Metro-North Railroad’s
Enterprise GIS Program:
Yesterday, Today, and Tomorrow

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Metro-North Railroad

- Three states, twelve county service area, 2,701 square miles.
- Five lines, three branches, 384 route miles, and 775 track miles.
- 1,072 bridges, 119 grade crossings, 77 substations.
- 124 stations, 1,258 railcars, 711 weekday departures carrying 284k customers.
- Full service commuter railroad with engineering responsibility for track, signals, power, structures, stations, and railcars.
## Business Case

Use company-wide survey instrument to generate interest in GIS

<table>
<thead>
<tr>
<th>GIS Need</th>
<th>% Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Describing a location (at least monthly)</td>
<td>90%</td>
</tr>
<tr>
<td>Communicating a location (e.g. geocodes) to an outside entity</td>
<td>66%</td>
</tr>
<tr>
<td>Locate a fixed asset in the field</td>
<td>62%</td>
</tr>
<tr>
<td>Plot a map for sharing, reporting, etc.</td>
<td>34%</td>
</tr>
<tr>
<td>Count features within a geographic area</td>
<td>62%-66%</td>
</tr>
</tbody>
</table>
Trigger Events

• Identified GIS Needs
  – Real-time incident management
  – Post-event reconstruction

• Westport 1532 (2011-07-22)
  – Real-time train location
  – Emergency access to ROW
  – Fire/EMS jurisdictions
  – Milepost/catenary pole/street address correlation

• Hurricane Sandy (2012-10-20)
  – Real-time storm tracking
  – Elevation of key rail assets
  – Post-event insurance claims
  – Mapping recovery efforts
  – Flood proofing future design
Hudson Line: “Water Level Route”

Kemeys Cove MP 29.7

Scarborough MP 29
Hudson Line: “Water Level Route”

Legend
- Substation
- A
- AE
- VE
- X
- Station Platform
- MNR Tracks
- Sandy Surge
Early Action—Inventory Existing Condition

- Hardware and Software
- Data Sources
  - Past projects
    (e.g., Positive Train Control LiDAR)
  - Publicly available
- Existing Systems
- Business Processes
- User base and skills
Early Action—Policies

- **Human Capital**: GIS/CAD as “preferred skill” in job qualifications
- **Software**: Push users towards GIS web viewers; limit desktops
- **Procurement (Boilerplates)**: Require GIS deliverable in all capital projects, i.e. As-built and other drawings, database outputs (track defect measurement system)
- **Data Security**: 3 levels of GIS Data
- **Data Hygiene**: Check-in/check-out, quality control procedures, etc.
- **Data Ownership and Update**: Working with ongoing Enterprise Asset Management (EAM) effort
Concept of Operations (ConOps) Study

- **Goals and Objectives Meetings**
  - Support from senior management
  - Loosely define user requirements
  - Find possible use cases

- **Data Inventory and Gap Analysis:**
  “Fishing expedition” to discover more data and resources

- **Business & Operational Processes:**
  “Institutionalization” of GIS
  - Straight Line Diagrams (SLD) Viewer
  - Integrated Property Boundary GIS (Yardi)
  - Plan Room Drawing Retrieval (CPRDRM)
  - Visual train tracking replacement
  - Ridership & Demographics Visualization

- **Staffing:** “Who’s doing what?”
  Add new staff if nobody there!
Marketing

- **Portal:** “at a glance” GIS resources webpage
- **Open REST Services Directory**
- **Email Blasts:** exec. level “this is what GIS can do”
- **“Infomercial” Videos:** like home shopping...
- **Roadshows:** visit regular departmental meetings or set up special targeted sessions
- **Ask Project Manager to Approve:** when receiving data, always circle back to PM (more for education than for review)
- **Early Products:** use 3D visualization, heat maps, BigData, etc., and circulate example map to generate interest
Early Map Products

• Employee Residences
  To estimate employee commute time

Employee Residences
Early Map Products

- Station Catchment
  Mail & Ride by Zip Codes to track parking demand at specific station
Early Map Products

- **MudSpot** to track weekly Mudspot maintenance
Early Map Products

- Third Rail Burner showing locations of third Rail brackets burning issue
Enterprise GIS Web Viewers

