INTEREST BASED SYSTEM FOR INFRASTRUCTURE-LESS DENSE-COMMUNICATON SCENARIOS

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INTEREST BASED DATA ... ...HMM...SOUNDS CHALLENGING !!!

MOTIVATION OF THE WORK

CURRENT SITUATION:
- Nowadays, people are connected through smart mobile devices more than ever before.
- Wireless technologies and smart mobile devices are becoming an important part of "Internet of Things" concept.
- Combined with wireless and network sensors they present a product of smart environment development.
- Smart environment -> Huge amount of sensors sharing different data.
- Communication -> Dynamic and mobile. This leads to enormous amount of data generated.

TOPIC PROBLEMS:
- Challenge -> segregating and classifying big amount of data in a proper way.
- Device density problem -> How many nodes are optimal for effective data transfer?
- Infrastructure problems -> Dependency of infrastructure (malfunction, loss, connection outage).

IMPROVEMENTS:
- Ad-Hoc interest based connection where devices share data of their concern (Interested data).
- Improving a segregation and classification of data leads to better QoS, Latency and Network overload problems.

APPLICATION AREA:
- Education, Security aware situations, Tourism info, traffic, etc.

BROADCASTING.... "IS THERE ANYBODY OUT THERE!?" "I'M AVAILABLE TO COOPERATE..."

HEY, HAVE YOU EVER HEARD OF IBEACONS??

RESEARCH PLAN

- Data broadcasting experiments to find a best way of deploying data in a dense node network scenarios.
- Introducing user profiles to broadcasting scenarios and handling information advertisements according to different profiles.
- Developing the best solution for effective interest based information sharing in a node communication approach.
- Using a BLE iBeacon technology to build a dynamic content distribution system that classify users to different profiles.
- Developing a user interest taxonomy and applying it to dynamic content advertising system.

YOU MEAN THE LATEST BLUETOOTH TECHNOLOGY?

THESIS OBJECTIVES

01 Data gathering and systematization in high dense communication environment where nodes share information.

02 Choosing the best strategy for transferring data according to ad-hoc behaviour environment.

03 Decision making and density analysis in static and mobile node environment according to type of communication and sharing interests.

04 Distributing information in a dynamic way according to previously recognized user profiles.

NEXT YEAR PLANNING

2018 — Complete of Research / PhD document preparation

2017/2018 — Dense interest based system development / Data collection methods / Data analysis and interpretation

2016/2017 — Literature review and necessary equipment review / Case Study Analisys / Design of the interest based model / Adjusting communications tecniques to the model

