

# BIG-IP® Advanced Routing™

## Basic Access Configuration Guide

Version 7.10.4





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# Preface

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This configuration guide is for network administrators and application developers intending to configure basic access for BIG-IP® Advanced Routing™ protocols. This guide attempts to make configuration simpler by adding topology illustrations and configuration samples. It covers basic configurations for Basic Access Networking Services. Use this guide in conjunction with the *BIG-IP® Advanced Routing™ Network Platform Command Line Interface Reference Guide* to get complete information on the commands used in the configurations displayed in this guide.

## Conventions

The following table displays the conventions for the syntax and procedures describing how to enter information, and how information displays on the console.

Convention	Description
command syntax	The new <code>courier</code> font represents command strings entered on a command line, and sample source code.
UPPERCASE	A variable parameter. Enter a value according to the descriptions that follow.
lowercase	A keyword parameter. Enter lowercase values exactly as shown
	The vertical bar. Delimits choices; select one from the list.
( )	Parenthesis. Delimits optional parameters. Do not enter parentheses as part of any command.
[ ]	Square brackets: groups parameters and keywords into a single unit. Take all parts within these brackets. Do not enter brackets as part of any command.
< >	Angle brackets: enclose a numeric range for a keyword. Do not enter angle brackets as part of any command.
description	Proportional font gives specific details about a parameter.
=	Equal sign: separates the command syntax from explanatory text.

Note: Unless otherwise stated, press Enter after each command entry.

## Configuration Format

The following table describes the configuration format used in this guide.

Format	Description	Example
<b>Scenario Description</b>	This section includes a description of both the topology and the configuration.	<b>Enabling RIP</b> This example shows the minimum configuration required for enabling RIP on an interface.
<b>Topology</b>	This section is an illustration of the topology. The figure might include the IP addresses and names of the devices used in the example.	
<b>Configuration</b>	This section has the complete configuration involved in the example. The prompt shows the execution modes of the commands.	<pre>R1 ZebOS#configure terminal ZebOS (config)#router rip ZebOS (config-router)#net... ZebOS (config-router)#net...</pre>
<b>Explanation</b>	The grey section next to the configuration provides an explanation of the action performed by a configuration.	<pre>Configure interface in bridge group Configure interface mode as trunk. Allow all VLANs on interface eth2.</pre>
<b>Commands Used</b>	This section lists the names of the commands used in the example. Users can look up the details of these commands in the specific command line reference guide. To avoid repetition, this section does not include common commands, such as “configure terminal.”	<b>Commands Used</b> router rip, network
<b>Validation Commands</b>	This section has the show commands that display the validation output.	<b>Validation Commands</b> show ip rip

## Command Line Interface

The ZebOS™ Command Line Interface (CLI) is a text-based interface that is used to interact with systems. Users can utilize many of the commands in scripts to automate many configuration tasks. Each command associates with a specific function or a common function performing a specific task. Multiple users can telnet and issue commands using the Exec mode and the Privileged Exec mode. The VTY shell, described in the ZebOS VTY Shell User Guide, gives users and administrators the ability to issue commands to several daemons from a single telnet session.



## Command Line Help

The ZebOS CLI contains a text-based help facility. Access this help by typing in the full or partial command string, then typing "?". The ZebOS CLI displays the command keywords or parameters plus a short description. For example, at the CLI command prompt, type `show ?` (the CLI does not display the question mark). The CLI displays this keyword list with short descriptions for each keyword:

```
bgpd#show
  debugging      Debugging functions (see also 'undebug')
  history        Display the session command history
  ip             IP information
  memory         Memory statistics
  running-config running configuration
  startup-config Contents of startup configuration
  version        Displays ZebOS version
```

## Syntax Help

The ZebOS CLI can complete the spelling of command or parameter keywords. Begin typing the command or parameter, then press TAB. At the CLI command prompt, type `sh`:

```
Router> sh
```

Press TAB. The CLI shows:

```
Router> show
```

If the command or parameter partial spelling is ambiguous, the CLI displays the choices that match the abbreviation. Type `show i`. Press TAB. The CLI shows:

```
Router> show i
interface ip
Router> show i
```

The CLI displays the `interface` and `ip` keywords. Type `n` to select `interface` and press TAB. The CLI shows:

```
Router> show in
Router> show interface
```

