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INNOVATIVE INFORMATION AND COMMUNICATION SERVICES FOR GREENER FREIGHT TRANSPORT

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ABSTRACT
Information and communication technologies and services represent one of the major factors of success in the development of greener freight transport. The success is particularly reflected through innovative information and communication services whose implementation in freight transport acts preventively on the eco system. Numerous information and communication solutions require adjustment and harmonization in order to improve the transport along certain traffic corridors. Most of the national documents for the traffic network development of the European Union member states have set the main goals of improving the current situation by implementing modern technologies. For this purpose it is necessary to allow the application of new technologies through the following services: development of route planners of freight movement, real-time information of stakeholders during transport, monitoring and tracking of freight, measuring and monitoring of the ecological impacts (consequences), integration with ERTMS system, integration with the administration systems of ports that have container terminals, maintenance of business processes, comprehensive knowledge bases about ICT tools, and development of green ICT strategy for short- and long-term goals in meeting the quality of service (QoS). The mentioned services can be unified and conceptualized by the application of new paradigm based on the cloud computing concept.

KEYWORDS
Information and communication services, green freight transport, cloud computing, XaaS models.

INOVATIVNE INFORMACIJSKO-KOMUNIKACIJSKE USLUGE ZA ZELENIJI TERETNI TRANSPORT

SAŽETAK
Informacijsko-komunikacijske tehnologije i usluge predstavljaju jedan od značajnih činitelja uspješnosti razvoja zelenog teretnog transporta. Uspješnost se posebno ogleda kroz inovativne informacijsko-komunikacijske usluge koje svojom primjenom na teretni prijevoz djeluju preventivno na eko-sustav. Brojna informacijsko-komunikacijska rješenja zahtijevaju prilagodbu i harmonizaciju u cilju poboljšanja transporta određenim prometnim koridorom. Većina nacionalnih dokumenata za razvoj prometne mreže država članica Europske Unije imaju za postavljene glavne ciljeve unaprijediti postojeće stanje primjenom suvremenih tehnologija. U tu svrhu potrebno je omogućiti primjenu novih tehnologija kroz slijedeće usluge: razvoj planera ruta kretanja tereta, stvarnovremensko informiranje dionika tijekom

transporta, praćenja i nadzor tereta, mjerenja i praćenja ekoloških utjecaja (posljedica), integracija sa ERTMS sustavom, integracija sa sustavima lučkih uprava koje imaju kontejnerske terminale, održavanja poslovnih procesa, opsežne baze znanja o ICT alatima te izrada green ICT strategije za kratkoročne i dugoročne ciljeve u postizanju zadovoljavanja kvalitete usluge (QoS). Navedene usluge moguće je objediniti i konceptualizirati primjenom nove paradigme zasnovane na konceptu računalstva u oblaku.

KLJUČNE RIJEČI
Informacijsko-komunikacijske usluge, zeleni teretni transport, računalstvo u oblaku, XaaS models.

1. INTRODUCTION

The intensity of the development of the traffic system in general, as well as the intensity of the development of intermodal freight transport require increased implementation of modified information and communication services. Using the information and communication services allows more efficient and optimal usage of the existing capacities, i.e. transport entities such as trucks, trains, barges, ships, and ports, intermodal centres, etc. In spite of the identified possibilities, the information and communication services are still insufficiently applied for freight transport requirements. There are numerous possibilities of the development and implementation, and these are reflected through different phases of the transport process. This is particularly seen in the inadequate correlation of different subsystems of freight transport as well as intermodal centres and ports from the aspect of communication and provision of the necessary information to all the stakeholders in real time. The information can be used before and during the transport having at disposal the services of pre-trip and on-trip information (via Internet network, GSM/GPRS/UMTS networks of mobile telephony, etc.) with the possibility of adaptive traffic management from the control centre. Relevant information can influence and/or improve the modal shift of freight transport, coordination between the transport modalities, allow better integration and act positively on the environment. One of the modern integrative approaches from the information and communication domain is the implementation of the cloud computing concept which ensures flexibility regarding the location of accessing computer resources. The paper proposes a concept of applying cloud computing for the stakeholders of freight transport that would allow omnipresent and adequate on-demand network access for sharing configurable computer resources, such as the network, servers, data storages, applications and services. The applicability is closely related to the interaction of the freight transport stakeholders and service providers and with the selection of the appropriate level of cloud computing services.

