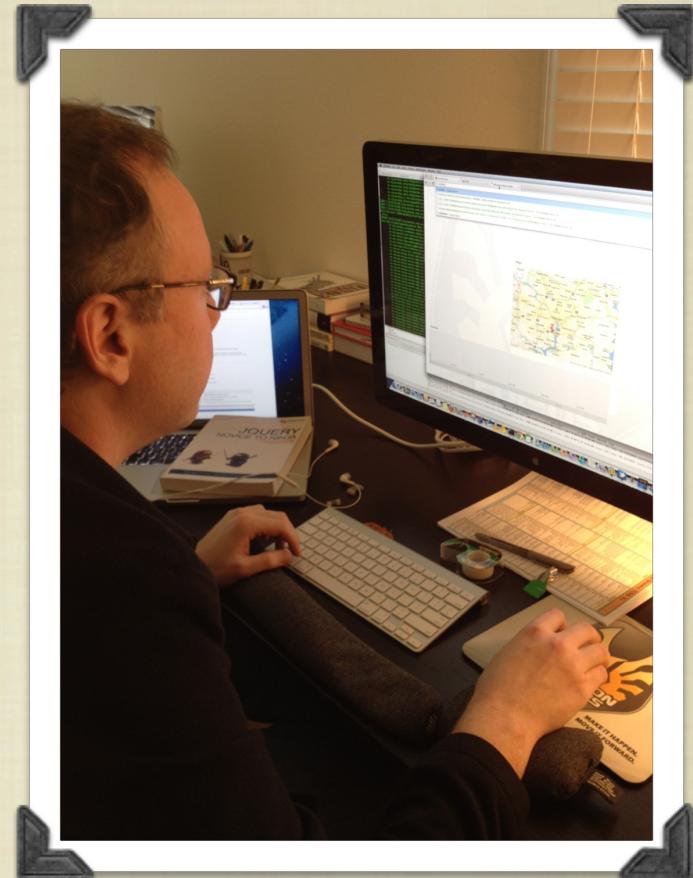
- CONFIGURE AND EXECUTE ARTIFACT INGEST
- SPECIFY OUT-OF-BAND METADATA

■ API

- SEMAPP MAP/REDUCE FRAMEWORK
- RESTFUL DATA & QUERY WEB SERVICES
- KML EXPORT

■ DOCUMENTATION

- DEPLOYMENT GUIDE, MANAGEMENT GUIDE, REST API





SEARCH UI

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Text Search:

Text:

Search Examples

Will Return any data space element or artifact entailing this text.
Example: Suzi, Andy, Car

Semantic Search:

Text:

Concept:

