Hotspot based mobile web communication and cooperation: ABRI+ Bus Shelter as a hotspot for mobile contextual transportation and social collaboration

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Abstract - In this research and development project we are exploring a new approach of mobile web and location-based services (LBS) for communication / collaboration which is based on a physical hot spot serving as an accumulation point; a hub for thematic and social collaboration. Different actors can consult, publish or exchange information in relation with the location materialized by the hot spot. This collaboration is mobile and contextual and in our case study transportation and local community social life cooperation oriented with a bus shelter as a location hot spot.

Keywords: Mobile web, Location-based services, contextual communication / cooperation, location-based cooperation, hot spot based cooperation

1 Introduction

From the historical point of view, the first taxonomy of cooperation situations was proposed by Ellis et al. [1] who identified local versus distant and asynchronous versus synchronous working conditions. The next step was to take into account the location of actors i.e. predictable or unpredictable [2]. At the moment we have a large number of solutions, from asynchronous (in the form of e-mail, SMS, MMS) to more or less synchronous as with ICQ, … From a device point of view, desktops or laptops are not anymore a unique kind of device, more mobile devices such as TabletPC, PDA, and mobile phone, called wearable or handheld computers, are being used more and more. In web-based cooperation the location of actors can be worldwide and more or less dynamic as are facebook or twitter. As the opposite collaborative tools such as Follow-me tool experimented at Interact 2003, are working on the basis of geographical proximity of actors, who can be detected by the locator and each actor is informed on the proximity of his “friends”. In our study we are concerned by an asymmetric situation in which the actors can be localized anywhere, but they have in common a particular location of which the objective is to be considered as a hot spot for the cooperation. In the next sections we will first present these hotspot based cooperation principles then we will describe in detail our case study which is bus shelter oriented.

2 Hotspot based communication and cooperation

In our studies we identified a new cooperation organization based on a hub or a hot spot of which the role is to concentrate the reasons for communication/cooperation. As previously mentioned, between a worldwide location, independent distant communication / cooperation (C/C) and proximity based local communication / communication (C/C) we identified an interesting situation in which the actors can be anywhere, but have a common reference point for communication. In their actions they mention a particular point of accumulation as a hot spot or a hub which plays a particular role in their communication / cooperation (C/C). This approach creates a new behavior in C/C, structuring and organizing the activities between actors in relation with this physical hot spot (figure1).

![Figure 1. Hotspot based Communication / Cooperation.](image)

The role of the hub (hotspot) can be either an important point of interest i.e. physical location for a particular activity such as transportation, or a meeting point for a rendezvous or an intermediate point for a message destination. The communication can be established between a particular actor and the information panel on the hotspot for effective advertising or a personal message in the form of a post-it, etc.
This communication can be also in the destination of a generically addressed person, who is identified by his role but not personally, like the bus driver of the bus on which the actor is boarding. In all these situations the hotspot plays an important role. We identified 8 basic communication / cooperation situations:

1. Global interaction between initiator actor and www server.
2. Local interaction between initiator actor and hub server.
3. Local interaction between initiator actor and hub server with propagation to final actor.
4. Local interaction between initiator actor and hub server with explicit consultation by the final actor.
5. Local public advertising sent by the servers or initiator actor to the Hub Public Screen, with possible propagation to final actors.
6. Local public advertising sent by the servers or initiator actor to the Hub Public Screen, with possible collection by final actors.
7. Local semi-public information sent by the servers or initiator actor to the Hub Public Screen, with possible collection by final actors.
8. Local private information sent by the servers or the initiator actor to the Hub Public Screen, with collection by final actors permitted by a received access code.

We summarized these behaviors with UML sequence diagrams (figure 2). Of course these situations can be combined and extended as we will observe in the following

Figure 2. Eight main Hotspot based communication / cooperation situations.
case study. Let us consider a concrete situation in which the hotspot is a bus stop or bus shelter. We will examine its role not only in transportation situations, but also in community neighborhood communication / cooperation.

3 Case Study: Bus shelter context

A bus stop is a designated place where buses stop for passengers to board or leave a bus. These are normally situated along the highway and are distinct from off-highway facilities such as bus stations. The construction of the bus stops tends to reflect the level of usage. Stops at busy locations may have shelters, seating and possibly electronic passenger information systems; less busy stops may use a simple pole and flag to mark the location and 'customary stops' have no specific infrastructure being known by their description. Bus stops may be grouped together into transport hubs allowing interchange between routes from nearby stops and with other public transport modes.

