Using the I-95 Corridor Coalition Vehicle Probe data to put Automated Travel Times on Dynamic Message Signs in Maryland

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CHART Systems Administrator
CHART Grew From Reach the Beach

- 1988
  - State Highway
  - State Police

- 1995
  - Statewide Operations Center
  - 2 Remote Traffic Operations Centers
  - MdTA AOC
But Quickly Grew Beyond it’s Limited Beginnings

- 1999
  - CHART on the Web
- 2001
  - Event-Based Control (allows multi-TOC Operations)
- 2002
  - Arbitration Queue (allows multi-agency Control)
- 2004
  - NTCIP for DMS
  - Web-based GUI
But Quickly Grew Beyond it’s Limited Beginnings

- **2006 - 2007**
  - Multicast Video (allows Multi-TOC and Multi Agency Control)

- **2008**
  - Real-time External Traffic Management Center Data Feed to DC and VDOT (RITIS allows multi-State Operations)

- **2009**
  - Real-Time 3rd Party input for Travel Times and Toll Rates on DMS
As recently as December 2007, Travel Times on DMS was scheduled for FY 2012 due to lack of infrastructure to provide good data and the need to devote a major build entirely to this effort.

In the meantime, CHART was preparing the background logic in smaller builds (System Alerts R3B1, Scheduler and Event-based Notification R3B2).
- That same month, Inrix was awarded the Corridor Travel Time contract and software development for automated messages on CHART signs was pushed forward to meet the challenge.

- Work was also begun on Engineering Guidelines for Implementing Travel Times On DMS in Maryland.

More Info, download Procedural Guidelines For Implementing Travel Time on DMS In CHART (PDF) at http://traffic.md.gov/readingroom/RR_ChartSWProgDocumentation.asp
- ...but... developing software to implement a 3rd party interface that had been neither developed nor tested was risky (to say the least)

- This is the 1st time EVER that messages will be put on a CHART field device without the direct approval or even overt knowledge of an operator. How do we manage our risk?

- ... and the FHwA “map” was not going away
Assumptions!

- If the 3rd party data is good, we can move automated travel times on DMS up to a non-dedicated build if:
  - Routes in CHART will be built using links that we choose
    - This will allow us to avoid obvious trouble spots for probe-based systems (e.g. welcome station on I-95 where long runs parallel to the highway may confuse the data)
  - Travel Time will run during hours of day that we choose
    - This will allow us to avoid obvious trouble spots for probe-based systems (e.g. low volume of probes between 2am and 4am)
Assumptions!

- Travel times will be displayed in ranges, not exact times
- The currently approved quality scores will be used to determine if a message is displayed
- A smoothing algorithm will be added to the travel time data received from Inrix
  - This should mitigate the severity of seriously outlying data points
Assumptions!

- If a maximum travel time threshold is received, the message will not be displayed and an alert will be set to the controlling Ops Center as well as notification to selected pager/email groups in the system.

- Travel times below a minimum will display travel time as if the speed limit were traveled.

Travel Time Settings (Edit)

- Travel Time Enabled: Yes
- Max Displayable Travel Time (mins): 25
- Min Travel Time (mins): 5
- Max # of Links Below Quality Threshold: 0
- Alert/Notification Travel Time (mins): 25
- Travel Time Alerts Enabled: Yes
- Op Ctr To Alert: SOC
- Travel Time Notifications Enabled: Yes
- Group To Notify: Travel Time Group
- 12/2007 – CHART Release 3, Build 3 changed to add Traveler Information Messages, including Travel Times and Toll Rates obtained via an external connection
- 4/2008 - I-95 Vehicle Probe Project Interface Guide (Draft) published (API)
- 4/2008 – CHART Board (Senior Traffic Operations Managers of the CHART program) briefed on assumptions of how CHART will handle the Inrix data feed
- 7/2008 – R3B3 Notice to Proceed
- 7/2008 Scope Doc/Project Plan
- 10/2008 - Updated Software Requirements
- 10/2008 – Notification by Inrix that there will be a mandatory change to one of the existing APIs for Connected Services (GetSecurityToken )
- 12/2008 - Detailed Design
- 12/2008 - “rumor” that Inrix will change the “quality” ratings in data feed
- 5/2009 – Inrix acknowledges by e-mail that new data quality score will be forthcoming, but not until June or July 2009
- 12/2009 – Inrix updated their “suite” of APIs (did NOT adversely affect us!!)
CHART Release 3, Build 3 was deployed in December 2009 and was composed of:

- Traveler Information Messages, including Travel Times and Toll Rates obtained via an external connection to the INRIX system and Vector system.

- Device Location fields to CHART devices, including DMS, TSS (Detectors), HAR, SHAZAM, and Cameras allowing the system to show devices close to traffic events to aid in event response.

- External Event Import including External Event Alert

- External DMS and TSS import from RITIS.

- Capability to manage geographical area definitions

- Direct TCP/IP communication for DMS and TSS

How Did It Turn Out?

- Privileged operators can create travel routes
How Did It Turn Out?

- For maximum flexibility, DMS Message Templates are used to define the format and layout of messages used to show travel times and/or toll rates on DMSs. Message templates target DMSs of a specific size (rows/columns) to allow layout features such as column data and to ensure messages created with the template match the layout specified by the template designer.

- Templates may contain both text and data fields. Data fields will be replaced with actual data from one or more Travel Routes when a template is used for a DMS message.

Travel Time / Toll Message Templates (1)
- Any Operator can see
  - The name and length of the route
  - The current travel time for the route
  - The current travel time trend
  - The current average speed on the route
  - The current toll rate for the route
  - The devices using the travel route
  - The roadway route(s) that are included in the travel route.
  - The roadway direction(s) that are included in the travel route.
  - The Counties that are included in the travel route.
• Travel Time started on I-95 between the beltways yesterday

• Travel Times will run 5am to 9pm weekdays
### Travel Routes (13)

<table>
<thead>
<tr>
<th>Name</th>
<th>Length</th>
<th>Trav Time</th>
<th>Trend</th>
<th>Speed</th>
<th>Toll Rate</th>
<th>Used By</th>
<th>Route / Dir</th>
<th>County</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMS 3320 to I-495</td>
<td>8.8 mi</td>
<td>11 min</td>
<td>Up</td>
<td>14:57</td>
<td>11:23</td>
<td>DMS 3320 RadioS NTCIP*</td>
<td>1-95 S</td>
<td>Prince George's County, MD</td>
</tr>
<tr>
<td>DMS 4404 to I-395</td>
<td>5.4 mi</td>
<td>6 min</td>
<td>Fix</td>
<td>14:57</td>
<td>10:49</td>
<td>DMS 4404</td>
<td>1-95 N</td>
<td>Baltimore County, MD</td>
</tr>
<tr>
<td>DMS 7701 to I-695</td>
<td>11.2 mi</td>
<td>11 min</td>
<td>Fix</td>
<td>14:57</td>
<td>10:34</td>
<td>DMS 7701</td>
<td>1-95 N</td>
<td>Baltimore County, MD</td>
</tr>
<tr>
<td>DMS 7702 to I-695</td>
<td>6.1 mi</td>
<td>6 min</td>
<td>Fix</td>
<td>14:57</td>
<td>10:59</td>
<td>DMS 7702</td>
<td>1-95 N</td>
<td>Howard County, MD</td>
</tr>
<tr>
<td>DMS 7703 to I-495</td>
<td>13.8 mi</td>
<td>17 min</td>
<td>Fix</td>
<td>14:57</td>
<td>9:16</td>
<td>DMS 7703</td>
<td>1-95 S</td>
<td>Howard County, MD</td>
</tr>
<tr>
<td>DMS 7704 to I-495</td>
<td>17.7 mi</td>
<td>20 min</td>
<td>Fix</td>
<td>14:57</td>
<td>9:00</td>
<td>DMS 7704</td>
<td>1-95 S</td>
<td>Prince George's County, MD</td>
</tr>
</tbody>
</table>
Travel Route Details: DMS 3320 to I-495

