

Market Report in IoT devices

Region: Croatia, Slovenia, Serbia

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Metković, August 2021.

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Introduction

About the Internet of Things (IoT)

Considering that **internet** per se is defined such as global computer network that provides various information, **internet of things** is network of things, tools or machines connected via digital infrastructure and interface generating information related to environment screening, usability measurement, defined indicators notifying, tracking, etc. Compared to infrastructure of internet, infrastructure of internet of things is wider and more complex considering number of connected devices, network speed, coverage, data generation, data analytics, security and maintenance.

Within this research, main focus was on Croatian market compared with other countries in EU.

Terminology:

IIoT (Industrial Internet of Things)

B2B (business-to-business) - transaction or business between one and another business

B2C (business-to-customer) - market terminology used for products or services oriented to end customers

LAN (Local Area Network) - is a group of computers and peripheral devices that share a common communications line or wireless link to a server within a distinct geographic area.

Wi-Fi - wireless network protocol used for connectivity based on radio waves between internet and digital devices

Li-Fi (light-fidelity) - networking technology based on light data transmission

Bluetooth Low Energy - network technology based on radio frequencies

RFID (Radio Frequency Identification) - technology for automatic object detection via electromagnetic fields

ZigBee - communication protocol for used for creating personal area networks

ZWave - wireless communications protocol used primarily for home automation

LoRa - low power wide area network

NFC (Near Field Communication) - set of communication protocols used between electronic devices on short range (4 cm)

Sigfox - network type used to build wireless networks to connect low-power objects

GSM (Global System for Mobile communications)

LTE - term used for particular type of GSM network 4G

M2M (Machine-to-machine)

UNB (Ultra Narrow Band)

STEM - an acronym for the fields of science, technology, engineering and math.

Market statistic

“According to Eurostat data, industrial production for the E-28 countries in September 2018 decreased by 0.2% compared to the previous month, but on an annual basis, compared to September 2017, increased by 1.1%.

Nevertheless, on an annual basis, the decline in industrial production for **Croatia** is -2.6% (with Malta -5.3% and the Netherlands -2.3%). From September 2015 to September 2018, the industrial production index in Croatia increased by 2.4, and the EU-28 average increased by 7.1.

For comparison, Poland recorded an index growth of 16.1. HGK believes that domestic demand is growing and has a favorable effect on industrial production, but it is still at low levels, ie personal consumption in 2017 was 7% lower in real terms, and gross fixed capital formation 23.8% less than in 2008 year. These data show the problem that **Croatia is facing in order to maintain its own production and reverse economic indicators.**” [11]

"The entire scale in Croatian is available in the supplementary material. Each item describes a certain activity *in pandemics* that digital devices could be used for:

- communication with friends and family,
- communication with business associates (work),
- reading informative and news sites for monitoring events around the world,
- seeking information regarding the COVID-19 pandemic, precaution measures, etc.,
- seeking advice on how to maintain psychological and physical health,
- entertainment, time passing and relaxing,
- creating personal content (e.g. taking photographs, writing blogs, sharing information and expressing personal opinions and attitudes), and
- learning and acquiring new skills and contents" [12]

IoT usage analysis in Covid-19 pandemic

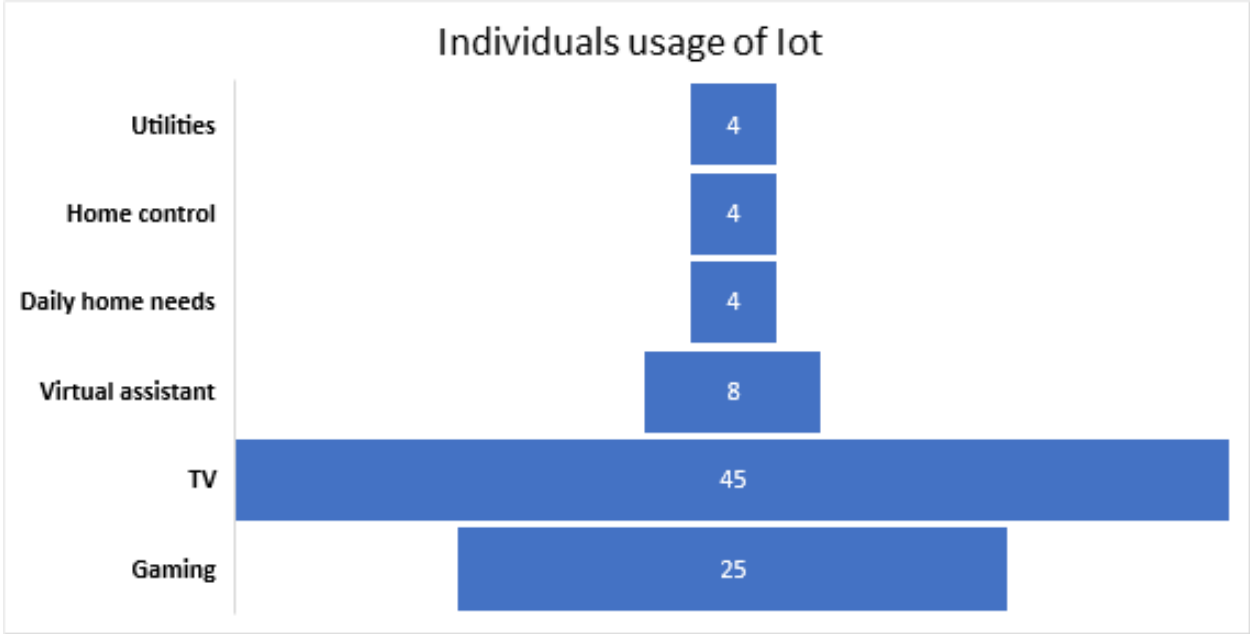
1) Individuals usage of IoT

Countries: Croatia, Slovenia, Serbia

Data compilation

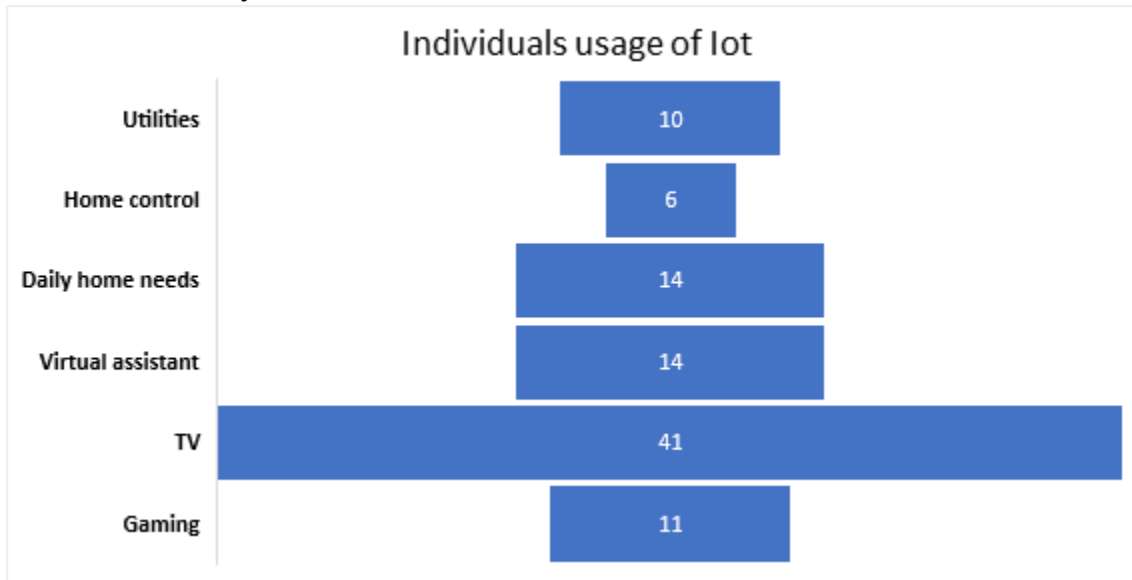
EU aggregates are compiled when the available countries represent 60% of the population and 55% of the number of countries defining the aggregate. Aggregates are only calculated using available data. No estimates are made for missing data except if provided by reporting countries. [25]

