2021

lyit
Institiúid Teicneolaíochta Leitir Ceanainn
Letterkenny Institute of Technology

Computing Department, Letterkenny Institute of Technology, Port Road, Letterkenny, Co. Donegal, Ireland.

Report for Security SCI assignment - - secure LAN and WAN connectivity

Author : Konrad Jeziorski (L00169649)
Course title : Secure Communication Infrastructure (2021/22)
Lecturer's name : Saim Ghafoor
Packet Tracer Ver. : 7.3.1.0362
Date Submitted : December 12, 2021

Table of Contents

1. Summary

This report provides detailed descriptions, procedures, and configurations for designing a LAN for an office building as an extension of a corporate network located in another city. Particular emphasis is placed here on matters related to a secure WAN network. As a network administrator, I have tried to meet these expectations. in the first step I designed the LAN network, then I devoted a lot of attention to the secure connection of the corporate network, I used tools such as Firewall and DMZ to control the network traffic and the servers to be well secured in the WAN network.

2. Introduction

The ordering party for the project is EXCEL FINANCE, operating in the financial investment industry, where customer and employee data is very important. Their headquarters are in Dublin, but they want to expand to County Donegal. They require an established network design with conference rooms, department offices, executive and administrative offices. Their office is located on the ground floor of the building. The building is 100 m east-west and 80 m north-south. The height of the storey is 4 meters. They expressed a concern for network security, so this is an important part when designing. Therefore, the goal of the network administrator is to plan the LAN design and strategy for secure network deployment.

3. General network specification

3.1. Components

Components of a computer network can be divided into two groups: active and passive devices. Active network devices are those that either generate or modify the signal transmitted over the network. Passive, in turn, are network elements that carry the signal, but do not modify it.

Examples:

Active elements: Routers, Switches, Access Points, Servers.

Passive components: Transmission media (cables), Patch panel, Rack, Socket.

3.2. Features of the LAN network

A well-designed and constructed computer network should have certain features that determine its quality, the most important features include:

- scalability,
- redundancy,
- performance,
- security,
- ease of maintenance and management.

More on this subject, along with a description of individual network features, can be found here >>> [1]

[1] https://students.mimuw.edu.pl/~zbyszek/sieci/CCNA4%20Sample.pdf

3.3. Hierarchical network model

When designing a computer network, you can use the model proposed by experts. This model assumes the use of 3 layers: core layers, distribution layers, access layer.

- the access layer enables end devices such as computers to access the network. Switches to which end devices are connected are usually located close to end devices,
- the distribution layer mediates data exchange between the access layer and the core layer,
- the core layer takes on traffic from the entire network and delivers data to the local network and beyond.

3.4. Structured Cabling

As we already know, a computer network consists of active and passive elements. Passive network elements do not interfere with the signal but can only transport it. All the passive elements of the network make up a whole called structured cabling. Structured cabling consists of:

- horizontal cabling,
- vertical cabling,
- campus (inter-building) cabling,
- distribution points,
- network sockets.

In this project, I will focus on the use of horizontal cabling, so it is worth describing this type of cabling a bit. Horizontal cabling is the part of structured cabling that connects the network sockets located at the office stand with the distribution point on the same floor. Mains cables run from all sockets to the patch panel located in the distribution point. The horizontal cabling system includes, apart from the mains cable, sockets, and the patch panel, also connection cables and station cables. They are used to connect a switch with a patch panel, as well as a socket with a computer. These cables, called patch cords, are terminated with RJ45 terminals. Assuming that the horizontal cabling system is based on a twisted pair cable, you can come across shielded (F/UTP) and unshielded (U / UTP) patch cords. When using copper cables, i.e. twisted pair, we must remember about the maximum length of the cable. If we use the FastEthernet and GigabitEthernet standards in the network, the maximum distance between the switch and the computer cannot be longer than 100 meters.

3.5. Distribution Point

Distribution points are where the cabling from the network segment converges. Distribution cabinets (RACK), in which all network equipment are mounted, are installed in distribution points. This is where servers and routers are stored, Internet access is provided, and structured cabling converges here. According to the standards, the rooms for distribution points should not be smaller than: 3 meters in length, 2.6 meters in height, 2.2 meters in width.[2]

[2] https://oit.duke.edu/sites/default/files/atoms/files/Design_2016.pdf

For the designed network to be consistent with the previously described features, it is necessary to mark the sockets and ports to which the other end of the cable has been attached in the patch panel. This marking will make it easier to find individual wires in the future.

4. Audit

4.1. Purpose and design assumptions

- The purpose of designing and implementing a local computer network for an office building is to provide reliable access to the hardware resources of the company's network and enabling access to the Internet for all employees of the company. In addition, the rights in it should be limited, in accordance with the provisions of the client. As already mentioned, the network MUST be secure. We already know the size of the floor on which the LAN is to operate.

- The number of computers assigned to IP addresses corresponds to the number of employees, but more employees are expected to be hired, therefore the number of network sockets in individual departments should be increased. For every 10m2 of office space, I have tried to put at least one socket (according to the standard).

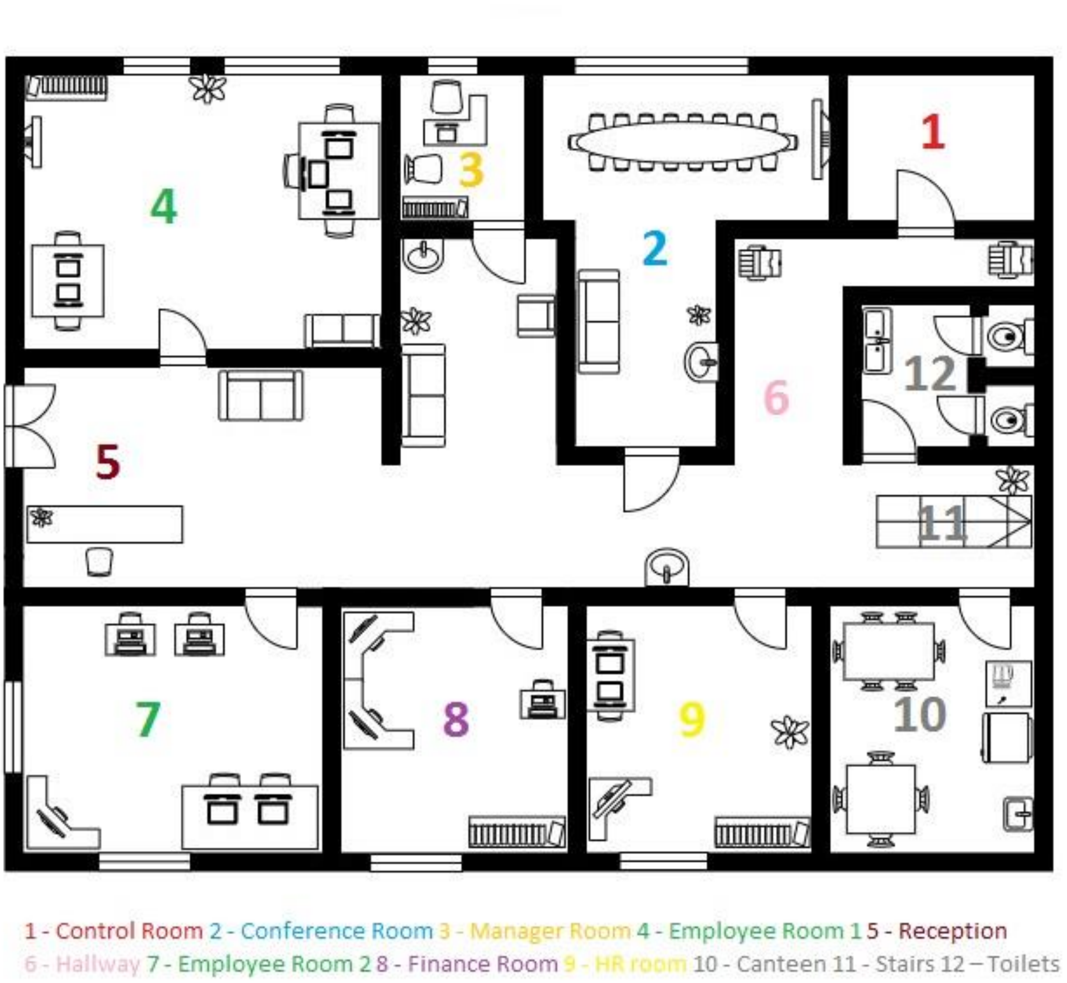
- The company already has an internet connection provided by XXXX.

- The project does not involve the implementation of electrical installations. We assume that it has been modernized and meets all the requirements for this type of installation confirmed by a certificate.

- The cabling of the network will be based on the F/UTP, cat. 6 cable for network sockets, while the cabling for MDF and IDF will be based on the U/UTP, cat. 5e cable.

- The following will be installed in MDF: routers, switches, servers, patch panels, ASA. I also recommend adding a UPS.

4.2. The floor plan of the building


1
2
3
4
5
6
7
8
9
10
11
12
1 - Control Room 2 - Conference Room 3 - Manager Room 4 - Employee Room 1 5 - Reception
6 - Hallway 7 - Employee Room 2 8 - Finance Room 9 - HR room 10 - Canteen 11 - Stairs 12 – Toilets

4.3. VLAN allocation

I decided to assign individual offices and departments to different VLANs. Here they are:

VLAN 10 - Employee: Employee Room 1, Employee Room 2

VLAN 20 - HR: HR Room

VLAN 30 - Finance: Finance Room

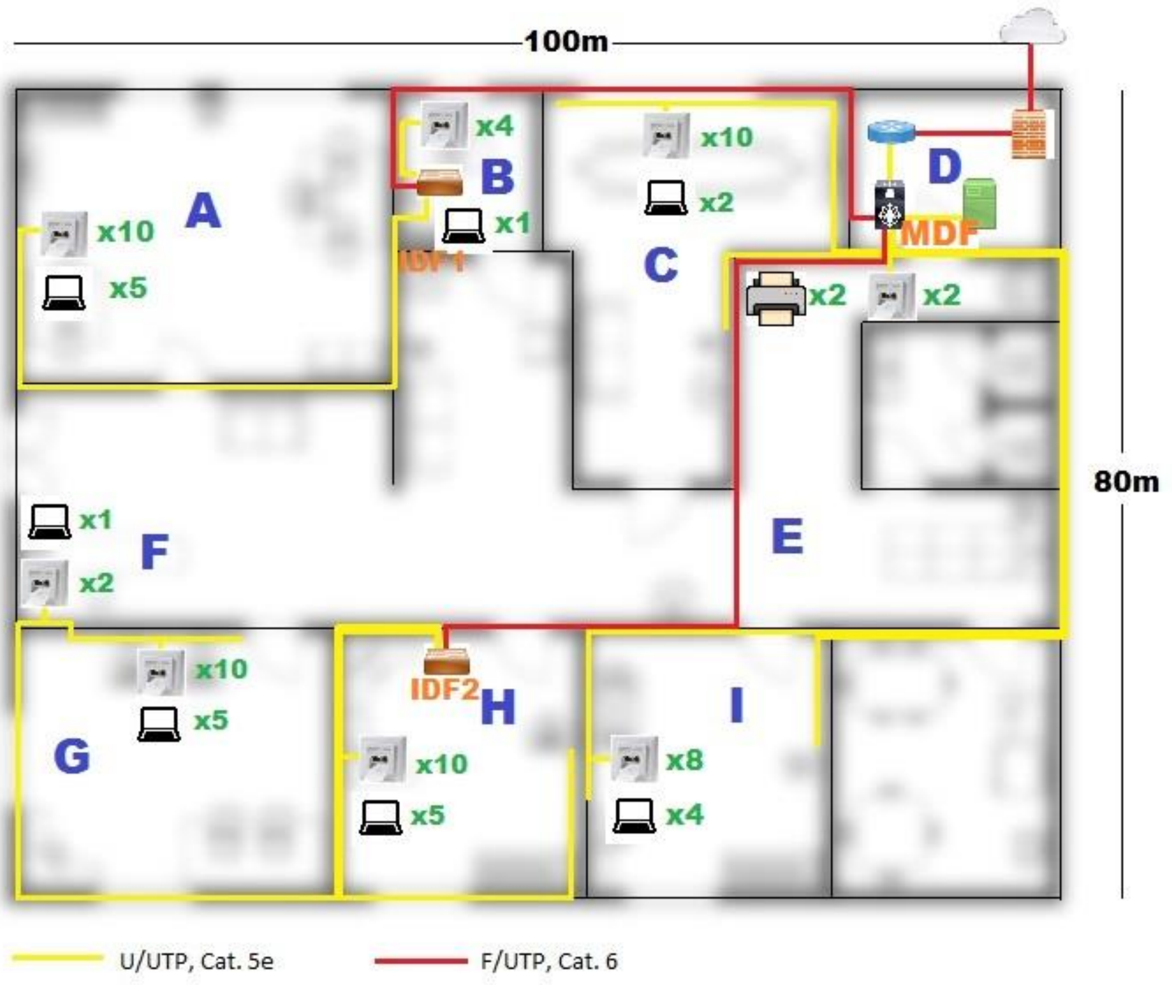
VLAN 40 - Management: Manager / Admin Room, Reception, Hallway (printers)

VLAN 50 - Consultation: Conference Room

Canteen, Toilets, Stairs will not be assigned to any VLANs, because there is no such need (they do not even have access to network sockets).

Addressing and connection specification of individual VLANs are available in the attached documentation: Connection Addressing, Subnetting for LAN.

4.4. Cabling and network sockets



Port designation	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	B1	B2	B3	B4
Cable length	10	10	20	20	20	20	30	30	40	40	10	10	15	15
Port designation	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	E1	E2	F1	F2
Cable length	10	10	10	10	20	20	25	25	30	30	15	15	60	60
Port designation	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	H1	H2	H3	H4
Cable length	20	20	30	30	40	40	50	50	70	70	10	10	15	15
Port designation	H5	H6	H7	H8	H9	H10	I1	I2	I3	I4	I5	I6	I7	I8
Cable length	15	15	25	25	35	35	60	60	60	60	70	70	90	90

A total of 1,991 meters for sockets - 1,810 meters plus 10% redundant cable.

