NETWORKING TECHNOLOGIES

ASSIGNMENT

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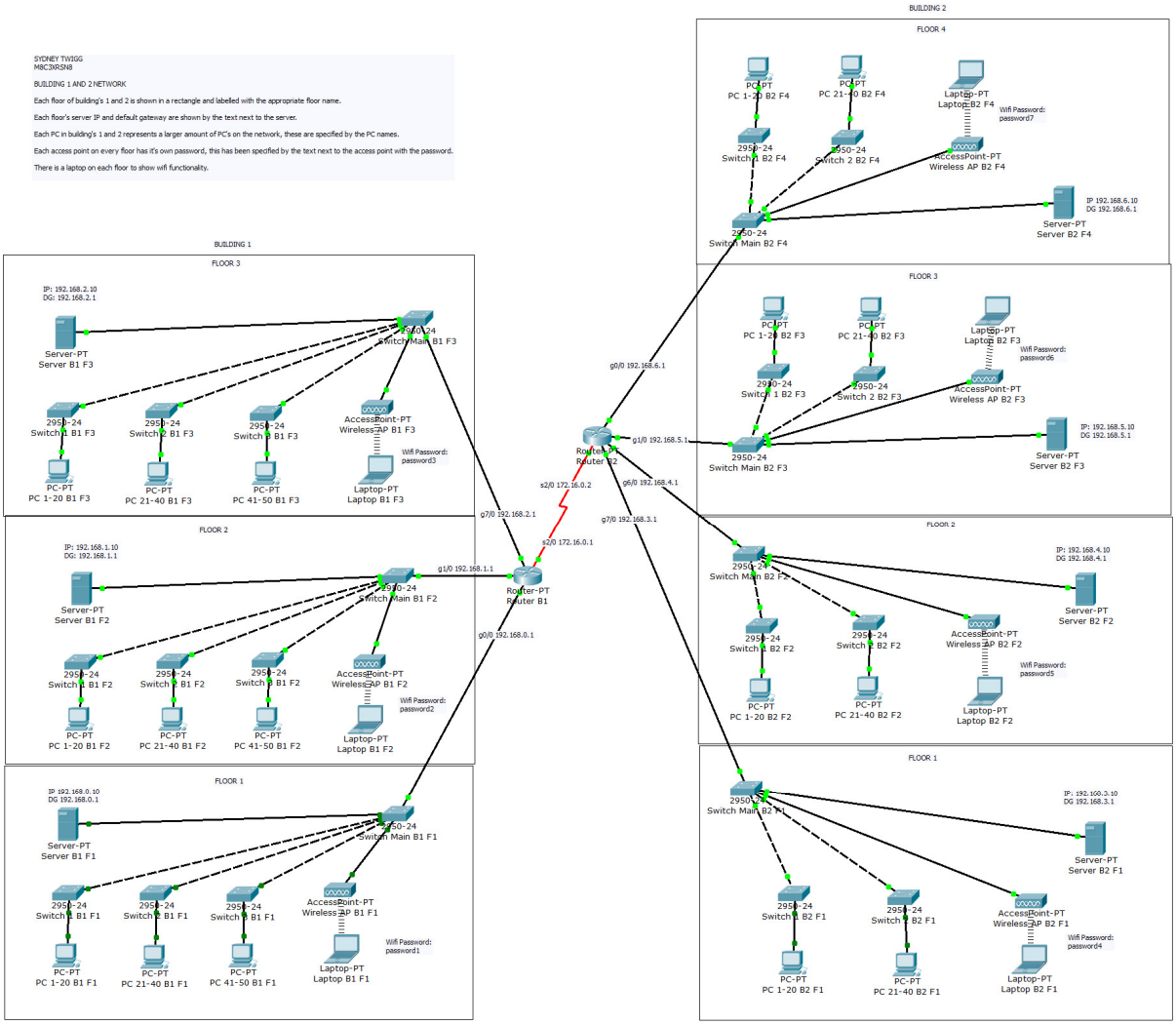
Contents

QUESTION 1

QUESTION 1.1



Screenshot showing the implemented company network in Cisco packet tracer.

