Weather Responsive Traffic Management in Maryland

Richard R. Dye
Maryland State Highway Administration
RWIS Grew From Ever Increasing Cost of Winter Operations $$ $$

- Pilot Program in 1993 installed 4 sites on Capital Beltway and I-270.
- Evaluated through 2 winters (better focus of plow/salt as well as better call-out vs. standby)
- CHART Program ITS device build out installed 43 locations from 1995-1996
- Statewide system now has 62 locations
Maryland State Highway Administration

CHART Grew From Reach the Beach

- 1988
  - State Highway
  - State Police

- 1995
  - Statewide Operations Center
  - 2 Remote Traffic Operations Centers
  - MdTA AOC

- Late 1990’s
  - Started consolidating development of ATMS Systems with Emergency Operations Systems

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These Systems Quickly Grew Beyond their Limited Beginnings

- **1999**
  - CHART on the Web (First in the nation and still one of the only 24 x 7 live streaming video sites ~ 1M page views a week)

- **2001 - 2004**
  - ATMS Event-Based Control (allows multi-TOC Operations)
  - ATMS Arbitration Queue (allows automated sharing of devices)
  - NTCIP for DMS
  - ATMS and Emergency Systems moved to Web-based GUIs
  - Fog Detection and Traveler Advisory warning signs in Western MD
  - Text Alerts for Low Visibility to locations in areas susceptible to Fog
  - 2 Automated Bridge Sprayer systems in Western Maryland
  - Wind monitoring on Thomas Johnson Bridge – Wireless Anemometer
These Systems Quickly Grew Beyond their Limited Beginnings

- 2005 - 2010
  - Multicast Video (allows Multi-TOC and Multi Agency Control
  - MDOT replaces WAN with gigabit ethernet.
  - Integrated Notification
  - Real-time External Traffic Management Center Data Feed to DC and VDOT (MATOC / RITIS allows multi-State Operations – MDOT Connection to 3rd Party more important than ever)
  - Scanweb RWIS data display and dissemination platform: SSI Polling, Database and Scanweb software
  - Provide data to Clarus and MADIS
  - Provide data to Telvent DTN weather forecast provider. Integrated into weather forecast and monitoring software

- CHART Web displays all Atmospheric data and Pavement Temp
- CHART Web provides archived data files for stations for public download and analysis
Maryland State Highway Administration

What’s new for 2011 and beyond?

• 2011
  – Emergency Operations Reporting System (EORS) now inserts and stores pavement temperatures for each shop report during winter events.
  – Statewide Summary reports now list pavement temperatures as part of weather information
  – CHART ATMS software integrates closest RWIS data automatically into Incident reports
  – RWIS hardware moving from SSI to Lufft
  – Polling software transitions to Lufft
### Maryland State Highway Administration

**SCAN Web**

**MSHA District 4**

**I-83@MD-137 (S5000)**

**Site Status**

**Current Time:** 09/19/2011 17:04 EDT

**Data Time:** 09/19/2011 17:02 EDT

<table>
<thead>
<tr>
<th>Air Data</th>
<th>Wind Data</th>
<th>Visibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temp</td>
<td>RH</td>
<td>Dew Point</td>
</tr>
<tr>
<td>65°F</td>
<td>67%</td>
<td>54°F</td>
</tr>
</tbody>
</table>

### Precipitation

<table>
<thead>
<tr>
<th>Type</th>
<th>Intensity</th>
<th>Rate</th>
<th>Last Precipitation Period</th>
<th>Accumulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>None</td>
<td>0.0 ph</td>
<td>09/17/2011 14:41</td>
<td>0.00 in</td>
</tr>
</tbody>
</table>

