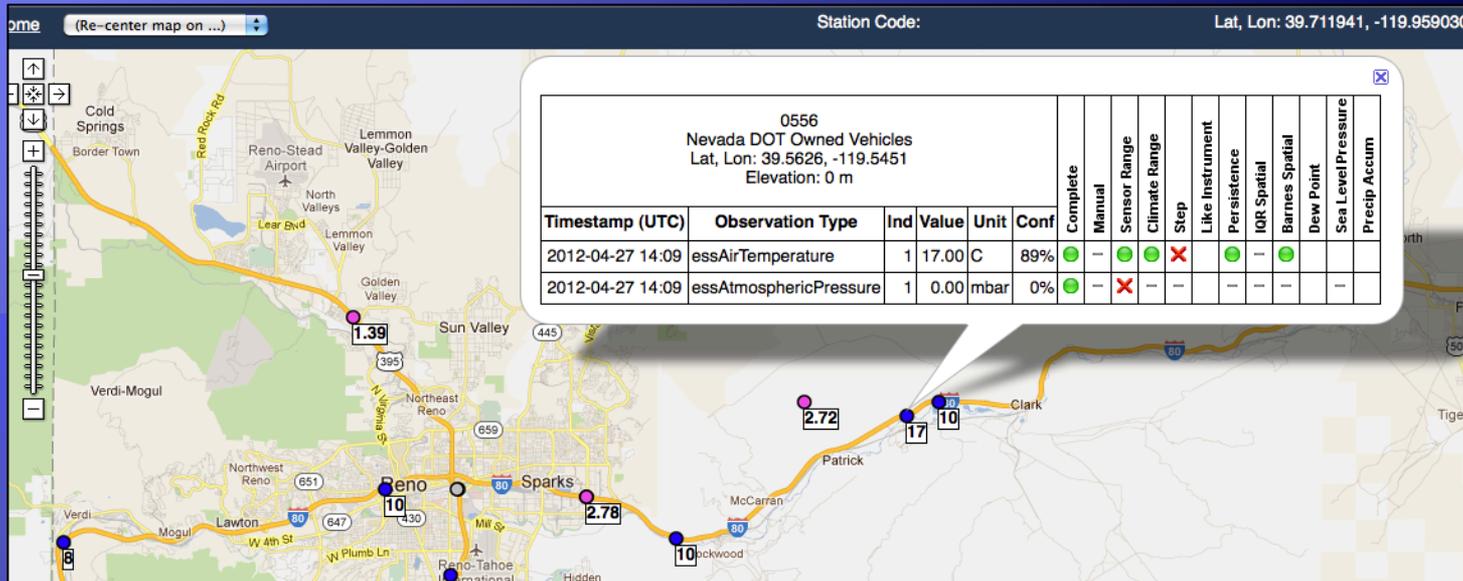


# Road Weather Management Stakeholders Meeting Nevada IMO 2.0



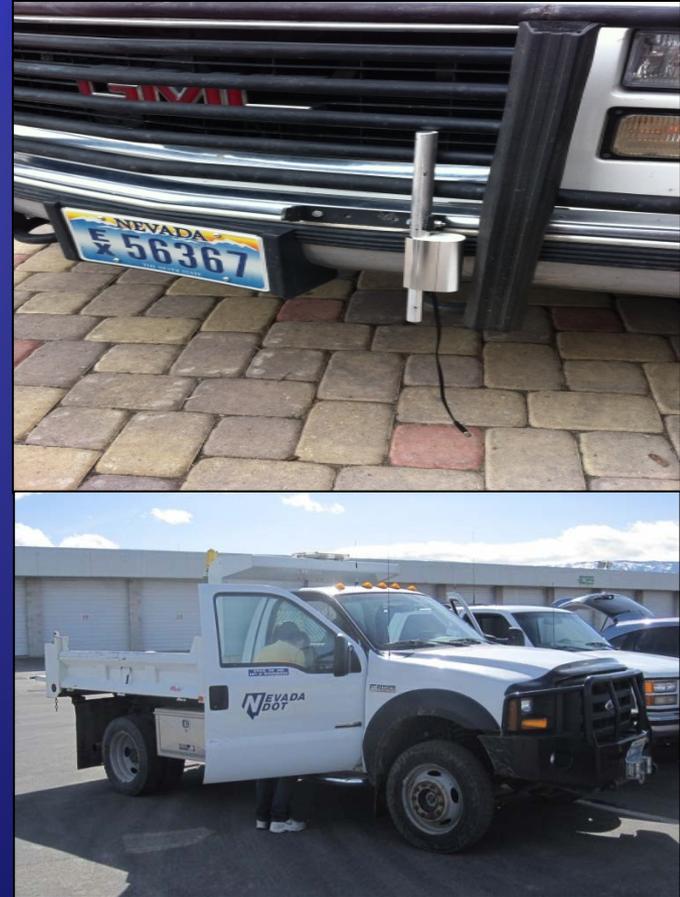
July 16-18, 2013  
Little Rock, Arkansas



- ◆ Federal initiative promoting safety, mobility & productivity in transportation through Road Wx research
- ◆ Nevada is striving to provide a safe and reliable transportation system to drivers

# Evaluating Data & Communication Methods Via Multiple Projects

- ◆ IMO 1.0
- ◆ IMO 2.0
- ◆ IMO Telemetry
- ◆ MDSS



# NIMO 1.0

- ◆ Develop communications utilizing the existing 800 MHz radio/EDACS system
- ◆ Connect 20 vehicles along the I80 corridor
- ◆ Capture weather and equipment related status for use by NDOT
- ◆ Project complete, although data is still being gathered on all equipped vehicles

# NIMO Telemetry

- ◆ Evaluate communication methods with greater bandwidth for gathering mobile observations
- ◆ Develop a system that will allow multiple transmission modes
- ◆ Agreement fully executed. Work will be scheduled to complement IMO 2.0

# Nevada IMO 2.0 Vehicle Hardware

## Objectives of Next Generation Hardware

- ◆ **Weather Data:** Gather and report weather data for use in practical applications.
- ◆ **Maintenance Data:** gather and report vehicle status data and road maintenance information.
- ◆ **Low cost hardware** explore cost vs. data quality and minimum per-vehicle installation costs.
- ◆ **Flexible data telemetry** (cellular, EDACS radio, WiFi, satellite, etc.)

# Nevada IMO 2.0 System Framework

Cellular

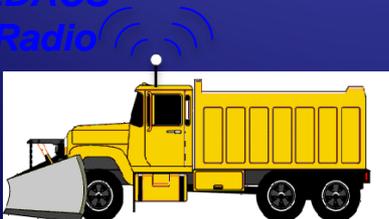


## PRIORITIZED MODE-SWITCHING TELEMETRY

- Cellular when available
- EDACS when cellular not available (rural)
- Store-and-forward when necessary

