

Test 2: NET3012 – IP Architectures & Solutions

Winter 2019

MPLS Modules 1-5; SA Module 1, Module 2 (SAPs), Module 3 sections 1-2 (VPLS)

Time: 60 minutes Test scored out of: 50 Total Marks available: 59

Instructions:

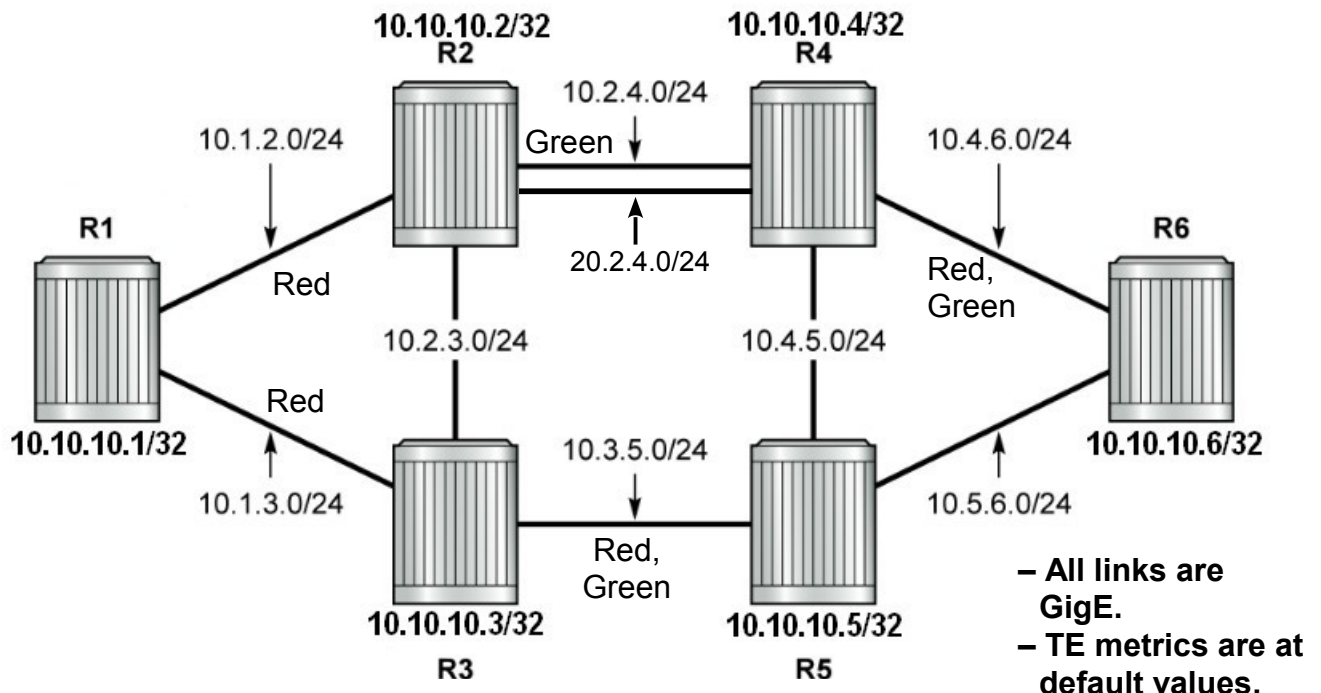
1. **BEFORE** answering any questions, please check that your copy of the test has all pages (as indicated in the footer at the bottom of each page). Please **read all questions** carefully, then answer question 0 first!
2. This is a **closed book** test. No textbooks, notes, electronic devices, or any other aids are permitted.
3. When the marks for a question are not shown, the question is worth 1 mark.
4. 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 the standard topology we have been using throughout the course.



1. [1 mark] How many SDPs in total need to be configured on a local ePipe service?
How many SAPs in total need to be configured for a local ePipe service?
Give exact numbers. (Adapted from end-of-chapter review question; SA mod 1, p 92)

2. [2 marks] Based on best practice, place the correct letter on each line: (SA mod 1, p 93)
SAP ID ___ a. Local significance
SDP ID ___ b. Global significance
VC ID ___ c. Point-to-point significance
Service ID _____

3. A. [2 marks] **Clearly** define the difference between "explicit NULL" and "implicit NULL" labels by describing how each one works.
(Each definition requires: sender; recipient; reason/action/effect.)

B. [1 mark] **Clearly** explain **why** these labels are used!

C. [1 mark; all-or-nothing] Give the specific value for each of these labels.

4. [8 marks] Study the reference topology on the cover page. All configured TE attributes are shown on the topology. In this question, you are **not** allowed to change any attributes.
- A. Use correct CLI syntax to write a definition for an LSP R1 → R6 which avoids R2. (Syntax need not be absolutely perfect.) Use whichever TE method/attributes you'd like.

