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Interacting with Physical World in E-Commerce

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The main goal of this final project is to conceptualise the interaction with the physical world with e-commerce. The aim is to build a digital service using different technologies and to prove how simple and easy it can be to collect data from a user for commercial proposes.

Since the Internet of Things is among us, collecting data from a person has become commonplace. The question is, how can we get better and trustable data? After considering many technologies, the service was built using Android, Firebase backend/Database, and Wordpress.

The service tracks beacons using Bluetooth and location, saving user's data to analyse their behaviour in a shop and what the possible interests are. In this way, companies can target specific offers to their customers.

The service is now fully operational and it is a Proof of concept with a very simple UI, in both mobile side and web shop side.

Keywords	Wordpress, Android, Beaons, Eddystone, Firebase, iBeacon, Location service, e-commerce, Mobile

Contents

Abbreviations

API =Application Programming Interface

CES = Consumer Electronic Show

CMS = Content Management System

GIF = Graphics Interchange Format

ICT = Information Communication Technology

IDE = Integrated Development Environment

IOT = Internet of things

JPEG = Joint Photographic Experts Group

M2M = Machine to machine

PNG = Portable Network Graphics

POC = Proof of concept

Table of figures

1 Introduction

In this thesis, the goal is to conceptualize the interaction with physical world in e-commerce and how the Internet of Things (IoT) is making this possible and every day in an easier and faster way. A digital service called MyShop was built, and its goal is to serve as proof of concept of how we can use mobile, web shops and beacons to analyse the behaviour and maybe tastes of people, and then use the data to display certain products that might be in the customer's interest as ads in the user's page when visiting the web shop as a registered user.

The concept of Internet of Things began back in 1999, when Kevin Ashton (co-founder of MIT's Auto-ID Center) coined the term Internet of Things in a presentation by Procter & Gamble (P & G) in which he basically describes a system in which the internet and physical things are connected by sensors. In 1999 smart phones, televisions and clocks were the future, now we have the feeling that internet connections are a natural thing and have always been there but this actually has been true for less than two decades.

At the beginning of the year 2000, the first projects were born that connected the Internet with other objects that were not computers. It was in 2004 when the tests began for GPS and now our world cannot live without it.

A year later (in 2005), the International Telecommunications Union published the first report about this topic and wrote:

"A new dimension has been added to the world of information and communication technologies (ICTs): from anytime, any place connectivity for *anyone*, we will now have connectivity for *anything*. Connections will multiply and create an entirely new dynamic network of networks—an Internet of Things" [1]

The beginning of the internet of things was declared when there were more things or objects connected to the internet than people and this situation was consummated between 2008 and 2009, the period in which the smart phone market also saw its commercial boom.

Just two years after the beginning of the Internet of Things (2011), according to Cisco, 20 homes generated more Internet traffic than the whole of 2008. Cisco is a leading provider of networking solutions, manufacturer and technology equipment consultant. Among the companies that started (also in 2011) academic programs, research and functional internet development of things are companies such as Cisco, IBM and Ericsson.

That same year, the implementation of native apps that could be used on the phone began. This was not only to make or receive calls, save phone numbers or schedule events on the calendar. With the beginning of browsers and mobile applications like Facebook, originally launched as a web page in 2007 but with a worldwide boom as a mobile app in 2014, and the real-time connection, mobile phones became every day's information allies where we get basically everything we need.

2 The Internet of Things and Some Examples

The internet of things is one of the buzz terms of recent years in the technology industry. In the CES 2015, many companies like Qualcomm or Samsung talked about products and ideas related to this concept and this generated a few important questions related to this as follows.

- What is the Internet of Things?
- Why do people give so much importance to this concept?
- How will it influence our future life?
- How does the Internet of Things work?

To answer these questions, very briefly, the Internet of Things is a concept that is based on the interconnection of any product with any product other around it. This means anything from a book to the fridge in your own home. The goal is to make all these devices communicate with each other and therefore be more intelligent and independent. To do this, it is necessary to use the IPv6 protocol and the development of numerous technologies that are currently being designed by the main companies in the sector.

Internet of Things transcendence can be brutal in both economic and social spheres. Even greater than the digital age. And the Internet of Things allows computers to interact with elements of real life and gain independence from humans, leaving us to command what really matters.

A practical example: thanks to the Internet of Things, our refrigerators would be able to measure the remaining food inside and order from the supplier the depleted items. Thus, we will never have to worry about buying milk, eggs or our favourite yogurts. The refrigerator will continually measure the stock and act independently accordingly.

Wearables are another example. Daily things like t-shirts, watches or bracelets, are made smart thanks to the application of this concept. Now clocks not only provide the time, but also connect to the Internet, exchange data with external servers and act accordingly to the information collected from both sensors and servers.

They can also be applied more deeply to the home. By installing a series of sensors and processors, is possible to automate the control of the windows, the temperature of the

home, the lights, etc. And, since the entire system is connected to the internet, it would also be possible to wirelessly control what we want.

Other main fields of application of the Internet of Things is the cities, making them more intelligent and efficient. For example, many times we wait before a red light in a totally absurd way, because no car or anyone around us circulates. Thanks to the Internet of Things, these traffic lights can be connected to a circuit of cameras distributed by the city that identify the level of traffic and of mass movement, thus avoiding those absurd waiting times in the zones of little movement.

Another example of applying the Internet of Things to cities is found in traffic signs. By applying the IoT, if we go at a higher speed than is allowed, our car would reduce it automatically when receiving data from any of the signals that surround us. This, in parallel, would facilitate the arrival and expansion of autonomous cars in our lives.

If we take the Internet of Things to wider grounds such as national security or business, the significance and possibilities are even greater. For example: automated orchards, intelligent lighting, supervision of machines and so forhth. The economic impact of this type of project would be significant, replacing many current jobs and, above all, it would mean considerable cost savings in the long term. It would be almost the second Industrial Revolution.

As we can see, the Internet of Things is clearly a big step in the technology industry. It opens a world of incalculable possibilities, even greater than the one that opened the digital era in its time. Everything would be based on the contextual, achieving greater independence of humans and, therefore, greater efficiency and comfort. The first steps are already taking place (standards, first prototypes and projects, etc.) but, according to several analysts, it will not be until 2020 when the Internet of Things begins to be something much more settled and common among us.

