Training Course for CWR Internals

Networking

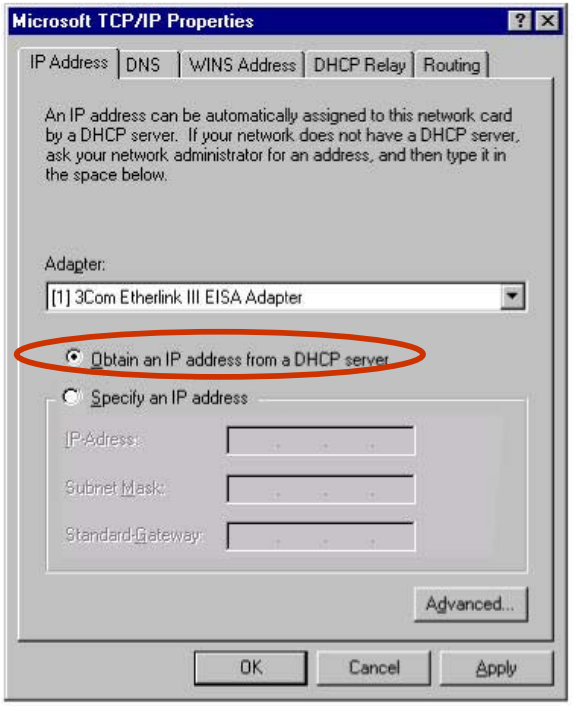
Windows NT Network Protocol Setup

Protocol Setup: TCP/IP

Installation of the TCP/IP Protocol Suite

- The TCP/IP protocol stack for Windows NT 4.0 must be installed via the Windows NT „**Control Panel**“
  - Doubleclick on the „**Network**“ icon to open network installation and administration window
  - Choose the register card "**Protocols**“, click on the button "**Add...**“, select the line "**TCP/IP Protocol**“, and confirm the selection by clicking on the „**OK**“ button.
  - Insert the Windows NT 4.0 Server CD into the CD-ROM drive and follow the instructions of the screen
  - After the installation of the TCP/IP software the window "**Network**" with the register card "**Protocols**" re-appears. Click on the „**Close**“ button to complete the installation
- After completion of the TCP/IP installation the window "**Microsoft TCP/IP Properties**" appears. Now you must configure TCP/IP for your local machine. In any case you have to configure the IP adresse(s).There are two options. For any of the network interface cards you may:
  - specify an **IP Address** and a **Netmask**

  or
  - decide to obtain the **IP Address** and other required parameters automatically from a DHCP server on your network.

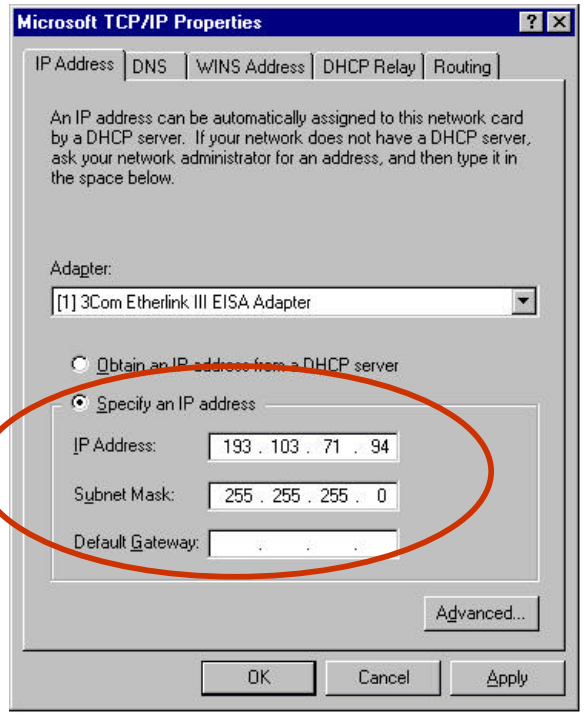


Please don`t forget to re-install the Windows NT 4.0 Service Pack 3 after installing the „TCP/IP Protocol“

Protocol Setup: IP Address Setup

DHCP versus manually administered IP Addresses

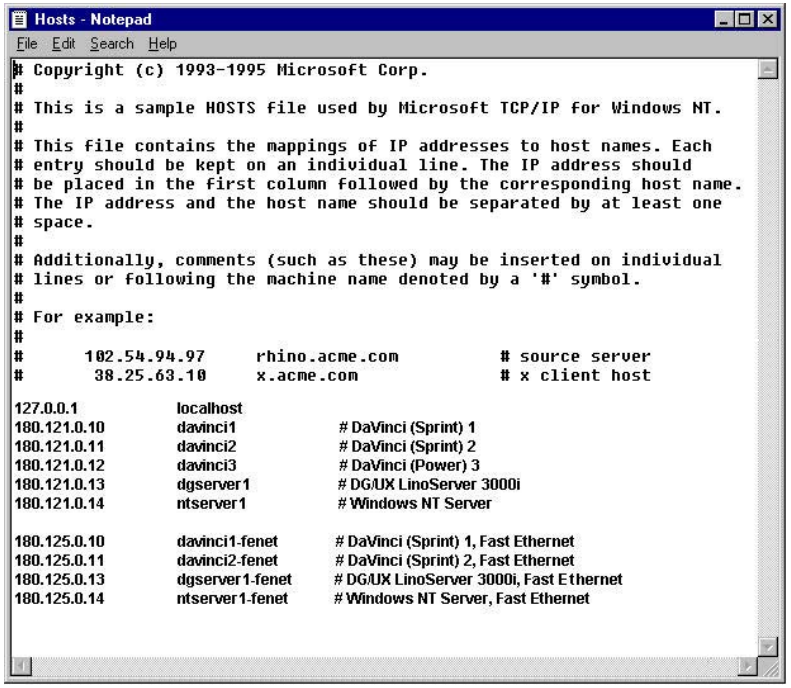
- The Windows NT 4.0 „**IP Address**“ register card allows you to choose between two different types of IP Address assignements:
  - Obtaining an IP Address from an **DHCP** Server
  - Specifying an IP Address **manually**
- If a DHCP Server exists in your network and you choose to obtain an IP address by DHCP requests then this server will automatically assign an IP address to your machine on request (during the system startup). This frees you of the burden to assign an address manually.
- If you choose to configure a specific IP Address to your machine you will have to ask your system administrator for the correct address. Manually administered IP Addresses allow you to specify an address that can be looked up in a „**hosts**“ file or via a Domain Name Service (**DNS**)



