Workshop Report: The First International Workshop on Active and Real-Time Database Systems (ARTDB-95)*

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1 Introduction

This report is a summary of the first International Workshop on Active and Real-Time Database Systems (ARTDB-95) [1], held at the University of Skövde in June 1995. The workshop brought together researchers and practitioners from both the active database community and the real-time database community. The major aims of ARTDB-95 were to identify motivations, problems and requirements when combining active and real-time capabilities.

It has been identified that mission-critical and real-time applications will not be supported by active database systems in the near future [5]. As a first step in providing support for applications that require both active and time-constrained capabilities we have in this report summarized the moderated sessions and conclusions from ARTDB-95.

At the beginning of the workshop it was concluded that active databases have become mainstream [3]. Most of the commercial relational database systems support triggers, but there is, to the best of our knowledge, no support for triggers in commercial object-oriented systems. However, it was noted that a large number of research prototypes for active object-oriented database systems are being built. Since active components are already in place in commercial (relational) systems, it is reasonable to assume that any commercial real-time database system will support active features as well.

The remainder of this report is based on the outcome of the two moderated sessions and the closing session. In section 2 we focus on applications that need both active and real-time capabilities. In section 3 we address system issues which need to be considered when combining active and real-time features. Finally, conclusions are presented in section 4.

2 Applications

The moderated discussion chaired by Umesh Dayal (HP Labs.) was focused on applications that need both active and real-time capabilities. Some of the key issues that were raised during the discussion follow.

Active database applications are being built as research demonstrations, but few real world applications have been built so far. It was pointed out by some of the participants that most software developers do not use active features in their projects due to complexity. Currently, software designers have no guidelines on what should be implemented as ECA rules and what should not. The participants agreed that there is a need to pro-

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vide tools for supporting active features in the software development process. It was further suggested that active database tools should be integrated with the software design tools that are already in common use.

Real-time database applications present the real-time database community with similar problems [2]. As for now, few real world database applications have been built for supporting complex applications. It was pointed out that users of potential real-time database applications are mostly conservative when it comes to adopting academic research findings. In this regard, most of the user requirements can be satisfied with existing technology such as high-performance engines, which not always enforces predictability and timeliness of the real-time system.

Active and real-time database applications do not currently use active or real-time database technology, but are instead individually developed, integrated systems. It was felt that the community of users was content with their proven techniques and associated tools, but would need convincing of the advantages of the open architecture promised by database technology. This was not considered to be simply a matter of education; there was a need to sell an integrated technology at the right application level.

There was a perceived need to view active and real-time aspects as functionalities required by applications, instead of separate entities. It was suggested that active and real-time databases (ARTDB) should target real-time capabilities of non-mission-critical applications as they seem to need the functionality of database management systems.

Different categories of applications that would benefit from ARTDB technology include air-traffic control, network management, workflow management systems, coordination infrastructure for distributed object systems, stream-oriented systems and multimedia systems (synchronization).

3 System Issues

The moderated discussion chaired by Sang H. Son (University of Virginia) was focused on identifying system issues for supporting both active and real-time capabilities. Some of the key issues that were raised during the discussion follow [4].

Some participants were concerned whether existing knowledge within each of the two database domains is sufficient in order to combine the two technologies. As of now few real-time database systems have been built given their complexity. Thus, it was argued that adding active database functionality might be too complex, since the effects of merging real-time features with non-real-time features is not fully explored. The participants agreed that real-time databases should only support a subset of the active functionality currently favored by the active database community. It was suggested that the community should adopt the term active and time-constrained instead of active real-time since the latter has a pre-defined connotation from the real-time community.

Predictability was raised as one of the major key issues for active real-time database systems. It was argued that predictability should be considered as the primary requirement for other issues such as transaction management and resource management. Most of the participants agreed that we need to put restrictions on some of the active capabilities in order to probabilistically guarantee a service. In this regard, it was argued that only the detached coupling mode could be used without extending the execution time of a transaction that triggers an event. Further, it was pointed that initial research should focus on primitive events for time-constrained event detection.

System architecture was considered as a critical issue with respect to distribution of functionality, since there may not be a general active real-time database system. Thus, it was suggested that the system architecture should be flexible in order to allow customization. The alternative would be to construct a system from scratch for each application.

Scheduling policies should consider approaches taken in both active databases and real-time databases, but it is unclear how these approaches can be combined and what the tradeoffs will be. Specifying time constraints for rules is not a problem. Once again, the issue of achieving correct semantics was raised as an important issue. Further, dynamic resource management policies and mechanisms for assigning priorities to events and actions, for fulfilling the resource requirements for a specific scenario, was identified as an area for further study. In order to determine the potential workload, the importance of preanalyzing transactions, extending the analysis to including the transactions that may be triggered, was pointed out. In some cases consistency and accuracy of data might be traded for timeliness of system response. However, methods must be developed for reasoning about inconsistency and accuracy, in order to balance the timeliness and the quality of a response.

At the end of the session the participants agreed that we need to develop a working prototype in order to convince users and developers that integrated support is feasible and beneficial. As an initial step it was suggested that we should consider an architecture which can process rules with deadlines and transactions with timing constraints that are associated with rule executions.

4 Conclusions

At the end of the workshop many participants agreed that there is a need for active and time-constrained database systems. However, it was addressed that more working prototypes must be built, which requires a close interaction between industry and academia. The development of working prototypes is crucial if the concepts of active and time-constrained databases are going to be adopted by the wider database community and real users. Finally, the ARTDB-95 workshop was considered a success.

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