Now type `?` and the CLI shows a list of parameters for the `show interface` command.

```
[IFNAME] Interface name
Router> show interface
```

## Command Abbreviations

The CLI accepts abbreviations for commands. For example, the following is an abbreviation for `show interface`.

```
sh in
```

## Command line errors

If the router does not recognize the command after ENTER is pressed, it displays this message:

```
% Invalid input detected at ``^` marker.
```

If a command is incomplete, it displays this message:

```
% Incomplete command.
```

Some commands are too long for the display line, and can wrap in mid-parameter or mid-keyword, if necessary:

```
area 10.10.0.18 virtual-link 10.10.0.19 authentication-key 57393
```

## Command Modes

The commands available for each protocol separate into several modes (nodes) arranged in a hierarchy; Exec is the lowest. Each mode has its own special commands; in some modes, commands from a lower mode are available.

### Modes Common to Protocols

---

Mode	Description
Exec	Also called the View mode, use this mode to perform basic commands, such as, show, exit, quit, help, list, and enable. This is the initial mode when users log in to any ZebOS CLI.
Privileged Exec	Also called the Enable mode, this mode allows users to perform debugging commands, write commands (for saving and viewing the configuration), and show commands.
Configure	Also called the Configure Terminal, this mode includes configuration commands and serves as a gateway to other configuration modes, including Interface, Router, Line, Route Map, Key Chain and Address Family modes. All ZebOS daemons have this mode.
Interface	Use this mode to configure protocol-specific settings for a particular interface. Any attribute configured in this mode overrides an attribute configured in the router mode.
Line	Use this mode to make access-class commands available.

---

### Modes Specific to Protocols

The following command modes are specific to a variety of protocols. The command used to enter these modes is different for each protocol.

---

Mode	Description
Router	Known as the Configure Router mode, this mode is available for the LDP, BGP, OSPF, RSVP-TE and RIP protocols. It provides access to router and routing command.
Route-map	Use this mode to set route metric, route-length and cost data. It is available for the BGP, OSPF, and RIP protocols.
Address Family	Use this mode for multiprotocol BGP extension. It includes address family-specific commands.
Key Chain	Use this mode to manage the key chain. It is available for the RIP and ISIS protocols.
Trunk	Use this mode to create or modify RSVP trunks. A trunk is the static definition for a Labeled Switch Path (LSP).
Path	Use this mode to create or modify RSVP paths.

---

The ZebOS basic access networking services are part of the ZebOS Integrated Management Interface (IMI). IMI is an advanced management plane that integrates all features of the ZebOS Layer 2, Layer 3 and MPLS components, key operating system components, and other third-party applications.

---

## Integrated Management Interface

The Integrated Management Interface (IMI) runs as a client of the NSM and routing protocols. It maintains a master database of data, such as, prefix-list, route-map, key-chain, access-list, and distributes this information to the protocols. This database enhances the capability and response to commands, such as, “show” or “write file”; the IMI collects and organizes data from the protocols, but displays the data directly. The ZebOS IMI includes:

- Persistent daemon - IMI is a persistent daemon that maintains up-to-date configuration of a system. When a protocol daemon restarts, IMI keeps the configuration of the daemon before it is stopped. It then configures the daemon after restart.
- Control over protocol start/stop - IMI has the capability to control start/stop of the ZebOS daemons, adding control over the entire system by the management plane.
- Central control of information - IMI provides central control over the running and static configuration of all of ZebOS protocols. This information can merge together to display configuration write and persistent backup information.
- Master copy of common data - Several ZebOS components receive the same types of information, which each protocol uses for various purposes. IMI now maintains a centralized copy of this information, off-loading several functions (such as display of active configuration) from the protocol modules.
- Multiple types of access (CLI, IMISH) - IMI provides a foundation (building block) for enabling several types of configuration options for the system. IMI supports both telnet CLI and IMISH.

The IMI provides access to the Basic Access Networking Services summarized in this chapter.

---

## DHCP

Dynamic Host Configuration Protocol (DHCP) is a protocol used for assigning dynamic IP addresses to systems on a network. Dynamic addressing allows a system to have a different IP address each time it connects to the network. DHCP makes network administration easier by removing the need to assign a unique IP address every time a new system is added to the network. It is especially useful to manage mobile users. Once a system is configured to use DHCP, it can be automatically configured on any network that has a DHCP server.

