Demonstrations of *Clarus* System Data

Clarus BAA Projects

The *Clarus* Initiative, a joint effort of the U.S. Department of Transportation Intelligent Transportation Systems (ITS) Joint Program Office and FHWA's Road Weather Management Program (RWMP), is a six-year effort to develop and demonstrate an integrated weather observation data management system that can reduce the impact of adverse weather conditions on surface transportation.

As part of that effort, the RWMP conducted two *Clarus* multistate regional demonstrations involving five use cases to test deployment of *Clarus* enabled services. As a complement to these very structured demonstrations, the U.S. Department of Transportation issued a Broad Agency Announcement (BAA) to fund the development of many other innovative applications that use *Clarus* data. Eight projects were awarded and they are summarized below.

Integrating *Clarus* Data with the New York 511 Traveler Information System

The goal of the project is to demonstrate the feasibility of collecting, integrating, and disseminating various types of current and forecast location-specific weather alert data for use by traffic managers and motorists for better decision-making, reductions in congestion, and improved safety.

This screen shot, courtesy of the New York 511 Traveler Information System, shows what is available when Clarus data is integrated.

The project involved the design, development, implementation, and evaluation of an intelligent transportation system that collected real-time *Clarus* Road Weather Information System data and other pertinent weather alert data from various sources on the Long Island Expressway (I-495) and I-87 in New York State. A display that integrated the information was provided to end-users through a modified 511 New York (511NY) traveler information web site.

The system produced a wide range of results during the three-month evaluation phase. While the weather alerts on the 511NY pre-production web site, for instance, were accurate, clear, and easy to understand, there are opportunities to enhance the information so there is no misinterpretation by the public and other users.

The information from the system was also very useful for traffic management purposes because it helped transportation managers alert motorists of upcoming weather disturbances as well as ready public safety and incident management staff and resources for impending weather conditions that could negatively affect the transportation system.

For more information, contact the contractor David Yohanan, Telvent, at david.yohanan@telvent.com or Roemer Alfelor, FHWA, at roemer.alfelor@dot.gov.

Passenger Bus Industry Weather Information Application

The objective of the Passenger Bus Industry Weather Information Application (PBI WxApp) was the integration of mobile platform environmental observations with fixed-site (airports and road-weather stations) observations to create meteorological information along a commercial vehicle's intended travel route.

The project, managed by Global Science and Technology, hoped to provide situational awareness for drivers, passengers, and dispatchers or other operations personnel, including those who use decision support systems. Mobile platform observations describe environmental conditions in locations not sampled by fixed-site road-weather equipment. Consequently, the PBI WxApp includes input of dynamic data that can change rapidly when vehicles encounter storms and precipitation.

The findings demonstrated *Clarus* system data and mobile platform environmental data can provide decision support for Greyhound Lines, Inc. (Greyhound). The Greyhound fleet was fitted with equipment that sampled and recorded environmental conditions while the buses traveled their routes. The contractor's Mobile Platform Environmental Data (MoPED) system, processed the data and delivered it as meaningful and relevant information

through the PBI WxApp. Design focus was directed toward weather that might significantly impact travel, such as winter precipitation, heavy rain, and fog.

Another finding indicated pavement forecast modeling and decision support systems, including MDSS, will benefit from the integration of data acquired by mobile platforms into the *Clarus* system. Mobile platforms can sample the environmental conditions of vast amounts of geography in between fixed-site stations and also effectively sample road and weather conditions near critical infrastructure (e.g., bridges, overpasses, low areas).

The development process also revealed the importance reconciling attribute expressions from disparate systems, i.e., *Clarus*, Automated Surface Observing Systems (ASOS), and the Road Weather Information System (RWIS), which all have attributes used by the PBI WxApp, but different native naming conventions. For example, what RWIS titles "Air Temperature," ASOS simply calls "Temperature." Reconciling the attribute expressions presented a challenge and pointed to the importance of the metadata component of the data systems.

For more information on the project, contact Paul Heppner, Global Science and Technology, at
Paul.Heppner@gst.com
or Gabriel Guevara, FHWA, at
gabriel.guevara@dot.gov.

Western States *Clarus* One-Stop Shop for Rural Traveler Information

The purpose of the project, which was conducted by the Western Transportation Institute at Montana State University, was the development of a web site that would display multistate *Clarus* Environmental Sensor System (ESS) data, along with other information streams.

This other information included state department of transportation Intelligent Transportation System (ITS) field elements; closed circuit TV (CCTV); planned and active closures, incidents, weather sensor readings from non-DOT sources; and National Weather Service forecast information.

The web site integrated these real-time data streams together in a single web-based location and in a user-friendly format. The work built upon previous efforts, particularly the Caltrans One Stop Shop for Rural Traveler Information project, which provided the technological foundations for how such information is acquired and displayed. The region for this project included the Western States Rural Transportation Consortium (WSRTC) region of California, Oregon, Washington, and Nevada.

