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COMMON:
Coordinated Multi-layer Multi-domain Optical Network Framework for Large-scale Science Applications

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Outline

- Introduction
- Project Objectives
- Experiments and Implementation
- Project Facts and Figures
- Project Tasks

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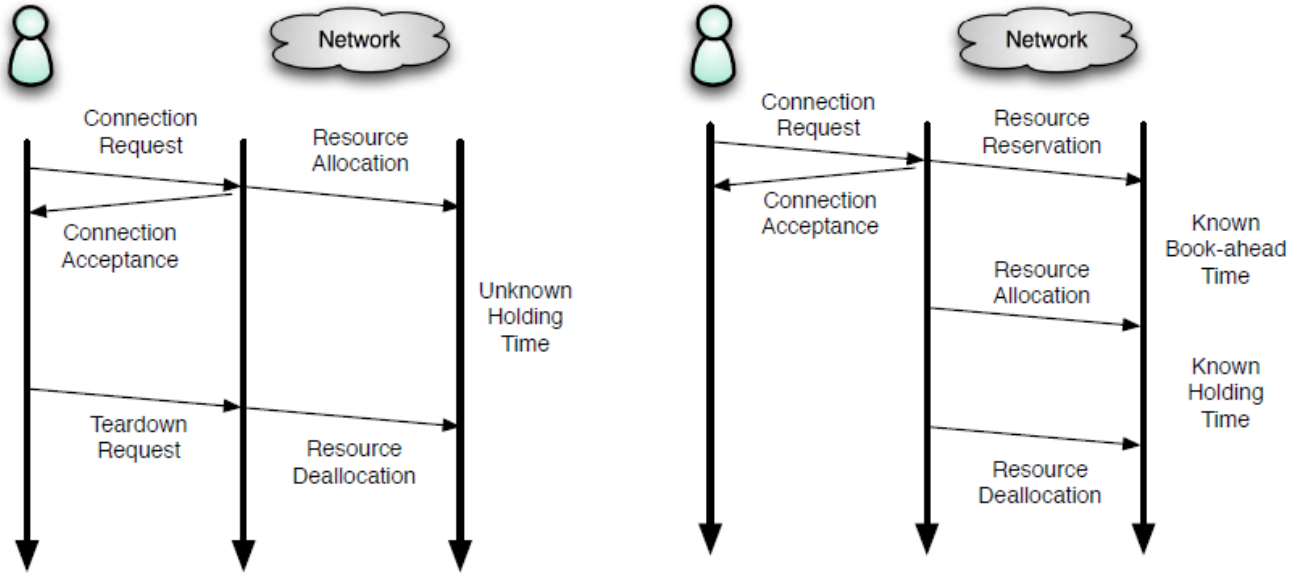
Introduction (i)

- To support large-scale science applications we need to provision network resources across multiple layers and multiple domains.
- The network needs to provision connections between clients efficiently.
  - Immediate reservation (IR): network provisioning "immediately" when the connection request arrives.
  - Advance reservation (AR): resources can be reserved at some point in the future.



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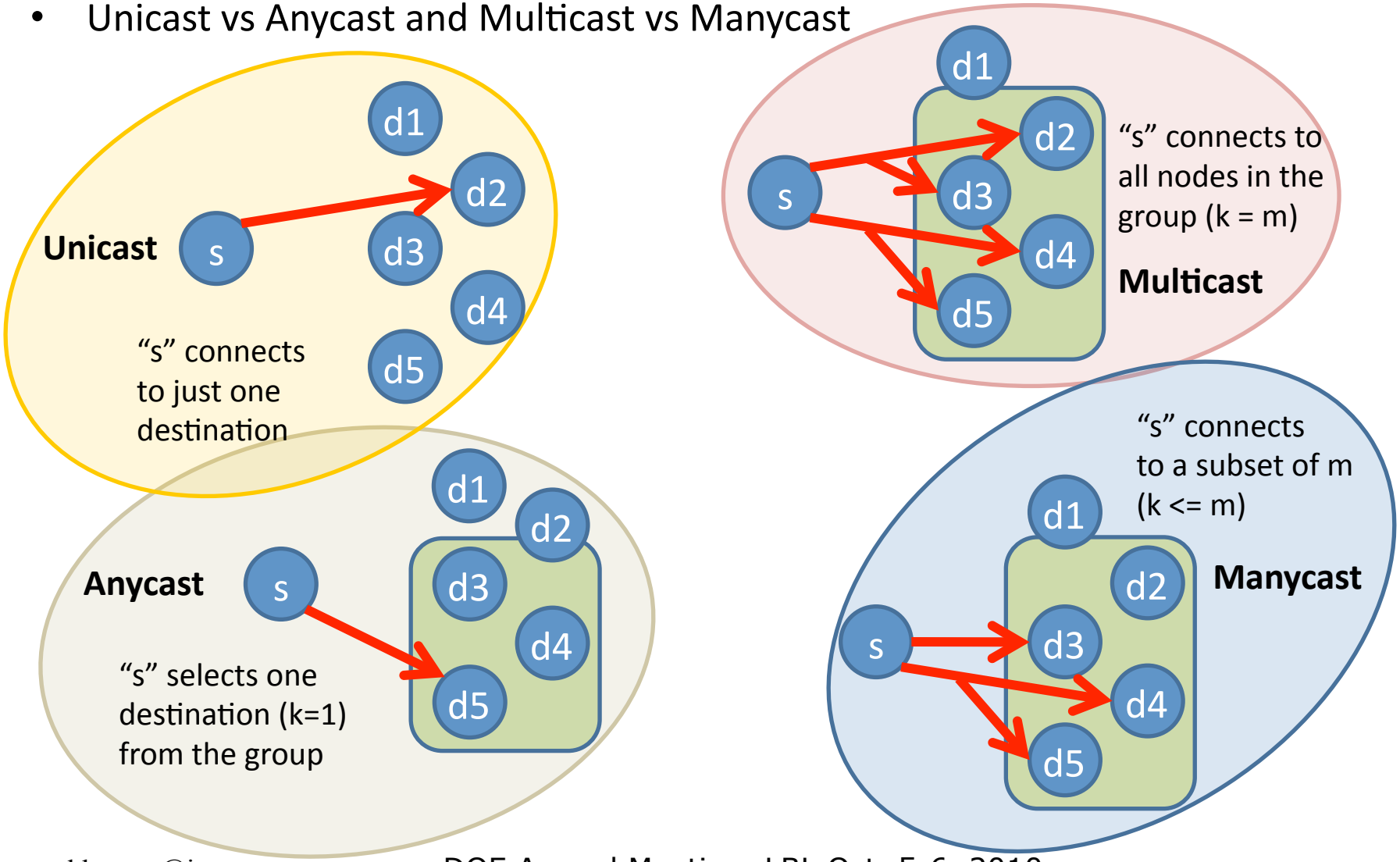
Introduction (ii)

