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ROAD TRANSPORT TELEMATICS

HIGH-LEVEL GROUP

Review of US National ITS Architecture

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Review of US National ITS Architecture

Executive Summary

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NOTICE

This document results from the review of the US National ITS Architecture carried out by a team of experts convened by the European Commission (DG XIII). It reflects as well the discussions held between this group of experts, other invited experts and European Commission officials.

The options expressed in this document do not necessarily represent the views of the European Commission services.

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1 Introduction

Development of Intelligent Transport Systems (ITS) in America was given a *tremendous boost* in 1991 with the Intermodal Surface Transport Efficiency Act, the law that formalised the American ITS Programme. Amongst other things it stimulated the production of a national plan for improving surface transportation. One part of this plan was a study programme which resulted in the development of a US National ITS Architecture for transportation systems. The result of this work is the subject of this report. This $25,000,000 programme **started in October 1993 and was completed in June 1996. The** resulting Architecture has been analysed and its consequences for Europe are addressed in this report.

2 Architecture Background and Development

SO what is the Us National ITS Architecture about? It provides a common structure **for the design of** intelligent **transport systems.** It **is** not **intended** to be a design but to be a framework around which multiple design approaches can be developed, each one tailored to meet individual needs for the user. The Architecture defines the functions (e.g. gather traffic information) that must be performed to implement *a given user service (e.g. traffic control),* the physical entities or subsystems where these functions reside (e.g. the roadside or the vehicle), the information flows between the physical subsystems. and the communication requirements for the information flows. In addition, it identifies and specifies the requirements for the interface standards needed to support national and regional interoperability, as well as product standards needed to support economy of scale considerations for equipment supply

Phase 1 of the system architecture study (1993-1994), which was completed in October 1994, involved four consortia led by the Hughes Aircraft Company: Loral Federal Systems, Rockwell International and Westinghouse Electric respectively. Each independently developed their concept of a US National ITS Architecture based on the Federal Highways Administration (FHWA) specification for the 29 User Service Requirements (USR's) - see Annex 1). All four consortia analysed the USR's and their inter-dependencies using established systems analysis techniques. They then developed a coherent vision of the functions to fulfill the USR's might be developed over time, implemented and operated. After evaluation of Phase 1 results at the end of 1994, two consortia - Loral and Rockwell - were retained for Phase II of the programme. This started in February 1995 and the consortia were asked to continue development of their architectures and incorporate features from those developed by the other two consortia. The Loral and Rockwell consortia decided from the outset that the most sensible course of action was to combine their efforts into the Architecture Development Team This produced the final version of the architecture in June 1996. It was developed from the best parts of those provided by all four of the Phase I consortia and included new features and facilities to

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improve its acceptability and compliance with revised User Service Requirements produced in July I994 by the FHWA.

During this whole Architecture definition process, an important activity was launched across the USA to reach out and gain stakeholders' inputs and comments. There have been two major system architecture workshops: one to define the relationship of the system architecture to the volunteer standard-setting process used in the US and the other to engage all ITS America committees in detailed architecture discussions and feedback to the architecture development consortia. In addition, architecture fora were organisd and over 25 outreach meetings were held across the US producing comments that have been incorporated into the programme.

The final result of this consolidation has been published in June 1996. It is composed of 5574 pages in 18 documents. However the FHWA are ensuring that the Architecture does not remain static. They have funded further work to enhance the Architecture through the introduction of an additional User Service Requirement for the Highway Rail Interface (HRI) The current Architecture is available on the Intemet http://www.rockwell.com/itsarch/.

In addition to the HRI work. the FHWA will fund Phase III of the US National ITS Architecture programme. This will be designed to maintain and develop the Architecture. feeding in any changes produced as a result of the standards setting programme and other ITS activities.

3 Purpose of this review

Following the production of the US National ITS Architecture, there was a clear need for Europe to -understand the possible consequences of its appearance and to initiate actions, if needed. These actions must also bear in mind that ITS world markets are growing and are likely to be influenced by the US National ITS Architecture as will be the ISO standardisation process.

In August 1996. the European Commission (DG XIII) launched an activity to review the US National ITS Architecture. to compare it to European achievements in Advanced Transport Telematics. It would also define a common European position that could be discussed in a later stage with the main European stakeholders.

