George Mason University
Graduate Course Approval/Inventory Form

Please complete this form and attach a copy of the syllabus for new courses. Forward it as an email attachment to the Secretary of the Graduate Council. A printed copy of the form with signatures should be brought to the Graduate Council Meeting. Complete the Coordinator Form on page 2, if changes in this course will affect other units.

Please indicate:  ____X__ NEW  ____ MODIFY  ____ DELETE

Local Unit: ECE/TCOM  Graduate Council Approval Date:

Course Abbreviation: TCOM  Course Number: 611

Full Course Title: Multi-Protocol Label Switching (MPLS)

Abbreviated Course Title (24 characters max.): MPLS

Credit hours: 3.0  Program of Record: MS in Telecommunications

Repeatable for Credit?  ____ D=Yes, not within same term  Up to hours

____ T=Yes, within the same term  Up to hours

____ N=Cannot be repeated for credit

Activity Code (please indicate):  ____ X__ Lecture (LEC)  ____ Lab (LAB)  ____ Recitation (RCT)

____ Studio (STU)  ____ Internship (INT)  ____ Independent Study (IND)

____ Seminar (SEM)

Catalog Credit Format  3.0: 3.0: 0  Course Level: GF(500-600)  ____ X__ GA(700+)

Maximum Enrollment: 35  For NEW courses, first term to be offered: Fall 2005

Prerequisites or co-requisites: prerequisite course TCOM 509 and TCOM 515, or equivalent

Catalog Description (35 words or less)  Please use catalog format and attach a copy of the syllabus for new courses: Development of Border Gateway Protocol and its application in today’s Internet routing architecture. The course will develop a full understanding of MPLS theory, technology, and implementation aspects through a detailed analysis of the MPLS routing concepts and protocol stacks and the completion of a major project aimed at reinforcing the students understanding of MPLS.

For MODIFIED or DELETED courses as appropriate:

Last term offered:  Previous Course Abbreviation:  Previous number:

Description of modification:

APPROVAL SIGNATURES:

Submitted by:  ____ Jeremy Allnutt  email: _jallnutt@gmu.edu_

Department/Program:  ____ ECE/MS in Telecommunications  Date: _Oct. 18th, 2004_

College Committee:  Date: _Oct. 21st, 2004_

Graduate Council Representative:  Date: _____________
GEORGE MASON UNIVERSITY
Course Coordination Form

Approval from other units: Not Applicable

Please list those units outside of your own who may be affected by this new, modified, or deleted course. Each of these units must approve this change prior to its being submitted to the Graduate Council for approval.

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<th>Head of Unit’s Signature:</th>
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Graduate Council approval: ___________________________ Date: __________

Graduate Council representative: ______________________ Date: __________

Provost Office representative: ________________________ Date: __________
1. CATALOG DESCRIPTION
(a) TCOM 611 Multi-Protocol Label Switching (MPLS) (3:3:0)
(b) Prerequisites: TCOM 609 or TCOM 610; good knowledge of an object oriented computer language
(c) Catalog Description:
The course will develop a full understanding of MPLS theory, technology, and implementation aspects through a detailed analysis of the MPLS routing concepts and protocol stacks and the completion of a major project aimed at reinforcing the students understanding of MPLS.

2. JUSTIFICATION
(a) Course Objectives:
This course is intended to build upon the advanced protocol courses TCOM 609 Interior Gateway Protocols (IGP) and TCOM 610 Border Gateway Protocols (BGP) and provide students with detailed design knowledge of Multi-Protocol Label Switching (MPLS). TCOM 611 provides students with a full understanding of MPLS network routing aspects through both a detailed analysis of the theory, technology, and implementation aspects of MPLS and by working on a major, individual project involving the writing of elements of the MPLS protocol stack, such an MPLS and RSVP extension module, using freeware code such as Zebra. By the end of the course, students will fully understand, and be able to successfully complete, such MPLS design aspects as: establish an LSP with or without BW; dynamically reroute an established LSP tunnel (if it fails); observe an actual route traversed by the established LSP tunnel; identify and diagnose an LSP tunnel; pre-empt an established LSP tunnel; use downstream on demand label allocation, liberal retention, and ordered control; and be able to support affinity class configuration.

(b) Course Necessity:
MPLS has become the protocol of choice for combining a variety of packet traffic over a single physical layer. A detailed understanding of MPLS is absolutely necessary for any network design engineer wanting to implement large-scale systems. The proposed course is one of a group of elective courses that will be part of the Protocol Course Progression in the TCOM program to be made available for advanced TCOM students and students from other, related, programs who desire to become experts in this area. TCOM 609 (Border Gateway Protocols) and TCOM 610 (Interior Gateway Protocols), with this proposed course, TCOM 611, form the heart of a proposed new certificate in Advanced Network Protocols for Telecommunications. The proposed new course, TCOM 611, will also form a necessary building block for Ph.D. students interested in developing Protocol Stacks.

(c) Relationship to Existing Courses:
The course is a natural progression for students to take following the advanced protocol courses TCOM 609 and 610, which provide students with the detailed knowledge of gateway protocol that are key to the understanding of MPLS. Either TCOM 609 or TCOM 610 may be taken as a prerequisite for TCOM 611. TCOM 609, TCOM 610, and TCOM 611 do not have any overlapping courses at George Mason University, although elements of all three courses have been taught previously as Advanced Topics course in the TCOM program.
3. APPROVAL HISTORY
ECE Department Date: October 18th, 2004
IT&E Graduate Committee Date: October 21st, 2004
IT&E Dean Date:

4. SCHEDULING
Every fall semester, starting fall 2005 and every two or three semesters thereafter.
Proposed Instructors: Dr. Jeremy Allnutt, Dr. Yunqing Wu, Mr. Tom Van Meter and other suitably qualified faculty.

5. COURSE OUTLINE
(a) Syllabus

Week 1
MPLS basics: Structure, signaling, RSVP-TE; LDP
[RFC 3031, RFC 3032, RFC 2702]
Project discussion

Week 2
RSVP-TE Signaling: Explicit routes, affinity class, bandwidth, priority, hello mechanism
[RFC 2205, RFC 2209, RFC 2210, RFC 3209, RFC 3210]

Week 3
RSVP-TE detail objects/LDP Signaling:
[RFC 3031, RFC 3032, RFC 2702, RFC 3036, RFC 3037]

Week 4
Bundling extensions and fast reroute
[RFC 2961, fast reroute draft]
Student design project initiated

Week 5
RFC 2547bis: L3-VPN, hub and spoke, carrier of carriers, interprovider VPNs, Internet access, MP-BGP extensions
[RFC 2547bis, RFC 2858, RFC 3107, RFC 2918]

Week 6
Rosen draft for 2547bis multicasting
Mid-term exam

Week 7
Layer 2 MPLS technologies: Kompella, Martini, and VPLS
[Kompella, Martini, and VPLS draft]
Week 8
*Layer 2 MPLS technologies (contd.):*

Week 9
*Project discussions and review*

Week 10
**GMPLS – functions and signaling**
[GMPLS draft specifications]

Week 11
*Project discussions and review*

Week 12
**MPLS QoS**: E-LSPs and L-LSPs
[MPLS QoS drafts]

Week 13
*Project discussions and review*

Week 14
*Project presentations/discussion and final examination review*

Week 15
Final exam

(b) Required Reading and Reference Material
Black: MPLS switching
*plus*
Instructor’s course notes and published RFCs.

(c) Student Evaluation Criteria

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