



# THING 5 UPDATE

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& Mission Focus



MOVE IT FORWARD. MAKE IT HAPPEN.



# CONTENTS

- RELEVANCE TO NGA
- THING 5 HERITAGE
- APPENDIX
- CURRENT CAPABILITIES
- OUTLOOK

MOVE IT FORWARD. MAKE IT HAPPEN.



# 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

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## 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

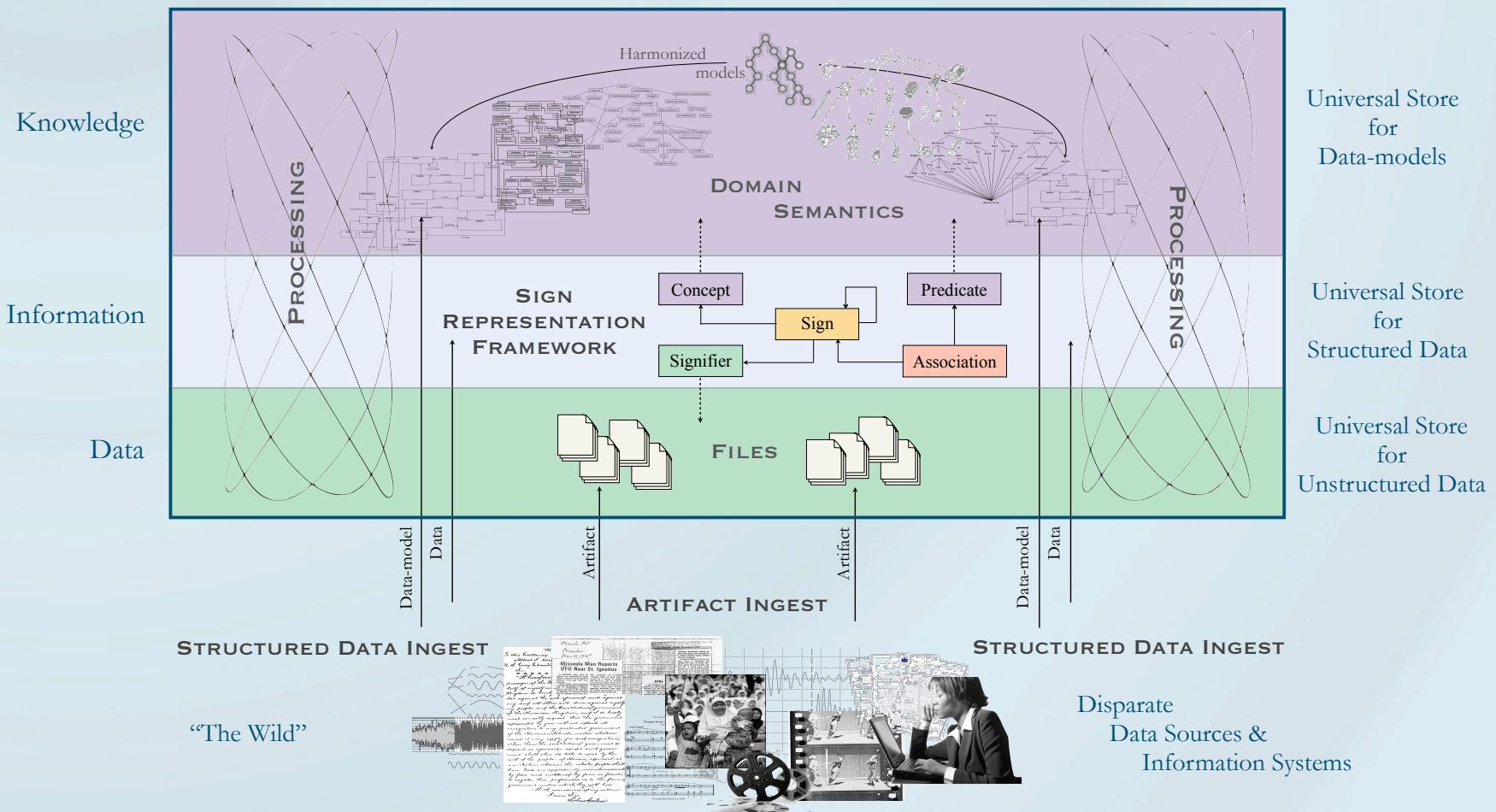
- Accommodates diversity, reduces ambiguity, and handles scale
- Access, understand, manage and use our data assets as a coherent whole
- Feed the production chain with rich, diverse information
- Custom / thematic maps as linked data using information from any source