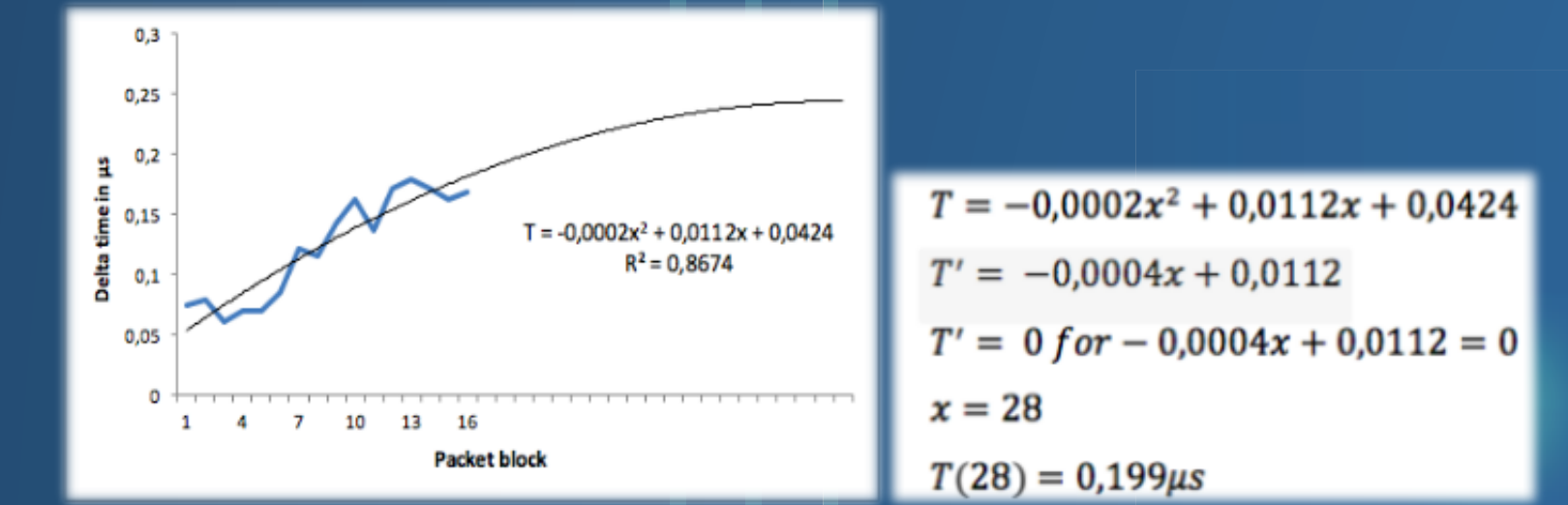**2015/2016** — Literature review and necessary equipment review
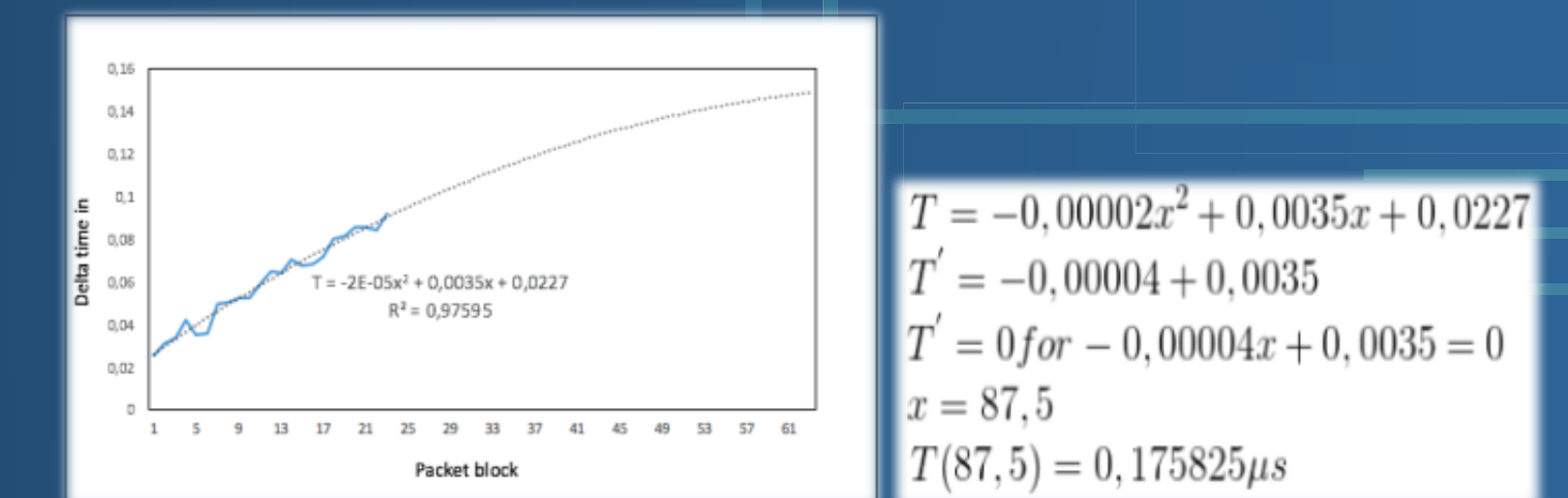
RESULTS & DISCUSSION

PART 1

Experimenting in the field of Bluetooth low energy advertising and conducting several static BLE node scenarios, showed us that broadcasting behavior of the BLE devices is different according to the density of network and the distance of the devices.

