



CBOE Network Connectivity

Version 1.1

A Guide to obtaining test and production IP network connections
to CBOE applications and services.

CBOE Proprietary Information

01 November 2001

Document #[NET-01]

Table of Contents

Table of Contents	2
List of Figures	2
Disclaimer and Change Notice	3
DISCLAIMER.....	3
CHANGE NOTICE.....	3
About This Document	4
PURPOSE	4
INTENDED AUDIENCE.....	4
RELATED DOCUMENTS	4
CONTACT INFORMATION	5
Introduction	6
Test Network Connections	7
FIRM CONFIGURATION.....	7
REQUESTING A TEST DIAL-UP CONNECTION	8
WORKSHEET A INSTRUCTIONS	ERROR! BOOKMARK NOT DEFINED.
Production Network Connections	9
CBOECONNECT	9
DIRECT NETWORK CONNECTIONS.....	9
EIGRP CONNECTION STANDARD.....	11
HSRP CONNECTION STANDARD	12
REQUESTING A PRODUCTION NETWORK CONNECTION.....	12
Glossary	13
Appendix A	16
ANALOG DIAL-UP EXAMPLE WITH WINDOWS NT	16
Appendix B	18
ISDN DIAL-UP EXAMPLE WITH A CISCO 802 ROUTER.....	18
Appendix C	20
PRODUCTION EIGRP CONFIGURATION EXAMPLE	20

List of Figures

FIGURE 1. CBOE DIAL-UP TEST NETWORK	7
FIGURE 2. CBOE PRODUCTION NETWORK CONNECTIVITY	10
FIGURE 3. EIGRP CONNECTION STANDARD	11
FIGURE 4. HSRP CONNECTION STANDARD.....	12
FIGURE 5. DIAL-UP NETWORKING CONFIGURATION – BASIC TAB	16
FIGURE 6. DIAL-UP NETWORKING CONFIGURATION – SERVER TAB.....	17

Disclaimer and Change Notice

Disclaimer

Copyright © 2000, 2001 by the Chicago Board Options Exchange (CBOE), as an unpublished work. The information contained in this document constitutes confidential and/or trade secret information belonging to CBOE. This document is made available to CBOE members and firms solely for the purpose of enabling them to connect to the CBOE network. This document is provided "AS IS" with all faults and without warranty of any kind, either express or implied.

Change Notice

The following change notices are provided to assist firms in determining the impact of changes to their network connections.

Date	Version	Description of Change
17 January 2001	1.0	Initial Release
27 February 2001	1.1	Minor changes to Production Network Connections section

The latest version of this document can be obtained by sending an email request to liaisongrp@cboe.com.

About This Document

Purpose

This document is intended to provide information and guidance on how to establish IP network connections to the CBOE, both for testing and for production. For more detailed information on specific IP based CBOE applications and services see the Related Documents below.

Intended Audience

This document is written for firm representatives and network engineers responsible for establishing and maintaining test and production network connections to CBOE.

Related Documents

CBOE Application or Service	Document Title
CMi	CBOE API Volume 6: Connecting to the CBOE Network
CWN	CBOE Member Firm RF Interview
FIX	CBOE FIX Volume 4: Connecting to CBOE FIX Services
MMHH	MMHH Non-CBOE Computer Interface Guide
SEMS	SEMS FIX Gateway Specification
VQI	Vendor Quote System Interface Detail Specification

Contact Information

For	Email	Phone
General questions about CBOE testing or IP network connectivity	liaisongrp@cboe.com	312-786-7606 312-786-7878
Setting up Common Wireless Network (CWN) connections	cwngrp@cboe.com	312-786-7606 312-786-7878
General questions about CBOE <i>direct</i> APIs	api@cboe.com	312-786-7300
Setting up CBOE Market Interface (CMi) connections	cmiconnect@cboe.com	312-786-7463 312-786-7878
Setting up Financial Information Exchange (FIX) connections	fixconnect@cboe.com	312-786-7463 312-786-7878
Setting up Market-Maker Hand-Held (MMHH) connections	mmhhgrp@cboe.com	313-786-7563 312-786-7878
Setting up Vendor Quote Interface (VQI) or Securities Exchange Management Solution (SEMS) FIX gateway connections	vqgrp@cboe.com	312-786-7164 312-786-7878

Introduction

This document describes the process for connecting to CBOE to access IP based applications and services, either for testing or for production. Information on the specific applications and services is provided in separate documents. This document does not discuss non-IP connections to CBOE or non-IP based applications or services.

To use a CBOE application, the firm must first demonstrate that its system works correctly in a test environment. A dial-up connection to CBOE is required for testing. Once the firm has passed the initial application tests via the dial-up connection, a final test with the permanent network connection to CBOE is generally required.

The Common Wireless Network (CWN) is a CBOE service rather than an application and, as such, there is no initial testing phase. After the firm has passed the final test it will be permitted to use its permanent network connection to CBOE in production.

