



**TRADING
TECHNOLOGIES®**

**TT TRADING SYSTEMS -
HARDWARE AND SOFTWARE
REQUIREMENTS**

VERSION 7.X

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HARDWARE AND SOFTWARE COMPONENTS

Due to the dynamic nature of the industry, designing a trading environment requires a detailed assessment of your current needs and future goals. In this ever-evolving, competitive marketplace, factors such as trading volume, diversification of products within a given exchange, and the implementation of divergent trading strategies, all play a significant part in determining the final makeup of your trading environment. In order to stay competitive, TT recommends you utilize every available advantage when creating your trading environment.

The purpose of this document is to present the available technological options and assist you in determining the optimal environment for your trading needs.

Note that hardware components are much like puzzle pieces and are highly interdependent. In a hardware system, the top speed is a matter of the slowest “piece of the puzzle”. Thus, if a certain component in the system 'tops out' at a certain speed, no matter what sorts of hardware you add to the other parts, you will not increase the speed of your system.

For example, if you are using a slow graphics card (see the **Graphics Card** section), and you increase the processing speed (CPU) or RAM, you may not increase the overall performance of the system. In this scenario, no matter how fast you make the computer, the speed with which information is presented to the monitor (and hence the trader) is not increased.

ANTI-VIRUS SOFTWARE

If you run anti-virus software, due to file naming and file writing schemas, you must exclude the TT directory from its scan.

Additionally, TT recommends that you scan for viruses only during non-trading hours.

NTP SOFTWARE

TT recommends that you avoid using time change software in your trading environment. If you use NTP software, do not synchronize your system during trading hours

CENTRAL PROCESSING UNIT (CPU)

Also referred to as the processor, the CPU determines how fast a machine runs and processes data into information (i.e., processing speed). Since profits and losses depend upon the speed with which traders execute their trades, it is important that traders receive, process, and send data as quickly as possible. With this in mind, the higher the processing speed, the faster TT software operates. However, like all hardware, processing speed is specific to the machine. If a trader has a high-speed processor but the TT Gateway does not, theoretically the trader can experience slow downs in the system.

MULTIPLE CPUS

TT applications are multithreaded, which means the Windows XP (Win 2000) kernel can load balance TT processes across multiple CPUs improving machine performance. However, this improvement is not linear. Because other non-CPU elements create a threshold, which limits performance improvement, you cannot expect to achieve a doubling of performance.

Even though this threshold exists, there is enough of a performance improvement that TT recommends you use faster, multiple CPUs.

HARDWARE DRIVERS

You must keep your hardware drivers up-to-date.

GRAPHICS CARDS

Measurements have shown that the graphics display is usually the performance bottleneck for client applications. With this in mind, TT recommends that the customer make the appropriate investment in capable and high-end graphics cards for machines that run TT client products. Faster CPUs do not improve performance if the graphics card cannot update the monitor quickly enough.

Use the following Desktop settings:

- Use a color setting of 65,536 (or 16-bit depth).
- Resolution of no greater than 1280 x 1024

Unless otherwise stated in a specific software product, TT recommends the following graphic cards:

For single screen: For all client class workstations, TT recommends a minimum of 32 MB SDRAM or DDR SDRAM graphics cards.

For multi-head display: When using multiple DVI ports (heads) for display purposes, you must use graphic cards that have at least 32 MB per head. TT recommends using at least one graphic card with two DVI ports. To support more than two monitors, it is preferable to use multiple two-port cards than four-port cards.



Warnings:

- Turn off all settings that auto-center dialog boxes or that force dialog boxes and program windows to display in a certain monitor. If you do not do so, X_TRADER® dialogs can display in inconvenient and unexpected locations. You can usually find this setting in the **Properties** dialog box of the Graphics Card that you use.
- **Virtual Desktop:** Do not use the Windows2000 or XP Virtual Desktop feature with TT products to combine two graphics cards into a single virtual display across two monitors. This configuration causes extremely high CPU overhead. Instead, use a single, multihead graphics card.

MONITORS

Multi-head setup involves connecting multiple monitors to the same machine. In order to configure a user's work area in this manner, you must follow the instructions in the previous section called **Graphics Cards**.

To conserve space, TT recommends that you use flat panel monitors whenever possible.