In our study we organize all activities around or in relation with the bus shelter. For us the bus shelter is not anymore only a waiting point for bus transportation as can be observed in figure 3a. Naturally our bus shelter is related with recent shelters proposed (figure 3b). Several architectures have been proposed [4], such as the solar bus shelters for San Francisco [5], or a bus stop of the future [6]. In Italy, futuristic bus stops were proposed to blend practical behavior with chic [7] and mainly a MIT's futuristic, networked bus stop design [8] is in direct relation with our point of view.

We are naturally related with MIT proposal, (figure 4) but in our study we are mainly oriented to the functional aspects of the bus shelter, physical and aesthetic designs are not our main priorities. We will work on this with our industrial partner after a functional validation of proposed services.

Figure 3. a) The Soviet Roadside Bus-stop [3] and b) a more modern bus shelter [4].

Figure 4. MIT Researchers Unveil EyeStop, a Bus Stop [9].
3.1 Bus stop infrastructure

Bus stop infrastructure ranges from a simple pole and sign or a rudimentary shelter, to more sophisticated structures. The usual minimum is a pole mounted flag with a suitable name/symbol. Bus stop shelters may have a full or partial roof, supported by a two, three or four sided construction. Modern stops are mere steel and glass/perspex constructions, although in other places, such as in rural Britain, stops may be wooden or brick built. The construction may include small inbuilt seats. The construction may feature advertising, from simple posters, to complex illuminated, changeable or animated displays. Some installations have also included interactive advertising [8]. Design and construction may be uniform to reflect a large corporate or local authority provider, or installations may be more personal or distinctive where a small local authority such as a parish council is responsible for the stop.

Individual bus stops may simply be placed on the sidewalk next to the roadway, although they can also be placed to facilitate the use of a busway. More complex installations can include the construction of a bus turnout or a bus bulb, for traffic management reasons, although use of a bus lane can make these unnecessary. Several bus stops may be grouped together to facilitate easy transfer between routes. These may be arranged in a simple row along the street, in parallel or diagonal rows of multiple stops. Groups of bus stops may be integral within Transportation hubs. With extra facilities such as a waiting room or a ticket office, outside groupings of bus stops can be classed as rudimentary bus stations.

Bus stops will often include timetable information, either the full timetable, or for busier routes the times or frequency at which a bus will call at a specific stop. Route maps and tariff information may also be provided, and telephone numbers to relevant travel information services. The stop may also include, or have nearby, real time information displays with the arrival times of the next buses. Increasingly, mobile phone technology is being referenced on more remote stops, allowing the next bus times to be sent to a passenger's handset based on the stop location and the real time information. Automated ticket machines may be provided at bus stops.

Modern passenger information systems and journey planners require a detailed digital representation of the stops and Transportation hubs. The CEN Transmodel data model [10], and the related IFOPT data interchange standard [11], defines how transport systems, including bus stops should be described for use in computer models. In Transmodel a single bus stop is modeled as a 'Stop Point' and a grouping of nearby bus stops as a Stop Area or Stop Place. The General Transit Feed Specification standard [12], which was developed by Google defines a simple widely used data interchange standard for public transport schedules which includes a table of Stop points and which gives an identified name and location for each bus stop. OpenStreetMap [13] has a modeling standard for bus stops.

The United Kingdom has collected a complete database of its public transport access points, including bus stops, into the National Public Transport Access Nodes (NaPTAN) database [14] with details of 350,000 nodes and which is available as open Data from data.gov.uk.

In our approach of the use of a bus shelter as a hotspot we are opposing classical www distributed and virtual Communication / Cooperation and situated hotspot based local Communication / Collaboration. We are mainly concerned by contextual mobile situated collaboration in two situations: transport cooperation management and social neighborhood management.

3.2 Transportation oriented Hotspot Communication / Cooperation

For transportation, we are concerned by users using public transportations in relation with a particular bus shelter. Our objective is to take into account intermodal transportation i.e. transportation allowing to the users to mix several sections of transportation which can be achieved by different transportation modes (bus, tram, metro, cycle, walk …). The main objective is not only to organize the transportation in a global way, but mainly to manage it locally in relation with appropriate shelters, the user’s nearest shelter at the current moment.

