

ITS-capable Road Weather Station

Timo Sukuvaara, Kari Mäenpää, Riika Ylitalo, Marjo Hippinen

Finnish Meteorological Institute, Finland
timo.sukuvaara@fmi.fi



Sodankylä Road Weather Station (RWS)

FMI (Finnish Meteorological Institute) has employed the combined Road Weather Station (RWS) and Road Side Unit (RSU) for supporting variety of research projects and initiatives related to vehicular networking and road weather service (figure 1). The general idea is to develop and deploy "Road Weather Testbeds" with advanced communication applications in the interesting environments to test wireless networks and communications in public. The procedure is to design, develop and test both the local road weather service generation and the service data delivery between RWS and vehicles.

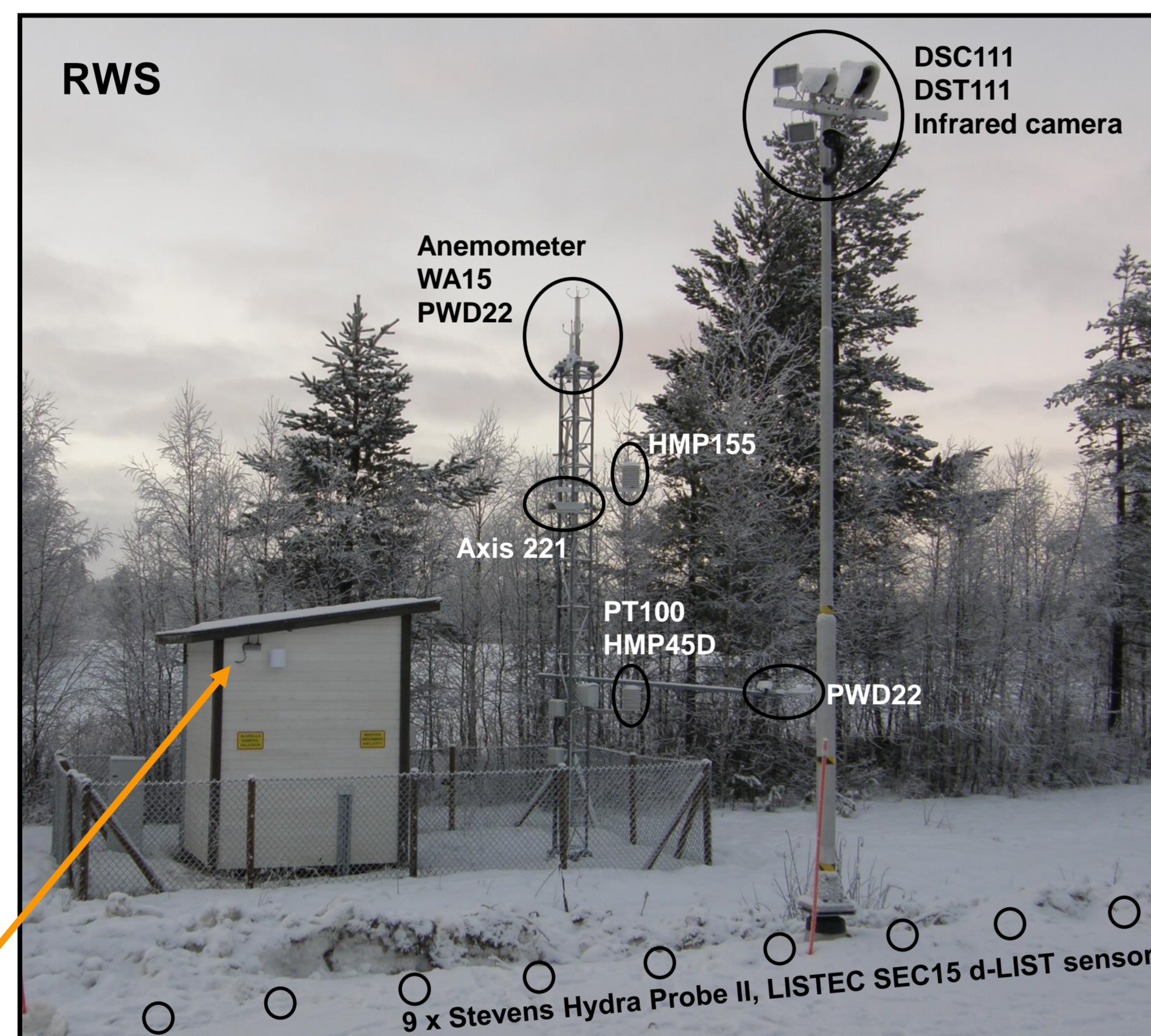
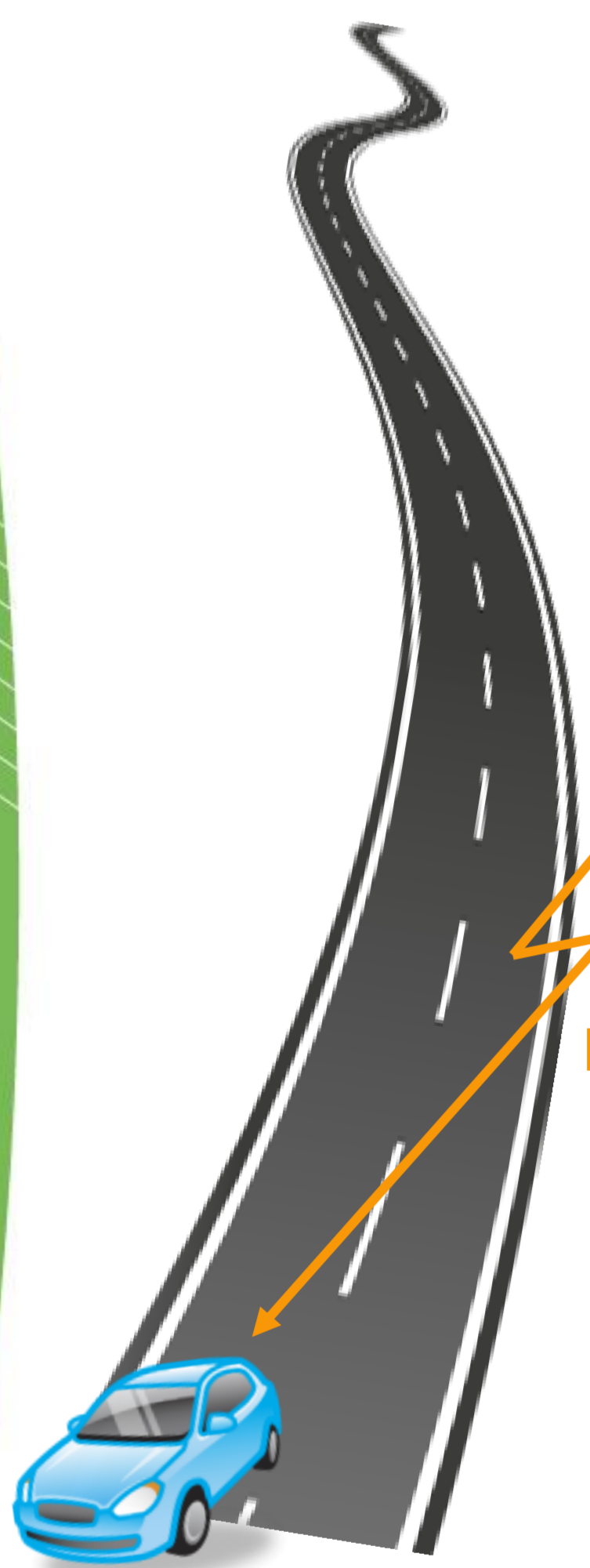


