# MEK: Using Spatial-Temporal Information to Improve Social Networks and Knowledge Dissemination

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**Abstract**: Most of the projects which envision knowledge dissemination, collaboration or knowledge management have aim at creating an unique knowledge base, where all items acquired are organized according to a simple classification, and supposedly shared and focused. This kind of 'centralized' approach shows some inconsistencies in relation to many of the theories that deal with knowledge, in which distribution and sociability are essential characteristics for the creation and sharing of knowledge. This incoherence partially explains the reason which leads many users into abandoning this kind of system because they have to adapt themselves to a classification and a rigid representation of the knowledge structure. On the other hand, a lot of tacit knowledge and interaction possibilities are lost in this centralized vision. So, based on the advantages of a distributed approach for knowledge dissemination and the improvement of interaction, we designed and constructed the Mobile Exchange of Knowledge (MEK). This approach involves, in a mobile way, the exchanging of knowledge between people who share the same interests. Some issues like ad-hoc networks, social networks, location prediction and distributed knowledge management are also related to MEK concept. However, to verify how effective our idea is we conducted an experiment in the geographical space of an university in Brazil where we analyzed the movements of students and also their interest and willingness to share knowledge items.

**Keywords**: CSCW, Knowledge Management, Mobile Computing, Distributed Collaboration, Social Networks.

## 1 – Introduction

The current revolution in wireless technologies brings new perspectives for communication and interaction in society. New communication and interaction trends began with the popularization of the Internet in 80s, and took a radical turn with the advent of mobile telephones (90s), wireless networks, and mobile devices, or PDAs, and notebooks. We can therefore point two new different characteristics on the way people

interact, at work or in their free time. First of all, time and space are no longer a problem. People can work and play anytime and anywhere, having just an Internet connection for it. The second difference is that human interactions are easier than in the past, although this is quite often just temporal. You can find and interact with people to help you with a specific problem, or to play, but these interactions are weak and are lost at the end of the task, game or Internet connection.

These points relate to a new phase of life, named cyberculture [1]. Cyberculture starts to involve people and objects in a widespread connection environment: no more access points, but places. Lévy [1] argues that with the spread of the Internet new forms of knowledge and new forms for its distribution emerge and these new forms transform not only the ways we manipulate information, but it alters society itself. According to Lévy [1], cyberculture is synonymous with this change as it refers to the 'set of techniques (material and intellectual), practical habits, attitudes, ways of thinking and values that develop mutually with cyberspace' and embodies 'a new form of universality: universality without totality'. Morse [2] defines cyberculture in a way that partly corresponds to Lévy's understanding. She sees cyberculture as an emerging juvenile and thus a predicated rather than a retrospectively reflected phenomenon. Similarly to Lévy, she defines cyberculture as a set of cultural practices enabling us to deal with new forms of information. Escobar's concept of cyberculture is not explicit, and remains generally contextual [3]. Cyberculture, according to Escobar [3], is defined by its relation to computer and information technologies, which 'are bringing about a regime of technosociality', and by its relation to biotechnologies, which 'are giving rise to biosociality'. These cultural regimes, a kind of discursive and narrative framework, "form the basis for … the regime of cyberculture". Escobar conceives cyberculture as a cultural mode that involves '...the realization that we increasingly live and make

ourselves in techno-biocultural environments, structured indelibly by novel forms of science and technology. [...] Despite this novelty, however, cyberculture originates in a well-known social matrix, that of modernity, even if it orients itself towards the constitution of a new order – which we cannot yet fully conceptualize but must try to understand...' [3].

So, in cyberculture, all use is part of a great network and somehow we are connected in an e-environment. With the development of mobile computing (and its devices such as laptops, PDAs and mobile phones) this kind of culture and its spaces are extending to a ubiquitous and pervasive scenario. We are in the era of a 'collective which is distributed' and the collective is the partial and temporal aggregation of many items. This connection scenario is changing the way people interact with space as the world takes some new dimensions [6]. According to Mitchell [4], 'gradually emerging from the messy but irresistible extension of wireless coverage is the possibility of a radically re-imagined, re-constructed, electronic form of nomadicity – a form that is grounded not just on the terrain that nature gives us, but in sophisticated, well-integrated wireless infrastructure, combined with other networks, and deployed on a global scale". Ito [5] give us an example about this disconnected scenario of this wireless network, and specially, on how people are interacting now, '…Because of this portable, virtual peer space, the city is no longer a space of urban anonymity; even when out shopping, solo youths will send photos to friends of a pair of shoes they just bought, or send fast-breaking news about a hot sale that is just opening. After meeting face to face, a trail of text messages continues the conversation as friends disperse on trains, buses and on foot, nimble thumbs touch-typing on numeric keypads.' [5].

The most popular and notorious mobile device is the mobile phone. Today, mobile phones have functionalities which have gone beyond the simple telephone call.

The modern mobile phone has GPS, photographic camera, and one can see photos, watch movies, listen to music, browse the Web, send text messages (SMS[1]) amongst other features. According to Ito [5] 'not too have *keitai* (cell phone) is to be walking blind, disconnected from just-in-time information on where and when you are in the social networks of time and place.'

Based on this scenario our hypothesis is that mobile technologies can be used to disseminate knowledge (in a pro-active way) and improve social networks. People often have the need to search for knowledge when they leave their physical spaces: either in their office, at home, or in college. And it is exactly at this moment that the concept of the Mobile Exchange of Knowledge (MEK) enters the arena.

From a MEK standpoint, each individual is a single, however disconnected, knot in a great entanglement of information and knowledge that is freely circulating everywhere but almost never interacting with each other. So it is more than logical that we have to have these knots make contact and change information in the most passive and transparent way for the people who will be involved in the process.

This transparent sharing would be possible through mobile devices such as cellular and pocket computers that would be carrying out the exchange of common interests, regardless of their users participating of an active interaction with the involved person, in such a way that, at the end of the day, any participant of a network where MEK is in operation could upload to his/her PC the sum of acquired information and verify the usefulness or not of what was absorbed from other people.