B. Use correct CLI syntax to write a definition for an LSP R1 → R6 which passes through at least one of the top routers (R2, R4) and at least one of the bottom routers (R3, R5). (Syntax need not be absolutely perfect.) You may **not** use any criteria which are configured in the CLI "path ..." context.

C. **Clearly** explain the resulting status of an LSP R1 → R6 that uses the single TE spec:

(i) includes Blue

(ii) excludes Blue?

D. [2 marks] For part A above, what message(s) would be sent if an LSP R1→R6 was up/up and the link 10.3.5.0/24 went down? Assume both R3 and R5 detect the failure. **Draw** and **label** the messages **clearly** on the cover page!! [Ref: MPLS slide 4-35]

5. [2 marks] Study the reference topology on the cover page and think about the goals of traffic engineering.
- We need two LSPs R1→R2→R4→R6: one for **\$\$\$ clients** and one for **low-cost clients**
 - In the event of a failure of either link R2→R4, the \$\$\$ LSP must continue to be up/up.
 - In the event of a failure of the top link, the low-cost LSP should go down so that low-cost clients don't congest the remaining link for the \$\$\$ clients.

Clearly describe how to define each of the two LSPs. (No CLI is necessary.)

6. A. [1 mark] There is a specific technical term for the traffic flooded in a VPLS. **Clearly** define the term and **clearly** identify the kind(s) of traffic to which it applies.

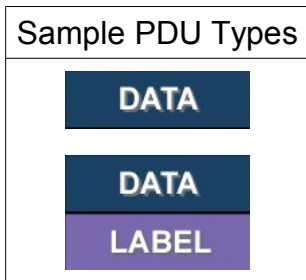
B. [2 marks] **Clearly** state the set of three (3) flooding rules for VPLS components.

C. [2 marks] Compare the flooding of traffic (as identified in part B) in a Cisco 3560 vs a VPLS. State whether it is identical or not, and **clearly** explain why or why not.

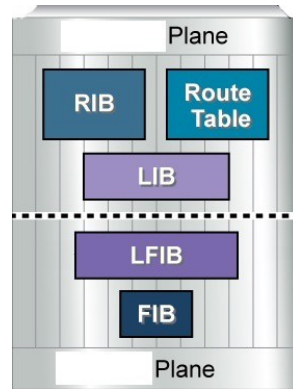
7. A. [6 marks] Imagine three routers which implement a Label Switched Path.

Use the diagrams of the routers provided below to:

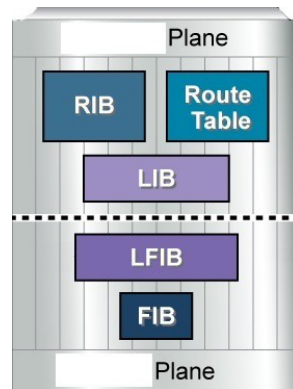
- clearly identify which *type of PDU* ingresses and which *type of PDU* egresses (i.e. re-draw them at each location where they should be!)
- clearly illustrate the flow of the frame *through* the router (i.e. which tables are used to process the frame), according to the role labeled for each router. (Ref: Mod 1.39-40)



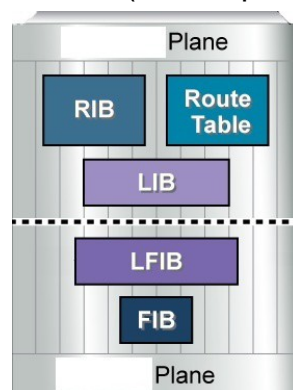
LSR (Label op = _____)



eLER (Label op = _____)



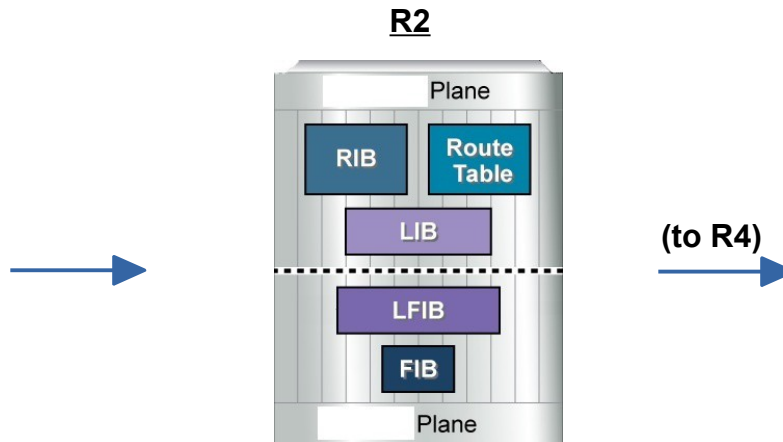
iLER (Label op = _____)



