شبكات الحواسيب
Computer Networks

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LAB2 (Theoretical)

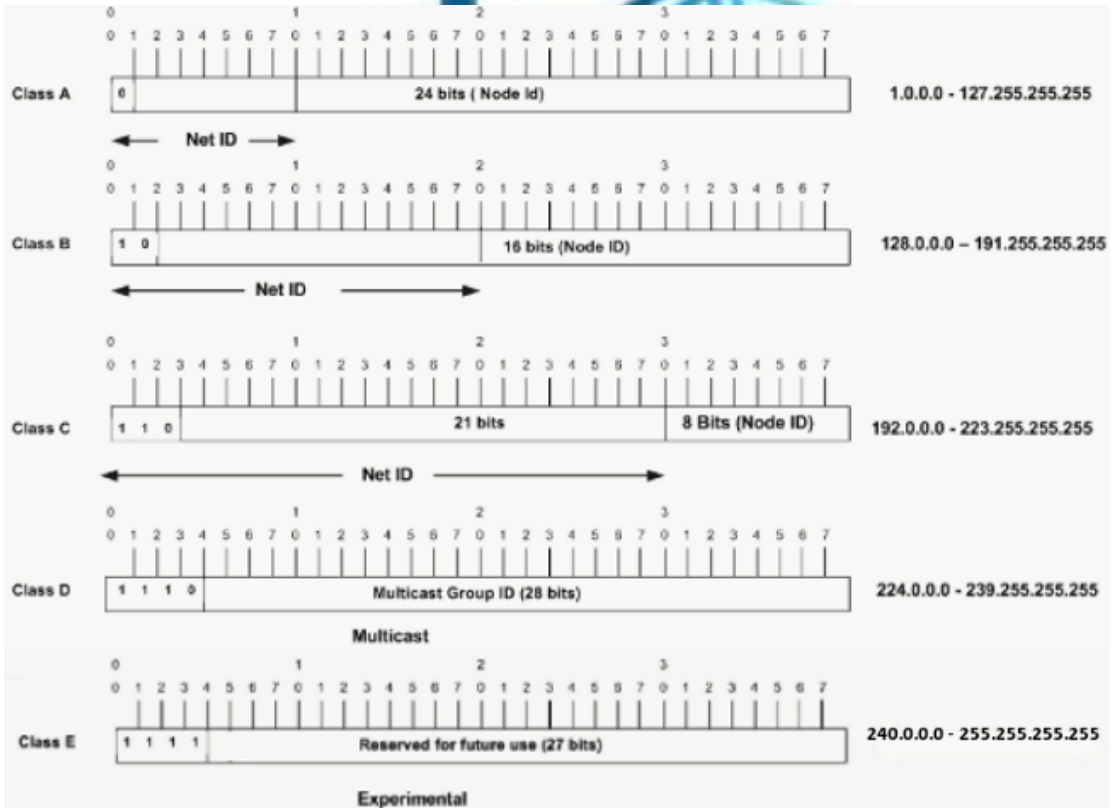
- Sub-Networking (Submask):
  - Definitions:
    - IP-Address: The unique number ID assigned to one host or interface in a network.
    - Subnet: A portion of a network that shares a particular subnet address.
    - Subnet mask: A 32-bit combination used to describe which portion of an address refers to the subnet and which part refers to the host.
  - IP-Address Classes:
    - Class A: 1.0.0.0 ~ 127.255.255.255 (Starting with 0)
    - Class B: 128.0.0.0 ~ 191.255.255.255 (Starting with 10)
    - Class C: 192.0.0.0 ~ 223.255.255.255 (Starting with 110)

    } Unicast

    - Class D:224.0.0.0 ~ 239.255.255.255 (Starting with 1110) Multicast
    - Class E:240.0.0.0 ~ 255.255.255.255 (Starting with 1111) Experimental

LAB2 (Theoretical)

- Sub-Networking (Submask):
  - IP-Address Classes:
    - Consisting of two parts: Network ID and Host ID



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LAB2 (Theoretical)

- Sub-Networking (Submask):
  - Network Masking (Sub-Networking):
    - Creating multiple logical networks that exist within a single Class A, B, or C network
    - Each Network Address consists of IP-Address and Submask Address
      - Represented as:
        - IP Address/Submask Address (192.168.1.2/255.255.255.0)
        - IP Address/Submask number (192.168.1.2/24)
    - Submask Address is a 32bits number subdivided into four 8bits numbers (255.255.255.0)
      - Each Byte of a Subnet Mask Address can take only the following numbers: 0, 128, 192, 224, 240, 248, 252, 254 or 255 with exception:
        - The first Byte will always take the number 255
        - The last Byte will not take the numbers 255 and 254
      - Number of Hosts = 2^{N0}-2 where N0 is the number of 0 bits in submask address (-2 represents the network address and broadcast address)
    - Example:
      - 192.168.2.7/255.255.255.0 (192.168.2.7/24)
      - 172.16.0.100/255.255.0.0 (172.16.0.100/16)

LAB2 (Theoretical)

- Sub-Networking (Submask):
  - Network Masking (Sub-Networking):
    - Understanding of subneting:
      - In order to subnet a network, extend the natural mask with some of the bits from the host ID portion of the address in order to create a subnetwork ID
      - Number of sub-network= $2^{(N1-Ncd)}$ where N1 is the number of 1 bits in submask address and Ncd is the number of 1 bits in default class submask address, N0=32-N1
        - E.g. 192.168.2.0/255.255.255.128 → the subnet mask is 11111111.11111111.11111111.10000000 → N1=25, N0=32-25=7, N= 25-24=1
    - Calculating the number of subnetworks and hosts:
      - Example: 192.168.2.0/255.255.255.128 (192.168.2.0/25)
        - N1=25, N=25-24=1, N0=32-2=7 → 2^1=2 subnetworks, 2^7-2=126 hosts
      - Example: 172.16.0. 0/255.255.248.0 (172.16.0. 0/21)
        - N1=21, N=21-16=5, N0=32-21=11 → 2^5=32 subnetworks, 2^{11}-2=2046 hosts
      - Homework Training:
        - Calculate the number of subnetworks and host for the following addresses and define the IP-Addresses Range:
          - 200.100.10.0/28
          - 100.100.1.128/25

LAB2 (Theoretical)