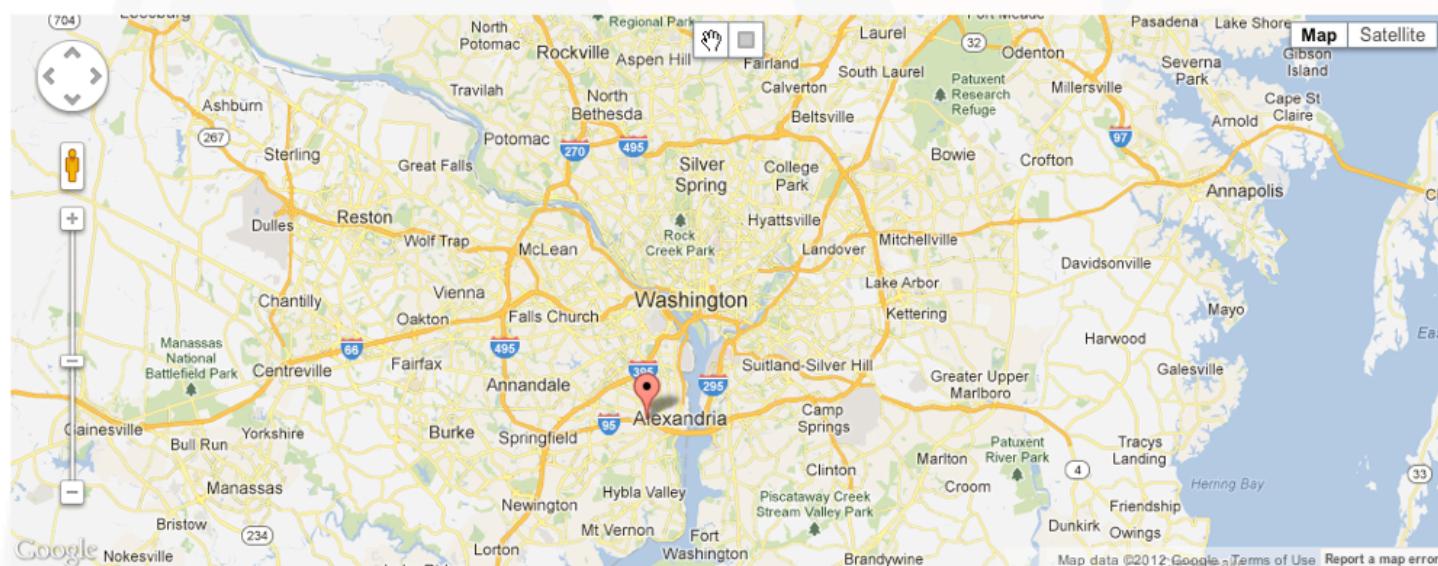
Search Examples

Will Return symantic elements that contain the following text in the sign. Example: Suzi, Andy, Artifact

Will Return symantic elements that contain the following concept.
Example: Email, Sender, Receiver

Visual Search:

Select an area to Search



Temporal Search:

From to

RESULTS PAGE

■ LIST OF RESULTS

■ WEB OF INFORMATION

■ IMAGE THUMBNAILS

■ MAP DISPLAY

■ COLLECTION FOOTPRINTS

■ TIMELINE DISPLAY

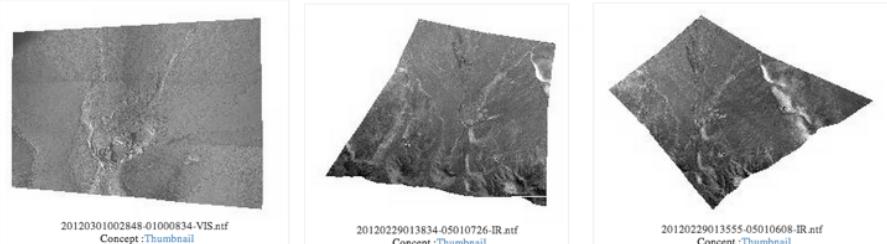
Associations

```

Terms
geometry
Concept : Collection Footprint
Perceivers : FootprintCreator
has Collection Footprint : clip_20120306_193042_967_SEDO.jpg
geometry
Concept : Collection Footprint
Perceivers : FootprintCreator
has Collection Footprint : udpcapture-1330976294561_IR.jpg
390e872d-7358-4546-b523-5e848f0b33
Concept : Image
Perceivers : NITFDigestBean
assoc Image Category : IR
assoc Image Date and Time : 20120229014003
assoc Image Geographic Location : +35.600-117.831+35.600-117.744+35.523-117.744+35.523-117.831
assoc Image Identifier 1 : AF_IR.JPG
assoc Image Identifier 2 : Default Image Identifier2
assoc Image Source : AngelFire IR Sensor
geometry
Concept : Collection Footprint
Perceivers : FootprintCreator
has Collection Footprint : udpcapture-1331062280768_HD.jpg
geometry
Concept : Collection Footprint
Perceivers : FootprintCreator
has Collection Footprint : clip_20120229_204037_880_UsableData_SCAN_EAGLE.jpg
geometry
Concept : Collection Footprint
Perceivers : FootprintCreator
has Collection Footprint : udpcapture-1330978103845_SEDO.jpg
4844339c-3c25-445a-8a52-f260c071b14b
Concept : Image
Perceivers : NITFDigestBean
assoc Image Category : IR
assoc Image Date and Time : 20120229013810
assoc Image Geographic Location : +35.617-117.861+35.617-117.744+35.504-117.734+35.504-117.861
assoc Image Identifier 1 : AF_IR.JPG
assoc Image Identifier 2 : Default Image Identifier2
assoc Image Source : AngelFire IR Sensor
geometry
Concept : Collection Footprint
Perceivers : FootprintCreator
has Collection Footprint : udpcapture-1331149334173_BlueDevil HD.jpg
Concept : Collection Footprint
Perceivers : FootprintCreator
has Collection Footprint : udpcapture-1331149334173_BlueDevil HD.jpg

