SYMPOSIUM 2. BEHAVIOR ANALYSIS IN TRANSPORTATION

IT platforms for safe and aware driving

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ABSTRACT

The paper discusses the state of the art the Information and Communication Technologies (ICT) in relation with transportation security and safety.

In particular it shows how ICT, while it is very aggressive in the consumer approach to the business, is in early stage in professional applications, such as transportation security and safety.

A technology assessment shows that ICT offers huge resource to build up high potential applications and finally it provides some high-level technical and business elements for the system designing in this application domain .

Keywords: IT platforms, Transportation, security, safety.

INTRODUCTION

The paper discusses the state of the art the Information and Communication Technologies in relation with transportation security and safety. The paper first shows that the advertised model of the Information and Communication Society, pushed by the ICT players, does not cover basic and urgent needs real life security and safety.

Then the paper shows that the basic performance figures are real very interesting assets made available by technology to build effective information sharing of vehicle and driver information.

Finally the paper propose a technical and management receipt to design IT platforms Architectures and to deploy Applications dedicated to the safety and security in transportation.

ICS VS SIC

This section emphasizes the contradiction between the Information and Communication Society (ISC) advertised by ICT players and the Society Information and Communication (SIC),i.e. the real information available to the human society.

INFORMATION AND COMMUNICATION SOCIETY (ICS)

ICT Experts usually define some "scenarios" for which their "solution" fit at large. These "scenarios" are usually projected in the future world, in which needs are solved with as much fascinating mechanisms as possible. In these scenarios, for instance, tourists immediately and automatically receive information of what they are looking at, business man are automatically put in contact with partners by software intelligent business broker , etc.

Unfortunately these scenarios are never described in full details, and, very often in such details stands the feasibility, marketability of the solution and the consequent possible or impossible return of investment.

The reason of this is that, at the time in which engines, radio broadcast, television, telephone were invented, the technology was pushed to solve very specific and real needs.

In the today ICT society, the situation is completely reverted, technology is pushing, or attempts to push the needs.

The typical way is the creation of ideas that often correspond to "buzzwords" such as: "Cloud", "Internet of Things", "Web 2.0", etc. Often behind such terms, typically characterized by rapid obsolescence, there are slightly imprecise definitions that do not corresponds to any effective innovation with respect to the technology available before such terms were invented. However these terms are created to be used by opinion makers, research managers, big ICT players to drive or often just to announce big investment in such themes, hoping to find out in this way, the application that can boost the market of electronics. Such applications are typically called "killer application", in the sense that these applications are difficult to find as the killers in murder novels. In reality the concept of "killer application" is itself the killer of the professional business as it propose the application at the final stage of the technology development.

SOCIETAL INFORMATION AND COMMUNICATION (SIC)

As opposite to the fancy world of ICT society it is very evident that the information and communication in the society, in security and safety domains, is really at a very early stage.

It is evident that lacking information is one of the first causes of damages and injuries:

- Most Accidents hit persons because they do not know in time what is going to happen e.g., finding obstacles in roads, being affected by early-stage diseases, incurring in an explosion, etc.

- Estimated stolen fuel amount in Italy ranges from 20 to 50 million Euros per year fuel as nobody knows when and where this happens.

- Allow me a not statistically significant tribute to my beloved father: he was physician and fully healthy: he did not know to be affected by a leg's phlebitis for three days. An embolus killed him. Information and Aspirin would have saved him.

The point to be clearly underlined is that "to know" in this context does not mean "know-how" (e.g. how to defeat cancer or amyotrophic sclerosis or how to electronically transfer the matter as in Star Trek movies), but it means to be **timely** informed **when**, **where** something of perfectly known, understood and coded, is happening or has just happened.

We observe that this lack of information forces to adopt very conservative approaches to the risk that is prevention, for which the lack of information is compensated by very restrictive measures that reduce the probability of some events almost to zero, instead of detecting such events.

TECHNOLOGY ASSET-DRIVEN ANALYSIS

In this situation the role of the Information Engineering is to consider the "basic" technology assets, free of any buzzwords and hypes, to really evaluate the raw material on the top of which it is possible to create new solutions for safety and security.

The technology asset-driven analysis considers the following dimensions :

1) Communication Paradigm

The most recent revolution in the telecommunication is mainly due to the possibility to make many objects to communicate simultaneously to many other objects or persons (see Table 1, at the end of the paper)

2) Data Transmission Costs

The cost of transmission in the last decade decreased by 3 order of magnitude.

in 2005 Wan Wireless (GPRS) : 1 €/MB transmission for on average 5 MB/month, whereas in 2015 Wan Wireless (4G) 1€ /GB for an average of 5 GB/month

3) Transmission Latency in Computer networks

Signal in copper and in optical fiber is around 2 Million meters/sec (67% speed of light)- E.g., from London to South Africa a 60 bytes packet takes on average 72 milliseconds to cover a geodesic distance of 9600 Km (i.e., 45% speed of light) including packet processing at each network node. This measure shows that actual message speed is only 30% lower than the maximum theoretical speed.