DHCP uses a client/server model, in which the DHCP server centrally manages the IP addresses used in the network. DHCP clients obtain an IP address on lease from the DHCP server. When the DHCP server starts, it reads the global parameters from the configuration file (`/etc/dhcp.conf`). These parameters apply to all clients, except for clients on which the parameters were explicitly changed. DHCP saves a list of IP addresses in memory for the subnets that it is serving. When the DHCP client starts, it requests an address from the server. The server checks the address list, and assigns an available address to the client. On startup, the IMI discards all configuration entries in the `/etc/dhcp.conf` file and replaces them with entries corresponding to the DHCP server configuration commands in ZebOS configuration file. During shutdown, the configuration entries added to the `/etc/dhcp.conf` file through the IMI are discarded.

---

## DNS

The Domain Name System (DNS) is an Internet service that translates domain names into IP addresses. Domain names are alphabetic, thus easier to remember. When a domain name is used, DNS service translates the name into the corresponding IP address. For example, the domain name, `www.abcdef.com`, might translate to `2.2.2.22`. The DNS has its own network. If one DNS server does not know how to translate a particular domain name, it gathers information from other Domain Name Systems to obtain the correct IP address. IMI interacts with DNS by modifying the `/etc/resolv.conf` file. After configuring DNS, validate it by examining this file. A basic method to test whether DNS is operating correctly is to use IMI to configure the test machine on an existing LAN. After the machine is configured, it should communicate with all other machines, and resolve host names.

---

## Storing DNS Configurations

On startup, the IMI discards all configuration entries in the `/etc/resolv.conf` file and replaces them with entries corresponding to the DNS configuration commands in ZebOS configuration file. During shutdown, the configuration entries added to the `/etc/resolv.conf` file through the IMI are discarded. To use DNS, you must have a Domain Name Server on your network.

---

## PPPoE

The ZebOS IMI permits configuration of the PPPoE protocol on any of the system interfaces. Point-to-Point Protocol over Ethernet (PPPoE) connects multiple systems, typically in a remote site, through one system at a local site. It is similar to dial-up services using PPP. It would primarily be configured on the upstream (WAN) interface of the local gateway system. DSL typically uses PPPoE.

---

## NAT

The IMI provides Network Address Translation (NAT) in net filter, the packet-filtering framework in the both the Linux 2.4 and 2.6 kernels. The NAT protocol enables a network to use more internal IP addresses by using different set of IP addresses for internal and external traffic. It allows one IP address to represent a group of systems to an external network. NAT also provides security by hiding internal IP addresses. Using NAT automatically creates a firewall between the internal and external network. The rules for NAT are stored in an `NAT` table. The `NAT` table consists of three rule-chains:

- `PREROUTING` Used for DNATing.
- `OUTPUT` Used for altering locally generated packets (on the gateway, itself).
- `POSTROUTING` Used for altering packets when they are just about to reach the firewall (SNATing).

The home gateway consists of a WAN interface and a LAN interface. The WAN interface connects to broadband access, such as DSL or Cable Modem.

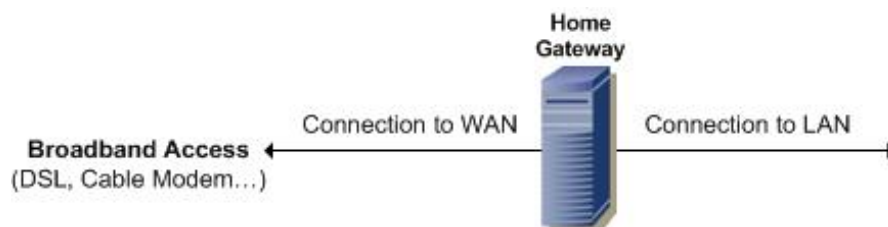


Figure 1: NAT Topology

The WAN interface has a public IP address (or multiple addresses) assigned by the ISP. The LAN interface can be used for the internal network of the user. This will use the private IP addresses, as defined in RFC 1918. These addresses are:

- 10.0.0.0/255.0.0.0
- 172.16.0.0/255.240.0.0
- 192.168.0.0/255.255.0.0

NAT will have to be provided to hosts (on the internal network) if they need access to the Internet. The gateway equipment provider uses the default rule-chain. A rule-chain, called "CUSTOMER", is created for the customer. All of the customers' rules are added to this chain. The default chain jumps to the customer's chain, after first applying the default rules.

