A Crash Recovery Mechanism for the NetTraveler Database Middleware System

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1. Abstract

The need for ubiquitous data access is quickly emerging in our everyday life. Every day we interact and access data on different devices such as cell phones, sensors, PDAs, laptops, servers among others. Each of these devices may contain data that we may want to access no matter which one of these devices we are using. Current database middleware systems can provide the means to access these otherwise heterogeneous data sources. Most database middleware systems assume that data sources and intermediate servers are permanently connected to the network and that component crashes during execution are not frequent. This may not be the case when mobile devices are used as data sources or service providers. This paper presents a crash recovery mechanism for the NetTraveler database middleware system which will recover lost query work due to crashes during execution.

2. NetTraveler Architecture

NetTraveler is a decentralized database middleware system for WSNs that is designed to efficiently run queries over sites that are either mobile clients or enterprise servers. The NetTraveler architecture can be observed in Figure 2.1. Additional information can be found on [1] and [2]. The different components of the NetTraveler Architecture are described in the following list.

- Query Service Brokers (QSBs) are the NetTraveler components responsible for coordinating the received queries and initiating recovery work if necessary. Figure 6.1 shows the QSB initializing recovery support when a new query is received, figure 6.2 illustrates the regular execution process of a QSB, and figure 6.3 shows the QSB recovering when a query has crashed.

3. Project Description

The distributed crash recovery mechanism for data retrieval on database middleware systems will be log-based since logs will be maintained at different components of the middleware system. Write-ahead logging, a pessimistic message logging method will be used since frequent crashes and unavailability of components of the system are expected and it has a lower crash recovery overhead than optimistic logging does. Furthermore, recovery logs will be kept at most components of the middleware system guaranteeing a recovery mechanism that will exploit the inherent parallelism of such systems during log writing and recovering. The recovery mechanism will provide query independent recovery for the components of the system. The component should try to recover a query only once a recovery request for a specific query is received.

4. Data Sources

Tuples retrieved from the data sources need to be numbered incrementally. This number will be used at other components of the system. Figure 4.1 illustrates the implementation and how results are returned afterwards.

5. Information Gateway

The Information Gateway is the middleware component responsible for data retrieval from a data source. Figure 5.1 illustrates the IG receiving a recoverable query and figure 5.3 illustrates the 5. IG performing recovery.

6. Query Service Broker

The Query Service Broker is the component responsible for coordinating the received queries and initiating recovery work if necessary. Figure 6.1 shows the QSB initializing recovery support when a new query is received, figure 6.2 illustrates the regular execution process of a QSB, and figure 6.3 shows the QSB recovering when a query has crashed.

7. Client

Clients are responsible for initiating contact with a QSB in order to perform queries to the underlying databases. Clients may request that a given query be recoverable, be recovered or use no recovery at all. In the case of a recoverable query, the Client will send the SQL query along with the constant stating that the query be recoverable to the QSB as shown in figure 6.1. In the case of a query requiring recovery, the SQL query along with the constant stating that recovery is needed and the recovery identifier for the last tuple received by the Client will be sent to the QSB as in figure 6.3. After either of the previously described scenarios the Client may start receiving results from the QSB as in figure 6.2.

8. References

1. E. Vargas-Figueroa, "Recovery of Client Query Work in the NetTraveler Middleware System".

2. E. Vargas-Figueroa, M. Rodriguez-Martinez, "Design and Implementation of the NetTraveler Middleware System based on Web Services".

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