Picture 1. Country: Croatia; Value: %, Year: 2020



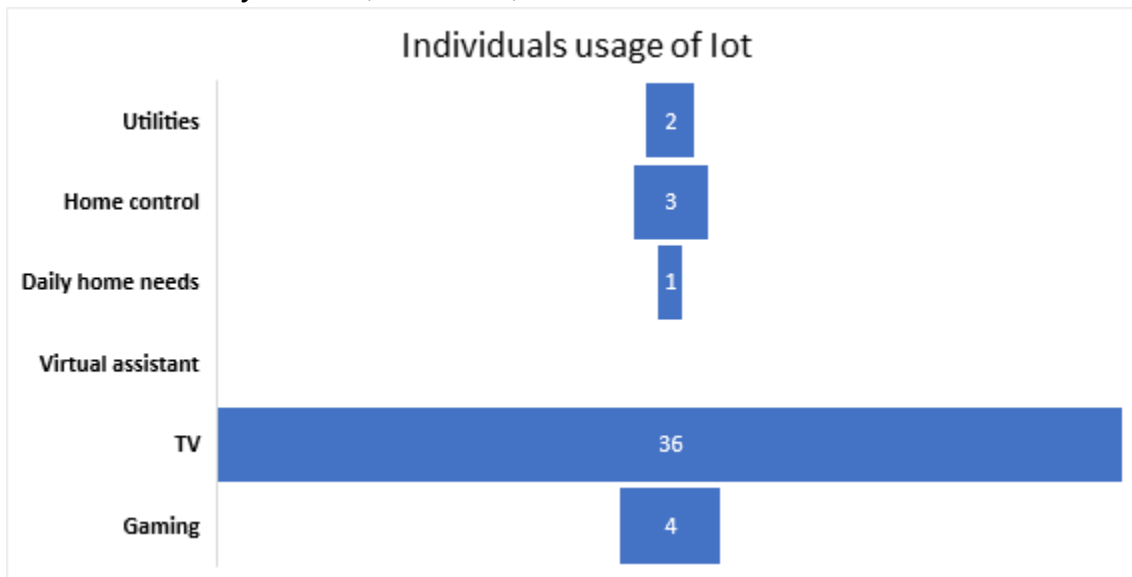
As shown on Picture 1 regarding Croatia, there is a significant difference in usage between IoT in entertainment (TV and gaming) then other types of usage. One of major circumstances for TV usage in pandemic is related to school programs broadcasting.

Picture 2. Country: Slovenia; Value: %, Year: 2020



Looking at results for Slovenia, among high TV usage, gaming category is a bit lower. Looking at other categories, usage of lot as virtual assistance, daily home needs and utilities are more than doubled comparing them to Croatian population.

Picture 3. Country: Serbia; Value: %, Year: 2020



After Croatia and Slovenia, while looking at results for Serbian population individual lot usage in pandemics, it is evident that TV is dominating comparing any other category.

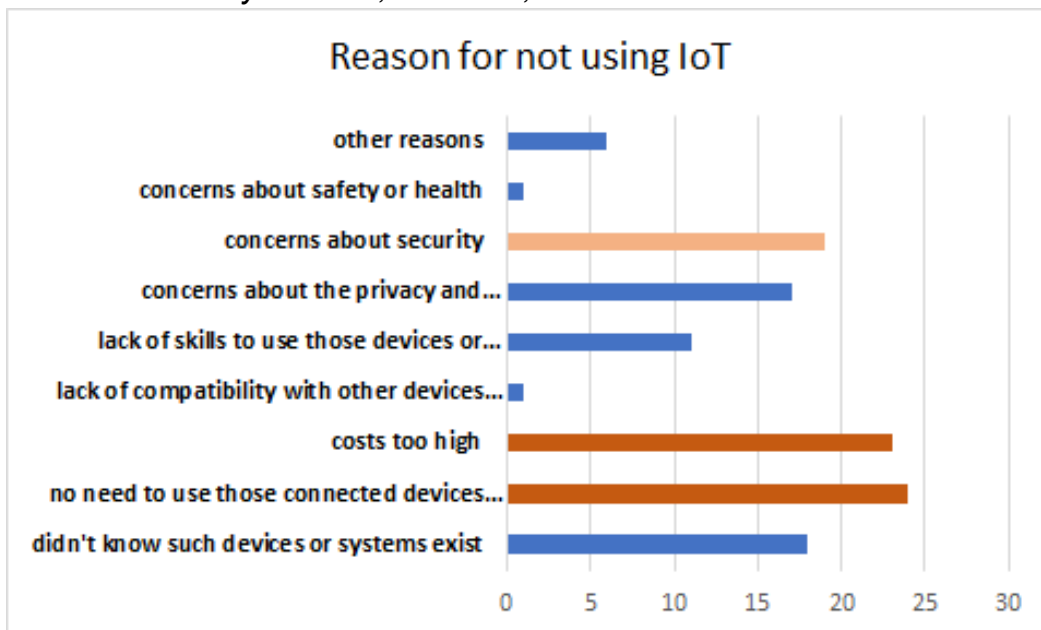
2) Reasons for not using IoT among individuals

Countries: Croatia, Slovenia, Serbia

Data compilation

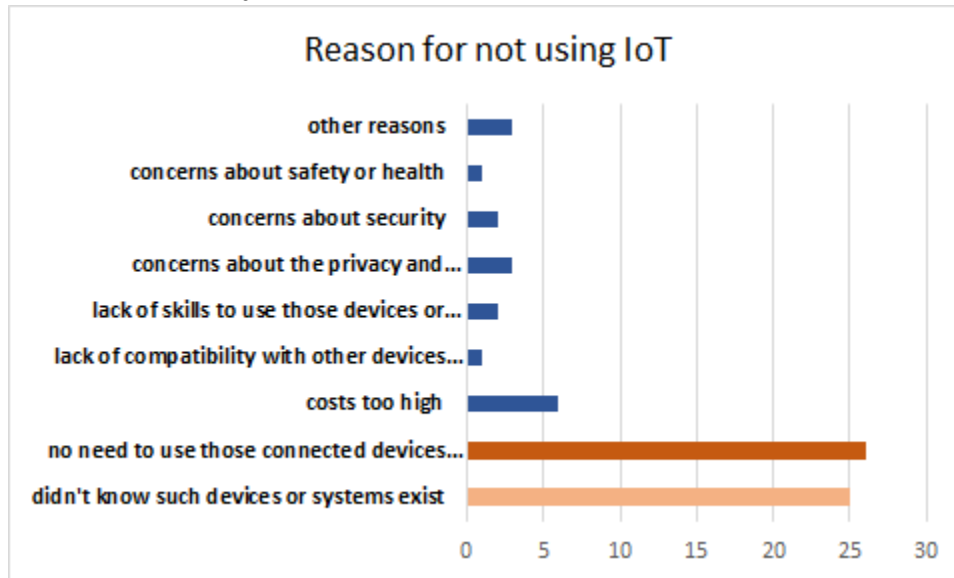
In this survey around 150.000 households with at least one person aged 16-74 and around 200.000 individuals aged 16-74 in the EU were surveyed (sample figures refer to the 2016 survey). [30]

Picture 4. Country: Croatia, Value: %, Year: 2020



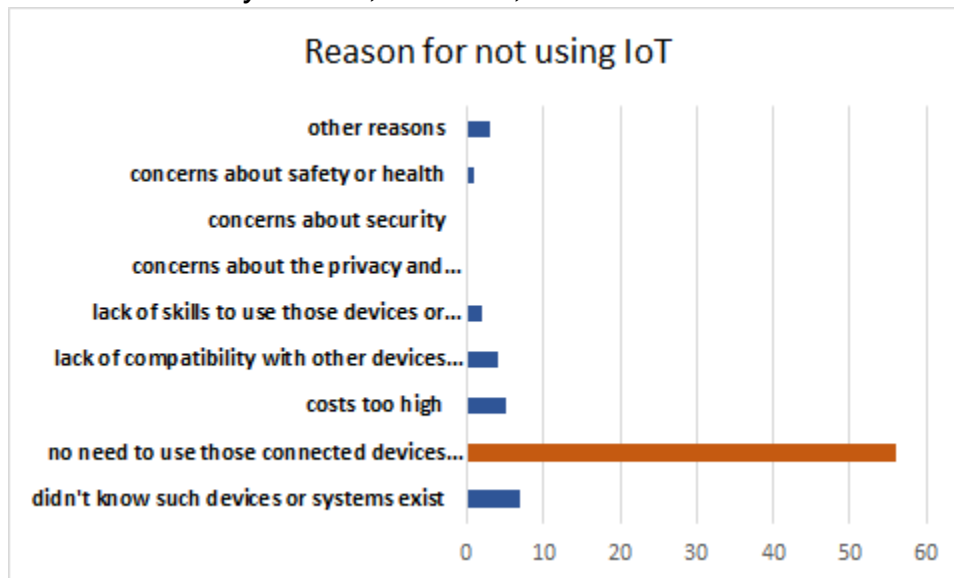
From statistics in picture above, it is evident that the lack of education and interest for using IoT devices in households with low usability due to high cost. Having in mind that majority of Croatian population are elder residents (age 45+) it could be one of the facts why internet of things is not recognized enough in daily usage. Looking at cost oriented fact, Croatian living standard is 30% lower (minimum wage around 600€) compared to western countries.

