



Buyer's Reference Manual

Merkato Version 2.2

July 2002

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What is Merkato?

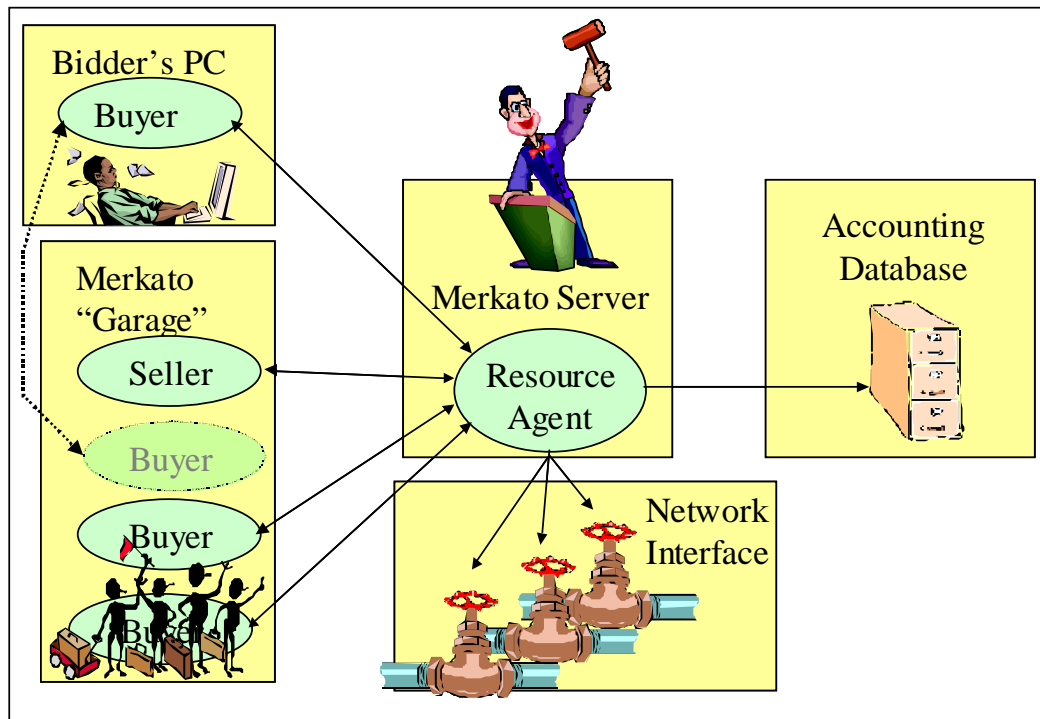
Merkato is a software platform that supports a unique way to obtain bandwidth, on demand, at fair and optimal prices.

There are two ways to purchase bandwidth in a Merkato system.

- You can get a fixed amount of bandwidth, at a fixed price, for a fixed term
- You can create a bidding strategy and contend for bandwidth with other buyers at frequent intervals, establishing a *fair market price* based on supply and demand

The first method is called the Reservation market. The second method is called the Spot market.

The Spot market provides a true balanced supply-and-demand marketplace. The Merkato Spot market uses the patent-pending Progressive Second Price Auction mechanism to collect bids from multiple buyers, analyze the bids to determine the natural market price for offered bandwidth, and then automatically apportion that bandwidth to bidders at the market price. The components of the Merkato system are illustrated below.



Buyers, Sellers, and Agents in the Auction Market

Agents are programs within Merkato that interact on behalf of buyers and sellers. Buyers can acquire bandwidth by configuring their agents with the price they are willing to pay for a range of available quantity, or with the reservation they want. Sellers configure their agents with a quantity of bandwidth for sale and a minimum price for that quantity. Buyer agents then express what they are willing to pay for bandwidth in the form of bids, consisting of a unit price and a quantity.

Sellers create a price floor by offering to purchase all the available bandwidth at their lowest acceptable price.

The Merkato market responds to bids with proposed allocations and pricing. The buyer and seller agents can either accept the proposed allocation (by not bidding further), or reject the proposed allocation (by submitting another bid). When there is no more bidding, the auction closes, and Merkato makes bandwidth allocations.

The auction process typically takes no more than five minutes. The auction is completely open and fair, with all bidders seeing what other bidders have offered. The Progressive Second Price auction mechanism (see “Merkato Auction Mechanism: The Progressive Second Price Auction” on page 67) ensures that all bidders receive their allocations at the fair market price, which is equal to or less than the price they offer.

The Spot Market and The Reservation Market

There are two ways to purchase bandwidth in a Merkato system.

- You can request and receive a fixed amount of bandwidth, at a fixed price, for a fixed term
- You can create a bidding strategy and contend for bandwidth with other buyers at frequent intervals

The first method is called the Reservation market and uses a reservation agent. The second method is called the Spot market and uses a spot agent.

Reservations eliminate uncertainty. You know how much bandwidth you will be receiving, for what duration, and for what price.

In the Spot market, distribution of bandwidth is based on ranking bidders by price offered. It is possible that for some period of time you will be unable to obtain the full amount of bandwidth you desire because you are out-bid by other buyers.

The Spot market provides true bandwidth-on-demand. The changes you make to your agent bidding profile take effect in five to ten minutes. You can even stop bidding entirely for a period.

Reservations may be cancelled, but the seller may have a cancellation fee.

The seller sets the Reservation market prices. Spot market prices are determined by a unique progressive second price bidding process. You do not necessarily pay what you offer; you pay the unit price of the lowest bidder to be awarded bandwidth. This is the true “market price” for the bandwidth offered by the seller, as established by the community of active buyers.

You need not choose one or the other purchasing option exclusively. Any bandwidth you purchase on the Spot market will be added to bandwidth you purchase on the Reservation market. Many buyers use the Reservation market to “lock in” their minimum required bandwidth, and then use the Spot market to purchase additional bandwidth as required.

Depending on how your administrator has set up your Merkato system, you may have separate login usernames for each type of agent or they may share a common username and password. (If different agents share the same username, you have to obtain them from different “garages.”)

The Resource Agent

The Resource agent is the core of the Merkato system. In addition to handling reservations for bandwidth, the Resource agent is responsible for:

- Informing all bidders of the quantity available
- Accepting bids from active bidders
- Determining a proposed allocation of bandwidth for each bidder based on *progressive second price auction* rules (see page 67)
- Calculating the market price
- Distributing this information anonymously to all bidders

These actions occur during a single cycle in the bidding process. Bidders who did not receive an allocation, or whose allocation was less than they wanted, can submit another bid to improve their positions. This cycle continues until bidders are satisfied with their allocations or don't want to bid at the current market price.

When bidding is complete, Merkato:

- informs all bidders of the final results
- sends the bandwidth distribution information to the Network Service Controller (NSC) to implement the bandwidth allocation
- sends the billing information to the accounting database

Automatic Remote Bidding

Although the auction allocation process runs continuously, there is no need for you to be directly involved at all times. Your Buyer agent can bid automatically for you, after you configure it with a profile of the value you place on bandwidth.

You indicate your budget limits, bandwidth desires, and bidding strategy in the Valuation and Strategy windows in the Merkato user interface.

Once you configure your agent you can either bid from your PC using a Java-based application or communicate remotely with your agent in the “garage.”

Bidding from your PC or operating a remote agent each has advantages. On your PC, the Merkato desktop display gives you real-time information about the auction and its participants. If you are not interacting with the agent, you can configure the agent and upload it to the garage. It will continue to run, and you avoid the chance of ceasing to bid if your PC crashes or you have network connectivity problems.

Starting Merkato

Your first point of entry to Merkato is through the Portal, a browser-based application that provides accounting and status information as well as access to the Merkato agent. Your version of the portal may have a slightly different appearance than shown below, but the functionality is the same.

Note: Merkato has been tested on Internet Explorer version 6.0 and later versions. While Merkato may work on other browsers, we have not verified this.

The opening page that contains Username and Password fields (see Figure 2.)

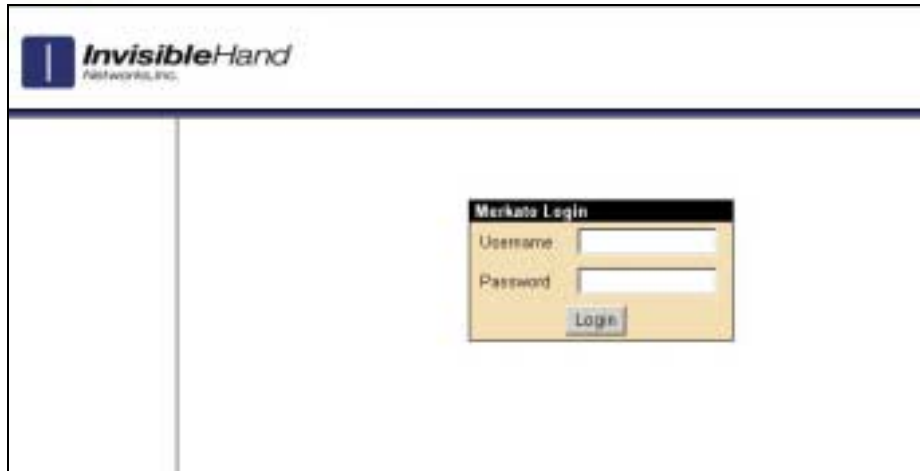


Figure 2: The Merkato Login Screen

Enter a valid user name and password and click **Login**.

After you log in the Merkato agent screen appears, displaying the Express interface (Figure 1).

From this top-level agent page you can get to the various screens that make up the portal, and to the desktop interface and the wizard (see page 7).

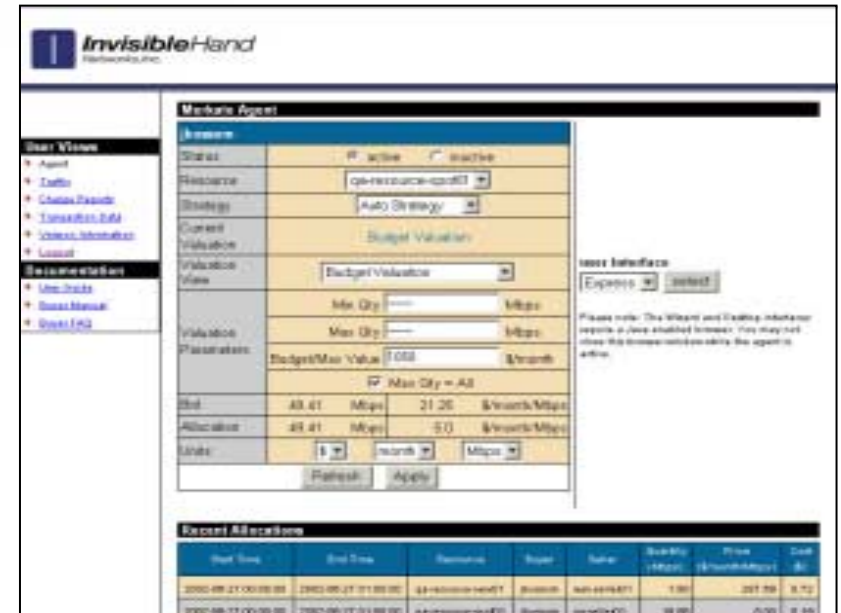


Figure 1: The Opening Merkato Portal Screen

Choice of Interface

You can choose from among interfaces to set preferences, get information, and handle transactions. The User Interface menu gives you three choices.



- The **Wizard** walks you through the steps for setting up your Merkato agent to obtain bandwidth. The settings are automatically transferred to your agent and can be viewed and altered from either the Desktop or Express interfaces.
- The **Desktop** interface allows you to purchase bandwidth through a series of user-selectable windows. Your agent is brought to your PC and bids on your behalf from there.
- The **Express** interface lets you obtain status information from, and send configuration information to, an agent in the garage. The Express interface is displayed on the Portal page upon successful login. The Express interface is considered advanced because the fields are less interactive than the Java-based Merkato Desktop interface.

When you first log in, the Express interface appears.

We recommended that, when you start using Merkato, you select the Wizard first to make basic buying choices. When you become more advanced in your use of Merkato you can make further changes to the Desktop interface. The Desktop interface also gives you the most detailed status information. As you become more proficient with Merkato you may want to use the Express interface to make quick configuration changes and status checks without downloading your agent to your PC.

Configuration Wizard

The Wizard walks you through the steps to set up Merkato to obtain bandwidth. The Wizard may be used alone (when launched from the original login screen) to alter settings to your agent in the garage. It may also be used to alter settings in your agent on your PC (when launched from a pull-down menu-bar in the Desktop interface).

To access the Wizard, select Wizard from the User Interface menu. (See “Choice of Interface” page 6.)

When you first launch the Wizard, the following window appears (Figure 3).

The Wizard guides you, step-by-step, through the following configuration choices:

- The resource from which you wish to purchase bandwidth
- The currency, quantity, and time units with which you would like to express your purchasing requirements. (Previously entered values are scaled to match the new units.)
- Your minimum bandwidth requirements
- Your maximum bandwidth requirements
- Your budget for purchasing bandwidth
- The state you wish your agent to be left in following the configuration changes (bidding or non-bidding)



Figure 3: The Merkato Configuration Wizard

Wizard Features

The Help box provides information about the impact of the parameters you are choosing. A check box at the bottom of the screen enables or disables help.

The values configured in your agent, at the time the Wizard is activated, are displayed as initial values in the applicable fields.

Use the **Next** and **Previous** buttons to navigate forward and backward through the Wizard. Until you click **Apply** at the last screen, none of your changes take effect. When you click **Apply** you see the following confirmation screen.



Click **Yes** to confirm your desire to apply your changes, or click **No** to return to the Wizard.

You may click **Cancel** at any time to exit the Wizard without making changes. Merkato will ask you to confirm your desire to exit the Wizard with a dialog box:



Desktop Interface

The Desktop interface allows you to purchase bandwidth through a series of user-selectable windows. Your agent is brought to your PC and bids on your behalf from the Merkato desktop.

To access the Desktop, select Desktop from the User Interface menu. (See “Choice of Interface” on page 6.)

The Desktop window appears (Figure 4).

Note: Do not close the Portal browser window when the Merkato Desktop is open. You may browse to other web pages, but you must leave the browser window open for the Merkato Desktop to continue operating properly.

The Desktop Agent

The Merkato Desktop is the window into which you download one or more Merkato agents.

1. From the File pull-down menu, select “Download Agent” (Figure 5).

The Download Agent window appears (Figure 6).

2. Enter the username and password for the desired agent.

By default, this is the same as the username and password you used to access the Desktop interface from the initial login; the fields are populated with this information. You may specify another valid username and password to download another agent.

3. If there are Garage choices on the pull-down list that indicates both spot and Reservation marketplaces, select the spot garage (to participate in the Merkato auction) or the reservation garage (to reserve bandwidth). (See Figure 7.) Click **Download**.

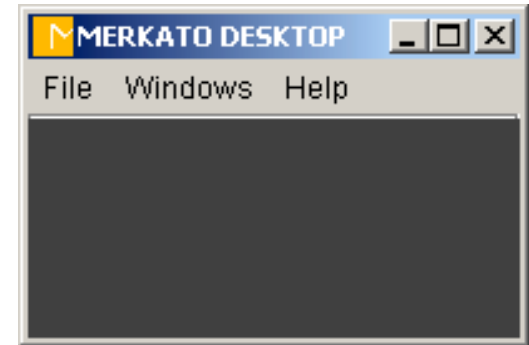


Figure 4: The Merkato Desktop

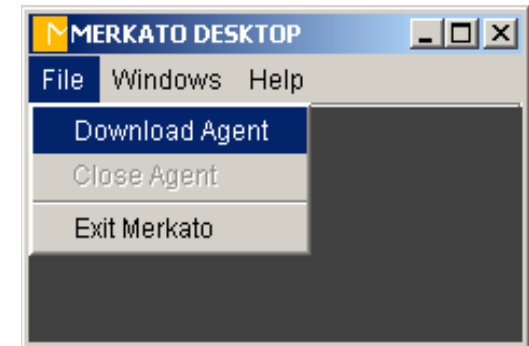


Figure 5: The Desktop Agent Download Menu

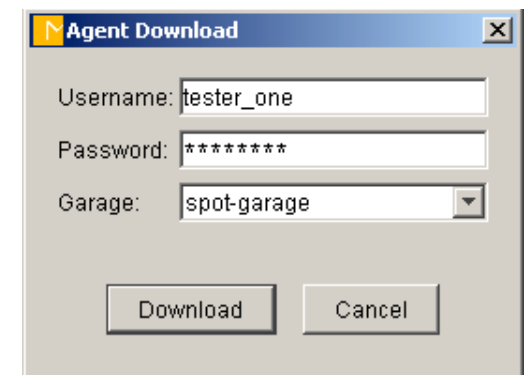


Figure 6: The Desktop Agent Download Window

If you have a single generic choice in the Garage field, your Merkato administrator may have given you distinct usernames and passwords for separate markets. In this case, make sure that the username and password correspond to the market you want to participate in. Then click **Download**.

The Agent window appears, as shown in Figure 8.

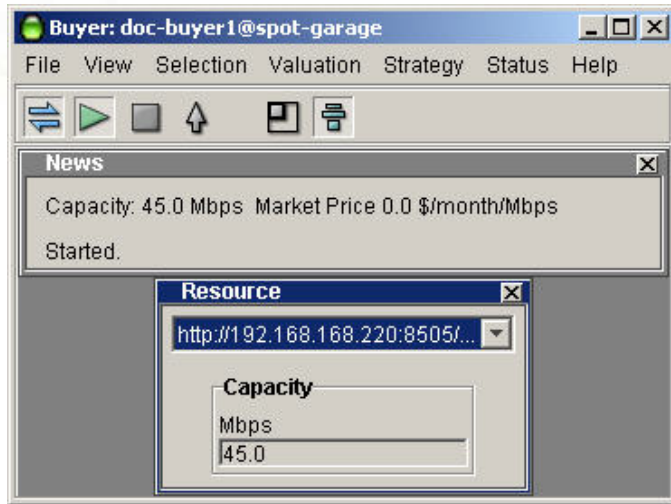


Figure 8: The Desktop Agent, as it Appears When First Downloaded

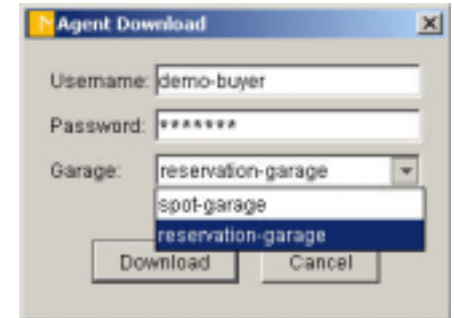


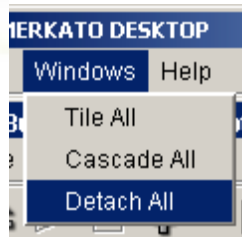
Figure 7: The Garage Selection Pull-Down Menu

Arranging Agent Windows

There is a variety of ways to arrange desktop agents on your screen.

Detached From Merkato Desktop

By default, all agent windows appear within the Merkato Desktop window. If you want the agent window to appear as an independent window on your Windows screen, select **Detach All** from the **Windows** pull-down menu, as shown below:



When you select **Detach All** a check appears beside the name in the menu-bar. The agent window separates, and can then be viewed outside of the Merkato desktop, as shown in Figure 9.

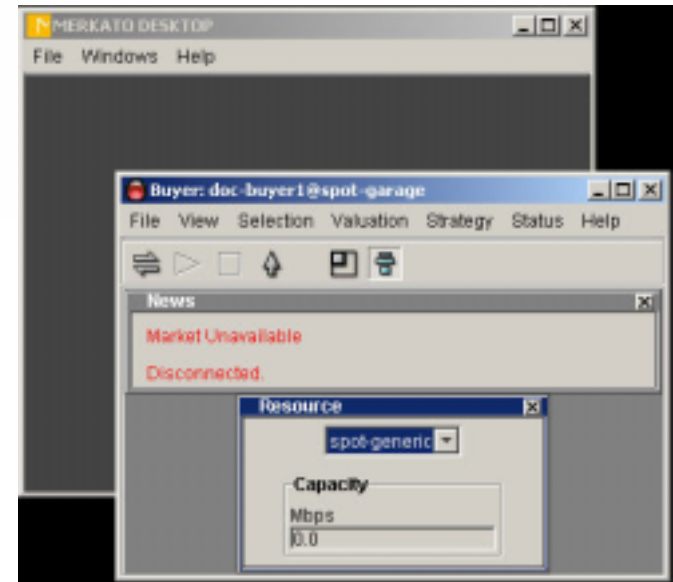


Figure 9: The Merkato Desktop Agent Detached From the Desktop

Tiled

Whether the agent windows are inside or outside the Desktop, they can be automatically arranged relative to each other. If you select Tile All from the Windows pull-down menu, the windows arrange themselves in a tight, non-overlapping pattern (Figure 10.)

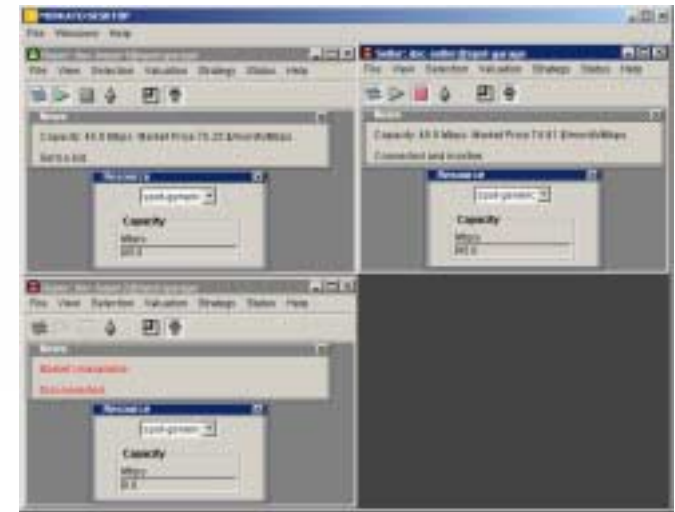


Figure 10: The Merkato Desktop with Multiple Agents Tiled

Cascading

If you select Cascade All from the Windows pull-down menu, the windows are all offset from each other and overlap, as shown in Figure 11.