```

Imagery



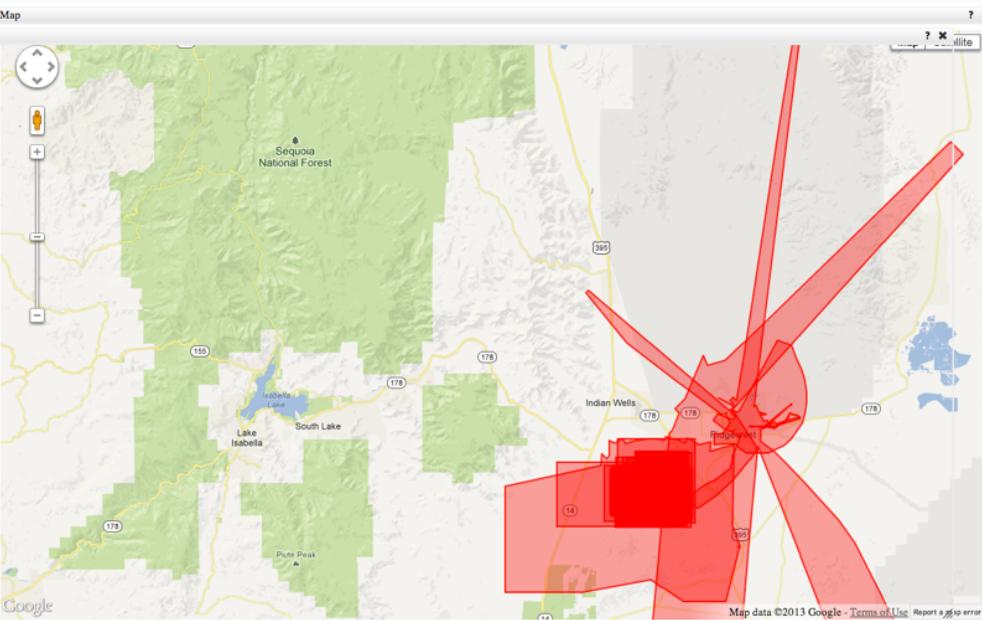
20120301002848-01000834-VIS.tif
Concept :Thumbnail