The results show the *Clarus* one-stop shop portal displayed weather and other traveler information for the four state region in a manner that was easily accessed and understood by users. Further the project demonstrated *Clarus* data, in conjunction with other traveler information, can be used and pre-sented across multiple states and provide travelers and agency personnel with a useful planning and management tools and information.

For more information, contact Douglas Galarus, Western Transportation Institute, at
DGalarus@coe.montana.edu or
Roemer Alfelor, FHWA, at
roemer.alfelor@dot.gov.

This screen shot, courtesy of Western Transportation Institute, shows the location of the Clarus ESS stations through the four state region examined in this BAA project. Screen shot courtesy of Clarus.
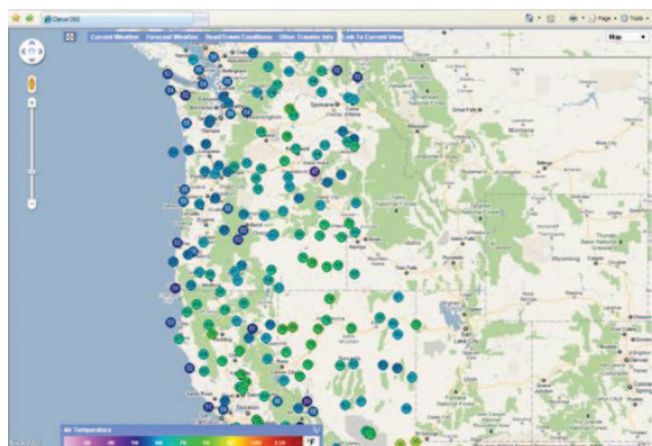
Application of *Clarus* System Data to Improve Mobile ESS Utilization

The aim of this project, which is ongoing, is to establish methodologies that can determine the quality of mobile Environment Sensor Station (ESS) data along with the capture of appropriate metadata to facilitate the monitoring and application of the ESS data and quality check flags.

The work will also attempt to define algorithms so fixed and mobile ESS quality check flags can be integrated within a transportation agency or road weather service provider. This will help determine which should be utilized in decision-making.

The work is currently being conducted by the Surface Transportation Weather Research Center at the University of North Dakota.

For more information contact Leon Osborne, University of North Dakota, at Leono@rwic.und.edu or Gabriel Guevara, FHWA, at Gabriel.Guevara@dot.gov.

Integration of *Clarus* data into RITIS system to create visualization tools

The Regional Integrated Transportation Information System (RITIS) automatically fuses, translates, and standardizes data obtained from multiple agencies in the region in order to provide an enhanced overall view of the region's transportation network, which in this case involved Virginia, Maryland, and Washington D.C.

The data did not include *Clarus* related data, which provides weather information and the impact of weather on traffic flow.

The objectives for this project, conducted by the University of Maryland at College Park, were to integrate *Clarus* data into Regional Integrated Transportation Information System (RITIS) platform,

develop meaningful visualization of *Clarus* real-time and archived data to allow for the exploration of multiple transportation data sets, and to test and deploy new functionality for operational, research and public use.

Findings so far reveal successful integration of *Clarus* data into the real-time RITIS application, and some visual clues have been developed to demonstrate different layers of notification.

For more information, contact Michael L. Pack, University of Maryland, at packml@umd.edu
or Mohammed Yousuf, FHWA, at mohammed.yousuf@dot.gov.

Clarus Data for Weather-Responsive Traffic Signal System Applications

The objective of this project, which is being conducted by the University of Idaho, is the development of a prototype for a real-time weather-responsive traffic signal control system to improve the efficiency and safety of traffic signal operations during inclement weather.

The proposed system will receive weather information from the FHWA's *Clarus* system database, analyze it, and make necessary changes to signal timing parameters in response to inclement weather conditions.

The system, which will use current traffic controller and controller cabinet technologies, also requires minimal hardware, in addition to traffic controllers for full implementation. Software design will incorporate self-diagnostic techniques for fault detection and recovery to maximize security and minimize cost. The project will be completed in December 2011.

For more information contact Ahmed Abdel-Rahim, University of Idaho, at ahmed@uidaho.edu or David Yang, FHWA, at david.yang@dot.gov.

Integrating *Clarus* Data and State Crash Data into a Travel Decision Support Tool

Most existing routing systems provide route recommendations based solely on computed travel times. Such an approach does not consider crash risk, especially crashes associated with adverse weather. Numerous studies have documented the changes in driver behavior under adverse weather conditions, which points to the need for more robust route recommend-ations. This study integrated road weather observations (from the *Clarus* System) and crash data to develop such recommendations, considering weather-related crash risk.

