Distributed Database*(preliminary)*

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1 Introduction

The Distributed Database (DDB) is a simple record/field oriented distributed database. It minimizes the need to be **Network Connected** at all times. The goal is to achieve the highest functionality in degraded modes.
DDB addresses the problem of system down time by keeping sufficient information on local computers to perform the majority of its tasks. This particularly supports **Real Time** and **Embedded Systems** since the relevant data is now local. It also reduces security risks, since only the relevant data is maintained, so a stolen computer, or a malicious attacker has little to gain.

1.1 Identification

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2 Goals

This section covers specific DDB goals including the primary goal to support complex engineering problems, complete with highest application functionality in degraded systems.

2.1 An Engineering Distributed Database

DDB primarily targets the distributed engineering environments supporting most levels of computing platforms. DDB understands standard engineering types, performance restrictions, and safety issues.

2.2 Degraded Systems

Achieve the highest application functionality in degraded systems.
The cost of system down time can be greatly reduced with minor planning. Many solutions to the down time problem is to use expensive networks and/or servers, when only planning is required. When software application designers are involved with degraded planning, unique and sometimes expensive solutions to maintain are used.

2.3 Low development costs

Low development costs can be achieved by separating the application developer from the tedious administration associated with a distributed database. DDB allows application developer to work (mostly) without knowledge of the final system data distribution architecture. The developer need only to include their dependencies on the system.

2.4 High performance

Typical **Real Time** and/or **Embedded Systems** require numerically compressed values for actions and data decisions and avoid string parsing. DDB only uses these numerically compressed values when communicating between systems, fully supporting these performance requirements.
However, to support user interactions, an local lookup dictionary can be maintained by DDB to support user interactions.

2.5 Relational

Records containing the same field can be logically joined. An index is kept local on the system to remove any network traffic or delays. Fields specified to be unique, aka record-index, allow some applications to maintain only the latest updated information. Applications not declaring a unique field can have a log of updates.

2.6 International

Multiple language support can be provided by the DDB required dictionary for user interaction. Unlike **gettext**, this could be dynamic and context sensitive.

2.7 Hardware Interfaces

DDB design shall support multiple hardware interfaces, but is optimized around TCP/IP UDP and multicast.

2.8 Security

DDB includes several security features.

2.8.1 Multiple Levels of Security

Encryption can be enabled and assigned on a field bases, allowing partitioning with multiple levels of security within the same record. Data can be distributed to many systems, but only the applications with the specific keys and passwords to the field can access it.
This support the highest functionality and minimizes the effects of stolen or compromised systems.

2.8.2 User/Group style local protections

DDB fully uses Unix/GNU-Linux user/group protections for reporting data. DDB treats field separately and can be assigned to a specific group. Allowing multiple groups to coexist on the same system. It can be used to determine the data to be maintained on the specific system.

2.8.3 Network

DDB can work behind a VPN or use SSH piping when entering or leaving a protected network. Within the protected network, DDB filters packets only relevant to the applications and users on the system.

2.8.4 Need to Know

DDB can be configured to distribute only the required data to specific systems. Separating personal identification, medical, and accounting information is now required from most governments. A stolen lab computer may contain minimal identification and medical information, but not enough for identity theft. A context sensitive DDB dictionary can further be used to filter sensitive into approved releasable media.