---

## Basic Firewall

IMI uses a stateful packet inspection (SPI) to implement the firewall technology. SPI firewalls close ports, until the connection to the specific port is requested. Closing ports reduces the likelihood of a hacker successfully employing a port scan, and finding an open port to exploit on the firewall.

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## Network Firewall

A network firewall is a stateful packet inspection firewall, which provides the security and flexibility in whom and what types of access can be permitted to and from the Internet to the private network. The NAT protocol allows private computers to share a single (or multiple) global IP address for access to the Internet. Scarce IPv4 addressing is a convenient technology that facilitates the private networks to access the Internet.

The firewall rules can be configured using Cisco IOS-like access lists. Sophisticated security policies can be defined using the access lists. Virtual Servers can be configured using the network firewall for running virtual servers within the private network accessible from the Internet. Based on netfilter, a network firewall is the highly reliable and secure packet-filtering software that is available on all Linux operating systems.



# CHAPTER 2 Basic Access Network Services Configuration

This chapter contains basic access network services configuration examples. To see details on the commands used in these examples, or to see the outputs of the validation commands, refer to the *ZebOS Network Platform Network Service Module Command Line Interface Reference Guide*.

The ZebOS IMI maintains the configuration for the system-access protocols, which allows users to configure using the IMI shell (IMISH). On start-up, depending on the service considered, IMI can either read the current configuration or use a new configuration. When users configure using the IMISH, IMI updates the relevant networking service's configuration file.

## Configuration Topology

The following topology illustrates a basic access example. In this topology, ZebOS software is running on R1, with IMI providing access to the basic access networking services. It is connected to three hosts through interface eth1. R1 is connected to the Internet through another interface labeled eth0.

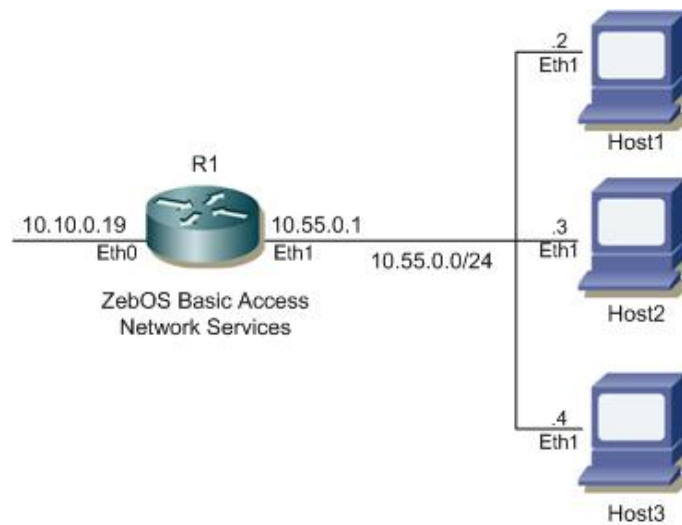


Figure 2: Basic Topology

## Enabling DNS

### R1

ZebOS#configure terminal	Enter the Configure mode.
ZebOS(config)#ip domain-name company.com	Set the default domain name for the DNS.
ZebOS(config)#ip domain-list company.com	Add the domain company.com to the DNS list.
ZebOS(config)#ip name-server 10.10.0.2	Add a Name Server to the DNS.
ZebOS(config)#ip name-server 10.10.0.88	Add another Name Server to the DNS.
ZebOS(config)#ip domain-lookup	Turn on the Domain Name Service (DNS).