The aim of the review was to provide answers to the following questions:

- What are the strengths and weaknesses of the US National ITS Architecture compared to the European results?
- What are the implications of the ITS Architecture results for Europe?
- Are there aspects of the US National Architecture that Europe should welcome and support? Are there other aspects which Europe should resist, or seek to modify?
- Are there any European results that would improve the US National ITS Architecture and could contribute to a global approach?
- is it possible to identify stakeholders who could be impacted by the American results?
- What could be an appropriate European response in the immediate and short term (1-2 years) and medium term (> 2 years)?
- What could be recommended for further European and international work? What actions are needed in research programmes and/or at the standardisation level?

The present document summarises the **key** findings of the review team based on the topics aforementioned.

4 Approach followed for the review

A team of experts has been identified by the European Commission These experts received guidelines from the European Commission for their work and a complete set of US National ITS Architecture documents. These experts covered the following areas of expertise:

Automatic Debiting System (ADS)	Mr. Bonora (Marconi) Mr. Vis (Rijkswaterstaat)
Public Transport (PT)	**Mr. Finn (ETT)**
Urban Transport (UT)	Mr. Bossom (Siemens) Mr. Lang (Ericsson)
Inter-Urban Transport (IUT)	Mr. Fisher (GF Consultancy) Mr. Pagny (DSCR-METT)
Freight and Fleet Management (FFM)	**Mr. Brand (Brand Consult)** Mr. Rennesson (AFT-TNT)
Vehicle Control (VC)	Mr. Munck (Volvo) Mr. Glathe
Information and Communication Systems (IS/CS)	**Mr.** Kossack (Siemens) Mr. Pfliegl (A lcatel)
Contribution for Standardisation	Mr. Kossack (Siemens) Mr. von Pattay (ERTICO)

A first meeting was organised by the European Commision in September 1996 to allow the experts to have a briefing on the activity and to share problems related to it.

The experts individually reviewed the US National ITS Architecture documentation and wrote reports with their findings related to the areas that they had been allocated, under the headings described in the previous section of this report.

The European Commission organized a workshop in October 96. First results from the reviews produced by the team of experts were presented to and discussed with European Commission officials and invited experts.

The present report has been compiled based on the consolidated results of all the reviews.

The next phase will include the organisation of events during which the results of this work will be presented to the main stakeholders' representatives. The document will also be submitted to the High Level Group on Road Transport Telematics of representatives from the Member States.

5 Key findings

5.1 Key features of US National ITS Architecture

General remarks:

The US National ITS Architecture can be viewed as an instrument to get the ITS market in the US moving with the speed and focus necessary to gain the critical mass for ITS in the US first. The political message "now we start" is as important as the technical content of the architecture. It has been launched by the Federal Government and has a comprehensive coverage of user services. The Architecture proves a systematic approach to the process, it is complete, consistent and covers a broad range of analysis and views. The homogenous appeal of the whole Architecture presentation is a tremendous strength from the marketing point of view (export) as compared to the EU where a multitude systems and solutions may make potential customers unsure.

The US National ITS Architecture covers a time horizon of about 16 years from ***now.*** lt takes into consideration the interdependencies between transportation and society. and the needs to develop an adequate telecommunication system It addresses road transport in most forms and provides links to other nodes.

US National ITS Architecture documentation is good, it is available to everybody and it is valuable to read (but difficult to navigate without prior knowledge). It presents Architecture features and functions in a way that can be understood by those without expertise in transport.

The US ITS Architecture provides a framework from which products can be developed without specifying the technology that is to be used. It is open to be implemented by different designs so long as they fulfill the specified functionality. In addition it has a very clear view of how industry should deploy the resulting products with customers- Market Packages have been proposed to create an environment for an ITS market.

There is nothing about the "look and feel" of the human-machine interfaces, as they were considered to be part of the detailed design. However the HMI design is critical for user acceptance, one of the main areas of competition for industry.

The US National ITS Architecture does not address organisation issues because they were considered outside the scope of the architecture and are too complex. But Institutional hurdles are identified highlighted and then passed on as potential problems to responsible people. The US national ITS Architecture stresses the concept of "Information Service Provider", an organisation providing travellers with a variety of services. This organisation may be part of a jurisdictional authority, or a private company.

Area specific remarks

For Automatic Debiting Systems:

- Integrated Payment System (IPS) is not completely developed (e.g. the usage of electronic payment as a tool for demand management, in public transport and the aspects of intermodality)
- It emphasises the concept of advance payment and not the concept of chained fare product. Payment instruments and financial institutions are considered as terminators outside the architecture.
- Adoption of the draft CEN 5.8 GHz standard is possible (DSRC move up to the 5.8 GHz band is mentioned).

