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# Mobil system in M2M environment

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**Abstract—** In this paper, we present a prospective approach to integrate mobile (smartphone and tablet) system in M2M environment based on M2M ETSI standard.

**Keywords-component; M2M, ETSI, ONEM2M, Fiware, mobile system, interoperability.**

## I. INTRODUCTION

The expansion of the Internet sometimes seems out of control with the connection of new servers every day. These servers offer many different services, like online shopping, telecommuting, online gaming, on-demand multimedia services (video, audio) and data storage (data, voice).

Mobile systems also participate this expansion and are part of our daily lives. They are perceived as personal items that go beyond the standard phone functionality. Personal mobile systems must be able to communicate with objects without the end user cares about the complexity or interoperability issues. In this context, one sees many solutions whose perimeter is relatively small: proprietary solution, no standard protocol, interoperability limitations etc. Of this, mobile systems used as a real remote face a true vertical segmentation applications. Although the state of the art provides solutions, there are few mobile platform that have implemented a true M2M solution in a recognized standard.

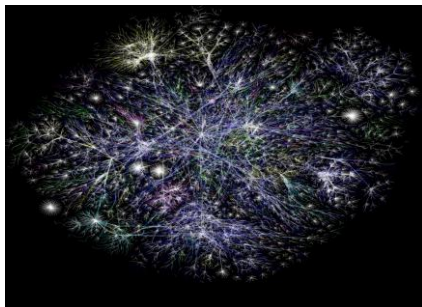


Fig. 1 – Internet cloud

Section II provides an interoperability solution proposed by ETSI . Section III presents the integration in a mobile system with Android support. Section IV presents the solution performance and the points that are subject of future studies and improvements.

## II. INTEROPERABILITY MODEL

The key point is M2M systems interoperability. M2M objects must have the ability to communicate , to understand , to

organize themselves in order to render the best service to the end user. On this principle , it is necessary to define a structure for M2M systems. In this context , the ETSI [1] model provides a standard for the organization, the behavior of M2M software and a representation of the data structures. The implementation of the recommendation is possible with free and many technologies.

### A) Structure of ETSI data

The general model must allow to express the information as a resource tree, this model is identified by a composite pattern that provides an elegant solution to model tree structures:

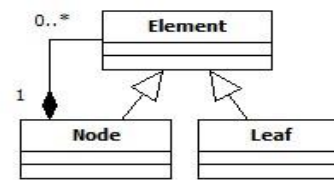


Fig 2 – Composite structure

The originality lies in the fact that tree structures are standardized. A client system can then easily identify the resources made provisions but also subscribe to resources on the principle of publish- subscribe.

### B) Structures of ETSI components

The ETSI models [1] provides a structured form of software components called SCL (Service Capability Layer).

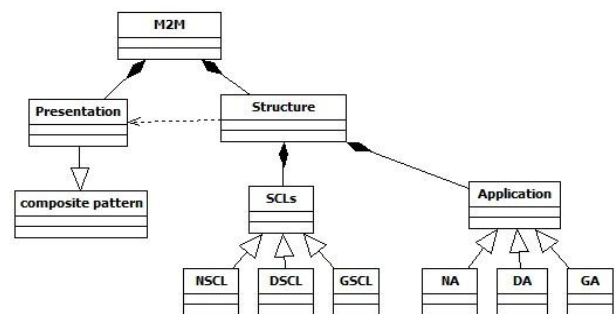


Fig 3 – ETSI structure

SCL allows structuring a functional distribution of services. The main services are as follows [3]: NSCL (Network SCL), DSCL (Device SCL), GSCL (Gateway SCL):

- NSCL: Network Service Capabilities Layer refers to M2M Service Capabilities in the Network Domain,

- DSCL: Device Service Capabilities Layer refers to M2M Service Capabilities in the M2M Device,
- GSCL: Gateway Service Capabilities Layer refers to M2M Service Capabilities in the M2M Gateway.