### Names of Commands Used

ip domain-name, ip domain-list, ip name-server, ip domain-lookup

### Validation Commands

show hosts

---

## Enabling DHCP Server

### R1

ZebOS#configure terminal	Enter the Configure mode.
ZebOS(config)#service dhcp	Enable the DHCP server.
ZebOS(config)#ip dhcp pool default	Configure the DHCP address pool and enter the DHCP mode to configure this pool.
ZebOS(dhcp-config)#network 10.55.0.90 10.55.0.95	Configure the address pool network and mask.
ZebOS(dhcp-config)#range 10.55.0.90 10.55.0.195	Add an address range to the DHCP pool. Addresses within this range are given to the DHCP clients that connect to the DHCP server.
ZebOS(dhcp-config)#lease 0 1 30	Set the expiration time for the leased address for the DHCP pool. In this example, it is set for one hour and 30 minutes.
ZebOS(dhcp-config)#exit	Exit the DHCP mode.
ZebOS(config)#interface eth1	Specify the interface (eth1) to be configured and enter the Interface mode.
ZebOS(config-if)#ip address 10.55.0.1/24	Set the IP address of this interface (eth1).
ZebOS(config-if)#no shutdown	Bring the interface up.

### Names of Commands Used

ip dhcp pool, network, range, lease, service dhcp, ip address, and shutdown

### Validation Commands

show ip dhcp pool

---

## Enabling NAT

### R1

ZebOS#configure terminal	Enter the Configure mode.
ZebOS(config)#interface eth0	Specify the interface (eth0) to be configured and enter the Interface mode.
ZebOS(config-if)#ip address 10.10.0.19/24	Set the IP address of this interface (eth0).
ZebOS(config-if)#ip nat outside	Configure the NAT outside interface.
ZebOS(config-if)#exit	Exit the Interface mode



ZebOS(config)#interface eth1	Specify the interface (eth1) to be configured and enter the Interface mode.
ZebOS(config-if)#ip address 10.55.0.1/24	Set the IP address of this interface (eth0).
ZebOS(config-if)#ip nat inside	Configure the NAT inside interface.
ZebOS(config-if)#exit	Exit the Interface mode.
ZebOS(config)#access-list zebos permitall permit any any any	Add an entry to the ZebOS extended access list permitting packets based on source and destination. In this example, the any parameter permits all packets, regardless of source or destination.
ZebOS(config)#ip nat pool natpool 10.10.0.19 10.10.0.19 255.255.255.0	Define a pool of global addresses to be allocated.
ZebOS(config)#ip nat inside source list permitall pool natpool	Specify static translation between inside local address and inside global address. Packets with source addresses that pass the specified access list (permitall) are dynamically translated using the addresses in the named pool (natpool).

### Names of Commands Used

ip nat outside, ip nat inside, ip nat pool, ip nat inside source list (*ZebOS Network Platform Integrated Management Interface Command Line Interface Reference Guide*)

access-list zebos, ip address (*ZebOS Network Platform Network Services Manager Command Line Interface Reference Guide*)

### Validation Commands

show ip nat translations

---

## Enabling NTP

NTP synchronization does not happen immediately. Wait at least 3-4 minutes before executing validation commands to verify synchronization.

### R1

ZebOS#configure terminal	Enter the Configure mode.
ZebOS(config)#ntp master 6	Define the system to be an authoritative NTP server, even if the system is not synchronized to an outside time source. Specify the stratnum number (6).

### H1

ZebOS#configure terminal	Enter the Configure mode.
ZebOS(config)#ntp server 10.55.0.1 Translating IPv4 address: 10.55.0.1 " " ... OK	Configure an NTP server. Enable this system to synchronize 10.55.0.1 with the other system, and not vice versa.

**Names of Commands Used**

ntp master, ntp server

**Validation Commands**

show ntp status, show ntp association

---

**Setting up a Virtual Server****R1**

ZebOS#configure terminal	Enter the Configure mode.
ZebOS(config)#interface eth0	Specify the interface (eth0) to be configured and enter the Interface mode.
ZebOS(config-if)#ip address 10.10.0.19/24	Set the IP address of this interface (eth0).
ZebOS(config-if)#ip nat outside	Configure the NAT outside interface.
ZebOS(config-if)#exit	Exit the Interface mode
ZebOS(config)#interface eth1	Specify the interface (eth1) to be configured and enter the Interface mode.
ZebOS(config-if)#ip address 10.55.0.1/24	Set the IP address of this interface (eth0).
ZebOS(config-if)#ip nat inside	Configure the NAT inside interface.
ZebOS(config-if)#exit	Exit the Interface mode.
ZebOS(config)#ip nat pool natpool 10.10.0.19 10.10.0.19 255.255.255.0	Define a pool of global addresses to be allocated when needed.
ZebOS(config)#virtual-server tcp 5000 10.55.0.2 8080 webserver	Set up the Virtual Server by specifying the public port number (5000), the private IP address (10.55.0.2), the private port number (8080), and the name (webserver) for the Virtual Server.