MDF: 10 meters of F/ UTP, Cat. 6 cable, including 10% redundancy, 2 meters of U/UTP Cat. 5e cable,

IDF1-MDF: 166 meters of F/UTP, Cat. 6 cable, including 10% redundancy,

IDF2-MDF: 178 meters of F/UTP, Cat. 6 cable, including 10% redundancy. *

Total cable size for U/UTP Cat. 5e – 1,993 meters

Total cable size for F/UTP, Cat. 6 – 354 meters

* The required length for MDF and IDF is calculated from the diagram presented in the next section.

Category 6 (F UTP, Cat. 6) twisted-pair cabling will enable a transfer rate of 1 Gb/s. The use of a shielded cable will also eliminate any interference generated by devices operating in the building. Unshielded twisted pair, category 5e (U/UTP, Cat.5e) will be used as the wiring to the sockets.

4.5. MDF and IDFs

4.5.1. Characteristics and evaluation

The active network devices used guarantee the reliability and efficiency of the network. In the core layer, two 3650-24PS Multi-Layer Switches work in parallel, in the event of failure of one of them, its tasks will be taken over by the other (I used redundancy).

The following devices will be used in the network:

- 3 x CISCO2911/K9 routers - with two Gigabit Ethernet ports, as well as free slots for expansion modules,
- 3 x WS-C3650-24PS-S Multi-Layer Switches - is the ideal access layer switch for small businesses with LAN access or office environments, combining 10/100/1000 and PoE configurations for maximum productivity and investment protection.
- 4 x Cisco Catalyst 2960X-24PS-L– those series switches provide branch office services to conventional office workspaces. They can work in the GigabitEthernet standard.
- 2 x Dell PowerEdge T1100 Rack Server - with a 4-core processor, 16 GB of RAM and two disks, each with 2 TB
- The Liebert PSI 3000VA (3kVA) UPS
- Cable organizer
- 42U RACK cabinet, TiRAX model.

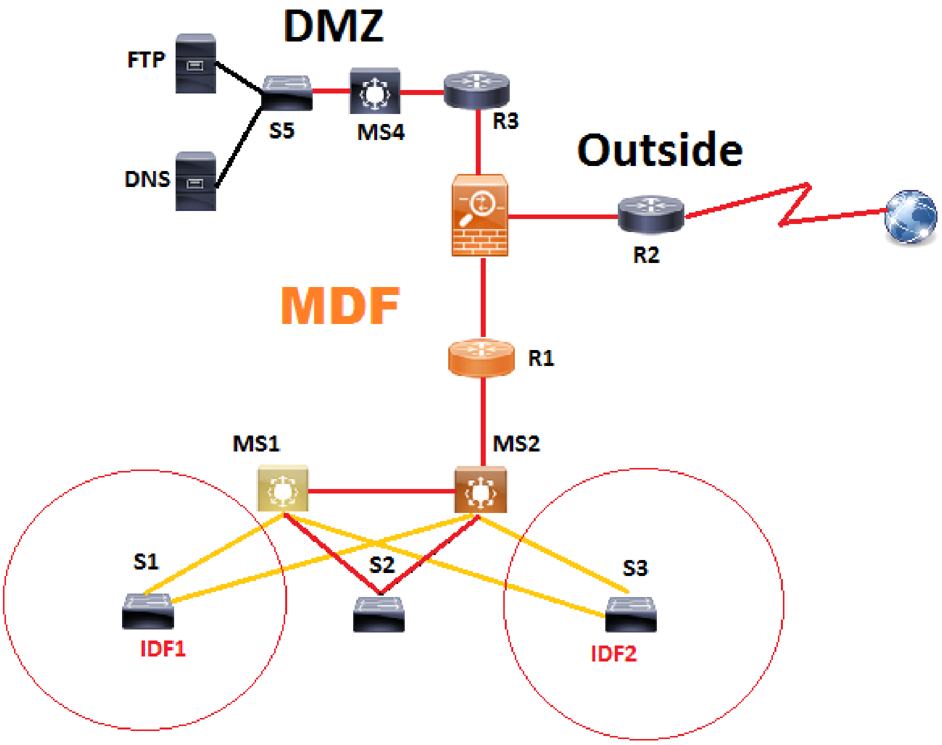
Active devices will be connected with each other with an excess number of wires, thanks to which the trouble-free operation of the network will be ensured. Two CISCO 2911 switches with patch panels will be placed in an Intermediate Distribution Frame (IDF) each. All but these two switches will be placed on the Main Distribution Frame (MDF).

Two IDFs will be connected to the MDF. MDF will also act as IDF for printers in the hallway, conference room and HR office.

IDF1 will include: Employee Room1 and Manager/Admin Room, and IDF1 will be connected to the sockets in Finance Room, Employee Room2 and the Reception.

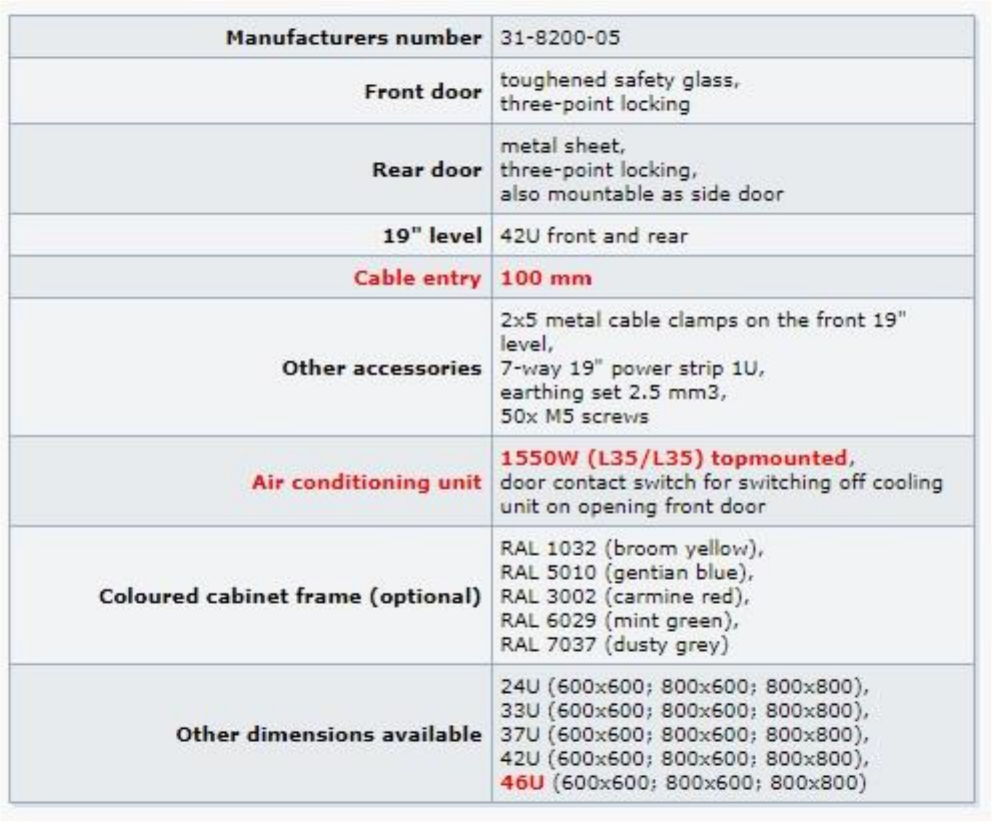
The network was made in an extended star topology, it will be based on MDF, which will be located in a well-protected room at the end of the corridor. It has no windows and requires multi-factor authentication to access it. In order to maintain the correct operating temperature and air humidity in the Control Room, the Midea MUB-36HRN1-R/MOU-36HN1-Rair conditioner will be installed.

4.5.2. MDF topology



4.5.3. Specification of network devices

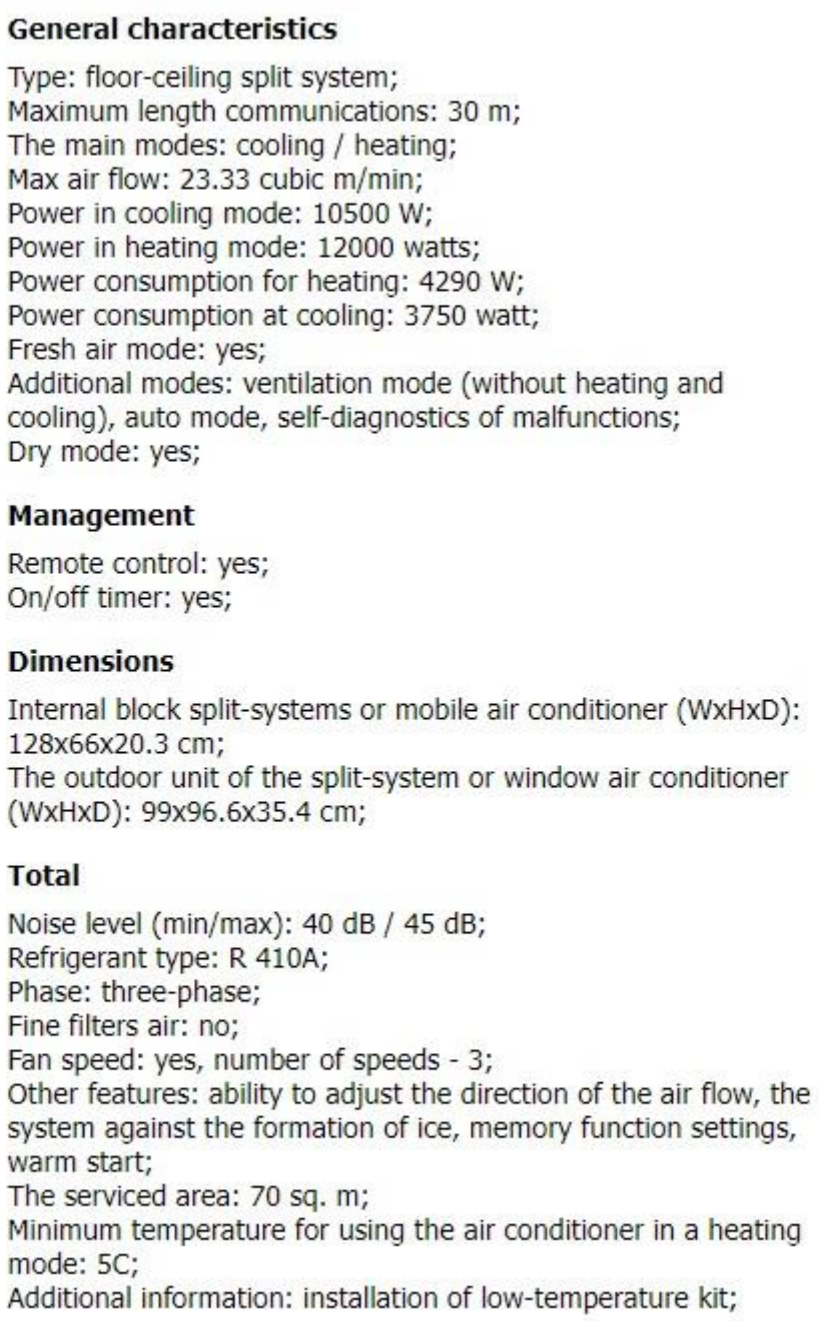
- Cabinet, 19", 42U, 'TiRAX cool-roof', 2000x800x800 mm (height,width,depth), IP 54, w/air conditioning [3]



Manufacturers number	31-8200-05
Front door	toughened safety glass, three-point locking
Rear door	metal sheet, three-point locking, also mountable as side door
19" level	42U front and rear
Cable entry	**100 mm**
Other accessories	2x5 metal cable clamps on the front 19" level, 7-way 19" power strip 1U, earthing set 2.5 mm3, 50x M5 screws
Air conditioning unit	**1550W (L35/L35) topmounted**, door contact switch for switching off cooling unit on opening front door
Coloured cabinet frame (optional)	RAL 1032 (broom yellow), RAL 5010 (gentian blue), RAL 3002 (carmine red), RAL 6029 (mint green), RAL 7037 (dusty grey)
Other dimensions available	24U (600x600; 800x600; 800x800), 33U (600x600; 800x600; 800x800), 37U (600x600; 800x600; 800x800), 42U (600x600; 800x600; 800x800), **46U** (600x600; 800x600; 800x800)

[3] https://www.atel-electronics.eu/produkt.php?hash=06215

- Midea MUB-36HRN1-R / MOU-36HN1-R[4]



General characteristics

Type: floor-ceiling split system;
Maximum length communications: 30 m;
The main modes: cooling / heating;
Max air flow: 23.33 cubic m/min;
Power in cooling mode: 10500 W;
Power in heating mode: 12000 watts;
Power consumption for heating: 4290 W;
Power consumption at cooling: 3750 watt;
Fresh air mode: yes;
Additional modes: ventilation mode (without heating and cooling), auto mode, self-diagnostics of malfunctions;
Dry mode: yes;

Management

Remote control: yes;
On/off timer: yes;

Dimensions

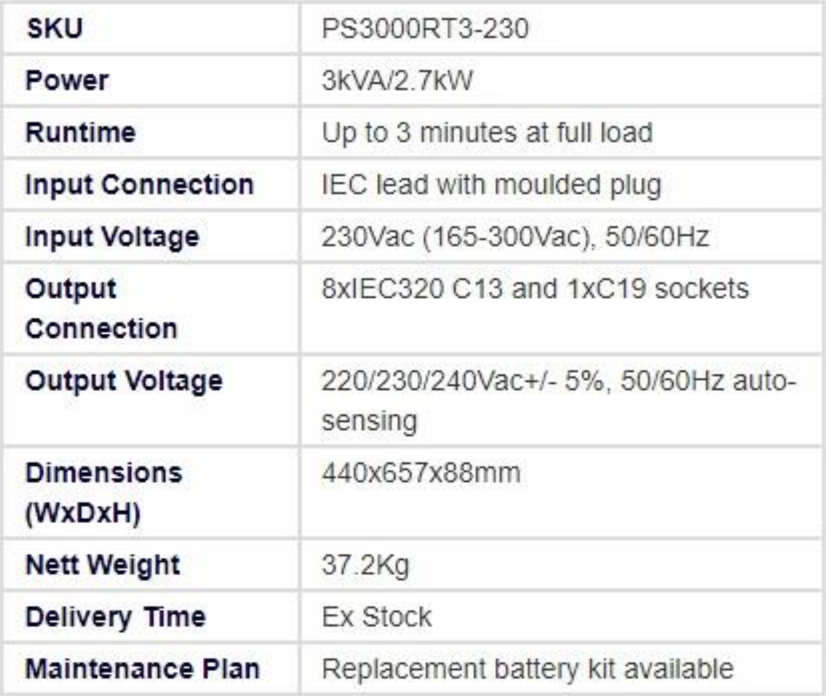
Internal block split-systems or mobile air conditioner (WxHxD): 128x66x20.3 cm;
The outdoor unit of the split-system or window air conditioner (WxHxD): 99x96.6x35.4 cm;