This work was born aiming at the improvement of the way people acquire and share the knowledge they possess so that more people can have increasingly faster

[1] SMS - Short Message Service

access as regards what they wish to further, making knowledge the most democratic and distributed thing possible.

To give validity to such concept and show the amount of information, of our own interest, with which we cannot make contact in our daily routines, an experiment was carried out with students at the Federal University of Rio De Janeiro (UFRJ), in Brazil, where they had to fill an online questionnaire where they named their interests, the degree of sharing of such interests (desire to acquire, knowledge possession, willingness to supply knowledge, and no interest in the matter) and some data that would help us trace their ways in time and space (days when the subject has lunch at the university, classes where one studies, what bus stop one embarks on, if one uses the bus or a car, etc.).

To describe this approach, we will be executing the concepts related to the work (section 2). To demonstrate the validity of this proposal, the experiment was carried out, and its results are explained in this work (section 3), as well as some application scenarios (section 4). Related works are also cited and compared (section 5). We then move onto the respective conclusions and possible future work (section 6).

## 2 – Mobile Exchange Proposal

Even with all the evolution in the Internet and the area of mobile devices, such as cellular phones, Smartphones and pocket PCs, many people still remain as small islands of knowledge, in many cases isolated, waiting to be discovered so that such knowledge can be propagated.

We try to fill this gap with MEK and make use of the idle moments of search to improve a social network and to disseminate knowledge in a pro-active way, as in

Figure 1. Such moments are those where a person could not be looking for information in which one would like to go deeper, or even those that one does not possess, but a moment in which one would like to acquire information.

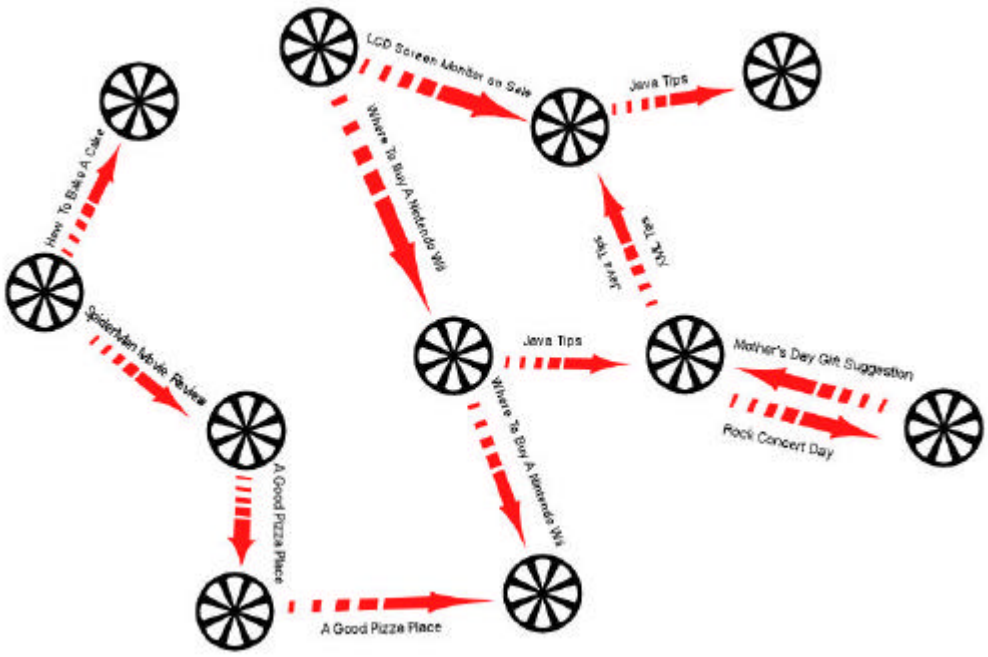


**Figure 1 - MEK Network Concept**

There are idle moments of search, and they can easily be identified, since they are present throughout the hours of a person's day. To illustrate it we will pinpoint all the activities that a degree student, whom we will call 'Enrique' (Figure 2) would have on one normal day and will enumerate the ocean of knowledge exchange opportunities regarding common interests that could be happening while one carries out one's daily chores.

*After waking up and dressing up Enrique has his morning breakfast with his brotherhood colleagues (1) preparing himself for his first day of class in the semester. After that he takes the bus to college (2). Having arrived, he walks the corridors filled with people (3) until he finds his classroom where he remains until the end of the lesson*

*(4) after which he leaves to the college cafeteria for lunch (5). Having had lunch Enrique remembers he has an appointment with his dentist and that makes him leave college earlier. Entering the commercial building he takes the lift with some other people (6) and follows to the dentist's surgery where he remains in the waiting room with other patients waiting to be called (7). After the appointment he goes to the gym (8) and from there he goes to the supermarket (9) and finally returns to the student's residence hall.*

