Multimedia Systems
DOI 10.1007/s00530-009-0172-2

REGULAR PAPER

Gaming on the move: urban experience as a new paradigm for mobile pervasive game design

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Abstract In this paper, we describe a pervasive treasure hunting game: "Team exploration" based on the Transhumance mobile ad-hoc network platform. The testers of this game came up with innovative suggestions that combined the technical features of the platform with their urban experience. They pointed to specific aspects of urban mobility that influence pervasive game design and contribute to the user's pleasure. These tests show that the notion of space (geometrical organization) is not enough to characterize and organize pervasive games and that four main anthropological features have to be taken into consideration: the concrete city (physical organization), the imaginary city (narratives), the functional city (services) and the city events. The multilayered urban experience is also defined by our schedules (including repetitive or exceptional events) and by our assessment of other users (the distance or proximity as they are felt). These diverse aspects and qualifications of urban experience provide an interesting framework for the understanding of pervasive game experimentations, as well as point to new directions in pervasive game design. Our paper advocates that further anthropological observations are part of the pervasive game design methodology.

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Published online: 26 November 2009

Keywords Mobile ad-hoc network · MANET · Game design · Mobility · Pervasive games · Urban anthropology

1 Urban anthropology as a starting point for pervasive game design

Most of today's videogame strategy does not have to take into consideration the anthropological data pertaining to the specific context of use. When and where, are not relevant to the game design. As was pointed by Magerkurth et al. [23], this way of designing traditional videogames is challenged by pervasive games; indeed, such games take place in streets, malls, countryside, school yards, etc. and open the closed system of videogames by including elements of real life within the game play. The technical characteristics of mobile devices, and the surge of mobile services in everyday life, offer a new framework for mediated outdoor games. Jegers [17] analyzes how pervasive games redefine what is considered as "game flow" and the pleasure experienced by gamers. Nevertheless, we still have to figure out what aspects of mobility and urban life influence game design and eventually contribute to the user's pleasure. How is mobility defined and what are the relevant parameters to design games that will adapt to and use the great diversity of urban situations? How does the mediated relation to the city enhance the different forms of mobility? What do users see as an agreeable urban experience? How can the city be fun?

This paper is based on the project "Transhumance" that developed a specific middleware for mobile ad-hoc networks (also referred to as MANET, i.e Mobile Ad-hoc NETworks). Mobile ad-hoc networks are self-configuring networks of mobile nodes connected by wireless links

(such networks may be obtained by using wifi cards in ad-hoc mode). We designed the game "Team exploration" as an experimental platform to test the middleware and services of Transhumance described in [30] and to experiment with new design concepts. In particular, we studied what real space parameters turn into game parameters. The tests completed the survey by pointing out how urban time and our representation of others provide a framework for a typology of games. The testers identified a new category of players (neither well known as friends or team members, nor unknown as in online gaming) appeared who were qualified as "close" because they are in the same place at the same time. They also came up with a new time category: neither hurried and professional nor totally leisurely, but mostly defined as enclaves of personal freedom while busy in the city. The results demonstrate that the where and when are indeed parameters to be taken into consideration, not only because pervasive games contents are based on the topography and/or actual elements of the cityscape by definition, but also because ad hoc mediation transforms the notions of space, place and neighborhood. These notions contribute to the definition of mobility that is also central to our experiment and pervasive games in general.

As Eva Nieuwdorp analyzes, it is difficult to give an unambiguous definition to the words pervasive computing and pervasive gaming. In this article, our definition of pervasive is clearly related to our research background that is based on the development of ubiquituous computing, that is to say technologies that spread beyond the computer desktop and augment everyday interactions through tangible objects and situations. Our work focuses on the social and cultural impacts of such technologies on existing practices in urban environment. We have been particularly influenced by Rich Gold's essay "This is not a pipe" [16], which points out to the creation of a "Doppelgänger" of our world and its artifacts, a double layer of information and meaning springing up under proper solicitation. Mobility is central to our experiment as it is the way to test the dialogue between real and virtual world and as it is a central feature of the spontaneous social network created by the ad hoc platform.

The name "Team exploration" points out the main originality of our game amongst a number of similar games and experiences. It is a treasure hunt related to games such as "Geocaching", "Conqwest", "Pirates!" [12, 26]… Moreover, it is a collective game where people can actually see each other, creating a complicity based not only on sharing information and collecting images but also on the physical "fooling around together". This shared experience is forced by the technical platform because there is no omniscient point of view based on a central server but only partial and subjective views of the situation by the players. People have to get together, to reunite to gather information and reduce the uncertainty of the game and its territory. The particularity of our pervasive game is that it is based on a fully distributed solution that mixes three types of mobility: a physical mobility that places it in the group of physically exerting and "paidia" [6] type of games based on free and playful experiences like "Can You See Me Now" [3]; a calculated mobility that turns moves into strategic activities such as in "CatchBob!" [15] that are more on the "ludus" [6] mode (games with rules); a cultural mobility linking places, people and things to expand our knowledge of the territory that relates it to serious games such as "REXplorer" [32]. Based on Michel de Certeau's distinction between "place" and "space" [7], we shall argue that the way people circulate in a "place " (i.e. an "instantaneous configuration of relations") generates a "practiced space"(i.e. "informed by use"). Mobility says something about one's relation to a specific "place". Each and every form taken by mobility corresponds to as many different ways of investing one self in a context and relating to it. Different types of mobility not only ground the relationship between individuals and territory but also participate in the construction of identity as was noted by Lussault and Augoyard [2, 22]. "Our existence is determined by the bits of space we assemble on a day to day basis in order to meet given objectives, (…) articulating life-spaces to each other, adjusting them to practical activities" [22]. Our mobility is part of our specific personal styles. This mobile style relies both on our ability to conduct activity while moving—an actor's potential for motion and his ability to conduct projects in motion has been coined "motility" [18] and what anchors we find in real world and virtual interfaces, that are resources for our actual mobility.

