information; receiving, from the server, an updated copy of at least a portion of the object, the updated copy of at least a portion of the object reflecting the requested modification, and replacing a corresponding portion of the object at the client device with the updated copy.

[0011] According to another aspect of the invention, a system includes a server and at least two clients coupled to the server. The server includes a storage device for storing an object data structure having a plurality of entries defining attributes of an object, the plurality of attributes apportioned into general entries and variable entries, the general entries including a list of members having access to the object and the variable entries including at least one item of persistent information associated with the object. The server also includes broadcast logic for broadcasting changes to the object data structure to the at least one member having access to the object. Each client includes a storage device for storing a copy of the object data structure including the at least one item of persistent information associated with the object and an application programming interface enabling the client to communicate with a server, including logic for requesting changes to the object data structure, and logic for updating the contents of the object data structure in response to communication from the server.

[0012] According to a further aspect of the invention, a data structure stored in a memory of a computer system having a mechanism for representing the data structure to at least two clients connected to the computer system is provided. The data structure includes a plurality of general entries including an entry identifying the at least two clients, wherein the modification of general entries is controlled by a central data structure server, and at least one variable entry, the variable entry being defined by one of the at least two clients, the variable entry including a name of an information item and a value of the information item.

[0013] According to another aspect of the invention, a collaboration system includes a plurality of objects, each object representing an item of information and having an access list identifying a group of members interested in the each object, and a relation database for storing, for at least one object, at least one identifier of at least one interested object, wherein the identifier is used to notify members in the group of the at least one interested object of changes to the item of information of the at least one object. With such an arrangement, the server process is able to support more complex collaboration through the aggregation of shared objects into hierarchies, graphs, or other structures. Shared objects can have arbitrary pointers to other shared objects. Each shared object within such a structure can have different membership. This approach allows for fine-grained access control to the data. Additionally, the server process may provide convenience functions to help manage the membership within these structures; e.g. when adding to or removing members from a single shared object, the server might provide options to propagate this operation to related shared objects. Likewise, when adding a new shared object to an existing shared object, the server may support conventions such as: aggregating the member lists of both objects, inheriting the member list of the existing objects, or allowing the member list of the new shared object to prevail.

[0014] According to a further aspect of the invention, a peer to peer collaboration system includes a first client device having a first storage device for storing a copy of at least one object to be shared with a second client device, the object having an attribute identifying information content associated with the object, and means for maintaining consistency of the information content associated with the object, including means for broadcasting changes to the information content made by the first client to the second client and means for updating the information content in response to an update notification received from the second client.

[0015] With such an arrangement, a group of members can asynchronously or synchronously modify the object, with the changes broadcast to each member of the group. Such a system may be used to establish a synchronous conferencing system, with the modified objects being persistently stored and available for access at any time thereafter. Alternatively, the system can be used to provide asynchronous control of shared resources, such as in a document repository. Seamless transitions between the two types of information access are readily supported. In addition, because the sharing of the resource involves only establishing the object at the server, and relationships between objects are controlled, the system provides for fine grained sharing of resources. Thus, the present invention provides a mechanism for seamlessly and efficiently controlling asynchronous and synchronous access to shared resources without the potential for data inconsistencies.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] **FIG. 1** illustrates a system in which the present invention may be utilized, including a number of clients connected to a server;

[0017] **FIG. 2** is a diagram of one embodiment of a generic shared object (GSO) data structure, including representative entries that may be included in a GSO data structure according to the present invention;

[0018] **FIG. 3** is a diagram provided to illustrate the various relationships that may exist between GSOs of the present invention; and

[0019] **FIG. 4** is a state diagram provided to illustrate various states of a programming interface that may be included in a client device coupled to a server of the present invention designed to manage generic shared objects;

[0020] **FIG. 5** is a flow diagram illustrating exemplary steps that may be used by a server of the present invention to manage Generic Shared Objects;

[0021] **FIG. 6** is a diagram of a peer to peer network architecture in which the present invention may be used to manage Generic Shared Objects between peer devices; and

[0022] **FIG. 7** illustrates screenshots for the purpose of describing how the servers of **FIGS. 1 and 6** and the processes of **FIGS. 3 and 4** may be used to enable synchronous collaboration between multiple users.

DETAILED DESCRIPTION

[0023] **FIG. 1** illustrates a network **10** in which the present invention may be implemented, including a server **20** coupled to a set of clients **12**, **14** and **16**. For the purposes of this application, the clients and the server communicate over a network **15** which may be any type of interconnecting