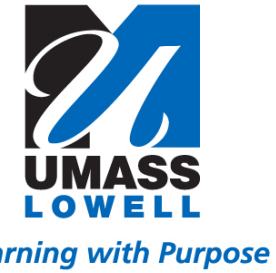

PROPER
Parallel Resource-Optimized Provisioning of End-to-End Requests

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Introduction

- "Big Data" application requirements necessitate evolution in data distribution paradigm.
  - Faster distribution of data to/from multiple storage centers.
  - Provide survivable backup paths for data transmission.
  - Split transfer of large data sets across multiple sites for quicker transmission .
- There is a discrepancy between availability and invocation of parallel technologies.
  - Data typically stored at multiple sites/repositories (Eg: Climate).
  - Networks can support guaranteed parallel transmissions via virtual circuits (OSCARS).
  - Applications/Schedulers **do not** currently take advantage of these parallelisms due to lack of storage and network resource awareness.

PROPER Project Objectives

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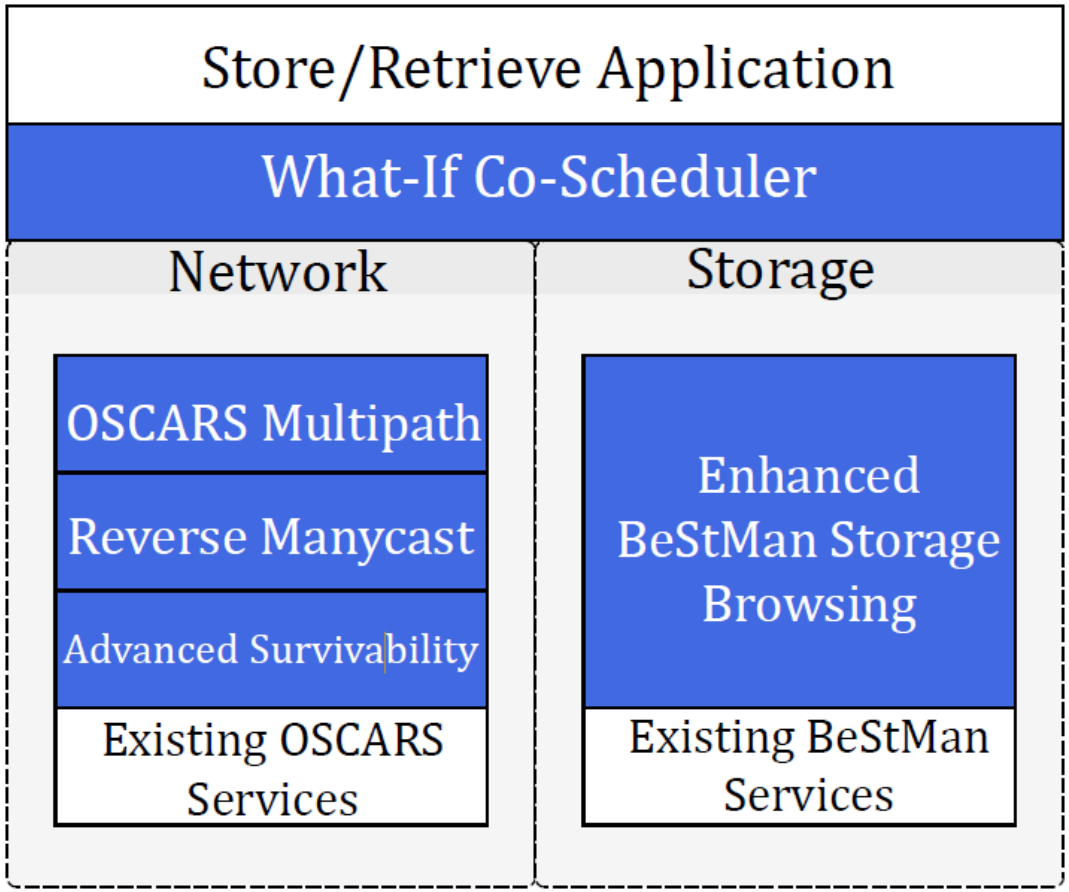
- We propose a co-scheduler that takes advantage of:
  - **Flexibility:** harness both time (advance reservation) and space (replicated data at multiple sites) domains.
  - **Parallelism:** incorporate parallel nature of storage and network resources into to the scheduler.
  - **Survivability:** protection of both network and storage resources.
  - **Negotiation:** co-scheduler will return a set of **What-If** scenarios that satisfy the user/application constraints.