Picture 5. Country: Slovenia, Value: %, Year: 2020



As per results for Slovenia, there is much lower concern about security compared with Croatia. Majority of scale shows that general IoT existing awareness and usage need, are the reason of not using IoT.

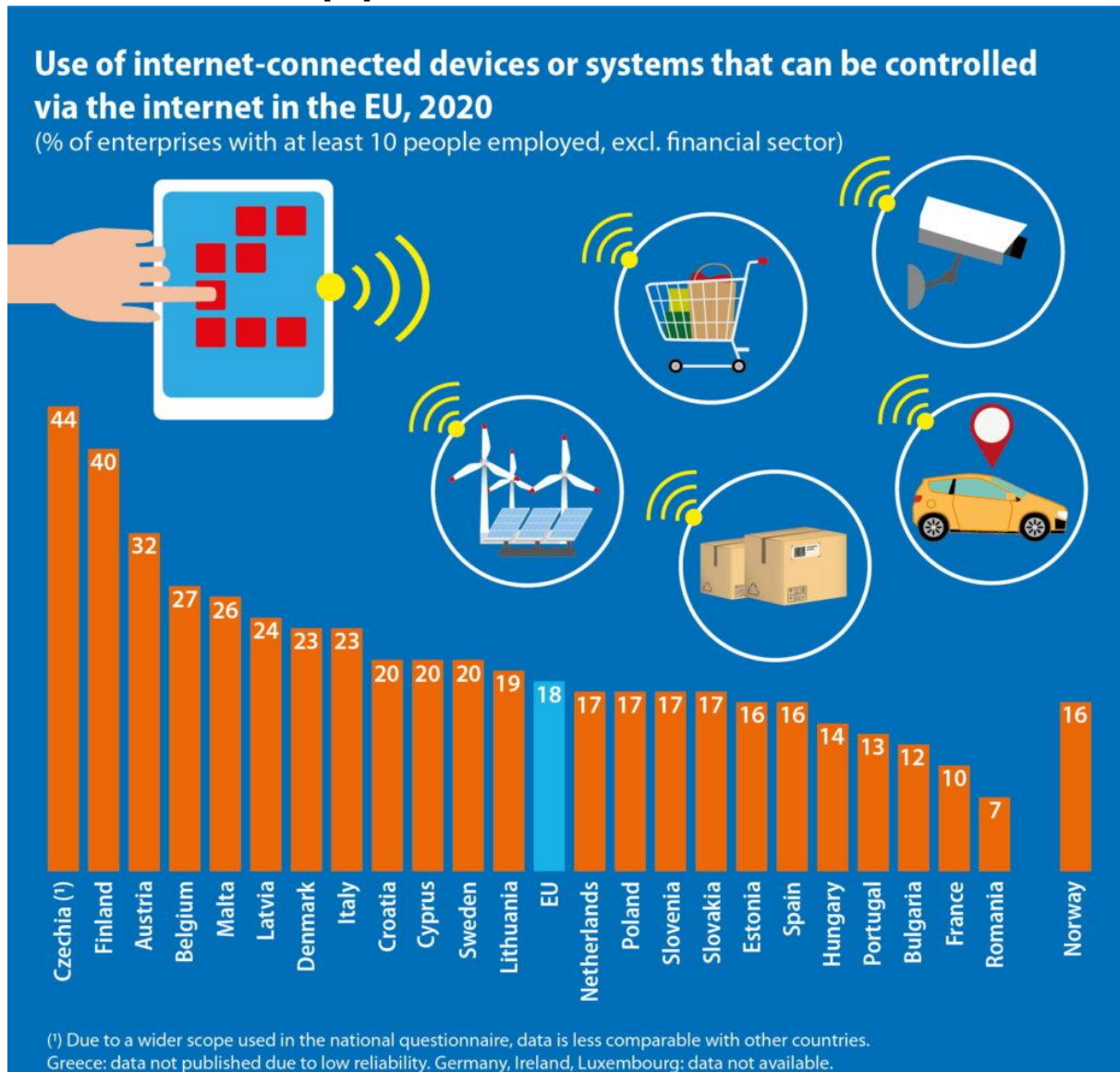
Picture 6. Country: Serbia, Value: %, Year: 2020



Regarding population of Serbia, majority of examinees answered that they have not been using IoT due to lack of need.

3) General usage of IoT in EU among companies

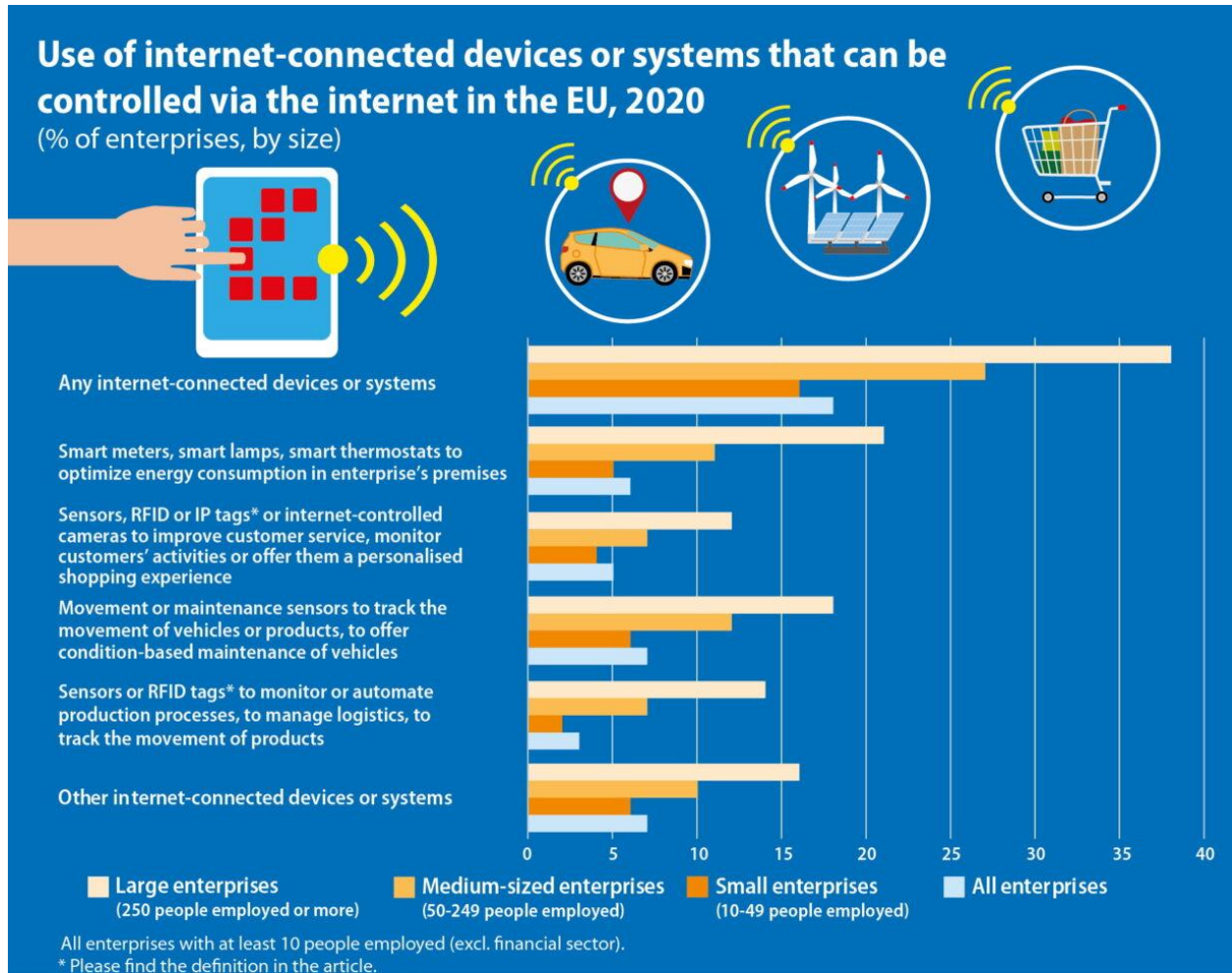
Picture 7. Use of internet-connected devices or systems that can be controlled via the internet in the EU, 2020 [25]



ec.europa.eu/eurostat

When comparing IoT usage among companies with 10+ employees between EU countries, Croatia is positioned a bit above the average. Having that in mind, IoT usage in Croatia oriented to B2C markets are less developed rather than B2B markets.

