Smart Transport Infrastructure Technology Forum
INFORMATION PAPER

Hosted by NICTA (**National ICT Australia)**
Wednesday, 28 April 2010
10-2 pm (optional working groups 2-4pm)
Level 4, 13 Garden St,
Australian Technology Park, Eveleigh NSW.

Thank you for registering to attend our Smart Transport Infrastructure Technology Forum. This brief paper outlines what is planned for the Forum and what we hope to achieve.

BACKGROUND

Awareness of the importance of what is increasingly known as 'Smart Infrastructure' has grown over the past year. As you may be aware, the House of Representatives Standing Committee on Infrastructure, Transport, Regional Development and Local Government has established an inquiry into Smart Infrastructure and held an associated conference 'ThinkFuture' at Parliament house in Canberra earlier this year. The areas of Smart Infrastructure which were covered by this conference included water, energy, transport and communications. (See http://www.aph.gov.au/house/committee/itrdlg/)

NICTA believes it is crucial to use ICT research to better position Australia to take advantage of advances in Smart Infrastructure (see attached – NICTA's information paper to the Committee on Smart Infrastructure).

NICTA and other research organisations and collaborators have been working on various aspects of Smart Infrastructure – smart energy and water use, building design and business logistics. This is an extensive field. For this Forum to have realistic and achievable objectives and outcomes on the day, the focus will be on applying ICT to Smart Transport Infrastructure. This includes smart roads, smart rail, smart airports, inter-modal interchanges and public transport.

Representation at the Forum includes industry, industry bodies, infrastructure suppliers, end users of infrastructure, vendors, research organisations and state and federal governments.

The aims of the Forum are

- to provide an overview of developments in Australia's Smart Infrastructure space
- to provide an overview of recent advances in ICT research which may assist in the future development of Smart Infrastructure
- to identify immediate and future problems which may be solved by ICT research and
- to provide information to policy-makers of the potential benefits of Smart Infrastructure

The Forum is expected to identify areas for collaboration, with a view to developing proposals for significant projects in Smart Infrastructure.

Expected Outcomes of the Forum

- representatives to reach a common understanding of each other's challenges and capabilities
- raised awareness of the problems and opportunities arising
- Smart Infrastructure priorities identified that will benefit Australia
- Future Smart Transport Infrastructure projects identified which may involve government, industry and research

Some examples of ICT research in Smart Infrastructure follow. A draft agenda is attached.

Examples of ICT that can be applied to Smart Infrastructure:

Intelligent video analysis

The advent of low-cost video cameras and significantly increased computational power now means video surveillance systems can be used for a wider range of applications. These include detecting and identifying people, vehicles and vessels, including presence, type, speed and direction. More expensive thermal imaging cameras can also be applied to high-importance applications. New techniques are also being developed which enable video cameras to see through fog and rain and other adverse weather conditions. The output of video cameras can also be combined with that of other sensors such as radar and acoustics using data fusion techniques to provide higher accuracy and context. For further information see [1].

Dedicated short-range communications and short-range radar

Dedicated short range communications (DSRC) will enable an important new range of Intelligent Transport Systems (ITS). This is a dedicated 5.8GHz radio communications technology designed for motor vehicles to communicate with each other and with the roads and freeways they are driving on. It can be used to disseminate information to and from vehicles and when combined with other technologies, such as short-range radar or location from a global positioning system, can improve navigation safety with features such as collision avoidance. DSRC or RFID (Radio Frequency ID) for vehicle identification and E-tolling is another emerging area. For further information see [2].

Sensor network technology

Sensor networks are typically low power radio transmitters attached to physical sensing devices such as moisture sensors, strain gauges, ice detectors and other measuring devices. Such radios are usually configured in a "mesh" so that they can communicate with each other but may also be arranged in a "daisy-chain" to reach a remote base station or control centre. These configurations have been successfully applied to irrigation systems and power grids but can also be applied to transport infrastructure. For further information see [3].

