ITS Texas 2024

Road Weather ITS Innovation and Application

Urban Flood and Friction Warning/Alert Systems

10/18/2016

WHY ARE WE CONCERNED ABOUT FLOODING AND FRICTION MONITORING?

- MAJOR FRESHWATER FLOOD EVENTS FROM 2004 TO 2014 COST AN AVERAGE OF $9 BILLION IN DIRECT DAMAGE AND 71 LIVES ANNUALLY.
- THE USDOT FEDERAL HIGHWAY ADMINISTRATION LISTS AN AVERAGE OF **1,836 DEATHS** AND **136,309 INJURIES** PER YEAR DUE TO SNOWY AND ICY ROADS. THESE FIGURES REPRESENT THE 10 YEAR AVERAGE BETWEEN 2005 AND 2014.
- THE AVERAGE ICY ROAD FATALITY COUNT IS **3.6 TIMES** THE TOTAL DEATHS FROM ALL OTHER WEATHER HAZARDS COMBINED. (OVER THE 10 YEAR AVERAGE).

Source: https://www.nationalacademies.org/, https://icyroadsafety.com, https://ops.fhwa.dot.gov/weather/

CAN YOU GUESS WHICH PICTURE CONTAINS A HAZARDOUS ROAD CONDITION…..

Did you get them right? The weather sensors will!
Remember: In addition to safety and mobility, chemical and labor are important cost variables.

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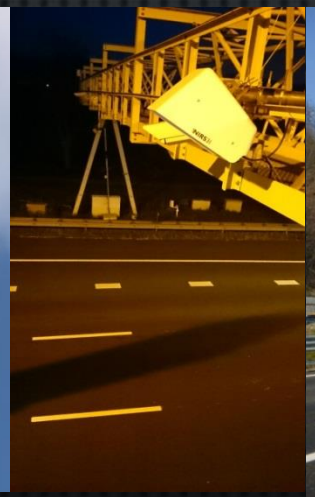
MODERN MINI AND INTEGRATED RWIS FLOOD AND FRICTION DETECTION SITES



LCOM - Lufft Communicator (Flexible RWIS and ITS platform)

Industrial Windows CE PC

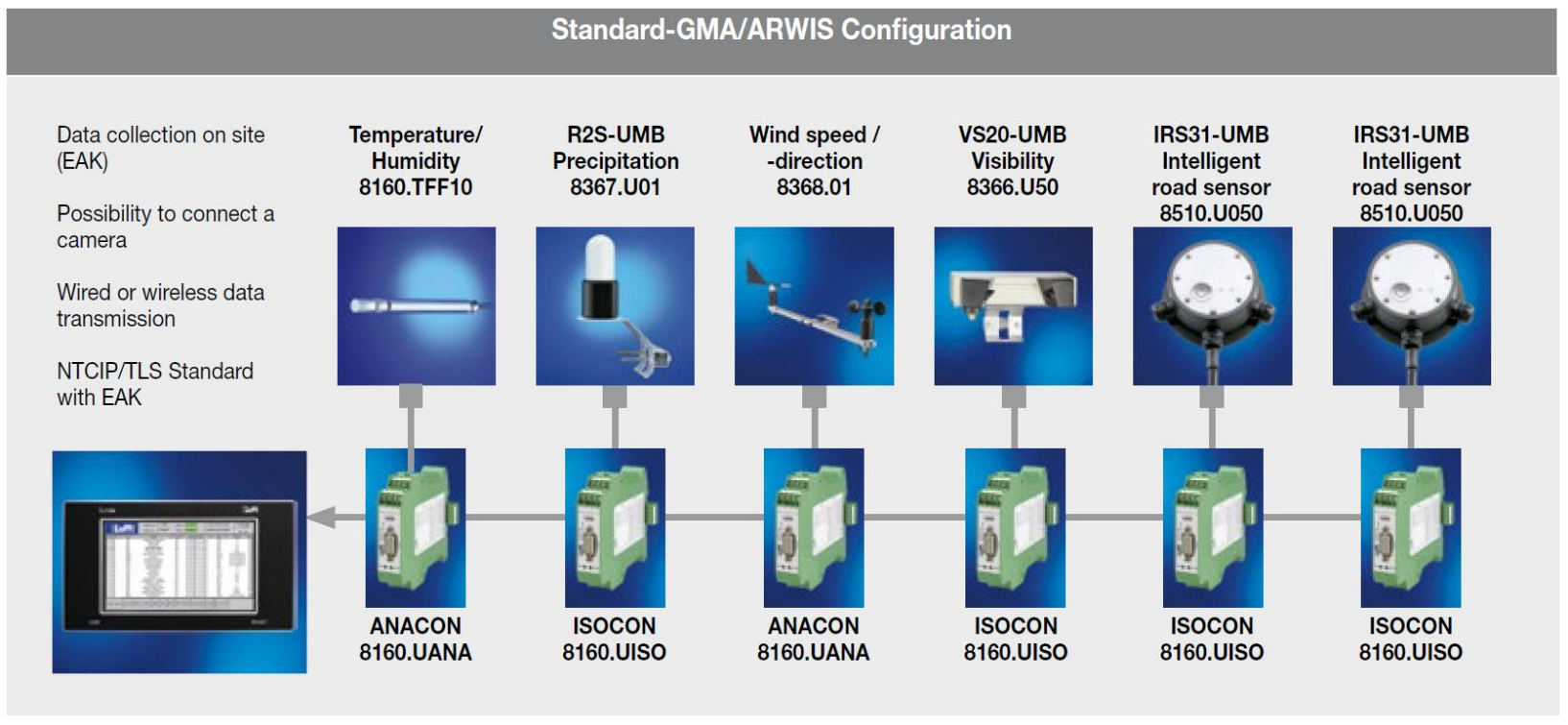
- Conversion of UMB-data into standard protocols: NTCIP
- Touch Screen Display
- Remote access – firmware updates
- Alarms: Digital alarm out – highly configurable
- Prognosis: Road condition, temp available with an LCOM
- Data History- Storage on LCOM in MSSI format and NTICP
- Pavement Sensor Flexibility
  - Support for multiple vendors
- RWIS Sensor network expansions without the need for an RPU
- Flexible for integration of various sensors
- Non-proprietary , NTCIP-ESS, Open protocol

