

Article

NFC Evaluation in the Development of Mobile Applications for MICE in Tourism

David Silva-Pedroza , Ricardo Marin-Calero  and Gustavo Ramirez-Gonzalez * 

Department of Telematics, Faculty of Electronic Engineering and Telecommunications (FIET),
University of Cauca, Popayán, Cauca 190001, Colombia; dasilvap@unicauca.edu.co (D.S.-P.);
ricardomarin@unicauca.edu.co (R.M.-C.)

* Correspondence: gramirez@unicauca.edu.co, Tel.: +57-2820-9800 (ext. 2127)

Received: 23 September 2017; Accepted: 16 October 2017; Published: 25 October 2017

Abstract: This paper presents an analysis and implementation of a service for the deployment of events in the Meetings, Incentives, Conferences, and Exhibitions (MICE) category, to answer the question: how can Near Field Communication (NFC) and mobile applications contribute to the development of tourism in the MICE category? First is an analysis of the applications that are currently on the market and an extraction of the features of greater relevance; later, we define the functionalities for our service, and finally we provide a performance test in a MICE-type event, the seventh Seminar on Emerging Technologies in Telecommunications “TET 2016” developed in Popayán, Colombia and the results of the experience are analyzed. The use of NFC technology with a mobile application allows the experience to be improved when a MICE event was made, for both the user and the organizer.

Keywords: NFC; MICE; event tourism; smart tourism

1. Introduction

In recent years, the use of smartphones has grown, reaching the point where they have become a necessity and are an indispensable part of society. They integrate daily activities such as work, entertainment, and social interaction, facilitating communication. Over the next 5 years, it is projected that there will be around 5.5 billion smartphone users, which will represent 70% of the global population by 2020 [1].

Following the dynamics of the market and the current needs of a globalized and constantly changing world, smartphones have evolved, integrating a series of features and turning them into tools of great utility and functionality, which have different communication interfaces such as WiFi, Bluetooth, and Near Field Communication (NFC), as well as high-frequency processors, high-capacity memories, and numerous peripherals such as Global Positioning System (GPS), acceleration sensors, compass, cameras, speaker systems, touch screens, and keyboards. One of the alternative devices or peripherals that are available to interact with the smartphones is NFC, which is used in diverse solutions applied to fields such as education [2], tourism [3], health [4], and sports [5], taking advantage of the characteristics offered by these technologies: speed, connectivity, location, and notifications to facilitate the processes of our daily life [6].

The tourism industry has benefited from these technologies [3,7,8]. The focus has shifted from desktop computers to smartphones as the tourism industry is able to take advantage of their processing capabilities, peripherals, and interfaces so that the tourist can access content at all times, facilitating their interaction and providing a better experience.

Currently, the increased number of tourists has led to the use of new technologies such as Big Data, web and mobile development which are directly associated with these types of technology [9]; tourism

has been complemented by different technological innovations arising in the 21st century, including social networks [10] or even 3D tourism that has been implemented and augmented with the use of virtual reality [11].

The number of events in tourism has increased considerably in recent years, and has been well received by society; it is important to highlight that this type of event for many cities is a letter of introduction; during these events, the city makes high profits and considerably increases its economy by the wave of tourists to the city, which increases commercial activity. These types of events are of all types, such as technological, sports, video games, gastronomic, etc. [8,12].

In the case of Colombian tourism, the country expected the opening of 25 new hotels in 2016 that provide 3987 rooms, and for the period 2017–2020 the opening of 45 new hotels; Colombia has 613 specialized centers in 29 cities, where Bogota, Cartagena, and Cali have the highest concentration. During the months of January–September 2016, the arrival of 3,585,191 passengers represented an increase of 8% compared to the same period of the previous year. Within this group, 106,810 travellers (2.98%) were for tourism reasons in the category of meetings, incentives, conferences, and exhibitions (MICE). This class focuses on generating a full range of travel services and conferences for all types of groups and events [13].

Although the development of mobile applications for tourism in the MICE category is increasing, they are essentially based on replacing or displaying web information with responsive design, without making use of other potentialities based on peripherals such as NFC. This is a disadvantage, since NFC allows context elements to be marked, provides localization, and allows the streamlining of processes such as authentication, registration to the event, delivery of refreshments, and many others, thus providing a large number of advantages and facilities for both organizers and attendees to the event [6,8].

2. Theoretical Background

Tourism has been significant for different social aspects; it is an industry of billions of dollars, and for some cities it is even the main economic activity [12]. Currently, as mobile and ubiquitous technologies advance, they are implemented in tourism to obtain a better experience for the tourist, taking advantage of the technological advances of smartphones, such as NFC, Bluetooth, high-performance processors, and high-speed internet connection, although in recent years these characteristics have not been used efficiently [3,7,12].

2.1. Event Tourism (MICE)

This is currently defined as the inclusion of all types of events in an integrated approach to development and marketing, which must be seen both from the supply and demand sides, determining who travels to an event and why, seeking to promote a good image of the place, and marketing in general [12]. The term MICE in the context of tourism is the acronym for meetings, incentives, conferences, and exhibitions; its market refers to a specialized niche of group tourism dedicated to planning, booking, and facilitating conferences, seminars, and other events, including different components which must provide a full range of tourism services and conferences for all types of groups and events. This field includes corporate meetings, conventions, and in general all kinds of events that need logistics [14].

2.2. Near Field Communication NFC

NFC is a short-range technology for contactless communications which uses the protocol half duplex for transmission in both directions (transmission and reception), but just one at a time, and works with an inductive coupling between the transmitting and receiving devices, where communication is made within a few centimeters and operates at a frequency of 13.56 MHz, which gives security between the devices used; NFC differs from other radio frequency communications employed in Personal Area Networks (PANs).

2.3. Android

Android is an open source operating system created for different devices such as televisions, appliances, and smartphones. The primary purpose of Android is to create an open software platform available to operators, original equipment manufacturers (OEMs) and developers to realize their innovative ideas and to introduce a successful product in the real world that improves the user experience [15]. In August 2015, there were approximately 1.5 billion users around the world. Starting in 2016 in the United States, 53.3% of people were Android users, while globally 87.5% of the phones use Android [16]. The advantage of Android over other operating systems lies in the fact that it is an open source system, which has many libraries created by the users of the development platforms, sharing knowledge between developers and thus generating applications of greater capacity and quality.

