

## 1 Introduction

The trading-shim<sup>TM</sup> is the fruit of an Open Source software development project. The ‘shim’ provides command-line and dbms controlled interface to the socket-based API of Interactive Brokers’ Trader Workstation. This functionality is interesting because Interactive Brokers makes their Trader Workstation software freely available, and provides access to comprehensive market data feeds and archives for tick and history data, and a paper account ideal for software testing [and low transaction costs for those who decide to trade ‘live.’]

The project leads are using the trading shim to explore a gamut of research interests in the context of a non-trivial system; e.g., the developers note conflicts between the theories trusted by academics (*viz.*, the various forms of the Efficient Market Hypothesis), and fundamentals investors, and the practical results observed by technical traders in reality. This provides a tool of interest to students of Economics, Finance, and related disciplines.

The project leads also are exploring software engineering issues related to mixed paradigm programming, design patterns, and test-driven development. The use of C++, mixed paradigm programming, design patterns, and test-driven development makes the project interesting to post-graduate students in Computer Science, as well.

The trading-shim is developed on the CentOS<sup>TM</sup> Linux<sup>TM</sup> distribution at its version 5, but tested as part of its external release process on CentOS 4 (i386), CentOS 5 (i386 and x86\_64), Debian Testing (i386), Debian Quantian (i386), and OS/X 10.4 (PPC). Each is a POSIX<sup>TM</sup> compliant Unix<sup>TM</sup> -like computational environment. It also is tested in a Xen virtualization instance (i386, and x86\_64, each para-virtualized).

It should run under VMware in a virtual Linux instance, on any other platform which that commercial product supports (Windows) but the developers do not test it in a proprietary software environment other than OS/X.

## 2 Hardware requirements

The trading shim and the TWS demand fairly modest hardware – any PC built in the last ten years should suffice to get started.

- Pentium class machine, 700 MHz or more, with 512k ram, and CD reader
- For burning the free install media, access to a CD burner is needed

## 3 Install Linux (free)

The Open Source movement's poster child of success is Linux, and behind that the compiler and Unix like tool chain developed under the umbrella of the Free Software Foundation.

Pointers to freeLinux downloadable installation media, and much more are at:

- Centos 5:  
<http://www.centos.org/modules/tinycontent/index.php?id=15>  
mirrors listed at that page
- Debian testing:  
<http://www.debian.com/distrib/>

Open Source Linux software offers many other tools of interest to a Finance professional (free):

1. R  
R is a language and environment for statistical computing and graphics. It is a GNU project which is similar to the S language and environment which was developed at Bell Laboratories.  
<http://www.r-project.org/>
2. gnuplot  
Gnuplot is a portable command-line driven interactive data and function plotting utility. It is well suited to visualization of numerical data.  
<http://www.gnuplot.info/>

3.  $\LaTeX$   
 $\LaTeX$  is a high-quality typesetting system, including Thesis stylesheets, and free PDF generation capabilities, initially produced by the effort of Leslie Lamport; it includes features designed for the production of technical and scientific documentation.  $\LaTeX$  is the de facto standard for the communication and publication of scientific documents – It is the lead incarnation in the Open Software community of Donald Knuth’s  $\TeX$ .  
<http://www.latex-project.org/>
4. beancounter  
a portfolio performance toolkit, which retrieves ‘EOD’ (end of day) security OHLC pricing and volume information, via the perl <sup>1</sup> Finance::YahooQuote <sup>2</sup> CPAN module; <sup>3</sup> Data is stored into an SQL database, for access from its own analysis engine, or by third-party packages such as the R Finance SIG, <sup>4</sup> under the editorship of Dirk Eddelbuettel.  
<http://dirk.eddelbuettel.com/code/beancounter.html>
5. Octave  
a command line interface for a ‘Matlab’-like numerical solver environment for linear and nonlinear problems.  
<http://www.gnu.org/software/octave/>
6. and much much more, in a complete and free computation and GUI visualization environment

## 4 Install the trading-shim

The shim is designed to compile and run as a non-root user. Setting up (installing) the packages needed to build the shim may require root privileges, but all normal operations are done as a normal non-privileged user. Additionally, the project leads run all provided updates from the upstream software distribution builders – CentOS, Debian, and Apple – to avoid security holes.

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<sup>1</sup> <http://www.perl.org/>,

<sup>2</sup> <http://dirk.eddelbuettel.com/code/yahooquote.html>,

<sup>3</sup> <http://www.cpan.org/>,

<sup>4</sup> <http://cran.r-project.org/src/contrib/Views/Finance.html>,

## 4.1 Getting the sources

Get the latest trading-shim sources (free)

The trading-shim sources are always freely available by FTP

<http://www.trading-shim.org/download/>

## 4.2 Prepare the build environment

Set up the build environment – this usually requires root rights

At a cold start minimum, packages providing the following \*nix build tools and the ‘dependencies’ which the relevant package installation tool pulls in [yum for CentOS; apt-get for Debian], are needed:

1. `g++` and the regular library headers (the compilation environment, from <http://gcc.gnu.org>)
2. `mysql.h`, as from `mysqlclient10-devel` (a library header needed for database connectivity, from <http://www.mysql.com>)
3. `make` (to perform the compilation steps set out in the `Makefile`, from <http://www.gnu.org/software/make/>)
4. `ruby` (a shell interpreter needed by the `Makefile`, from: <http://www.ruby-lang.org/>)

And for a documentation rebuild, at least the following \*nix build tools :

1. `graphviz` (Open Source graph visualization software, from <http://www.graphviz.org/>, initially from AT&T Research)
2. `latex` from `LATEX` (see section 3, *infra*)

## 4.3 Compile the shim

Compile the shim – this does not require root rights

Untar the sources into a work directory, `cd` into the newly created sources, and type:

```
make all
```

More information is in the tarball, and at the trading-shim website.