Included in this document are generalized descriptions of the test and production network connections, worksheets that must be filled out to request a connection and several example configurations. Also included is a preliminary discussion and diagram of *CBOEconnect*, a new Wide Area Network (WAN) that will be built and maintained by CBOE for the exclusive use of firms for connecting to CBOE services and applications. All acronyms and many of the special terms used in this document are defined in the Glossary.

Test Network Connections

Access to the CBOE application testing environments is accomplished via dial-up connections. The CBOE access server provides both analog and ISDN dial-up capabilities. All the CBOE application test environments can be accessed through a single dial-up connection. The CBOE Dial-up Test Network is shown in Figure 1.

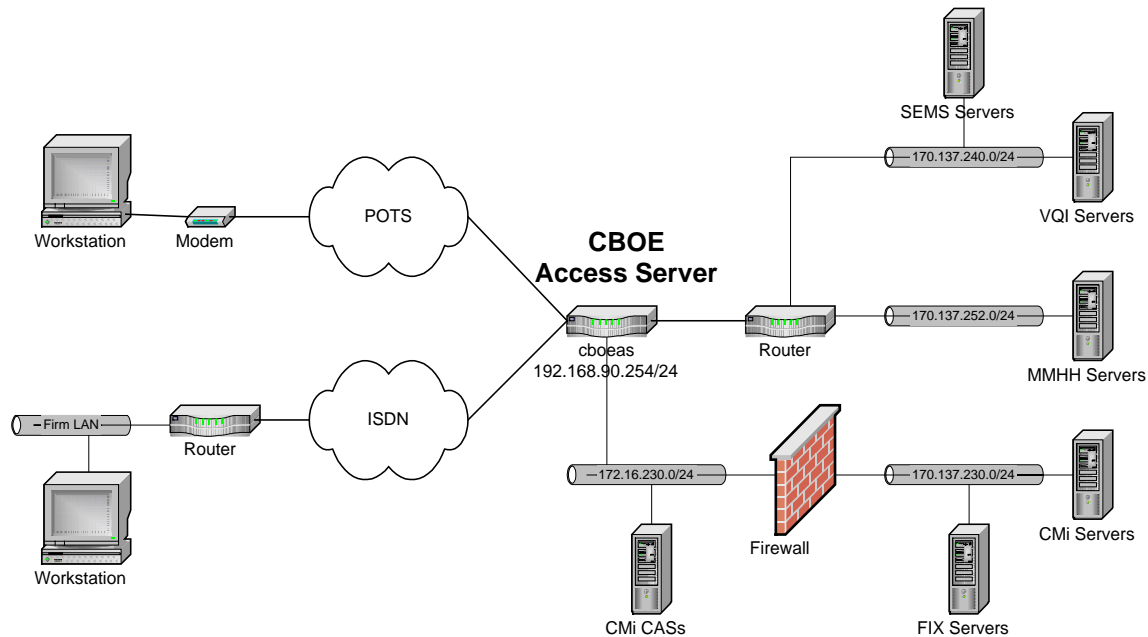


Figure 1. CBOE Dial-up Test Network

Firm configuration

The firm is responsible for providing the equipment for the dial-up connection at its site. This can be accomplished by using a router or by connecting a modem directly to the test workstation. These two configurations are shown in Figure 1. If there will be more than one test workstation, a router is recommended. Otherwise, each workstation will need its own dial-up connection.

In either configuration both analog (POTS) and digital (ISDN) dial-up connections are supported. For certain CBOE applications, an analog connection should provide sufficient bandwidth for testing. However, for Vendor Quote (VQI), FIX 4.2 and CMi use of an ISDN line is recommended. If more than one application or more than one workstation are to be used in testing simultaneously, then an ISDN line is recommended. An ISDN connection will provide two and a half to five times the bandwidth of an analog connection.

All test dial-up configurations use IP over PPP. Each firm selects a username and password and authenticates with the CBOE access server using CHAP. CBOE must confirm that each username and password are unique. If a workstation connected to a modem is used to dial-in, it will have the PPP IP address assigned by CBOE. If a router is used, the PPP IP address is applied to the router's dial-up interface. Static routes must then be used to route traffic between the firm LAN where the workstations are connected and the CBOE test networks.

Appendix A provides an example of how to configure a Windows NT workstation to dial-in to the CBOE access server with a modem. Appendix B shows a sample configuration for a Cisco 802 router using ISDN for the dial-up connection.

The CBOE access server uses an Access Control List (ACL) to filter out incoming traffic that is not directed to the application test servers. The firm can use a firewall between its LAN and the CBOE access server if desired, but it will be the firm's responsibility to configure the firewall and ensure that it does not affect application testing.

CBOE highly recommends that the firm's test environment be similar to its planned production environment to minimize problems when moving into production. CBOE also recommends that the firm maintain the test connection so that additional capabilities can be tested as they are developed by CBOE. The test connection will also allow the firm to develop and test its own software after it is in production.

