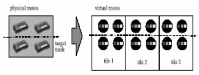
Kansei

Sensor Testbed for At-Scale Experiments

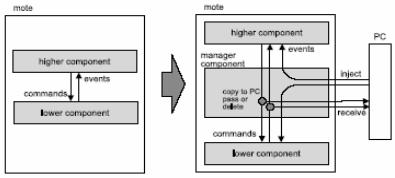
Dependable Distributed and Networked Systems
Dept. of Computer Science and Engineering, The Ohio State University
http:/www.cse.ohio-state.edu/exscal

GOALS

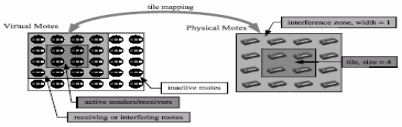
1. Truly heterogeneous test-bed with multiple communication networks, computation engines, multi-modal sensors, static and mobile nodes.
2. Enables high-fidelity experimentation at very large scale through large-scale simulation with virtual context maintenance of large numbers of nodes. Synchronization of real and simulated time. High-fidelity representation of deployment considerations (radio interference, environmental sensory input). Hybrid simulator appropriately intermixes execution of real and simulated components with injection of representative environmental input from actual deployment sites. Tiling for virtualizing simulated nodes models communication and sensing characteristics of an arbitrarily large network on an array of fixed size.
3. Integrated detection, command and control experimentation with sensors, actuators and mobile intruders. Synchronized direct observation, real-time data feeds and visualization
4. Software tools and out-of-band network for instrumentation of sensor network experiments for "automated" network state information collection.
5. Platform support for advanced development environments and languages
6. Repeatable, time-efficient experimentation through remote (web and through services) observation, visualization, debugging and health monitoring of applications and test-bed components, and reusable software components and utilities
7. Evolvable, re-configurable, extensible modular physical and network architecture



Tiling for Target Tracking



Event Driver Architecture



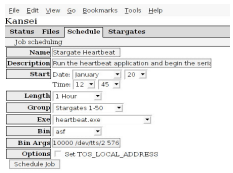
Tiling for Message Transmission

Experiment Scenarios

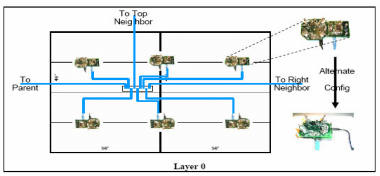
1. Validation of interaction properties of control applications and middleware services (including track maintenance services) in Pursuer-Evader scenarios.
2. Verification and validation of Tier-2 IEEE-802.11-based application protocols (Initialization, Unicast, and Sprinkler)
3. Verification of time-synchronization convergence under hardware, communication and environmental constraints and considerations (i.e. clock skew, asymmetric radio performance etc.)
4. Evaluation of message routing protocols for target tracking
5. Validation of DESAL (Dynamic Embedded Sensing and Actuation Language) development environment and synthesized applications

Features

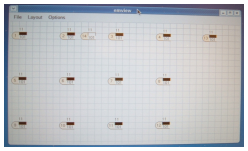
1. 5800 sq. ft. of warehouse space. Re-configurable grid of 35 4'x6' tables allows variable spacing of [2,3] feet with 210 nodes, [3,4] feet with 140 nodes, [4,6] feet with 70 nodes [6,infinity] feet with 35 nodes
2. Stargate-XSM and Stargate-MICA2 pairs
3. Attenuators, omni-directional antennas and TX power control enable testing of large multi-hop as well as dense networks in scale with realistic multi-user interference.
4. Multiple networks (XSM and Mica-2 433 MHz radio, wired Ethernet, Stargate 802.11 wireless network
5. Experiment scheduling through Web interface. Independent scheduling of Stargate, XSM and MICA 2 jobs and job groups



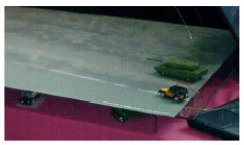
Web interface for scheduling



Connectivity

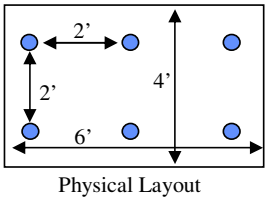


Visualization tool for Sprinkler

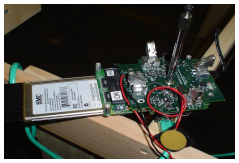


Mobile Robots and Sensors on Transparent Plane

Testbed Benchwork



Physical Layout



Stargate and XSM

Coming soon:

1. TELOS mote with TELOS 802.15.4 Network
2. Integrated visualization and monitoring w/ visualizers and overhead camera
3. Mobility plane (Fig: Transparent mobility plane, mobile robots)
4. Library of software components and utilities for logging, exfiltration and visualization
5. Integration of TOSSIM-based hybrid simulator (from Kent State University)
6. Development of portable sensor array with satellite uplink

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