The internet of things is a system of data collection that makes it easier to live with our objects. M2M (or machine-to-machine) data are the result of all connections between our objects and such results can be analysed for commercial purposes by companies that supply any service.

Embedded systems are the technical principle by which it is possible to interconnect everyday objects with the Internet since, by their nature, these systems cover specific needs and can perform tasks in real time. Smart interfaces are also one of the essential components for the factual functioning of objects with the Internet.

At home, an ideal example of how the internet works begins when your alarm clock rings in the morning and at that precise moment (as in the final episode of the first season of Black Mirror) your coffeemaker starts making coffee as you like. When brushing your teeth, your toothbrush detects a tooth decay and schedules an appointment with the dentist, your refrigerator tells you which foods will expire and those that are no longer listed and ordered by the supermarket. Even your own toilet can give you information if something is wrong.

In the industry, the Internet of Things has a more productive application than the one that it has in home automation. Production processes are more agile and efficient and put companies on the radar of mass production. It also allows you to know with greater certainty the sales forecasts so as not to lose money. In livestock, a microchip in each head of cattle can help the owner to know the conditions of their animals in real time and that will avoid losing money with sick animals.

In the health sector, the ideal situation would be for the mobile phone to send data about our biological signs to detect possible health problems that normally are presented unexpectedly, for example, a heart attack. In these cases, the conversion of the data that would store our phone with useful information could save our life.

One of the fields where great results are expected from the application of the internet of things is in environmental control. The questions are: can IoT reverse climate change? How can we use it to restore the environment? In Brazil, a pilot project is carried out to reduce illegal logging in the Amazon rainforest, trees in a protected area have been equipped with a chip that sends information about its location at all times, in case of being cleared an alert is issued of location and perpetrators can be captured.

Nowadays we have plenty of things that help people in everyday life, we go deeper and deeper in a full tech life using the internet and all kind of devices to do things that years ago we probably could not even imagine. This chapter presents a short IOT List of the most innovative things available for us. [1, 2]

2.1 Awair Glow: Smart Plug that Tracks Air Quality.

Figure 1 Awair Glow [3]

This device is able to track toxins and chemicals that are present in you air and it gives recommendations to help you stay safe and in a healthy environment. The system provides you with very detailed information like temperature humidity, CO2 and chemicals in the environment. With a coloured LED, you can easily get your air status. You also get in-depth insights and tips how to improve your air quality from the app, available for Android and IOS. [3]

Figure 2 Awair Glow lighting and phone app [3]

The device uses Bluetooth and Wi-Fi for the connectivity, you can plug any device like a fan or humidifier, and any plugged device can be customized to automatically turn on/off depending of your preferences.

The app is connected to a cloud service with a database collecting environmental data which can be accessed anytime and anywhere by the authorized person using the app

or the web service. Overall this provides accurate data about your living environment and how to improve it if necessary.

2.2 Smart Wi-Fi LED Bulb with Colour Changing Hue

With this smart bulb, you can get full access and control of your house lights. It gives you the possibility of controlling the lights using your phone/tablet wherever you are. By connecting the bulb directly to your home network via Wi-Fi, you can use the app available in Android and IOS, and fully control the bulbs using your voice (Amazon Alexa and the Google Assistant).

Figure 3 Smart Wi-Fi LED Bulb [4]

Some of the features of Smart Wi-Fi LED Bulb are:

- **Manage remotely:** directly connected to WI-FI network (no hub required) to control the lights from anywhere.
- **Color change hue:** Change lights colours for different occasions.
- **Voice control:** pairing it with Amazon Alexa and Google assistant to control lights using your voice.
- **Save energy**: Reduces energy consumption by 80% without losing brightness or quality
- **Compatible with IOS, Android, Google assistant and Amazon Alexa.**

Figure 4 Smart Bulb features [4]

This device has been very popular since the launch. The most popular feature that makes this a wanted gadget at home is to be able to control your lights from any place in the world with internet access.

2.3 Estimote Beacons

2.3.1 The Beginning of Estimote Beacons

The first generation of these beacons contains an ARM® Cortex ™ M0 CPU. This chip was unveiled by its manufacturer in early 2013. This small chip, 56 instructions and low consumption, has been designed to integrate the devices of daily life into the Internet of Things. One of the key features is that the chip has virtually no power consumption when powered on without a processor. According to ARM, the processor consumes only nine micro amps per megahertz, an incredibly low figure that manages to provide Bluetooth and Wi-Fi devices with years of battery life.

The Estimote hardware uses a System on a Chip (SoC) Nordic Semiconductor nRF51822. It integrates the Cortex-M0 CPU, a bi-directional Bluetooth Low Energy chip, with 256 KB of flash memory and 16 KB of RAM. This compendium of technologies means that the device is capable of both communicating through BLE and being reconfigured wirelessly.

According to Estimote, each beacon also contains a simple accelerometer as well as a temperature sensor. The Cortex CPU samples the sensors through an SPI interface,

and, when there is a significant change determined by a certain tolerance threshold, this additional information about the change is sent through BLE. Finally, the complete system is powered by a 620 mAh Lithium-Ion (CR2450) battery.

2.3.2 How the Beacons Work?

The mode of operation of the beacons is quite simple. The device announces its presence by sending a small package that has enough information for an iPhone or Android phone to know the exact position where it is, for example, inside a store.

Depending on the configuration, the device can warn you of its presence up to 70 meters away. Smartphones or any other device that supports Bluetooth LE can detect the radio signal, receive the transmitted data as well as estimate the distance to the Estimote beacon by measuring the power of the received signal (RSSI). The physical basis is clear: the closer you are to the beacon, the stronger the signal.

In addition, smartphones can sample the signal with frequencies between 1 to 10 times per second. A higher sampling rate provides greater accuracy of the measurements, but as expected, this means a higher energy expenditure.

Each beacon sends a unique ID, for example c2d360a002a601315add1040f3913c300102, so that it can be identified by other devices. These unique IDs are like an IP address for each of them. Each ID contains 20 bytes, and is divided into three sections: _ Proximity UUID + major number (2 bytes) + minor number (2 bytes) _. Smartphones can detect multiple beacons in their surroundings and classify them by ID and distance. Figure 5 shows the users' flow of Estimote beacons.

