IN723 Advanced Networking - Project 2022
LAN and WAN Design

Level 7 – 15 Credits

Worth 40%

Using Packet Tracer and GNS3

Due: Due: by **Monday May 23**

Where to hand in: submit to Michael Holtz via Teams

Late Penalty: 10% per day late

<u>Learning Objectives</u>

1.   Understand, evaluate and implement designs for facilitating large scale wide area networks.
2.   Plan and deploy mechanisms for secure network information exchange.
3.   Understand, evaluate and implement solutions for network virtualisation.
4.   Design and implement fault tolerant solutions for high availability of local area and wide area networks.
5.   Adapt the above tasks as required for specific ICT contexts and/or organisational domains.

<u>Overview</u>

Tyrell Corp is opening a new head office site. You have been asked to provide a submission for the network LAN and WAN design as per the following customer specifications.

Your predecessor had agreed a base design for both the LAN and WAN, however there are a number of decisions to be made and full design specification to be supplied including proof of concept configurations and testing.

Refer to the LAN diagram in the appendix.

Special Note

This assessment has a special emphasis on critical evaluation. This means that where possible you are to describe why you have chosen the various features / technologies and give consideration for alternative solutions. Use the customer questions / requirements below in red to guide you.

Customer Specifications – Head Office LAN

Design
The customer requires a hierarchical design with discrete Access, Distribution and Core layers providing for availability, scalability and security.

You are tasked with designing:
- The Core layer
- WAN edge block
- User access block

The core design must allow for additional distribution blocks to be added in the future.

User Departments
The user access block will provide for 4 main departments. Each department will exist within its own subnet. You have been allocated the network range 10.7.0.0/16 to cater for all required subnets including point to point addressing and management.

- Admin (12 staff)
- Sales & Marketing (60 staff)
- HR (20 staff)
- Finance (20 staff)

Growth for each department is not expected to exceed 100%

Subnetting
The customer has requested that subnet allocations are easy to summarise, understand and support.

1. You must describe why this is true for your design.

2. You must provide documentation that lists each of the IP Subnets (including L3 links) and what they are used for.

Consider how device management addressing will be allocated. *Ensure some point-to-point /30 networks are set aside for the WAN design.*

Access
The company's existing LAN deployments utilise L2 VLANS and STP from the distribution layer to the access layer, however the company will consider layer 3 to the access layer.

3. You are to decide if the access to distribution will be layer2 or layer3 and provide an argument that considers both pros and cons of your decision.

4. You are to decide if VLANs need to be spanned across access switches or if each access switch will have a dedicated user VLAN. Why have you made this decision?
Note this decision will influence if the link between the distribution switches is L2 or L3.

Resilience

The HO LAN is to provide redundant links and paths where possible while minimising convergence time. The design needs to consider the impact of a switch failure.

5. The customer requests you describe traffic flow and how it is affected by at least three potential failure scenarios. Use diagrams to indicate primary and alternate traffic paths in the event of device and or link failures.

6. You are to explain how you are using ether channel and if not why?

7. Explain how have the core to distribution links been designed to minimise convergence?

Answer either 8 or 9 (Not both)
8. If the access layer to distribution layer is layer 2 then spanning tree is required. In addition as redundant default gateways are required for each user VLAN and a switch management VLAN. Describe how both STP & FHRP are deployed. Which FHRP have you chosen and why? Which STP protocol have you chosen and why?

   or

9. Alternatively if you are using a layer 3 access then describe how you have done this including the routing protocol used and how the routing metrics have been configured and why. How does this impact the ability to have redundant host default gateways?

Routing
You must specify an appropriate interior gateway protocol to be used for internal routing within the HO site. The interior routing protocol will be used between the Distribution layer, Core layer and edge routers.

10. Explain why you have chosen the IGP?

11. Explain how you have configured the IGP including methods you have employed to minimise convergence time, optimise traffic flow and limit the wasting of bandwidth and CPU calculations.

Security
The customer has asked you to consider security.

12. Are there any security features that should be deployed within the new HO LAN? Explain your choices.

Customer Specifications – WAN Connectivity

Design
The WAN core is a service provider managed MPLS service.
The HO LAN will connect to the WAN via two separate connections.
The WAN links to the provider are 100Mb Ethernet.
Ensure to design the WAN connectivity and routing as per the customer requirements below.

Refer to the WAN diagram in the appendix.

ISP IP Addressing
The ISP has allocated two point-to-point networks of 172.16.17.0/30 & 172.16.17.4/30 for the Head Office's WAN links to the service provider.
172.16.17.12/30 has been allocated for the Liverpool WAN link.
172.16.17.16/30 has been allocated for the Fulham WAN link.
Use 172.16.17.8/30 for the link between the Provider Edge routers.