Proposed Work

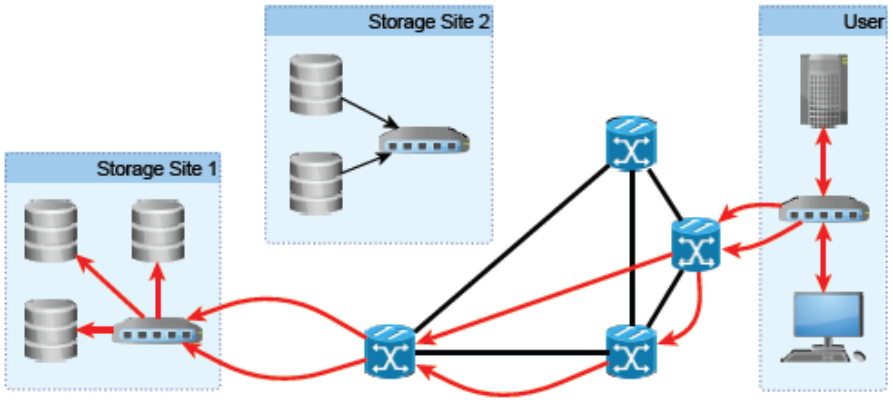
The proposed co-scheduler interfaces with the end-user application to identify areas of flexibility in both network and storage domains.



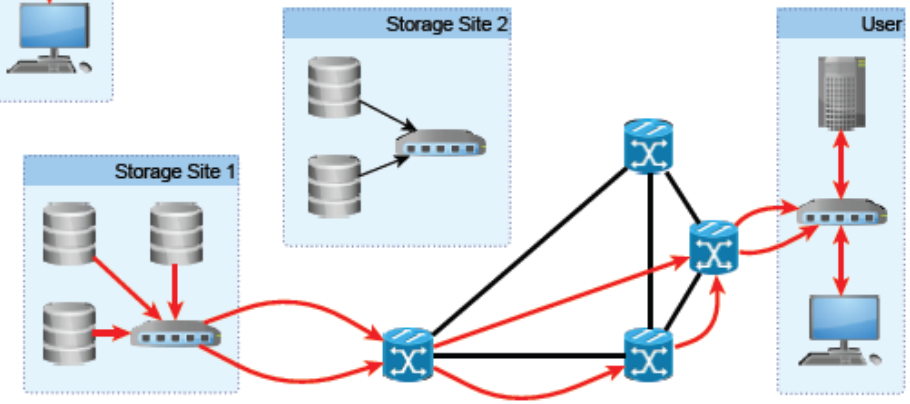
Proposed Work

Task 1: Parallel transfers over multipath circuits.

- Facilitate parallel transfer from a single sender to a single receiver.



Multipath store

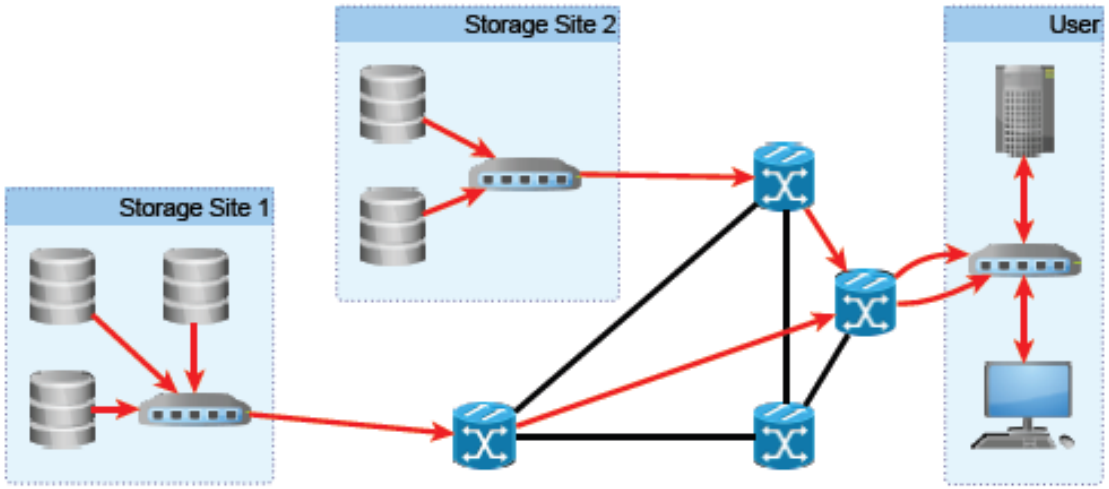


Multipath retrieve

Proposed Work

Task 2: "Reverse Manycast" Data Retrieval (Many to One)

- Transfer multiple chunks of a single data set from multiple repositories to a single user/datacenter.



Reverse Manycast

- "**Reverse Anycast**": Transfer a single copy of replicated data from the **best** storage repository (**any to one**).