Figure 5 Estimote beacons users' flow [5]

2.3.3 How can Estimote Make IoT Possible?

These mobile eyes consist of small wireless sensors that can be attached to any surface. They work by transmitting small radio signals that smartphones can receive and interpret a kind of "signal" of what is happening, something that the company calls contextual awareness. In other words, they are smart tags that can be programmed to transmit certain type of information to a mobile application which, in turn, will provide a specific response. It is also a good way to generate a database that can be exploited under different circumstances

From the technical point of view, as stated above, the sensors have an ARM processor, memory, a Bluetooth module, as well as motion and temperature sensors. [7]

There are four versions available:

- Location beacon, shown in figure 6, that have a larger battery life and is designed for a more commercial use, for indoor location, supporting multiple packets, mesh net-working, and have built-in sensors.

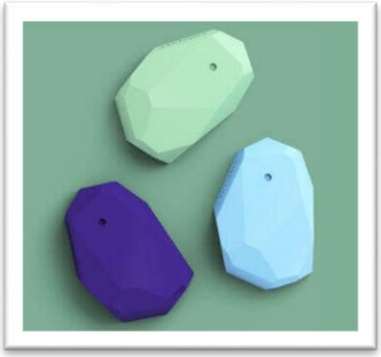

Figure 6 Estimote Location becaons [5]

- Sticker Beacons, shown in figure 7, that turn any objects into nearables, which would mean something like 'objects that can be detected when nearby'.

Figure 7 Estimote Sticker beacons [5]

- Figure 8 shows Proximity beacons, which are the most popular beacons of the market supporting iBeacons and Eddystone, also having NFC technology for touch experiences.

Figure 8 Estimote Proximity beacons [5]

These stickers would be dedicated to personal use to interact with everyday things like a bike or a bag as an example.

- Video beacons, the first video beacon available in the market, when connected to a screen, it shows personalized and contextual user content and is compatible with Estimote stickers. Figure 9 depicts Estimote video beacons.

Figure 9 Estimote Video beacons [5]

2.4 Difference between IBeacons and Eddystone Beacons

Some of the main differences are that iBeacon was introduced by Apple in December 2013 and Eddystone was introduced by Google almost a year and half later, in July 2015. Both are supporting Android and IOS operating systems and frame type transmitted by an iBeacon is only UUID, Eddystone can transmit up to 3 frame types: URL, UID and TLM. Both need Bluetooth to operate.

While at first it seems that Eddystone offers a more complete solution, in practice the difference is not so big. Eddystone-URL can communicate without the need for a mobile application, but this does not mean that it will continuously track users as in the case of applications (which are in constant communication), nor will it send push notifications. The main difference is that while applications send information when devices are detected, URLs are sent when devices request them from their browsers.

3 MyShop Digital Service POC

3.1 Overview of the Service

MyShop is a mobile application able to scan beacons in the background, register the data in a firebase database and get results in a word press site and the Android application itself. The platform used is Android 4.4 kitkat or above versions.

The application is only a POC and the aim of the service is to demonstrate how the Internet of Things is used in everyday life to make it easier for shops that want to advertise specific products to their customers, tracking the possible interests from a user using beacons.

3.2 Used Technology

The whole service is built on the top of a Firebase backend/database, a WordPress site as front end and a native Android application.

The WordPress is emulating a hardware store web shop page. The user can authenticate using Google and Facebook to retrieve all the personal data and prefill the user's profile. The site is also a POC so it does not have any high-end design, just a basic WordPress theme to show the whole service functionality and data.

In the Android side, the application emulates a shop mobile app, where the user can make purchases, search for products, view products and access profile. In the background the app is constantly looking for beacons and registering the data, sending data in real-time to the Firebase database.

Firebase backend manages the user authentication, stores and sends data from and to the specific front end when required.

3.3 Components of the Application

3.3.1 Firebase

Firebase is a service capable of providing us with a backend in the cloud with a real-time data source and libraries to access it from web applications, iOS and Android.

Firebase is a clear example of the possibilities of development in the cloud. From a web service, it offers the possibility to program applications with data that are synchronized in real time through multiple devices, avoiding many of the cumbersome tasks in which we would have to devote time to programming.

For us to understand, it is basically a remote database, hosted in the cloud and able to be accessed from browsers and apps for devices, whose main feature is that it responds in real time to the changes made in the data. In practice, through Firebase we can write data in a database and this data is communicated to all connected clients to the same data source.

If you access the home page of firebase you will see an animation of what would be an application in real time. In it any updates sent via the web or a mobile are transferred to any other browser or device that is accessing the application. The good thing is that this communication is done internally in Firebase without the programmer having to intervene at all.

Firebase has a series of bookstores through which we can connect and remain subscribed to data changes, compatible with the most common systems such as iOS, Android and Web, but also to several server-side programming languages as they might be Python or PHP.

The other service that Firebase mainly offers is authentication, so we can log in to the system and create multiuser applications without having to program the entire part of the authentication. It allows login with user and key, as well as with different social connectors like Facebook, Twitter, Google, etc.

However, Firebase offers us the possibility to make applications of advanced functionalities programming only the part of the client side. In other words, it allows us to program

an application by focusing only on the part of the frontend, leaving the backend completely managed with Firebase.

3.3.2 WordPress

WordPress is a content management system (CMS) that allows you to create and maintain a blog or other type of web.

With almost 10 years of existence and more than a thousand themes (templates) available on its official website, it is not only a simple and intuitive system to create a personal blog, but allows you to make all kinds of web more complex.

WordPress is an ideal system for a website that is regularly updated. If you write content with a certain frequency, when someone accesses the website, you can find all those contents sorted chronologically (first the most recent and last the oldest).

It is the ideal system for beginners, or for those who do not have much technical knowledge. WordPress has a system of plugins, which allow to extend the capabilities of WordPress, that way you get a more flexible CMS.

3.3.3 Android Mobile Application

Android is a set of software for mobile devices that includes Operating System, middleware and main applications. The Android SDK provides the necessary tools and APIs to start developing applications for the Android platform using the Java programming language.

Android has been growing in the last years to a very big scale. It contains a Framework that allows the reuse and replacement of components and running in a Dalvik virtual machine optimized for mobile devices. It has an integrated browser based on free code engine WebKit.

Graphics in Android are based on the OpenGL (currently version 3.1), provided by a collection of custom 2D and 3D graphics, depending on the Android device hardware the optional hardware acceleration.

Storage with an internal memory and microSD (depending on the device), it uses SQLite for structure data storage.

