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BROADBAND TELECOMMUNICATIONS TECHNOLOGIES FOR ITS

The article deals with a few issues of broadband telecommunications technologies for ITS in the first decade of the 21st century. There is a world tendency of moving from narrowband to broadband technologies in many public and business services within the Information Society. Broadband telecommunications technologies seem to be very prospective in the field of modern transport services. An attempt is taken to formulate a methodological approach to the issue in the field of intelligent transportation.

TECHNOLOGIE SZEROKOPASMOWEJ ŁĄCZNOŚCI W INTELIGENTNYM TRANSPORCIE

W artykule przedstawia się niektóre zagadnienia związane z zastosowaniem szerokopasmowej łączności w inteligentnych systemach transportowych w pierwszej dekadzie XXI wieku. Istnieje światowa tendencja do przechodzenia od wąskopasmowych do szerokopasmowych technologii świadczenia usług publicznych i biznesowych w ramach społeczeństwa informacyjnego. Technologie szerokopasmowej łączności wydają się bardzo obiecujące w zastosowaniach do usług transportowych. W artykule podjęto próbę sformułowania metodologicznego podejścia do zastosowania szerokopasmowych technologii w dziedzinie inteligentnego transportu.

1. INTRODUCTION

It is commonly accepted to define ITS as the application of information and communication technologies (ICT) to the operation of transportation systems. From this point of view all the developments in ICT technologies can impact ITS. One of the changes in ICT technologies has recently been the introducing of broadband telecommunications. A good example of the process is broadband access to the Internet.

ITS can be considered as a subsystem within a transport system, for example, a road transport system. Such a system has its architecture. The ITS architecture is a framework defining the technical, institutional and organizational, commercial and other features of a ITS system as a whole, which shows how all the individual subsystems and components can work together.

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The technical architecture of a ITS system comprises all the devices and technologies (hardware, software) , including exchange of information between all the subsystems of ITS. It is used for transmitting data through communications channels within ITS and with the environment of ITS. The structure of the data flows is of great importance as well.

Transportation systems are usually rather old, so they have constantly improved and modernised. There always is an existing communication network within each of them, called its legacy. Such a network, often based on out of date infrastructures and communications technologies, should be updated to provide end users with new, better transport services. Telematics technologies have been widely applied in USA, Japan and a few EU countries for over fifteen years. The environment of the transport systems has been rapidly changing by introducing broadband telecommunications services. The problem is why not more widely use broadband telecommunications technologies in transportation as more prospective to narrowband ones? What approach should be taken?

2. DEFINITION OF BROADBAND

There exist various definitions of broadband that have assigned a minimum data rate to the term. It may be defined as transmission capacity with sufficient bandwidth to permit combined provision of voice, data and video. Sometimes high bandwidth channels are referred to as "broadband" if it means 1.5 –2.0 Mbit/s or higher transmission speed of units of data (bits).

3. BASICS OF METHODOLOGY

There are known several framework architectures of ITS in the world, among them the most famous is the USA one, others are the EU one, called KAREN, and those formulated in Japan, Canada and Australia. Generally speaking, most of them are based on the ISO TC204 Working Group 1 - list of ISO ITS User Services, especially the USA and EU ones.

The ITS architecture in the KAREN Project is treated as a complete European ITS Framework Architecture. It contains a set of specific architectures as follows:

- European ITS Functional Architecture
- European ITS Physical Architecture
- European ITS Communications Architecture.

The assumed procedure of specific architectures building runs from the list of ITS user needs through ITS functional Architecture, next via ITS Physical Architecture to ITS Communications Architecture. ITS Communications Architecture defines and describes the means which support the exchange of information between different parts of the ITS system. This information exchange is carried out by using Physical Data Flows that are described in a Physical Architecture. The KAREN project architectures can be a starting point for broadband telecommunications analyses. Therefore we should start from a list of users needs.

The Karen project set of needs is presented in table 1.

Table 1

Specific User Needs Regarding Communications

Allocation within KAREN User Needs				
Group		Category		Expected broadband applications
Number	Name	Number	Name	
2	Management Activities	2.1.1	Information Management	
		2.2	Infrastructure Maintenance Management	
		2.2.3	Maintenance Units	
3	Policing/Enforcing	3.1	Policing/Enforcing Traffic Regulations	x
4	Financial Transactions	4.1.3	Transaction	
5	Emergency Services	5.1	Emergency Notification and Personal Security	x
6	Travel Information	6.1.3	Traveller Interaction	x
		6.2.3	Traveller Interaction	
		6.4.2	Traveller Interaction	
7	Traffic Management	7.1	Traffic Control	x
		7.1.3	Traffic Control Centres	x
		7.1.8	Roadside-Vehicle Communications	
		7.2	Incident Management	x
		7.2.1	Emergency Services	x
8	In-Vehicle Systems	8.2.4	Short Range Communications	
		8.2.5	Speed Control	
9	Freight and Fleet Operation	9.1	Commercial Vehicle Pre-Clearance	
		9.2	Commercial Vehicle Administrative Processes	
		9.3	Automated Roadside Safety Inspection	
		9.4	Commercial Vehicle On-Board Safety Monitoring	

