

# Asynchronous Contact

Luigi Liquori

#### Tracing

current development of SmartM2M TS 103757 standard







#### Contact Tracing systems in a nutshell

- Based on protocols that trace contacts between peoples and warn them if they had contact with a person that was tested positive for COVID-19
- Almost all of these protocols use:
- Mobile Applications and Bluetooth BLE underlay network
- Trace close contacts between 2 persons (usually the golden rule is 2 meters / 15 minutes)
- Interoperability of different apps: KO. Usefulness of those apps: TBD.

#### Asynchronous Contact Tracing: What is it?

- ACT is another way to do Contact Tracing
- It's an ETSI standard TS 103757 since 2021



SmartM2M; Asynchronous Contact Tracing System; Fighting pandemic disease with Internet of Things (IoT)

#### Asynchronous Contact Tracing: Features

- 1. It's inspired by an historical paper that invented *Group Testing*
- 2. It is Asynchronous because the user do not communicate any information with anyone, so respecting privacy
- 3. Not related to any time or space constraints

#### THE DETECTION OF DEFECTIVE MEMBERS OF LARGE POPULATIONS

BY ROBERT DORFMAN

Washington, D. C.

The inspection of the individual members of a large population is an expensive and tedious process. Often in testing the results of manufacture the work can be reduced greatly by examining only a sample of the population and rejecting the whole if the proportion of defectives in the sample is unduly large. In many inspections, however, the objective is to eliminate all the defective members of the population. This situation arises in manufacturing processes where the defect being tested for can result in disastrous failures. It also arises in certain inspections of human populations. Where the objective is to weed out individual defective units, a sample inspection will clearly not suffice. It will be shown in this paper that a different statistical approach can, under certain con-

# Test groupé de Dorfman

On teste un mélange du groupe.

 Si le mélange est négatif, alors les k individus sont négatifs.

 Si le mélange est positif, alors on teste les k individus individuellement.

# Asynchronous Contact Tracing: How does it works?

- It's Asynchronous, *i.e.* the user do not communicate any personal information with anyone (he just *listen* "IoT sensors")
- Any person visiting a potentially infected physical location at a given time take advantage of sensors installed around that physical position checking (semi) automatically *dirty water* or *hepa air filters*



# Asynchronous Contact Tracing: oneM2M<sup>©</sup> Architecture



# Few words on oneM2M ICON by TIM

A Home

Ł Export

A Resource Tree

**Jul Charts & Reports** 

API docs

ICON is an *implementation* of

ETSI oneM2M standard that

allows user to deploy IoT

devices as digital twins on

ICON cloud using RESTful API

*@Luigi: if you are late move to the Smart Mobile Application* 

**TIM** 

| Dashboard   |              |                 |                       |             |              | <b>å</b> ac <u>i</u> _t |
|---|--------------|-----------------|-----------------------|-------------|--------------|-------------------------|
| 1<br>Applications   |              | 3<br>Containers |                       | 499<br>CINs | 2            | Subscriptio             |
| View Details O  | View Details | 0               | View Details          | Θ           | View Details |                         |
| 琶 Server info   |              | C               | A Notifications Panel |             |              | 1                       |
| Server: Mobius:Yellow Turtle  |              |                 | ✓ Server connected    | i           |              | less than a minute ago  |
| Version: 2.3.4<br>Fork version: 0.4.0   |              |                 | of Server started     |             |              | about 4 hours ago       |
| Date version:   |              | View All Alerts |                       |             |              |                         |
| Server host: icon-as1<br>Server uptime: 03:48:03<br>Memory free/avail: 1892 Mb / 3974 Mb (44<br>Disk free/avail: 9 Gb / 18 Gb (52% free)<br>OS: Linux linux<br>CPU: 2 | % free)      |                 |                       |             |              |                         |