For Public Transport:

- Fare collection is biased to electronic payment.
- Demand responsive systems are only partly covered in the sense of advising the ride requirement but it does not appear to extend back into the practicalities of procuring

For Urban Transport:

- A wide variety of traffic management strategies are supported. including those for parking management and control of vehicle induced pollution.
- Road pricing through tolling is included, but given low priority.

- The management of incidents is given great priority in order that their impact on the whole transportation network may be minimised.
- The use of smart cards arid driver licences for access control is not included in the User services. .

For Inter-Urban Transport:

- Strategies for the management and control of inter-urban traffic are provided.
- The main area of attention for the Inter-Urban network relates to the use of wireless communications in almost all applications and services.
- The use of probe data has been adopted, for the collection of network information data. However its application does not appear to have been clearly researched. This is a change of concept for "traditional" traffic engineers who have built their systems on the concept of collecting data from fixed point traffic count stations.

Freight and Fleet Management:

- It focuses on enhancing truck mobility and reducing the time that they are stopped for inspection, ie. interaction between freight transport industry and administrations.
- Commercial and operational fieight and fleet management are provided to a limited extent.
- CVO (Commercial Vehicle Operations) infrastructure only based on DSRC (Dedicated Short Range Communications) along the highway.

Vehicle Control:

- European work on architechture and system integration is lagging behind the US. There has been however a substantial amount of technical development has been carried out in Europe.
- Co-operative driving is properly addressed. For safety reason the US National ITS Architecture assumes a combination of road side and in-vehicle intelligence. How to achieve an optimum depends on the results of large scale tests. The Architecture leaves space for different designs.
- Advanced vehicle safety systems not fully addressed. Implementation decisions in the physical architechture are left to the manufacturers.

Communication and information systems:

- American approach cannot he applied to the European scene on a single country basis due to the complexity of the various national situations. A co-ordinated European approach is necessary.
- European results are closer to its market but the lack of a common vision is a handicap for Europe.
- Its approach to communications, which separate the transportation layer from the application layer conforms with OSI.

Standardisation:

- The study is sceptical about the desirability and feasibility of international standards for all service definitions, interfaces and protocols needed in ITS, due to legal, regulatory and cultural differences between countries.
- Development of the US market and US standards are given a high priority in the document'

5.2 Strengths and weaknesses of the US approach

Strengths:

- It has powerful support from Federal Government and other organisations such as the AASHTO.
- It provides one single and consistent overview of the framework for the development of ITS. It is available to use and easy accessible.
- It provides planning confidence to the great diversity of players in the US market place. The Architecture provides enough functional details for the next step of product design to be started. The support of the Government make the players confident the architecture will be reliable and stable.
- it is a well founded document for further discussion and development.

Weaknesses

- Some of the user services lack maturity. They give no real idea of what is required.
- Compatibility with the US National ITS architecture does not yet guarantee the compatibility of products/interoperability of services.
- The communication architecture document covers more or less all state-of-the-art technologies and does not favour, for cost or performance reasons. a limited range of technologies to be recommended for further developments.

5.3 Suitability and relevance of the US National ITS Architecture for Europe

Most of the US National ITS Architecture may be used in Europe but the User Needs and the focus will need to be different. User services and user needs is the right starting point for European architecture development. Once the European architecture has been developed, the next step will he to shift the focus to standardisation, particularly of communications interfaces.

The following issues are different in Europe and are therefore not addressed in the US National ITS Architecture:

- The institutional framework is different in Europe.
- The language problem is not addressed.

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2 The NTClP protocol is specified to be used for the transfer of data between the roadside and operating centres and between operating centres themselves. This protocol is a good candidate for an international standard

- There is not enough focus on public transport and intermodality.
- Integrated payment is more central for automatic debiting systems in EU, but interoperability between on-hoard unit and roadside as a final goal is the same.
- Very few European standards are referenced in the Standards Catalogue. 14 % of the listed specifications are international standards and 1,5 % national standards from outside the US.
- RDS/TMC has been given a low priority.
- In the US Freight and Fleet Management (FFM) is focused on reducing the time trucks are stopped for inspection. The work in Europe has put emphasis on the reduction of the amount of empty kilometres in road freight, and the development of intermodality. In the US FFM systems including on board equipment are in place, interfaces to public administrations are under way and the interest in intermodal FFM applications has just started. In Europe the situation is different: Company FFM systems are under implementation, interfaces to applications are not being developed and the applications are already underway.
- The user needs in urban transport differ between US and EU, due to difference in city planning and population density. There is a more widespread knowledge on transport management and advanced technology in European cities.
- Significant differences are observed between the role of standards in the US and Europe. Procurement in Europe is guided by standards including "voluntary" standards to much higher degree than the US market.