It is therefore necessary to point what in the game is going to structure this motility and invite so to speak its different forms of expression as shown by Licoppe and Inada on the subject of the pervasive game Mogi [21]. The two authors talk of distributed motility. The environment of the game provides clues and handles for motion, i.e. virtual, geo-localized objects placed by the designers in the space of the game. These objects are a resource for players, a way for them to figure out where to go. "The game provides a motivation and the means for interpreting and collecting the virtual geo-localized objects that they find along the way, depending on their position and their trajectories in the city. By reconfiguring the motility of the players, Mogi has a profound impact on their mobility" [21]. Experiments in pervasive and mobile gaming engage personal styles of motility and actual mobility. Though every expression will be deeply personal, social and cultural traits of urban mobility can be studied that inform pervasive game design.

These mobile expressions take place in an environment that Certeau qualifies as a set of constraints (based on Foucault's analysis). But Certeau also demonstrates that urban dwellers reinvent the city assigning new meanings and new functions to places, tracing new paths, etc. This was of course important to us as it stressed two points that we would have to take into consideration: the city is not a blank page nor an empty screen, it is a strongly organized setting from which one might take some distances, some liberty but not any kind of liberty, as in a traditional videogame. Our task would therefore be to define how we could play with the city, what kind of distance the game would offer, and when and with whom the gamers would be willing to dare it.

After a description of the technical platform and of the game, we present the results of our experiments with gamers. We intend to focus more precisely on how space as a geometrical structure and place as an anthropological experience [1], become parameters of the game design and how pervasive games change our relationship to our environment [11]. The paper will therefore deal first with the different forms of urban experience that were tested through Team Exploration. We will analyze how the city can be seen as a physical field of training but also as a narrative that can support pervasive games. We will then study how the city as a reunion of people plays a part in the perception of game participants and contents. We will eventually study how our game did not quite choose between two scenarios, one oriented toward action and speed and the other toward culture and discovery, because we did not anticipate that time and people representations would impact the experience. We then proceed to define a typology of pervasive games based on these two parameters.

2 Transhumance middleware

Transhumance project is at the same time a technical research project on middleware for mobile ad-hoc networks and an opportunity to observe how a city can be reinvented through a technology. Our game fully relied on the middleware that was developed on this occasion. We therefore will describe the technical architecture and choices, pointing to the way these characteristics were 'seamfully' integrated in the design of the game.

In Transhumance, we target small networks of up to 20 handheld nodes, which correspond to manageable human size groups. We assume that nodes move at pedestrian speed. The handheld terminals are characterized by their limited capacities in terms of energy (since the mobility implies battery-operated devices), memory and CPU.

Mobile ad-hoc networks bring new constraints: in particular, since nodes act both as end-user terminals and as routers and since they are mobile, they may become out of reach (for a short or long period of time, or even permanently). This must be addressed by the middleware in order to ease the development and the deployment of applications. The middleware must also provide applications with common features such as communication mechanisms, resources discovery and security management. Energy management is also a crucial issue for battery-operated mobile devices.

We conducted a bibliographical study of existing middleware systems [28] in which we analyzed systems such as Proem [20], JMobiPeer [4] and Steam [23]. The study showed the existence of a common set of functionalities in the studied systems: communication protocols, group structure and service discovery. It also showed that security and energy management were often identified as key issues, but were never completely addressed in a fully integrated and operational solution.

Transhumance is designed to meet this requirement. It provides the applications with full functionalities for communication (transport protocol, event service), group management, service discovery and management and additional high-level services such as vote and chat. Transhumance also provides security mechanisms based on groups. Concerning the energy awareness, Transhumance middleware is designed to be adaptable to the energy level [29].

The middleware is distributed under LGPL licence on SourceForge [31].

2.1 Transhumance architecture

This section gives an overview of the Transhumance middleware architecture and functionalities.

Figure 1 presents the architecture of Transhumance. It is organized into five functionality blocks: energy management, communications, "identity, presence and hardware management", common services and security.

The *energy management* block involves a monitoring module and a decision module. The decision module decides, based on a policy and on the information about the energy collected by the monitor, of the adaptation actions to be executed. The possible actions are implemented in middleware modules and consist in adaptations of their behavior that reduces the energy consumptions (e.g. stopping messages acknowledgements in the transport protocol). The question of energy management is fundamental to the deployment of handheld devices as most people are reluctant to empty their battery because of an application (be it a brilliant game…). In the design of the game, we ended up choosing the time allotted to the party so that the

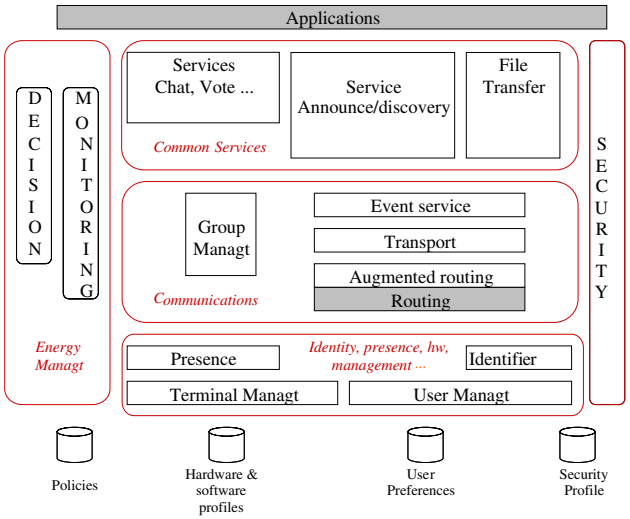

Fig. 1 Transhumance node architecture

devices would not run out of energy before the end of the game. Before the final version of Team Exploration, we even thought of giving the players a full view of their energy consumption, showing them how different types of activity would affect more or less their battery. The whole game could have revolved on strategic decisions whether or not to communicate for instance, or whether or not allowing others to use one's device as a node. We eventually decided against it, as we also wanted to encourage users to enjoy relating to each other and not necessarily resenting it.