Figure 1. Road weather station and vehicle-to-infrastructure communication.

IEEE 802.11p
Wi-Fi
3G



Vehicle-to-Infrastructure Communication

IEEE 802.11p is the primary communication protocol, but also the traditional Wi-Fi communication is supported. The RWS/RSU is linked with IEEE 802.11p for communication attempting, but it has also internal Wi-Fi modem, and both of these communication channels are actively seeking the bypassing vehicle communication systems. through 3G. The vehicle bypassing the combined RWS/RSU is supplemented wirelessly and automatically with up-to-date road weather related data and services, and at the same time possible vehicle-oriented measurement data is delivered upwards.

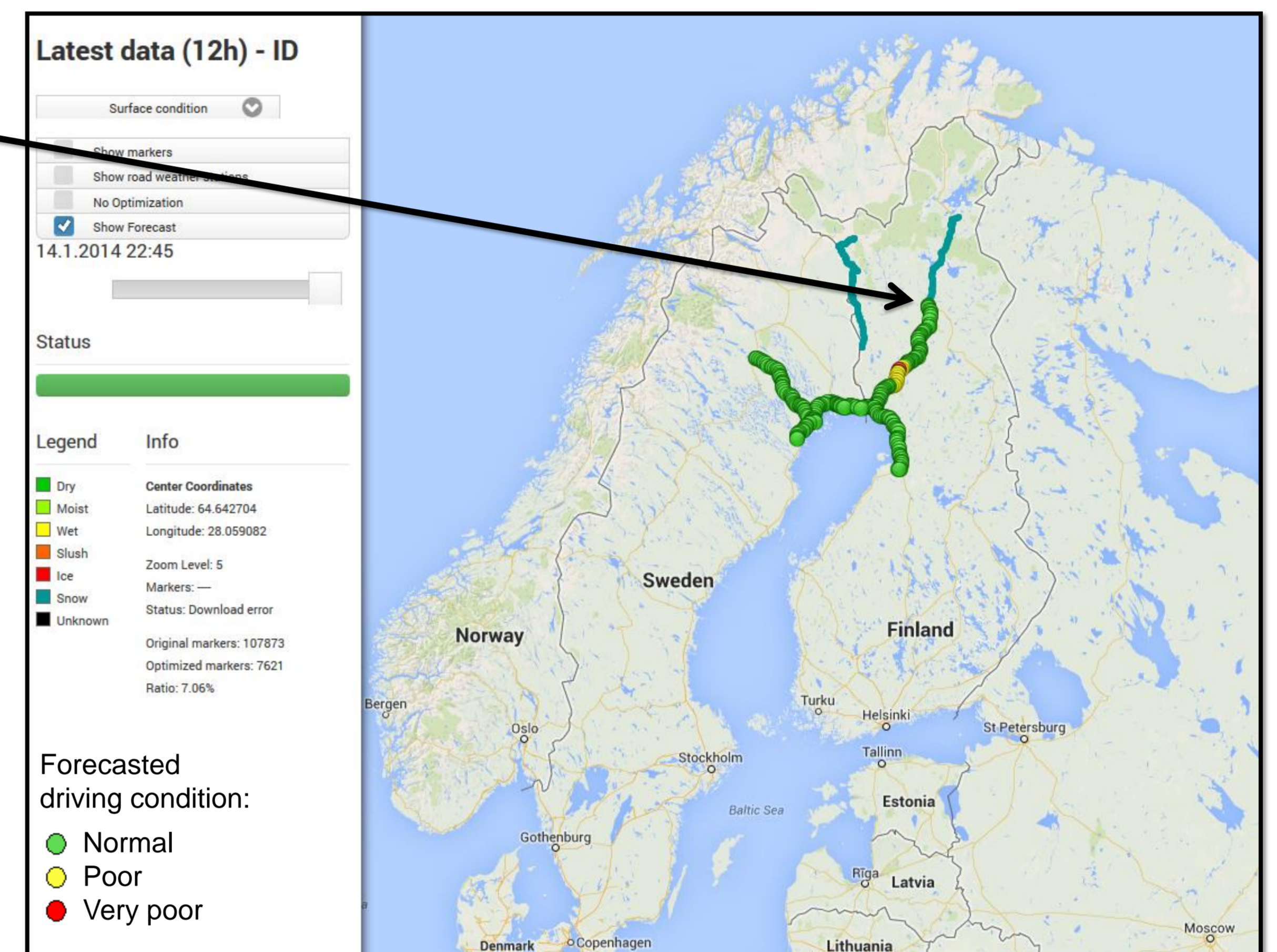


Figure 2. Latest data and the road weather forecast for the dedicated road stretches.

Road Weather Data and Forecasts

The advanced services are developed in FMI facilities and delivered back to the RWS/RSU and ultimately to the vehicles. The services provided to vehicles are two kinds, based on data analysis or purely measurement data. The data analysis based service forecasting driving conditions at dedicated road stretch is pictured above (figure 2) and still to come is a snowdrift forecast service. The measurement data provided to vehicle consists of friction, temperature, wind and visibility (figure 3).



Figure 3. Road weather service to vehicles.

Measurements

The FMI RWS station in Sodankylä is equipped with up-to-date road weather measurement instrumentation (table 1), compatible (but not limited to) with the equipment expected to be available also in the demonstration sites own, permanent and locally owned RWSs. The local server is also gathering measurement data from local measurement entities in the RWS. The data from these sources, together with possible vehicle-oriented data is sorted and further delivered to FMI local facilities.



Figure 4. Infrared camera images from the RWS.

Table 1. RWS instrumentation

Parameter	Sensor	Measurement height/depth	Measurement period
Temperature	PT100	2 m	Oct. 2011 →
Humidity	HMP45D	2 m	Oct. 2011 →
Wind speed and direction	Thies Clima 2D Ultrasonic Anemometer	6.5 m	Oct. 2011 →
Soil moisture profile	Stevens Hydra Probe II	-1,-5,-10,-20,-30,-50,-100,-200,-300 cm	Oct. 2011 →
Soil temperature profile	Stevens Hydra Probe II	-1,-5,-10,-20,-30,-50,-100,-200,-300 cm	Oct. 2011 →
Present weather and visibility	Vaisala PWD22	2.4 m (Oct. 2012 - 7.9.2012: 2.6 m)	Oct. 2011 →
Road weather camera	Axis 221 camera	4.5m	Oct. 2011 - Oct. 2013
Road surface state (remote)	Vaisala DSC111	4.5m	Nov. 2012 →
Road surface temperature (remote)	Vaisala DST111	4.5m	Nov. 2012 →
Road surface state and temperature	Vaisala DRS511	0 cm	Oct. 2012 →
Wind speed and direction	Vaisala WA15	6.3 m	Nov. 2012 →
Air humidity	Vaisala HMP155	4.5 m	Oct. 2012 →
Air temperature	Vaisala HMP155	4.5 m	Oct. 2012 →
Soil temperature	Vaisala DTS12	-40 cm	Oct. 2012 →
Present weather and visibility	Vaisala PWD22	6 m	Oct. 2012 →
Infrared camera	Zavio B7210 Full HD	4.5m	Nov. 2012 →
Soil temperature profile	LISTEC SEC 15 d-LIST Sensor	0-3m	Nov. 2013 →