

Advanced traffic and transport management

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A foreign language?

Our cars are talking to us – but how can
we make use of what they are saying?

ICH BIN
HIER.

THIS IS MY
LOCATION.

I'M
TRAVELLING
AT 37KM/H.

HELLO.
I AM HERE.

THERE HAS BEEN
AN INCIDENT
AHEAD

AS I WAS SAYING...

Bill Sowell revisits the future of vehicle detection

WHEEL-TIME INFORMATION

How ITS is making cycling safer

A CURE FOR CONGESTION

Paul Vorster assesses the IRF's ITS Manifesto

Solid state

Dr Amir Ziv Av, the Chief Scientist at the Israeli Ministry of Transport, discusses his country's robust ITS strategy

From a systems engineering perspective, National Intelligent Transport Systems (ITS) are among the most to implement. ITS utilizes advanced technologies in many fields, some of them cutting edge. They also incur a high level of risk due to the many stakeholders, subsystem interfaces and human behavior aspects involved. Investments in ITS projects involve a long period of time from initiation to operation, with the systems subsequently serving for many more years.

This article describes an ITS vision for Israel, and suggests a methodological approach for increasing the probability for design and implementation success through the use of two key success factors: simplicity and robustness.

The proposed methodology can be a valuable guideline to many complex technological projects, not necessarily ITS.

THE ROAD IS LONG...

There are many Intelligent Transportation Systems deployed in Israel that encompass

various standards and technologies but do not comprise a common architecture. As a result, they cannot effectively address issues such as the congestion created by the growing rate of yearly kilometers driven as compared to roads paved.

Only a comprehensive national ITS strategy (policy and technology) that will improve infrastructure efficiency while increasing the use of public transportation can facilitate the problem-solving process.

For a high probability of success, the ITS strategy must be simple, robust



This vision for Israel's ITS strategy is based on existing technologies

“Only a comprehensive national ITS strategy that will improve infrastructure efficiency while increasing the use of public transportation can facilitate the problem-solving process”

(not sensitive to a working point) and based on existing, proven technologies. For example: smartphones will connect all transportation users – public transportation passengers as well as drivers – to the national ITS. The ITS will be supported by camera (and other sensor) coverage across the road/railway networks, providing real-time information on all traffic and incidents on roads, intersections and railways, and available to all users and stakeholders. The user interface will be vocal (VUI) – simple and safe. All tolling and payments (public transportation, parking, toll-roads, etc.) will be automatic and unobtrusive – eliminating the need for cash, tollbooths, waiting in line, etc.

The article describes a national ITS strategy and suggests principles for robust and simple implementation.

THE ITS STRATEGY

The national ITS strategy would aim to address two issues: infrastructure inefficiency, and the relatively low use of public transportation.

The “strategy” of every project is comprised of requirements and concept; details comprise the “tactics”. Optimal strategy is a key factor for project success, whereas tactical errors can be corrected “along the way” (the development process being iterative).

REQUIREMENTS

Our goal is to produce the best solution to a complex problem, with many objectives, regarding their respective importance. The requirements are formulated as the objectives of that goal function.

The requirements can be divided into three main groups: performance, functional, and value chain.

Performance requirements can be measured quantitatively and are recognized by all authorities dealing with ITS:

- Minimum journey time for people and goods;

- Minimum congestion;
- Modal change from private to public transportation;
- Minimum time to incident detection;
- Minimum time to incident clearance;
- Event management;
- Public transportation vehicles priority (traffic lights and lanes);
- Maximum safety.

Functional requirements that define the system concept:

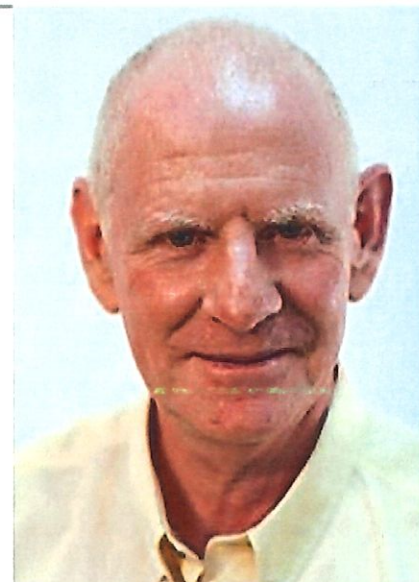
- Accessible real-time information for all users, and uncertainty reduction;
- Simple smartphone voice user interface;
- Unobtrusive automatic tolling/payment for all situations (bus, train, toll road, parking, police fines);
- Minimum sensitivity to cyber attacks;
- Minimum sensitivity to natural disasters;
- Minimum sensitivity to security incidents.

Value chain requirement, allows the ITS development to be robust and simple, in this author's opinion a condition for the success of every complex and large-scale development project. In this case, the definition of robustness: not sensitive to the working point (for the reason that the system designed today must be relevant and efficient also in 2040), and incorporating scalability, modularity, and design margin.