Picture 8. Use of internet-connected devices or systems that can be controlled via the internet in the EU, 2020 [25]

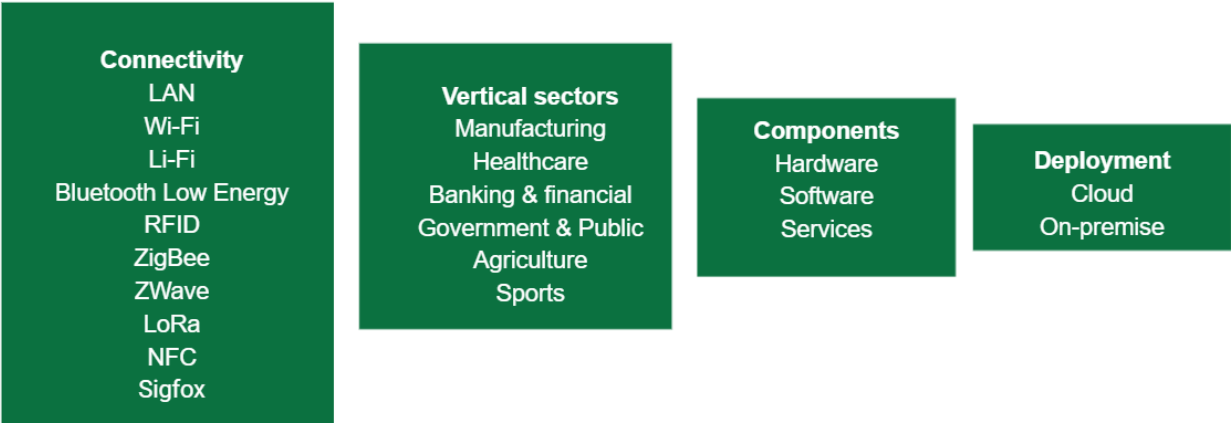


ec.europa.eu/eurostat

From above shown, it is clear that large companies (250+ employees) have more tendency in lot usage, especially in tools oriented on energy measurement and movement sensors for vehicles.

Connectivity and general segmentation

Picture 9. General segmentation



On the basis of connectivity, the global agile IoT industry has been segmented into LAN, Wi-Fi, Li-Fi, BLE, ZigBee, ZWave, LaRa, RF, and others. On the basis of vertical, the global agile IoT industry has been segmented into BFSI, Public sector, Manufacturing, Healthcare, Government, and others. On the basis of deployment, the global agile IoT industry has been segmented into On-Premises and cloud. On the basis of organization size, the global agile IoT market has been segmented into large, medium, and small scale. [11]

Picture 10. Low Power Wide Area Networks (LPWAN) comparison [18]

Low Power Wide Area Networks (LPWAN)							
Technical capabilities	LoRaWAN	Neul	NWave	SigFox	Weightless -N	Weightless -P	Cellular
Range (km/m)	2-5 urban; 15 suburban; 45km rural	up to 10km	up to 10km	up to 10km urban; 50km rural	5km	2km	35km GSM; 200km 3G/4G
Deep Indoor Performance	Yes	ISM yes, Whitespace no	Yes	Yes	Yes	Yes	No
Freq. Band	Varies, Sub-GHz	ISM or Whitespace	Sub-GHz	Frequency independent; 868/902MHz	Sub-GHz	Sub-GHz	900/1800/1900/2100MHz
ISM?	Yes	Yes, depends on base-station	Yes	Yes	Yes	Yes	Depends
Fully Bi-Directional	Yes, depends on mode	Yes	No	No	Uplink only	Yes	Yes
Data Rate	0.3 - 50 kbps adaptive	10 - 100kbps	100bps	10 - 1000bps	30kbps - 100kbps	up to 100kbps adaptive	35-170kbps GSM/ 3 - 10mbps LTE
Power Profile	Low	Low	Low	Low	Low	Low	Medium
Authentication	Yes	-	Yes	Yes	Yes	Yes	High security, back by major telecoms
E2E Encryption	Yes	-	Yes	Yes	Yes	Yes	Yes
Over the Air Software Upgrades	Yes	-	No	No	No	Yes	Yes
Supports sensors moving between hubs	Yes	-	No	No	Yes	Yes	Yes
Location Aware	Yes	-	No	No	No	-	Yes
Operational Model	Public or private	-	Public or private	Public	Public or private	Public or private	Public or private
Standard	LoRaWAN	Weightless	Weightless	No	Weightless	Weightless	GSM, LTE etc
Scalability	Yes	Yes	Yes	Yes	Limited	Yes	Yes

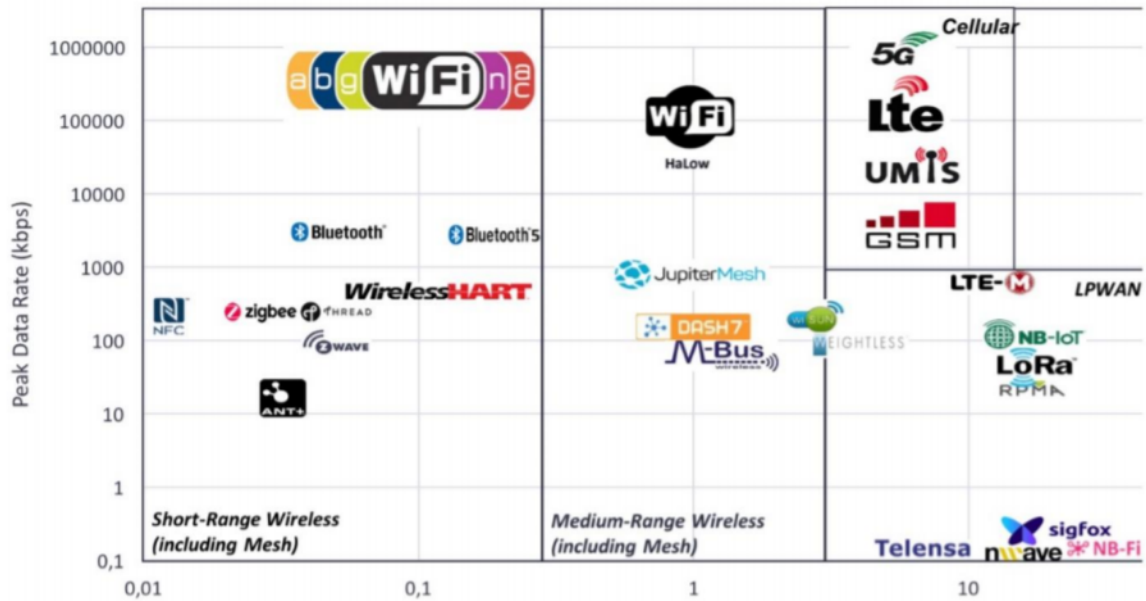
Izvor: <https://publisher.opensensors.io/connectivity>

Picture 11. Short Range Networks comparison [18]

Short Range Networks				
BLE	WIFI	Thread	ZigBee	Z-Wave
80m	50m	Mesh	100m/Mesh	30m/Mesh
No	No	No	-	-
2.4GHz	2.4GHz	2.4GHz	915MHz/2.4GHz	900MHz
Yes	Yes	Yes	Yes	Yes
Yes	Yes	-	Yes	Yes
< 1mbps	600mbps max	-	250kbps	10 - 100kbps
High	High	Low	Low	Low
Trusted devices problematic	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes
Yes	Yes	-	Yes	Yes
Yes	Yes	No	Yes, mesh-based	Yes, mesh-based
No	Yes	-	-	-
Public or private	Public or private	Private/WIFI backbone	Public or private	Public or private
Bluetooth 4.0	IEEE802.11	Thread, based on 6LoWPAN IEEE802.15.4	ZigBee	Z-Wave
Yes		Yes	Yes	Limited