Figure 11: The Merkato Desktop With Multiple Agents Tiled

Arranging Sub-Windows Within the Agent Window

The agent window consists of smaller sub-windows, each of which can be displayed or closed as necessary. By default, windows are stacked vertically in the agent window, as shown in Figure 12.

Each time you select a window for viewing it appears beneath the previously activated window. To close a window, either click the close-box tab at the upper right hand corner of the window (X), or de-select the window in the pull-down menu-bar lists. The window closes and the other windows fill in the spot it occupied.

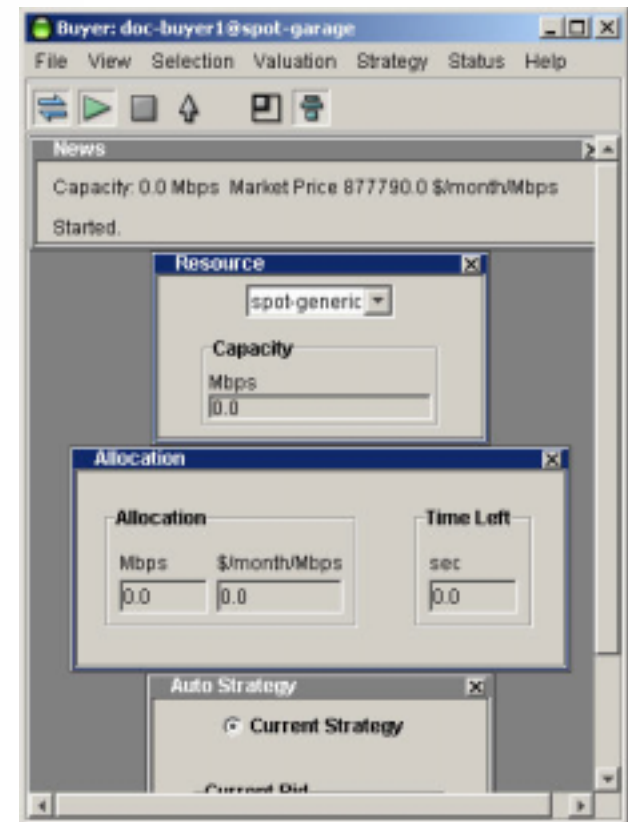




Figure 12: The Merkato Agent With Stacking Enabled

To freely drag boxes within the agent window, de-select the Stack () icon or go to the View pull-down menu and de-select Stack. When Stack is disabled you can move windows freely (Figure 13.)

To resize the agent window to exactly match the windows displayed, click the Pack icon () or select Pack from the View pull-down menu.

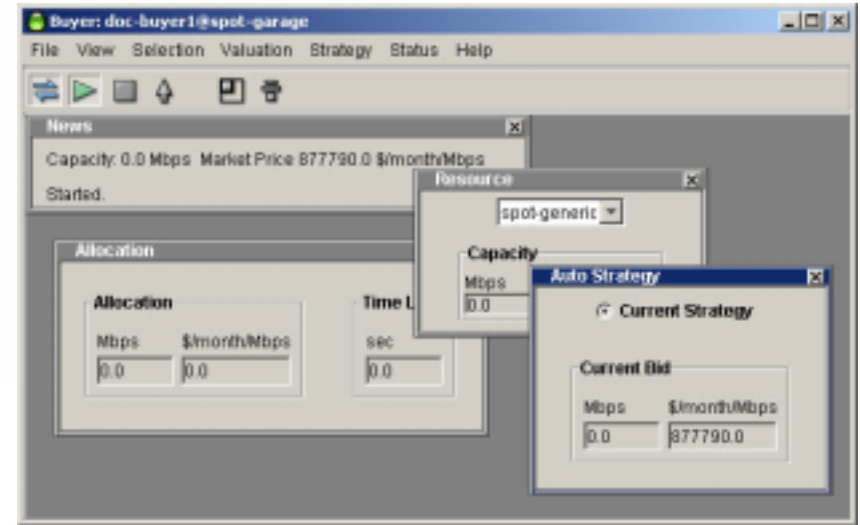



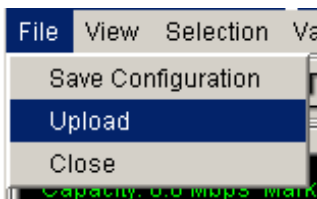
Figure 13: The Merkato Desktop With Stacking Disabled

Uploading an Agent to the Garage

A Buyer agent obtains bandwidth for you by sending bids to a Resource agent. You can have your agent bid from the Garage, which normally runs on the same server as the Resource agent. Your Spot-market agent may continue to bid on your behalf from the Garage when you close the agent on your PC (using your current Desktop agent settings). This is known as “uploading” your agent. When you upload your agent, all configuration changes are saved and the agent on your PC is closed.

Unlike a Spot-market agent, there is little harm if you exit a Merkato session without uploading a reservation agent. If you don’t upload your agent you lose the last changes you made in the reservation quote request window, but not the reservations you have already confirmed. Confirmed reservations are stored in a Merkato database, not in your reservation agent profile.


You can upload either by pressing the up-arrow on the icon bar () or by selecting Upload from the File pull-down menu.




Connect/Start/Stop


The three icons at the upper left of the icon bar indicate “Connect”, “Start”, and “Stop” (from left to right).



When you first download a desktop agent, before you configure it to start bidding, it is disconnected from the auction. Your agent does not bid or allow you to view auction status when it is disconnected, although you can change its configuration. When the connect symbol on the icon bar ( on the far left) is un-depressed and un-colored the agent is disconnected.

When you connect to the auction in “Stopped” mode you can observe the auction but you are not participating in it. The Auction Graph and Auction Table (Figure 14) show you the current auction in progress and allow you to determine whether you wish to join it. The Auction Graph and Auction Table are shown below:

When you want to start bidding, either click the Start icon ( second from left on the icon bar) or select Start under the Selection menu. Bidding starts immediately with the current active settings.

To stop bidding, click the **Stop** icon ( third from left on icon bar) or select Stop from the Selection menu. Your agent stops bidding and you are returned to Stop mode and disconnected. To begin viewing the auction again you must reconnect.

Note: You need a Merkato login ID to bid. If two users have the same login, both may try to bid using the same agent. Bidder’s names do not appear on the auction graph or auction graph—bidders are identified with arbitrary numbers. There is no way to know whether your agent is already active on another desktop when you preview an auction (although once you become adept at reading the auction table and auction canvas, it is possible to detect bidders who appear to have your valuation settings).

If an agent is already logged in with the same ID you are using, when you click **Start**, the message below appears. If you click **Yes**, confirming your wish to begin bidding, your agent gains control of the bidding process. The agent on other user’s PC is disconnected.

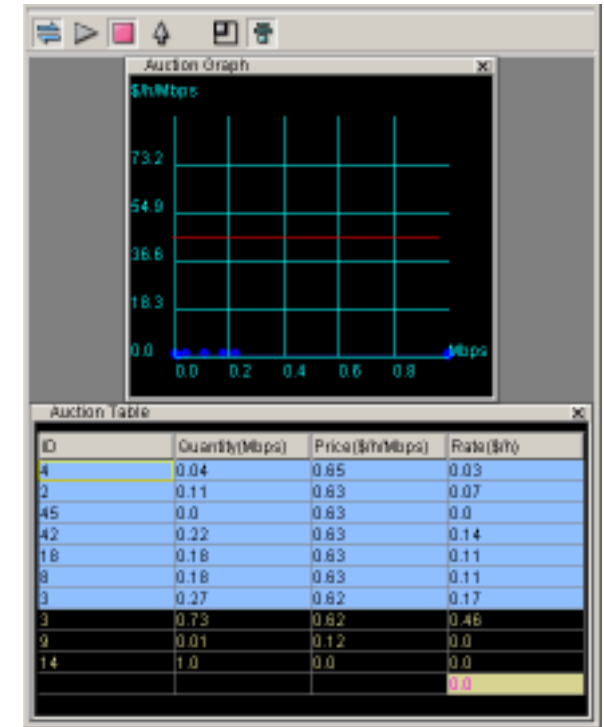
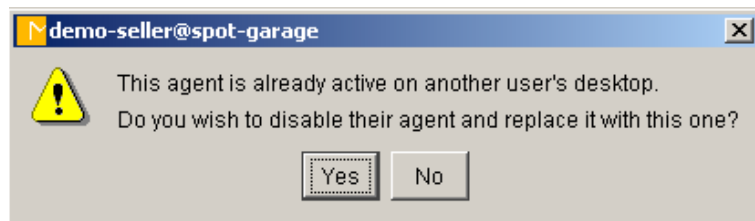


Figure 14: The Auction Graph and Auction Table

The last user to log in successfully always wins control of the agent, and the previous user receives an error message, as shown below, indicating that user's agent is no longer bidding.



Desktop Agent Features

The desktop agent window consists of multiple sub-windows that may be displayed, or not displayed, as needed. The sections below describe the windows, in roughly the order a first-time user might access them.

Much of the bidding functionality of the agent is determined by how you set a value on bandwidth and on the buying strategy you use. These are each described in later sections with an overview of the concepts. See “Valuations Overview” on page 24 and “Strategy Overview” on page 45.

Resource Window

The Resource window (Figure 15) includes a pull-down menu of the resources available to the agent. It shows the amount of bandwidth available at the resource selected.

Open the Resource window by selecting it from the Selection pull-down menu. If the agent is connected to the auction, the Capacity display indicates the total amount of bandwidth available for sale.

Note that a single agent can only bid on one resource at a time. If you select one resource, you automatically de-select the others.

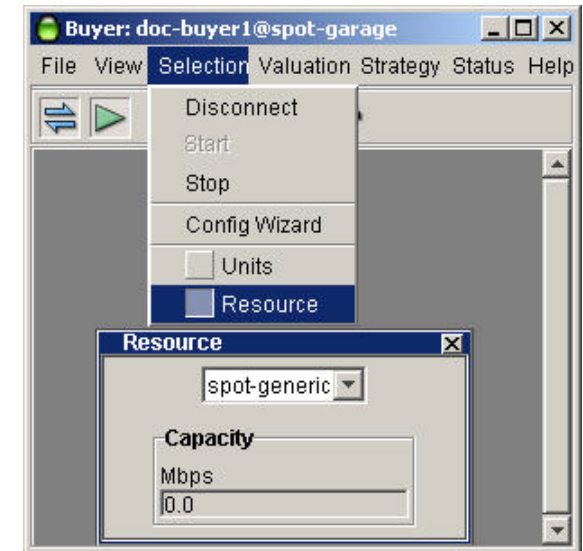


Figure 15: The Resource Window

Units Window

The Units window (Figure 16) lets you select units in which currency, bandwidth, and time are displayed. Units you select appear in the labels of windows as well as in pop-up message screens.

Currency units supported are dollars (“\$”) and cents (“c”).

Quantity units supported are kilobits per second (“Kbps”), Megabits per second (“Mbps”), and gigabits per second (“Gbps”).

Time units supported are minutes (“min”), hours (“h”), days (“day”), and months (“month”).

The changes to any units take effect immediately. All values in every window are automatically scaled to reflect the new units without changing the actual values.

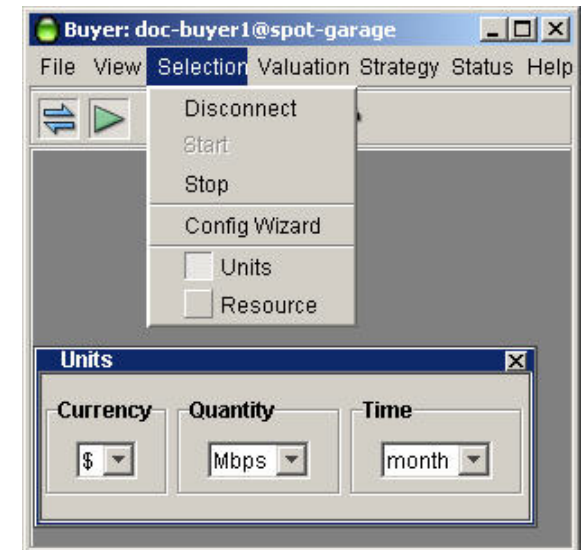


Figure 16: The Units Window

Auction Graph

The Auction graph indicates the state of the Merkato auction in progress, not only for your agent but for all others actively bidding. The Auction graph is shown in Figure 17.

The graph elements are:

- Y-axis, indicating unit price (the axis scales automatically to show all current bids).
- X-axis, indicating quantity (the axis scales automatically to show available quantity).
- Blue dots, representing the last bids received from all bidders (excluding a bid by your agent, which is shown as a red dot).
- A red dot, with ID number, indicating the last bid from your agent.
- A magenta circle, representing the current proposed allocation for your agent. (If no other bids are received, this is the allocation you receive.)
- A solid magenta dot, indicating the allocation you received during the previous auction round.
- A red line, representing your agent's valuation curve, as determined by settings in your active valuation window.
- A blue shaded area, representing the allocation of bandwidth to successful bidders, except for any bandwidth allocated to your agent. This area is a series of blocks, where the height represents the unit price paid and the width represents the quantity allocated. (The bandwidth allocated to your agent is the amount of blue under the red dot and to the left.)

The black area above the blue shaded area represents the level at which you would have to place a bid to outbid a current bidder. Your active valuation curve is visible in relation to other bidders, whether you are bidding or not. This allows you to optimize your valuation curve with respect to the other bidders before you begin actively bidding.

While you are not bidding, the place at which the red curve intersects the top of the blue shaded area indicates the quantity and price of bandwidth you would receive if other bidders placed the bids you can currently observe. Of course, once you start bidding, other bidders will react to your bids and perhaps raise the market price (the blue shaded area) above what it was without you.

The two screens shown below illustrate this happening, as the bidders reacts to your presence in the marketplace. The best way of fending off other bidders and getting exactly the bandwidth you want is to have your curve nearly vertical at the quantity you desire. (Of course, this also means that you are willing to pay a higher unit price for bandwidth as well.)

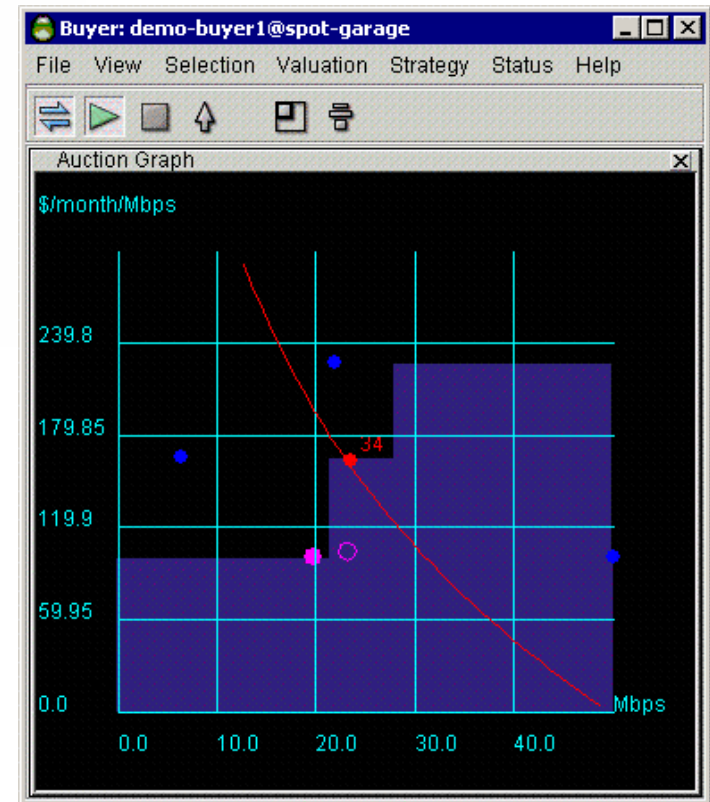


Figure 17: The Auction Graph

Clicking the right mouse button changes the scale of the unit price axis (Y axis). Note the units on the X axis in the examples shown in Figure 18. The cursor changes to indicate that the scale is expanded or contracted.

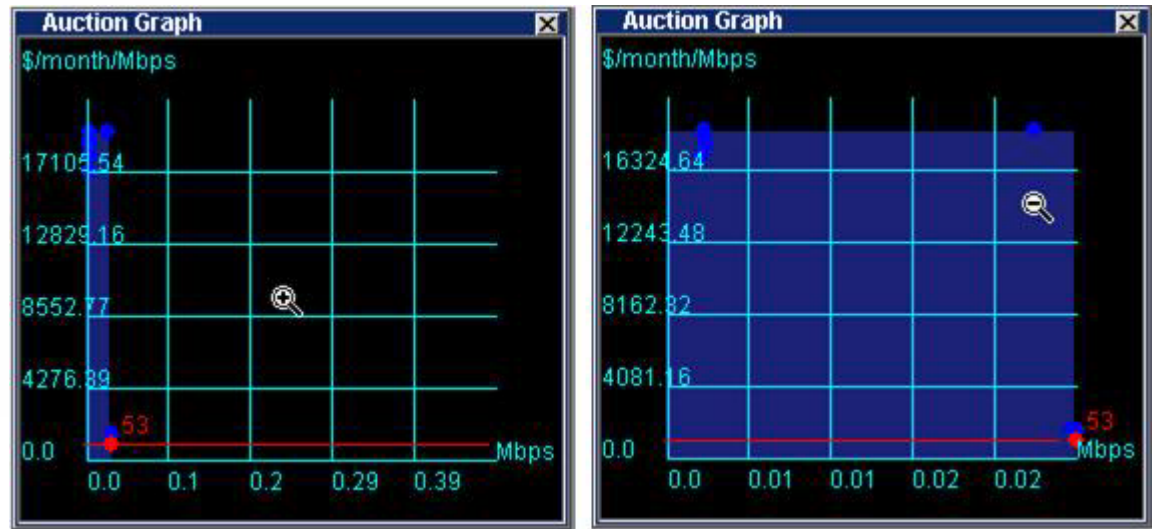


Figure 18. The Auction Graph, Showing the Effects of Scaling by Right-Clicking the Mouse

Auction Table

The Auction Table (Figure 19) gives you a quantitative, real-time view of the auction in progress.

The columns in the auction table are as follows:

ID	The ID of the bidder. A bidder agent receives a new ID whenever it is uploaded to or downloaded from the garage.
Quantity	The quantity requested in the last bid placed (note that this may be split into multiple rows, as explained below).
Price	The price (unit price) requested in the last bid placed.
Rate	The rate represented by the bid. This is the quantity times the price. It is the maximum cost represented by that bid, but not necessarily the price that will be paid by the bidder.

ID	Quantity(Mbps)	Price(\$/month/...	Rate(\$/month)
102	32.34	30.92	1000.0
108	11.25	30.81	346.57
107	1.41	30.81	43.32
107	9.84	30.81	303.25
106	22.5	30.65	689.66
106	18.28	30.65	560.34
			992.91

Figure 19: The Auction Table

The rows of Auction Table are as follows:

Your agent's last bid is shown in red. The last bids of all other agents are shown in black (in the blue shaded area) or in yellow (in the black area).

Any bidders, including your agent, that receive an allocation of bandwidth are shown in the blue shaded area. Any bidder who does not receive an allocation is shown in the black area. Bidders that receive only a portion of an allocation are shown in both the blue and black areas, with their quantities split accordingly.

Bidders currently unsuccessful in the auction round are shown in the black area. The price offered by unsuccessful bidders forms the basis for the actual cost paid by your agent if it receives an allocation. (See "Merkato Auction Mechanism: The Progressive Second Price Auction" on page 67.) If you are currently winning an auction round, the rates shown in the yellow-shaded area are the rates offered by bidders whose combined rate offers your offer has exceeded. These bidders are thus pushed out by your agent's bid.

The rate offered by the highest unsuccessful bidder is the basis of your cost. The magenta number (in the yellow cell) at the bottom of the table is a calculation of the rate you would pay should the auction end immediately. It is based on the rate offered by the highest bidders currently in the black area. (To figure your corresponding unit price, divide this number by the amount of bandwidth indicated for your agent in the blue shaded area.)

The columns of the Auction Table may be resized (by clicking and dragging column boundaries in the header) or reordered (by clicking and dragging the column headers themselves).

Allocation History Graph

The Allocation History graph (Figure 20) displays three types of history for the agent: measured traffic, allocation quantity received, and price paid:

At the top of the graph are three buttons.

Alloc Price: The price you have paid for bandwidth, in, for example, dollars-per-month per Mbps unit (the units are configurable). When you click this button, the Y-axis of the graph shows these units.

Alloc Quantity: The amount of bandwidth you have been allocated. When you click this button, the Y-axis of the graph scales to match this measurement.

Usage: The amount of your traffic that Merkato has measured. This measurement is used in Traffic-based and Quick Response bidding. When you click this button, the Y-axis of the graph scales to match this measurement.

The graph can be scaled to show greater or smaller time intervals. Inside the graph, right-click the mouse button. The time-scale choices appear:



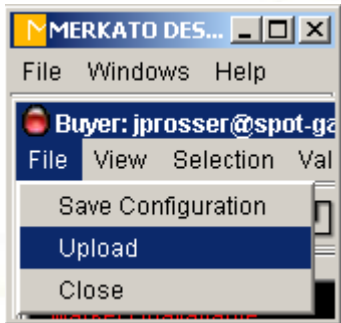
Select a time from the list. The graph's scale changes.