B. [2 marks] Next, clearly label the different **planes** for each of the three types of routers.

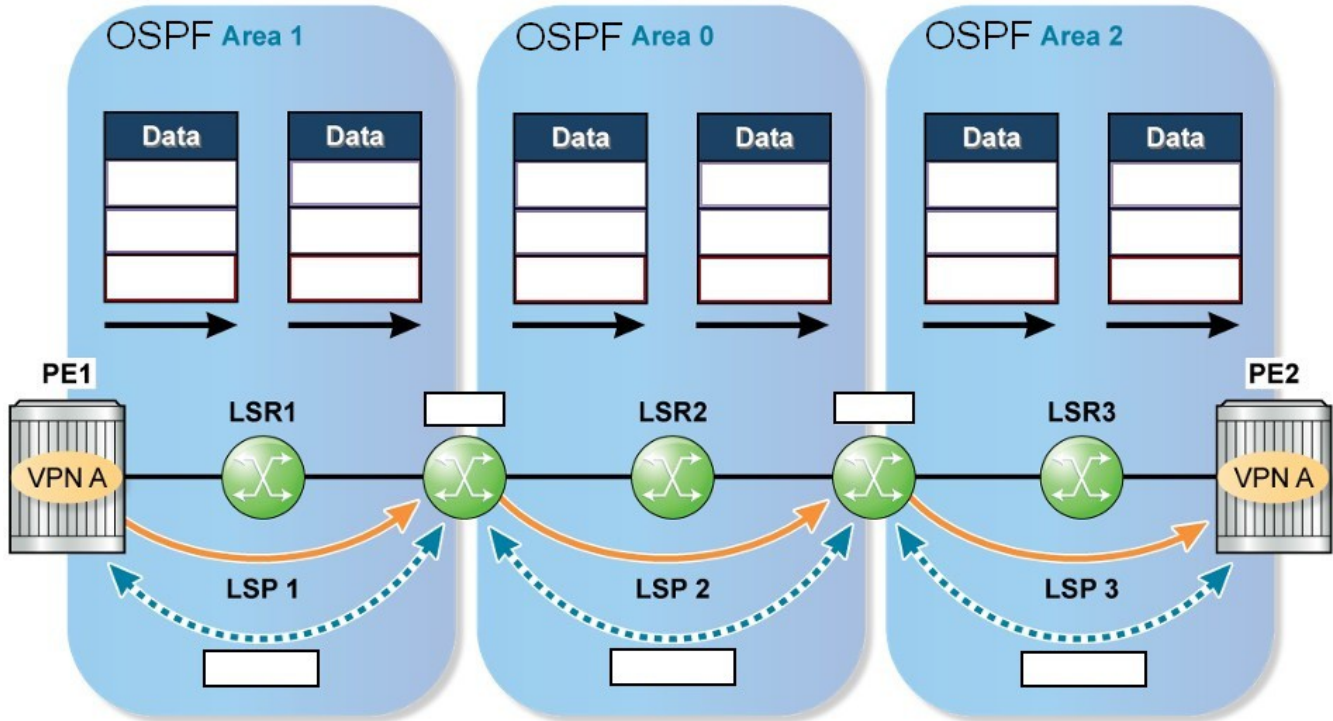
C. [1 mark] Lastly, clearly label the type of label operation that's occurring at each router.

8. A. [2 marks] Similar to the previous question, clearly identify the flow of a ***PATH message*** through a MPLS router. Ref: Module 4.18, 20, 21



- B. [2 marks] Assuming the ***PATH message*** is sent by **R1 to R6**:
- draw a simple sketch of the ingress packet and egress packet in the correct locations;
 - clearly** identify actual values of key fields (and any important options) in the IP header, and any label values (if appropriate).
9. Given user data with an inner tag of 15 and an outer tag of 30, write the definition for:
- A. [1 mark] a fully service-delimiting QinQ SAP on port 1/1/1
- B. [1 mark] a wildcard SAP on port 1/1/1.
10. [2 marks] **Clearly** explain each of the two "Router Alert" options we've covered:
- A. What purpose or use do they serve?
- B. In which data field or header are these options? If we've seen actual value(s), what are they?

