Test 2: NET3012 – IP Architectures & Solutions
Winter 2016
MPLS Modules 1-5; SA Module 1, Module 2 section1

Time: 60 minutes; Test scored out of: 47   Total Marks available: 52
(Allocation of marks is shown beside each question)


Instructions:

1. <u>BEFORE</u> 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. Multiple choice questions are worth 1 mark unless otherwise noted.

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?   <u>Answers</u>

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.
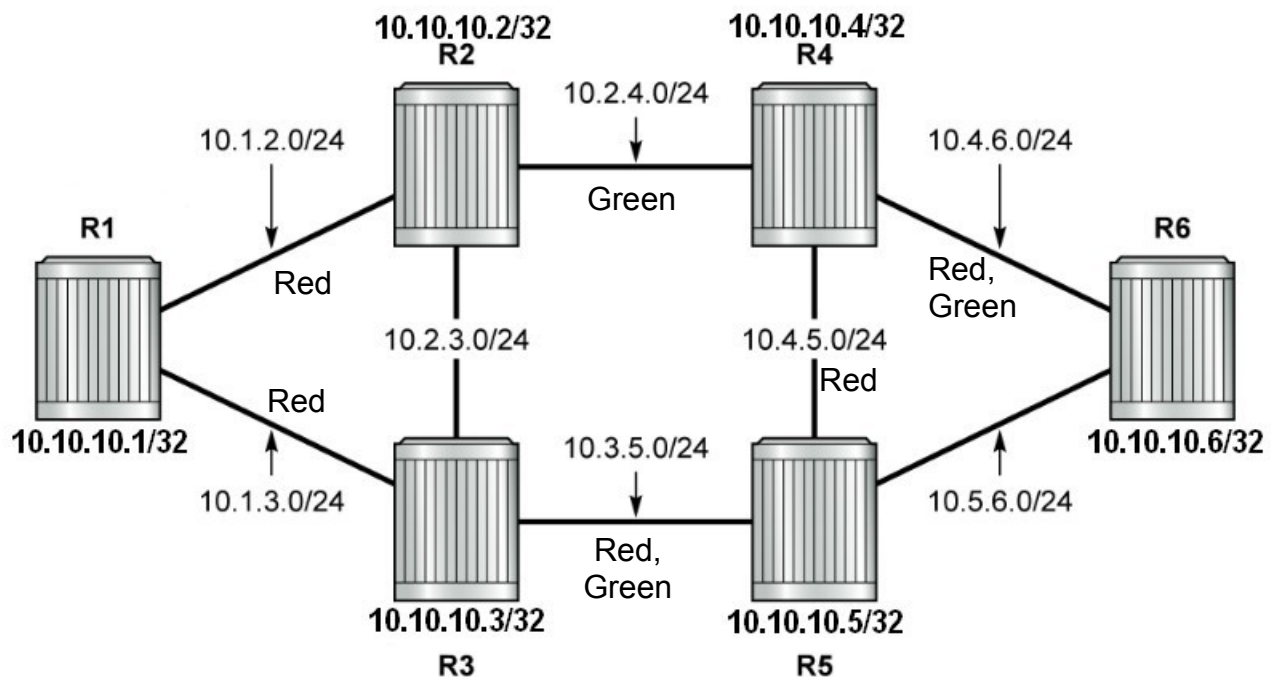
1. What is the maximum rate at which an interface can be oversubscribed to actual bandwidth on an Alcatel-Lucent 7750 SR? (Hint: this value is typical of most similar equipment.)
   A. 50%
   B. 100%
   C. 1,000%   **Correct**
   D. 10,000%
   E. There is no oversubscription limit.

2. Which statement is correct regarding constraint-based routing?
   A. TE-LSPs always follow the best IGP route.
   B. LDP is commonly used for constraint-based routing applications.
   C. Constraint-based routing can be used to provide QoS functions in the data plane.
   D. The route for a TE-LSP is calculated at the head end router.   **Correct**
   E. None of the above statements are correct

3. Which statement is incorrect regarding CSPF calculations?
   A. The router doing the CSPF calculation puts itself as the root of the SPF tree.
   B. CSPF calculations are performed on the TED.
   C. Traffic engineering metrics are stored in the LSDB.   **Correct**
   D. Hop count can be used as a constraint for a TE-LSP.
   E. All of the above statements are correct.

