Replication in Mobile Environments

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**Data Replication Over Disadvantaged Tactical Communication Links: Replication in Mobile Environments**

**Research Establishment for Applied Sciences Research Institute for Communication, Information Processing, and Ergonomics**

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What is the Problem?

Data replication among distributed databases occurring over disadvantaged (unreliable, low bandwidth or energy constrained) mobile wireless military communication networks

- extremely limited and highly variable **data throughput**
- **energy constraints**
- **inconsistent** databases
Different Ways of Solving the Problem

• Developing a solution in the described environment without considering existing solutions

• **here:**
  - Studying existing solutions journals, conferences, dissertations, ...
  - Check whether those solutions are applicable in our environment

• **Example:**
  - Dissertation David Howard Ratner: “Roam: A Scalable Replication System for Mobile and Distributed Computing”
Replication Models

- **Master - Slave**
  one replica: master, all others: slave
  slaves are read-only
  modifications are only performed with the master

- **Client - Server**
  functionality (modifications / updates) of clients improved
  multiple inter-communicating servers permitted
  no intercommunication between clients

- **Peer - to - Peer**
  all replicas are equal
  any replica can synchronise with any other replica
Problems of Replication Models

- **Master - Slave and Client - Server**
  - no intercommunication between clients
  - don’t get replica from the nearest partner
  - important position of server
  - if server down, no update for clients

- **Peer - to - Peer**
  - storing all necessary replication knowledge at every site
  - exceedingly large data structures
  - scaling problems
Ward Model [David Howard Rattner]

- **Wide Area Replication Domains**
- based on a hybrid between client-server and peer-to-peer
- one **ward master** representing the group
- Ward Grouping depends on:
  - Geographic location
  - Expected bandwidth
  - Connection latency
  - Expected network connectivity
  - Network cost
- All ward members are peers
Ward Example
Military Application

- Low-level units, like battalions or companies, that communicate via wireless communication systems, are modelled as a ward.
- Higher-level units, like brigades,... are modelled out of wards.
Two approaches to achieve global consistency:

- **Conservative Approach**
  - locking, voting, primary-site techniques to prevent conflicting updates
  - not viable because of disconnection and partitions

- **Optimistic Approach**
  - concurrent updates and conflicts are rare
  - allows updates to be performed independently
  - improving availability, but conflict resolution needed
Application in the Military Environments

- **Combination** of conservative and optimistic approach?
- Do we need **global consistency**?
- Is the described solution **applicable in military environments**?
- Are the advantages of **Broadcasting** integrated?
- Can **Selective Replication** be applied to reduce the number of replicated information?
  
  ATCCIS: replication by contracts