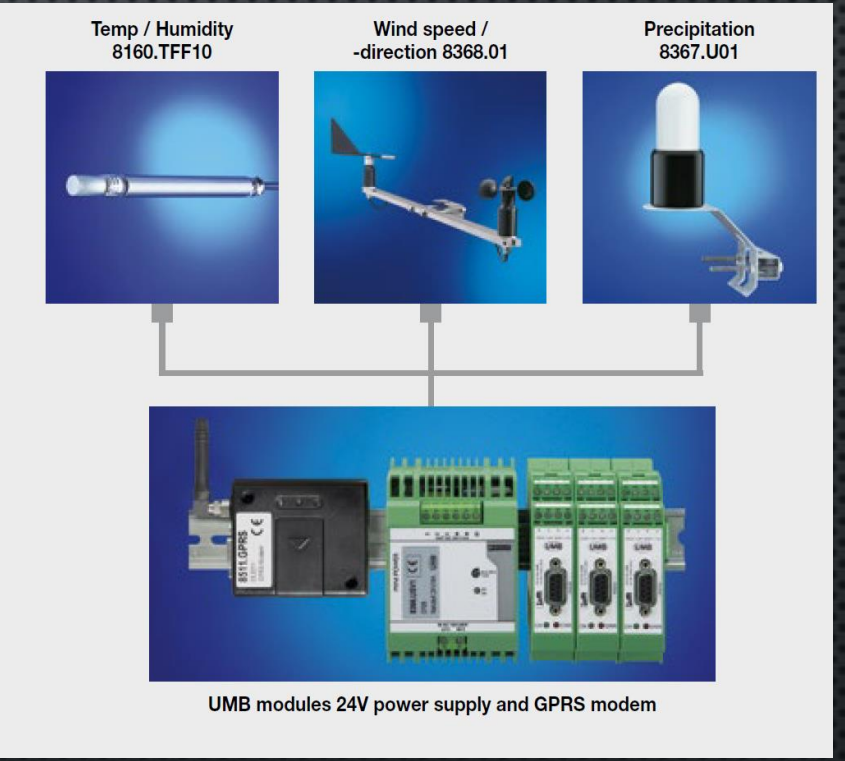
UMB-TECHNOLOGY
UNIVERSAL-MEASUREMENT-BUS

Advantages of UMB:

- One software-protocol for all devices
- One hardware-interface for all devices
- One industrial power supply (24VDC) for all devices; UMB modules and (heated) sensors
- All components for DIN-rail assembly with bus-connector
- Firmware-Update via RS232 or RS485
- One software-Tool for all sensors
- FLEXIBILITY for integration of various sensors, various vendors

Typical RWIS site hardware architecture





Flood and Black Ice Observation and Detection Technology

Ott HydroMet/Lufft

1. Flooding: Radar Level Sensor - RLS Sensor

2. Black Ice: Friction Observations: NIRS31 - Non Intrusive Roadway Sensor

RLS – Radar Level Sensor

- Increase of interest in flood warning systems
- Hangs below a bridge and connects with analog communication
- ✓ Most reliable/less maintenance compared to pressure transducing sensing technology

Complete solution for low lying, flash flood areas

BLACK ICE

- The air has warmed but the pavement has not and there is some sort of moisture
- Liquid precipitation (rain) on frozen ground causes black ice (road temperature below 32 degrees and no salt in the liquid)
- Utilize pavement temperatures and subsurface temperatures on RWIS
- Two detection methods
  - Capture freeze point data of liquid on the Roadway
  - Capture Grip or Friction coefficient on the Roadway

What do RWIS pavement sensors tell us?

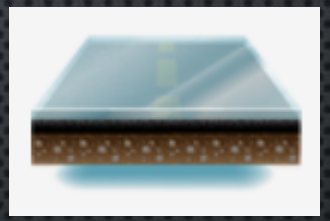
- Pavement Conditions
  - Solution depth (water, ice)
- Salt/Chemical concentration
- Liquid freezing Temperature - Tf
  - Point at which the first ice crystals start to appear
- Freezing temperature - Tr
  - Point at which the surface becomes slippery following the formation of Ice
- Pavement-Friction
- Wind speed and direction at the roadway surface.
- Air temperature, Relative Humidity (Dew Point)

FREEZE POINT – DECISION POINT

- When using Freeze Point, the decision point is many times not as simple as it could be.

Surface Temp 29°F (-1.6° C)
Fp 28°F (-2.2° C)
Chemically wet / wet & treated

Surface Temp 29°F (-1.6° C)
Fp 30°F (-1.1° C)
Chemically wet / wet & treated



Surface Temp 29°F (-1.6° C)
Fp 32°F (0° C)
Ice Warning

When this change will occur is not easy to tell.

Maintenance Manager Use of Friction Measurement Readings

Grip Coefficient of Friction Reading Rule of Thumb:

Level of Grip	Description*
0.6 and above	Grip good
0.4 to 0.59	Grip poor
0.39 and below	Pavement slippery – Very poor grip

*These descriptions are intended only as indicators, as the real friction values depend on many variables, such as vehicle type and speed, tire type, road surface structure, etc.

NIRS- NON-INTRUSIVE ROADWAY SENSOR

The NIRS provides measurements of:

- Wetness
- Ice
- Snow/frost
- Water film height
  - ✓ Important for both flooding and reduced friction applications
- Ice percentage in water and surface freeze-point
- Measurement of friction

❖ InfraRed technology

YEAR ROUND- MULTI-TASKING, FLEXIBLE RWIS/ITS PLATFORMS

- **Black Ice/Friction Warning Systems**
- **Flood/High Water Warning Systems**
- **Hydroplaning Detection Systems**
- **Low Visibility/Fog Systems**
- **Traffic count/volume/speed Systems**
- **High Wind Warning Systems**

NIRS31

WS200

VS20k-UMB

ISOCON

LCOM (RPU)

Relay Output Module

Relay 1: Beacon

Relay 2:
Variable Message Sign

Example

- IF [NIRS31 CH900 Road Condition] = "**Freezing Wet**" THEN trigger relay 1
- IF [NIRS31 CH900 Road Condition] = "**Critical**" THEN trigger relay 2
- IF [WS100 CH700 Precipitation Type] = "**Freezing Rain**" THEN trigger relay 3
- IF [VS20k CH600 Visibility] < **300m** THEN trigger relay 4
- IF [NIRS31 CH820 Friction] < **.55** THEN trigger relay 5

