WIRELESS TECHNOLOGIES IN THE COMMERCIAL BUSINESS

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ABSTRACT
Purpose: The main aim of this study is to review some widespread wireless technologies and the possible dimensions of their operation in the commercial business. Methods: The paper uses general and specific methods such as the descriptive method, situational and content analysis. Results: Wireless technologies are becoming a mandatory element in various situations of personal and business life. Their role is growing both in terms of information and communication exchange, but also in relation to the creation of new application areas for their use in business. Each wireless technology has certain physical specifics and characteristics that predetermine the field for their successful implementation and usefulness in trade. Conclusions: In the commercial business, wireless data and information transmission is a technological factor in accelerating the economic process and is an integral part of the digital transformation in the implementation of product exchange in both traditional physical and online store environments.

Key words: commerce, wireless network, Bluetooth, RFID, NFC

INTRODUCTION

The digitalization of commercial business is a complex evolutionary process that brings a wide variety of positives for all participants in the economy of trade. One of the dimensions of the digital transformation is the expansion of the areas and scope of application of wireless technologies for data transmission and communication. Through them, a full information and communication exchange is provided, which allows the implementation of traditional operations and activities in trade in a new way, but also the emergence of completely new functions and applications that can be implemented as a continuous process, carried out in real time and in physical distance. Wireless technologies put both the consumer and the product in the center of business interest and open

up a field for innovative application to both parties. Moreover, they define new dimensions of the understanding of place or space, as the possibilities for their use go beyond some of the obstacles and limitations of the physical commercial environment. In addition, they allow active monitoring and remote management of products and people, which improves the control and timeliness of management decisions.

The aim of the present work is to systematize the characteristics and application specifics of wireless technologies used in the commercial business.

METHODS

In the course of the present study of the use of wireless technologies in commerce, general and specific methods such as the descriptive method, situational and content analysis has been applied. The research accepts all the achievements of the widely known and more popular in the scientific community conceptual foundations of wireless technologies and they are presented through the

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fundamental need to clarify and assess their importance and application in the activities of trade operators. This paper summarizes secondary data on the expected development of the key wireless technologies for the commercial business in the near future. The main limitation of the work relates to the selected wireless technologies that are presented and they are limited only to those that are most widespread in the trade at the moment.

RESULTS

Wireless technology means devices that use a wireless connection, which "only describes the way of accessing a network or other communication partners, i.e. without wire. The wire is replaced by the transmission of electromagnetic waves through "the air" (although wireless transmission does not require any medium)" (1). Wireless technologies use "wireless networks, which are networks that use radio waves to connect devices, without the necessity of using cables of any kind" (2).

Wireless technologies are user-oriented and are designed to be used for multiple purposes and areas of application. Their main advantage is that their use remains in conditional invisibility for consumers who receive directly or indirectly the results of their operation. This means that, for the users, the functioning of this technology is carried out independently of them in a relatively fully automated process of operation of digital technology and its algorithms, but with all the positives perceived by the joined participants. In essence, wireless technologies allow optimizing the physical dimensions of commercial infrastructure and mainly that part of it related to communication and information exchange. The physical parameters and features of any wireless technology are a research problem that is also constantly evolving, in search of solutions to improve bandwidth, capacity, efficiency of use of technology and resources that it involves, etc. In the different dimensions of its application, each wireless technology may have certain limitations related to coverage or distance of operation, speed of data transmission, interference and conflict between the same and different technologies, security risks and access restrictions, the impact of electromagnetic radiation, strong dependence on electricity or

external suppliers, the need for trained specialists to set up, administer and use wireless technologies and mainly to eliminate problems related to them, the requirement for basic and continuing training of all users of the technology, its applications, etc.

Every wireless technology is subject to continuous research interest, which leads to new high tech innovations, scientific discoveries and overcoming the current limitations. This causes the solution of the existing problems and difficulties, but also sets new limits of application, for which solutions should be sought in the future, until the moment when this is feasible and economically justified.

The specificity of the application of wireless technologies in the commercial business is related to the involvement of three groups of participants. The first, is narrow specialists who determine the operating parameters and bring the technology into a functioning mode and carry out its improvement, administration and ongoing maintenance. The second, is sales staff who uses the technology before, during the actual and after the sales process in its relatively "invisible" and without access to the customer part (back office, internal activities and operations, administration) and "visible" in commercial sale services part. The third, is the end customers, who are mainly information users of wireless technologies, but they can also use them in the purchase activities (for self-checkout, payment, information support, commercial communication, etc.).