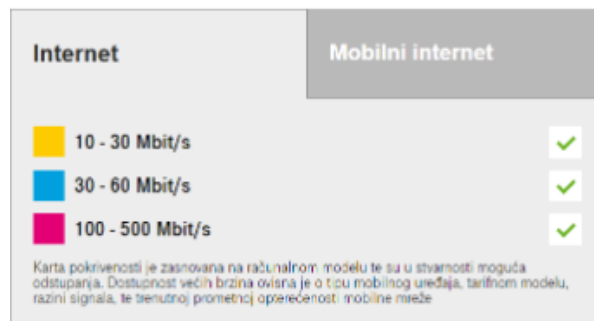
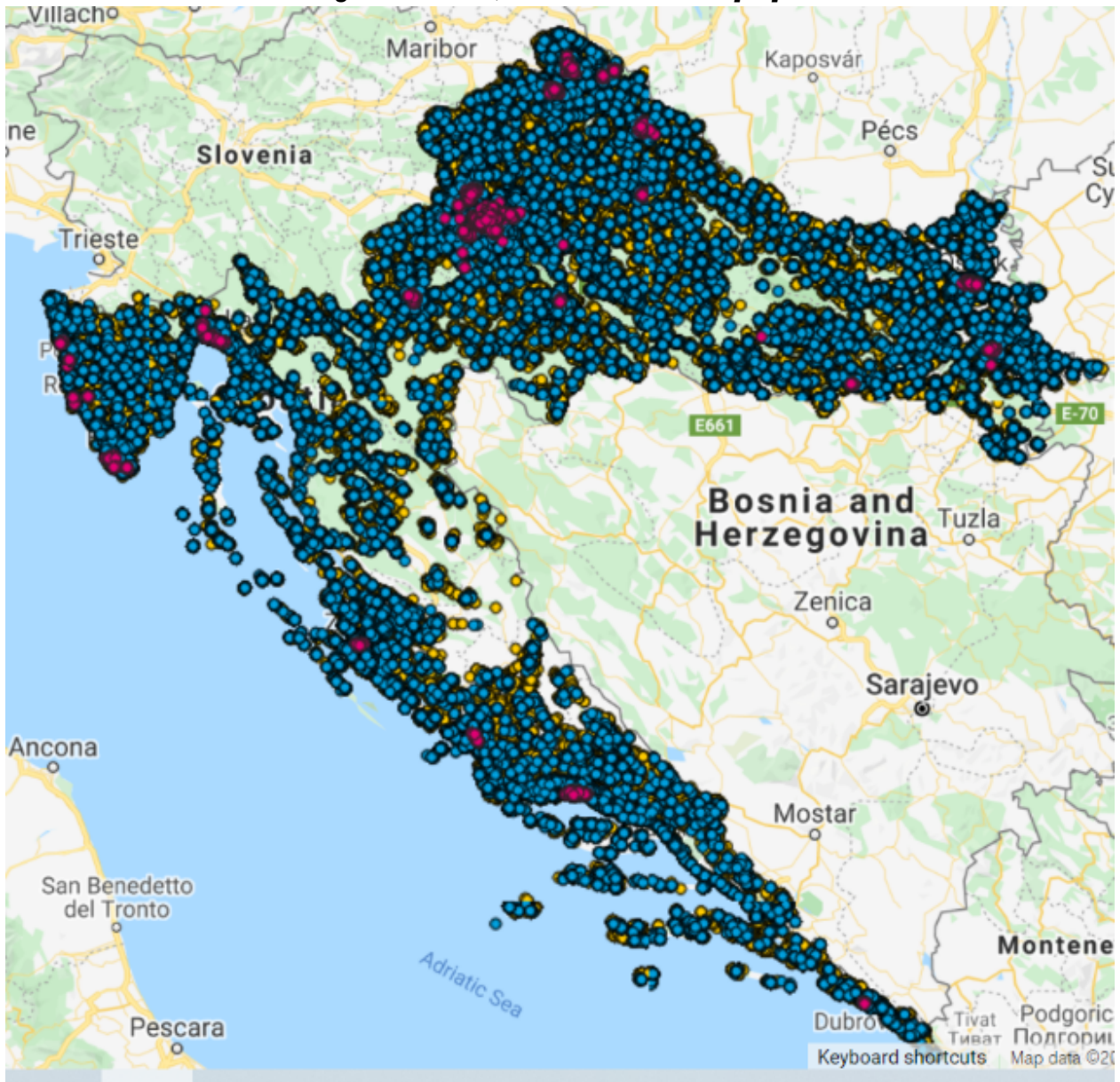
Izvor: <https://publisher.opensensors.io/connectivity>

Picture 12. Iot connectivity technologies by Peak Data Rate [20]

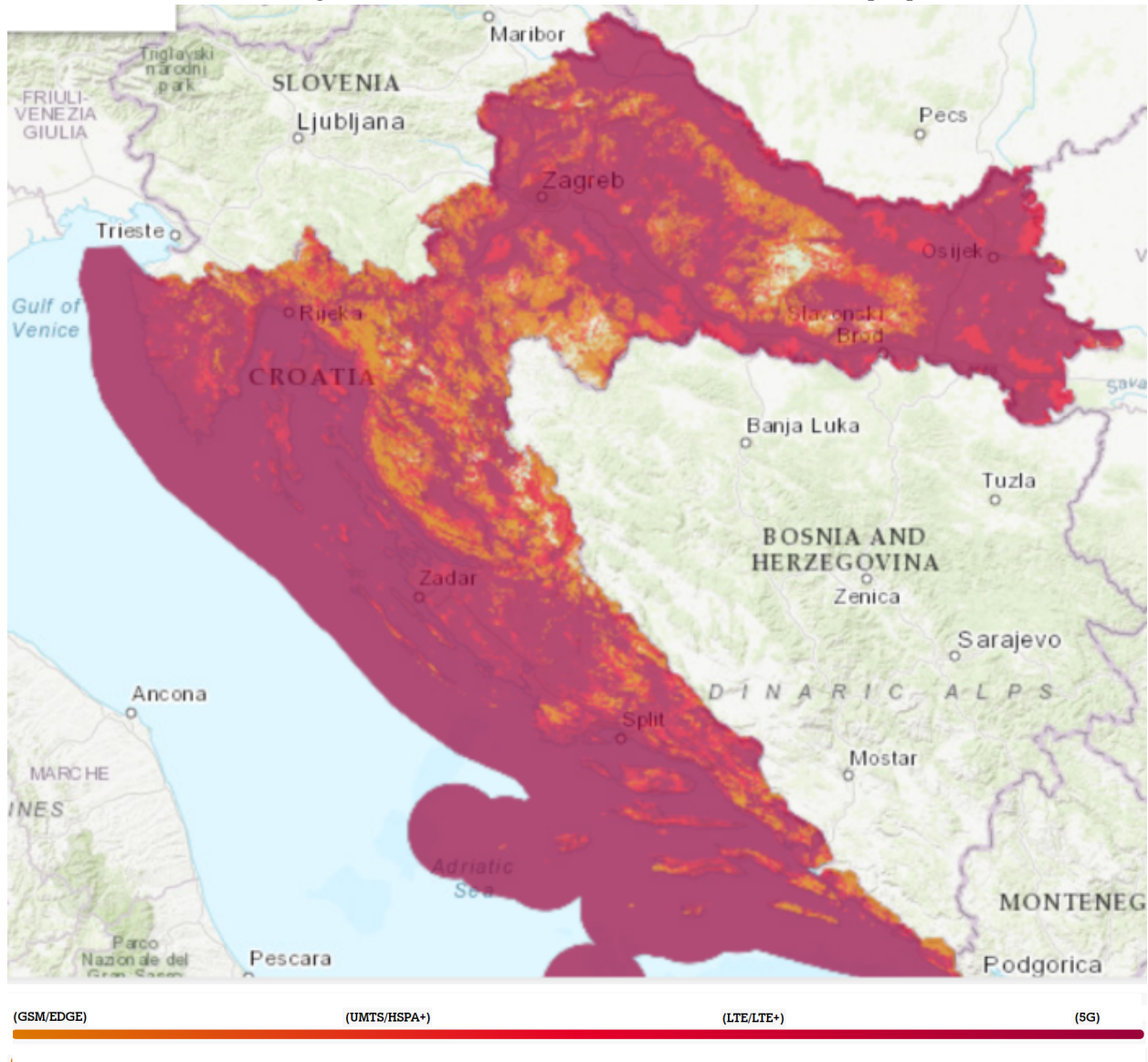


"Costs are a major obstacle to the feasibility and scalability of IIoT implementation. Device costs, cellular connectivity, and closed proprietary systems make it difficult to achieve ROI goals. As a key, we see low-power (LPWAN) networks such as LoRa, Sigfox, NB- IoT and LTE Cat-M driver of cost reduction and introduction of IoT for the masses ". [10]

Picture 13. Internet coverage in Croatia; Provider: HT d.d. [21]



Picture 14. GSM coverage in Croatia; Provider: A1 Hrvatska d.o.o. [22]



From showing pictures about internet and GSM connectivity, Croatia is covered with solid infrastructure which is continuously improving.