**Actions**

Remove

Back to Travel Route List

### Link Status

<table>
<thead>
<tr>
<th>Ext Sys</th>
<th>Ext ID</th>
<th>Route</th>
<th>Link Name</th>
<th>Time</th>
<th>Travel Time (mins)</th>
<th>Trnd</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>INRIX</td>
<td>110-04263</td>
<td>I-65 S HOWARD/PRINCE GEORGE'S CO LINE (LAUREL) (WEST)</td>
<td>14:59 0:32 (20)</td>
<td>Flat</td>
<td>64 mph</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INRIX</td>
<td>110-04262</td>
<td>I-65 S HWY 105/EXIT 33</td>
<td>14:59 1:03 (20)</td>
<td>Flat</td>
<td>61 mph</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INRIX</td>
<td>110N04262</td>
<td>I-65 S HWY 105/EXIT 33</td>
<td>14:59 1:41 (20)</td>
<td>Up</td>
<td>44 mph</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INRIX</td>
<td>110-04261</td>
<td>I-65 S HWY 212/EXIT 29</td>
<td>14:59 4:33 (20)</td>
<td>Up</td>
<td>40 mph</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INRIX</td>
<td>110N04261</td>
<td>I-65 S HWY 212/EXIT 29</td>
<td>14:59 0:54 (10)</td>
<td>Flat</td>
<td>59 mph</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INRIX</td>
<td>110-04260</td>
<td>I-95 S I-495/EXIT 27-25</td>
<td>14:59 0:47 (10)</td>
<td>Flat</td>
<td>61 mph</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INRIX</td>
<td>110N04260</td>
<td>I-95 S I-495/EXIT 27-25</td>
<td>14:59 1:35 (10)</td>
<td>Flat</td>
<td>58 mph</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Link Travel Time History

| Ext Sys | Ext ID  | Route                      | Link Name                        | Now   | 14:55 | 14:50 | 14:45 | 14:40 | 14:35 | 14:30 | 14:25 | 14:20 | 14:15 | 14:10 | 14:05 |
|---------|--------|----------------------------|----------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| INRIX   | 110-04263 | I-95 S HOWARD/PRINCE GEORGE'S CO LINE (LAUREL) (WEST) | 0:32 (20) | 0:30 (20) | 0:31 (20) | 0:32 (20) | 0:30 (20) | 0:31 (20) | 0:32 (20) | 0:31 (20) | 0:32 (20) | 0:31 (20) | 0:32 (20) | 0:31 (20) |
| INRIX   | 110-04262 | I-95 S HWY 105/EXIT 33    | 1:03 (20) | 1:02 (10) | 1:04 (10) | 1:05 (10) | 1:05 (10) | 1:06 (10) | 1:07 (10) | 1:07 (10) | 1:08 (10) | 1:08 (10) | 1:09 (10) | 1:09 (10) |
| INRIX   | 110N04262 | I-95 S HWY 105/EXIT 33    | 1:41 (20) | 1:38 (20) | 1:36 (20) | 1:34 (20) | 1:32 (20) | 1:32 (20) | 1:32 (20) | 1:32 (20) | 1:32 (20) | 1:32 (20) | 1:32 (20) | 1:32 (20) |
| INRIX   | 110N04261 | I-95 S HWY 212/EXIT 29  | 0:54 (20) | 0:54 (20) | 0:52 (10) | 0:52 (10) | 0:52 (10) | 0:52 (10) | 0:52 (10) | 0:52 (10) | 0:52 (10) | 0:52 (10) | 0:52 (10) | 0:52 (10) |
| INRIX   | 110-04260 | I-95 S I-495/EXIT 27-25 | 0:47 (10) | 0:47 (10) | 0:46 (10) | 0:46 (10) | 0:46 (10) | 0:46 (10) | 0:46 (10) | 0:46 (10) | 0:46 (10) | 0:46 (10) | 0:46 (10) | 0:46 (10) |
| INRIX   | 110N04260 | I-95 S I-495/EXIT 27-25 | 1:35 (10) | 1:34 (10) | 1:20 (10) | 1:19 (10) | 1:19 (10) | 1:19 (10) | 1:19 (10) | 1:19 (10) | 1:19 (10) | 1:19 (10) | 1:19 (10) | 1:19 (10) |

