BLADERUNNER: GPS SUPPORT FOR DSNY FIELD OPERATIONS

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Game-Changing Initiatives for Solid Waste
The Cooper Union
June 10, 2015
AGENDA

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HISTORY

- After a severe blizzard hit New York City in 2010, DSNY implemented an online tool to track snow-fighting operations.
- A key requirement was to enable New Yorkers to see snow removal progress – block-by-block, across the entire City.
- This substantial effort included installing GPS tracking devices (Motorola flip phones) in most of the fleet. Working with DoITT, applications for internal and public views were implemented.
- As the Department used this technology to manage snow clearing operations, new ways to improve and expand operations came to light, including non-snow related activities.
CHALLENGE

- DSNY tracks and manages over 3,000 snow-fighting assets, including: salt-spraying equipment; plows; mobile supervisors; and vehicles and staff from Other City Agencies (OCAs).

- Collectively, they must clear more than 19,000 lane miles of public roadways – often multiple times, depending on the severity of the weather event.

- There are more than a dozen different types of routes that are run for various purposes, such as collections, recycling, CFC evacuation, etc.
Field Supervisors must:
- During Snow Operations: Oversee 20-50 plows and salt spreaders in one of NYC’s 59 districts
- During Normal Operations: Oversee 15+ collection trucks and sweepers in traffic and multi-tasking (hands-free, of course!)
- Orient themselves when assigned to unfamiliar geographic areas

Managers and Executives must:
- Report progress of snow clearing efforts – at the Citywide, borough, district and citizen level (through public website).
- Be alert to local issues as displayed on public-facing PlowNYC website and correlate with high-complaint areas
- Track compliance with all operational orders
SOLUTION: BLADERUNNER

- Implement a highly-customized, next-generation GPS Tracking solution, AKA BladeRunner.

- BladeRunner was designed from the ground up to meet the specific needs of DSNY field staff and users at the headquarters.

- An RFP was developed in 2012. From the beginning, business requirements were defined with deep user involvement.

- The Geographic Information System (GIS) software platform chosen was ESRI, an industry leader in Geospatial technology.
- We selected an ESRI Partner firm (Critigen) from available City back-drop contract vendors.

- An Agile software development life cycle was used, allowing users to flesh out requirements and quickly try out working code.

- The scope included replacement of end-of-life flip phones with dedicated “black box” devices built specifically for fleet tracking purposes.

- The first phase of BladeRunner was rolled out to production in October 2014.
BLADERUNNER FEATURES: FIELD SUPERVISORS

- User interface optimized for Samsung smartphones
- Pre-populated with operational data from other systems
- Supervisors can easily select vehicles to track
- Quick access to truck’s current vital statistics
- Stopped truck alerts, options to flag and follow trucks
- Ability to display a truck’s route over 8-hour period
- Many map layers for daily collection areas and facilities
- Search feature to locate facilities and ‘Find-me’ to orient supervisor and provide detail on current location
BLADERUNNER FEATURES: FIELD

Select Trucks
BLADERUNNER FEATURES: FIELD

Details:
- Address
- In garage?
- # Dumps
- Up/Down?
- GPS OK?
- # Salt loads
- Center Truck
- Flag Truck
- Alerts on/off
BLADERUNNER FEATURES: FIELD

- Breadcrumbs
- Geofences
BLADERUNNER FEATURES: FIELD

Alerts
- Yellow (30’-45’)
- Orange (45’-60’)
- Red (60’+)
BLADERUNNER FEATURES: FIELD

Alerts on Map
BLADERUNNER FEATURES: FIELD

Track Route
- 8-hour interval
Scheduled Collection Areas
BLADERUNNER FEATURES: FIELD

‘Find Me’
BLADERUNNER FEATURES: FIELD

Search DSNY Facilities
BLADERUNNER’S BASE MAP

- 11 zoom levels, from Citywide to block details
- City-standard base map includes:
  - County, borough, District, police precinct borders
  - Streets with names and traffic direction
  - Parks, water bodies
  - Building outlines
BLADERUNNER FEATURES: HEADQUARTERS

For Managers:

- User interface optimized for Citywide and borough overviews
- Pick groups of trucks by assigned functions, identified by distinctive icons (Plowing, Salting, Collection, Supervision)
- Map layers for street priority/sectors, time since last plowed/salted
- Map layer and data grid giving percent completed for Plowing and Salting, by district/boro/City and street priorities/sectors.
- Formatted screen prints for history and sharing around the organization.
HQ CONSOLE: PERCENT COMPLETE
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IMPORTANCE OF SNAP-TO-GRID

From this…

To this…
FUTURE ENHANCEMENTS

Additional map layers showing:

- Time block was last serviced (field)
- Percent route/area completed (field)
- Display 311 complaints/clusters on the map

Additional capabilities:

- Find trucks that traversed a specific location during a time period.
- Have ability to communicate from the field to HQ about alerts, complaints, weather, etc.
FUTURE ENHANCEMENTS CONTINUED

- Issue operations orders from HQ to the field
- Integration with:
  - Supervisors’ daily activity logs
  - Daily operations scheduling system
  - Accident reporting
- Replay history of blocks serviced for a full district in a storm
- Expanded reporting, simulation and analysis
- Digital turn-by-turn directions for drivers
- Explore route optimization
TECHNOLOGY: OVERVIEW

GPS signals are sent on average every 12 seconds per device = 960,000 signals per hour.
TECHNOLOGY: DEDICATED GPS DEVICES

- DSNY chose to use dedicated devices for the second generation GPS system.
- Installed under vehicle dashboard to minimize damage.
- Can be used with an external antenna to improve accuracy.
- Over-the-air management capability to install patches, check health, reboot device, etc.
- Serial ports to enable additional sensor inputs.
- Piloted a “dead reckoning” (DR) device to mitigate “urban canyon effect” in certain areas.

CalAmp LMU 4225 device
KEY CHALLENGE: POSITION ACCURACY

Internal antenna

External antenna
TECHNOLOGY: SOFTWARE

- The application is built on the C# .NET platform.

- It was conceived and designed as a mobile application from the beginning; the display is highly optimized for smart phone usage.

- A proprietary system (Rastrac) is used for collecting GPS data points, providing system management tools, and generating public-facing information on when a block was last serviced (during snow).

- Rastrac processes the raw GPS signals to link each GPS location point to a specific block in the City’s street network (“snap-to-grid”).
TECHNOLOGY: SOFTWARE CONTINUED

- ESRI-based servers are used to further relate GPS points to specific map views which DSNY maintains and controls internally.

- ESRI geo-fencing services are used to identify whether a GPS point is located within the boundaries of garage, a salt dome or a disposal location.

- Oracle and MS-SQL databases are used for storing large quantities of GPS points which are processed by multiple ESRI and BladeRunner servers.
LESSONS LEARNED

- Do not underestimate level of effort. AVL GPS systems are very complicated.

- Data volumes are extreme and specialized architectures are required.

- Determine the level of accuracy required upfront before evaluating tracking device options.

- Clearly define operational requirements: If you are a first responder or have a public-facing component, increase your time/budget for failover design and add extra time for stress and load testing.
LESSONS LEARNED CONTINUED

- Conduct extensive device testing in all representative geographic operating areas.
- Urban Canyon effect - impact on street painting
- Organizational change management is required to achieve maximum operational benefit.
- Minimize the number of vendors involved in building and maintaining the system.
- Understand the entire end-to-end architecture for both hardware and software; your weakest link will kill you.
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