Some more features are:

- Multimedia support for audio, video, and image formats (MPEG4, H.264, MP3, AAC, AMR, JPG, PNG, GIF)
- Bluetooth, EDGE, 3G, 4G and WiFi (hardware dependent)
- Camera, GPS, accelerometer (hardware dependent)
- A rich development environment including a device emulator, debugging tools, reminder and memory profiles, main tool to develop Android is Android studio.

Figure 10 shows the main components of the Android operating system. Each section is described in more detail below.

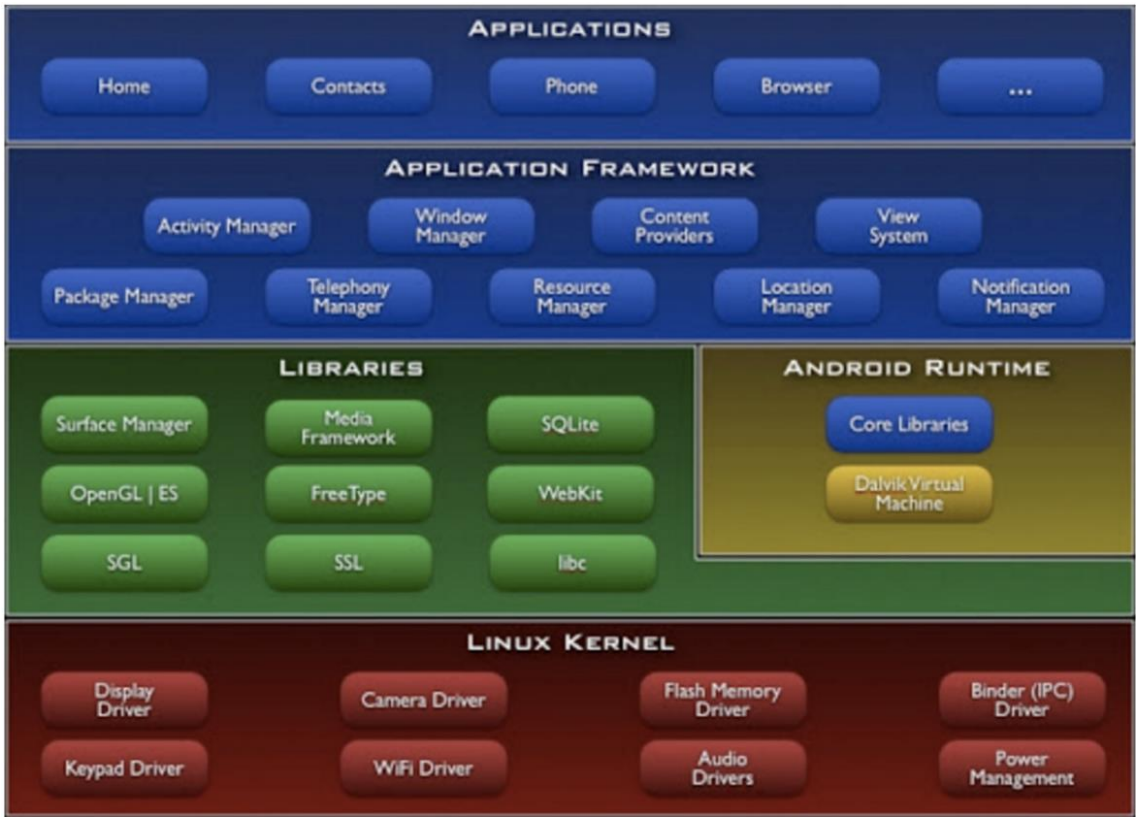

Figure 10 Android architecture diagram

As displayed in the diagram, Android has the following layers:

- Applications (written in java, executing in Dalvik).
- Framework services and libraries (written mostly in java)

  - ✓ applications and most framework code executes in a virtual machine
- Native libraries, daemons and services (written in C or C++)
- The Linux kernel, which includes
  - ✓ drivers for hardware, networking, file system access and inter-process-communication

3.4 Use Case of the Service

In the physical hardware store, beacons are installed in different areas/zones, for example, in ACER, ASUS, SAMSUNG, SONY and HP sections. Every beacon has a unique URL to identify the specific section and will be recognize by the application. In every scan made by the application, the closest beacon information is stored in the application memory. Every 60 seconds the application analyses the data and sends to back end the most seen beacon in all scans during that minute.

Figure 11 shows an example of the data in an Android database:

```
{"beacon_scan":[
                    {
                    "beaconUrl": "http://www.myshop.com/acer",
                    "distance": "3.4",
                    "user": “Rolando Ojeda”
                    ]}
}
```

Figure 11 Firebase database data example

The background scan period and interval can be set programmatically in the app source code, shown in figure 12.

```
1.  @Override
2.      public void onCreate() {
3.          super.onCreate();
4.          verifyBluetoothOn();
5.          closestBeaconSelector = new ClosestBeaconSelector(6, this);
6.          closestBeaconsInRecentScans = new ArrayList<>();
7.          region = new Region("all-beacons", null, null, null);
8.          beaconManager = BeaconManager.getInstanceForApplication(this.getAp-
    plicationContext());
9.          beaconManager.getBeaconParsers().add(new BeaconParser().setBea-
    conLayout(EDDYSTONE_URL_LAYOUT));
10.         beaconManager.setForegroundScanPeriod(500L);
11.         beaconManager.setForegroundBetweenScanPeriod(500L);
12.         beaconManager.setBackgroundScanPeriod(500L);
13.         beaconManager.setBackgroundBetweenScanPeriod(500L);
14.         beaconManager.bind(this);
15.         mContext = getApplicationContext();
16.         FirebaseApp.initializeApp(getApplicationContext());
17.         mDatabase = FirebaseDatabase.getInstance().getReference();
18.     }
```

Figure 12 Beacons configuration in application source code example

This means that the library will scan for beacons for 500 milliseconds. After the scan is done, the application will pause the scanning for 500 milliseconds. Values can change depending on the use case to save battery life.

With this scan period and scan interval we will get 60 scans per minute, the application analyses the 60 scans that are stored in the device's database and sends to the backend the one that was found more times. For example, if the data shows that beacon placed in ACER was the closest 45 times and the other 15 times it found something else, data sent to back end is ACER, and data will be removed from local storage to save new data.

Figure 13 shows the Firebase real-time database.