We should include in the European architecture development, the European strengths such as a wide spread knowledge on transport management and advanced technology in cities and interurban traffic control It is also a European strength to have communication systems with pan European coverage (i.e. RDS, ISDN and GSM). It is the developers who bring an architecture into effect. That has to be seen if the US top-down approach with a clear vision is more effective than the European "simultaneous" approach However the simultaneous approach must be led by a goal to be efficient.

5.4 Relevant European results

There is no consensus on European System Architecture results (e.g. SATIN, TELTEN) although many results are already available, see annex 2.

The lack of common architecture vision in Europe can be explained if we look at the genesis of the SATIN task force. This was called upon to build on previously available results from European projects. The US chose to adopt "greenfield" approach coupled with an implementation time frame of 20 years (end date is 2012). This provided complete freedom for the architecture to specify new developments and time in which to implement a migration path from the current diverse architectures.

The horizontal project CONVERGE in the Telematic Application Programme in the fourth framework programme is helping projects define, develop and harmonise the documentation and presentation of their architectures. This approach will not by itself alone provide, in a systematic way, the interoperability of services or compatibility of products in Europe.

The initial CEN TC 278 workplan (1991) was the first attempt to establish a top-down systems architecture and it has lead to a number of consensus documents and pre-ENVs.

5.5 Stakeholders

The main stakeholders identified across all areas are the public transport authorities, the public road authorities. the motor vehicle industry, the transport equipment industry, the telecommunications industry and the multi-national IT-industry.

5.6 Problem areas for Europe

Europe lacks (but the US has) a clear vision of why it needs to have a single transport telematics architecture. Without this vision it is pointless going ahead with any further work on the development of an architecture.

There are too many views in Europe on what is an architecture, what it should cover and what it should be used for. Local actors and industries are afraid of a Systems Architecture, because it is perceived that it may stop and delay their plans and (for industry) erode hard won market.

Europe is missing a powerful promoter/developer of the systems architecture. It has not been seen as a top priority issue in Europe despite the inclusion of the topic in the Gall for Proposals of the 3rd and 4th Framework Programmes as shared cost activities. This is one of the reasons why the problem outlined in the previous two paragraphs exist.

Nothing like ITS America and FHWA (Federal Highway Administration) exists in Europe to push systems architecture. The High Level Group established by the Commission could act as a promoter but input from private sector must be secured.

In Europe, the understanding that “simultaneous engineering” between public agencies, private companies and user associations does not interfere with the responsibilities each one of them has in his particular sector is not properly understood and developed. Enabling these groups to participate will give them a feeling of ownership, that can only help increase the acceptance of an architecture across Europe.

Any European architecture will have to address the complex problems of data protection and privacy. This issue is further complicated by the legal constraints that apply in these areas. The architecture must be flexible in the way it classifies data and uses it for enforcement purposes.

The architecture must allow for an alternative to sending identifying data to enforcement agencies in violation handling due to legal constraints. The flexibility in classification and enforcement must be built into the architecture.

The architecture must be capable of handling truly intermodal transport solutions as understood within European transport policy.

6 Proposed European actions

The reviewers propose a European approach based on the following points:

- Europe must develop and promote a framework for products and services This could be called the European Transport Telematics Architecture. It would be a top down guidance to achieve fully integrated systems. There is no need for a European ITS Architecture competing with the US ITS Architecture. Instead the general European approach should aim for to include as much as possible of the US architecture. However, the European Transport Telematics Architecture should be based on European User needs. include European results and take account of what already exists in Europe. A completely new exercise is not necessary but there should be a collection and adaptation of existing documentation into a consistent document.

- A co-ordinated European action is needed. It will not be possible for Europeans to gain the critical mass for one of their specifications before US does, unless the Europeans co-operate, agree on common specifications and implement them without undue delay. A powerful promoter/developer should initiate the development of a European business plan for Transport Telematics including a plan for deployment and a long term strategy for standardisation. The promoter/developer must also make his commitment visible (the US Transport Minister Pena's initiative "Operation Time Saver" is a good example).
- CEC DGXIII should influence more the CEN/TC 278 work. Specifically WGl3 should put more effort in co-ordinating the other Working Groups and try to separate application level from communication level in order to make standards more technology independent. The Commission should also support CEN TC 278 WG 13 to promote a European view on architecture in ISO.
- Reports produced in European public funded R&D projects should be made widely available using means such as the Internet.

