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TOWARDS A PHYSICAL INTERNET: THE IMPACT ON CEP SERVICES IN SERBIA

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Abstract: *The courier, express, and parcel (CEP) market is known for being one of the most competitive. However, the way parcels are currently transported, transshipped, stored, and distributed is not economically, ecologically, and socially sustainable. This paper introduces the concept of the Physical Internet (PI) as one of the most ambitious approaches to enhance efficiency and sustainability in transport. Focusing on the national market, the paper describes how PI can be applied to CEP delivery services. It explores the potential benefits as well as the challenges in implementation and discusses strategies for overcoming these barriers.*

Ključne reči: *courier, express, parcel, delivery, physical internet*

1. Introduction

The courier, express and parcel (CEP) sector refers to the transportation and delivery services for packages and parcels. It has been greatly influenced by e-commerce in recent years. The exponential growth rate of e-commerce, additionaly accelerated by the COVID-19 pandemic, has contributed to a significant growth to the volume of shipments in the CEP segment. In the EU countries, the number of package shipments in the period from 2017 to 2021 grew at an annual rate of about 14.6%. In the same period, courier and express services grew at a rate of about 18% per year, that is, the total volume of these shipments increased by about 91% in five years. Also, there was an increase in the volume of postal shipments weighing less than 2 kg that contain goods, by about 33% per year, or about 215% in the same period. A significant increase in the volume of shipments in this segment has also been recorded in Serbia due to the factors such as rising disposable incoms, urbanization and the growing middle class. Despite the fluctuations experienced during the COVID-19 pandemic, the parcel shipments achieved an annual growth rate of approximately 6%. At one point during this period, it even reached a peak volume of around 1.1 million shipments per year. On the other hand, courier and express shipments have recorded a constant growth of about 12.1% annually since 2017, i.e. in the period from 2017 to 2021. The total volume of these shipments increased by about 58%. In 2022, around 51.2 million parcels were delivered in the courier, express and parcel (CEP) market in Serbia (Statista, 2023).

This positive trend in CEP segment will be continued in forseeable future due to the intensive expansion of e-commerce, technological development and shift in consumer preferences towards convenient and efficient delivery services. However, this intensive growth of CEP market implies some challenges both for logistics service providers as well as for the society. Since the CEP market represents the first/final leg of supply chain management that includes urban logistics, the presence of delivery vans in urban areas has a detrimental effect on urban traffic. For CEP delivery companies this leads to increased amount of transportation activities and the higher delivery cost as well as the quality of service provision. Presence of inadequate infrastructure also limits logistics and delivery capabilities. Community is faced with social, environmental and economic consequences mostly in the form of traffic congestion, noise, pollution as well as increased risk of traffic accidents. An additional problem, which exacerbates the aforementioned issue of congestion, is that at the moment, each service provider offers CEP delivery services as a separate competitor. While this is economically advantageous for customers, it comes at a significant cost to society and the city (Bartucz et al., 2023). Currently, the most commonly used vehicle size by CEP service providers in Serbia is light diesel vans with a total permissible weight of 3 to 4 tones. According to insights from one courier company, the utilization of these trucks is low, at around 60%, resulting in a significant number of kilometers driven either empty or with a very low payload. Each courier company operates its regional centers in different parts of the country. However, these hubs currently provide sorting and consolidation functions exclusively for the owning company, and their storage and processing capacity greatly exceeds the actual workload. All of these issues, in conjunction with the increased demand for CEP delivery, lead to economic, ecological, and environmental sustainability concerns.