Figure 20: The Allocation History Graph

Saving, Uploading, and Exiting

Upload (and Exit)



When they end a session on their Desktops, most users want to upload their Spot-Market agents to the garage to continue bidding automatically. This is not as important for Reservation agents.

Use either the up-arrow in the icon bar () , or the “Upload” menu-bar item in the “File” category to access this function. A confirmation query message appears, as shown in Figure 21.

The confirmation message indicates the garage where your agent will be placed. If you click **Cancel** the Desktop agent returns and no upload occurs.

The confirmation message indicates whether your agent is bidding. (See Figure 22.) If your agent is stopped when you upload, your confirmation message looks like the one below. (Notice the red circle in the upper left.)

Make sure the bidding state is the one you wish to maintain while your agent is in the garage. Then click **OK**.

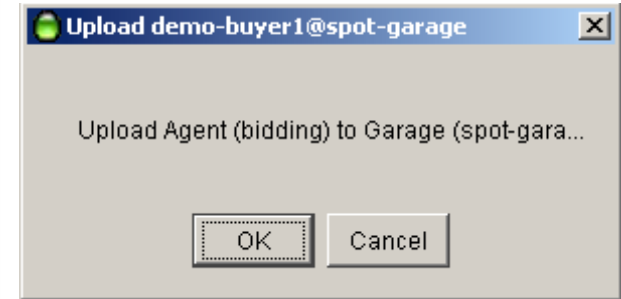


Figure 21: Upload Confirmation Box When the Agent is Active

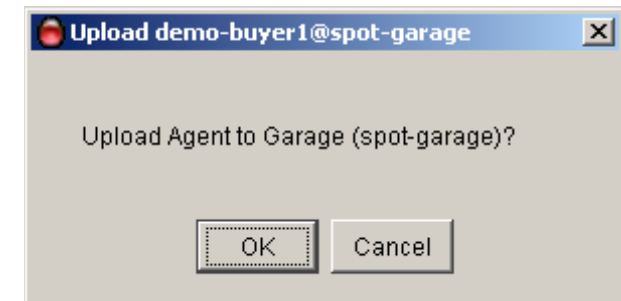


Figure 22: Upload Confirmation Box When the Agent is Not Bidding

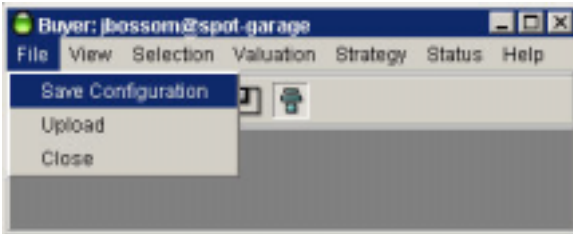
Save Your Configuration

Saving your configuration preserves changes to your agent's profile in the garage while you continue to bid from your desktop. While you are bidding on your desktop there is a non-active profile of the agent's parameters stored in the garage, which should be kept up to date.

If you don't keep this configuration up to date you could lose the changes you made to your agent while bidding on your desktop if:

- your desktop is rebooted or crashes before you can upload
- another user knows your agent's username and password, logs in and takes control of the agent using the obsolete profile in the garage.

If you want to save the way your agent is configured, but not upload your agent to the garage, from the File menu, select Save Configuration:



A confirmation box appears (Figure 23), asking which garage you want to save your configuration to. (If multiple garages are available, they will appear in a pull-down list.)

This is useful if there is more than one garage available and you want to make the same agent configuration available in each garage.

Click **OK** to confirm saving your configuration.

Exit (Without Saving)

In rare instances you will want to close your Desktop window without updating your Spot-Market agent's profile in the garage. (Uploading is not as important for a Reservation agent.) Exit without saving by selecting **Close** rather than **Upload**. The following confirmation screen appears:

If you click **Yes**, your agent is uploaded to the garage before it is closed on the desktop.

If you click **No**, your agent closes without any changes saved.

If you click **Cancel**, you return to your Desktop agent; the agent is neither uploaded nor closed.

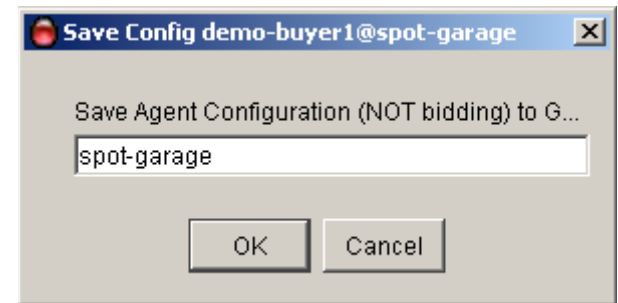


Figure 23: Save Configuration Confirmation Box

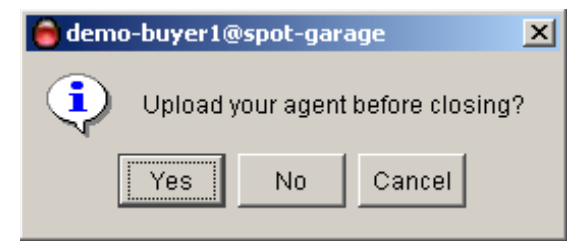


Figure 24: Exit Confirmation Box

Valuations Overview

Your valuation indicates your maximum willingness to pay for various amounts of bandwidth. In the course of an auction, your agent uses this valuation information to determine whether to bid, how much bandwidth to ask for, and how much money to offer, in response to changing market conditions.

You choose a valuation from the Valuation pull-down menu. The selection of valuations you can choose from is determined by the Seller and the Merkato administrator.

The first item in the menu, Show Only One, controls whether multiple valuation windows can be displayed. If a check mark appears before this control, only one valuation can appear on the desktop.

Each valuation has a Current radio button at the top of the window. Select the Current button to make a valuation active. (This automatically de-selects whichever valuation had been active.) The green arrow in the menu-bar pull-down list also indicates which valuation is active.

Valuations use different parameters to change their shapes and values, but all result in a representation of valuation and cost for a quantity of bandwidth. The graph to the left of the numerical entry boxes shows two curves; the red curve represents valuation relative to quantity and the yellow curve represents maximum cost relative to quantity. If there appears to be only one curve, both curves may be identical and overlapping.

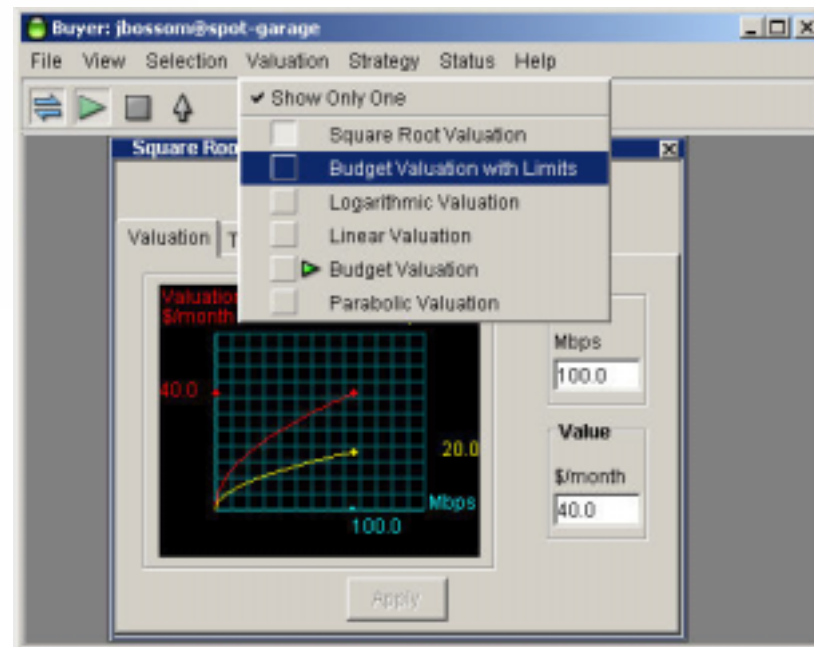


Figure 25: The Valuation Menu

Red Curve

Valuation, represented by the red curve, means the value buyers put on a resource. The cash value buyers put on a resource depends on its scarcity or availability. Mathematically, valuation is the area under a curve on graph (in math terms, the *integral*) of unit *price* versus *quantity*. Merkato uses this curve to determine the actual bids to be placed. If the red curve is not visible in a valuation graph it is under the yellow curve—it is exactly the same curve.

Yellow Curve

The yellow curve is more valuable for non-economists. On a graph, this curve represents the maximum you would pay per quantity of allocated bandwidth. The amount you actually pay depends on the bid of the second highest bidder. (See “Merkato Auction Mechanism: The Progressive Second Price Auction” on page 67.)

Types of Valuations

You create a valuation profile by entering values for price and quantity. The following sections describe each valuation profile in detail. The choice of valuations you can choose from is determined by the Seller and the Merkato administrator.

If all the valuations are enabled, the choices are:

Budget Valuation – You submit your total budget, and your agent bids such that it does not exceed this constant total cost for any quantity of bandwidth.

Budget Valuation with Limits – Same as budget valuation but you can set the minimum and maximum bandwidth for which you will offer your fixed cost amount.

Linear Valuation – Your agent bids at a constant unit price regardless of the quantity. Similar to a take-it-or-leave-it bid. You may get less quantity than you ask for, but the unit price will never vary.

Square Root Valuation – Similar to budget valuation except you lower the total cost you are willing to pay as bandwidth decreases.

Logarithmic Valuation – Use this valuation if you wish to bid aggressively at a mid-point in the quantity range and less aggressively for higher or lower amounts. The agent using this valuation bids most aggressively at 37% of the maximum quantity you specify.

Parabolic Valuation – Use this valuation if you wish to bid aggressively at a mid-point in the quantity range and less aggressively for higher or lower amounts. The agent using this valuation bids most aggressively at 50% of the maximum quantity you specify.

The graph in Figure 26 compares the types of valuations.

This graph shows, for each type of valuation, how much an agent will bid as it acquires increasing quantities of bandwidth. The graph is normalized to a maximum cost of \$10,000 per month and a maximum desired quantity of 100 Mbps.

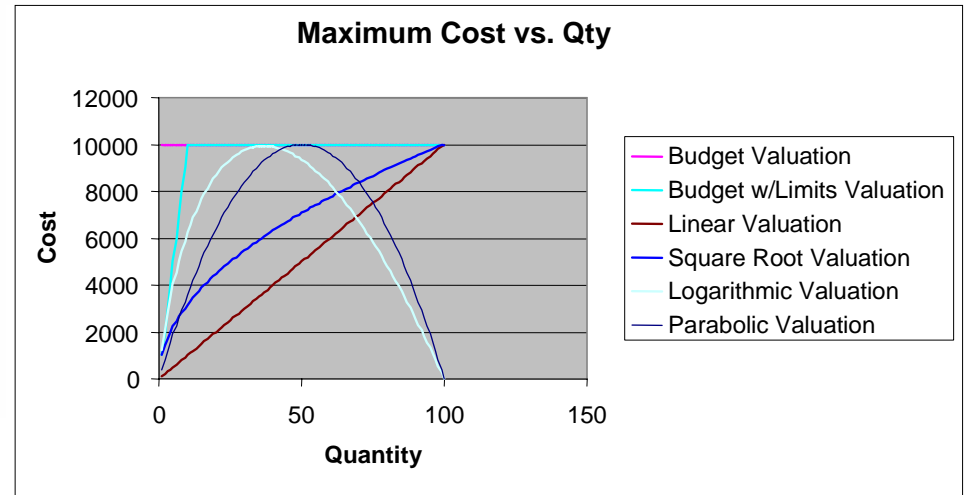


Figure 26: Graph Showing Comparison of Valuations

Setting Your Valuation's Maximum Quantity

Most valuations let you specify the maximum quantity you want to bid for. Budget Valuation does not specify a maximum quantity. Budget Valuation with Limits lets you specify All as your maximum.

High Maximum Quantity Strategy

You may specify that you want a maximum quantity that is greater than the quantity the seller is offering.

You might do this in case the seller decides to offer more bandwidth later. You may also do this to achieve a desired bid valuation curve (especially when you are using the logarithmic or parabolic valuation—the maximum desired quantity sets the most aggressive bidding point. Your agent will still begin bidding at the amount the seller is offering, at the unit price indicated from your valuation curve.

Your bidding strategy can go beyond entering the amount of bandwidth you want and the price you are willing to pay. Using the Traffic-based tab, you can set your agent to adjust how much bandwidth it bids for as your traffic changes. (See page 28.)

The Danger of a High Maximum

A Buyer agent will not bid for an amount smaller than $1/500$ of the maximum quantity—either the Seller's offered amount or the amount you specify in the Qty field, whichever is smaller. Automatic bidding increments in amounts no smaller than $1/500$ of the maximum.

If you have not specified a maximum (you are using Budget Valuation or Budget With Limits Valuation), and the Seller offers a lot of bandwidth, the minimum bid may be very large. If you have no maximum, and the Seller offers 500 Mbps in the Merkato auction, your agent will bid for no less than 1 Mbps. Even if you want more than 1 Mbps, your agent will bid for bandwidth in increments of 1 Mbps—bidding for 1.5 Mbps will not be possible.

Traffic-Based Bidding

Each valuation window has a Traffic-based tab.

If you activate Traffic-based bidding (Figure 27), your agent changes its maximum quantity according to changes in rates of usage at user-set intervals. Traffic-based bidding automatically aligns your bidding with your utilization.

Time Window—The Measurement Window. Your agent continuously measures the amount of traffic you generate in five-minute increments. The Time window setting tells the agent, in minutes, how far back in time to look for the peak. The smallest interval you can select is 6 minutes. Unless your Merkato administrator has changed this, the largest allowed interval is 200 minutes (in other words, the peak of the last 40 5-minute traffic samples).

Meas. Traffic—Measured Traffic (Display Only field). The peak amount of traffic the agent measures at the interval you set in the Meas. Window field. Merkato uses this peak five-minute interval as the basis for the “Max Quantity Requested” calculation. (See below.)

Qty Margin—Quantity Margin. This is the amount of bandwidth your agent attempts to obtain above that of the recent measured peak. There are many reasons why you might want to obtain more bandwidth than your recent measured peak. The most significant reason is that you will not be able to measure peak traffic above your most recently measured peak if your allocation only allows that amount of traffic to pass through the Merkato system (it becomes a self-fulfilling prediction). Similarly, if your traffic goes to zero for any length of time, your agent would start to ask for zero allocation and you would never be able to increase your allocation beyond this value. Set your Quantity Margin to the maximum expected jump of traffic within a five-minute period.

Max Qty Requested—Maximum Quantity Requested (Display Only field). The Merkato agent adds the measured traffic to the Quantity Margin to create this number. This is the value that is carried forward into the main valuation calculation. It is called the “Maximum Quantity Requested” because Merkato compares to the “Max Qty” value in the main valuation window. Merkato uses whichever value is smaller as the basis for the maximum quantity requested. (In other words, traffic-based settings can only reduce the amount of bandwidth you ask for relative to the main valuation settings—they never increase it.) Note that the “Max Qty Requested” value only changes the initial bidding point. Should your offered bid price be insufficient to get that amount of bandwidth, your agent may use your pre-determined valuation curve below that value (unless you are using a linear valuation) to attempt to obtain as much bandwidth as possible.

Active check box—Checking this box enables Traffic-based bidding on your agent.

Apply—Clicking **Apply** makes the numbers entered in the fields of the Traffic-based window active.



Figure 27: A Valuation Window Showing the Traffic-based Tab

Example

In the illustration (Figure 28) the traffic window is set to 30 minutes. The agent bids for the quantity of bandwidth used during peak traffic during the previous 30 minutes. Every five minutes the agent examines the traffic during the previous 30 minute window.

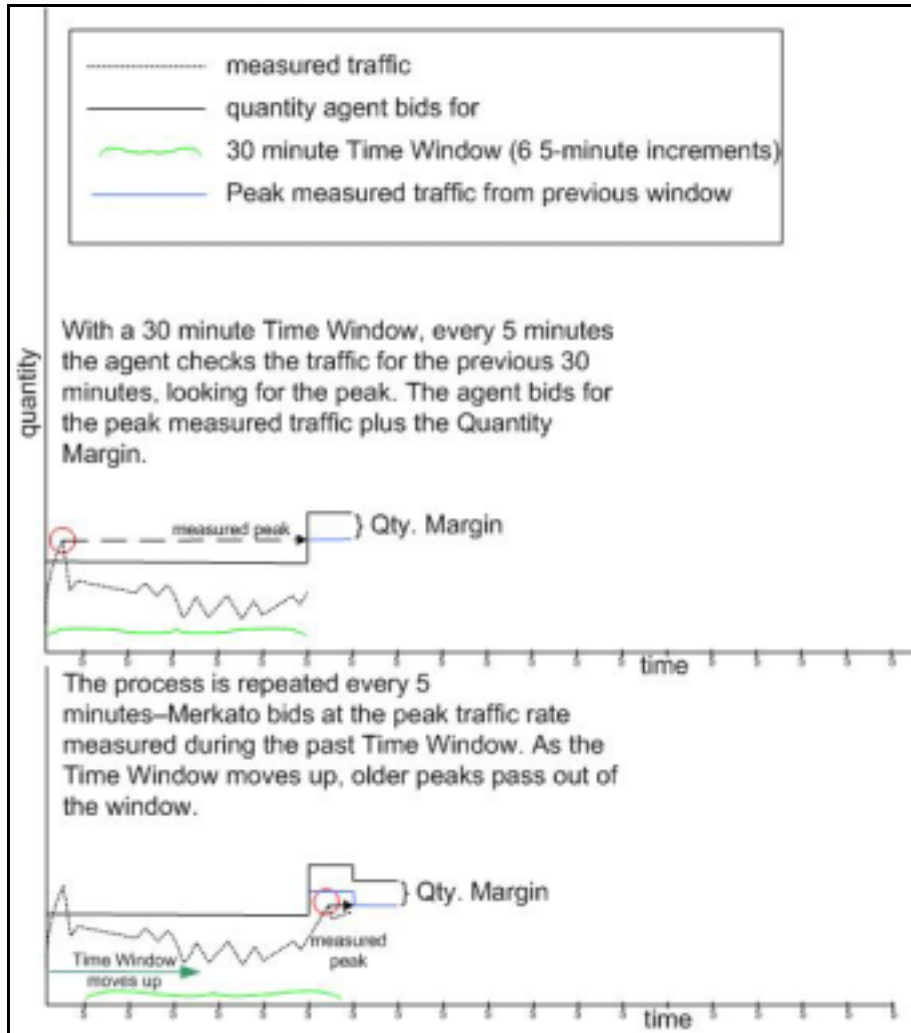


Figure 28: Traffic Based Valuation

Quick Response Bidding

The Quick Response tab (see Figure 29) works with Traffic-based bidding to make Merkato respond faster to increased traffic. It works only when Traffic-based bidding is activated.

When Traffic-based bidding is active Merkato monitors your traffic and adjusts bid quantities. When Quick Response is enabled as well, your agent reacts to bursts of traffic according to the values you place in two fields:

Traffic Threshold is the quantity of traffic that triggers the Quick Response. When Merkato detects this level of traffic it changes the amount of bandwidth that the agent bids for.

When Quick Response is triggered, the amount the agent bids for is the amount you enter in the **Est. Peak Traffic** field, plus the Quantity Margin (see “Quantity Margin” on page 28).

Note: Est. Peak Traffic cannot exceed the amount in the valuation window’s Quantity field.

The Merkato agent continues bidding at the Quick Response rate until the Time Window has elapsed (see Time Window on page 28). The display shows the Quick Response is Engaged.

When the Time Window has elapsed, if no traffic above the traffic threshold has occurred, Traffic-based bidding resumes. The display shows that Quick Response is Not Ready. This state remains until the end of the next Time Window.

If, during the Time Window, Merkato detects traffic above the threshold, the display returns to Engaged and the agent resumes bidding at the Quick Response Rate.

If, during the Time Window, Merkato **does not** detect traffic above the Traffic Threshold, the display returns to **Ready**. The agent resumes Traffic-based bidding. This continues until the next time Quick Response is triggered.

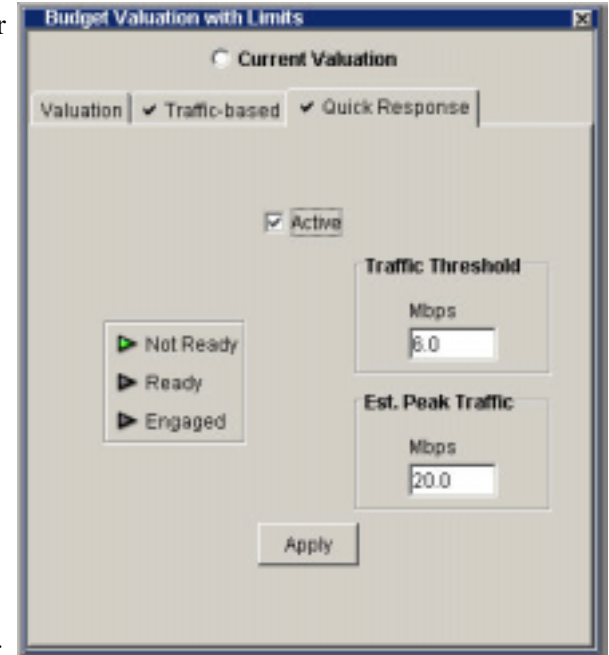


Figure 29: A Valuation Window Showing the Quick Response Tab

The signals mean the following:

Not Ready: Quick Valuation has been engaged, but there has not yet been a Time Window during which all traffic is below the Traffic Threshold. If a Traffic Window ends with no traffic above the threshold, the signal returns to Ready.