Protocol Setup: IP Address Setup

The „hosts“ file

- The so-called „**hosts**“ file is used for local **host name to IP address resolution**
- Derived from the UNIX system environment it is also available on Windows NT systems under the path „**\winnt40\system32\drivers\etc**“
- It contains a list of IP address to host name mappings for an IP „Internet“
- Hosts are represented by a logical name at the application level.
- The „TCP/IP“ software looks up the IP address for a host name specified by upper level software using the „**hosts**“ file
- There are also other IP address resolution mechanisms like:
  - the **LMHOSTS** file for NetBIOS names
  - **WINS** (Windows Internet Name Service) which dynamically resolves NetBIOS names
  - **NIS** (Network Information Service) maintains just one central hosts file on a NIS server
  - **DNS** (Domain Name System) which dynamically resolves hierachical names based on a name resolution database hierarchically distributed over a number of DNS servers



Protocol Setup: TCP/IP - DHCP

What is the DHCP ?

- The **D**ynamic **H**ost **C**onfiguration **P**rotocol (**DHCP**) was developed by the Internet Engineering Task Force (**IETF**) to reduce the administrative overhead for TCP/IP environments
- DHCP **centralizes the management and the assingment of IP Address, Netmask, and Default Gateway information**
- DHCP Servers provide these IP configuration parameters to DHCP clients
- A DHCP Server holds at least one pool of IP Addresses which is called a „**Scope**“. ***Scopes of different DHCP Servers are not allowed to overlap!***
- When an DHCP Server receives an IP address „**lease**“ request from a client, it will select an unleased IP address from its scope and offer this address to the client (in most cases together with additional configuration parameters like the Netmask and the Default Gateway)
- DHCP is an **extension to the Bootstrap Protocol** (**BOOTP**) which was also designed by the IETF and which is used to boot and configure diskless clients

What are the DHCP Advantages ?

- **No need for manual IP address configuration** on any IP station. Stations will automatically request an IP address from a DHCP Server
- **Reduced administration overhead** for IP address setup. Only a centralized address pool is managed by the system administrator
- **Stations can be moved** from one subnetwork to another **without any IP address reconfiguration**. A station automatically releases its leased IP address on shutdown and automatically requests a new one on bootup on the new subnetwork.

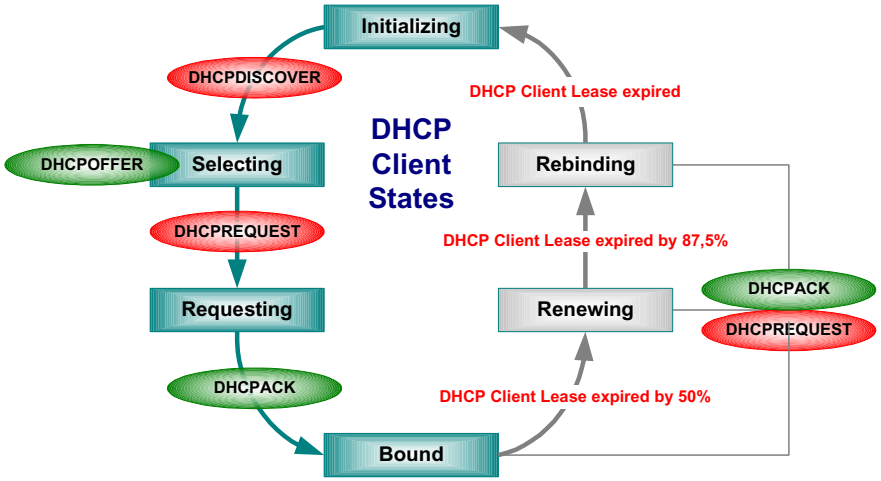
Note:

- DHCP is generally **NOT** synchronized with the contents of „**hosts**“ files or with name resolution services like **DNS** (Domain Name System) or **NIS** (Network Information Service)
- Therefore DHCP IP address assignment should not be used in fully DNS or NIS resolved network environments
- **This will change with Distributed DNS for Windows NT 5.0 (Windows 2000)**

Protocol Setup: TCP/IP - DHCP

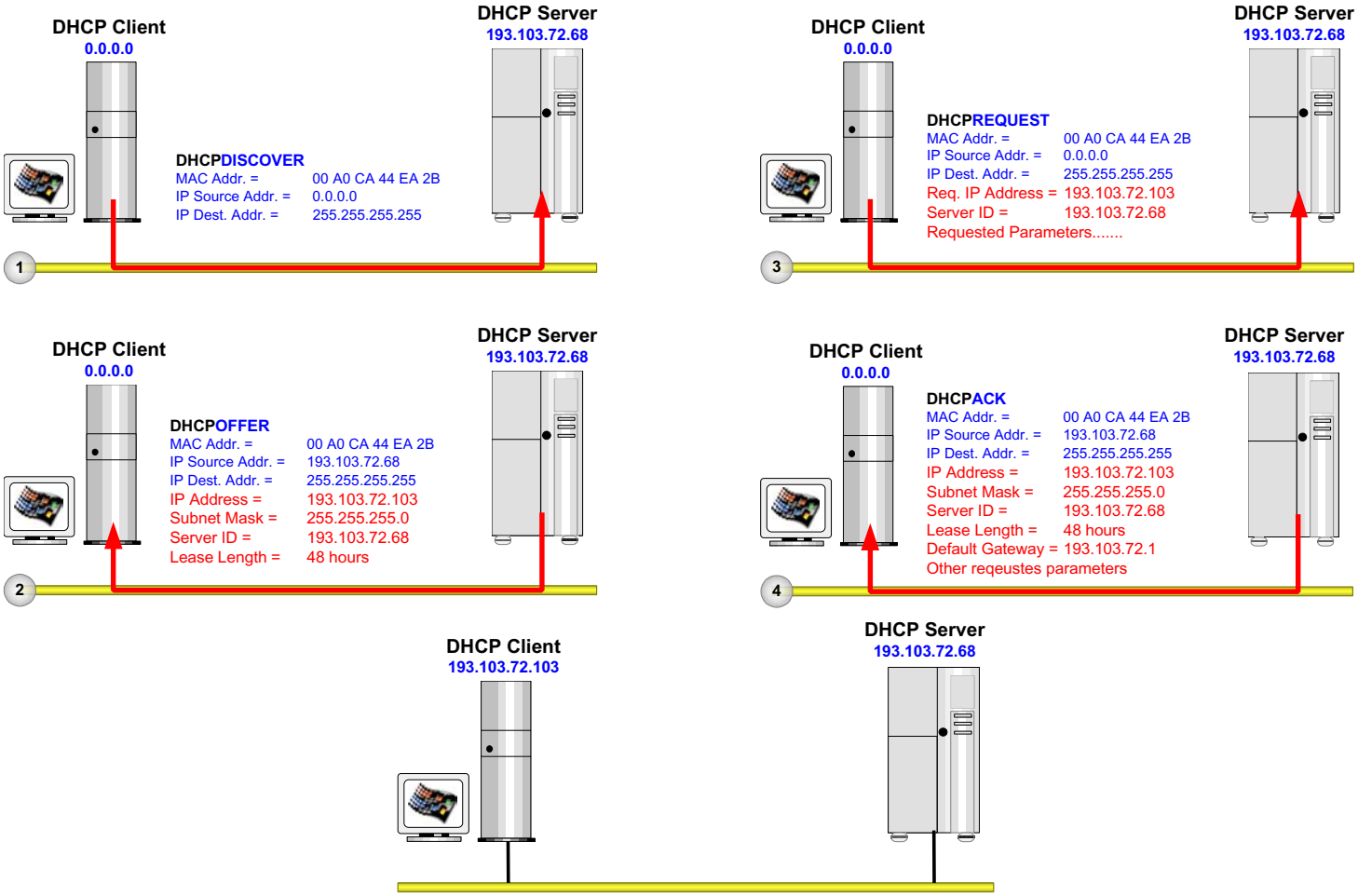
How does DHCP work ?

