Intelligent Networks as a Data Intensive Application (INDIA)*

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Abstract. The Intelligent Network (IN) is an architectural concept that enables telematic services (freephone, virtual private network, televoting, etc.) to be rapidly deployed and effectively used in the telephone network. The INDIA project investigates database techniques for dealing with the severe data and service evolution management problems resulting from the IN concept. A concurrency management technique called Atomic Delayed Replication (ADR) is presented that takes advantage of the special application semantics of the Service Logic Programs that implement IN. It can address replicated concurrency control for both the service data and the service logic. ADR has been implemented on top of a commercial DBMS as part of an experimental IN environment.

1 Introduction

Given the enormous data management problems in telecommunications, the use of database technology seems a natural solution [19]. Nevertheless, telecommunications people have been highly critical of available database systems and have typically continued to develop their own special-purpose systems. Kerboul [18] discussed the main reasons for these difficulties along the three dimensions shown in Fig. 1:

Distribution is the essence of telecommunication networks and services, thus also for the supporting data. Data may be fragmented and replicated throughout the system [21]. Failures of nodes or links can not be ignored as the size of the networks may span nations and continents.
Consistency: The manipulation of data must keep them in a consistent state with regard to the application semantics. The transaction model is a well-understood concept for controlling the parallel execution of applications.
Performance: The introduction of new services only makes sense if they can be executed in real time with very many simultaneous users. This depends on the throughput for a single service and on the multiplexing capabilities of the service threads.

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From the viewpoint of telecommunication data management, present-day local databases offer reasonable performance and consistency, but obviously no distribution. Present distributed database techniques are good at distribution and consistency but much too slow. The "ideal", a distributed, fully consistent real-time DBMS, seems out of reach.

To be taken seriously by the telecommunications community, database researchers must investigate trade-offs for the above dimensions which are suitable for particular application areas within telecommunications data management. In the INDIA project, we are studying this problem for the task of supporting Intelligent Network (IN) service management and evolution. IN has created a new market by making telephony much more flexible through new services such as virtual private networks, freephone, or televoting. It is obvious that the introduction of new services is cumbersome and expensive without appropriate database support since changes of (distributed) service logic and data will occur frequently.

In section 2 we start with a presentation of the general challenge of IN databases. The INDIA approach to the problem relies on a careful relaxation of the requirement of consistency to promote distribution (partitioning and replication) and performance. This implies specific guidelines for system architecture, database design, and concurrency control which are addressed by a new approach, called Atomic Delayed Replication (ADR). It is described in section 3 in conjunction with some currently existing solution attempts. The integration in the current INDIA prototype has shown significant improvements but also pointed out further challenges which are discussed in section 4. Section 5 summarizes our conclusions.