Additionally TT recommends that you use monitors with:

- Highest refresh rate possible with a minimum of 60Hz for LCDs and 72Hz for standard CRTs
- Resolution set to 1280 x 1024
- 21" diagonal length standard or minimum 19" diagonal length for flat panels

NETWORK HARDWARE, TOPOLOGY, AND DEPLOYMENT

For information regarding TT's recommendations on network hardware, topology, and its deployment, refer to the *TT Trading Systems - Network Administration Manual*.

NETWORK CARDS

The network card that you use on a workstation or server determines the speed with which it sends and receives information over the network. It is important that you optimize the network card to suit your particular network.

If the network allows Gigabit network speeds but your network card supports only 10 Mbps, then the user experiences a slowdown. The only way to rectify this situation is to replace your network card with a Gigabit, PCI, PCI-X or PCI-Express based NIC. If your motherboard has an integrated NIC (LOM), ensure that it is capable of Gigabit data transfer speeds.

The opposite is also true. If a trader has a Gigabit NIC, but the network supports only 100 Mbps, then information flows to and from the trader's workstation at 100 Mbps.

Never use a NIC card that comes with a DSL modem.

HUBS

Refer to the *TT Trading Systems - Network Administration Manual* for TT's recommendation on the use of hubs.

POWER SAVE, HIBERNATION, AND CPU THROTTLING FEATURES

To avoid unexpected disconnections and to help ensure proper TT application functionality, turn off any Power Save or Hibernation functionality on machines that host TT software. Also, you must turn off any CPU throttling features. This includes Intel's SpeedStep® and AMD's Cool 'n' Quiet™ technology.

INTERNET FIREWALL

If you use TT software on a machine that runs Windows XP Professional Service Pack 2, turn off Microsoft's Internet Firewall. By default, Service Pack 2 turns this firewall on.

RAID

To provide redundancy and disaster recovery flexibility, TT recommends that you set up your TT Gateways with a RAID level 1 or 5.

RAID 1

Level 1 RAID (or RAID 1) is also referred to as disk mirroring. In this configuration, you set up a controller-based (versus software-based) disk mirroring. Whenever data is written to the drive, it is actually written to two disks. This affords the user an increased level of redundant information and backup support should a disk fail.

When you use RAID 1, TT recommends that you dedicate a pair of disks for the operating system, and another pair of disks for TT software for a total of four disks.

RAID 5

Level 5 RAID utilizes at least three hot swappable drives. If one disk fails, the user can switch processing over to the spare drive. While the spare drive is in use, the user can swap out the failed drive and replace it with a new one.

OPERATING SYSTEMS AND HARDWARE

TT develops its software according to the available features in the hardware and operating systems currently available on the market. Thus, as TT software is designed, developed, and released to customers, you must continue to upgrade your hardware and software to take advantage of TT's new functionality.

An illustration of this principle of hardware and software upgrades is Microsoft's development of Operating Systems. When you compare the various Microsoft Operating Systems released in the last 2 years, the hardware required to run these systems has increased significantly (Windows 9X, 2000, to XP).

Concerning TT software, every major version works well with the current mainstream hardware available at the time (current meaning no older than 1/2 year). When you plan your machine sizing, keep this average release schedule in mind to help you determine how long your hardware and operating systems can support TT functions.

Due to the exponential growth of computing power, high-end hardware tends to become mainstream within a year and low-end after two years. Thus TT recommends that you upgrade your hardware at reasonable intervals:

- Once every two years if you upgrade to high-end hardware
- Once every year if you upgrade to mainstream hardware

To follow this schedule of upgrades (once every year or two), you will require an ongoing budget. Although it is possible to use TT software with older hardware, you might encounter performance degradations. Because electronic trading is very sensitive to time and performance considerations, TT recommends that you keep your hardware up-to-date. Even with the same version of TT software, upgrading frequently allows you to stay competitive in the market place.

Price trends have shown that for client applications:

- A professional workstation (no monitor) with mainstream hardware costs approximately \$2,800.
- A professional workstation (no monitor) with high-end hardware costs approximately \$4,000.

Because much of the development and processing is done on the front-end trading screen, upgrades for TT Gateway hardware are required less often. However, the electronic derivatives market has exploded recently causing a significant increase in the transaction load on TT Gateways. CME and LIFFE are both excellent market examples of this increase in transaction load. As the electronic trading market continues to experience increases in the volume and sophistication of trading applications, market participants need to position themselves advantageously by keeping desktop, server, and network hardware up-to-date.