4. Which of the following attributes is **not** carried in link-state packets for Traffic Engineering?
   A. Maximum bandwidth
   B. IGP metric   **Correct**
   C. Administrative groups
   D. Unreserved bandwidth
   E. Maximum reservable bandwidth
   F. All of the above parameters are carried in link-state packets.

5. If an opaque-capable but non-TE–capable OSPF router in an area receives a traffic engineering LSA, what actions will it take?
   A. It will flood the LSA.   **Correct**
   B. It will silently discard the LSA.
   C. It will discard the LSA and send an error to the originating router.
   D. It will discard the LSA and send an error to the router from which it received the LSA.
   E. It will not take any of the above actions.

6. Which of the following statements about the OSPF-TE Type 10 LSA is **incorrect**?
   A. The Type 10 LSA has two subtypes.
   B. The subtype 1 of the Type 10 LSA contains the router's IP address.
   C. The subtype 2 of the Type 10 LSA contains TE information for all links on the router. **Y**
   D. Each Type 10 LSA only contains one subtype.
   E. All of the statements are correct.

7. [2 marks] **Clearly** explain the basic principles and operation of how CSPF identifies a path which satisfies all the configured constraints.

    1. CSPF (temporarily) eliminates all links in the database which don't meet constraints
    2. CSPF runs the normal SPF algorithm to find an optimal route (if one exists)

8. [4 marks] One of the uses for MPLS is 6PE. To successfully implement 6PE in lab work, two different export policies were required.
   – Write out each of the 2 policies, including the exact context where they would be applied
   – Spelling and syntax need *not* be perfect, but your answer must be unambigous and show a clear understanding.

```
policy statement OSPFv3-Routes          policy statement BGP-Routes
entry 10                                entry 10
   from protocol ospf3                     from protocol bgp
   action accept                           action accept
exit                                    exit

configure router bgp group xxx          configure router ospf3
   export OSPFv3-Routes                    export BGP-Routes
```

9. [3 marks] **Clearly** explain the specifics of the MPLS configuration required to create an end-to-end Traffic Engineered LSP across a multi-area IGP.

    – Within each area, must have **bi-directional** RSVP LSPs configured between ABRs
    – Within each area, must have **bi-directional** T-LDP sessions between ABRs
    – Must enable *ldp-over-rsvp* (in the IGP context e.g. OSPF)

10. **Clearly** explain:
   A. [1 mark] What is the ERO (in an MPLS context)

    ERO = Explicit Route Object; used in an RSVP PATH msg to dictate the LSP path

   B. [2 marks] What two sources may be used to build / populate it

    ERO is entirely built by CSPF (if it's enabled);
    otherwise the ERO is populated with any loose/strict hops in the LSP-path definition
    otherwise it is empty

   C. [1 mark] Whether it is used with LDP, RSVP, or both?

    Only used by RSVP

11. [4 marks] Carefully examine the reference topology on the front cover. What are all the possible LSP paths, if any, for a primary path from R1 to R6 with the criteria:

A. include Green: None

B. exclude Green: None

C. include Red   R1-R3-R5-R4-R6

D. include Green *and* include Red   None

12. A. [1 mark] **Clearly** explain the difference between a *local* service and a *distributed* service. Where appropriate, your explanation *must* refer to service components from the diagram in Question 19. (It may be convenient to use an epipe as an example.)

    A *local* service only has SAPs for connectivity with the CE.
    The definition of a *distributed* service is that it includes SDP(s).