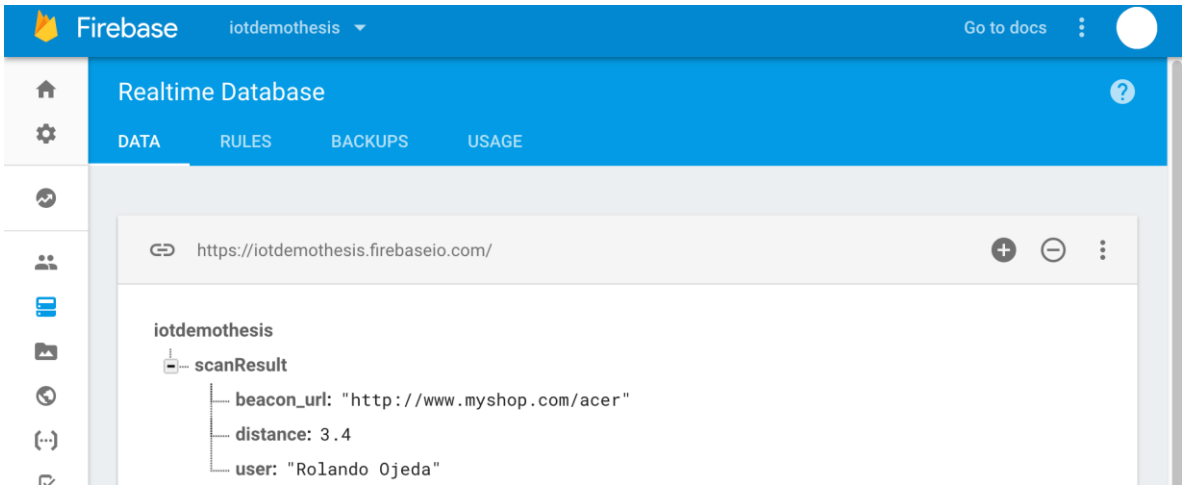

Figure 13 Firebase database tree data

This data is retrieved by the mobile application or the website when the user visits the online shop and is logged in. Data is used to know what section of the shop was most visited in the last 30 days to show to the user the best offers of that specific brand or place. As Acer was used as an example, the user will get Acer products ads in the front page, but if the most visited place was the bikes section, the user will receive ads of current bikes on offer.

3.5 Architecture of the Application

The main idea of this application is to collect data in real time. Authentication and databases are handled by Firebase, as shown in figure 14. The architecture of the app shows how the flow works and that the whole service is connected to the same database.

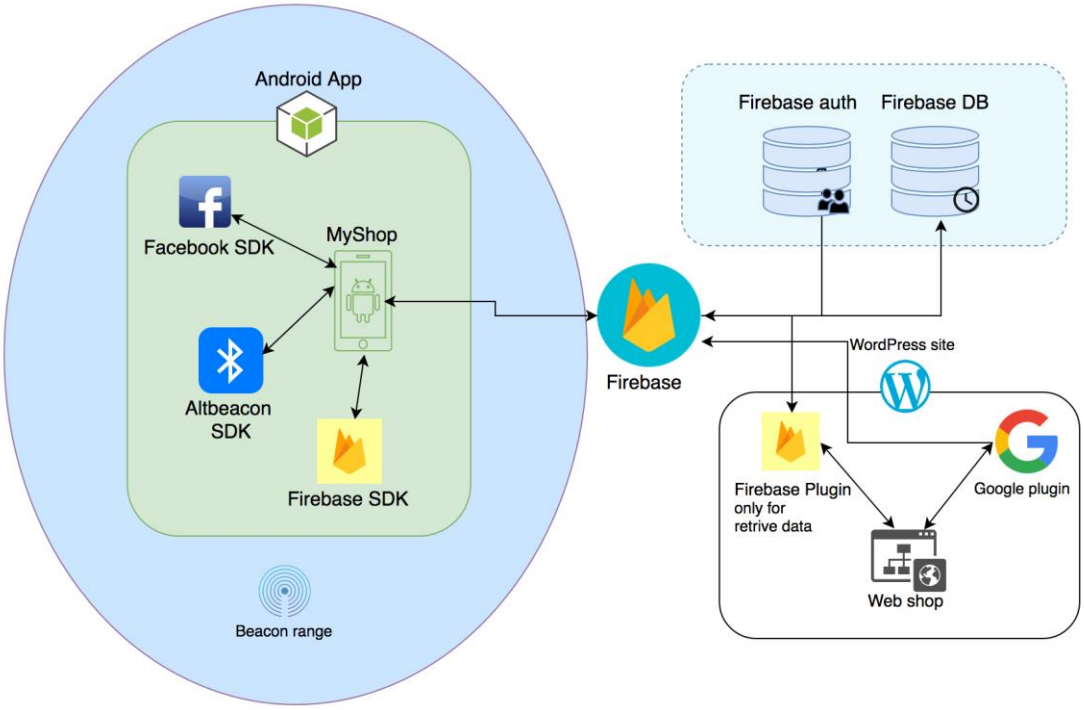

Figure 14 MyShop application architecture

4 Implementation of MyShop Service

4.1 Setting Up a WordPress Environment

WordPress is nowadays a very popular tool to create blogs and websites, and is also very easy to set up. You can install WordPress manually or with an assistant, but the assistant is usually provided by your hosting. For a manual installation, you need to create a database (MySQL), download all the WordPress files from www.wordpress.org and upload all the files to the server's public html folder. You can use free FTP software like Filezilla or CiberDuck to upload your files.

Things you should know before installation are the basic features of the hosting:

- Disk space – With 100 Mb is more than enough to start, a blog does not usually require much space unless you are hosting many videos or high resolution images. It is not the most vital decision and you can extend the space later. However, it is recommended that, given the current prices, you contract more than 5 Gb.

- PHP and MySQL – With 1 database is enough for a WordPress site. It is imperative to install WordPress.

- Transfer Rate – This is another vital element because, besides being the most expensive element, it is the one that will guarantee the smooth flow of your blog/site. The minimum "start-up" must be 10 Gb, and you must increase the transfer rate as your blog grows. There are hostings that make specific offers if you hire several Gb. The usual case is that once your blog is popularized you have to extend the transfer to 30 Gb or more. It deepens if you offer files for download, if you use large images and the number of visits you have.