An approach to address the above mentioned problems is to develop a solution based on the idea of moving the digital packets over the Internet. The concept of Physical Internet (PI or π) proposed for the first time by The Economist in 2006 (Rusich, 2017) and further developed by Montreuil (Montreuil, 2011; Montreuil, 2012) may sound like a theoretical model, however the technology is already available and potential barriers are purely economic, social or political not technical (Milenkovic, 2022). PI represents a relatively new logistics and supply chain management concept designed on top of different technologies such as Internet of Things (IoT) with the aim to contribute to a radical improvement of economical, ecological and social efficiency and sustainability of shipment transport, storage, distribution and use (Treiblmaier, 2020). The main purpose of the PI is to universally interconnect logistics networks through world-standard modular containers, interfaces and protocols in order to improve the worldwide efficiency and sustainability of logistics (Montreuil et al., 2012). Interconnection and synchronization of logistics networks will result in a creation of a collaborative physical network of networks which will be capable to autonomously optimize the shipment of encapsulated goods of various sizes and types by means of routing protocols, tracking mechanisms and interoperability standards (Marino et al., 2019). In general, as well as in the context of CEP delivery services, introduction and operationalization of PI may lead to numerous positive effects such as increased efficiency and flexibility, improved sustainability, lower operational costs and improved customer satisfaction. However, shift to PI requires overcoming a number of issues. Some of the most important are the lack of standardization,

misalignment of infrastructure capacities, lack of trust and collaboration between the actors in supply chain and legal and data sharing constraints. The aim of this paper is to analyze the actual process of CEP services in Serbia, describe potential weaknesses of existing system of parcels distribution and propose improvements based on the PI paradigm.
The paper is organized as follows. The second section gives the detailed overview of the PI concept and its main components. Third section is dedicated to an analysis of existing CEP services in Serbia and identification of gaps towards shifting to PI-based parcel distribution proces. Concluding remarks are given in the fourth section.

2. Physical Internet

Physical internet is defined as an open, global and multimodal logistics system founded on universal physical, digital and operational interconnectivity and enabled through standard encapsulation, protocols and interfaces (Montreuil, 2011). Therefore, the main purpose of the Physical Internet is to universally interconnect logistics networks through world-standard modular containers, interfaces and protocols in order to improve the worldwide efficiency and sustainability of logistics (Montreuil et al., 2012). Interconnection and synchronization of logistics networks will result in a creation of a collaborative physical network of networks which will be capable to autonomously optimize the shipment of encapsulated goods of various sizes and types by means of routing protocols, tracking mechanisms and interoperability standards (Marino et al., 2019). The design and operationalization of the Physical Internet is based on Digital Internet as an already widely accepted service technology. The Digital Internet connects billions of devices all over the world and allows every device to communicate with all others. The users of Digital Internet are private, commercial or governmental entities equipped with computers or smart phones. The users insert flows into the Digital Internet in the form of digital data, which is sealed in data packets and transmitted via a network of communication links. The data flows are embedded in data packets. The data within a packet is encapsulated and is not dealt with by Internet. The packet header contains all information required for identification of the packet and its proper routing to the destination. The data packets are directed via routers, carried over the links through physical media such as optical cables and switched between different physical media via modems (Dong and Franklin, 2018). The internet services are operated by various Internet Service Providers (ISPs) which ensure smooth flows of all kind of digital information. In Digital Internet, internet protocols have been introduced to standardize and organize its operationalization. A protocol defines the format of the packets of digital information exchanged between peers in the Digital Internet, how hosts should be addressed as well as the actions taken in the transmission of the packets across the Digital Internet. The design of the Digital Internet and its protocols provide users with a “connection-free” service: they can simply use the Digital Internet without a need to understand how their data will be routed from its origin to destination point.

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In the Physical Internet, the users can be commercial and private shippers. The flows they insert in the Physical Internet consist of various physical objects (groceries, consumer goods, etc.) packed into standardized packages known as π-containers and then transported in a network of physical corridors. Mixing/distribution centers navigate the π-container flows in the network, transportation modes carry the π-container flows whereas intermodal terminals allow cargo to switch between different transport modes. The Physical Internet services will be operated by various Logistics Service Providers (LSPs) which secure smooth deliveries of all types of physical objects. Shipments delivery is also characterized by protocol-like international agreements to standardize the flows, securing that cargo from different origins around the world can be delivered. The implementation of a similar “connection-free” service is considered in the design of Physical Internet: a user of Physical Internet trusts the Physical Internet and its services to ship their goods to any destination without knowing about the route that the goods take (Dong and Franklin, 2018). The concept of Physical Internet is illustrated on Figure 1.