20120229013834-05010726-IR.tif
Concept :Thumbnail

20120229013555-05010608-IR.tif
Concept :Thumbnail

20120301002848-01000834-VIS.tif
Concept :Thumbnail

Map



Map data ©2013 Google - Terms of Use Report a Map Problem

Timeline

Date	Footprint ID
Feb 29	af9b84-a1c5-4a7-a115-b3863abef6d
Mar 1	21e037-de01-45b8-83f1-24672841dfb
Mar 1	w5b344c-7720-4ac0-8141-6d2fa4d9c048
Mar 1	e1698cb8-d664-4026-b571-e2328842d723
Mar 1	01faef2f-9f99-455b-9485-0265a60020ef
Mar 1	c1c2c2b-3274-43b4-b5c2-2d1ad28822ba
Mar 1	2930f133-45e0-46b5-81e7-062fb6ea3960
Mar 1	d163aae-879c-44cf-8dfe-533a0f3bb464
Mar 1	2f60d6bc-8d1e-40f3-9c3-bbb6b3ac949d
Mar 1	714445b1-2fca-43b6-9146-9a8d8e3aa5e
Mar 1	9103340d-e9d0-4d3a-9e6d-047453e3a365
Mar 1	8740a9e5-d5d5-4bdc-81e2-ac0e8a4a95d
Mar 1	e2550562-197a-4edc-8d01-cff0f1d4d758
Mar 1	dec9d34e-d998-415d-436d-18ae9a20202e
Mar 1	af6d9457-53e4-45f1-9e99-3d3e32e00045
Mar 1	10e872d-7358-4546-b523-5e8841
Mar 2	0729401-38f8-4e9-8516-bf7ef0557

Timeline

Timeline of Events

2012



SHAPEFILE FEATURES

MOVE IT FORWARD. MAKE IT HAPPEN.

Map

Sign : Woodside Dr
Concept : Road Name
Perceivers : ShapeDigest.district_of_columbia_highway.decoder
assoc Number of Lanes : *****
assoc ONEWAY :
assoc Road Type : residential
Geometry : LINESTRING (-77.248761 38.948948, -77.248743 38.948914, -77.248699 38.9488709, -77.24864 38.948846, -77.248213 38.9487669, -77.247743 38.948681, -77.247252 38.948586, -77.247078 38.94854, -77.246903 38.948483, -77.246809 38.948437, -77.24672 38.948376, -77.246648 38.9482969, -77.246574 38.948199, -77.246516 38.948029, -77.246457 38.947978, -77.246378 38.947856, -77.246267 38.947717, -77.246167 38.9476159, -77.246095 38.947556, -77.246005 38.947503, -77.245911 38.947458, -77.24579 38.9474189, -77.245361 38.9472639, -77.245239 38.94721, -77.245081 38.947108, -77.244988 38.947023, -77.244926 38.946947, -77.244915 38.946929, -77.244878 38.946838, -77.2448579 38.946719, -77.244849 38.946621, -77.244848 38.946378, -77.244817 38.944926)

Map | Satellite

Get Current Map Results as KML
View Current Map Results in Google Earth
Get Current Map Results as KMZ

Map data ©2013 Google - [Terms of Use](#) [Report a map error](#)

Get All Search Results as KML
View All Search Results in Google Earth
Get All Search Results as KMZ

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CAPABILITIES - OTHER

MOVE IT FORWARD. MAKE IT HAPPEN.

■ MONITORING & METERING

- PERSIST LOG MESSAGES IN THE SIGN-SPACE
- MONITOR & METER
 - DISK & CPU UTILIZATION ACROSS THE CLUSTER
 - HADOOP & ACCUMULO SW INFRASTRUCTURE
 - SEMAPP CORE METHODS AND SERVICES
 - INGEST MESSAGE TRANSFERS



■ SECURITY

- DATA CLASSIFICATION PERSISTED AT THE CELL-LEVEL
- RELEASABILITY DETERMINED BY USER CREDENTIALS & DATA CLASSIFICATION
- APPLICATIONS USER AUTHENTICATION & AUTHORIZATION
- ENGINEERED FOR PL4

■ CONTINUOUS INTEGRATION

- UNIT TESTS (AS RESULTS FROM TEST DRIVEN DEVELOPMENT)
- TEST FRAMEWORK - SET SIGN-SPACE STATE, MANAGE TEST SUITES
- MAVEN BUILD & DEPENDENCY MANAGEMENT
- GIT CODE & ARTIFACT REPOSITORIES
- JENKINS AUTOMATED BUILD, QUALITY CHECKS, & REGRESSION TEST
- AMBIENT VISUALIZATION OF BUILD & TEST STATUS

