- **Query Phase:** The query phase involves the querying of the QDB to get all information required by the client to obtain a selected movie or scene. The query mechanism is implemented using a remote procedure call (RPC) between the video-playout client and the QDB.[6] The user begins the query by selecting a category from the *Category Screen*. The client-system then queries the remote database (the QDB) for movies belonging to that particular category. The user can get more detailed information of the movies including a summary, poster, or textual description of a scene by further querying the QDB for movie-specific data.

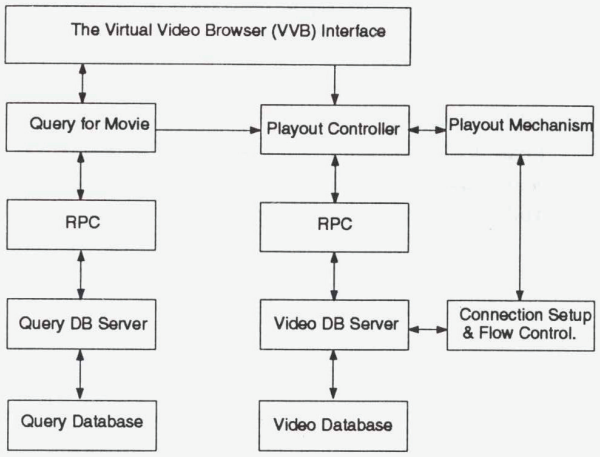

Figure 6: Mechanics of the VVB Operation

After the query phase, a movie can be selected for playout. The video playout phase is divided into two parts; the connection setup phase, and the connection management phase. During connection setup, the client checks with the VDB to see if it can support a new connection. If a connection can be set up, a negotiation phase is initiated during which QOS parameters are negotiated. If the negotiation proceeds to a successful conclusion, the connection setup and maintenance phases are initiated.

- **Connection Setup Phase:** The connection-setup phase establishes a dedicated client-server UDP connection to facilitate continuous media data transfer. Synchronized flow control is satisfied by a separate dedicated TCP control channel.

[6] POSTGRES is the DBMS used in the VVB implementation of the QDB.

- **Connection Maintenance Phase:** The connection maintenance mechanism ensures that a satisfactory performance is delivered to the user. This process requires the use of flow control mechanisms to ensure continuous playout at the client station. It ensures timely delivery of video frames to the client by monitoring a control signal returned via the TCP connection. The system thus adapts itself to load changes that can affect continuous media playout.

After connection establishment, video data is delivered to the client via a dedicated UDP connection. The choice of UDP was based on the need to support data delivery in real-time. Even though TCP is a more reliable protocol, it can introduce delays due to retransmission of lost packets, which is not acceptable for real-time video communication. In addition, video data are tolerant to losses and we exploit this characteristic in our design.

5 Summary and Conclusion

In this paper we have presented a distributed database organization for multimedia information systems based on the use of metadata and resource servers. We have identified and illustrated the service primitives required for the management of continuous-media sessions in a distributed system. The concepts presented are illustrated by example of a prototype distributed application called the Virtual Video Browser. The VVB employs a client-server architecture to support browsing of a metadatabase of video databases and to set up video sessions to remote video servers.

The VVB employs a two phase process to serve its users. These are (1) a query phase during which user queries are sent to the metadata server and (2) a connection establishment and maintenance phase, during which connections are set up between the video server and the client machine. The VVB is currently in use on a testbed of Unix workstations interconnected via Ethernet. To be used as a viable alternative to applications such as courses-on-demand, the VVB needs to support a large number of users and a rich data archive. We are currently considering the effort required for such a scale-up.

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