These services are modular and allow to structure most systems that we can conceive, be they conventional systems hosted on servers or to different mobile systems components or hybrid models.

Components of the application such as NA (Network Application) , DA ( Device Application ) , GA ( Application Gateway ) are Associated with SCL corresponding services. These applications perform the data processing and their representation.

### III. ETSI MODEL IMPLEMENTED IN MOBILE SYSTEM

Mobile phone systems such as Android smartphone , have software features that require transposition of the model in order to use the software components as proposed by ETSI. In the context of a mobile system , several solutions are possible:

- Embedded a GSCL to link the smartphone to a more complex system , here the NSCL acts as a gateway,
- Embedded DSCL a federating data and communicates with a NSCL.

#### A) DSCL embarqué

The onboard DSCL offers a better level of integration that GSCL in the M2M environment and allows local produce treatments thanks to the computing power of the smartphone. The embedded SCL may be a GSL but in this case the mobile system is perceived as an external entity that collects and simply relays the information to a NSCL . In the context of embedded DSCL data is relayed to a NSCL who then proposes the presentation layer of a specific composition according to ETSI pattern . The operation of the application generally follows the standard proposed by ETSI with specific facilities for the Android platform target .

#### B) Access to NSCL

The NSCL is external and is located in a local network in the case of our experiments. The NSCL informs SCL available.

#### C) Implementation model

The composite model ETSI transposed to the Android platform is:

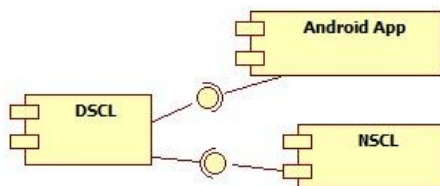


Fig 4 – Component diagram for embedded solution with ETSI structure

The embedded solution derived from the Eclipse project OM2M [2] is a REST-style solution which allows better integration of the mobile system in the context M2M . The choice of the architecture depends on the ability of the host system to process the data.

#### D) Design model

The embedded application uses the Android SDK. The application class is derived from the Activity. The DSCL is used as a service and derived class service. An Android application works with its own process ( sandox ) , then it is necessary to use the system to communicate AIDL . The DSCL must then implement a communication interface.

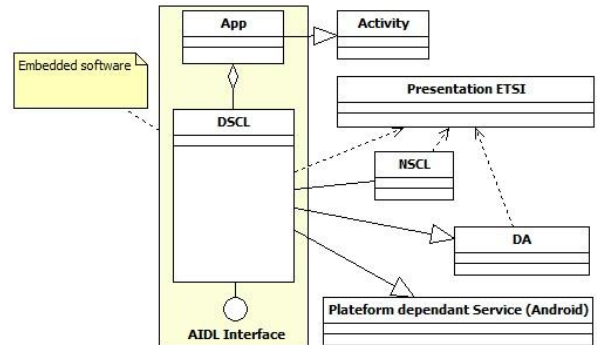


Fig 5 – Mobile embedded solution with ETSI structure

#### E) Subscription DA - DSCL - NSCL

ETSI The model is based on the principle of publish-subscribe . For each posted data , a notification is sent to the registered applications.

According to the ETSI model, we can distinguish several phases:

- Phase 1: The mobile application is recorded in the DSCL (creation of M2M application) , the NSCL is updated with mutual discovery (1,2,3,4) .
- Phase 2: application in DSCL subscribed to receive notifications ( 5).
- Phase 3: creation of happy bodies (6) , notification of data (7, 8, 9).
- Phase 4 : End of subscription application.

