High Performance Database Replication for Storage Area Networks

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Background

- High availability of data has become crucial for the dependability of many applications and services.
- A replicated database replicates data in several locations to increase data availability and scalability.
- Replication protocols coordinate the execution of transactions on a replicated DB and the propagation of changes.

Current Status

- Full replication does not scale beyond certain limits and is inappropriate for large scale systems:
  - Full replication performance is bounded by the amount of remote work to be done.

First Stage

- From full replication to partial replication:

  **Full Replication**
  - Sites contain an entire copy of the DB
  - Updates impose a fraction of work to the other replicas

  **Pure Partial Replication**
  - Sites only contain a fraction of the DB

  **Hybrid Replication**
  - Some sites contain the full DB (full replicas).
  - Others only a fraction (partial replicas).

This PhD will

- explore partial replication as one additional mechanism to overcome the scalability ceiling of current approaches.
- exploit new correctness criteria such as 1-copy snapshot isolation to enhance scalability.
- build a highly scalable replicated database upon SANs (low latency and cards that execute firmware to offload protocol processing from the host)
- develop autonomic reconfiguration and optimisation techniques to maximise performance.

Analytical Model

- An analytical model for the scale out of hybrid and pure partial replication has been developed.
- The scale out measures how many times the throughput of a non-replicated site is increased by the replicated system.
- The scale out is modelled as:
  - An equation system.
  - An linear program that maximizes the scale out.

Preliminary Conclusions

- Partial replication increases scalability.
- With pure partial data replication the scale out only depends on the number of replicas.
- Hybrid partial replication scales slightly better than full replication.

PhD Timeline

- Analytical model + a pure partial replicated database
- Improving partial replication taking advantages of SANs
- Providing self-adaptation features for partial replication over SANs

Analytical Results

- Partial Replication
- Full Replication
- Hybrid Replication

Scale Out

- **Analytical Model**: Analytical model + a pure partial replicated database
- **Improving Partial Replication**: Improving partial replication taking advantages of SANs
- **Providing Self-Adaptation Features**: Providing self-adaptation features for partial replication over SANs

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