QUESTION 1.2.a

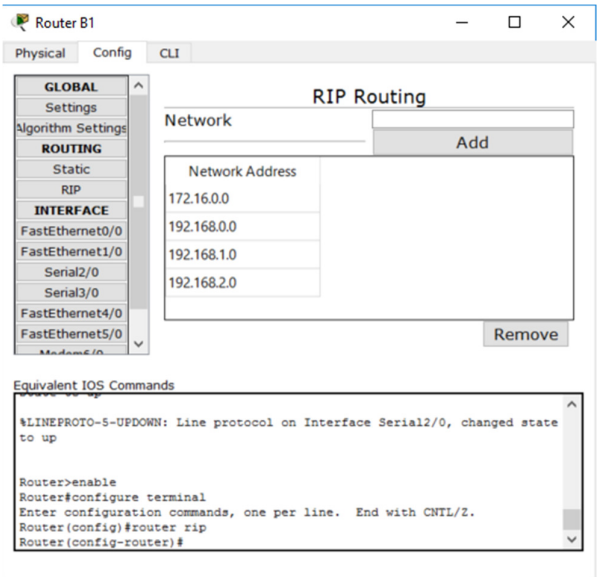
The routing protocol implemented on the routers in the network was Routing Information Protocol (RIP). RIP is a routing protocol that exchanges network information between routers dynamically using local broadcasts (ComputerNetworkingNotes, 2016).

I chose to use RIP for the following reasons:

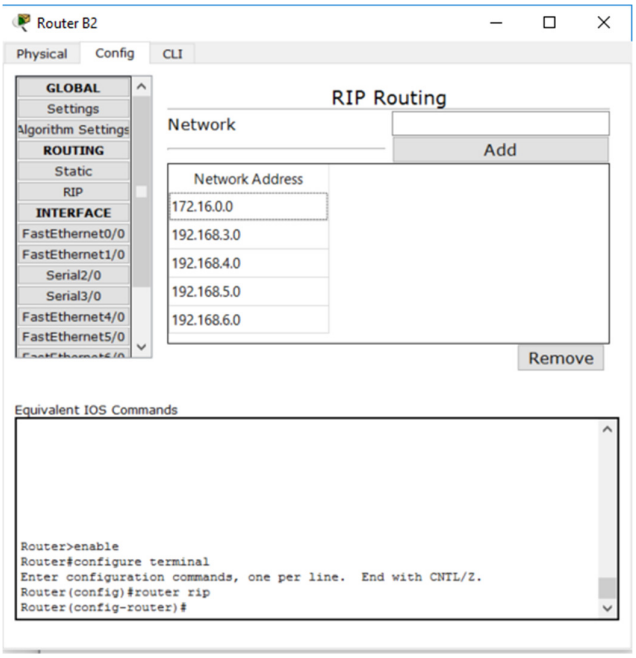
- RIP is an Interior Gateway Protocol - a protocol for routers that move traffic around within a larger autonomous system network. This is suited to the network designed as it is a large network comprised of smaller separate local area networks (each floor of each building is a separate LAN) connected through routers. (Rouse, 2016)
- RIP uses routing tables, which are a list of all destination networks it knows how to reach, these are broadcasted every 30 seconds. Routers using RIP learn routing information from directly connected neighbouring routers, this allows for dynamic routing. Using dynamic protocol allows for easier configuration of the router, as you only have to configure the networks that you would like the router to show, and the other networks will be picked up through neighbouring routers that are directly connected to the networks (ComputerNetworkingNotes, 2016).