Route History: (1 link is only partially included)

### Link Configuration

<table>
<thead>
<tr>
<th>Ext Sys</th>
<th>Ext ID</th>
<th>Route</th>
<th>Link Name</th>
<th>Length</th>
<th>County</th>
<th>Dist From Prior</th>
</tr>
</thead>
<tbody>
<tr>
<td>INRIX</td>
<td>110-04263</td>
<td>I-65 S HOWARD/PRINCE GEORGE'S CO LINE (LAUREL) (WEST)</td>
<td>1.1 mi</td>
<td>Prince George's County, MD</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>INRIX</td>
<td>110-04262</td>
<td>I-65 S HWY 105/EXIT 33</td>
<td>1.1 mi</td>
<td>Prince George's County, MD</td>
<td>0.0 mi</td>
<td></td>
</tr>
<tr>
<td>INRIX</td>
<td>110N04262</td>
<td>I-65 S HWY 105/EXIT 33</td>
<td>1.2 mi</td>
<td>Prince George's County, MD</td>
<td>0.0 mi</td>
<td></td>
</tr>
<tr>
<td>INRIX</td>
<td>110-04261</td>
<td>I-65 S HWY 212/EXIT 29</td>
<td>2.9 mi</td>
<td>Prince George's County, MD</td>
<td>0.0 mi</td>
<td></td>
</tr>
<tr>
<td>INRIX</td>
<td>110N04261</td>
<td>I-65 S HWY 212/EXIT 29</td>
<td>0.8 mi</td>
<td>Prince George's County, MD</td>
<td>0.0 mi</td>
<td></td>
</tr>
<tr>
<td>INRIX</td>
<td>110-04260</td>
<td>I-95 S I-495/EXIT 27-25</td>
<td>0.9 mi</td>
<td>Prince George's County, MD</td>
<td>0.0 mi</td>
<td></td>
</tr>
<tr>
<td>INRIX</td>
<td>110N04260</td>
<td>I-95 S I-495/EXIT 27-25</td>
<td>1.5 mi</td>
<td>Prince George's County, MD</td>
<td>0.0 mi</td>
<td></td>
</tr>
</tbody>
</table>
Toll Rate Configuration

<table>
<thead>
<tr>
<th>Ext Sys</th>
<th>Start Id</th>
<th>End Id</th>
<th>Description</th>
<th>Add Toll Rate Source</th>
</tr>
</thead>
</table>

**General Settings** *(Edit)*
- **Name:** DMS 3320 to I-495
- **Destination (preferred):** Ex 27 I-495
- **Destination (option 1):** I-495
- **Destination (option 2):** 495

**Location Settings** *(Edit)*
- **Source:** Derived from Links
- **Counties:** Prince George’s County, MD
- **Routes:** I-95 S
- **Directions:** South
- **Length:** 8.8 mi

**Travel Time Settings** *(Edit)*
- **Travel Time Enabled:** Yes
- **Max Displayable Travel Time (mins):** 27
- **Min Travel Time (mins):** 9
- **Max # of Links Below Quality Threshold:** 5
- **Alert/Notification Travel Time (mins):** None
- **Travel Time Alerts Enabled:** No
- **Travel Time Notifications Enabled:** No

**Toll Rate Settings**
- N/A (must select a toll rate source first)