PERFORMANCE OPTIMIZATION

CLIENT GUIs

When using client GUIs, do not run MP3 or Streaming Video.

Additionally, to optimize the performance of client GUIs:

- Close or minimize as many windows on the Desktop as possible (i.e., all windows not in use).
- Do not run TT applications in tandem with non-TT programs.
- Limit the number of rows displayed in grids (i.e., Market Grid).
- Minimize the amount of displayed depth in MD Trader™.
- Limit the number of different types of columns displayed in the **Fill** window, **Order Book**, **Audit Trail**, and **Trade** window.
- Turn off unneeded services. Set these services to manual startup in the Services dialog box.
- Filter the **Audit Trail** so that only needed messages are displayed.
- If possible, turn off highlighting (i.e., **Highlight Text on Change** and **Highlight Borders on Change**). If you do not turn off highlighting, then restrict the number of columns that you highlight.
- If possible, turn off MD Trader™ price consolidation.
- Refer to **System Tuning** for further information on optimizing the workstation.

SYSTEM TUNING

TT recommends that you tune your system by performing the following tasks:

- Dedicate CPUs to X_TRADER®. Use separate CPUs to receive and analyze market data or to provide other functions not related to TT products.
- Download and install the most recent hardware drivers on a regular basis.
- If you have a choice between using Microsoft drivers and vendor drivers, always use the vendor drivers.
- If you use USB mice and keyboards, you must use USB 2.0 ports and devices.
- Set the monitor's refresh rate to the highest setting possible.

- Set the monitor's screensaver to **(None)**.
- For monitor settings, use **65536 Colors** (16-bit color depth).
- For monitor settings, use a resolution of no greater than **1280 by 1024 pixels**.
- For all servers and clients, use only recommended hardware.

In addition to these recommendations, to operate TT software effectively, you must turn off the following power-saver / hibernation features:

- CPU low energy mode
- HDD spin down
- NIC card sleep
- Any other power-save or hibernation features in the machine or monitor

AGGRESSIVE TUNING

Aggressive tuning is considered to be "at your own risk." The following tunings can destabilize your system and are included here only as suggestions (not official recommendations):

- Set your mouse pointer speed to **Fast**. You edit this via the **Mouse** settings in the Control Panel. In the **Hardware** tab, click **Properties**. The pointer speed is configured in the **Pointer Options** tab.
- Turn logging levels down for all applications (including TT, Microsoft, and exchange software).
- Manually set the operating system to write back (lazy write).
- Use GMRP Cisco switch setup.

CLIENT CLASS MACHINE SPECIFICATIONS

Client class workstations are those that run any of the following software products:

- X_TRADER®
- X_TRADER® Pro
- TT_TRADER™
- TT Trainer
- X_RISK® client component
- X_FILE™
- TTAPI
- X_RISK®
- X_STUDY™
- Position Mover

GENERAL REQUIREMENTS

The following general requirements concern all types of client class machines both entry level and high performance.

Operating System	Windows 2000 (Service Pack 3 or higher) Windows XP Professional (including Service Packs 1 and 2)
Note: Although no issues have been found running TT client applications (e.g., X_TRADER) on Windows XP Home Edition, TT does not fully support it. If an issue is found while running particular versions on Windows XP Home Edition, TT will make a reasonable effort to correct the problem.	
Middleware	TT Messaging (TTM)
Graphics Card	PCI-Express based graphics card with at least 128MB of memory. To support a dual monitor setup, TT recommends using at least one graphic card with two DVI ports. To support more than two monitors, it is preferable to use multiple two-port cards than to invest in a card with four.
Network Card	Any brand name Gigabyte NIC. This card must be manually set for speed and duplex. Do not use autosense.
Mouse	3-button mouse to support middle button click trading. Remove all Microsoft Intellimouse (IntelliPoint) software
Monitor	Any 21" monitor with resolution of 1280 x 1024 (SXGA mode)

ENTRY LEVEL SPECIFICATIONS

These specifications are written with the entry-level trading user in mind. If you trade fewer products and perform a minimal amount of transaction each day, these specifications will allow you to use TT products without excessive investment. Note, following these specifications can put you at a serious disadvantage over the competition.