2. INFORMATION AND COMMUNICATION INFRASTRUCTURE AS FREIGHT TRANSPORT DEVELOPMENT FACTOR

By studying the trends of freight transport on the traffic corridors of the Republic of Croatia and the examples of good practice from the European Union, the key factors of sustainable development have been identified. The factors are reflected through the development proposals of Transport Infrastructure, Transport Services, Information & Communication Technologies and Services, Transport Market – Private sector and Environment [1]. For the development and establishment of a more efficient freight transport the application of information and communication technologies and services is a necessity.

This necessity is reflected in all the phases of transport, and especially in planning and organizing where the stakeholders need reliable, accurate and timely information about the traffic system situation. Transportation supply chains involve hundreds of economic agents, and the freight transport stakeholders as potential users of information and communication services are national public administrations, railway transport operators, combined transport operators, terminal operators, port operators, railway infrastructure managers, motorway operators, IWW[1] transport operators, road transport operators, freight forwarders, 3PL, 4PL, shippers, etc.

Realization wide spectrum of services in ITS mean implementation of modern computers, senzors and communication systems. Therefore is especeally important telecommunication infrastructure which is responsible for ensurance of maximum distributed backbone for interconnection of terminal equipment, signaling and sensor equipment in buildings, controll and information spots, as well as mobile terminals in vechicles and users in movement [2]. The information and communication infrastructure has to allow the accessibility of services the purpose of which is to inform the stakeholders about the route of movement of the traffic entity, real-time information of the stakeholders during transport, tracking and monitoring of freight, measuring and tracking of environmental impacts and possible consequences, integration with ERTMS – European Rail Traffic Management System, integration with systems of port administrations that have container terminals, maintenance of business processes, monitoring of the results of measuring CO2 by means of ICT tools, etc. The research done in the international project GIFT[2] [1] has consolidated the proposals that refer to the application of information and communication technologies and services on Corridor V (through the Republic of Croatia), and that are related to the road, rail, and maritime freight transport mode:

- Development / integration of telematic platforms for freight transport and logistics;
- Introduction of ITS (Intelligent Transport Systems) to streamline the logistic operations;
- Real time information system during the journey;
- Monitoring and cargo control;
- Monitoring and measuring of environmental impacts.

Construction and implementation of the integrated information and communication system inside subsystems freight transport contributes to:

- Faster and more efficient information exchange, briefing and remote access;
- Company's centralized database, security, archiving, surveillance and management system;
- Efficiency of entire business system by using: Business Intelligence (BI), Enterprise Resource Planning (ERP) and Customer Relationship Management (CRM) systems;
- Integration, coordination and supervision of larger number of users, processes, flows and activities;
- Transfer of information from sensors that are placed on roads towards central office;
- Web access, video and IP telephony services [3].

[1] Inland Waterways
[2] Green Intermodal Freight Transport in South East Europe region

3. CLOUD COMPUTING IN THE FUNCTION OF GREENER FREIGHT TRANSPORT

The information and communication technologies supporting the transport should be observed on the basis of the ICT infrastructure available to all stakeholders. Studying the freight transport issues and the possibilities of the implementation of different information and communication services, the need has been noted to have a unique platform that would have integration, financial and ecological effect. The mentioned synergic group of effects can be realized by the application of the cloud computing concept thus achieving rationalization at all levels of the application of the information and communication services. Cloud computing represents an aspect of computing where the scalable information and communication capacities and their possibilities are offered in the form of service with the usage of internet technologies to a large number of external users. The service users i.e. freight transport stakeholders need only to take care about what this service can do for them, and not how it is implemented. In order to monitor and identify freight in intermodal transport it is necessary to connect the systems based on GIS, GPS and GPRS technologies in combination with Cloud services. Figure 1 shows the cloud computing architecture and different transport process participants from the domain of freight transport, who, by means of wireless technologies, access the information and communication service by using adequate client. The application is accessed by means of different devices and interfaces (web browser).

