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DAS-- Deployment Analysis System

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DAS– Deployment Analysis System

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<http://lecs.cs.ucla.edu/~kchang/das>

Introduction: It is difficult to understand deployed wireless sensor networks (WSN)

Currently Deployed WSN

- **System metrics provide insights into running WSN (Wireless Sensor Networks).**
System metrics include neighbor lists, link-qualities, next hops, etc.
- **Most deployed WSN do not transmit sufficient system metrics.**
We use Sympathy, which provides a more comprehensive set of system metrics to the user.
- **System metrics and sensor data can be used in conjunction to explain anomalous system behavior.**
However, analyzing huge amounts of system metrics and sensor data is time-consuming.

Goals

- Create a system that allows users to quickly perform complex data-mining on both the system metrics and sensor data:
 - A system that helps pinpoint unexpected WSN behavior
 - A system that generates graphs that highlight data correlations
 - A system that provides historical map visualization
- Create a system that speeds up the repetitive task of querying huge amounts of historical data.
- Create a system that is both easy to use and easy to access.

Problem Description: Excessive data-mining system metrics and sensor data

Existing Techniques Focus on Retrieving and Interpreting Data Log File

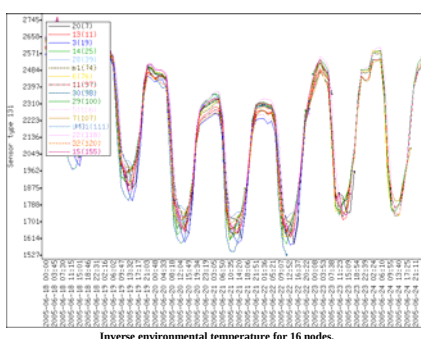
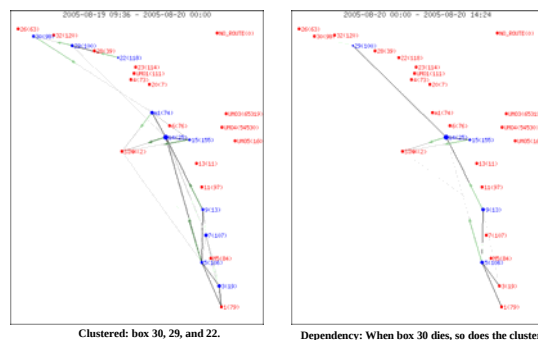
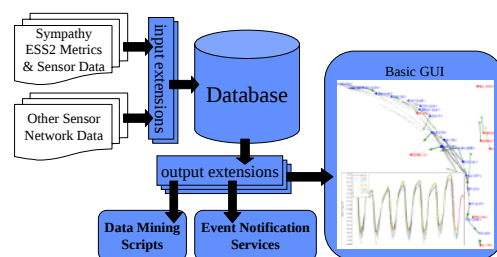
- Ramanathan et al. [1] collects and sends important system metrics on existing applications using Sympathy
Log files and status files are generated
- Zhao et al. [2] focus on metric *collection* instead of metric *content*
This work is complimentary to Sympathy
- SNMS focuses on *infrastructure* to *deliver* metrics, and code size
- Log files contain excessive data which are difficult to analyze
- Real-time Simulation/Visualization provide real-time information; do not capture *historical context* or aid in *root-causing* a failure

[1] N. Ramanathan, K. Chang, R. Kapur, L. Girod, E. Kohler, D. Estrin, "Sympathy for the Sensor Network Debugger", in Proc. of SenSys 2005.
[2] J. Zhao, R. Govindan, and D. Estrin, "Computing aggregates for monitoring wireless sensor networks," in Proc. of the IEEE ICC Workshop on Sensor Network Protocols and Applications, AK, 2003, IEEE.

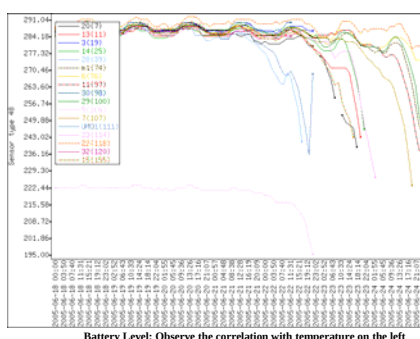
Proposed Solution: Create DAS– Unified tools for WSN data-mining

Implemented Features

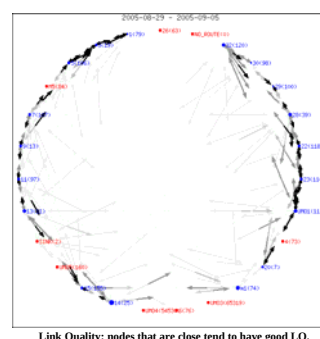
- **Fast topological map generator**
The topological map shows historical and immediate view of the system status with metrics such as routing table, neighbor tables, number of neighbors heard, etc. It also provides historical routing replay animation.
 - We used DAS and observed that nodes at high elevation tend to have good one-way link quality, and are frequently used as a next hop neighbor even though they are much farther away from the destination.
 - We used DAS to observe that equal GPS distance does not provide good routing. In many cases, when one mote became inoperative, the communication for a cluster of other motes were cut-off even though proximities should have provided redundancy.
 - We used DAS to verify that the primitive link quality estimation algorithm we used was sufficient. Nodes that are close to each other and/or are high elevation tend to have good link quality.
 - Easy to use and fast– Each map to the right is generated within seconds, with no more than 2 mouse clicks.
- **Fast graph generator**
DAS generates single-metric multiple-nodes graphs, multiple-metrics single-node graphs, and link-quality graphs.
 - We used DAS to show that the battery voltage of nodes tends to degrade simultaneously. We use this observation to apply to later deployments– if the battery level of a few motes starts to degrade, we change batteries quickly as a preventive measure from total system failure.
 - We used DAS to observe a direct relationship between the mote batteries and the temperature.
- **Notification system**
Programmers can easily setup triggers and event thresholds to notify system failures or in some cases abnormal system behaviors.
- **Status display**
We display DAS on a 42" plasma screen in the lab to provide programmers and field specialists an instantaneous and most updated summary of deployment health.



Inverse environmental temperature for 16 nodes.



Battery Level: Observe the correlation with temperature on the left graph. Note that the entire system breaks within 3 days.



Link Quality: nodes that are close tend to have good LQ.