VISION PROGRAM

Vehicle Information System & Integrated Operations Network
January 21st, 2016
HISTORY OF CAD/AVL AT TTC

- CAD/AVL (Computer-Aided Dispatch and Automatic Vehicle Location)
  - Fleet Management System for TTC Surface Operations
- Original System from 1978
  - One of the first such systems in public transit
- Terrestrial Sign Post and Radio Based system
- Significant investments made over the years ($36M)
  - Computing Upgrades
  - Introduction of GPS
  - Digital Cellular from Analogue
- Built and supported in-house
LIMITATIONS OF CURRENT SYSTEM

- Antiquated system architecture
  - Challenge to support and modify
  - Difficult to grow and add modern features
- Hardware provider no longer in business
- On-board system is not integrated
  - Organic Growth of Disparate Systems
  - Next Stop Announcements
  - Automatic Passenger Counters
  - Cameras
- Communications
  - UHF radio on legacy system
  - CDMA cellular End of Life (Early 2018)
• In 2012-2013 the TTC contracted IBI Consultants to review the current CIS and develop options for a way forward strategy which resulted in a recommendation for replacement

• New VISION System will deliver:
  • Improved Service Delivery to customers through enhanced route management and AVL for buses and streetcars
  • Modern life safety communications for operators
  • Better integration with TTC maintenance systems, Yard Management and Real-Time Information, Automatic Passenger Counting and Open Data Toronto
  • Automated Vehicle Health and Condition monitoring
  • Integration with existing and future Transit Signal Priority (TSP)
### ESTIMATED COST EFFICIENCIES

<table>
<thead>
<tr>
<th></th>
<th>Extend CIS SOGR</th>
<th>VISION Program (updated with proposed 2016 contract values)</th>
<th>Cost Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implementation Costs</td>
<td>$62,900,000</td>
<td>$99,100,000</td>
<td>($36,200,000)</td>
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<tr>
<td>20-Year Operating Costs</td>
<td>$383,000,000</td>
<td>$123,700,000</td>
<td>$259,300,000</td>
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<tr>
<td>Total Cost of Ownership</td>
<td>$445,900,000</td>
<td>$222,800,000</td>
<td>$223,100,000</td>
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</table>

Methodology used is consistent with the CIS Way Forward Study concluded in 2013. The cost savings include:

- Reduction in personnel to operate and maintain system
- Reduction in end-user personnel for service delivery and management;
- Reduction in manual data processes
- Replacement instead of rebuild of communications architecture and TRUMP units
- Termination of CIS SOGR program
KEY DELIVERABLES

- VISION Operations Control System
  - Improved monitoring of service to identify delays
    - Headway adherence for streetcar and high-frequency bus routes
    - Schedule adherence for low-frequency bus routes
    - Real-time dashboards to track overall performance and drill down where needed
  - Expedite service adjustments in response to delays (e.g. change offs, short turns, add/remove service, shuttle service)
  - Effective detour management functions
  - Transfer connection protection for blue night services

*Improved on-time performance and reliability*
- **KEY DELIVERABLES**

  - **VISION Operations Control System**
    - Emergency management functions
      - Integration to covert alarm
      - Security events
        trigger highest-priority response
      - Integration to on-board camera system
      - Coordinate response between Central Control, On-street Supervisor and first responders
    - Upgrade to TETRA and LTE communications

  **Improved safety and security**
- **Route Supervisor Solution**
  - Runs on standard field-ruggedized tablets integrated and synchronized with the VISION Operations Control System
  - Monitor service remotely and receive automatic alerts/notifications
  - Adjust service to respond to on-site issues
  - Complete and submit incident forms while in field

*Improved coordination between central and on-site supervisors*
- Smart Vehicle Equipment
  - Modern color touch-screen (Mobile Data Terminal) to interface with operators
  - Enhanced voice and text communications channels to provide support when required
  - Vehicle On-board Computer that *knows* and responds to what’s happening:
    - Informs operator if they are late or early to enable autonomy and improved performance
    - Updates customers of detours and broader service issues
    - Activates Transit Signal Priority if delayed
    - Informs central control if there are maintenance issues

*Improved service performance and operator satisfaction*
- **Yard Management System**
  - Sensors at all divisions and car-houses that automate process for identifying where vehicles are parked
  - Automate process for vehicle pull-in, assigning parking spots according to asset utilization and next-day service requirements

*Improved asset utilization and efficiencies*
KEY DELIVERABLES

- Vehicle Health Monitoring
  - Monitor vehicle health information while in-service to minimize and control change-offs
  - Collect and analyze significant detail about vehicle health to improve overall utilization
  - Interface to TTC’s IFS maintenance mgt. system to automatically generate work orders and schedule preventative maintenance

Reduction in change-offs and associated service delays
KEY DELIVERABLES

- Operator Workflow Automation
  - Sign-in kiosks at divisions to pick-up assignment and updates/notices
  - Yard management solution that identifies vehicle locations to the operator
  - Circle check completed electronically on vehicle to automate submission and tracking of issues
  - Parking direction via Mobile Data Terminal upon returning to yard
KEY DELIVERABLES

