Innovative solutions for implementation of new types of organizations in Intelligent Transport Systems

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ABSTRACT

In this paper new type of organizations will be emphasized, with different characteristics against bureaucratic ones, from among the most relevant is the virtual organization that needs innovative technical solutions for communications processes between enterprises.
ITS[1] is a global phenomenon attracting world-wide interest from various groups of people in the field of transport. Why? Transport planners and engineers have always faced a certain dilemma in respect of the transport process. Transport is a vital part of society, providing numerous benefits such as mobility and accessibility. ITS is an example of concept that will support virtual organization.
Along with the new challenges in the economical and political fields, modernization and new technology infusion are the main concerns of both engineers and politicians in transports, in order to upgrade the system requirements and services. We think that the new generation of telecommunication equipment that supports i.e. new VoIP[2] architectures could be merged in ITS and this communications architectures must be carefully analyzed.
Organizations in transport areas are very important aspects. Innovations in ITS, together with other top technological and economical innovations, contribute to the knowledge-driven society development.

Keywords: intelligent transportation systems, innovation, knowledge-driven economy, virtual organizations, VoIP, VPN, communications.

1. INTRODUCTION

The European Council held a special meeting in Lisbon few years ago to agree a new strategic goal for the Union in order to strengthen employment, economic reform and social cohesion as part of a knowledge-based economy. The Union had set itself a new strategic goal for the next decade: to become the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion. Achieving this goal required an overall strategy aimed at: preparing the transition to a knowledge-based economy and society by better policies for the information society, as well as by stepping up the process of structural reform for competitiveness and innovation; modernizing the European social model, investing in people and combating social exclusion; sustaining the healthy economic outlook and favorable growth prospects by applying an appropriate technical development and macro-economic policy mix. [1]
As Lisbon European Council sustained, knowledge is considered as an economic

[1] ITS = Intelligent Transport Systems;
[2] VoIP = Voice over Internet Protocol

driver in today's economy, this evolution has been enhanced by the development of Information and Communication Technologies (ICTs) that have reduced the cost of gathering and disseminating knowledge. A knowledge-based economy is defined as an economy directly based on the production, distribution and use of knowledge. In such economies there is a high degree of connectivity between the agents involved, and knowledge is widely used and exploited in all manner of economic activity. We have now progressed from the knowledge-based economy to the knowledge-driven economy, emphasizing the fact that the current contribution of knowledge is very much as the dynamo of our economy. The knowledge-driven economy brings new challenges for business. Markets are becoming more global with new competitors, product life cycles are shortening, customers are more demanding and, very importantly, the complexity of technology is increasing. So while the knowledge economy represents new opportunities, certain actions are needed to support and take advantage of these developments.

One of these new technological opportunities is represented, for example, by ITS. Transportation network infrastructures are historically a collection of many traditional networks. These networks are stable and reliable, but often lack the economies of scale necessary to deliver the performance requirements of today ITS solutions. A top priority of a network upgrade is to deliver an infrastructure built on a single, standards-based, scalable technology. Ethernet, the most widely recognized networking standard today, is an obvious consideration. It is prevalent in most networks worldwide, is extremely cost-effective (due to a supplier base that is shipping millions of ports a month), and is easy to deploy and manage. As such, it is the technology of choice for many next-generation ITS networks. The shift to a single underlying technology in the ITS network infrastructure is a natural convergence, completed in the corporate network a decade ago and rapidly moving into many new applications today. Manufacturing (industrial Ethernet), telecommunications (metro Ethernet), and ITS networks are migrating to Ethernet as an underlying technology.

2. INNOVATION IN KNOWLEDGE-DRIVEN ECONOMY

In the knowledge-driven economy, innovation takes many forms. Innovation can result from technology transfer or through the development of new business concepts; it can be technological, organizational or presentational. In addition to technological innovation, there is innovation through new ways of organizing work, as well as innovation in design. Managing and exploiting to best effect all these different kinds of innovation represents a major challenge to businesses today. [2]

Innovation is a essential point of the "Lisbon strategy", emphasized by subsequent European Councils, in particular at Barcelona in 2002. The Lisbon European Council rightly recognised that Europe's future economic development would depend on its ability to create and grow innovative sectors capable of competing with the best in the world.