# Smart Mobile Application Implementation

- The ACT mobile application forks the wellknown Android Application called "WiFi Analyzer" (1ML+ download) and add some features (Kotlin programming language)
- To guarantee devices compatibility, we choose to fork an existing and maintained application instead of building all functionalities from scratch

| 17:32                      |                            | <b>X</b> i (5)    | <sup>R</sup> III .III 64 | %     |
|----------------------------|----------------------------|-------------------|--------------------------|-------|
|                            | ss Points                  |                   | Ŧ                        | н     |
| PlanetCampus (             | 84:23:88:d8:e              | c:58)             |                          |       |
| -65dBm CH 1<br>65Mbps 10 1 |                            |                   |                          |       |
| Compo ro.                  | 00.00.207                  |                   |                          |       |
| PlanetCampus (             | 84:23:88:d8:d              | 5:b8)             |                          |       |
| 2402 - 2                   | 422 (20MHz)                | RUCKUS WIREL      |                          |       |
| 😭 🔂 [NONE]                 |                            |                   |                          |       |
| PlanetCampus -             | Prive 004503               | 8 (84:23:88:98:d5 | i:b8)                    |       |
| -59dBm <b>CH 1</b> 24      | 12MHz ~8,8n                |                   |                          |       |
| IWPA21                     | 422 (20MHZ)                | RUCKUS WIREL      |                          |       |
| eduroam (84:23:            | 88:18:d5:b8)               |                   |                          |       |
| -60dBm <b>CH 1</b> 24      |                            |                   |                          |       |
| 2402 - 2                   | 422 (20MHz)                | RUCKUS WIREL      |                          |       |
| PlanetCampus (             | 84·23·88·d8·e              | c:58)             |                          |       |
| -65dBm <b>CH 1</b> 24      | 12MHz ~17,6                | m                 |                          |       |
| 2402 - 2                   |                            | RUCKUS WIREL      |                          |       |
|                            |                            |                   |                          |       |
| -65dBm CH 1 24             | 12MHz ~17 6                | (84:23:88:98:c3   | :48)                     |       |
| 2402 - 2                   | 422 (20MHz)                | RUCKUS WIREL      |                          |       |
| 👷 🔒 [WPA2]                 |                            |                   |                          |       |
| PlanetCampus (             | 84:23:88:d8:c              | 3:48)             |                          |       |
| -66dBm CH 1 24             | 12MHZ ~19,7<br>422 (20MHz) |                   |                          |       |
| A [NONE]                   |                            |                   |                          |       |
| eduroam (84:23:            | 88:18:c3:48)               |                   |                          |       |
| -66dBm <b>CH 1</b> 24      | 12MHz ~19,7                |                   |                          |       |
| IWPA21                     | 422 (20MHZ)                | RUCKUS WIREL      |                          |       |
| PlanetCampus (             | 84:23:88:d9:0              | 8:d8)             |                          |       |
| -69dBm CH 11 2             | 462MHz ~27                 | ,3m               |                          |       |
|                            | 472 (20MHz)                | RUCKUS WIREL      |                          |       |
| PlanetCampus -             | Prive 004503               | (84:23:88:99:08   | 3:d8)                    |       |
| -69dBm CH 11 2             | 462MHz ~27                 |                   |                          |       |
| <b>~</b>                   | 0                          |                   | ~                        | /     |
| Access Points              | Qualità Canali             | Grafico Canali    | Grafico <sup>-</sup>     | Tempo |

# ACT Mobile Application (new features)

17:41 🖪 🖸 📲 🙃 📲 .il 63% 💼 WiFiAnalyzer Choose if you want to run the app using the Normal mode or the ACT mode NORMAL ACT Ínría OLYTECH



| 18:45 E | • •  | ¥ 🖘 🛍 .iii 37% 🛢 |
|---------|--|------------------|
|         | Paramètres   |                  |
|         |  |                  |
| ••      | <b>Fréquence d'analyse</b><br>30                     |                  |
| **      | Location Scan Interval in 5                          | seconds          |
| ▼       | Distance filter in meters (<br>50                    | (-1=Off)         |
|         |  |                  |
| =       | <b>Trier les points d'accès p</b><br>Force du signal | ar:              |
|         | <b>Grouper les points d'accè</b><br>Aucun            | es par:          |
| -=-     | Affichage de la connexio                             | n                |
|         | Compact  |                  |
|         | Affichage des point d'acc<br>Détaillé                | bès              |
|         |  |                  |
|         | Graphique Puissance ma<br>-20dBm                     | ximale du sign   |
|         | Légende pour le graphiqu<br>Masqué                   | ue des canaux    |
|         | DATABASE BACKU                                       | >                |