EDACS

Radio



## MULTI-MODE RECEIVING STATION

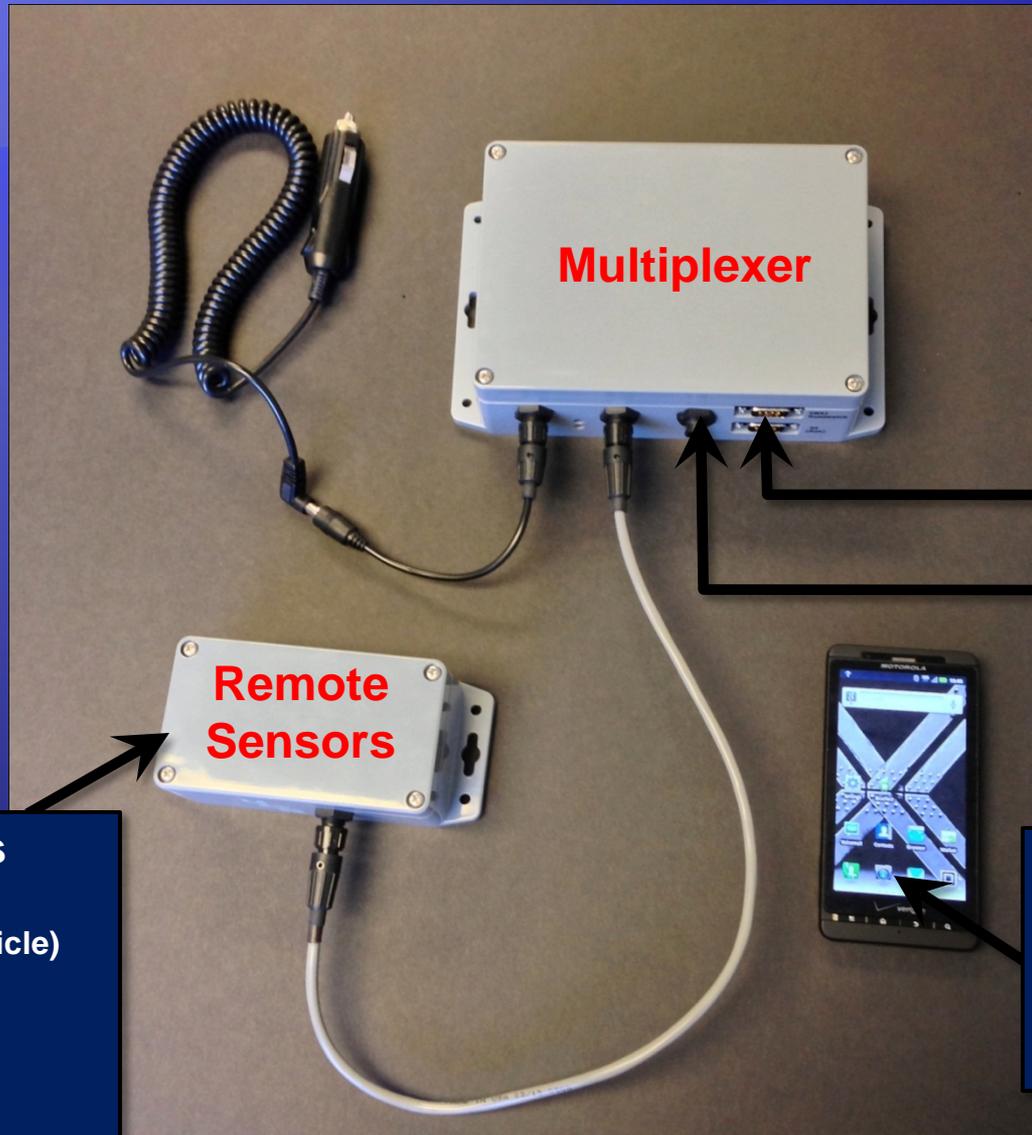
- Receives data from mobile stations
  - Cellular
  - EDACS radio
- Archives and forwards data



## APPLICATIONS



# Nevada IMO 2.0 Vehicle Hardware



## Off-the-Shelf Serial Devices:

### Road Watch

- Air Temperature
- Surface Temperature

### Also useable for:

- Vaisala Surface Patrol
- OBD Scan Tools
- EDACS Radios

## Custom Sensors:

### Pulse Counters

- Spreader shaft speed

## Weather Sensors

### (I2C)

(remote mount on vehicle)

- Air Temperature
- Barometric Pressure
- Relative Humidity
- Dew Point

## Main Processor

(Android-OS Cellular Phone)