The knowledge society covers every aspect of the contemporary economy where knowledge is at the heart of value added — from high-tech manufacturing and ICTs[3] to knowledge intensive services. Up to 30 % of the working population is estimated in future to be working directly in the production and diffusion of knowledge in the manufacturing, service, financial and creative industries alike. [3]

The possibilities for wider economic structures to create the network economy and society are being opened up by ICTs. Value is being created less in the simple transformation of inputs into outputs but more in fundamentally enlisting the new capacity and competences created by ICTs to meet individualized and complex customer needs. Successful companies are becoming more networked and customer focused. Knowledge and the potential of ICTs penetrate every link in the economic chain, not just the manufacturing core. [4]

3. THE NETWORK AS THE PLATFORM

The age of information is now at a critical turning point where the promise of Internet technology still exists, and innovators

[3] ICT = Information and Communication Technologies;

are rethinking how to harness and deliver it to businesses and consumers alike. Rather than taking existing business models and simply automating them onto a network, innovators are starting with the network and re-architecting the business models and processes around this new platform.

The network as a platform is about much more then IT innovation, it is about the way the world performs business. It is as expansive as what the railway system did when it was fully adopted, when today's distribution systems of plane, trains, and automobiles were fully realized. It changes business models, it changes the way people interact, and it changes the world. The network is an effect of cooperation between companies. [5]

4. NEW ARCHITECTURES AND CONCEPTS IN ITS

A closer look at the needs of today's ITS networks makes the benefits of Ethernet clear. ITS infrastructures demand the following to scale to today's services:

•*Commonality.* Network administrators are interested in deploying a single underlying technology for the network infrastructure. Ethernet is the most recognized networking standard today, and is a comfortable solution for many ITS network administrators.

•*High bandwidth and bandwidth optimization.* Video monitoring is becoming an important element of an ITS network. Ideally, project managers can provide the ability to monitor up to hundreds or even thousands of locations. A digitally encoded video-over-IP solution requires data streams of 500 kbps to 6 Mbps in size.

•*Network security.* A well managed ITS network carries data that is valuable to many end users. Police and fire departments can use ITS data for emergency response and monitoring. Local TV stations can use video streams to broadcast traffic conditions. Commuters would like access to traffic conditions via the Internet. To effectively deliver these services without compromising sensitive information or making the network susceptible to threats, network security is essential. Figure 1 shows an end-to-end ITS infrastructure, based on IP. In the example, Ethernet is used as a backbone technology connecting the traffic operation center, traffic intersections, traditional closed-circuit TV (CCTV) over Asynchronous Transfer Mode (ATM) networks, and data handoffs to the Internet.

Ethernet is one of the most common methods of networking computers in a LAN. Ethernet can handle about 10,000,000 bits-per-second and is compatible with almost any kind of computers. As Ethernet is being considered as the technology for end-to-end connectivity, service availability is becoming one of the fundamental requirements. [6]

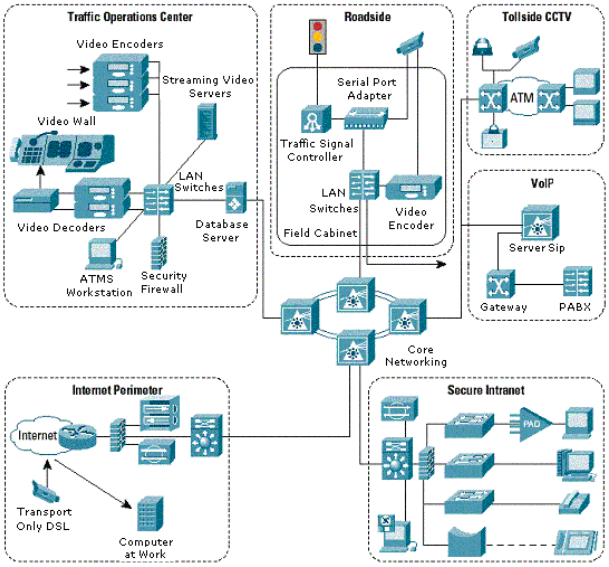

Figure 1. An Ethernet ITS architecture (with VoIP)