One of the main factors driving the widespread application of wireless technologies in the commercial business is the declining value of technology and its mainstreaming. This is because each technology gains its practical application at the moment when the price for its essential use becomes insignificant to the price of the products in which it is integrated or to which it is applicable. Wireless technologies contribute to cost savings mainly in terms of those physical resources that are elements of any network infrastructure such as physical components (cables, connectors, adapters, etc.). Thus, the installation of a specific wireless technology and its use can be realized regardless of the parameters and characteristics set in the technical

designs of the architecture of commercial premises or with minimal interventions and adjustments in the trade environment. Moreover, wireless technologies are very well adapted to the existing characteristics of physically built networks and overcome many of their limitations. Different wireless technologies have specific characteristics and features that are a product of their physical parameters **(Table 1)**. Their unique features predetermine the areas of their application in business and personal life. The main differentiating criterion by which we can distinguish the selected wireless technologies is the radio frequency range or spectrum as areas and sub-areas in which they operate. Hence, the specific distinctive features that are related to the spatial scope of each of the technologies, the speed of information transfer, the ability to connect devices, the dependence on electricity, etc. The unique specifications of each wireless technology determines to the greatest extent the areas of their application in trade. For example, WiFi (Wireless Fidelity) technology has the widest application in terms of information flow management between the individual departments and units in the store in an intranet network, but also between the individual sites in a commercial system (extranet), another main direction is related to the ability of connecting customers and their smart devices to the wireless network of the commercial organization and the implementation of WiFi marketing by the trade operator. Bluetooth technology can be implemented in commercial marketing solutions using Bluetooth Beacons. Infrared sensors placed in the trade outlets allow the collection of large amounts of information about customer behavior and its prediction, this technology is also applicable in electronic price tags and shelf labels. RFID (Radio-frequency identification) technology allows wireless identification of any product with a chip attached to it, this finds its wide application in product supply chains, card systems for customer identification and to stimulate and reward customer loyalty, self-service technology and self-checkout in the sales area. NFC (Near-Field Communication) technology increases the levels of product protection and monitoring at the point of sale, the fight against counterfeit products, contactless payments and more.

The main areas of application of wireless technologies in the commercial business are related to:

1. Possibilities for tracking the movement of physical units in the product distribution channels and product identification. In addition to individual stock keep units, tracking can also be introduced for other merchant assets (vehicles, mobile commercial equipment, etc.) or human resources. The latter in view of the performance of employment duties, and not for the purposes of illegal entry into personal space and / or malicious use of personal data related to the employee.

2. Establishing product inventories on the sales floor or warehouse premises and advanced systems for securing of goods during the physical movement of products (on the retailer's premises and in the supply chain). This allows to increase the protection levels for the individual items of the merchant assortment in the overall commodity security system. At the same time, the trader's information security about the product storage location, its precise localisation, etc. is improved.

3. Better management of inventories and product turnover. With the help of wireless technologies it is possible to introduce and improve the inventory system in the commercial site in real time and the prevention of product obsolescence to the level of an individual product unit. This allows products with a certain shorter shelf life or specific storage regime to be individually traced to the extent that those with critical or compromised characteristics, or those with an expiring shelf life, are properly managed in order to disposal or removed from the commercial process. In this aspect, it is even possible for certain measurable circumstances related to the specific product unit, as a data, to be transmitted to the trader's information system to take correct and timely action, which can also be automated. The latter can be a prerequisite and source of information for the use of Electronic Data Interchange between business partners and their networked computer systems. Moreover, combining these technologies with an artificial intelligence system allows "technical systems to monitor their environment, receive data (prepared by others or collected by themselves), process them and perform actions related to achieving a specific goal" (9).