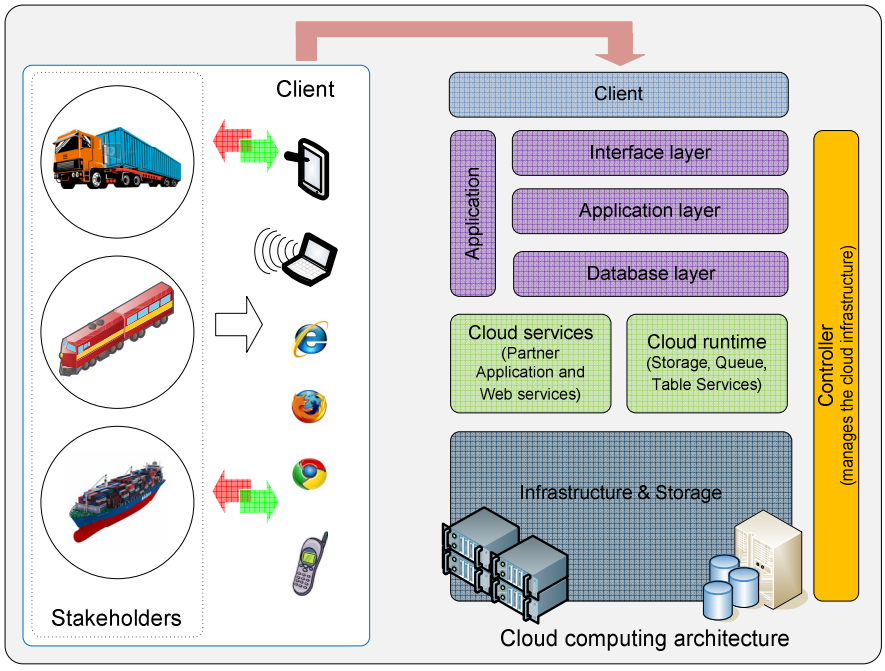

Figure 1 - Cloud computing architecture
(Source: Created by authors)

There are four different models of cloud computing implementation and depending on the needs they are designed in four different ways: Public Cloud, Private Cloud, Community Cloud and Hybrid Cloud [4], [5]. Each of the mentioned methods has a different function, structure and control method, and they are interconnected by standardized or proper technologies that allow efficient transfer of data or applications [6], [7]. According to the classification of the National Institute of Standards and Technology (NIST) three basic services are known and they are designated as SPI model (*Software - SaaS, Platform - PaaS and Infrastructure - IaaS*) [8].

Figure 2 shows the stakeholders of freight transport and different levels of cloud computing that are based on the application, platform, infrastructure and possible sources of traffic data on a certain observed corridor or road.

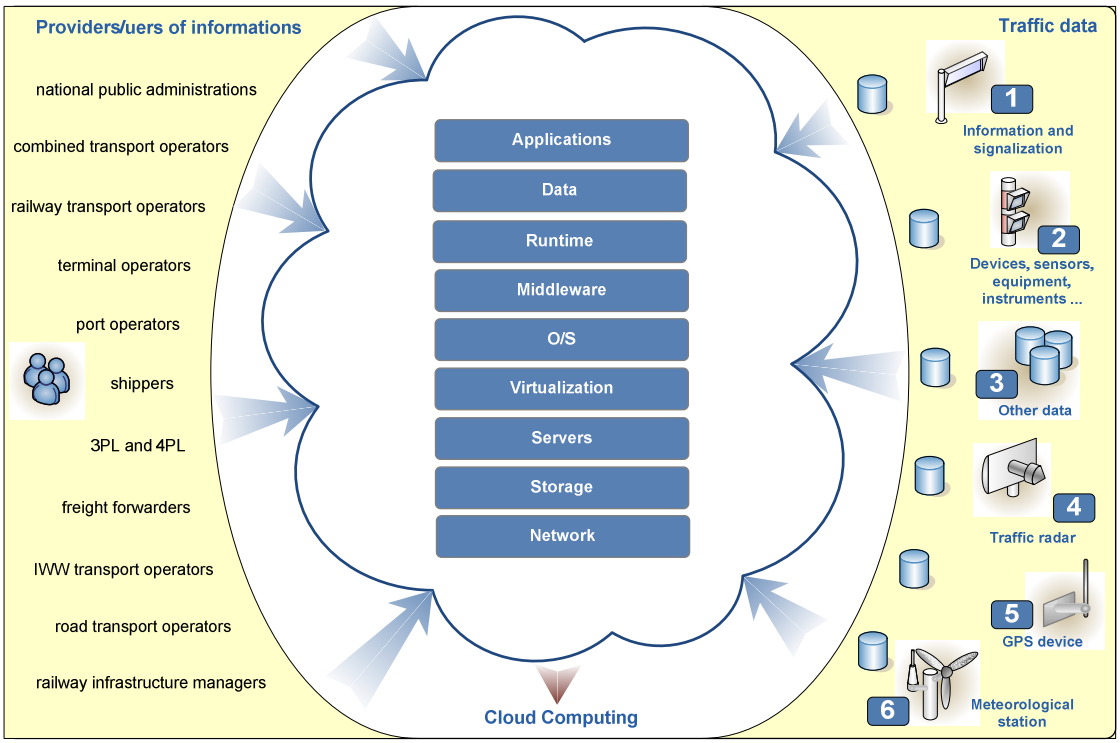

Figure 2 - Freight transport stakeholders and different levels of cloud computing
(Source: Created by authors)

One of the most abundant is GIS CLOUD system whose operation is based on the mentioned technologies. Among others, one of the main advantages are daily updates and the ability to adapt to the system user requirements. Services based on Cloud principles could provide:

- Lower maintenance costs and system upgrades;
- Availability of data at any time;
- Data security, and
- Large number of users, etc.