Proposed Work

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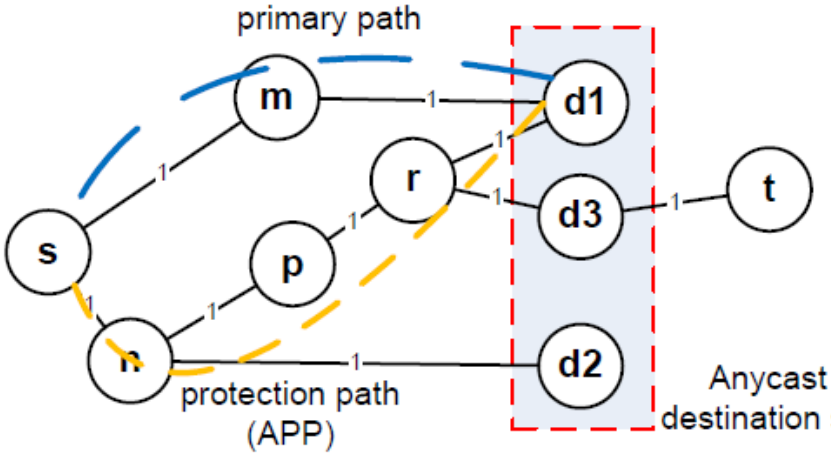
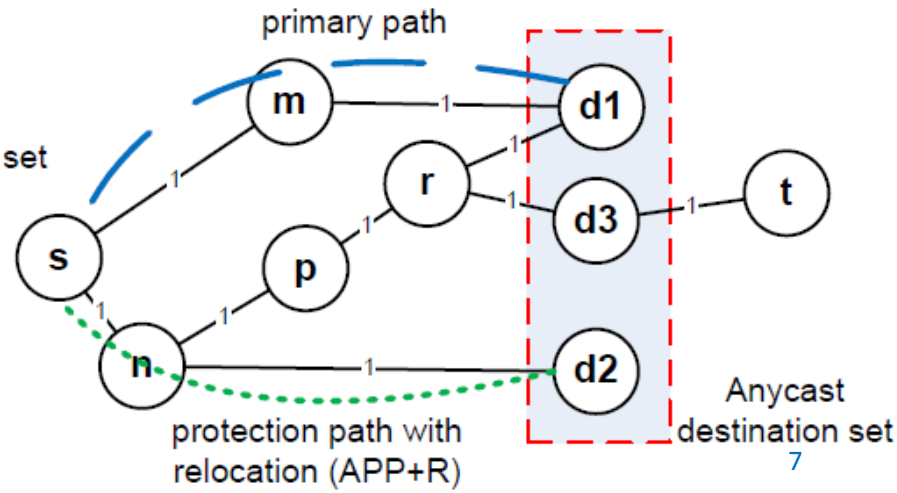
Task 3: Survivable Anycast

- Resiliency not only against network failure, but also destination node/datacenter failure.

Anycast Path Protection



Anycast Path Protection with Destination Relocation



Proposed Work

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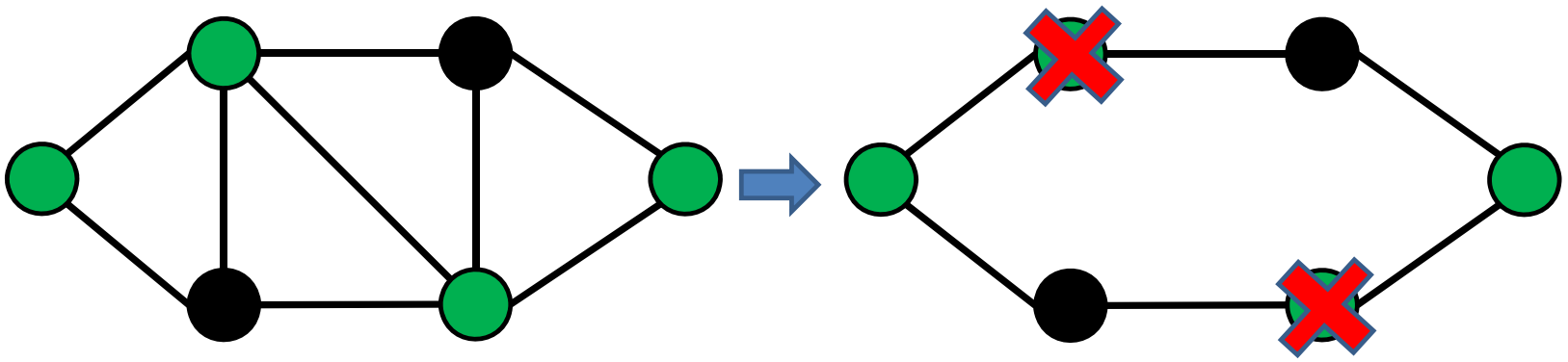
Task 4: Survivable Manycast (1:M and M:1)

- Survivable solutions that protect against node failure.
- Preliminary work: Network biconnectivity.
  - A biconnected graph becomes disconnected if and only if, at least two nodes are removed.
  - Objective: Create biconnected subgraphs that include all resource nodes in a set.



