Test 2: NET3012 – IP Architectures & Solutions
Winter 2014

Time: 50 minutes; Test scored out of: 43   Total Marks available: 46
(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. 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?   __Answers_____

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.
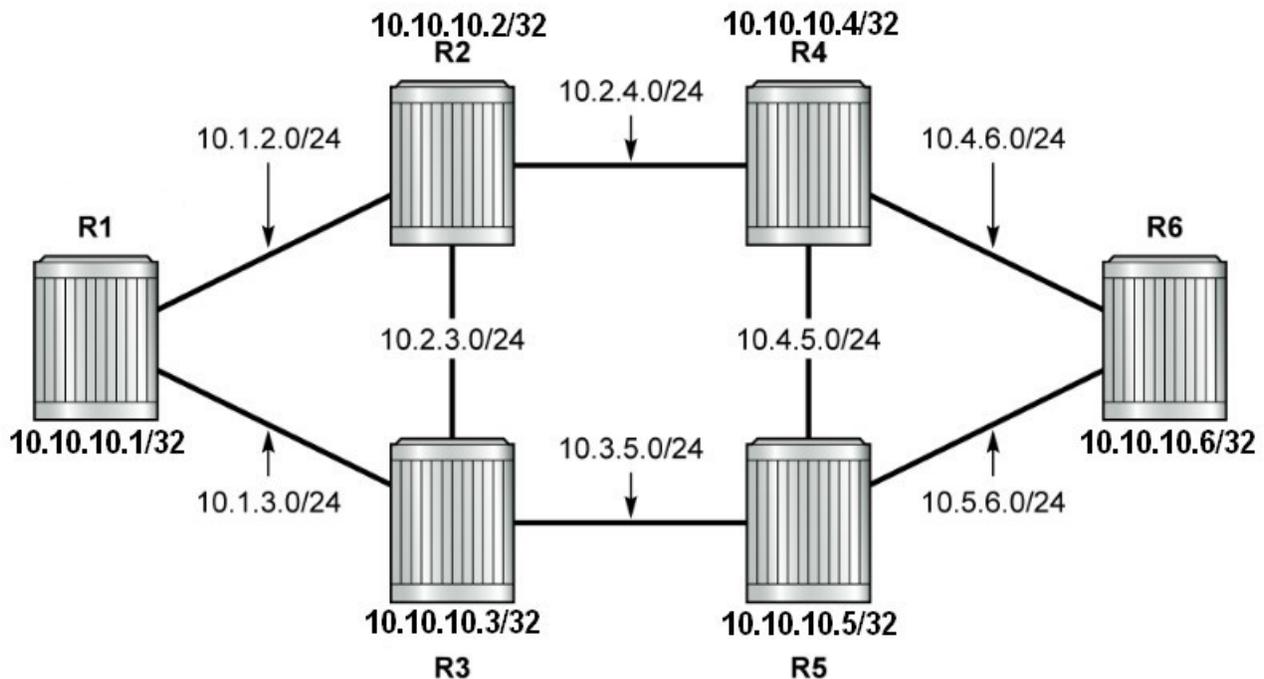
1. [1 mark] What is the *one* parameter for RSVP path selection that is included in the "path" specification?

> loose / strict hop specification

2. [5 marks] Name and **clearly** describe five (5) other parameters which can be used for Traffic Engineering.

> bandwidth, # of hops, link colouring, TE metrics, SRLG + descriptions of each
> Definitions for each can be found in the MPLS courseware.

3. [1 mark] Which of the above five parameters can also be used for path selection with LDP?

> None – that's why RSVP is used / necessary! @@@@ Double-check hop-count! @@

4. [1 mark] When explicit routing is used for path selection, what mechanism (or object) does RSVP use to communicate the path to downstream routers?

> Explicit Route Object (ERO)

5. [1 mark] What parameter must be specified/configured for TE parameters to actually be used in determining the LSP path?

> CSPF

6. [3 marks] Refer to the topology diagram on the cover page. For each of the following path specifications, indicate whether or not an LSP **from R1 to R6** can be successfully created using that path as the *primary*. For any that fail, identify the specific node at which it fails.

path "test2Q6A"
  hop 10 10.10.10.3 strict
  no shutdown
exit
	path "test2Q6B"
	  hop 10 10.10.10.4 strict
	  hop 20 10.10.10.6 strict
	  no shutdown
	exit
		path "test2Q6C"
		  hop 10 10.10.10.2 strict
		  hop 20 10.2.4.4 strict
		  hop 30 10.4.6.6 strict
		  no shutdown
		exit

OK: no need for all hops to be identified	**Fail**: missing R2!	**OK**: can specify either system IP or IP at opposite end of link

7. [1 marks] Refer to the topology diagram on the cover page. Give the loose / strict path specification for an LSP from R1 to R6 which goes:
   always from R1 to R3, then any way to R5, and then directly to R6.

   hop 10 10.10.10.3 strict;   hop 20 10.10.10.5 loose;   hop 30 10.10.10.6 strict

8. [3 marks] Prove that you know your troubleshooting tools! Name and **clearly** describe at least three different types of "ping" that could be used in verifying an ePipe service (or a VPLS if you wish). Note that for full marks:
   – the description must indicate whether the ping is a uni- or bi-directional test at that level;
   – you must list your answers in order according to the level of functionality which they test.