This behavior gives faster network saturation in the case when devices are in a closer range of advertising.

Maximum device delay multiple advertisers - 1 meter distance

$$T = -0,0002x^2 + 0,0112x + 0,0424$$
$$R^2 = 0,8674$$
$$T' = -0,0004x + 0,0112$$
$$T' = 0 \; for \; -0,0004x + 0,0112 = 0$$
$$x = 28$$
$$T(28) = 0,199\mu s$$

Maximum device delay multiple advertisers - 10 meter distance

$$T = -0,00002x^2 + 0,0035x + 0,0227$$
$$R^2 = 0,9759$$
$$T' = -0,00004x + 0,0035$$
$$T' = 0 \; for \; -0,00004x + 0,0035 = 0$$
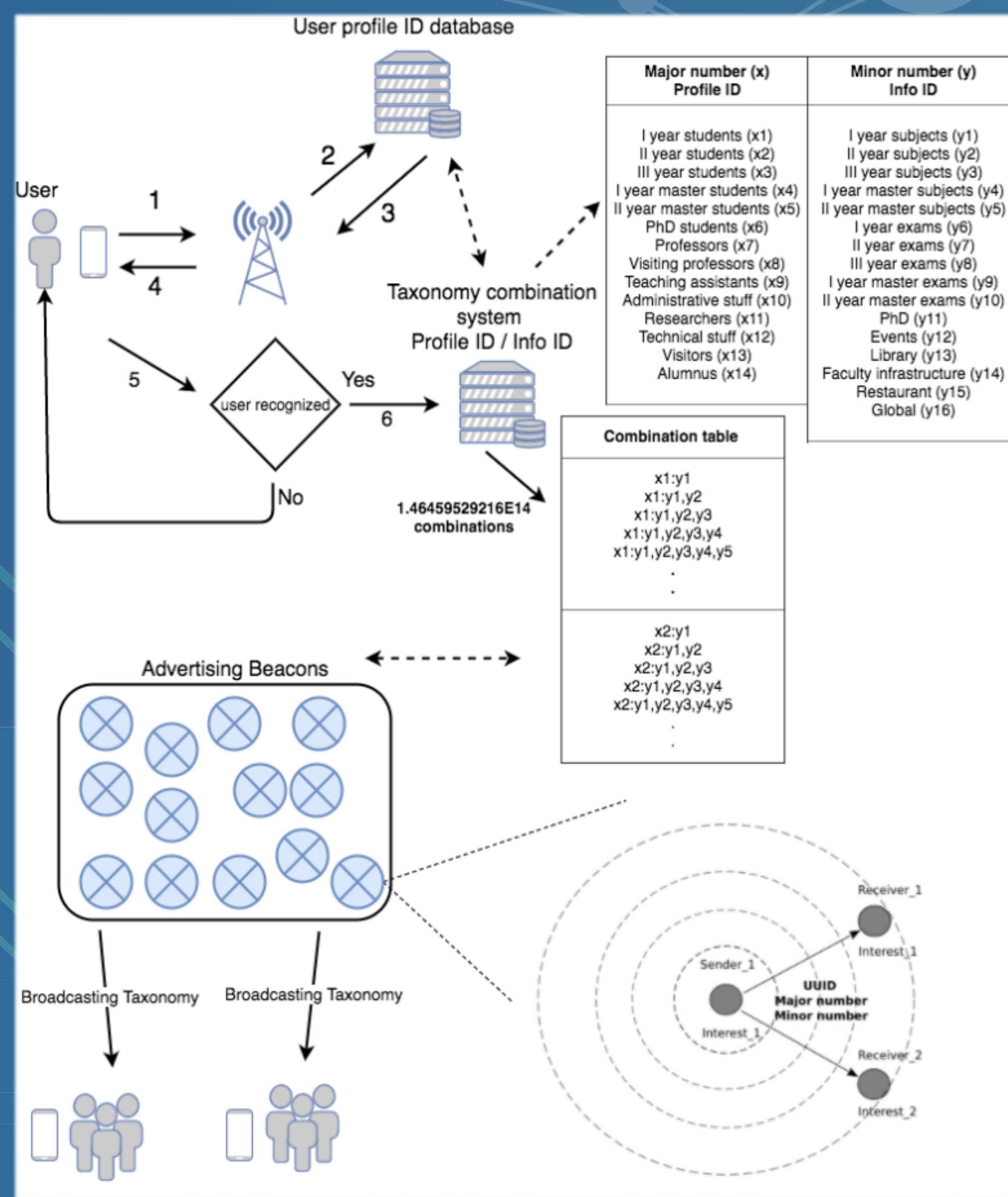$$x = 87,5$$
$$T(87,5) = 0,175825\mu s$$