The *communication* block relies on the OLSR routing protocol [9]. Transhumance "augments" the routing protocol with additional functions provided by the augmented routing module. The Transport module is a UDP-based transport protocol that supports message fragmentation, acknowledgment (optional) and message encryption (optional). Transhumance also supports a publish-subscribe event-based system that enforces message persistency ("guaranteed" message delivery). In addition, this event system provides basic point-to-point and group message passing in push–pull mode. The event system is central since it provides a communication mechanism that makes the system robust to disconnections. We therefore describe it in more details below. Finally the communication block includes a group management module that is in charge of managing communities of users sharing common interest. Services and security are offered within groups.

The "identity, presence and hardware management" block includes four modules: user management, terminal management, identifier and presence. Users of Transhumance do not need any preliminary knowledge such as security certificates or a list of resources; they must, however, define their profile (name, address, points of interest, etc.) and their preferences (privacy, Transhumance and service configuration parameters, etc.). This is supported by the user management module. Terminal management abstracts some useful functionalities of the underlying operating system and hardware, such as file system calls and interface to battery. It therefore acts as an adaptor. The identifier module manages three types of identifiers: terminal hardware identifier, communication identifier (in practice an IP address chosen within an interval) and user identifier. The presence module indicates who is present in the mobile ad-hoc network and within how many hops.

The *advanced services* block regroups high-level services such as chat service, file transfer service and voting service. It also provides an announcement/discovery service to advertise existing services.

T*he security component* looks after security of the node resources, groups and communications. It is managed in a fully distributed way. It comprises ciphering and a certificate manager. We now present in more details the event-based communication that is key to the approach.

The whole point of the Transhumance platform is to explore the absence of a central server. This implies that each user has to agree to be seen first as a dot on a radar screen (though there is no positioning system here so that the identity based on position remains hidden). Then the whole system functions on trust. Groups are easy to create but people have to be invited by the game master to be able to participate. It meant that the interface needed to provide two views: one that would show connected people, the other that would show the group. This 'on invitation only' basis triggered a lot of discussions within our research team. It seemed to restrict the participation of the game to people that were already friends of the game master or that the game master at least knew. One of the advantages was that the constitution of the groups would rely on a common interest and that they would agree to be connected rather because of a common activity than only an attraction to some profile. The model for our game in those circumstances was obviously treasure hunts organized also on an invitation only basis. But this question of group should definitely be more closely analyzed as the testers' feedback pointed that they would like to expand this platform to other kind of games or cultural activities. The question of the game master or the user who launches the activity (be it an institution like a cinema, an association, or a representative of a trusted organization) must be addressed in any event.

2.2 Event-based communication

Transhumance employs Chapar, a novel event system that uses the underlying routing protocol for event

dissemination [19]. Contrary to other event systems that rely on a single broker to handle event publications and subscriptions, Chapar replicates the event brokers on the Multipoint Relays (MPRs) defined in OLSR. This choice is made to avoid having a single point of failure and a performance bottleneck. The event brokers are responsible for subscription and for leading the published events to their corresponding subscribers. Thus, we may consider Chapar as a self-configured overlay network using cross-layer information to store and forward the events from publisher(s) to subscriber(s). Using the underlying routing layer enables us to constitute the multicast trees to deliver events instead of using expensive unicast communication and flooding which is not scalable. Moreover, the OLSR routing information empowers us to handle node mobility in the network and cope with network transient topology changes.

The event system supports both real-time event dissemination and storing events in the brokers until their lifetime elapses. This functionality helps the event system to deal with network partitioning which is likely to happen in actual mobile ad-hoc networks. For instance, if the network is portioned into two partitions, the events published in one partition cannot be notified to subscribers connected to the other partition. However, using memorized events, the published events are stored in the broker nodes and as network topology changes over time, any subscriber that joins the network within the event lifetime period is notified of the event.

In Chapar, the subscription and the notification are one-hop communications since each node has at least one broker in its neighborhood. Thus, for real-time event forwarding to subscribers, the intermediate brokers that constitute the overlay network lead the published event to the right broker nodes, so it will be delivered to the subscriber. For memorized events, a copy of the published event is stored in every single broker in the network. The subscribers who are present at the publication time are notified of the event, and those who are disconnected from the network will be notified when they connect to the network.

An event is as a structured message, composed of the following fields:

Event type: advertisement, data, query, answer, …
Identifier: uniquely identifies the event in the network.
Subject: free character string.
SenderID: identifies the event sender.
Lifetime: time for which to keep the event in the network.
Persistence: delivery guaranteed or not.
Range: internal (for the local system) or external (for the network) event.

Content (or payload): data contained in the event.

The event service proposes filtering facilities. An application can create filters on the event subject, the sender, the content, etc. When an event is received, it goes through the different filters and the event is notified to the corresponding subscribers. Otherwise, the event is dropped. In order to address transient disconnections and network partitioning the event system supports event persistency (an event may be kept for a given time or until it is delivered to all its subscribers).

Events are also supported in other middleware for mobile ad-hoc networks such as Steam [24] and Emma [27]. Contrary to Steam, we do not take into consideration the distance between the sender and the receiver. Our approach is more similar to that of Emma (e.g. every device can communicate with all other devices). However, the events do not use a dissemination (epidemic) algorithm to reach their destination.

In [20], we show that the event system yields good performance in particular because it causes less network overhead than other solutions. All Chapar calculations and algorithms are based on simple hash functions and logical operations which makes it very light in terms of computation and resource consumption.