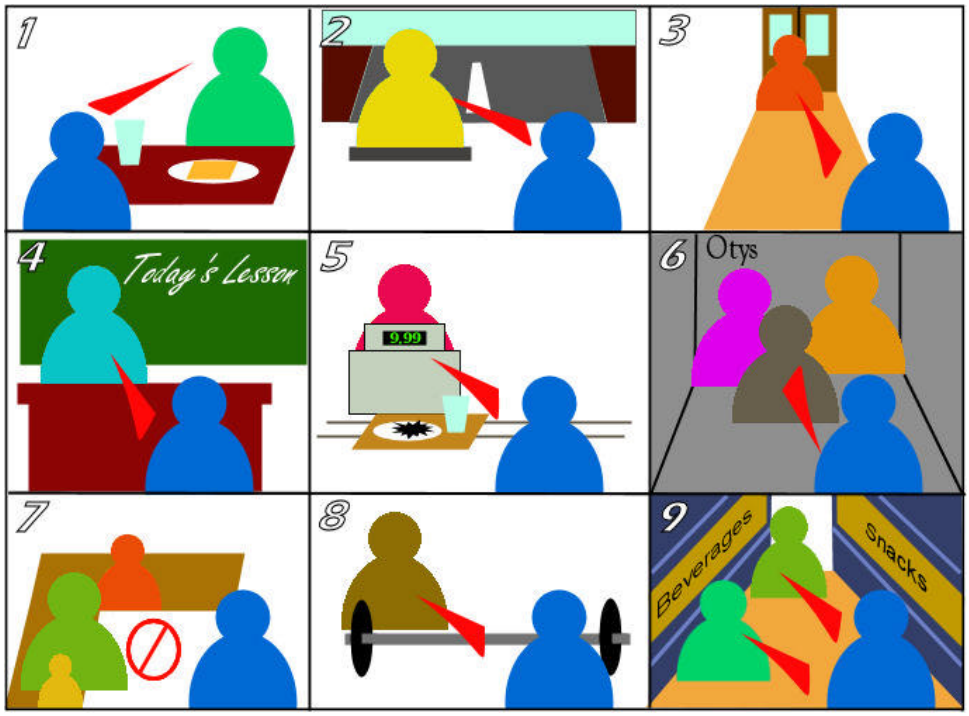


**Figure 2 - Enrique's Exchange Instances**

Now, we will see the gains that the Mobile Exchange of Knowledge could provide in each occasion:

*(1)* – Enrique's portable device found an equivalent device with one of his friends, who was going to be at a birthday party, at the local pub that evening.

*(2)* - An exchange with the driver is carried out and Enrique gets to know that the price of the bus ticket will be increased in one week.

*(3)* – Passing by an unknown girl in the corridor, the devices carry out an exchange that informs the sudden change of classroom between History III and Physics Fundamentals I.

*(4)* - The personal assistant of the professor wires all the data and knowledge related to the lesson of the day.

*(5)* - The nutritional factor of that day's meal is not only acquired, from a device built into the cashier's point, as well as a cellular of a boy seated two tables behind Enrique informs the latest new TV series features, E.R.

*(6)* - At this point, Enrique is the one who supplies a man with information regarding dog races.

*(7)* - Although there was a lot of information circulating in the waiting room in the doctor's office, none served Enrique's needs and he does not possess in his device any information that could be useful to the ladies that were there.

*(8)* - He receives information about his gym series of exercises from the instructor, as well as supplies information on where to buy nutritional supplements for two other people who were sharing equipment with Enrique.

*(9)* – He discovers a new sweet on sale at the market from one of the employee's devices who was doing a markdown of products. He also discovers that day the place and how much it will cost to go to a show of a rock band he loves.

Of course the examples above are merely illustrative, but the mobile exchange of knowledge could be applied to a professional scenario to solve problems, FAQs, complementation of knowledge and identification of interests, for example.

In the nine cases above we could see the moments where the exchange occurs and what could be exchanged. Not only information exchange, but in all the examples

there are some implicit opportunities for social interaction (when people with the same interests are identified) and possibly, tacit knowledge exchange.

## 2.1 – Mobile Exchange in a Nutshell

When we say MEK, we mean a ‘carry and share your knowledge anytime-anywhere’ philosophy. So we are saying that we have three main objectives:

1. Maintain bits of knowledge acquired by the user. This kind of acquisition can be achieved by the MEK system installed in a mobile device or inputted directly, carried out by a synchronization process with the desktop. These knowledge items can have multiple formats like hyperlinks, text, files, etc.
2. To be a knowledge seeder, because it has the possibility of sending one knowledge item to a variety of people that are interested on that kind of subject.
3. Capture and acquire knowledge from a number of people about subjects of your interest. This acquisition can happen with the exchange of explicit knowledge and also in the interaction between persons, in which case we can have the exchange of tacit knowledge.

What makes MEK so innovative is the transparent way in which knowledge is browsed through and shared between the participants of the invisible network that connects its users. This means that the user does not have to interact with MEK once he/she has configured the kind of knowledge items one is interested in. Even when one goes for a walk in the street one could be exchanging information about a film director one likes or about a restaurant that opened near his work. An user could, for instance,

obtain knowledge on a event one did not expect but that would be interesting. As in Figure 2 (box 9) where the user could be a rock fan and end up by acquiring passively the knowledge of a ‘Rock Concert Day’.

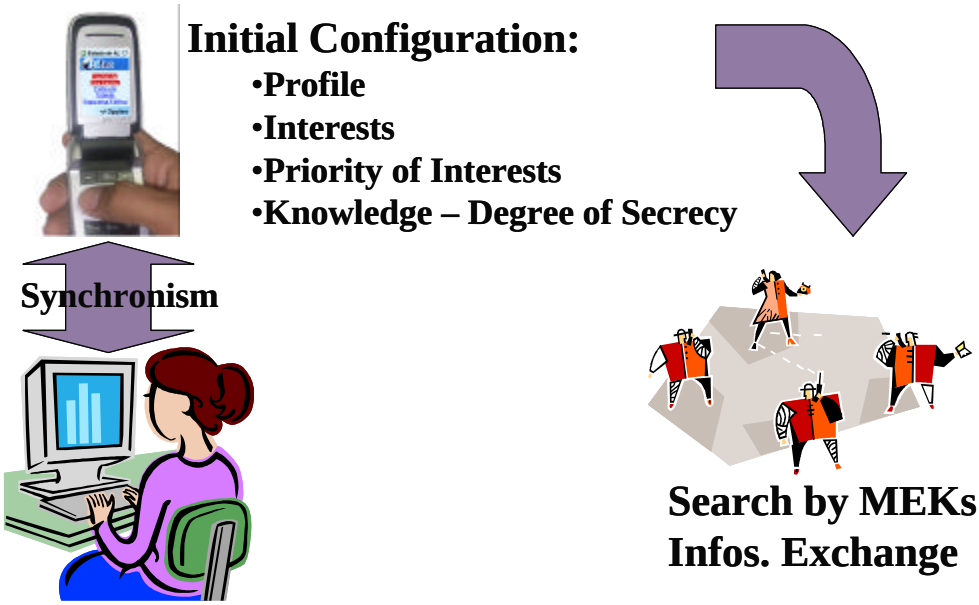


**Figure 3 - Steps in MEK's Usage**

Before any exchange occurs it is necessary that the user who possesses the system installed in his/her portable device configures certain basic parameters related to personal information and interests he/she, in some way, would like to be exchanging with other users. As personal information, no mention is made of the user’s name, his/her address (optional), his/her telephone – office and home - number (optional), his/her mobile telephone number, his/her competences and the degree of competences (high, medium, low levels), and his/her attention status (‘available’, ‘busy’, ‘do not disturb’). Interests are categorized and the user can define some priorities about them. In our scenario, the interests and the information can be categorized using different

