KanseiGenie:

GENI-fying and Federating

Autonomous Kansei Wireless Sensor Networks

Spiral 1 – Quarter 2 Report

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1. Major accomplishments

- We completed refactorizatation of the Kansei design, as well as the implementation of most of the components of Kansei
- We completed the implementation of the Web Service Layer (see Fig.1 below)
- We completed the design of integrating KanseiGenie with ORCA, and demonstrated how KanseiGenie clearinghouse can integrate with ORCA

2. Milestones achieved

- KANSEI: 1a Import a GENI-compliant control framework based on ORCA
  - Deployed ORCA
- KANSEI: 1b Establish Kansei testbed clearinghouse
  - Deployed ORCA, and based on ORCA implementation, implemented KanseiGenie clearinghouse framework
- KANSEI: 1c Refactor Kansei researcher portal
  - Done
- KANSEI: 1d Refactor Kansei component and aggregate managers
  - Done
- KANSEI: 1f Demo basic virtualization and experiment control functions
  - Done. Demonstrated KanseiGenie design and implementation at GEC4
- KANSEI: 1g Open Kansei testbed to GENI users
  - Done. KanseiGenie is ready for public access

3. Deliverables made

1. Documentation on the refactored Kansei. See: http://sites.google.com/site/siefastgeni/documents-1/KanseiGENIfication.doc
2. Milestones and detailed near-term roadmap. See: http://sites.google.com/site/siefastgeni/roadmap.
3. Catalog of Kansei resources/connectivity.

4. Description of work performed during last quarter

- Refined the architecture of KanseiGenie. The refined architecture will support the integration of KanseiGenie and ORCA
- The refined architecture is as follows:

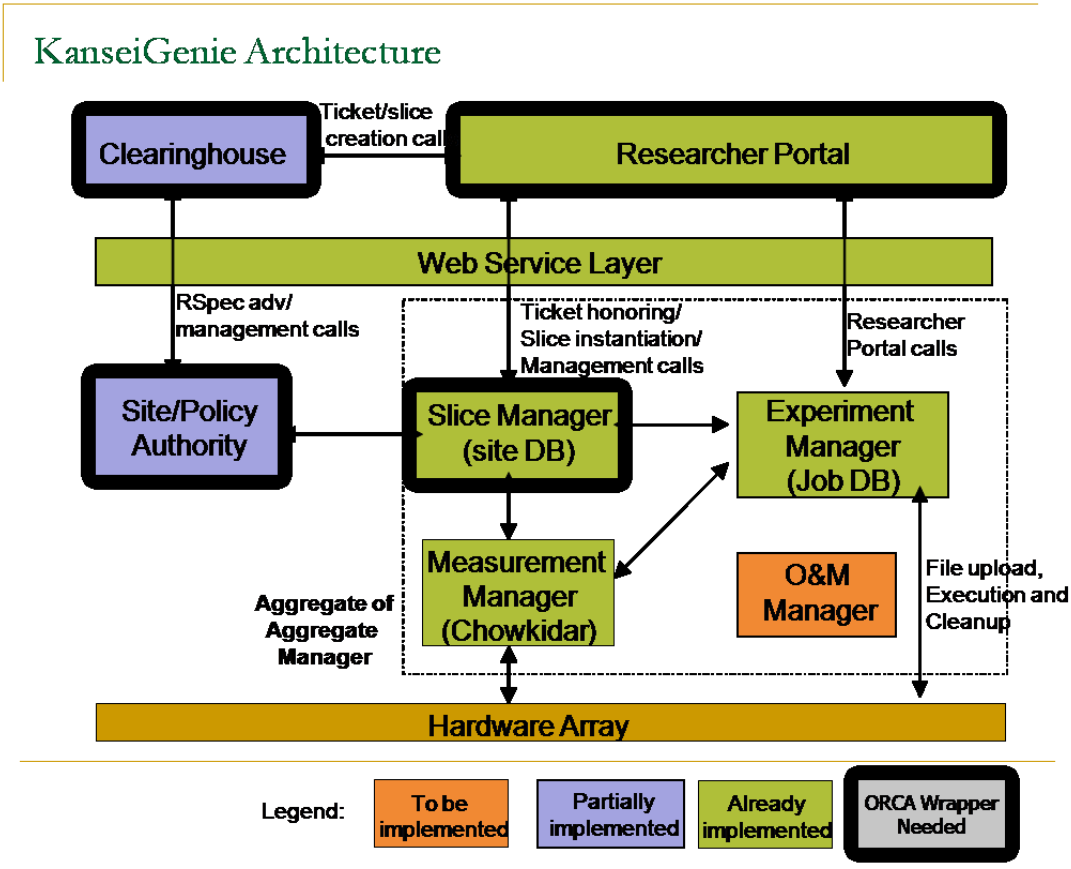
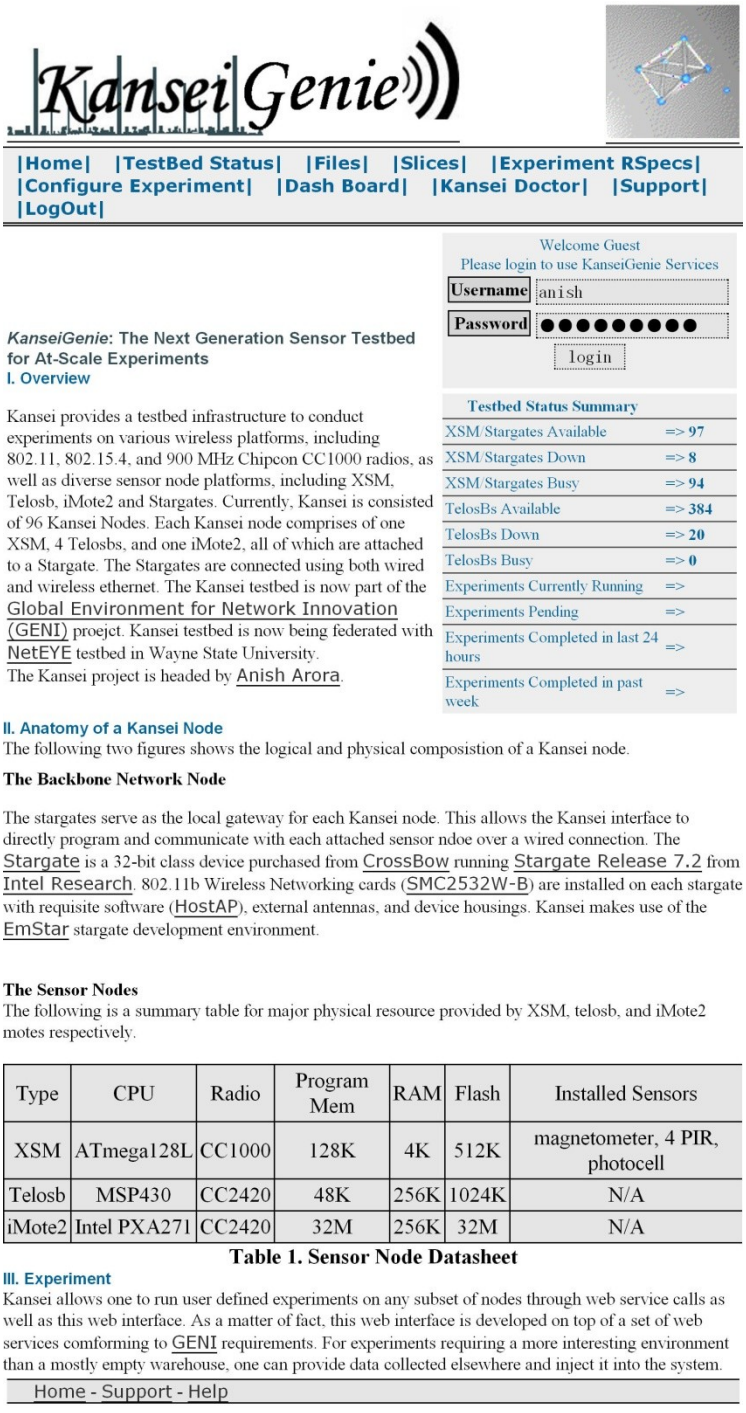


Fig.1 The four boxes in the dotted frame correspond to the four planes suggested by GENI

- Refactored Kansei web interface into Researcher Portal. The research portal user interface is as follows:



KanseiGenie

|Home| |TestBed Status| |Files| |Slices| |Experiment RSpecs| |Configure Experiment| |Dash Board| |Kansei Doctor| |Support| |LogOut|

Welcome Guest
Please login to use KanseiGenie Services
Username anish
Password ●●●●●●●●●
login

KanseiGenie: The Next Generation Sensor Testbed for At-Scale Experiments

I. Overview

Kansei provides a testbed infrastructure to conduct experiments on various wireless platforms, including 802.11, 802.15.4, and 900 MHz Chipcon CC1000 radios, as well as diverse sensor node platforms, including XSM, Telosb, iMote2 and Stargates. Currently, Kansei is consisted of 96 Kansei Nodes. Each Kansei node comprises of one XSM, 4 Telosbs, and one iMote2, all of which are attached to a Stargate. The Stargates are connected using both wired and wireless ethernet. The Kansei testbed is now part of the Global Environment for Network Innovation (GENI) proejct. Kansei testbed is now being federated with NetEYE testbed in Wayne State University.
The Kansei project is headed by Anish Arora.