The event-based communication allowed us to think about the game design in terms of collaboration as a strategic aspect of the game. Indeed, connecting to people would be at the same time something that could wait—until the connection was restored—but also could trigger strategies of physical moves to make sure that the message would be passed along. In other words, players saw that they could trust the platform to keep the information. But being disconnected was also part of the seamful design of the game. This allowed for a freedom of movements and for the players to decide what they wanted to do and create strategies relying on the in and out of the network, and on the hop structure.

3 “Team exploration”: a mobile ad-hoc network game

Transhumance research project gave us the opportunity to conduct a game experiment based on the above described. We designed “Team Exploration” a pervasive treasure hunting game played on Nokia 770 PDAs, with wifi cards in ad-hoc mode. The interface of the game is provided by a map of la Butte-aux-Cailles (a picturesque part of Paris) partitioned in 20 rectangles (see Fig. 2). On the left of this map, five pictures are displayed that represent details of the cityscape that players have to look for. The four pictures below correspond to photos that were taken in the area. Players have to find in which area (a rectangle on the map) each of the four pictures was taken. The top one appears “blurred”. It will be disclosed as all the pictures are

Fig. 2 Screenshot of the team exploration game

Fig. 3 A team exploration player looking for a cityscape detail

Fig. 4 The players of a same team validating together their findings

localized. This last image shows the place where all players must meet.

There is a limited time to localize the pictures and, when a proposal is made, it must be approved by the rest of the team through the game interface. The two concurrent teams must find and validate as many images as possible to reach the final meeting place. On the right side of the screen, a basic topology of the network shows who is connected (letters represent players) and the number of hops between players. During the game, players will lose and get the connection, although, to validate an image, all members of the team must be connected. The game play relies both on solitary errands and on collective sharing. Strategies can be more "group oriented"—gamers stay within reach of each other—or more "independent"—with rare "get together" sessions. Because it is devoid of any central server and depends on people participation and a loose model of collaboration, it allows new forms of exchange and a spontaneous organization. Our testers were very much aware of the fact that the network is born out of everybody's presence and also appreciated that there was no need to find a network infrastructure and no need to register in advance.

We organized three tests of the game. The main experiment included two teams of four players—some knew the area and some did not—and as many observers and interviewers who first followed and recorded the action and then conducted long qualitative interviews. Our purpose was to see how players organized themselves, distributed the tasks at hand, spread in the streets (see Figs. 3, 4). We also watched their use of the interface as the game went on and asked them to comment on what they were doing. Eventually, we questioned them about their perception of the game in relation to their experience of the city, their use of technical mobile devices, and their playing habits (including video and non video games). In the main experiment, gamers were chosen with specific backgrounds in urban sociology, geography, design, economics, anthropology of mobility and migrations, information and communication. They were not game designers and did not necessarily have a lot of experience in video games in general. The purpose was to tap into their expertise of what it means to be in a city, not only as regular users but also as theoreticians of this question.

4 Gaming on the run: the city as concrete environment

One of the first remarks of our users was that the game was thrilling in particular because it "takes away the sacred aura" of our relationship to the city. Indeed, cities are governed by rules organizing our relationship to it. Where to drive, where to walk, how to behave properly in a farmers' market or on a town square, in a church or in a parking place. Relationships between people are strongly related to the definitions and tasks related to such places. In other words, players no longer followed the rules of proper

street behavior. Running—not for fear of being late—acquired legitimacy through the game, as well as retracing one's steps, or staying and gaping at buildings. "To play and to be mobile is more fun, less geek. It is more sociable. I think that running or reintroducing childish activities helps building up social relationships in addition to relax from work".

The physical challenge was accentuated in the game by the time limit (30 min). Though the perimeter of the game was not too large players still had to cover some ground to find the clues.

Some players noticed an additional difficulty as in the "Bill" game designed by Glasgow University [8]: one has to watch out for cars. As also noted by Chalmers et al., gamers seem to be able to manage their PDA and the streets events. And indeed, in our own experiments, nobody got run over. This might be anecdotal and pretty obvious but it tells something about the way people have to manage their "in" and "out" of the game flow. "You have to take care of cars and then you are no longer concentrated on the game. And when you are fully involved in the game as I can be, you can be inattentive to what happens in the street". The question raised is not only one of propriety and safety. It also challenges the way we design games. In video games, there are phases of climax and anticlimax when the gamer can look at her scores, armaments, or simply pause. When defining flow, pervasive game designers have to consider how they will balance careful/carefree behaviors. There are of course quite obvious solutions like limiting urban playing to pedestrian zones. But one can imagine that the design of the game itself could take on the constraint and turn it into a meaningful element of the game, either with motion captors sensing vehicles, either using sound design to provide information.

It is important to note that we had no geolocalisation which makes our experiment quite different from other pervasive games such as "Mogi" [21] or "Pirates!" [5]. Though the absence of geolocalisation could be considered as one of the project drawbacks, we could, in fact, explore other aspects of social relationships and space mediation that open up potential for pervasive gaming. We have discussed in [10] how the need to introduce the topology of the network in the design of the interface was felt and how it became a way of evaluating distances and managing interactions. People had to consider speed but also the physical obstacles posed by the urban configuration. As was noted in [3] and [8] coverage and the loss of connection are quickly woven into the game play by the players who exploit the faults to hide or trick their opponents into thinking they are somewhere where they are not, or who use the lack of connection to pause. Seamful design was fully integrated in our game and players organized their strategy around the risk of losing the connection. This part of the game, would suggest a use of urban environments as in the urban phenomenon of "Parkour" or "Free Running" or any kind of games that turn the city dweller into an "active performer" [12]. In Team exploration, participants managed both real and radio spectrum obstacles. They considered the architectural and urban configurations as key elements of the game play: whether because they might get out of reach and use that as a way to organize their strategy or because one has to keep in touch with the other members of the team despite the physical obstacles. In Team Exploration, relation to space is therefore not a question of pointing things and people on a map like in "CatchBob!" [15] but of organizing a spontaneous social network based on co-presence in a physical space. Players thought about the distances between each other. They tested the elasticity of the coverage by taking careful steps and watching the signals or lack of. The game therefore brought another reading of the city in terms of covered territory, architecture, flux of people, etc. This is, without doubt, the main difficulty of ad hoc games as their success relies on the number of people actually on the premises and who can sustain the adhoc network. Even if we think that mobile ad-hoc networks develop in the future, it still means that urban flux will have to be carefully analyzed and exploited by the game design.

