ITTIA DB SQL

Relational Embedded Database

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Leading Edge RDBMS

(Embedded Systems and Devices)

Overview

- Embedded Data Management
  - Design considerations
  - Challenges
- Custom Solutions
  - Flat Files
- Embedded RDBMS and Benefits
- ITTIA DB SQL

The evolution of RDBMS

- Mainframe – 1970…
- Personal Computers – 1980…
- Web and Internet – 1990…
- Embedded Systems – 2000…
  - Intelligent Devices
- Era of connected intelligence – 2010
  - Interoperability
  - Maintainability

Evolution of Embedded Systems

ITTIA DATABASE

- Embedded systems take on enterprise characteristics
  - More complexity
  - More long-term data storage
- Not economical to rewrite code from scratch for each new product
  - Software must be maintainable
  - Software must be interoperable
- Specialized processor architectures
    - Intel, ARM, PowerPC, ….

Challenges - Embedded Development

- Software is built for specific hardware
  - Can build framework from scratch to focus on platform's unique problems
  - Custom framework seems simple at first
    - **Quickly becomes overwhelming as expectations mount**
- Exact memory layout for a given application varies by processor architecture
- Alignment
  - Integers may be aligned on word boundaries
  - Structures may be padded to align members
  - Arrays may be padded to align elements
- Byte order
  - Big-endian
  - Little-endian

Design Considerations

- Performance
  - Fast Data Access
- Footprint
- Fail-safe Reliability
  - Data Consistency
- Concurrency
  - Multi-User Access
  - Synchronization
- Portability
- Cost

Flat Text Files/Custom Binary Files

- **Flat Text Files**
  - Human-readable format simplifies testing
  - Must rewrite entire file for any change
  - No protection against data loss
  - No efficient “search” method when file is large
  - Entire file must fit in RAM

Flat Binary Files

- Random access permits writing partial changes
- Painful to view and edit by hand
- Easily corrupted, but data loss is usually isolated to one part of the file
- Difficult to store variable-width data

Flat and Binary Files Challenges

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- Limited Life Cycle
  - Custom formats are not portable
  - Do not scale easily
  - Sharing persistent data between processes and threads is cumbersome
  - Multiple readers and writers access the data over a long period of time
  - Optimization and maintenance requires dedicated development effort

Why Relational Data Model?

- Interoperability
  - Communication with other embedded systems
  - Integration with development tools
  - Standards (SQL, ODBC, etc.)
  - No impedance mismatch
- Maintainability
  - Minimize training for new developers
  - Leverage existing database experience
  - Schema upgrades

Why Relational?

- Indexed Search
  - Information is organized into tables
  - Search efficiently with B+tree indexes
    - Consistent performance regardless of table size
    - Search megabytes of data with kilobytes of RAM
  - Multiple indexes on each table for multiple access patterns
  - Database applications are inherently scalable

ITTIA DB-SQL History

- **Market R&D (2002-2005)**
- **November 2005 – Beta I**
  - Database Kernel
- **May 2006 – ITTIA DB 1.0**
  - Multi-threaded
  - C API
- **May 2007 – ITTIA DB 2.0**
  - Multi Process Support
  - Client/Server
  - Change Notification
- **December 2007 – ITTIA DB 2.5**
  - SQL
- **August 2008 – ITTIA DB 2.6**
  - SQL Optimization
- **October 2008 – ITTIA DB 2.7**
  - Introduced Compact
  - Client/Server Optimization
- **November 2008 – ITTIA DB 2.8**
  - ODBC Driver
- **October 2009 – ITTIA DB 3.1**
  - In-Memory
- **December 2010 – ITTIA DB 4.X**
  - **Replication, HA, On-line back-up**
- **Next**
  - **Synchronization**

