(see last page for a summary of lab work)

Overall **MPLS Course** Objectives
- The drivers for MPLS
- MPLS control and data plane operation
- MPLS terminology and uses in a Nokia environment
- LDP and RSVP protocol operation and configuration
- Options available for TE in an MPLS network, including configuration and operation
- How to traffic engineer in a hierarchical network using LDP-over-RSVP
- [Week11-12] The available options for achieving resiliency with MPLS networks
- [Week11-12] The implementation of fast re-route in a Nokia environment

Mod 1, Sec 1: MPLS drivers – the role of MPLS in:
- Improving forwarding performance
- Traffic Engineering applications
- Building High Available Networks
- Consolidation of Services over a common infrastructure
- Delivering Layer 2 and Layer 3 Services
- Triple Play Solutions
- Building a BGP Free Core

Mod 1, Sec 2: Intro to MPLS – a brief definition of MPLS and provide RFC references.
- Offer a brief definition of MPLS and provide RFC references.
- Introduce the concept of a label.
- Introduce the data plane operation of MPLS (Push, POP, Swap)
- Define the basic terminology used in MPLS (P/PE/CE, LER, LSR, FEC)
- Present the requirements for label signaling protocols in MPLS and relate the LIB/LFIB relationship to the RIB/FIB of IP routing protocols.

Mod 2, Sec 1: MPLS data plane operation
- Explain the MPLS Label Stack Operation
- Explain the MPLS Label structure in detail (label values, EXP, S, TTL fields)
- Explain pipe vs. uniform mode operation with respect to TTL, EXP; the impact to a label stack
- Explain frame vs. cell mode label implementation

Mod 2, Sec 2: MPLS control plane operation
- Explain the requirement for IGP and label distribution protocols.
- Discuss the various label distribution and control and retention modes.
- Introduce the various label space implementation modes.
- Introduce the various MPLS signaling protocols.
- Explain the use of MPLS reserved labels (0-15).
- Explain the Nokia Service Router support for the various presented modes and features.

Mod 3, Sec 1: LDP operation
- Explain the LDP peer discovery and session establishment processes.
- Describe the prerequisites and parameters to establish LDP sessions.
- Investigate the label distribution process for Link LDP and explain how the label databases are populated.

Mod 3, Sec 2: Additional LDP features
- ECMP for LDP
- LDP Export and Import Policy Implementation
- Label Withdraw and Release Actions
- LDP aggregate-prefix-match feature
- Targeted LDP
- LDP Authentication

Mod 4, Sec 1: RSVP control plane operation
- Introduce the Resource Reservation Protocol (RSVP).
- Introduce RSVP with Traffic Engineering (TE) extensions.
- Explain LSP signaling using RSVP.
- Explain RSVP session establishment process for an LSP.
- Introduce RSVP message types to establish or clear LSPs, and to signal error conditions.
- LSP-Ping and LSP-Trace for RSVP-TE based LSPs.

Mod 4, Sec 2: RSVP session refresh optimization
- RSVP-TE Hello Protocol
- Refresh-Time Randomization (RFC 2205 – Section 3.7)
- RSVP Refresh Overhead Reduction
  - Reliable message delivery using MESSAGE-ID and MESSAGE-ACK
  - Summary Refresh messages

Mod 5, Sec 1: MPLS Traffic Engineering Fundamentals
- Review the drivers for Traffic Engineering (TE)
- Discuss the additional information required in TE (administrative constraints).
- Understand how these attributes are signaled via IGP (OSPF and IS-IS TE extensions)
- Discuss the operation of CSPF (Constraint-Based Shortest Path First) algorithm.
- Discuss the use of ERO (Explicit Route Object) for signaling TE-based LSP paths.

<u>Lab Work</u> (weeks 1-4)
In lab:
- Intro to SR OS CLI; hardware provisioning, interfaces, static routing
- IGP (OSPF) configuration
- LDP configuration; ECMP
- Export policies, LDP-shortcuts for IGP forwarding, basic RSVP

Post-lab:
- MyNetworkLab connectivity
- Multi-Area OSPF
- BGP, policies, route redistribution
- LDP for iBGP full-mesh shortcuts; logging facilities