- GPS (location, time)
- Cellular data link
- Accelerometers
- Compass

# NIMO 2.0 HTML Grid Display

| Vehicle | Home Location | Date       | Time [UTC] | Speed [m/s]  |         | Road Temp [°C]      | Air Temp [°C] |                     |         |         |        | Pressure [kPa] |         |         |        | Humidity [%] |         |         |        |
|---------|---------------|------------|------------|--------------|---------|---------------------|---------------|---------------------|---------|---------|--------|----------------|---------|---------|--------|--------------|---------|---------|--------|
|         |               |            |            | GPS / Airmar | Canbus  | Roadwatch / Vaisala | Airmar        | Roadwatch / Vaisala | Canbus  | Omega   | UNR WX | Airmar         | Canbus  | Omega   | UNR WX | Airmar       | Vaisala | Omega   | UNR WX |
| 3319    | Reno          | 06/15/2013 | 00:40:42   | 0            | 0       | 19                  | N/A           | 18 [RW]             | 16      | N/A     | N/A    | N/A            | 86      | N/A     | N/A    | N/A          | N/A     | N/A     | N/A    |
| 3320    | Reno          | 05/30/2013 | 14:16:02   | 0            | 0       | 13                  | N/A           | 11 [RW]             | 11      | 23      | N/A    | N/A            | 86      | 86      | N/A    | N/A          | N/A     | Err     | N/A    |
| 0702    | Lovelock      | 05/30/2013 | 15:26:08   | 28           | 29      | 24                  | 14            | 16 [RW]             | 16      | N/A     | N/A    | 88             | 88      | N/A     | N/A    | 10           | N/A     | N/A     | N/A    |
| 0682    | Elko          | 06/27/2013 | 20:11:40   | 0            | Err     | 53                  | N/A           | 36 [RW]             | Err     | No Data | N/A    | N/A            | Err     | No Data | N/A    | N/A          | N/A     | No Data | N/A    |
| 0684    | Wells         | 06/07/2013 | 20:52:57   | 33           | 34      | 51                  | 31            | 32 [RW]             | 33      | N/A     | N/A    | 84             | 84      | N/A     | N/A    | Err          | N/A     | N/A     | N/A    |
| 0706    | Wendover      | 05/21/2012 | 19:14:46   | Err          | Err     | Err                 | Err           | Err [RW]            | Err     | N/A     | N/A    | Err            | Err     | N/A     | N/A    | Err          | N/A     | N/A     | N/A    |
| 0752    | Wendover      | 05/08/2012 | 17:55:30   | 0            | N/A     | 38                  | 19            | 24 [RW]             | N/A     | N/A     | N/A    | 102            | N/A     | N/A     | N/A    | 8            | N/A     | N/A     | N/A    |
| 0671    | Elko          | 07/02/2013 | 21:41:55   | Err          | 0       | 22                  | 26            | 25 [RW]             | 20      | N/A     | N/A    | 85             | 84      | N/A     | N/A    | Err          | N/A     | N/A     | N/A    |
| 1327    | Reno          | 07/02/2013 | 21:50:26   | 0            | 0       | 47                  | 40            | 37 [RW]             | Err     | N/A     | N/A    | 102            | 86      | N/A     | N/A    | Err          | N/A     | N/A     | N/A    |
| 0339    | Fernley       | 04/30/2013 | 16:38:16   | 0            | 0       | 17                  | 14            | 15 [RW]             | Err     | N/A     | N/A    | 102            | 88      | N/A     | N/A    | Err          | N/A     | N/A     | N/A    |
| 0761    | Carson City   | 06/14/2013 | 14:57:28   | 0            | N/A     | 23                  | 16            | 19 [RW]             | N/A     | N/A     | N/A    | 86             | N/A     | N/A     | N/A    | Err          | N/A     | N/A     | N/A    |
| 0156    | Elko          | 06/27/2013 | 19:42:07   | 0            | No Data | 57                  | N/A           | 34 [V]              | No Data | N/A     | N/A    | N/A            | No Data | N/A     | N/A    | N/A          | 16      | N/A     | N/A    |
| 1826    | Elko          | 06/19/2013 | 01:31:46   | 24           | 23      | 29                  | N/A           | 28 [V]              | 34      | N/A     | N/A    | N/A            | 83      | N/A     | N/A    | N/A          | 10      | N/A     | N/A    |
| 3216    | Elko          | 05/31/2013 | 19:43:35   | 14           | 13      | 43                  | N/A           | 19 [V]              | 24      | N/A     | N/A    | N/A            | 85      | N/A     | N/A    | N/A          | 20      | N/A     | N/A    |
| 1828    | Elko          | 06/11/2013 | 23:49:44   | 0            | 0       | 37                  | N/A           | 34 [V]              | 38      | N/A     | N/A    | N/A            | 84      | N/A     | N/A    | N/A          | 12      | N/A     | N/A    |
| 0342    | Winnemucca    | 06/20/2013 | 19:35:51   | 1            | N/A     | 36                  | 17            | 21 [RW]             | N/A     | N/A     | N/A    | 87             | N/A     | N/A     | N/A    | 16           | N/A     | N/A     | N/A    |
| Android | Reno          | 07/08/2013 | 19:23:41   | 0.0          | N/A     | 25.6                | N/A           | 27.5 [RW]           | N/A     | N/A     | 28.2   | N/A            | N/A     | N/A     | 86.25  | N/A          | N/A     | N/A     | 18.5   |