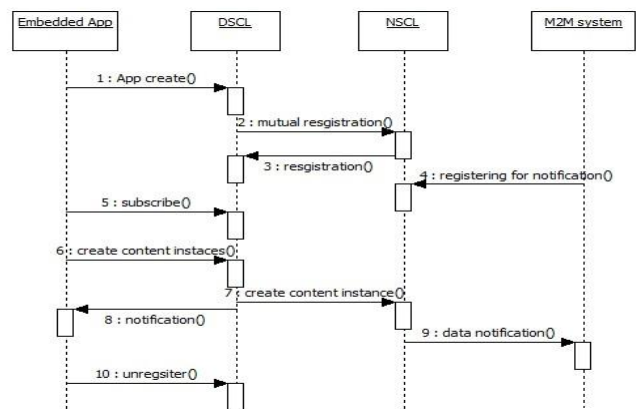


Fig 6 – Application diagram sequence

### F) Deployment diagramm

Applications use DSCL component to register and also to subscribe to the published data. Data is stored in a OMRLite database. The embedded Jetty server can communicate to http NSCL.

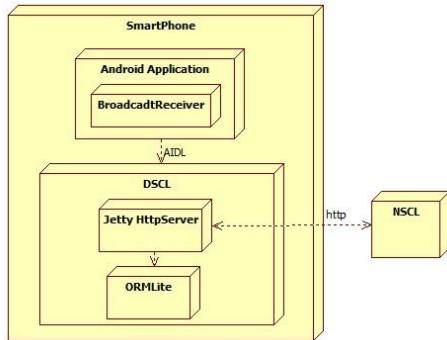


fig 7 – Deployment diagramm

### G) Arbre de ressource

The resource tree follows the ETSI standard . It is available via the DSCL or from the NSCL giving a reference on the DSCL.



Fig 8 – Embedded solution with ETSI structure

Attribute objects in the resource tree are also compatible with the ETSI standard.

Attribute	Value
accessRightID	nscl/accessRights/AR_ADMIN
searchStrings	<div style="border: 1px solid #ccc; padding: 5px;"> <p style="text-align: center; margin: 0;"><a href="#">searchString</a></p> <p>ResourceType/Scl</p> <p>ResourceID/dscl_8ab03cc0_17a2_4ef5_bdcc_75453fe87b58</p> </div>
pocs	http://140.93.64.167:8080/om2m
onlineStatus	ONLINE
serverCapability	true
link	<a href="#">dscl_8ab03cc0_17a2_4ef5_bdcc_75453fe87b58</a>
expirationTime	2046-05-14T16:04:32.031+02:00
creationTime	2014-09-05T14:17:53.031+02:00
lastModifiedTime	2014-09-05T14:17:53.032+02:00
mgmtProtocolType	OMA DM

Fig 9 – Embedded solution with ETSI structure

### H) Not ETSI external application

Most applications are not in a standard M2M and most of the time must be re- written to the built environment M2M power. Android applications are often associated with a content provider . A content provider is a software layer that provides access to application data ( phone , multimedia , calendar ... ) . Provided that the content provider application gives permission then it is possible to develop an external application with a listener on the provider and happy and power the DSCL.

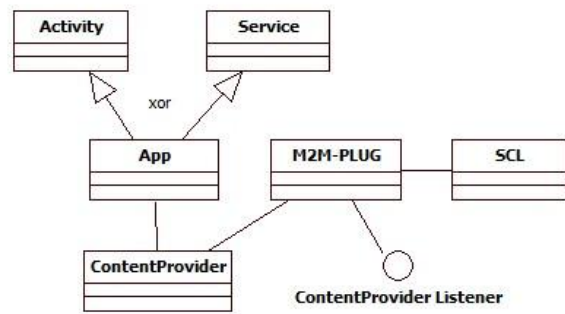


Fig 10 – Embedded solution with ETSI structure

In figure 10, the class M2M-PLUG can enable the interconnection of an application to a M2M environment. However, this only allows the transfer of data by feeding Content Instance . Superscriptions of complex phases can not be achieved in this type of approach.

M2M applications sometimes require real-time processing, however by default smartphone are not equipped with a real-time kernel. The only treatment to prioritize requests in a queue.

