Embedded Database – Pushing the Application Envelope

Empress Software Inc.

Agenda

- What does the next generation of embedded databases have in store for you?
- Empress Ultra Embedded V10.20
- Multitude of Different APIs
- Different Embedded Configuration Scenarios

Agenda

- Multi-Task Model
- In-Memory Features
- Encryption
- SQL Features

Agenda

- Cross-Platform Development
- Text Search Index Capability
- Instead of Conclusion

Empress API's

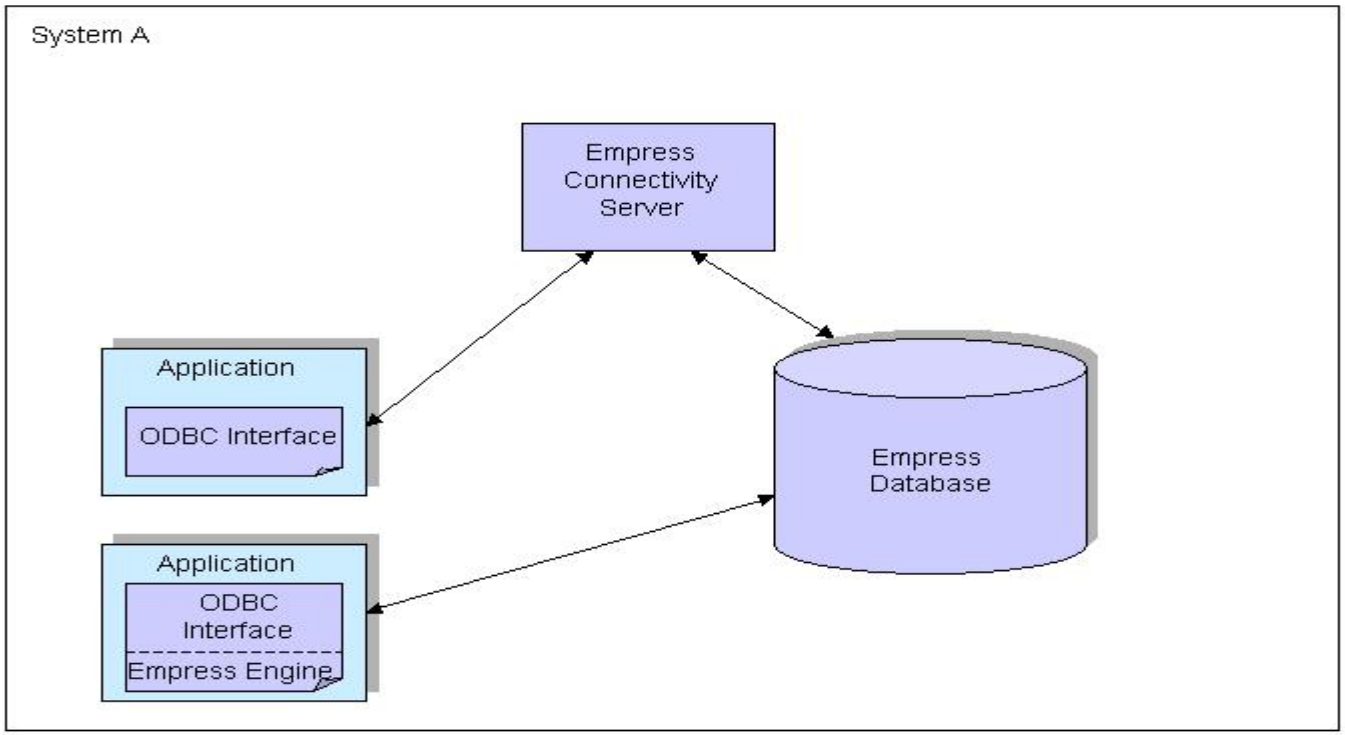
Languages: C,C++, Java, …

Code Sets: Latin-1, Unicode, UTF-8, EUC-JP, SJIS, …

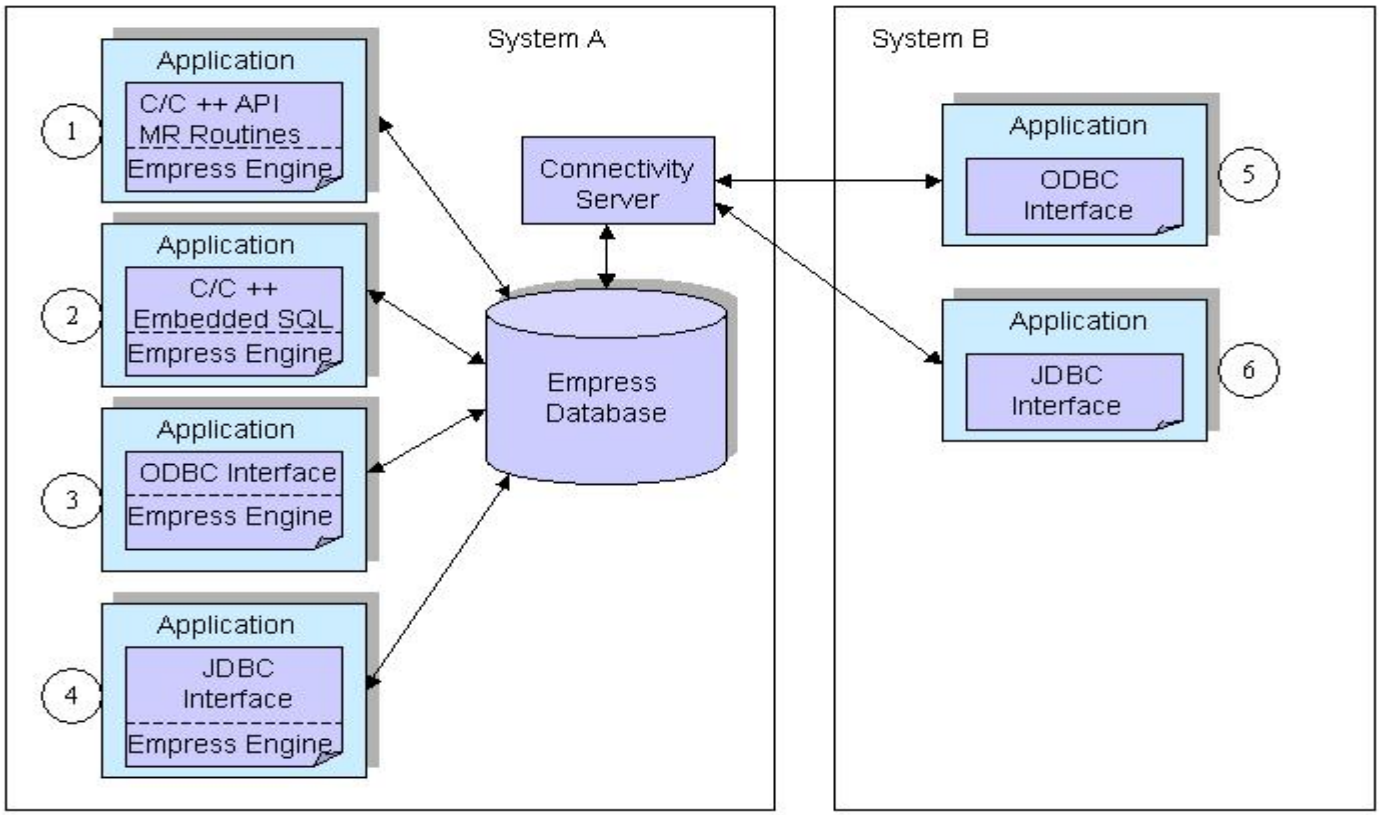
- C/C++ Kernel Level Interface - mr Routines
- Embedded Static and Dynamic SQL
- *ODBC Interface*
- *JDBC Interface*

