Fei Liu

Context discovery in ad hoc networks

Context awareness is quickly gaining ground as a key quality factor in future ICT services. Users are offered interesting services, geared to their current environment and circumstances. But how do you explore your environment, particularly in ad hoc – thus unpredictable – networks? Fei Liu is researching a context discovery method that does not overburden the network with useless searches.

'How do users ascertain which network environment they have entered? There may be sensors nearby, providing information about the environment, other PDA or laptop users, or a server with information. Each offers information or a service. As a user, you enter the network environment as a new node, acting as both consumer and provider. In the ideal situation, service provision would be tailored and geared to the environment. To make this possible, however, you – as a user – must explore your environment, and the environment must recognize you as well. Take, for instance, emergency situations. You want to find the nearest emergency services, but the emergency services also want information about your situation and details about your current environment. A personalized, context-aware approach can play a significant role in these types of situations.'

'We are looking for a "context discovery" solution: what is the context? Where is the information located? The problem is that context searches can overburden the network. If every node identifies itself completely, you effectively put all data into the network. That requires a tremendous amount of energy, whereas ad hoc networks are designed for low energy consumption with a lot of battery-powered devices. On the other extreme is a situation in which the nodes do not identify themselves at all and know nothing about their environment. This leads to extensive searches, which again demand a lot of energy and involve a substantial risk of yielding no relevant result.'

'For this reason, we want to simplify the exchange of information. We have opted to use Bloom filters, which can be compared to fingerprints of the nodes. A Bloom filter contains information about a specific node and those nearby, up to some "hops" away. While it is not an extensive listing of context information, the Bloom filter offers the probability that certain information is available within a few nodes. With high success rate, it tells you how far the information is away from you and in which direction you have to search. The Bloom filter changes when a new user (i.e. new node) is added. The new node's fingerprint is then placed 'over the existing fingerprint' to yield a new environment fingerprint. This facilitates finding the best route to the information required. This represents a great new application of Bloom filters, which were conceived in the 1970s and are used for such purposes as hyphenation and spell checkers.'

'The results are quite promising. This approach can be seen as a compromise between the two energy guzzling extremes. Our approach generates much less network traffic. The next step is to refine the model and study the scenarios in greater detail. Using a simulator or prototype, we want to test whether the method works in actual practice. For me, these are the steps towards the ideal network, enabling the provision of an even greater degree of tailored services.'

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