Liverpool Site
The remote Liverpool site is included for routing testing purposes.
The LAN IP address range is 10.8.0.0/16. You will specify this range in any policy, filtering, routing etc as needed.

Fulham Site
The remote Fulham site is included for routing testing purposes.
The LAN IP address range is 10.9.0.0/16. You will specify this range in any policy, filtering, routing etc as needed.

BGP AS Numbering

The MPLS Core BGP AS is 4700
The Head Office has been allocated BGP AS 65007
Liverpool has been allocated BGP AS 65008
Fulham has been allocated BGP AS 65009

Routing – HO LAN to Service Provider

You are required to use BGP to connect the head office site to the ISP. The company has purchased an active / active service offering from the provider. This means that the company can choose which link to use on a per subnet basis.

You are to configure BGP policy on the HO LAN WAN Routers such that:

For inbound traffic from the Service Provider (& other attached sites) to the HO LAN networks, Link 1 (see appendix diagram) will be used as the primary path. Traffic will route over Link 2 if the primary path fails. Only a summary route of the Head Office LAN networks is to be advertised to the ISP via the primary and backup paths.

Outbound traffic from the HO LAN network to the Liverpool site will use Link 2 as primary and Link 1 as backup.

Outbound traffic from the HO LAN network to the Fulham site will use Link 1 as primary and Link 2 as backup.

13. You are to specify and describe how BGP will be configured to accomplish the above including detail of which BGP attributes are used and why and how the HO LAN networks are summarised.

14. You are to ensure the Head Office cannot be used as transit between any other Service Provider attached sites. Explain how you have achieved this.

15. You are to ensure end to end connectivity between the HO user VLANs and Liverpool and Fulham sites. Provide evidence of this.

Security
The customer has asked you to consider security.

16. Anti spoof (URPF or ACL) not break Asymmetric traffic

17. You are to choose at least two additional security features that should be deployed on the WAN routers (not related to VTY or console passwords)? Explain your choices.

Deliverables

Provide the following documents and evidence.
Ensure your work adheres to the marking rubric.

a) Deliverable – LAN design (25%)

1. Describe the LAN design, giving a broad overview of how the design works and meets the customer requirements.

2. Provide detail of how the chosen features work, paying careful attention to answer the customer questions in red within the customer specifications above. Supply tables and diagrams as requested.

3. Supporting references. Include in text referencing and a table of references.

b) Deliverable – WAN design (25%)

1. Describe the WAN design, giving a broad overview of how the design works and meets the customer requirements.

2. Provide detail of how the chosen features work, paying careful attention to answer the customer questions in red within the customer specifications above. Supply tables and diagrams as requested.

3. Supporting references. Include in text referencing and a table of references.

c) Deliverable – LAN Logical topology diagram (5%)

You are to provide a LAN logical topology diagram that includes the following:

1. Access, distribution, core and WAN edge intermediary devices

2. VLANs / Network addressing

3. Port numbering for infrastructure links (not access ports).

4. Routing domains / Autonomous systems / Areas

5. Default gateways, Virtual IPs

6. Show traffic flows (primary / backup paths)

If needed the diagram can be split into multiple parts. The diagram must be separate to the supplied packet tracer or VIRL configuration (though packet tracer or VIRL can be used as the basis).

d) Deliverable – WAN Logical topology diagram (5%)

You are to provide a WAN logical topology diagram that includes the following:

1. Distribution layer, WAN edge, Service provider, Liverpool, Fulham

2. Interface / port assignment

3. Network addressing

4. Routing domains / Autonomous systems / Areas

5. Any relevant feature information (e.g. BGP attributes)

6. Show traffic flows (primary / backup paths)

If needed the diagram can be split into multiple parts. The diagram must be separate to the supplied packet tracer or VIRL configuration (though packet tracer or VIRL can be used as the basis).

e) Deliverable – LAN Working Configuration (15%)

You are to provide a working proof of concept lab within packet tracer.

1. Include all access, distribution and core switches.

2. Include the WAN edge routers, however BGP configuration is not required on these within Packet Tracer.

3. Ensure all specified technologies and features (including specified security features) are configured correctly and working.

