AgilTrack: Agile Cargo Tracking Using Mobile Agents

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“Agilla: support for flexible deployment of adaptive software in wireless sensor networks.”

Motivation

- 7 million containers arrive annually into the US; it is impossible to check every container
- Existing container security devices are limited:
  - Require line-of-sight with satellite
  - Low-bandwidth (six 9-Byte messages per day)
  - $500/device, $34.95/month
- Applications must be flexible: they must adapt to changes in a container’s location, local security policies, tracking technologies, and customer needs

Dynamic Context Discovery & Multi-Hop Network Formation
- Use beacons for neighbor and context discovery
- Use geographic routing for multi-hop inter-agent communication

Custom Agents for Varying Needs
- Many mobile agents can be deployed over time in the same sensor network
- Support custom agents for each kind of user, e.g., customs officers, shippers, customers, etc.
- Allow applications to adapt to changing threat levels

Many Agents Already Supported
- Update electronic manifest list
- Search containers for a specific item
- Count and locate all containers
- Monitor accelerometer for sudden motion
- Monitor light sensor for unauthorized entry into container
- Find all recorded accelerometer and light events

Box Interrogator Application
- Discover available sensor networks
- Load electronic manifest into containers
- Inject agents to track and query cargo
- Display results graphically
- Forward results to an event correlation engine

Performance Evaluation

- Find Cargo
- Load Manifest
- Find Intrusions
- Manifest
- Security Flags

Agilla: Mobile Agent Middleware

Open-Source Software
- Platform
  - Implemented on Mica2, ported to MicaZ, and NMRC Dsys25 motes
  - TinyOS 1.1.14, NesC 1.2
  - Integrated with the Cricket Indoor Localization System
- Middleware
  - 4 Agents/mote
  - 100 byte tuple space
  - 46K ROM, 3.3K RAM

Integration with IP Networks
- Base stations and clients connected over an IP network
- Each base station connected to a separate Agilla network
- Clients and base stations discover each other using a central Limone service registry
- Clients place requests and Agilla agents into base stations’ Limone tuple spaces
- Base stations straddle middleware and network boundaries, converting incoming Limone tuples into Agilla operations

Enhance each container with a mote (i.e., a “hyperactive RFID”)

Migration instructions are more reliable because of hop-by-hop acknowledgements...

…but remote tuple space operations have less overhead

http://mobilab.wustl.edu/projects/agilla/index.html

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