# Intelligent Inhabited Environments as Location Based Services

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## Introduction

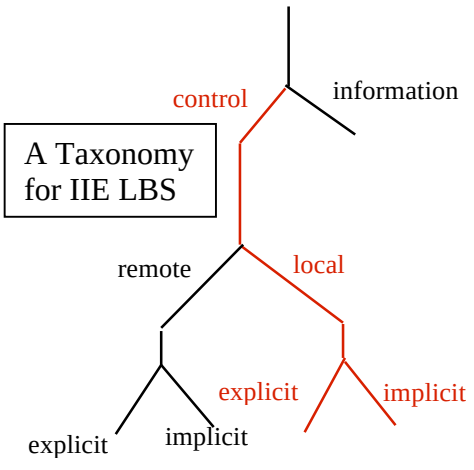
This paper addresses an opportunity for the provision of novel location based services generated by the newly emerging application area of "Intelligent Inhabited Environments", a form of pervasive / ubiquitous computing that uses agent based embedded computing devices to construct technologically driven living environments.

Intelligent Inhabited Environments (IIEs) can be regarded as being similar to intelligent buildings or smart houses in that they harness collections of network enabled embedded-computing devices to control environments such as houses, or offices, but extends the concept by addressing vehicles, body worn devices and public spaces. Another distinguishing characteristic is the use of intelligent agents embedded into the computational artefacts making up the space. Typical services being controlled include lighting, heating, entertainment, information, access, etc. The role of the embedded agent is both to provide value added service and functionality in addition to providing a means to make the system work without incurring the user in cognitive effort to deal with the technology. Also, the embedded-agents controlling the artefacts or acting on behalf of the user/owner behave in a location aware manner providing access to services or control over the local environment, depending on location or context.

## Location Based Services From an IIE Based Perspective

In terms of inhabited intelligent environments, LBS generally relate to systems that are physically embedded into the environment and are static or, at best, nomadic in nature (e.g. building services). Whereas most LBS are information-based systems, IIE LBS are fundamentally concerned with *control of physical entities* by a user (implicitly or explicitly). These systems are usually networked together providing for both local and remote access. The diagram provides a first attempt at simple taxonomy for location-based services within an IIE context. In order to illustrate how this taxonomy applies to the work we are doing at Essex University we discuss a few examples based around a temperature service (i.e. a room or cabin heater).

- Local Explicit Control – This would involve the *user* requesting a change to the temperature of his local environment via an interface (e.g. phone, pda, vrml voice, or traditional room control).
- Local Implicit Control - This would involve a *room agent* requesting a change to the temperature of the local environment based upon preferences provided by a *user agent* (e.g. moving



with him via his phone or network, and learning his preferences).

- Remote Explicit Control – This would involve the *user* requesting a change to the temperature of a *remote* environment via an interface (eg phone or other networked interface).
- Remote Implicit Control - This would involve a *room agent* requesting a change to the temperature of the local environment based upon a preference provided by a *remote user agent*

All of our research involves the use of *explicit local control*, such as being able to alter the temperature of the room via some local interface (e.g. a pda with a bluetooth connection). In our care agent work (funded by the UK-Korean Scientific fund) we are concerned with effecting control between remote spaces. For this we have created two network-linked rooms, one in Korea the other the UK. From this work we have been able to demonstrate *remote explicit control* (e.g. someone leaving his office and explicitly turning on the heating in his home) via a variety of interfaces and network technologies. In our work on eGadgets (funded by the EU Disappearing Computer programme) we have been experimenting with the use of embedded intelligent agents to implement *implicit* LBS arrangements. For example, considering *local implicit control*, an agent associated with a user entering a room might request a change in temperature to better suit the preferences it had learned about its owners control of the environment. An example of *remote implicit control* might be when a user leaves his office, his *agent* (or an agent in that room) requests his destination system (e.g. home) to switch on the heating (having learned that this was his habitual preference).

## Summary

In summary we have argued that the profusion of embedded computers into environments such as intelligent buildings and ubiquitous/pervasive computing are in reality a variety of location based services with associated opportunities and challenges. Also, we have tried to draw a distinction between *information* and *control* based services. Our current research is mostly directed at the development of computationally small intelligent agents that can be integrated into either service providing appliances or service seeking devices. More information is available in other papers and on our web site.

## Some Related References

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