Intelligent road side platform for future applications

Mikael Töyrä [1] and Jenny Ericson[1]

[1] Combitech AB, Sweden

Corresponding author's E-mail: mikael.toyra@combitech.se
Corresponding author's E-mail: jenny.ericson@combitech.se

ABSTRACT

Imagine an ITS infrastructure where vehicle, road side units and sensors can connect and communicate wireless with each other and work together. With more computer power in the road side units, it's possible to analyze and process data in the field and make faster decisions. This new infrastructure can be used to build more automated and intelligent ITS systems to get faster and safer transportations, while reducing the load on the environment.

Keywords: wireless sensor networks, data models, ITS-platform, image analysis, open source

1 INTRODUCTION

In most ITS application today information travels along familiar routes, from a few wired sensor and equipment to a centralized database, data is later used for decision making and visualisation. These pathways are changing: sensors and equipments are communicating with each other through wireless networks and analysis and decision are done automatic in the field. To be able to decentralize the decision making and analyzing there is need to move the intelligence into the road side units (RSU). The RWIS network usually covers a large area of the countries. This means that there are many locations where communication and power is available and where new intelligent ITS applications can be installed.

These ITS applications demand an intelligent and modern platform that offers computational power, storage capacity and the ability to withstand harsh climate. High reliability is a very important factor. Combitech AB has developed a new field station that fulfills all criteria necessary to act as a future ITS-platform with the capability to handle these new applications.

2 ITS-PLATFORM WITH OPEN SOURCE SOFTWARE

Combitech AB has developed a new field station that fulfills all criteria necessary to act as a future ITS-platform with the capability to handle these new applications. The hardware is based on standard components, such as the Intel Atom processor and the Linux operating system. The architect is based on Computer-On-Module (CoM) standard called QSeven, that integrates the entire core (cpu, memory, watchdog, e.g.) components of a common PC and is mounted onto an specific carrier board. The computer module is a COTS product can be upgraded in the future without changing the carrier board or the software.

ITS-PLATFORM FEATURES

Parameter	Specification
Ethernet	4 x 10/100/1000 Megabit Ethernet
Serial ports	2 x RS-232 4 x RS-232/422/485 (selectable)
USB	2 x USB 2.0
GPS	1 x GPS receiver, 50 channels
SDIO	1 x Secure Digital Input/Output (WLAN, ZigBee, Bluetooth, storage)
PCIe PCIe mini card	1 x PCIe x1 slot (graphic card, exp) 1 x PCIe mini card (GPRS, GSM)
Storage	1 x SATA
Display	1 x LVDS connector
Watchdog	Dedicated MCU for supervision of the carrier board and Q7 module
Software	Open Source

ITS-PLATFORM FEATURES

Parameter	Specification
Digital	16 x Input 16 x Output 16 x Bidirectional Input/Output
Analogue	16 x Input
Counter	8 x Counters
FPGA	1 x FPGA for high speed processing of digital, analogue and counter inputs/outputs
Power	5 VCD, 12 VCD for PCIe
Operating system	Linux 2.6
Temperature	-40 … +55 C°
Size	233,4 x 220 mm
CoM QSeven	1.6 Ghz, 1 GB RAM www.qseven-standard.org

2.1 OPEN SOURCE SOFTWARE

The software is free and Open Source so users can take the software and tweak it to suit their needs; for example adding new features and sensors. Benefits with open software are freedom, cost, no vendor lock in, and a helping community.

The overall design of the software in the ITS-platform is a layered solution where applications in different layers communicate trough an Enterprise Service Bus (ESB). Different layers have different functional responsibilities. For example; the integration layer communicates with actual real world sensors, the fusion layer process and stores the sensor data and the application service layer encapsulate different functionalities to an application.