Once that is done, you must modify the wp-config.php file that usually comes as wp-config-example.php. Rename it to wp-config.php and edit it. The file should look like the one shown in figure 15:

```
16
17  // ** MySQL settings - You can get this info from your web host ** //
18  /** The name of the database for WordPress */
19  define('DB_NAME', 'wordpress');
20
21  /** MySQL database username */
22  define('DB_USER', 'root');
23
24  /** MySQL database password */
25  define('DB_PASSWORD', 'root');
26
27  /** MySQL hostname */
28  define('DB_HOST', 'localhost');
29
30  /** Database Charset to use in creating database tables. */
31  define('DB_CHARSET', 'utf8');
32
33  /** The Database Collate type. Don't change this if in doubt. */
34  define('DB_COLLATE', '');
35
```

Figure 15 WordPress wp-config file example

DB_NAME: name of the database.
DB_USER: username for the database.
DB_PASSWORD: password for db user.
DB_HOST: usually this is localhost, but name can also variate depending on the hosting.

After this is done, you can start the installation by just writing your http address in the browser and it will show the installation assistant to choose language, default theme and set up of the database. Once done, you are ready to start adding content to your site.

You can install custom themes by uploading any theme folder in wp-content/themes path, then just activate the theme in the appearance/themes section.

4.1.1 Authenticating WordPress User with Google

Authenticating WordPress using Google account, is possible thanks to a plugin called Google Apps Login. For installing the plugin, search for Google Apps Login and install it. For configuring the login with Google you must go to the Google API console and get a Client ID and secret required by the plugin. You can get the client ID and secret from firebase console too.

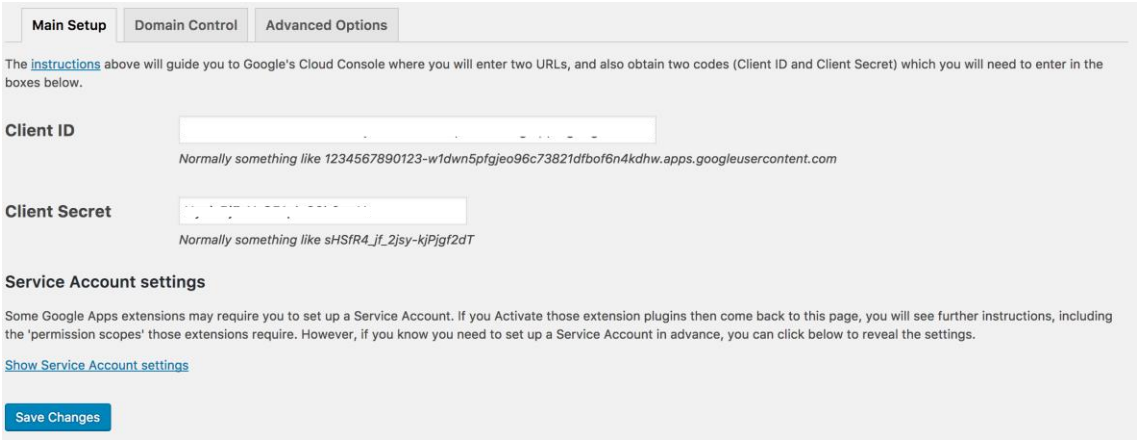

Figure 16 Google apps login configuration page

4.1.2 Getting Data from Firebase in WordPress

For this, a plugin called Firepress is used. The installation is very simple, from the plugins section, search for Firepress and install it, then activate the plugin. This is a free plugin to retrieve data from Firebase, and only requires the authenticated Firebase URL to get the data. This is not the best way of getting the data but is the only free available plugin to achieve this. Other options on Firebase – Wordpress integrations are available but they all cost money. Figure 17 shows the Firepress configuration page.

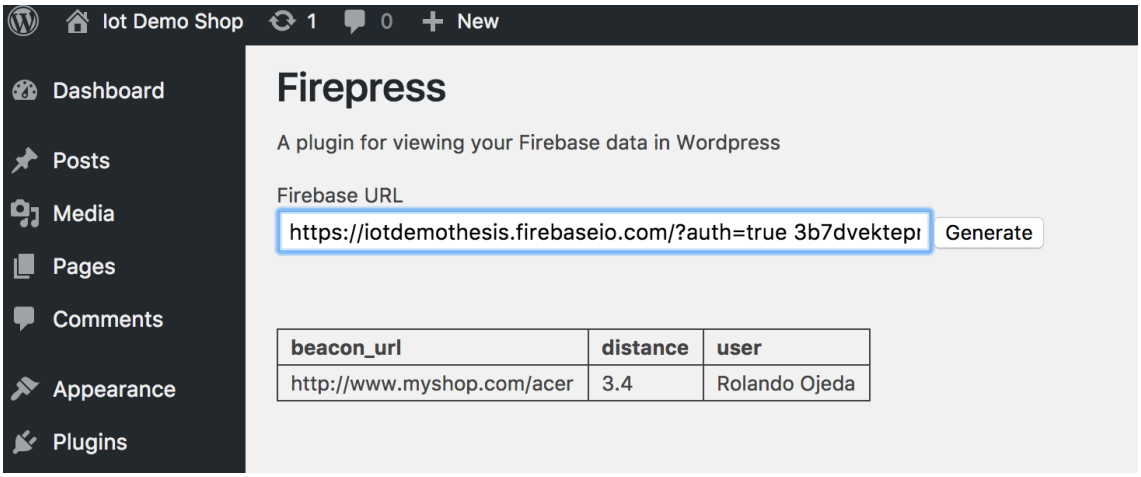

Figure 17 Firepress configuration page

With this data we get all the results from Firebase database and analysing and displaying the best offer for the customer in the FrontPage becomes enabled.

4.2 Setting Up an Android Project

For developing the app, the latest 2.3.2 Android Studio integrated development environment (IDE) version was used.

4.2.1 Android Studio: Brief History

Android Studio was announced in 2013 at the Google I / O conference. It was created to replace Eclipse, the platform that was used for the creation of applications and that still today is used by many programmers. In this way, with Android Studio, Google gets its own IDE for the development of applications, being able to install the whole SDK to develop specific apps adapted to most versions.

Android version 1 was announced on Google I / O, but the first stable version was released in December 2014, available for Windows and Mac.

Android, according to various sources, has a market share of more than 80%. With the launch of this program, Google benefits from having its own Android application creator and currently has the Android Studio version 2.3.2. Obviously, being a Google mobile operating system has many advantages, such as having always updated software and many more.