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# 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

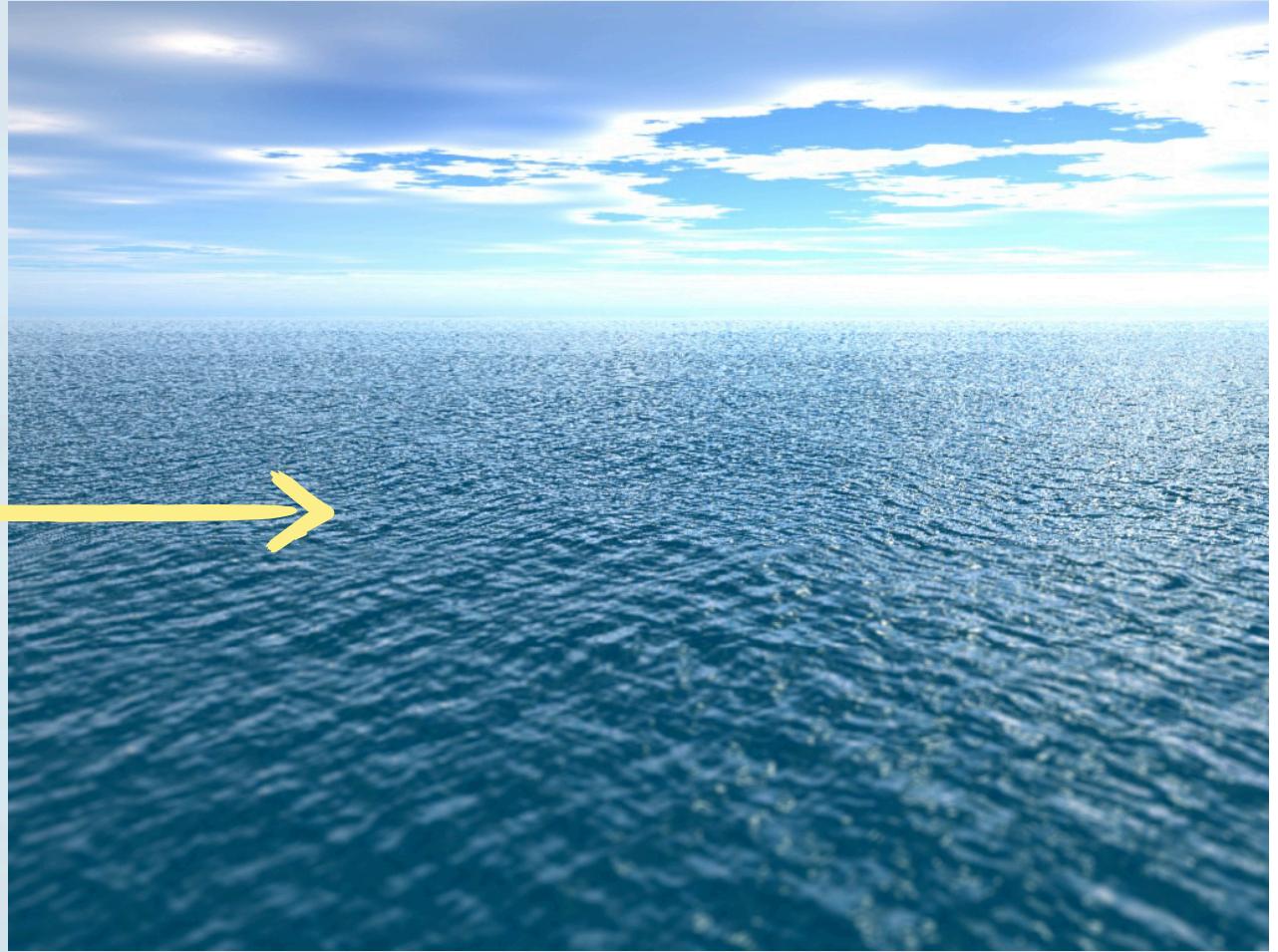
- Replaces the pipeline model with a wave model - analytic waves over data at rest
- Leverage, understand, manage and apply our analytic assets as a coherent whole
- All analytics access and enrich a shared ocean of data, information, knowledge
- Simple, robust, efficient, powerful, creative

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MOVE

# PIPELINES TO WAVES





# 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

- An Ultra-Large Scale systems problem
- No single right way to represent all knowledge - current practice fails
- No feedback mechanism whereby output (product) enriches the input
- Inability to grow, change, or even fully use what we have