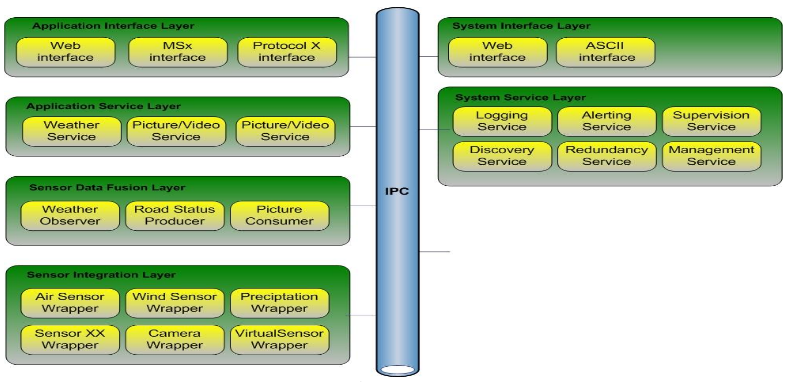


Figure 1 Software Architecture

ESB

The main responsibility for the ESB is to provide a lightweight and a common communication infrastructure for all applications in the system.

The ESB should at least provide these capabilities:

- Communication between applications on the same computer and across the network
- End-point plug-in support. New applications must be able to connect without any changes in the ESB
- Information shared on the ESB should be defined as is part of an information model and can be published/produced and subscribed to.
- The information model defines messages, entities
- Publish/Subscribe architectural pattern should be supported

- Support for both messages and service calls
- The communication is IP-based

Sensor Data Model

This picture below describes and defines data model of an ITS-platform. The focus in the model is on weather sensors but is intended to define a general sensor measurement model.

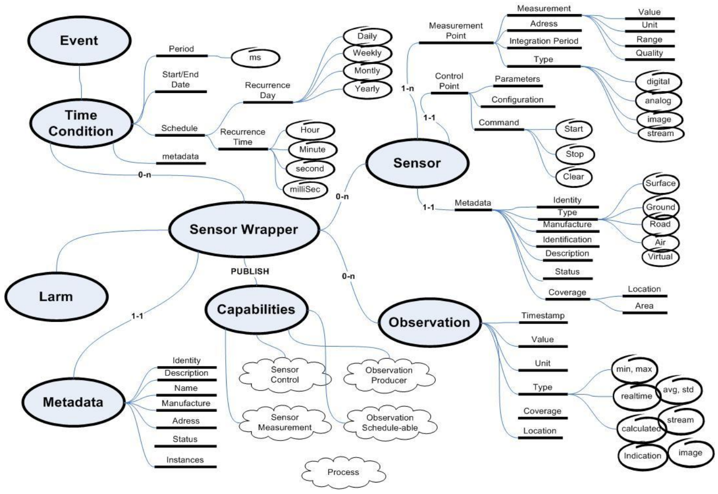


Figure 2 Sensor Data Model

Observation Data Model

This picture below describes and defines data model for weather observations. Observations are processed and refined measurements that are publish by the ITS-platform.

