



Road Weather and the Connected Vehicle

Improving Road Weather Awareness

Good drivers know what is happening in and around their vehicles, but today they are not alone in sensing the roadway environment. Right now, many vehicles collect information on vehicle conditions (lights, wipers, etc.), ambient temperature, and atmospheric pressure.

Research is currently underway to take this information and combine it with other data on weather and road conditions to provide a more complete and accurate picture of current weather conditions in and around the roadway.

The initiative is part of the U.S. Department of Transportation's (DOT) Intelligent Transportation Systems (ITS) program on connected vehicles, which involves the development and deployment of a fully connected transportation system that allows vehicle to vehicle, and vehicle to infrastructure communication.

This is not science fiction but a real world program in which the DOT is investing considerable resources so people, goods, and services can travel our roads and highways faster, more efficiently, and safer than ever before.

Weather is a significant part of the program because 24 percent of all crashes occur under adverse weather conditions and result in over 7,100 deaths and more than 673,000 injuries each year. Weather also affects road capacity and is a factor in 25 percent of all non-recurring delays, costing drivers close to one billion hours of delay due to snow, rain, ice, wind, and fog.

Accurate and timely information on weather and road conditions can reduce the number of crashes and delay caused by weather. For instance, advanced road weather information helps transportation agencies apply the

right treatment material on the roadway at the right time, and timely information to motorists can help them make better and safer decisions.

That is why the Road Weather Management Program (RWMP), automakers, the National Center for Atmospheric Research (NCAR), and state departments of transportation are expanding on existing technologies to test the concept of the vehicle as a mobile weather station.

The program is using data that already exists on the vehicle and is capitalizing on the applications and services of existing programs such as *Clarus*, which is a national network that combines road weather information from 47 jurisdictions. Given the fact weather conditions can change dramatically even within a few hundred feet, the advantage of the connected vehicle is that it becomes a source that collects information in real time at precise locations.

Vehicle Data

Through the program, vehicle sensors collect measurements on temperature, pressure, and humidity and combine it with onboard information such as the use of windshield wipers, lights, and the activation of antilock brakes and traction control systems, and transmit it wirelessly to a data network for distribution.

Figure 1 shows the data elements that many newer vehicles already collect. The RWMP combines this information with other roadway and environment data to improve the accuracy and completeness of road weather data.

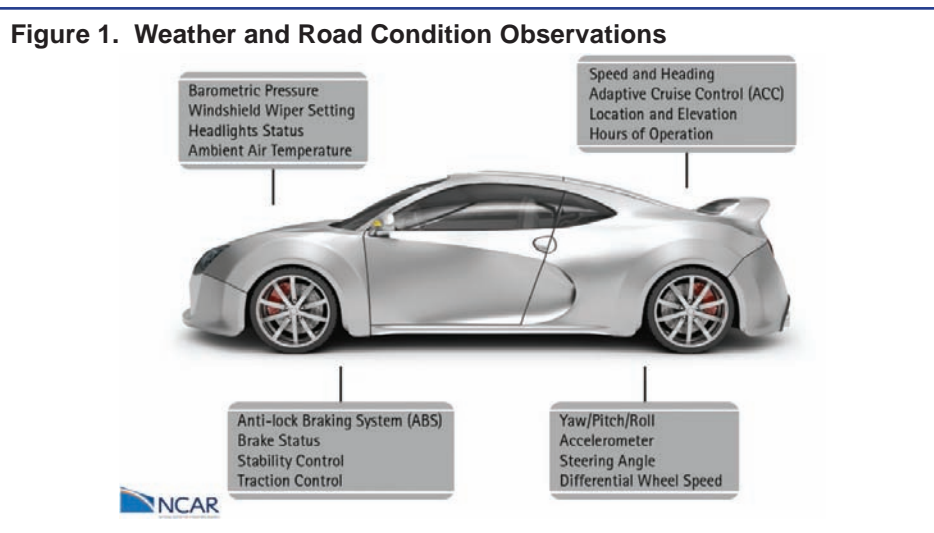


Figure courtesy of National Center for Atmospheric Research (NCAR)

“Anytime, Anywhere Road Weather Information”

The use of a moving data probe (vehicle) as opposed to sparsely placed fixed sensors provides greater road weather specificity that can help transportation agencies apply appropriate mitigation measures, allow meteorologists to provide precise forecasts, and benefit RWMP programs such as *Clarus* and the Maintenance Decision Support System (MDSS).