- Advance reservation can improve the performance of the network by increasing the connection success rate and guaranteeing the availability of resources for the application.
  - Some extra parameters (start time, end time, and duration) are needed.
  - Open research problems to be addressed for AR:
    - Multi-layer multi-domain survivability,
    - Multi-layer multi-domain QoS, and
    - new communication paradigms, such as anycast.

Communication Services - Introduction (iii)

- Unicast vs Anycast and Multicast vs Manycast



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What is Manycast?

- Point to multi-point communication paradigm
- Source communicates with any *k* destinations from a larger candidate set, D_c
- Defined as: (s, D_c, k) (e.g. (1, {3,5,6,7}, 2))
- Multicast: $|D_c| = k$ (e.g. (1, {3,5}, 2))
- Unicast: $|D_c| = k = 1$ (e.g. (1, {3}, 1))
- Anycast: k = 1 (e.g. (1, {3,5,6,7}, 1))

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Project Objectives

- Implement a Coordinated Multi-layer Multi-domain Optical Network Framework for Large-scale Science Applications.

- This involves the definition of new algorithms and mechanisms for advance and immediate reservation of network resources.

- Specific problems to be addressed in COMMON:
  - Multi-layer multi-domain path survivability (Task 1 - T1).
  - Multi-layer multi-domain quality of service (T2).
  - Anycast (multicast-/manycast-overlay) request provisioning (T3).

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T1: Multi-layer Multi-domain Path Survivability

- Survivability for immediate and advance reservation of dynamic connections.
- Issues to investigate:
  - Definition of parameters and design of basic IR/AR survivability schemes
    - Number of connection requests to re-route.
    - Time-shifted backup reservations.
  - Multi-layer survivability
    - IP layer vs Ethernet vs WDM/SONET
    - how higher layers (in OSCARS) can be mapped to lower-layer survivability mechanisms.
  - Multi-domain survivability
    - new topology abstractions with temporal information.

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T1: Multi-layer Multi-domain path survivability

Summary of Tasks			
T1.1	Provisioning of multi-layer path suvivability for IR requests.		
T1.2	Handling different failure scenarios for multi-layer multi-domain IR survivability.		
T1.3	Handling different failure scenarios for multi-layer multi-domain AR survivability.		
Deliverables			
ID	***Name***	***Start***	***End***
D1.1	Develop algorithms for coordinated multi-layer survivability and deployment on OSCARS	7/2011	10/2012
D1.2	Extend multi-layer and multi-domain survivability techniques and deployment on OSCARS	4/2012	9/2013

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T2: Multi-layer Multi-domain QoS

- Ensure the QoS for different CoS defined in the multi-layer framework, especially for high priority traffic.
- Issues to be addressed:
  - Mapping of IP QoS (DHCP) and Ethernet VLAN priorities to circuit priorities
  - Multi-layer QoS → Guarantee the QoS metrics across multiple layers.
  - Multi-domain QoS → Ensure minimum level of service is guaranteed across different domains.