Requesting a Test Dial-up Connection

To request a test dial-up connection to CBOE, Worksheet A must be filled out. This worksheet is available on the CBOE API web site and can be filled in and sent via email to liaisongrp@cboe.com. The API web site may be found at <http://systems.cboe.com/webapi>. Registration is required.

After Worksheet A has been received, CBOE will complete the shaded portions of the worksheet and return it. Additional application information is typically required before testing can begin. Please refer to the appropriate application document in the Related Documents section for further details.

Production Network Connections

CBOEconnect

CBOE is negotiating with major nationwide network service providers to build a private, managed WAN for the exclusive use of firms connecting to CBOE services and applications. The box in the lower left of Figure 2 shows how firms can use *CBOEconnect* to access the CBOE services and applications shown at the top of the diagram.

CBOE will provision, manage and maintain the WAN routers at the firm site and the network links to CBOE. It is CBOE's goal to use *CBOEconnect* for all firm production network connections in the future. Details of *CBOEconnect* have not been finalized at this time. Future revisions of this document will have further information on *CBOEconnect*.

Direct Network Connections

Until *CBOEconnect* is available, all firms must supply their own production network connections to the CBOE facility. CBOE will provide dedicated 10baseT Ethernet interfaces on redundant routers for each firm. The box on the lower right of Figure 2 shows how a firm can use direct network connections to CBOE to access the different CBOE services and applications shown at the top of the diagram.

CBOE has developed two standard configurations for direct router to router connections. These standards were developed to provide complete redundancy and rapid and automatic fail-over in the event of problems. Firms are required to provide redundant links, routers and switches. CBOE maintains a fully redundant network.

Note: The CAS and CMi Test Client shown at the firm sites in Figure 2 are only used with the CMi application. For all other applications, the client machines communicate directly with the appropriate servers at CBOE.