Currently Android Studio is the platform that is postulated as the most complete IDE to develop Android applications with many features that stand out from the other programs used for this work. It is based on IntelliJ and can be downloaded for free through the license Of Apache 2.0.

It has a simple structure that allows organizing the projects in a way that facilitates their location and publication, as well as an environment to develop more powerful, easy and intuitive apps. It allows you to see the real-time development of the applications and screens in which the application will be used, and offers templates for different elements to program like the use of maps, etc.

In summary, Android Studio makes work easier for developers, having easy accessibility to their folders, files and whatever they are using to create an application, this program is completely up-to-date and although applications written in the Java language can be compiled and leave them as an .apk file in a very simple way.

4.2.2 Project Initial Setup

The configuration used for this project is as follows:

- Platform: Phone and Tablet
- Minimum SDK: API 19, Android 4.4 (Kitkat)
- Boilerplate: A blank activity and black layout resource file

4.3 Setting Up Firebase

First of all, navigate to the Firebase console to create a new project. You have to use the same package name that you used when creating the Android application. Firebase will provide a json file that has to be added into the Android project. Figure 18 shows the Firebase configuration new app screen.

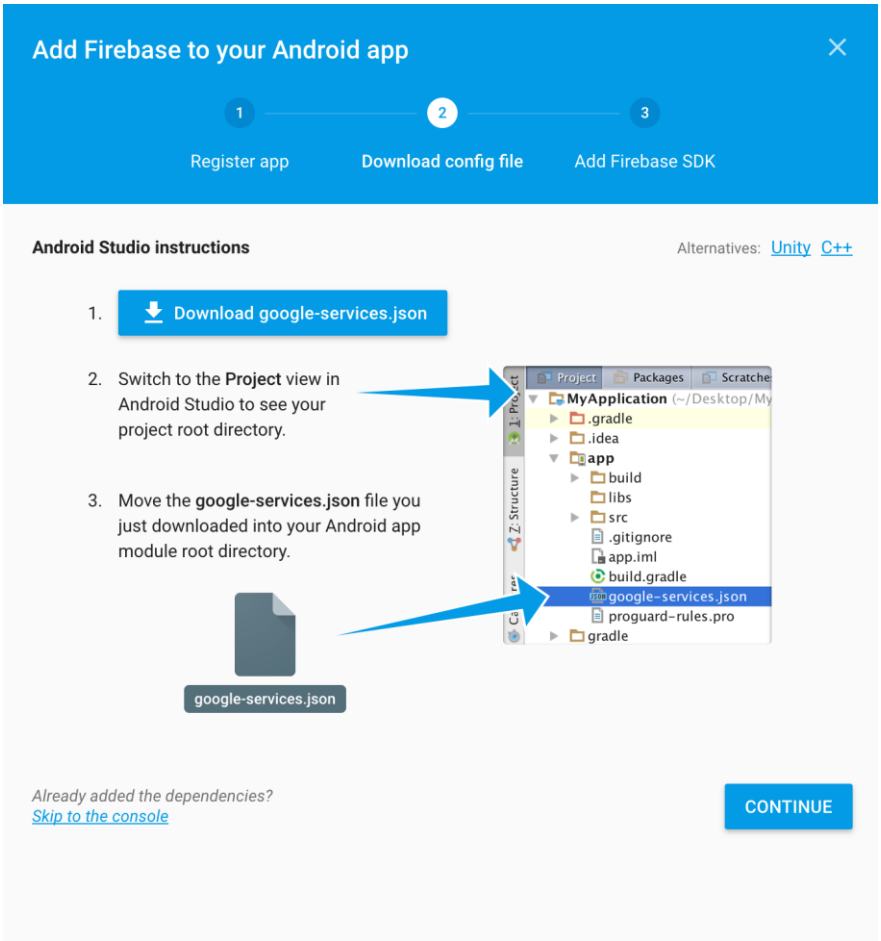

Figure 18 Firebase configuration new app screen

The next step is to configure the gradle files in order to get all the required files into your project using the following:

Modify your build.gradle files to use the plugin.

1. Project-level build.gradle (<project>/build.gradle):

```
buildscript {
  dependencies {
    // Add this line
    classpath 'com.google.gms:google-services:3.0.0'
  }
}
```

2. App-level build.gradle (<project>/<app-module>/build.gradle):

```
…
// Add to the bottom of the file
apply plugin: 'com.google.gms.google-services'
```

includes Firebase Analytics by default help_outline

3. Finally, press "Sync now" in the bar that appears in the IDE:

After syncing, the files will be downloaded and placed in the correct place in the project. This SDK can be used only with Android 4.0 or above.

4.3.1 Write Data to Firebase Database

Data can be pushed directly as a Java Object to a node. For writing data to a JSON tree, the database object must be initialized in onCreate() method in the Android activity:

```
private DatabaseReference mDatabase;

mDatabase = FirebaseDatabase.getInstance().getReference();
```

For sending the data to database we use:

```
mDatabase.child("BeaconScans")
        .child(FirebaseAuth.getInstance().getCurrentUser().getDisplayName() + String.valueOf(System.currentTimeMillis()))
        .setValue(Data);
```

FirebaseAuth.getInstance().getCurrentUser() is the authenticated user and we get that data from a Firebase Authentication that is required when writing or reading any data from database.

To make this authentication possible we need to enable the Google authentication in the Firebase console, as shown in figure 19.