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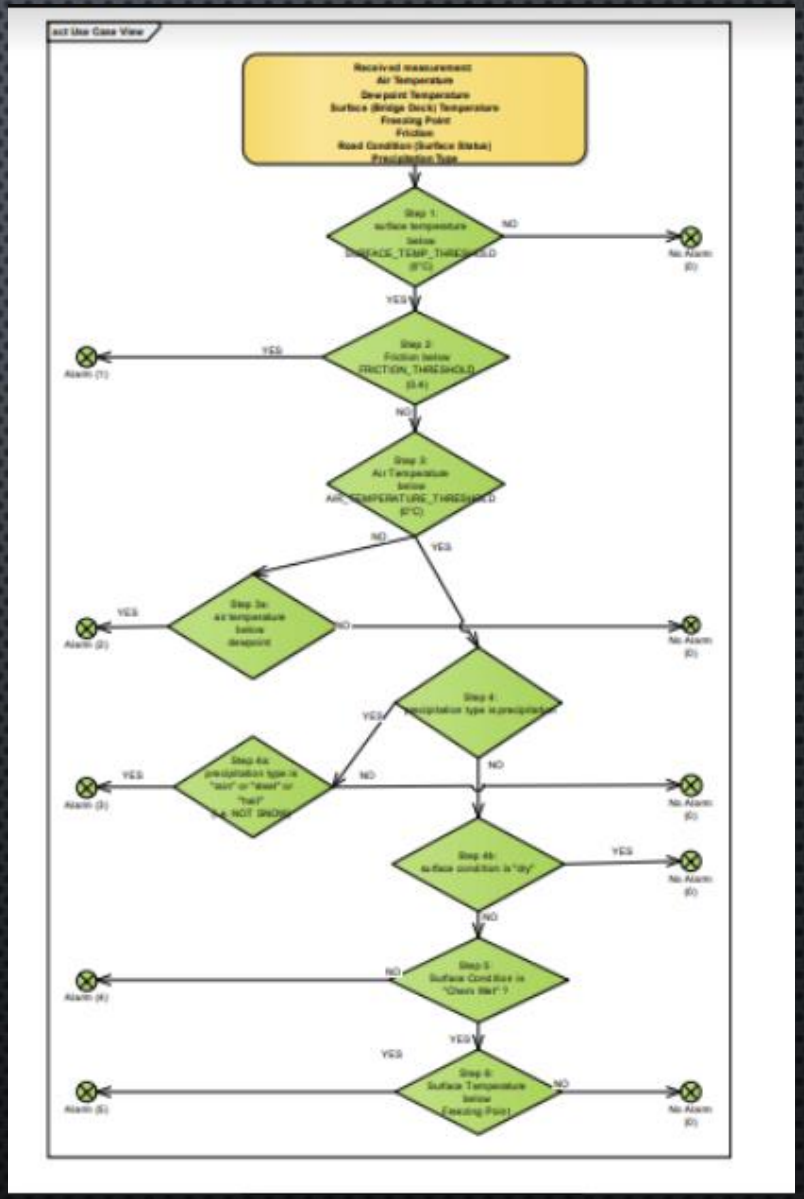
