ConStruct – A Decentralised Context Infrastructure for Ubiquitous Computing Environments

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Abstract: In this paper we describe ConStruct, a distributed, decentralised infrastructure for the collection, processing and distribution of context information in a ubiquitous computing environment.

1. Introduction

Most existing context services rely heavily on centralised logic or complex communication algorithms in order to collect and deliver information to users [1, 2]. Such designs, however, are inappropriate for the ad-hoc and volatile nature of ubiquitous environments. In this paper we describe ConStruct, a fully distributed and decentralised context aggregation infrastructure.

2. Design Philosophy

The variance in number, heterogeneity and connectivity of devices that make up a ubiquitous environment adds complexity to the design process. Devices may join or leave a ubiquitous environment in an unpredictable fashion, and device failure must be treated as commonplace.

Earlier work on ConStruct demonstrated the need for simple decentralised interactions when developing services for such environments [1]. Complex distributed communication algorithms resulted in a system, which proved hard to maintain in these dynamic environments.

With these issues in mind, we have changed our approach to designing ubiquitous systems. We remove the need for centralised logic by delegating control to each participating device and favour the exploitation of emergent behaviour in order to reduce the overall complexity of interactions. With these principals in mind we have redesigned ConStruct as a fully distributed and decentralised context aggregation infrastructure.

3. ConStruct

Each participating device in a ubiquitous environment runs an instance of ConStruct. Each deployment manages and distributes the local data provided by *entities* of the environment and collectively they maintain a global model of the environment. Each entity is associated with an instance of ConStruct and exchange data with it.

Data are modeled in RDF format and describe contextual properties of the environment. Gossiping [3] is used to propagate this data across the environment. Intelligent entities, with domain specific knowledge may aggregate data from multiple

sources, and contribute further data. Stored data are associated with system metadata, which permit lifespan and security restrictions.

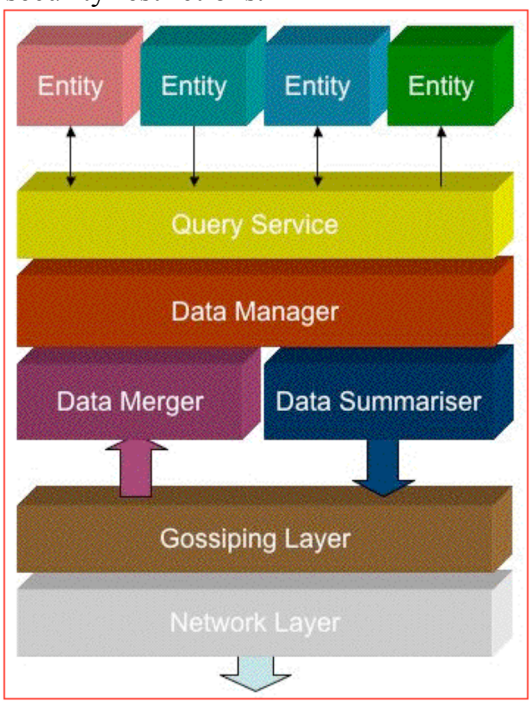

Fig 1 – ConStruct's Core Components

ConStruct's functionality is provided by a core set of components as shown in Fig. 1. The data manager controls access to its local data store. It is responsible for merging RDF documents received from entities and removing old data as they expire. Querying services allow entities to access local data. The gossiping layer is responsible for selecting peers with which to share data. Beneath the gossiping layer is the network layer, which handles the point-to-point transfer of data. Data summarisers are responsible for restricting the local view of data to be gossiped and data mergers take data received during a gossip session and integrate them into the data store.

4. Conclusions

This paper describes ConStruct, a context infrastructure for ubiquitous computing environments. Construct is designed with simple decentralised interactions in mind, to mitigate the challenges associated with ubiquitous environments. We also outlined the core components of ConStruct.

References

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