## THING 5

- Provides an Ultra-Large Scale systems solution
- Grow, change, and fully use what we have
- Products are an enrichment of the web - a rich, living web of information naturally emerges
- Fully implement Structured Observation Management
- Achieve and apply new levels of understanding to achieve mission objectives and make NGA better

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## 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

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### AN ANALYST NEEDS A GOOD NOTEBOOK

**A NOTEBOOK APPLICATION**

- ❑ A tool for performing research and analysis
- ❑ Collect, associate, and annotate sign-space elements
  - Artifacts, signs, associations

**SIMPLE APPLICATION DATA-MODEL**

- ❑ A book containing pages
- ❑ Each page consists of a linked list of parts
- ❑ Any sign-space element can be represented within a part

**CONOPS**

- ❑ Author assembles parts into a page
  - Drag - drop / copy - paste / edit - assert
- ❑ This enriches the sign-space with associations
  - No actual document is created
  - Originating author (perceiver) is recorded
- ❑ Multiple authors may collaborate on a page

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## INFORMATION WEB GROWS AS A SIDE-EFFECT OF ANALYTIC WORK



# 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](mailto: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

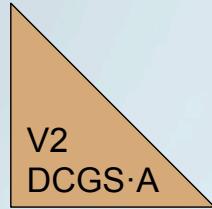
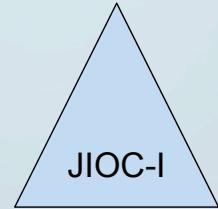
- Native GEOINT support
- Ideal platform for ABI
- Search, explore, discover, enrich, manage, exploit these unifying threads throughout our data
- IC solution for GEOINT storage and processing

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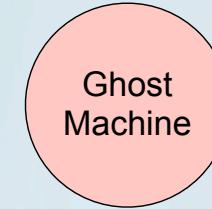


# THING 5 HERITAGE

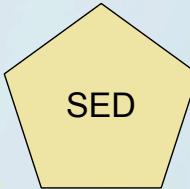
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- Dr. Suzi Object Sciences @ I2WD
- JIOC-I V2 integration
- Universal store for documents meets UFEIEO
- We need a universal store for structured data



- Andy SSS / TexelTek under Dr. Heath @ NSA
- GeoBoost – thin client Geo visualization
- Ozone widget framework
- Cloudbase analytics under Dr. Dowd



- Dr. Suzi PIPS @ I2WD Tech Dir
- Andy SSS / TexelTek
- Cross-domain MLS Oracle
- Data Description Framework
- The data integration problem



- Dr. Suzi IMI @ I2WD SETA Tech Dir
- Andy MissionFocus
- Compute & storage cloud aspiration
- Legacy integration implementation



- Dr. Suzi IMI & MissionFocus
- Andy MissionFocus & IMI
- GEOINT Compute & storage cloud implementation
- Sign Representation Framework
- PL4 design
- Marry cloud technology with semiotic science

**BATTLE SCARRED AND A WHOLE LOT SMARTER**



MOVE IT FORWARD. MAKE IT HAPPEN.

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

Every system should have the ability to export its data

Everything changes when you start writing the code

Our data & processing assets belong to the nation

(not the system or the contractor)

There's More  
In\_all\_of\_it\_Together  
Than we are getting or  
could possibly get out of  
All of the Parts



Be happy, write code!

Godspeed

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

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



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# 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

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- 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