- Sub-Networking (Submask):
  - Network Masking (Sub-Networking):
    - Calculation of Net-ID, Host-ID:
      - N=N1-Ncd=$\log_2$(Number of Sub-Networks), N0=32-N1=$\log_2$(number of hosts+2). Note that we round up the value of $\log_2$
      - In other words: Class C: N=8-N0, Class B: N=16-N0, Class A: N=24-N0
      - Example: finding out the network and broadcast addresses as well as Net-ID and Host-ID for Sub-network with 32 hosts (IP: 172.16.100.1)
        - N0=$\log_2$(32+2)=5.08≈6→Number of hosts = 2^6-2=62 hosts
        - N=16-6=10 → Number of Sub-Networks = 2^{10}=1024 Sub-Networks
        - N1=N+Ncd=10+16=26
        - Subnet Mask → 11111111.11111111.11111111.11000000➔255.255.255.192
        - Network Address → using logical operation and
          - 172.16.100.1 & 255.255.255.192➔ 10101100. 00010000. 01100100.00000001 & 11111111.11111111.11111111.11000000 ➔ 10101100. 00010000. 01100100.00000000➔ 172.16.100.0
        - Broadcast Address→ changing all bits in the network address which are corresponding to the 0 bits of Sub Mask
          - 10101100. 00010000. 01100100.00000000 ➔ 10101100. 00010000. 01100100.00111111 ➔ 172.16.100.63

LAB2 (Theoretical)

- Sub-Networking (Submask):
  - Network Masking (Sub-Networking):
    - Calculation of Net-ID, Host-ID:
      - Example: finding out the network and broadcast addresses as well as Net-ID and Host-ID for Sub-network with 32 hosts (IP: 172.16.100.1)
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        - N1=N+Ncd=10+16=26
        - Subnet Mask → 11111111.11111111.11111111.11000000➔255.255.255.192
        - Another method: Network Address → using the effected Byte from the IP address
          - To detect the effected byte from Network address we select the corresponding byte from Sub Mask which consists of both 0 and 1 in it
          - From Sub Mask address we find out that the last byte is the corresponding one→ 11111111.11111111.11111111.11000000
          - Calculating the corresponding Byte using this equation: round down(the corresponding Byte from given IP address/$2^{(\text{number of 0 bits in corresponding bit})}$)* $2^{(\text{number of 0 bits in corresponding bit})}$
          - Round down(1/64)*2^6=0➔172.16.100.0
          - If the corresponding Byte is not the last Byte then set all low Bytes to 0
        - Broadcast Address→ adding ($2^{(\text{number of 0 bits in corresponding bit})}$ -1) to the network address corresponding bit → 0+2^6-1=63 ➔ 172.16.100.63
          - If the corresponding Byte is not the last Byte then set all low Bytes to 255

LAB2 (Theoretical)

- Sub-Networking (Submask):
  - Network Masking (Sub-Networking):
    - Calculation of Net-ID, Host-ID:
      - Example: finding out the network and broadcast addresses as well as Net-ID and Host-ID for Sub-network with 320 hosts (IP: 172.16.100.1)
        - N0=$\log_2(320+2)=8.33\approx9$→Number of hosts = $2^9-2=510$ hosts
        - N=16-9=7 → Number of Sub-Networks = $2^7=128$ Sub-Networks
        - N1=N+Ncd=7+16=23
        - Subnet Mask → 11111111.11111111.11111110.00000000➔255.255.254.0
        - Network Address → using logical operation and
          - 172.16.100.1 & 255.255.254.0➔ 10101100. 00010000. 01100100.00000001 & 11111111.11111111.11111110.00000000 ➔ 10101100. 00010000. 01100100.00000000➔ 172.16.100.0
        - Broadcast Address→ changing all bits in the network address which are corresponding to the 0 bits of Sub Mask
          - 10101100. 00010000. 01100100.00000000 ➔ 10101100. 00010000. 01100101.11111111 ➔ 172.16.101.255

LAB2 (Theoretical)

- Sub-Networking (Submask):
  - Network Masking (Sub-Networking):
    - Calculation of Net-ID, Host-ID:
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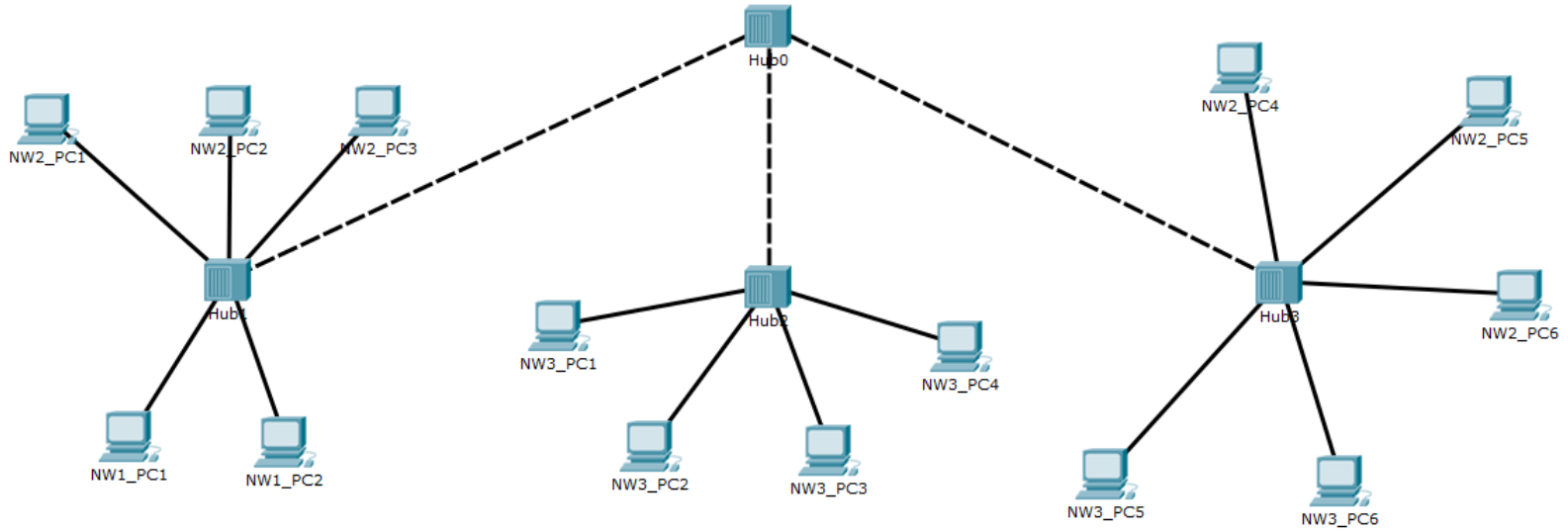
        - Subnet Mask → 11111111.11111111.11111110.00000000➔255.255.254.0
        - Another method: Network Address → using the effected Byte from the IP address
          - From Sub Mask address we find out that the last byte is the corresponding one→ 11111111.11111111.11111110.00000000
          - Round down$(100/2^1)*2^1=100$➔172.16.100.0
        - Broadcast Address→ adding $(2^{\text{(number of 0 bits in corresponding bit)}}-1)$ to the network address corresponding bit → $100+2^1-1=101$ ➔ 172.16.101.255