B. [1 mark] **In total**, how many SAPs are in an epipe service that is (a) local; (b) distributed?

    Always exactly 2 regardless of local or distributed
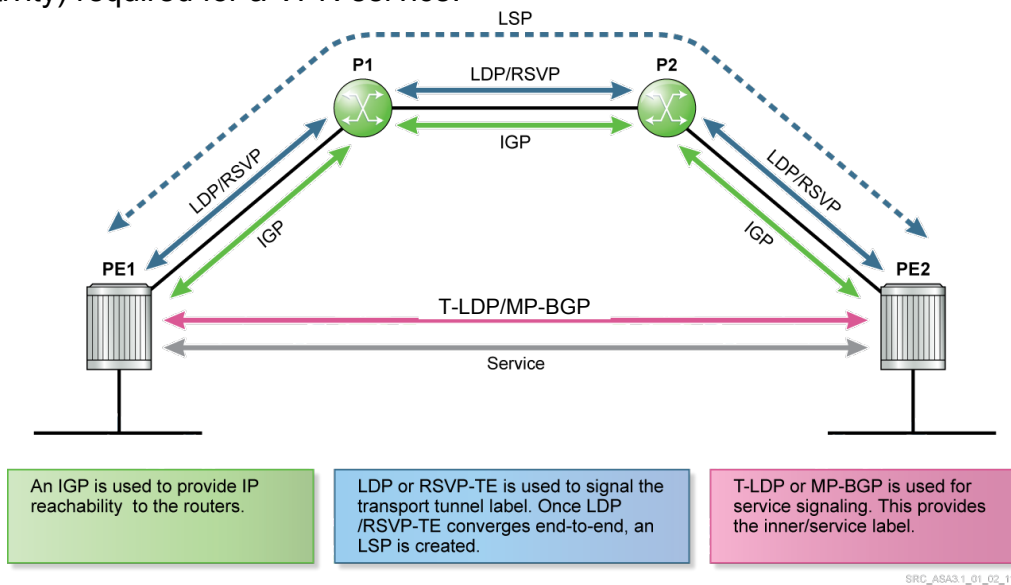
13. Carefully examine the diagram below.
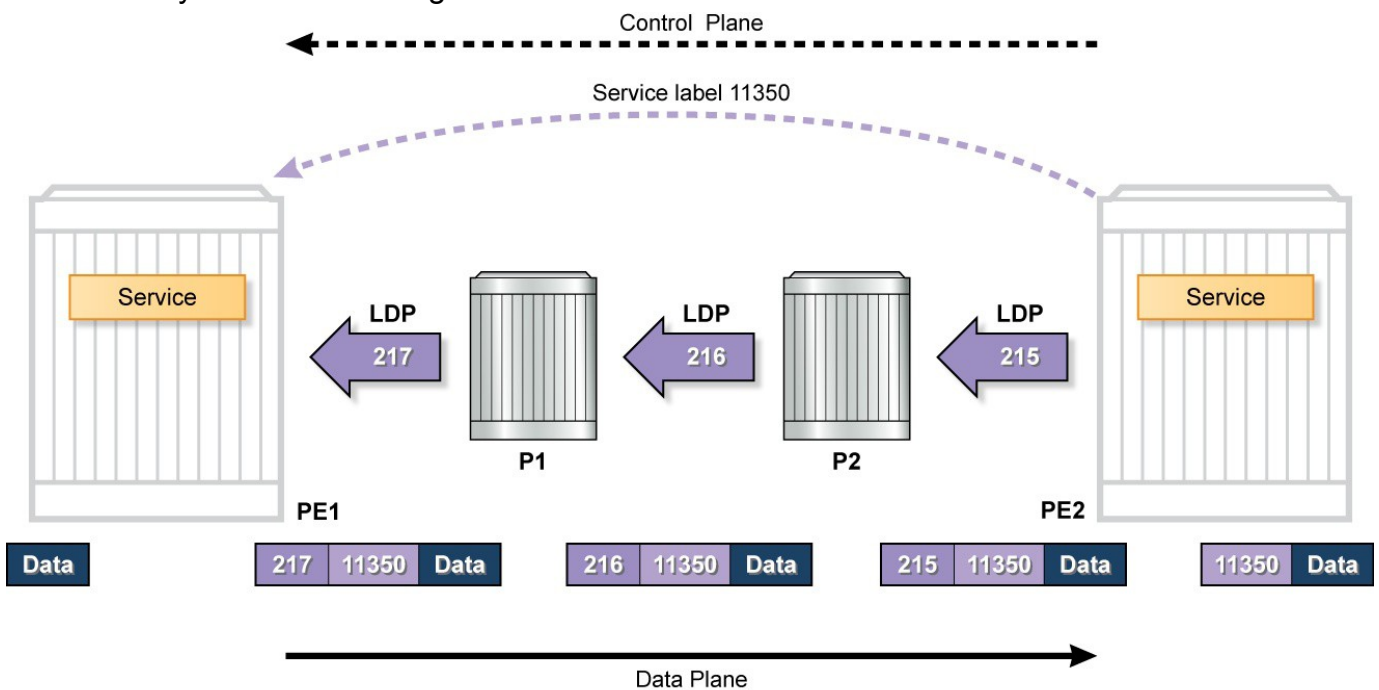
A. [2 marks] **Clearly** label the diagram to indicate the label values for each PDU.
B. [1 mark]   Identify the type of VPN service *and* explain your reasoning. If there is insufficient info, say "unknown".