Figure 1. Concept of Physical Internet (Milenkovic, 2022)

The establishment of global logistics standardization is essential for a continuous growth in international trade and the increase in transport demand. World logistics largely uses 20 and 40 feet container shipments (90% of the world containers are 20 and 40 feet containers). For this reason, major international hubs provide specialized terminals for handling and transshipment of containers from one mode to another. Packaging standardization is also implemented by DHL, FedEx, UPS and other LSPs in the last mile delivery. The Physical Internet generalizes and significantly extends the notion of standardization.

As it is mentioned above, the Physical Internet will not deal with freight. Pallets will no longer exist. Physical Internet will only deal with packages of goods, equivalently to ports that deal only with containers. These packages, hereafter termed π-containers (π symbol corresponds to the Greek letter PI, which corresponds to the two-letter abbreviation for the Physical Internet) so as to differentiate them from current containers, will be of standard size (just like existing 20- and 40-foot containers), environmentally sustainable (built from eco-friendly materials), smart (trackable/routable by RFID and GPS), secure (π-containers will be sealable for security in the same way as a shipping container is sealed today) and modular (Figure 2.).

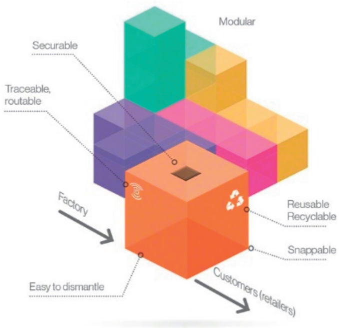

Figure 2. Characteristics of π-containers (Milenkovic, 2022)

Universal connectivity represents one of the most important features of the Physical Internet (Hofman et al, 2017). From a logistics perspective, universal connectivity refers to easing the movement of physical objects or shipments, from one component to another, their storage or treatment within any of its capable constituents as well as responsibility sharing and contracting between actors. Universal connectivity enables a high degree of cooperation on various levels and between various actors.

Universal connectivity should be achieved through physical, digital and operational interconnectivity (Montreuil et al, 2012):

- Physical interconnectivity secures that physical entity (shipment) can flow seamlessly through the PI. In order to achieve this, physical objects are encapsulated in standard modular PI containers or π-containers.
- Digital interconnectivity ensures that physical entities, constituents and actors can seamlessly exchange meaningful information across the Physical Internet. This includes tracking of objects within the Physical Internet, message exchange among the objects and human actors enabled by the Internet of Things.
- Operational interconnectivity ensures that in-the-field operational processes as well as the business processes are seamlessly interconnected so that it is easy and

efficient for users to exploit PI for fulfilling their logistics needs and for PI constituents to seamlessly collaborate in serving the logistics users of PI users.

In the PI, π-containers will be moved by π-movers. The main types of π-movers are (Montreuil et al., 2010):

- π-transporters which include π-vehicles and π-carriers, respectively vehicles (trains, trucks, ships) and carriers (wagons, trailers) specially designed for easy, secure and efficient moving of π-containers. The main difference between π-vehicles and π-carriers is that the first are self-propelled whereas the second have to be pushed or pulled by π-vehicles or π-handlers;
- π-conveyors are specialized in continuous flowing of π-containers along determined paths without using π-vehicles and π-carriers. π-conveyors may differ from contemporary conveyors by not having rollers nor belts (Figure 3.);

Figure 3. π-conveyors (Milenkovic, 2022)

In the Physical Internet there will be only π-container material handling and storage systems empowered by innovative technologies and processes which enable the following functional capabilities (Montreuil, 2011):

- Enabling fast and reliable input and output performance;
- Providing a seamless interface with vehicles and systems moving products in and out, as well as with client software systems for tracking and interfacing with the π-containers;
- Monitoring and protecting the integrity of π-containers;
- Securing the π-containers on the desired level.

