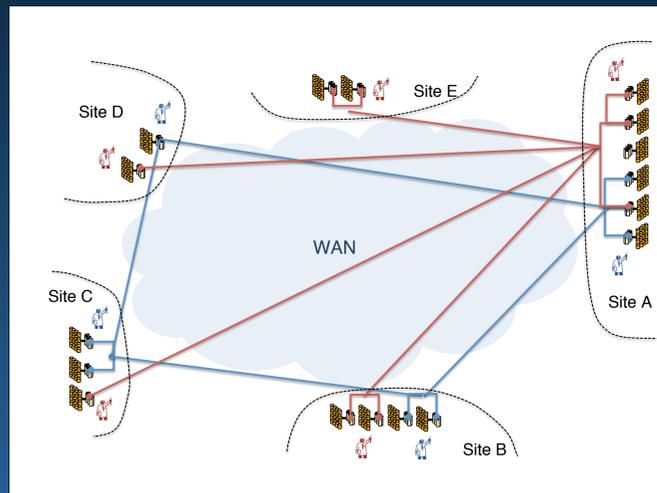


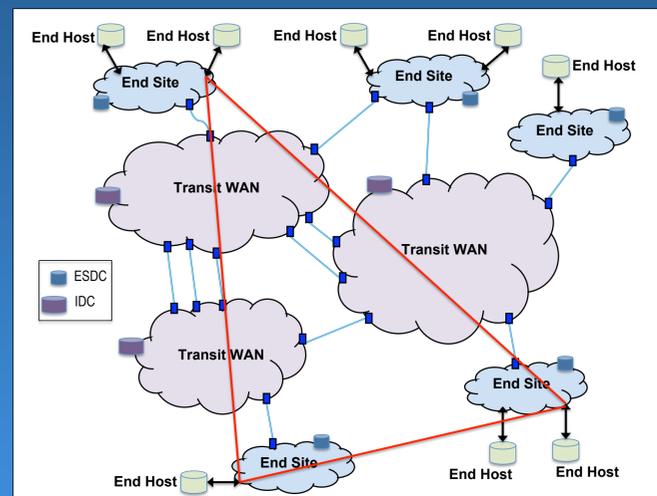
Dimitrios Katramatos Dantong Yu Sushant Sharma
Brookhaven National Laboratory

End Goal: Capability to create on-demand virtual networks with guaranteed QoS composed of end-to-end virtual paths
Each virtual network services a user community

- What is the input, and how is it provided?
 - Flexible resource reservation requests between end hosts
 - Multiple requests
 - Each request can be between end hosts on different end sites
 - End sites are connected via WANs
 - A front end to submit requests
- What is the output?
 - Appropriate reservation schedule across domains to satisfy input requests
 - Results in a virtual network connecting given end hosts
 - Each link connecting two end hosts is a virtual link
 - End users should be unaware of underlying virtual links
- What to reserve (i.e., a reservation schedule)?
 - Need algorithms to calculate reservation schedules
 - RRA: Resource reservation algorithm [Sharma:SC]
 - Can accommodate multiple flexible requests on a given path
 - Others algorithms in progress
 - When path is not given.
 - When end points of separate requests are different.



Virtual Network Domains



System Setup

BROOKHAVEN NATIONAL LABORATORY VNOD: Virtual Network On Demand

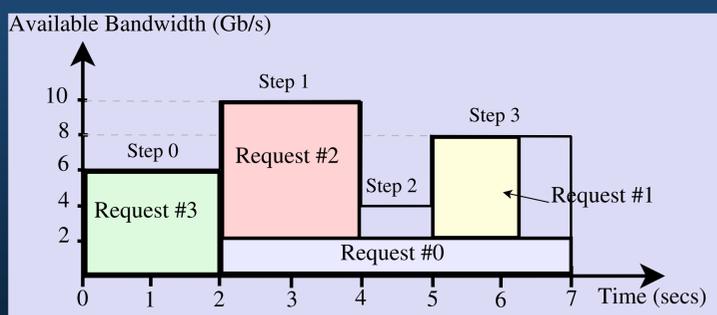
Request: Source: rdma04.bnl.gov Destination: tera04.ultrahigh.org Volume (Gb): 100 Earliest Start Time: 2011/Nov/4 14:41 Deadline: 2011/Nov/4 15:11 BW (Mb/s): 1000

Source	Destination	Volume (Gb)	Requested Schedule			Generated Reservation Schedule		
			Earliest Start Time (YYYY/MM/DD HH:MM)	Deadline (YYYY/MM/DD HH:MM)	Max Usable BW (Mb/s)	Start Time (YYYY/MM/DD HH:MM)	End Time (YYYY/MM/DD HH:MM)	Reserved BW (Mb/s)
rdma04.bnl.gov	tera04.ultrahigh.org	100	2011/Nov/4 14:41	2011/Nov/4 15:11	1000	2011/Nov/4 14:41	2011/Nov/4 14:43	1000
rdma03.bnl.gov	host2.udel.edu	150	2011/Nov/3 13:00	2011/Nov/3 13:30	1100	2011/Nov/3 13:00	2011/Nov/3 13:03	1100
host.udel.edu	tera05.ultrahigh.org	50	2011/Nov/4 7:00	2011/Nov/4 7:30	600	2011/Nov/4 7:00	2011/Nov/4 7:02	600

Reservations were successfully activated.

Submit Requests Accept Schedule Reject Schedule

Request Submission

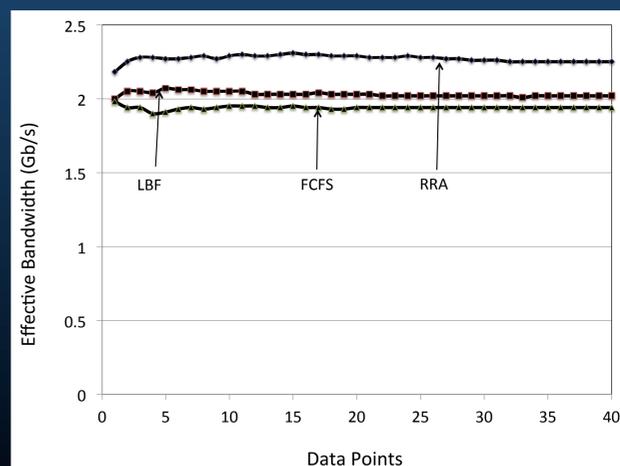


An Example of Output Schedule

[Sharma:SC] S. Sharma, D. Katramatos, and D. Yu, "End-to-end network QoS via scheduling of flexible resource reservation requests," To appear ACM/IEEE Supercomputing Conference (SC), Seattle, WA, November, 12–18, 2011.

How to reserve?

- A new framework to create an on-demand virtual network
 - Network controllers
 - End-Site Domain Controllers (ESDC)
 - TeraPaths
 - ESCPS
 - Inter-Domain Controllers (IDC)
 - OSCARS
 - Intelligent resource schedulers
 - Modular architecture
 - Capability to plugin different controllers and schedulers
- Challenges
 - Bandwidth availability changes over time
 - Maintaining such availability at end sites
 - Requesting availability from WANs
 - Each domain can have heterogeneous QoS capabilities
 - All encountered scheduling problems are NP-hard



Advantage of Efficient Scheduling