### Surface Data

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Status</th>
<th>Date Time</th>
<th>Cond</th>
<th>Temp</th>
<th>Humidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>83 SB (0)</td>
<td>Dry</td>
<td>09/18/2011 17:01</td>
<td>-</td>
<td>85°F</td>
<td>-</td>
</tr>
<tr>
<td>137 WB Br (1)</td>
<td>Dry</td>
<td>09/18/2011 17:01</td>
<td>-</td>
<td>86°F</td>
<td>-</td>
</tr>
<tr>
<td>137 WB (2)</td>
<td>Dry</td>
<td>09/18/2011 17:01</td>
<td>-</td>
<td>85°F</td>
<td>-</td>
</tr>
</tbody>
</table>

### Subsurface Data

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Temp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Sensor (C)</td>
<td>75°F</td>
</tr>
</tbody>
</table>

### Video

09/19/2011 16:51

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**Next Poll:** 2011/09/19 15:00:00

**Water Film**

- 2011/09/19 14:55:00
  - 79.00

**Water Film Height**

<table>
<thead>
<tr>
<th>Date Time</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011/09/19 14:55:00</td>
<td>79.00</td>
</tr>
</tbody>
</table>

**Precipitation Type**

- 2011/09/19 14:55:00
  - 0.00 no precipitation

**Air Temperature**

- 2011/09/19 14:55:00
  - 66.87°F

**Relative Humidity**

- 2011/09/19 14:55:00
  - 63.80%

**Absolute Air Pressure**

- 2011/09/19 14:55:00
  - 1003.10 hPa

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9 Detailed Design – SCAN Weather Integrations

9.1 Human-Machine Interface

Weather Integration

Traffic Event Details Page

When a Traffic Event is created where an operator can select Roadway Conditions (currently Incidents and Weather Events) the Roadway Conditions section of the Traffic Event Details page will now be automatically populated.

To populate the Road Surface Condition field, the system will select data from the nearest weather station if three criteria are met: 1) the weather station must be within a given radius of the event and 2) its data must be no older than a given age and 3) the weather station must have at least one roadway sensor. Both the radius and maximum data age will be configurable via System Profile settings.

If a weather station is identified that meets these criteria, the Road Surface Condition field is assigned by matching the traffic event’s roadway and direction to the roadway and direction of the weather station’s roadway sensors. This matching is accomplished according to the following algorithm:

1) Select all roadway sensors whose roadway and direction match the traffic event
2) If none, select all roadway sensors whose roadway matches the traffic event
3) If none, select all roadway sensors
Once the (possibly empty) set of sensors is collected, the traffic event’s Road Surface Condition is assigned the worst surface condition in the set according to this list of increasingly worse conditions:

1) UNSPECIFIED
2) DRY
3) WET
4) CHEMICALLY WET
5) ICE OR SNOW

If an automatic selection is made, other relevant weather conditions from the weather station will also be displayed. The information shown represents a snapshot of the weather data from the time when the automatic selection was made.
The user can override the automatically-selected Road Surface Condition by making another selection; however, the Nearby Wx Station information will still be displayed.

(Normally the automatic selection will appear as soon as the traffic event is created, but if the call to get the weather information takes longer than a configurable about of time, this information may be filled in after event creation, in which case it would appear on the next page refresh. The amount of time will be configurable via a System Profile setting. This mechanism will prevent excessive delays while creating Incidents or Weather Service Events if there is a problem getting the data.)

If the system is able to set the Road Surface Condition according to the criteria described above, then it will record this in the traffic event history log. Similarly when a traffic event that supports Roadway Conditions is closed, a separate Roadway Conditions history log entry will be made. Because the same algorithm is applied at event closure, it is possible a different roadway sensor may be used than at event creation (e.g. if the traffic event location or weather system configuration has changed in the interim).
Maryland State Highway Administration

Current Users of CHART
(Over 36 agencies in over 80 operations centers)

