Righter shade of pale

Jon Tarleton, Quixote Transportation Technologies, Inc., talks about developments in mobile weather information gathering

Road surface temperature measurement systems have been common equipment on snowploughs since the 1990s. QTT is now pushing for such vehicles to become full-on mobile weather stations

Quixote Transportation Technologies, Inc. (QTT) is promoting the greater use of mobile technologies to provide infill between fixed Road Weather Information System (RWIS) infrastructure. It is, the company says, a means of reducing the expense of providing comprehensive, network-wide coverage, particularly in geographic locations where the sheer number of centreline miles causes cost to be a limiting factor.

"Over the last 30-35 years, the technology has existed and has been in place at fixed weather reporting stations to measure a variety of road surface and weather conditions," says the company's Marketing Manager, Jon Tarleton. He has produced a White Paper looking at mobile sensing in which he makes a case for better understanding of the dew point's role (see Sidebar, 'A point long over dew').

"The density of deployment is much greater in Europe, for example, than in the US but that's a product of geographical spread in the case of the latter; it's difficult to justify the return on investment in fixed infrastructure on hundreds of miles of roads which are typically used infrequently and by fewer people."

Since the 1990s, it has become far more commonplace for snowploughs to be deployed with infrared road surface temperature sensors, the information from which is displayed in-vehicle to the driver as an aid to making a decision on when to start the distribution of salt, grit or other defrosting agents. Automatic Vehicle Location (AVL) using digital cellular communication, meanwhile, also allows in-vehicle modems to transmit that information to a central control or dispatch location. That information can feed supervisory mapping and make fleet/asset deployment a lot more effective and cost-efficient.

"In Europe, the use of mobile weather sensing technology is growing," Tarleton continues. "It hasn't occurred at anything like the rate it has in the US however AVL usage is more common in Europe so we're trying to push the concept to the market there."

Mobile weather station

At this year's ITS America annual meeting, which took place in May, QTT launched the Surface Patrol HD mobile pavement data sensor. This measures several parameters: dew point, relative humidity, air and pavement temperatures. Surface Patrol HD was developed in part to address evolving customer requirements. It is, says Tarleton, a whole new concept.

"Temperature-only measurement is now widespread but this new solution is effectively a mobile weather monitoring station. Our next step will be to add other measurement parameters such as pavement condition – whether it be wet, dry or covered in ice or snow. We're only in the early stages of achieving that at present but we're looking to remove human subjectivity from reported road surface conditions."

The launch of Surface Patrol HD and its predecessors has given QTT something of a lead in mobile weather sensing, according to Tarleton; QTT is currently positioning itself as the only organisation able to supply both fixed and mobile solutions with common, supporting synergies.

Infrared focus

The ability to deliver accurate information remotely is always going to be the key driver in the mobile arena. QTT concentrates on the use of infrared technologies. In part this is because existing patents limit technology choice but Tarleton says that there is much to support the technology choice: "Standards exist for fixed installations, NTCIP in the US and CEN in Europe, for instance, but there are none as yet for mobile solutions. That makes for challenges as mobile sensing in particular needs robust technologies. In general infrared offers greater range, and therefore greater deployment flexibility, and there are pricing advantages as the sensor technology is less expensive."

Cost, as ever, is an issue when it comes to achieving ubiquity. One of the applications more commonly referred to within future cooperative infrastructures is better weather information: in a not-too-distant Utopia, it is hoped, every vehicle on the road will be a probe providing real-time data on traffic and environmental conditions. The reality is that this remains some way off, although Tarleton is keen to see inroads made.

Common goal

"I think in the future, as mobile technologies progress, we'll come to rely on it for a good proportion of our data. Improved weather monitoring is a part of the US's IntelliDrive programme and the next big leap will be from public sector or fleet vehicles into private vehicles. That will give us a huge increase in data but the reality is that the technology involved is too expensive for passenger vehicles at the moment.