LAB2 (Practical)

- Task is to connect two subnetwork via a Hub
  - Each subnetwork consists of:
    - 5 computers
    - Start IP-Address for first subnetwork: 192.168.GpNr+1.10
    - Start IP-Address for first subnetwork: 192.168.GpNr+1.50
  - Define the suitable subnet mask
  - Is it necessary to configure the Gateway and DNS server?
- Where GpNr represents the Student Group number

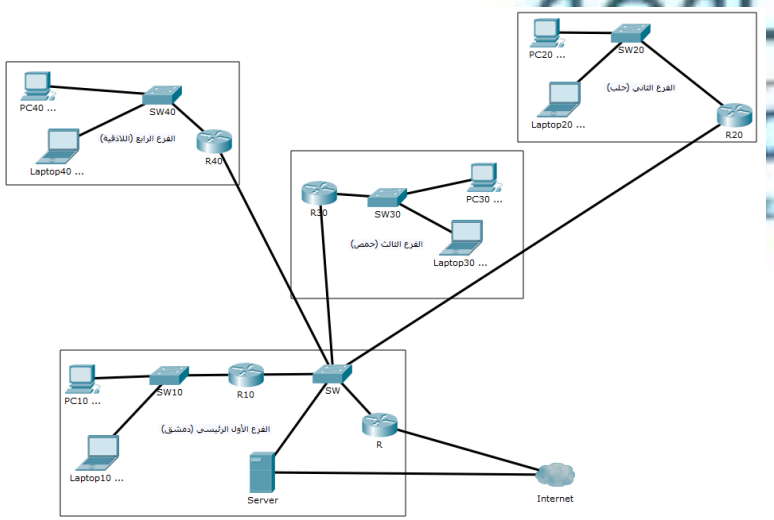
LAB2 (Practical)

- ليكن لدينا ثلاثة شبكات (NW1, NW2, NW3) المبينة بالشكل والمطلوب تحديد عنوان الشبكة وعنوان البث لكل شبكة بالإضافة إلى إدخال عناوين الـ IPالكل جهاز من أجهزة الشبكات الثلاثة السابقة، علماً أنه تم اعطاء عنوان الـ IP لجهاز واحد في كل شبكة على الشكل التالي:
  - NW1_PC1={172.10.10.2/255.255.255.252}
  - NW2_PC1={192.168.10.134/255.255.255.248}
  - NW3_PC1={10.10.10.75/255.255.255.224}
- .



LAB2 (Practical)

- ليكن لدينا الشبكة الموضحة بالشكل والخاصة بشركة مؤلفة من 5 أفرع والمطلوب حدد مجال عناوين الشبكة (IP Address) لكل فرع من أفرع الشركة (عنوان الشبكة، عنوان البث، Subnet Mask) مبيناً نوع الشبكة فيما إذا كانت خاصة أم عامة بالإضافة إلى صنف الشبكة الأنسب (A, B, C) وبناءً عليه قم بالإعدادات المطلوبة لعناصر الشبكة (PC, Laptops, Server, Router, Switch) علماً أنه:
  - عنوان الـ IP لخط الانترنيت المشترك هو 170.10.100.100/25
  - تم حجز عنوانين عامين Public IP Addresses للشبكة هما 170.10.100.200/25 و 170.10.100.201/25
  - تم تخصيص 300 عنوان للفرع الرابع و500 عنوان للفرع الثالث و700 عنوان للفرع الثاني و1000 عنوان للفرع الأول (المركز الرئيسي)



LAB2 (Practical)

- الحل: يجب أولاً تحديد مجال وصنف شبكة كل فرع وذلك اعتماداً على عدد الاجهزة المخصصة لكل فرع كما هو موضح بالجدول (هنا مجال العناوين اختياري)

الفرع		النوع	الصنف	عنوان الشبكة	عنوان البث	Subnet Mask
دمشق	Local	Private	B	130.100.0.0	130.100.3.255	255.255.252.0
	Intranet	Private	C	192.168.1.0	192.168.1.7	255.255.255.248
حلب	Local	Private	B	130.100.0.0	130.100.3.255	255.255.252.0
	Intranet	Private	C	192.168.1.0	192.168.1.7	255.255.255.248
حمص	Local	Private	B	130.100.0.0	130.100.1.255	255.255.254.0
	Intranet	Private	C	192.168.1.0	192.168.1.7	255.255.255.248
اللاذقية	Local	Private	B	130.100.0.0	130.100.1.255	255.255.254.0
	Intranet	Private	C	192.168.1.0	192.168.1.7	255.255.255.248
الموجه المركزي (خط الانترنيت)	Intranet	Private	C	192.168.1.0	192.168.1.7	255.255.255.248
	Internet	Public	B	170.10.100.0	170.10.100.127	255.255.255.128
المخدم	Intranet	Private	C	192.168.1.0	192.168.1.7	255.255.255.248
	Internet	Public	B	170.10.100.128	170.10.100.255	255.255.255.128

LAB2 (Theoretical)