*To deliver highly detailed transportation information* a new type of communication via a concerned hub gives precise information to the user on the real transportation situation. In this way the actor can take an appropriate decision in relation with the current real time situation and communicate it to the shelter, which then can be able to propagate it to the bus or tram driver. And who can, in this way, know the number of passengers to board at this stop, the total number of passengers and their destination, as well as special requests (cycle or baby carriage, elderly or disabled passengers …). Based on the passenger’s destination and in relation with the previous and the next bus the driver can dynamically organize rapid or snail transportation, according to a majority passenger destination. If a large majority passenger destination is unique (such as a university or school stop), the driver can decide and indicate to the passengers that this destination has priority and the bus will become a fast transportation bus (without intermediary stops). Following bus then takes the role of a snail distribution bus respecting all stops. Usually this kind of decision is mainly in relation with school or university commuters.

The shelter can also be used as a support for other transportation actions such as car sharing or hitch-hiking.
management by using an Electronic Display Board (EDB) located on the shelter and oriented to the vehicle’s route. This EDB can be addressed by initiator actors, indicating expected destination. The hub server is able to manage several compatible destinations and present them in a coherent manner. This information can also be propagated to car drivers evolving in the area (figure 5).

3.3 Neighborhood life oriented Hotspot Communication / Cooperation

Another use of a bus shelter can be neighborhood community life oriented. The idea is that the location is frequently visited by the neighborhood when boarding and getting off the bus and in this way it can be used for common information, advertising…

We decided to use the shelter, which is equipped by several large public screens with associated interactions (i.e. multi-touch) such as local animation during the waiting period for adults and children. For adults advertising can be useful, for children short cartoons are very much appreciated. In addition to these local off-line animations, our approach is able to put in more interactive and up-to-date information. As mentioned transportation intermodal information can be observed in the shelter, as well as shopping and tourist information, cultural and sport activities are also available (figure 6). This sort of information is highly dynamic, putting in view the day’s news and activities. Theatre, sport games, community associations meetings are therefore proposed. Information located on the large public screens can be collected on the handheld device, using a collection technology (i.e. RFID reader or QR-code recogniser). In this way the reference of the information can be moved to the handheld device and consulted or remembered on it for later treatment (figure 7). Local information such as just in time shopping advertising from local shopkeepers, bakers or butchers, can be presented in the evening. Neighborhood exchange of used clothes or appliances can be sent for display on to this large public screen, as well as more personal post-its with personal messages.

Figure 5. Bus Shelter based Transportation communication / Cooperation.

Figure 6. Bus Shelter based General and Local Communication / Cooperation.
be managed by the hotspot. In this way the sender can ask for an ID, which will be used to deposit the parcel, and the distribution service will use same ID to take the parcel and vice versa for the distribution of parcels.

**Figure 7.** Information exchange between a large public screen and personal handheld devices by QR-Code to appropriate, personal and confidential exploration and treatment.

4 Final discussions

Bus shelters in urban locations and on busy traffic routes are often provided without charge by companies such as JCDecaux, Clear Channel Communications and CBS Outdoor in return for valuable out-of-home advertising rights. In this way economical considerations can be integrated into this global negotiation. Another important aspect is related to prevention of vandalism and degradations. Naturally this is an important aspect mainly in certain county areas and districts. The solution is not easy but can be oriented to different approaches: physical protection, appropriate technical and technological solutions such as with no large screens and only individual devices on which the information is exclusively displayed, and so on.

Another important problem is naturally related to the acceptability of such a system, in its different aspects which are more or less intrusive in an actor’s private life [15]. Of course, two excessive attitudes are to be eliminated: nothing and everything. We expect to carry out appropriate acceptability studies in relation with which different prototypes on which we are working at the moment will be experimented.

5 Conclusions and future work

We have presented in this paper an original mobile web and location-based services for communication / cooperation situations characterized by mobile contextual hotspot based cooperation allowing actors located worldwide but having a particular location point of interest, to organize their communication / cooperation in relation with this hub. We have described a generic view of this style of communication / cooperation and its adaptation to a particular situation related to transportation and neighborhood life. We have explained typical relationships and their contextualization in our case study. This list of typical relationships is not closed: we are searching for more cooperative situations concerning more than 2 actors. We are at the moment creating a first prototype in order to be able to appreciate its feasibility and acceptability.

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6 References