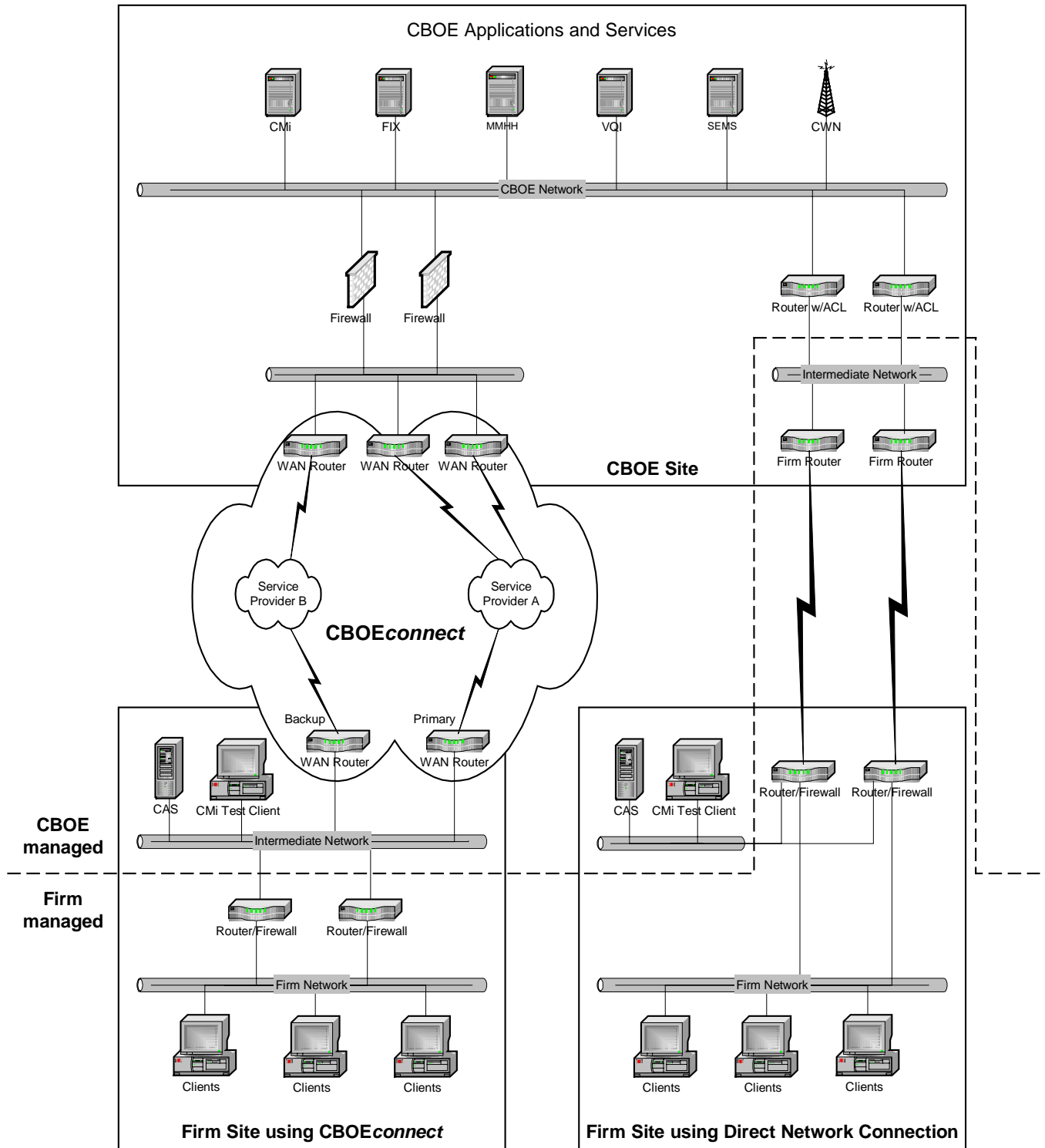


Figure 2. CBOE Production Network Connectivity

EIGRP Connection Standard

The Enhanced Interior Gateway Routing Protocol (EIGRP) connection standard is the preferred configuration for direct router to router connections. This configuration, shown in Figure 3, is used when the firm servers are located on a remote firm network. This standard makes use of a routing protocol to exchange routes between the firm and CBOE routers. By using a dynamic routing protocol this standard provides a higher level of fault tolerance than the HSRP standard explained in the next section.

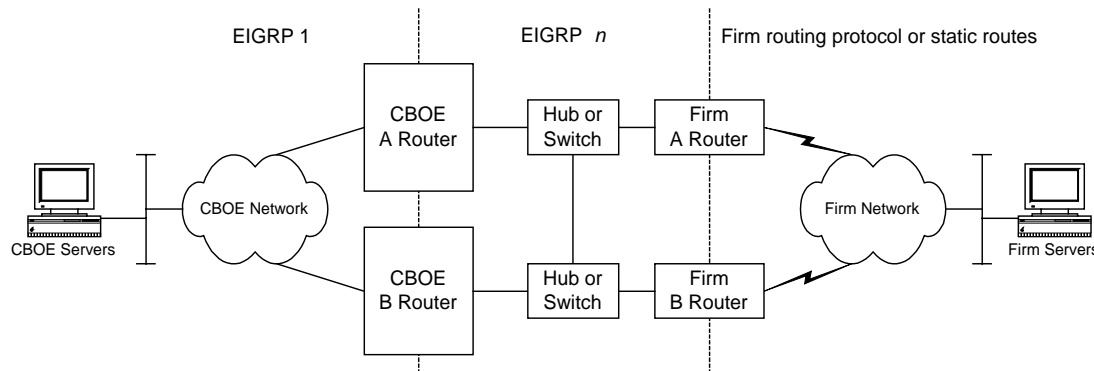


Figure 3. EIGRP Connection Standard

In this network configuration the two CBOE routers and the two firm routers are connected to an intermediate network. CBOE will assign the addresses to be used on the intermediate network. The firm must provide the hubs or switches for this network. CBOE will provide the required cabling to connect the CBOE routers to the hubs or switches.

A shared EIGRP routing process (n) is used to exchange routing information between the four routers and provide automatic and rapid fail-over in the event of an outage. If the firm does not use Cisco routers, OSPF can be used as the shared routing process. To prevent potential routing conflicts and to increase network security, the shared routing process must be different than the routing process used in either the firm or CBOE networks. Redistribution is used to exchange routes between the different routing processes. Again to prevent potential routing conflicts and to increase network security, route-maps and distribute-lists must be used to limit the redistribution to only those routes that are required.

For security, ACLs are applied on the CBOE routers' Ethernet interfaces. These ACLs only permit ICMP and the specific ports and IP addresses required for each CBOE application the firm will be using.

HSRP Connection Standard

The Hot Standby Router Protocol (HSRP) standard, shown in Figure, is used when firm servers or firewalls are on the same network as the CBOE routers.

Note: This configuration is not recommended for use with the CMi application. See the document API-06 for details.

