

Test 1: NET3012 – IP Architectures & Solutions

Winter 2017

Time: 60 minutes; Test scored out of: 48 Total Marks available: 53
(Allocation of marks is shown beside each question)

Instructions:

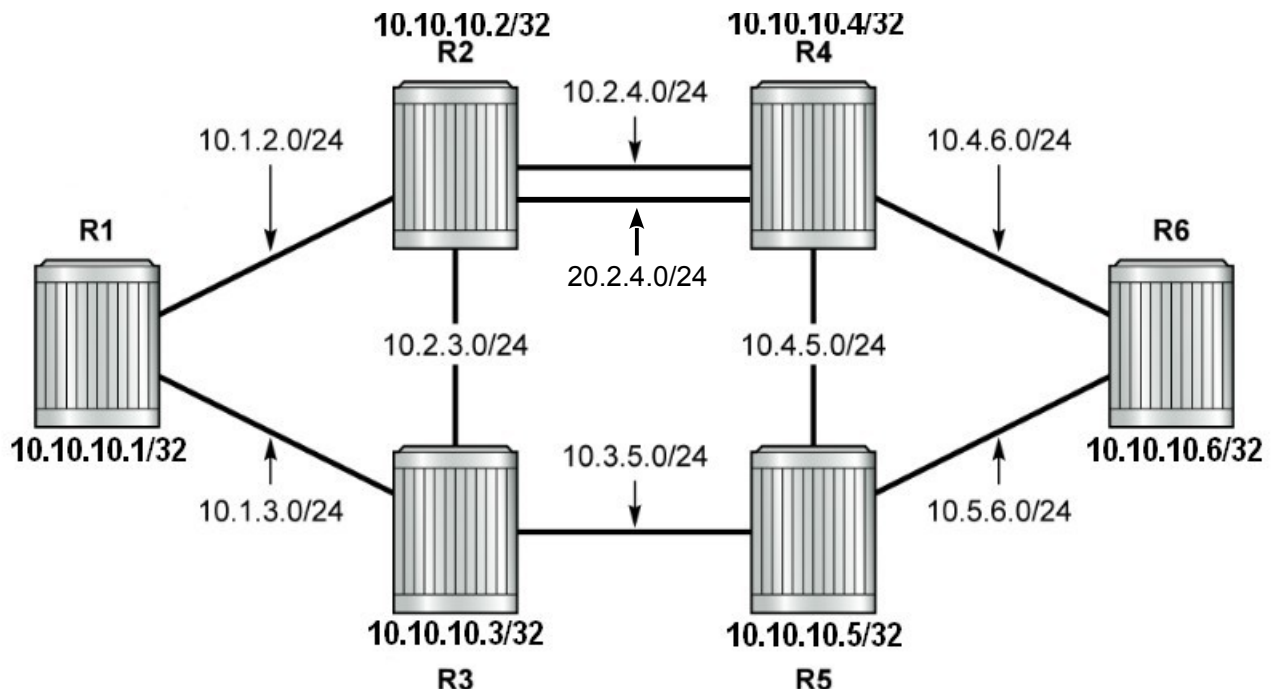
1. **BEFORE** answering any questions, please check that your copy of the test has all pages (as indicated in the footer at the bottom of each page). Please **read all questions** carefully, then answer question 0 first!
2. This is a **closed book** test. No textbooks, notes, electronic devices, or any other aids are permitted.
3. Be sure to carefully examine the reference topology provided below.
4. There's one question where you think you need extra space to answer but you don't.
5. If you are uncertain what a question is asking, make reasonable assumptions, write those assumptions down on this test paper, and continue answering the question.

0. What is your:

NAME? _____

Reference Topology

Use the topology below for questions which refer to R1-R6 but do **not** have a topology diagram. Note that this is similar to the topology used throughout the MPLS courseware and slide decks.



