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Application of Firebase Cloud Service for Storing and Analysing Data from IoT Mobile Devices

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***Abstract*— Cloud services and the concept of IoT enabled storage of data to be more oriented on different software services and the quality of communication channels instead on the capacity of the data logger's memory space. One of the most important cloud service is Firebase, which easily enables the integration of different operating systems and software platforms. In this paper are presented results of using Firebase cloud services for storing different kind of data (temperature, flow, GPS position, time of sampling) from the IoT mobile device.**

***Keywords*— Firebase, Cloud service, IoT, GSM GPS**

I. INTRODUCTION

The exponential growth of semiconductor circuits had led to massive expansion of integration of sensors with processor in one device. These device, connected with advanced communication technologies (WiFi, Bluetooth, LoRa, ZigBee, Insteon, GSM 3G, GSM 4G, etc.) become part of Internet of Things (IoT) [1-2]. IoT is the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment [3].

Today, according to postscapes.com [4] there are at over 100 IoT cloud platforms on global marketplace which offer services to different groups of users, such as: businesses, governments, farmers, healthcare, communication, transportation and production. The lack of information about IoT cloud platforms very often limit there right choice from end users [5]. In some cases, this can cause problems of response of a IoT system.

IoT are beginning to transform our life's in many ways. The IoT system generates a huge amount of data (Big Data), which lead to great pressure on the Internet infrastructure. In order to solve this problem, many companies are working to find ways to relieve this pressure of Big Data. The total amount of generated data worldwide at the annual level in zettabytes (1 zettabyte = 1 million gigabytes) is presented in Fig 1.

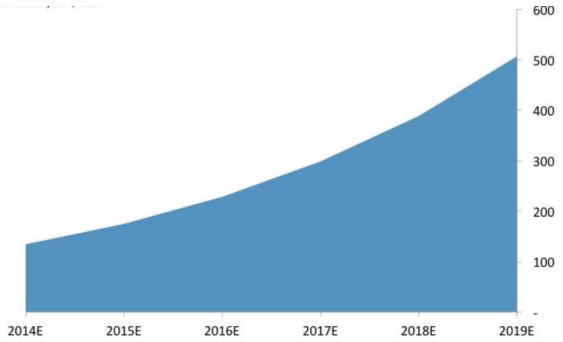

Fig. 1 Total amount of data created worldwide by connected people and things [4]

Cloud computing, often called simply "the cloud," involves delivering data, applications, photos, videos, and more over the Internet to data centres. IBM has helpfully broken down cloud computing into six different categories [5]:

- Software as a service (SaaS): Cloud-based applications run on computers off site (or "in the cloud"). Other people or companies own and operate these devices, which connect to users' computers, typically through a web browser.
- Platform as a service (PaaS): Here, the cloud houses everything necessary to build and deliver cloud-based applications. This removes the need to purchase and maintain hardware, software, hosting, and more.
- Infrastructure as a service (IaaS): IaaS provides companies with servers, storage, networking, and data centres on a per-use basis.
- Public Cloud: Companies own and operate these spaces and provide quick access to users over a public network.
- Private Cloud: Similar to a public cloud, except only one entity (user, organization, company, etc.) has access.
- Hybrid Cloud: Takes the foundation of a private cloud but provides public cloud access.

The Firebase is development platform with a real-time backend database that supports several features, such as encryption, authentication, and cloud data storage [6]. These features are used in following services:

- Firebase Analytics
- Firebase Cloud Messaging
- Firebase Auth
- Realtime Database
- Firebase Storage
- Firebase Hosting
- Firebase Test Lab for Android
- Firebase Crash Reporting
- Firebase Notifications
- Firebase App Indexing
- Firebase Dynamic Links
- Firebase Invites
- Firebase Remote Config

The Firebase uses the HTTPs communication protocol that supports bidirectional communications encryption between a client and server.

The Internet of Things, meanwhile, refers to the connection of devices (other than the usual examples such as computers and smartphones) to the Internet. Cars, kitchen appliances, and even heart monitors can all be connected through the IoT. And as the Internet of Things surges in the coming years, more devices will join that list.

In next chapters will be presented a simple IoT device based on the the Arduino Mega as a microcontroller and SIM900 GPRS (General Packet Radio Service)/GSM (Global System for Mobile communication) module for data transferring. The role of this device is to store data collected from temperature sensor, flow meter and GPS (Global Positioning System) positions and then send it to Firebase cloud service.

II. Connection of IoT Devices

The IoT concept is based on connecting the device to the Internet. There are two ways for wireless connection of IoT devices to the Internet. Both ways have their advantages and disadvantages. The first one is using the Wi-Fi network, and the other one is using the GPRS/GSM network. There is also the option of connecting of stationary IoT device to the Internet with a LAN (Local Area Connection) cable.