Market segmentation Croatia

1) Segmentation by sector

Notes: Within the following market segmentation, there will be listed companies present in Croatia selected by sector type with financial revenue listings and relevant services and/or products.

a) Wired telecommunications activities

Parent company: CMOBIL B.V. (52,17%)
Local company: HT d.d. (Hrvatski Telekom d.d.)
Revenue 2020 (EUR): 763.388.706
Sector: Wired telecommunications activities
Web: <https://www.hrvatskitelekom.hr/poslovnict/m2m-internet-of-things>
Products: Fixed and mobile phones, IPTV
Services: Telecommunications, Data transmission, M2M

b) Wireless telecommunications activities

Parent company: Kroatien Beteiligungsverwaltung GmbH
Local company: A1 Hrvatska d.o.o.
Revenue 2020 (EUR): 433.924.436
Web: <https://www.a1.hr/>
Products: Fixed and mobile phones, IPTV
Services: Telecommunications, Data transmission, M2M, Smart home

Parent company: CompING d.o.o.
Local company: IoT NET ADRIA d.o.o.
Revenue 2020 (EUR): 35.887
Web: <https://www.ionet.hr/tehnologija.aspx>
Services: Sigfox network service (IoT, UNB, LPWA, M2M)

Owner: Republic of Croatia
Local company: Odašiljači i veze d.o.o.
Revenue 2020 (EUR): 32.688.684
Web: <https://oiv.hr/en/home/>
Services: Multi-purpose platform for the Internet of Things

c) Collection of non-hazardous waste

Parent company: INTERSEROH Austrija GmbH

Local company: Interseroh d.o.o.

Revenue 2020 (EUR): 4.831.039

Sector: Collection of non-hazardous waste

Web: <https://www.interseroh.hr/shop/product-category/pametne-kante/>

Products: Smart bins

Services: Smart waste management

d) Manufacture of communication equipment

Parent company: TELEFONAKTIEBOLAGET LM ERICSSON (49,07%)

Local company: ERICSSON NIKOLA TESLA d.d.

Revenue 2020 (EUR): 190.826.998

Web: <https://www.ericsson.hr/en/homepage>

Services: High performance networks, Digital transformation

Parent company: Private owners

Local company: MICRO-LINK d.o.o.

Revenue 2020 (EUR): 3.745.536

Web: <http://www.microlink.hr/iot-rjesenja.aspx>

Services: Transmission solutions, Private Mobile Radio implementation,

Parent company: Private owners

Local company: MOBILISIS d.o.o.

Revenue 2020 (EUR): 5.072.911

Web: <https://www.mobilisis.com.hr/>

Products: IoT gateway, Parking sensors

Services: Fleet management, Sensor intelligence, Traffic solutions

e) Manufacture of computers and peripheral equipment

Parent company: aconno gmbH

Local company: aconno d.o.o.

Revenue 2020 (EUR): 138.82

Web: <https://aconno.de/>

Products: IoT Development Tools

Services: Industrial design, Integration, Maintenance

Parent company: Private owners
Local company: M SAN GRUPA d.o.o.
Revenue 2020 (EUR): 271.811.560
Web: <https://msan.hr/djelatnosti/#distribucija>
Products: TV, Electric scooters, Computer components
Services: Distribution, Logistics, Production, Ecommerce

f) Manufacture of electronic components

Parent company: CAREL INDUSTRIES S.P.A.
Local company: CAREL ADRIATIC d. o. o.
Revenue 2020 (EUR): 46.063.982
Web: <https://www.carel.com/web/guest>
Products: Connectivity Sensors and protection devices
Services: IoT digital Services

Parent company: Private owners
Local company: SELK d.d.
Revenue 2020 (EUR): 18.311.344
Web: <http://www.selk.hr/>
Products: Voltage dependent resistors

g) Other information technology and computer service activities

Parent company: Private owners
Local company: AG04 INNOVATIVE SOLUTIONS d.o.o.
Revenue 2020 (EUR): 6.654.258
Web: <https://spotsie.io/>
Products: Spotsie
Services: IoT based location solution for EX environments and large facilities

Parent company: Private owners
Local company: PANOS ING d.o.o.
Revenue 2020 (EUR): 2.064.112
Web: <https://panosing.com/iot-rjesenja/?lang=hr/>
Services: engineering services, installation and testing of measuring equipment

h) Software programming

Parent company: HOME CONTROL AS

Local company: Home Control d.o.o.

Revenue 2020 (EUR): 1.621.349

Web: <https://homecontrol.no/#2>

Products: Smart home, Software

Parent company: ASCALIA LTD

Local company: Ascalia d.o.o.

Revenue 2020 (EUR): 305.73

Web: <https://ascalia.io/>

Services: Smart factory

i) Wholesale of computers, computer peripheral equipment and software

Parent company: Private owners

Local company: PROAXIS d.o.o.

Revenue 2020 (EUR): 4.859.665

Web: <https://www.proaxis.hr/industrijska-mreznarjesenja-m2m.html>

Services: Industrial network solutions

j) Wholesale of electronic and telecommunications equipment and parts

Parent company: SCHRACK TECHNIK GmbH

Local company: SCHRACK TECHNIK d.o.o.

Revenue 2020 (EUR): 13.824.954

Web: <https://www.schrack.hr/trgovina/it-tehnologija-sat-sustavi/komunikacijski-i-serverski-ormari.html>

Products: Industrial equipment, Solar technology, Electronic components

k) Manufacture of electricity distribution and control apparatus

Parent company: E.G.O. Elektro-Geräte AG

Local company: E.G.O. Elektro-komponente d.o.o.

Revenue 2020 (EUR): 54.320.230

Web: <https://www.egoproducts.com/en/products/connectivity>

Products: Smart cooking technology, household connectivity devices

When looking at major key-players in Croatia in each sector selected, there is certain dominance in revenue comparing to other companies lower in scale. To point out, difference between top 3 companies per sector and 10 companies lower, is almost 50 times lower in revenue. That shows that market share is usually split 70/30 with majority of dominant companies, looking at the revenue parameter.

Taking into consideration Croatian key players owners, it is evident that foreign investors are taking place. Only several family held or private owned companies came on top of the list.

Regarding success in lot services or products implementations, major attribute is strong connectivity within the group of companies. Let me show you few real examples on Croatian market with companies listed above in this report.

Example 1

HT group (HT d.d.) is telecommunication provider that offers mobile phones, IPTV, internet connectivity equipment, smart home packages, machine to machine service etc. Their partner in network infrastructure is Ericsson (ERICSSON NIKOLA TESLA d.d.) who is currently in charge for 5G implementation in Croatia.

Example 2

IoT NET ADRIA d.o.o. provides global lot network brand Sigfox. Owner of IoT NET ADRIA is Comping d.o.o. that is software company and provides tailor made solutions when comes lot project implementation.

2) Segmentation by IoT products offerings online

Notes: By information searching via web, there has been detected few foreign companies (mostly China) that are marketing on Croatian area. Product types with pricing are shown only on those ones listed with no additional inquiry required.

1. MokoSmart
Web: <https://www.mokosmart.com/hr/about/>
2. YIC international
Web: <https://hr.y-ic.com/>
3. Hang Tun electronics Ltd
Web: <http://hr.ht-transformers.com/about-us>
4. LINOVISION
Web: <https://www.linovision.com/bs/iot/>

Product name	Price*
Versatile IoT Gateway for Comprehensive Management of IoT Sensors and Cameras	599\$
LoRaWAN Wireless Industrial Temperature Sensor with Range from -200 to 800°C	155\$
LoRaWAN Wireless Ultrasonic Distance/Level Sensor with Battery	349\$
LoRaWAN Wireless Temperature & Humidity Sensor with Battery and Waterproof	79\$

**shipping or other costs not included*

Additional discovery

Following link is interesting to point out showing the list of various distributors and local service providers for lot implementation in households.

Link: <https://www.somfy.hr/gdje-kupiti->

Challenges

“IoT technology has been authorized around the globe in order to connect people and businesses both. This allows retailers to gain insights regarding the performance of products and **find innovative ways of engaging customers** with existing customers and new customers both of which can be considered as the major challenge in the global Agile IoT market growth.” [4]

"The sector **most affected by the pandemic is transport, and trade, tourism, energy and finance**. Asia, Europe and the United States are hardest hit. " [5]

“For starters, it doesn’t make sense to invest in AI for data analytics if you don’t have the ability to collect data,” West said. "I think before companies look at technology, they really **need to make a little self-assessment about where they are today**. And what level are they at?" [10]

Despite better technology and effort to use them, certain problems in IoT are still present. The **need for rapid implementation** encouraged by COVID-19 created problems. [10]

Here are listed main challenges that customers face:

- legacy (old) systems,
- cyber security and data privacy
- skills development,
- ROI check
- lack of integration
- operating model after implementation (change management e.g. firmware maintenance and batteries).