Designing ad hoc mobile games means that space is considered as a physical challenge, not only in terms of moving or running but also when one has to deal with network coverage. Buildings and certain street configurations can break the connection between players who have to anticipate the possible obstacles. Space is also defined by the events that structure the flux within the cities. Flux of the city and flow of the game can be tuned so as to provoke real/virtual events in the game play. It is this kind of double narrative that we tested within another research program: ANR SAFARI, where we invented a game based on train departures doubled as spaceship take off. It was designed for the French National Railroad Company (SNCF) and called Treenor.[1] Players could consult train timetables and go to the dock to board the train/spaceship they chose to "fly" with. The game was synchronized with the actual schedule of train arrivals and departures. The player had to stand on the platform of the actual train to be able to board the virtual spacecraft. The synchronization of virtual and real world along actual events happening in the railway station, the arrivals and departures of trains, was unanimously noted by the testers to be the strongest feature of the game. Mapping city events, either regular or exceptional can be part of the narrative springboard of pervasive games.

[1] 2003–2005, ANR –RNRT, mobile ad-hoc network research project SAFARI.

5 From maps to memory

The question of representing the space/place where people would play was a difficult issue of the interface design.

Our game relied on the analysis of currently used mobile applications that represent space. As is abundantly clear, there are two main families of mobile services: those that extend the office, with emails and internet access, and those that focus on and accompany mobility: maps, GPS, and local information. It is our belief that the design of our game, based on a new technology, had to rely at least on a basic familiarity with these services. Hence, the map representing the board game. Its first function was to introduce and focus on the place where the game took place and set the limit of the treasure hunt so that players would not stray away. In Team Exploration, the city was no longer only considered as a giant playground like in "Can You See Me Now" [3] or "Conqwest" [12] but also as an element that could give to the game an atmosphere, a narrative, a framework. The map was also the interface through which the players could validate their findings. In other words, people had to do the geolocalisation themselves. They had to read streets signs, recognize street patterns to be able to figure where they were and more importantly where were the clues. In true Parisian fashion, the layer of streets is far from regular and one suddenly realizes that certain street configurations can be misleading. In a certain way, the game tested the players' ability to read a map. They did not only position themselves for directions (which is the way most people use maps) but also had to position objects, which required even more precise skills. More that once, players debated about the right position of the clues. The experiment did confirm how much we are in need of help when we are on the move… Yankel Fijalkov, sociologist of urban territories and geographer, who tested and analyzed our game, stressed the difficulty to read the city as a physical environment. He notably pointed out that there is a major difference between looking at streets configuration while being inside the streets, reading a map for directions (meaning you are not there and just want to pass through), and representing the city with a drawing [13]. Again this is a very important distinction for games that would rely, as ours, on an exploration of the city. We can draw at least two consequences from such observations. Geolocalisation is not the overall answer to problems of mobility. Representations of space are a graphic design challenge, first because they rely on people's ability and culture to read such documents, and because they should adjust to the activity. In addition to the rendition of streets configuration, there are questions of scales, of visual landmarks to be addressed, with images or texts that are based on the way people describe their environment: close the church, after the MacDonald, …

More originally, it slightly altered the status of the map turning it from a tool of mobility to a journal and testimony to a journey. The scale of the clues certainly invited to such a transformation. Indeed, we did not choose major landmarks (useful for directions) but mostly tiny, discreet details of street art. The bigger artefact was a fountain but otherwise certain drawings could be a few centimetres large. These details give a certain flavor to the place but cannot help to direct oneself. We will come back to that when analyzing the photographic essence of the experience, but let's say some testers wished they could keep a memory of this game that would testify of their scrutiny of the streets and newly acquired familiarity with the surroundings as it was proposed in "REXplorer" [32]. The map thus became a page to be completed. Players regretted that they could not draw on it, mark their respective positions and trajectories with different colours as they finally did… using a piece of paper. In any event, there was a general demand that the itinerary and physical moves should be more meaningful and not only a means to an end. For instance, some players imagined that the device could actually take picture of the place and its clue to actually prove that they had been there. In other words it meant the map as a tool could be turned into a personal cartography. It also introduced the idea of mixed narratives: game narrative, personal and city narratives.

6 City narrative/game narrative

Contrary to a new video game that can open a blank page, pervasive games are based on urban representations. There is always a first narrative that is that of the city. People have a clear idea of the fashionable places, the dangerous neighborhoods, the living or working areas. Pervasive games are counterpoints to these narratives based first on a collective imagery of the place, then on more neutral "non places" that punctuate the cityscape and finally on the presence of inhabitants.

Our testers, as well as any urban citizen, have a wealth of images, anecdotes, stories, experiences to share about cities even if they discover it for the first time. It means that pervasive gaming can use elements of the cityscape, be it a castle (as in the very interesting experiments made in Nottingham or more generally within the SHAPE European project) or street art in our Team Exploration game. It also means that the pervasive narrative has to weave itself into the city narratives, either to bank on them, or to question them, but that it cannot ignore them. The concept of "place" as it is defined in anthropology is useful to qualify this symbolic and practical relation to the city. The anthropologist Marc Augé [1] points out that places are the basis for our identity, our history, and our social network.