    unknown: no real details on how the customer data is treated.

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14. [5 marks] Complete the following chart by providing the correct SAP definitions.
    – Assume the port is 1/2/3
    – Assume the inner tag is 10 and the outer tag is 20
    – Enter "DNE" if the particular definition *Does Not Exist* for a SAP

SAP type	Encapsulation type		
	Null [**1 mark**]	Dot1q [**2 marks**]	QinQ [**2 marks**]
default	1/2/3	1/2/3:*	DNE
fixed	DNE	1/2/3:10	1/2/3:20.10
null	DNE	1/2/3:0	1/2/3:0.*
null-bottom	DNE	DNE	1/2/3:20.0
wildcard	DNE	DNE	1/2/3:20.*

15. [3 marks] Carefully examine the diagram below which shows supporting infrastructure (i.e. connectivity) required for a VPN service.

Clearly label the diagram with the connectivity *type* provided by each of the 5 sets of lines

16. [1mark] Fill in the blank: A SAP can only be configured on a port which has been configured as an ___**access**___ port.   Ref: SA 1-81.

17. [2 marks] Carefully examine the reference topology. Give an MPLS path definition on R1 that ends at R6, that includes exactly two loose hops and exactly two strict hops.

    Any valid path definition that meets the criteria is acceptable.
    Note that hop destination addresses may be either system or link addresses;
    and that the destination (R6) may be included as one of the hops.

18. A. [2 marks] What is the correct many-to-one question (or are both valid)? What is the correct answer to all these questions?
    How many SAPs can be in a service? How many services can be in a SAP?

    Both are valid: many ("unlimited") SAPs per service, but exactly one service per SAP

    B. [2 marks] What is the correct many-to-one question (or are both valid)? What is the correct answer to each of these questions?
    How many SDPs can be in a service? How many services can be in a SDP?

    Both valid: many ("unlimited") SDPs per service, and many (unlimited) services per SDP