In ITS networks, users in vehicles expect that they are able to receive useful information continuously at any time, anywhere. Assumed ITS network model consist of a backbone network and access networks. In this model, we consider two types of communication infrastructure in access networks that are wireless networks and cellular networks. Each access network has some local regions. A local region shows a hierarchical network, and is composed of multicasting routers, base stations that are located at the edge of the fixed network, and mobile hosts. Based stations are grouped into a subnet based on their proximity in the network. A designated server called a gateway server is positioned at the top of each local region. Mobile hosts move from one location to another across local regions and communicate with application servers through base stations while it is in its cell – this approach can guide to virtual organization. Below it is shown the

architecture that can collect information from different interest point from traffic [7]:

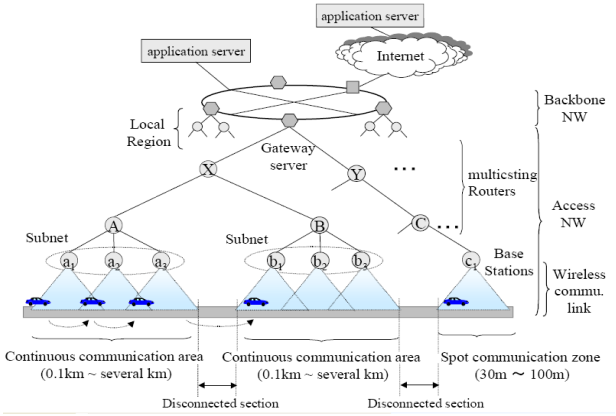

Figure 2. Wireless architecture - based on ITS network model

The virtual organization is a temporary configuration of partners working together for achieving bargain goals. The aspect of reconfigurability and the same temporality of partners is one of the most frequently feature of virtual organization appointed by authors writing on the organization of the future. The virtual organization bases on team working. It exploits the mutual adjustment mechanism of coordination which depends on informal and direct contact between team members. The mechanism is efficient when the partners conform their actions to the achievement of common goal and express the willingness of cooperation. [8]

5. NEW TYPES OF ORGANIZATIONS

Regard to the general framework in which the new forms of organizing appear, it is observed that almost all XX century was influenced by the bureaucracy existence as an organizing model, as well as historical specific form of administration, with universal applicability pretences. Bureaucracy has shown itself a form of organization proper in the conditions of a stable medium and of purely economical aims.

The change of conditions (economical, technological, political, social, cultural etc.) of medium determines a chain of changes that involves the emergence of post bureaucratic forms of organization, whose characteristics are projected to respond to the knowledge society demands. [9]

A first change is represented by borders vanishing or their permeability increasing, within organization, as well as between organizations and its medium; to become flexible, centered on innovation, organizations use: the hierarchy reducing, the downsizing, the decentralization of making decision process, the individuals and groups empowering through the auto control practices implementation; longlife learning etc. (Also Fukuyama observed that "the authority doesn't disappear in a flat or a network organization, but it's internalized to allow auto organization and auto leading"). [10]

The borders permeabilization doesn't produce only within organization (through permanent their members' moving from a place to another), but between organization and its medium.

That's why today we are speaking about "organizations without borders", as an effect of widening and application of information technologies through computers, with whose support the constraints imposed by time and space are surpassed.

Some new organization forms, considered specific to present and future, are:

network-based organization, services contracting out of organization (outsourcing), virtual organization. [11]

Network-based organizations have emerged as a response at the growth of the interdependences complexity between corporations, in the same time with the recognition that they can't survive through the isolation from the competitors, rather entering in a complex interactions network, based on cooperation.

The formal links that has integrated in the past one organization unities are replaced now by the partnership between different organizations; and the almost vertical communication and control relations are replaced by the horizontal relations.

Network-based organization can emerge also as a result of contracting the almost services out of organization (outsourcing) or as a result of the small companies collaboration, whose operation scale doesn't allow them to be competitive on international markets.

When all activities of an organization are contracted out of its borders, the virtual organization emerges. The virtuality became

possible through computer introduction and usage; for example, network-based organizations can be considered virtually in a large measure, since the network members can interaction without seen each other face to face, and the transactions is accomplished in a virtual space. The most important impact of the information technology refers to not as much at the effect on products and services, but on way in which it *dematerializes* modern organization.

The electronic information can be accessed from everywhere, simultaneously, and can be used by everyone, simultaneously, indifferently of geographical localization on the globe, and the cryptically function assures its security.