In this respect, staging a game in a city will always confront people's intimate relation to place.

This leads us to another consideration emphasized by our testers. Cities are not only anthropological places, they are also "non places" with special functions. To go back to Augé's analysis, modern cities are organized so that certain tasks can be performed without necessary contributing to the inhabitants' sense of identity. Augé stresses the role of airports, highways, or supermarkets as specialized areas with definite purposes: traveling or buying. Urban games are also caught in the purposefulness of public transportation and commuting, office buildings and work, private buildings and privacy, churches and spiritual life. Even though Paris is a rather thoroughly mixed environment, testers pointed that they would pay attention to the functions of specific locations. For instance, private buildings would be off the limit because of the disturbing nature of the game for the inhabitants. Religious buildings would also be ruled out because of the discrepancy of purposes and out of respect for religious practices. On the contrary, more neutral locations were repeatedly opted such as public transportations, bus stops, train stations. Due to their rather intrusive nature, pervasive games can more easily start from neutral grounds than deeply personal ones. Our hypothesis is that these neutral settings, small enclaves of "non places", were also valued as they offer natural standpoints to look at rich cultural and social areas, while slightly off the main venues. They are windows onto the outer world. Experiments of mobile ad-hoc networks in train stations confirmed that the players would use the system to expand their perception of the city from the station.

In any case, the exhilaration comes from turning one specific place or location into something else. The sense of freedom experienced by the players stems from the temporary laying off of urban everyday use. The city is, for a while, experienced out of its social and organisational functions. It is no longer estimated through its utility or its dysfunctions, it is considered as a new text to be deciphered. Pervasive games have people consider otherwise transparent surroundings. Treasure hunts, in general, bring some kind of photographic quality to the experience of the city. People look for clues, pay attention to details, read the cityscape. As was noticed by some of the players, the devices could be used to document this reading through actual photographs or recordings of their finds.

Finally, part of the city narrative comes from the inhabitants. Streets can be felt to belong to a rather secluded lot, either in good or bad terms. The city is not only considered as a place to visit but as a place to meet and be part of the local community. In our experiment, La Butte aux Cailles is considered by many as a Parisian village. People know each other, there are terraces where patrons talk to each other, there is an overall endearing quality of complicity. The technical device was then conceived as to gain insight in some of its intimate life. Some players imagined scenarios where the actual inhabitants would willingly contribute to the game, and in doing so, would testify to the possibility of an ephemeral but real relationship based on mutual discovery. That might well be one of the utopias brought about by this new technology and prompted by the special atmosphere of this area of Paris. Nevertheless, the complicity brought about by sharing space and activity was also pointed out, for instance when waiting in line for a movie, or sharing an experience of any kind. To go back on Augé's definition of anthropological places, these reactions also show that the technology based on closeness of the participants in relation to the city reactivates a longing for relationships based on a mutual experience of a specific location, far from the virtual distant communities. It could also be that re-enchanting locations are one the main purposes of pervasive game design. The Butte aux Cailles provides with all the anthropological data that give us a feeling of being at home in a rich environment, but some players pointed that some areas are characteristically devoid of any charm and that virtual and communal contents could contribute to add meaning to particularly desolate locations. Table 1 recapitulates the different levels where the game is tuned to the city.

Table 1 Tuning the game to the city

City	Pervasive game
City as a practical experience	Turning urban services, urban organization into elements of the gaming experience
Urban layout	Obstacles and resources
City events and flux	Rhythm of action, double meaning of events, narrative devices
City culture	Narrative background (to build on or against)
City map	Game board

7 Collaborative contents

As we said before, the technology is based on mobile ad-hoc networks which means that the network relies on people. In a way, technical network and people are fused. This is important in several respects. First, it means that the dynamics of the game is necessarily collaborative. Second, for the designers of the game as well as the testers, the contents are relative to a certain place. Hence, the importance of local narratives and the longing for communal contents. Third, it also means that the game is at the

crossroad between what local people can offer and what passers by, tourists, or commuting people expect from it.

In this respect, our particular game provoked a controversy. Players would disagree about the right contents for a tool and services that are based on nearby urban actors. Two distinct strategies were evoked. Either the legitimate contents were cultural and apparently pretty innocuous, or they could, under certain circumstances, be more commercially oriented. In the case of cultural contents, testers agreed that mobile ad-hoc networks would not only provide clearly marked cultural landmarks. On the contrary, many suggested that contents should be designed by people actually living on the premises, leading to the discovery of crafts, tiny details of architecture, original anecdotes. A kind of grass root tourism. But then, shop owners, restaurants, and consumers alike might also want to contribute to the picture. Shop owners to promote their goods, and consumers to give advice about precisely the same items. Consequently, our testers feared of spam, and commercial invasion.

This controversy does not only reflect on the general weariness provoked by commercials in real streets and all media. It raises the question of the legitimate authors and actors of pervasive gaming. As we stressed before, the street is not a blank page. Not only is it a narrative in itself but it is also a place inhabited by people with different activities who are going either to be ignored (and it does not really matter where we are) or to be taken into consideration (and the game relies on the specificity of place). A certain number of players suggested that mobile ad-hoc networks, as a "proximity" technology relying on people, was an opportunity to meet "neighbors" but they would not want to meet anybody either… A lot remains to be defined for a proper encounter. Our testers revealingly turned towards actors of the public sector as an easy way out of the dilemma. The townhouse, associations, but also public transporters were deemed legitimate and trustful editors of contents. People and public institutions are perceived as reliable which means, for instance, that a kind of hierarchy of authors can be established. In a train station, fellow commuters are worthy participants in a mobile ad-hoc network, but the railway people are felt more competent when it comes to train planning information or station services.