concepts and knowledge areas defined by CNPq[2]. CNPq created a 'Knowledge Areas' classification table, which is used by all research centres in Brazil. It is the Brazilian attempt to establish an unique classification, a national ontology on which academic systems and digital libraries can lean upon. The knowledge areas classification has an eminently practical purpose: its function is to provide an agile and functional way to classify and organize information for Science and Technology Institutions. This classification has some main areas, such as Exact and Earth sciences, Biological Sciences, Engineering, Health Sciences, Agrarian Sciences, Applied Social sciences, Humanities, Linguistics, Languages and Arts. Each area contains a sub-tree with further concept categories. In Brazil, all scientific information and researchers profiles are classified using CNPq's Knowledge Areas and this is one of the reasons why we decided to use it from the start. Users can identify the areas of interests in CNPq's Knowledge Areas and mark the degree of sharing they have which, in the case of the system, has four positions ('Possesses that Knowledge', 'Willing to Acquire', 'Willing to Supply', 'No Desire to Share'). It is important to point that the 'No Desire to Share' option exists for cases where a certain subject would not, temporarily, be willing to acquire data on a specific subject but could later be willing to have it back on his/her list. Otherwise the user can simply delete such interest. Finally, an ordinance can be executed according to priority with the selected interests and a classification into some categories such as: 'Personal Interests', 'Entertainment', 'Professional Interests', 'Academic Interests' and 'Nothing Important'.

The user profile, interests and knowledge can be disseminated. The knowledge which can be distributed includes: ideas, news, hypotheses, symptoms, problems,

[2] The National Council for Scientific and Technological Development (CNPq) is a foundation linked to the Ministry of Science and Technology (MCT), to support Brazilian research.

solution attempts, event notifications, materials (papers, technical reports, e-books, etc), and excerpts from forum discussions, mental maps, queries, experiments, links and images. Users should identify the knowledge item in some CNPq Area (at least one), the type of knowledge (such as 'idea', to give an example) and the degree of sharing 'Free Dissemination', 'Only If I Accept' and 'No Dissemination'.

After completing this initial stage we arrive at the second part which is the search for similarity of interests or for people that know about this. That is, at the moment where the individual places his/her portable device or mobile phone in the pocket and leaves to his/her daily routine.

At this point, many people are leaving their homes with their respective portable devices, having their interests, knowledge items and configured degrees of sharing. From then on, such devices start to emit Wi-Fi signals to indicate that they possess the MEK system, simultaneously with the reception of signals that indicate the presence of other similarly loaded devices.

From the moment a match is detected an analysis of similarity through keywords is made, comparing at first the common areas of interests. After this first step, an analysis is made to verify if there are needs that could be satisfied, which means the existence of at least one 'Desire To Acquire Knowledge' of an user for each 'Would Supply Knowledge' of another user. Maybe he/she who has competence in this area does not have nothing in MEK about the specific query that another user is trying to solve, but can be available to meet and interact with the other user. For that, users can see the profile of the other users.

When there is a match of interests the MEK systems can exchange knowledge items. It is important to remember that everything which is identified as "Free Dissemination" is freely distributed to others. To those identified as 'Only If I Accept',

the MEK system only sends the title, the owner and the type of this knowledge item. After the receiver has read the description, he/she can contact the owner of the original knowledge and ask (in a synchronous or asynchronous way) for this specific knowledge item, as show in Figure 4.


**Figure 4 - MEK Example: Matching interests and synchronous communication**

By the end of the day, the user would have the option to upload the information acquired throughout the day to his/her PC. He/she could also simply synchronize them with the existing information that he/she already has, adding that to the knowledge libraries in his/her PC. It is important to say that the user could consult his portable knowledge library at any time, without the need to wait for the end of the day to do so.

It is obvious that information filtering becomes necessary as much of the data could be from previous knowledge the user received. However, at this initial point of system development, such filtering must be manually made by the user, unless such information, with its respective ID (identification) still remains in the portable device of the user. If that is the case, a comparison is made between IDs for the information (present and acquired) and when these are verified as identical, the exchange is not concluded for them.