6. TECHNICAL SOLUTIONS FOR NEW TYPES OF ORGANIZATIONS: INTRANET AND EXTRANET VPN

This service allows projecting and implementing of a local area network for a company. It allows the implementation of the client-server mediums that are more performant when it uses dedicated connections that can reach high transfer rates (e.g. E1), the limit being determined by the money that the company wants to invest in its informational infrastructure.

This architecture uses two routers at the end-to-end connections, between these a secure tunnel will be up. In this case, the usage of a VPN[4] client isn't necessary anymore, but only the IPSec usage. IPSec (*IP Security Protocol*) is a layer 3 standardized protocol with assures authentication, confidentiality and integrity of the data transfer between peer-to-peer equipments that are in a communication process. This protocol are based on a *Internet Key Exchange* (IKE) that needs the use of a authentication key at both ends of the connection and this keys will allow a reciprocal authentication. The connection is represented below schematically:

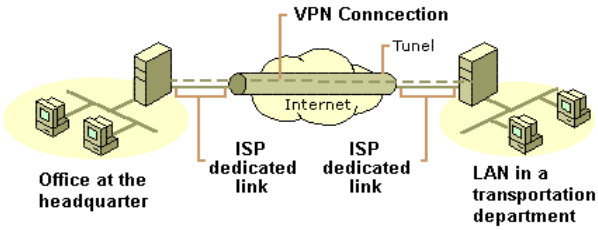

Figure 3. VPN – a possibility of implementing in ITS.

Extranet VPN look like Intranet VPN but the first one can extend the Intranet limits allowing new links, new connections from the other locations (business partners, clients etc.) to the headquarter. This type of connection allows access to users with are not part of the organization structure – creating a virtual organization. In order to accomplish this, the network administrators will use digital certifications which are the base of the secure tunnels.

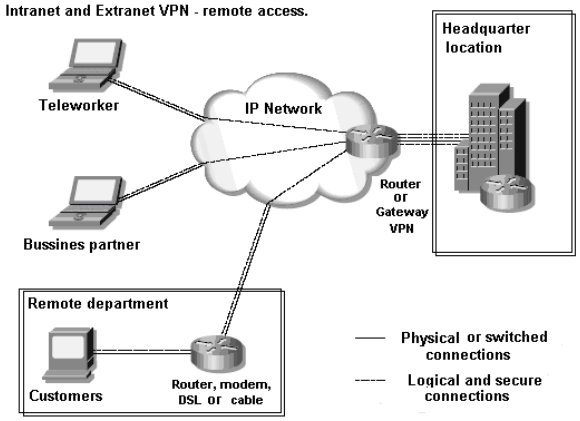

Figure 4. Extranet VPN – new applications in ITS

A possible configuration example of a VPN connection between two locations is shown below:

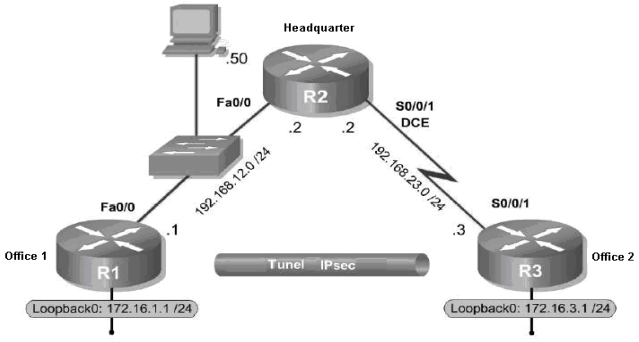

Figure 5. IPSec connection example

[4] VPN = Virtual Private Network

The effective routers configurations, all commands of the operating system of such equipment are listed through following Internetwork Operating System commands [12] :