Empress API's

Configuration Scenarios



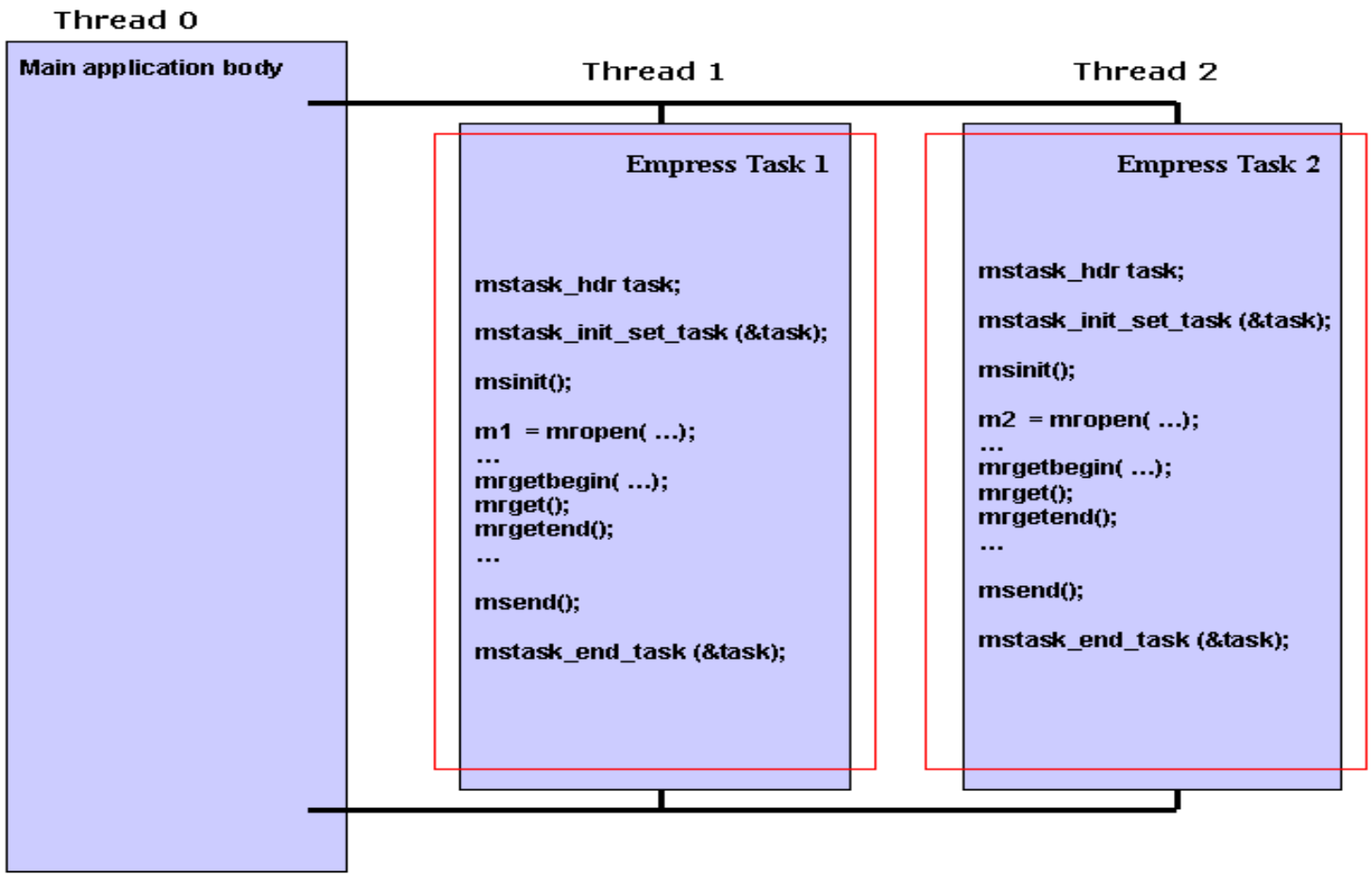
Empress API's



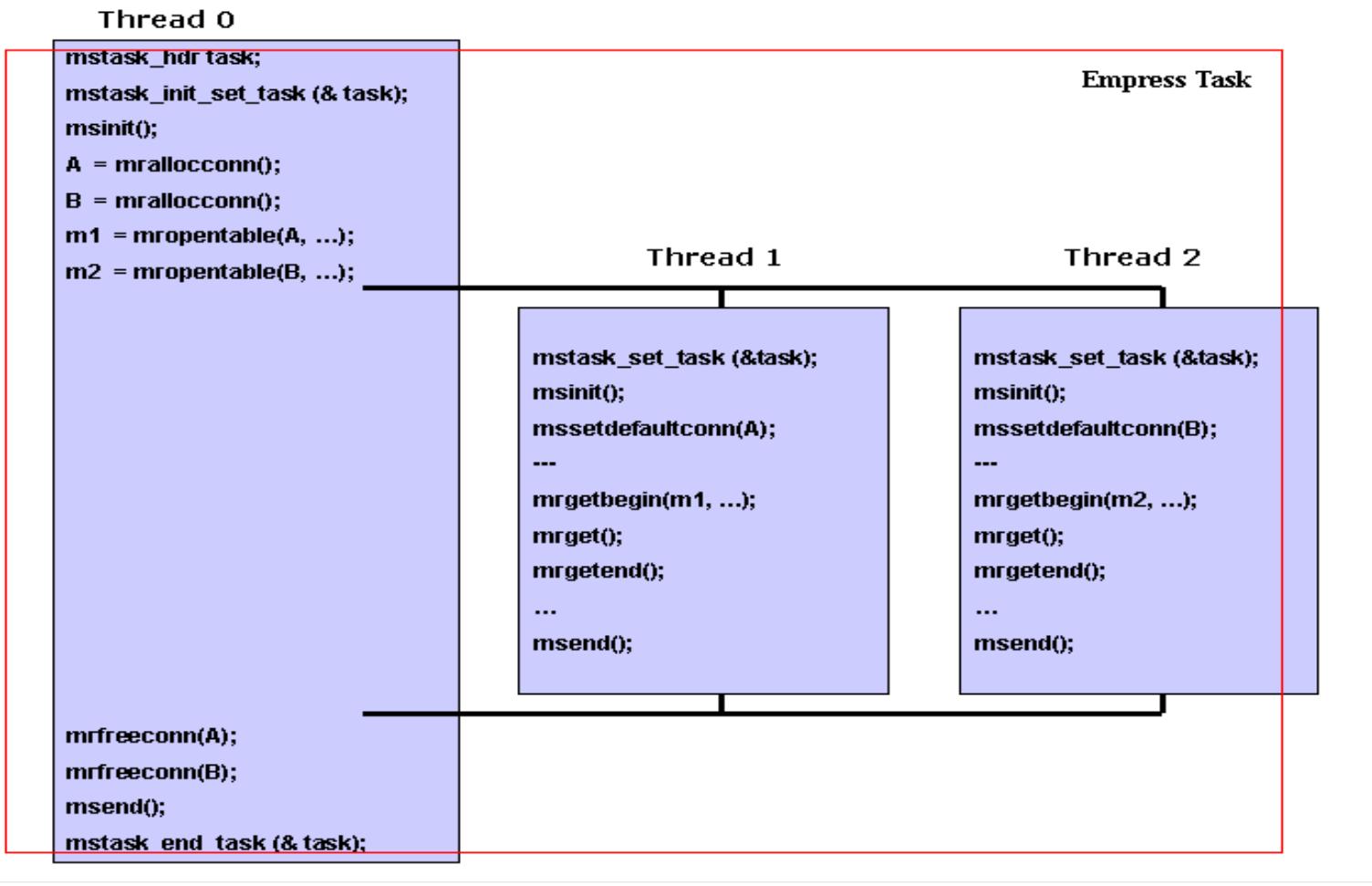
Empress Task Model

- Enables parallelism
- True multi-threading
- Powers non-process based environments
- Parallel programming fully exploits multicore processors
- New C/C++ MR Routines