Red Date - Vehicle's most recent transmission exceeds one week

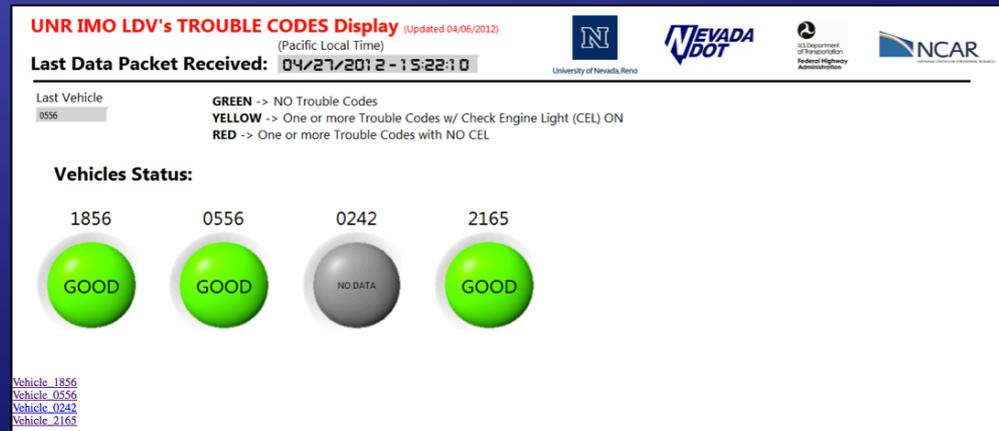
N/A - Vehicle does not have device

No Data - Data expected but not present in last received packet

Err - Device transmitted error value [-255, 127, etc.]

# Value to Being “Connected”

- ◆ Real-time data will improve maintenance decisions via MDSS, MMS and in-vehicle info
- ◆ Increase reliability & mobility for drivers
- ◆ Increase efficiency
- ◆ Reduce roadway operating & maintenance costs



# MDSS

- ◆ Evaluated different approaches to data transmission from remote sites and the use of the EDACS radio as well as vehicle integrations
- ◆ Evaluation of MDSS software and cost-benefit study.

## Maint. Accountability Program

- ◆ Developing methods for measuring winter maintenance performance
- ◆ Future data would benefit the objectivity of the performance
- ◆ Automated data sources would increase the cost effectiveness of data collection

## Weather Forecasting

- ◆ Schneider is interested in integrating IMO data into their weather and pavement decision support systems

# Accomplishments

- ◆ Developed communications utilizing existing 800MHz radio system
- ◆ Reduced system/equipment costs
- ◆ Interest in data utilization within NDOT divisions and programs

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