■ DEPLOYMENT - INSTALL, CONFIG, TEST ON PRODUCTION HARDWARE

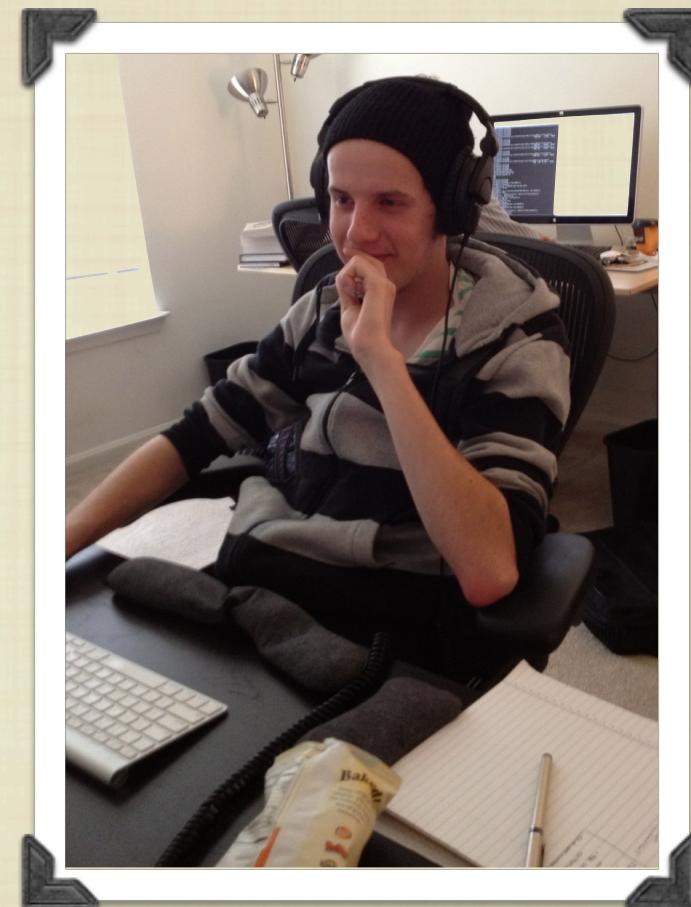
- SEMAPP KICKSTART
 - RHEL + PACKAGES INSTALL (STIG'D)
 - DISK PARTITIONING
 - NIC BONDING
- PROCEDURES FOR NTP CONFIG, CLOUD INFRASTRUCTURE AND SEMAPP SOFTWARE DEPLOY
- TEST PROCEDURES FOR CONFIGURATION AND CORE FUNCTIONALITY
- PASSED AREA 59 FAT



TEST DATA

COLLECTED FROM THESE SOURCES

- ALOE 1 & 2
 - IMAGERY, VIDEO, WAMI, CHAT
- BLUE DEVIL ONLINE ARCHIVE
 - IMAGERY, VIDEO
- MICHELSON LAB ARCHIVES, CHINA LAKE
 - VARIOUS
- OPEN SOURCE
 - GovTRACK
 - TWITTER
 - WIKIPEDIA
 - FEDERAL CONTRACT SPENDING
 - AUDIO METADATA
 - US PATENTS
 - PROJECT GUTENBERG
 - OPEN SECRETS
- SAIC GSTI
 - LIDAR



OUTLOOK



MOVE IT FORWARD. MAKE IT HAPPEN.