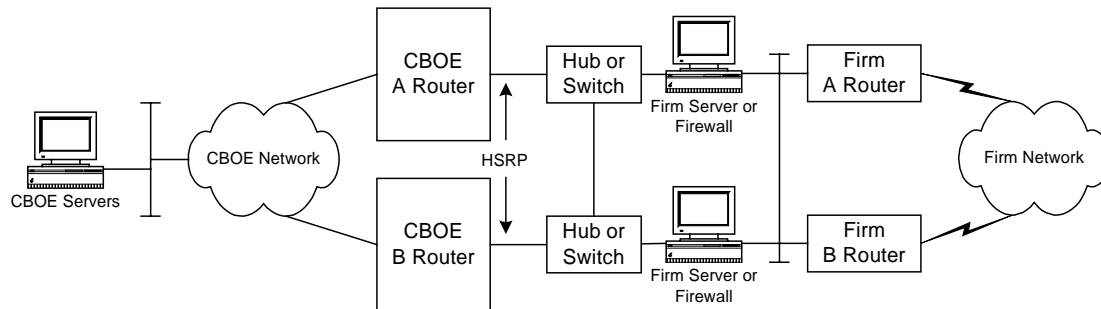


Figure 4. HSRP Connection Standard

In the HSRP configuration the firm servers or firewalls are connected to an intermediate network with the two CBOE routers. The HSRP is used on the CBOE routers to provide a redundant next-hop address. CBOE will assign the addresses to be used on the intermediate network. The firm must provide the hubs or switches for this network. CBOE will provide the required cabling to connect the CBOE routers to the hubs or switches.

For security, ACLs are applied on the CBOE routers' Ethernet interfaces. These ACLs only permit ICMP and the specific ports and IP addresses required for each CBOE application the firm will be using.

Requesting a Production Network Connection

To request a production network connection to CBOE, Worksheet B on the web site must be filled out and sent via email to liaisongrp@cboe.com. A diagram of the proposed production network connection must also be sent. After Worksheet B and the network diagram have been received, CBOE will complete the shaded portions of the worksheet and return it. Additional application or service specific information is typically required before the production network connection can be used. Please refer to the appropriate application or service document in the Related Documents section for further details.

Glossary

Term	Abbreviation	Definition
10BaseT		10-Mbps baseband Ethernet specification using two pairs of twisted-pair cabling (Category 3, 4, or 5): one pair for transmitting data and the other for receiving data.
Access Control List	ACL	A filter on routers that restricts network access to specific addresses and/or ports.
Application Programming Interface	API	A set of routines, protocols, and tools for building software applications.
Basic Rate Interface	BRI	ISDN interface composed of two B channels and one D channel. The two B channels can be combined with multi-link PPP to provide 128 Kbps of bandwidth.
CBOE Application Server	CAS	CBOE developed software that provides caching, session management, system access to applications requiring access to Exchange Services. Clients access the CBOE Application Server via the CBOE Market Interface.
CBOE <i>connect</i>		A private wide area network built and managed by CBOE for the use of firms needing production network connections to CBOE.
CBOE <i>direct</i>		The CBOE electronic trading system.
CBOE Market Interface	CMi	One of the CBOE APIs that provide access to CBOE <i>direct</i> and to CBOE open outcry markets.
Challenge Handshake Authentication Protocol	CHAP	Security feature supported with PPP encapsulation. CHAP does not itself prevent unauthorized access, it merely identifies the remote end. The router or access server then determines whether that user is allowed access.
CMi Client		Any trading terminal that communicates to CBOE by means of the CMi API.
CMi Test Client		The CBOE Trader Workstation installed with a CAS at the firm site.
Common Wireless Network	CWN	A wireless network infrastructure on the trading floor managed by CBOE for the use of member firms.

Term	Abbreviation	Definition
Enhanced Interior Gateway Routing Protocol	EIGRP	A routing protocol developed by Cisco. Provides superior convergence properties and operating efficiency, and combines the advantages of link state protocols with those of distance vector protocols.
Exchange Services		Services provided by CBOE, such as order entry and routing, order matching, reporting, and market data services.
Firewall		A device used as a buffer between any connected networks. A firewall uses access lists and other methods to ensure the security of one network from the others.
Financial Information Exchange Protocol	FIX	Open standard conceived of by a group of institutions and brokers interested in streamlining the trading process. It is now used by a variety of firms and vendors.
Gateway		A computing device, such as a router, computer, or firewall, that sits between two networks to deliver messages between the two networks.
Hot Standby Router Protocol	HSRP	A Cisco version of the Virtual Router Redundancy Protocol. Provides high network availability and transparent network topology changes. HSRP creates a Hot Standby router group with a lead router that services all packets sent to the Hot Standby address. The lead router is monitored by other routers in the group, and if it fails, one of these standby routers inherits the lead position and the Hot Standby group address.
Internet Control Message Protocol	ICMP	Network layer Internet protocol that reports errors and provides other information relevant to IP packet processing.
Internet Protocol	IP	Protocol that is designed to be independent of underlying physical network structure. Uses an independent numbering scheme (IP Addressing) to provide network messaging that can be independent and easily routed between heterogeneous networks. Part of the TCP/IP Protocol Suite.
Integrated Services Digital Network	ISDN	Communication protocol, offered by telephone companies, that permits telephone networks to carry data, voice, and other source traffic in a digital format.