4. Provide testing output as supporting evidence (e.g. output of relevant show commands) for each feature.

Note: Due to the number of devices you are requested to use packet tracer. Due to packet Tracer limitations, some features may not be available or work as intended. If you have specified any such features in your design you are to provide the configuration of the feature separately.

f) Deliverable – WAN Working Configuration (15%)

You are to provide a working proof of concept lab within GNS3 (portable project)

1. Include all routers for the HO LAN, Provider edge, Liverpool, Fulham

2. The HO LAN WAN edge distribution switches are to be included (to source the HO LAN networks) however as GNS3 is resource intensive (CPU, mem) the following option can be implemented to help minimise resource use.

<u>HO LAN</u>
Can be simulated with a single device that uses loopbacks to source the HO LAN networks as required. Make sure these match any summary addresses you may already have created within the HO LAN design. See appendix.

3. Ensure all specified technologies and features (including specified security features) are configured correctly and working.

4. Provide testing output as supporting evidence (e.g. output of relevant show commands) for each feature.

5. While the service provider core is stated as running MPLS, you do not need to provide any MPLS configuration.

g) Deliverable - Time sheeting

To ensure accurate billing you have been asked to record the time you spend on each activity, including date, length of time and a brief description of the activity.

h) Deliverable – Grade your work

You are to review the marking rubric against your work and provide a grade on a scale from F to A+ for each item.
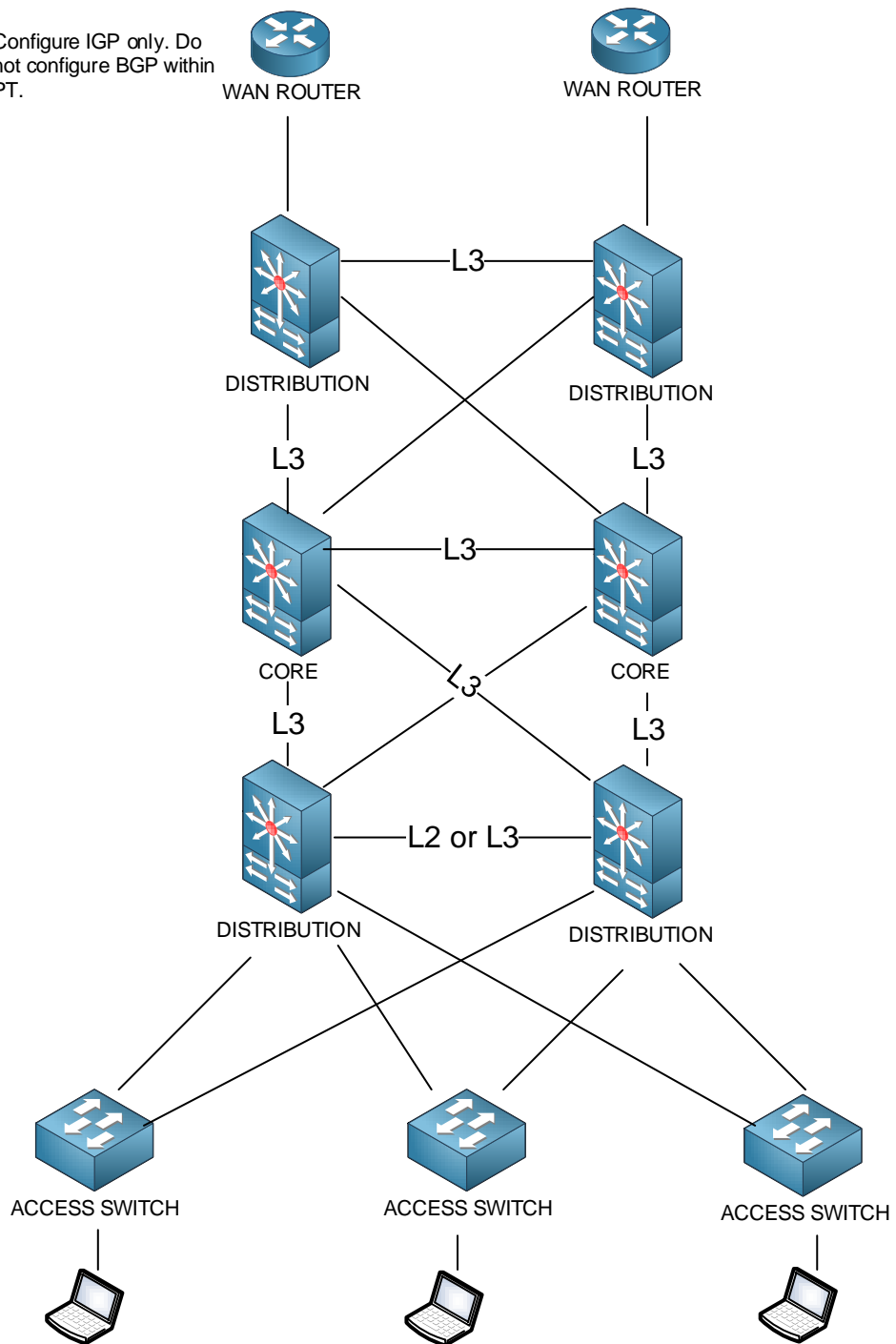
Marking Rubric