3. Research Methodology

3.1. Symbols Used in Research Methodology

The acronyms used in this chapter are displayed on Table 1.

Table 1. This table shows the acronyms used in this chapter.

Symbols	Description	Symbols	Description
APS	Application Search	AC	Application Characterization
At _j	Attendees	Bs _j	Business People
FS _k	Field of Study	FE	Functionalities Specifications
IC _j	Important characteristics	KW _j	Key Words
Mg _j	Manager	Pr _j	Press
S _k	Specifications	Sp _j	Sponsor
T _k	Title	PABS	Percent of the number of Apps based on the group of Study

Following the methodology presented in Figure 1, we proceed to the search and analysis of existing applications in the current market and establish prototype functionalities, with each part described below.

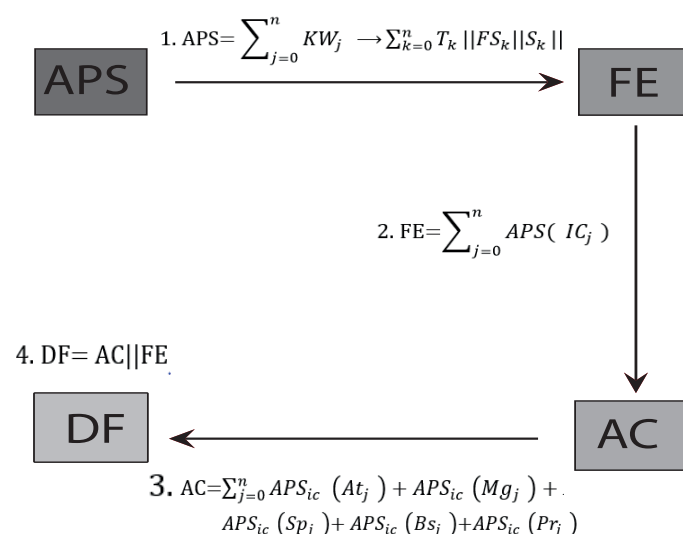


Figure 1. Research methodology. Own source.

1. Keywords were selected, then with those keywords, research was made based on the titles, fields of study, and app specifications.
2. Based on the application search, we analyzed the most relevant characteristics of each one, extracting from the application group the frequency of each characteristic and its importance.
3. With the essential features obtained, we performed an analysis of the relevance for each actor (attendees, managers, speakers, business people, press).
4. After the analysis, the most important features for our application were found, dividing it into two important parts—one for organizers and another for attendees.

3.2. Applications Search

A market study of mobile operating systems (OSs) was executed, finding that in recent years it has been a race of only two companies: the Google Android platform in the forefront followed by Apple iOS, as these two platforms combined represent 99.6% of the total market [17]. Based on this, the Google Android platform was chosen over Apple iOS because it is an open source platform with a great deal of documentation, and is better positioned in the market, since 87.5% of smart phones use this operating system at a global level [16].

Research on the digital distribution platform “Play Store” which belongs to Google Android and offers the ability to browse and download applications developed by the Android SDK was done [18], with related terms such “event manager”, “event app”, “event tourism”, “Meetings Incentives Conferences and Events”, as well as research for the most outstanding applications currently on the market (e.g., Eventmobi, Webmovi, Whova).

The results obtained, taking into account the number of downloads and rating of the applications to determine the most relevant. Since some of the apps are similar, it was decided to leave the most appropriate versions, this results are described in Table 2.

Table 2. Results of the Search.

N	Applications	D/L	Rating	N	Applications	D/L	Rating
1	WMT Events	0	--	13	IBM Conference App	43	4.4
2	Sysmex MICE	100	--	14	Google I/O 2016	21,801	4.3
3	MICE Chiang Mai	100	--	15	TED Connect	354	4.3
4	EventMobi	0	--	16	ASH annual Meeting	34	4.2
5	KOREA MICE EXPO 2015	100	--	17	Ginstr Events	14	3.9
6	Entre Manager	788	4.8	18	Event Guide	10,000	3.8
7	Townscript Event Manager	4	4.8	19	ACS Meeting Fall 2015	43	4.4
8	Conferences Events Made Easy	13	4.8	20	Ross dd's	10,000	3.3
9	Whova	676	4.6	21	Grupio	59	3.1
10	ASSA Meeting	26	4.6	22	EventPilot Conference App	59	3.1
11	EventsAir	1000	4.4	23	IEEE PES General Meeting	5	2.6
12	ASCB Meeting	14	4.4	24	MWC Event App	50,000	2.6

Next, we will analyze the applications found, where the characteristics and functionalities are extracted, making a general scheme, allowing us to have a better idea of the tourism applications in the MICE category on the current market in order to discover the most relevant functionalities and apply them to our prototype.

3.3. Evaluation of Possible Functionalities, Requirements, and Characteristics

Analyzing each application individually, we extracted the characteristics of each one, adding them to a comparative table (Applications and Features). It explains the frequency of features; by determining the most used in the current market, we added functionalities that are considered appropriate and of great utility for this type of application.

Some of the most used features are the event schedule, reminders, schedule updates, GPS location map, and access to the speakers profile. Some applications differ from others by changing technical aspects, which in addition to focusing on end users (event attendees) also focus on event organizers, implementing features such as attendee registration, setting up notifications, and changing conference schedules.

3.4. Application Characterization

It was decided to divide the results of the research by the different actors: speakers, attendees, press, organizers, and business people.

The characteristics that we considered significant and others that were presented by some applications were connected to these actors, and we counted the applications having each of these features.

3.4.1. Group by Speakers

At present, there are few applications that have features oriented to the speakers, leaving their importance and the fundamental role they represent at the time of performing an event unaddressed. For this reason, some features that we considered necessary which were not present in the current applications were added both actual applications and features we considered important are shown in the Table 3.

Table 3. Table grouped by speakers.