- First a client broadcasts a **DISCOVER** request to the DHCP Server
- The server selects an unused IP address from (one of) its address pool(s) and responds to the client with an **OFFER** broadcast message containing this address
- The client collects all OFFER responses from DHCP Servers it receives and chooses one of the offers (in most cases this will be the first one received)
- The client now broadcasts a **REQUEST** message containing the ID of the selected DHCP Server to accept the IP address lease offer
- Finally the DHCP Server responds with an **ACK** (Acknowledgement) message containing the leased IP Address, the lease time, and all other required and requested parameters
- When the lease time expired by 50% the client tries to renew the lease by sending an unicast REQUEST message to the server
- If possible the DHCP Server then will renew the lease by responding with an unicast ACK message



Protocol Setup: TCP/IP - DHCP

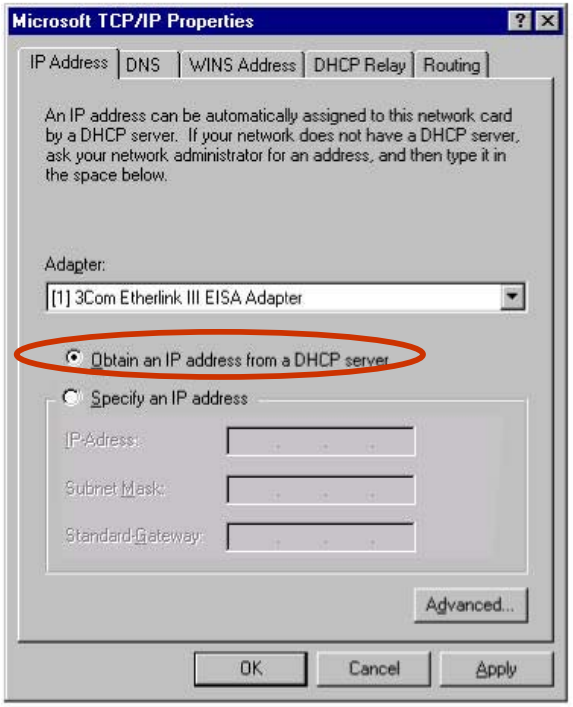
DHCP Request/Response Sequence



Protocol Setup: TCP/IP - DHCP

DHCP Client Setup

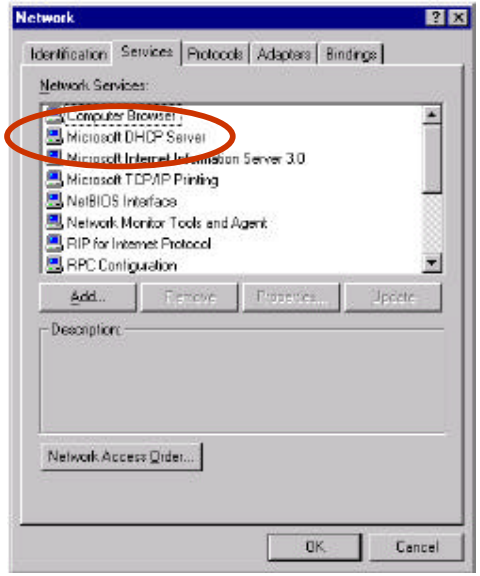
- To set up a Windows NT station as a DHCP client you only need to select „**Obtain an IP address from a DHCP server**“ in the IP Address register card
- For every installed network interface you have to choose between DHCP and a manually administered IP address
- If you want to use the DHCP address assignment then your system environment has to contain at least one DHCP server with an valid IP address pool
- The utility **IPCONFIG.SYS** allows you to check if DHCP is enabled and which IP address has been leased to your system:
  - The command „**ipconfig**“ can be started within a DOS box
  - „**ipconfig /all**“ displays all of the TCP/IP configuration parameters
  - „**ipconfig /release [adapter]**“ allows you to release the currently leased IP address of your system
  - „**ipconfig /renew [adapter]**“ forces your system to renew the lease if currently has for an IP address