"We're looking to work with the US agencies involved in IntelliDrive, although we're not currently. I'm hopeful that the work we're now conducting will result in the right connections being made.

"When it comes to the automotive OEMs, economies of scale are what're going to make the difference. They're not interested at the moment as, per-vehicle, the cost point needs to hit the $10 mark whereas for comparison one of our systems comes in at around $2,000.

"More work needs to be done with the OEMs and Tier One suppliers to bring that market to maturity. There's plenty of work to be done on the fleet side before doing that, however." ■

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A point long over dew

One of the key issues pertaining to successful weather monitoring is determining which variables to measure, says Tarleton in his White Paper.

"No-one would argue that the single most important variable is pavement temperature as it does not typically match the air temperature. A pavement which is above freezing means there will be little to no impact on road conditions during a snow/ice event. Pavement temperatures also determine the effectiveness of de-icing chemicals.

"The next most useful value has been debated for decades. The dew point, though poorly understood, has a huge impact on road transportation yet the problems it causes go unnoticed. Heavy rain, ice or snow have very visible impacts and typically cause changes to driving behaviour. Atmospheric moisture values on the other hand are nearly impossible to see.

"The amount of moisture in the air, which changes constantly, is most commonly quantified using dew point and relative humidity. The latter has become the most commonly used by the general public, yet the dew point is much easier to understand and has a direct correlation to moisture interaction with the roadway. It is the temperature to which the air must cool for saturation of the air to occur and is reported in either Fahrenheit or Celsius.

"The dew point temperature can be equal to the air temperature but never higher. When the difference between the air temperature and dew point is very large it takes a lot of additional moisture to saturate the air, whereas when it is small the air is nearly saturated. This is especially important during a snowstorm. Snow falling from the clouds can be affected by the amount of moisture in the air near the surface. When the difference between the air temperature and dew point is large it will take a longer time before snow begins reaching the ground, if indeed it does at all. When the difference is small snow begins reaching the ground immediately.

"The dew point is a critical value to monitor because the temperature of the pavement can and does fall below it. When this occurs, condensation begins to occur. If the surface of the pavement is below freezing then frost begins to form. Frost may appear harmless on vehicle windshields or roof tops however on a road surface it is just as dangerous as ice or snow. If the pavement is below the dew point but not yet at freezing, dew (or liquid) water begins to form on the surface. If the pavement temperature then falls below freezing the water freezes, becoming one form of black ice. Because it freezes from a liquid to a solid, black ice freezes clear and is invisible to the driver.

"There are two situations where it is common for the pavement surface to fall below the dew point. The first is when the pavement temperature cools rapidly. This most commonly happens during the winter on bridge decks and elevated road surfaces. On a clear, calm night, surface heat from the day is released back to the upper levels of the atmosphere. Bridges and elevated structures cool quicker than the surrounding air and can many times fall below the dew point of the air, causing frost to develop on the bridge if it is below freezing. The second situation is when air with a higher moisture content moves in over a cold surface. This can happen in many different situations. One example is when moist ocean air moves inland and over a roadway that has been allowed to cool earlier in the night. Almost all dew point-related road problems occur at night."

Longer-term and regional developments

When it comes to fixed weather sensing systems, by far the greatest percentage (Tarleton puts the figure in the high 90s) are embedded. As with other forms of sensors for different road monitoring applications, there is though a trend towards non-intrusive solutions; in the weather monitoring sector that means optical or infrared technologies in particular.

"There is a trade-off for the customer, in that accuracy is sacrificed to some degree, but that has to be set against no lane closures and increased ease of maintenance," says Tarleton.

"It's likely that we'll see a meld of sensors going forward. Non-intrusive sensors will become more prevalent in metropolitan areas whilst embedded sensors will continue to be common in rural areas.

"In North America and Europe, I would put market growth at about 5-10 per cent a year. The use of weather sensing is becoming more common in China and Latin America but it remains in its very early stages. Eastern Europe is another region with significant growth potential."