The National Broadband Network

There is considerable excitement and public interest in the proposed rollout of a national broadband network which will eventually cover of 90% of Australia's population with optical fibre connections at speeds of at least 100 Mbits/second. The remaining 8-9% of the population will receive high-speed coverage using broadband wireless technologies such as 4G mobile or WiMax. The final 1-2% will use satellite communications. The scale and ubiquity of this rollout provides the opportunity for many new applications such as remote collection of energy and water meter readings. Its potential use in smart transport is large and depends on the connectivity along urban streets and major transport corridors. For further information see [4].

Autonomous and Semi-Autonomous vehicles

Autonomous vehicles, long a feature in science-fiction movies, are being used in real-world applications. An early adopter of this technology has been the mining industry, but it is also applicable to moving goods, particularly in ports, and more recently to autonomous motor vehicles. The recent DARPA grand challenge shows that it is feasible for vehicles to navigate urban environments autonomously. It may be some time before this is acceptable on public highways and as a first step the R&D community has started developing technologies for co-operative driving among vehicles. For further information see [5].

Cooperative driving solutions will include:

- Cars that never tailgate but may safely 'platoon' with other vehicles
- Automatic crash avoidance and mitigation systems
- "Sticky" lanes that will keep cars where they should be
- Smart Intersections that prevent accidents and enable better traffic flow
- Parking lots that talk to vehicles in need of a place to park
- Beacons and sensing systems for pedestrians and cyclists to make them part of a cooperative mobility system

Intelligent Fleet Logistics

A major problem facing logistics operators is to quickly re-calculate routes for their delivery vehicles as the destinations, loads, and traffic conditions change - often quite dynamically. A number of new scheduling and optimisation techniques have been developed in the research community which offer much greater fleet efficiency to operators such as commercial carriers, armoured cash services and car-share providers. For further information see [6].

Situation awareness and other artificial intelligence (AI) techniques

Recent problems on the F3 motorway north of Sydney and on the Great Barrier Reef highlight the challenges facing control room operators in understanding the vast quantities of information presented to them by the various sensors and technologies described above.

Modelling, visualisation and the use of artificial intelligence techniques to inform and control decision-making across multiple and related domains will be increasingly important. An example of this is the smart electricity grid where operators have to act on masses of information supplied by sensors and meters in the network in the light of myriad dependencies across homes, commerce, hospitals, and transport.

Transport control rooms for airports and roads and ports have similar problems and new technologies using artificial intelligence have been demonstrated and applied to solving some of these problems. For more information see [8,9].

Background Information

[1a] See information on NICTA's Smart Transport and Roads Project
http://www.nicta.com.au/research/projects/smart_transport_and_roads
and information on NICTA's video surveillance projects
http://www.nicta.com.au/research/projects/safe_as
http://www.nicta.com.au/research/project_list/completed_projects/video_analysis_and_content_management_for_surveillance

[2] See Information on Embedded Systems Australia's DSRC projects
http://www.embeddedsystemsaustralia.com.au/node/35

[3] See information on NICTA's Sensor Network Projects
http://www.nicta.com.au/research/project_list/completed_projects/nicta_open_sensorweb_architecture
http://www.nicta.com.au/research/project_list/completed_projects/water_information_networks

[4] See http://www.nbnco.com.au/

[5] See work on autonomous vehicles at the Australian Centre for Field Robotics
http://www.acfr.usyd.edu.au/research/projects/others/darpa.shtml
For information on the Grand Cooperative Driving Challenge http://www.gcdc.net/

[6] See information on NICTA's Intelligent Fleet Logistics Project.
http://www.nicta.com.au/research/projects/intelligent_fleet_logistics

[7] See CSIRO research on managing terminal operations
http://www.cmis.csiro.au/asn/capital-intensive-sc/index.htm

[8] See NICTA's Situation Awareness by Logic and Inference project.
http://www.nicta.com.au/research/project_list/completed_projects/situation_awareness_by_inference_and_logic