4) Type of sensors

On a smart phone, there are camera, audio, acceleration sensors. The industrial technology provides hundreds type of sensors. Table 2, at the end of the paper, shows a list of 240 types sensors categorized in 11 categories, also including biometrical sensors.

5) Computing Power

Current microprocessors mounted in servers are able to perform a magnitude order of 100 billions floating point operation (e.g., sum, multiplications on fractional numbers) per second (see Fig. 1)

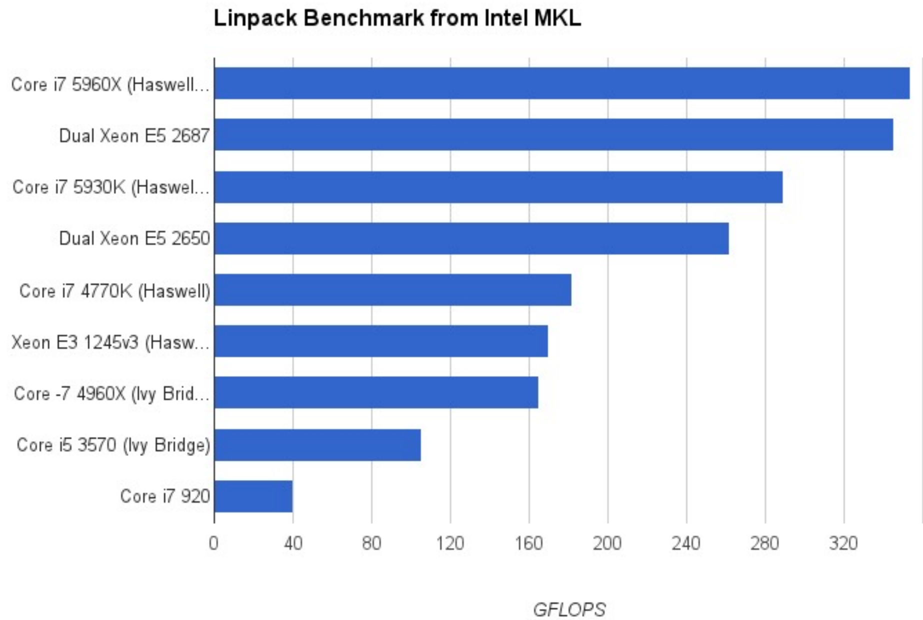

Figure 1 | Million floating operations per seconds (GFlops) delivered by recent server microprocessors

As a consequence of this analysis we can state the following proposition

Proposition 1

At the cost of 5€/month, every second autonomous object can send the measure of 120+ analogue sensors to many objects or persons in any part of the digitised world, assuming a sample resolution of 0,0015% over the measured range with a maximum delay of 150 ms. A single server can deliver one thousand operations per each sample managing 100 million sensors.

IT Platform Architecture challenge

Proposition 1 shows that the challenge of making accurate information is evidently not the resource availability, but instead the platform architecture. Also it is evident that a single server can getting million vehicle information, including sensors data scanning the behaviour of the driver at a remarkable affordable costs

The existing gap stands in the IT platform architectures, that are today to be re-designed in such a way to support such applications

1) Real-Time information handling, i.e. the information must be processed as soon as it enter the server.

2) Real-Time classification, the information must generate immediately derived information

3) Real-Time information routing and dispatching: information must be immediately forwarded to the stakeholders.

In fact a very small real-time remote control application for road safety that controls just a small set of vehicles (e.g. 5.000) classifies every day the amount of data of all the id cards of the Italian population.

The IT platform challenge is

- to design affordable platforms able to process million streams of thousands signals per day in real-time
- to split correctly the on-board processing and the ground processing [2]

This is possible but it deserves to re-think the base software, e.g.,

- abandoning client-server paradigm,
- organizing the storage in a different way with respect to the conventional DBMS,
- making data access not depending on the software control flow, and the software control depending on the data flow.

APPLICATION DEPLOYMENT RECEIPT

The platforms should be developed very tightly to the application

- Build up the minimum application such that the cost of the application + the cost of the infrastructure is paid back by the value of the information provided
- Provide systems as a service in such a way
  - to reduce the maintenance cost test and deployment costs
  - to make available agile beta versions to get quick feedback [3]
- Do not make pay the development job, but the value of your service, as this encourages the innovation
- Do not buy hardware or software systems to exactly implement what you need
- Education and Training on IT and software programming should study inside the systems not how to use them.
- To think that in software systems it deserves to re-inventing the wheel if the

existing wheels cannot fit your axles.