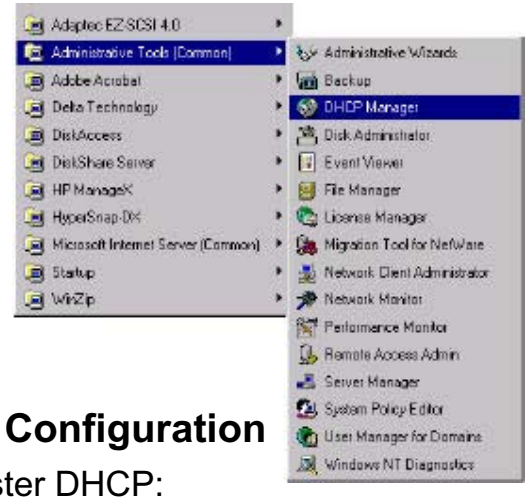


Protocol Setup: TCP/IP - DHCP

DHCP Server Installation

- To install the DHCP Service for NT
  - Open the „**Network**“ Window in the „**Control Panel**“ and select the „**Services**“ register card
  - „**Add**“ the „**Microsoft DHCP Server**“ and confirm the selection.
  - After the next reboot the DHCP Service will be started and you may configure the DHCP parameters and scopes (IP address pools)





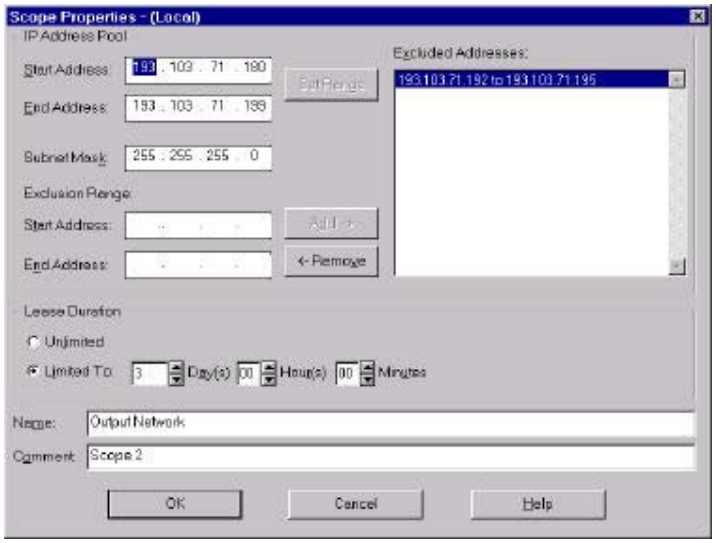
DHCP Server Configuration

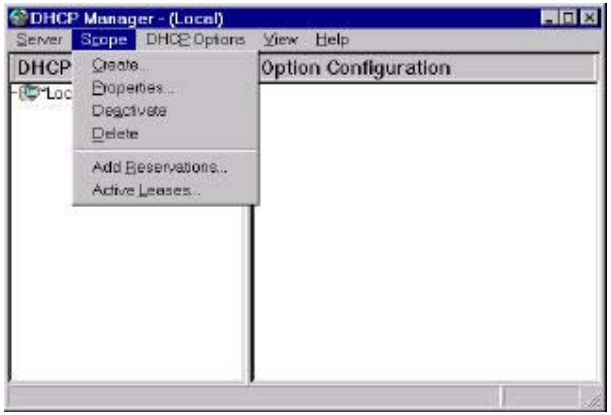
- To administer DHCP:
  - Select the „**Administrative Tools**“ and start the „**DHCP Manager**“
  - The first step to configure the DHCP server is to **create a Scope**. This is a range of IP addresses which can be leased to DHCP clients. A scope is created by defining a start IP address, an end IP address, and a subnet mask.
  - Furthermore you may define address **sub-ranges to be excluded from the scope** and it is possible to **reserve specific IP addresses** for clients which are known by their MAC addresses

Protocol Setup: TCP/IP - DHCP

Creating a DHCP Scope

- Select „**Create**“ in the „**Scope**“ drop down menu of the DHCP Manager
- Enter the **Start Address** and the **End Address** of the scope
- Enter the **Subnet Mask** for the address pool
- Set the **Lease Duration** either to unlimited or to a specific value (the default value is three days)
- In addition you may secify a **Name** and a **Comment** for the scope
- The **Default Gateway** for a scope may be defined via the „**DHCP Options**“ - „**Scope**“ menu. Here you need to add the „**Router**“ option and specify the IP address of the router





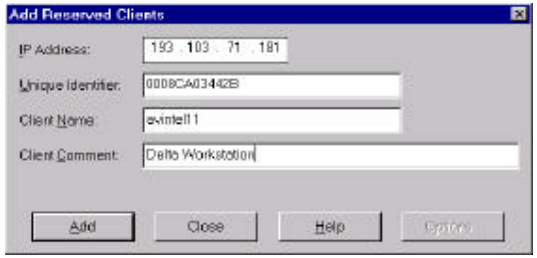
Creating an Exclusion Range

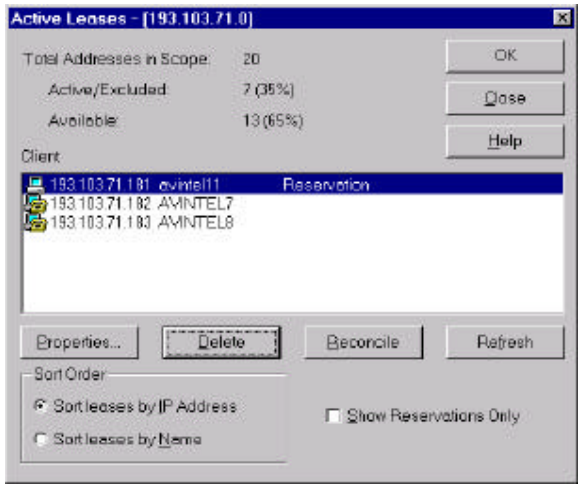
- If you need to exclude a specific range within the defined scope such as the IP addresses of the DHCP servers then:
  - enter the **Start Address** and the **End Address** of the range to be excluded
  - and press the „**Add**““ button to add this range to the list of excluded IP addresses.