- The network created is a small network, thus RIP will not face any issues within the network. The network is suited to it as RIP has a small range of metrics. RIP uses hop count as a metric to rate the value of routes in the network, 0 being the directly connected neighbour, and 16 being out of reach. The network used is small enough that there will be no routes out of range, thus will not create an instability while running RIP. (Cisco, 2014)

QUESTION 1.2.b



Screenshot showing the implementation of RIP routing on the router for building 1



Screenshot showing the implementation of RIP routing on the router for building 2

QUESTION 1.3

Two types of copper cables that can be installed on the designed network are: (Linux Information Project, 2005)

- Copper straight-through cable:
  - Twisted pair copper wire for LAN use with RJ45 connectors at each end with the same arrangement of conductors.
  - Used to connect end-user devices (PC's, printers, etc.) to networking devices (servers, switches etc.).
- Copper crossover cable:
  - Identical to a copper straight through, however, the wires are switched so that the signal pins are opposite on each side – for example having T568A on one end, a crossover cable will have T568B on the other end.
  - Crossover cables are used to link two of the same devices, such as a PC to a PC, switch to a switch etc.

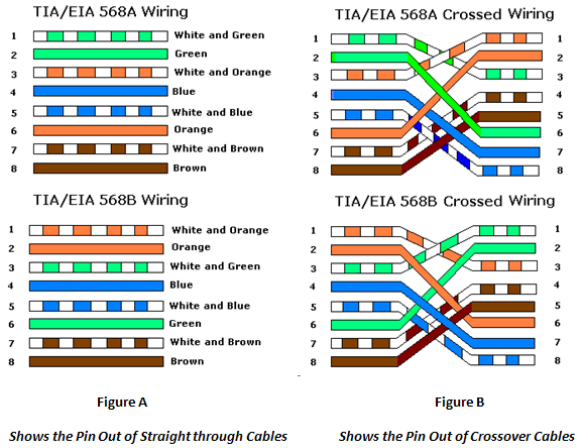


Image showing the difference between a copper crossover and a copper straight-through cable. Source: (Haynie, 2011).

Instances of installed copper cables in the designed network:

Straight-through:

- PC to switch
  - Each PC in the network is connected to a switch, each of these will have a straight-through cable installed.
  - Example:
    - *PC 1 B1 F1* connected to *Switch 1 B1 F1* using a copper straight-through cable.
- Server to switch
  - Each server in the network is connected to a switch, each of these will use a copper straight-through cable.
  - Example:
    - *Server B1 F1* connected to *Switch Main B1 F1* using a copper straight-through cable.
- Wireless access point to switch
  - Each floor has a wireless access port to provide Wi-Fi, this will be connected to a switch using a copper straight-through cable.
  - Example:
    - *Wireless AP B1 F1* connected to *Switch Main B1 F1* using a copper straight through.

Crossover:

- Switch to switch
  - Each switch in the network is connected to another switch, this will have a copper crossover cable installed.
  - Three examples of instances of this being utilised in the designed network are:
    - *Switch 1 B1 F1* connected to *Switch Main B1 F1*
    - *Switch 3 B1 F3* connected to *Switch Main B1 F3*
    - *Switch 2 B2 F2* connected to *Switch Main B2 F2*

An example of when a copper crossover isn't used for two of the same devices would be two routers, as these are connected by serial cables.

QUESTION 2

QUESTION 2.1.B

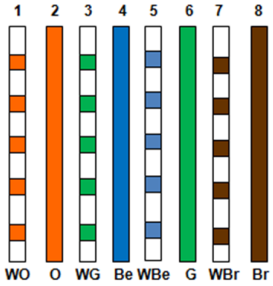
ASSEMBLING A CAT5E CABLE WITH AN RJ45 CONNECTOR:

What is required:

- Cat5e cable
- RJ45 connectors
- Scissors
- Crimping tool
- Cable tester (Rhee, 2011) (dial2fast, 2013).