- Comparison between Host (Workstation) and Server
  - E.g.: windows and windows server
- Application Layer Services and their Services
  - Using Server
    - In this model it can be used two NICs
      - Two networks can be connected
      - To configure each NIC, we can choose it s shown in figure
      - Then we can give the IP address
      - The IP address in server should be static in order to see it from clients
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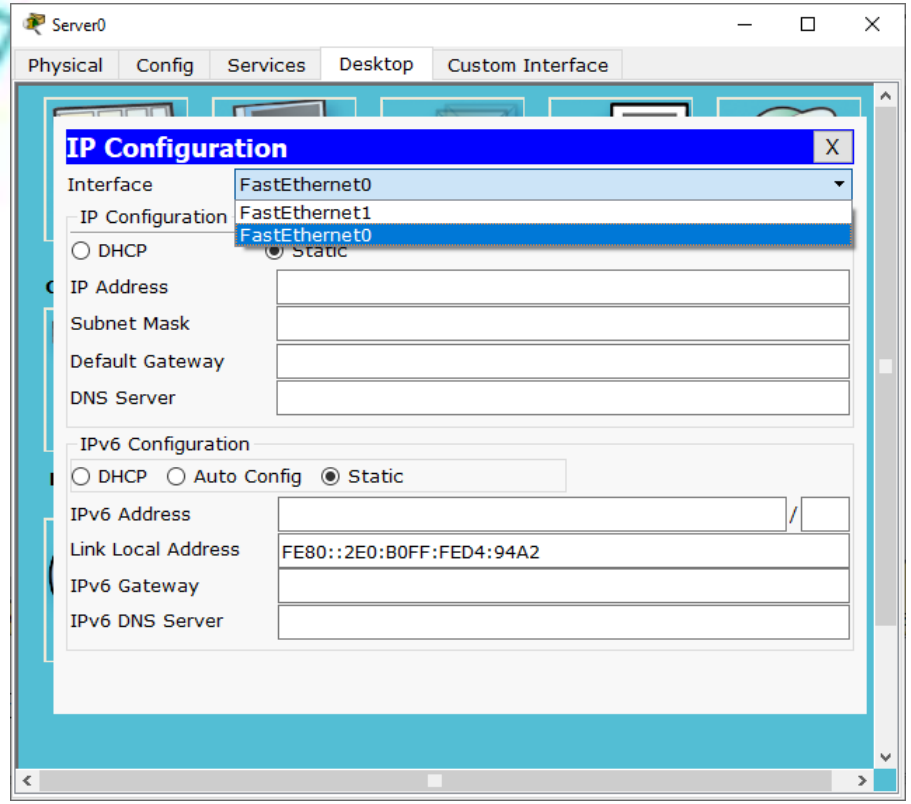
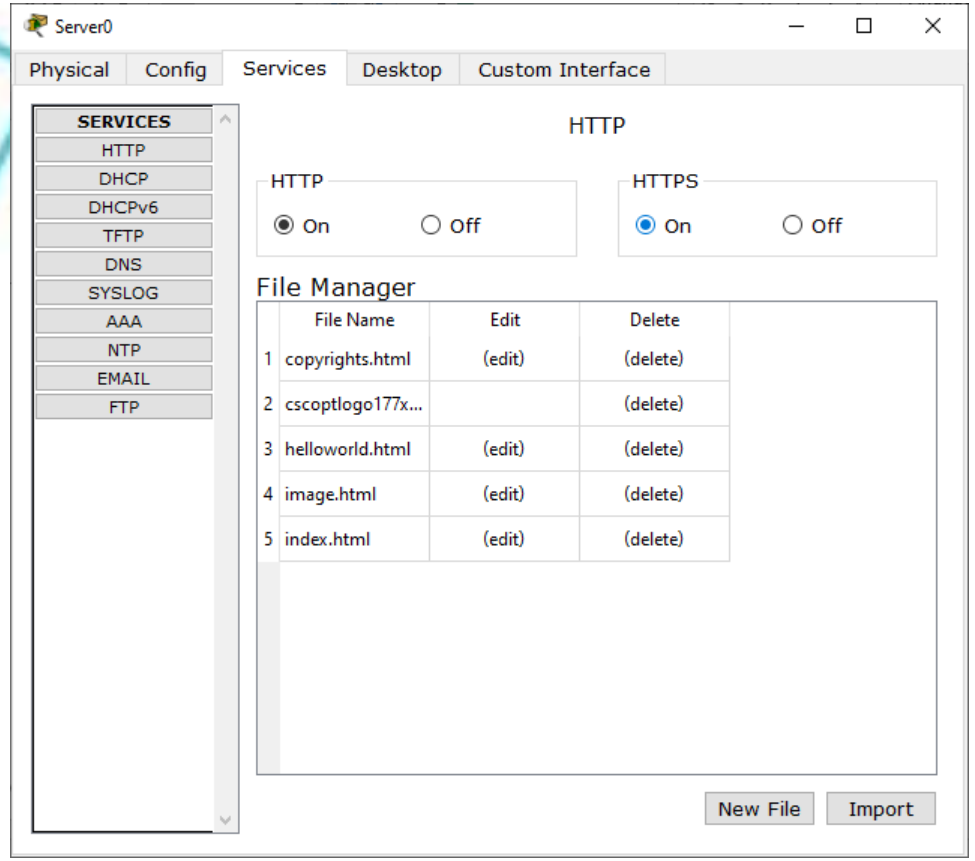


LAB2 (Theoretical)

- Comparison between Host (Workstation) and Server
- Application Layer Services and their Services
  - Using Server
    - To use the different services, we open the tab services and choose the suitable service and activate it by changing the switch from off into on



