Big Data Use Cases

Thomas Paschke
Product Specialist Real-Time & Big Data

EDC Forum - Big Data Analytics in Geographic Information Systems
ArcGIS Enterprise

with real-time & big data capabilities

10.5

IoT → GeoEvent Server (ingest, analyze) → spatiotemporal big data store → GeoAnalytics Server (analyze) → Big Data

ArcGIS Enterprise
Real-Time GIS usage as of June 2017

1,144 Organizations
85 Countries

Commercial
- Financial Services
- Insurance
- Logistics / Trucking
- Manufacturing
- Media & Entertainment
- Real Estate
- Retail

Natural Resources
- Agriculture
- Forestry
- Mining
- Oil & Gas
- Pipeline

Transportation
- Aviation
- DOT
- Railways
- Maritime & Ports
- Public Transit

Utilities
- Electric & Gas
- Telco / Cable
- Public Works

Water
- Water resources
- Water / wastewater / stormwater

Professional Services
- AEC
- Environmental Mgmt
- GIS & IT

Nonprofits & Education
- Conservation
- Humanitarian
- Sustainable Development
- Higher Ed
- Research/Science Institutions

Defense & Intelligence
- Intelligence
- Military Operations

Public Safety
- Emergency / Disaster Mgmt
- Fire, Rescue, EMS
- Homeland Security
- National Security
- Law Enforcement
- Special Events

Health & Human Services
- Hospital & Health Systems
- Pharmaceuticals
- Public Health

Government
- National
- State
- Local
2014-2017 Boston Marathons

Public Safety
2014/2015 Boston Marathon

Boston Marathon Operations - Public Safety

Significant Events

Road Closure / Lane Restriction

Northbound at Exit 4 - (11:55) - Atlantic Ave & Essex St (Lincoln St) remains closed (expected to be removed 4/15). Northbound at Exit 2 - (11:50) - Canal St remains closed (expected to be removed 4/15).

Other / Non-Specified

Transported

Transported

Transported
### Los Angeles Bureau of Sanitation

#### Vehicle Tracking & Service Management

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alley or Abandoned</td>
<td>29</td>
</tr>
<tr>
<td>Completed</td>
<td>65</td>
</tr>
<tr>
<td>All Routes - Count</td>
<td>245</td>
</tr>
<tr>
<td>Not Out</td>
<td>68</td>
</tr>
<tr>
<td>Routes on 2/14/15 Close codes</td>
<td></td>
</tr>
<tr>
<td>Clean Streets - Alley or Abandoned Waste</td>
<td>70 (28.6%) Null</td>
</tr>
<tr>
<td>Request Completed</td>
<td>65 (26.5%)</td>
</tr>
</tbody>
</table>

*Data for Feb 14, 2015 Routes*
Alternative Energy

Sensor Network Monitoring
The Waze Connector for GeoEvent Extension includes a connector that can be used with ArcGIS GeoEvent Extension for Server to receive live traffic and alerts from the Waze Connected Citizens Program feed.
ArcGIS Enterprise

with real-time & big data capabilities

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ArcGIS Enterprise

IoT

GeoEvent Server

ingest, analyze

spatiotemporal big data store

GeoAnalytics Server

analyze

visualize

Big Data
Use Case – PV Output Prediction

Real-Time: Installed PV Output

Ingest Real-Time Data

GeoEvent (Realtime)

Join weather forecast to PV locations

GeoAnalytics

Business Logic: Calculate forecasted output

Stockexchange Broker

Dashboard

Capacity planning & optimization

Big Data Store

Process

Datatransfer

Echtzeit: Weather Information

Ingest Real-Time Data
Summe: 167,714.07 kW

99,892.78 kW
Summe: 99,892.78 kW
Summe: 50,637.65 kW

Leistung - Prognose: 3,642.03 kW
Use Case – Flood Warning

+ Ingest and analyze precipitation forecast via GeoEvent Server
+ Perform scheduled and reoccurring analysis to aggregate precipitation data into catchment areas for sewer system
  > Predict which roads will probably be flooded
  > Better coordinate help & counter measures

Port Challenges

The Port should become smarter, faster and more sustainable

Allard Castelein
CEO Port of Rotterdam
Access information in three clicks
Usage of ship position data

- Harbour master
  - Incident analysis
  - Safety checks
- Capacity management
  - Identifying bottlenecks
  - Planning decision support
- Environmental management
  - Pollution (NOx) calculations
  - Speed measures to reduce pollutions
Where is $\Delta \approx 0$?
Looking at data without location, most of the time seems like looking at just part of a story. Including location and geography in analysis reveals patterns and associations that otherwise are missed. As Big Data emerges as a new frontier for analysis, including location in Big Data is becoming significantly important.

Data that includes location, and that is enhanced with geographic information in a structured form, is often referred to as Spatial Data. Doing Analysis on Spatial data requires an understanding of geometry and operations that can be preformed on it. Enabling Hadoop to include spatial data and spatial analysis is the goal of this Esri Open Source effort.

GIS Tools for Hadoop is an open source toolkit intended for Big Spatial Data Analytics. The toolkit provides different libraries:

- **Esri Geometry API for Java**: A generic geometry library, can be used to extend Hadoop core with vector geometry types and operations, and enables developers to build MapReduce applications for spatial data.
- **Spatial Framework for Hadoop**: Extends Hive and is based on the
GIS TOOLS FOR HADOOP

- Computational Geometry Library
- Hive Spatial UDF Functions
- GeoProcessing Extensions to ArcMap
PACI Kuwait

PACI Data Concept

14 TB

- > 249,701 Parcels
- > 194,462 Buildings
- > 669,851 Units

People

> 4.2 mio inhabitants

Buildings & Units

- > 124,440 Establishment

Establishments
Kuwait Finder
Phone = Sensor
Local Traffic Insight ?
Requirements

• No Single Point of Failure
• Still have data in SQLServer for legacy apps
• Fast Write and Read to „database“
• Log everything
• Quick Analytics and On Demand Maps
Fast Road Snapper

- Given GPS location, heading, speed, time
- Given street type, direction, length
- Find snapped location
- Update and accumulate number of snaps per segment
Smart Snap
SOI

- ArcGIS Server Object Interceptor
- Intercepts MapService Request
- Invokes Spatial Query on Elasticsearch
- Creates Dynamic Map Image of Result
GeoAnalytics Server
spatiotemporal big data store
GeoEvent Server
BDS MapService
with on-the-fly Aggregation

GeoAnalytics Server
spatiotemporal big data store
GeoEvent Server
BDS MapService with on-the-fly Aggregation
Sensors

ArcGIS Enterprise with real-time & big data

Sources
Hubs
Spatiotemporal archive
Ingest
Store
Visualize
Real-time
Batch
Analyze

Web Maps Layers

Distributed Services

Web
Device
Desktop
Apps

project Trinity

R&D
ArcGIS Enterprise with real-time & big data

Continuous Resilient Stream Processing

- sources
- hubs
- real-time

spatiotemporal archive

Reoccurring every x Minutes

batch

Scala, Kafka, Spark, Elasticsearch, Spark
• “Map epidemiological issues, such as babies with low birth weights”
• “Aggregating personal health information to identify patterns”


“Predicting Crime Using Analytics and Big Data”

“Merged Esri’s GIS software with police data and city maps to create new maps displaying the migration paths of neighborhood shootings […]”


“Social Media Content Fuels Big Data Analytics for Esri and IBM.”

“Twitter content is now being mined and is used in analytics methodologies developed by Esri, IBM, and various stakeholders”

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