The definition of location given by the testers was obviously based on traditional categories that include buildings, streets, squares, parks, etc. But the game revealed that people considered micro places such as taxi stand or bus stop as perfectly relevant to structure their relation to the city. Indeed urban furniture would stand for the institution behind it—in terms of contents and legitimacy—as well as visual landmarks. Some testers also suggested that these urban elements could be considered as local "actors" of a mobile ad-hoc network. It was not that these elements would impersonate some imaginary characters (though why not) but that local information can be delivered slightly in advance. A bus stop could be turned into an ad-hoc hotspot transferring information about bus arrivals in the neighborhood. "We would not have to wait 20 min in the cold. I could leave my flat at the appropriate time". This also tells us that four things are going to actually structure a pervasive game: the concrete city (physical organisation), the imaginary city (narratives), the functional city (services) and the city events. Events are all the regular and irregular happenings that take place in the city and that give a certain rhythm to its life. The city is a network of timed arrivals of public transportation, opening and closing of shops, offices, public institutions, etc. It is also the theatre of unexpected or exceptional events: demonstrations, festivals, strikes, etc. This strikes us as a particularly interesting feature as taking events into consideration not only provides dramatic material but also contributes to a reflection on rhythm within the pervasive game design.

As we know this question of content production is far from being trivial and is a major problem of pervasive game business models (and probably one the reasons why there is no commercial games so far, apart from Mogi [21]). Indeed creating specific contents for a specific place means that a huge amount of time is devoted to producing a cultural product that few are actually going to enjoy. Moreover, pervasive games are not limited to the discovery of a new place. As our testers pointed out, urban mobility is primarily concerned by repetitive journeys either to commute or simply to shop, accompany children to school or to walk the dog. This presents another challenge. How do we adapt contents to repeated trips? [14]

8 The errors of our ways

These experiments not only helped figure what we should first analyze (city narratives) then weave into the game narrative. We also discovered that the limits of our game were due to a wrong balance between the time allotted to the players and the fundamentals of our pervasive game play. During the design of Team Exploration, we repeatedly evoked the question of timing and we decided that the players should be granted little time and thus race to gather the clues as quickly as possible. The number of clues and their position in real space were chosen so as to make the endeavor feasible. We walked and measured the Butte aux Cailles many times so as to physically test the relation between walking and finding clues. Still, the players complained that they were partly denied the pleasure of the game as it oscillated between an enriched experience of the city and a race that was a lot of fun but contradicted the

more leisurely pace that was deemed necessary to enjoy the neighborhood. In fact, we hesitated between two ways of walking in the street. Between street performer of the Yamakasi type and the "flâneur" (stroller) described by Baudelaire, there is a major gap that does not only reflect on diverging profiles but also different situations. As our testers pointed, different games must be designed for different types of mobility. Team Exploration was classified in the "vacation time" game category. It takes place after work, "to relax". But suggestions were made that mobile ad-hoc games could take advantage of public transportation and commuting time to create collaborative games with other travelers. Waiting times were also mentioned whether at the Post Office, the movie theatre, the train station. The notion of spontaneous network was fully endorsed in this type of games that would take less time and would rely rather on people around us than on the city.

As in every treasure hunt there is a tension between what is "treasurable" and the attention that players might want to pay to the discovery of a place and the hunt which actually means that little attention is paid to the surroundings and the emphasis lays more on the physical capacities of the team. In the end, we understood that we could have chosen more explicitly a game that focuses on physical prowess and even choreography.

In other words, "Team Exploration" oscillated between two types of play as defined by the anthropologist of play, Roger Caillois [6]. On the one hand, we offered a narrative, even a limited one that connected the different clues. We chose a theme (at the beginning female figures in the street then street art) and put an emphasis on collective gaming rather than solitary play. This gave rise to narratives from each player who would remember personal anecdotes. It transformed the immediate practical purpose of the city into a place to be discovered and imagined for its own sake. Caillois defines these types of games as belonging to "mimicry" where people invent a surrogate life, an imaginary role, a symbolic quest. On the other hand, we promoted speed and manoeuvres of the team that relate our game to "agon", that is to say competition where equally equipped players try to outplay the others. In video games, both types can be stimulated at the same time, as gamers are engrossed in an adventure where they must shoot first. But in pervasive games, where you cannot die though the obstacle are real, the whole balance between exerting oneself and competing with others, and inventing a story based on the actual surroundings might be difficult to achieve.

9 A typology of urban ad-hoc mobile games

The previous remarks lead us to envision a typology of ad-hoc mobile games that would take at least two parameters in consideration: subjective relation to others because the mobile ad-hoc network implies close relationships and types of urban mobility. These two parameters—qualification of time and qualification of people—work together and can account for existing games as well as possibly point to new mobile ad-hoc networks games. The first axis on Fig. 5 rates relationships between people from unknown to known. The second axis qualifies length and quality of time from brief moments to long periods, pertaining to activities qualified as constrained or leisurely. We will also try to emphasize what other parameters could get into play such as the identity or legitimacy of actors and institutions pertaining to the city. Indeed as we saw, not only passers-by can be players but places are characterized by those who live or use them on an intimate or at least regular basis. The city does not exist as a whole but is divided in multiple parts that are qualified according to certain criteria. We shall address first the question of time then that of human relationships.