Data above are part of the paper "BLE broadcasting impact in a real world environment, Miran Boric, Ana Fernández Vilas, Rebeca P. Díaz Redondo." Presented at: ICC '17, March 22 2017, Cambridge, United Kingdom Copyright 2017 ACM. ISBN978-1-4503-4774-7/17/03 DOI: http://dx.doi.org/10.1145/3018896.3018949

Presented data from part 2 are part of two papers "Miran Boric, Ana Fernández Vilas, and Rebeca P. Díaz Redondo. "An Interest-Based Dynamic BLE Beaconing System" and "Dynamic Content Distribution over BLE iBeacon Technology: Implementation Challenges", and are currently a subject of a journals review (Ad Hoc Networks & Wireless Personal Communications).
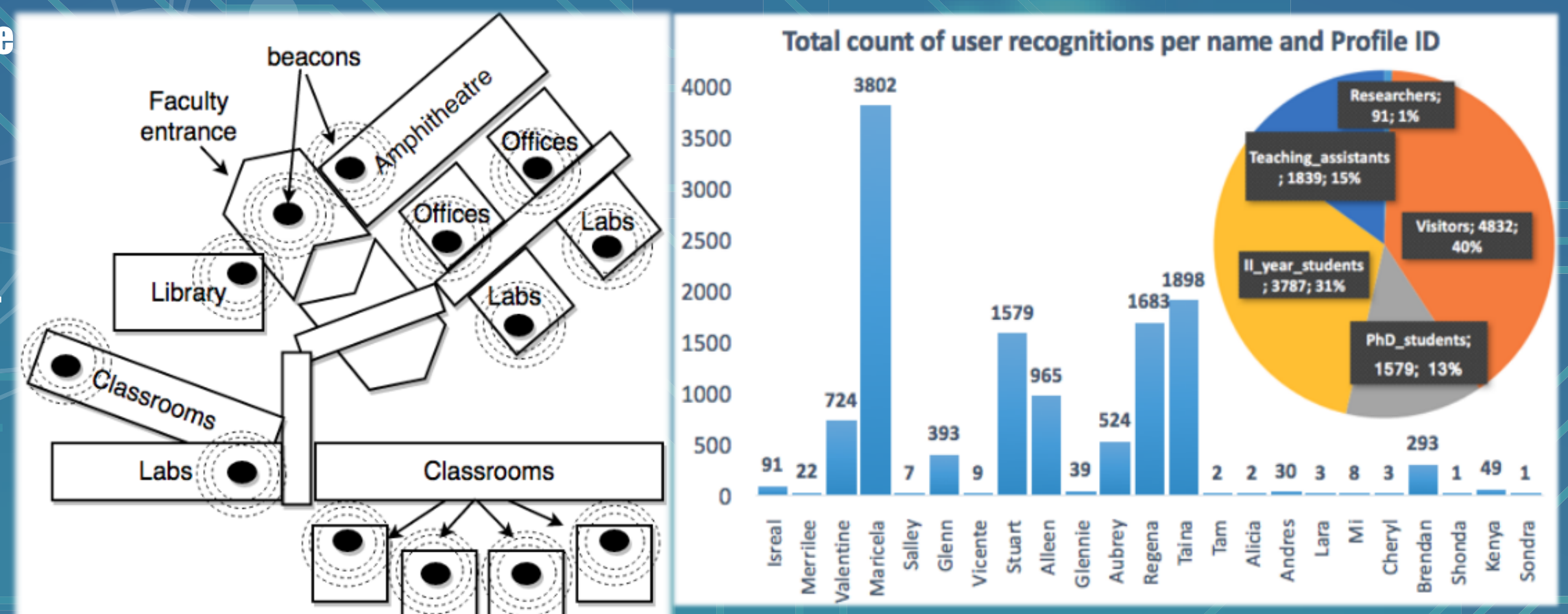
PART 2