Term	Abbreviation	Definition
Local Area Network	LAN	A computer network covering a small geographical area, typically confined to a single building.
Market-Maker Hand-Held	MMHH	A CBOE API that supports submission of price reports and trade match records in an electronic manner from NCCs. It also supports submission of stock orders in an electronic manner from CBOE handheld computers to SEFs.
Network Address Translation	NAT	Network Address Translation – The conversion of the source and/or destination IP address on a packet when traversing a gateway, typically a firewall.
Non-CBOE Computer	NCC	Trade enabled Non-CBOE Computers.
Open Shortest Path First	OSPF	A link-state, hierarchical interior gateway routing algorithm. OSPF features include least-cost routing, multipath routing, and load balancing.
Plain Old Telephone Service	POTS	Traditional phone service designed to support analog voice communications at frequencies up to 4 KHz. Modems are required to transmit data with this service.
Point-to-Point Protocol	PPP	Protocol that provides router-to-router and host-to-network connections over synchronous and asynchronous circuits. PPP also has built-in security mechanisms, such as CHAP.
Portable Document Format	PDF	A platform independent file format developed by Adobe.
Stock Execution Firm	SEF	Stock Execution Firm Non-CBOE Computers.
Securities Exchange Management Solution	SEMS	A system for trading CBOE equity-structured products. One interface to this system is the FIX protocol.
Vendor Quote Interface	VQI	A CBOE API that provides an electronic means for CBOE member firms to automatically submit option quotes into the CBOE system environment.
Wide Area Network	WAN	A computer network that spans a relatively large geographical area and makes use of circuits and/or data transport services purchased from a carrier.

Appendix A

Analog Dial-Up Example with Windows NT

The following steps demonstrate how to establish a PPP dial-up test connection to CBOE using a Windows NT workstation with an analog modem.

1. Install Dial Up Networking if it is not already installed.
2. Double click on My Computer then on Dial-Up Networking.
3. Click the New... button to create a new Phonebook Entry.
4. If the New Phonebook Entry Wizard appears, check the box to edit the properties directly and then click on Finish.
5. On the Basic tab put in an Entry name and the Phone number provided by CBOE as appropriate for your locale. See Figure.

