Progress Report

DOE award number: DE-SC0002350

Name of the recipient: University of Virginia

Project title: Resource optimization in hybrid core networks with 100G systems

Principal investigator: Malathi Veeraraghavan

Date of report: Sept. 16, 2010

Period covered by the report: May 1- Aug 31, 2010

Comparison of the actual accomplishments with the goals and objectives established for the period and reasons why the established goals were not met.

The goals for this quarter, as stated in the 3Q report, have been met. We have uploaded the HNTES software modules to the ANI Tabletop testbed and have been running experiments. For the router control interface module, we have been using JunOS scripts provided by ESNet for our testing. The HNTES design document is complete and posted on the project web site. We have completed long-flow traffic analysis for one 5-day period from two Internet2 routers. Data collection from other routers is ongoing. In the meantime, we provided ESnet with our statistical analysis programs, and Chris Tracy, ESnet, has successfully executed our programs on ESnet Netflow data.

A discussion of what was accomplished under these goals during this reporting period, including major activities, significant results, major findings or conclusions, key outcomes or other achievements. This section should not contain any proprietary data or other information not subject to public release. If such information is important to reporting progress, do not include the information, but include a note in the report advising the reader to contact the Principal Investigator or the Project Director for further information.

1 Activities

- Most of the modules of the Hybrid Network Traffic Engineering System (HNTES) software have been implemented and tested. These include the Flow Monitoring Module (FMM), InterDomain Controller Interface Module (IDC-IM), Monitored Flow Data Base (MFDB), MFDB Interface Module, and Offline Flow Analysis Tool (OFAT).

- Tabletop testbed experiments: A series of experiments are currently being conducted on the Tabletop Testbed supported by ESnet to test the above-listed software components of HNTES.

- Traffic analysis of Internet2 Netflow data for one 5-day period is completed and posted on our project web site: [http://www.ece.virginia.edu/mv/research/DOE09/index.html](http://www.ece.virginia.edu/mv/research/DOE09/index.html) under Talks.

- As part of technology transfer to ESnet, we provided ESnet with the Offline Flow Analysis Tool (OFAT). This software consists mostly of R statistical programs for Netflow data analysis. Chris Tracy, ESnet, has executed this software on ESnet collected Netflow data. We are working with ESnet to obtain the results of this analysis for our continued further study. This analysis of ESnet Netflow data is required to estimate expected returns on investment, i.e., percent of the traffic...
that can be moved to virtual circuits, before the HNTES technology can be considered for deployment on ESnet.

- A Call For Papers has been issued for a special issue of IEEE Communications Magazine on "Hybrid Networking: Evolution Towards Combined IP Services and Dynamic Circuit Network Capabilities". It is available here: http://dl.comsoc.org/ci1/info/cfp/cfpcommag0511.htm. Admela Jukan, Malathi Veeraraghavan and Masum Hasan, Cisco, are guest editors.

- A theoretical study to understand which traffic types are best for dynamic circuits is being undertaken. Several research publications were reviewed and discussed. Four characteristics of traffic flows are being considered: size (bytes), duration, rate, burstiness. Flows are classified in a paper by Lan and Heidemann, 2006, as elephants and mice on the size dimension, tortoises and dragonflies on the duration dimension, cheetah and snails on the rate dimension, and porcupine and stingrays on the burstiness dimension. The question we are addressing is what type of flows, elephant, tortoises, cheetah or porcupine are best suited for redirection to circuits.

2 Findings

- An updated version of a software tool, called BWdetail, which is an extended version of iperf was tested on the Tabletop testbed. It is available through the DOE web site.

- MySQL was installed by ESnet on the Tabletop testbed for this project. The HNTES MFDB was installed and tested.

- An MPLS LSP was set up by ESnet between the Juniper routers on the Tabletop testbed to provide an alternate path for rerouting certain flows. This is being used for our HNTES software testing.

- Preliminary analysis of ESnet data shows that there are some flows that occur multiple times in a day, and could be good candidates for redirection to circuits.

Cost Status. Show approved budget by budget period and actual costs incurred. If cost sharing is required break out by DOE share, recipient share, and total costs.

Please see attached file.

Schedule Status. List milestones, anticipated completion dates and actual completion dates. If you submitted a project management plan with your application, you must use this plan to report schedule and budget variance. You may use your own project management system to provide this information.

Next quarter deliverables:

By the end of the next quarter, Nov. 30, 2010, the following deliverables will be completed:

- An alternative version of OFAT, which is primarily based on the characteristics of flow sizes, will be designed and tested on Internet2 Netflow data. The results from these tests will be compared against results from the current version of OFAT, which is duration based.
• Router control interface module implementation will be completed.

• The theoretical study of the suitability of different traffic types for IP vs. DCS will be continued.

• A conference paper on the topic of resource optimization in hybrid networks will be prepared.

• Work on assigning reviewers for the papers received for the Special issue of IEEE Communications Magazine will begin, as the call deadline is Nov 1, 2010.

Any changes in approach or aims and reasons for change. Remember significant changes to the objectives and scope require prior approval by the contracting officer.

None.

Actual or anticipated problems or delays and actions taken or planned to resolve them.

Delays may occur as the Tabletop testbed is moved to Long Island.

Any absence or changes of key personnel or changes in consortium/teaming arrangement.

None

A description of any product produced or technology transfer activities accomplished during this reporting period, such as:

A. Publications (list journal name, volume, issue); conference papers; or other public releases of results.


B. Web site or other Internet sites that reflect the results of this project.

• UVA Hybrid Networking Project web site: http://www.ece.virginia.edu/mv/research/DOE09/index.html

• Collaboration web site for project participants to post documents, discuss issues in an online forum, archive emails, etc. The password-protected site is: https://collab.itc.virginia.edu/portal/site/e121f110-7b37-4021-8ac1-4d61197c067a/page/d4fece61-b037-411e-9866-c8a890ee22c2

C. Networks or collaborations fostered.
We are interacting closely with the Chris Tracy, ESnet, and the ANI Tabletop Testbed design team, including Brian Tierney, Inder Monga, Chin Guok and Eric Pouyoul, ESNet.

D. Technologies/Techniques.

HNTES software has been developed. It is currently under test. As noted earlier, the software is available on an open project web site.

E. Inventions/Patent Applications

None.

F. Other products, such as data or databases, physical collections, audio or video, software or netware, models, educational aid or curricula, instruments or equipment.

HNTES software, results of traffic analysis, a long-flow data base are all available through our project web site.