Protocol Setup: TCP/IP - DHCP

Reserving a Client IP Address

- If required it is possible to reserve specific IP addresses for DHCP client stations
- Select „**Add Reserverations...**“ in the „**Scope**“ drop down menu of the DHCP Manager
- In order to specify the reservation you need to know the MAC (Ethernet) address of the client (you may get it at the client using the commands „**net config rdr**“ or „**ipconfig /all**“)
- Enter:
  - the reserved **IP Address** (must be within a valid scope)
  - the clients MAC address (**Unique Identifier**)
  - the **Client Name**, and optionally a **Cient Comment**





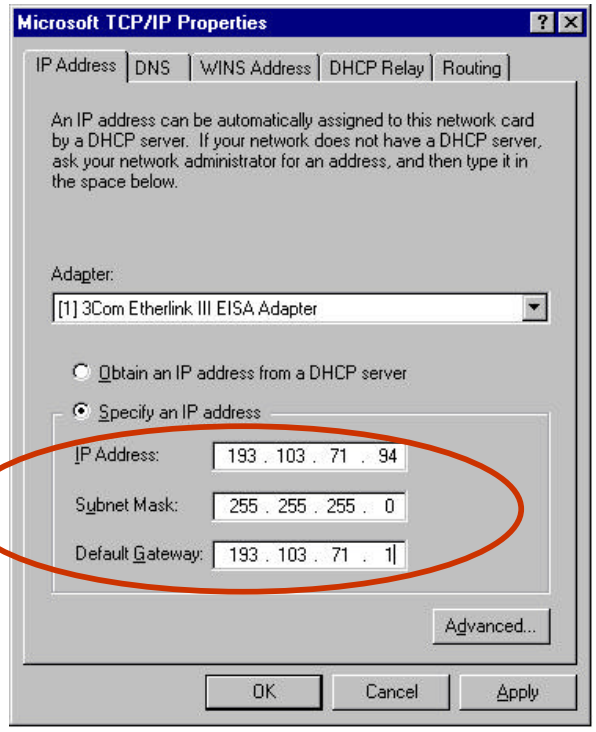
Displaying active Leases

- To view the active leases and reservation select „**Active Leases**“ in the „**View**“ drop down menu of the DHCP Manager
- Within the „**Active Leases**“ window you may delete active leases as well as reservations (the changes will become valid when the client tries to renew its lease)
- By pressing the „**Properties**“ button you can view details as the IP address, Mac address or the client name

Protocol Setup: TCP/IP - Routing

Default Gateway

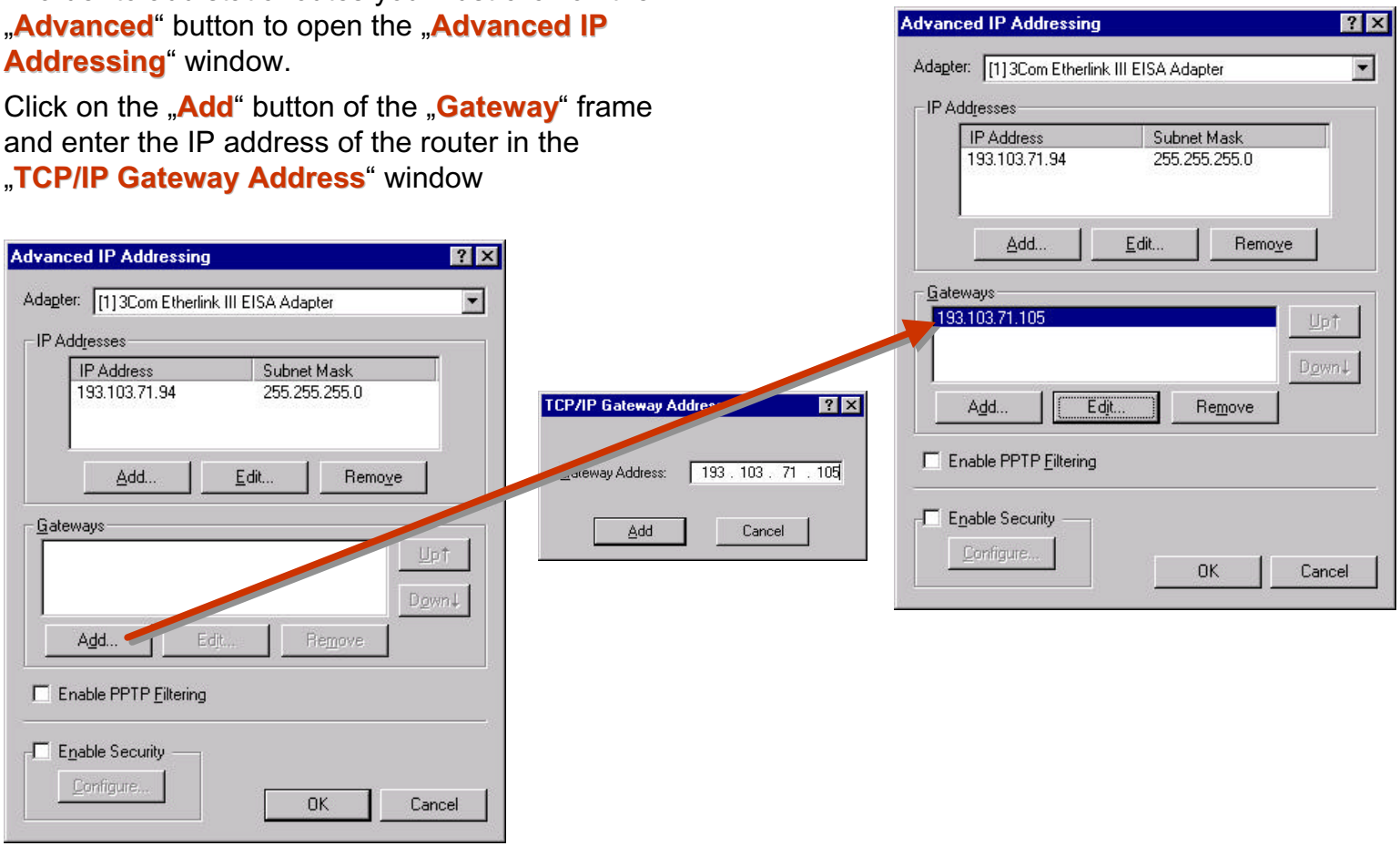
- In a subnetted TCP/IP network environment any station needs to know at least one router in order to talk to remote stations outside its local subnetwork.
- The „**IP Address**“ register card in the Windows NT 4.0 „**Control Panel**“ allows you to specify the IP address of a default router, called the „**Default Gateway**“
  - The Default Gateway is the primary IP router to access other subnetworks
  - A major disadvantage of defining a Default Gateway is:
    When the IP address of the router changes the IP address of the Default Gateway must be changed on any station on that subnetwork
- In addition to the Default Gateway you may also specify other static routes. In order to do this you must click on the „**Advanced**“ button to open the „**Advanced IP Addressing**“ window.
- You may click on the „**Apply**“ button to apply the settings to the IP configuration.



