Satellite Services Enable Rural Intellidrive Applications

National Rural ITS Conference
Seaside, Oregon
August 23 – 27

Ralph Robinson
ITS Integration Office
University of Michigan Transportation Research Institute
Ralphrob@umich.edu
(734) 764-2181
Rural Applications

- **Driver safety information**
  - Icy bridge ahead

- **Driver alerts and warnings**
  - Too fast for upcoming stop sign

- **Traveler Information**
  - Local facilities (location, availability)

- **Incident Detection**
  - Road blockages

- **Commercial transactions**
  - Freight hauling safety inspections
Driver Safety Information

- Safety warnings/alerts
  - Stop Sign Violation
  - Road Closed – Detour
  - Curve Speed Warning
  - School zone warning
  - Avalanche Area
  - Rail Crossing Alert
  - Work Zone Warnings
  - Icy Bridge warning
  - Animal in Roadway Alert

- Driver In-vehicle Signage helps in
  - Fog
  - Heavy Rain
  - Snow white outs
  - Truck blocking view
  - Sun blindness
Traveler Information

- Location based traveler information assists tourists with area information
  - National/State park information
  - Parking and ride Sharing
  - Rest Areas
  - Gasoline Stations
  - Recreational facilities
  - Medical facilities

- May be commercial application provided by third party
Location-based Applications

- Most information provided to the driver is location-based where the driver is given information when it is needed
- An on-board GIS map database would contain this pertinent information
  - An on-board map may contain a stop sign placed at an intersection
  - The system informs the driver if the vehicle is approaching too fast to stop safely
MAP Contents

- The onboard map is a digital representation of the roadway infrastructure with situational information
  - Interconnecting links for navigation and routing
  - Road geometry: lanes, merge lanes, lane widths
  - Movement restrictions: stop sign locations, one-way streets, right/left turn prohibitions, speed limits, etc.

- Map overlays
  - Foul weather zones
  - Incident locations, type, time of occurrence, time to clear
Map Update and Delivery

- Map contents are updated by local TOCs and sent to a broadcaster for delivery.
- Vehicle receivers select and store the section of map or map overlays surrounding their vehicle location.
- As a vehicle progresses, new sections of map are added, over-writing older sections that are no longer needed.
- Updated maps can be distributed by any wireless data channel available: satellite, cellular, DSRC, etc.
Dynamic Map Information

- The TOCs must have the opportunity to get some location based information to affected drivers quickly (5 minutes?)
  - Violent weather alerts
  - Evacuation announcements
  - Incident notifications
- Some information may be changed more slowly
  - Construction work zone locations and times
  - Road blockages
  - Planned event congestion management
- Variable response times are weighted with priority levels
Dynamic Content Updates

- Dynamic content is broadcast as independent layers
- Fast changing layers with high priority is broadcast more often than slowly changing information with low priority
- An optimal system design will trade-off bandwidth, number of channels used, database sizes and needed response
Connectivity

Government Transportation Operations Centers

Network Operations

GIS Map data
DGPS corrections
Security Certificates

Sirus XM Satellite System

DSRC

Cellular Communication System

May Day Alerts

Probe data
Route guidance
Fee transactions

The Science of Driving
## Wireless Coverage

<table>
<thead>
<tr>
<th>Service</th>
<th>DSRC</th>
<th>Cellular</th>
<th>Satellite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active Safety</td>
<td>X</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>Driver Safety Information</td>
<td>O</td>
<td>O</td>
<td>X</td>
</tr>
<tr>
<td>Driver Warnings</td>
<td>O</td>
<td>O</td>
<td>X</td>
</tr>
<tr>
<td>Traveler Information</td>
<td>O</td>
<td>O</td>
<td>X</td>
</tr>
<tr>
<td>System information</td>
<td>O</td>
<td>O</td>
<td>X</td>
</tr>
<tr>
<td>MAP Updates</td>
<td>O</td>
<td>O</td>
<td>X</td>
</tr>
<tr>
<td>Commercial Transactions</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Probe Data</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Fee-based transactions</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
# Wireless Coverage

