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Using ITS Deployments for Wireless Network Performance Monitoring

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Abstract

Wireless infrastructure communication networks are a critical part of ITS deployments since they are needed to collect the sensing data from vehicles. However, when choosing the communication technology and network provider, customers are left with very limited information about the performance of the networks. In this work we propose a new ITS application for monitoring the performance of the wireless networks. The data collected can be used to develop new solutions to enhance the use of the networks, to check service level agreements and to enhance network planning/maintenance. A prototype application is currently being developed and tested in the ITS Platform project[1].

Keywords:

Wireless, Communication Networks, Performance, Monitoring

Introduction

Wireless infrastructure networks such as cellular GPRS/UMTS/LTE are an important part of most ITS deployments, at least until special purpose technologies like DSRC can be deployed. These networks are used to collect the sensing data from the vehicles and to distribute information to them. In most countries there are already a number of different co-existing technologies and different network providers to choose from. These different combinations offer different performance characteristics in terms of bandwidth, latency, radio coverage etc. However, the network performance information presented to customers is often very limited. In Denmark, the information consists of a theoretically calculated map of the expected bandwidth. The information from these maps is overly optimistic for many locations.

To improve this situation, we propose to use ITS deployments for the collection of network performance data. ITS deployments offer a number of unique features making them ideal for this purpose. The OBUs are equipped with GPS providing accurate location information and the possibility of highly synchronised clocks. The vehicles cover large areas of the network

and can perform continuous monitoring. The ITS deployments will also offer a lot more application control than other platforms such as smartphones.

State-of-the-art

A similar method has been deployed in Sweden[2], where applications have been developed for smartphones and PCs to let users voluntarily test their internet connections. On the contrary, what is proposed here has the advantage that other applications using the network can be controlled. Also, since it is managed centrally, the monitoring can be scheduled to cover enough areas to create full performance maps, whereas the smartphone approach will be more sporadic.

Wireless network performance monitoring

Network performance data can be obtained either passively such as recording the signal strength or actively by injecting network packets into the network such as sending ICMP packets to measure Round Trip Time (RTT). However, active monitoring can interfere with other ITS applications using the network unless it is scheduled to avoid interfering. It can also increase the cost of using the network for cellular subscriptions. Furthermore, some active measurements also need a special measurement server. On the other hand, active measurements can be conducted when they are needed, and can be crafted to show specific properties. Any network performance metric sample can be viewed as information from a sensor and treated as such in an ITS deployment.

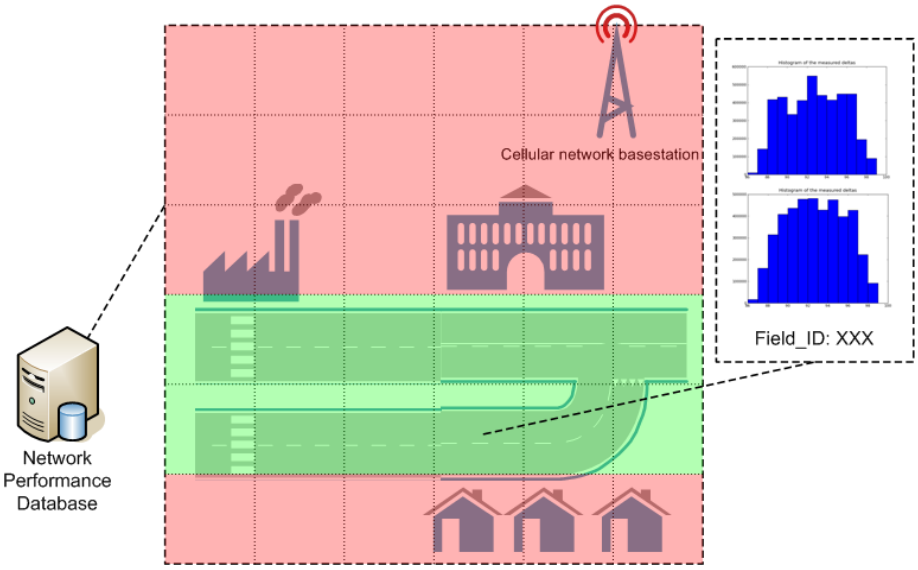

Figure 1 – ITS network performance monitoring overview

An overview of the proposed application is illustrated in Figure 1. The application located on the OBUs can collect performance samples and add metadata like time and location to them. Like floating car data, the performance samples are collected centrally, and these data can be extracted for a given region as illustrated by the histograms in Figure 1. Since vehicles typically only travels using the road network, performance measurements will not be collected for some regions as indicated with red markings in Figure 1. However, since the road network spans most of the developed countries, we believe the coverage will be adequate.

A prototype application is currently being developed as part of the ITS Platform project. In the first version, it will measure RTT and various passive metrics only, since this can be done without special server side software and is a simpler metric to measure than other metrics such as throughput[3]. The ITS Platform project will be deployed to 500 cars in Q1 2012 and it is planned to deploy the proposed application to a significant part of those cars.

Further work on the application includes extending the number of metrics the application can record, developing scheduling policies to both avoid interfering with other ITS applications and to control where/when measurements should be conducted and to investigate methods to improve measurement quality such as when cross traffic is present.

Work is currently ongoing to demonstrate how to use network performance maps to optimise TCP based file downloads in vehicular scenarios. By avoiding to use the network in regions with poor network quality the communication overhead can be minimised to save data costs.

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