

GENI Project Quarterly Progress Report, 4Q08 corrected 1/14/09

Project Title: Open Virtualized WiMAX Base Station Node for GENI Wide-Area Wireless Deployments

Principal Investigators: Dipankar Raychaudhuri, WINLAB, Rutgers University & Sampath Rangarajan, NEC Labs, Princeton, NJ.

1. Major accomplishments:

Milestones achieved:

Task 1: WiMAX BS performance evaluation

1.1 NEC WiMax profile A base station product delivered to Princeton Lab

Per Sampath and Ray on 1/14/09: two were delivered, on loan from Stanford; two more were ordered, expected 2/10/09; when received, will send first two back to Stanford; overall, no delays in project

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| 1.2 WiMax BS system setup (indoor) | - done Oct 20, 2008 |
| 1.3 NEC WiMax indoor performance evaluation | - done Nov. 15, 2008 |
| 1.4 Testing NEC BS interfaces | - done Dec. 15, 2008 |
| - BS/MS R1 | - done Dec 24, 2008 |
| - BS/ASN-GW R6 | - in progress (due 1/09) |
| 1.5 NEC WiMAX outdoor performance evaluation | - moved to 4/09 |
| 1.6 Experimental license for WiMax obtained at Rutgers University | - approved 12/08 |

Task 2. Custom ASN-GW implementation and testing

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|---|---------------------------|
| 2.1 Understanding NEC WiMAX BS interfaces | - 80% complete (due 1/09) |
| 2.2 Understanding NEC ASN-GW functions | - in progress (due 1/09) |

Task 3. Base Station API software

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| 3.1 Open API requirements document | - done Dec. 15, 2008 |
| 3.2 Initial design of the open API: functions definition | - in progress (due 1/09) |
| 3.3 Development of API software on GENI controller | - starts 1Q09 |

Deliverables made:

None

2. Description of work performed during last quarter

Activities and findings: This project is aimed at the development of an open virtualized WiMax base station for wide-area wireless deployments in GENI. The technical approach leverages a commercial “profile A” WiMax base station product from NEC Corp as the starting point, with an open API being added for the purpose of interfacing an external GENI controller that provides L2/L3 flexibility. As the next step, software for the external GENI controller will be developed to support virtualization, experimental programmability and control features. The prototype base station will be tested in the laboratory and then deployed as part of the ORBIT campus network at Rutgers University.

During this reporting period (4Q08), the WiMax base station was delivered on schedule to NEC’s lab in Princeton and this equipment has been set up in the laboratory for initial testing and API development. The NEC WiMax base station is based on the IEEE 802.16-2005 standard, and is also compliant with the WiMAX Forum Wave 2 system profiles. Basic operation of the base station has been validated in the lab, and the “R1”, “R6” control interfaces and SNMP management interface have been studied for subsequent open API development. An initial open API design document has been completed, and API software development work for the external GENI controller has been started. No major technical or logistic hurdles have been encountered on the project so far, and the work is progressing according to the original plan and time-line. The only exception is the task on outdoor evaluation of the WiMax base station which has been deferred to

4/09 in order to coincide with outdoor deployment activities. An experimental license for WiMax operation on the Rutgers campus was approved by the FCC in Dec 08. We plan to demonstrate basic GENI functionality (virtualization, L2/L3 programmability, control of key base station parameters) for the base station during 1Q09.

In terms of key findings, our initial tests with the laboratory setup of the NEC WiMax base station show that the selected equipment provides flexible service configuration, reliable transport and carrier-grade reliability. It also provides the necessary interfaces for open API design as required for GENI programmability and measurements. The base station features control and monitoring capabilities for key link layer parameters (such as bandwidth, rate, modulation and coding scheme, link quality, scheduling priority, traffic class, etc.), so that we expect to be able to design an open API with a high degree of experimental flexibility. One open design issue still to be addressed is that of slice isolation and QoS management in the system as a whole. The OFDMA MAC used in WiMax makes it possible to assign resources on a per-flow basis, but there is currently no support for aggregate slice level resource management with statistical multiplexing. We plan to implement appropriate policies which balance slice isolation/QoS against overall bandwidth utilization as part of the “resource manager” module in the external GENI controller. This will require further understanding of the scheduling and queuing mechanisms currently used in the NEC base station along with experimental evaluation of alternative slice management policies on the external controller. Another open issue is support is for multiple slices on a single mobile WiMax device running operating systems such as Linux or Android.

Project participants:

Rutgers: Manasi Jagganathan, Ronak Daya (graduate students), Ivan Seskar, Dipankar Raychaudhuri
 NEC: Meilong Jiang, Rajesh Mahindra, Sampath Rangarajan

Publications:

Internal project documents:

1. GENI WiMax system engineering document, 11/08
2. Open API specification document, 12/08

No external publications during this reporting period

Outreach activities:

None

Collaborations:

1. Coordinating with Stanford U (Prof. Nick McKeown) to make the same NEC WiMax base station available for OpenFlow campus network deployment.
2. Collaborating with ORBIT project team to use the ORBIT Management Framework (OMF) software as the foundation for the WiMax base station controller.

Other Contributions:

None