## 2.2 – The MEK Architecture

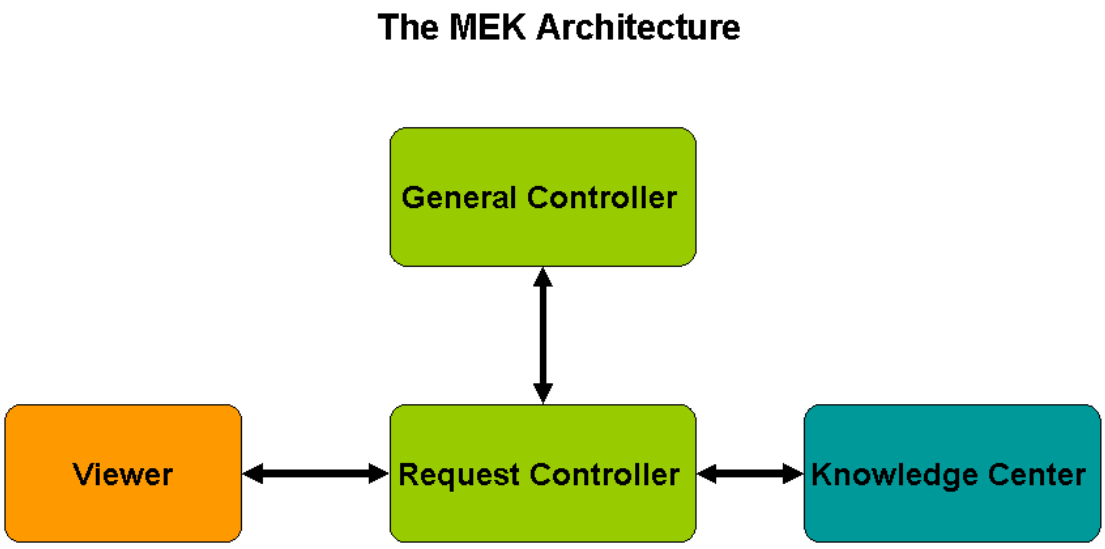


**Figure 5 - MEK Architecture**

MEK has four main modules as shown in Figure 5.

- Viewer – responsible for the interface in addition of data input and visualization of information received and catalogued.

- General Controller – responsible for all logical operations with a given action carried out by the user (ex. knowledge categorization and one's respective availability).
- Request Controller – module responsible for all requests sent by other MEK systems.
- Knowledge Centre – responsible for the storage of all knowledge, and also its association with the previously set knowledge categories.

Although the approach has been developed to contemplate any type of mobile device, we are currently implementing this solution focusing on cell phones as this is the type of device that more and more people carry today. To be a little more specific, MEK is being implemented based on a Nokia S60[16] because of its excellent Java™ compatibility.

The first point we had to consider was the platform on which we were going to develop, and for that we chose JME [8], for its high portability. This guarantees greater compatibility with MEK because most of cell phones and mobile devices in stores nowadays are using this platform, partially or fully.

XML (eXtensible Markup Language) is the most flexible and compatible form for information transmission. MEK uses XML for general requisitions, profile exchange, messages (chat) and the exchange of interests *per se*. For file transfers MEK send a XML with details of the file and when it receives a XML confirmation this will send the file through the connection. For the interpretation and reading of XML files in MEK we built a parser. The XML file parser is done with the help of the kXML[14] library which allowed the creation of methods that understand XML as a set of structured information items. The use of XML became essential not only for making MEK portable for more than one type of mobile device but also because we could

absorb the data, information and knowledge items of the MEK into the most diverse devices, mobile or desktop.

P2P (peer-to-peer) is a technology capable of establishing virtual networks with devices using virtually any type of connection [7]. The connections between the MEK systems follow the P2P technology in which each mobile device at a given moment will be acting as a client and also as a server. This duality is what allows each node to share its knowledge with each one of the other nodes.

The connection technology known as Bluetooth is highly spread out in the mobile devices and has high acceptance amongst the public, given that today the majority of the adverts have this kind of technology embedded. And, in opposition to conventional connections (WAP, Edge, etc.), the Bluetooth only depends on the device and therefore it can process a larger volume of data without this generating cost for the user. This type of connection is used as a base for the P2P technology, and on top of that, a MEK system can interact with other MEKs exchanging XMLs of interest, knowledge items, requests or even files.

All of these technologies are integrated to the MEK thanks to the compatibility of the JME, which nowadays makes use of many compatible technologies. However, these technologies bring technical limitations of a logical and physical nature. The ones we encountered were the following:

- JME is a wide platform but nor all compatible devices contain the same JSRs (Java Specification Requests) [9], being able to have one or more JSRs used in the MEK that are not contained in the device that it is being used. Each JSR is in fact a set of specifications of an API for its creation/use. It is as if each JSR extended the capabilities of the Java code. As an example we have the critical case of JSR-82 (JSR extends its

Java to access the Bluetooth connection), because some devices that implement the Bluetooth interface do not contain the JSR-82, not making it possible to access JME applications to the hardware for Bluetooth connections.

- Bluetooth currently has a reach limit of 1,10,100 metres (3,30,300 feet). This would already be a problem but since we are speaking of P2P then the lesser reach between the two devices that will make a connection with themselves will be the maximum reach for this connection.
- Another Bluetooth limitation is how much bandwidth that varies for the version of Bluetooth at 1-3 Mbps, making it difficult to move large files in the MEK system as to have a successful file transfer we would have to get the two devices remain a long time next to each other.
- Another drawback, although it is the less concerning one, is the storage capacity of mobile devices, even if we consider that their capacity is steadily increasing. It is easy to imagine the case where the knowledge desired by an user is in a file bigger than the capacity one has available.

Having gone through the technological incompatibilities, we are studying the alternatives to decide how to solve some problems such as: i) data exchange between MEKs, allowing us to interact with desktops and other applications; ii) transfer of a relatively large amount of data without having the cost making the process not practical; and iii) control of simultaneous accesses of several MEKs.

# 3 – The Study Case

To show that the idea presented here possesses validity and that people have inherent knowledge that is not shared with other people due to the lack of opportunity, an experiment in the physical environment of UFRJ was carried out.

The experiment consisted of three stages. The first stage was carried out by the filling of an online questionnaire by nearly 100 students where they informed their interests, location and periods of permanence in such places (classrooms, laboratories, etc.) at UFRJ. With such data, we entered the second stage, which consisted of the surveying the data and using it to create a graph for each student, placed inside the map prepared for the environment where the people polled used to be found in. Finally, the third and final stage, the crossing of such data was done to allow checking if a person was near another that had common interests at the same time.

As a scenario, we used graduate and post-graduate Engineering students for the ease of access they provided, and also for being individuals with latent research and knowledge needs. Thus, we imagined that they would be people with a great need of knowledge exchange. Moreover, we can add the fact that they were easier at interaction in a more restricted environment, such as the university.