Features	Number of Applications	PABS
Solve questions instantly	3	12.5%
Review conference participants	1	4.2%
Event map	1	4.2%
Exclusive section for speakers	0	0%
Show important items on the cell phones of attendees	3	12.5%
Attendees can instantly answer questions made by the speakers	1	4.2 %
Share slides or material with attendees	2	8.3%
Create surveys	3	12.5%
Receive phone calls	1	4.2%

3.4.2. Group by Attendees

The attendees are the greatest actor, since the event is aimed at them and they are the ones who generate the profits. Therefore, all of the applications are specifically focused on them; it is possible to say this because the features are abundant, as are the number of applications that implement them (see Table 4). However, they are added features that were considered necessary and are not presently present.

Table 4. Table grouped by attendee-focused application features.

Features	Number of Applications	PABS	Features	Number of Applications	PABS
Attendance validation	7	29.1%	Share user profile	2	8.3%
Build and update an agenda for each user	20	83.3%	Navigate through the attendants list	7	29.1%
Access to the event agenda	23	95.8%	Explore attendee profiles	2	8.3%
Reminders before the start of the sessions	6	25%	Phone call to the assistant	1	4.2%
Get information about social events	6	25%	Send an SMS to an assistant	3	12.5%
Receive a notification when the event agenda changes	16	66.6%	Navigate through speakers list	12	50%
Organizer messages	7	29.1%	Explore speaker profiles	10	41.6%
Event map and GPS location	16	66.6%	Call speakers	1	4.2%

Table 4. Cont.

Features	Number of Applications	PABS	Features	Number of Applications	PABS
Places of interest locations	2	8.3%	Send SMS to speakers	1	4.2%
Social events locations	2	8.3%	Find close attendees with the same interest	2	8.3%
Native App without internet needed	6	25%	List attendees with the same interest	3	12.5%
Take notes of the presentations and e-mail it	9	37.5%	Chat between attendees	5	20.8%
Information about related conferences	7	29.1%	Build a network between attendees with the same interest	5	20.8%
Create a professional profile with the persons you share interests with	5	20.8%	Watch the presentations and sessions live	2	8.3%
Log in through Facebook or LinkedIn	1	4.2%	Monitor publications and conversations on social networks related to the conference	7	29.1%
See survey results	1	4.2%	Make publications about the event (feeds)	3	12.5%
Download content from the sessions at any time	4	16.6%	Make real-time questions to speakers	3	12.5%
News related to the event	2	8.3%	Answer surveys in real-time	4	16.6%
Chat with the app support	1	4.2%	Chat with the event support	0	0%
Recommendations about conferences in the same event	1	83.3%			

3.4.3. Group by Press

Currently available applications do not consider the press or their relevance, and do not include any feature focused on them. Thus, they do not have an exclusive section where press can transmit news or conduct an interview. Because of this, it is observed in the Table 5 that there were considered characteristics which are important to take into account. Additionally, in the current market, only one feature within the group of analyzed applications was found.

Table 5. Table grouped by press features.

Features	Number of Applications	PABS
Real-time event news	16	66.6%
Distinction of people for interviews	0	0%
Event map	0	0%
Exclusive section for press	0	0%

“Real-time event news” refers to certain applications that are updated by notifications or another method, to know what is happening in the event.

3.4.4. Group by Event Managers

It was possible to determine that the current market applications consider the organizers of the event, their importance, and the fundamental role that they play. This is why there are a large number of features in the analyzed applications group focused on them. It was found that there are important aspects to consider, as seen in the Table 6.

One point to consider is that no event manager can independently generate the application for her event; this means that a development team is required to implement a mobile application for her event needs. This limits the features that the administrator can add for the event.

Table 6. Table grouped by features geared towards event managers.

Features	Number of Applications	PABS
Create, build, and modify the event agenda	4	16.6%
Search attendees with a pre registration.	6	25%
Register the entrance of the attendees	8	33.3%
Register the exit of the attendees	2	8.3%
Have sale statistics	8	33.3%
Have attendance statistics	7	29.1%
Monitor publications and conversations on social networks about the conference	7	29.1%
Send SMS to the attendees	7	29.1%
Make agenda updates	12	50%
Chat with the application support	0	0%
Chat with the speakers	1	4.2%
Establish meeting place for sessions	1	4.2%
GPS location that shows near important places	1	4.2%

3.4.5. Group by Business People

Business people have a significant role which the current applications do not address; they represent big economic gains for the event in exchange for advertising or advertising spaces in the event in the form of stands to promote their products, and have a stake with the public. None of the applications had features focused on them, excluding this market, which is an exciting field of study to consider in our analysis. Characteristics found necessary for this actor are shown in the Table 7, including the only application that we found among those analyzed.

Table 7. Table grouped by features geared towards event business people.

Characteristics	Number of Applications	PABS
Sales of your products according to customer	0	0%
Product promotion using metadata	0	0%
Show people in their same field	0	0%
Exclusive section for business people	0	0%
Show sales statistics	0	0%
Publicity on the app	2	8.3%

3.5. Definition of Requirements, Functionalities, and Characteristics

Based on the previous analysis, we considered different factors for the definition of requirements such as: the number of applications that have the characteristic, the relevance that it has, the actors to consider (speakers, attendees, press, business people) and the ease with which the users can interact. We also propose characteristics that are deemed necessary and very useful for different factors.

The following are the requirements, functionalities, and features chosen according to the different actors:

Attendees Application:

- Main screen where the general information for the event is located (objective, date, location)
- Display of the list of speakers where you will find the most relevant information of each one of them.
- Schedule of each of the days of the event where you will find the most pertinent information on the presentations and schedules.
- Location where the places of interest are, using GPS location.
- Reception of notifications sent by the managers.

Managers' Application:

- The main screen where you choose the activity to register the users with the NFC tags.
- Write NFC tags with the users' information.

Web Application:

- Create profiles for attendees.
- Send notifications to the attendees' application.
- Attendee data (number of people who went to activities).
- Add bookmarks to the application map
- Modification of the different aspects of the application such as speakers, timetable, and activities.

4. Methods and Design*4.1. Symbols Used in Methods and Design*

The Acronyms that are going to be used in this chapter are described in Table 8.

Table 8. Acronyms to be used in this chapter.