Protocol Setup: TCP/IP - Routing

Static Routes

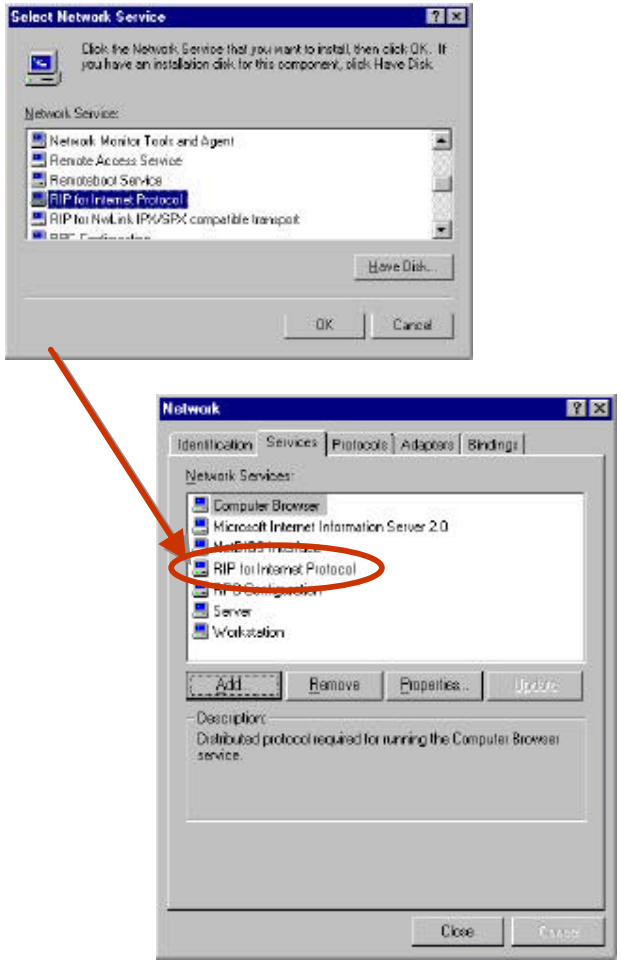
- In order to add static routes you must click on the „**Advanced**“ button to open the „**Advanced IP Addressing**“ window.
- Click on the „**Add**“ button of the „**Gateway**“ frame and enter the IP address of the router in the „**TCP/IP Gateway Address**“ window



Protocol Setup: TCP/IP - Routing

RIP for Internet Protocol

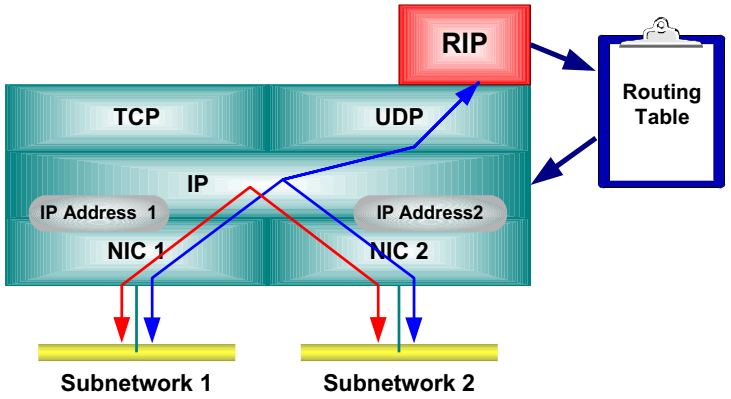
- Routing tables can be edited manually by entering the required information such as the **Default Gateway** and **Static Routes**.
- However, in subnetted IP network environments a route path finder protocol is usually employed to dynamically update the routing tables. The protocol most commonly used in IP networks at present is the **RIP** (**Routing Information Protocol**).
- In order to maintain automatically updated IP routing tables under Windows NT 4.0 the „**RIP for Internet Protocol**“ service must be installed:
  - Open the Windows NT „**Control Panel**“
  - Doubleclick on the „**Network**“ icon to open network installation and administration window
  - Choose the register card “**Services**“
  - Click on the button "**Add...**“, select the line “**RIP for Internet Protocol**“, and confirm the selection by clicking on the „**OK**“ button.
  - Insert the Windows NT 4.0 Server CD into the CD-ROM drive and follow the instructions of the screen
- **Please don`t forget to re-install the Windows NT 4.0 Service Pack 3 after installing „RIP for Internet Protocol“**



Protocol Setup: TCP/IP - Routing

RIP for Internet Protocol

- After installing the „**RIP for Internet Protocol**“ service and rebooting the system your Windows NT 4.0 Server station will automatically learn all route pathes from RIP boadcast messages generated by IP routers in the directly accessible subnetworks
- The actual contents of the IP Routing table can be visualized using the „**netstat -r**“ command (within a DOS box)
- With RIP for Internet Protocol installed:
  - You do not need to specify a Default Gateway
  - Changes of the route pathes are learned automatically. Any IP router supporting the Routing Information Protocol broadcasts its routing table every 30 seconds
  - Redundant route pathes to the same destination are detected automatically and the IP layer always accepts the route path with the lowest „**costs**“ such as router hop counts
  - Statics routes may be specified additionally to add pathes via routers who do not support RIP



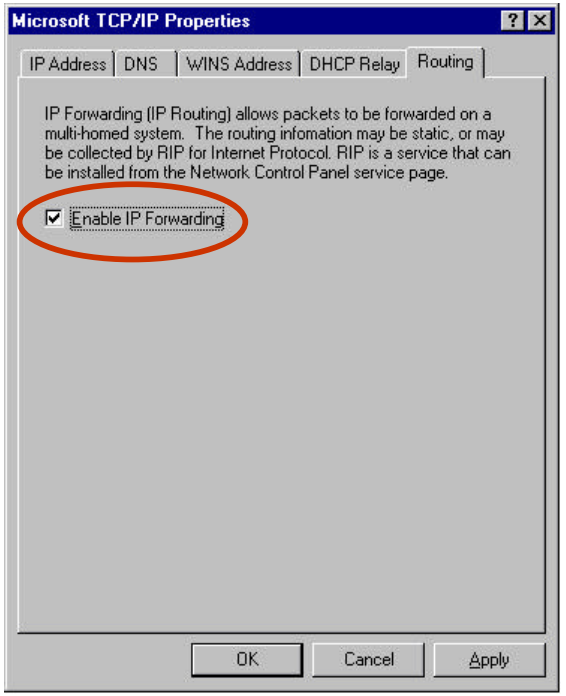
Protocol Setup: TCP/IP - Routing

IP Forwarding

- If your Windows NT 4.0 Server is equipped with
  - more then just one network interface card