Wi-Fi is a set of specifications for Wireless Local Area Networks (WLAN) based on the IEEE 802.11 standard. Wi-Fi was intended to be used for mobile devices and LANs, but is now often used for Internet access. It enables wireless-enabled devices (computer or personal digital assistant (PDA)) to connect to the Internet when in proximity of an access point. Using this technology we can connect devices anywhere in a home or office to the network using radio signals, and they can be up to 30 m or so apart [7]. Architecture of Wi-Fi network connection is show on Fig. 2.

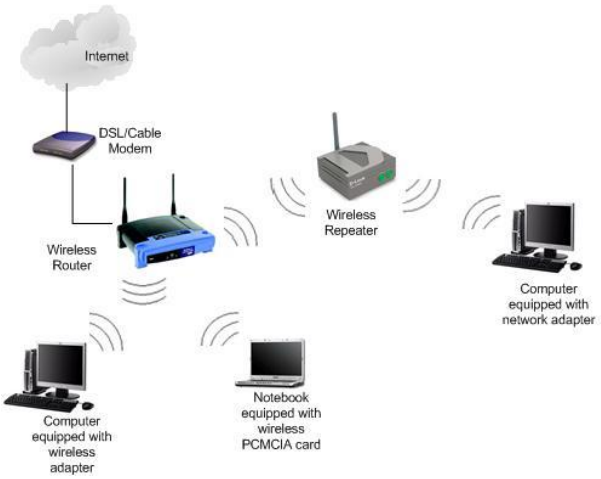

Fig. 2 Architecture of Wi-Fi network connection

GPRS is a standard technology that extends GSM voice networks with support for data services. GPRS applies a packet radio principle to transfer user data packets in an efficient way between GSM mobile stations and external packet data networks. GPRS data speeds vary from up to 115 kbit/s to up to 117 kbit/s, but is likely to average at 56 kbit/s, with between 28 and 40 kbit/s initially [8]. Fig. 3 shows the architecture of a GPRS network [9].

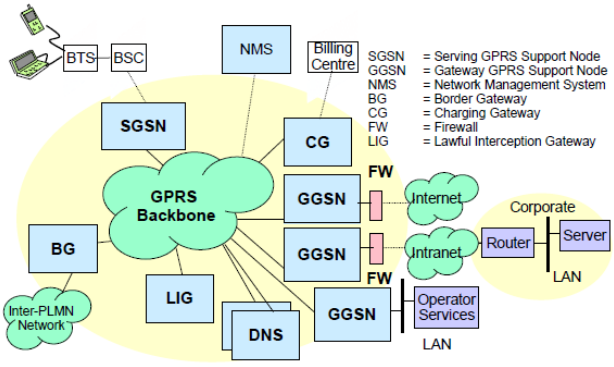

Fig. 3 Architecture of GPRS connection [9]

Wired and Wireless have both advantages and disadvantages. Understanding these advantages and disadvantages will help us to make decision an IoT solution. The wired networks are mature technology and it is easy to get plugged into if you already have cable lines (phone lines, power lines, coaxial, fibre optic).

III. IoT Mobile Device

The IoT mobile device in this case study is based on the the Arduino Mega 2560 (Fig 4) as a microcontroller, SIM900 GPRS/GSM module (Fig 5) and GPS GY-GPSV3-NEO-7M module (Fig 6). SIM900 GPRS/GSM module is used for data transferring. GY-GPSV3-NEO-7M module is GPS receiver is used for positioning of the IoT mobile device.

Fig. 4 Arduino Mega 2560 (Fig 4) microcontroller

Fig. 5 SIM900 GPRS/GSM module

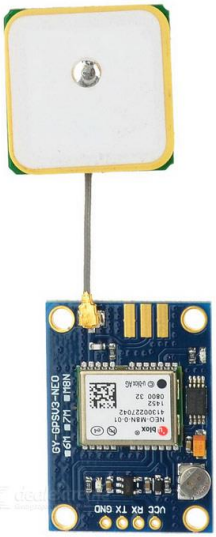

Fig. 6 GPS GY-GPSV3-NEO-7M module

Also, this device can be used as a data logger, because data must not be loose in case of broken communication. Communication is key element in the technology of IoT data storage which is shown in Fig. 7.

Fig. 7 The IoT data storage

The IoT mobile device have two sensors: temperature sensor and flowmeter. These to sensors use for collection data from an object of measurement.