Partners

Transportation Management

CHART Statewide Operations Center
CHART DC Region Traffic Center
CHART Baltimore Region Traffic Ctr
CHART Annapolis Region Traffic Ctr
Bay Bridge Traffic Operations Center
Authority Operations Center
Montgomery County Traffic Center
Prince George's County Traffic Center
Anne Arundel County Traffic
BWI Airport Operations
Northern Virginia DOT Traffic Center
Washington DC Traffic Mgt Center
Ravens Traffic Operations Center
Redskins Traffic Operations Center
Baltimore City DOT

Law Enforcement

Baltimore County Police
Maryland State Police Barracks - Annapolis
Maryland State Police Barracks - Rockville
Maryland State Police Barracks - Forestville
Maryland State Police Barracks - Golden Ring
Maryland State Police Barracks - College Park
Maryland State Police Barracks – Waterloo
Maryland State Police Barracks – Glen Burnie
US Park Police (Greenbelt)
Maryland Transportation Authority Police
Baltimore City Police Department

Highway Maintenance

Dayton Shop
Owings Mills Shop
Laurel Shop
Fairland Shop
Annapolis Shop
Gaithersburg Shop
Golden Ring Shop
Upper Marlborough Shop
Harford Shop

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(Over 36 agencies in over 80 operations centers)

Partners (Continued)

Emergency Operations

Information Share / Lab

Device Maintenance

- SHA Wash DC Region Emergency Operations Center
- SHA Baltimore Region Emergency Operations Center
- SHA Annapolis Region Emergency Operations Center
- Maryland Emergency Management Agency
- Maryland Emergency Medical Services (Ambulance)
- Harford County EOC / 911
- Howard County EOC / 911
- Anne Arundel County Fire Dispatch (Soon EOC)
- Baltimore County EOC (Soon PD/Fire/911)

- Network Operations Center
- Traffic Signal Repair Shop
- Radio and Camera Repair Shop
- Dynamic Message Sign Repair Shop
- University of Maryland Center for Advanced Transportation Technology Lab
Types of Events

- There are eight types of events available in the CHART system:
  - Action Event
  - Congestion Event
  - Disabled Vehicle Event
  - Incident Event
  - Planned Roadway Closure Event
  - Safety Message Event
  - Special Event
  - Weather Event
## Incident @ I-270 SOUTH PRIOR TO EXIT 5 MD 189 FALLS RD [Disabled In Roadway]

### General Event Information (Edit)
- **Event Name**: Incident @ I-270 SOUTH PRIOR TO EXIT 5 MD 189 FALLS RD [Disabled In Roadway]
- **Source**: CHART Unit (9307)
- **Regional**: MD (channel)
- **Queue (mi)**: 0.5
- **Opened**: 14:50
- **Confirmed**: 14:50
- **Delay Cleared**: No
- **Scene Cleared**: No
- **Est. Hours To Clear**: Unknown
- **Op Center POC**: Unknown
- **On Scene POC**: Unknown
- **Comments**: Unknown
- **Open Event Remind Time**: 16:50
- **Owning Organization**: Unknown
- **Web Alert**: NOT ENABLED

### Location Information (Edit) (Show on Map)
- **Location Description**: I-270 SOUTH PRIOR TO EXIT 5 MD 189 FALLS RD
- **County**: Montgomery County
- **State**: MARYLAND
- **Route Type**: Interstate
- **Route**: I-270
- **Direction**: south
- **Point Along Roadway**: PRIOR EXIT 5 - MD 189 FALLS RD
- **Lat/Long**: 39.073996° N, 77.164472° W (Intersection data - GIS Lookup)
Incident Information

Incident Type: Disabled In Roadway

HAZMAT: YES

Vehicle Count

<table>
<thead>
<tr>
<th>Involved</th>
<th>Overturned</th>
<th>Lost Load</th>
<th>Jack-Knifed</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Unit Truck</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

TMDD Vehicle Count: 1 Truck

Edit Incident Info False Alarm

Roadway Conditions

Direction: South
Road Surface Condition: Dry

Nearby Wx Station: Location: I-270 @ I-370; Distance: 3.7 mi; Surface Condition: DRY; Air Temp: 69 F; Precip Type/Intensity: None/None; VIS: 1.1 mi; Wind: 0 MPH W; System: SCAN; 9/19/2011 2:45:36 PM