Ready: Quick Response is active, but no traffic above the Traffic Threshold been detected.

Engaged: Quick Response is active and Merkato has detected traffic above the Traffic Threshold. This state remains for the duration of the Traffic Window.

There is no guarantee of getting an amount of bandwidth equal to your estimated peak traffic. There are two reasons for this:

- The Estimate Peak Traffic may exceed the amount the Seller is offering.
- The Estimate Peak Traffic may exceed your budget, for instance, if demand is high and your budget does not cover the cost.

Example

Figure 30 shows normal Traffic-based buying.

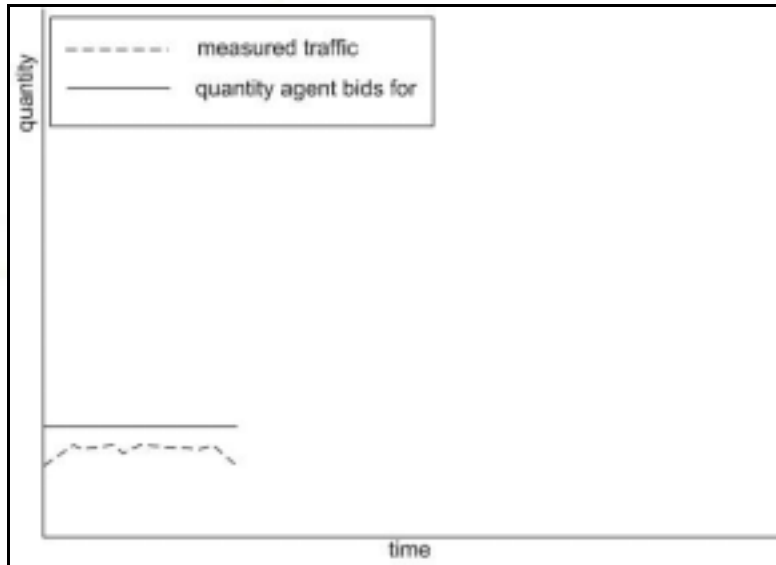


Figure 30: Traffic-based Bidding Level Before Quick Response Has Been Triggered

When traffic exceeds the Traffic Threshold you set, the Quick Response feature causes the agent to start bidding at the estimated peak, as shown in Figure 31.

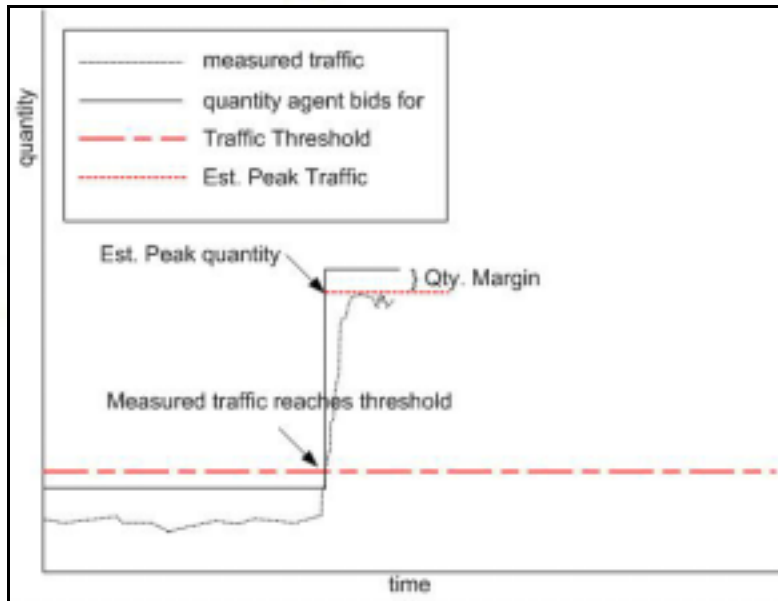


Figure 31: Quick Response Bidding, Once Triggered, Causes the Agent to Bid at the Peak Level

The agent continues to bid at the estimated peak at least the duration of the Time Window, as shown in Figure 32.

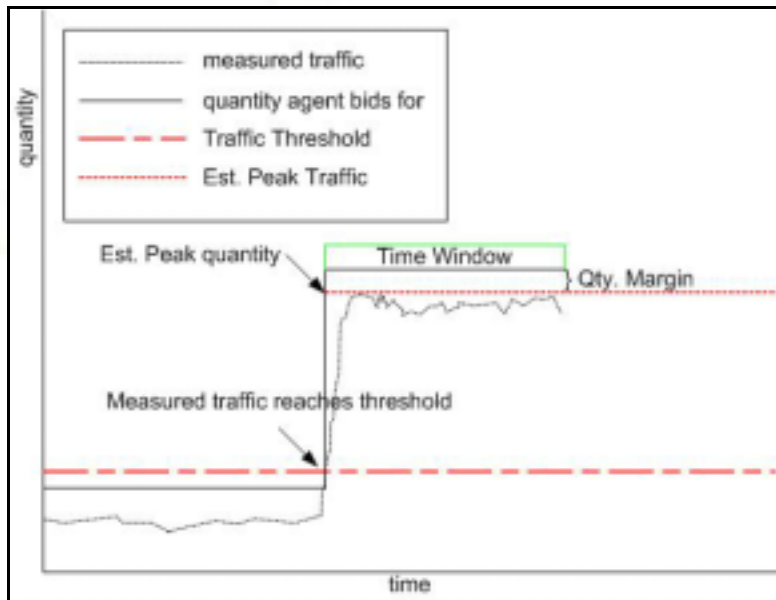


Figure 32: Quick Response Bidding Continues For the Duration of the Time Window

When Merkato detects no traffic above the threshold for the duration of a Time Window, it returns to Traffic-based bidding—the Ready state—until it is triggered again, as shown in Figure 33.

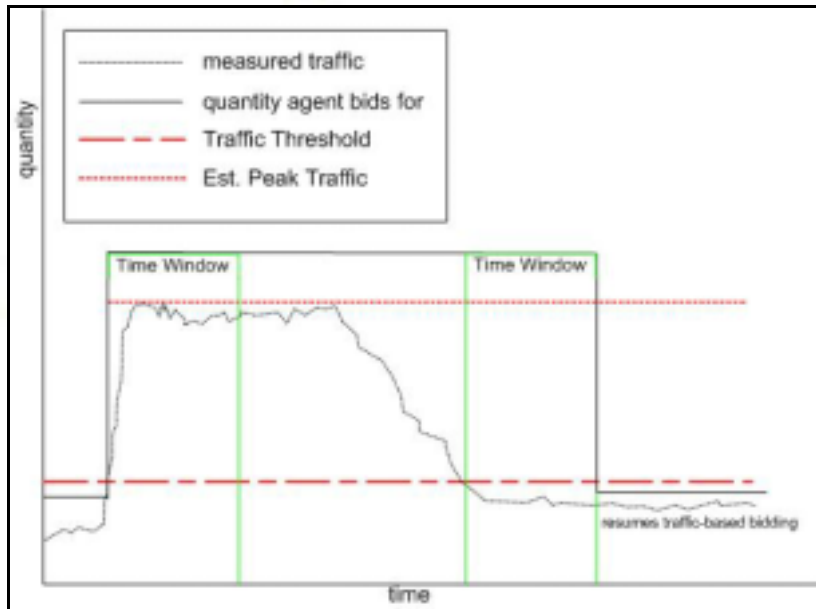


Figure 33: Normal Bidding Resumes After Merkato Finds That All Traffic Was Below the Threshold For the Duration of the Time Window

Budget Valuation

The Budget valuation (shown in Figure 34) has a single configurable parameter—the “budget,” which is the total amount you are willing to pay for any amount of bandwidth.

This is the easiest valuation to understand and configure. Use it when you want to purchase the maximum amount of bandwidth possible in each auction round.

Your agent begins by offering the unit price corresponding to your budget for all the bandwidth available. If your agent finds it will not receive this full allocation because the price it offers is too low, it bids again. The new bid raises the unit price offered and lowers the desired quantity requested so that the out-of-pocket amount remains the same. Of course, other agents may re-bid also when your offer is provisionally accepted but theirs is not. This process continues until all bandwidth is apportioned among all bidders who are willing to pay the market price.

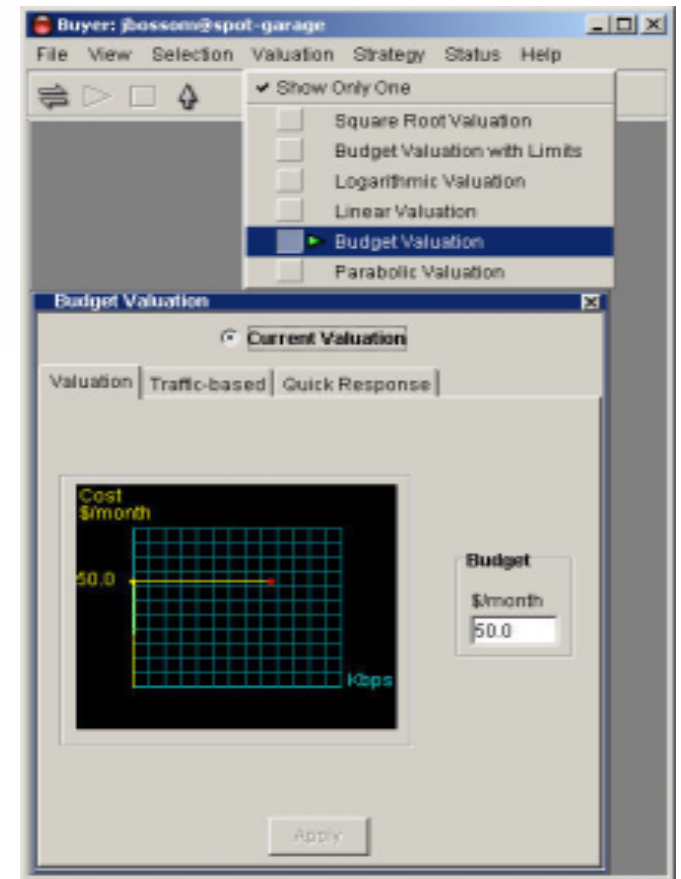


Figure 34: The Budget Valuation Window

The graph in Figure 35 shows the calculation your agent does in response to rising market prices.

An advantage of the Budget valuation is that your agent always begins by bidding for the full amount of bandwidth the seller is offering, whether it increases or decreases over time. With most of the other valuations, you must specify the maximum quantity you are interested in obtaining and would have to increase this setting to obtain more if the seller offered more.

There are two disadvantages to the Budget valuation:

Because you begin bidding by asking for all the bandwidth at your budgeted price, if your unit price is higher than the seller's configured floor price, your agent sets the price floor for every agent bidding.

If your budgeted amount is low compared to other bidders, you could end up paying your entire budget for a very small amount of bandwidth. The minimum amount an agent will bid for is 1/500 of the amount available. Your agent will continue to offer your entire budget for amounts as small as 1/500 of what is being offered, before it finally gives up and lets itself receive no allocation.

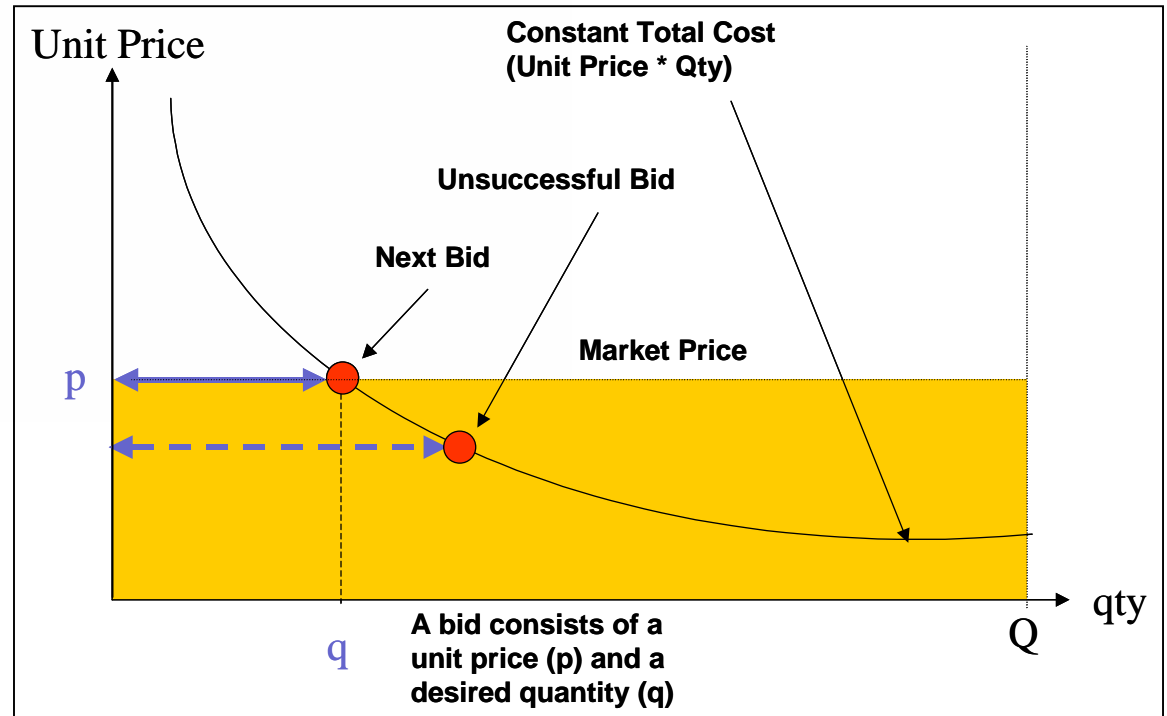


Figure 35: Graph Showing the Budget Valuation

Budget Valuation with Limits

The Budget Valuation with Limits is the one most commonly used, and the only valuation currently supported by the Wizard configuration application. (See Figure 36.) There are three parameters that determine the bidding behavior for this valuation:

- **Budget**—The maximum out-of-pocket amount you are willing to spend
- **Max Qty**—The maximum amount of bandwidth you desire
- **Min Qty**—The minimum amount of bandwidth for which you are willing to pay your budgeted amount

Your agent begins bidding for your configured maximum quantity at the unit price represented by your budget. If your agent finds that it will not receive this allocation, it bids for a lower amount of bandwidth at a higher unit price, so that the total out-of-pocket amount remains the same. This behavior continues until either the agent receives the amount requested or the minimum specified quantity is reached. At this point, the agent makes one final bid for the minimum quantity at the unit price represented by the budget.

Three outcomes are possible:

- The agent receives the requested amount of bandwidth at the market price set by the lowest successful bidder.
- The agent is the lowest successful bidder and receives a portion of the requested amount.
- The offered bid price is less than the market price and the agent does not receive an allocation this round.

There are advantages to this valuation:

- By restricting the amount of bandwidth initially requested, you will make bandwidth available for lower bidders who would set the market price. The result is that you pay less than your budgeted amount for the bandwidth you receive.
- By setting a lower boundary on bandwidth desired, you do not offer your full budget for a very small amount, should bidding become very aggressive. Of course, you run the risk of receiving no allocation of bandwidth at all and share the best-effort queue with the other bidders who also received no allocation, or are currently not participating in the auction.

You should be careful about setting your maximum quantity to All.

A Buyer agent will not bid for an amount smaller than 1/500 of the maximum quantity—either the Seller's offered amount or the amount you specify in the Qty field, whichever is smaller. Automatic bidding increments in amounts no smaller than 1/500 of the maximum.

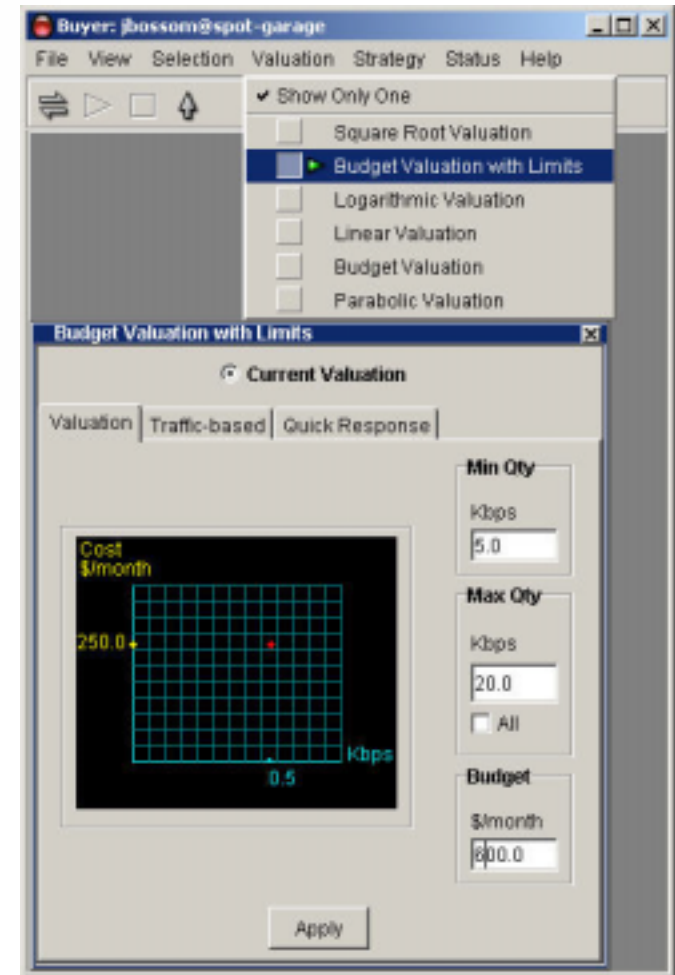


Figure 36: The Budget Valuation With Limits Window

If you specify “All” in the Max Qty field, and the Seller offers a lot of bandwidth, the minimum bid may be very large. If you have no maximum, and the Seller offers 500 Mbps in the Merkato auction, your agent will bid for no less than 1 Mbps. Even if you want more than 1 Mbps, your agent will bid for bandwidth in increments of 1 Mbps—bidding for 1.5 Mbps will not be possible.

Linear Valuation

The Linear valuation (formerly called the Inelastic valuation) should only be used in unique situations. (See Figure 37.)

With a Linear valuation, your agent offers the same unit price regardless of the quantity requested. At first might at first seem desirable, but it may be impractical. Because the Resource agent ranks bids based on unit price offered, the results is a take-it-or-leave-it offer by your agent. You receive an allocation only if the market price stays at or below your offered price. Your agent is not empowered, as in other valuations, to offer a higher unit price for a lower quantity to continue contending for an allocation.

Two configurable parameters determine the behavior of the Linear valuation.

- “Qty” sets the maximum quantity desired. Your agent initially bids for this amount, and, if it is unsuccessful, may only request a lower amount at the same unit price.
- “Value” sets the maximum amount of out-of-pocket cost you are willing to pay for the maximum quantity desired. The unit price that your agent will offer in its bids is the “Value” divided by the “Qty.”

Note that with a Linear valuation the cost and valuation curves are identical, so the graph only shows the cost (yellow) curve.

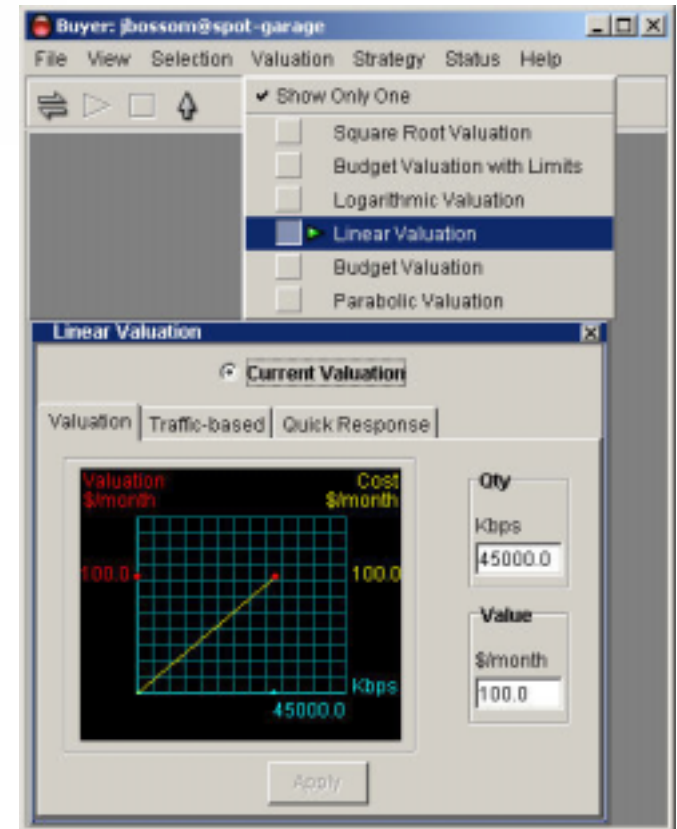


Figure 37: The Linear Valuation Window

Square Root Valuation

The Square Root valuation (formerly called the Elastic valuation) is similar in concept to the budget valuation, but it bids at a reduced overall cost as the market price rises. In other words, as the market price rises, the Square Root agent asks for less bandwidth than a similarly configured Budget agent. (See Figure 38.)

The two configurable parameters for the Square Root valuation are maximum quantity (“Qty”) and maximum value (“Value”). Set the maximum value to the maximum price you are willing to pay should you receive all of the maximum quantity you specify. Configure the maximum quantity to correspond to the maximum quantity you would like to be allocated. The maximum cost is always half of the “Value” you enter, as indicated in the graph to the left of the numerical entry boxes.