Steps:

1. Strip the cable jacket
    - Measure out ±3cm of the cable.
    - Place the scissors at the measured out point, and twist the scissors while gently applying pressure in order to cut the jacket without cutting the inside twisted wires.
    - Pull the now cut off cable jacket off, exposing the twisted wires.
2. Untwist the wires
    - Separate the wires in their twisted form.
    - Untwist each pair of wires from each other and try to straighten the wires out for easy arranging later on.
3. Arrange the wires
    - Arrange the wires according to the T568B standard, in the following order:



T568B Standard. Source: (Pacific North West Spine, n.d.)

4. Trim wires
    - Measure out ±1.5cm
    - Cut wires as straight as possible while still keeping them in order.
5. Attach connector
    - Ensure you are holding the connector the correct way – with the tab facing downward.
    - Insert the wires in the correct order into the connector, ensuring that each wire is passing through the correct guides in the connector.
6. Check
    - Check that the wires have been inserted into the connector correctly, that all are extended to the end and the jacket is far enough into the connector.
7. Crimp
    - Insert the connector into the 8P slot of the crimping tool, and crimp all the way down.
8. Test
    - Use a cable tester to check that the cable has been terminated correctly.

QUESTION 3

IMPLEMENTATION OF NETWORK FOR ABC COMPANY

INTRODUCTION

Designing and implementing a network is a lengthy process that requires thought and consideration of various factors in the company, technology, and networking concepts. The following report lays out the process and considerations that should be taken into account when designing and implementing a network based on how the network for ABC Company was created and implemented.

PLANNING OF THE PROJECT

As planning for the project, I first created a diagram of how I believed the network should look and to give myself an idea of what the layout of the network would be, how many devices I would need, what connections I would need and to allow myself to have a good foundation to build my network on.

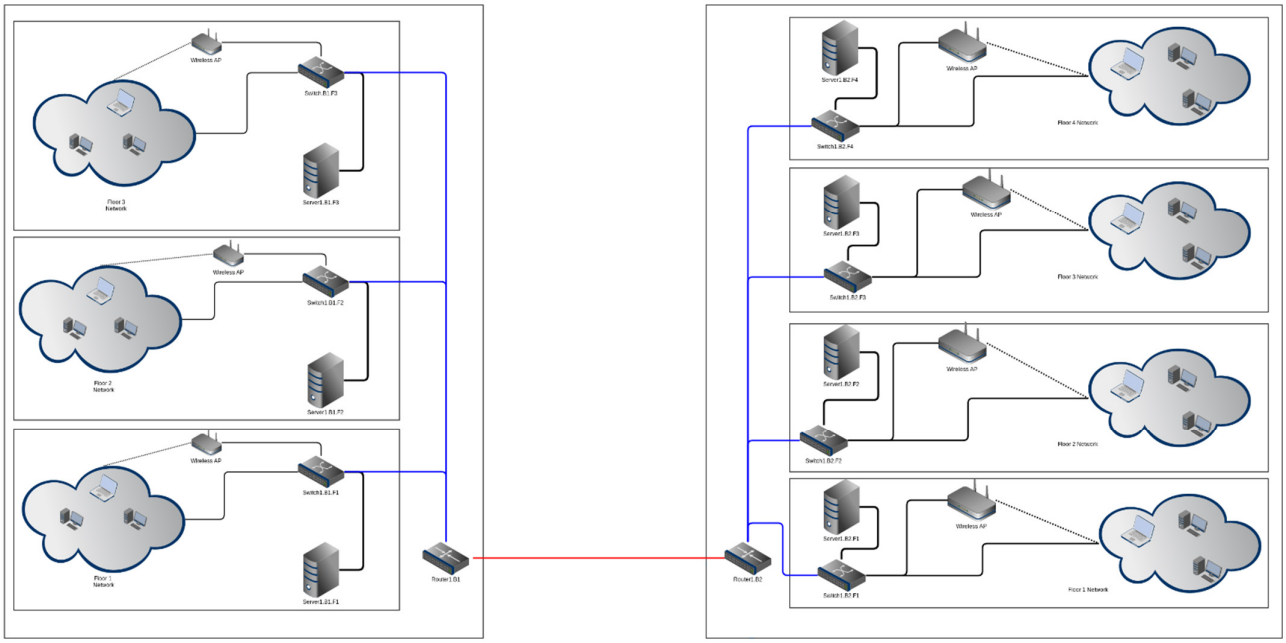


Diagram showing initial planning of my network design.