π-container material handling and storage will be conducted in π-nodes. π-containers will be stacked in π-node like the containers are stacked in the ports, there will not be a need for storage racks since the pallets are eliminated from the system. In other words, π-nodes are locations in which the operations with π-container such as receiving, routing, handling, storing, folding, composing, decomposing and others, are performed (Montreuil et al., 2010). There are different π-nodes with different scope of services from the simple transfer of π-carriers between π-vehicles to complex multimodal multiplexing of π-containers. Activities at a π-node may affect physical changes such as switching from a transportation mode to another. π-nodes are publicly rated based on some key performance indicators such as speed, service, handled dimensions of π-containers, capacity and others. This information will be used by the clients during the decision making process as well as by the other Physical Internet actors for routing purposes.

In current freight transportation there are two distinct ways that freight is transported. Direct service or point-to-point service is established between an origin-destination pair in case when there is enough volume of freight to justify dispatching of a truck (full truckload), train or a ship. In Physical Internet a distributed multi-segment intermodal transport will be the preferred way of moving freight from origin to destination. The distributed multi-segment travel includes movement of π-containers by different carriers and/or modes taking charge of inter-node segments with π-nodes which will enable seamless transfer of π-containers and/or carriers between segments (Figure 4.). More precisely, the delivery process will look like a relay race (Trebilcock, 2012). Each π-transporter will carry a load up to the next transit hub, then he will pick up a backhaul and return home within its work shift time. There, another transporter (the same or other mode of transport) would pick up the load within a short time interval and move it until the next transit hub. It is expected that by this distributed multi-segment process the delivery time could be significantly shortened.

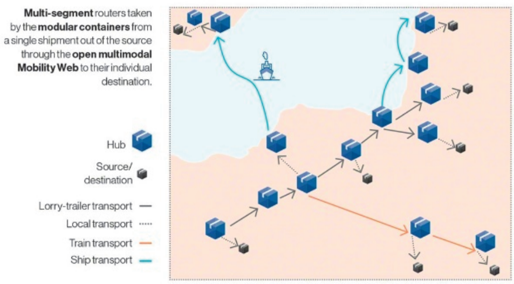

Figure 4. Enabling an open global mobility web (Milenkovic, 2022)

Various levels of decision making centralization and autonomy are possible in distributed multi-segment travel (Montreuil, 2011):

- Low level: π-container does not have any decision making capability. Shippers or LSPs are planning complete routes prior to departure. They may impose also a set of key intermediary nodes and or links and the rest can be left to more autonomous decision-making.
- Medium level: π-container has a minimum decision making autonomy. Human or virtual logistic agent takes decisions instead of a π-container, and transmits it to it and to other Physical Internet elements involved in the route.
- High level: π-container has a maximum decision making autonomy. Shippers specify only desired dispatching time and final destinations of the π-containers and maximum budget allowed. π-containers decide on their routing dynamically, adopting their plans instantaneously based on the latest information received due to their smart and connected nature.

In existing logistics system, warehouses and distribution centers (DCs) are used by a limited number of actors, in some cases only by one actor. Physical Internet enables transition from private supply chains to global, open supply Web with the following main characteristics (Montreuil, 2011):

- The nodes (distribution centers, warehouses and others) are fully accessible to most actors (manufacturers, distributors, LSPs, retailers or users). That means that a DC will be open to receive or crossdock containers from any other company just like a port. The users can better select the stocking points of their products and make more flexible and responsive replenishment plans. Replenishments between open warehouses are also allowed in Physical Internet. This will contribute to improved inventory level and service rate to clients in contrast to traditional hierarchical and independent supply chains.
- The service capacity of nodes is available for contract on demand, on a per use basis, for processing, storage or moving activities.