Symbols	Description	Symbols	Description
WT	Write Tag	RT	Read Tag
RUI	Register User Id	IEP' _{NUA}	Info Event Program (Native user application)
IMD	Info Maps Data	IGR	Info General Requested
IN	Info Notifications	IEP	Info Event Program
RIR	Return Info Request	Na _u	Name User
Te _u	Telephone User	Em _u	Email User
Rn _u	Read Name User	Rt _u	Read Telephone User
Re _u	Read Email User	Ud _k	User Data
Ed _k	Event Data	Sd _u	Speaker Data
OB _e	Objective Event	DA _e	Description Event
LO _e	Location Event	MN _s	Message Notification Event
AC _m	Access Certification Maps	LP _m	Location Point Maps
DU _k	Data User	DE _k	Data Event
ND _k	Notification Data	DE _s	Data Event Server
DP _s	Data Participant Server	BM _f	Broadcast Message FireBase

4.1.1. Architecture

Figure 2 shows the architecture that handled the service, the data that we added to the NFC label through the administrators' application, how this information was then used to register the different event activities, finally being stored in a database in the web service.

The attendees' application receives the relevant information to them for use during the event, after the administrator sends the necessary event information through a web service.

Each symbol used is detailed in the following.

1. The management's app writes the NFC tag with the user info (name, cell phone number, and email).
2. The management's app reads the NFC tag and extracts the data elements (RN_u, RT_u, RE_u)
3. After reading the NFC tag, the management's app sends the user information to the server and registers it in the database.
4. The users' app downloads the event information given to the server, and the description of data in the IEP (Info Event Program) is detailed as follows:

- (a) $Ed_k = EH_k || EN_k || ET_k || ES_k || EC_k || EL_k$
 (b) $Sd_k = SN_k || SS_k || SX_k || SF_k || SH_k$

where the app takes the scheduling information, speakers, object, and other things relevant to the event, and provides some notification to the user, helping them to optimize their use of the information.

- An important part of the user application is the GPS location using the Google API; the app communicates with a Google server, first sending the authentication ID and then downloading the data, giving the user the option of navigating through the maps and points of interest.
- The server puts the general system information in the database to generate a backup with all user registrations and assistant controls.
- The database gives the server the event registration information and also forwards it to the attendees in order to allow them to monitor and update the information.
- The server communicates with the FireBase to send notifications, and the management can send notifications to generate interest and give relevant information to organize the attendees.
- The user's app has an internal backup so that the attendee does not require an internet connection to use it.

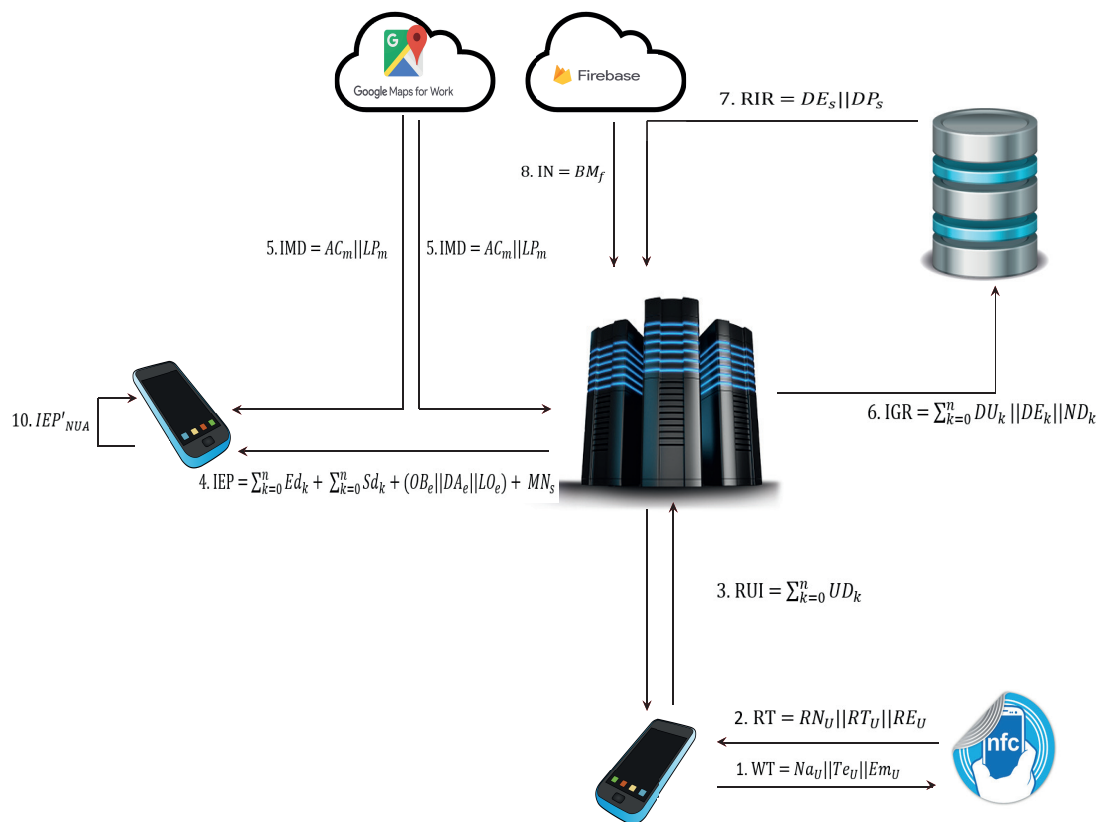


Figure 2. Service Architecture, data read and write, storage and functions. Own source.

4.2. ID Smart Design

In designing the ID, we considered the organizers of the “TET2016”. We had different design factors, such as publicity, dimensions, and relevant information—the organizers were responsible for this part.

For the location of the NFC tag, we accounted for the analysis of the ID dimensions and defined the best place to locate it. The chosen area is in the lower right, because it is easy to read, coexists with other technologies, and also makes it easier to interact, the Figure 3 shows this ID.