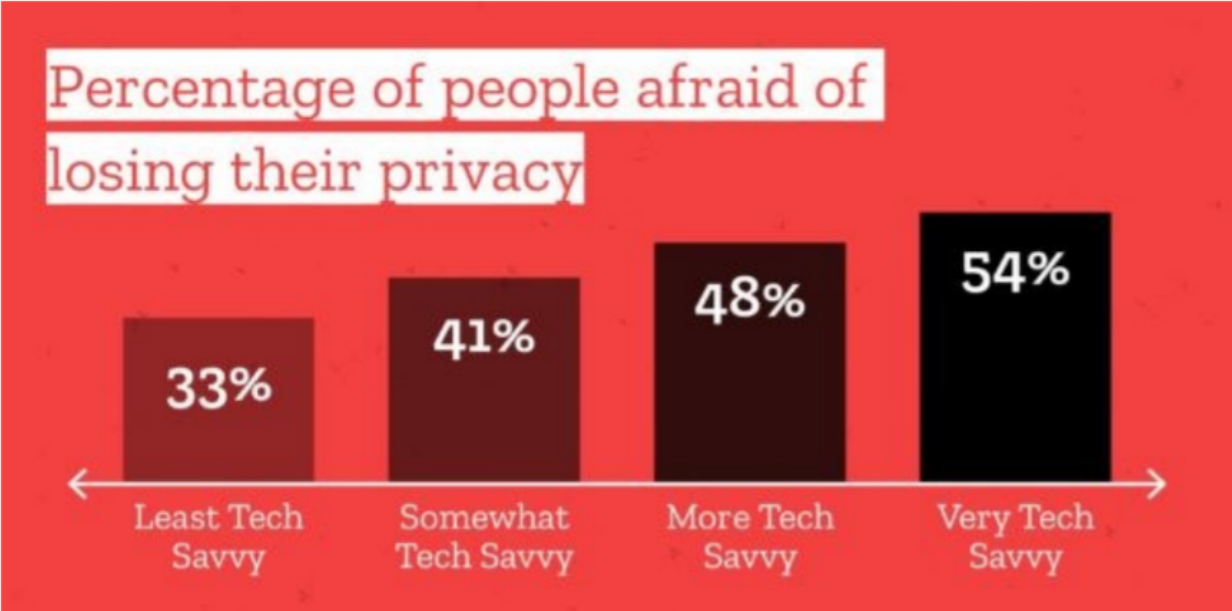
Remodeling legacy equipment: The average production plant has large machines that have been in use for about 15 years. These are machines that were never designed to connect. Companies need to look at how and whether they **need to retrofit and upgrade them or work on other data collection and analysis equipment as part of the overall connectivity trend**. [10]

“As the number of cases started rising and death tolls increasing, technologies like Artificial Intelligence and the **Internet of Things have become valuable tools during these difficult times**.” [13]

With the lock in the economy and the introduction of social distancing measures, **consumers have focused their spending on devices that can provide them with entertainment at home**, so the demand for smartphones, the latest series of game consoles, and tablets and TVs has increased. All of these devices of course **require huge amounts of electronic chips**.

In addition to all this, there have been some structural changes in the **semiconductor** industry. Most of the companies involved in chip design have separated production in recent years and switched to companies specializing in semiconductor manufacturing. " [14]

Picture 15. Percentage of people afraid of losing their privacy [18]



Picture above shows that more tech oriented populations are more aware of losing privacy. As technical education will leave more impact, privacy awareness will also raise more fear and doubt. This fact can definitely indicate on IoT usage resilience if right communication (PR) and actions about data security will not take place in the right time.

Development

The **initiative is being implemented globally**, and most **Sigfox 0G network operators** have already joined in the accelerated end of this crisis by creating technological solutions. The Internet of Things can be used, for example, in goods tracking and monitoring, medical inventory management, assistance to healthcare professionals, patients in temporary hospitals, tents and many other areas. "

"The shortage was due to several reasons, primarily the one related to the consequences **of the crisis caused by the coronavirus**. Namely, during the pandemic there was a rise in demand for personal computers and other electronic devices needed for work and schooling from home.

"The initiative is primarily aimed at system integrators and IT companies involved in the design and production of sensors and software, but also other companies that want to support the initiative. For example, startups can test their solutions on a 0G network free of charge - **the only condition is aimed at mitigating the effects of a pandemic.**" [8]

Moreover, the Asia Pacific region and European regions are expected to witness significant **growth due to the rapid developments in these regions.** [4]

"COVID-19 has changed the functioning of the **agri-food industry**, as well as the ways of buying food and the general attitude of consumers towards food products. An analysis of the megatrends already visible among food producers and processors could be useful to understand what may lie ahead in the ever-changing situation of a sampled pandemic. In this report, we summarize their impact on the agri-food sector and present the resulting impacts of risks and opportunities," says Zlatko Bazianec, head of Deloitte's Croatian office and partner in the Business Consulting Department. [6]

"Increased use of IIoT devices would generate more and more data. These data are at the heart of the fourth industrial revolution because the insights gathered from these data help companies make better decisions. While this is a critical advantage, Alex West, senior chief technology analyst at OMDIA, points out that **effective data collection is essential.**" [10]

"Croatia has always **had major problems with industrial production** and has not been able to position itself adequately in previous industrial revolutions. As a European country that is compared to countries that developed early industrially (many of which were rich in ores, and some were colonial powers), **Croatia is progressing economically and industrially slowly**, and for centuries can not catch up with the middle developed EU countries." [11]

Thanks to its own development of ICT services and solutions, A1 **Croatia** enables the user to **digitize a large number of different metering points in the entire network** - from the entry point, through the entire distribution network with all its subsegments, to the point of handover and billing (OMM).

“The healthcare industry has relied somewhat on IoT technology for years, and this sector is ideal in terms of adopting innovations. Healthcare uses wearable sensors and devices, tracking technology and internal navigation. Like factories, healthcare facilities are full of huge and state-of-the-art equipment, and just managing temperature and light using IoT technology could lead to big changes. Lighting plays a key role in patient recovery, and IoT can improve lighting systems by connecting them to health monitors and deploying sensors. The IoT will turn healthcare facilities into smart buildings, help generate revenue and enable savings on healthcare costs.”

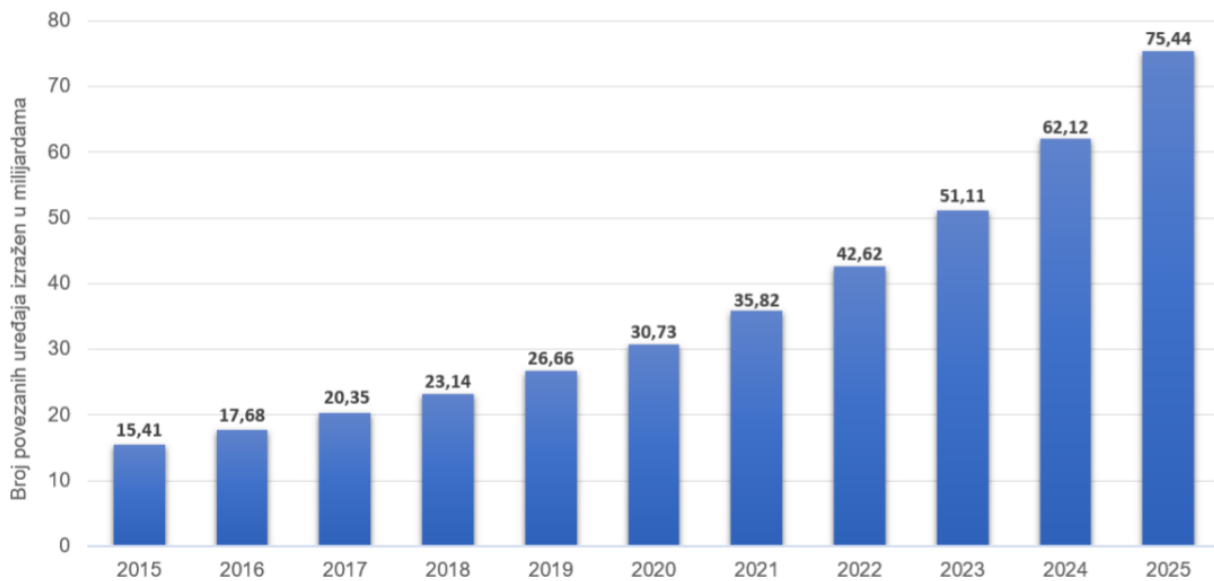
Drivers

“The factors that are contributing to the growth of the global Agile IoT industry are the realization of several years of healthy **growth by the semiconductor industry** which has been able to witness the consequences of the financial crisis globally, due to the rise in demand for tablets and smartphones around the globe, it has created the demand for the **wireless applications and mobile**. The average growth rate of the industry between 2010 and 2013 was near about 5%.” [4]

“The reason was the saving of time spent on the traditional system of measurement and data collection, but also the Covid 19 pandemic, which made it difficult to access the meter for reading and the problem of accuracy of the obtained data.

