

UCLA

Posters

Title

The Extensible Sensing System

Permalink

<https://escholarship.org/uc/item/8rv785zx>

Authors

Eric Osterweil
Mohan Mysore
Mohamad Rahimi
et al.

Publication Date

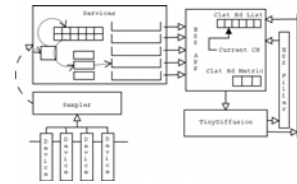
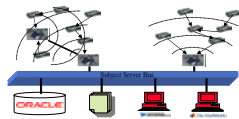
2003

The Extensible Sensing System

Eric Osterweil, Mohan Mysore, Mohammad Rahimi, Andrew Wu
CENS – <http://www.cens.ucla.edu/>

Overview: How the ESS Enhances Systems

- The goals of the *Extensible Sensing System (ESS)* are:
 - Provide taskable and triggered data extraction in the presence of failures
 - Support network monitoring and manageability
 - Serve as the testbed for one of the World's largest sensor network deployments
- Within the ESS there are 2 classes of nodes:
 - Sensor nodes provide data and perform the bulk of the application logic
 - Concentrators provide highly available and higher power resources such as network backbone access
- Data is multicast over the Internet through a *publish-and-subscribe* bus system called the *Subject Servers* to clients such as databases, GUIs, and other data analysis tools.



- The ESS is deployed at the James Reserve to facilitate micro-climate analyses using:
 - Mica2 motes equipped with a specialized Sensor Interface Board
 - iPAQ nodes acting as Concentrators
- The sensor system is decomposed into logical components
 - TinyDiffusion* for data transport
 - ESS application and diffusion-filters for management
 - A Services component for data manipulation and caching
 - A Sampler for device management and interface.

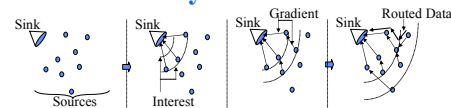
System Architecture: Components of the System

Sensor Interface Board

- A general framework for attaching multiple instances and different types of sensors
 - ADC true 12bit
 - High gain differential channels
 - Digital Input (Interrupt driven)
 - Digital Outputs
 - Counter, frequency
 - Relay output
 - On board voltage, temperature and humidity
- Flexible sampling rate*
- Configurable for different translation functions per channel based on the sensors that has been attached
- Tested with different sensor types.
 - <http://www.cens.ucla.edu/~mhr/daq/>

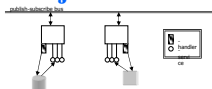


TinyDiffusion



- ESS uses a variant of Directed Diffusion called "*One Phase Pull*" (Heidemann-Silva) on the sensor nodes
- Interest packets sent by sinks are flooded
- Data is sent back by each source along a single chosen gradient to a single sink at a time
- One Phase Pull uses symmetric links:
 - Achieved using the neighbor link characterization module
 - Link loss rate is assessed using heart-beat packets
 - EWMA* used for loss calculation and *Hysteresis* for "good link" selection

Subject Servers



- The goals of the Subject Servers
 - Data dissemination to arbitrary set of clients
 - Internet connectivity for remote access
 - Transport-independent API*
- Methodology
 - Data from sensors, GUIs, etc. is published
 - Clients subscribe to data they want

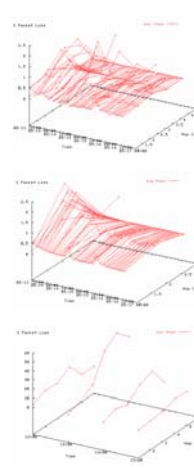
User Interface



- The GUI acts as a Subject Server client
 - Requests for data are passed to the bus
 - The bus returns the response from the database server
 - Posts results in a *dynamically generated web document*

ESS Deployment

- Researchers have been able to study a variety of network characteristics in this real-world in-situ deployment
- Average system loss rates have been analyzed over fixed intervals and related to nodes of various: average, minimum, and maximum hop counts
- Additional nodes have been deployed to augment the persistent ESS topology in order to study effects such as
 - Loss experienced by nodes that are introduced with less ground clearance.
 - The effects of increased network congestion
 - The effects of increased hop counts



Future Work

- The ESS has proven to be a very large step forward for real-World sensor network deployments.
- The system has been designed to easily incorporate:
 - In-network processing*
 - In-network triggering*
 - Remote sensor tasking
 - Remote network monitoring
 - Support 1451 *plug-and-play* standard
- As the supported set of operations grows, the ESS deployment will become a valuable asset for:
 - Supporting natural-science applications
 - Deploying experimental network applications
- Immediate potential for ESS:
 - Soil arrays for contaminant monitoring and precision agriculture
 - Canopy instrumentation
 - Structural monitoring
 - Macro-programming*