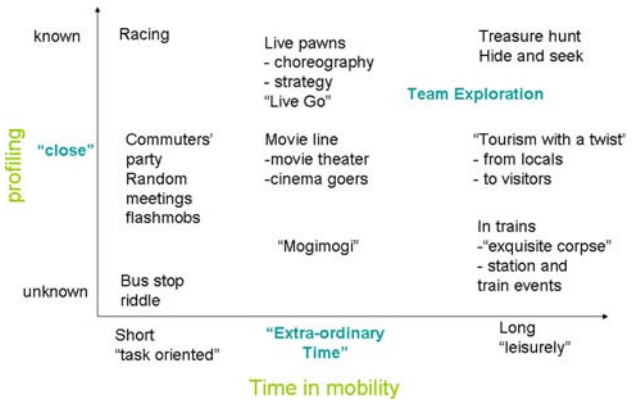

Fig. 5 A typology of urban mobile ad-hoc games

First, when people are on holidays or weekends they classify mobile ad-hoc games along with classical or pervasive treasure hunts like "Can you see me now" or "Pirate", or tourist activities, or gaming evening with friends. Team exploration was clearly identified as such a game. Our testers suggested that it should definitely be reorganized to give more time for discovery. Such games were often compared to cultural activities taking place in a city or a museum. Rather than giving information on a top down, linear basis as audio-guides, they could be construed as collaborative discoveries leading to a playful appropriation of the city. They also thought of games where you do not actually move but you are out for a certain length of time. They pointed that trains not only give you a lot of time and a good number of potential players, they can also organize the framework and the plot of a game: our testers thought of games like the Oulipo's "Exquisite Corpse" game where you pass and augment a sentence or a drawing,

from one end of the train to the other. They also thought that trains were great setting for role playing games.

On the other end of the diagram, our testers thought of games that would require brief moments. In this respect, city events appeared to be triggers for quick gaming activities: bus arriving, trains leaving, shops opening or closing would start a riddle, a shooting game, a virtual flashmob.

Testers also created a time category that did not fit into hurried—task oriented—time or leisure, but extra-ordinary time that you steal from your schedule. For instance in Mogi, which is a collecting game that we introduced earlier in this article, players take more time than just efficiently commute (Mogi induces new routines: a salesman changes his route to see his clients to grab one of the virtual images that lie somewhere in the city of Tokyo; a hostess does not go back home directly after work but take some time to wind down and collect some virtual items). This extra-ordinary time can also be when we wait for something. One of our Team exploration testers explained that he always went to the cinema alone because his friends and family did not like what he watched. For him, Transhumance meant that he would feel less alone if he could engage in some kind of conversation with people going to the same movie and waiting on line. Chat services, or other kind of community tool could be organized around a shared activity.

Urban time could therefore be a parameter for designing games because time is always socially qualified. Every span of time is devoted to a social activity but also to a certain place that is or is not legitimate in terms of game and play. Testers thought of their schedule, their day trips, from the tiny fragment of time (smoking a cigarette outside the workplace) to trips spanning several hours.

This time parameter has to be confronted to that of the qualification of users. We do not play the same games with the same people. Our testers immediately classified games according to the kind of relationship they would have with their co-gamers. It is possible, as in a multiplayer game, to play pervasive, ad-hoc, games without knowing who is playing with you. The short distance between players might make it difficult to hide totally from sight but our testers meant that familiarity was not necessary to the game play. They mentioned Naughts and Crosses, or Rock-paper-scissors or shared riddles as the kind of games that could be easily played on an ad-hoc platform. On the other end, a promising aspect about the Transhumance platform was that it actually engaged bodies: so that connected people could organize a choreography in the city or play a live Go. That would mean a certain amount of familiarity as testers were very much aware that recognition of physical proximity entailed a certain amount of trust.

Eventually, a new category of gamers—neither known nor unknown—appeared: people qualified as close because they belonged to the same neighborhood or shared the same experience. The idea was not to meet "new friends" but that being somewhere at the same time creates a feeling of complicity, of connivance. Again, a certain number of testers expressed a longing for more authentic relationships with the original inhabitants of a neighborhood. They mentioned that a line of tourism might stem from a system that allows close but discreet relationships. The actual situation or activity would be a pretext for conversation or a ludic discovery of the context and its inhabitants. We explain in [14] how another experiment in pervasive gaming (PLUG-The Secrets of the Museum) gave us the occasion to address the issue of collaborative production of contents and mashups.

Representing people and a form of topology of the network finally appeared necessary because it enabled strategic moves. A precise positioning could only apply in games with people knowing each other enough so that they would not mind being in contact or sharing a space that would guarantee a certain amount of security. Mogi is a case in point. It was invented in France but was deployed in Japan. Many things can explain this situation but one of them is that people would feel more secure in Tokyo than in Paris and sociability would allow for a civilized interaction. Another example is Plug-The Secrets of the Museum that we designed for the Museum of Arts and Crafts in Paris. People would play together and even have direct relations because the context of the museum was reassuring in terms of profiles (museum goers are not everybody in the street) and basic security issues (guards everywhere in the museum). The shared activity provided with a good reason to interact but the interaction was made possible first and foremost by the quality of the context.

10 Conclusion

The absence of geolocalisation helped us to concentrate on the diversity of urban experiences rather than focusing uniquely on the geographical skills of players engaged in a treasure hunt or pursued by other players. Maps and trajectories (reinforced by geolocalisation) are one aspect of treasure hunts but companionship and discovery are at the core of the pleasure of pervasive games based on mobile ad-hoc networks because people are the network. With Team Exploration, as the name suggests, we switched from a model of treasure hunt to a model of collaborative exchanges. The exploration of the city was therefore closely related to team building and strategic thinking. Being in a group changes the relation to the city and therefore the device and ad-hoc platform give users a new way of appropriating [7] the city as was pointed by Montola and Waern [25].

Beyond our specific game and tests, and what they helped to define for the pervasive genre, what appears is that the anthropological approach becomes part of game design methodology. It is certainly one of the challenges as pervasive contents and scenarios will change regarding the type of urban setting. Paris presents specific features that will not necessarily apply to Los Angeles. Nonetheless, a certain number of anthropological urban features that qualify our relation to others and our relation to time in the city can be isolated that helped us create a typology of pervasive games.

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