19. Carefully examine the diagram below which illustrates a service topology.
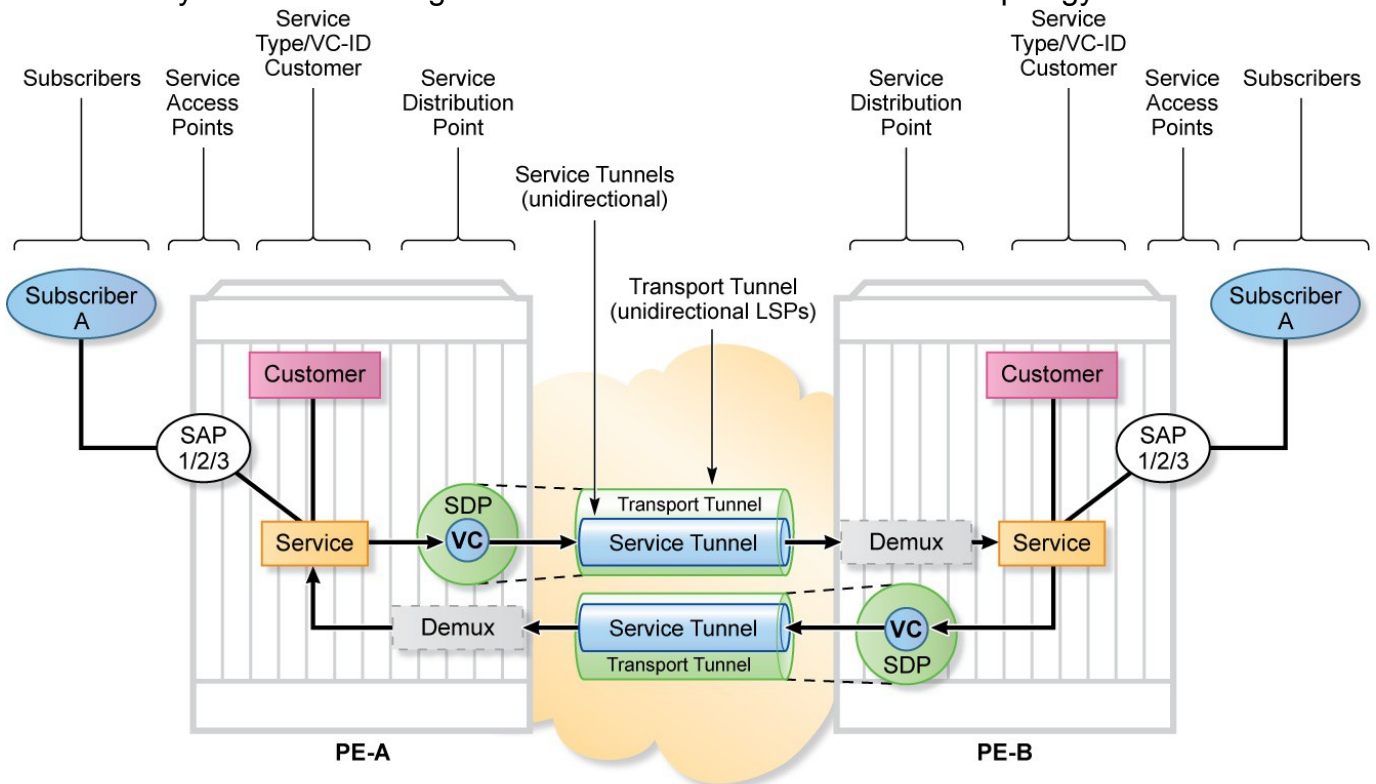
A. [4 marks] **Clearly** label the diagram to identify each component in a complete service. Most labelling can be done at the top of the diagram, but some will need to be written in the spaces that have been blanked out.

B. [1 mark] **Clearly** identify the one component which **must** be identical end-to-end and *should* be globally unique.

    VC-ID, otherwise the service will stay operationally *down*

C. [1 mark] It is **highly recommended** to make at least two other components globally unique. **Clearly** identify these two.

    The customer ID and service ID *should* be unique for ease of mgmt & troubleshooting

20. [2 marks] Assume the reference topology shown on the front cover is configured to provide a L3 VPN service from R1 to R6. Draw a **clear** diagram showing the frame containing customer data as it is traversing the link from R1-R2. Identify **all** fields and include their length (when known).

L2 header	Transport Label	Service Label	Customer L3 header	Customer Packet
14 Bytes	4 Bytes	4 Bytes	20 Bytes	(additional Bytes)

21. [1 mark] **Clearly** describe the thing that interested and impressed you the most during the field trip to Nokia's Kanata campus, and explain _why_. Be **specific**!
As an alternative question, you can answer any of the questions that was on field trip questionnaire (published on the course site).

    Any valid answer that is clear and specific is acceptable.

  By far, the most common answer (and thus presumably the most impressive aspect) was the extent to which virtualization had taken hold of the deployment and daily operations of the company. Virtualization is _heavily_ used for simulating and testing all products produced at the Kanata campus.

Extra Work