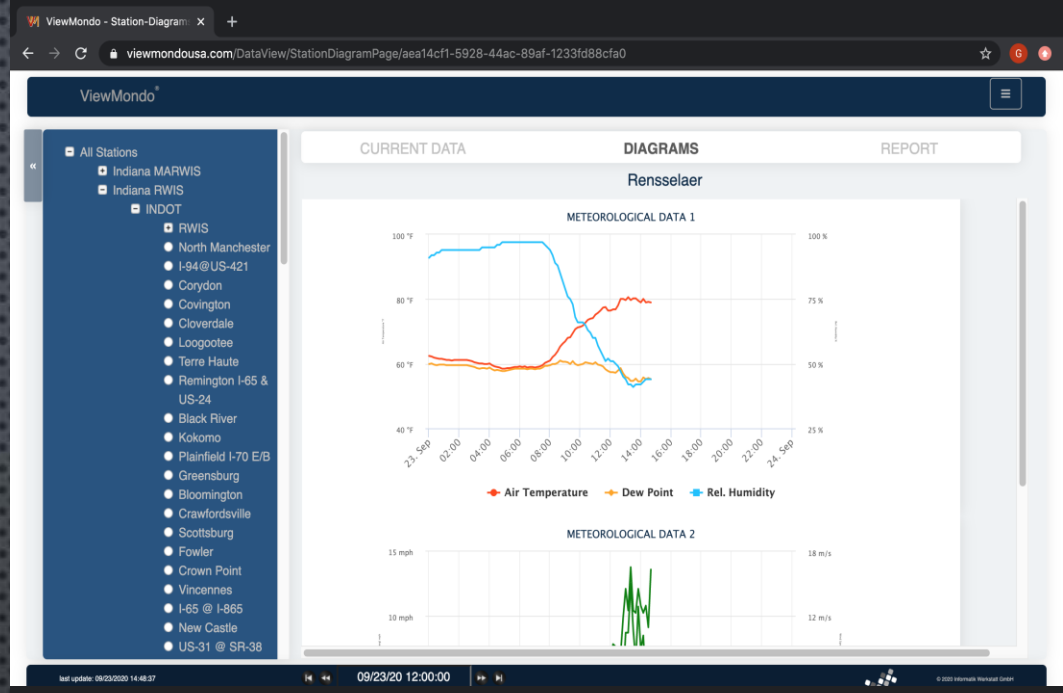
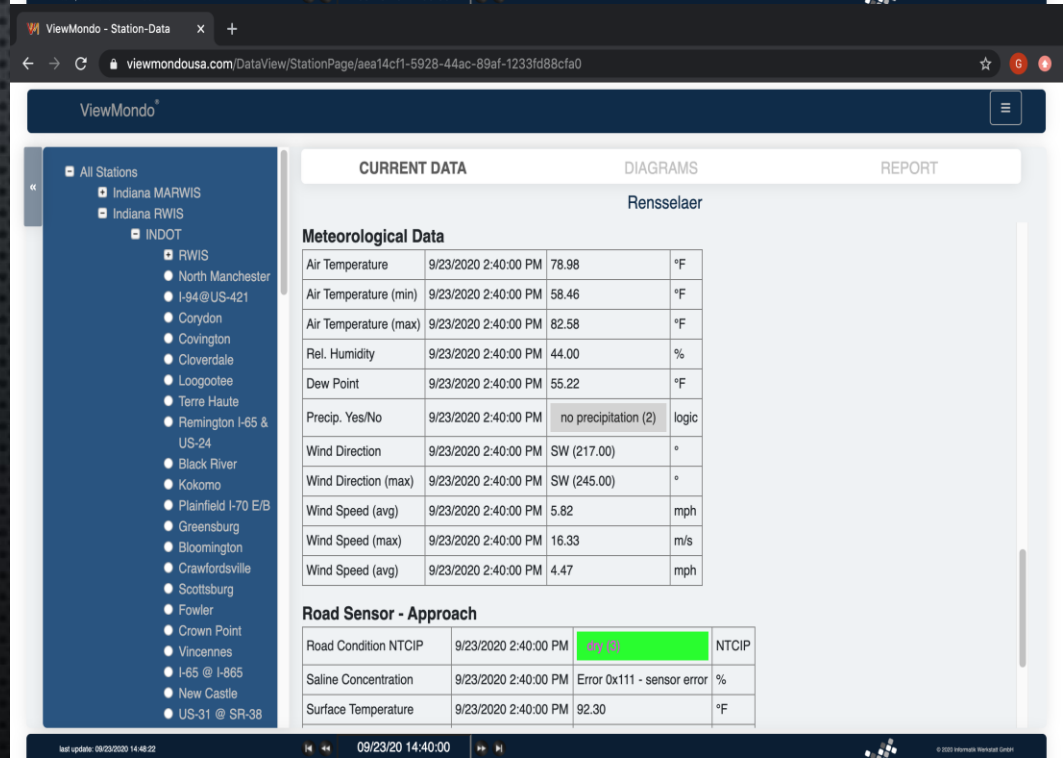
CUSTOM ALERTING AND SIGN ACTIVATION ALGORITHM