After designing a network plan, I started to plan the IP addressing for each server and each floor. This involved creating a table and designating IP addresses, default gateways, router ports that the switch will connect to and the Wi-Fi password for each floor. As I worked with Cisco packet tracer I adjusted the information as I went along. This table was very useful as it provided me with a reference when working with the routers, and when implementing RIP in my network.

BUILDING 1	BUILDING 2
Floor 3: Server IP: 192.168.2.10 Default Gateway: 192.168.2.1 Wireless AP Password: password3 Port: g7/0	Floor 4: Server IP: 192.168.6.10 Default Gateway: 192.168.6.1 Wireless AP Password: password7 Port: g0/0
Floor 2: Server IP: 192.168.1.10 Default Gateway: 192.168.1.1 Wireless AP Password: password2 Port: g1/0	Floor 3: Server IP: 192.168.5.10 Default Gateway: 192.168.5.1 Wireless AP Password: password6 Port: g1/0
Floor 1: Server IP: 192.168.0.10 Default Gateway: 192.168.0.1 Wireless AP Password: password1 Port: g0/0	Floor 2: Server IP: 192.168.4.10 Default Gateway: 192.168.4.1 Wireless AP Password: password5 Port: g6/0
	Floor 1: Server IP: 192.168.3.10 Default Gateway: 192.168.3.1 Wireless AP Password: password4 Port: g7/0

Table showing planning of each floors networks.

I went on to beginning to create my network in Cisco packet tracer using my diagram and my table to guide me when setting up the DHCP servers and the Wi-Fi for each floor. I did research on each device I was using as I went along in Cisco packet tracer, and this allowed me to make strategic decisions on how to present my project. An example of how this helped with my planning was that I discovered that the switches available to me on Cisco packet tracer only supported 24 connections, so I had to figure out how to connect the 50 and 40 computers per floor to the router; I decided on segmenting the computers into groups and adding extra switches that would all connect to one 'main' switch per floor.

JUSTIFICATIONS OF DEVICES USED

Server PT:

A generic server for each floor was used, this was adequate for its purpose to act as a DHCP server on each floor. The servers used were connected to each PC on each floor via the main switch on each floor.

PC PT:

Generic PCs were used on this server, as their purpose in my designed network was to show the working DHCP functionality and represent a greater number of computers on each floor.

Laptop PT:

I included a single laptop with a wireless card installed on each floor of both buildings to show the Wi-Fi functionality on the floors, these represent the 10 users on each floor that would need access to Wi-Fi.

Switch 2950-24:

I used the Switch 2950-24 provided on Cisco packet tracer as this allowed me to connect up to 24 devices. The Cisco 2950 Series switches feature Cisco Device Manager software which allows users to configure and monitor the switch using a web browser, you do not need to have in depth knowledge of the command line interface to use it. This switch also features Enhanced Image software that provides additional security. (Cisco, 2016)

Access Point PT:

A wireless access point was included on each floor of both buildings to provide Wi-Fi to the floor for users that needed, this was secured with WPA2-PSK authentication, with a different password on each floor. The bandwidth capabilities of the access point were set to 100Mbps in order to support 10 users with few issues.

Router PT:

I used the generic router provided on Cisco packet tracer, as this was the only router that allowed me to add additional modules onto the device. I used two routers in my designed network as any more would be unnecessary for such a small network, and would become costly and inefficient in the designed network. I installed extra PT-ROUTER-NM-1CFE modules in my router to allow me to connect additional Fast Ethernet devices – in this case, extra switches – this allowed me to connect all main switches from each floor to each building's router, as well as have a port available to connect my two routers via serial cable.