<table>
<thead>
<tr>
<th></th>
<th>DSRC</th>
<th>Cellular</th>
<th>Satellite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active Safety</td>
<td>X</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Driver Safety Information</td>
<td>O</td>
<td>O</td>
<td>X</td>
</tr>
<tr>
<td>Driver Warnings</td>
<td>O</td>
<td>O</td>
<td>X</td>
</tr>
<tr>
<td>Traveler Information</td>
<td>O</td>
<td>O</td>
<td>X</td>
</tr>
<tr>
<td>System Information</td>
<td>O</td>
<td>O</td>
<td>X</td>
</tr>
<tr>
<td>MAP Updates</td>
<td>O</td>
<td>O</td>
<td>X</td>
</tr>
<tr>
<td>Commercial Transactions</td>
<td>X</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>Probe Data</td>
<td>X</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>Fee-based transactions</td>
<td>X</td>
<td>X</td>
<td>-</td>
</tr>
</tbody>
</table>
## Wireless Coverage

<table>
<thead>
<tr>
<th>Service</th>
<th>DSRC</th>
<th>Cellular</th>
<th>Satellite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active Safety</td>
<td>X</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Driver Safety Information</td>
<td>O</td>
<td>O</td>
<td>X</td>
</tr>
<tr>
<td>Driver Warnings</td>
<td>O</td>
<td>O</td>
<td>X</td>
</tr>
<tr>
<td>Traveler Information</td>
<td>O</td>
<td>O</td>
<td>X</td>
</tr>
<tr>
<td>System information</td>
<td>O</td>
<td>O</td>
<td>X</td>
</tr>
<tr>
<td>MAP Updates</td>
<td>O</td>
<td>O</td>
<td>X</td>
</tr>
<tr>
<td>Commercial Transactions</td>
<td>X</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>Probe Data</td>
<td>X</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>Fee-based transactions</td>
<td>X</td>
<td>X</td>
<td>-</td>
</tr>
</tbody>
</table>
## Wireless Coverage

<table>
<thead>
<tr>
<th>Service Type</th>
<th>DSRC</th>
<th>Cellular</th>
<th>Satellite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active Safety</td>
<td>X</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Driver Safety Information</td>
<td>O</td>
<td>O</td>
<td>X</td>
</tr>
<tr>
<td>Driver Warnings</td>
<td>O</td>
<td>O</td>
<td>X</td>
</tr>
<tr>
<td>Traveler Information</td>
<td>O</td>
<td>O</td>
<td>X</td>
</tr>
<tr>
<td>System information</td>
<td>O</td>
<td>O</td>
<td>X</td>
</tr>
<tr>
<td>MAP Updates</td>
<td>O</td>
<td>O</td>
<td>X</td>
</tr>
<tr>
<td>Commercial Transactions</td>
<td>X</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>Probe Data</td>
<td>X</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>Fee-based transactions</td>
<td>X</td>
<td>X</td>
<td>-</td>
</tr>
</tbody>
</table>

*Note: X indicates availability, O indicates availability.*
Sirius XM Broadcast Services

- Every car company offers Sirius XM as a standard or an option
- Over 130+ audio stations plus infotainment services broadcast 24/7
- Three Sirius geosynchronous operating satellites; Two XM geostationary satellites
- Signal augmented with hundreds of terrestrial repeaters
- 90% of OEMs have launched Sirius XM Traffic data service since 2006
- Other infotainment services -- Weather, sports, gasoline prices etc -- have been offered by multiple OEMs since 2008.
- Similar to Intellidrive Driver Info apps
Sirius XM Weather Application

- Bushnell desktop 5 day Weather forecaster - $59
- Sirius XM receiver
- Similar to 2010 Lincoln weather service
- Emergency alerts
Conclusion

- Broadcasting driver information via satellite adds considerable capability to the Intellidrive architecture
- On-board map facilitates most Intellidrive mobility apps
- By leveraging existing systems and components, some applications can be launched within two years and cover the entire geographical area of the US
- Sirius XM is a partner in the Rural Intellidrive Model Deployment Program seeking Tiger Grant (Stimulus) Funding