PANDA

PRACTICAL AD-HOC NETWORKING DEVELOPMENT APPARATUS

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Background

- No shortage of ideas for WSN applications (see DIVA – and the next slide)
- Applications tend to be one-of (custom)
- Confusions and trade-offs:
  - Devices (footprint, energy, cost, massive deployment)
  - Software (rapid development, implications for device footprint)
  - Algorithms, protocols (feasibility, multi-hop communication)
- No general purpose development toolkit for this class of applications
Collaborative Effort

- Working together to produce wireless ad-hoc networking based applications:
  - **PANDA**: Complete ad-hoc networking design tool (SDK: PicOS, IDE, simulator/emulator + hardware)
  - Applications
    - **Ariadne**: Distributed Localization (a project with DIVA)
    - **FRACTA**: Freight Monitoring System
    - **ILIAD**: Independent Living Inconspicuous Anomaly Detector
    - **Seawolf**: Social Networks
    - **EcoNet**: Environmental Monitoring
    - **IKiosk**: Interactive Displays
Freight Monitoring

Freight Monitoring Systems

Key Features
- Monitor cargo singularly or in a networked environment
- Fractal-like local-global functionality
- Simple inexpensive modules
- Low-power operation
- Small footprint
- Unprecedented flexibility
- Alarms & event notifications
- Group control
- RTLS

Wireless Sensors

Alarms, Chronicle

- Drop
- Temperature
- Border Crossing
- Tampering

Group Control

All in?
ILIAD (anomaly detector)

A network of wireless monitoring devices managed by a central server.

Operating System Support - Architecture

Wireless Monitoring Devices

Resident Safety Monitor Mobile Extension

Take it on the road with our mobile OSS for your smartphone or tablet device.
Seawolf (proximity-based social net)

Small device paired via Bluetooth with a smartphone application, used to detect others in close proximity and “sense” their profiles.
PANDA: the enabling concepts

• PicOS (how to program tiny devices, so they act big).

• VUEE (rapid development, “virtually” authoritative verification, demonstrations, domain specific extensions, mobility).

• TARP (how to harness WSN nodes, so they truly collaborate, instead of getting in each other’s way).

• SDK: a glue for the above + experimental hardware and IDE (Windows/Linux).
This part can be re-compiled and executed in a virtual environment called VUEE (Virtual Underlay Execution Engine)
PicOS

- Small footprint OS for organizing multiple activities of embedded reactive applications.
- C style programming.
- Application (praxis) defined as a set of FSMs.

Advantages over TinyOS:

- Greater flexibility with dynamic memory allocation – even with devices with < 1K RAM.
- All program dynamics available to program captured with PicOS threads rather then ISRs (callbacks).
VNETI – Versatile Network Interface

- Collection of APIs independent of the underlying network.
- Enables rapid development of networked applications for microcontrollers.
- Layer-less.
- Ability to add plugins (eg. TARP can be replaced with another routing protocol implementation).
VUEE - Virtual Underlay Execution Engine

- Emulator for PicOS applications and their underlying networks.
- Can simulate communications, sensors, energy use, etc.
- Verify application functionality.
- XML files used for configuration (network parameters, mobility, sensor info etc.)
- Well defined interfaces/protocols make it easily extended.
PANDA: sample wireless nodes
PANDA: sample deployments
PANDA: visualization (snippets)
PANDA Demonstration
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