CONCLUSIONS

The paper shows that Road and Transportation Safety Applications demand an approach to the ICT business based slightly different from the ICT consumer business. The paper puts in evidence that the emphasis must be given to the design of new platform architectures directly built on the available basic ICT assets.

Telecommunication System	Year	From (caller)	To (callee)	Caller TO Callee	Callee TO Called	Enabling technology
Wired Telegraph	1865	Single Station	Single Station	X		Electricity
Telephone	1910	Single Residence	Single Residence	X	X	Switched Network
Radio Telegraph	1925	Single Station	Many Stations	X		Radio
Radio Broadcast & Television	1935	Single Station	Many Residences	X		Radio Spectrum
Fax	1980	Single Residence	Single Residence	X		Digital Modems Microprocessors Home computers
BBS/minitel	1985	Many Residences	Single Station		X	
Machine to Machine	1985	Single Station	Many objects		X	
		Many Objects	Single Station	X		
Internet (E-mail)	1990	Single Residence	Single Residence		X	Packet Switched Internet-working
Internet (Web)	1995	Many Residences	Many Stations		X	HTTP 0.9 Search Engines
Internet (Web 2.0)	2000	Many Residences	Many Stations	X	X	HTTP 1.1
Internet (Web-Services)	2000	Many Stations	Many Stations	X	X	WDSL/SOAP
Internet of Things	2005	Many Objects	Many Stations	X	X	GPRS
Wireless Social	2010	Many Individuals	Many Individuals	X	X	Publish/Subscribe
IoT 2.0 Challenge	Today	Many objects	Many Individuals	X	X	??
		Many objects	Many objects	X	X	

Table 1 | Telecommunication Paradigms

TYPE	LIST OF SENSORS
Automotive transportation:	Air–fuel ratio meter,Blind spot monitor,Crankshaft position sensor,Curb feeler, used to warn driver of curbs,Defect detector, used on railroads to detect axle and signal problems in passing trains,Engine coolant temperature sensor, or ECT sensor, used to measure the engine temperature,Hall effect sensor, used to time the speed of wheels and shafts,MAP sensor, Manifold Absolute Pressure, used in regulating fuel metering.,Mass flow sensor, or mass airflow (MAF) sensor, used to tell the ECU the mass of air entering the engine,Oxygen sensor, used to monitor the amount of oxygen in the exhaust,Parking sensors, used to alert the driver of unseen obstacles during parking maneuvers,Radar gun, used to detect the speed of other objects,Speedometer, used measure the instantaneous speed of a land vehicle,Speed sensor, used to detect the speed of an object,Throttle position sensor, used to monitor the position of the throttle in an internal combustion engine,Tire-pressure monitoring sensor, used to monitor the air pressure inside the tires,Torque sensor, or torque transducer or torquemeter measures torque (twisting force) on a rotating system.Transmission fluid temperature sensor, used to measure the temperature of the transmission fluid,Turbine speed sensor (TSS), or input speed sensor (ISS), used to measure the rotational speed of the input shaft or torque converter,Variable reluctance sensor, used to measure position and speed of moving metal components,Vehicle speed sensor (VSS), used to measure the speed of the vehicle,Water sensor or water-in-fuel sensor, used to indicate the presence of water in fuel,Wheel speed sensor, used for reading the speed of a vehicle's wheel rotation.
Chemical:	Breathalyzer, Carbon dioxide sensor, Carbon monoxide detector, Catalytic bead sensor, Chemical field-effect transistor, Electrochemical gas sensor, Electronic nose, Electrolyte–insulator–semiconductor sensor, Fluorescent chloride sensors, Holographic sensor, Hydrocarbon dew point analyzer, Hydrogen sensor, Hydrogen sulfide sensor, Infrared point sensor, Ion-selective electrode, Nondispersive infrared sensor, Microwave chemistry sensor, Nitrogen oxide sensor, Olfactometer, Optode, Oxygen sensor, Ozone monitor, Pellistor, pH glass electrode, Potentiometric sensor, Redox electrode, Smoke detector, Zinc oxide nanorod sensor, Electric current, electric potential, magnetic.
Radio:	Current sensor, Daly detector, Electroscope, Electron multiplier, Faraday cup, Galvanometer, Hall effect sensor, Hall probe, Magnetic anomaly detector, Magnetometer, MEMS magnetic field sensor, Metal detector, Planar Hall sensor, Radio direction finder, Voltage detector, Flow, fluid velocity[edit], Air flow meter, Anemometer, Flow sensor, Gas meter, Mass flow sensor, Water meter, Ionizing radiation, subatomic particles[edit], Cloud chamber, Geiger counter, Neutron detection