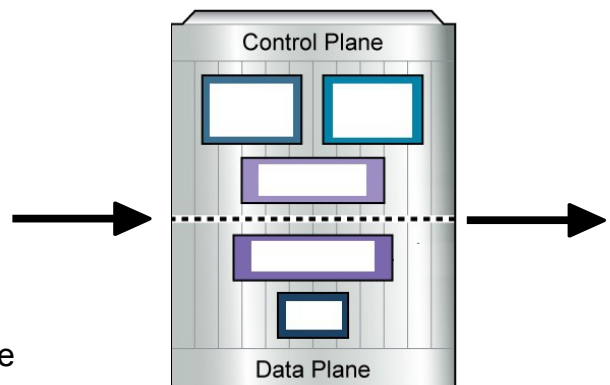
1. [2 marks] Module 1 identified two mechanisms of MPLS that provide High Availability. **Clearly** identify each of the two mechanisms. Hint: this is a repeat from a previous midterm except the wording has been changed slightly. Ref: slide 15.

2. [2 marks] Module 1 says that MPLS can help solve the problem of hyper-aggregation. From amongst the various forms of MPLS protocols that we've studied, **clearly** identify all that are suitable for reducing or eliminating hyper-aggregation and **why**.

3. [2 marks] Draw a **clear** sketch of an MPLS header. Be sure to identify the name and size/length of each field.

4. [1 mark] Explain **clearly** why LDP would be used for implementing a BGP-free core rather than RSVP.

5. A. [1 mark] In the diagram on the right shows an MPLS router. **Clearly** identify (eg. name) all the most important data tables that are maintained (i.e. via dynamic protocols).
 B. [1 mark] Assume the router is a "P" router. **Clearly** illustrate which tables are involved in forwarding an MPLS packet through the router. (One way to illustrate is to mark-up the diagram similar to the way it was originally marked up in the slide deck!)



6. Carefully examine the output of "show router ldp bindings active" below.

```
# show router ldp bindings active
```

Prefix	Op	IngLbl	EgrLbl	EgrIntf/LspId	EgrNextHop
10.10.10.1/32	Push	--	131070	1/1/3	
10.10.10.1/32	Swap	131067	131070	1/1/3	
10.10.10.2/32	Push	--	131071	1/1/4	
10.10.10.2/32	Swap	131071	131071	1/1/4	
10.10.10.3/32	Push	--	131071	1/1/3	
10.10.10.3/32	Swap	131069	131071	1/1/3	
10.10.10.4/32	Push	--	131068	1/1/4	
10.10.10.4/32	Swap	131068	131068	1/1/4	
10.10.10.5/32	Pop	131070	--	--	
10.10.10.6/32	Push	--	131068	1/1/3	
10.10.10.6/32	Swap	131066	131068	1/1/3	

A. [1 mark] On which router was this command executed?

B. [1 mark] Explain **clearly** why? i.e. Justify your answer.

C. [1 mark] There are **no** repeated numbers showing in the IngLbl column. Explain **clearly** whether this must always be the case or whether there could be repeats.

D. [1 mark] In the EgrLbl column there are repeats of pairs of labels with identical values. Explain **clearly** whether this must always be the case or whether there could be *no* repeats.

E. [2 marks] The listing has been edited for this test. Were the entries in the EgrLbl column changed in a way that results in two (or more) LSPs that merge together into one (ie. labels having the same value)? Explain **clearly** why or why not.

7. [2 marks] **Clearly** explain the **difference** between "per platform" and "per interface" LDP label spaces, and give **examples** of where each is used.
8. [4 marks] Assume a service provider's network consists of 3 routers organized in a simple chain. **Clearly** explain the effects on the IP TTL field in a customer's packet when traversing an ePipe service operating in:
- A. pipe mode
 - B. uniform mode
 - C. What exact protocol would be used to signal the service labels for the above ePipe?
 - D. **Clearly** explain which label(s) would have the S bit set to 1. (A conceptual answer is sufficient for this question.)
9. [3 marks] This question refers to **LDP** configured in the reference topology (cover page)
- A. How many LDP sessions exist between each pair of routers? (Assume all interfaces are suitably and correctly configured for LDP.)
 - B. Now, go back and re-examine R2 & R4. Does your answer change? **Clearly** explain why or why not; include references to specific fields or parameters in your answer.