Manycast Survivability using Network Biconnectivity
Simple example: Ring

Proposed Work

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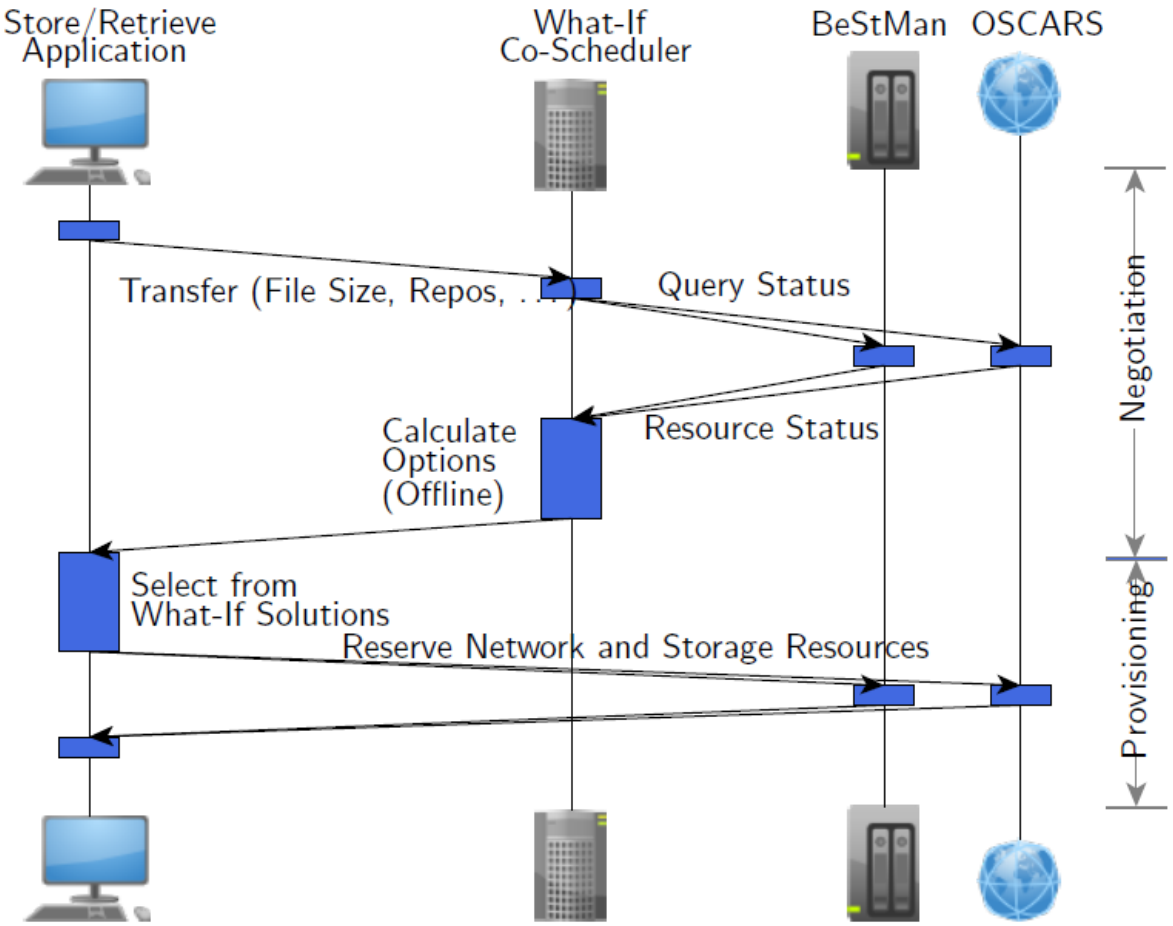
Task 5: Berkeley Storage Manager (BeStMan) Tasks (with Alex Sim)

1. Extend the browsing capability of the BeStMan for its managed storage space.
2. Implement dynamic cataloging of file-system contents including database design and caching implementation.
3. Develop queuing algorithms for meta-data queries.

Proposed Work

Task 6: What-If Co-scheduler



What question(s) does your research motivate you to now ask?