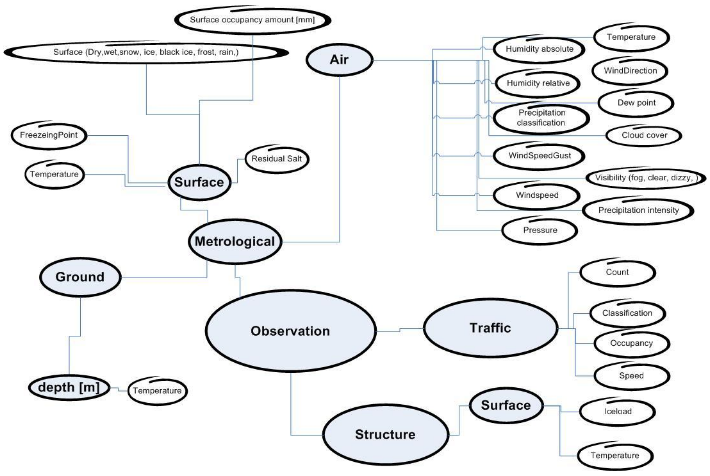
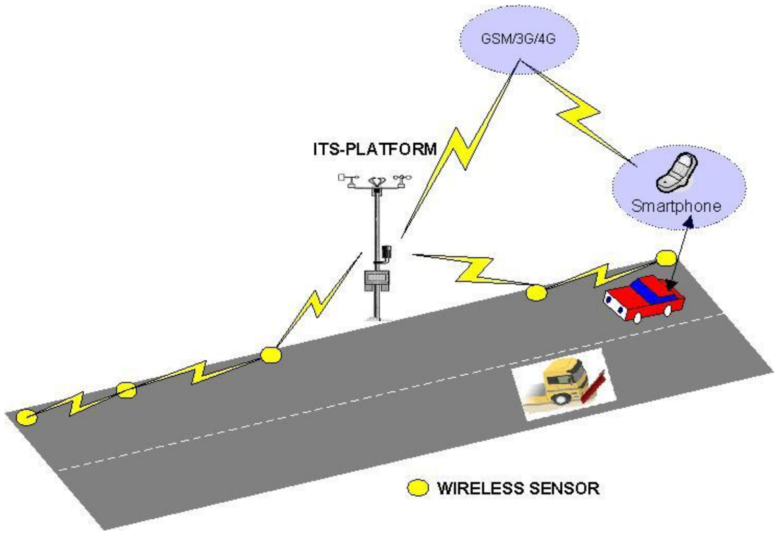


Figure 3 Observation Data Model

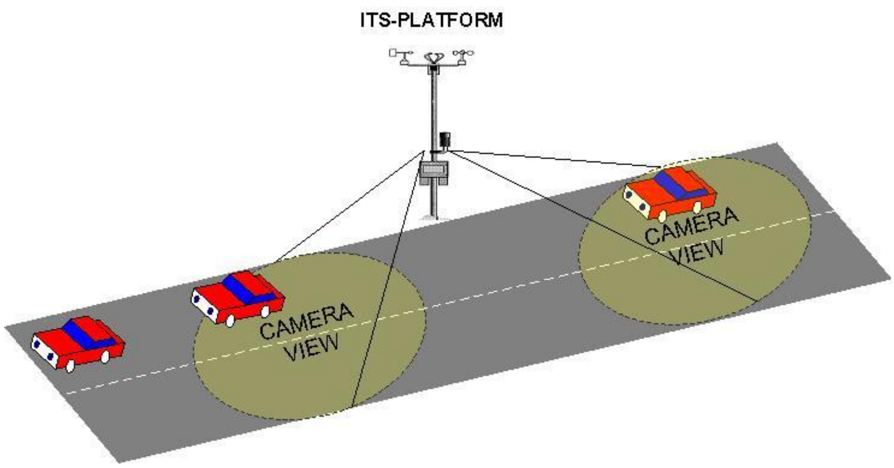
3 WIRELESS ROAD STATUS

To limit the operation and maintenance costs should wireless sensor networks with distributed functionality used because the technology already exists, see [1], [2]. In wireless sensor networks in the proximity of existing ITS-platform it becomes possible to read the road status over a wider road than today. Sensor networks can be placed on more critical issues such as dips/slumps/downturns, shadows and viaducts. Sensor data (e.g. temperature, snow depth, surface, residual salt) is transmitted wirelessly to the ITS-platform, which then transmits the information to road users. Road safety and accessibility enhanced by information and warnings in real time to road before crossing a critical road sections. Road maintenance vehicles could use this information to minimize the use of salt.



4 IMAGE ANALYSIS

Many road weather stations have cameras and these are mostly used to give the operators a view over the traffic. With real time image analysis (see 4) out in the field all these cameras can be used for tasks such as vehicle tracking, speed measurement, ghost driver detection, jam detection, number plate recognition and road surface classification. Using these new tasks will be a cheap and easy way of extending the already existing road infrastructure.



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