2.9 Data Integrity

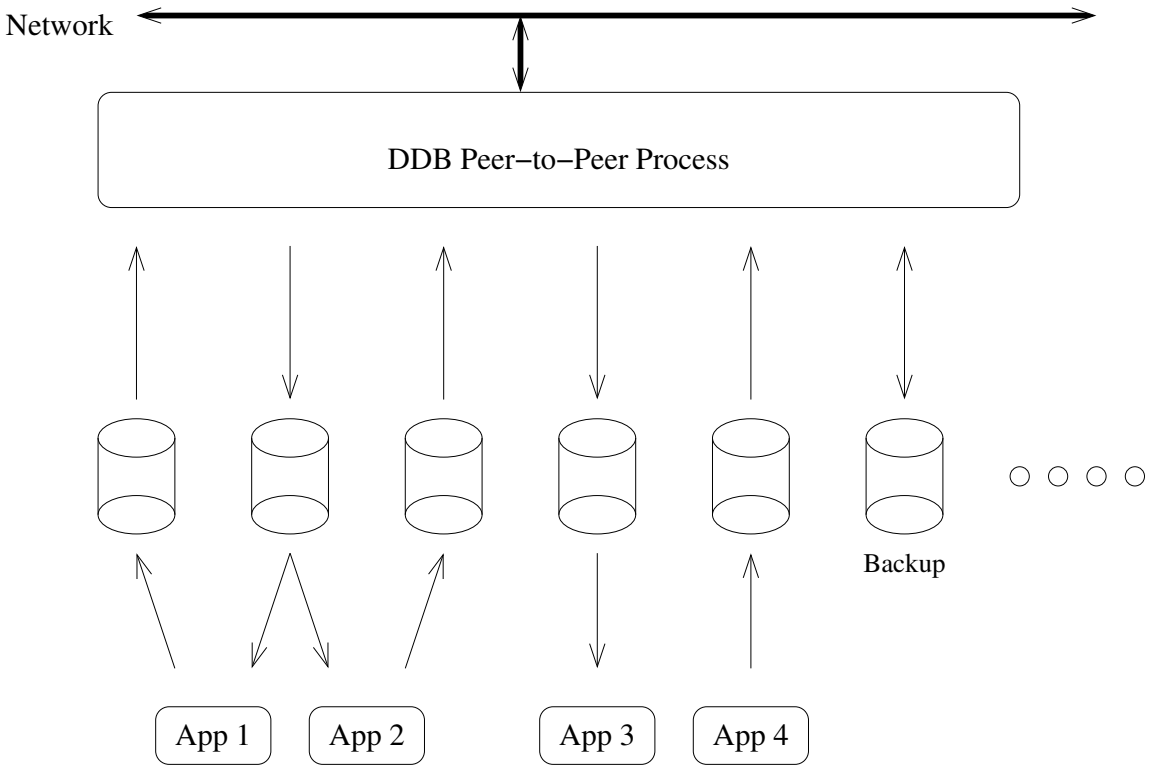
DDB can guarantee limited data integrity after a suspected network disconnect or lost packet. Each DDB requests updates from the network.

2.10 Record Variation

DDB shall support records with varying fields and units. Thus allowing embedded applications free of non-relevant fields and conversions.

3 Architecture

The basic DDB architecture consists of a network peer-to-peer process feeding one way tables. Systems including embedded systems, may use restricted shared memory or files for these tables. With proper permissions, the applications can read and monitor one or more of these tables. Conversely, if an application has data to report, it creates and maintains an out going data file. In all cases, only one process (application or network process) is responsible for maintaining a given file.



$Id: architecture.fig 1 2013–01–07 03:11:41Z ty $

4 Engineering Data Specifications

DDB uses the Electronic Capabilities Manager (ECM) method of specifying DDB requirements within the application source code. Typically within Doxygen's comment strings /** or ---. Example:

```
/**
  Calculates: energy W/hrs = windmill(wind miles/hr, model);
  */
```

Informs DDB that the application supplies an energy table for a windmill based on the speed of the wind in the units miles per hour.
An associated include file is generated for the application to fill in an energy table. It also publishes this capability to the current and future users.

5 Organization

A very important distinction to note: **DDB does not use multiple individual tables** as many databases. DDB only has and maintains records which can be joined or tightly coupled. DDB does support logical or virtual Tables. DDB defines *Table* as an array of records containing a specific attribute. The above windmill example would create a windmill *Table*.
Each field within a record can be owned by different processes on different systems. Multiple sources for a field are flagged by DDB as a **warning** and are treated as unique records.
Every record has a unique local *rec_id*. DDB defines *rec_id* as an array of pointers to the actual record data.

Keys can be used for sorted or creating groups of records. DDB defines *Key* as a pre-selected set of records. SQL users may consider a pre-compiled select statement.

5.1 Records

All records are referenced by rec_id. To preserve full database atomic during updates, the reference table address is replaced pointing to a completed record structure. The old record shall be garbage cleaned up only after a specified amount of time to allow slower applications to complete their task.

5.2 Tables

Tables (shared memory or files) are of three base types:

History records are only appended. Some history tables are a circular queue, others a maintained as daily files. History records are used to generate and update data table records. Note that data tables are not always required. The life of the history table depends on the need for long term records.

Data tables are an indexed lists of data records. Generally updated from history table updates. A data tables can report change amounts by keeping available a previous record.

Key is a sorted table containing index values into data tables. Key table are only generated on local systems if required by a local application.

5.3 String Enumeration

DDB uses string enumeration for the following:

Dynamic Multilingual support for immediate updates between international groups.

Embedded applications can have the strings removed from the application.

Performance gains are seen when string manipulations are removed from real time or embedded applications.

Space gains are seen when applications and databases only store enumerated values.

5.4 No Locking

DDB does not support record locking, only field ownership. Locking is dangerous in most prioritized and distributed systems where high functionality is important. The same functionality can typically be achieved via *request* and *current* data organization. An example camera manager application can take a prioritized list of *requests* from the system, but will only report the *current* or actual camera configuration.

5.5 Optimized functions

Some functions can be compile time optimized, such as *sum()*, *count()*, *select()*, and unit conversions.

5.6 Capabilities and Dependencies

Capabilities and *Dependencies* are electronically available for complete system analysis.

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