MORE To Do

- **ASSERT, RETRIEVE, DELETE, EXISTS, TALLY**
 - GEOMETRY EXTENSIONS
 - MODEL EXPORT
 - PURGATORY
 - SIGNS WITH INTERNAL STRUCTURE
 - SIGNS WITH MULTIPLE GEOMETRIES
- **API**
 - VIDEO PLAYBACK
 - TESTING
- **APPLICATIONS**
 - DATA SA
 - SIGN-SPACE NOTEBOOK
 - INGEST LOCAL ARTIFACTS
 - OPERATORS CONSOLE
 - PROCESS REGISTRATION
 - USER ASSERT SIGNS, ASSOCIATIONS, CONCEPTS, PREDICATES
 - USER SELF-REGISTRATION
 - FOUNDATION BUILDER
 - ...AND MANY MORE!
- **CAPACITY & STABILITY**
 - LOAD BALANCING
 - M/R SCHEDULING
 - CACHING
- **DEPLOYMENT ACTIVITIES**
 - DEPLOYMENT READINESS
 - SITE INTEGRATION
 - IA
 - THEATER SUPPORT
- **DOCUMENTATION**
 - APPLICATION USER GUIDES
 - DATA ARCHITECTURE GUIDE
 - DEVELOPER'S GUIDE
 - MANAGEMENT GUIDE
 - OPERATOR'S GUIDE
 - PROCESS DOCUMENTATION
 - TRAINING MATERIALS
- **INDEX**
 - PROCESS WAVE DECOUPLED FROM INGEST
 - ASSOCIATIONS BY PREDICATE
- **INGEST**
 - RDB
- **INTEGRATION**
 - BULK IMPORT / EXPORT
 - JPIP
 - NVS-ABI
 - VIRGO
- **M&M**
 - PROCESS PERFORMANCE
 - QUERY PERFORMANCE
- **MODEL SERVICES**
 - QUERY BROADEN / NARROW
 - SAMEAS HANDLING
- **PROCESS**
 - NLP ANALYTICS
 - UNIFIED GEOSPATIAL EXTRACTOR
 - FILE TYPE DETERMINATION
 - REASONING ENGINES
- **QUERY**
 - BOOLEAN EXTENSIONS

MOVE IT FORWARD. MAKE IT HAPPEN.

R 0.15 - R 0.21 Schedule

	Jan-Feb 2013	Mar-Apr 2013	May-Jun 2013	Jul-Aug 2013	Sept-Oct 2013	Nov-Dec 2013	Jan-Feb 2014
Core Services & Processes	R 0.15	Now R 0.16	R 0.17	R 0.18	R 0.19	R 0.20	R 0.21
	Gazetteer NVS Integration Shape File Index decoupling	ABI Integration Virgo Integration Index associations OWL expressiveness	Bulk Export Model Export RDB Ingest	SameAs Handling Query Bool Ext	Query Broaden Query Narrow Search Engine	Named Entity JPIP	User Messaging Automated Reasoning
Applications	Web app security Data Mgmt Process Mgmt	Operator Console	User Assert User Ingest	SemApp Notebook Data SA	ABI	Search Engine User SA	Process Reg Mission Scrum
Test & IA	Performance Testing	Interface Testing	Theater Smoke Test Regression Testing IA Scan	Regression Testing Theater ATO	Regression Testing	Regression Testing	Regression Testing
Deployment & O&M	Deployment prep		China Lake Update	Theater Deploy Site Integration	Theater Support Config & SW Update New Feature Deploy	Theater Support Config & SW Update New Feature Deploy	Theater Support Config & SW Update New Feature Deploy
Documentation & Training	Operator's Guide Management Guide Process Docs REST API Doc	ConOps	Data Arch Guide Priv User App Guides Search-Surf Guide	Operator Training Manager Training User Assert Guide User Ingest Guide	User Training Developers Guide Notebook Guide Data SA Guide	Developer Training Training (as needed) ABI Guide	Training (as needed) User SA Guide Mission Scrum Guide
Completed In progress Slow / Blocked							