10. [3 marks]

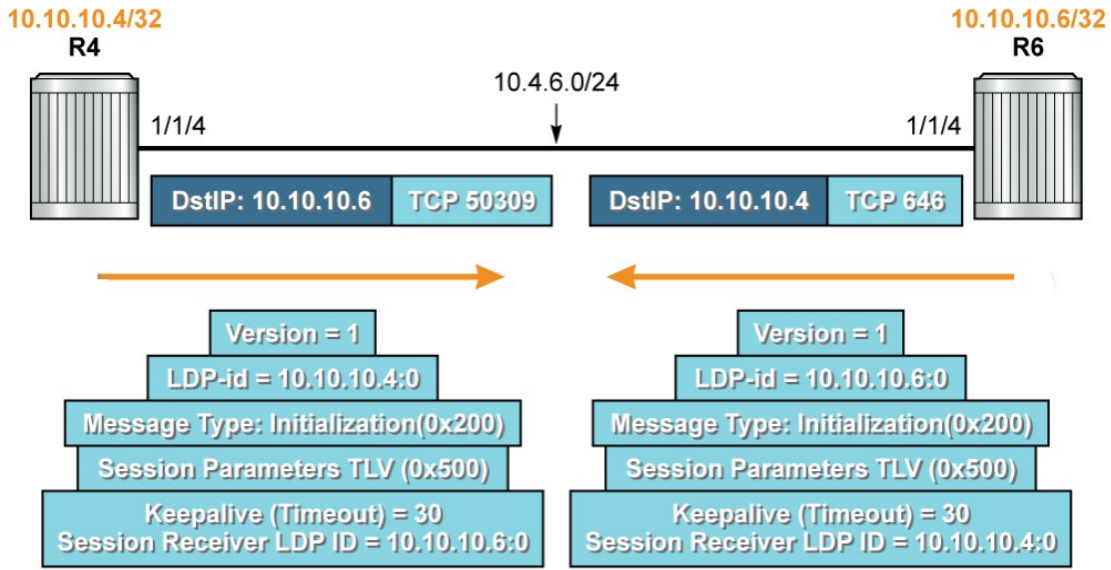
A. Similar to STP bridge ID and port ID, "LDP ID" is a two-part field. Draw a diagram of the complete field, **clearly** identifying the source and length (in bytes) of each part.

B. Give example values for **both** parts (i.e. for a Nokia 7750 router running SR OS).

11. [5 marks] **Clearly** define the difference between "explicit NULL" and "implicit NULL" labels by describing how each one works. Be sure to include **why** these labels are used!

B. Give the specific value for each of these labels.

12. [6 marks] Carefully examine the diagram below of two routers exchanging messages.



A. **Clearly** identify what kind of messages these are.

B1. Which router *initiated* this exchange of messages?

B2. *Why* (how) was that router chosen to initiate the exchange?

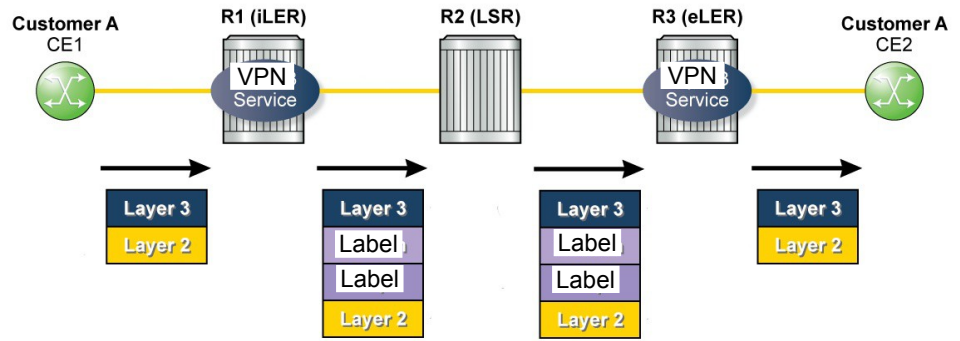
C. What is the L4 transport protocol used for these messages?

D1. What kind/which messages use the *other* L4 transport protocol?

D2. For messages that use the *other* L4 transport protocol, what is the destination port?