<table>
<thead>
<tr>
<th>Location</th>
<th>Route / Direction</th>
<th>Surface Condition</th>
<th>Surface Temp</th>
</tr>
</thead>
<tbody>
<tr>
<td>370 EB Ramp</td>
<td>1-370 EAST</td>
<td>DRY</td>
<td>79 F</td>
</tr>
<tr>
<td>270 NB</td>
<td>1-270 NORTH</td>
<td>DRY</td>
<td>61 F</td>
</tr>
<tr>
<td>270 NE Br</td>
<td>1-270 NORTH</td>
<td>UNSPECIFIED</td>
<td>-00 F</td>
</tr>
<tr>
<td>370 EB</td>
<td>1-370 EAST</td>
<td>DRY</td>
<td>115 F</td>
</tr>
</tbody>
</table>

Edit Road Configuration False Alarm

Road Configuration Description: 4 Traffic Lanes and 2 Collector / Distributors in each direction, with shoulders and median.

Lane Closure Description: 2/6 Southbound-2 right Traffic Lanes closed
(For Notification): 2/6 South-2 Right lanes closed
### Participation

<table>
<thead>
<tr>
<th>Participant</th>
<th>Type</th>
<th>Notified</th>
<th>Arrived / Responded</th>
<th>Departed</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHART Unit 9300</td>
<td>CHART Unit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHART Unit 9307</td>
<td>CHART Unit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fireboard</td>
<td>Agency</td>
<td></td>
<td>14:55</td>
<td></td>
</tr>
<tr>
<td>HazMat</td>
<td>Special Needs</td>
<td></td>
<td>14:30</td>
<td></td>
</tr>
</tbody>
</table>

### Device(s) Within 3 Miles (33) Show

### Response

#### Add Items To Response Plan

- Search: AFDMs, HARs and Plans
- For
- Search

- Select DMSs
- Select HARs
- Select Plan

#### Response Plan

<table>
<thead>
<tr>
<th>Device</th>
<th>Proposed Message</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>3303</td>
<td>ACCIDENT I-270 SOUTH PRIOR EXIT 5 MD 189 2 RIGHT LANE BLOCKED</td>
<td>Executed</td>
</tr>
<tr>
<td>8303</td>
<td>ACCIDENT I-270 SOUTH PRIOR EXIT 5 MD 189 2 RIGHT LANE BLOCKED</td>
<td>Executed</td>
</tr>
</tbody>
</table>

- Edit DMS (Auto) / Edit DMS (Manual)
- Execute
- Revoked Execution
- Remove

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Incident - Weather Closure, High Water @ I-95 NORTH PRIOR TO MD 198

Source: State Police (Q)

Location: I-95 NORTH PRIOR TO MD 198

Direction: North

Start date: Sep 8, 2011 6:19:41 PM

Confirmed date: Sep 8, 2011 6:19:41 PM

End date: Sep 8, 2011 8:45:53 PM

Duration: 2 hours 26 minutes

Vehicles involved
### Log entries (17)