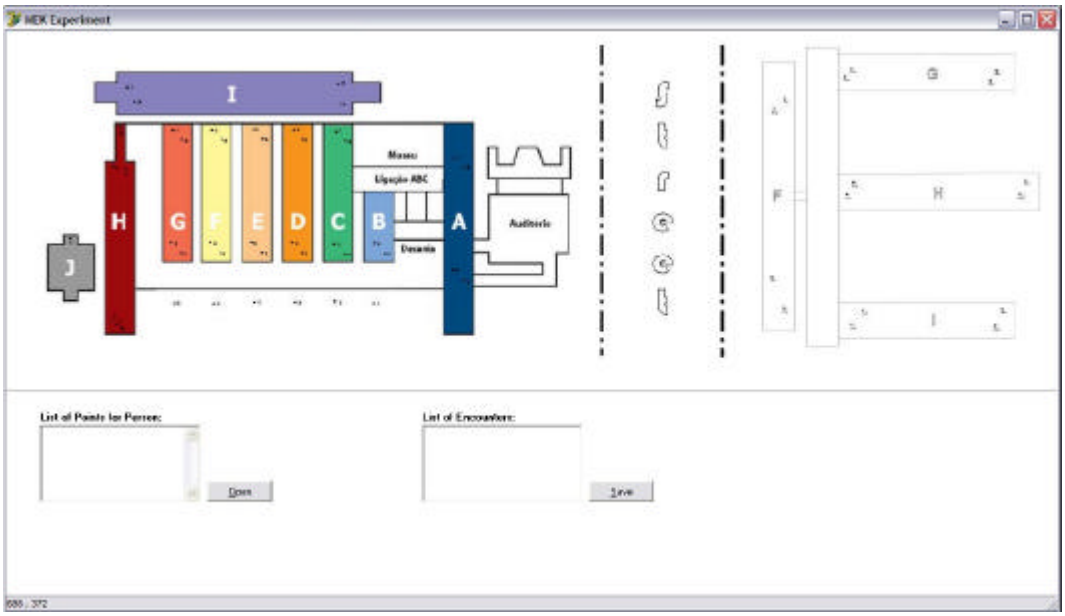


**Figure 6 - MEK Simulator**

We implemented a prototype, as in Figure 6, that simulates all possible interactions. We interviewed 169 students from the B.Sc., M.Sc. and D.Sc. Engineering courses. In total, these students came from 80 different courses. With this data, we could conduct the analysis.

All the people polled listed their interests, which are described in Table 1.

**Table 1 - Interests and number of people with the same interests**

| Interest | # of people |
|---|---|
| Dancing | 55 |
| I.T. | 55 |
| Sports | 55 |
| Architecture | 55 |
| Financing/Economy | 55 |
| Literature | 55 |
| Cinema | 55 |
| Fashion | 55 |
| Science | 55 |
| Sex/Pornography | 54 |
| Politics | 54 |
| TV Shows | 54 |
| Music | 54 |
| Painting | 54 |
| Health | 54 |
| Religion | 54 |

| Interest | # of people |
|---|---|
| Theatre | 54 |
| Food | 38 |
| Magazines | 34 |
| Games | 22 |
| Nightlife and parties | 19 |
| Foreign languages | 17 |

To examine the possibility of people with the same interests sharing the same space at the same time, we analyzed some common moments of all students when they were in ‘campus’. The first one was lunch time. So, in Table 2, we can see people who have the same interests and could exchange knowledge during lunch time (an idle period).

All participants say this approach is very usable and could help students in solving problems, clearing doubts, and providing entertainment information and curiosities.

What we wanted to prove with this experiment was that multiple, possible, knowledge exchanges were lost throughout the day. And this was proven, since after the accomplishment of the experiment, we could verify that at some points, at the same time of day, there were people, that may or may not have known each other, but had the same interests. Due these results, we decided to implement the MEK for mobile phones.