Total

Noise level (min/max): 40 dB / 45 dB;
Refrigerant type: R 410A;
Phase: three-phase;
Fine filters air: no;
Fan speed: yes, number of speeds - 3;
Other features: ability to adjust the direction of the air flow, the system against the formation of ice, memory function settings, warm start;
The serviced area: 70 sq. m;
Minimum temperature for using the air conditioner in a heating mode: 5C;
Additional information: installation of low-temperature kit;

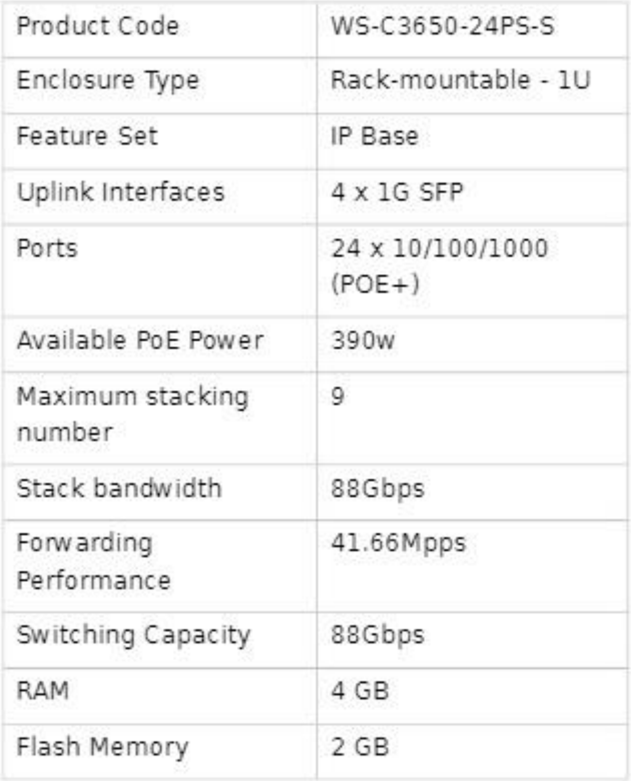
[4] http://specsan.com/air-conditioners-midea/midea-mub-36hrn1-r-mou-36hn1-r/

- Liebert PSI 3000VA Rackmount/Tower UPS[5]



SKU	PS3000RT3-230
Power	3kVA/2.7kW
Runtime	Up to 3 minutes at full load
Input Connection	IEC lead with moulded plug
Input Voltage	230Vac (165-300Vac), 50/60Hz
Output Connection	8xIEC320 C13 and 1xC19 sockets
Output Voltage	220/230/240Vac+/- 5%, 50/60Hz auto-sensing
Dimensions (WxDxH)	440x657x88mm
Nett Weight	37.2Kg
Delivery Time	Ex Stock
Maintenance Plan	Replacement battery kit available

- WS-C3650-24PS-S[6]

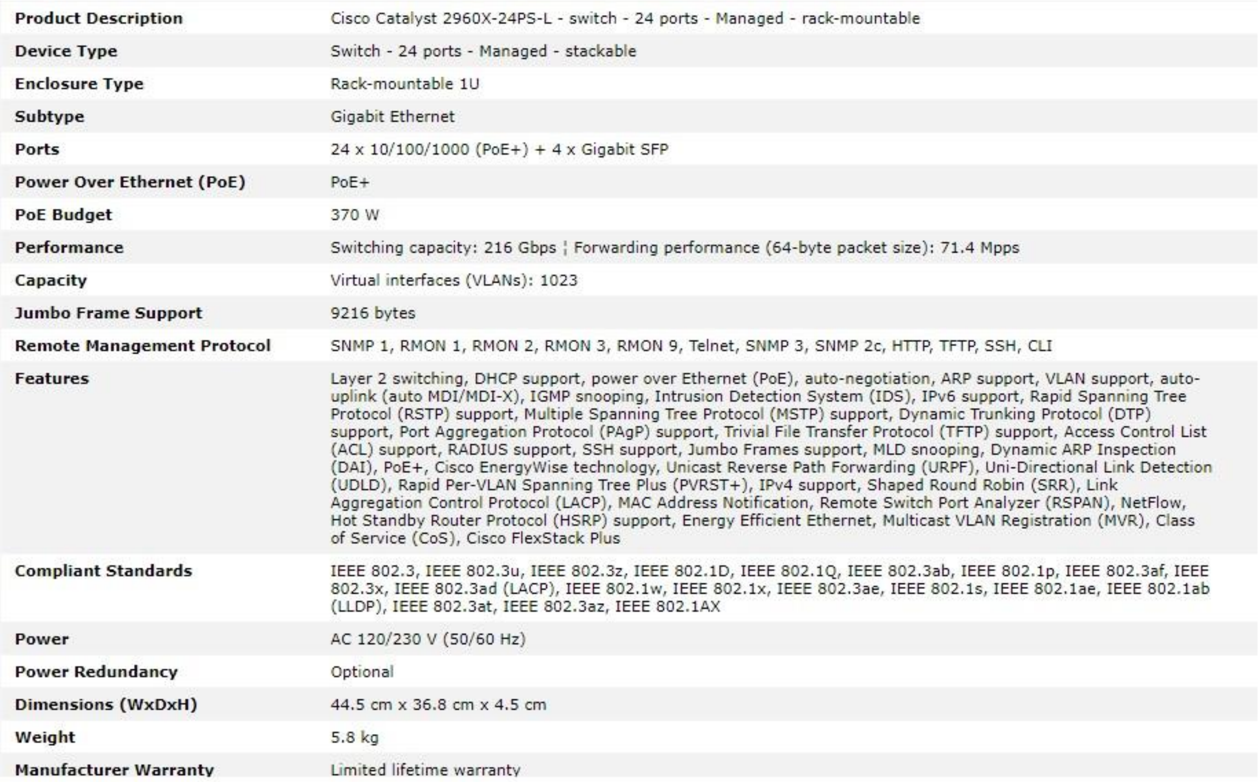


Product Code	WS-C3650-24PS-S
Enclosure Type	Rack-mountable - 1U
Feature Set	IP Base
Uplink Interfaces	4 x 1G SFP
Ports	24 x 10/100/1000 (POE+)
Available PoE Power	390w
Maximum stacking number	9
Stack bandwidth	88Gbps
Forwarding Performance	41.66Mpps
Switching Capacity	88Gbps
RAM	4 GB
Flash Memory	2 GB

[5] https://www.ecopowersupplies.com/emerson-network-power/liebert-psi-3000va-rackmount-tower-ups

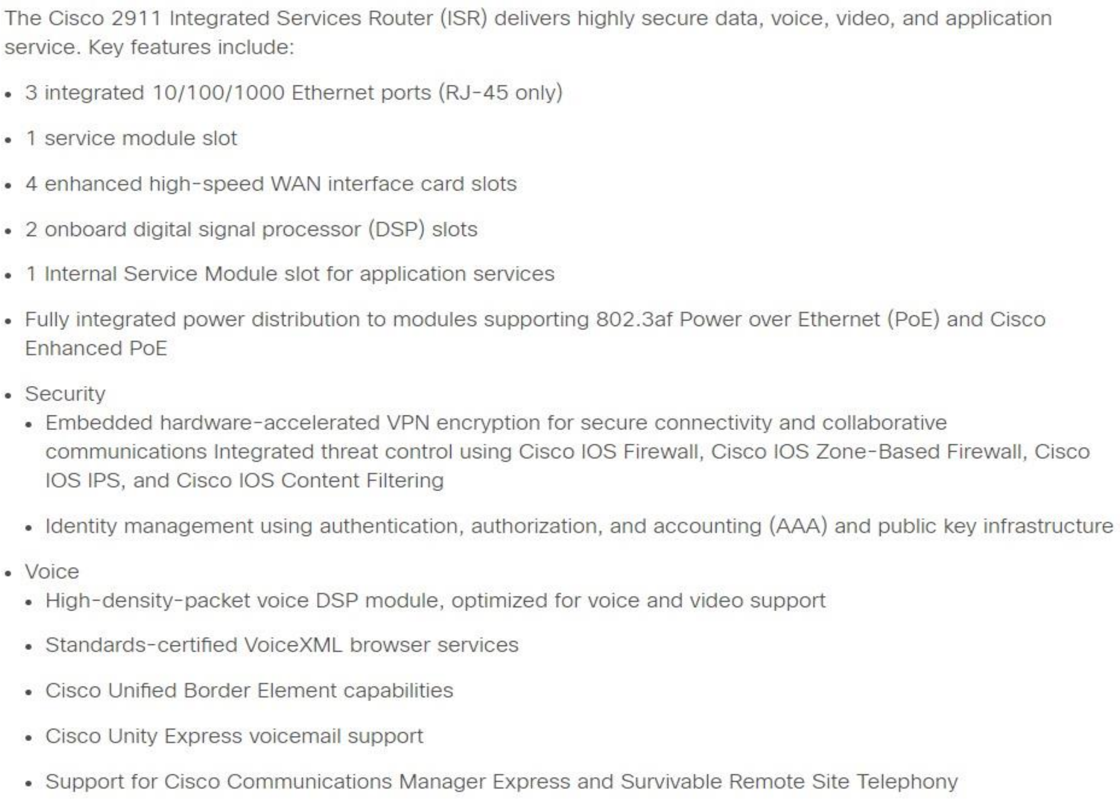
[6] https://issuu.com/routerswitch5/docs/cisco_catalyst_3650-24ps-s_datashee

- Cisco Catalyst 2960X-24PS-L[7]



Product Description	Cisco Catalyst 2960X-24PS-L - switch - 24 ports - Managed - rack-mountable
Device Type	Switch - 24 ports - Managed - stackable
Enclosure Type	Rack-mountable 1U
Subtype	Gigabit Ethernet
Ports	24 x 10/100/1000 (PoE+) + 4 x Gigabit SFP
Power Over Ethernet (PoE)	PoE+
PoE Budget	370 W
Performance	Switching capacity: 216 Gbps ¦ Forwarding performance (64-byte packet size): 71.4 Mpps
Capacity	Virtual interfaces (VLANs): 1023
Jumbo Frame Support	9216 bytes
Remote Management Protocol	SNMP 1, RMON 1, RMON 2, RMON 3, RMON 9, Telnet, SNMP 3, SNMP 2c, HTTP, TFTP, SSH, CLI
Features	Layer 2 switching, DHCP support, power over Ethernet (PoE), auto-negotiation, ARP support, VLAN support, auto-uplink (auto MDI/MDI-X), IGMP snooping, Intrusion Detection System (IDS), IPv6 support, Rapid Spanning Tree Protocol (RSTP) support, Multiple Spanning Tree Protocol (MSTP) support, Dynamic Trunking Protocol (DTP) support, Port Aggregation Protocol (PAgP) support, Trivial File Transfer Protocol (TFTP) support, Access Control List (ACL) support, RADIUS support, SSH support, Jumbo Frames support, MLD snooping, Dynamic ARP Inspection (DAI), PoE+, Cisco EnergyWise technology, Unicast Reverse Path Forwarding (URPF), Uni-Directional Link Detection (UDLD), Rapid Per-VLAN Spanning Tree Plus (PVRST+), IPv4 support, Shaped Round Robin (SRR), Link Aggregation Control Protocol (LACP), MAC Address Notification, Remote Switch Port Analyzer (RSPAN), NetFlow, Hot Standby Router Protocol (HSRP) support, Energy Efficient Ethernet, Multicast VLAN Registration (MVR), Class of Service (CoS), Cisco FlexStack Plus
Compliant Standards	IEEE 802.3, IEEE 802.3u, IEEE 802.3z, IEEE 802.1D, IEEE 802.1Q, IEEE 802.3ab, IEEE 802.1p, IEEE 802.3af, IEEE 802.3x, IEEE 802.3ad (LACP), IEEE 802.1w, IEEE 802.1x, IEEE 802.3ae, IEEE 802.1s, IEEE 802.1ae, IEEE 802.1ab (LLDP), IEEE 802.3at, IEEE 802.3az, IEEE 802.1AX
Power	AC 120/230 V (50/60 Hz)
Power Redundancy	Optional
Dimensions (WxDxH)	44.5 cm x 36.8 cm x 4.5 cm
Weight	5.8 kg
Manufacturer Warranty	Limited lifetime warranty