To handle the volume of data, researchers developed a Vehicle Data Translator (VDT), which processes and refines the vehicle, roadway, and environment data. The VDT performs several vital functions that make the data from the connected vehicle more valuable including the following:

- Extract the necessary data to derive weather and road condition information;
- Filter the data to remove unnecessary or unwanted information;
- Quality-check the information using other local surface observations and ancillary datasets; and
- Organize and process the data for user-defined road segments.

The VDT is a three-stage process starting with the data collected by personal vehicles and Department of Transportation vehicles. The VDT takes the mobile data, parses or analyzes it, and extracts relevant information, i.e., time, location, ambient temperature, windshield wiper status, traction control, etc., and passes it through the Output Data Handler. The translator also has the ability to take and read preprocessed data such as the information coming from the *Clarus* system.

In stage two, the system combines quality checked mobile data with ancillary data from satellites, radar, and the road weather information system (RWIS) to compute road segment statistics such as the mean air temperature over an individual road segment for a given time step. In stage three, advanced road

segment data is obtained by gathering additional information from radar, satellite, and fixed surface stations to produce a derived product over an individual road segment for a given time period.

Throughout the process, algorithms are used to quality check the data.

For example, it identifies observations outside the range of the known sensor hardware specifications, and it compares observations with neighboring vehicles and roadside sensors. Once the data are quality checked, wireless applications will transmit it to transportation and weather agencies and organizations.

Figure 2 shows how these types of data fit into the bigger picture of the connected vehicle, and how these capabilities can benefit road users, i.e., route guidance for fleet managers, dynamic message signage, real time travel information, etc. This is a focal point of the work of the ITS program has been doing.

A paper prepared by NCAR, the RWMP, the U.S. DOT Research and Innovative Technology Administration, and Noblis entitled "Connected Vehicles Road Weather Research & Development – The Vehicle Data Translator," provides details of how the VDT would function. For more information, go to <http://ops.fhwa.dot.gov/weather/resources/publications/itsapaper9005/>.

Road weather connected vehicle applications are the next generation of applications and services that assess, forecast, and address the impacts of weather on roads and vehicles. For

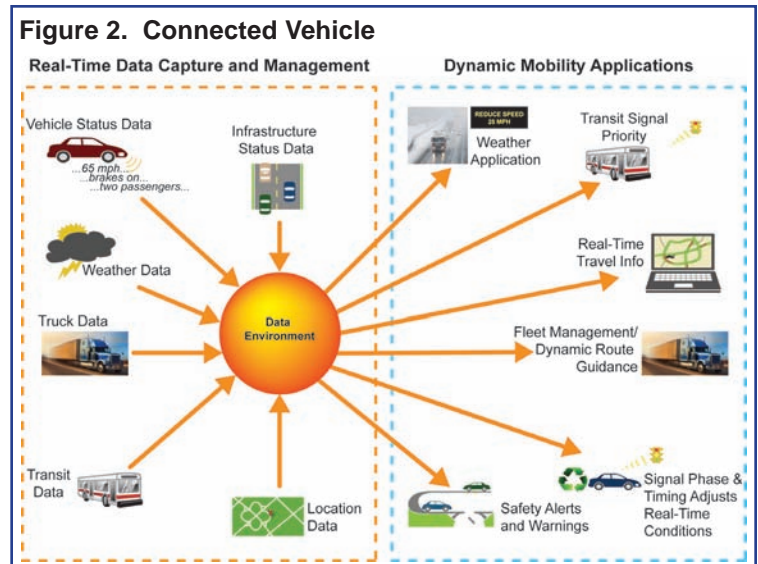


Figure courtesy of U.S. DOT ITS/JPO

anyone who uses or manages the transportation system, the benefits are substantial. Connected vehicle data is valuable for traffic management, incident management, maintenance, emergency management, and homeland security. Ultimately, travelers could receive timely and localized alerts about black ice, fog, and other hazardous weather conditions. Overall, the connected vehicle concept will improve an understanding of weather's impact on safety, capacity, and efficiency, and improve weather and road condition analysis and forecasts.

All photos courtesy of the RWMP



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