Figure 3. FBTS architecture.

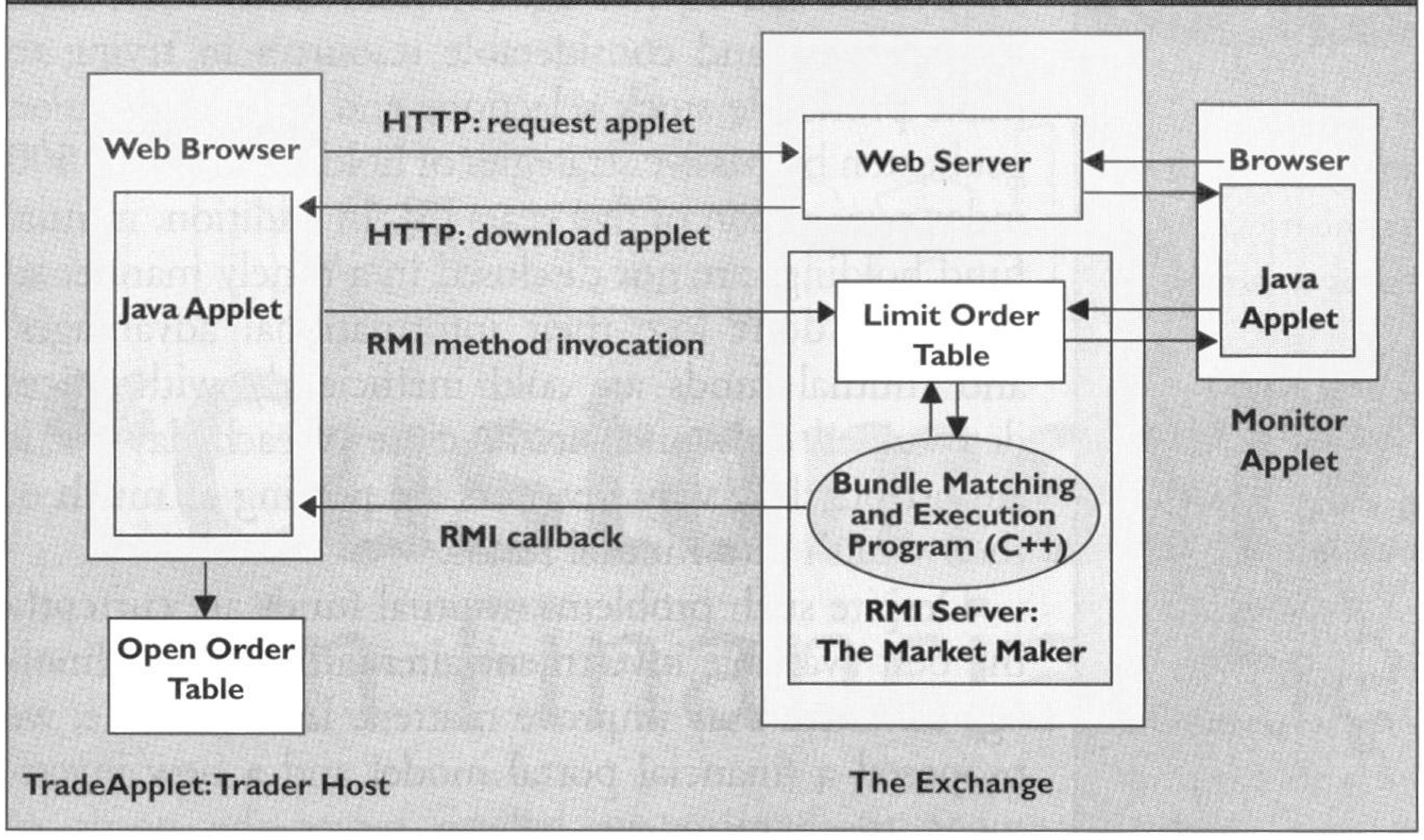

Table 1. A bundle trading example.

Index	Shares (i)	Previous Close Price (ii)	Next Day's Trading Range (iii)	Next Day's Worst Price (iv)	Trade executed? Yes/No
T	-200	125	129-132	129	Y
F	-100	95	93-94	93	N
R	+150	110	111-112	112	N
U	+150	120	121-122	122	N
(a)=Σ(i)*(ii)		$0			
(b)=Σ(i)*(iv)				$0	

flows from the investments (see Figure 2 and the sidebar "Mean-Variance Framework").

In mean-variance optimization, investors will be provided with proprietary input data consisting of expected returns, standard deviations, and correlations of returns for the indices created. The optimizer will then determine the efficient frontier, taking into account any restrictions, such as minimum or maximum allocations to certain indices, placed by the investor. Combining this information with the applicable borrowing and lending rates, the optimizer will then be able to come up with a single optimal portfolio for the investor. As a last step, the investor may then decide how much borrowing or lending is to be done to achieve the final asset allocation. The appropriateness of these portfolios (or bundles of indices) will have to be verified periodically and adjusted as needed.

Portfolio optimizing using the mean-variance criteria is not a new idea. Simple electronic financial advisors that make asset allocation suggestions using the universe of stocks and mutual funds are currently available. All of these tools aim to help investors make better investment decisions. While the tool we envision starts out with the same goal, it goes beyond what is currently available. By allocating investors' assets to our proprietary indices, we can better span the market and move toward a truer sense of a diversified portfolio as opposed to a portfolio of stocks and bonds.

Our second approach to optimizing investor portfolios involves a scenario analysis. Examining an investor's current investable wealth and future income and obligations (such as mortgage payments and college costs) under different scenarios, this approach tests different combinations of indices to maximize the discounted value of net cash inflows under various scenarios (see Figure 2). The investor may then choose among the most appropriate alternatives.

Bundle Trading

Once portfolio allocations are made, investors must be able to trade these bundles to revise their allocations as conditions change, which can be done using the bundle trading concept. In bundle trading, investors buy or sell bundles of securities (in this case bundles of indices) by specifying a price for the bundle they want to trade. When all components of the bundle can be matched with other outstanding orders, the bundle executes. At that point, prices for the individual bundle components can be imputed. An experimental financial bundle trading system (FBTS) has been designed and tested at the Center for Research in Electronic Commerce at The University of Texas at Austin. This system uses a distributed object model based on Java RMI (remote method invocation) and supports interactive communication between trading applications and the market. The FBTS architecture is illustrated in Figure 3 and is explained in detail in [4] and [5].

The main advantages of bundle trading is the ability to accept conditional orders, provide simultaneity of transactions, and reduce transaction costs—see the sidebar "Financial Bundle Trading System (FBTS)." To illustrate, assume we want to rebalance our portfolio by selling 200 shares of the technology index (T) and 100 shares of the financial index (F) while buying 150 shares each of the retail (R) and utility (U) indices (see Table 1). If we believe the previous day's close prices are fair values for all four indices, and we place limit orders based on the prices as displayed in column (ii), only the buy order for T will get executed according to the next day's trading ranges for these indices (column (iii)).