VIEWMONDO GRAPHIC USER INTERFACE

- User friendly Interface (GUI)
- No customer software necessary.
- multiple user access
- Mobile device compatible.
- Included in package at no additional cost.
- Alarm and Alert Feature.
- 98%+ system up-time.
- Comprehensive Data Management included.
- RWIS system monitoring included.





INDOT MOBILE RWIS AND FIXED RWIS PROGRAM

- Tool for public safety as well as DOT winter maintenance decision support/MDSS program
- Year round public safety solution for flash flood management and hydroplaning mitigation and alerting systems
- Can be a great Social media tool to reach large segments of the population.

MULTIPLE CAPABILITIES AND ITS FUNCTIONALITY CAN BE ADDED AS NEEDED

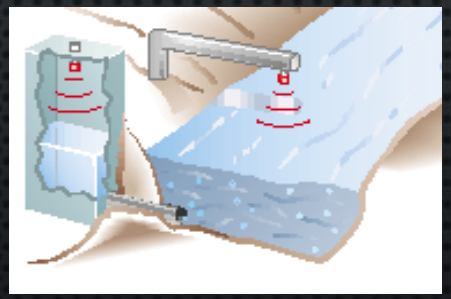
Camera's

Remote Processing Unit (RPU)

DMS/Device Control

Radar Traffic Sensors

Barometric Pressure



Stream Gauges/Flash Flooding/Hydroplaning

Road Visibility

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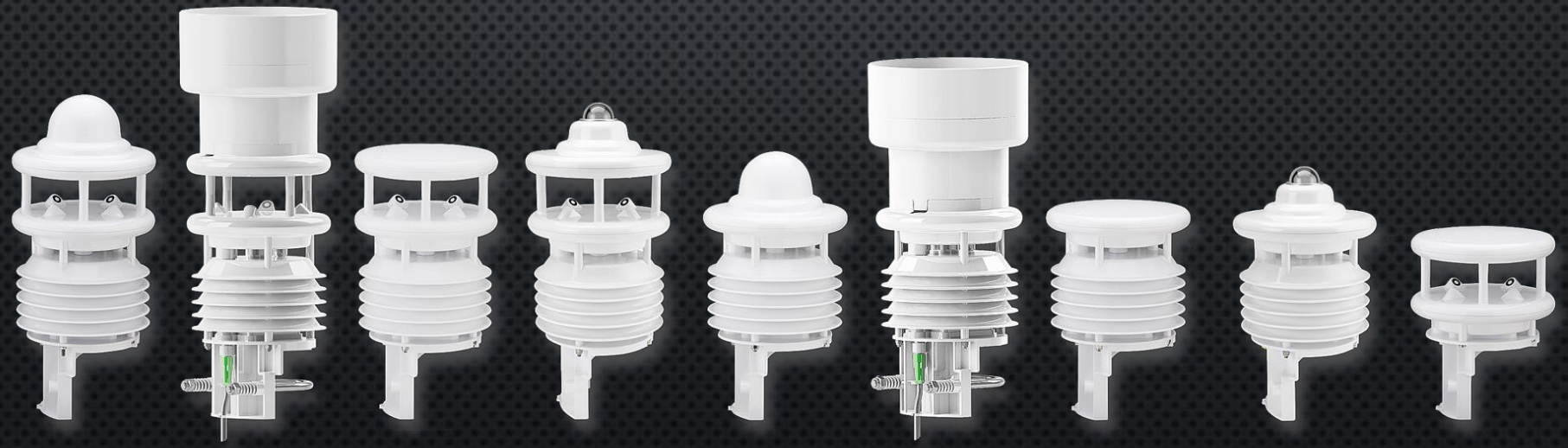
Smart Weather Sensors

Intelligent sensors with many different interfaces (protocols)

WS Series Compact Weather Station, low-power-low-voltage-operation, analog output



WS600

Integrated design with ventilated radiation protection for measuring the following parameters:

- Air temperature
- Relative humidity
- Precipitation intensity
- Precipitation type
- Precipitation quantity
- Air pressure
- Wind direction
- Precipitation quantity
- Wind speed

- Relative humidity is measured by means of a capacitive sensor element (a precision NTC measuring element is used to measure air temperature)
- Precipitation is measured by a 24 GHz Doppler radar, which measures the drop speed of an individual drop of rain/snow.
- Precipitation quantity and intensity are calculated from the correlation between drop size and speed.
- The difference in drop speed determines the type of precipitation (rain/snow).
- Maintenance-free measurement offers a major advantage over the common tipping spoon and tipping bucket processe
- Ultrasonic sensor technology is used to take wind measurements.

RWIS ADVANCEMENTS OVERVIEW

- New technology has made Urban and Rural Flood and Friction Warning and Alert Systems more affordable and effective
- System flexibility
- Upfront costs are minimal.
- Installation is simple and fast.
- Roadway Safety, Return on Investment (ROI), and Emergency Management Value are substantial.

THANK YOU!

Kurt Kinion | Director of Road, Runway, Rail Weather & ITS Development

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