  and
  - the „**TCP/IP Protocol**“ suite as well as the „**Routing Information Protocol Service for IP**“ is installed

  then you may **configure your computer to act as an IP Router and to forward IP frames between subnetworks**
- Your station then will periodically (every 30 seconds) advertise itself as an IP Router by **broadcasting RIP frames** containing its actual Routing Table to the subnetworks it is connected to
- Just by clicking on the check box "**Enable IP Forwarding**" of the „**Routing**“ register card within the „**Microsoft TCP/IP Properties**“ window (selectable via „Protocols“ register card of the „Control Panel“) you can enable the forwarding of IP packets between subnetworks connected to your server



Protocol Setup: TCP/IP - WINS

Windows Internet Name Service (WINS)

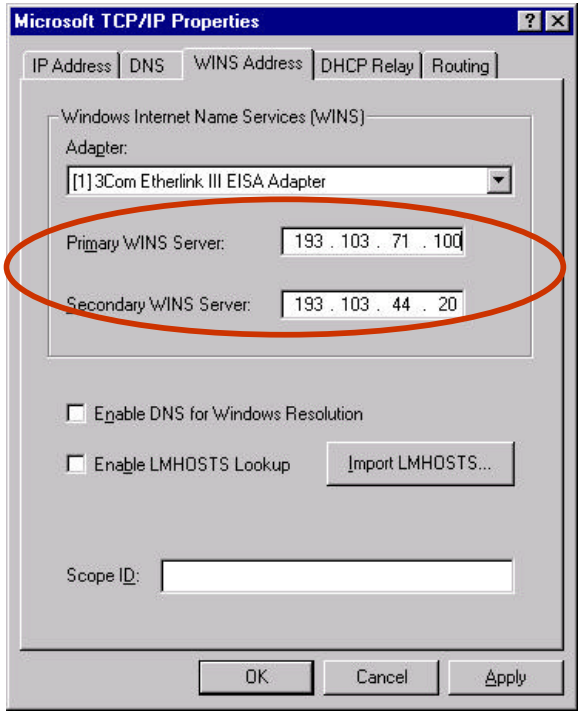
- **WINS is a Microsoft Name Service that resolves IP addresses for NetBIOS computer names**
- This service is required for TCP/IP based Microsoft network environments since the TCP/IP services do address remote nodes via IP addresses (like *192.168.11.132*) and are not aware of Microsoft UNC (Universal Naming Convention) NetBIOS computer names such as „\\server2“
- Stations may resolve the computer name to IP address mapping via one of three methods:
  - via ***broadcast request*** (forwarded throughout the whole network)
  - via a ***static local LMHOSTS mapping file*** („\winnt40\system32\drivers\etc\LMHOSTS“) that has to be administered manually on every „NetBIOS“ host on the network
  - via ***WINS Servers***
- WINS was designed by Microsoft to avoid NetBIOS name resolution broadcast traffic, the need for static LMHOST mapping files, and the danger of duplicate NetBIOS names
- In order to use the Windows Internet Name Service **at least one WINS server must exist** within the network environment. **The WINS Server maintains an IP address to NetBIOS computer name database**
- The IP addresses of a primary and a secondary WINS Server are specified at each WINS Client
- WINS Clients send unicast name resolution requests to WINS Servers to resolve NetBIOS name to IP address mappings for remote stations
- WINS Server know the mappings for the NetBIOS names of all stations since all **clients register their NetBIOS names an the corresponding IP addresses at their primary WINS Server**

Protocol Setup: TCP/IP - WINS

WINS Client configuration

- A **WINS Client** needs to know the IP address of a primary WINS Server and optionally the IP address of a secondary WINS Server
- To set the IP addresse(s) of the WINS Server(s) please select the register card „**WINS Address**“ within the „**Microsoft TCP/IP Properties**“ window (selectable via „Protocols“ register card of the „Control Panel“). Within this window you can enter the IP address of the primary and the secondary WINS Server.
- All other WINS and Name Resolution related items such as :
  - setting up and maintaining a **WINS Server**
  - maintaining the **LMHOSTS file**
  - the **D**omain **N**ame **S**ystem (**DNS**)

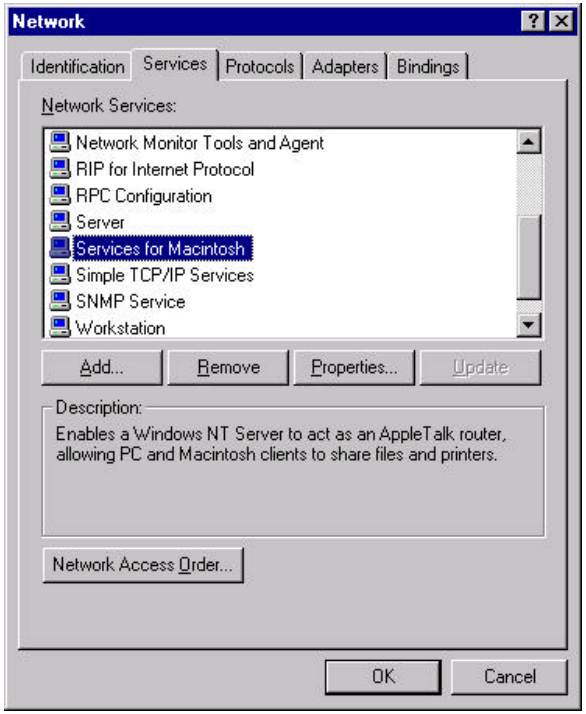
  are outside the scope of this document.