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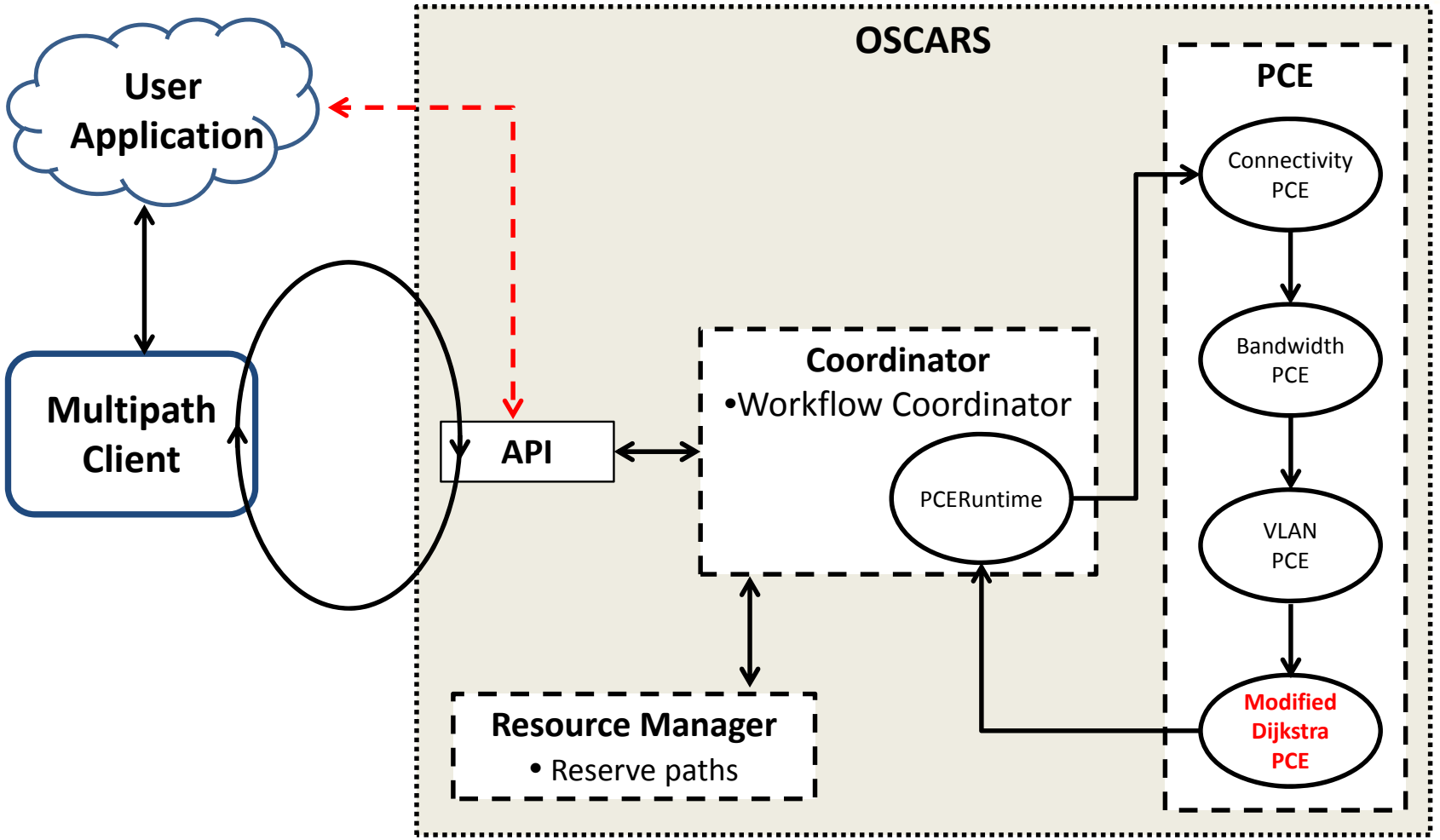
3 months in, we don't have a lot of insight …..

- How do users discover these new network services?
  - Is What-If module the best place to "hide" new services like
    - anycast, manycast, multi-path, survivability?
- How do we implement this on a multi-domain network and storage?
  - ESnet now supporting NSI for multi-domain transfers.