		9.5.1	Road Freight Management	
		9.5.2	Road Freight Fleet Management	
		9.5.3	Road Vehicle, Driver, Equipment and Cargo Management	
10	Public Transport	10.1.5	Communications	
		10.2.2	Communications	
		10.5	Public Travel Security	

Source: *Specific User Needs Regarding Communications (an extract of the Karen project documentation, except "expected broadband" column)*

The following telecommunications technologies can be used to satisfy the needs:

a) Wireless technologies: GSM, UMTS, W-CDMA and TD-CDMA, DECT, TETRA (PMR-System), TETRAPOL (PMR-System), Satellite Communications Systems, Satellite Positioning Systems, Broadcast Radio, Television and Short Range Communication Systems;
b) Wired technologies: telephone, DSL,X.25 (Packed Switched Date), Frame Relay, ATM and Internet;
c) Optical Networking: SDH/SONET, Packed over SONET (POS) and WDM.

In 1999, when the list of the telecommunications technologies was formulated, broadband applications were beginning to emerge in the transport sector, so they are nearly not mentioned in the KAREN Project documents. What is more, the KAREN Project did not intend to deliver the technical solutions that perfectly suit a ITS system, since such solutions do not exist. The Communication Architecture in the Karen project is based on generic approach that gives a frame where most important matters are tackled. This frame gives a global vision of the telecommunication issue that enables economical and technical issue linked with designing ITS solutions to be addressed more efficiently. However, in practice, the most developed area of applications have been such telecommunications solutions as DATEX, RDS-TMC, TPEG, EFC (electronic fee collection) based on DSRC.

When analysing the list of user needs in table 1 we can see that some of them are possible as areas of broadband technologies applications, especially where broadband access to the Interned is used. The broadband technologies can be possibly applied when there is a need for transmission of large quantities of multimedia data in real time. However we should carefully consider the telecommunications links of ITS sub-systems.

There are some alternatives for many data flows because of bandwidth requirements and perceived cost restrictions. Data flows between:

a) centre-centre
b) centre-traveller
c) centre-vehicle
d) centre-roadside

can be supported by:

- narrowband or broadband communications
- wireline or wireless communications.

Currently there appears the need of bundling voice, data, and video service for transmission over a single link of communications system in the transport sector.

In some countries, e.g. USA, broadband wireless has already begun to appear in the transportation and public safety domains, particularly travel information, traffic management, emergency and incident management and law enforcement. In the UK Marconi SDH/ATM infrastructure heralds new high communications era by a broadband network within the National Traffic Control Centre project in the Midlands.

Broadband technologies enable to send images from locations of, for example, accidents. Moreover, broadband networks, particularly wireless and satellite networks, can help police, fire and some law enforcement personnel in many crisis situations. It is due to the fact that data and image files (videos) can be quickly transferred

Broadband creates opportunities for bundling services together and enables transport operators to offer more services to consumers at lower prices, and in real time. The economic benefits of broadband can result from efficiencies in the distribution of goods, services and information.

4. CONCLUDING REMARKS

Broadband technologies have rapidly developed in many sectors of public and private services in the developed countries of the world. They give some serious advantages. The process is emerging in the transportation sector, stimulated by the broadband services in other sectors of the information society.

The key problem in the transportation sector of the developed countries will often be copy with narrowband telecommunications infrastructures (legacy) in ITS to quickly archive expected benefits. It is also the matter of costs. Costs are mainly linked with the acquisition of the broadband solution, with the migration from the narrowband solution to the new, broadband solution, with the running of the solution, and with the replacement of the solution. These costs must be considered not only in terms of material and services, but also in terms of personnel involved in all these phases.

In the developing countries, ITS systems, if any, built on narrowband technologies, are weakly deployed, so the countries have a chance to leapfrog the underdevelopment of ITS applications in transportation by using broadband technologies in the future. The oportunity is especially for the countries which have been building up new highways and express roads, e.g. Poland. It should be taken into account from a strategic point of view when considering an effective participation of Poland in the European transport network services market and supplying modern transport services.

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