ORBIT Radio Grid Tested for Evaluation of Next-Generation Wireless Network Protocols

1. Introduction

Motivation: With the rapid growth in research activity on future wireless networking applications and protocols, experimental study and validation is becoming an increasingly important tool to obtain realistic results that may not be possible under the constrained environment of network simulators. Thus, there is an increasing need in the research community to be able to perform controlled experimental investigations of protocols and evaluations of system design using real-world wireless devices. These considerations motivated the ORBIT (Open Access Research Tested for Next- Generation Wireless Networks) tested project which aims to provide a flexible, open-access multi-user experimental facility to support research on next-generation wireless networks.

Collaborators: This effort is a collaborative project with leading research institutions and universities such as Columbia University, Princeton University, IBM T.J. Watson Research Center, Thomson Multimedia and Lucent Bell Labs.

2. ORBIT System Architecture

The Grid: that will support upto 400 radio nodes having 802.11a/b/g wireless cards laid out in a 20x20 grid with ~1m spacing between nodes.

Design criteria: The ORBIT testbed is designed to support the following features.

- ***scalability***, in terms of the total number of wireless nodes (~100's).
- ***reproducibility*** of experiments which can be repeated with similar environments to get similar results.
- ***open-access flexibility*** giving the experimenter a high-level of control over protocols and software used on the radio nodes.
- ***extensive measurements capability*** at radio PHY, MAC and network levels, with the ability to correlate data across layers in both time and space.
- ***remote access*** testbed capable of unmanned operation and the ability to robustly deal with software and hardware failures

Figure 1 8*8 ORBIT testbed

3. ORBIT System Components

3.1. ORBIT Radio Nodes

- 1-GHz VIA C3 processor
- 512 MB of RAM and a 20 GB local hard disk
- two wireless mini-PCI 802.11a/b/g interfaces
- two 100BaseT Ethernet ports for experimental data and control respectively

Figure 2 ORBIT Radio Node

3.2. Controlled Interference Injection and RF Spectrum Analyzers

To provide controlled access to artificial interference injectors and spectrum analyzers in order to create various types of artificial RF interference (white noise, colored noise, microwave oven like noise etc.) inside the grid

3.3. Independent WLAN monitor system

To provide a MAC/network layer view of the radio grid's components using a number of WLAN "observers" spread across the system

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3.4. ORBIT Measurement Framework and Library (OML)

To provide a framework for experimenters to define the measurement points and parameters, collect and pre-process measurements, and organize the collected data into a single database with the context of the experiment and isolates the burden of measurement collection, transportation and storage from application development

3.5. Libmac

- Custom user-space C library that provides an API for the applications to inject and capture MAC layer frames.
- Allows manipulation of wireless parameters such as TxPower, channel settings and recording RSSI, noise on an aggregate and a per-packet basis
- Provides a bridge between device drivers and the applications such that application developers can easily use a standard interface to communicate with wireless device drivers

3.6. Support services

ORBIT uses additional support software services to run experiments, re-image node hard disks with custom user provided images and to remotely control node health status and to power cycle prior to running experiments

4. How Is An Experiment Conducted

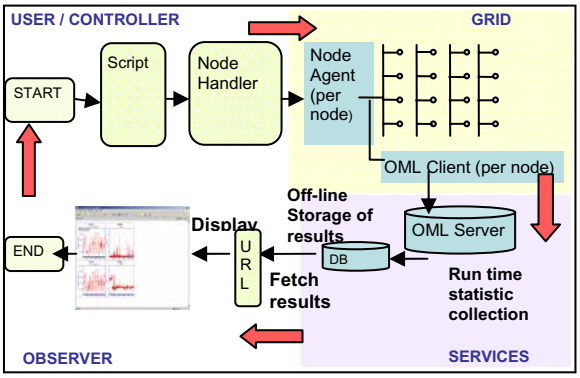

Figure 3 Life-Cycle of An ORBIT Experiment

- The experiment details are translated into a script that identifies the nodes to be assigned for the experiment, configures the wired and wireless interfaces according to the requirements of the experiment, fetches the appropriate application, libraries required to run the experiment and specifies (optional) statistic collection points and intervals
- This information is disseminated by the control software to the corresponding software *agents* residing on each node.
- The *software agents* execute the script, performs the experiment which may involve statistics collection done by the OML library.
- Separate measurement collection network handles the statistics collection

Time-scheduled access to the ORBIT Radio Nodes for experimentation

5. Summary of Resources Available to Experimenters

- Time scheduled access to the ORBIT radio nodes for experimentation (includes, root access, installation of custom images etc.)
- ORBIT Measurement overlay framework to extract experiment statistics in a type-safe manner
- Time-stamped experimental results available to users using mysql queries or flat files to correlate with prior results.
- Software tools such as traffic generator, database plug-in tools to extract results into MATLAB or Excel.

6. Contact Us

For further details on the various aspects of the testbed, you may contact the following people

1. **General Inquiries**:
   Dr. Dipankar Raychaudhuri
   Director, WINLAB, Rutgers University
   732-445-0877
   ray@winlab.rutgers.edu

2. **Software Architecture**
   Dr. Max Ott,
   max@winlab.rutgers.edu

3. **Hardware Components**
   Ivan Secker
   seskar@winlab.rutgers.edu

7. Further Information

http://www.orbit-lab.org