Simplicity is defined here as “minimum resources per goal”, and incorporates: managing only what is essential; using straightforward, proven, reliable, updated, available and durable technologies; making use of a minimum of technology types; using minimum technological and organizational interfaces; making the best use of existing systems; proven ITS national architecture (USA, etc.); international standards.

CONCEPT

The two main goals of this national ITS strategy, as mentioned above, are to improve infrastructure efficiency and,



The Ministry of Transport, Infrastructure and Road Safety's Chief Scientist Dr Amir Ziv Av

simultaneously, to encourage the shift from private to public transportation.

Improving infrastructure efficiency means the optimal use of infrastructure and public transportation. Comprehensive optimization, similar to the situation in the aviation or maritime industries where every passenger and every container is fully managed (exact details are known about the passenger – name, seat number and geographic location on specific date and hour, month, flight; the same regarding every container at sea), is an unlimited problem regarding ground transportation. The course of every driver on the road and of every passenger on public transportation cannot be managed, and this means that the problem must be simplified in stages.

CONCEPT SIMPLIFICATION

I suggest a four stage approach to simplification that will reduce the problem order by 100 or 1000 but the efficiency penalty by only a few per cent:

Stage 1: the ITS strategy will deal only with general optimization, whereas local optimization will be carried out by the users – drivers and public transportation passengers – who will possess all the necessary, relevant real-time information. The system will identify the real-time location of every vehicle on the road/railway networks (as an anonymous point), based on vehicle/driver GPS/smartphone and camera coverage as well as other sensors (video + picture analysis; this author estimates about 3000 traffic management and 1000 enforcement cameras for the entire infrastructure network).

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“The dialogue between the system and the users will be vocal – the easiest and safest method”

General optimization includes management of the following sub-systems:

- intersection and ramp traffic lights;
- changeable lanes;
- variable message signs;
- cellular/Internet information;
- public transportation vehicle priority;
- emergency vehicle priority;
- public transportation synchronization;
- tolling, road charges and fare collection enforcement.

Stage 2: there is no need for the system to manage the total area of Israel: three metropolitan regions – Tel-Aviv (14 towns), Haifa (five towns), and Jerusalem – and the countrywide network are suffice, meaning that the system will deal with less than 20 per cent of Israel's total area.

Stage 3: the system will deal only with corridors (that serve as alternatives to one another) where diverting traffic according to traffic load is justified.

Stage 4: the system will manage only heavy traffic routes, meaning that the system will deal with less than 10 per cent of Israel's roads.

The general picture of movement along the entire road/railway networks will be given, as previously mentioned, by floating sources (GPS/smartphones) that will be part of every vehicle (or driver), while accurate intersection and road management will be carried out by the dynamic picture analysis of camera (and other sensor) coverage.

The real-time occupancy of all public transportation vehicles will be known (in addition to their location, as with all other vehicles) in order to facilitate supplementary services such as minibuses and so on, as needed.



Israel is developing a far-reaching and robust ITS system

TOLLING AND PAYMENTS

Tolling/payment will be automatic and unobtrusive in all situations: toll roads (illustrated by Israel's toll road Highway 6), parking lots, pavement parking along streets, buses, trains, police fines, etc. Payment will be conducted through smartphones serving as “identity cards” for every vehicle and public transportation passenger, in such a way as to allow “enter – exit – payment completed”. This user-friendly method of payment will do away with lines at parking lot entrances (that in many cases overflow onto the street), at toll road entrances and exits, and will encourage public transportation use.

USER INFORMATION

All users – public transportation passengers as well as drivers – will have access to all the information necessary to make optimal on-the-spot or advance decisions (local optimization) for planning their journeys, thanks to available, real-time information. This information can be obtained from the Internet, variable message signs along roads, radio traffic announcements, smartphone messages, and electronic public transportation information displays on buses and at stations (“next bus”, “next station”, real-time location, position on route, journey timetable, etc).

USER INTERFACE

The user interface will be simple and safe. This is a key factor in encouraging potential passengers to actually use public transportation (instead of private transportation), and in transferring information and recommendations to drivers so that they may choose the

most convenient route. The dialogue between the system and the users will be vocal – the easiest and safest method. Public transportation users will tell their smartphones the desirable destination, and the system, recognizing their locations (cellular-GPS), will supply recommendations as to which bus station to go to, which bus to take, where to alight, and journey timetable. The system will inform the passengers of any time delays caused by unexpected incidents along the route. In a similar way, drivers will receive information and recommendations about their routes and any real-time incidents.

CONCLUSION

This vision for Israel's ITS strategy is based on existing technologies. The technology penetration rate exceeds all estimations, and a large number of advanced technologies are already in use in Israel. Development of a robust and simple ITS is key to successful usability (accessible real-time information available to all users; simple dialogue between user and system). The challenge will be to guide all stakeholders in a coordinated and coherent way. 

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