By using Bluetooth Low Energy solution we add dynamism into the iBeacon advertisement process and model the concept of user interest within iBeacon architecture.

BLE ⟷ MAC ⟷ TAXONOMY ⟷ IBEACON

Users are automatically recognized from their MAC addresses. According to this, a user interest taxonomy is applied to customized iBeacon BLE architecture. After having deployed the system, the results showed its high potential to become a low cost, scalable solution for dynamic information distribution.

User profile ID database

Major number (x) Profile ID	Minor number (y) Info ID
I year students (x1)	I year subjects (y1)
II year students (x2)	II year subjects (y2)
III year students (x3)	III year subjects (y3)
I year master students (x4)	I year master subjects (y4)
II year master students (x5)	II year master subjects (y5)
PhD students (x6)	I year exams (y5)
Professors (x7)	II year exams (y6)
Visiting professors (x8)	II year exams (y7)
Teaching assistants (x9)	III year exams (y8)
Administrative stuff (x10)	I year master exams (y9)
Researchers (x11)	I year master exams (y10)
Technical stuff (x12)	PhD (y11)
Visitors (x13)	Events (y12)
Alumnus (x14)	Library (y13)
	Faculty infrastructure (y14)
	Restaurant (y15)
	Global (y16)

Combination table

1.46459529216E14 combinations

x1:y1
x1:y1,y2
x1:y1,y2,y3
x1:y1,y2,y3,y4
x1:y1,y2,y3,y4,y5
...
x2:y1
x2:y1,y2
x2:y1,y2,y3
x2:y1,y2,y3,y4
x2:y1,y2,y3,y4,y5

Advertising Beacons

Broadcasting Taxonomy

UUID
Major number
Minor number

DYNAMIC ADVERTISING SYSTEM IMPLEMENTED AT TELECO

Total count of user recognitions per name and Profile ID

Researchers; 91; 1%
Teaching_assistants ; 1839; 15%
Visitors; 4832; 40%
II_year_students ; 3787; 31%
PhD_students; 1579; 13%

Israel 91, Merrilee 22, Valentine 3802, Maricella 724, Sailey 7, Glenn 9, Vicente 393, Stuart 1579, Aileen 965, Glennie 524, Aubrey 1683, Regena 1898, Tana 2, Tom 2, Alicia 30, Andres 3, Lara 8, Mi 3, Cheryl 293, Brendan 49, Shonda 1, Kenya, Sondra

IBEACON ADVERTISING SYSTEM

NEW IMPROVED WAY — DYNAMIC CONFIGURATION
- MULTIPLE USER PROFILES
- ONE DEVICE NEEDED
- RECOGNIZING USERS
- PREDEFINED USER INTERESTS
- OPEN SOURCE
- ADVANCED BROADCASTING
- USING DIFFERENTLY BLE TECHNOLOGY
- SEGREGATING INFORMATION
- USER MONITORING
- SCALABLE SYSTEM

OLD WAY — STATIC CONFIGURATION
- ONE DEVICE - ONE USER PROFILE
- TOO MANY DEVICES NEEDED
- USERS NOT RECOGNIZED
- NONEXISTENT USER INTEREST
- COMMERCIAL SOLUTION

INFO DISTRIBUTION
INTERESTED DATA SHARING
USER CLASSIFICATION
PROFILE RECOGNITION

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