TT recommends you use at least a Workstation Class Machine.

Hardware Type	
Motherboard	Should contain one or more PCI-Express 16x slots for graphics card.
Memory	1 GB or more
Processing Speed	At least a Dual Core processor running at 2.0GHZ.
Network Card	Integrated Gigabit Network Interface Card (NIC)
Hard Drive	80GB or more of available space. In addition, TT recommends 10GB or more of available free space for TT software and log files. TT suggests a SATA or Parallel ATA drive with a minimum rotation speed of 7200rpm.

HIGH PERFORMANCE SPECIFICATIONS

These specifications are written for the competitive user. If you need the ability to view multiple market grids, trade a diverse range of products or utilize a variety of applications simultaneously, these specifications will provide you with a fully functioning trade environment.

TT recommends you use at least a Workstation Class Machine.

Hardware Type	
Motherboard	Should contain a PCI-X 133 slot for NIC and one or more PCI-Express 16x slots for graphics card.
Memory	2GB or more
Processing Speed	2-AMD 2200 Series Opteron or 2-Intel 5000 Series Xeon Dual Core processors running at 2.6GHZ.
Network Card	Gigabit NIC on a PCI-X 133 slot.
Hard Drive	120GB or more of available space. In addition, TT recommends 10GB or more of available free space for TT software and log files. TT suggests a SATA or Parallel ATA drive with a minimum rotation speed of 7200rpm.

REMOTE CONNECTIONS

For remote mode connection or personal WAN Routing setups, observe the following requirements:

Internet Connection	Leased line, ISDN, DSL, or Cable Modem recommended Due to high latency, do not use Satellite Broadband
VPN (Optional)	Cisco PIX



Warning: Using Proxy servers causes significant latency problems. TT does not support their use in a TT trading system.

CLIENT EXCEPTIONS

The following exceptions exist to the standard hardware and software requirements for TT client products:

- If you use X_TRADER[®] Pro (i.e., Autospreader or Autotrader), you must conform to the **High Performance Specifications**.
- If you use X_STUDY[™], you must conform to the **High Performance Specifications**.
- If you use TT_TRADER[™], X_STUDY[™], or X_TRADER[®] Version 7.3 or higher, you must install Microsoft .NET Framework 2.0.
- If you use the X_RISK client GUI, your client workstation must have 512 MB memory per 50,000 fills. For example, if you routinely process between 30,000 and 60,000 fills per day, you must use 1 GB.
- Super Guardian[™] clients require SNMP to be installed and running.
- If your workstation also runs MISS exchange software, you must refer to the particular exchange's documentation for further requirements.
- If you use Guardian's email notification functionality, you must install an email client on each client machine. This client must use the MAPI protocol.
- If you use Position Mover, TT recommends installing on a Server Class Machine. If you must use a Workstation Class Machine, you must conform to the **High Performance Specifications**.

SERVER CLASS MACHINE SPECIFICATIONS

Server class machines host are necessary for a variety of TT products, including:

- FIX Adapter
- FMDS
- Lite Server
- TT Demo
- TT Gateway
- TT Relay
- TTSIM
- Super Guardian
- SQL Databases
- Transaction Logger
- X_ADMIN™
- X_RISK®
- X_RISK® server components
- Position Mover

Exceptions are listed in the section called **Server Exceptions**.

TT Gateways use a Synthetic Order Manager (SOM) which interacts with a SQL database. Refer to the section called **Server Exceptions** if you decide to install the SQL database onto the TT Gateway.

Note: If you are running Windows 2000 Server, in the Windows 2000 Server Advanced System Properties, **Performance Options** dialog box, you must optimize the performance for **Background services**.

GENERAL REQUIREMENTS

The following general requirements concern all types of server class machines both entry level and high performance.