   oam lsp-ping (uni), oam sdp-ping (uni), oam svc-ping (*), cpe-ping ("bi"), ping (bi)
   * svc-ping uses parameters to determine which outbound / return method to use

9. A. [1 mark] This course covers at least four types of ping commands, but only one MPLS related "xxx-trace" command? What is that command? Hint: It was covered in both theory and lab work.

   oam lsp-trace

   B. [1 mark] Referring to TE, clearly explain how the "xxx-trace" command can help humans understand what is happening.

   Any of the TE constraints may cause the LSP to take an unanticipated path
   LSP path changes may be necessary as a result of links or nodes going down.
   In the MPLS Ch 6, we'll also see how secondary paths and FRR affect the LSP path

10. [1 mark] By what mechanism are TE properties propagated through an OSPF network?

   Opaque or type 10 LSAs

11. [1 mark] **Clearly** identify any restriction(s) on the propagation of TE properties in a network.

   Intra-area only
   Another acceptable restriction is that routers must be configured for Opaque support

12. [1 mark] Other than OSPF, what other routing protocol is capable of carrying TE properties? (Or, equivalently, identify at least 3 other routing protocols that can **not** propagate TE info.)

   ISIS works;   RIP, BGP, EIGRP don't work

13. [1 mark] **Clearly** describe the default mechanism that RSVP uses as a "keep-alive" for the LSPs that it creates.

    Path/Resv messages, identical to those originally sent to create the LSP.

14. [1 mark] **Clearly** explain the purpose of the command: "tools perform router mpls cspf …"

    Allows a dynamic query of the opaque-database; for checking if a path is possible
    The command is for *informational* purposes only, and does *not* "enable" anything!

15. [1 mark] **Clearly** explain who or what is TED, in the context of this course.

    Traffic **E**ngineering **D**atabase, ie. opaque-database in sh router ospf opaque-database
    (It turns out that Ted is *not* the name of the guy on the cover of the courseware.)

16. [3 marks] In the output of the command "show router mpls lsp to_Rx path detail" includes three sections titled "ExplicitHops", "Actual Hops", and "ComputedHops". **Clearly** explain the _difference_ between these three, eg. by explaining where the information comes from.

    Explicit: admin configured in path statement

    Computed: determined by the CSPF algorithm, taking TE constraints into account

    Actual: obtained from the RSVP RRO; resulting path currently active (links down, etc)

17. [3 marks] Name, and **clearly** describe, at least three (3) different uses for MPLS. (Note: you may **not** include VPN services in your answer, even though it's a very common use for MPLS!)

    BGP shortcuts, 6PE, IGP shortcuts
    These shortcuts are the subject of MPLS Module 5, Section 5 on "MPLS shortcuts"

18. [1 mark] In the SR OS, what is the maximum number of link "colours" that may exist?
    32

19. [1 mark; Bonus] Based on lab results with the CLI, what is the maximum number of link "colours" that may be applied to a single link, in the SR OS? (This isn't a trick, although it's a subtle detail.)

    5 – try it in lab! In case you're wondering, there is an identical limit for SRLG attributes.

20. [1 mark] Refer to the topology diagram on the cover page. An LSP must traverse directly from R1 to R6, **without** going over any vertical links (ie. R2-R3 or R4-R5). What value must be specified for the hop-count in the LSP parameters?

    4 – must include the originating router in the count!

21. [2 marks] For type 10 LSAs, **clearly** explain the two (2) top-level TLV sub-types they contain, and what each TLV specifies.

    Router (just 4 bytes for router ID) and Link (complete IP addr & TE info for that link)

22. [1 mark: Bonus] **Clearly** explain the difference between the ability to *propagate* Opaque LSAs and the ability to *generate* Opaque LSAs. Hint: refer to lab work!

    Opaque LSA support (ie. propagation of type 9, 10, 11) is enabled by default for ALU
    Generation of Opaque LSAs (type 10 only!) only occurs if TE extensions "On" in OSPF

23. A. [5 marks] Name and **clearly** describe the five (5) numeric items that are necessary when defining a distributed ePipe service. (See part B before you start writing!)

    customer ID, service ID, SAP encap, SDP ID, VC-ID
    A suitable definition clearly differentiates these items by giving an example value,
    or explains the use (eg. customer ID is for billing & accounting purposes)
    Descriptions can be obtained from SA Modules 1 or 2, or from lab work.

    B. [1 mark] Now go back and **clearly** identify which of the above items are *locally significant* and which are *globally significant*.
    All are locally significant, except the VC-ID which is globally significant.

24. [1 mark] **Clearly** explain the difference between a _local ePipe_ service and a _distributed ePipe_ service.

  Local won't have/need an SDP; distributed ePipe uses exactly one SDP.

25. [1 mark: Bonus] The course notes use the word "Null" for two different meanings when referring to a SAP. **Clearly** explain the difference between "null encapsulation for a SAP" vs the "Null SAP"

  "Null encapsulation for a SAP" means that no Q-tags are used, ie. not Dot1q or QinQ
  "Null SAP" means a very specific SAP definition (ie. x/x/x**:0**) which accepts frames
  without a tag or frames with a tag where the VLAN number is 0.

26. [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 below if you need more space.)

  Any reasonable answer is acceptable, provided that the explanation of "why" is clear!

Extra Work