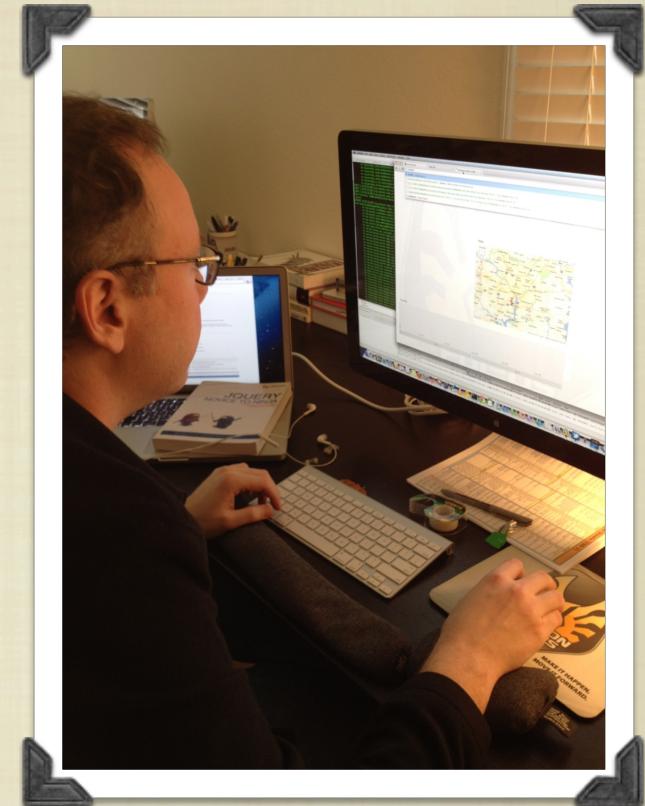
Ingest*	NITF	Marking Extraction	Ruminate*	Digest*
			Image Extraction	
			Proofer	
			Text Index*	
	email	Ruminate*	Text Index	
			Digest*	
	Chat	Ruminate*	Text Index	
			Digest	
	MP2TS	Marking Extraction	Ruminate*	Digest*
				Footprint Extraction
	Shape	Digest*		
	all-parsables	Text Index*		
	...	Artifact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



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# 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





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# SEARCH UI

## Text Search:

Text:

## Search Examples

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

## Semantic Search:

Text:

## Search Examples

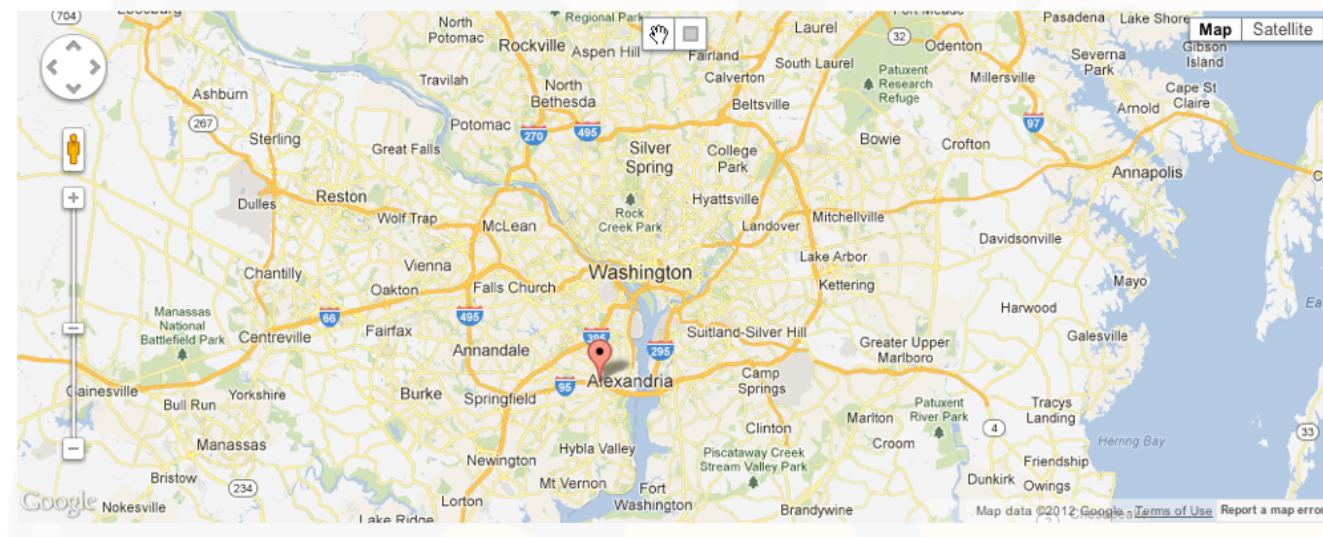
Will Return semantic elements that contain the following text in the sign. Example: Suzi, Andy, Artifact

Concept:

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

## Visual Search:

## Select an area to Search



## Temporal Search:

From

to

Search



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# 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.mpg
- geometry  
Concept : Collection Footprint  
Perceivers : FootprintCreator  
has Collection Footprint : udpcapture-1330976294561\_IR.mpg
- geometry  
Concept : Image  
Perceivers : NITFDigestBear  
assoc Image Category : IR  
assoc Image Date and Time : 20120229014003  
assoc Image Geographic Location : +35.600-117.837+35.600-117.744+35.523-117.764+35.523-117.831
- geometry  
Concept : Collection Footprint  
Perceivers : FootprintCreator  
has Collection Footprint : udpcapture-1331062280768\_HD.mpg
- geometry  
Concept : Collection Footprint  
Perceivers : FootprintCreator  
has Collection Footprint : udpcapture-133097810345\_SEDO.mpg
- geometry  
Concept : Collection Footprint  
Perceivers : FootprintCreator  
has Collection Footprint : udpcapture-133097810345\_SEDO.mpg
- geometry  
Concept : Image  
Perceivers : NITFDigestBear  
assoc Image Category : IR  
assoc Image Date and Time : 20120229013810  
assoc Image Geographic Location : +35.617-117.861+35.617-117.734+35.504-117.734+35.504-117.801
- geometry  
Concept : Collection Footprint  
Perceivers : FootprintCreator  
has Collection Footprint : udpcapture-1331149334173\_BlueDevil HD.mpg
- geometry  
Concept : Collection Footprint  
Perceivers : FootprintCreator

### Imagery

20120301002848-01000834-VIS.tif  
Concept :Thumbnail

2012029013834-05010726-IR.tif  
Concept :Thumbnail

2012029013555-05010608-IR.tif  
Concept :Thumbnail

20120301002848-01000834-VIS.tif  
Concept :Thumbnail

### Map

Map data ©2013 Google - Terms of Use Report a map error

### Timeline

Date	Event/Action
Feb 29	clip_20120306_193042_967_SEDO.mpg
Mar 1	udpcapture-1330976294561_IR.mpg
Mar 2	udpcapture-1331062280768_HD.mpg

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# SHAPEFILE FEATURES

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, -77.24664 38.9482969, -77.246574 38.948199, -77.246516 38.9480829, -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, -77.244859 38.946719, -77.244849 38.946621, -77.244848 38.946378, -77.244817 38.944926)

Map | Satellite

Map data ©2013 Google - Terms of Use Report a map error

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

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

## ■ 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

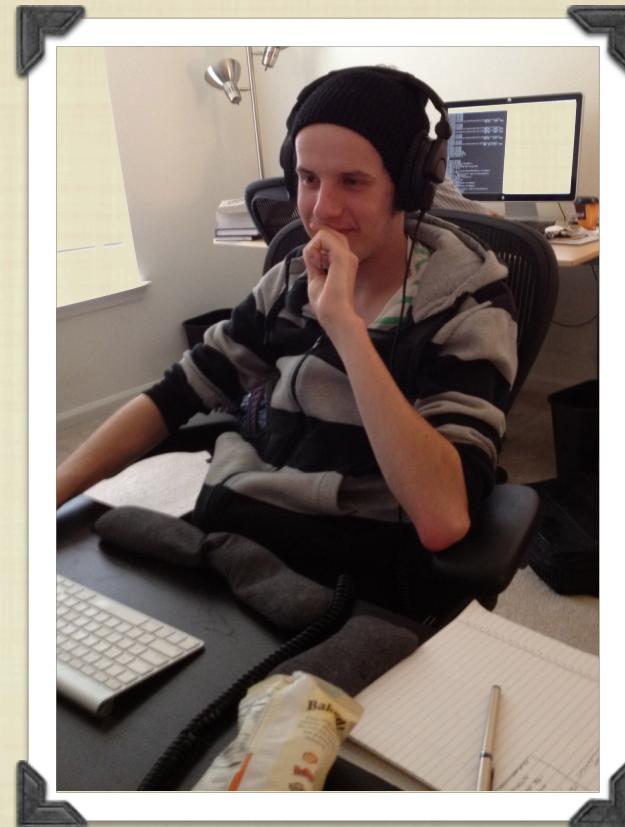
- SEMAPP KICKSTART
  - RHEL + PACKAGES INSTALL (STIG'D)
  - DISK PARTITIONING
  - NIC BONDING
- PROCEDURES FOR NTP CONFIG, CLOUD INFRASTRUCTURE AND SEMAPP SOFTWARE DEPLOY
- TEST PROCEDURES FOR CONFIGURATION AND CORE FUNCTIONALITY
- PASSED AREA 59 FAT



# 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



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# MORE To Do

MOVE IT FORWARD. MAKE IT HAPPEN.

- 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

# 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
<b>Core Services &amp; Processes</b>	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
<b>Applications</b>	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
<b>Test &amp; IA</b>	Performance Testing	Interface Testing	Theater Smoke Test Regression Testing IA Scan	Regression Testing Theater ATO	Regression Testing	Regression Testing	Regression Testing
<b>Deployment &amp; O&amp;M</b>	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
<b>Documentation &amp; Training</b>	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						