Implementation of Track & Trace system could provide real-time information with the ability to define points of interest (POI) and use of SMS or email to obtain relevant information. The function of route planner's freight movement system is to monitor and route freight from one mode of transport (e.g. road) to another (e.g. rail) using RFID (Radio Frequency IDentification) and NFC (Near Field Communication) technologies. The obtained real-time information enables a more efficient transport system. Information and communication services and applications in freight transport represent a significant development and impact on the ecosystem:

- they can be used to facilitate the exchange of crucial business information on international scale;
- to realise the proactivity of the users and integral improvement of capacities;
- availability of real-time information, decision-makers do not have to wait log for the research results and changes in the transportation method of certain goods;
- simpler collection of data using unique databases;
- simpler establishment and maintenance of contacts with the target groups;
- tracking and communication with the performers of certain transport processes;
- connecting of ports and intermodal centres with the environment (business partners/operators, other intermodal centres, regional scientific and research&development institutions, etc.) in the form known as "virtual organisation";
- possibility of planning certain intermodal delivery (from – to), based on the valid data of different operators.

Further in the text the XaaS models (*X as a Service*) are explained as a platform for the delivery of information and communication services of freight transport stakeholders.

4. XAAS MODELS AS PLATFORM FOR THE DELIVERY OF INFORMATION AND COMMUNICATION SERVICES

The implementation of the model based on XaaS would allow the users to use the services of adjustment and usage of applications which can be found on the service provider's infrastructure. The service provider provides the application required by the user as well as the required hardware (servers, memories, processors, etc.). XaaS key characteristics include: high scalability, multi-tenancy, online and automated provisioning, device independence that (in many cases) enables users to access software regardless of what device they are using, location independence, term-based billing or pay-as-you-go models, etc. XaaS models for greener freight transport presented in Figure 3.

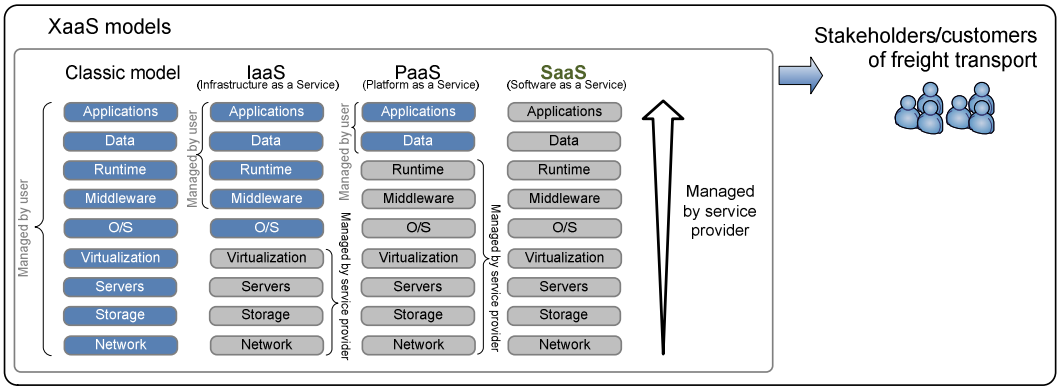

Figure 3 - XaaS models for greener freight transport
(Source: Created by authors)

The concept of the PaaS (*Platform-as-a-service*) and SaaS (*Software-as-a-service*) models is reflected in service providers offering their customers complete services, both software and hardware platforms and the necessary user equipment "packaged" and offered on the market as a certain service. Besides many other mentioned advantages, a positive impact on environmental protection is achieved. The positive impact is expressed in the optimization of costs (the emphasis is on the fact that there is no need any more for CAPEX costs) and services of freight transport stakeholders for each single freight delivery, electronic connection of different groups of shipments, provision of unique digital identity of stakeholders, locations and products with individual access to different levels managed by the service provider.

5. CONCLUSION

The research has shown that XaaS is a very suitable platform, both for private companies and corporations in the domain of freight transport, and for the managers of the transport infrastructure. The study of XaaS platform has shown that the PaaS service model has the best predispositions for the implementation in case of intermodal freight transport. The implementation of the principles and services based on PaaS, minimal cost would be realized, and safe and reliable access to Cloud in the function of electronic data exchange that would make it possible for the freight transport, regardless of the transport mode, to be more efficient at all levels of activity. The efficiency of the freight transport affects directly the realization of the tendency to achieve sustainable and greener freight transport.

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