- Operator Performance Management and Support
  - Enhanced vehicle sensors to detect:
    - Hard acceleration/braking
    - Abrupt lane changes/turning
    - Speeding
    - Excessive revving and idling of engines
  - Direct operator feedback to promote safe and effective driving
  - Analytics reporting to identify persistent issues for training opportunities

Improved driving safety and reduction in fuel consumption
KEY DELIVERABLES

- Customer Information
  - Initial integration to current provider for seamless transition to customers
  - New real-time information responsive website and modern mobile applications (iOS and Android)
  - E-mail and SMS next vehicle alerts at stops and for service bulletins
  - Open Data (GTFS-Realtime) to enable third-party development of customer applications

*Improved customer information and satisfaction*
KEY DELIVERABLES

- **Historical reporting**
  - Analyze data to identify patterns and trends
  - Generate standard and custom reports
  - Data is pushed out to TTC’s Enterprise Data Warehouse for further utilization
  - Feedback to service schedules

- **Incident playback**
  - Replay and investigate incidents or issues resulting from internal and external requests
  - Export playback as video file for future reference or to respond to request
KEY DELIVERABLES

- System integration requirements:
  - Central via middleware:
    - Scheduling and Maintenance System
    - Customer and Operator Information
    - City of Toronto Traffic Signal Control System (for TSP)
    - City of Toronto Traffic Office
    - Enterprise Data Warehouse
    - PRESTO
  - On-board:
    - Vehicle sensors and diagnostics
    - Speakers and signs (for next stop calling)
    - Automatic Passenger Counter
    - On-board camera system and covert alarm
- Vendor Services will include:
  - System Engineering and Design (multiple stages)
  - Configuration of their standard solution to meet TTC’s stated needs
  - System Quality Assurance and Testing (multiple stages)
  - Installation support
  - Documentation
  - Training
  - Project Management
A DAY IN THE LIFE – CUSTOMERS

- Trip planning
- Information at stops and stations
- Information on-board

VISION System

2016-01-21
LIFE TOMORROW – CUSTOMERS

Trip planning

Information at stops and stations

Information on-board

Vision System 2016-01-21

Information integrated across channels
A DAY IN THE LIFE – OPERATIONS

Supervision and control

Automate manual processes

In-service

Check-in and Pull-out
LIFE TOMORROW – OPERATIONS

Supervision and control

Automate manual processes

In-service

Check-in and Pull-out
A DAY IN THE LIFE – MAINTENANCE

Automation and service reliability

Vehicle repairs

Pull-in and ready for service

In-service

Source: Toronto Star
LIFE TOMORROW – MAINTENANCE

Automation and service reliability

In-service

Pull-in and ready for service

Vehicle repairs

Source: Toronto Star

2016-01-21
A DAY IN THE LIFE – MANAGEMENT

Data availability and timing for decision-making

Service oversight, monitoring and reporting
Service oversight, monitoring and reporting
Procurement Process for the VISION project

- RFI conducted to gauge capabilities and order of magnitude costs of current CAD/AVL product offering – 7 responses received
- Legal firm with system procurement expertise engaged to draft contract schedules and agreements published as part of RFP
- External Fairness Monitor engaged to oversee RFP process
- RFP issued – 49 vendors downloaded the RFP
- 7 proponents submitted responses
Multi-stage RFP vendor evaluation followed for system acquisition

- Commercial Compliance evaluation – all 7 proponents met the requirements
- Short listed proponents based on scoring of written technical and legal responses – 6 proponents were short listed
- Score short listed proponents based on product demonstrations
- Score proponents based on submitted pricing
- Negotiate contract with highest scoring proponent based on the above
## PROJECT TIMELINE

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contract Award</td>
<td>Q1 - 2016</td>
</tr>
<tr>
<td>Showcase Event</td>
<td>Q3 - 2016</td>
</tr>
<tr>
<td>System Design complete</td>
<td>Q4 - 2016</td>
</tr>
<tr>
<td>Factory Acceptance Test complete</td>
<td>Q1 - 2017</td>
</tr>
<tr>
<td>Deployment begins</td>
<td>Q2 - 2017</td>
</tr>
<tr>
<td>Mini Fleet complete</td>
<td>Q3 - 2017</td>
</tr>
<tr>
<td>Roll-out to remaining vehicles begins</td>
<td>Q3 - 2017</td>
</tr>
<tr>
<td>Deployment to Buses complete</td>
<td>Q4 - 2018</td>
</tr>
<tr>
<td>Deployment to ALRVs complete</td>
<td>Q4 - 2018</td>
</tr>
<tr>
<td>*Deployment to LFLRVs complete</td>
<td>Q1 - 2020</td>
</tr>
</tbody>
</table>

*Based on LFLRV Delivery Schedule*