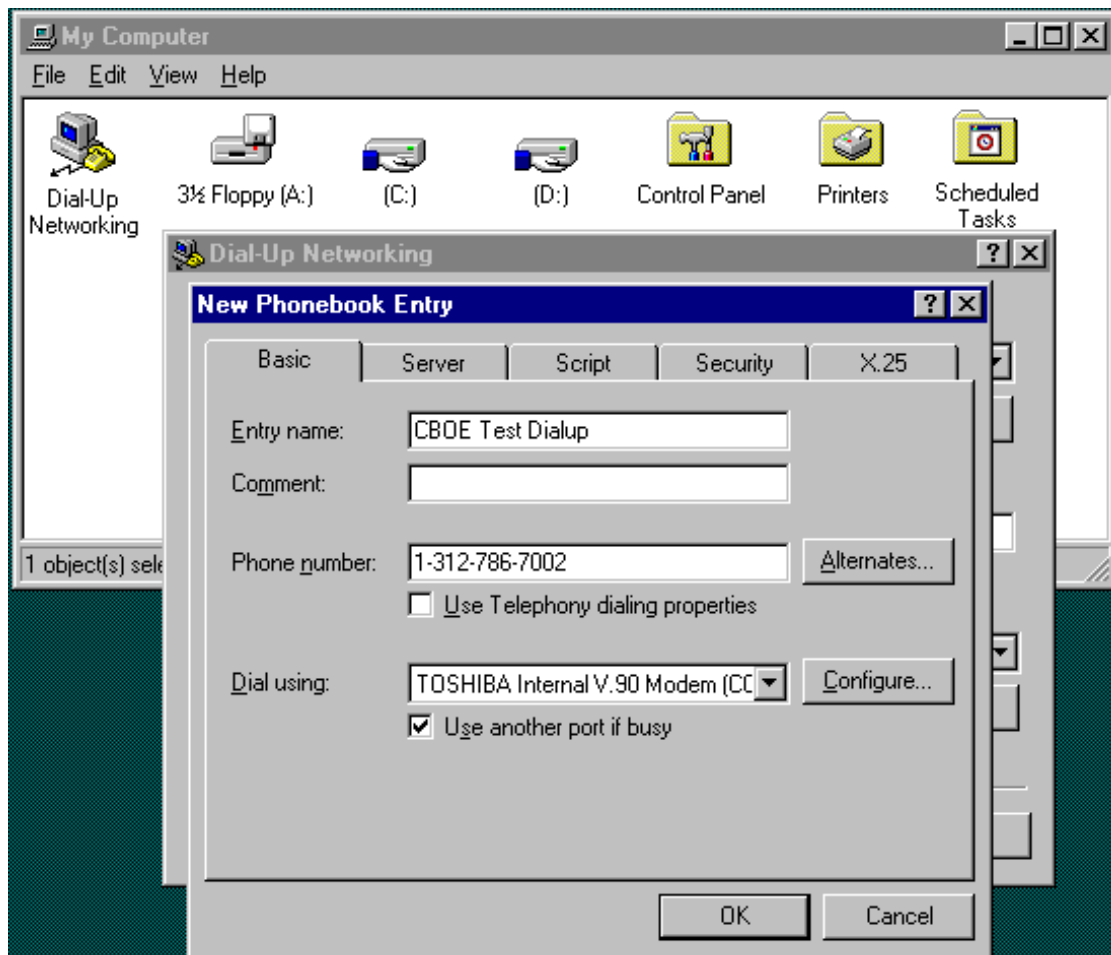


Figure 5. Dial-Up Networking Configuration – Basic Tab

- Click on the Server tab. Uncheck the IPX/SPX compatible box. Leave the TCP/IP Settings at the default values. Click on OK to finish. See Figure.

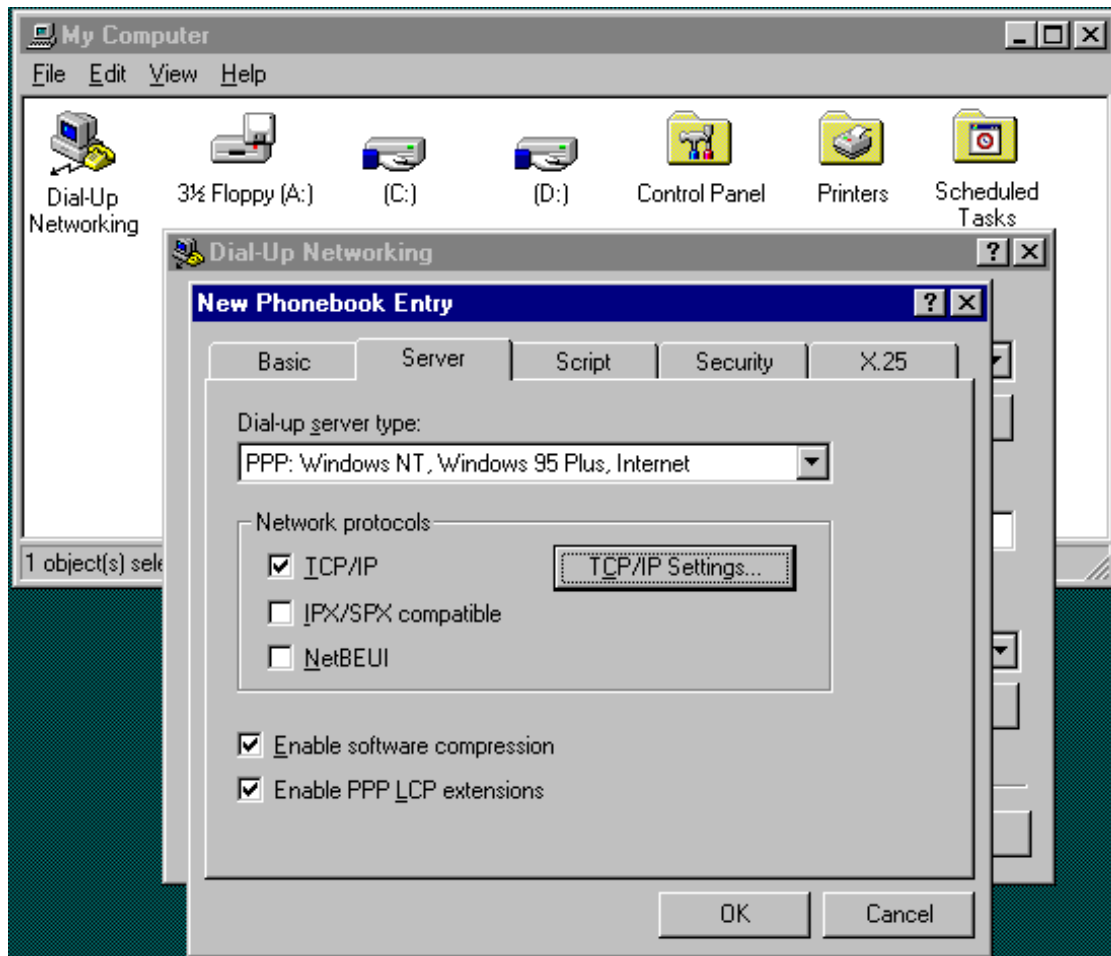


Figure 6. Dial-Up Networking Configuration – Server Tab

After the Phonebook Entry has been created, click on the Dial button. When prompted, enter the PPP User name and Password that were selected when the dial-up connection was requested. Leave the Domain field blank. The workstation will automatically be assigned the correct PPP IP address. To test the connection, ping the CBOE PPP and Server IP addresses.

Appendix B

ISDN Dial-Up Example with a Cisco 802 Router

This example demonstrates how to configure a Cisco 802 router with an ISDN BRI line to dial into CBOE for testing.