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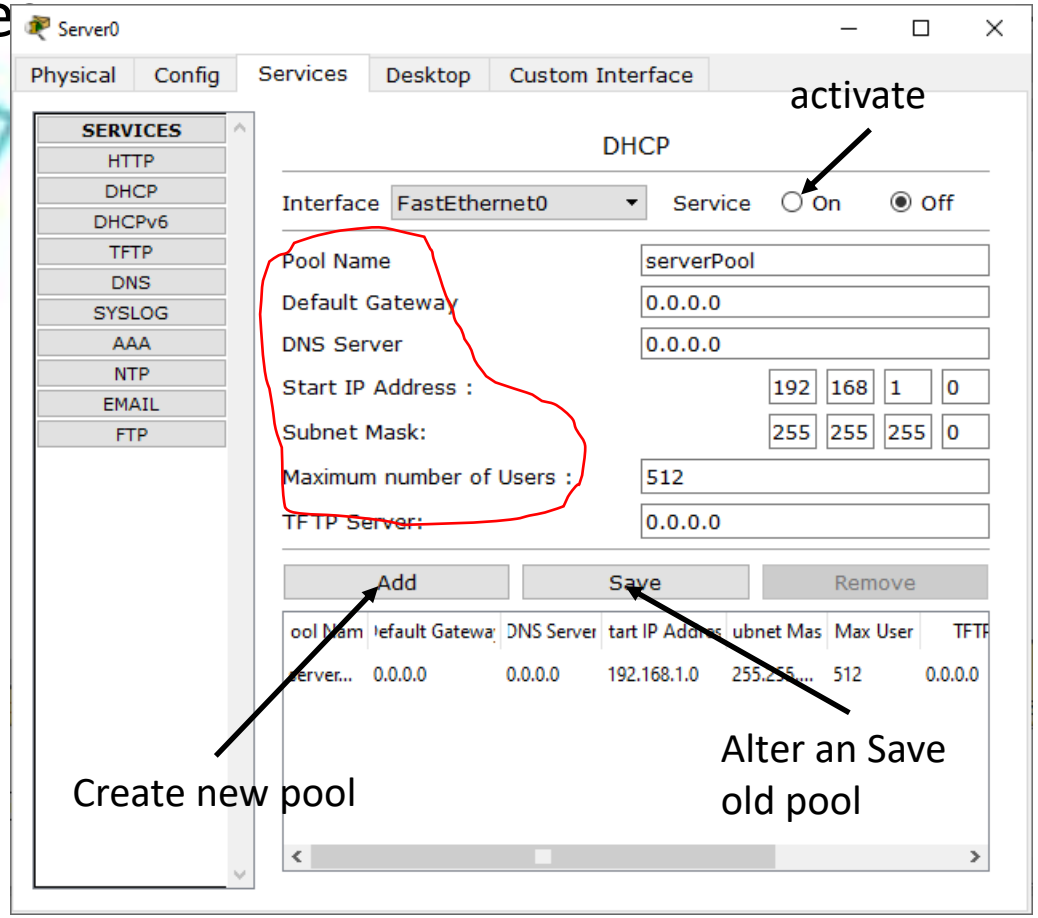
LAB2 (Theoretical)

- Comparison between Host (Workstation) and Server
- Application Layer Services and their Services
  - Using Server
    - DHCP Configuration:
      - Configure a static IP Address and Submask for the Server
      - Enable the DHCP Server from the Services Tab
      - Set up the Default Gateway and DNS Server
      - Set up the start IP-Address and its Submask
      - The Maximum Host Number will be the set up automatically
      - Test the DHCP via setting up the Hosts in the NW as DHCP Clients

LAB2 (Theoretical)

- Comparison between Host (Workstation) and Server
- Application Layer Services and their Service
  - Using Server
    - DHCP Configuration:



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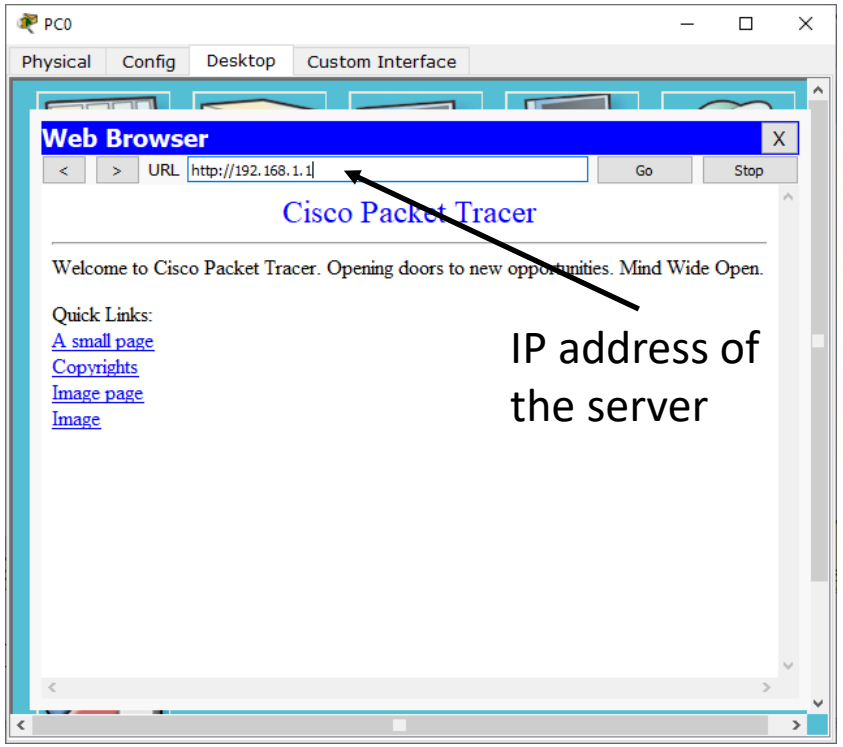
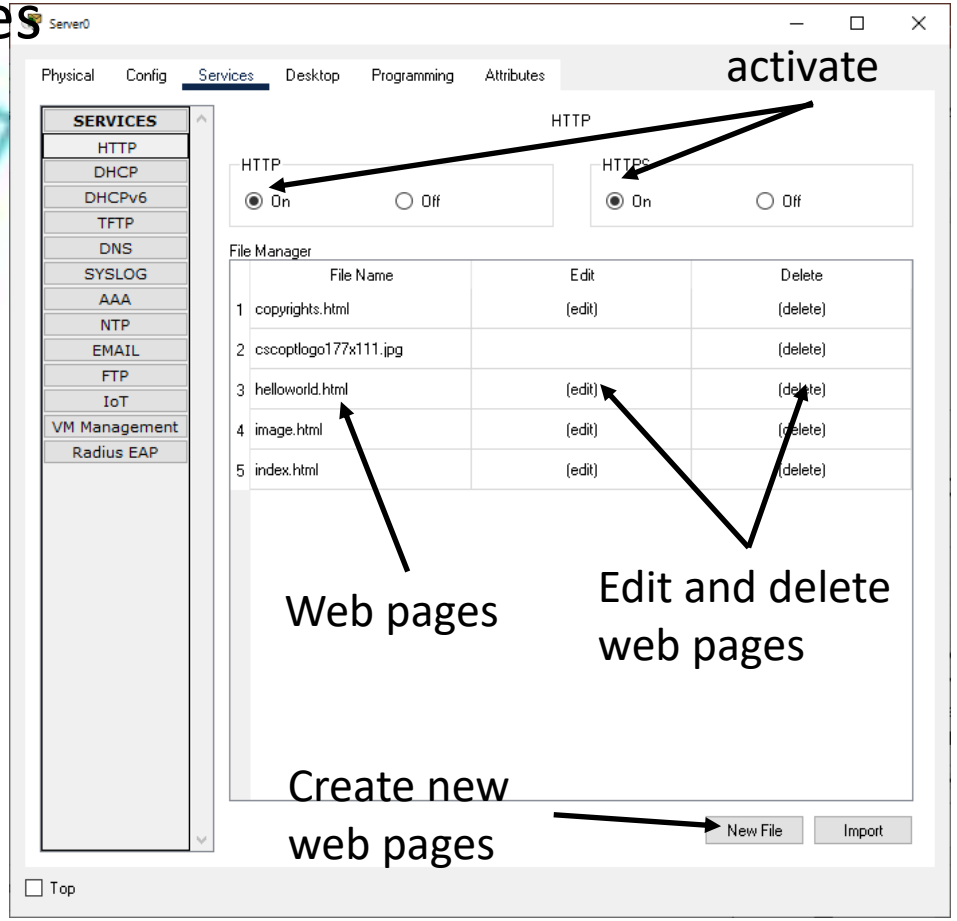
LAB2 (Theoretical)