## IV IMPLEMENTATION OF EMBEDDED MODEL

For our experiments, we chose cardiotracking an embedded application on a smartphone. This application has become a standard, there are currently many commercial solutions. Most of these applications are however not open to M2M standard, we will show here how to adopt the structure presented in the previous chapter.

### A) Structure

Cardio tracking application registers with the DSCL and publishes data [fig11]. NA type applications (Network Application) can then subscribe and receive data to perform specific treatments for example.

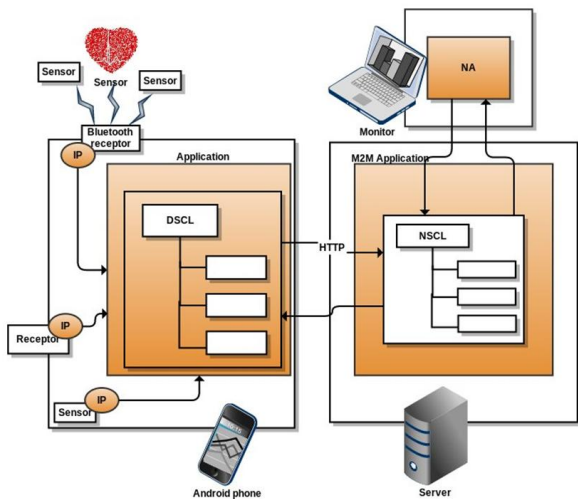


Fig 11 – Embedded application in mobile phone

Opening the field for embedded mobile applications is very large. On a mobile phone even more sensors may be used.

### B) Internal Implementation

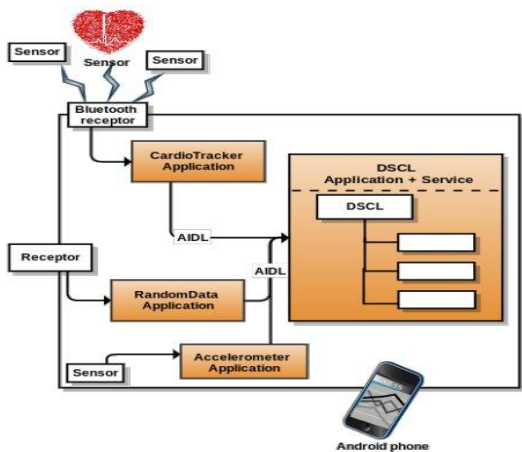


Fig 12 – Embedded application in mobile phone

Android APIs enable integration without great complexity . However the translation of ETSI structures to the android platform asked many adaptations . The use of Android Interface Definition Language ( AIDL ) defines a common interface for access to DSCL .

### C) Performance

Using a REST protocol defines a minimum understanding between the different SCL . Transactions between the various internal components are made at low frequency (about 1 Hz ) and do not disturb the overall operation of the smartphone. The most critical point is to ensure stable behavior over time.

### D) Security

System security is fairly basic since it is based solely on the native Android system security:

- Protection of directories and files,
- Process executed in independent process.

### E) Consumption

One of the main challenges in embedded applications and reduce energy consumption. In the example of DSCL , it is necessary to optimize communications http by sending packets with a maximum payload [4]. To save battery, we must :

Optimize data transfers:

- minimize the frequency of transfers,
- minimize the size of the payload data (bandwidth),
- optimizing the timing of transfers according to [4].

The following means:

- consolidate shipments / data recovery,
- transfers or eliminate non-critical periodic polling,
- assess the criticality of data.

## V CONCLUSION

ETSI has a software model and structural structuring interesting for heterogeneous M2M communication systems. In the field of mobile systems , we were able to demonstrate that a smartphone can incorporate important M2M capabilities with a relatively negligible impact on system power consumption .

Our study does not address the safety aspects and is based solely on the security of the Android platform; however ETSI recommended standard that could be considered.

This model developed with ETSI approach can also be integrated into the concept Fiware [5] through an IOT agent.

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