IV. Testing Results

During testing period of IoT mobile device are observed some problems with connections on GSM mobile network and using GPRS service. We used SIM card of Telenor mobile operator. Territory of testing was area of city of Novi Sad. According to official site of the mobile operator, all testing territory is covered with good quality of GSM signal which is shown in Fig. 8 [10].

Fig. 8 Quality of GSM signal [10]

In same places quality of signal was not enough to have quality communication with the cloud platform. In these cases all data were store in internal memory of the IoT device.

Also, we had problems with delay of GPS module. Namely when the IoT mobile device switch on, the device is not able to determine the GPS position at the moment (up to 20 s). In some cases it takes up to 12 minutes for determining position of IoT mobile device. In Fig. 9 is shown the worse delay to establish GPS coordinates during testing period. You can see the number of satellites which are detected from the IoT mobile device, HDOP (horizontal dilution of precision), latitude, longitude, date, time, altitude and verification of received data respectively.

There was no problem in the work of Firebase cloud platform. All used services were constantly available. During the testing period, only free of charge services were used. This possibility provided by the Firebase cloud platform is very suitable for initial testing and for proving of the concept.

Sats	HDOP	Latitude (deg)	Longitude (deg)	Date	Time	Alt (m)	Chars RX	Sentences RX	Checksum Fail
****	9999	**********	**********	**********	06:58:07	******	63	0	1
0	9999	**********	**********	00/00/2000	06:58:08	******	280	0	1
0	9999	**********	**********	00/00/2000	06:58:09	******	607	0	1
0	9999	**********	**********	00/00/2000	06:58:10	******	879	0	1
0	9999	**********	**********	10/03/2017	07:08:57	******	18588	0	1
0	9999	**********	**********	10/03/2017	07:08:58	******	18629	0	1
0	9999	**********	**********	10/03/2017	07:08:59	******	18670	0	1
3	444	**********	**********	10/03/2017	07:09:00	******	18712	0	1
3	444	**********	**********	10/03/2017	07:09:01	******	18764	0	1
3	444	**********	**********	10/03/2017	07:09:03	******	18815	0	1
3	444	**********	**********	10/03/2017	07:09:04	******	18867	0	1
3	444	**********	**********	10/03/2017	07:09:05	******	18918	0	1
3	445	**********	**********	10/03/2017	07:09:22	******	19621	0	1
3	445	**********	**********	10/03/2017	07:09:23	******	19662	0	1
3	445	**********	**********	10/03/2017	07:09:24	******	19703	0	1
5	132	45.245635	19.849987	10/03/2017	07:09:25	84.00	19754	2	1
5	132	45.245639	19.849990	10/03/2017	07:09:26	84.00	19805	4	1
5	132	45.245643	19.850002	10/03/2017	07:09:27	82.10	19857	6	1

Fig. 9 Quality of GPS signal during testing period

V. CONCLUSIONS

The weak part of this project is the security of the data sent. These data can be accessed by anyone who knows the address to be accessed in the search engine. In the future, additional work will be focused to protect this data, as Firebase provides some of the protection measures. It is possible to assign an identification character string to each user and, prior to each access authorization, to verify that the user attempting to access the data has the right of access and it is very suitable for initial testing and for proving of the concept.

REFERENCES

[1] P. P. Ray, "A survey of IoT cloud platforms" Future Computing and Informatics Journal, Volume 1, Issues 1–2, pp 35-46, December 2016.

[2] S.Stankovski, G. Ostojić, X. Zhang, "Influence of Industrial Internet of Things on Mechatronics", Journal of Mechatronics, Automation and Identification Technologyvol. 1, no. 1, pp. 1-6, 2016.

[3] http://www.gartner.com/it-glossary/internet-of-things/. Retrieved 16 Mart 2018.

[4] Postcapes, IoT Cloud Platform Landscape, https://www.postscapes.com/internet-of-things-platforms/ Retrieved 16 Mart 2018.

[5] A. Meola, "The roles of cloud computing and fog computing in the Internet of Things revolution," unpublished

[6] https://firebase.google.com/, Retrieved 16 Mart 2018.

[7] https://www.home-network-help.com/images/wireless-repeater-network.jpg, Retrieved 16 Mart 2018.

[8] http://educypedia.karadimov.info/library/GPRS.pdf, Retrieved 16 Mart 2018.

[9] http://citeseerx.ist.psu.edu/viewdoc/download;jsessionid=4C0A0F6038F632F7991DFAFB52B1DA59?doi=10.1.1.697.7011&rep=rep1&type=pdf, Retrieved 16 Mart 2018.

[10] https://www.telenor.rs/sr/o-telenoru/o-nama/telenor-mreza/mapa-pokrivenosti, Retrieved 16 Mart 2018

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