• Map railroad features on web application to improve data access
• Publicly available GIS layers overlaid with railroad locations
  – Census Demographics
  – Environmental features
  – FEMA flood information; Public and Quasi-Public facilities, etc.
• Link existing PDF maps into viewer as repository of drawings
  – Signal block plans, Power sectionalizing diagrams, Val maps, etc.
  – Avoids labor intensive Georeferencing for now
• Google Maps and Street View Integration at critical points
Enterprise GIS Architecture

• ESRI ArcGIS for Server 10.2
  – with Web Adaptor
  – Access via web viewers and REST services (intranet only)

• File geodatabase on server
  – Migrating to Oracle
  – Effectively read-only for now
  – Power users on Desktops
  – GIS Manager is gatekeeper

• Mobile access via tablets with AirWatch software

• Inter-agency (MTA, LIRR, NYCT) access via selected opening in the firewall
Metro-North Enterprise GIS Web Viewers
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Environmental Features
Metro-North Enterprise GIS Web Viewers

U.S. Census Demographics
Metro-North Enterprise GIS Web Viewers
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Track Sensor Data

Legend

- Track and Tie Defect
  - Rail End Mismatch Conditions
  - Sporny Car Defects
  - Spring 2014 Track Geo Defect
    - Priority (MNR defect)
    - Urgent (FRA defect)
- Joint Bar Tie Conditions
  - BAD Joint Bar Ties
  - FAILED Joint Bar Ties
- Bad/Failed Tie Cluster
  - BAD Tie Cluster
  - FAILED Tie Cluster
Metro-North Enterprise GIS Web Viewers

West of Hudson Signal Project
Metro-North Enterprise GIS Web Viewers

Topographical Contours
Limited English Proficiency
Metro-North EGIS: Asset Locations
Metro-North EGIS Tools: Search
Enterprise GIS Tools: Measure Distance
Enterprise GIS Tools: Google Street View
Enterprise GIS Base Map Choices
EGIS Next Steps

• Migration Issues
  – ArcGIS 10.2 to 10.3
  – Dev/Prod Resiliency

• Implement Five Baseline Applications

• GIS Staffing Roles
  – SLD Engineer
  – Licensed Surveyor
  – Drawing Archivist/CAD
  – GIS App Developer
  – Demographer

• In House Training

• Other Applications
  – GIS Viewer for Security Management
  – Sustainability Initiative - “Green” GIS
  – GIS Viewer for Emergency Management Application
Questions?  

Data Request?  

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EXTRA CONOPS SLIDES

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Straight Line Diagrams

- Plot GPS coordinates, milepost, locations on a straight line diagram (SLD) like track chart
- Overlay data on marked-up track chart: slow orders, outages, tonnages, track geometry, signal/power/buried utility, etc.
- Replaces current laborious process of producing track charts
- Enables interdisciplinary information & intelligence sharing
- Improved capability & speed in identifying defects
- Vastly improve field data accessibility over paper
Property Management GIS Integration

• Provide accurate, surveyed property lines of Metro-North rights of way, yards, leases, etc.
• Integrate with proprietary tenant management system
• Supports capital project planning, asset maintenance, operations, and emergency management
• Support entry permit process
• Support rent collection process and lease requests from utilities
Virtual Train Tracking System Replacement

- Display live train locations in near real-time on a diagrammatic map, line chart, as a colorized delay diagram, and allowing drill-downs into additional and historical data
- Display train movements relative to location features & infrastructure
- Delay visualization on mobile devices
- More accurate prediction of delays
- Better data for trainmasters making real-time assignments due to tight integration with crew and consist management systems
Plan Room Drawing Retrieval Mapper

• Recently scanned 100,000+ as-built drawings to PDF
• Allow user to visually look for drawings “by map”—self service drawing retrieval
• Geo-reference and improve indices by keyword/discipline
• Strikes balance between fully digitizing versus text-based location descriptions only
• Allows archivist to focus on minority of exception cases
Ridership & Demographics
GIS Visualization

• Construct a database to capture, house, and display maps of automated and manually collected data sources:
  – Ridership, loads, capacity, train counts, on/off, demographics, and surveys

• New computerized database platform:
  – Migrating existing data from mainframe
  – Store, process, and query automatically collected data (ticket sales, load weigh sensor/automated passenger counter (APC), automated station counts, etc.)

• Supports demand/revenue forecasts, contingency planning, outage assessment, risk assessment, etc.