Table 1. *Wireless technologies characteristics*

Parameters/ Characteristics	Wi-Fi	Bluetooth	IR	RFID	NFC
Standardization	IEEE, WECA	Bluetooth SIG	Infrared Data Association	IEEE Council on RFID	ISO/IEC 14443, FeliCa, ISO/IEC 18092, NFC Forum
Range	0 – 100 m	0 – 10 m – up to 100 m	Standard: 0 – 2 m – up to 30 m	0.1 – 200 m	0 – 0.04 m
Frequency range	RF waves 2.4 GHz and 5 GHz	RF waves 79 channels in the 2.4 GHz band with 1 MHz carrier spacing	A cordless data connection using infrared light. Frequency range between 300 GHz and 400 THz and wavelength range: 1 mm and 750 nm	Passive and Active technology LF: 125 – 134.2 kHz и 140 – 148.5 kHz HF: 13.56 MHz UHF: 865 – 928 MHz Microwaves: 2450 –5800 MHz and 3.1 – 10 GHz	13.56 MHz
Capability to transfer data	54 mbps – 12 gbps	720 kbits – 800 kbits. Up to 1-2 mbps	Fast Infrared (FIR) up to 4 mbps. Serial Infrared (SIR) – 3-96-115 kbps	4 kbps – 848 kbps and more depending on the protocol and frequency used	106 kbits – 424 kbits. No need of connection configuration
Size of network	2-200 devices, depends on Wi-Fi components/devices used	2-8 devices	2 devices	2 devices	2 devices
Technology implementation	Any modern device: laptops, notebooks, smartphones, tablets, gaming consoles, wearable devices, computer peripheral devices, home appliances, bank ATM's, Wi-Fi marketing, smart price labels, etc.	Any modern device: laptops, notebooks, smartphones, tablets, gaming consoles, wearable devices, computer peripheral devices, home appliances, smart price labels, etc.	PDAs, printers, desktop adapters, notebooks, cameras, palm devices, home appliances with IR remote control, copiers, fax machines, overhead projectors, telephones, bank ATM's, credit cards, game controls, and headsets. Direct line-of-sight requirement	Access control systems, identification and tracing of goods, humans and animals, yoll systems and road tax, machine-readable documents, lLocalization of sites (transport packaging, vehicles, etc.), reporting of sports activities, monitoring of the condition of goods, automated invoicing. RFIDs are not communication devices	Contactless bank cards, access control systems, portable devices (mobile phones, etc.), smart price labels and product packaging labels
Need for electricity	Yes, with low consumption	Yes, with high consumption	Yes, with very low consumption	No (in read mode)	No (in read mode)
Cost	Wi-Fi cost vary depends on speed, location, type of technology, count of users, etc.	Low cost	It is a low-cost transceiver signaling technology for two way data exchange.	Very cheap tags/chips	0.01 USD per chip
Security	Very secure, with authentication, authorization and encryption	Very secure, with authentication, authorization and encryption	Very secure. No authentication, authorization and encryption	Secure Hardware and protocol level	Secure Hardware and protocol level
Se up time	5 ~ 60 sec.	~ 6 sec.	~ 0.5 sec.	< 0.1 msec.	< 0.1 msec.

Source: (1) (3) (4) (5) (6) (7) (8)

4. Realization of precise observations about the products and the visitors in the trade premises.

This makes it possible to detect conditionally heavily loaded areas or those that do not attract

enough consumer interest. In this way the direct effects of the promotional events and the advertising at the point of sale, the efficiency of the commercial facilities, the rationality of the positioning of the commercial equipment, the way of the client in the trade hall and many more can be assessed. The implementation of such market research is extremely effective because it involves less company resources, but mainly human and can be carried out in a continuous and unrestricted mode within the working hours of the store.

5. More precise individualization of consumers as customers and their consumption profile, through advanced loyalty incentive systems. The use of wireless technologies (in loyalty cards, through costumer profiles or otherwise to personalize the buyer) in identifying the customer at the point of sale or at the point of contact, is a modern approach to stimulate his interest, full management of the relationship with the client, which has its economic and social dimensions and effects for the parties participating in the program. It allows, through wireless technologies, customer information to be fully accumulated, retrieved and used to make personalized offers and with a view to achieving higher levels of satisfaction. Of course, this again raises the question about the type and volume of acquired information, the possibilities for its use in commercial activities and last but not least the protection of personal data related to the client.

6. Development of technologies for cashless and contactless payments. The increase in the share of payment transactions made with electronic money is stimulated by the proliferation and enforcement of wireless technologies applied at the point of sale, which is associated with many advantages and risks. We associate the positives with the conditional speed and functionality, the conveniences for the parties in the trade exchange, the high levels of security and hygiene, etc. But there are also growing problems with data protection, access control and authentication, levels of authorization and use, the rise of cybercrime, the collapse of computer systems, the unavailability of the Internet to either party, the critical importance of electricity and more.