ADDRESSING SCHEMES USED

The designed network is a class C network, thus I used the default subnet mask of 255.255.255.0 and a private IP address of 192.168.xxx.xxx – this allowed for subnetting of each floor. Each floor was subnetted and assigned a server to act as a DHCP to assign the IP addresses for each device dynamically. The subnetting allowed my network to support more than 254 hosts in total in order to support the total number of hosts that are in the network. I used a default gateway of 192.168.xxx.1 for each network and allocated the starting IP address as 192.168.xxx.10 to avoid any clashes with the default gateway. (Microsoft, 2016)

The following table illustrates a portion of the IP addressing scheme as well as the range of the network's IP addresses from Building 1 Floor 1 to Building 2 Floor 4:

BUILDING 1 FLOOR 1		BUILDING 2 FLOOR 4	
Device Name:	**IP Address**	**Device Name:**	**IP Address**
Server B1 F1	192.168.0.10	**Server B2 F4**	192.168.6.10
PC 1-20 B1 F1	192.168.0.11	**PC 1-20 B2 F4**	192.168.6.11
PC 21-40 B1 F1	192.168.0.12	**PC 21-40 B2 F4**	192.168.6.12
PC 41-50 B1 F1	192.168.0.13	**Laptop B2 F4**	192.168.6.13
Laptop B1 F1	192.168.0.14		

Table showing IP addressing scheme of designed network

COST BREAKDOWN OF DEVICES USED

Due to generic devices used in the designed network, I am only able to give average prices based on similar Cisco models.

Server PT:
The average price of a server: $9000 (Cisco, 2016).

PC PT:
The average price of a generic PC: $500 (GreenBiz, 2012).

Laptop PT:
The average price of a generic laptop: $600 (GreenBiz, 2012).

Switch 2950-24:
The price of this specific model is $1295 (Cisco, 2016).

Access Point PT:
The average cost of a generic access point: $1500 (Cisco, 2016).

Router PT:
The average price of a 4-slot modular router: $2000 (Cisco, 2016).

Cables:
The average price of all cables: $100 (Cisco, 2016).

The table below shows an estimated cost breakdown of the implementation of the designed network:

BUILDING 1

Device	Devices per Floor	Total # Devices	Price	Price per Floor	Total Price
Server	1	3	9000	9000	27000
PC	50	150	500	25000	75000
Laptop	10	30	600	6000	18000
Switch 2950-24	4	12	1295	5180	15540
Access Point	1	3	1500	1500	4500
Router	0,3	1	2000	600	2000
Cables	9	27	100	900	2700
Total					**144740**

BUILDING 2

Device	Devices per Floor	Total # Devices	Price	Price per Floor	Total Price
Server	1	4	9000	9000	36000
PC	40	160	500	20000	80000
Laptop	10	40	600	6000	24000
Switch 2950-24	3	12	1295	3885	15540
Access Point	1	4	1500	1500	6000
Router	0,25	1	2000	500	2000
Cables	7	28	100	700	2800
Total					**166340**

TOTAL COST OF IMPLEMENTATION	**311080**

All prices are shown in USD ($)

WORK BREAKDOWN STRUCTURE

NETWORK IMPLEMENTATION

1. Planning
    1.1. Design network
        1.1.1. Create diagram
        1.1.2. Review diagram and devices
    1.2. Plan IP Addressing scheme
        1.2.1. Create table with IP addresses for each floor
        1.2.2. Review all device IP addresses and subnets
2. Implementation
    2.1. Implement design in Cisco Packet Tracer
        2.1.1. Add all devices to network
        2.1.2. Add all connections to network
        2.1.2. Implement DHCP and IP addresses to network
3. Testing
    3.1. Test connections
        3.1.1. Test ping between devices in individual subnets - each floor.
        3.1.2. Test ping between devices on different floors in the same building
        3.1.3. Test ping between devices in different buildings