Researchers are focusing on **LiFi as a viable solution for the rapid growth of IoT** and Big data, and are working on developing smarter, faster and more reliable methods of data transmission. The efficacy of these technologies is entrenched into the efficiency of the network that supports them. Therefore, LiFi could be deemed as an enhancement for the workability of IoT devices, and as a means to leverage their optimum potential. Ambient intelligence refers to an electronic environment that has the ability to recognize a human presence and adapt and communicate with people accordingly. It is often **associated with the concept of smart homes, but can also be used in offices, shops, hospitals and other public institutions**. [19]

Picture 16. Representation of IoT devices over the years [20]



Axis X: years

Axis Y: Nr of connected devices expressed in billions

“**Increased digitalization and connectivity of devices via the Internet of Things (IoT)** and the growing amount of business data encourage companies, but also public institutions, to use LI (**Location Intelligence**). By discovering the latest consumer trends and improving existing business intelligence (BI) and analytical capability, LI helps companies stay competitive. And the growing awareness of the benefits of location intelligence is currently expanding its application to charging **electric cars**, **setting up a 5G network**, **analyzing data collected by drones**, while the demand for LI in the health, employment and education sectors is also expected to increase.” [17]

Opportunities

"The different phases of agile manufacturing are often differently understood by different experts who are managing the production systems and the stakeholders. The mechanical setups and machines could be made agile by increasing the number of combinations of sets of software parameters, machines, and mechanical that a machine can have. **This probably could create opportunities for the manufacturers to make machines malleable to many types of end products and many needs.**" [4]

"The epidemic has brought an opportunity to, through the reorganization of the global industrial structure, could give an opportunity to select and develop small and medium enterprises, by moving to **shorter supply chains.** (Jurgensen, et al., 2020) " [5]

"Due to the corona crisis, digitalization has penetrated into all spheres of life. Everything that was announced to be realized in the future is being applied today. Industry 4.0 has **allowed some companies to stay productive even during the corona crisis.**" [5]

The advent of advanced technologies such as irrigation systems, variable speed technology, IoT, AI and remote sensing have transformed the agricultural industry into a technology-intensive, data-rich industry. **Smart agricultural technologies help increase profitability, improve sustainability, protect the environment and reduce the consumption of resources such as water, fertilizers and energy.** IoT is implemented in a variety of applications, including precision farming, livestock surveillance, precision aquaculture, smart greenhouse and precision forestry. [6]

Integrated analytics is now embedded in IoT solutions as providers seek to speed up data analysis. Such analytics are introduced directly into machine learning applications, and this design supports IoT devices, processes, customization, and infrastructure optimization. IoT data will be sold as goods that will be targeted mainly at device manufacturers, and data sales will be used to **demonstrate product sustainability.** [7]

The combination of concerns about COVID-19, the need for increased productivity, and a tighter risk / regulatory environment are driving demand, encouraging companies to look beyond IoT issues. In addition to higher productivity, companies are also trying to diversify their services, offer additional products, and **adopt better business models for growth.** [10]

Mailboxes can be connected via multiple networks, so Wi-Fi, GSM or NB IoT networks can be selected. Particularly interesting in **this pandemic time is the non-contact opening and antibacterial coating and the hermetic closure of the waste container.** [24]

Local regulative

“In addition, the openness of public data is important for the development of Internet of Things services and applications [16, 17]. In order to boost the European data economy, one of the new objectives is set: the economy's access to machine-generated data to **stimulate innovation and the digital economy** [18].

The complexity of the problem of standardization and the regulatory framework is obvious. The Internet of Things has been defined by the European Commission as one of the key areas of standardization, in addition to 5G technology, cloud computing, cyber security and data technologies, related to the Internet of Things [19-22]. The development of the regulatory framework is not defined so "precisely" - the legal **aspects of data protection and privacy are mostly emphasized, and the availability of the frequency spectrum and numbering system is mentioned as possible obstacles.**

Standardization is not and will not be enough to exploit the innovation potential of the Internet of Things and associated technologies, not only to address societal challenges, but also for industrial development Looking to the future 2020 41 and the emergence of new industries. It will reduce the problems of bonding with one and changing manufacturers or service providers, but will not in itself create a competitive IoT environment in which businesses of all sizes, from micro-enterprises to global companies, operate with citizens as active participants.

Smaller economies such as Croatia may have only physical facilities in the country - things that provide Internet of Things services and end users - consumers who pay for them (individuals and legal entities), and the systems that provide services and service providers will be "Anywhere", with the explanation that "the Internet enables it", with "much lower costs due to economies of scale" (known model from material production: export of raw materials (data), import of higher value-added products (services and applications)). It may happen that the normative openness of the Internet of Things does not bring real openness, from software platforms and open source solutions, to society and markets that encourage and enable creativity, innovation and competitiveness, industrial development and the emergence of new industries.

It is therefore necessary to establish an open distributed environment with ISPs and service providers with different IoT platforms, open and proprietary, and solutions for their interoperability that enable and facilitate the development of innovative services and applications by micro, small and medium enterprises. multiple IoTplatforms [1].

Regulatory processes in the field of the Internet of Things should take into account the dynamics of introduction, innovation, investment, legal certainty and the social and business environment. In areas that are not harmonized at the level of the European Union, soft regulation procedures are appropriate. However, their effectiveness requires a national innovation strategy and industrial policy in the domain of the Internet of Things. Regulators can then guide and encourage the implementation of strategic goals, monitor developments and contribute to the understanding of the Internet of Things.” [18]

Conclusion

Within this report it is only shown how the IoT market, mostly in Croatia, has been developing within the time, who are dominant companies and which trends are taking place.

Mainstream trends are smart cities, smart factories, smart homes, smart mobility etc. It is evident that after having smart phones, 'smart' trend grew rapidly on other things or machines.

Most growing sectors are industrial (manufacturing), agriculture, residential, transportation and logistics.

Although the health-care and public sector are globally growing, especially after the pandemic started, in Croatia these sectors are still, unfortunately, very non-agile and slow with decision making. The bright side of this pandemic is forced digitalization that took place in named sectors. The impact that is made with this is mind-set change and facing consequences of missed opportunity to digitalize and implement technical solutions much earlier.

Continuing development when looking at IoT products will be in drones (delivery service), robots (logistic and manufacturing assistance), sensors (motion, quality, frequency etc.), buttons (usability), accessories (sport tools) etc.

Due to social distancing, IoT and experimenting in home usage has potentially increased since COVID-19 pandemic started.

From statistics shown above for Balkan area, it is clear that the usability knowledge and product cost are major reasons for not using IoT among individuals.

If being optimistic having in mind IoT growth predictions, only younger generations will and are increasing IoT usage. To continue, financial standard increasement within Balkan area will allow individuals to use IoT more.

Still doubting points will be data security and privacy.

IoT development will depend on semiconductor production sustainability and electronic components availability.

Although China has a strong impact on IoT devices offerings with manufacturing, in Croatia and the region, there is huge potential for growth.

One of the reasons is Croatian history in the manufacturing segment with strong export orientation. Another reason is high STEM education and career development.

From IoT connectivity point of view, it so hard to shape one solution for all due to variety of connectivity types per each IoT product or purpose. From market perspective, when looking to connectivity development, 5G implementation is rapidly growing on European markets. Perhaps, with combination with Li-Fi network used for local data transmission, it could be future in speed internet which impacts IoT communication as well.

Appendix

Research details

Goal

- To discover if there were any trends in the usage of communication devices during different Covid phases on Croatian market

Methodology

- Public domain data
- The report is based on publications and information available over the internet

Time frame

- (2017.,2018.) 2019. - 2020. (2021.)

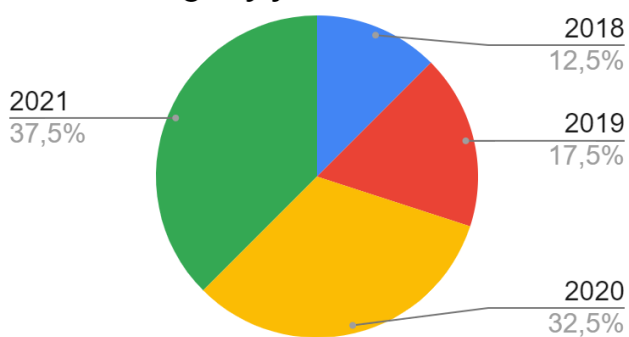
Tools

- Google.com
- Google docs

Research data usage statistics

Total articles detected: **40**
Total articles used: **18**

Articles usage by year



Key words vs articles targeting

Key words entry	Nr articles detected
trends in the use of iot	4
iot	3
network coverage map	3
The Agile IoT industry is working efficiently	2
use of electronic components in times of pandemic and earlier	2
use iot before and after a pandemic	2
the impact of the pandemic on the iot industry	2
list of all croatian magazines link	1
trends in the usage in communication devices during the different Covid phases in iot	1
comparison of iot device connection	1

Sources types vs articles number

Source type	Nr of articles
Media	5
Company	6
Master's thesis	1
Portal	5
Scientific work	1
Master's thesis	1

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