- Comparison between Host (Workstation) and Server
- Application Layer Services and their Services
  - Using Server
    - HTTP Configuration:
      - Enable the HTTP Server from the Services Tab
      - Add your HTML-Pages via new File or Import
      - Test the HTTP via the Browser from any Hosts

LAB2 (Theoretical)

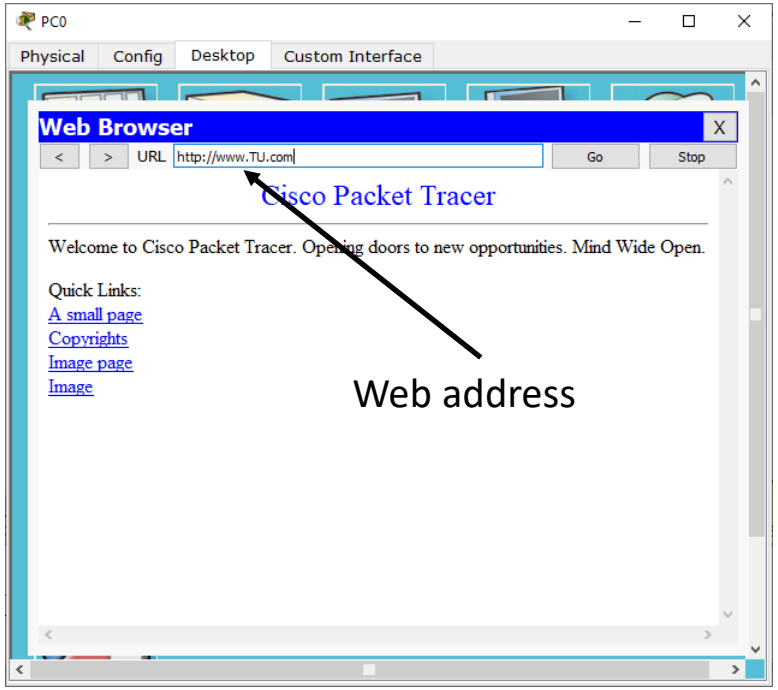
- Comparison between Host (Workstation) and Server
- Application Layer Services and their Services
  - Using Server
    - DHCP Configuration:

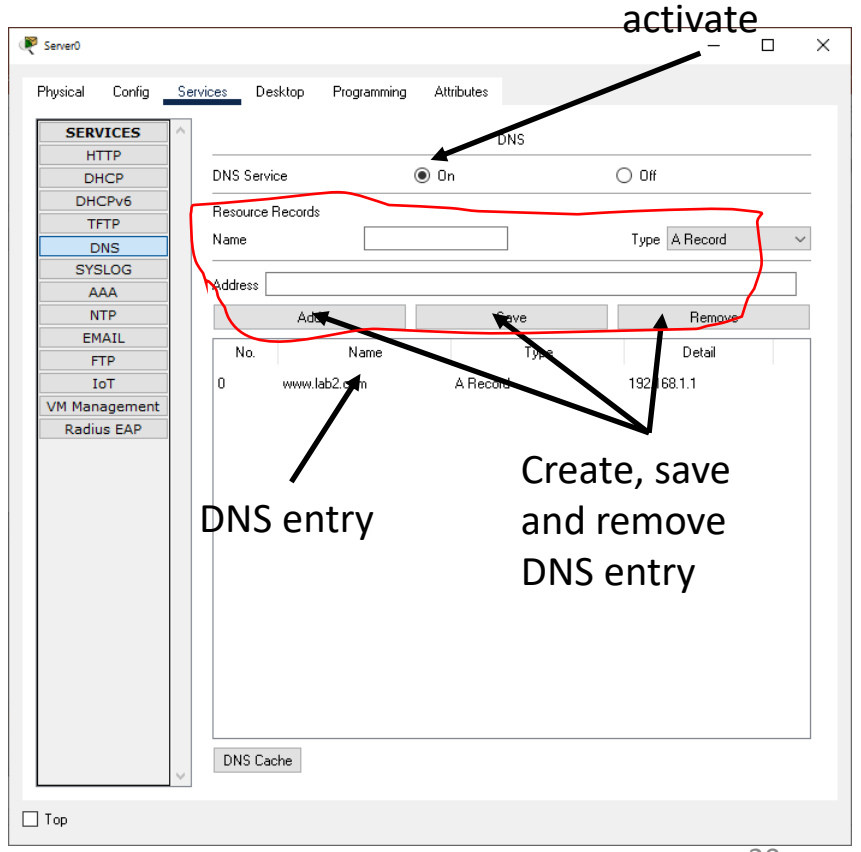




LAB2 (Theoretical)

- Application Layer Services and their Services
  - Using Server
    - DNS Configuration:
      - Enable the DNS Server from the Services Tab
      - Add new Pair (DN, IP) with type Record
      - Test the DNS via the Browser or command “ping” from any Hosts