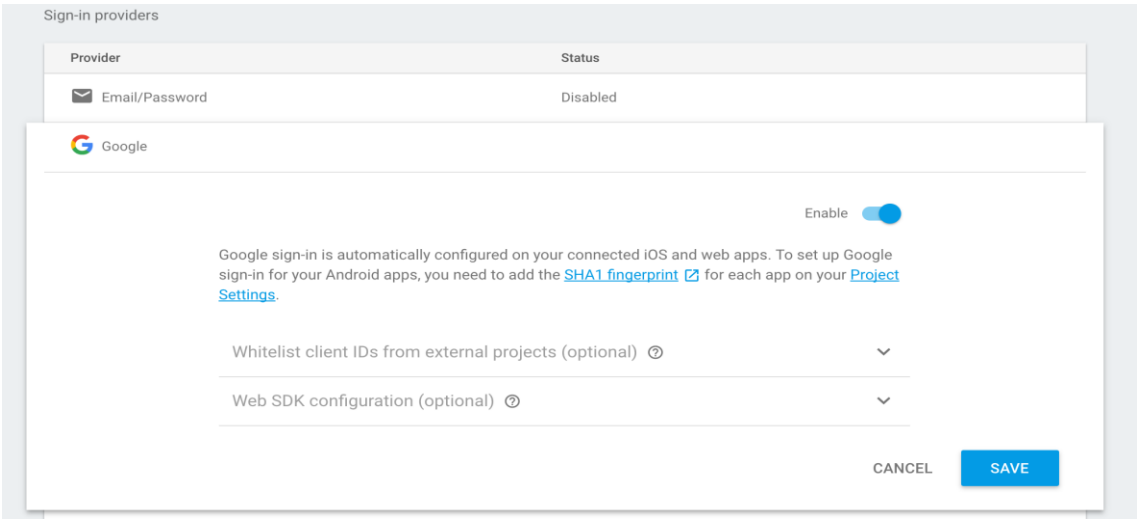

Figure 19 Firebase sign-in providers page

After this, implementing it in the Android app is very simple, calling a IntentBuilder provided by the Firebase AuthSdk, shown in figure 20.

```
    Button signInButton = (Button) findViewById(R.id.sign_in_button);
    signInButton.setOnClickListener(new View.OnClickListener() {
        @Override
        public void onClick(View v) {
            startActivityForResult(
                    AuthUI.getInstance().createSignInIntentBuilder().setProviders(Arrays.asList(
                            new AuthUI.IdpConfig.Builder(AuthUI.GOOGLE_PROVIDER).build()
                    ))
                            .build(),
                    RC_SIGN_IN);
            Log.d(LogTag.FirebaseAuth, "onAuthStateChanged:signed_out");
        }
    });
}
```

Figure 20 AuthSDK code snipped to login

As figure 21 illustrates, when the user is authenticated the app can use the user's data everywhere in the app using FirebaseAuth.getInstance().getCurrentUser();

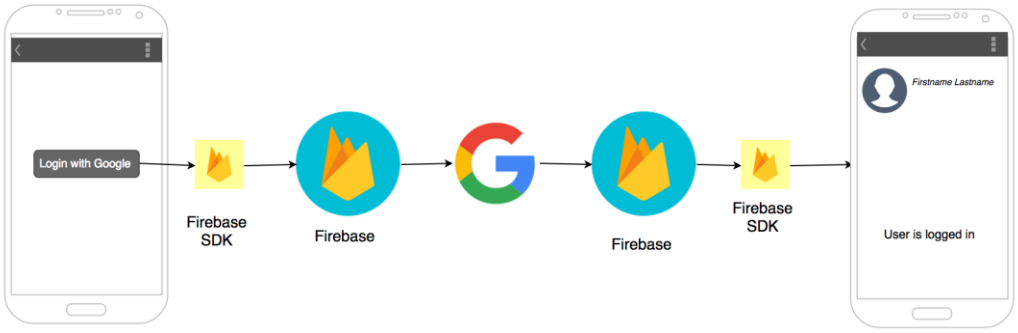

Figure 21 Authentication flow using Firebase

4.3.2 Read Data from Firebase Database

If you need to read data in Android, it is possible to use FirebaseRecyclerAdapter. In this case myShop app does not need to read any data, since that is only done by the Word-Press site using the Firepress plugin.

4.4 Mobile and Web UI

The POC application has a very simple UI with 3 activities. The first is the welcome screen and login button, the second, profile page and the third page is a webview that shows the WordPress site web shop with user authenticated. Figure 22 also shows the user's offer after some data from beacon was collected.

Figure 22 MyShop Ui example

The application will ask users using Android 6.0 or above for location permissions as is required feature to be able to search for beacons after first time authentication. Prior to Android 6.0 the permissions were added in the Android Manifest file, but since the 6.0 permissions will be asked and controlled by the users.

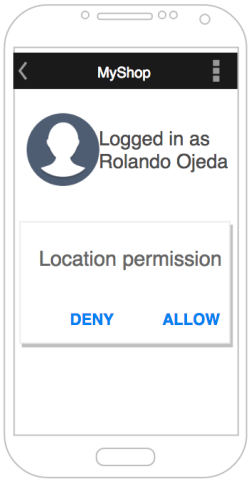

Figure 23 MyShop app permission request

```
private void requestLocationPermissions() {
    if (Build.VERSION.SDK_INT >= Build.VERSION_CODES.M) {
        if (ContextCompat.checkSelfPermission(this, Manifest.permission.ACCESS_COARSE_LOCATION)
                != PackageManager.PERMISSION_GRANTED) {
            requestPermissions(new String[]{Manifest.permission.ACCESS_COARSE_LOCATION},
                    MY_PERMISSIONS_REQUEST_COARSE_LOCATION);
        }else if (ContextCompat.checkSelfPermission(this, Manifest.permission.ACCESS_FINE_LOCATION)
                != PackageManager.PERMISSION_GRANTED){
            requestPermissions(new String[]{Manifest.permission.ACCESS_FINE_LOCATION},
                    MY_PERMISSIONS_REQUEST_FINE_LOCATION);
        }
    }
}
```

Figure 24 Permission request source code

The permissions can be changed by the user anytime, by navigating to setting/apps/myShop.

The web UI as it is a Proof of concept, is a default WordPress template that shows you a dialog with the best offers available for you after reading the collected data from the database. It is important to remember that the main functionality of the service is to collect real time data from beacons with a specific ID, and estimate the best offers for the user depending on what the section was where most time was spent in the shop.

5 Conclusion

The goal of this final project was to show how in the present we can basically be connected to mostly everything and get data from it. A mobile app, and website (shop) was built as a proof of concept to demonstrate how companies are able to track people and obtain all kind of data that later on can be used for commercial proposes. Sometimes this can happen without our permission, and companies will pay a great deal of money to get a person's private data where to spam, call or send offers of their products.

Our data gets collected from every device we have and send to the company servers for analysis. This is the case for laptop, mobile phone, watches, smart tv, etc. If you are watching YouTube videos about birth and you are a woman, the next time you go to the Facebook app, you will get ads about pregnancy tests and things related with that. Everything is linked together making people wonder, can I really use this device safely. As one of the disadvantages regarding the Internet of things, privacy is unfortunately something that is starting to disappear.

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