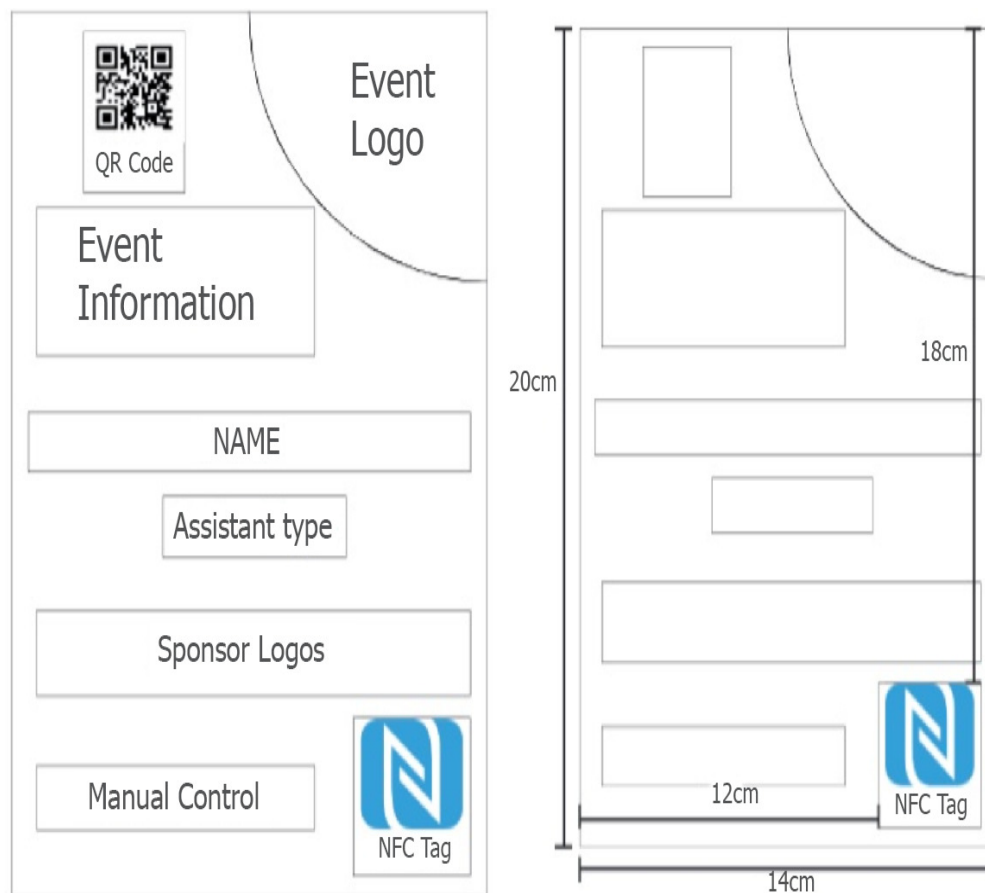


Figure 3. Attendee ID Design. Own source. NFC: Near Field Communication.

5. Mobile Application

We made two applications: one for the event attendees and another for the organizers; therefore, we will explain each of them in more detail in the following.

5.1. Attendee Application

The attendees' application displays all of the relevant event information: the speakers, the conference schedule, the location of points of interest, and a notifications function allowing the organizers to stay in contact with the attendees (described later).

The sections of the mobile application are described below.

Schedule

This screen (Figure 4B) shows the event schedule, describes the time of each session, the speaker in charge, the location, the company in charge, and the session description.

Speakers

In the speakers component, it was decided to make a list which had each speaker's name accompanied by their photo (Figure 4C), and according to which further information is provided (Figure 4D), showing the name, company, international training, experience, and skills.

Location

Location is a very important aspect because many of the attendees are not from the city hosting the event, and do not have the information to locate or move around the city and get to the place where the event is located. For this reason, a part of the app was geared towards these people, where the location of the event was placed and the location of social activity points such as the welcome of the event (Figure 4E) could also be obtained using the smart phone's GPS, allowing routes to be defined for faster arrival (Figure 4F).

Notifications

In order for organizers to keep in touch with the attendees, we used notifications to give information according to the event as programming changes, as well as messages to generate interest in the sessions, etc. Organizers were also able to send any notification without requiring knowledge of programming. The mobile application was always aware of the notifications, and they were immediately displayed after they were sent from the web page (Figure 4G); additionally, users were able to access all of their notifications so that they were able to see them when desired (Figure 4H).



Figure 4. Mobile user's application Screenshots. Own source.

Main

The last part provides a general description of the event (Figure 4A), including its objectives, the scheduled days, and the location of the event, in order to give the user a general view of what they can expect. To change between sections, four buttons were used at the end of the screen.

5.2. Management Application

To facilitate and assist the controls of the organizers, a system was conceived in which NFC tags are used on the ID of the attendees, in order to allow their registration for the different event activities, such as entry and delivery of refreshments, as this often demands a great deal of time and several groups of people are formed and annoy the attendees. In addition, organizers have the records of these activities for later analysis.

Therefore, a unique application was developed for the organizers which was able to read and write the NFC tags (Figure 5B) and then register them in a database; each tag has the user's information such as name, email, and phone. The application has a function which may be selected by the organizer, allowing them to begin recording each event (Figure 5C), and this option can be found on the main screen (Figure 5A).



Figure 5. Mobile management application Screenshots. Own source.

5.3. Web Application

An essential part of our service is the web application, since this is the interface where the event organizer can view and modify event data.

To connect the web page with the application, we used a database on MySQL; in turn, to communicate with the database, we used the PHP language which is a prevalent open source language especially suitable for web development that can be embedded in HTML [19].

We designed the webpage within the framework of the seminar on emerging technologies in telecommunications (“TET 2016”), which took place in the city of Popayán on 20–22 October 2016; here, we present the attributes on the web page:

Home

The page was named “Management APP TET 2016” and was located in the domain of the University of Cauca; this gives a description of what can be done in the application and the benefits it brings.

Schedule

The user must create and modify the schedule depending on the needs of the event.

Creation

Space was set up on the website for the creation of the calendar for the event “TET 2016”, where each activity, event day, time, description, name, speaker, company, and place must be specified.

Modification

In case a modification had to be made on any day of the event, the option to “modify” was used where the properties of each activity could be accessed to enable users to eliminate the activity or change its parameters.

Event Attendance Information

This section reported the number of attendees who attended each event of “TET 2016”, and showed the ID of the NFC card to prevent double participation in events such as breakfasts or lunches; the e-mail, name, and phone number of attendees were also included.