ITTIA DB Datasheet:
http://www.ittia.com/files/resources/ittiadb_data_sheet.pdf

ITTIA DB Three-Editions

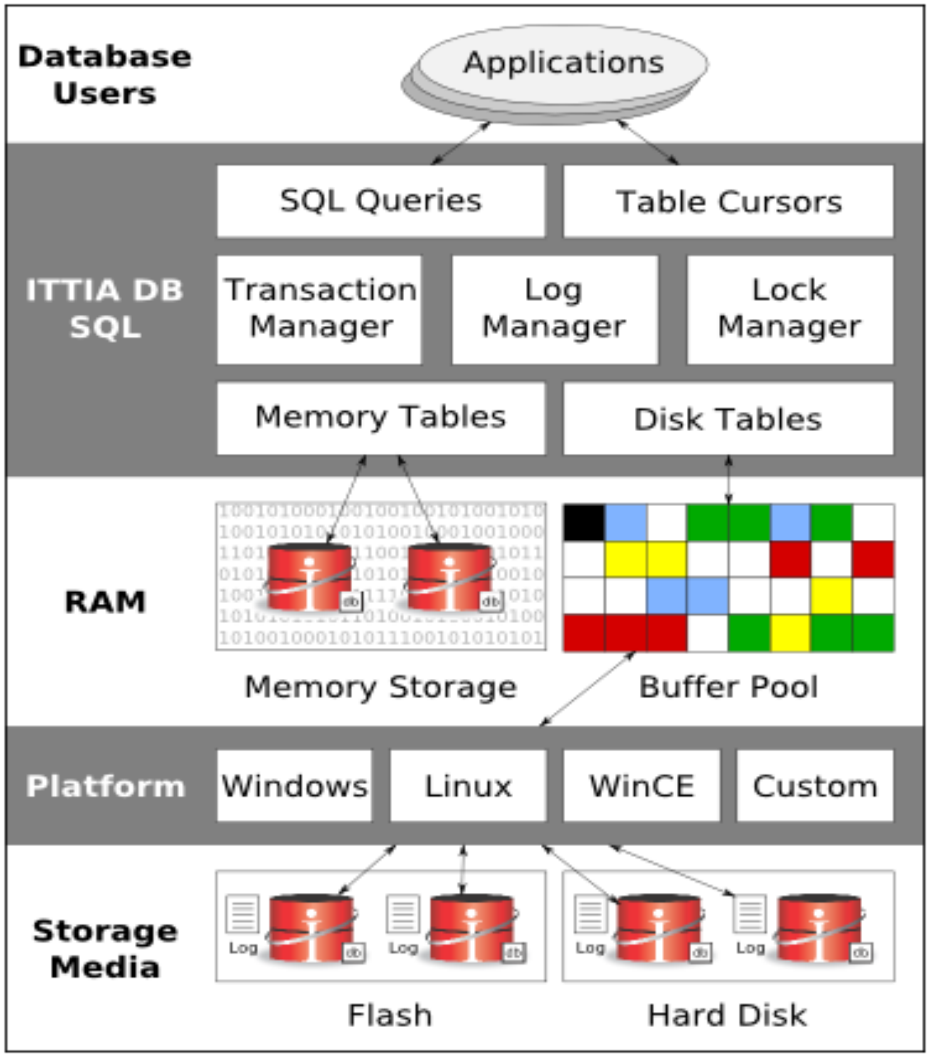
- **ITTIA DB – Compact**
  - Low-level access to ITTIA DB files with minimum code footprint
- **ITTIA DB-SQL Standard**
  - Single User/Single Thread/Optional run-time SQL queries
- **ITTIA DB-SQL Plus**
  - Multi-user/Multi-threaded/Client/server/Concurrency Support

Feature comparison

- http://www.ittia.com/products/features

- Each edition available in object and source code packages.

ITTIA DB-SQL Architecture



ITTIA DB-SQL

- Powerful database library
  - On-Disk and In-Memory
- Targeted at embedded and device developers
- Small footprint and great performance
  - 135K to 750/850K
- Power of cross platform
  - Easy to compile on a new platforms (OS)
- Elegant APIs (C/C++)
  - Low Level Navigational Calls
- JNI and .NET API
- ODBC

Navigational Table Cursors

- Low-level table scan and index sequential access
- Execution plan completely specified by the developer
- Bypass the overhead of SQL parsing, optimization, and execution
- Reduce processor usage
- Footprint reduction

Cross Platform

- **Operating Systems**
  - Windows
    - WinCE, Mobile, Pocket PC
    - Win32
  - Linux
    - WindRiver Linux
    - Embedded Linux
    - Etc.
- QNX
- VxWorks, ThreadX
- Meego
- Custom OS
- …no OS

Customers

ITTIA
DATABASE

PSE PUGET SOUND ENERGY
The Energy To Do Great Things

FRESENIUS

freescale™
semiconductor

PVPowered

Panasonic
ideas for life

gsk GlaxoSmithKline

- **PSE** – Puget Sound Energy, Washington state's largest and oldest energy utility, selects ITTIA DB to manage mobile data.
- **Fresenius –** Fresenius the market leader in infusion therapy and clinical nutrition with products for dialysis. Fresenius selects ITTIA DB to store patient's data on intelligent devices.
- **Freescale** – There are more than 18 billion Freescale semiconductors SDK in automobiles, computer networks, communications infrastructure, office buildings, factories, industrial equipment, tools, home appliances and consumer products.
- **PV Powered –** PV Powered, a solar power manufacture company selects ITTIA DB for its solar industry's photovoltaic solar inverter solutions.
- **Panasonic -** A world leader in consumer electronics chose ITTIA DB technology as a central component of a major product.
- **Glaxo Smith Kline** - One of the world's leading research-based pharmaceutical and health care companies, selects ITTIA database technology for one of its complex products cost-savings and financial decision support applications.

Conclusion

- Embedded Data Management Uniqueness
- Right SDK with careful analysis
- Flat Files are not robust
- Concurrency – Synchronization - Connectivity
- Cost
- Single Solution
  - ITTIA DB SQL

Thank you

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