Component DBMS Architecture for Nomadic Computing

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Abstract. Current database management system technology is unable to provide adequate support for Nomadic Computing. Mobile applications require systems which are sufficiently lightweight and customisable to provide high performance while consuming minimal power, yet extensible enough to adapt to a constantly changing environment. Current DBMS architectures do not provide this level of customization or adaptability. In this paper we introduce Component-Based Database Management Systems (CBDMS) and discuss their suitability for mobile computing.

1. DBMS Architectures are Obsolete?

New technology is placing greater expectations on DBMS. That is, we anticipate greater use of wide-area networks, heterogeneous platforms, information sharing, higher flexibility and dynamic system modification such as 'plug and play' and hot swap. Historically, enhancing features were just added to the DBMS kernel thickening it and reducing performance. This solution will not work for mobile DBMS applications as the mobile unit is very limited in resources .

Industry, has identified a number of key application areas which would benefit from mobile DBMS. These are: healthcare, sales force automation, tourism and transportation. In particular, sales force automation allows the salesperson to use a unit connected through a mobile network to a set of databases. Furthermore, they can quickly configure complex customer solutions and customised financing options *while with the customer*. This type of operation requires that the mobile client can *update* the DBMSs as the transaction occurs which is still *not* being addressed by the DBMS community.

Performance and adaptability are key requirements of mobile data processing environments which existent DBMS architectures fail to provide. These present new challenges in areas such as query processing, data distribution and transaction management which are being re-thought in terms of performance, battery life and less reliable communication systems.

2. A New Adaptive DBMS architecture based on Components

To provide the amount of flexibility to enable mobile data processing, we require a combination of a lightweight yet extensible DBMS. We look to the history of operating systems for an answer. Early monolithic and micro-kernel operating systems were limited in extensibility and performance, so research looked at extensible kernels, and more recently component-based operating systems [Kostkova96], as a solution.

Current DBMS technology is monolithic and is neither lightweight nor flexible enough to support mobile computing. There has been attempts to make DBMS architectures more lightweight, or to be extensible, [Boncz94], however they all are unsuitable for general DBMS applications. Therefore, DBMS need to be componentised where only the components required for a particular operation are loaded, saving performance and power costs. Furthermore, a component DBMS can extend its functionality on demand -- it binds its components at run-time, adapting to new environments. For example, the movement from a wireless network to a fixed network can trigger a new resource manager or query optimiser to be dynamically loaded as the system is no longer constrained by battery power and wireless communications. Furthermore, as processing is componentised, its migration between mobile network cells becomes more fluid.

3. Our Work and Conclusion

In this paper we have shown that to balance performance efficiency, power efficiency and cost efficiency in nomadic computing, we need more than new transaction processing and query optimisation strategies. For a DBMS to operate efficiently in a mobile environment it needs to be lightweight and customisable, providing high performance while consuming minimal power. Furthermore, the architecture must adapt to a constantly changing environment. We believe that an alternative DBMS architecture based on components is a viable solution. To this end we are currently implementing a CDBMS, which is already beginning to demonstrate its level of real-time configurability and improvement in performance, for not only mobile applications but more traditional applications.

4. References

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