5.4. Data Base

For our system, it was considered appropriate to have two databases—one for the attendances that consist on the data registered in the NFC tag, this rows are shown on Table 9, composed of a table for each activity performed, and another for the schedule of the different sessions scheduled (Table 10). We will show these columns below.

Table 9. NFC information Data Base.

Column	Type	Description
Idp	int (11)	ID key for the data base
Id	varchar (20)	MAC of the NFC tag
e-mail	varchar (100)	Email of the owner of the NFC tag
Name	varchar (100)	Name of the owner of the NFC tag
Tel	int (11)	Telephone of the owner of the NFC tag
Type	int (3)	An entire number to define the kind of user (assistant, speaker, press, etc.)
Ide	int (4)	ID of the activity in which the user is participating

Table 10. Schedule Data Base.

Column	Type	Description
Id	int (11)	ID key for the data base
Idd	int (11)	Id of the day on course
Ido	int (11)	Id of the activity at the day on course
Hour	varchar (10)	Hour of the activity
Event	varchar (100)	Description of the activity
Title	varchar (100)	Title of the activity
Speaker	varchar (100)	Name of the speaker
Company	varchar (100)	Company of the speaker
Place	varchar (100)	Place of the activity

The appearance of the web page is displayed in Figure 6.

Managment APP TET 2016



Figure 6. Management APP TET 2016 Home page. Own source.

6. Case Study

6.1. Test Performance in a MICE Event

For the performance test, we chose “TET 2016”, an event of emerging technologies in telecommunications, with approximately 250 attendees, organized by the IEEE student branch. This event took place on 20–22 October 2016 in the city of Popayán, at the theater Guillermo León Valencia. It is one of the flagship events of the University of Cauca.

6.1.1. Description of the Selected Place

The site chosen for the event was the Guillermo León Valencia Theatre, located in the center of the city of Popayán, with a total capacity of 780 people distributed in the following way:

- Stalls for 281 people
- First floor 124 people
- Second floor 112 people
- Third floor 140 people
- Fourth floor 140 people

It also has a foyer for exhibitions, lectures, or conferences, with a capacity for 100 people and a terrace with capacity for 120 people in which various social activities can take place.

6.1.2. Preparing the Experience

We implemented NFC tags for attendees and organizers; each of the NFC tags comprised the profile of the person to establish a social interaction between them, allowing them to share their data

via the ID from the other person's cell phone and automatically adding the contact. To obtain this data, we contacted the organizers of the database of attendees and speakers. NFC tags could be implemented in the attendance log, either at the entrance or at the time of delivering snacks, which is why the organizers responsible for this part were trained in the management of the application and collection of the data.

Since the organizers had the option to send notifications, they were instructed on how to enter the web platform for this, and also on how to change the schedule if necessary. For our part, the organizers were always accompanied by the event developers, providing support and helping in any way required.

6.1.3. Operation of the System

To successfully evaluate the operation of the system, we defined different steps, as follows:

Registration

This information was inserted manually into the NFC tags which were placed on the back of the ID; the manager's app did this, so each ID had the name of the assistant, in addition to the information of the tag (name, phone, email), the Id is showed on the Figure 7.

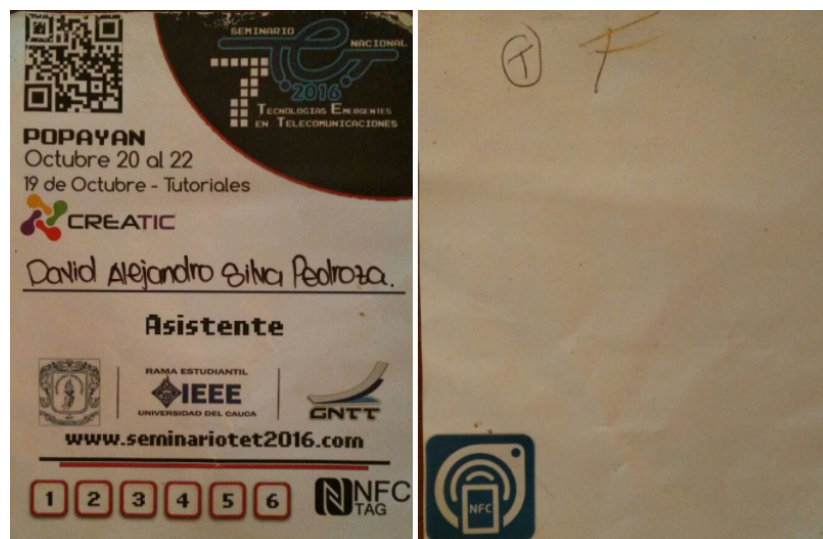


Figure 7. Attendee ID. Own source.

Update Schedule

If for some reason the organizers of the event had to change the speakers or move their schedule, they entered the management's app page on the day they wanted to change, where they had the option to modify by accessing the previous data and changing them for the new data, before proceeding to notify the attendees of this change.

Send Notification

The organizers could be in contact with the attendees through the notifications—they served to give information and generate interest in the event; if the organizers wanted to send a notification, they would have to enter it into the Firebase page. First, they opened the Firebase console, and in the notifications module the option “new message” allows them to write and send the message, as seen in the following figure. There was also a record of the notifications sent and the number of users who saw it.

Description by Days

First Day

The first day was the registration and welcome of the event. In this part, the attendees were given the event identifications and the new attendees who were arriving were registered. The staff of the TET 2016 seminar were instructed to do the registration and installed the organizers' application on their cell phones. They explained the use of their ID to the attendees. For the record of attendance, two people (two organizers) were placed at the Guillermo Valencia theater entrances with the organizers' application, so each time an attendant entered, they were asked to bring the identification with the NFC card to register.

In order for all attendees of the event to obtain the APK of the application, a download link was provided on the page provided by TET 2016 (www.semirariotet2016.com). In the introduction of the event, the presenter explained how to download and install it and explained its operation; later, a test was run to determine the number of users who had the application.

On that day, it was planned to give two snacks; so, in the delivery of these, two people were placed at the entrance of the designated hall, in charge of the registration of people who consumed meals. We kept this record on a database, so each attendee could only access the room once.