Figure 5. illustrates a transition from private supply networks to an open, global supply web.

a) Five-single company distribution networks of a closed distribution web (Milenkovic, 2022)

b) Collaborative distribution web dedicated to five partnering companies (Milenkovic, 2022)

Figure 5. Transition from private supply networks to open, global supply web, five firms serving the markets in North America (Sohrabi et al., 2012)

3. Towards a PI-based CEP sector in Serbia

According to EU Green Deal, the ambition of the European Union is to be the first climate-neutral continent by 2050. Physical Internet supports the transition towards zero emission. According to a roadmap proposed by ALICE (Alliance for Logistics Innovation through Collaboration in Europe) full realization of Physical Internet is expected in 2040 (Alice, 2020).

PI implementation requires development of innovative and complex cooperative business models in order to enable open logistics network where resources are compatible accessible and easily interconnected. In terms of CEP delivery services, this requirement can be implemented through cooperation between a number of providers directly and indirectly engaged in a CEP service. The literature distinguishes numerous forms of cooperation such as (Rusich, 2017):

- Vertical cooperation – occurs between two or more business units operating at different layers of a same supply chain (shipper – LSP, LSP-carrier etc.). Vertical cooperations are essentially subcontracting relationships. In the CEP sector, service providers often use subcontractors to supply different parts of the process (Bartucz et al., 2023).

- Horizontal cooperation occurs between two or more companies operating at the same industry level. It can be of different type, such as cohexistence, cooperation, coopetition, competition. For example, in CEP sector, two courier companies share logistics resources (vehicles, drivers, hubs, software tools) to improve the delivery performances as a whole.
- Diagonal cooperation represents a bi-dimensional cooperation strategy aimed at enhancing supply chain flexibility.
- Interconnected cooperative logistics models are based on combining the basic three cooperative relationships at various levels and in various modes simultaneously, thus creating interconnected logistics networks.

At the moment, in Serbia, there is an established partnership between PE 'Post of Serbia' and DHL. This form of horizontal cooperation includes the sharing of 'know-how' and the use of PE 'Post of Serbia' facilities for the distribution of DHL services. Cooperative relationships based on sharing transport and storage capacities do not currently exist. Trust and data exchange issues are considerable barriers to the introduction of cooperative relationships. To address the lack of trust and the issue of data exchange between the actors, CEP carriers for example (in case of horizontal cooperation), the use of blockchain technology may represent a solution (Hribernik et al., 2020). Nowadays in Serbia, more than 50 courier companies operate, and all of them have their own hubs for manipulation with parcels. Each company has around 10 regional hubs. These hubs are exclusively used by the owning company. In the PI the role of distribution centers and warehouses will be changed to open hubs allowing shipments to flow through similar to the flow of data packets over the Internet. The hubs will be 100% neutral and independent. The number and locations of hubs will be optimized based on the network costs as a function of hub locations their number and routing. For example, DHL provides warehouse space sharing. American Seattle-based startup Flexe has also developed a marketplace for excess warehouse space (DHL, 2017). In line with PI concept, national Post Operator (Post of Serbia) as well as a number of private courier companies built a network of openly available locker terminals located in convenient and public locations. In the perspective of using Hyperconnected Modular Containers (π-containers), the lockers terminals should be able to communicate with the parcels (for example through RFID technology) enabling the system to get information from sensors, tracking location, and to change routing decisions (Fuagere and Montreuil, 2016). Establishing of standardization will also require substantial time and investments. PI requires standardization of information (data, formats, content), communication technology (data transfer, data access and IT functionalities), logistics products and mathematical optimization logics (Gasperlmair et al., 2016). Regarding π-containers, they can be differentiated on transport, handling and packaging containers (T/H/P containers respectively). The P containers are of smallest size and used for packing of physical goods. H-containers will be of middle size and used for handling purposes such as moving carrying and storing temporally a set of P-containers. The T-containers are used for transporting a huge volume of H-containers and/or P-containers across cities, counties and continents (Tran-Dang et al., 2020). In CEP market packets and pallets are used as the main loading units. The dimensions of π-containers and the sizes of the products which must be mutually aligned will be a subject to an international standard committee as well. Bigger operators in Serbia (such as Post of Serbia and other private operators) has already made huge investments in handling and storage infrastructure and ICT so they will be reluctant to any radical change at least on a mid-term horizon. The actors on the CEP market have proprietary software solutions (transport management systems, warehouse management systems, ERP software) with different data structures which requires significant investment in the development of interfaces. PI requires synchronization between different modes of transportation. This concept, also known as synchromodality, represents an ability to switch freely between transport modes at certain nodes while meeting cost and service level requirements (Lemmens, 2019). On the level of CEP services, this would include the development of synchromodal urban delivery network which will enable the best choice among alternative options to deliver parcels to customers as well as a temporal synchronization of modes at multiple echelons. Currently in CEP sector in Belgrade (50% of CEP delivery is realized in Belgrade) there is a limited number of modes (vans, eco delivery by bike for some very light shipments) and delivery options (doorstep, lockers by a few operators) so there is no real possibility for redesigning the CEP delivery system.