- CISCO2911/K9

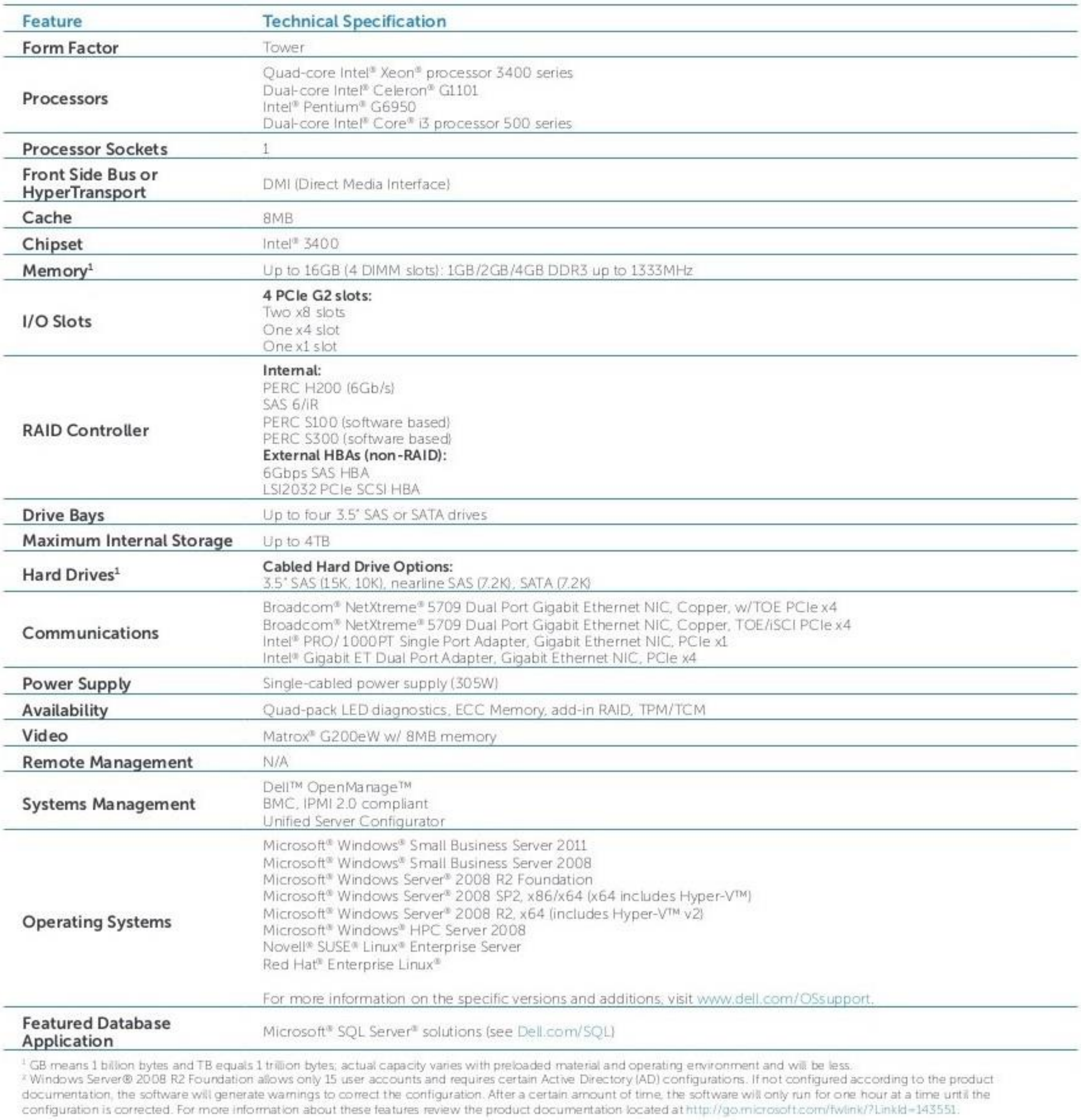


The Cisco 2911 Integrated Services Router (ISR) delivers highly secure data, voice, video, and application service. Key features include:

- 3 integrated 10/100/1000 Ethernet ports (RJ-45 only)
- 1 service module slot
- 4 enhanced high-speed WAN interface card slots
- 2 onboard digital signal processor (DSP) slots
- 1 Internal Service Module slot for application services
- Fully integrated power distribution to modules supporting 802.3af Power over Ethernet (PoE) and Cisco Enhanced PoE
- Security
  - Embedded hardware-accelerated VPN encryption for secure connectivity and collaborative communications Integrated threat control using Cisco IOS Firewall, Cisco IOS Zone-Based Firewall, Cisco IOS IPS, and Cisco IOS Content Filtering
  - Identity management using authentication, authorization, and accounting (AAA) and public key infrastructure
- Voice
  - High-density-packet voice DSP module, optimized for voice and video support
  - Standards-certified VoiceXML browser services
  - Cisco Unified Border Element capabilities
  - Cisco Unity Express voicemail support
  - Support for Cisco Communications Manager Express and Survivable Remote Site Telephony

[7] https://www.elara.ie/productdetail.aspx?manufacturer=CISCO&mancode=WS-C2960X-24PS-L

- Dell PowerEdge T1100 Rack Server [8]



Feature	Technical Specification
Form Factor	Tower
Processors	Quad-core Intel® Xeon® processor 3400 series Dual-core Intel® Celeron® G1101 Intel® Pentium® G6950 Dual-core Intel® Core® i3 processor 500 series
Processor Sockets	1
Front Side Bus or HyperTransport	DMI (Direct Media Interface)
Cache	8MB
Chipset	Intel® 3400
Memory[1]	Up to 16GB (4 DIMM slots): 1GB/2GB/4GB DDR3 up to 1333MHz
I/O Slots	**4 PCIe G2 slots:** Two x8 slots One x4 slot One x1 slot
RAID Controller	**Internal:** PERC H200 (6Gb/s) SAS 6/iR PERC S100 (software based) PERC S300 (software based) **External HBAs (non-RAID):** 6Gbps SAS HBA LSI2032 PCIe SCSI HBA
Drive Bays	Up to four 3.5" SAS or SATA drives
Maximum Internal Storage	Up to 4TB
Hard Drives[1]	**Cabled Hard Drive Options:** 3.5" SAS (15K, 10K), nearline SAS (7.2K), SATA (7.2K)
Communications	Broadcom® NetXtreme® 5709 Dual Port Gigabit Ethernet NIC, Copper, w/TOE PCIe x4 Broadcom® NetXtreme® 5709 Dual Port Gigabit Ethernet NIC, Copper, TOE/iSCI PCIe x4 Intel® PRO/ 1000PT Single Port Adapter, Gigabit Ethernet NIC, PCIe x1 Intel® Gigabit ET Dual Port Adapter, Gigabit Ethernet NIC, PCIe x4
Power Supply	Single-cabled power supply (305W)
Availability	Quad-pack LED diagnostics, ECC Memory, add-in RAID, TPM/TCM
Video	Matrox® G200eW w/ 8MB memory
Remote Management	N/A
Systems Management	Dell™ OpenManage™ BMC, IPMI 2.0 compliant Unified Server Configurator
Operating Systems	Microsoft® Windows® Small Business Server 2011 Microsoft® Windows® Small Business Server 2008 Microsoft® Windows Server® 2008 R2 Foundation Microsoft® Windows Server® 2008 SP2, x86/x64 (x64 includes Hyper-V™) Microsoft® Windows Server® 2008 R2, x64 (includes Hyper-V™ v2) Microsoft® Windows® HPC Server 2008 Novell® SUSE® Linux® Enterprise Server Red Hat® Enterprise Linux® For more information on the specific versions and additions, visit www.dell.com/OSsupport.
Featured Database Application	Microsoft® SQL Server® solutions (see Dell.com/SQL)

[1] GB means 1 billion bytes and TB equals 1 trillion bytes; actual capacity varies with preloaded material and operating environment and will be less.

[2] Windows Server® 2008 R2 Foundation allows only 15 user accounts and requires certain Active Directory (AD) configurations. If not configured according to the product documentation, the software will generate warnings to correct the configuration. After a certain amount of time, the software will only run for one hour at a time until the configuration is corrected. For more information about these features review the product documentation located at http://go.microsoft.com/fwlink/?LinkId=143551.

[8] https://www.slideshare.net/PascalJanot/dell-poweredge-t110-spec-sheet

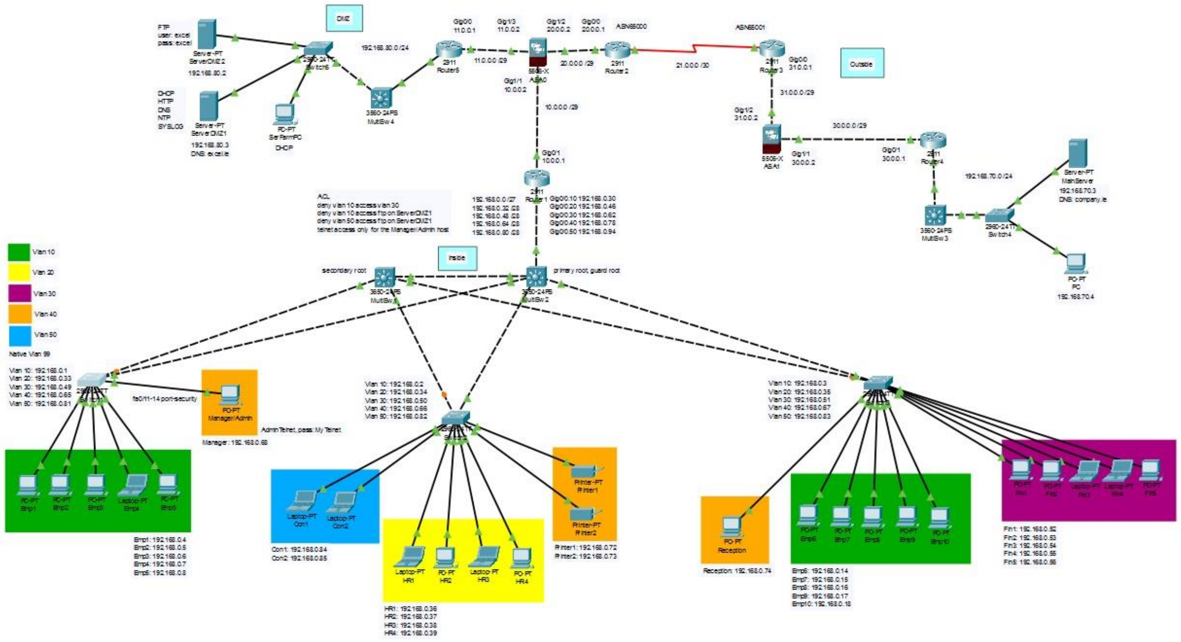
5. Building a LAN

To take a closer look at the process of building a LAN, let me walk you through the Cisco Packet Tracer simulator. I will show the configuration of the devices selected above, network functionality and, of course, applications related to its security.

5.1. Subnetting and Addressing

All IP addresses, subnetting, VLANs, etc. can be found in the sheets attached to the project: Connection Addressing, Subnetting for LAN.

5.2. Topology

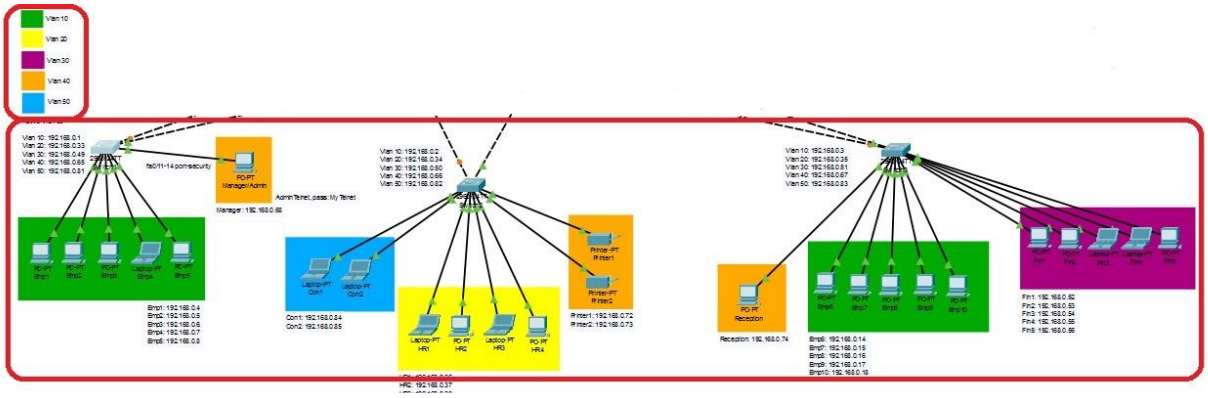


5.3. End Devices layer

I started by allocating individual departments to VLANs, according to their purpose. I combined some rooms or parts of devices from different locations of the building into a shared VLAN. I believe that dividing them into smaller VLANs would not be too necessary here.

Switch1 is in IDF1, Switch two is in MDF, and Switch 3 is located in IDF2.

The diagram below shows the individual VLANS and the access devices.

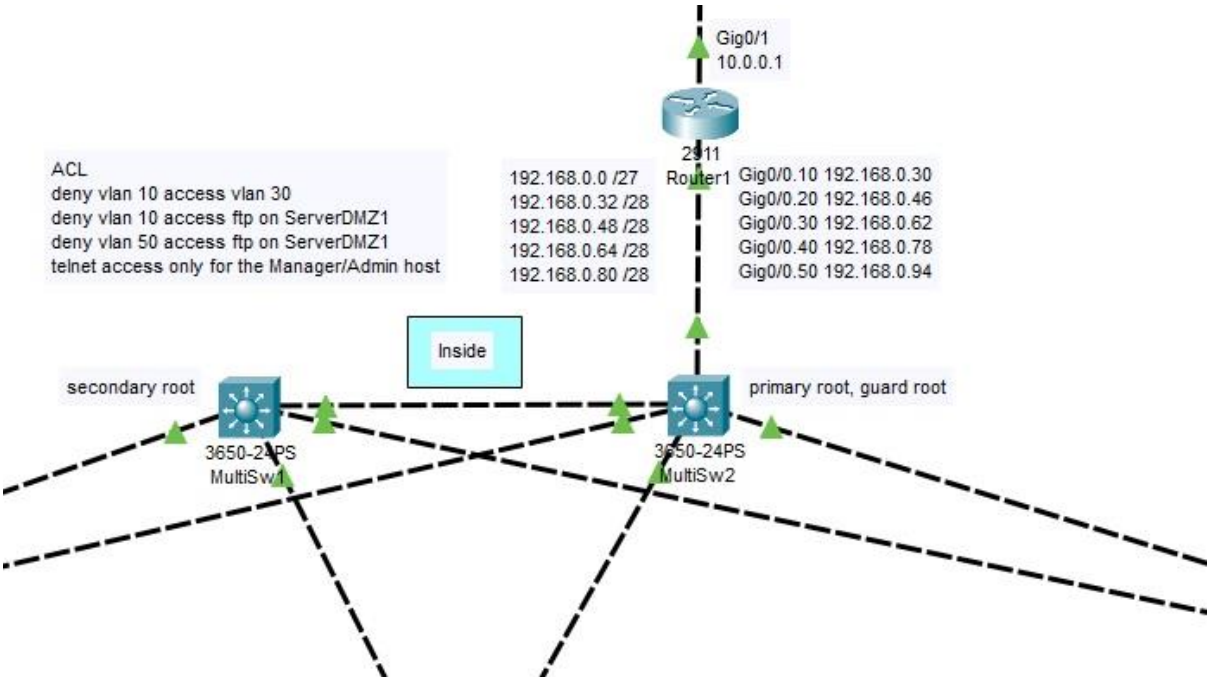


An example of the configuration (command lines for creating VLANs with addressing) on the Switch is given below.

```
config terminal
vlan 10
name Employee
vlan 20
name HR
vlan 30
name Finance
vlan 40
name Management
vlan 50
name consultastion
int range fa0/1-10
switchport mode access
switchport access vlan 10
int range fa0/11-14
switchport mode access
switchport access vlan 40
int vlan 10
ip address 192.168.0.1 255.255.255.224
int vlan 20
ip address 192.168.0.33 255.255.255.240
int vlan 30
ip address 192.168.0.49 255.255.255.240
int vlan 40
ip address 192.168.0.65 255.255.255.240
int vlan 50
ip address 192.168.0.81 255.255.255.240
```

5.4. Distribution and Core layers

After assigning each department to a VLAN, I configure the distribution layer along with the core layer.