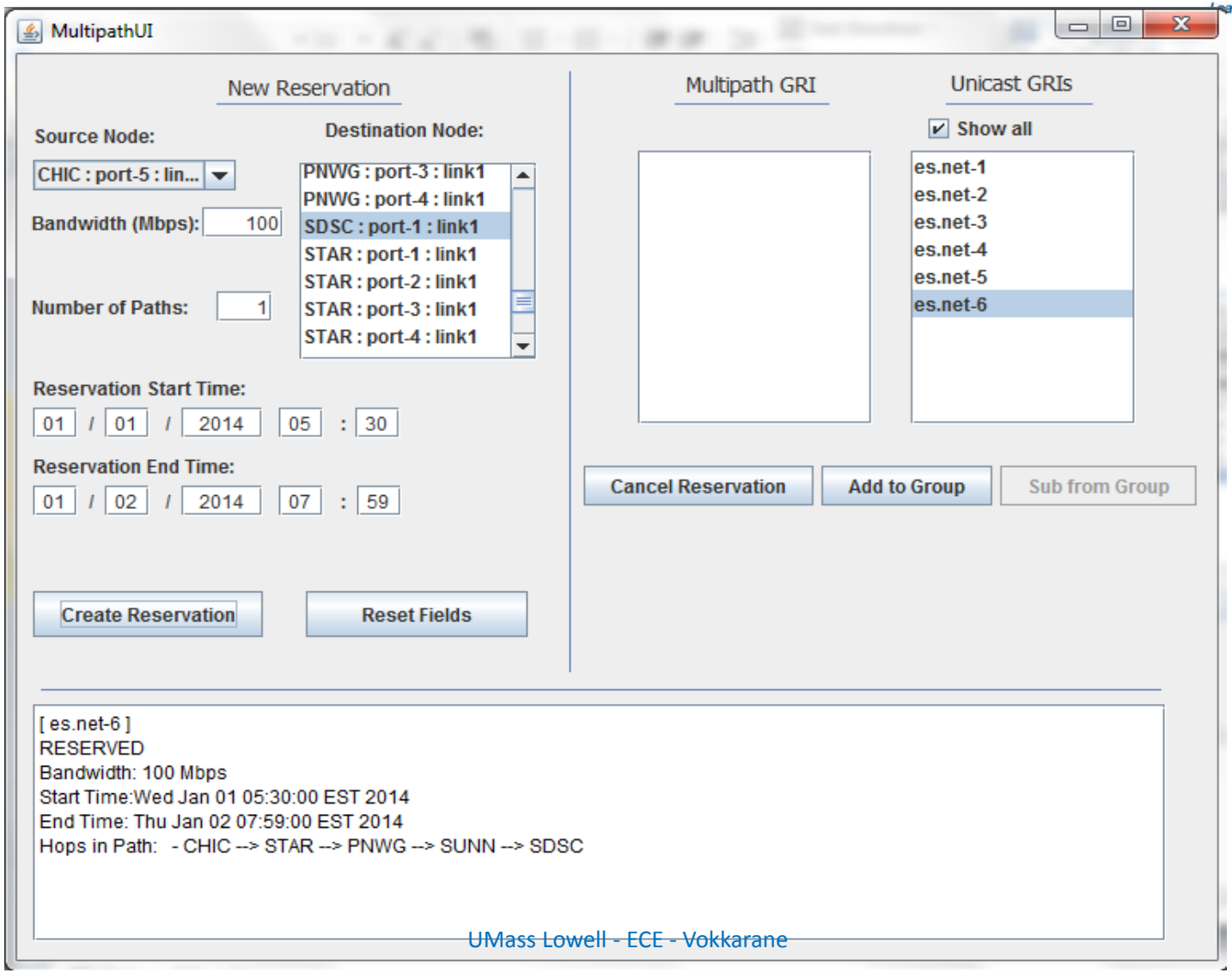
Multipath Client for OSCARS

Demo

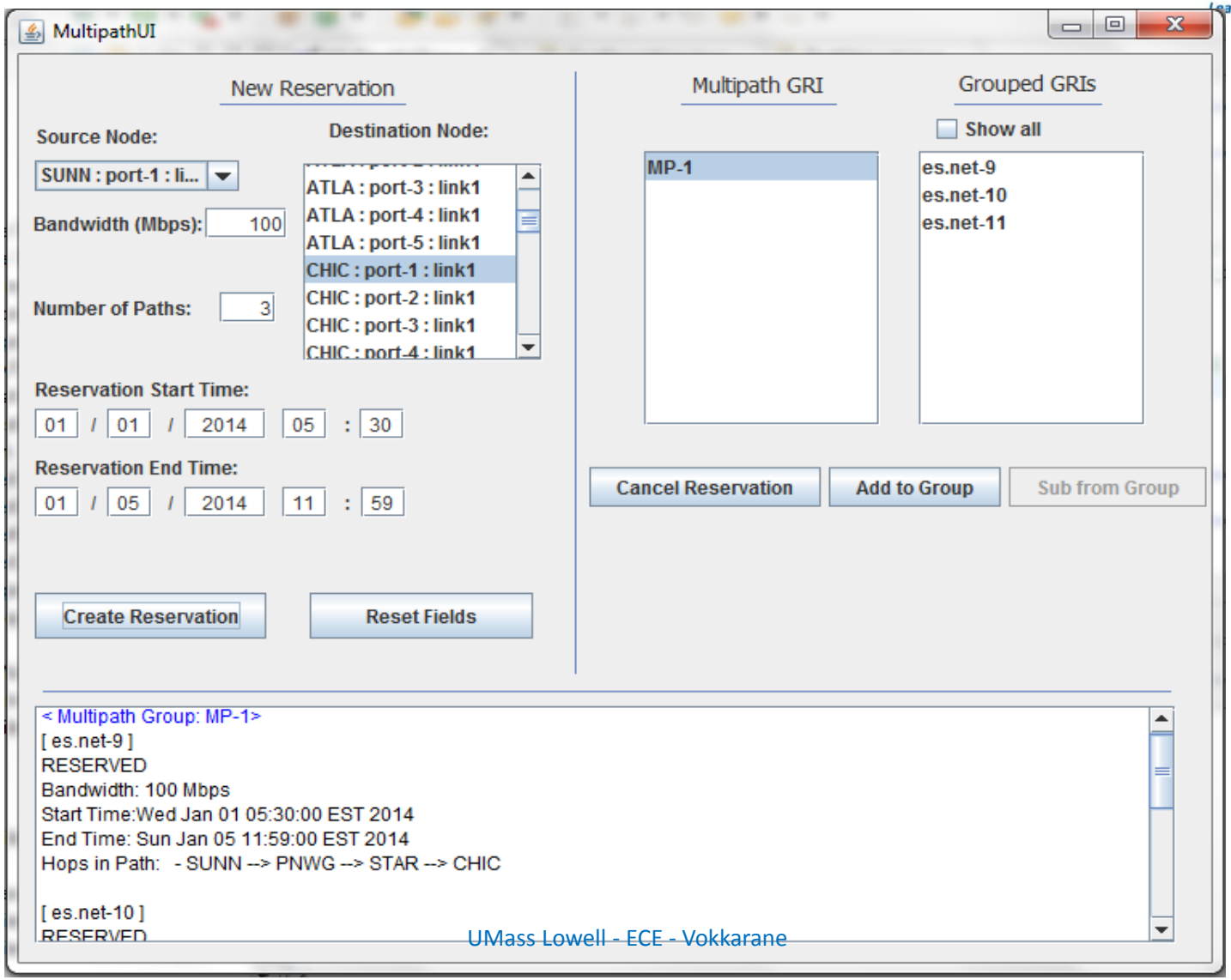
Multipath Client Design