**Names of Commands Used**

ip nat outside, ip nat inside, ip nat pool, virtual-server, and ip address

**Validation Commands**

show virtual-server

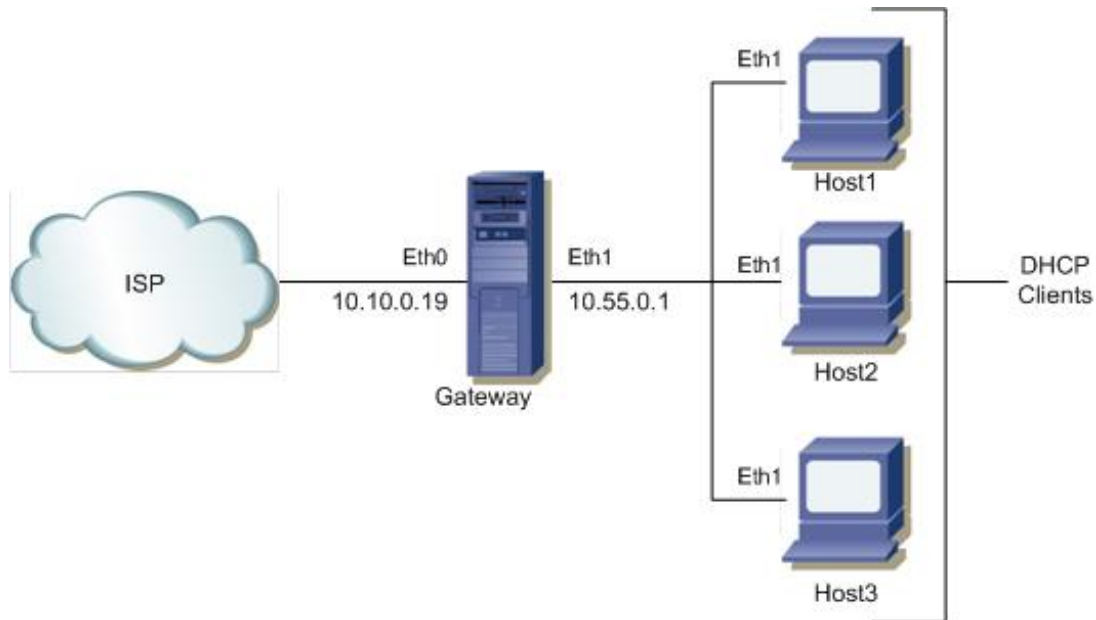
---

**Configuring Basic Access Services for a Home Office**

A home office setup is used to illustrate how basic access services are used and configured. In this setup, a Local Area Network (LAN) is connected to the ISP through a single gateway. Domain Name Service (DNS) is configured on this gateway to enable name resolutions, allowing the gateway to resolve any requests for a named site (for example, www.yahoo.com) from the hosts in the LAN.

The gateway is configured as a DHCP Server, and the interfaces connecting the LAN to the gateway are enabled with DHCP. This avoids manual configuration, and dynamically assigns IP addresses to the hosts. Virtual Server and NAT are configured on the gateway to make the Web Server accessible through the gateway IP. NAT translates all addresses to the Global address 10.10.0.19. The LAN is defined on an inside interface, and the external network is defined on an outside interface. The external network is aware of only the global address (10.10.0.19). This adds to the

security of the LAN by allowing only an internal host to connect to an outside network, but not allowing an external client to connect to the internal FTP server. Access list is configured to prevent sensitive data (coming from the LAN) from going out to the external network. NTP is configured to time-synchronize the private LAN with the gateway.