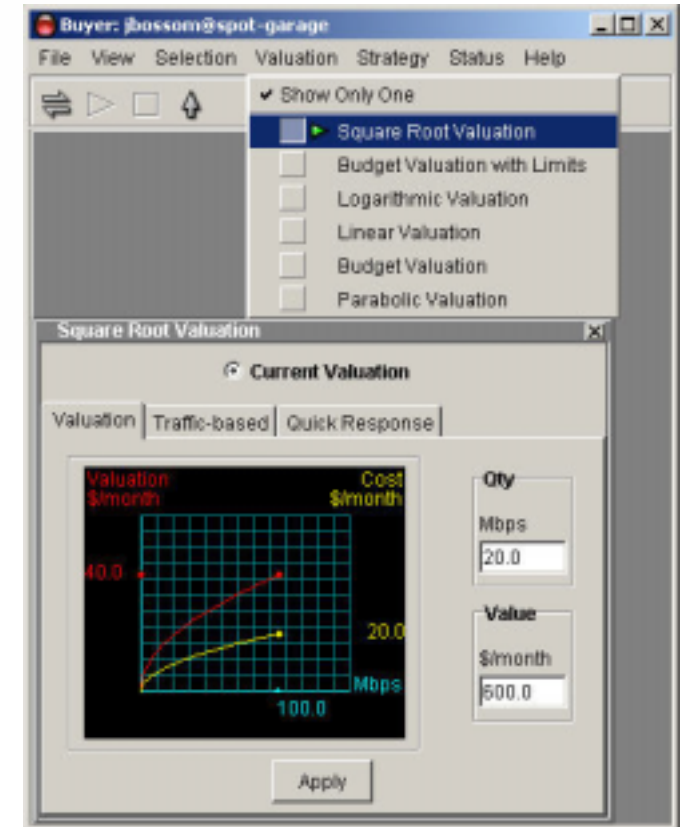


Figure 38: The Square Root Valuation Window

Logarithmic Valuation

Use this valuation if you want to bid more aggressively for a certain amount of bandwidth, but progressively less aggressively for amounts above and below that amount. The Logarithmic valuation bids according to a formula where the maximum price offered for bandwidth occurs at a mid-point of the specified quantity, rather than at a maximum specified quantity. (See Figure 39.)

The Logarithmic valuation applies a formula that corresponds to a curve on a graph. Setting the most bandwidth you could possibly want (maximum quantity, “Qty”) and a value you place on bandwidth (maximum value “Value”) creates the curve. The agent bids based on the relationship of that curve to a third factor, the market rate. The agent reacts based on where the market rate intersects the curve on the graph.

You should set the maximum quantity based on one of two possible criteria:

- Set the maximum quantity to correspond to the greatest amount of bandwidth you would consider obtaining. Note that your agent’s bid is zero at this point, so it is impossible for you to receive exactly this amount.
- Set the maximum quantity to place the peak cost bid at a desired quantity. The peak cost bid will be offered at around 37% of the maximum quantity you specify. For example, if you wanted to bid most aggressively at 20 Mbps, you would set the maximum quantity to $20/0.37 = 54$ Mbps.

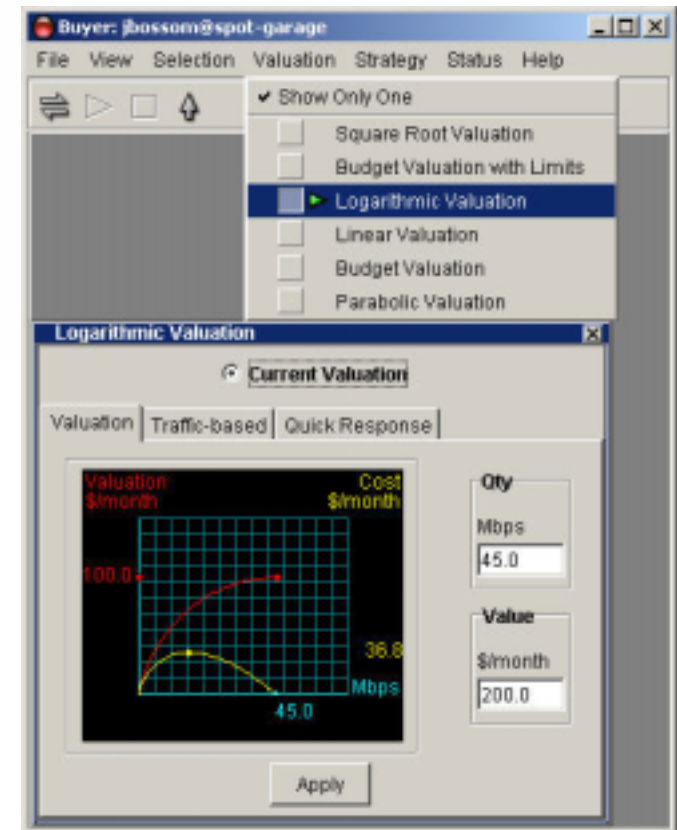


Figure 39: The Logarithmic Valuation Window

Set the maximum value to correspond to the desired maximum cost. The maximum out-of-pocket cost will be approximately 37% of the value you set, as indicated by the graph to the left of the text entry fields. Continuing the previous example, if you are willing to pay up to \$200 per Mbps (per month) for the 20 Mbps you desire, this is a total cost of \$4,000 per month. The valuation you set is $\$4,000/0.37 = \$10,811$, as shown in Figure 40.

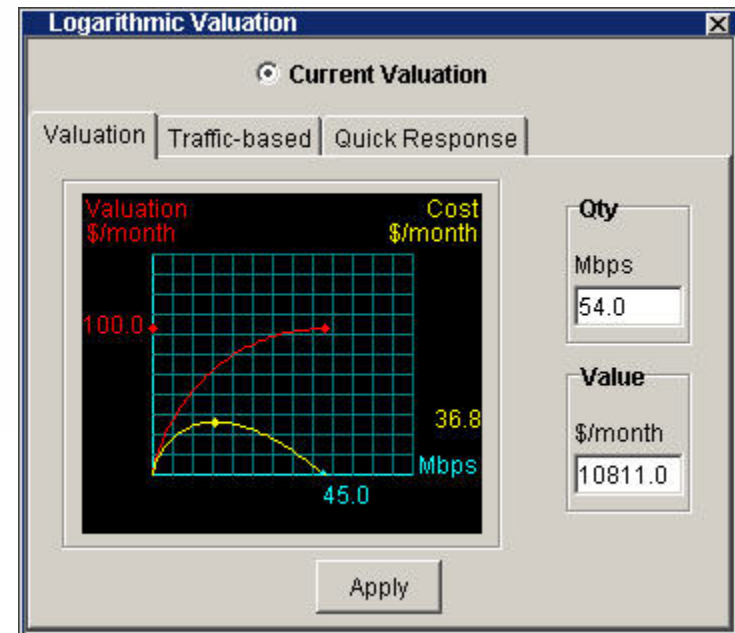


Figure 40: The Logarithmic Valuation Set to Bid Most Aggressively for 20 Mbps

Parabolic Valuation

Parabolic valuation works like Logarithmic valuation, but with a different formula. Use this valuation if you want to bid more aggressively for a certain amount of bandwidth, but progressively less aggressively for amounts above and below that amount. The Parabolic valuation works such that the maximum cost offered for bandwidth occurs at a mid-point of quantity, rather than at a maximum specified quantity. (See Figure 41.)

The Parabolic valuation applies a formula that corresponds to a curve on a graph. Setting the most bandwidth you could possibly want (maximum quantity, “Qty”) and a value you place on bandwidth (maximum value “Value”) creates a curve. The agent bids based on the relationship of that curve to a third factor, the market rate. The agent reacts based on where the market rate intersects the curve on the graph.

You might want to set the maximum quantity based on one of two possible criteria:

Set Qty to correspond to the greatest amount of bandwidth you would consider obtaining. Note that your agent’s bid is zero at this point, so it is impossible for you to receive exactly this amount.

Set the maximum quantity to place the peak cost bid at a desired quantity. The peak cost bid will be offered at 50% of the maximum quantity you specify. For example, if you wanted to bid most aggressively at 20 Mbps, you would set the maximum quantity to $20/0.5 = 40$ Mbps.

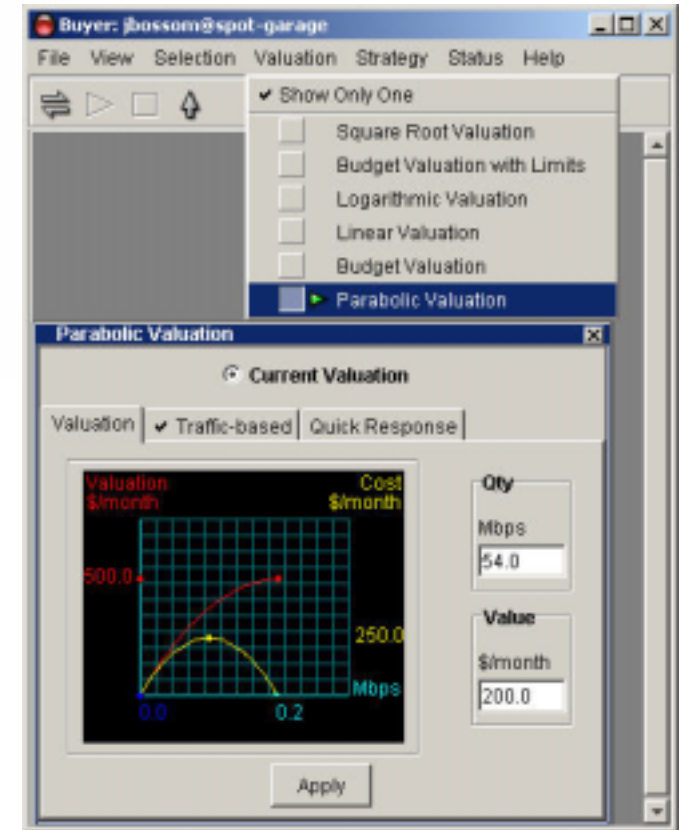


Figure 41: The Parabolic Valuation Window

The maximum out-of-pocket cost will be 50% of the value you set, as indicated by the graph. Continuing the previous example, if you are willing to pay up to \$200 per Mbps (per month) for the 20 Mbps you desire, this is a total cost of \$4,000 per month. The value you set is $\$4,000/0.5 = \$8,000$, as shown in Figure 42.

Aside from the slight differences in “peak aggressiveness” quantity, the Parabolic valuation is much less aggressive than the Logarithmic valuation when bidding for very low units of bandwidth.

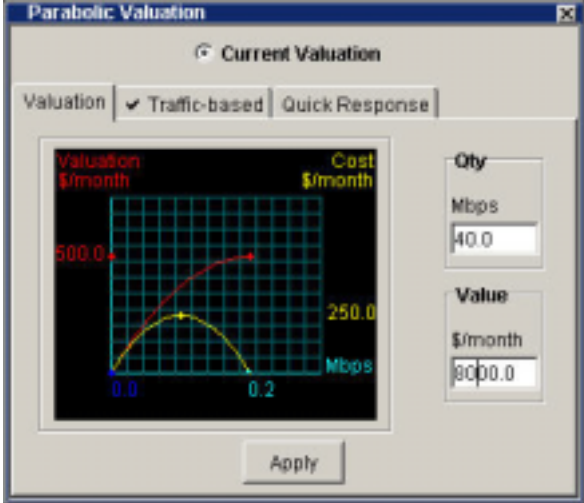


Figure 42: The Parabolic Valuation Set to Bid Most Aggressively for 20 Mbps

Strategy Overview

Once you have configured your valuation (see page 24) you must configure how you want your agent to use that information. There are two strategy options for use in the Spot market: Automatic and Manual.

You may view and select strategy settings independently of each other, though only one at a time can be the current strategy. (See Figure 43.)

If you wish to view multiple strategies on the desktop, de-select the “Show Only One” option.

Select the active strategy by selecting the “Current Strategy” radio button at the top of each Strategy window. Clicking this button activates that strategy and deactivates the other strategy. A green arrow in the menu-bar list also indicates the current active strategy.

Automatic Strategy

The Automatic strategy is most commonly used. It begins by bidding as specified by your valuation settings. If the agent doesn’t obtain this amount of bandwidth it bids again, if permitted by the valuation, at an incrementally higher unit price. It adjusts the amount of bandwidth requested to agree with the value you place on the bandwidth. This process continues until either the agent receives the amount it requests or it cannot meet the current market price due to limits imposed by the valuation settings.

The two display fields in the Automatic Strategy window show the current bid quantity on the left and unit price on the right.

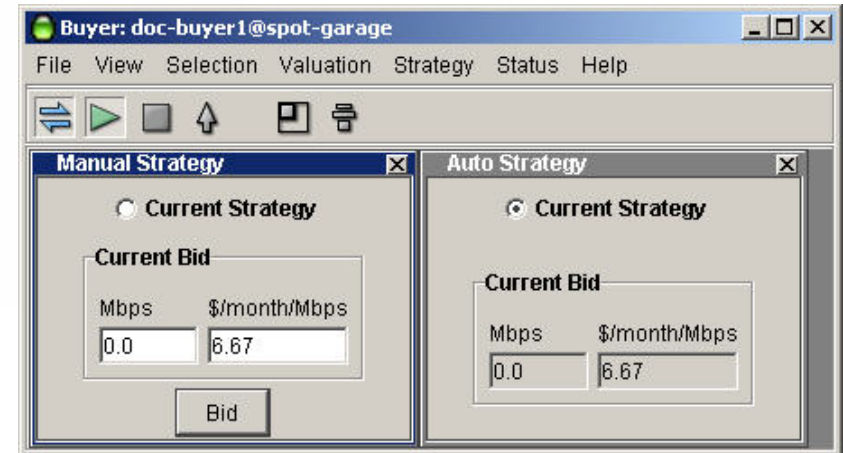


Figure 43: Both Strategy Windows

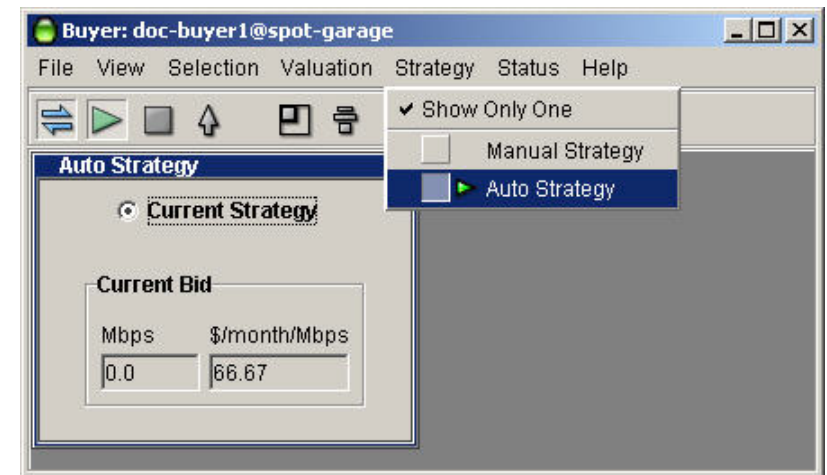


Figure 44: The Automatic Strategy Window

Manual Strategy

Manual strategy ignores the valuation settings completely and allows the user to place bids without a set valuation. Note that these bids are a one-time occurrence and are not submitted automatically in the next auction round. If you wish to place a take-it-or-leave-it bid automatically at each auction round use the Linear valuation and select the Automatic strategy.

To place a manual bid, enter the quantity desired in the left hand numerical entry box, and the desired unit price in the right hand numerical entry box (pay close attention to the units displayed so you do not make an error). After you enter both numerical values, click **Bid**. Your bid is submitted to the Resource agent. You may observe the results of your bid in the Auction Table or the Auction Graph window.

The initial displayed value in the Manual strategy window is the last bid placed by the Automatic strategy. You may, if you wish, view both the automatic and manual strategy screens simultaneously and quickly activate the manual strategy if you wish to place a bid. If you return to the Automatic strategy, the agent will return to bidding along the original valuation curve according to its standard bidding strategy.

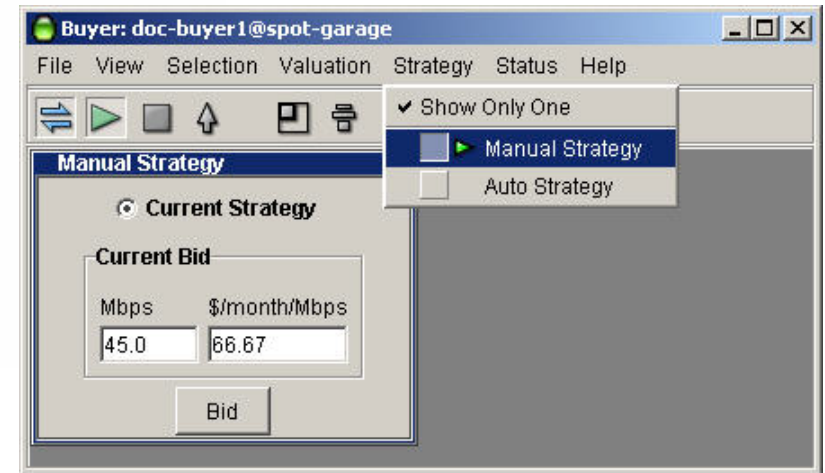


Figure 45: The Manual Strategy Window

News Windows

The News window provides real-time status of your Merkato agent. It is useful when you want to get a quick summary of marketplace conditions and confirm the state of your agent.

When your agent is disconnected, you see a News display similar to Figure 46:

When you are connected but not bidding, the News window looks like the one shown below. It indicates the capacity being offered by the seller and the current market price of the auction as it is proceeding without your agent's participation.



Once you begin bidding you see displays like the ones below, containing information on activity between your agent and the Resource agent (which conducts the auction).

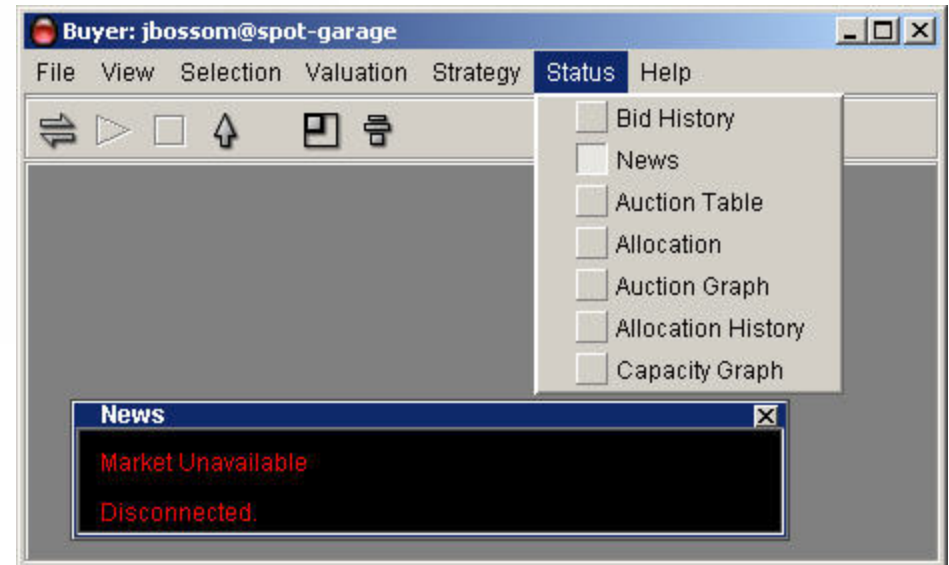


Figure 46: Selecting the News Window

Allocation Window

The Allocation window provides information about the quantity of bandwidth you bought and the price paid for that bandwidth at the close of each auction. It also monitors the time left in the current auction. (See Figure 47.)

When an allocation is made to your agent it appears in the left-hand side of the Allocation window, and is displayed until the next allocation. After a period of non-bidding, the allocation indicated is the last one made to this agent when it was last active.

The allocation window also provides a time indicator for the current auction. Each time any buyer places a bid the timer is set back.

When all bidders cease bidding (either because they are satisfied with their proposed allocation or have dropped out of the bidding because of the market price), the timer counts down to zero. At this point the Resource agent turns the proposed allocations into real allocations. This occurs during a “pause” period. The pause period is indicated by several changes to the time display: the timer label changes from “Time Left” to “Time Since,” the font changes to red, and the counter counts up to the pause limit, rather than counting down as before (see Figure 48).

Reservation Agent

Buying a reservation gives you guaranteed bandwidth for a set period of time at a fixed price. The pricing is set by the seller and depends on both the quantity of bandwidth desired and the duration of the reservation. There is no additional fee.

Reservations can start and end at any time in the future, up to a future time specified by the seller.

You can cancel reservations any time prior to expiration, but there may be a cancellation fee based on a percentage of the remaining value of the reservation. The fee may be anywhere between 0% (no penalty for cancellation) to 100% (no refund on cancellation). Merkato quotes the cancellation percentage to you when you make the reservation and again when the cancellation is confirmed.

The following sections describe the use of these reservation windows in detail.

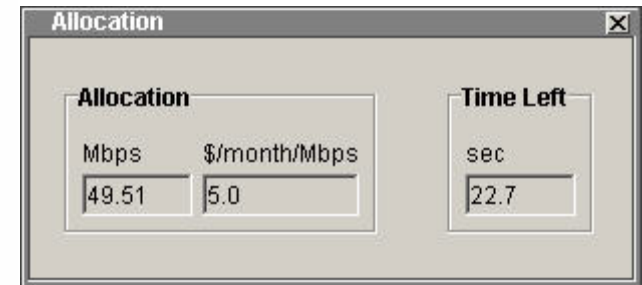


Figure 47: The Allocation Window

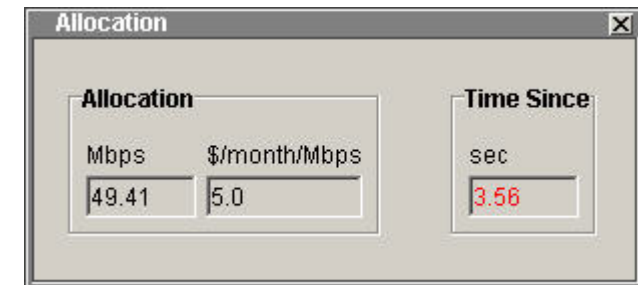


Figure 48: The Allocation Window When an Auction Has Ended

Resource Window

Although a reservation and Spot marketplace may allocate the same physical resource, Merkato controls them via separate Resource Agents. Bandwidth is pre-assigned to each of these markets, so reservations do not take bandwidth from the Spot market or vice versa.