7. Increased levels of information security and response to the information needs of the customer at the point of contact with the product. Wireless technology is a channel through which product information can be supplied in its fullest extent and provided to the customer at the point of contact so that it can be used before or at the time of the purchase decision or stored for future use. Searching and receiving information is valid both for the customer and for sales staff, who may have access to additional data on product availability, customer profiles and more.

8. Monitoring and adjusting the parameters of the trading environment. Wireless technologies that are embedded in physical objects (commercial buildings, commercial furniture, vehicles and other objects and items in the store environment) allow remote interaction and control, according to the wishes of the store managers or automatically at set parameters or characteristics of the internal and external environment.

All this confirms the finding that "wireless technologies are causing retailers to think of new and better ways of selling to customers, increasing security, reducing theft by both customers and associates and decreasing operating expenses on the store floor" (10). In addition to the listed specifics, areas of application and advantages, wireless technologies also suffer from certain general shortcomings, which are expressed in terms of the security of digital technologies. Access without physical contact to the wireless network or its components allows a wide range of people to have access, behind which there may be certain malicious behavior and goals. Another serious problem facing any radio frequency wireless technology is its interference with other technologies operating at the same or similar frequency, as well as the influence of heterogeneous electromagnetic interference. The inability of some of the wireless technologies to deal with physical obstacles, as well as the reduction of their capabilities when passing through various barriers or the creation of areas and objects without coverage by wireless technology. The limited characteristics of wireless technologies in some respects compared to traditional wired and modern optical connections.

According to the Cisco Annual Internet Report (2018-2023), by 2023, 2/3 of the world's population will have access to the global network,

with one person in the human population will have 3.6 network devices, half of which will be linked into M2M architecture (machine-to-machine) or so-called Internet of Things technology (11). The availability and mass use of network devices and the penetration of Internet technology in an unprecedented way transforms the course of human everyday life, and this process will continue to accelerate in the dimensions of faster data speed, declining transmission costs, coverage of mobile networks, integration of mobile technologies with those used in personal and professional life, etc. The main factor behind such a scenario of the expected development is the forecasts that in 2023 71% or 5.7 billion of the human population will be provided with mobile access to the global network, whose average speed will increase to 43.9 mbps (11). The wide possibilities for the integration of wireless network technologies allows the traditional everyday processes to achieve full digitalization, which results in their acceleration, a decrease of their value, reduction of errors caused by the human factor, etc. effects that determine their faster acceptance and imposition as a new standard of living and working in the digital age of human existence. In the different segments of the presented wireless technologies, the forecasts estimates are: the total RFID market to reach a volume of 13 billion USD in 2022 and to continue to grow to 15.2 billion USD in 2024 (12), the size of the global NFC market will reach 47.3 billion USD in 2024 (13), and annual shipments of Bluetooth devices worldwide are expected to reach 6.2 billion units in 2024 (14), 22.2 billion devices worldwide will be connected via WLAN in 2021 (15).

The increasing variety of wireless technologies, as well as the declining cost of their components, mass application and their combined use, will allow them to be incorporated in the product and mainly in commodity packaging, which can be already made at the time of the production phase. This will empower the concept of self-service in physical retail outlets to be further developed, where the possibility of self-checkout will acquire the characteristics of a basic sales mechanism. Its organization and implementation technology will feature error minimization and maximum reporting scope. The latter is made possible due to the fact that the goods will not be able to leave the store uncontrolled, as each product unit is subjected to continuous real-time monitoring.

Additional opportunities for the growing application of wireless technologies are the dimensions for improving consumer protection: more complete product information that reaches the end customer in a multilingual format and it is easy to update or upgrade; easier tracking of product units in claim process under the Consumer Protection Act; facilitated mechanism for returning goods in accordance with the permitted regimes for this, for example, in the case of off-premises and distance contracts; traceability of the physical movement and localization of product units and batches.

CONCLUSION
In different everyday situations, wireless technologies carry a huge variety of positives and risks of their application. In the commercial business, they are a key factor for accelerating the economic process and a technological step in the digital transformation of the forms and models for product exchange. Their future application growth will depend on the increased "efficiency of devices, which needs to be improved in terms of power, size and capacity utilization" (16), which will materialize in future generations of wireless technology solutions.

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