	A Range	B Range	C Range	Fail
LAN design Evidence of critical evaluation of the selected technologies in consideration of the customer's questions. Proposed solution is technically sound and meets customer requirements. (25% of mark)	Demonstrates critical, in-depth evaluation of the chosen technologies in answering all customer questions. Proposed solution is technically strong and meets all stated customer requirements.	Demonstrates some critical, in-depth evaluation of the chosen technologies in answering most of the customer's questions. Proposed solution is mostly technically sound and meets most of the stated customer requirements.	Demonstrates limited critical evaluation of the chosen technologies in answering some of the customer's questions. Proposed solution is limited technically and meets some of the stated customer requirements.	Demonstrates minimal critical evaluation of the chosen technologies. Includes minimal consideration for the customer's questions. Proposed solution is technically weak and meets all few customer requirements.
WAN design Evidence of critical evaluation of the selected technologies in consideration of the customer's questions. Proposed solution is technically sound and meets customer requirements. (25% of mark)	Demonstrates critical, in-depth evaluation of the chosen technologies in answering all customer questions. Proposed solution is technically strong and meets all stated customer requirements.	Demonstrates some critical, in-depth evaluation of the chosen technologies in answering most of the customer's questions. Proposed solution is mostly technically sound and meets most of the stated customer requirements	Demonstrates limited critical evaluation of the chosen technologies in answering some of the customer's questions. Proposed solution is limited technically and meets some of the stated customer requirements.	Demonstrates minimal critical evaluation of the chosen technologies. Includes minimal consideration for the customer's questions. Proposed solution is technically weak and meets all few customer requirements.
Evidence of external sources / literature Supporting both LAN & WAN (5% of mark)	A wide range of relevant literature that supports your technical understanding and critical analysis of the technology	A range of relevant literature that supports your technical understanding and critical analysis of the technology	A limited range of or less relevant literature that supports your technical understanding and critical analysis of the technology	A minimal range of or non-relevant literature that supports your technical understanding and critical analysis of the technology
LAN/WAN topology diagrams 5% each (10% of mark)	Topology diagrams are coherent, comprising all requested elements and strongly support the proposed design. The diagrams are comprised of industry accepted symbols.	Topology diagrams are mostly coherent, comprising most of the requested elements and adequately support the proposed design. The diagrams are comprised mostly of industry accepted symbols.	Topology diagrams convey limited meaning, comprising of some requested elements and provides limited support for the proposed design. The diagrams are comprised of some industry accepted symbols.	Topology diagrams convey minimal meaning, comprise a minimal number of requested elements and provides minimal support for the proposed design. The diagrams lack industry accepted symbols.
LAN Configuration	Device configurations provided with strong	Device configurations provided with	Device configurations provided with some	Device configurations are untested and show

(15% of mark)	evidence of testing and have minimal mistakes.	evidence of testing and have few mistakes.	evidence of testing and have a number of mistakes.	many mistakes.
WAN Configuration (15% of mark)	Device configurations provided with strong evidence of testing and have minimal mistakes.	Device configurations provided with evidence of testing and have few mistakes.	Device configurations provided with some evidence of testing and have a number of mistakes.	Device configurations are untested and show many mistakes.
Presentation / Timesheet / Grade your work (5% of mark)	Few or No basic errors – spelling, grammar Referencing for all sources and quotes Time sheet provided with accurate record of time per task provided including date, length of time and brief description of activity. Genuine attempt to provide an accurate assessment of your work.			Legibility (spelling and grammar) interrupts communication of meaning. Referencing and formatting inaccurate. Minimal effort in breaking down time or providing description of activity. No or minimal attempt to provide an accurate assessment of your work.

APPENDIX

LAN Diagram

Configure IGP only. Do not configure BGP within PT.

WAN Diagram

AS 65008

Liverpool

AS 65009

Fulham

Service Provider

Provide Edge 1 — iBGP — Provide Edge 2

AS 4700

eBGP

eBGP

eBGP

eBGP

Link 1

Link 2

Redistribution between IGP & BGP at
WAN edge (redist on Dist SW = full
iBGP mesh or RR)

WAN ROUTER 1 — iBGP — WAN ROUTER 2

IGP

IGP

HO LAN

AS 65007