The Capacity display in the Resource window tells you the bandwidth currently available to you in that marketplace, taking into account quantities currently being allocated to other reservation buyers. (See Figure 49.)

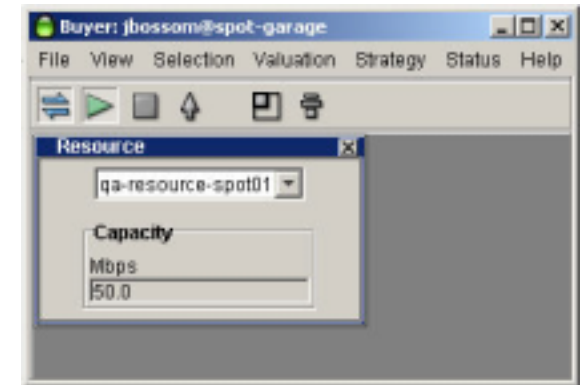


Figure 49: The Resource Window

Capacity Graph

The capacity graph shows the bandwidth capacity available to be reserved. (See Figure 50.) The capacity available is shown as a yellow line on the graph. Existing reservations are shown in blue. Note that you can not make a reservation when there is no capacity.

The capacity graph is helpful if you are planning to make future reservations and you want to know how much capacity the seller has available at any time in the future. Before making a reservation in the future, check to see if the seller has provided capacity during the period you have in mind.

The Capacity graph can be adjusted to show smaller or larger scales of time. If you right-click the mouse while it is over the graph, a menu appears. From the menu, you can select Minute, Hour, or Day to alter the graph's scale. (See Figure 51.)

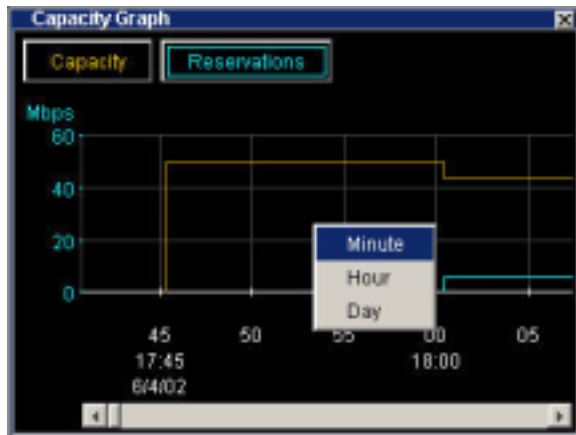


Figure 51: Scale Selection on the Capacity Graph



Figure 50: The Capacity Graph

Reservation Strategy

The Reservation Strategy window lets you create a reservation. (See Figure 52.) There are separate panels for Start Time and End Time. The Reservation panel lets you input the quantity of bandwidth you want to reserve.

Note Regarding Current Time

When making reservations on Merkato, synchronize your PC clock time to the time shown in the Reservation Strategy window.

The “Current Time” display shows the time on the Merkato system. Be sure to compare this time with the time displayed on your PC. Merkato uses its own clock to determine the beginning and end of reservations you make.

Start Time Panel

The Start Time panel indicates when you want the reservation to begin. There are three choices.

Current Time: If you select Current Time, the reservation, if accepted, begins immediately. To select the present as a start time click the radio button on the left.

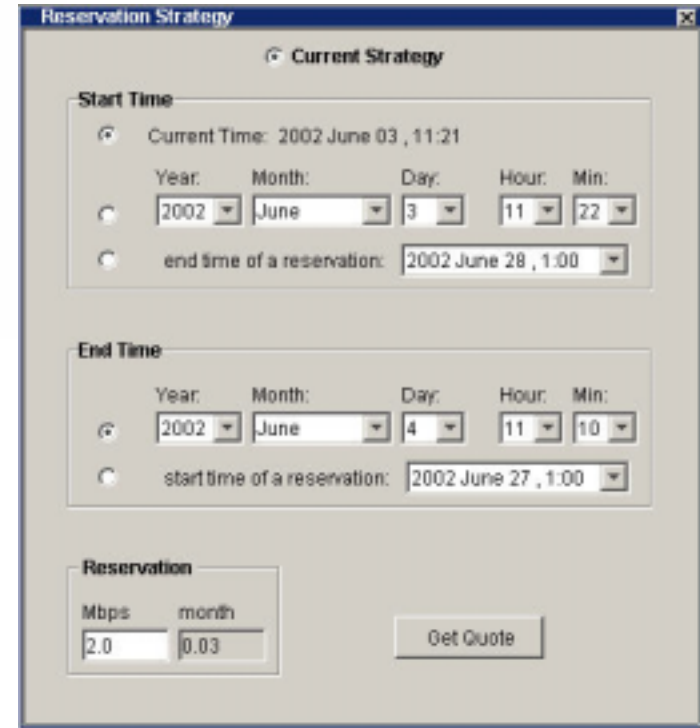
Future time: If you want the reservation to start in the future, enter the Year, Month, Day, Hour, and Minute at which you want the reservation to start. You must make sure that the date is valid (not February 30th, for example). Should you inadvertently enter an invalid date, Merkato attempts to determine your intent and present an equivalent valid date. If this is not what you intended to specify, refuse the reservation and return to the date selection window. To select a future start time, enter the time and click the radio button on the left.

End time of a reservation: If you have already created one or more reservations, they appear in this pull-down list. You can select the end of one of these existing reservations as the start time of the new reservation you are making. Select it from the list and click the radio button on the left.

End Time Panel

The End Time panel indicates when you want the reservation to end. There are two choices.

Future time: Enter the Year, Month, Day, Hour, and Minute at which you want the reservation to end. You must make sure that the date is valid (not February 30th, for example). Should you inadvertently enter an invalid date, Merkato attempts to determine your intent and present an equivalent valid date. If this is



The screenshot shows the 'Reservation Strategy' window with the following details:

- Current Strategy:** Selected.
- Start Time:**
 - Radio button selected: Current Time: 2002 June 03 , 11:21
 - Year: 2002, Month: June, Day: 3, Hour: 11, Min: 22
 - Radio button selected: end time of a reservation: 2002 June 28 , 1:00
- End Time:**
 - Radio button selected: 2002, June, 4, 11, 10
 - Radio button selected: start time of a reservation: 2002 June 27 , 1:00
- Reservation:**
 - Mbps: 2.0, month: 0.03
 - Get Quote button

Figure 52: The Reservation Strategy Window

not what you intended to specify, refuse the reservation and return to the date selection window. To select an end time, enter the time and click the radio button on the left.

Start time of a reservation: Lets you specify the start of an existing reservation as the end of the reservation you are making. If you have already created one or more reservations, they appear in this pull-down list. You can select the beginning of one of these existing reservations as the end time of the new reservation you are making. Select it from the list and click the radio button on the left.

Reservation Panel

The reservations panel indicates the quantity and calculated duration of your reservation. (The units for these fields match those selected in the Units window.) To complete your desired reservation profile, enter your desired amount of bandwidth and click **Get Quote**. A pop-up confirmation window appears, shown in Figure 53:

This confirmation form indicates:

- The amount you have requested
- The end date and time of your reservation
- The total cost (unit cost times quantity time duration) of your reservation
- The percentage cancellation fee, applied against the remaining value of the reservation, which will be charged should you elect to terminate a reservation before the end date and time.

Look over all this information carefully before you click **Accept**. If the end date and time are different than you specified, it indicates that you entered an invalid date and Merkato made the best guess of your intent by adding the duration to the current date and time.

If you inadvertently specify an end date before the start date, the error message appears:

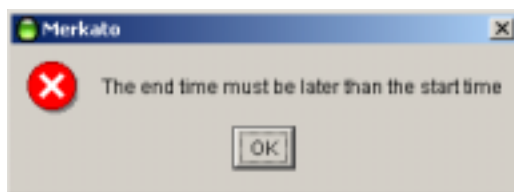
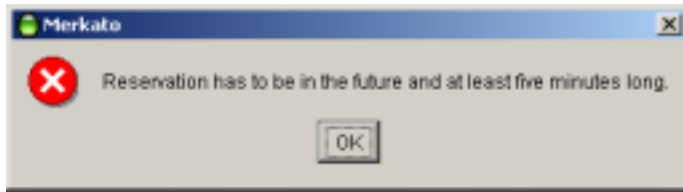
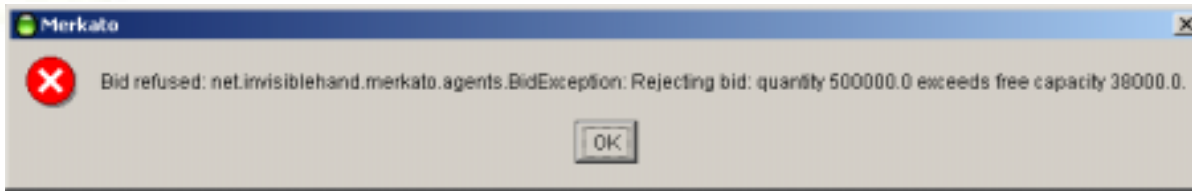


Figure 53: The Reservation Confirmation Box

If your reservation is for a time period that is too short, the following error message appears:



If you specify a quantity that cannot be allocated to you due to other active reservations, the following error message appears.



This error message informs you of both your requested quantity and the quantity available, so you can make appropriate adjustments.

Reservations Table

Select the Reservations table from the Status pull-down menu (Figure 54).

When you confirm your reservation it appears in your Reservation table. The Reservations table lets you view and cancel reservations.

The columns of the reservation table can be resized and reordered. To resize a column, click and drag the boundary line between columns within the column header. To move a column to another position, drag and drop its header either to the right or to the left of its current position.

Should you want to cancel a reservation, click anywhere in the row that represents the reservation. The reservation is highlighted in blue. Then click **Cancel Reservation** at the bottom of the window.

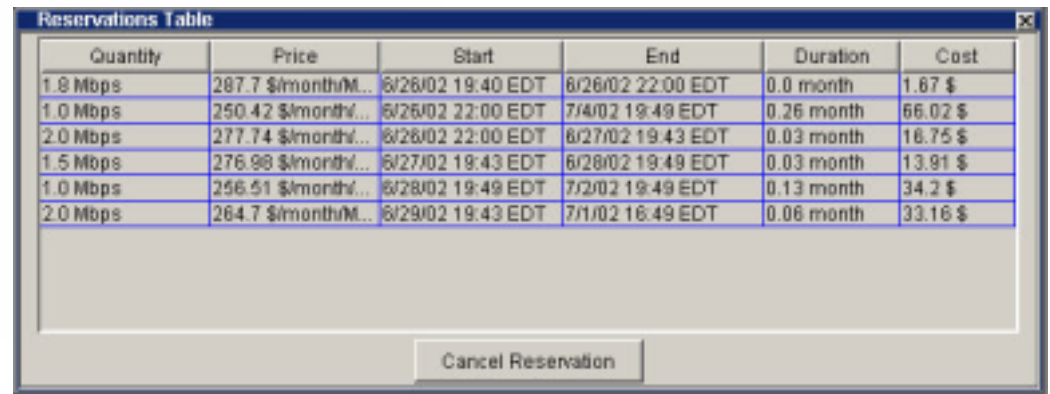
A confirmation pop-up window appears (Figure 55):

The reservation cancellation confirmation screen indicates the following information:

- the quantity of the reservation
- the scheduled end date and time of the reservation
- the percentage cancellation fee that will be applied to the remaining value of your contract if you confirm the cancellation
- the total amount you will be billed based on the remaining duration of your reservation, the original total value of your reservation, and the percentage cancellation fee

If you wish to proceed with canceling the reservation under these terms, click **Yes**. If you wish to not cancel your reservation, click **No**.

Merkato removes expired reservations from the Reservation table after their end time.



Quantity	Price	Start	End	Duration	Cost
1.8 Mbps	287.7 \$/month/M...	6/26/02 19:40 EDT	6/26/02 22:00 EDT	0.0 month	1.67 \$
1.0 Mbps	250.42 \$/month/...	6/26/02 22:00 EDT	7/4/02 19:49 EDT	0.26 month	66.02 \$
2.0 Mbps	277.74 \$/month/...	6/26/02 22:00 EDT	6/27/02 19:43 EDT	0.03 month	16.75 \$
1.5 Mbps	276.98 \$/month/...	6/27/02 19:43 EDT	6/28/02 19:49 EDT	0.03 month	13.91 \$
1.0 Mbps	256.51 \$/month/...	6/28/02 19:49 EDT	7/2/02 19:49 EDT	0.13 month	34.2 \$
2.0 Mbps	264.7 \$/month/M...	6/29/02 19:43 EDT	7/1/02 16:49 EDT	0.06 month	33.16 \$

Figure 54: The Reservation Table

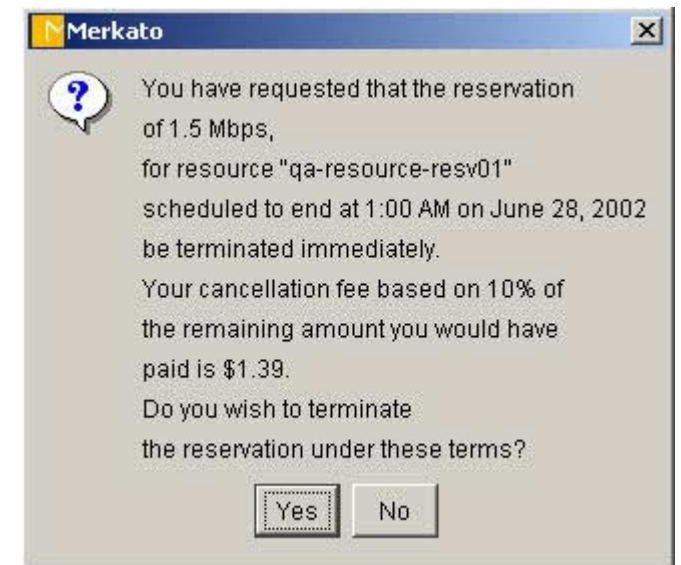


Figure 55: The Reservation Cancellation Confirmation Box

The Merkato Portal

The portal is the entry point to gain access to the agent applications, as well as to obtain historical allocation and billing information. When you select the Streaming Hand web site, the opening screen looks similar to the one in Figure 56.

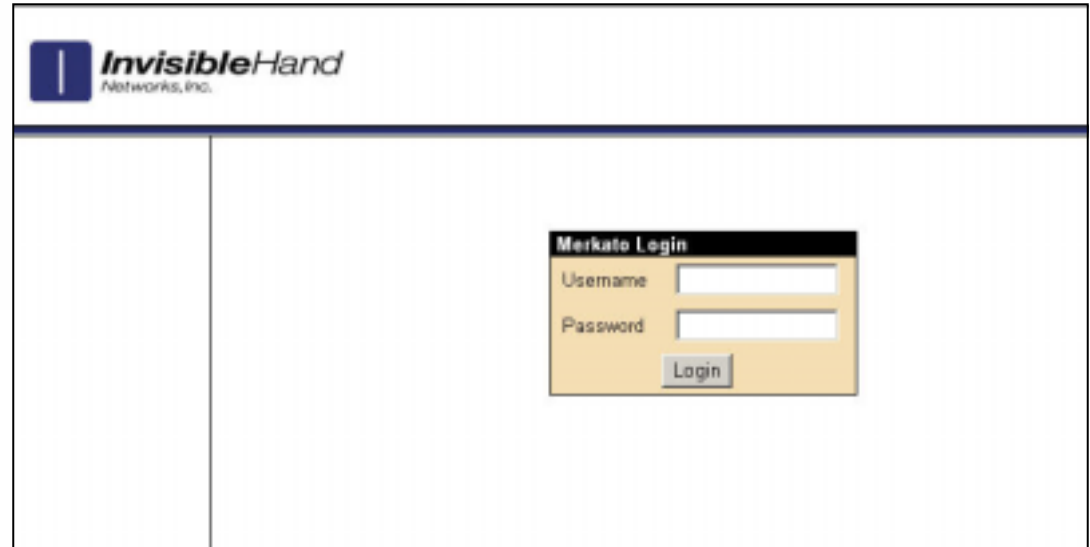


Figure 56: The Merkato Login Screen

If you enter a valid username and password, and click **Login**, the top-level agent screen appears (Figure 57).

The central portion of the window shows the Merkato Agent. This is the express agent interface. Below this area, if you scroll down, are the agent status screens, indicating recent allocations and market price.

To the right, the pull-down user interface menu allows you to select the Wizard, Express, or Desktop interface.

The left portion of the page contains a navigation bar, which provides access to all pages of the portal:

- **Agent** – (The page shown) contains the Express agent interface, the user interface selection pull-down, the allocation table, and market price graphs.
- **Traffic** – Contains Monthly, Weekly, and Daily graphs of traffic associated with this user.
- **Charge Reports** – Opens an interface that allows you to create queries into the Merkato database. Using these tools you can determine the ongoing cost of your bandwidth allocations.
- **Transaction Data** – Opens a billing interface that allows you to create queries into the Merkato database, providing a history of transactions for your account. The data is downloaded as a spreadsheet file.
- **Version Information** – For the Merkato and the database it uses, provides the version, build date, and installation date. Use this information to determine what version of Merkato you are using.
- **Logout** – Returns user to login screen.

Recent Allocations

Start Time	End Time	Resource	Buyer	Seller	Quantity (Mbps)	Price (\$/month/Mbps)	Cost (\$)
2002-06-27 00:00:00	2002-06-27 01:00:00	qa-resource-nov01	jbossom	nov-sella01	1.80	287.89	0.72
2002-06-27 00:00:00	2002-06-27 01:00:00	qa-resource-spo01	jbossom	qa-sella01	12.85	4.00	0.14

Figure 57: The Express Interface in the Merkato Portal

Agent View

The Interface pull-down portion of the screen provides access to the Wizard and Desktop agent applications, described in their own sections of this document. The other areas of the Agent page are described below.

Express Agent

The Express interface is an HTML version of the Desktop interface, with some significant differences:

- It leaves your agent in the garage and controls it remotely. Should you inadvertently close this window, it will make no different to your agent in the garage.
- Your screen is not updated in real time. You must click the “Refresh” button to update information in status displays.

The Express interface is meant to support advanced users who know what the fields mean and wish to have a quick way to check agent status or make configuration changes.

You access the Express interface through the initial portal browser window. If your agent was active and bidding from the garage, you will see a window like Figure 58.

The Express agent doesn’t allow the same functionality as the Desktop agent. It doesn’t support creating or canceling reservations, traffic-usage based valuations, or manual bidding. You can make these settings using the desktop agent and then make unrelated changes via the Express agent.

The two buttons at the bottom of the window control your communication with the Resource agent:

- **Refresh** updates the configuration and status fields in the windows without sending configuration changes to the Resource Agent. Click **Refresh** to return the display to the last saved configuration should you wish to erase changes made to the values prior to applying them.
- **Apply** sends configuration changes to the Resource Agent.

To exit the Express window without sending configuration changes to the Resource Agent click **Refresh**. All values saved the last time changes were applied are restored.

The fields in this display are as follows (identified by their row headers):

- **Status** – Controls whether the agent is bidding or not. You must click **Apply** for this change to take effect.

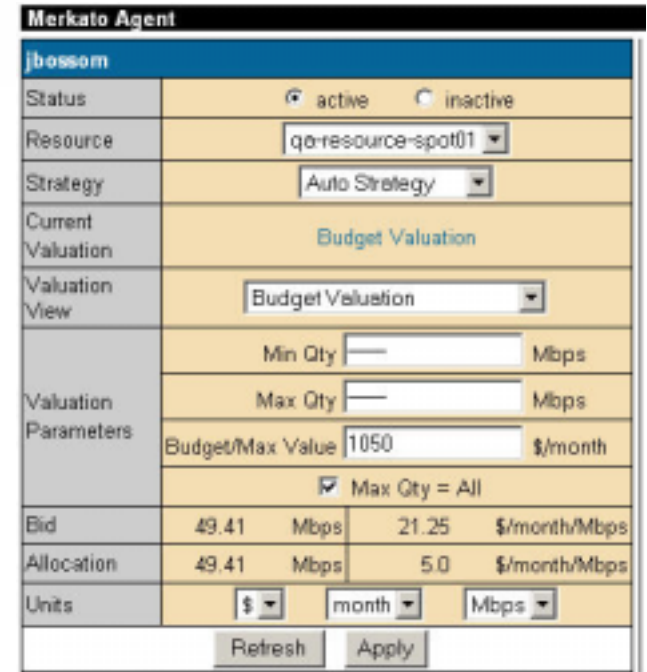


Figure 58: The Express Agent Interface

- **Resource** – Selection list for the resource for which you are bidding. You must click **Apply** for this selection to take effect.
- **Strategy** – Auto Strategy is the only strategy supported by the Express interface. You can select Manual strategy, but there are no bid entry fields. Creation and cancellation of reservations are not currently supported (although you may view confirmed reservations in the allocation list just below the Express interface in the Portal).
- **Current Valuation** – This is display of the valuation currently in use. Choices are the same as in the Desktop interface. To change the current valuation, select another valuation from the menu and click **Apply**.
- **Valuation View** – This pull-down menu selection allows you to select and alter settings of valuations without making them active. When you are satisfied with the settings for a new valuation, click **Apply**. The displayed valuation becomes the active (current) one with the configuration values you have entered.
- **Valuation Parameters** – This set of windows contain the settings for the valuation chosen. You must click **Apply** after changes are made, for them to take effect. Not all parameters have meaning for all valuations. If a parameter is not used, its value is indicated as a horizontal bar.
- **Bid** – A read-only display indicating the latest bid submitted. You must click **Refresh** to update this display. If this display is missing, it indicates that your agent is inactive and not bidding.
- **Allocation** – A read-only display indicating the allocation received in the last round. You must click **Refresh** to update this display. If this display is missing, either your agent is inactive or it did not receive an allocation in the previous auction round.
- **Units** – The selections made in this window change the units displayed for all other windows. All values are scaled to reflect the change in units. You need not click **Apply** for this change to take effect.