I designate the traffic network here. I connect all 3 Switches 2960 with each Multilayer Switch, and I also connect these with each other. Thus, we have redundant connections. From now on, in case of failure of one of the cables connecting the lower switches with the multilayer switch, the transmission will go through another. MultiSwitch2 works as Primary Root here, which means that traffic from all lower switches goes to it first. I used Router On The Stick here, it is a method of routing between VLANs. It has a single physical or logical connection to the network, in other words, the router is connected to the switch with a single cable. This diverts traffic between locally attached hosts in separate logical routing domains. The discussed configuration on Multi-Switch and Router is listed below.

MultiSwitch2

```
config terminal

vlan 10

name Employee

vlan 20

name HR

vlan 30

name Finance

vlan 40

name Management

vlan 50
```

```
name Consultation
spanning-tree vlan 1-4094 root primary
int range g1/0/1-24
spanning-tree guard root
int range g1/1/1-4
spanning-tree guard root
```

Router1

```
int g0/0.10
encapsulation dot1Q 10
ip address 192.168.0.30 255.255.255.224
exit
int g0/0.20
encapsulation dot1Q 20
ip address 192.168.0.46 255.255.255.240
exit
int g0/0.30
encapsulation dot1Q 30
ip address 192.168.0.62 255.255.255.240
exit
int g0/0.40
encapsulation dot1Q 40
ip address 192.168.0.78 255.255.255.240
exit
int g0/0.50
encapsulation dot1Q 50
ip address 192.168.0.94 255.255.255.240
exit
int g0/0
no shut
int gi0/1
ip address 10.0.0.1 255.255.255.248
no shut
```

6. Over the LAN network – ASA and Outside and DMZ

Before we discuss the firewall application in detail, let's create a connection with the company's headquarters and DMZ, also known as a separate server zone (server farm).

6.1. Routing

First of all, we need to create routing on all servers and ASAs. I used RIP on local networks, and I used BGP for WAN connection. Border Gateway Protocol (BGP) refers to a gateway protocol that allows the Internet to exchange routing information between autonomous systems (AS). BGP enables peering. Special BGP attributes allow for greater flexibility and to make complex decisions about choosing the best routes. RIP is a distance vector routing protocol but has a slow convergence time.

Examples of routing commands below.

Router1 (RIP)

```
Router rip

Network 192.168.0.0

Network 192.168.0.32

Network 192.168.0.48

Network 192.168.0.64

Network 192.168.0.80

Network 209.165.200.224
```

Router2 (BGP)

```
Router bgp 65000

bgp log-neighbor-changes

no synchronization

neighbor 21.0.0.2 remote-as 65001

network 20.0.0.0 mask 255.255.255.248
```

6.2. Firewalls

CISCO ASA, next to routers and switches, is another network device whose main task is to protect our network against intruders and unauthorized access. This protection works by blocking illegal network traffic. The ASA device in the network controlled by us acts as a firewall.

6.2.1. ASA1

This firewall is to protect our network against access from outside and from the DMZ. I have defined a set of rules protecting the local network against unauthorized access from the DMZ zone and the Outside zone, ensuring simultaneous access to them.

ASA1 configuration

```
hostname ASA
int gi1/1
no ip address
no nameif
no security-level
exit
int gi1/2
no nameif
no security-level
no ip address dhcp
exit
int gi1/3
no nameif
no security-level
no ip address dhcp
exit
int gi1/1
ip address 10.0.0.2 255.255.255.248
nameif Inside
security-level 100
no shut
exit
int gi1/2
ip address 20.0.0.2 255.255.255.248
nameif Outside
security-level 0
no shut
exit
int gi1/3
ip address 11.0.0.2 255.255.255.248
nameif DMZ
```

```
security-level 70
no shut
exit
Router rip
Network 10.0.0.0
Network 11.0.0.0
Network 20.0.0.0
object network INSIDE-NET
subnet 192.168.0.0 255.255.255.224
subnet 192.168.0.32 255.255.255.240
subnet 192.168.0.48 255.255.255.240
subnet 192.168.0.64 255.255.255.240
subnet 192.168.0.80 255.255.255.240
subnet 10.0.0.0 255.0.0.0
nat (inside,outside) dynamic interface
exit
conf t
class-map inspection_default
match default-inspection-traffic
exit
policy-map global_policy
class inspection_default
inspect icmp
exit
service-policy global_policy global
policy-map global_policy
class inspection_default
inspect http
exit
policy-map global_policy
class inspection_default
inspect dns
```

```
exit
policy-map global_policy
class inspection_default
inspect ftp
exit
conf t
object network INSIDE-DMZ
subnet 192.168.0.0 255.255.255.224
subnet 192.168.0.32 255.255.255.240
subnet 192.168.0.48 255.255.255.240
subnet 192.168.0.64 255.255.255.240
subnet 192.168.0.80 255.255.255.240
subnet 10.0.0.0 255.0.0.0
nat (inside,dmz) dynamic interface
exit
conf t
class-map inspection_inside_dmz
match default-inspection-traffic
exit
policy-map inside_dmz_policy
class inspection_inside_dmz
inspect icmp
exit
conf t
service-policy inside_dmz_policy interface inside
policy-map inside_dmz_policy
class inspection_inside_dmz
inspect http
exit
policy-map inside_dmz_policy
class inspection_inside_dmz
inspect dns
```

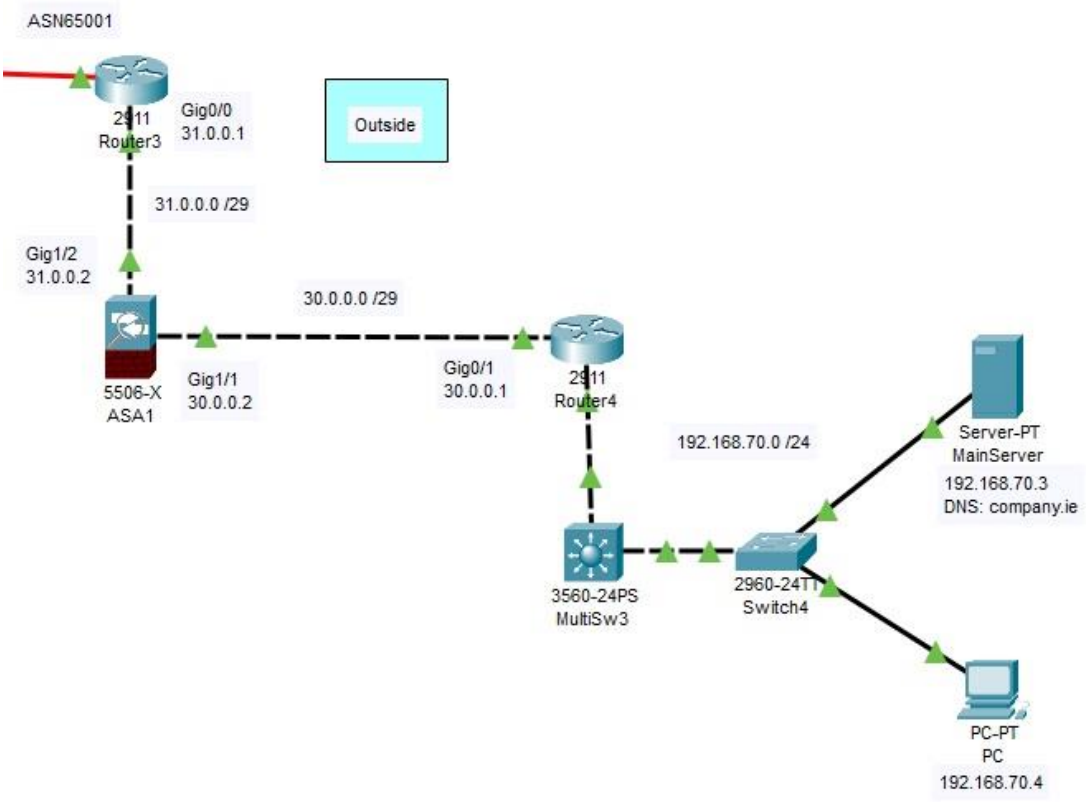
```
policy-map inside_dmz_policy
class inspection_inside_dmz
inspect ftp
exit
object network DMZ-OUTSIDE
subnet 11.0.0.0 255.255.255.248
subnet 192.168.80.0 255.255.255.0
nat (dmz,outside) dynamic interface
exit
conf t
class-map inspection_dmz_outside
match default-inspection-traffic
exit
policy-map dmz_outside_policy
class inspection_dmz_outside
inspect icmp
exit
service-policy dmz_outside_policy interface dmz
policy-map dmz_outside_policy
class inspection_dmz_outside
inspect http
inspect dns
inspect ftp
exit
```

6.2.2. ASA2

The second firewall is on the Dublin side. I assumed they had agreed to set the ASA Security Level to 0 during testing so that I could check our communication with their network.

6.2.3. Outside

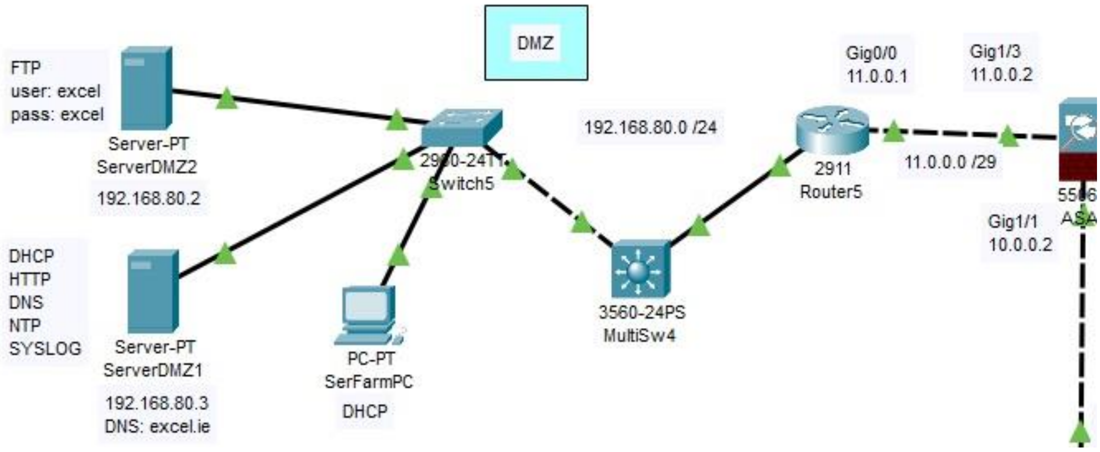
On this side I put one computer and a server. The connection of devices is similar to our side, the Switch connected to the Multi-Layer Switch and the Routers going towards the WAN.



6.2.3. DMZ

Here is a server farm and internet access. It is important that this part of the network is well secured. There are two servers here, one of which has only FTP service. The second one has active DHCP (used only on the DMZ side), DNS, HTTP, SYSLOG, NTP.

Access to this zone is possible only from the Inside zone (from our LAN network). Later, I will assign the access control list to the ASA for the outside computer so that it can also access one of the server's services.



7. Security implementation and configuration

Once we have the entire network created with proper routing, we should focus on its security. I will break this chapter down into sections. First, I will discuss the designed LAN network, I will determine the appropriately selected permissions for individual VLANs.

7.1. Secured LAN

Let's focus on the correct security and configuration of our switches, starting from the end point. After that we will go up to the router and then to the firewall.

7.1.2. Native VLAN

The default native VLAN on CISCO switches is VLAN 1, the one to which all switch ports belong before virtual networks are implemented. Good network security practice is to move the native VLAN to a different network than the default one, preferably one that is separated from other VLANs, of course only when the native VLAN does not carry some actual traffic that is desired in the network. Trunks, known as 802.1Q buses, can handle traffic from different VLANs, tagged traffic, but also traffic outside of the VLAN.

The commands must be executed on each Switch that has a VLANs assigned to it, each connected port.

Configuration example on Switch1

```
interface GigabitEthernet0/1

switchport trunk native vlan 99

switchport trunk allowed vlan 10,20,30,40,50,99

switchport mode trunk

interface GigabitEthernet0/2

switchport trunk native vlan 99

switchport trunk allowed vlan 10,20,30,40,50,99

switchport mode trunk
```

7.1.3. Guard Root

Root Guard is an STP feature that is enabled for each port. Prevents the configured port from becoming the root port. Root Guard prevents a switch (often misconfigured or bogus) from becoming a root bridge in a topology.

guard root configuration on Multi-Layer Switch 2

```
int range g1/0/1-24

spanning-tree guard root

int range g1/1/1-4

spanning-tree guard root
```

7.1.4. Port Security

Port Security is a type of security that allows you to transmit frames only to trusted devices, not everyone connected to the switch. Thanks to the appropriate configuration of this functionality, we will secure the network in such a way that only one computer can use a given port. The switch saves the MAC addresses of individual computers as trusted. I decided to assign a security port for the Management Department on Switch1 (Manager/Admin Office), because the most important data flows through these ports, incl. only here and only from one host is it possible to access telnet.

Security port commands used on Switch1

```
int range fa0/11-14

switchport mode access

switchport port-security

switchport port-security maximum 1

switchport port-security mac-address sticky

switchport port-security violation shutdown
```

7.1.5. VLANs and security

By creating VLANs, we divide our network into many smaller logical parts. In addition, we reduce the number of devices participating in the broadcast, and thus maintain the efficiency of our network at a high level. We can assign appropriate permissions for each VLAN allowing access to special resources and in the case of using security solutions.