That night, a welcome cocktail was organized in the Casa Mosquera—thinking about people who were not from the city, a map marker was provided in the application. Additionally, as a reminder, notifications were sent to the attendees to remind them of the dress code, time, and location. In addition, at the end of the cocktail event, it was planned to go to a nightclub to finish the welcome, so a notification was sent with the following message: "All cocktail attendees, please we mobilize towards the Corona disco to finish the welcome" in order to coordinate the people and help the organizers in their work.

Second Day

The second day was very similar to the first, had two snacks and the location was the same; the only thing outstanding was that one speaker could not attend and had to use the option to modify the schedule and send a notification. Additionally, new users and speakers who arrived that day were registered.

The social event at night was a tour of the city of Popayán in "Chivas Rumberas" and ended in a nightclub; therefore, notifications were sent out clarifying the departure time, the starting point, and reminding attendees to carry their identification for the disco entrance. The point of departure was provided in the application.

Third Day

The last day of the seminar was held in the faculty of health of the University of Cauca; because of this, users were given notifications on the previous day and on that morning regarding the change of scenario with the following message: *"Good morning, the participants of the TET 2016 are reminded that the activities of the day are in the auditorium of the Faculty of Health Antonio José Lemús Guzmán."* and could locate it with the application map.

Finally, the TET 2016 seminar held its closing party in the "Club de Leones" of Popayán. It was a gala party, and so notifications were sent through the application reminding users of timely attendance and the dress code.

Results

The Table 11 shows and analyzes the results obtained during the TET 2016 seminar. We obtained the number of people who installed the application per day; this data was obtained through Firebase. Each time a notification was sent, it showed the number of individuals who received it. Additionally, the growth of users using the application is analyzed with the number of attendees who installed the application over the course of the event.

The Symbols used in the notifications description are described next on Table 12.

Table 11. Notifications throughout the event.

Day	Notification Number	Hour	App Users	Type
Day 1	Notification 1	13:45	31	In
Day 1	Notification 2	17:46	43	Sc
Day 1	Notification 3	20:17	56	Re
Day 1	Notification 4	13:45	58	Ar
Day 2	Notification 5	9:29	66	In
Day 2	Notification 6	11:51	68	Sp
Day 2	Notification 7	11:59	68	Ar
Day 2	Notification 8	17:18	73	Ar
Day 2	Notification 9	19:07	73	Re
Day 2	Notification 10	21:24	74	Re
Day 3	Notification 11	9:36	79	Re
Day 3	Notification 12	10:34	80	Ln
Day 3	Notification 13	13:09	81	Ar
Day 3	Notification 14	15:38	81	Ar
Day 3	Notification 15	15:48	81	Re
Day 3	Notification 16	19:55	80	Re
Day 3	Notification 17	20:34	79	Re

Table 12. Symbols used in the notifications table.

Symbol	Definition
In	Information: General information about the event.
Sp	Sponsor: Message sent by a sponsor.
Ar	Attendees Re-organization: To group the attendees if required.
Re	Reminders: Send reminders if necessary

On the first day, the application was installed by 59 people, which increased when the TET 2016 host recommended it, since it provided the location of the integration event that evening.

On the second day of the seminar, the users of the application increased by 15 people, since among the same attendees the application was recommended for users to have more information about the event.

On the last day of the event, the number of users of the application increased by two. After the end of the seminar sessions, the attendees began to uninstall the application.

Additionally, the organizers made a survey where they asked users how useful the application was and what rating they would give it.

6.1.4. Survey

A survey was conducted for the assistant's application in order to obtain feedback; the two most relevant questions were: Did you find the application useful? Thirty-two people answered this question, and 71.95% percent of the attendees approved of the application. The second question asked users what rating they would give to the application, where five is the best, and one is the worst. Thirty-two people answered this question, as follows: three people gave the rating ("1"), zero people gave the rating ("2"), nine people gave the rating ("3"), sixteen people gave the rating ("4"), and four people gave the rating ("5").

We can observe that for the attendees of the event, the application had a high level of acceptance, which means that the application performed well during the event, not generating any error, and was very useful both at the time of the sessions and during social activities; accordingly, the characteristics chosen and implemented were correct, thanks to the analysis performed before. Additionally, the work

of the organizers was facilitated, making it faster and more efficient. Therefore, they recommended the application and its implemented functions highly.

7. Discussion

The combination of NFC technology with MICE events is advantageous for many reasons during event development, where different actors are considered; in this case, we will focus on two—organizers and attendees. From the organizers' perspective, the technology allows for the optimization of time. This is seen at the moment of refreshments delivery and assistant control, where users were admitted by just bringing the NFC tag to the cell phone instead of marking the scarf of each assistant manually, saving a great deal of time. From the attendees' point of view, these characteristics could improve their social interaction, because approaching the ID with the NFC tag to the smartphone could share the contact information, allowing a quick and easy way to add a new contact to the smartphone, enabling communication and improving the experience of both organizers and attendees.

The system described in this article expands the influence of sponsors beyond physical advertising located in the event; they are also able to send advertisements in the form of notifications to all attendees. The objective of an event in the MICE category is to generate a pleasant and complete experience for all users. Thus, the intelligent design of this application simplified this goal. From the administrators' point of view, a better fluency of the event was achieved, since all aspects related to it worked correctly and efficiently.

Taking advantage of the fact that TET 2016 was a technology event, it was given an intelligent approach, allowing the attendees the use of NFC technology with mobile application. Thanks to its implementation, the attendees were satisfied with the system deployed, because the waiting times were minimal, and they had better social interaction as well as better communication with the organizers. The attendees used the application to view speaker information, schedule changes, and receive notifications from organizers.

An aspect of the NFC tags to highlight is their endurance and durability, since at the time of the development of the "TET 2016" event, they were put to the test in one of the social events, where in the course of the "Chivas Rumberas"—by giving the participants a small cultural sample of the city of Popayán—it was decided to play with Carnival Foam in the Pubenza carnival [20], wetting their smart ID and practically the whole body. Therefore, it would be thought that the NFC tag of the ID would suffer damages, but this did not happen—the next day in the delivery of snacks, the NFC tags continued working correctly, although the ID had been exposed to foam.