When your agent is inactive and not bidding from the garage, the Bid and Allocation rows are missing, as shown in Figure 59.

Merkato Agent	
demo-buyer1	
Status	<input type="radio"/> active <input checked="" type="radio"/> inactive
Resource	demo-spot
Strategy	Auto Strategy
Current Valuation	Logarithmic Valuation
Valuation View	Logarithmic Valuation
Valuation Parameters	Min Qty <input type="text"/> Mbps
	Max Qty 44 Mbps
	Budget/Max Value 10000 dollar/m
	<input type="checkbox"/> Max Qty = All
Units	dollar month Mbps
<input type="button" value="Refresh"/> <input type="button" value="Apply"/>	

Figure 59: The Express Interface in the Inactive State

Error messages are displayed in the browser window, above the Express Interface area. (See Figure 60.)

Action rejected.

Invalid minimum quantity greater than maximum quantity

Merkato Agent	
demo-buyer1	
Status	<input type="radio"/> active <input checked="" type="radio"/> inactive
Resource	demo-spot
Strategy	Manual Strategy
Current Valuation	Linear Valuation
Valuation View	

Figure 60: An Express Interface Error Message

Recent Allocations Table

The Recent Allocations table shows bandwidth allocated to the current user and the amount charged for this bandwidth. (See Figure 61.) Allocations are shown in order (sorted by end date/time); most recent at the top. Confirmed reservations are at the top, followed by the most recent Spot market allocations. Each Spot market allocation entry contains a summary of information for an hour, which generally includes many auction rounds.

The columns are as follows:

- **Start Time** – The start date and time for this allocation
- **End Time** – The end date and time for this allocation
- **Resource** – The name of the bandwidth product allocated
- **Buyer** – The Buyer agent that won the allocation
- **Seller** – The Seller agent that sold the allocation
- **Quantity (Mbps)** – The bandwidth quantity for this allocation. (For Spot market allocations, this is the average quantity obtained over the time period indicated.)
- **Price (\$/month/Mbps)** – The unit price for this allocation. (For Spot market allocations, this is the average price obtained over the time period indicated.)
- **Cost (\$)** – The bottom-line cost for this allocation. (For Spot market allocations, this is the average cost over the time period indicated.)

The Allocation table gives you an indication that Merkato auctions have been providing the desired results. You may obtain information for longer timeframes in the Billing page via custom queries.

Recent Allocations							
Start Time	End Time	Resource	Buyer	Seller	Quantity (Mbps)	Price (\$/month/Mbps)	Cost (\$)
2002-06-26 23:00:00	2002-06-27 00:00:00	qa-resource-spot01	jbossom	qa-seller01	9.27	5.00	0.06
2002-06-21 18:00:00	2002-06-21 19:00:00	qa-resource-spot01	jbossom	qa-seller01	0.00	4740.41	0.02
2002-06-21 17:00:00	2002-06-21 18:00:00	qa-resource-spot01	jbossom	qa-seller01	0.01	4749.79	0.06
2002-06-21 16:00:00	2002-06-21 17:00:00	qa-resource-spot01	jbossom	qa-seller01	0.01	4740.77	0.06
2002-06-21 15:00:00	2002-06-21 16:00:00	qa-resource-spot01	jbossom	qa-seller01	0.01	4673.32	0.04

Figure 61: The Recent Allocations Table

Traffic View

The traffic page shows the amount of data transferred through the Merkato network control point by the data stream associated with this user. (See Figure 62.) Three graphs are provided to represent three time scales:

- Daily graph showing 5 minute granularity
- Weekly graph showing 30 minute granularity
- Monthly graph showing 2 hour granularity

All three graphs are based on five-minute sample intervals. Merkato gathers traffic statistics in both the input and output direction every five minutes. Each five-minute sample represents an average over that five-minute period. In other words, peaks lasting less than five minutes are not accurately represented in the graphs. These five-minute samples are used directly in the daily graph. These values are then combined into longer averages for the weekly and monthly graphs.

The green-shaded portion of the graph indicates traffic in the incoming direction. Traffic indicated by the blue line is in the outgoing direction. If you are unclear which direction corresponds to “in” and “out” with respect to your application, contact your Merkato administrator.

Use the traffic graphs to help you decide how much bandwidth to purchase on the spot and reservations markets. Often, the best buying strategy is to buy what you normally use on the Reservation market, then purchase additional bandwidth during periods of burst demand on the Spot market. The traffic graphs can also help you select the maximum desired quantity for your Spot market valuation settings. There is little performance improvement, but potentially significant cost impact, when you purchase more bandwidth than you need.

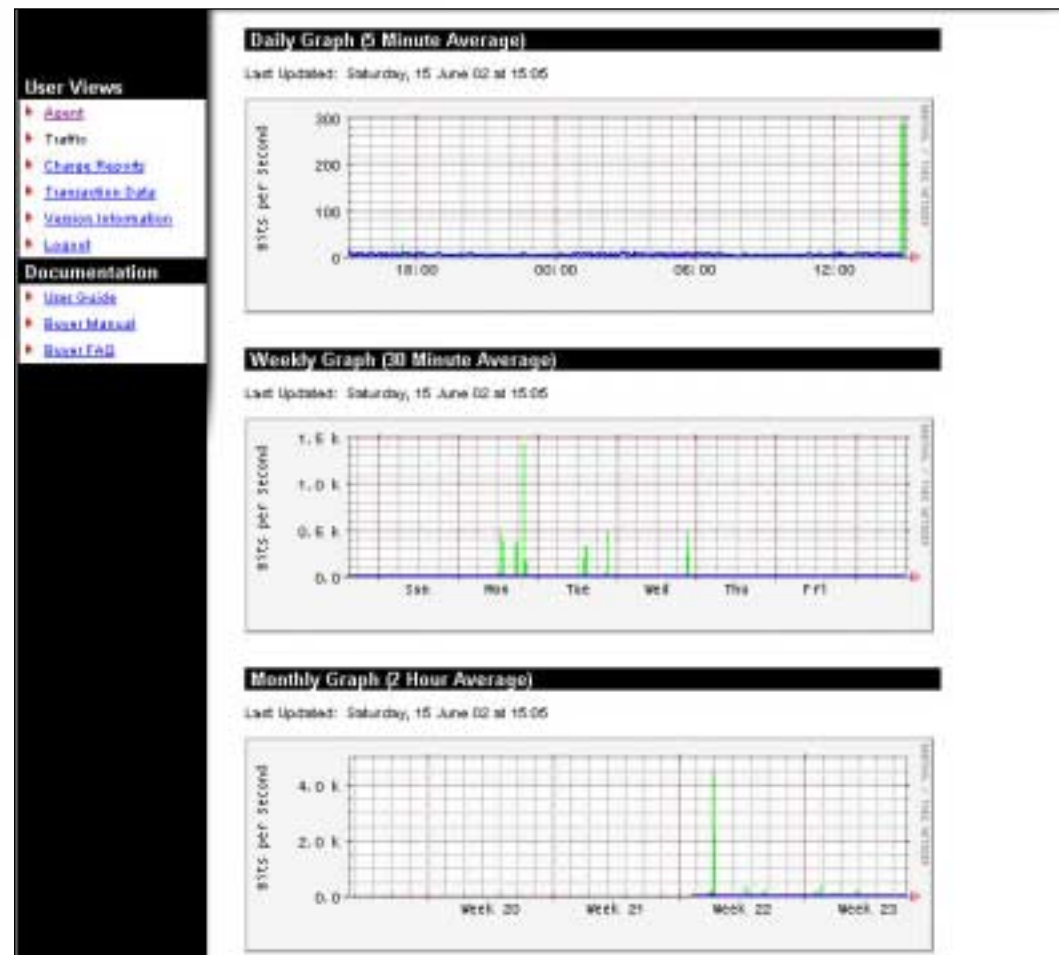


Figure 62: The Traffic View

Charge Reports

Merkato's Charge Reports feature lets you see details about bandwidth allocations you have received. (See Figure 63.) The reports it generates provide all the details about each allocation, but they are also summarized.

Figure 64 is an example of a charge report for one day:

The following fields appear in the Charge Reports screen:

From (mm/dd/yyyy): Enter the date you want the charge report to begin on.

To (mm/dd/yyyy): Enter the date you want the charge report to end on.

Resource: (optional) Enter the resource (from whom you have received allocations) whose charges to you will appear in the report.

Ordered By Day: A report ordered by day lists charge information from all resources grouped by day.

Ordered By Resource: A report ordered by resource lists charge information from each individually. If you select Detailed, within the listing for each resource, charges are ordered by day.

Summary: All charges are grouped and totaled.

Detailed: Charges are displayed separately by individual resource.

Figure 63: The Charge Report Selection Window

Resource	Seller	Buyer	Date	Quantity (Mbps)	Price (\$/month/Mbps)	Allocation Time (hours)	Cost (\$)
qa-resource-spt01	qa-seller01	jbossom	2002/06/13	0.00	0.00	24.00	0.00

Resource	Seller	Buyer	Date	Quantity (Mbps)	Price (\$/month/Mbps)	Allocation Time (hours)	Cost (\$)
qa-resource-spt01	qa-seller01	jbossom	2002/06/13	0.00	0.00	24.00	0.00

Figure 64: Sample Charge Report


Rather than enter start and end dates manually, you can click on the small calendar icon () to the right of the field. A pop-up calendar (Figure 65) appears from which you can select your start and end dates.



Figure 65: The Pop-Up Calendar

Similarly, when you click the pie-chart icon () , a list box (Figure 66) appears from which you can select a resource on which to do billing queries.



Figure 66: The Pop-Up Resource Selection Window

For example, if you select Ordered by Day and Summary and click Generate Report the view looks like

Figure 68:

Details for 2002/06/14							
Resource	Seller	Buyer	Date	Quantity (Mbps)	Price (\$/month/Mbps)	Allocation Time (hours)	Cost (\$)
qa-resource-spo01	qa-seller01	jbossm	2002/06/14	0.00	2759.93	24.00	0.01

Summary for 2002/06/14						
Buyer	Date	Quantity (Mbps)	Price (\$/month/Mbps)	Allocation Time (hours)	Cost (\$)	
jbossm	2002/06/14	0.00	2759.93	24.00	0.01	

Details for 2002/06/15							
Resource	Seller	Buyer	Date	Quantity (Mbps)	Price (\$/month/Mbps)	Allocation Time (hours)	Cost (\$)
qa-resource-spo01	qa-seller01	jbossm	2002/06/15	0.01	3466.55	24.00	1.10

Summary for 2002/06/15						
Buyer	Date	Quantity (Mbps)	Price (\$/month/Mbps)	Allocation Time (hours)	Cost (\$)	
jbossm	2002/06/15	0.01	3466.55	24.00	1.10	

Figure 68: Sample Charge Report Set to Summary, Ordered By Day

If you select Ordered by Resource and Detailed and click **Generate Report**, the view looks like Figure 67:

Details for qa-resource-resv01							
Resource	Seller	Buyer	Date	Quantity (Mbps)	Price (\$/month/Mbps)	Allocation Time (hours)	Cost (\$)
qa-resource-resv01	qa-seller01	jbossm	2002/07/16	0.24	298.99	24.00	2.39
qa-resource-resv01	qa-seller01	jbossm	2002/07/17	0.25	282.61	24.00	2.41

Summary for qa-resource-resv01						
Resource	Buyer	Quantity (Mbps)	Price (\$/month/Mbps)	Allocation Time (hours)	Cost (\$)	
qa-resource-resv01	jbossm	0.25	290.75	48.00	4.80	

Details for qa-resource-spo01							
Resource	Seller	Buyer	Date	Quantity (Mbps)	Price (\$/month/Mbps)	Allocation Time (hours)	Cost (\$)
qa-resource-spo01	qa-seller01	jbossm	2002/07/12	0.38	49.14	24.00	0.63
qa-resource-spo01	qa-seller01	jbossm	2002/07/13	0.88	37.93	24.00	1.11
qa-resource-spo01	qa-seller01	jbossm	2002/07/14	0.88	37.93	24.00	1.11
qa-resource-spo01	qa-seller01	jbossm	2002/07/15	0.65	43.17	24.00	0.93
qa-resource-spo01	qa-seller01	jbossm	2002/07/16	0.47	80.99	24.00	1.28
qa-resource-spo01	qa-seller01	jbossm	2002/07/17	0.47	83.78	24.00	1.33

Figure 67: Sample Charge Report Set to Detailed, Ordered By Resource

Transaction Data

The Transaction Data view allows you to query the accounting database. (See Figure 69.) When you click **Generate Data**, Merkato lets you download a file.

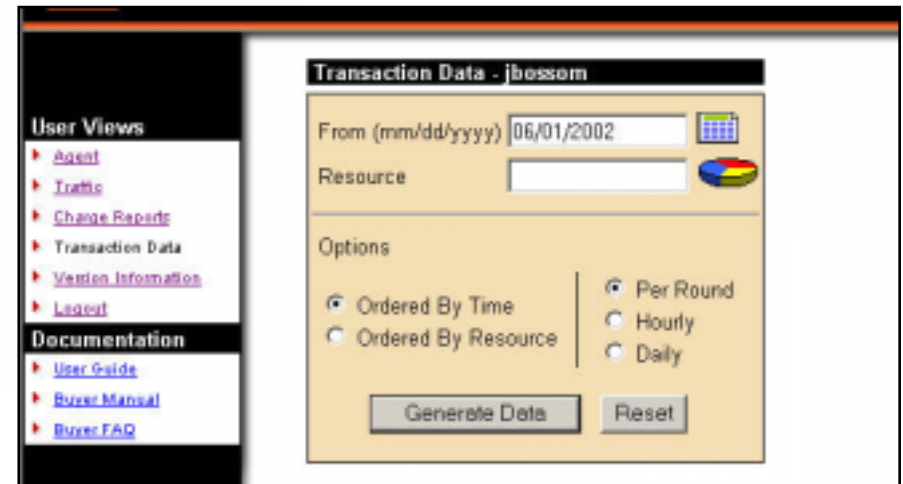


Figure 69: The Transaction Data Selection Window

You can read this file in a spreadsheet program or as plain text. (See Figure 70.)

The seven columns are the following:

- Start time of the allocation (mm/dd/yyyy hh:mm)
- End time of the allocation (mm/dd/yyyy hh:mm)
- Buyer Agent
- Resource (the source of the bandwidth that was sold)
- Quantity
- Price (in dollars per month per Mbps)
- Cost of allocation (in dollars—the amount billed)

6/14/2002 23:51	6/15/2002 0:00	tester01	qa-resource-spot01	0	1.55E-07	0
6/15/2002 0:00	6/15/2002 0:06	tester02	qa-resource-reservation01	0	1.55E-07	0
6/15/2002 0:06	6/15/2002 0:12	tester03	qa-resource-spot01	11.48438	1.55E-07	0.631086
6/15/2002 0:12	6/15/2002 0:20	tester04	qa-resource-spot01	0	1.55E-07	0
6/15/2002 0:20	6/15/2002 0:26	tester05	qa-resource-spot01	0	1.55E-07	0
6/15/2002 0:26	6/15/2002 0:32	tester06	qa-resource-reservation01	11.48438	1.55E-07	0.627813
6/15/2002 0:32	6/15/2002 0:41	tester07	qa-resource-spot01	0	1.55E-07	0
6/15/2002 0:41	6/15/2002 0:48	tester08	qa-resource-spot01	12.44141	1.51E-07	0.804358
6/15/2002 0:48	6/15/2002 0:56	tester09	qa-resource-spot01	0	1.55E-07	0
6/15/2002 0:56	6/15/2002 1:02	tester10	qa-resource-reservation01	0	1.55E-07	0
6/15/2002 1:02	6/15/2002 1:10	tester11	qa-resource-spot01	11.48438	1.55E-07	0.909653
6/15/2002 1:10	6/15/2002 1:16	ibossom	qa-resource-spot01	12.44141	1.51E-07	0.691248

Figure 70: Sample Transaction Data Report

The following fields appear in the Transaction Data screen:

From (mm/dd/yyyy): Enter the date you want the charge report to begin on.

Resource: (optional) Enter the resource (from whom you have received allocations) whose charges to you will appear in the report.

Ordered By Time: A report ordered by day lists charge information from all resources separated by each day.

Ordered By Resource: A report ordered by resource lists charge information from each individually.

Merkato Auction Mechanism: The Progressive Second Price Auction

The patent-pending Progressive Second Price (PSP) auction mechanism creates the rules by which the Merkato marketplace operates. PSP provides the following:

- The ability to divide resources among many bidders
- The ability to react quickly to changes in a buyer's valuation of the resource for sale
- The ability to support any number of bidders who may enter or leave the bidding at will
- Establishment of market mechanisms that create a fair market price for bandwidth, benefiting both buyers and sellers
- Creation of market rules that encourage bidders to be maximally truthful about their desires and willingness to pay, allowing auctions to converge quickly

These things are true of the PSP auction mechanism generally. The Merkato implementation of PSP provides the following additional features:

- A lightweight protocol between bidders and the Resource agent that does not contribute significantly to bandwidth utilization
- Support for multiple buyers and one seller, as well as multiple sellers and one buyer
- Ability of customers to create automated bidding decisions based on mix-and-match combinations of valuation, budget, and strategy
- Inclusion of sellers as bidders, allowing them to take bandwidth off the market if they do not feel the price is sufficiently high

To understand the Progressive Second Price auction mechanism, it helps to consider the rules and motivations behind a non-progressive simple second price auction.

In a simple auction, where the highest bidder pays the price bid, bidders raise their bids incrementally in successive bidding rounds. Each bidder's goal is to obtain the item at the lowest price, which is the price just above what the second-place bidder is willing to pay.

In an auction where many buyers are bidding for a single item, a second price mechanism is a way to quickly decide the highest bidder without the normal incremental bidding process.

The *second price rule* does away with the incremental bidding—but achieves the same result—by asking each bidder for a single highest bid. The highest bidder wins the item, but pays the amount offered by the second highest bidder. The highest bidder is guaranteed not to overpay for the item by revealing the

maximum he or she is willing to pay. The seller gets essentially the same price for the item had the bidding price been raised incrementally until the second place buyer dropped out.

Applying this principle to a divisible resource such as bandwidth requires that the second price auction become “progressive.” In a progressive second price auction, each bid consists of a unit price and the quantity desired at that price. The bidders are ranked by unit price and then are tentatively awarded the amount they requested until the supply is exhausted. Unsuccessful bidders may re-bid in an attempt to replace successful bidders in the ranking (hence the term “progressive”). The price every successful bidder pays is the price offered by the lowest *successful* bidder. (In a strict interpretation of second price rules, it would be the highest unsuccessful bidder(s) who sets the price. However, the “progressive” nature of the bidding tends to turn all bidders into winners, which leaves no basis from which to set the price.)

Eventually, all bidders will have been awarded a share of the bandwidth or dropped out of the bidding because the market price is higher than they will pay for any amount of bandwidth.

Example:

Assume that the seller has 10 Mbps to sell and that six bidders are interested. Bids indicate the amount of bandwidth desired, as well as the unit price they are willing to pay. Let’s assume that the initial bids are these:

Bidder A: 3 Mbps desired at \$100 unit price (\$300 total)

Bidder B: 5 Mbps desired at \$80 unit price (\$400 total)

Bidder C: 3 Mbps desired at \$50 unit price (\$150 total)

Bidder D: 4 Mbps desired at \$30 unit price (\$120 total)

Bidder E: 6 Mbps desired at \$20 unit price (\$120 total)

Bidder F: 3 Mbps desired at \$10 unit price (\$30 total)

Bidders would be ranked according to their offers, as shown in Figure 71:

The shaded area represents the amount of money the seller is being offered (unit price times quantity). The green part of the shaded area at the left represents the amount offered by *successful* bidders.