## 4.4 Test the shim

A minimal test, assuming a `./shim` binary resulted, is to run:

```
$ ./shim --help
```

and a basic help message will appear:

```
[herrold@centos-4 shim_071128]$ ./shim --help
Pair: 1 0xb6ff0e20 0xb6fe3804 0xb6fe37f0 DbvI
Pair: 1 0xb6ff0e20 0xb6fe5044 0xb6fe502c DbvK

Pair: 1 0xb6ff0e20 0xb6fe3804 0xb6fe37f0 DbvI
Pair: 1 0xb6ff0e20 0xb6fe5044 0xb6fe502c DbvK
x86 /proc/cpuinfo: 2793845000;
time stamp clocks: 2792910377
 116 116 112 116 112 116 112 116 112 116 112 116 112 116 <snip>
x86 /proc/cpuinfo: 2794
time stamp clocks: 2794, 2794000 1
```

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### Online Help

The help command provides information about trading-shim operation and the shim command set. There is one argument, selecting a command verb or topic:

The shim command verbs:	General topics:
-----	-----
help	mode
ping next	opts
wait wake quit	link
read load list	cmds
*bind	args
verb news open acct	
info *wild *exec	Note: commands marked
tick book past *scan	with an asterisk are
wire *xmit *cash	not yet implemented.

Syntax:

```
help <verb>;
help <topic>;
```

where <verb> or <topic> is from one of the tables above.

Exit by simply typing: `quit`; and the ENTER key.

Congratulations; if you saw that screen, you have solved the basic compilation issues. If not, consider the next section.

## 4.5 Debugging

Try to solve problems using existing resources:

1. the FAQ:  
<http://www.trading-shim.org/faq/>
2. the mailing list archive:  
<http://www.trading-shim.org/pipermail/ts-general/>
3. there is a search box for all site content:  
<http://www.trading-shim.org/search/>

## 5 Connection to Interactive Brokers™

All connections to Interactive Brokers data in this example are mediated through a locally running TWS to Interactive Brokers instance, which provides for socket based connections, as outlined at the trading-shim website, as well at the Interactive Brokers website. Obviously therefore, one needs to get a running TWS instance the shim can connect through. [this overstates the matter a bit – it is perfectly possible to connect across a LAN to any TWS instance which permits such connection, up to the 8 connection limit, as in a shared TWS instance in a lab setting.]

### 5.1 Install Java

Obtain the Java™ JDK, which is available without charge. Install it per the instructions at the trading-shim FAQ

<http://www.trading-shim.org/faq/>

Again, installing and configuring the Java package needed to run the TWS may require root privileges, but all normal operations are done as a normal non-privileged user. Additionally, the project leads run each provided update from Sun to avoid security holes.

### 5.2 Install the TWS

Obtain the UNIX Standalone TWS JAR from Interactive Brokers (free)

<http://individuals.interactivebrokers.com/en/p.php?f=tws>

and install it per their instructions

Installing the TWS JAR does NOT require root privileges. The developers track each updated TWS from Interactive Brokers, and as IB occasionally changes their API, it may take a week or so until the developers release an updated trading-shim after major changes.

### 5.3 Start and connect the TWS to Interactive Brokers

The Interactive Brokers describes the manner in which to start the TWS at:

<http://individuals.interactivebrokers.com/en/control/systemstandalone.php?os=unix>

Log in to the TWS using the free sample account:

item	value
userid:	edemo
password:	demouser

Configure the TWS for socket based connections, and as needed add permitted IP, as outlined at the trading-shim website.

## 6 Adding the shim database backend

The next step is to set up the database from which the shim reads information about markets and symbols in which one is interested; through which the shim recies some commands; and in which the shim stores the results of market data history queries and order and execution results.

This is an extended topic, well covered in the manual (see section 9).

## 7 Additional resources

The entire trading-shim website is designed to try to answer all recurring questions, and to express the knowledge acquired in running this Open Source project.

## 8 Further study

If you become even more interested, free accounts with additional features are available through the Interactive Brokers Trading Olympiad for students:

<http://www.interactivebrokers.com/en/general/education/IBTradingOlympiad.php>

The project leads are in no way affiliated with Interactive Brokers (beyond the obvious connection of as a user of their services), but note that Interactive Brokers have paid out substantial cash prizes (up to \$100,000), and minimum \$1,000 participant prizes for entrants in recent years. When written, there are such incentives for up to 100 entrants.

## 9 Further interest

Consider subscribing to and participating in the mailing list:

<http://www.trading-shim.org/mailman/listinfo/ts-general>

Bill publishes a technical manual:

<http://www.trading-shim.org/pdfs/manual.pdf>

Russ has a draft command reference with many examples:

<http://www.herrold.com/commands.pdf>

## 10 Explore the Open Source environment

TBD