**Table 2 - People with the same interests who have lunch at the same time and in the same place.**

| Interest | Day | Qty |
|---|---|---|
| Architecture | Wednesday | 5 |
| | Thursday | 3 |
| | Monday, Wednesday and Friday | 5 |
| | Monday | 2 |
| | Tuesday and Thursday | 10 |
| | All days | 20 |
| Science | Wednesday | 4 |
| | Thursday | 3 |
| | Monday, Wednesday and Friday | 5 |
| | Monday | 2 |
| | Tuesday and Thursday | 10 |
| | All days | 21 |
| Cinema | Wednesday | 4 |
| | Thursday | 3 |
| | Monday, Wednesday and Friday | 5 |
| | Monday | 2 |
| | Tuesday and Thursday | 10 |
| | All days | 21 |
| Food | Wednesday | 2 |
| | Thursday | 2 |
| | Monday, Wednesday and Friday | 3 |
| | Monday | 2 |
| | Tuesday and Thursday | 9 |
| | All days | 13 |
| Dancing | Wednesday | 5 |
| | Thursday | 3 |
| | Monday, Wednesday and Friday | 5 |
| | Monday | 2 |
| | Tuesday and Thursday | 10 |
| | All days | 20 |
| Sport | Wednesday | 4 |
| | Thursday | 3 |
| | Monday, Wednesday and Friday | 5 |
| | Monday | 2 |
| | Tuesday and Thursday | 10 |
| | All days | 21 |
| Finance / Economics | Wednesday | 4 |
| | Thursday | 3 |
| | Monday, Wednesday and Friday | 5 |
| | Monday | 2 |
| | Tuesday and Thursday | 10 |
| | All days | 21 |
| Foreign Languages | Thursday | 2 |
| | Monday, Wednesday and Friday | 3 |
| | Monday | 2 |
| | All days | 3 |
| I.T. | Wednesday | 4 |
| | Thursday | 3 |
| | Monday, Wednesday and Friday | 5 |
| | Monday | 2 |
| | Tuesday and Thursday | 10 |
| | All days | 21 |
| Games | Thursday | 2 |
| | Monday, Wednesday and Friday | 3 |
| | Monday | 2 |
| | Tuesday and Thursday | 2 |
| | All days | 6 |
| Literature | Wednesday | 4 |
| | Thursday | 3 |
| | Monday, Wednesday and Friday | 5 |
| | Monday | 2 |
| | Tuesday and Thursday | 10 |
| | All days | 21 |
| Fashion | Wednesday | 5 |
| | Thursday | 3 |
| | Monday, Wednesday and Friday | 5 |
| | Monday | 2 |
| | Tuesday and Thursday | 10 |
| | All days | 20 |
| Music | Wednesday | 4 |
| | Thursday | 3 |
| | Monday, Wednesday and Friday | 5 |
| | Monday | 2 |
| | Tuesday and Thursday | 10 |
| | All days | 21 |
| Nightlife and parties | Thursday | 2 |
| | Monday, Wednesday and Friday | 3 |
| | Monday | 2 |
| | All days | 4 |
| Painting | Wednesday | 5 |
| | Thursday | 3 |
| | Monday, Wednesday and Friday | 5 |
| | Monday | 2 |
| | Tuesday and Thursday | 10 |
| | All days | 20 |
| Politics | Wednesday | 5 |
| | Thursday | 3 |
| | Monday, Wednesday and Friday | 5 |
| | Monday | 2 |
| | Tuesday and Thursday | 10 |
| | All days | 20 |
| TV Shows | Wednesday | 4 |
| | Thursday | 3 |
| | Monday, Wednesday and Friday | 5 |
| | Monday | 2 |
| | Tuesday and Thursday | 10 |
| | All days | 21 |
| Religion | Wednesday | 4 |
| | Thursday | 3 |
| | Monday, Wednesday and Friday | 5 |
| | Monday | 2 |
| | Tuesday and Thursday | 10 |
| | All days | 21 |
| Magazines | Thursday | 2 |
| | Monday, Wednesday and Friday | 3 |
| | Monday | 2 |
| | Tuesday and Thursday | 7 |
| | All days | 12 |
| Health | Wednesday | 4 |
| | Thursday | 3 |
| | Monday, Wednesday and Friday | 5 |
| | Monday | 2 |
| | Tuesday and Thursday | 10 |
| | All days | 21 |
| Sex/ Pornography | Wednesday | 4 |
| | Thursday | 3 |
| | Monday, Wednesday and Friday | 5 |
| | Monday | 2 |
| | Tuesday and Thursday | 10 |
| | All days | 21 |
| Theatre | Wednesday | 4 |
| | Thursday | 3 |
| | Monday, Wednesday and Friday | 5 |
| | Monday | 2 |
| | Tuesday and Thursday | 10 |
| | All days | 21 |

# 4 – Application Scenarios

This approach can be used in some application scenarios, as follows:

**Social Network**

The social network directly applies to the interaction proposal of this article, although it ought to be a passive and transparent interaction to the user.

A social network is characterized by a set of concrete interpersonal relations that tie individuals with other individuals [31]. Thus, when adding our idea of interaction, aiming at knowledge exchange, to the idea of a social network, we can have a catalytic factor to speed up and refine our search for information, because if the system could have previous knowledge of who knows who, the exchange would have an initial parameter for the search, that would be the relationships of that specific user.

Another contribution would happen the other way round. That is, we would have the mobile exchange contribute for the increase of social networks, since if an individual has common shared interests with other people, he/she could even try an easier approach with those people, in spite of not knowing them very well or even if they are complete strangers.

**Wicked problems**

Wicked problems have incomplete, contradictory, and changing requirements; and solving them is often difficult, as well as recognizing them, due to their complex interdependencies [32]. Problems whose solution requires large groups of individuals to change their mindsets and behaviours are likely to be wicked problems. The authors, in

[32], pointed out that, in solving a wicked problem, the solution of one aspect may reveal another, more complex problem.

So, this approach, due to its collaborative and distributed features, can help in finding the solution for this kind of problem. The problem can be spread and different kind of solutions can be recommended by the crowd.

**User profile identification**

User profiling has been extensively used as a basis for recommendation, customization and matchmaking. These types of systems can be beneficial in volatile environments, helping users to stay up-to-date and find collaborators. However, these systems must be able to adjust themselves to changes in the environments and in their users' preferences and characteristics to continue to be useful.

This approach can help, by having the recent interests of an user, in recommendation, customization and matchmaking systems.

# 5 – Related Works

Some similar projects in the area of mobile computing are mentioned and we have also highlighted some differences between our approach and those of such projects.

Bliin[10]- Project in which affiliates can mark manually or capture via GPS (Global Positioning System) their geographic position, making it possible for their friends to know when they are near one another. Making use of the Google Maps [29] service, the system can also show where each friend is, making it possible to contact and set an appointment, meetings or parties. Although this project has the proposal of integrating friends, it does not bring any type of sharing or exchange of knowledge, that is the main goal of MEK.

Push!Music[11] – It is a music player that does more than simply playing music but can share your songs with other people, and the user can choose what song will be copied or not. Imagine if you songs could be heard by thousands of people and you heard a lot of new songs you probably would never hear. This is the idea of this project. Just as the MEK can exchange files of any type this project can exchange music and nothing else. If you want information on the discography of an artist or about the history of Blues or Rock, then this is a task for the MEK.

Track [12]– Aims at keeping the experiences of the user along the way. Things such as the surround sound, the music one is listening to, heart and breathing frequency. All of these experiences can be re-lived by you or by any other person, the only thing necessary is that the user has access to the path previously made. The system is provided with a GPS system that indicates the current position so that the Track stores at regular intervals one's experiences along the way. The Track provides an efficient way to store experiences, but for this the path made by the user must be spread out and followed by another person. MEK, on the other hand, stores part of the constructed knowledge day by day with the iterations with other users. And the dissemination is of a packed knowledge, not a trajectory, without the need for the execution of routes to get it.