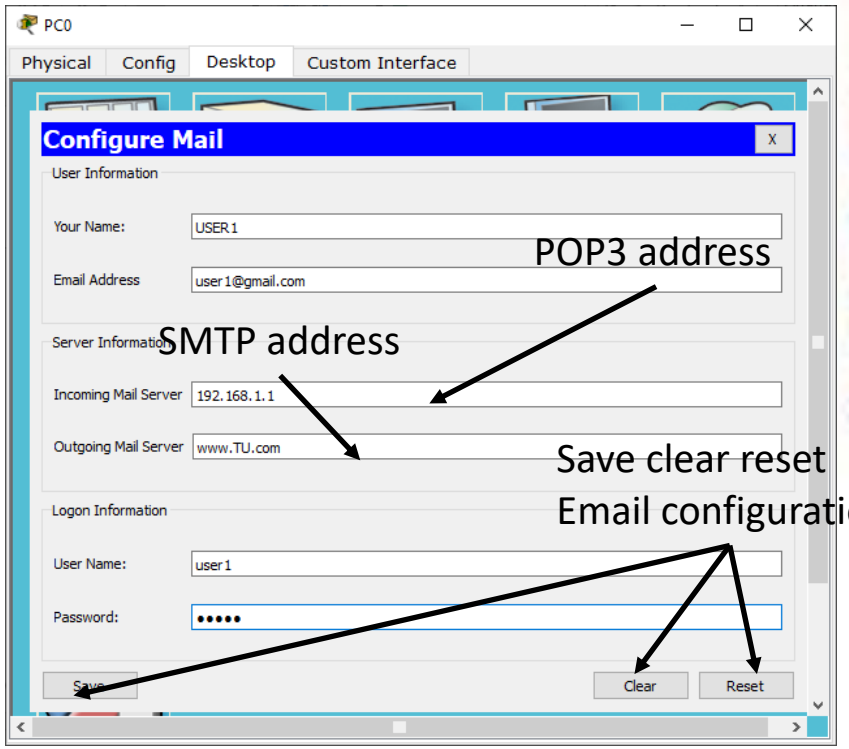


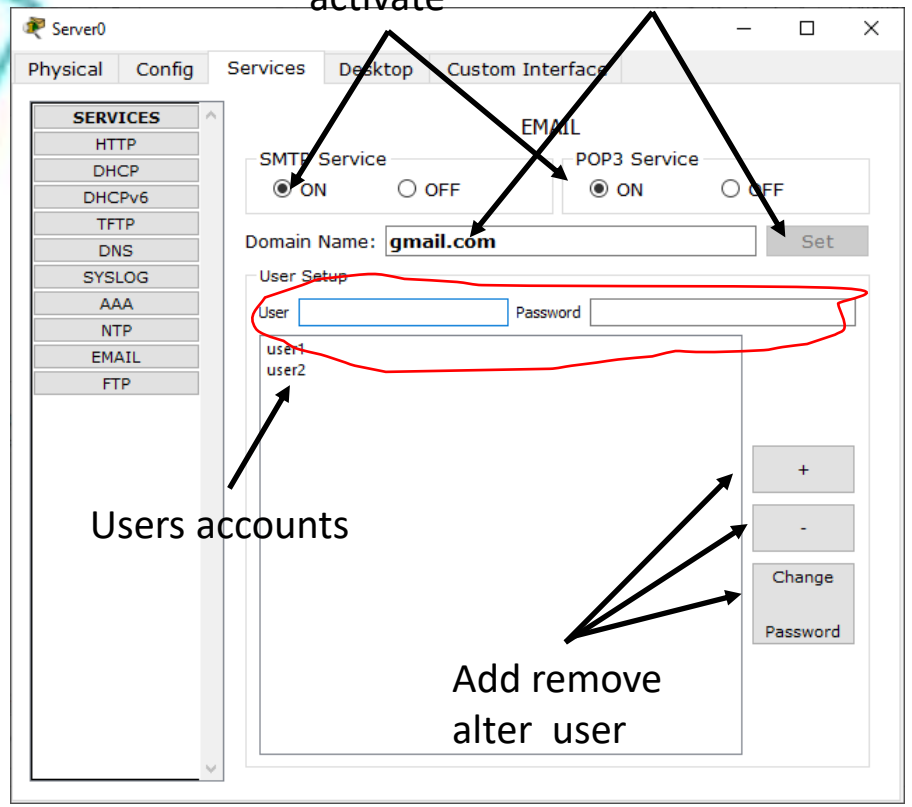
LAB2 (Theoretical)

- Application Layer Services and their Services
  - Using Server
    - E-Mail Server Configuration:
      - Enable the E-Mail Server by enabling both SMTP and POP3 Services from the Services Tab
      - Set up the Domain Name for the E-Mail Server
        - Can be DN or IP
      - Adding a new user account by setting up their user-name and password
      - Test the E-Mail Server via the e-mail client from any hosts
        - Must configure the e-mail client by setting up the incoming and outgoing E-Mail server

LAB2 (Theoretical)

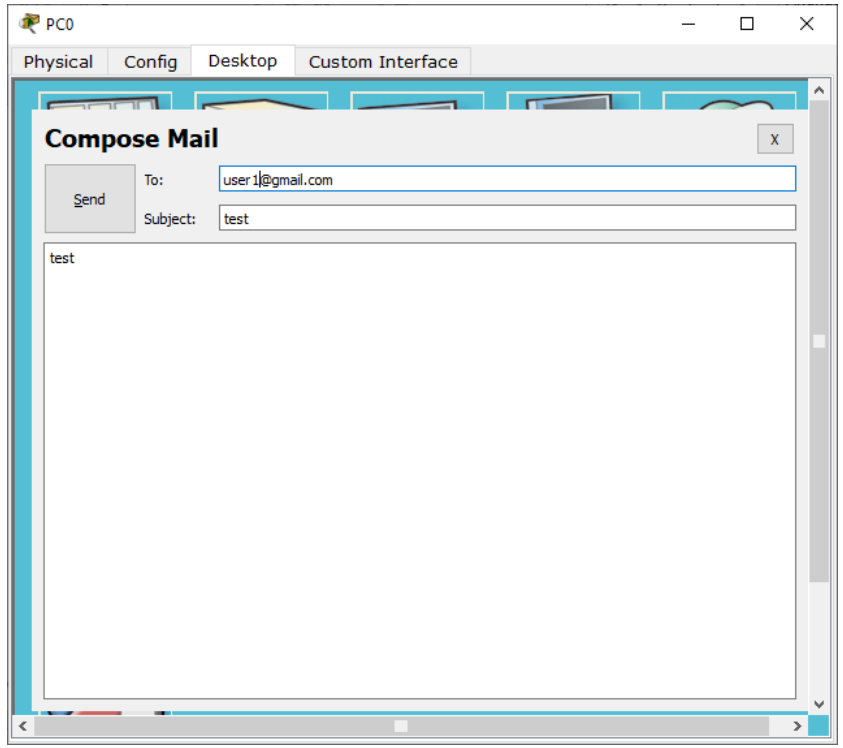
- Application Layer Services and their Services
  - Using Server
    - E-Mail Server Configuration:

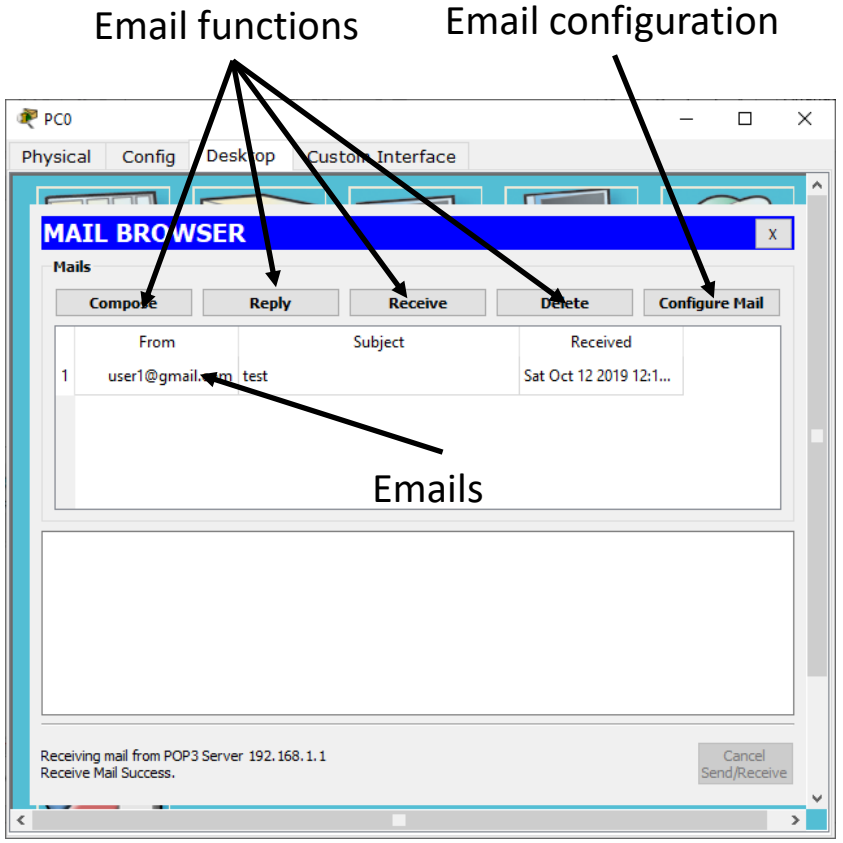




LAB2 (Theoretical)

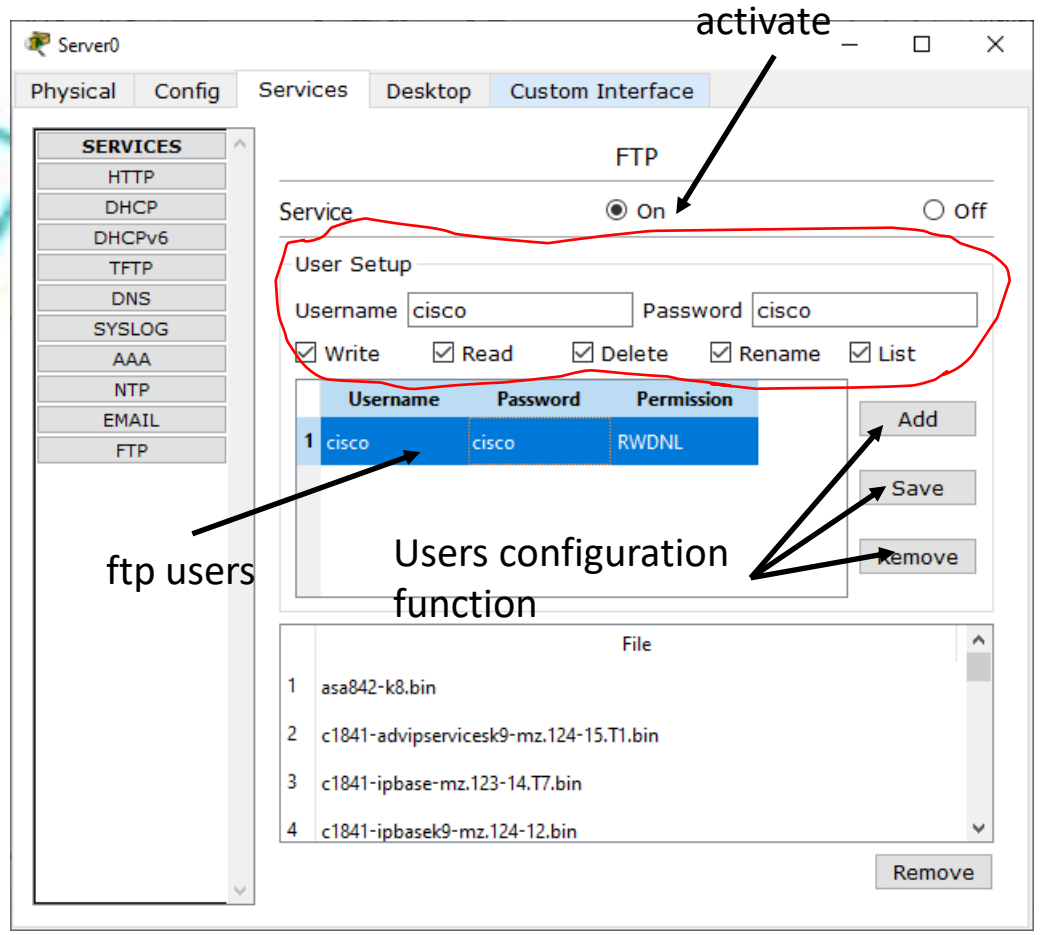
- Application Layer Services and their Services
  - Using Server
    - E-Mail Server Configuration:





LAB2 (Theoretical)

- Application Layer Services and their Services
  - Using Server
    - FTP Configuration:
      - Enable the FTP Server from the Services Tab
      - Adding a new user account by setting up their user-name and password
      - Test the FTP via the Command Prompt from any Hosts
      - FTP commands:
        - ftp server_address
          - username
          - password
        - put, get, dir, cd, delete, quit, …



LAB2 (Theoretical)

- Application Layer Services and their Services
  - Using Server
    - Firewall Configuration:
      - Enable the Firewall from the Desktop Tab
      - Adding a new record containing (action, protocol, IP remote, local and remote port and remote wildcard mask)
        - Wildcard mask → inversion of submask
          - Submask=255.255.255.0 → wildcard mask = 0.0.0.255