The objective of this project, conducted by the Michigan Technological University, was to leverage weather and road condition data from the *Clarus* System to provide real-time information on recommended travel routes based on the time-dependent safety effects of adverse weather.

The project resulted in the development of a user-friendly, informative web-based decision support tool that integrates *Clarus* data with crash data to recommend optimal driving routes in different weather conditions.

The tool synthesized data from multiple sources, passing that data through computational models, and presenting the information in an accessible format that clearly denotes the recommended route given the weather conditions at that time, along with driving directions.

For more information, contact John Hill, Michigan Technological University, at johnhill@mtu.edu or Paul Pisano, FHWA, at paul.pisano@dot.gov.

New Brunswick – Nova Scotia
Clarus Integration Plus

The main thrust of this project was to facilitate the use of *Clarus* ESS data to increase the productivity of those responsible for road maintenance. Specifically, the project would provide transportation managers with *Clarus* ESS data from a broad geographic area covering their collective storm source regions.

In addition, it would provide visualization tools to more readily assess the direct impacts of the approaching weather on roads over a broad area of interest (colored ESS sites on a map background) and to more closely examine trends in the road weather data at specific ESS sites anywhere within their area of interest (ESS trend graphs).

The objectives for the project, conducted by AMEC Earth & Environmental, A Division of AMEC Americas Ltd, integration of ESS/RWIS data from New Brunswick and Nova Scotia into *Clarus*, and a demonstration of the utility of *Clarus* for road maintenance staff across Maine, New Brunswick, and Nova Scotia using GIS industry standards.

The project also involved the preparation of a vetted English-French lexicon of road weather data elements; the development of a bilingual *Clarus* interface; and the development of proposals for the integration into *Clarus* of Infra-Red (IR) Thermal Finger-prints (TF).

A web-based system was developed, in industry standard GIS (Geographic Information System) formats, that enabled road maintenance staff across Maine, New Brunswick, and Nova Scotia, to seamlessly view ESS data

from across the region. This resulted in enhanced situational assessment features including the following:

- The inclusion of ESS sites on the map layer with variable colored dots in accordance with reported pavement conditions;

- The use of *Clarus* data in the generation and posting of trend graphs for individual ESS sites when a location is selected; and

- Importation of additional ESS data into *Clarus* such as camera imagery from New Brunswick and Nova Scotia.

This functionality enables transportation managers to make more effective decisions, ultimately resulting in an improved level of service. For more information, contact Andrew Nelson, AMEC , at andrew.nelson@amec.com or paul.pisano@dot.gov.

As apparent through these eight projects, the number of ways in which *Clarus* data can be used is limitless. Based on these projects, the FHWA hopes that other innovative applications will be developed by transportation and weather professionals.

All photos other than those with attribution are courtesy of the RWMP.
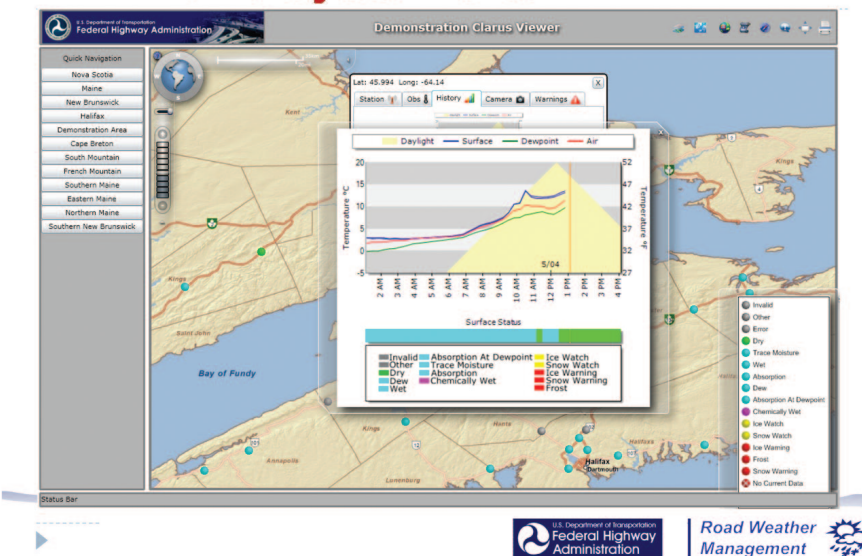
This screen shot of the Clarus Viewer, courtesy of AMEC, shows the information that is available for system users, including surface conditions and temperatures at various times of day.

**U.S. Department of Transportation
Road Weather Management**
1200 New Jersey Avenue, E86-205
Washington, DC 20590

Paul Pisano
202-366-1301
E-mail: paul.pisano@dot.gov
http://ops.fhwa.dot.gov/Weather/index.asp

Federal Highway Administration
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"Anytime, Anywhere Road Weather Information"

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