Seamful Games

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ABSTRACT
Seamful games are mobile multiplayer games for PDAs with 802.11 and GPS, designed to highlight and let people use the GPS for positioning and wireless networks for communications—but also to be able to hide in the 'shadows' of GPS caused by buildings and in the cold spots of low network connectivity. Our system explores a novel approach to design that aims to make positive use of infrastructure features often considered as either negative, negligible or non–existent, and to reveal how people accommodate and take advantage of spatial variation in connectivity and positioning.

INTRODUCTION
In research set within the Equator interdisciplinary research collaboration, we have been experimenting with a 'seamful' design approach to ubicomp systems. This term comes from Mark Weiser who, in his invited talk at UIST94 [1], advocated *seamful* systems (with "beautiful seams") as a key goal for ubicomp. Paraphrasing Weiser's talk slides only slightly, and retaining his emphasis: making everything the same is easy; letting everything be *itself*, *with* other things, is hard. Weiser was referring to the unique features that characterise or define an ubicomp system, in particular the seams that appear when one tries to connect a system to another, or use it with other media.

In ubicomp, the seams in infrastructure often show through in interaction. What is 'infrastructure' to system designers may then be 'interface' to users. Examples are the 'urban canyons' where GPS positioning is poor, the 'cold spots' between areas of wireless network coverage, and the tunnels and interiors where mobile phone signal strength is weak. Engineers and designers generally consider these features as problems to be solved, but users can and often do accommodate such seams, and find ways to use them as solutions for their own problems. For example, patchy network coverage is a fact of everyday life for mobile phone users. We learn when and where we might lose a signal, even though we are rarely shown this information explicitly. We know where we can relax without likely interruption, and know when we can use lack of signal as a plausible excuse for not answering.

Sometimes we cannot smooth over or hide these seams that, to some extent, define ubicomp infrastructure such as 802.11 and GPS. Weiser encouraged us to use such features as resources for design and interaction, and take positive account of these reminders of the finite and physical nature of digital systems. Seamful design, therefore, involves deliberately but selectively revealing seams to users, and taking advantage of features usually considered as negative or problematic [2].

Many other researchers' designs have let people accommodate or defend themselves against such seams, e.g. [3], but we aim to support more positive appropriation of seams i.e. to help users develop new patterns of behaviour that take advantage of characteristic interactional details of ubicomp infrastructure. There have been other games that have used the discovery of 802.11 access points as a resource, such as *Noderunner* game (www.noderunner.org) demonstrated at Ubicomp 2003, but our game involves real–time interaction between players exposes the spatial distribution of 802.11 coverage rather than just access points. As the next section describes, our 'seamful game' relies on the spatial variation of 802.11 and of GPS positioning, and makes this variation central to the user experience.

PLAYING THE SEAMFUL GAME
Our game system employs a set of VPN–connected wireless access points, and a laptop to run a game server that handles and distributes game information via this wireless network. Two teams of players use Compaq iPAQs, each with a GPS unit in a CF slot and built-in 802.11, to gain information from the server about the position of periodically appearing 'coins', the locations of other players, and 802.11 signal strength as sampled by players during the game. The PDA interface is shown in Figure 1, below. Players have 30 minutes to get as many points for their teams as they can. The team with the most points at the end is the winner.

To gain points, a player has to get close to a coin (according to GPS), and use a GUI *Pickup* command to pick it up.

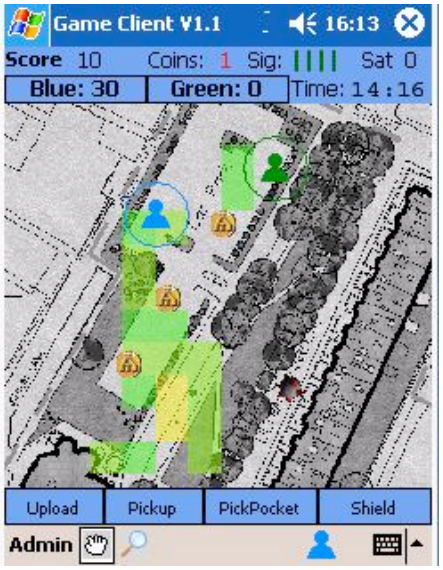

Figure 1. Each PDA has a street map on which it shows players' positions (circled icons), as well as coins (smaller circular icons) and a transparent overlay of sampled 802.11 signal strength that varies from pale green (high) through yellow (medium) to clear (low). Game commands are buttons below the map, e.g. *Upload*, while a bar at the top shows data such as player and team scores, current 802.11 strength (*Sig)* and number of GPS satellites (*Sat)*

Then, the player can *Upload* the coins he or she is carrying, and get a point for each coin. If two players in the same team upload coins to the same access point at the same time, each coin is worth double points.

The game has an inbuilt tension between being in net coverage and being out. Initially, players are uncertain as to where there is coverage, but they watch and talk to other players as they move, and use the dynamically updated 802.11 map overlay as they discover new access points and reveal more of the coverage to each other. Coins often appear in areas where there is no coverage, but one needs net coverage in order to upload coins and get game points. When one is in coverage, one can also get updates on players' positions, new coins and net coverage, and one can use the *Pickpocket* command. This steals coins out of the PDAs of any players within 10m (according to GPS). To counter this, a *Shield* protects a player from pickpockets for 10 seconds, but it can only be used once and then the player has to use the same button (relabelled *Request*) and wait for a new one. Players usually hide from each other and keep their coins safe by being out of net coverage or in GPS shadows—and of course by not being directly visible to other players, e.g. hiding behind trees and walls. To get points, however, one has to get into net coverage and avoid pickpockets as one uploads coins. To gain double points, teammates have to carefully time when to jointly approach an access point—thus making themselves a prime target for a pickpocket—and upload.

Our user studies are ongoing, and we hope to use the experiences of Ubicomp participants who play the game to add to our observations of the system in use. We have found in our initial experiments that players develop tactics grounded in the characteristics of the system infrastructure as reflected in the game design. For example, some players become specialist pickpockets, lurking near to access points ready to leap out and steal coins from other players. We have also observed players taking advantage of GPS 'jitter' in areas of poor positioning. Even though a coin may be too too far to pick up normally, jitter can briefly make one appear to the server as if one is close enough to pick the coin up—before the temporary error in positioning is corrected and one jumps back to one's 'true' position.

CONCLUSION

In the game, infrastructure is central content rather than peripheral or invisible context. While infrastructure is not often considered as part of the user interface, the characteristics of wireless networks, GPS and other commonly–used ubicomp infrastructure clearly affect user interaction and therefore are good candidates to be part of the interface. Deliberately exposing selected aspects of infrastructure can help users develop their own ways to take advantage of the limits, gaps and seams in ubicomp technology, and decide when to use older media such as buildings and books, and when to use old and new media in combination. As Weiser suggested, ubicomp aims to let us select from and combine new and old media in ways that suit our changing priorities, which may suggest a more holistic approach to design that treats each member of this heterogeneous mix of media as peers [4].

We emphasise that we do not see seamlessness as always bad and seamfulness as always good. Seams shown in an interface have to be chosen and designed well, just as any other interface features do, and designers should ask themselves whether, given the particular users, seams and activities under consideration, revealing seams will offer useful opportunities for user understanding or will be merely be distracting and intrusive. Therefore we see seamful design as just one potential way to 'design for appropriation' and to support the more widespread acceptance of ubicomp technologies.

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