**Figure 3: Basic Home Office Topology**

### On Gateway

ZebOS#configure terminal	Enter the Configure mode.
ZebOS(config)#ip domain-name ipinfusion.com	Set the default domain name for the DNS.
ZebOS(config)#ip name-server 10.10.0.2	Add a Name Server to the DNS.
ZebOS(config)#ip name-server 10.10.0.88	Add a secondary Name Server to the DNS
ZebOS(config)#ip domain-lookup	Turn on the Domain Name Service (DNS)
ZebOS(config)#ip dhcp pool APSpool	Configure the DHCP address pool and enter the DHCP mode.
ZebOS(dhcp-config)#network 10.55.0.0 255.255.255.0	Configure the network and mask for the DHCP address pool.
ZebOS(dhcp-config)#range 10.55.0.90 10.55.0.99	Add an address range to the DHCP pool. The DHCP hosts will get addresses within this specified range.
ZebOS(dhcp-config)#lease infinite	Set an infinite lease for this DHCP pool. Any IP assigned addresses will not change.
ZebOS(dhcp-config)#exit	Exit the DHCP mode
ZebOS(config)#interface lo	Specify the loopback interface (lo) to be configured and enter the Interface mode.
ZebOS(config-if)#ip address 127.0.0.1/8	Set the IP address of this interface.
ZebOS(config-if)#exit	Exit the Interface mode
ZebOS(config)#interface eth0	Specify the interface (eth0) to be configured and enter the Interface mode.
ZebOS(config-if)#ip address 10.10.0.19/24	Set the IP address of this interface.
ZebOS(config-if)#ip nat outside	Configure the NAT outside interface.
ZebOS(config-if)#exit	Exit the Interface mode

## Basic Access Network Services Configuration

ZebOS(config)#access-list zebos denyhost1 deny any 10.55.0.92/32 any	Add an entry to the ZebOS extended access-list that denies packets to and from Host 1 (10.55.0.92/32).
ZebOS(config)#access-list zebos permitall permit any any any	Configure the extended access-list to permit all traffic allowing NATing for traffic from any source and to any destination.
ZebOS(config)#interface eth1	Specify the interface (eth1) to be configured and enter the Interface mode.
ZebOS(config-if)#ip address 10.55.0.1/24	Set the IP address of this interface.
ZebOS(config-if)#ip nat inside	Configure the NAT inside interface.
ZebOS(config-if)#ip access-group denyhost1 forward	Apply the access-list denyhost1 on this interface.
ZebOS(config-if)#exit	Exit the Interface mode and enter the Configure mode.
ZebOS(config)#ip nat pool NatPool 10.10.0.19 10.10.0.19 255.255.255.255	Define a pool of global addresses to be allocated, as needed.
ZebOS(config)#ip nat inside source list permitall pool NatPool	Configure NAT to perform static translation between the inside local address and inside global address. Packets with source addresses that pass the access list are dynamically translated using the addresses in the named pool.
ZebOS(config)#virtual-server tcp 5000 10.55.0.99 8080 webserver	Set up a virtual server.
ZebOS(config)#ntp authenticate	Enable the authentication feature.
ZebOS(config)#ntp authentication-key 5 md5 shared-key	Define each of the authentication keys. Each key has a key number, type, and value.
ZebOS(config)#ntp trusted-key 5	Define the authentication key as “trusted”, specifying that this system will be ready to synchronize to a system that uses this key in its NTP packets.
ZebOS(config)#ntp master 10	Configure to make the system to be an authoritative NTP server, even if the system is not synchronized to an outside time source.

## Host1

ZebOS#configure terminal	Enter the Configure mode.
ZebOS(config)#interface lo	Specify the loopback interface to be configured and enter the Interface mode.
ZebOS(config-if)#ip address 127.0.0.1/8	Set the IP address of this interface.
ZebOS(config-if)#exit	Exit the Interface mode
ZebOS(config)#interface eth1	Specify the interface (eth1) to be configured and enter the Interface mode.
ZebOS(config-if)#ip address 10.55.0.92/24	Set the IP address, obtained through DHCP, for this interface.
ZebOS(config-if)#exit	Exit the Interface mode
ZebOS(config)#ntp authenticate	Enable the authentication feature.
ZebOS(config)#ntp authentication-key 5 md5 shared-key	Define each of the authentication keys. Each key has a key number, type, and value.
ZebOS(config)#ntp server 10.55.0.1	Configure an NTP server enabling this system to synchronize 10.55.0.1 with the other system, and not vice versa.

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