Operating System	Windows 2000 Server or Workstation (Service Pack 3 or higher) or Windows 2003 Server (Service Pack 1).
	Note: If running Windows 2003, you must install the Microsoft Hotfix KB897667. For more information, contact your TAM.
Network Card	At least one Server class Gigabit PCI NIC. You should manually set for speed and duplex.
Database	(Optional) The TT Gateway installation comes with MSDE 2000 SP 3 database software. When using MSDE 2000 TT supports the use of SP 3 only. If you use SQL Server software to support the SOM and HPS, you must use SQL Server 2000 of Version 8.00.760 or higher. If you are sizing a TT Gateway with a resident SOM SQL database, refer to the section called Server: Hosting a SQL Database for additional requirements.
Hard Disk	TT recommends a hard drive with a sufficient amount of disk space and at least 10GB or more of available space for TT software and log files.
Mouse	Any
Miscellaneous	Dual power supplies with UPS backup Backup fans

ENTRY-LEVEL SPECIFICATIONS

If you trade fewer products and perform a minimal number of transactions each day, these specifications allow you to use TT products without excessive investment. However, following these specifications can put you at a disadvantage over the competition.

TT recommends you use a Server Class Machine.

Motherboard	Should contain a PCI-X 133 slot for NIC and one or more PCI-Express 16x slots for graphic card.
Memory	2GB or more at 667Mhz
Processing Speed	AMD 2200 Series Opteron or Intel 5000 Series Xeon Dual Core processor running at 2.6GHZ.
Network Card	Integrated Gigabit NIC

HIGH PERFORMANCE SPECIFICATIONS

If you are a competitive trader or need the ability to view multiple market grids, trade a diverse range of products or utilize a variety of applications simultaneously, these specifications provide you with a fully functional trading environment.

TT recommends you use a Server Class Machine.

Motherboard	Should contain a PCI-X 133 slot for NIC and one or more PCI-Express 16x slots for graphic card.
Memory	2GB or more at 667Mhz
Processing Speed	2-AMD 2200 Series Opteron or 2-Intel 5000 Series Xeon Dual Core processors running at 3GHZ.
Network Card	Dual Gigabit NICs on PCI-X 133 slots

SERVER EXCEPTIONS

For the servers below, you must incorporate the following exceptions:

TT CME FIX GATEWAY VERSION 7.3.1 OR HIGHER

If are using TT CME FIX Gateway Version 7.3.1 (or higher) with Eurodollar Options Strategy (EOS) Products turned on, the following server specifications are required.

Memory	4 GB RAM
Processor	Dual Processor 3.2GHz or higher
Network Card	Two or more NICs with one pointing to your internal network and one or more pointed to the CME price distribution.
Connectivity	Customer must purchase dual T1 lines that connect to CME

TT LIFFE AND EURONEXT GATEWAYS

Connectivity	The customer must purchase sufficient bandwidth for the number of LIFFE Connect exchanges to which the customer connects Consult the exchange to determine the required bandwidth
LIFFE Solaris Gateways	Each TT Gateway requires a unique LIFFE Solaris Gateway for the Financial Futures, Equity Options, and eCBOT markets In a failover group TT recommends each TT Gateway connect to a unique LIFFE Solaris Gateway

TT MISS GATEWAYS

Operating System	Windows 2000 English Language (Service Pack 3 or higher) If running Windows 2003 (only an option for Eurex 7.4 Gateways and higher), you must install the Microsoft Hotfix KB897667. For more information, contact your TAM.
Additional Software	Values API installed and configured
MISS Device	Each TT MISS Gateway requires a fully configured MISS Device. Multiple TT MISS Gateways can connect to one MISS Device

TT EUREXPF GATEWAYS

Memory	All Servers: 4 GB RAM
Processor	All Servers: Dual Processor 3.2GHz or higher
Network Card	<p>Price Server: 3 NICs with two to receive market data from each of the PDS boxes (for failover) and one to multicast market data</p> <p>Order Server: 2 NICs with one to manage data flow with the MISS Device and one to manage the multicast with client applications</p> <p>Price Distribution Server: 2 NICs with one to process the feed from the exchange and one to transmit data to the price server(s)</p>
Connectivity	Customers must purchase at least one 10 MBit line to connect to Eurex. Customers must use two 10 Mbit lines to support failover.

FMDS

Hard Disk	TT recommends a configuration for a controller-based RAID 5
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TT SFE GATEWAY VERSION 7.1

Miscellaneous	To run the AOEI Subscription Manager, you must install Microsoft .NET Version 2.0.
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X_RISK®

If you intend on using the e-mail alert functionality of X_RISK®, you must install Windows Messaging on the X_RISK® workstation. This is packaged with the Windows Setup but does not install by default.