7.1.5. Access Control Lists

I used all the following access control lists commands on the main LAN router (Router1)

- **No communication between VLANs 10 and 30.** In accordance with the ordering party's instructions, I limited unnecessary communication between the Employee and Finance Departments.

  ```
  ip access-list extended Block_Emp-Fin

  deny ip 192.168.0.0 0.0.0.31 any

  permit ip any any

  exit

  int g0/0.30

  ip access-group Block_Emp-Fin OUT
  ```

- **No access to FTP Server for VLANs 10 and 50**. Some departments should be blocked from accessing important corporate files on the FTP server.

  ```
  ip access-list extended ftp10
  deny tcp 192.168.0.0 0.0.0.31 host 192.168.80.2 eq ftp
  permit ip any any
  exit
  ```

```
int g0/0.10
ip access-group ftp10 IN
exit
ip access-list extended ftp50
deny tcp 192.168.0.80 0.0.0.15 host 192.168.80.2 eq ftp
permit ip any any
exit
int g0/0.50
ip access-group ftp50 IN
exit
```

- **Telnet access.** Telnet is an internet protocol that allows you to connect to another computer on your local network or the Internet. Take measures to protect your computer from unauthorized remote access. It is important that it is available only to an authenticated user, and that the password to it is encrypted.

```
line vty 0 4
password MyTelnet
login
exit
ip access-list extended AdminTelnet
10 permit tcp host 192.168.0.68 any eq telnet
line vty 0 4
access-class AdminTelnet in
exit
```

7.1.6. Passwords

It is good practice to use passwords to access all network devices.

Below I provide passwords for routers, switches, as well as server services in our LAN network.

All Routers in LAN: excel

All Switches: excel

FTP Server: user: excel, password: excel

Telnet: MyTelnet

```
line con 0
password excel
```

```
logging synchronous

login

history size 10 #sets the number of previous commands stored in the session history

exec-timeout 6 50 #after 410 seconds of inactivity, the session will be disconnected, and the user will need to supply the console password to log back in

exit
```

7.1.7 Failover

I mentioned earlier about using additional connections to ensure network reliability. I could increase the reliability of the LAN by adding another cable that would connect Multilayer Switch1 with Router1, then I would have to add a cross-over cable length of 1 meter. I leave the decision for analysis; it would also require adding the configuration on the GigabithEthernet0/2 port of the Router.

7.2. ASAs

Cisco ASA is a security platform that implements, among others firewall functions. I have configured traffic on ASA ports. Anyone who tries to access our network from outside and from the DMZ is blocked, but at the same time has access to them. It is a good practice to protect the network against unauthorized intrusion, thanks to which the network is very well secured. This is how ASA firewalls work.

Below I present the ASA1 configuration.

```
hostname ASA

int gi1/1

no ip address

no nameif

no security-level

exit

int gi1/2

no nameif

no security-level

no ip address dhcp

exit

int gi1/3

no nameif

no security-level

no ip address dhcp

exit
```

```
int gi1/1
ip address 10.0.0.2 255.255.255.248
nameif Inside
security-level 100
no shut
exit
int gi1/2
ip address 20.0.0.2 255.255.255.248
nameif Outside
security-level 0
no shut
exit
int gi1/3
ip address 11.0.0.2 255.255.255.248
nameif DMZ
security-level 70
no shut
exit
Router rip
Network 10.0.0.0
Network 11.0.0.0
Network 20.0.0.0
object network INSIDE-NET
subnet 192.168.0.0 255.255.255.224
subnet 192.168.0.32 255.255.255.240
subnet 192.168.0.48 255.255.255.240
subnet 192.168.0.64 255.255.255.240
subnet 192.168.0.80 255.255.255.240
subnet 10.0.0.0 255.255.255.248
nat (inside,outside) dynamic interface
exit
```

```
conf t
class-map inspection_default
match default-inspection-traffic
exit
policy-map global_policy
class inspection_default
inspect icmp
exit
service-policy global_policy global
policy-map global_policy
class inspection_default
inspect http
exit
policy-map global_policy
class inspection_default
inspect dns
exit
policy-map global_policy
class inspection_default
inspect ftp
exit
conf t
object network INSIDE-DMZ
subnet 192.168.0.0 255.255.255.224
subnet 192.168.0.32 255.255.255.240
subnet 192.168.0.48 255.255.255.240
subnet 192.168.0.64 255.255.255.240
subnet 192.168.0.80 255.255.255.240
subnet 10.0.0.0 255.255.255.248
nat (inside,dmz) dynamic interface
exit
```

```
conf t

class-map inspection_inside_dmz

match default-inspection-traffic

exit

policy-map inside_dmz_policy

class inspection_inside_dmz

inspect icmp

exit

conf t

service-policy inside_dmz_policy interface inside

policy-map inside_dmz_policy

class inspection_inside_dmz

inspect http

exit

policy-map inside_dmz_policy

class inspection_inside_dmz

inspect dns

policy-map inside_dmz_policy

class inspection_inside_dmz

inspect ftp

exit

object network DMZ-OUTSIDE

subnet 11.0.0.0 255.255.255.248

subnet 192.168.80.0 255.255.255.0

nat (dmz,outside) dynamic interface

exit

conf t

class-map inspection_dmz_outside

match default-inspection-traffic

exit

policy-map dmz_outside_policy
```

```
class inspection_dmz_outside
inspect icmp
exit
service-policy dmz_outside_policy interface dmz
policy-map dmz_outside_policy
class inspection_dmz_outside
inspect http
inspect dns
inspect ftp
exit
```

It is also a good practice to secure ASA by adding a password on it. This is done with the command: *enable password*

8. Conclusion

Reliable, efficient, functional, and secure network infrastructure is the basis of every company today. All network services critical to maintaining business continuity are based on a well-designed and implemented computer network. Properly designed infrastructure should meet business expectations and ensure business continuity. The proper functioning of the network is influenced by many interdependent factors that should be considered already at the LAN design stage.

However, it should be remembered that the implementation of appropriate devices along with the correct configuration of their functionality is not everything. Current analysis and planning, appropriate policies, and procedures and, above all, competent IT staff also count.

The corporate network is a dynamic environment that evolves with the development of each enterprise. The bandwidth requirements of LAN / WAN connections are increasing regularly. It may be necessary from time to time to implement new systems that will improve and optimize work. Such infrastructure requires further analysis and interference with the existing architecture.

Excel Finance should take these facts into account.

The project includes this report, a simulation performed in Cisco Packet Tracer version 7.3.1, worksheets that can help you locate ports, understand addressing and routing.

9. References

Students.mimuw.edu.pl, *Introducing Network Design Concepts*, Available at: https://students.mimuw.edu.pl/~zbyszek/sieci/CCNA4%20Sample.pdf

DukeIOT, FEB 2016, *Communication Facilities Construction Design Standards*, Available at: https://oit.duke.edu/sites/default/files/atoms/files/Design_2016.pdf

Atel-electronics.eu, *Server Cabinet, rack 19", 42U, 'TiRAX cool-roof', 2000x800x800 mm (height,width,depth), IP 54, w/air conditioning,* Available at: https://www.atelelectronics.eu/produkt.php?hash=06215

Specsan.com, *Midea MUB-36HRN1-R / MOU-36HN1-R Air conditioning specs, reviews and features*, Available at: http://specsan.com/air-conditioners-midea/midea-mub-36hrn1-r-mou-36hn1-r/

Ecopowersupplies.com, *Emerson Liebert PSI 3000VA Rackmount/Tower UPS UPS Systems | PS3000RT3-230*, Available at: https://www.ecopowersupplies.com/emerson-network-power/liebert-psi-3000va-rackmount-tower-ups

Issuu, *Cisco catalyst 3650 24ps s datasheet*, Available at: https://issuu.com/routerswitch5/docs/cisco_catalyst_3650-24ps-s_datashee

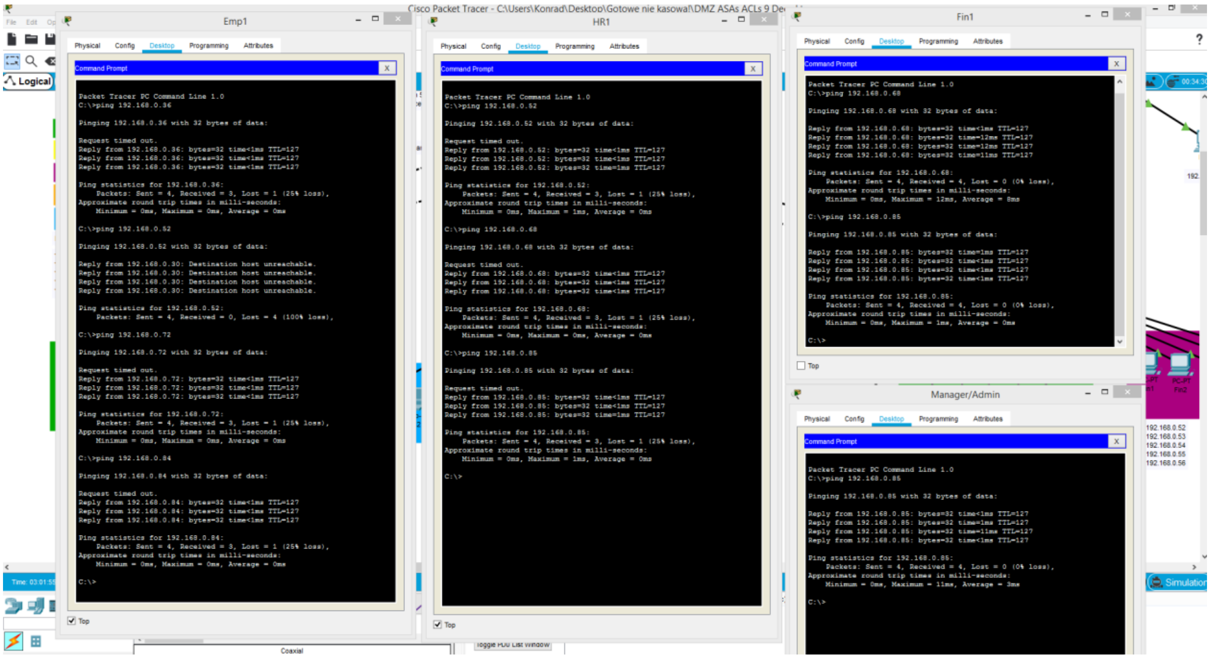
www.elara.ie/, *Buy Online - WS-C2960X-24PS-L - CISCO Cisco Catalyst 2960X-24PS - Elara Online Ireland*, Available at: https://www.elara.ie/productdetail.aspx?manufacturer=CISCO&mancode=WS-C2960X-24PS-L

Slideshare.net, *Dell poweredge t110 spec sheet*, Available at: https://www.slideshare.net/PascalJanot/dell-poweredge-t110-spec-sheet

Saim Ghafoor, *COMM_IT801 - LY_ICYBR_B: Secure Communication Infrastructure (2021/22),* Available at: https://lyitbb.blackboard.com/ultra/courses/_52520_1/cl/outline

10. Appendix – Connectivity tests

10.1. Communication between VLANs



Emp1:

```
Packet Tracer PC Command Line 1.0
C:\>ping 192.168.0.36

Pinging 192.168.0.36 with 32 bytes of data:

Request timed out.
Reply from 192.168.0.36: bytes=32 time<1ms TTL=127
Reply from 192.168.0.36: bytes=32 time<1ms TTL=127
Reply from 192.168.0.36: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.0.36:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 192.168.0.52

Pinging 192.168.0.52 with 32 bytes of data:

Reply from 192.168.0.30: Destination host unreachable.
Reply from 192.168.0.30: Destination host unreachable.
Reply from 192.168.0.30: Destination host unreachable.
Reply from 192.168.0.30: Destination host unreachable.

Ping statistics for 192.168.0.52:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\>ping 192.168.0.72

Pinging 192.168.0.72 with 32 bytes of data:

Request timed out.
Reply from 192.168.0.72: bytes=32 time<1ms TTL=127
Reply from 192.168.0.72: bytes=32 time<1ms TTL=127
Reply from 192.168.0.72: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.0.72:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 192.168.0.84

Pinging 192.168.0.84 with 32 bytes of data:

Request timed out.
Reply from 192.168.0.84: bytes=32 time<1ms TTL=127
Reply from 192.168.0.84: bytes=32 time<1ms TTL=127
Reply from 192.168.0.84: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.0.84:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

☑ Top

HR1:

```
Packet Tracer PC Command Line 1.0
C:\>ping 192.168.0.52

Pinging 192.168.0.52 with 32 bytes of data:

Request timed out.
Reply from 192.168.0.52: bytes=32 time<1ms TTL=127
Reply from 192.168.0.52: bytes=32 time<1ms TTL=127
Reply from 192.168.0.52: bytes=32 time=1ms TTL=127

Ping statistics for 192.168.0.52:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 192.168.0.68

Pinging 192.168.0.68 with 32 bytes of data:

Request timed out.
Reply from 192.168.0.68: bytes=32 time<1ms TTL=127
Reply from 192.168.0.68: bytes=32 time<1ms TTL=127
Reply from 192.168.0.68: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.0.68:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 192.168.0.85

Pinging 192.168.0.85 with 32 bytes of data:

Request timed out.
Reply from 192.168.0.85: bytes=32 time<1ms TTL=127
Reply from 192.168.0.85: bytes=32 time<1ms TTL=127
Reply from 192.168.0.85: bytes=32 time=1ms TTL=127

Ping statistics for 192.168.0.85:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>
```

☑ Top

Fin1:

```
Packet Tracer PC Command Line 1.0
C:\>ping 192.168.0.68

Pinging 192.168.0.68 with 32 bytes of data:

Reply from 192.168.0.68: bytes=32 time<1ms TTL=127
Reply from 192.168.0.68: bytes=32 time=12ms TTL=127
Reply from 192.168.0.68: bytes=32 time=12ms TTL=127
Reply from 192.168.0.68: bytes=32 time=11ms TTL=127

Ping statistics for 192.168.0.68:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 12ms, Average = 8ms

C:\>ping 192.168.0.85

Pinging 192.168.0.85 with 32 bytes of data:

Reply from 192.168.0.85: bytes=32 time=1ms TTL=127
Reply from 192.168.0.85: bytes=32 time<1ms TTL=127
Reply from 192.168.0.85: bytes=32 time<1ms TTL=127
Reply from 192.168.0.85: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.0.85:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>
```

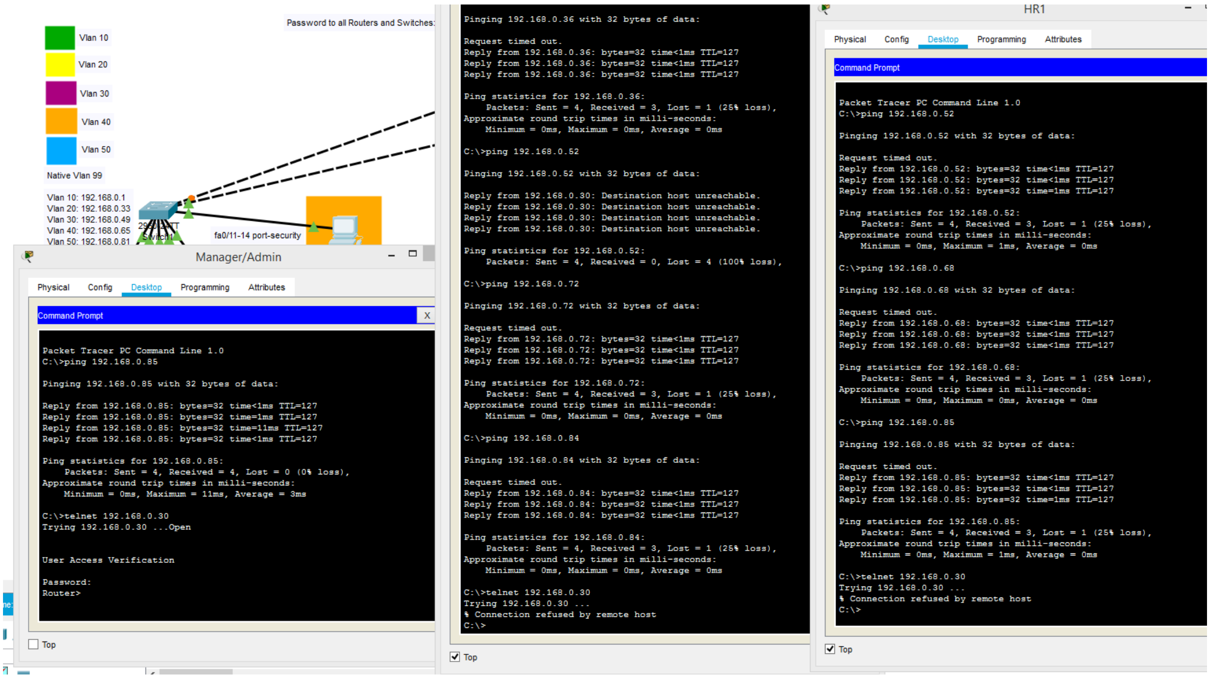
□ Top

Manager/Admin:

```
Packet Tracer PC Command Line 1.0
C:\>ping 192.168.0.85

Pinging 192.168.0.85 with 32 bytes of data:

Reply from 192.168.0.85: bytes=32 time<1ms TTL=127
Reply from 192.168.0.85: bytes=32 time=1ms TTL=127
Reply from 192.168.0.85: bytes=32 time=11ms TTL=127
Reply from 192.168.0.85: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.0.85:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 11ms, Average = 3ms

C:\>
```

Successful! VLAN10 can’t ping VLAN30 (as we wanted), the rest of the VLANs are pinging with each other.

10.2. Telnet Access



Manager/Admin:

```
Packet Tracer PC Command Line 1.0
C:\>ping 192.168.0.85

Pinging 192.168.0.85 with 32 bytes of data:

Reply from 192.168.0.85: bytes=32 time<1ms TTL=127
Reply from 192.168.0.85: bytes=32 time=1ms TTL=127
Reply from 192.168.0.85: bytes=32 time=11ms TTL=127
Reply from 192.168.0.85: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.0.85:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 11ms, Average = 3ms

C:\>telnet 192.168.0.30
Trying 192.168.0.30 ...Open

User Access Verification

Password:
Router>
```

□ Top

```
Pinging 192.168.0.36 with 32 bytes of data:

Request timed out.
Reply from 192.168.0.36: bytes=32 time<1ms TTL=127
Reply from 192.168.0.36: bytes=32 time<1ms TTL=127
Reply from 192.168.0.36: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.0.36:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 192.168.0.52

Pinging 192.168.0.52 with 32 bytes of data:

Reply from 192.168.0.30: Destination host unreachable.
Reply from 192.168.0.30: Destination host unreachable.
Reply from 192.168.0.30: Destination host unreachable.
Reply from 192.168.0.30: Destination host unreachable.

Ping statistics for 192.168.0.52:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\>ping 192.168.0.72

Pinging 192.168.0.72 with 32 bytes of data:

Request timed out.
Reply from 192.168.0.72: bytes=32 time<1ms TTL=127
Reply from 192.168.0.72: bytes=32 time<1ms TTL=127
Reply from 192.168.0.72: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.0.72:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 192.168.0.84

Pinging 192.168.0.84 with 32 bytes of data:

Request timed out.
Reply from 192.168.0.84: bytes=32 time<1ms TTL=127
Reply from 192.168.0.84: bytes=32 time<1ms TTL=127
Reply from 192.168.0.84: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.0.84:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>telnet 192.168.0.30
Trying 192.168.0.30 ...
% Connection refused by remote host
C:\>
```

☑ Top

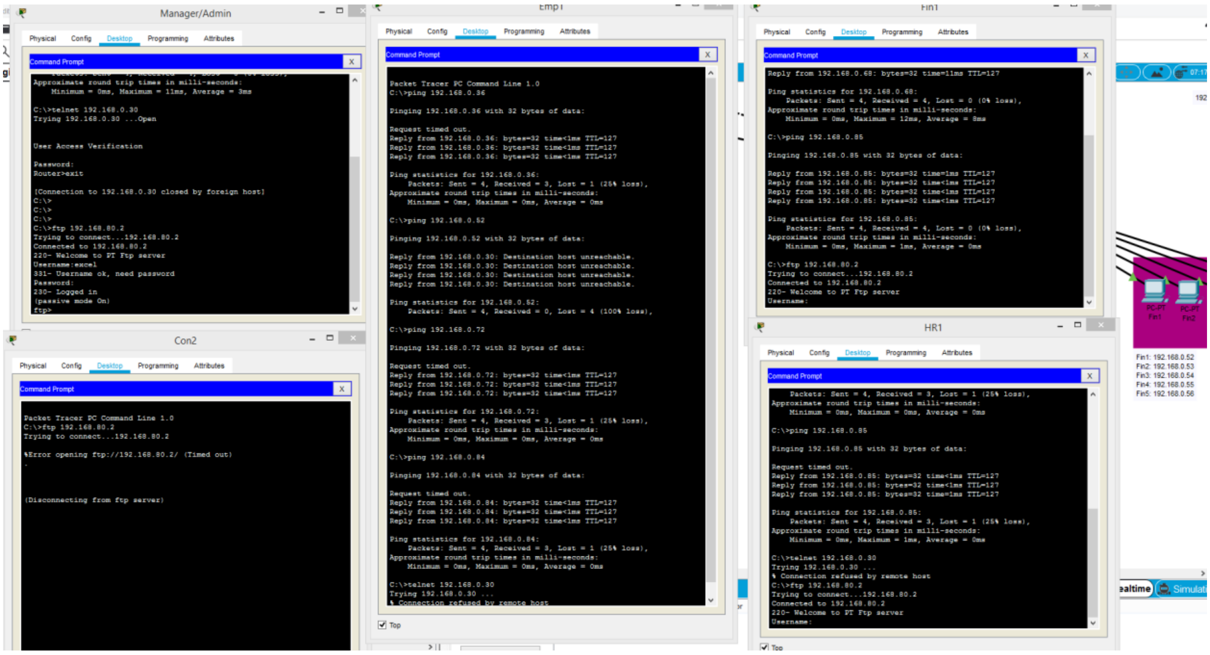
HR1:

```
Packet Tracer PC Command Line 1.0
C:\>ping 192.168.0.52

Pinging 192.168.0.52 with 32 bytes of data:

Request timed out.
Reply from 192.168.0.52: bytes=32 time<1ms TTL=127
Reply from 192.168.0.52: bytes=32 time<1ms TTL=127
Reply from 192.168.0.52: bytes=32 time=1ms TTL=127

Ping statistics for 192.168.0.52:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 192.168.0.68

Pinging 192.168.0.68 with 32 bytes of data:

Request timed out.
Reply from 192.168.0.68: bytes=32 time<1ms TTL=127
Reply from 192.168.0.68: bytes=32 time<1ms TTL=127
Reply from 192.168.0.68: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.0.68:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 192.168.0.85

Pinging 192.168.0.85 with 32 bytes of data:

Request timed out.
Reply from 192.168.0.85: bytes=32 time<1ms TTL=127
Reply from 192.168.0.85: bytes=32 time<1ms TTL=127
Reply from 192.168.0.85: bytes=32 time=1ms TTL=127

Ping statistics for 192.168.0.85:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>telnet 192.168.0.30
Trying 192.168.0.30 ...
% Connection refused by remote host
C:\>
```

☑ Top

Successful! Only host Manager/Admin can telnet.

10.3. FTP Access



Manager/Admin

```
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 11ms, Average = 3ms

C:\>telnet 192.168.0.30
Trying 192.168.0.30 ...Open


User Access Verification

Password:
Router>exit

[Connection to 192.168.0.30 closed by foreign host]
C:\>
C:\>
C:\>
C:\>ftp 192.168.80.2
Trying to connect...192.168.80.2
Connected to 192.168.80.2
220- Welcome to PT Ftp server
Username:excel
331- Username ok, need password
Password:
230- Logged in
(passive mode On)
ftp>
```

Con2

```
Packet Tracer PC Command Line 1.0
C:\>ftp 192.168.80.2
Trying to connect...192.168.80.2

%Error opening ftp://192.168.80.2/ (Timed out)



(Disconnecting from ftp server)
```

Emp1

```
Packet Tracer PC Command Line 1.0
C:\>ping 192.168.0.36

Pinging 192.168.0.36 with 32 bytes of data:

Request timed out.
Reply from 192.168.0.36: bytes=32 time<1ms TTL=127
Reply from 192.168.0.36: bytes=32 time<1ms TTL=127
Reply from 192.168.0.36: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.0.36:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 192.168.0.52

Pinging 192.168.0.52 with 32 bytes of data:

Reply from 192.168.0.30: Destination host unreachable.
Reply from 192.168.0.30: Destination host unreachable.
Reply from 192.168.0.30: Destination host unreachable.
Reply from 192.168.0.30: Destination host unreachable.

Ping statistics for 192.168.0.52:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\>ping 192.168.0.72

Pinging 192.168.0.72 with 32 bytes of data:

Request timed out.
Reply from 192.168.0.72: bytes=32 time<1ms TTL=127
Reply from 192.168.0.72: bytes=32 time<1ms TTL=127
Reply from 192.168.0.72: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.0.72:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 192.168.0.84

Pinging 192.168.0.84 with 32 bytes of data:

Request timed out.
Reply from 192.168.0.84: bytes=32 time<1ms TTL=127
Reply from 192.168.0.84: bytes=32 time<1ms TTL=127
Reply from 192.168.0.84: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.0.84:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>telnet 192.168.0.30
Trying 192.168.0.30 ...
% Connection refused by remote host
```

Fin1

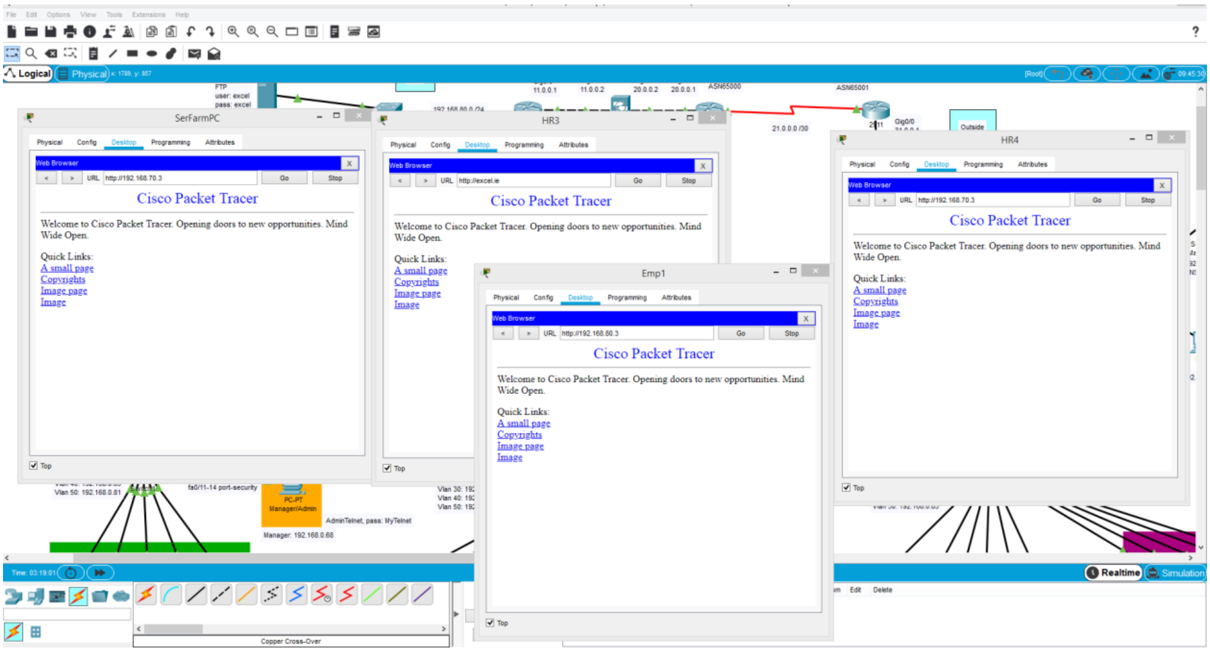
```
Reply from 192.168.0.68: bytes=32 time=11ms TTL=127

Ping statistics for 192.168.0.68:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 12ms, Average = 8ms

C:\>ping 192.168.0.85

Pinging 192.168.0.85 with 32 bytes of data:

Reply from 192.168.0.85: bytes=32 time=1ms TTL=127
Reply from 192.168.0.85: bytes=32 time<1ms TTL=127
Reply from 192.168.0.85: bytes=32 time<1ms TTL=127
Reply from 192.168.0.85: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.0.85:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ftp 192.168.80.2
Trying to connect...192.168.80.2
Connected to 192.168.80.2
220- Welcome to PT Ftp server
Username:
```

HR1

```
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 192.168.0.85

Pinging 192.168.0.85 with 32 bytes of data:

Request timed out.
Reply from 192.168.0.85: bytes=32 time<1ms TTL=127
Reply from 192.168.0.85: bytes=32 time<1ms TTL=127
Reply from 192.168.0.85: bytes=32 time=1ms TTL=127