Mobiluck [13] - Chat with your friends and meet new ones. With this project you can chat to friends near you, send photos and seek new ones. As well as the MEK system, this program uses a Bluetooth connection to connect unknown people, but in Mobiluck each and every iteration for the exchange of knowledge or files has to be done by the user. This type of interaction violates the 'carry and share the knowledge at any time and in any place' philosophy of MEK, since its pro-activity is its stronger point.

neXus [17] – The intention of this project is to deal with context-aware applications, which means basically applications that are capable of identifying the place and situation where the person is and function accordingly. If it is day or night, cold or warm, if it is a relaxed or a more formal environment. These are some of the possible data items that the neXus platform can use. In a generalized manner they are applications that bring a gamma of information to better serve the users in that specific situation in which one founds oneself, through data supplied by the same users of the neXus network. This project would be particularly complementary to MEK, since it could be observed an embryonic interest [18], [19] in using mobile devices to better map the network and to supply data to users. Without taking into account that we could know if an individual is in a situation where, given a scale of priorities, it would be better to receive one specific datum in detriment from another one, such as for example, a movie review in detriment of a cake recipe, in case one is arriving at a cinema.

Interrelativity [20] – The proposal of this tool envisioned by Joe McCarthy has as main goal to make people relate to each other. It presents large displays that when detecting the presence of a person through RFID (radio frequency identification) tags it and informs the preferences one has in the screen, serving as ice breakers and conversation starters. The idea of this project would also serve in a way to complete MEK since it is not mobile, although they possess plans to add this functionality with Bluetooth enabled mobile phones [21], but we could think of adding it to one of our previously mentioned (section 4) application scenarios for profile detection.

Dodgeball [22]- Dodgeball was acquired by Google. The site is designed to build social networks based on popular bar and restaurant locations. It allows you and your network of Dodgeball friends to update each other on what bars and restaurants

you are at using short text messages from your cell phone. But it does not concentrate on the exchange of knowledge as MEK does.

BEDD [23] – *'BEDD is new mobile social intergalactic software, seeking to connect people for any reason.'* – That is what they are saying in their site. However, it attains only one of the possibilities MEK offers, which is the matching of profiles. MEK goes beyond this as it has already been well elucidated.

Urban Tapestries – Similar to *Track,* Urban Tapestries is an experimental software platform for knowledge mapping and sharing – *public authoring*. It combines mobile and Internet technologies with geographic information systems to allow people to build relationships between places and to associate stories, information, pictures, sounds and videos with them [24]. The idea is good, however it could be a complement to the MEK system, since the intention of Urban Tapestries is to create histories for places and to share them with other people, although this is something extremely personal. MEK, in its turn, can share basically any kind of information.

TxtMob [25]– It is a fast and easy form to send text messages to friends, partners and even to strangers. One basically registers an user and a cell phone number (yours preferably) at the site. And after activating your registration one can join the discussion groups (public, private, secret) and from that point on it is possible to send messages through the site for all cell phone numbers in that group. We can see that MEK allows the exchange of much more information in a much more mobile, practical and transparent way.

Bedouin [26] – WiFi.Bedouin is basically a backpack. But it goes beyond that, since it is also a mobile 802.11b node disconnected from the global Internet. It forms a WiFi ***"Island Internet"*** challenging conventional assumptions about WiFi and suggesting new architectures for digital networks that are based on physical proximity

rather than solely connectivity. Most significantly, WiFi.Bedouin facilitates the creation of a truly mobile web community. This means we could use it as a propagator for our MEK network.

MagicBike [27] – Exactly as the Bedouin, but in a bicycle format.

# 6 – Conclusion and Future Works

The next stage of development within the MEK project is to enable a wider range of tasks for it which is nowadays limited by the reach of the Bluetooth connection technology. With the increasing popularization of cell phones endowed with the Wi-Fi technology [15], the implementation of the MEK system through this type of connection becomes feasible. And as a double bonus, the project would not only increase the working range, but also an easier integration with desktops since Wi-Fi possesses a longer reach and is capable of connecting all the computers that are in the same *hotspot* (working area of a Wi-Fi network), giving power to MEK not only to access a single computer, but all the network that has access to that specific *hotspot*.

MEK can also be seen as a tool of fundamental importance to help in the balancing of social networks, as seen in [28]. This balancing happens from the moment we observe vulnerable points in our social network, such as centralizing nodes, which are commonly known as ‘Focal Points’, or nodes that are very far from each other, making communication difficult. Since the intention of balancing is exactly to try and unify the network in a way that it becomes as fluid as possible, so that knowledge can flow quickly and without barriers. MEK can aim at balancing the work of a social network indicating some attributes for analysis, as people who have the same interest and share the same physical space during a common period of time. So, these people can probably be connected providing new links to a social network.

It is known that social networks evolve. They changed with the passing of time. People leave them while other new people appear, and with this, relationships are made and unmade. If we do not make a constant verification of our network, we can lose these valuable points of analysis as mentioned above, and end up not seeing the changes in our network, which is never static. The MEK system, with its capability of analysis of the exchange of information between users, fit the requirements perfectly so that we can verify who is in contact, changing information, and checking the frequency with which this happens and how long contacts last. We can therefore help to intensify certain weak relationships in our social networks as well as identify vulnerable points as already mentioned in the previous paragraph. And on top of this we can make numerous suggestions to always improve the flow of knowledge of our network, keeping it alive. The use of space-temporal information within MEK to help the balancing of social networks is a future work, to be developed in [22].

Another future work is the integration with a Knowledge Management Environment, called GCC [30]. The idea is the exchanging of user profiles and useful information between these environments.

Another point we will work on in the near future is Attention Management. As the amount of information people interact with increases it can become quite overwhelming, and we need better techniques to deal with the flow not only from a data capture perspective but also from an user interface perspective. In a way, there may be more information to be presented to the user and this can disturb and be distracting. One approach to this is to provide ways to size the amount of attention required at different points in time, rather than attention being an all or nothing affair. So, it is necessary in MEK to prioritize information delivery, obeying the attention status for a topic, at that time and in space.

Nowadays, we use to represent context for the “SPACE x TIME x INTEREST” relation. In future, we intend to enrich this representation.

Moreover, we will do more experiments using mobile phones and possibly will use sensors to get some extra information on the physical scenario.

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