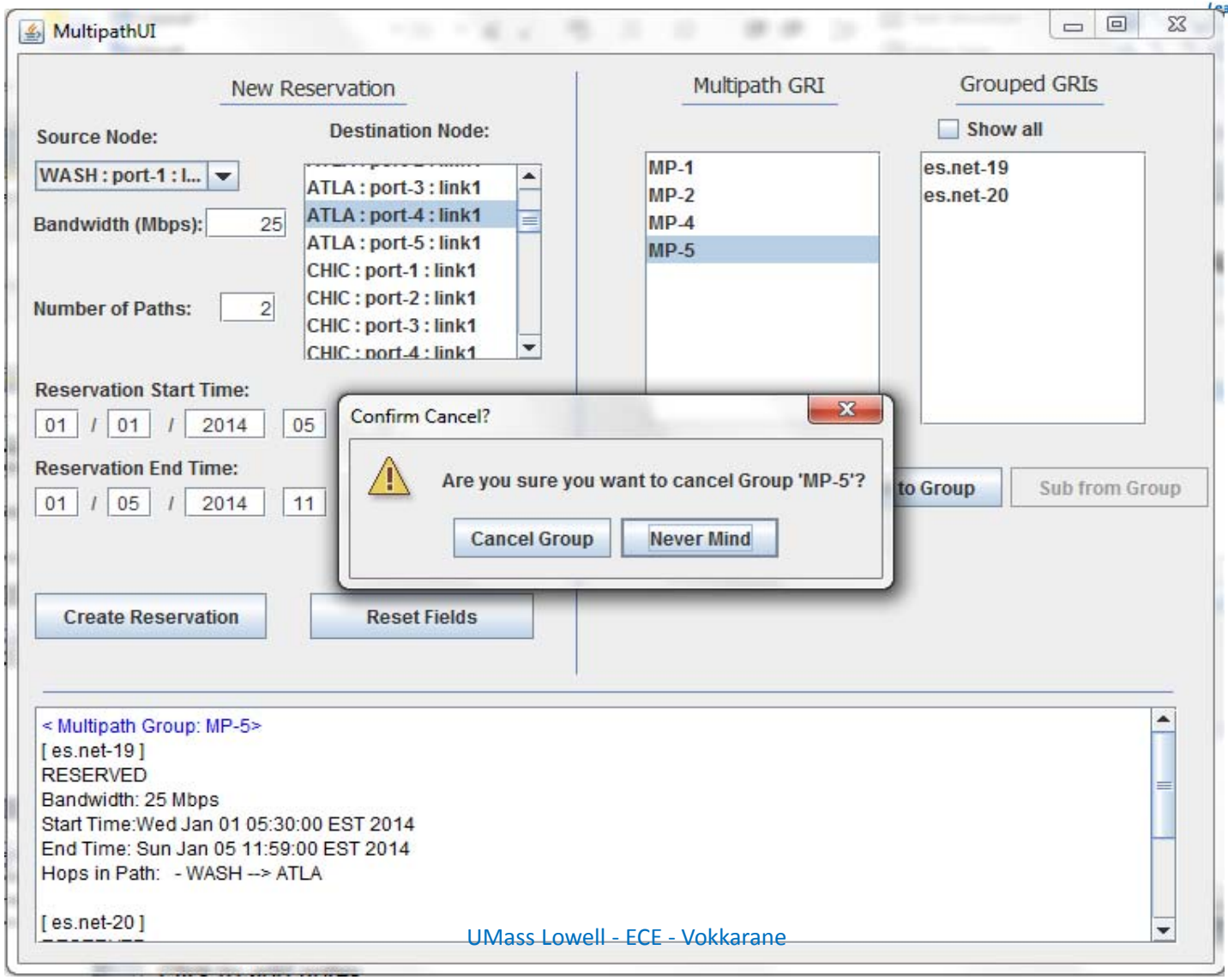
Sample Multipath GUI – New Unicast



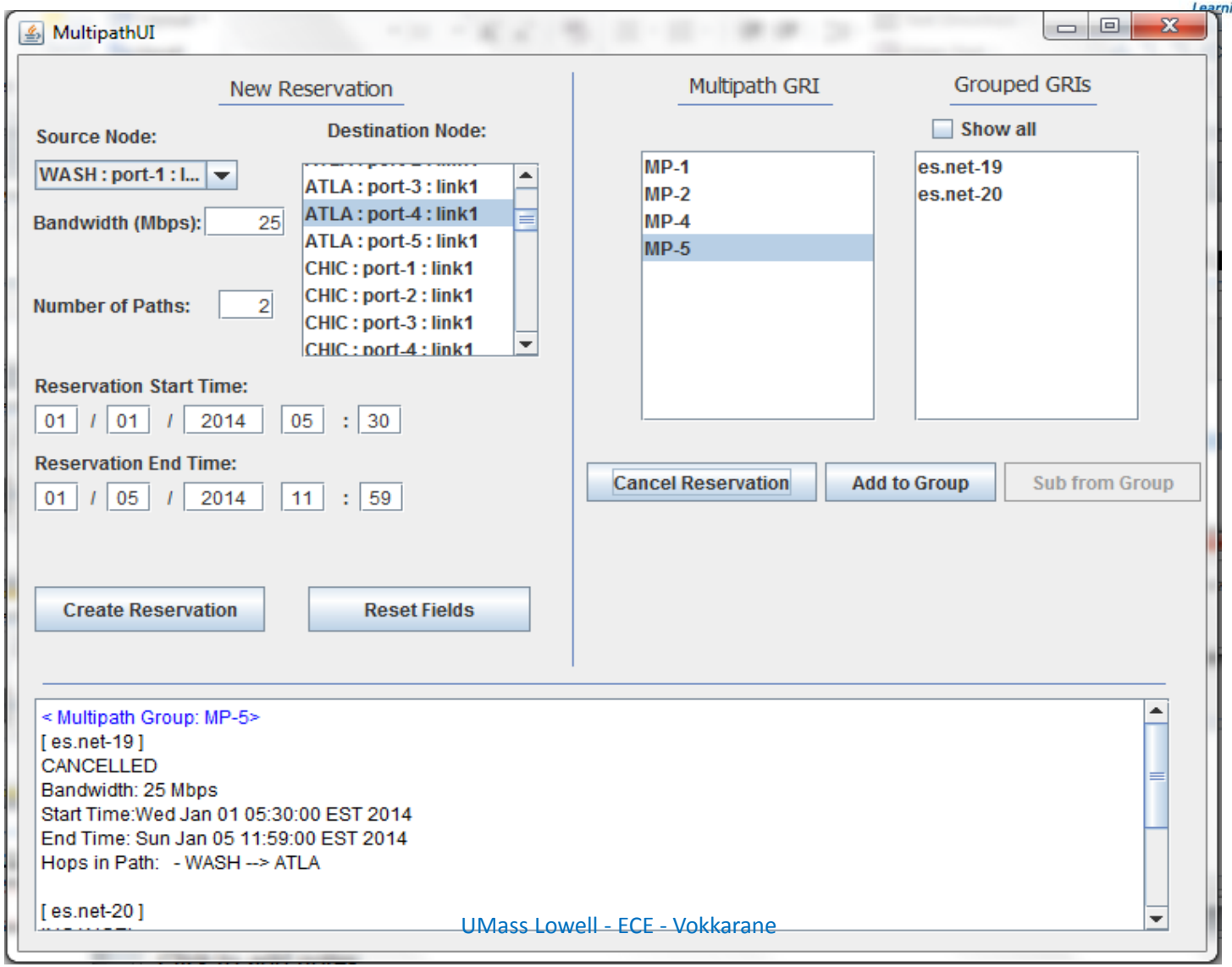
Sample Multipath GUI – New Multipath



Sample Multipath GUI – MP Group Cancel



Sample Multipath GUI – MP Group Cancel



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Questions?