G E N I

Global Environment for Network Innovations

GENI Quarterly Status Report

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under project Nr. 1653

"Data Plane Measurements"

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1 MAJOR ACCOMPLISHMENTS

1.1 Milestones achieved

Milestone 3: Identify external measurement equipment

The purpose of this milestone is to identify and document external measurements equipment (if any) and/or recommend where external measurement devices could benefit spiral-1. The possible external measurements equipments identified are documented based on the information from equipment vendors and discussions with the prototypes.

1.2 Deliverables made

- Milestone 3: Identify external measurement equipment.
- GENI Quarterly Report (June' 09)

2 DESCRIPTION OF WORK PERFORMED DURING LAST QUARTER

2.1 Activities and findings

2.1.1 Identify External Measurement Equipment

"Identify external measurement equipment" (GENI-MS3- DMEAS-May09-v1.0) [geni09_2] milestone is achieved and the deliverable has been made to GENI. External measurement instruments are investigated depending on needs assessment in a GENI control framework. GENI has to have programmable measurement services. Examples of measurements include power attenuation and chromatic dispersion on a specific wavelength, BER of particular wavelength channels and time and spectral analysis of sources for varying transmission wavelengths.

The key requirements that are considered while investigating the external measurements are:

- Identify data plane measurements a particular prototype can host depending on the network infrastructure and its benefit to the prototype.
- Identify the test equipments that can deliver measurements according to the above-mentioned requirements.

2.1.2 Discussions with other clusters

We had teleconferences and email exchanges with the cluster groups to identify what kind of experiments that can be hosted on a particular prototype that would require external measurement equipment. The detailed findings are documented in the milestone document "Identify external measurement equipment" (GENI-MS3- DMEAS-May09-v1.0) [geni09_2].

Cluster C (CMU Lab):

The standard physical layer measurements can be supported on Homenet testbed. The emulator testbed can also support such measurements. There are a number of measurements that can be collected using the wireless devices that participate in an experiment like signal level for incoming packets, signal quality, noise floor, etc. Different cards offer different types of information. Monitoring spectrum in a specific frequency band at a certain location provides most accurate way of capturing the interference and noise in the network. Mitigating the interference to maximize spatial reuse is very crucial.

Cluster D (BEN):

BEN is a dark fiber testbed. Cross-layer-enabled routing, novel transmission schemes and hybrid transmissions are some of the experiments that require physical layer measurements.

Cluster E (Orbit Testbed and WiMax):

ORBIT testbed has 802.11 radio nodes that are wifi enabled, which are capable of standard physical layer measurements like power level, modulation, frequency and time occupancy and receive power on per-cell basis. Adaptive transmit power control in 802.11 Wireless LANs [4] (WLANs) on a per-link basis helps

increase network capacity and improves battery life of Wifi enabled mobile devices. Adaptively adjusting transmit PHY parameters like frequency, power and time occupancy based on local observations of the radio band techniques are used for avoidance of reactive interference. External test equipments are useful in determining the PHY parameters. In 802.11 wireless LANs, senders can use one of multiple transmission rates for sending packets. The choice of the rate is determined by an estimate of channel condition by Signal to Interference and Noise Ratio (SINR) estimate. Device identity management through radiometric identification is based on physical layer parameters.

PHY layer parameters will help in evaluating indoor and outdoor performance of the NEC IEEE 802.16e WiMax base station under different traffic loads and channel conditions. These results will help to determine practical limits on BS virtualization in terms of total network capacity, variations due to signal quality, etc. NEC WiMax base station has access to several PHY parameters – frequency, DL:UL ratio, channel duration and transmit output power.

2.1.3 Participation in GENI Measurement Workshop

A presentation on "Data Plane Measurements" was presented at GENI Measurement workshop on June 26th 2009. The presentation outlined the review all (optical, wireless, etc.) substrate technologies in spiral-1 from a measurement and monitoring point of view. Data Plane Measurements are classified as embedded and external measurements that are required to monitor the physical layer characteristics on GENI. Embedded measurements are readily accessible measurements on network nodes. External measurement instruments are investigated depending on needs assessment in GENI control framework.

"Networking of Instruments" and "Re-configuration and programmability" are very important for a GENI researcher. The desirable attributes for networking of instruments are remote access mechanism, flexible API to interface with the aggregate managers across GENI and storage. Remote access mechanisms may include Ethernet, USB or have a computer (server) at each instrument site. Interface to the external test equipments will involve coupling of programmable vendor API/drivers with the GENI control frameworks (Planetlab interface (rspecs), ORCA interface (NDL), ProtoGENI interface (Emulab)). Storage involves experiment execution, data collection and analysis.

The desirable attributes for re-configuration and programmability are configuring measurement parameters, re-program a measurement resource and slice a measurement instrument for multiple user access. The measurement parameters that are relevant for the experiment are configured for an experiment. Reconfiguration of the parameters can be done within the range of configuration. Re-programmability of a measurement resource is based on the needs of analysis requirements. It could involve local analysis and then report end results instead of continuous raw data reporting or uploading custom measurement software to instruments. Slicing of a measurement instrument will involve multiple researchers accessing the same or different measurement parameters at the same time.

2.1.3 Describe the network connection

This is our future milestone which is due August 31st 2009. This milestone will document the network connections between specific external test equipment identified/recommended above and spiral-1 substrate components.

2.2 Project participants

- Principal Investigator:

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2.3 Publications

None.

2.4 Outreach activities

Connection with LEARN through D. Gurkan's ISSNet lab (Interoperable Smart Sensors and Networking Lab).Evaluation agreement with Infinera to host a DTN node at UH and Rice has been signed with LEARN (Lonestar Education and Research Network). The DTN node has been installed at ISSNet Lab and Rice University with one link connection.

2.5 Collaborations

- **LEARN** (Lonestar Education and Research Network)
- **Real-time Measurements :** Dr. Keren Bergman, Columbia University, New York
- **Cluster D :** BEN

  Discussions with ORCA/BEN (with Ilia Baldine and Jeff Chase) on creation of measurement resource interfaces.

2.6 Other Contributions

None.

3 BIBLIOGRAPHY

[1] [geni09_1] GENI Project Office, "Spiral 1 substrate catalog", 22 February 2009.

[2] [geni09_2] GENI "Identify external measurement equipment", 30 May 2009.