11. [9 marks] Carefully study the diagram below which illustrates an Epipe deployed with LDP over RSVP. [MPLS slide 5.151]



A. For each of the seven routers, **clearly** identify the protocols which have been configured. (Use the space immediately above this question.) If LDP is used, be specific about the type. Don't forget, it's an Epipe deployed with LDP over RSVP.

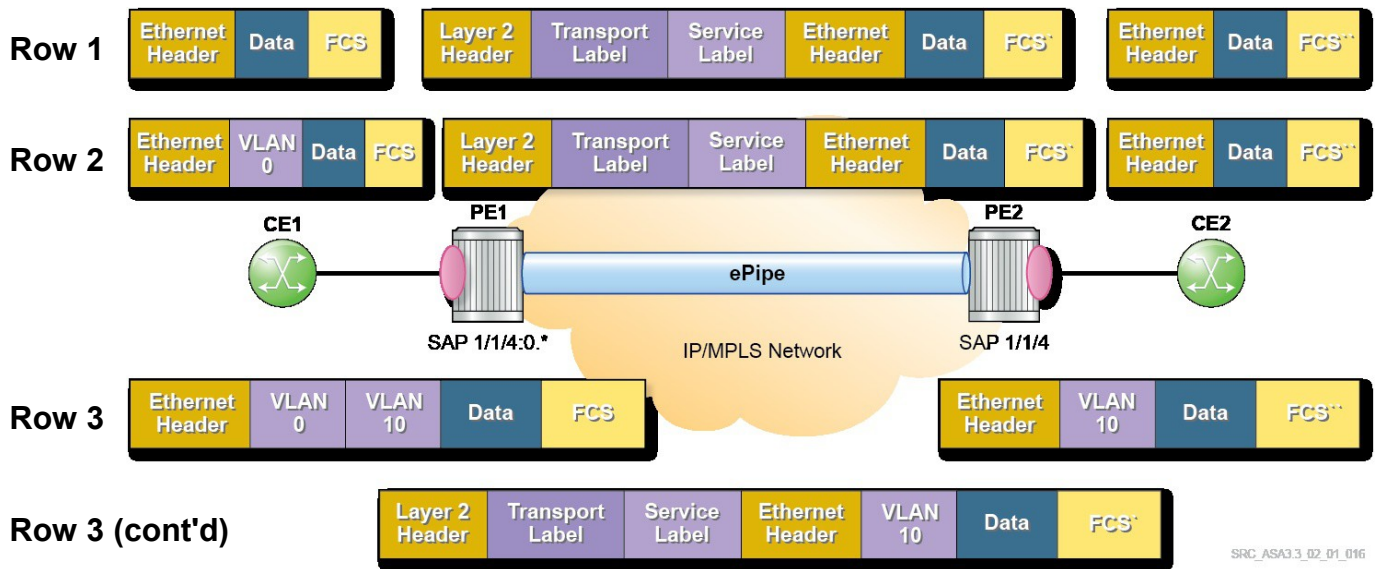
B. Assuming that data flows in one direction only, which protocol is responsible for each of the arrows appearing below the routers? Again, **label** the diagram.

C. Two routers in the diagram are unlabeled. Add appropriate labels based on an important role that they serve. Hint: LSR is not the required answer.

D. The top of the diagram shows a label stack. Fill in example label values (so that it's clear when label values are identical and when they are different!)

E. **Clearly** explain why LDP-over-RSVP is useful / necessary?

12. Carefully study the diagram below which illustrates a VPN service. [Ref: SA slide 2.14]



A. [1 mark] For Row 1: the leading field is labeled either "Ethernet Header" or "Layer 2 Header" **Clearly** explain the difference, if any, between the two.

B. [2 marks] For Row 1: I grabbed a wireshark capture of frames on the left side, and then frames in the middle. Unfortunately I got the captures mixed up immediately afterwards. **Clearly** explain how I can determine which is which using only the info from the leading field (i.e. 1st Header). **N.B.** Part B is looking for a different answer/info than Part A.

C1. For Row 1: Examine the FCS fields carefully.
 – [0 marks] Yes/no: Are the markings correct? (Either no "*", 1 "*", or 2 "**")
 – [2 marks] **Clearly** explain and justify your answer.

C2. [2 marks] Repeat your analysis of the FCS for Rows 2 and 3.

D. [1 mark] **Clearly** identify the type of service pictured above. It is a: _____

F. [1 mark] If I changed the SAP definition on PE2 to **sap 1/1/4:*** would the service still work as pictured? Explain **clearly** why or why not.

13. [2 marks] Identify something *important* that you learned during the field-trip to Alcatel-Lucent. You must also explain **clearly** *why* it is important! (Continue last page if you need more space.)

Extra Work