5. Concluding remarks

CEP services represent a very challenging and dynamic market segment. Despite the fact that the CEP service is also a very profitable business, there is a space for improvement of its efficiency and sustainability. The concept of Physical internet can offer significant improvements in agility, robustness, resilience and environmental footprint of CEP services. In this paper, the concept of Physical Internet was described and its potential for implementation was analyzed in the context of CEP services in Serbia. In comparison with the rest of the world, in Serbia, there are no initiatives related to implementation of Physical Internet. One way to a growing exploration and adoption of Physical Internet would be a phased approach with incremental grow in terms of complexity and coverage of Physical Internet initiative. This can be realized though a continuous research and innovation action based on intensive collaboration between industry and academia.

References

[1] Statista (2023, Nov 1). Courier, express and parcel (CEP) market volume in Serbia from 2015 to 2022 [Online]. Available at: https://www.statista.com/statistics/1219818/courier-express-parcel-market-volume-serbia/.

[2] C. Bartucz, L. Buics, and E. Sule, “Lack of Collaboration on the CEP Market and the Underlying Reasons – A Systematic Literature Review”, Sustainability, 15, pp. 1-22., 2023.

[3] Rusich, “Collaborative Logistics Networks”, Doctoral Thesis, University of Trieste, Italy, 2017.

[4] Montreuil “Towards a Physical Internet: Meeting the Global Logistics Sustainability Grand Challenge”, Logistics Research, 3, 2-3, pp. 71-87, 2011.

[5] Montreuil. (2012). Physical Internet Manifesto [Online]. Available at: https://www.slideshare.net/physical_internet/physical-internet-manifesto-eng-version-1111-20121119-15252441