The workstation that will be used for testing in this example is on the 192.168.91.0/24 network behind the router. By default Cisco routers will use the router hostname for the CHAP Username as shown in the configuration below. The CHAP password that was chosen is entered with the CBOE CHAP Username in the username statement. The PPP IP address that was assigned by CBOE is applied to the BRI interface. The CBOE PPP IP address and Username and the phone number that was assigned are entered in the dial map statement. Static routes for the CBOE server networks are entered with the CBOE PPP IP address as the next hop. Once the router has successfully dialed in and set up a PPP session, the connection can be tested by pinging the CBOE PPP and Server IP addresses.

Router Configuration:

```

version 12.1
no service pad
service timestamps debug uptime
service timestamps log uptime
service password-encryption
!
!       This is the CHAP username:
!
hostname cboetest
!
boot buffersize 8077
boot system flash c800-y6-mw.121-3.T
logging buffered 4096 debugging
enable secret 5 *****
!
!       Enter the CHAP password here with the Username
!       of the CBOE router:
!
username cboeas password 7 *****
!
ip subnet-zero
!
isdn switch-type basic-ni
!
interface Ethernet0
 ip address 192.168.91.254 255.255.255.0
 no cdp enable
!
interface BRI0
!
```

```

!      Enter the PPP IP address that has been assigned to
!      you here:
!
ip address 192.168.90.128 255.255.255.0
encapsulation ppp
!
!      Enter the CBOE PPP IP address and Username and the
!      phone number here:
!
dialer map ip 192.168.90.254 name cboeas 7863878
dialer load-threshold 150 either
dialer-group 1
isdn switch-type basic-ni
isdn spid1 31236216260101 3123621626
isdn spid2 31236216590101 3123621659
no cdp enable
ppp authentication chap
ppp multilink
!
no ip http server
ip classless
!
!      Use the CBOE PPP IP address and the CBOE server
!      networks in the static routes here:
!
ip route 170.137.230.0 255.255.255.0 192.168.90.254
ip route 170.137.240.0 255.255.255.0 192.168.90.254
ip route 170.137.252.0 255.255.255.0 192.168.90.254
ip route 172.16.230.0 255.255.255.0 192.168.90.254
ip route 192.168.90.254 255.255.255.255 BRI0
!
!      The CBOE server networks are also entered in the
!      dialer-list access-list:
!
access-list 100 permit ip any 170.137.230.0 0.0.0.255
access-list 100 permit ip any 170.137.240.0 0.0.0.255
access-list 100 permit ip any 170.137.252.0 0.0.0.255
access-list 100 permit ip any 172.16.230.0 0.0.0.255
dialer-list 1 protocol ip list 100
no cdp run
snmp-server engineID local 00000009020000B0C28A44FA
snmp-server community public RO
snmp-server chassis-id JAD04330IBX
!
line con 0
  exec-timeout 0 0
  transport input none
  stopbits 1
line vty 0 4
  password 7 *****
  login
!
end

```

Appendix C

Production EIGRP Configuration Example

The following example demonstrates the EIGRP configuration for production direct router to router connections shown in Figure 3.

In this example the following is assumed: the firm is using EIGRP 100 in its network; the shared EIGRP process is 150; the CBOE servers are on the 170.137.80.0/22 and 170.137.212.0/24 networks; the intermediate network is 192.168.6.32/28; and the firm servers are on the 172.21.1.0/24 network.

On the firm routers, 170.137.80.0/22 and 170.137.212.0/24 are redistributed from EIGRP 150 into EIGRP 100 and 172.21.1.0/24 is redistributed in the opposite direction. The following is the relevant section of the firm routers' configuration:

```
firm#
router eigrp 100
  network (firm network)
  passive-interface (192.168.6.x interface)
  redistribute eigrp 150 route-map to-cboe
  no auto-summary
router eigrp 150
  network 192.168.6.0
  passive-interface (all except 192.168.6.x interface)
  redistribute eigrp 100 route-map to-firm
  distribute-list cboe in
  no auto-summary
route-map to-cboe permit
  match ip address cboe
route-map to-firm permit
  match ip address firm
ip access-list standard cboe
  permit 170.137.80.0
  permit 170.137.212.0
ip access-list standard firm
  permit 172.21.1.0
```

The following is the relevant section of the CBOE routers' configuration:

```
cboe#
router eigrp 1
  network 170.137.0.0
  passive-interface (192.168.6.x interface)
  redistribute eigrp 150 route-map to-firm
  no auto-summary
router eigrp 150
  network 192.168.6.0
  passive-interface (all except 192.168.6.x interface)
  redistribute eigrp 1 route-map to-cboe
  distribute-list firm in
  no auto-summary

route-map to-firm permit
```

```
        match ip address firm
route-map to-cboe permit
        match ip address cboe
ip access-list standard firm
    permit 172.21.1.0
ip access-list standard cboe
    permit 170.137.80.0
    permit 170.137.212.0
```