R1# show run

```
!
hostname R1
!
crypto pki trustpoint TP-self-signed-1455051929
enrollment selfsigned
subject-name cn=IOS-Self-Signed-Certificate-
1455051929
revocation-check none
rsakeypair TP-self-signed-1455051929
!
crypto pki certificate chain TP-self-signed-
1455051929
certificate self-signed 01
quit
username ciscosdm privilege 15 password 0
ciscosdm
!
crypto isakmp policy 1
encr 3des
authentication pre-share
group 2
!
crypto isakmp policy 10
encr aes 256
hash md5
authentication pre-share
group 5
lifetime 28800
crypto isakmp key cisco address 192.168.23.3
!
crypto IPsec transform-set cisco_lab_transform
esp-aes 256 esp-sha-hmac
!
crypto map SDM_CMAP_1 1 IPsec-isakmp
description Tunnel to 192.168.23.3
set peer 192.168.23.3
set transform-set cisco_lab_transform
match address 101
!
interface Loopback0
ip address 172.16.1.1 255.255.255.0
!
interface FastEthernet0/0
ip address 192.168.12.1 255.255.255.0
crypto map SDM_CMAP_1
no shutdown
!
router eigrp 1
network 172.16.0.0
network 192.168.12.0
no auto-summary
!
ip http server
ip http authentication local
ip http secure-server
!
access-list 100 remark SDM_ACL
Category=4
access-list 100 remark IPsec Rule
access-list 100 permit ip 172.16.1.0 0.0.0.255
172.16.3.0 0.0.0.255
access-list 101 remark SDM_ACL Category=4
access-list 101 remark IPsec Rule
access-list 101 permit ip 172.16.1.0 0.0.0.255
172.16.3.0 0.0.0.255
!
line vty 0 4
login local
transport input telnet ssh
!
end
```

R2# show run

```
!
hostname R2
!
interface FastEthernet0/0
ip address 192.168.12.2 255.255.255.0
no shutdown
!
interface Serial0/0/1
ip address 192.168.23.2 255.255.255.0
clock rate 64000
no shutdown
!
router eigrp 1
network 192.168.12.0
network 192.168.23.0
no auto-summary
!
end
```

R3# show run

```
!
hostname R3
!
enable secret 5
$1$gJqP$HsL/xMjpFvacHs7bWGvIK.
!
crypto isakmp policy 1
encr 3des
authentication pre-share
group 2
!
crypto isakmp policy 10
encr aes 256
hash md5
authentication pre-share
group 5
lifetime 28800
crypto isakmp key cisco address 192.168.12.1
!
crypto IPsec transform-set cisco_lab_transform
esp-aes 256 esp-sha-hmac
!
crypto map SDM_CMAP_1 1 IPsec-isakmp
description # Apply the crypto map on the peer
router's interface having IP address 192.168.23.3
that connects to this router.
```

```
set peer 192.168.12.1
set transform-set cisco_lab_transform
match address SDM_1
!
interface Loopback0
ip address 172.16.3.1 255.255.255.0
!
interface Serial0/0/1
ip address 192.168.23.3 255.255.255.0
crypto map SDM_CMAP_1 no shutdown
!
router eigrp 1
network 172.16.0.0
network 192.168.23.0
no auto-summary
!
ip access-list extended SDM_1
remark SDM_ACL Category=4
remark IPsec Rule
permit ip 172.16.3.0 0.0.0.255 172.16.1.0
0.0.0.255
!
line vty 0 4
password cisco
login
!
end
```

7. CONCLUSIONS

Despite the necessity to innovate continuously in present society, the innovative organizations are faced with some objective difficulties, such as: lack of financial resources for advanced technologies buying; the entrepreneurs' absence of risks undertaking that are involving by the innovation; insufficient cooperation between research and production that determines the lack of technological transfer between these sectors (the difficult transition from knowledge to innovation and market), the clients' incapacity to buy new services and from here their reticence vis-à-vis innovations etc.

In this moment, the virtuality could be accomplished easily through the high level of the technological equipments. Technical changes will generate virtual processes, at economical as well societal level, determining the apparition of the organizations that involve new concepts, such as teleworking, telecommuter, teleconferences etc.

Traditional transportation networks are being upgraded to meet the traffic requirements, using fiber, wireless technology, lower-cost endpoints, and scalable architectures. Ethernet is a cost-effective, high-bandwidth, intelligent technology that gets the most out of the ITS network infrastructure. So, we recommend to project managers which activate in ITS area to take in consideration Ethernet as a solution to the problem of communications integration to meet the end users needs. Converging network resources also improves operational efficiency and support for innovative services that create new revenue streams. An innovative, end-to-end Ethernet-based communications architecture (including VoIP services) is useful to be designed for highly reliable, fault-tolerant communications between transportation organizations.

Although is premature to speak about the possibility that virtual organizations will replace completely bureaucratic ones, the Internet development hurries present companies to adopt technical solutions presented in this paper.

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