Currently, improvements are being made to the system, which include the following: the administrator can generate all the programming and relevant aspects of the event from a web platform, later creating an XML file with the necessary information to be entered into a mobile application. This application is initially a "blank" template; we are going to add some extra functions for other actors, such as entrepreneurs and the press. With this, it is possible to avoid the need of hiring a mobile developer for each event that is desired, having an easy-to-use system with great utility.

In order to see the scalability of the system developed and implemented, the following future work is proposed:

- Using other technologies in the development of the service, a good option may be the use of beacons, since they would improve the interaction of the attendees when using the service for indoor locations, when the physical site of the event is very extensive and has several pavilions. The beacons could help the user to locate and navigate easily, and a notifications option could be added, where the beacon would generate an alert when a user walks near a pavilion. This is a good option for a moderate cost and would greatly improve the interaction of the attendees and facilitate the work of the organizers.

- The performance of the service should be evaluated on a larger scale, implementing it in a big event with international reach that has physical space for its extensive development and several pavilions, to evaluate different factors and the feasibility of the service.

Finally, we describe the limitations of the service; in this case, being an application for academic purposes, the server of both the website and mobile applications was very limited. If it were desired to expand the device for use with a significant number of users, it would be necessary to have the funds for high-quality servers and support for them.

Another limitation is the public to whom the service is directed. It is not accessible to all people due to the use of a smartphone and NFC technology; the attendees need to have a medium–high economic level to obtain these devices and thus benefit from the complete experience of our service.

8. Conclusions

- The combination of NFC and mobile applications for the development of tourism in the MICE category shows a high level of acceptance by the participating public which allows us to conclude that events carried out with this type of technology will be improved by the logistics that are implemented.
- Many of the applications focus on the attendees without considering the other important players such as business people, organizers, press, and exhibitors.
- Approximately 41% of attendees used the application for this event (“TET 2016”).
- NFC tags allow organizers to have greater agility for making records of the attendants; this is because they are able to read the data faster with the application than in the standard way.
- During the three days, the number of application users increased, and the users had access to functions such as location GPS, notifications sent by the organizer, and schedule changes.
- The attendees who have the application are always up-to-date with the schedule changes.
- The NFC tags are very resistant to different factors such as weather, dust, cold, and heat.

Author Contributions: All authors collaborate equally.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Statista. *Smartphone Users Worldwide 2014–2020*; Statista: Hamburg, Germany, 2017.
2. Shota, N.; Michitoshi, N.; Erjing, Z. Student Attendance Management System with Bluetooth Low Energy Beacon and Andriod Devices. In Proceedings of the International Conference on Network-Based Information Systems, Taipei, Taiwan, 2–4 September 2015.
3. Baldo, D.; Benelli, G.; Pozzebon, A. The SIESTA project: Near Field Communication bases applications for tourism. In Proceedings of the 2010 7th International Symposium on Communication Systems Networks and Digital Signal Processing (CSNDSP), Newcastle upon Tyne, UK, 21–23 July 2010.
4. Araki, H.; Kim, J.; Zhang, S. Materials and Device Designs for an Epidermal UV Colorimetric Dosimeter with Near Field Communication Capabilities. *Adv. Funct. Mater.* **2017**, *27*, doi:10.1002/adfm.201604465.
5. Kirkup, J.A.; Rowlands, D.D.; Thiel, D.V. Team Player Tracking using Sensors and Signal Strength for Indoor Basketball. *IEEE Sens. J.* **2016**, *16*, 4622–4630.
6. Vedat, C.; Busra, O.; Kerem, O. *A Survey on Near Field Communications (NFC) Technology*; Springer Science + Business Media: Dordrecht, The Netherlands, 2012.
7. Egger, R. The impact of Near Field Communication on Tourism. *J. Hosp. Tour.* **2013**, *4*, 119–133.
8. El-kassas, W.; Solyman, A.; Faro, M. mTourism Multilingual Integrated Solution: A case Study “Egypt Travel”. In Proceedings of the eChallenges e-2014 Conference, Belfast, UK, 29–30 October 2014.
9. Shafiee, S.; Rajabzadeh Ghatari, A. Big Data in Tourism Industry. In Proceedings of the International Conference on e-Commerce with Focus on e-Tourism, Isfahan, Iran, 15–16 April 2016.
10. Senthill, V. A study of social media applications in Indian Tourism. In Proceedings of the 3rd International Conference on Computing for Sustainable Global Development, New Delhi, India, 16–18 March 2016.

11. Karouw, S.; Wowor, H. Designing minahasa toulour 3D animation movie as part of Indonesian e-Cultural Heritage and Natural History. In Proceedings of the 2014 International Conference on Advanced Computer Science and Information Systems, Jakarta, Indonesia, 18–19 October 2014.
12. Getz, D. Event Tourism: Definition, Evolution and Research. *Tour. Manag.* **2008**, *29*, 403–428.
13. ProColombia. Turismo de Reuniones en Colombia. Available online: <http://www.procolombia.co/actualidad/colombia-suben-escalafon-mundial-de-turismo-de-reuniones> (accessed on 22 August 2017).
14. Figueroa, A. Travel Definitions: What is MICE? Available online: <http://tourism.about.com> (accessed on 16 September 2017).
15. Archive.org. The Android Source Code. Available online: <https://source.android.com/source/> (accessed on 16 September 2017).
16. Expandedramblings.com. Android Statistics. Available online: <https://expandedramblings.com/index.php/android-statistics/#.WeVrqGjWzIU> (accessed on 16 September 2017).
17. Gartner. Gartner Says Worldwide Sales of Smartphones Grew 7 Percent in the Fourth Quarter of 2016. Available online: <https://www.gartner.com/newsroom/id/3609817> (accessed on 16 September 2017).
18. Support_google. Place an Order at the Google Store. Available online: <https://support.google.com/store/answer/6380409?co=GENIE.Platform%3DDesktop&hl=en> (accessed on 17 September 2017).
19. Php.net. What Is PHP? Available online: <http://php.net/manual/en/intro-what-is.php> (accessed on 20 September 2017).
20. Colombia.travel. Popayan a Breathtaking City in Cauca-Pubenza Carnival. Available online: <http://www.colombia.travel/en/where-to-go/pacific/popayan/activities/pubenza-carnival> (accessed on 28 September 2017).



© 2017 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0/>).