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T2: Multi-layer Multi-domain QoS

Summary of Tasks			
T2.1	Provisioning of multi-layer QoS to IR requests.		
T2.2	Provisioning of multi-layer QoS to AR requests.		
T2.3	Incorporation of QoS metrics into multi-layer multi-domain path setup.		
Deliverables			
ID	***Name***	***Start***	***End***
D2.1	Implementation of requests preemption on OSCARS to support multiple CoS.	10/2011	12/2012
D2.2	Implementation of multi-layer QoS on OSCARS.	10/2012	9/2013

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T3: Anycast/Multicast/Manycast service

- There exist other communication paradigms that could be very beneficial for large-scale experimentation.
  - **Anycast**: communication from a source to a unique destination within a candidate destination set.
  - **Multicast**: communication from a source to all the destinations from the destination set.
  - **Manycast**: communication from a source to a group of destination from a larger candidate destination set.
- We aim to provide support for these communication paradigms in the IR/AR framework.
- We may have to support these as overlays over point-to-point unicast connections in OSCARS.

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T3: Anycast/Multicast/Manycast service

Summary of Tasks			
T3.1	Anycast (multicast and manycast) IR algorithms.		
T3.2	Anycast (multicast and manycast) AR algorithms.		
T3.3	Provide multi-domain extensions for anycasting (multicast and manycast)		
Deliverables			
ID	***Name***	***Start***	***End***
D3.1	Deploy anycast (multicast and manycast) IR algorithms on OSCARS	10/2010	9/2011
D3.2	Deploy anycast (multicast and manycast) AR algorithms on OSCARS	1/2011	3/2012

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Project Facts and Participants

- Project timeline:
  - October 2010 – August 2013
- Number of work packages and tasks:
  - 13 tasks in 3 different WPs.
- Number of deliverables:
  - 2 deliverables per WP.
- Number of researchers/students involved:
  - Principal Investigator (PI).
  - 1 Full-time Post-Doctoral Researcher.
  - 1 Full-time Visiting Scholar.
  - 2 Ph.D. students (from Spring/Fall 2011).
  - 3-4 Master's thesis students.

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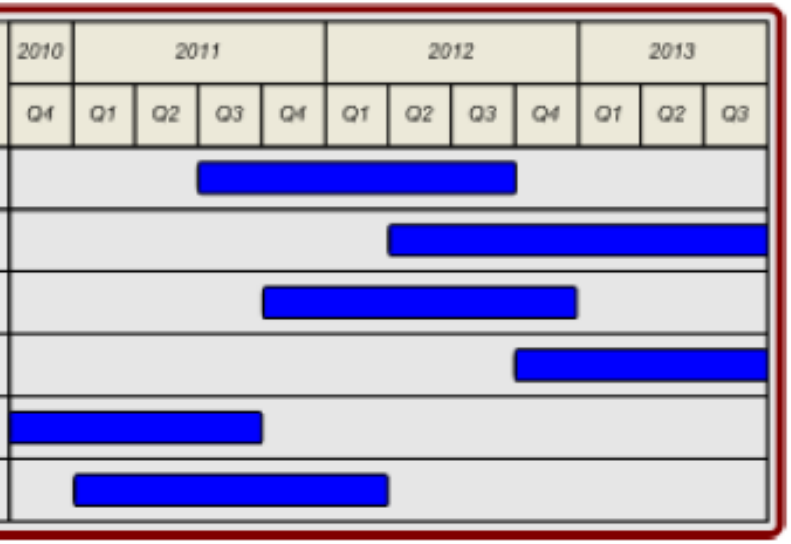
Project Timeline

ID	Deliverable Name	Start	Finish
1	Deliverable 1.1	7/1/2011	10/1/2012
2	Deliverable 1.2	4/2/2012	9/30/2013
3	Deliverable 2.1	10/3/2011	12/28/2012
4	Deliverable 2.2	10/1/2012	9/30/2013
5	Deliverable 3.1	10/1/2010	9/30/2011
6	Deliverable 3.2	1/3/2011	3/30/2012



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Research Group Background

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3. Balagangadhar G. Bathula, Rajesh R.C. Bikram, Vinod M. Vokkarane, and Srinivas Talabattula, **"Quality of Transmission Aware Manycasting Over Optical Burst-Switched (OBS) Networks**," *IEEE/OSA Journal of Optical Communications and Networking (JOCN),* vol. 2, no. 10, pp. 820–830, Oct. 2010.
4. N. Charbonneau and V.M. Vokkarane, "**Multicast Advance Reservation RWA Heuristics in Wavelength-Routed Networks**," to appear, Proceedings, IEEE Globecom 2010, Optical Networks and Systems Symposium, Miami, FL, Dec. 2010.
5. J. Wang, V.M. Vokkarane, R. Jothi, X. Qi, B. Raghavachari, and J.P. Jue, "**Dual-homing protection in IP-over-WDM networks**," *IEEE/OSA Journal of Lightwave Technology*, vol. 23, no. 10, pp. 3111-3124, 2005.
6. Q. Zhang, V.M. Vokkarane, J.P. Jue, and B. Chen, "**Absolute QoS differentiation in optical burst-switched networks**," *IEEE Journal on Selected Areas in Communications*, vol. 22, no. 9, pp. 1781-1795, 2004.