THE RELEVANCE OF INTELLIGENT TRANSPORTATION SYSTEMS (ITS) IN SUB-SUB-SAHARAN AFRICA

Thinus Booysen, Senior Lecturer at Stellenbosch University
mjbooysen@sun.ac.za.

Countries like the United States, Japan, and a number of countries in Europe, have led the way in a field that has become known as Intelligent Transportation Systems. The term broadly describes any intelligent intervention in the transportation industry, specifically the road transportation industry. Initially, these countries applied ITS for simple traffic control (e.g. traffic light coordination) and later Electronic Toll Collection (ETC), but it has since evolved to include electronic ticketing and automated fare collection, in-vehicle navigation and route guidance, real-time public transportation information distribution, monitoring and active control of traffic flow, and even vehicles that intercommunicate to prevent accidents. As could be expected, every region decided on a different approach, and the companies responsible for implementations used proprietary technologies. This haphazard approach has led to various incompatible standards and systems, which is seen as a major impediment to large scale implementation of ITS. Because of its dependence on wireless communications, electronic sensing, and computer-based data aggregation and visualization, successful deployment and maintenance of ITS is heavily dependent on advanced, and expensive technology and Information Technology (IT). Currently, the main drivers for ITS adoption are safety, efficiency, and environmental impact reduction.

With Sub-Saharan Africa (SSA) squarely on the wrong side of the digital divide, the questions needs to be asked: Is ITS relevant to SSA? Can SSA benefit from ITS at all? The answer is a resounding yes. The solutions realised by ITS address the needs of Africa as if tailor-made. To name a few, ITS implementations have the following benefits: improvement in traffic congestion (which directly improves productivity), improvement in efficiency and effectiveness of public transportation, help with transportation infrastructure management, prevention of accidents, improvement in emergency services, and reduction of emissions and global warming. The bleak reality is, however, that SSA so desperately needs ITS, precisely because investment into infrastructure has been crippled by monetary constraints, mismanagement, and historical disadvantage – the same reasons it was wrong-footed by the digital divide, and the same barriers that might prevent successful ITS deployment. This article will evaluate some of the challenges to successful implementation in SSA countries, and also cover some of the unique opportunities.

Despite the financial challenges, being on the wrong side of the digital divide provides an opportunity for SSA countries to leapfrog some of the technical development phases, especially the wireless communications technologies. If the decision makers are therefore empowered and knowledgeable, they could avoid many of the mistakes made, and unnecessary expenses incurred, during initial implementation in the developed countries. An interesting trend world-wide, is to move away from standards specifically developed for ITS, and instead use existing cellular communications such as or Third generation (3G), WiMAX, and Long Term Evolution (LTE). The data rates of modern cellular networks can support a large number of the applications foreseen for ITS, including Vehicle to Infrastructure (V2I) communications. In V2I

communications vehicles, as opposed to the passengers in it, communicate with the ITS in a Machine-to-Machine (M2M) configuration (Figure 1).

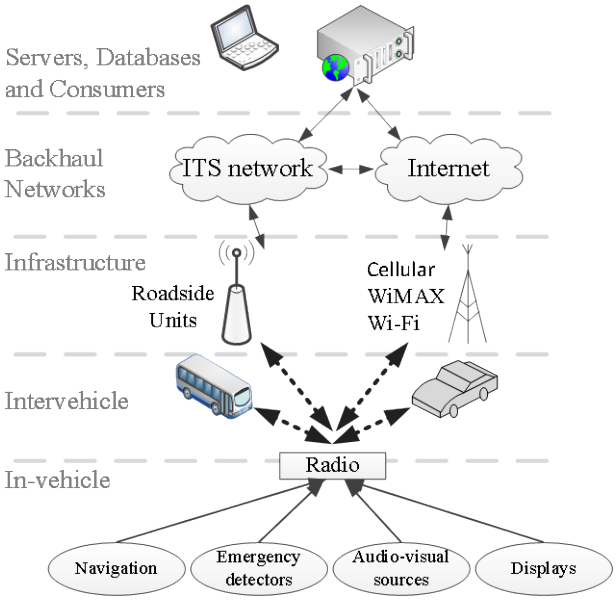

Figure 1: Generic diagram of the connected vehicle.

Given the large penetration of cellular networks in Africa, the cost of investment in ITS infrastructure could be substantially less than a traditional ITS implementation. An evolution to using cellular networks in ITS would, for example, mean that instead of using the traditional road-based traffic sensors (loops and radar), vehicles with a smartphone or cellular tracking device, could be used as a probe to measure traffic flow – significantly reducing the financial and maintenance burden on road agencies. Moreover, knowledge gained from the installation of cellular networks could be leveraged for ITS installations and applications. When one considers the cellular coverage maps of countries like Botswana, Zambia or Kenya, it is clear that cellular coverage is most predominant in the large cities and along the main roads, which exactly where one would need vehicular connectivity and other ITS services.

As an example, an area with substantial potential for ITS implementation in Sub-Saharan Africa is the informal public transport system. Since little or no investment has been made in rail and formal public transportation since liberation, the informal taxi industry has sprawled into a vibrant industry. A recent study by the Trans-Africa consortium found Lagos alone had 80,000 informal minibuses. According to the Arrive Alive campaign, South Africa alone has around 200, 000 minibus taxis. The story is similar for other countries in SSA, consider for example the ubiquitous Dala-Dalas in Tanzania, and Ndiaga Ndiaye from Senegal. According to the Trans-Africa study, the majority of taxi owners in SSA manage to cover their operation costs, but cannot afford to adequately maintain and upgrade their fleets, comprising on safety and quality. Both Senegal and South Africa have introduced fleet renewal programs, with varying levels of success. One way to improve efficiency and achieve regulation of the industry is to require every vehicle to connect to the infrastructure with a cellular tracking device (around US$ 35). This will enable each vehicle to autonomously announce its location and speed in real-time. The device could be augmented with sensors to report occupancy and driver behaviour (e.g. acceleration and deceleration). This information (where every taxi is, how fast it is moving, number of passengers, driver behaviour) empowers the authorities to measure traffic flow, enforce routes, enforce speed restrictions, and understand public transport better. If the

information is made available to the public on a cellular platform, passengers will also have a lot more information to make informed decisions.

At Stellenbosch University's Electronic Engineering department and the MIH Media Lab, we have been investigating some of the novel applications of ITS, mostly related to connected vehicles. Some of these include a minibus tracking system to report location, speed, occupancy and driver behaviour, in real-time over a cellular network.

Is ITS relevant to Africa, and in particular Sub-Saharan Africa? Absolutely – ITS could be a major enabler and developing countries are in a unique position to use ITS to dramatically improve transportation safety and efficiency. The crucial question is whether Sub-Saharan countries will make the right decisions on implementation of these technologies, and at the right time. Will decision makers make ITS an integral part of their transportation (both road investment and public transportation) strategies right from the start? Will they be enticed into installing expensive and unmanageable equipment based on a false notion of national pride, or will they decide to implement solutions that address specific needs and improve the lives of their people?

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