Operating System	Also compatible with Windows Server 2000 SP 2 and 3 If running Windows 2003, you must install the Microsoft Hotfix KB897667. For more information, contact your TAM.
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X_RISK® SQL SERVER MACHINE

Additional Software	Microsoft SQL Server
Memory	2 GB (although this is also dependent upon the number of users)
Processing Speed	AMD Opteron or Intel Xeon 2.6 GHz or higher
Hard Disk	RAID Controller with level 1 or 5 RAID
Miscellaneous	FTP server services must be activated on the host machine

SERVER: HOSTING A SQL DATABASE

In addition to the **Standard Requirements** for all servers, whatever machine hosts the SQL Database must also conform to the following specifications:

Memory	Coupled with TT Gateway	At least 1 GB
	De-coupled	At least 1 GB for one to five connecting TT Gateways At least 2 GB for six or more connecting TT Gateways
Additional Software	Microsoft SQL Server 2000 or MSDE 2000 Note: TT Gateways come with MSDE 2000	
Processors	Coupled with TT Gateway	Dual processors
	De-coupled	Dual processors for one to five connecting TT Gateways Four processors for six or more connecting TT Gateways
Hard Disk	Coupled with TT Gateway	Additional 12 GB worth of disk space
	De-coupled	A base of 10 GB dedicated solely to the SQL database software Additional 2 GB for each connecting TT Gateway RAID 5 with at least four hot swappable drives

SUPER GUARDIAN™ SERVER MACHINE SPECIFICATIONS

Run TT Super Guardian™ on a server class machine that matches at least the entry-level requirements. Additionally, the following requirements are needed:

Additional Software Components	SNMP Standard Microsoft Extension Agents (Both components come with standard Windows installations)
Operating System	Windows Server 2000 (Service Pack 3 or higher)
Memory	1GB RAM or better
Processing Speed	AMD Opteron or Intel Xeon 2.0 GHz or higher
Hard Disk	9 GB of <u>available</u> hard disk space for software and log files

HOST DAEMON AND WAN ROUTER MACHINE SPECIFICATIONS

WINDOWS MACHINE REQUIREMENTS

Operating System	Windows 2000 Workstation (Service Pack 3 or higher)
Memory	1 GB RAM minimum
Processing Speed	Intel Xeon or AMD Opteron Dual Core 2.8 GHz CPU or better
Hard Disk	Hard disks formatted using NT File System(NTFS) 1GB of available hard disk space for software and log files
Network Card	Server Gigabyte PCI-Express NIC You should manually set for speed and duplex.
Monitor	TT recommends any SVGA or better Note: A monitor is not required to run TT software
Mouse	Any
Additional Software	TT Guardian™
Sessions	Each machine should be host to no more than fifty session connections
Firewall (optional)	Cisco PIX 525 or better
VPN (optional)	Firewall (as above) with VPN Accelerator card (hardware assist)
X_TRADER® Remote Host Connectivity	DS1 or better connectivity to Tier One ISP

LINUX MACHINE REQUIREMENTS

Operating System	Red Hat Enterprise version 4.1 with kernel version 2.6.9-11 -or- Red Hat Enterprise version 4.2 with kernel version. 2.6.9-22
Memory	1 GB RAM minimum
Processing Speed	Intel Xeon or AMD Opteron Dual Core 2.8 GHz Xeon CPU or better
Hard Disk	1GB of available hard disk space for software and log files
Network Card	Server Gigabyte PCI-Express NIC This card must be manually set for speed and duplex. Do not use autosense.
Monitor	TT recommends any SVGA or better Note: A monitor is not required to run TT software
Mouse	Any
Additional Software	None
Sessions	Each machine should be host to no more than fifty session connections
Firewall (optional)	Cisco PIX 525 or better
VPN (optional)	Firewall (as above) with VPN Accelerator card (hardware assist)
X_TRADER® Remote Host Connectivity	DS1 or better connectivity to Tier One ISP

RELATED DOCUMENTATION

TT recommends that you refer to the following documents for related information:

- For information regarding TT's recommendations on network hardware, topology, and its deployment, refers to the *TT Trading Systems - Network Administration Manual 7.X*.
- For information regarding setting up, maintaining, and tuning TT Gateways, refer to the *TT Gateways System Administration Manual Version 7.X*.