Navigation instruments:	Air speed indicator, Altimeter, Attitude indicator, Depth gauge, Fluxgate compass, Gyroscope, Inertial navigation system, Inertial reference unit, Magnetic compass, MHD sensor, Ring laser gyroscope, Turn coordinator, TiaLinx sensor, Variometer, Vibrating structure gyroscope, Yaw rate sensor,
Position, angle, displacement, distance, speed, acceleration:	Auxanometer, Capacitive displacement sensor, Capacitive sensing, Free fall sensor, Gravimeter, Gyroscopic sensor, Impact sensor, Inclinometer, Integrated circuit piezoelectric sensor, Laser rangefinder, Laser surface velocimeter, LIDAR, Linear encoder, Linear variable differential transformer (LVDT), Liquid capacitive inclinometers, Odometer, Photoelectric sensor, Piezocapactive sensor, Piezoelectric accelerometer, Position sensor, Rate sensor, Rotary encoder, Rotary variable differential transformer, Selsyn, Shock detector, Shock data logger, Stretch sensor, Tilt sensor, Tachometer, Ultrasonic thickness gauge, Variable reluctance sensor, Velocity receiver
,Optical, light, imaging, photon:	, Charge-coupled device, CMOS sensor, Colorimeter, Contact image sensor, Electro-optical sensor, Flame detector, Infra-red sensor, Kinetic inductance detector, LED as light sensor, Light-addressable potentiometric sensor, Nichols radiometer, Fiber optic sensors, Optical position sensor, Photodetector, Photodiode, Photomultiplier tubes, Phototransistor, Photoelectric sensor, Photoionization detector, Photomultiplier, Photoresistor, Photoswitch, Phototube, Scintillometer, Shack-Hartmann, Single-photon avalanche diode, Superconducting nanowire single-photon detector, Transition edge sensor, Visible light photon counter, Wavefront
Pressure:	Barograph, Barometer, Boost gauge, Bourdon gauge, Hot filament ionization gauge, Ionization gauge, McLeod gauge, Oscillating U-tube, Permanent Downhole Gauge, Piezometer, Pirani gauge, Pressure sensor, Pressure gauge, Tactile sensor, Time pressure gauge
Force, density, level:	Bhangmeter, Hydrometer, Force gauge and Force Sensor, Level sensor, Load cell, Magnetic level gauge, Nuclear density gauge, Piezocapactive pressure sensor, Piezoelectric sensor, Strain gauge, Torque sensor, Viscometer, Thermal, heat.
Temperature:	Bolometer, Bimetallic strip, Calorimeter, Exhaust gas temperature gauge, Flame detection, Gardon gauge, Golay cell, Heat flux sensor, Infrared thermometer, Microbolometer, Microwave radiometer, Net radiometer, Quartz thermometer, Resistance temperature detector, Resistance thermometer, Silicon bandgap temperature sensor, Special sensor microwave/imager, Temperature gauge, Thermistor, Thermocouple, Thermometer, Pyrometer, Proximity, presence[edit], Alarm sensor, Doppler radar, Motion detector, Occupancy sensor, Proximity sensor, Passive infrared sensor, Reed switch, Stud finder, Triangulation sensor, Touch switch, Wired glove

Other:	Actigraphy, Analog image processing, Atomic force microscopy, Atomic Gravitational Wave Interferometric Sensor, Altitude control (spacecraft), Horizon sensor, Earth sensor, Sun sensor, Catadioptric sensor, Chemoreceptor, Compressive sensing, Cryogenic particle detectors, Dew warning, Diffusion tensor imaging, Digital holography, Electronic tongue, Fine Guidance Sensor, Flat panel detector, Functional magnetic resonance imaging, Glass break detector, Heartbeat sensor, Hyperspectral sensors, IRIS (Biosensor), Interferometric Reflectance Imaging Sensor, Laser beam profiler, Littoral Airborne Sensor/Hyperspectral, LORROS, Millimeter wave scanner, Magnetic resonance imaging, Moire deflectometry, Molecular sensor, Nanosensor, Nano-tetherball Sensor, Omnidirectional camera, Organoleptic sensors, Optical coherence tomography, Phase unwrapping techniques, Positron emission tomography, Push broom scanner, Quantization (signal processing), Range imaging, Scanning SQUID microscope, Single-Photon Emission Computed Tomography (SPECT), Smartdust, SQUID, Superconducting quantum interference device, SSIES, Special Sensors-Ions, Electrons, and Scintillation thermal plasma analysis package, SSMIS, Special Sensor Microwave Imager / Sounder, Structured-light 3D scanner, Sun sensor, Attitude control (spacecraft), Superconducting nanowire single-photon detector, Thin-film thickness monitor, Time-of-flight camera, TriDAR, Triangulation and LIDAR Automated Rendezvous and Docking, Unattended Ground Sensors.

Table 2 State-of-the-art Sensor List (source Wikipedia)

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