Wireless Networks of Devices (WIND)
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Hari Balakrishnan and John Guttag

Project Overview

URL: http://wind.lcs.mit.edu/

The goal of the WIND project at MIT is to design and implement self-organizing networks with a high degree of decentralization, robustness and distributedness in their operation. The WIND protocols and middleware provide built-in support for user and device mobility, resource discovery, service location, and group communication in a decentralized manner. Our key innovation is the use of an intentional naming architecture where applications describe what they are looking for (i.e., their intent), not where to find it (which is how most network naming schemes work today). In this architecture, name resolvers can also route messages to the eventual destinations, leading to an integrated approach to resolution and routing. Thus, WIND is built around the premise that a flexible naming architecture and the ability of the name resolution process to be involved in data routing is a key enabler of large-scale self-organizing device networks.

Our application scenario uses these building blocks to demonstrate a location-aware applications over heterogeneous indoor wireless technologies (in-building RF wireless LAN and Infrared). Here, users can access data and control dynamic, mobile information sources (e.g., mobile cameras, sensor nodes) as well as enable devices to obtain information based on their location (e.g., if you walk into a specific room, the devices, nodes and users in that room automatically become known to your handheld or laptop computer) or other system characteristics. Our vision is to achieve all this with no prior manual configuration. The navigation metaphor for WIND is via an active map application called "floorplan".

Progress through December 1999

1. Design and prototype implementation of location-support system

We have designed and have an early prototype implementation of a location-support system, called "Cricket" for in-building, mobile, location-dependent applications in WIND. It allows applications running on mobile and static nodes to learn their physical location by using "listeners" that hear and analyze information from "beacons" spread throughout the building. Cricket has several design goals, including user privacy, decentralized administration, network heterogeneity, and low cost. Rather than explicitly tracking user location, Cricket helps devices learn where they are and lets them decide whom to advertise this information to; it does not rely on any centralized management or control; it provides information to devices regardless of their type of network connectivity; and each Cricket device is made from off-the-shelf components and costs less than US\$10. Cricket beacons use a randomized algorithm to transmit information, concurrent radio and ultrasonic signals to infer distance, and its listener inference algorithms overcome both multipath (of ultrasonic signals) and interference (of RF).

2. Integrating Jini with INS

Jini from Sun is a middleware for distributed applications, especially for devices. But it does not handle either service mobility or graceful failover in its service discovery. We have designed a way of having Jini use the WIND intentional naming system (INS) for service discovery. We expect to implement this in the next few months.

Research Plan for the Next Six Months

1. Implement applications using the Cricket location-support system

We plan to implement a few applications like an active map that allows users to automatically obtain maps as a function of their location as they move around in a building.

2. Experimental evaluation of location-support system

We plan to conduct a thorough evaluation of the performance and ease-of-use of the Cricket system.

3. Implement Jini discovery using INS.

This will allow fault-tolerant discovery of mobile Jini services.

4. End-to-end IP mobility protocol

We are working on a completely end-to-end approach to handling node mobility, without requiring any router support. The key ideas of our scheme are (i) using dynamic DNS updates to track host location, and (ii) a secure and efficient TCP connection migration scheme that allows a connection to continue across an IP address change.

5. Wide area service discovery using intentional naming

We plan to complete the design of this in the next few months.