<table>
<thead>
<tr>
<th>Log time</th>
<th>Center</th>
<th>Author</th>
<th>Log entry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sep 8, 2011 6:19:41 PM</td>
<td>TOC3</td>
<td>fluck</td>
<td>Confirmed flag set to true</td>
</tr>
<tr>
<td>Sep 8, 2011 6:19:41 PM</td>
<td>TOC3</td>
<td>fluck</td>
<td>Confirmed time set to Thu Sep 08 18:19:41 EDT 2011</td>
</tr>
<tr>
<td>Sep 8, 2011 6:19:41 PM</td>
<td>TOC3</td>
<td>fluck</td>
<td>County Code: &quot;to '16'. County FIPS Code: &quot;to '033'. County Name: &quot;to 'Prince George's County'. Location Text: &quot;to 'I-95 NORTH PRIOR TO MD 198'. USPS State Code: &quot;to 'MD'. State FIPS Code: &quot;to '24'. Route Specification Type: &quot;to '0'. Route Type: &quot;to '0'. Road Name: &quot;to 'CAP BELT IL HY'. Route Prefix: &quot;to 'I'. Route Number: &quot;to '95'. Direction Code: &quot;to '2'. Intersecting Feature Type: &quot;to '0'. Intersecting Feature Proximity: '9' to '2'. Intersecting Route Specification Type: &quot;to '0'. Intersecting Route Type: &quot;to '1'. Intersecting Road Name: &quot;to 'SANDY SPRING RD'. Intersecting Route Prefix: &quot;to 'MD'. Intersecting Route Number: &quot;to '198'. State Full Name: &quot;to 'MARYLAND'. Latitude: &quot;to '39099805'. Longitude: &quot;to '-76889703'. Geolocation Source Type: &quot;to '1'. Geolocation Source Desc: &quot;to 'GIS Lookup'. Show Route Name Flag: &quot;to '0'. Show Intersecting Route Name Flag: &quot;to '0'.</td>
</tr>
<tr>
<td>Sep 8, 2011 6:19:41 PM</td>
<td>TOC3</td>
<td>fluck</td>
<td>Incident type set to Weather Closure, High Water</td>
</tr>
<tr>
<td>Sep 8, 2011 6:19:41 PM</td>
<td>TOC3</td>
<td>fluck</td>
<td>Road condition set to Wet</td>
</tr>
<tr>
<td>Sep 8, 2011 6:19:41 PM</td>
<td>TOC3</td>
<td>fluck</td>
<td>Road condition supplied by weather web service:Wet</td>
</tr>
<tr>
<td>Sep 8, 2011 6:19:41 PM</td>
<td>TOC3</td>
<td>fluck</td>
<td>Source set to 'State Police (Q)'</td>
</tr>
<tr>
<td>Sep 8, 2011 6:19:41 PM</td>
<td>TOC3</td>
<td>fluck</td>
<td>Traffic Event &quot;Incident @ I-95 NORTH PRIOR TO MD 198 [Weather Closure, High Water]&quot; opened.</td>
</tr>
<tr>
<td>Date/Time</td>
<td>TOC</td>
<td>Participator</td>
<td>Message</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----</td>
<td>---------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Sep 8, 2011 6:20:18 PM</td>
<td>TOC</td>
<td>fluck</td>
<td>&quot;CHART Unit 9307&quot; participation added</td>
</tr>
<tr>
<td>Sep 8, 2011 6:20:18 PM</td>
<td>TOC</td>
<td>CHARTLite</td>
<td>'CHART Unit 9307' notified flag set to 'true'</td>
</tr>
<tr>
<td>Sep 8, 2011 7:52:30 PM</td>
<td>TOC</td>
<td>ncooksey</td>
<td>HIGH WATER IS DUE TO ROAD MILLING FOR ICC PROJECT</td>
</tr>
<tr>
<td>Sep 8, 2011 8:01:37 PM</td>
<td>TOC</td>
<td>ncooksey</td>
<td>&quot;MARK COBLENZ ICC&quot; participation added</td>
</tr>
<tr>
<td>Sep 8, 2011 8:01:37 PM</td>
<td>TOC</td>
<td>CHARTLite</td>
<td>'MARK COBLENZ ICC' notified flag set to 'true'</td>
</tr>
<tr>
<td>Sep 8, 2011 8:45:53 PM</td>
<td>TOC</td>
<td>ncooksey</td>
<td>Road condition supplied by weather web service: Wet</td>
</tr>
<tr>
<td>Sep 8, 2011 8:45:53 PM</td>
<td>TOC</td>
<td>ncooksey</td>
<td>Traffic event closed</td>
</tr>
</tbody>
</table>