Proposed immediate European actions:

- Provide a powerful promoter/developer for the whole programme to develop and deploy a European Transport Telematics Architecture. This body could be funded as part of the EC R&D programme and be responsible for organising the completion of the following activities:

  - production of a set of User Needs for Europe which are to be satisfied by the Architecture and which include target date (or dates) by which they must be satisfied;
  - the actual development of the European Transport Telematics Architecture, including au analysis of communications needs, costs, benefits, risks, deployment plans, etc.;
  - the activation of the standards creation activities for interfaces defined by the Architecture;
  - promotion of outreach and consensus forming activities to ensure that Europe will take ownership of the User Needs, the Architecture, resulting standards, and actively promote their deployment and implementation;
  - generation, together with key stakeholders, of a business plan for Transport Telematics products and services;
  - establishment of a time scale for the above activities, highlighting their various completion dates, and taking into account the target date(s) specified for the satisfaction of the User Needs;
  - promote the topic with EU Member States' governments to ensure that they are all actively involved and in favour of the activities outlined above;
  - the recruitment of individuals and/or organisations to assist and participate in the above activities, subject to funding from and the approval of the EC.

- There must be a clear decision point for the course of action to be adopted by Europe, and . an accepted implementation Plan with the needed resources allocated to it: Key players from the different sectors should draft a business plan for Transport Telematics. under the lead of a promoter/developer.
- The Commission is requested to improve the running of horizontal actions in DGVII and DG XIII and others with regard to Transport Telematics in Europe in order to ensure the achievement of a co-ordinated strategy.
- Support CEN TC 278 WG 13 to promote a European view on architecture in ISO.

Proposed European actions in the short term (l-2 year)

- Define a European Transport Telematics Architecture based on US and European work.
- Support European standardisation in CEN. The public standards are developed in a democratic process and are based on consensus of ah interested parties. This is a strength but the resulting standards development process takes too long to implement. One of the reasons is that additional financial resources are needed as standardisation is mostly driven by vohmteers, setting aside days from their already busy schedules to do unpaid-for work. A number of improvement of the standardisation process have to be made in order to speed it up (see annex 11).
- Form a concertation framework by actively involving stakeholders such as infrastructure owners, cities using Transport Telematics today (i.e. the POLIS network) and the new Information Service Providers (ISP' s) in the Architecture development process.
- Promote transport and traffic information services via GSM as additional pan-European service to RDS/TMC. The pan-European services could provide important feed back from deployment of designs included in the Architecture.
- Develop and foster skills and training in the domain of system architecture to support European industry
- Carry out market characteristics and market opportunity studies in USA and Pacific Rim countries to assist European industry to increase its penetration of the world-wide ITS market.
- The European Commission should enhance the rules for public procurement. This is to enable public procurement to overcome the effects of purchasing products and systems with proprietary interfaces. The change to the rules would require the supplier to commit himself to provide the specification of vital interfaces and protocols for public standardisation or to license everybody at fair and non-discriminatory conditions for any patent needed to supply subsystem to inter-work.

The actions in some of the bulleted items above will form part of the work for the promoter/developer role.

Proposed European actions in the long term (>2 year)

- Maintain and develop the architecture based on real designs and new user needs including further consideration of intermodal aspects.
- Develop and promote standards for European road pricing as a means to further increase the pan-European key Transport Telematic services.

The actions in some of the bulleted items above will form part of the work for the promoter/developer role.

Annexes

The following annexes have been produced as part of this report. They are not included in the draft Executive Summary distributed to the High Level Group on Road Transport Telematics and will be provided at *a* later date.

1. User Services
2. An overview of Programme level achievements on Systems Architecture, CONVERGE project.
3. The need for a European Transport Telematics Architecture. Benefits and Opportunities. CONVERGE project.
4. Area Automatic Debiting System (ADS) review report, Bonora (Marconi), Vis (Rijkswaterstaat)
5. Area Public Transport (PT) review report, Finn (ETT)
6. Area Urban Transport (UT) review report. Bossom (Siemens), Lang (Ericsson)
7. Area Inter-Urban Transport (IUT) review report. Fisher (GF Consultancy), Pagny (DSCR-METT)
8. Area Freight and Fleet Management (FFM) review report, Brand (Brand *Consult.)*. Rennesson (AFT-TNT)
9. Area Vehicle Control (VC) review report, Munck (Volvo) Glathe
10. Area Information and Communication Systems (IS/CS) review report, Pfliegl (Alcatel), von Pattay (ERTICO), Kossack (Siemens)
11. Area Contribution for Standardisation review report. von Pattay (ERTICO)