Protocol Setup: AppleTalk

Windows NT Services for Macintosh

- To be accessible for Apple Macintosh computers a Windows NT Server has to support the AppleTalk protocol stack
- Microsoft‘s Windows NT „**Services for Macintosh**“ implement the AppleTalk protocol stack and provide the following services for Apple Macintosh clients:
  - ***File Sharing***
  - ***Print Sharing***
  - ***AppleTalk routing***
- The „**Services for Macintosh**“ have to be installed via the Windows NT „**Control Panel**“
  - Doubleclick on the „**Network**“ icon to open network installation and administration window
  - Choose the register card “**Services**“, click on the button "**Add...**“, select the line “**Services for Macintosh**“, and confirm the selection by clicking on the „**OK**“ button
  - Insert the Windows NT 4.0 Server CD into the CD-ROM drive and follow the instructions of the screen
  - After the installation of the Services for Macintosh the window "**Network**" with the register card "**Protocols**" reappears. Click on the „**Close**“ button to complete the installation

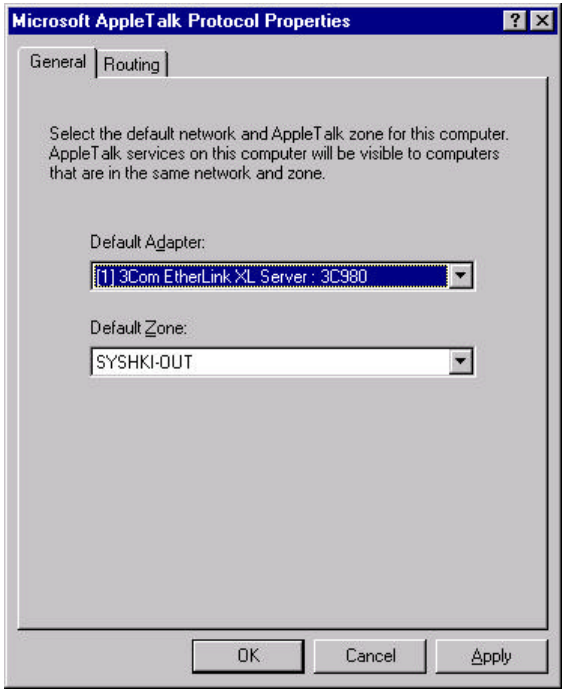


Please don`t forget to re-install the Windows NT 4.0 Service Pack 3 after installing the „Services for Macintosh“

Protocol Setup: AppleTalk

AppleTalk Configuration

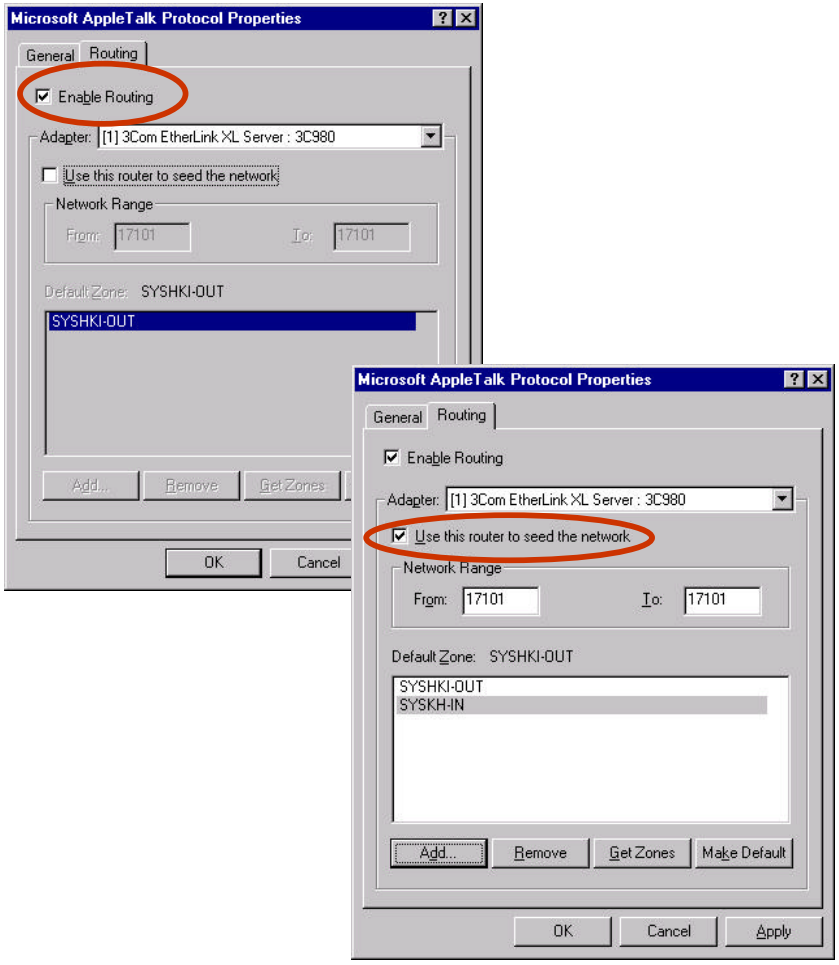
- On the register card "**Services**", select the line "**Services for Macintosh**", and click on the „**Properties**" button to open the „**Microsoft AppleTalk Protocol - Properties**" window which allows you to:
  - select a **default network** (adapter)
  - enable your station as an AppleTalk **non-seed router**
  - enable your station as an AppleTalk **seed router** including the **definition of a network range and zone names**
- The basic configuration register card „**General**" :
  - shows the default network adapter as well as all other adapters bound to the AppleTalk protocol stack and allows you to select one of the network adapters (if there are more than one) as the default one
  - shows the default zone and allows you to select one of the zones (if there are more than one) as the one in which the Windows NT file and print server will appear
- For the advanced AppleTalk (non-seed or seed router) configuration please choose the register card „**Routing**"



Protocol Setup: AppleTalk

AppleTalk Routing Configuration

- On the register card "**Routing**" of the „**Microsoft AppleTalk Protocol Parameters**" window, it is possible to:
  - enable the local machine (if it is equipped with at least two network interface cards) as an AppleTalk (non-seed) router:
    - Just click on the check box „**Enable Routing**" to enable AppleTalk non-seed routing
  - enable the local machine as an AppleTalk seed router, seeding a AppleTalk „**network range**" and AppleTalk „**zones**":
    - If you already enabled your machine as an AppleTalk router, then click on the check box „**Use this router to seed the network**" to configure your computer as a seed router
    - specify a „**From**"- „**To**" network range
    - Specify a default zone and optionally additional zones. Click on the „**Add...**" button to add zone names



End of the Training Course on the Windows NT Protocol Setup