BACKUP

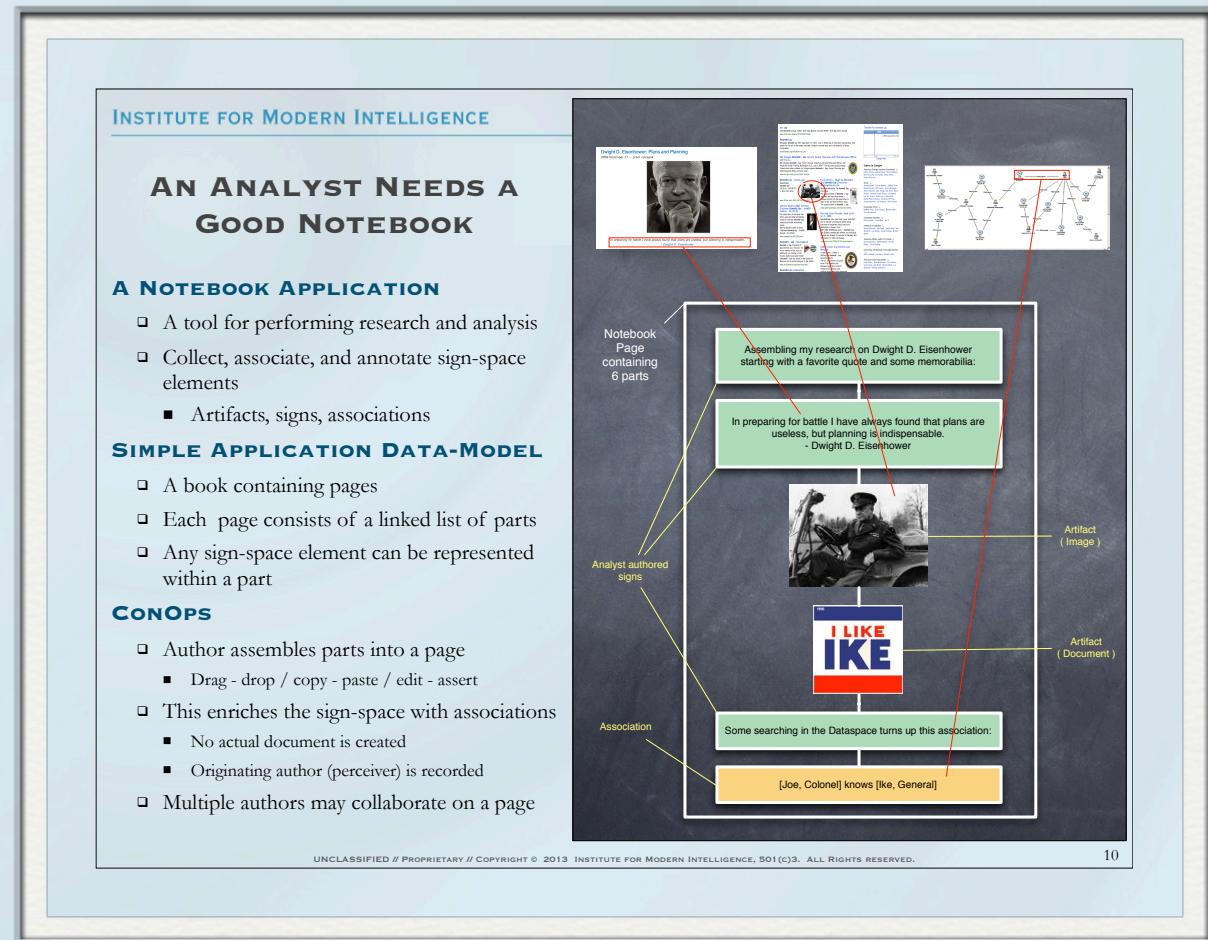


MOVE IT FORWARD. MAKE IT HAPPEN.



PRODUCTS AS INTERCONNECTED DATA

- ❑ A product consists of
 - Selected elements of information (signs and associations)
 - Linked together (associations)
 - Displayed by an application to suit a particular purpose
- ❑ Examples
 - Notebook
 - Thematic map
 - Social network
 - Geospatial track
- ❑ Information elements can appear in any number of different products
- ❑ Product creation enriches the web of interconnected data
- ❑ Nothing to “re-ingest”
- ❑ Every product makes the information more valuable



INFORMATION WEB GROWS AS A SIDE-EFFECT OF ANALYTIC WORK