Testbed Status Summary	
XSM/Stargates Available	=> 97
XSM/Stargates Down	=> 8
XSM/Stargates Busy	=> 94
TelosBs Available	=> 384
TelosBs Down	=> 20
TelosBs Busy	=> 0
Experiments Currently Running	=>
Experiments Pending	=>
Experiments Completed in last 24 hours	=>
Experiments Completed in past week	=>

II. Anatomy of a Kansei Node

The following two figures shows the logical and physical composistion of a Kansei node.

The Backbone Network Node

The stargates serve as the local gateway for each Kansei node. This allows the Kansei interface to directly program and communicate with each attached sensor ndoe over a wired connection. The Stargate is a 32-bit class device purchased from CrossBow running Stargate Release 7.2 from Intel Research. 802.11b Wireless Networking cards (SMC2532W-B) are installed on each stargate with requisite software (HostAP), external antennas, and device housings. Kansei makes use of the EmStar stargate development environment.

The Sensor Nodes

The following is a summary table for major physical resource provided by XSM, telosb, and iMote2 motes respectively.

Type	CPU	Radio	Program Mem	RAM	Flash	Installed Sensors
XSM	ATmega128L	CC1000	128K	4K	512K	magnetometer, 4 PIR, photocell
Telosb	MSP430	CC2420	48K	256K	1024K	N/A
iMote2	Intel PXA271	CC2420	32M	256K	32M	N/A

Table 1. Sensor Node Datasheet

III. Experiment

Kansei allows one to run user defined experiments on any subset of nodes through web service calls as well as this web interface. As a matter of fact, this web interface is developed on top of a set of web services comforming to GENI requirements. For experiments requiring a more interesting environment than a mostly empty warehouse, one can provide data collected elsewhere and inject it into the system.

Home - Support - Help

- Genified Kansei user services as web services
  - e.g. implemented experiment interaction interfaces as web services
- Genified Kansei scheduler
- Genified CM/AM aspects of Experiment & Slice Management planes
- We spent a fair amount of effort studying the control frameworks, and we have completed the design on integrating KanseiGenie with ORCA

5. Activities and findings

The following tasks are ongoing:

- Integration with ORCA
  - Substrate and user service (I)
    - Site authority ↔ ORCA Site Authority core
      - driver, handler (e.g., setup, teardown), policy module
  - Researcher Portal ↔ ORCA Service Manager core
    - handler (join, leave), policy module for resource request, etc.
  - Clearinghouse (I)
    - Clearinghouse ↔ ORCA Broker core
      - handler, policy module for resource allocation, etc.
  - ORCA extensions for sensor networks and sensor network federation
    - additional mechanisms for flexible interaction among service manager, broker, and site authority; etc.
- Substrate and user service
  - Refactor & integrate KanseiDoctor into Measurement Plane
  - Complete CM/AM refactoring for Measurement/O&M planes
  - Implement clearinghouse based resource discovery/slice creation at the researcher portal
  - If time permits,
    - refine basic wireless sensor network slice resource specification and corresponding embedding service
    - extend experiment configuration for extended specification
- Clearinghouse
  - Define interaction protocol, message format (including those for RSpec, Ticket, etc.)
    - between clearinghouse and research portal
    - between clearinghouse and site authority
  - Implement protocols using XML.RPC, SOAP

We have identified the following risks as well as risk mitigation approaches.

- Risk: integration with ORCA

Mitigation: use the following staged integration plan

- Reuse current synchrony model: actor plugins and driver/handler APIs
- Extend state machine to support on-demand, reactive resource discovery between brokers and sites
- Extend state machine to support federation

- Risk: limited documentation on detailed ORCA design and implementation

  Mitigation:

  - Begin early prototyping with ORCA
  - Close engagement with other ORCA implementers, such as RENCI

- Risk: Uncertainty in wireless RSpec (Our first draft of RSpec is at: http://sites.google.com/site/siefastgeni/documents-1/Kansei-RSpec.doc)

  - This is a critical risk since a defined RSpec is essential for our future development and the RSpec definition is to a limited extent outside our control, as it is influenced by the Clearinghouse implementation groups.

  Mitigation: Close engagement with Clearinghouse implementation groups.

6. Project participants

Investigators:

Anish Arora

Rajiv Ramnath

Hongwei Zhang

Vipul Gupta

Sami Ayyorgun

Staff:

Mukundan Sridharan

Wenjie Zeng

Xi Ju

7. Publications (individual and organizational)

A book chapter describing KanseiGenie will appear in a book on Next-Generation Networks.

8. Outreach activities

9. Collaborations

Held discussions with Dr. Vinayak Naik at CSE, Indian Institute of Science, Bangalore and Dr. S. Krishnamoorthy at CSE, Indian Institute of Technology, Madras about GENI related testbed development.

10. Other Contributions

We have contributed GENI Working Group activities:

- Providing feedback to the GENI Control Framework Requirements
- Via presentations and demos at the GEC4