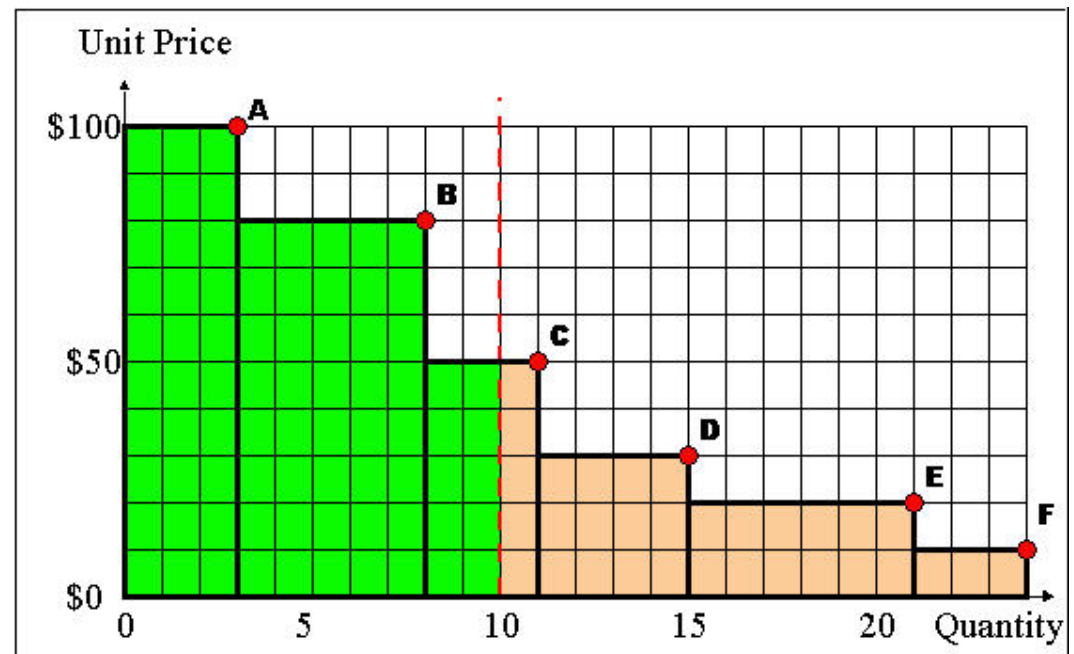


Figure 71: Stacked Bids Received for Portions of 10 Mbps of Bandwidth Offered by Seller

It might be instructive to determine what the seller would receive had the seller simply taken the highest initial offers. With 10 Mbps for sale, the highest two bidders (“A” and “B”) would receive what they want, and the third highest (“C”) would receive two of the three Mbps bid for. If the seller simply accepted the offers, the seller would receive $\$300 + \$400 + \$100 = \800 for the bandwidth offered from the successful bidders. This represents \$80 per Mbps average price for the 10 Mbps offered.

Now let’s look at how the bandwidth would be sold in a Merkato Progressive Second Price auction. To recap, the rules of the second price auction are as follows:

- All bidders may make multiple sequential offers.
- After each offer is received, the Resource agent (that runs the auction) ranks the bids according to price offered and apportions bandwidth to the highest bidders.
- The price at which the lowest successful bidder receives bandwidth is the “market price,” which every successful bidder pays.

The bid and re-bid cycle repeats until all bidders are satisfied with the amount of bandwidth received, and their price, or have dropped out of the bidding.

Let’s assume that the initial offers from all bidders are as before. All bidders are informed that the current market price is \$50 and the successful and unsuccessful bidders are informed of their status and allocation (if any). If the second price auction stopped here, the seller would receive \$50 for each unit of bandwidth or a total of \$500 for the 10 Mbps of bandwidth, which is \$300 less than he would have received by simply accepting the initial offers. Fortunately for the seller, the process does not end here!

The unsuccessful bidders will bid again, if they can afford to. Bidders “stay in the game” by increasing the unit price offered for bandwidth, above that of the lowest successful bidder.

How can bidders afford to do this if they revealed what they are willing to pay in their first bid? Well, assume that the bidder’s initial offer was determined by a total cost limit as opposed to a desired unit price. In this case, the bidder would desire to re-bid as long as a consistent total cost was maintained by lowering the requested amount of bandwidth proportionally to any increase in offered unit price. (In Merkato, this price-verses-quantity information is carried by the valuation settings.) Let’s assume, for simplicity, that all the bidders follow this same strategy and that their initial bids represent their total budget for bandwidth.

Bidder “D” was the highest unsuccessful bidder, offering a unit price of \$30 for 4 Mbps of bandwidth. This represents a budget of \$120. Bidder “D” sees he can become a successful bidder this round by bidding above a unit price of \$50. His next offer could be \$60 per unit for 2 Mbps of bandwidth and stay within his budget limits. Each bidder can do this in turn if they find themselves pushed out of the successful bidder’s column.

Although all the examples so far have involved increments of 1 Mbps of bandwidth, bidders are under no such restriction. Even bidder “F,” with a \$30 budget, may become a successful bidder by asking for a fractional amount of bandwidth.

In such a simulation, when the bidding ends, the final bids would look like this:

Bidder A: 2.7 Mbps desired at \$112 unit price (\$300 total)

Bidder B: 3.6 Mbps desired at \$112 unit price (\$400 total)

Bidder C: 1.3 Mbps desired at \$112 unit price (\$150 total)

Bidder D: 1.1 Mbps desired at \$112 unit price (\$120 total)

Bidder E: 1.1 Mbps desired at \$112 unit price (\$120 total)

Bidder F: 0.2 Mbps desired at \$112 unit price (\$30 total)

The graph, in Figure 72, shows the bids graphically, as before:

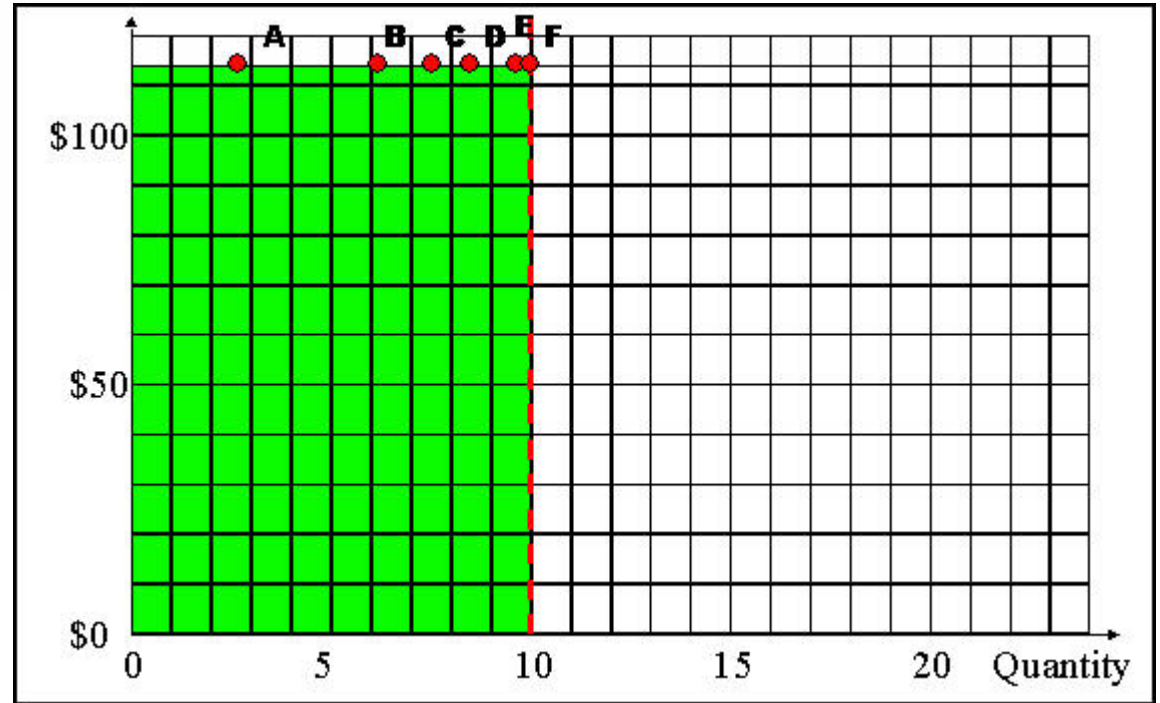


Figure 72: Auction Results Under Progressive Second Price Mechanism

The market price of \$112.00 represents the amount all bidders would have to offer in order that all are awarded bandwidth, but stay within their initial budget. The seller would receive \$1120.00 for the 10 items.

All bidders are “winners” and receive an amount of bandwidth proportional to their willingness to pay and consistent with the bidding policies they established for their Merkato agents.

Advanced Buyers Guide

This section contains advice for advanced users who are familiar with Merkato and want to optimize the settings further.

Optimizing Your Valuation Settings

There are various ways you can use the Merkato capabilities to maximize the amount of bandwidth received and minimize your cost.

Using the “Max Qty” (or “Qty”) Valuation Settings

The “Max Qty” setting in the Budget Valuation with Limits and the “Qty” settings in the Square Root, Linear, Parabolic, and Logarithmic valuations constrain your agent to purchase no more than the quantity entered. Using this parameter to buy only the amount of bandwidth you need lowers your cost for two reasons:

1. Simple mathematics; Once the market price has been established, if you purchase less bandwidth, you will pay less in total cost.
2. Requesting less bandwidth will often lower the market price for everyone. In Merkato, market price is driven by demand. If all bidders begin their bidding by asking for all the bandwidth the seller has available, the market price is driven up as buyers bid and re-bid in an effort to win an allocation. If a bidder initially asks for a small fixed quantity at a high price, however, they essentially “take that bandwidth off the top” and the other bidders will contend for what is left.

Example:

If 5 bidders, each with a budget of \$5000, bid for a total of 100 Mbps, each would receive an allocation of 20 Mbps at a market price of \$250/Mbps. If one bidder decided that 20 Mbps was too much and used the Budget Valuation with Limits to set a maximum quantity of 15 Mbps, demand would drop. The market price would drop to \$235 for everyone. The dropping bidder would pay a total cost of \$3,530 for the 15 Mbps (as opposed to \$5,000 for 20 Mbps the bidder didn't really need). Of course, the other bidders would benefit from the market price drop as well. However, their benefit would be in the form of increased allocation rather than decreased cost. They would each receive 21.25 Mbps for their \$5,000 budget.

Using the “Min Qty” setting in the Budget-with-limits valuation

One disadvantage of the Budget valuation is that it makes the agent continue attempting to obtain as much bandwidth as it can, for the budgeted amount, as market prices rise. This means that in extreme

circumstances, a bidder could pay his entire budget for a very small amount of bandwidth. Under the Merkato system, bidders who receive no allocation during a round have their traffic routed through a shared, fixed-bandwidth data path. Ask your Merkato administrator for the size of this “best-effort queue” and use that information to determine the level of bandwidth for which you would rather be in the shared data path “for free” rather than pay your budget for an allocation of a similar amount. Be conservative, though. The throughput and latency of your data stream when you are in the “best effort queue” depends heavily on how many other bidders are there and how much data they are transferring at the same time.

Bidding Only When You Need Bandwidth

Merkato allows you to stop bidding at any time. If your application requires bandwidth only during certain time of the day or days of the month, consider stopping your agent during periods of inactivity. This is an alternative to traffic-based bidding. You can then either pocket the money you save, or use it to raise your budget (and receive a greater allocation) during times when you are actively using the link.

Bidding Lower For Excess Bandwidth

Many people like the benefits of setting a maximum quantity, but would not mind receiving more bandwidth if the price were right. Both the Logarithmic and Parabolic valuation can be used to create such a strategy. (Select between them based on how you wish to bid for low quantities of bandwidth.)

Using Both the Spot and Reservation Markets

The Reservation market allows you to purchase bandwidth for an extended time at a fixed price. The Spot market reacts quickly to changes in buyer valuation and may result in either savings or a price premium relative to the reservation pricing. A desirable strategy might be to purchase the absolute minimum amount of bandwidth you require via a reservation and then use the Spot market to add additional capacity if the price is attractive or your needs increase unexpectedly.

Using the Bid Table to Estimate Market Prices

Although you can preview an auction without entering it, this information does not indicate directly what impact the participation of your agent has on the market price. You can estimate your impact if you can determine the valuation used by other bidders.

It is sometimes possible to guess a bidder’s valuation based on these entries shown in the Auction Table. (See Figure 73).

- If the “rate” (far right value) of a bidder remains constant, that bidder is most likely bidding on a budget.

ID	Quantity(Mbps)	Price(\$/month/...	Rate(\$/month)
102	32.34	30.92	1000.0
108	11.25	30.81	346.57
107	1.41	30.81	43.32
107	9.84	30.81	303.25
106	22.5	30.65	689.66
106	18.28	30.65	560.34
			992.91

Figure 73: The Auction Table

- If the quantity (second from left) field is constant, it indicates that the bidder has set a maximum bandwidth level. (The other indicator is that the bidder is offering more than the current market price, but is not driving the market up to the bidder's level.)

If you can divide all bidders into these two categories, you can estimate the market price you will have to pay for any unit of bandwidth, without bidding. Then continue the process as follows:

1. Add up the total bandwidth requested by all bidders who have set a maximum bandwidth level and for whom the market price is lower than their offered price. Subtract this bandwidth from the total the seller is offering.
2. Add up the rates of all the bidders who are using "budget" valuation. Divide this number by the amount of bandwidth remaining from the first calculation. This is the natural market price for this auction.
3. To determine what you would have to pay for an amount of bandwidth, assuming these bidders keep their current valuations and budgets, subtract the bandwidth you want from the total that the "budget" bidders were contending for. Then re-do the market price calculation.

You would have to bid above this calculated price to obtain the bandwidth you desire. You ensure that your agent will bid this amount by using the Budget or Budget Valuation with Limits and entering a budget equal to this price multiplied by the amount of bandwidth desired. If you use the Budget-With-Limits valuation, also set the Max Qty to this desired amount of bandwidth.

Valuation Formulas

The formulas from which valuations are derived are provided below. You may wish to enter them into a spreadsheet to analyze them. Remember, these formulas determine what you *bid*, but your actual cost is based on the market price as determined by progressive second price auction rules.

The curves defined by these formulas vary according to settings in the valuation windows. To avoid confusion, the names of the settings have been given in the formulas as:

- **Budget** for budget settings in budget-based valuations
- **MaxQty** for either Max Qty in Budget Valuation With Limits or the single Qty setting in the other valuation windows
- **MinQty** for the minimum quantity setting in the Budget-with-limits valuation
- **MaxValue** for the Value setting in the valuation windows

The variables in the equations are:

- **Price** for the unit price
- **Qty** for the quantity of bandwidth that will be requested at that price

Note that the units you use do not matter as long as you are consistent throughout:

- Budget is specified in currency-per-unit-time (such as \$/month).
- “Quantities” are quantities of bandwidth expressed in Gbps, Mbps, or kbps.
- Price is specified in currency per unit bandwidth per unit time (such as \$/Mbps/Month).
- MaxValue is given in terms of currency per unit time (such as \$/month).

To convert a price equation to cost, multiply the price equation by the quantity variable (“Qty” in the equations).

Budget Valuation

$$\text{Price} = \text{Budget} / \text{Qty}$$

Budget Valuation With Limits

For $\text{Qty} < \text{MinQty}$

$$\text{Price} = \text{Budget} / \text{MinQty}$$

For $\text{MinQty} \leq \text{Qty} \leq \text{MaxQty}$

$$\text{Price} = \text{Budget} / \text{Qty}$$

For $\text{Qty} > \text{MaxQty}$

$$\text{Price} = 0$$

Linear Valuation

For $\text{Qty} \leq \text{MaxQty}$

$$\text{Price} = \text{MaxValue} / \text{MaxQty}$$

For $\text{Qty} > \text{MaxQty}$

$$\text{Price} = 0$$

Square Root Valuation

Note: "SQRT" = Square Root of what follows in parentheses

For $\text{Qty} \leq \text{MaxQty}$

$$\text{Price} = \text{MaxValue} / (2 * \text{SQRT}(\text{MaxQty}) * \text{SQRT}(\text{Qty}))$$

For $\text{Qty} > \text{MaxQty}$

$$\text{Price} = 0$$

Logarithmic Valuation

Note: “Ln” = Natural logarithm of what follows in parentheses

For Qty \leq MaxQty

$$\text{Price} = (\text{MaxValue} / \text{MaxQty}) * \text{Ln}(\text{MaxQty} / \text{Qty})$$

For Qty $>$ MaxQty

$$\text{Price} = 0$$

Parabolic Valuation

For Qty \leq MaxQty

$$\text{Price} = 2 * \text{MaxValue} * (1 - \text{Qty} / \text{MaxQty}) / \text{MaxQty}$$

For Qty $>$ MaxQty

$$\text{Price} = 0$$

- Maximum price bid (at Qty = 0) = $2 * \text{MaxValue} / \text{MaxQty}$
- Maximum cost offered (at half MaxQty) = $\text{MaxValue} / 2$

Glossary

agent: The program that interacts with the rest of Merkato on behalf of buyers and sellers. Buyers can acquire bandwidth by configuring their agents to offer the price they are willing to pay for a range of available quantity, or use their agent to request a quote for a fixed-price bandwidth reservation. Sellers configure their agents with a quantity of bandwidth for sale and a minimum price they are willing to accept for that quantity.

allocation: An amount of bandwidth available for your use. Depending on the type of service being offered through Merkato, this can represent the maximum bandwidth available to you or a minimum guarantee of bandwidth available to you.

bandwidth: The amount of data transmitted or received per unit of time. When we refer to acquiring or selling bandwidth, we mean the amount of information that can be sent over a connection at one time, at the allowed speed, without packet loss or excessive delay. Bandwidth is measured in bits-per-second.

bumping: Bumping occurs when a user logs in using the ID and password of an active agent. The user who is logging-in sees a message that an agent with this login ID is already active. If the new user proceeds, the old user is disconnected. The agent uses the saved configuration of the agent, not necessarily the configuration of the previously active agent.

Buyer agent: The program that interacts with the rest of Merkato on behalf of buyers. Buyers can acquire bandwidth by configuring their agents with the price they are willing to pay for a range of bandwidth (on the Spot market), or with a time-frame and desired quantity (on the Reservation market). In a Merkato auction, Buyer agents signal what they are willing to pay for bandwidth in the form of bids, consisting of a unit price and a quantity.

capacity: In the Merkato interface, the term capacity refers to the total amount of bandwidth available from the Seller.

data transfer rate: The speed at which data is transferred from one port to another. See Kbps, Mbps, and Gbps.

Desktop agent: The Merkato application for buyers or sellers that runs on a Windows PC. Merkato desktop agents bid for bandwidth from the user's PC using a Java-based application. Alternatively, Merkato agents can run as an application on a server, called the "Garage." Users can interact with these remote agents through an HTML browser interface.

Express agent: The Merkato HTTP application for buyers or sellers that configures and obtains status from Merkato agents running from a remote location. Accessing the agent in this way is an alternative to bringing the agent to the user's desktop and using the Java-based interface. The Express agent is accessible through the Portal.

floor price: The lowest price the seller will accept for bandwidth. The seller can establish the floor price through the Seller agent.

garage: A server from which buyer and seller agents can bid when they are not actively bidding on a user's PC desktop. The garage is generally installed on the Merkato server, providing maximum performance and reliability.

Gbps: One of the ways of expressing units of bandwidth; gigabits-per-second (1,000,000,000 bits-per-second).

Java: A programming language, useful for internet and networking applications. The environment used for the Merkato Desktop Interface.

kbps: One of the ways of expressing units of bandwidth: kilobits-per-second (1,000 bits-per-second).

market price: The price for something that buyers and sellers agree on. Merkato establishes a market price for bandwidth during each Spot market auction round. There is a fixed amount for sale, so as demand increases, prices rise. The market price is reached when the cumulative demand of all the buyers is exactly equal to the amount of bandwidth being offered by the seller.

Mbps: One of the ways of expressing units of bandwidth: megabits-per-second (1,000,000 bits-per-second).

Merkato desktop: The Merkato desktop is the first window that appears when the user begins to bring the Merkato buyer or seller agent to their desktop. It lets users specify which Merkato agent or agents they want to download to the desktop.

Merkato: InvisibleHand's software platform, which dynamically prices, sells, and allocates IP bandwidth in real time. Merkato means "market" in Esperanto.

Player: A buyer or seller in the Merkato auction.

Portal: The main access point to all Merkato applications. It is an HTML-based interface accessible from a standard web browser.

progressive second price auction: The unique market mechanism by which Merkato allocates bandwidth to potential buyers at an optimal market price. An auction is established, where each bid consists of a unit price and the quantity desired at that price. Bidders are ranked according to the unit price they offer. Bidders who get an allocation pay the unit price offered by the lowest accepted bidder. (This is the "second price" aspect of the auction.) Bidders who don't get an allocation can re-bid at a higher unit price, in an attempt to improve their ranking in the auction. (This is the "progressive" aspect of the auction.) An auction round closes when all bidders are either successful, based on their last bid, or cannot match the price offered by the current lowest successful bidder.

PSP: See “progressive second price auction.”

Reservation market agent: A buyer agent connected to the Reservation market.

Reservation market: The Merkato market mechanism by which a specified quantity of bandwidth, for a specific duration, is sold for a firm price specified by the seller and agreed to by the buyer. This is an automated process based on a rate sheet that the seller establishes in advance.

Resource agent: The application that manages the Merkato marketplaces, where bids are received and allocations issued (the Spot market) or where price quotes for reservations are generated and accepted quotes for reservations are processed.

Seller agent: The program that interacts with the rest of Merkato on behalf of sellers. Sellers configure their agents with a quantity of bandwidth capacity for sale and a minimum price for that quantity. Buyer agents then express what they are willing to pay for bandwidth in the form of bids, consisting of a unit price and a quantity. Currently, there is no seller agent for the Reservation market, but one will be supported in a future release.

Spot market: The Merkato mechanism by which bandwidth is traded, in a progressive second price auction. An optimal fair market price is established and bandwidth is allocated to buyers, based on their bids relative to other buyers.

Spot Market agent: A Buyer agent or Seller agent connected to a Spot market. There are also reservation agents (for buyers only).

valuation: The value a buyer or seller places on bandwidth. Setting a valuation is part of setting a purchasing strategy. Valuation settings within a buyer agent let buyers specify the amount they are willing to pay for varying amounts of bandwidth. This information is used by the agent to respond to changing market conditions during a Merkato progressive second price auction.

Wizard: In Merkato, an automated series of inquiry screens that walks you through the process of creating and configuring a Spot market Buyer agent.