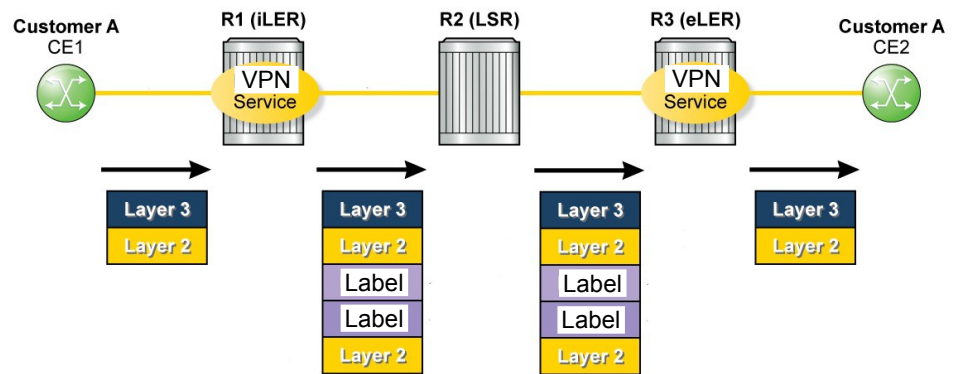
13. [2 marks] When testing an LSP, the test request travels via the LSP and the response returns via the IGP. **Clearly** explain why logically this must be the case for how it works.

14. [8 marks] Carefully examine the diagrams below, showing a pair of MPLS services between the same two locations (e.g. Toronto and Vancouver).



Transport=?

Service=?



Transport=?

Service=?

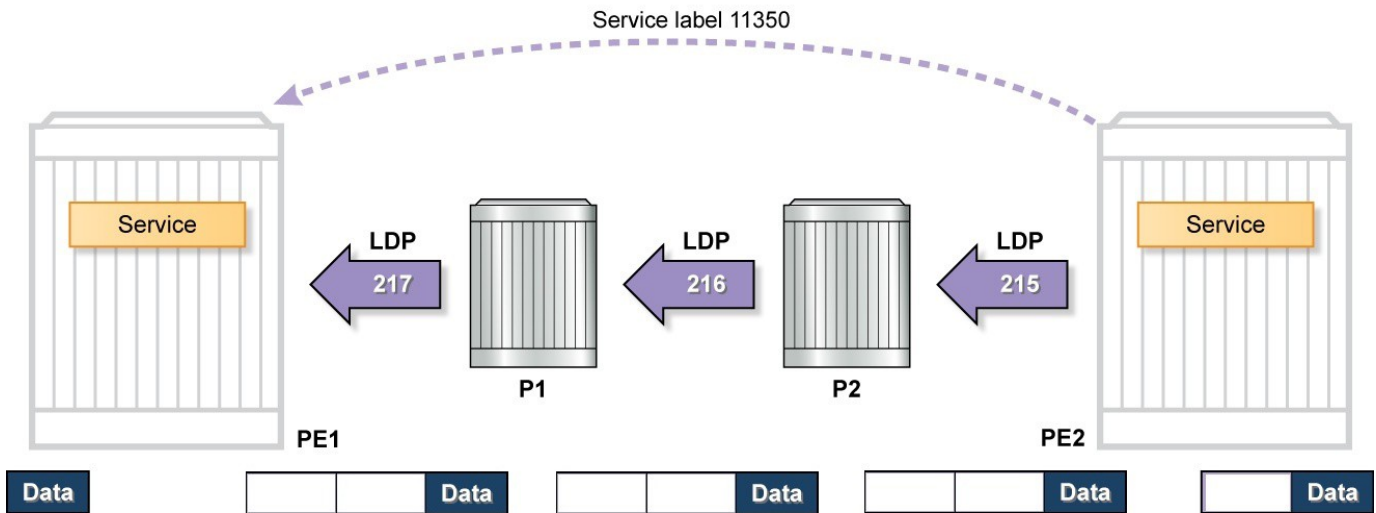
A. Draw lines that connect **labels** with identical values, and write "unique" beside all others. Think carefully before you start drawing!

B. Draw lines that connect identical **L2 headers**, and write "unique" beside the others.

C. Complete the diagram by filling in **all** possible protocols which could have been used to exchange service and transport labels.

D. Which service(s) above, if either, would always leave the customer TTL unchanged (regardless of whether pipe or uniform mode was used)?

15. Carefully examine and then complete the diagram below.



- A. [2 marks] **Clearly** label the diagram to indicate the label values for each PDU.
- B. [1 mark; all-or-nothing] Draw two arrows to indicate the direction of the Control Plane flow and the Data Plane flow.
- C. [2 marks; Bonus] Based on your knowledge of label ranges:
 Is 11350 a valid value for service label?
 Are labels 215-217 valid values for LDP?
 Are labels 215-217 valid values for LSPs?

Extra Work