[6] M. Milenkovic (2022). Physical Internet: disruptive innovation for a sustainable supply chain. Mecalux [Online]. Available at: https://www.mecalux.com/logistics-articles/physical-internet-milos-milenkovic
[7] H. Treiblmaier, K. Mirkovski, P. B. Lowry, and Z. G. Zacharia, "The physical internet as a new supply chain paradigm: a systematic literature review and a comprehensive framework", The International Journal of Logistics Management, 31(2), pp. 239-287.
[8] B. Montreuil, E. Ballot, and F. Fontane, "An Open Logistics Interconnection Model for the Physical Internet", Proceedings of the 14th IFAC Symposium on Information Control Problems in Manufacturing, Romania, 2012.
[9] F. Marino, I. Seitanidis, P. V. Dao, S. Bocchino, P. Castoldi, and C. Salvadori, "IoT enabling PI: towards hyperconnected and interoperable smart containers", Proceedings of 6th International Physical Internet Conference, pp. 349-362, England, 2019.
[10] C. Dong, and R. Franklin, "From the Digital Internet to the Physical Internet: A conceptual framework with a simple network model", Journal of Business Logistics, 42(1), pp. 108-119, 2018.
[11] W. Hofman, J. Spek, and C. Brewster, "Applying Blockchain Technology for Hyperconnected Logistics", Proceedings of the 4th International Physical Internet Conference, pp. 59-71, Austria, 2017.
[12] B. Montreuil, R. D. Meller, and E. Ballot, "Towards a Physical Internet: The Impact on Logistics Facilities and Material Handling Systems Design and Innovation", Proceedings of the 11th IMHRC, pp. 11-23, USA, 2010.
[13] H. Sohrabi, W. Klibi, B. Montreuil, "Modelling scenario-based distribution network design in a Physical Internet-enabled open Logistics Web", Proceedings of the 4th International Conference on Information Systems, Logistics and Supply Chain, pp. 1-12, Canada, 2012.
[14] Alice, 2020. Roadmap to the Physical Internet. Alliance for logistics innovation through collaboration in Europe [Online]. Available at: http://www.etp-logistics.eu/alice-physical-internet-roadmap-released/
[15] M. Hribernik, K. Zero, S. Kummer, and Herold, D.M., "City logistics: Towards a blockchain decision framework for collaborative parcel deliveries in micro-hubs", Transportation Research Interdisciplinary Perspectives, pp. 1-8, 2020.
[16] DHL, 2017. Sharing economy logistics. DHL Customer Solutions & Innovation [Online]. Available at: https://www.dhl.com/discover/content/dam/dhl/downloads/interim/full/dhl-trend-report-sharing-economy.pdf
[17] L. Faugere, and B. Montreuil, "Hyperconnected city logistics: Smart lockers & Last mile delivery networks", Proceedings of the 3rd International Physical Internet Conference, USA, 2016.
[18] Gasperlmair, H.-C. Graf, S.-T. Hörtenhuber, F. Ehrentraut and C. Landschützer, "Go2PI – Practically proved steps to implement the Physical Internet", Proceedings of the 3rd International Physical Internet Conference, USA, 2016.

[19] H. Tran-Dang, N. Krommenacker, P. Charpentier, and D. S. Kim, “Toward the Internet of Things for Physical Internet: Perspectives and Challenges”, IEEE Internet Things Journal, 7, pp. 4711–4736, 2020.
[20] N. Lemmens, J. Gijsbrechts, and R. Boute, “Synchromodality in the Physical Internet – dual sourcing and real-time switching between transport modes”, European Transport Research Review, 11:19, pp. 1-10, 2019.

Abstract: *Tržište kurirskih, ekspresnih i paketskih usluga (KEP) predstavlja jedno najkonkurentnijih tržišta. Međutim, način na koji se paketi prevoze, pretovaraju, skladište i distribuiraju nije održiv sa ekonomske, ekološke i društvene tačke gledišta. U radu je opisan fizički internet (FI) kao jedan od inovativnih pristupa za poboljšanje efikasnosti i održivosti u transportu. Sa fokusom na nacionalno tržište KEP usluga, navedeni su osnovni pravci primene fizičkog interneta u domenu KEP usluga. Date su moguće koristi, prepreke u primeni koncepta kao i strategije za prevazilaženje ovih prepreka.*

Keywords: *kurirske, ekspersne, paketske, isporuka, fizički internet*

U SUSRET FIZIČKOM INTERNETU: UTICAJ NA CEP USLUGE U SRBIJI

Miloš Milenković, Nikola Knežević, Nebojša Bojović