WORK BREAKDOWN STRUCTURE DIAGRAM

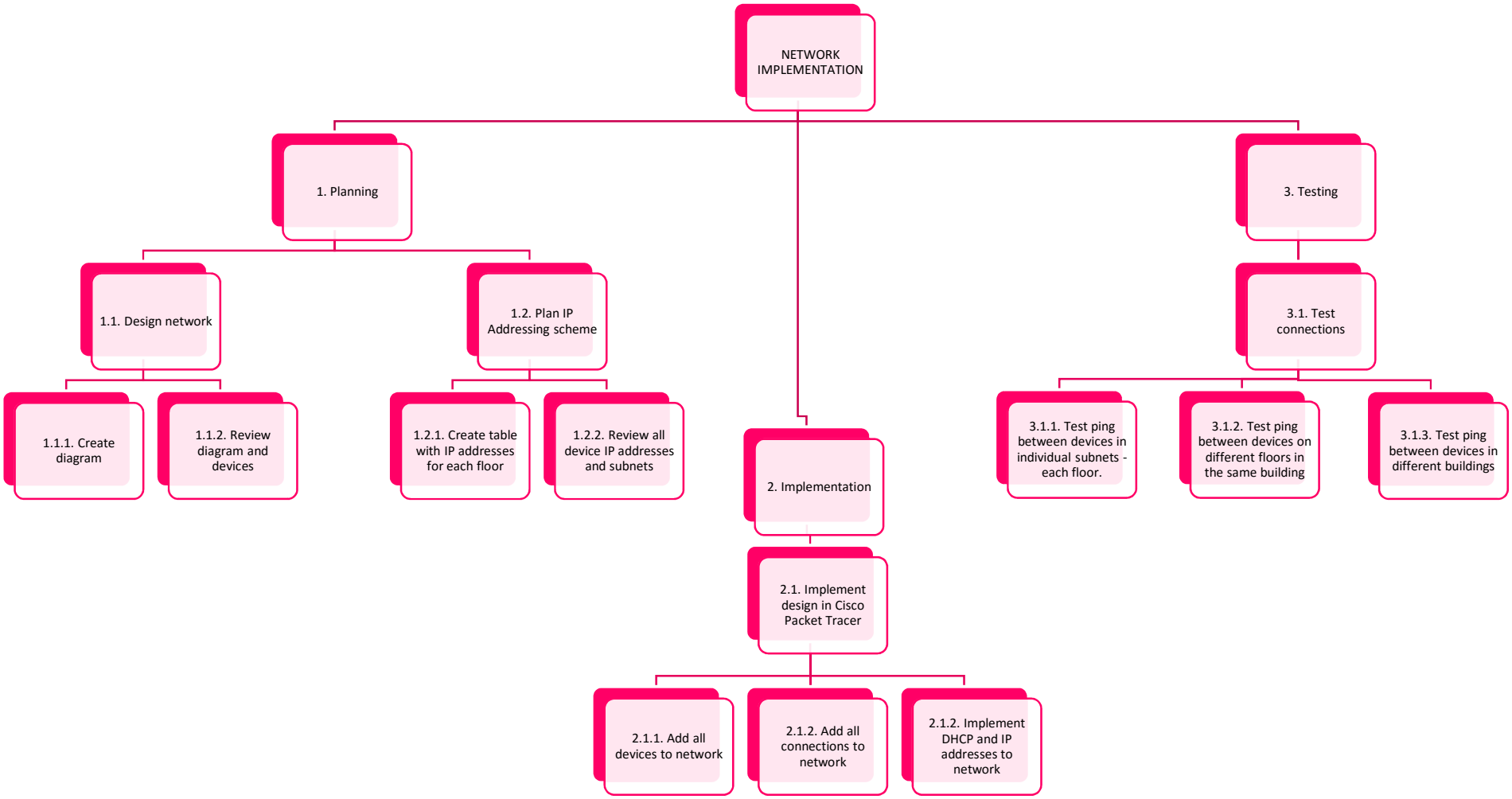


Diagram displaying the work breakdown structure of the implementation of a network

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