# **ACT Display Application Implementation**

- It is a Web application that read an open source map showing the areas at risk of infection by identifying them through the access points installed
- Is possible to draw the area (polyhedral) for whic the user wants to check the contagion risk and apply time filters
- Developed using the Django framework via Python, HTML, CSS, JavaScript languages

@Luigi: stop, skip experiments and goto the conclusions



# Real size Experiments @ Inria building

Lagrange building, First floor



#### **Conclusions and Future Work**

- We have (approx) a Proof of Principle @ 2-3 TRL
- To apply Machine Learning algorithms for
- ritlatter of time ... let's keep ready with a iction Algoritheter of time ... ETSI standard no GPS) iction Algoritheter of rediceosy ET cases of COVID-19 on a matter of rediceosy ET cases of COVID-19 on protection source, and easy ET cases of COVID-19 on protection source • To apply Prediction Algorith rt virus is just the ACT Display
- nple, concrete
- We are looking for academic/industrial collaborations



#### PASTEUR'S QUADRANT

Basic Science and Technological Innovation

Donald E. Stokes

## Research vs. Standards



# **Detection Service Implementation**

- Is a server that receives a JSON by POST call
- It uploads this information inside the relative ICON container



17/27

# Local Service Implementation

- Is a server that receives a JSON by POST call
- It upload this information inside the relative ICON container
- It can send a POST call to the Detection Service to change his settings



# **Control Service Implementation**

- Is a server that receives a JSON by POST call from Local Service and PHA
- Receives the new JSON from the PHA & uploads the content in the local database and inside the relative ICON container
- Based on the geohash received, it provides to the user the list of Peripheral Services identified as infected



# Public Health Authority Implementation

- Is a simulation of the PHA, it receives a JSON from Control Service
- It defines the risk's degree according to the National Laws



# Asynchronous Contact Tracing: oneM2M Components Interaction



#### Fieldwork Experiments Results

False positive Total network ratio based on distance filter with 10 second of Scan interval on Samsung A52



Number of false positives based on the distance filter with 10 second of scan interval on Samsung A52



False positive Total network ratio based on distance filter with 10 second of Scan interval on Umidigi F1 Play



Number of false positives based on the distance filter with 10 second of scan interval on Umidigi F1 Play



22/27

# Asynchronous Contact Tracing: Geohash

- Geohash is a public domain geocode system which encodes a geographic location into a short string of letters and digits
- It allows to know in what area of map the user is
- It also provide a degree of anonymity as we don't expose the exact position of the user

Digits and precision in km [edit]

| geohash length | lat bits         | Ing bits | lat error | Ing error | km error |
|----------------|------------------|----------|-----------|-----------|----------|
| 1              | 2                | 3        | ±23       | ±23       | ±2500    |
| 2              | 5                | 5        | ±2.8      | ±5.6      | ±630     |
| 3              | 7                | 8        | ±0.70     | ±0.70     | ±78      |
| 4              | 10               | 10       | ±0.087    | ±0.18     | ±20      |
| 5              | <mark>1</mark> 2 | 13       | ±0.022    | ±0.022    | ±2.4     |
| 6              | 15               | 15       | ±0.0027   | ±0.0055   | ±0.61    |
| 7              | 17               | 18       | ±0.00068  | ±0.00068  | ±0.076   |
| 8              | 20               | 20       | ±0.000085 | ±0.00017  | ±0.019   |