Ping statistics for 192.168.0.85:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>telnet 192.168.0.30
Trying 192.168.0.30 ...
% Connection refused by remote host
C:\>ftp 192.168.80.2
Trying to connect...192.168.80.2
Connected to 192.168.80.2
220- Welcome to PT Ftp server
Username:
```

Successful! VLAN20, 30, 40 can reach FTP (as we wanted)

10.4. DNS, HTTP Access



SerFarmPC — Web Browser — URL http://192.168.70.3

Cisco Packet Tracer

Welcome to Cisco Packet Tracer. Opening doors to new opportunities. Mind Wide Open.

Quick Links:
A small page
Copyrights
Image page
Image

HR3 — Web Browser — URL http://excel.ie

Cisco Packet Tracer

Welcome to Cisco Packet Tracer. Opening doors to new opportunities. Mind Wide Open.

Quick Links:
A small page
Copyrights
Image page
Image

Emp1 — Web Browser — URL http://192.168.80.3

Cisco Packet Tracer

Welcome to Cisco Packet Tracer. Opening doors to new opportunities. Mind Wide Open.

Quick Links:
A small page
Copyrights
Image page
Image

HR4 — Web Browser — URL http://192.168.70.3

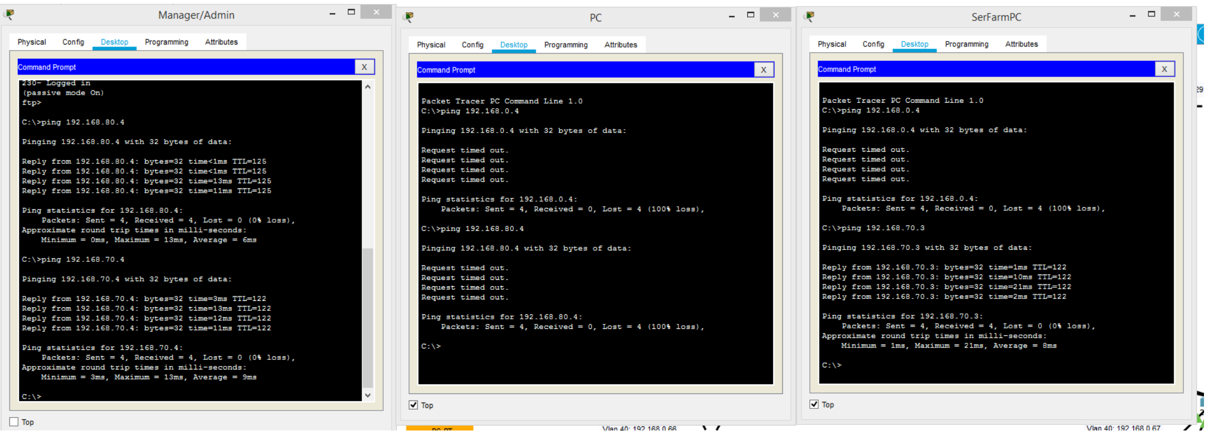
Cisco Packet Tracer

Welcome to Cisco Packet Tracer. Opening doors to new opportunities. Mind Wide Open.

Quick Links:
A small page
Copyrights
Image page
Image

Successful! Computers on our network can use DNS and HTTP services of the DMZ server as well as on the Dublin side. The DMZ computer can use DNS and HTTP services from the Dublin server.

10.5. Connectivity (ICMP) between Inside, Outside, and DMZ



```
230- Logged in
(passive mode On)
ftp>

C:\>ping 192.168.80.4

Pinging 192.168.80.4 with 32 bytes of data:

Reply from 192.168.80.4: bytes=32 time<1ms TTL=125
Reply from 192.168.80.4: bytes=32 time<1ms TTL=125
Reply from 192.168.80.4: bytes=32 time=13ms TTL=125
Reply from 192.168.80.4: bytes=32 time=11ms TTL=125

Ping statistics for 192.168.80.4:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 13ms, Average = 6ms

C:\>ping 192.168.70.4

Pinging 192.168.70.4 with 32 bytes of data:

Reply from 192.168.70.4: bytes=32 time=3ms TTL=122
Reply from 192.168.70.4: bytes=32 time=13ms TTL=122
Reply from 192.168.70.4: bytes=32 time=12ms TTL=122
Reply from 192.168.70.4: bytes=32 time=11ms TTL=122

Ping statistics for 192.168.70.4:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 3ms, Maximum = 13ms, Average = 9ms

C:\>
```

```
Packet Tracer PC Command Line 1.0
C:\>ping 192.168.0.4

Pinging 192.168.0.4 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 192.168.0.4:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\>ping 192.168.80.4

Pinging 192.168.80.4 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 192.168.80.4:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\>
```

```
Packet Tracer PC Command Line 1.0
C:\>ping 192.168.0.4

Pinging 192.168.0.4 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 192.168.0.4:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\>ping 192.168.70.3

Pinging 192.168.70.3 with 32 bytes of data:

Reply from 192.168.70.3: bytes=32 time=1ms TTL=122
Reply from 192.168.70.3: bytes=32 time=10ms TTL=122
Reply from 192.168.70.3: bytes=32 time=21ms TTL=122
Reply from 192.168.70.3: bytes=32 time=2ms TTL=122

Ping statistics for 192.168.70.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 21ms, Average = 8ms

C:\>
```

Successful!

Inside can ping Outside and DMZ,

Outside can't ping Inside and Outside,

DMZ can't ping Inside but can ping Outside.

10.6. Test - access to the server in the DMZ from Outside

By introducing the appropriate access control lists (ACL) on ASA1, we can ensure that computers from Outside have access to our resources (DMZ). This is just a test showing the possibilities of using ACL on ASA (as I mentioned earlier, I also assumed that during the connectivity tests, the headquarters in Dublin set their Firewall to level 0 to outside and inside.

I would also like to emphasize that the ASA configuration is not stable, the settings are not saved and after restarting, ASA must be added from scratch (copy / paste of the previously written commands save the situation). In this case ASA also becomes unstable after a while, so I assume it's a bug. Either way, it works in the early stages.

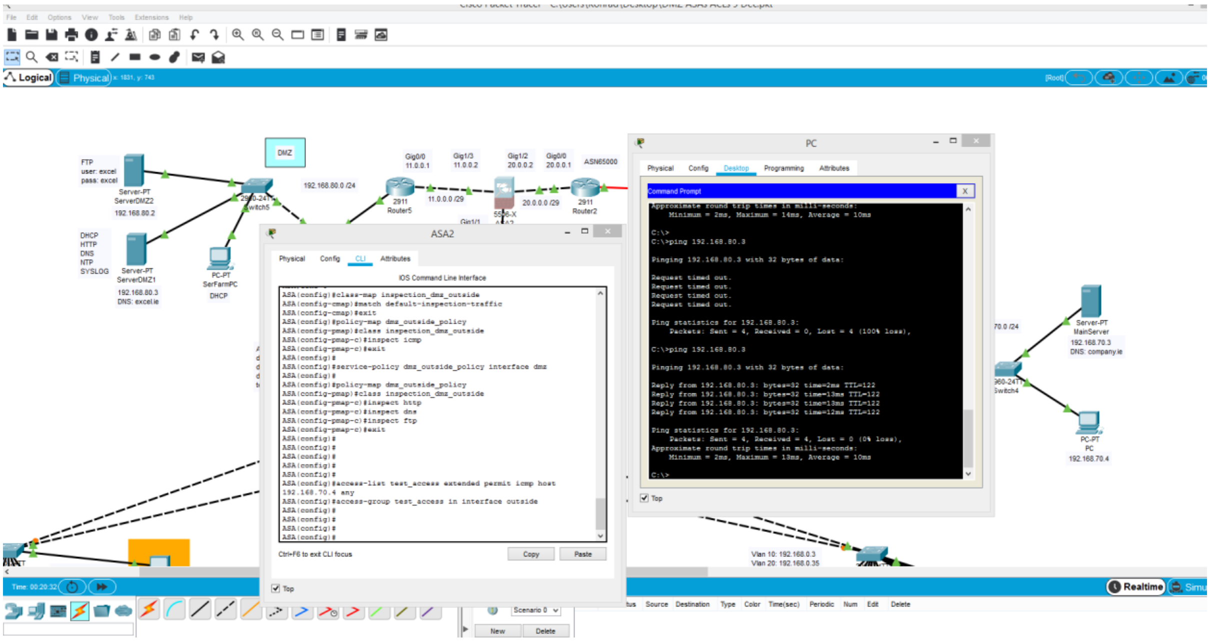
I will use the following commands on ASA1:

access-list test_access extended permit icmp host 192.168.70.4 any

access-group test_access in interface outside

access-list dns_access extended permit tcp host 192.168.70.4 any

access-group dns_access in interface outside



ASA2 — Physical | Config | CLI | Attributes — IOS Command Line Interface

```
ASA(config)#class-map inspection_dmz_outside
ASA(config-cmap)#match default-inspection-traffic
ASA(config-cmap)#exit
ASA(config)#policy-map dmz_outside_policy
ASA(config-pmap)#class inspection_dmz_outside
ASA(config-pmap-c)#inspect icmp
ASA(config-pmap-c)#exit
ASA(config)#
ASA(config)#service-policy dmz_outside_policy interface dmz
ASA(config)#
ASA(config)#policy-map dmz_outside_policy
ASA(config-pmap)#class inspection_dmz_outside
ASA(config-pmap-c)#inspect http
ASA(config-pmap-c)#inspect dns
ASA(config-pmap-c)#inspect ftp
ASA(config-pmap-c)#exit
ASA(config)#
ASA(config)#
ASA(config)#
ASA(config)#
ASA(config)#
ASA(config)#access-list test_access extended permit icmp host
192.168.70.4 any
ASA(config)#access-group test_access in interface outside
ASA(config)#
ASA(config)#
ASA(config)#
ASA(config)#
```

Ctrl+F6 to exit CLI focus

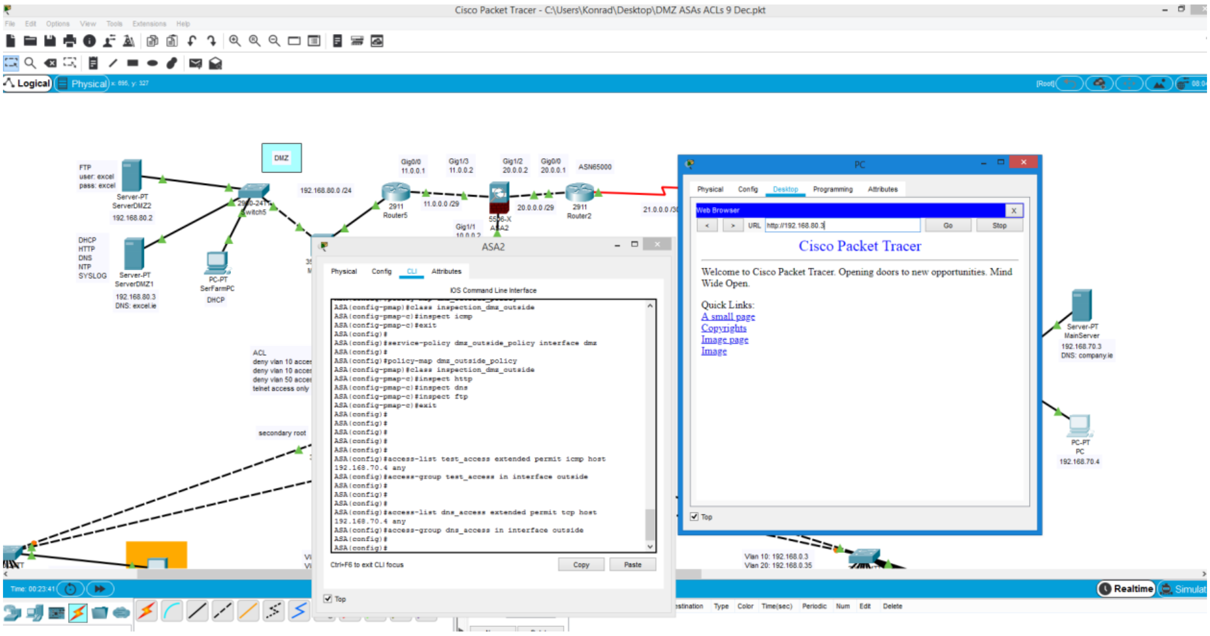
☑ Top

PC — Physical | Config | Desktop | Programming | Attributes — Command Prompt

```
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 14ms, Average = 10ms

C:\>
C:\>ping 192.168.80.3

Pinging 192.168.80.3 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 192.168.80.3:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\>ping 192.168.80.3

Pinging 192.168.80.3 with 32 bytes of data:

Reply from 192.168.80.3: bytes=32 time=2ms TTL=122
Reply from 192.168.80.3: bytes=32 time=13ms TTL=122
Reply from 192.168.80.3: bytes=32 time=13ms TTL=122
Reply from 192.168.80.3: bytes=32 time=12ms TTL=122

Ping statistics for 192.168.80.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 13ms, Average = 10ms

C:\>
```

☑ Top

ICMP works!



ASA2 — Physical | Config | CLI | Attributes — IOS Command Line Interface

```
ASA(config-pmap)#class inspection_dmz_outside
ASA(config-pmap-c)#inspect icmp
ASA(config-pmap-c)#exit
ASA(config)#
ASA(config)#service-policy dmz_outside_policy interface dmz
ASA(config)#
ASA(config)#policy-map dmz_outside_policy
ASA(config-pmap)#class inspection_dmz_outside
ASA(config-pmap-c)#inspect http
ASA(config-pmap-c)#inspect dns
ASA(config-pmap-c)#inspect ftp
ASA(config-pmap-c)#exit
ASA(config)#
ASA(config)#
ASA(config)#
ASA(config)#
ASA(config)#
ASA(config)#access-list test_access extended permit icmp host
192.168.70.4 any
ASA(config)#access-group test_access in interface outside
ASA(config)#
ASA(config)#
ASA(config)#
ASA(config)#access-list dns_access extended permit tcp host
192.168.70.4 any
ASA(config)#access-group dns_access in interface outside
ASA(config)#
ASA(config)#
```

Ctrl+F6 to exit CLI focus

☑ Top

PC — Physical | Config | Desktop | Programming | Attributes — Web Browser

URL: http://192.168.80.3

Cisco Packet Tracer

Welcome to Cisco Packet Tracer. Opening doors to new opportunities. Mind Wide Open.

Quick Links:
A small page
Copyrights
Image page
Image

☑ Top

TCP works!