Empress Task Model

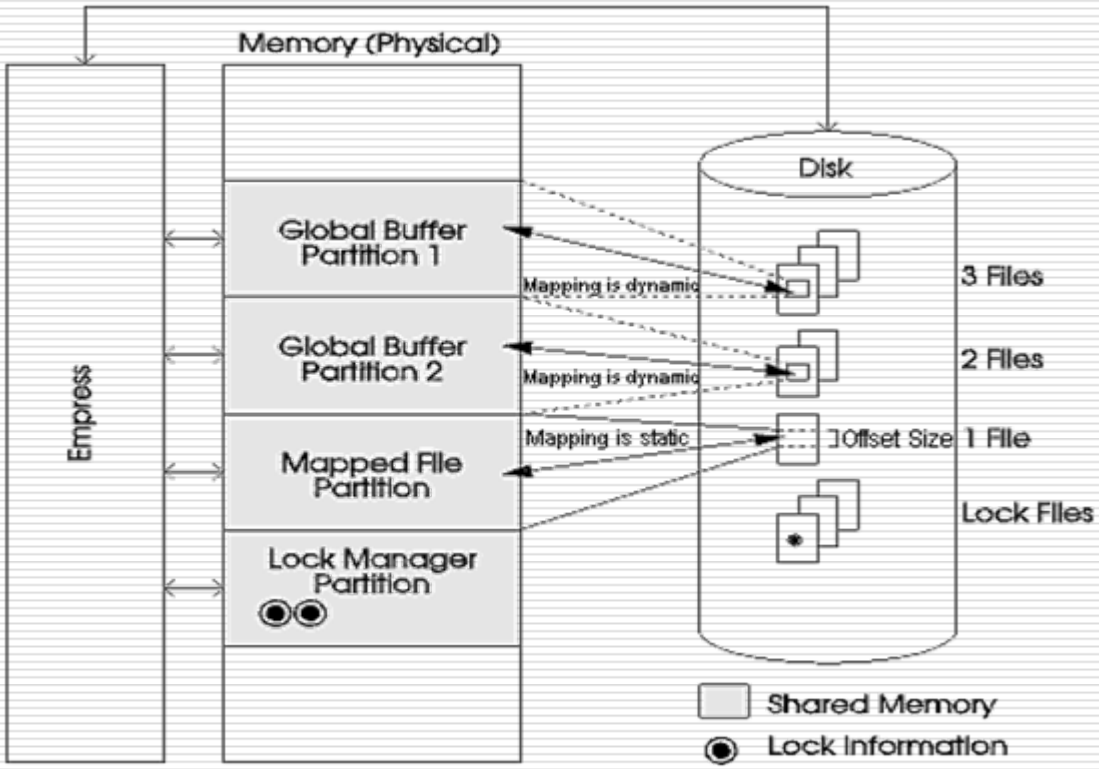


Empress Task Model



In-Memory Features

Shared Memory Configuration Option



In-Memory Features

Shared Memory Configuration Option

- Shared Memory Mapped File Option - MSPARTMAPFSYNC

- Three options for MSPARTMAPFSYNC:
  - writethrough
  - close
  - never

In-Memory Features

In-Memory Table

- CREATE TABLE ... LOCATE IN MEMORY
- Non-persistent solution
- Only for non-process based environments

Writing Data to Persistent Storage

New MR routine mrflush()

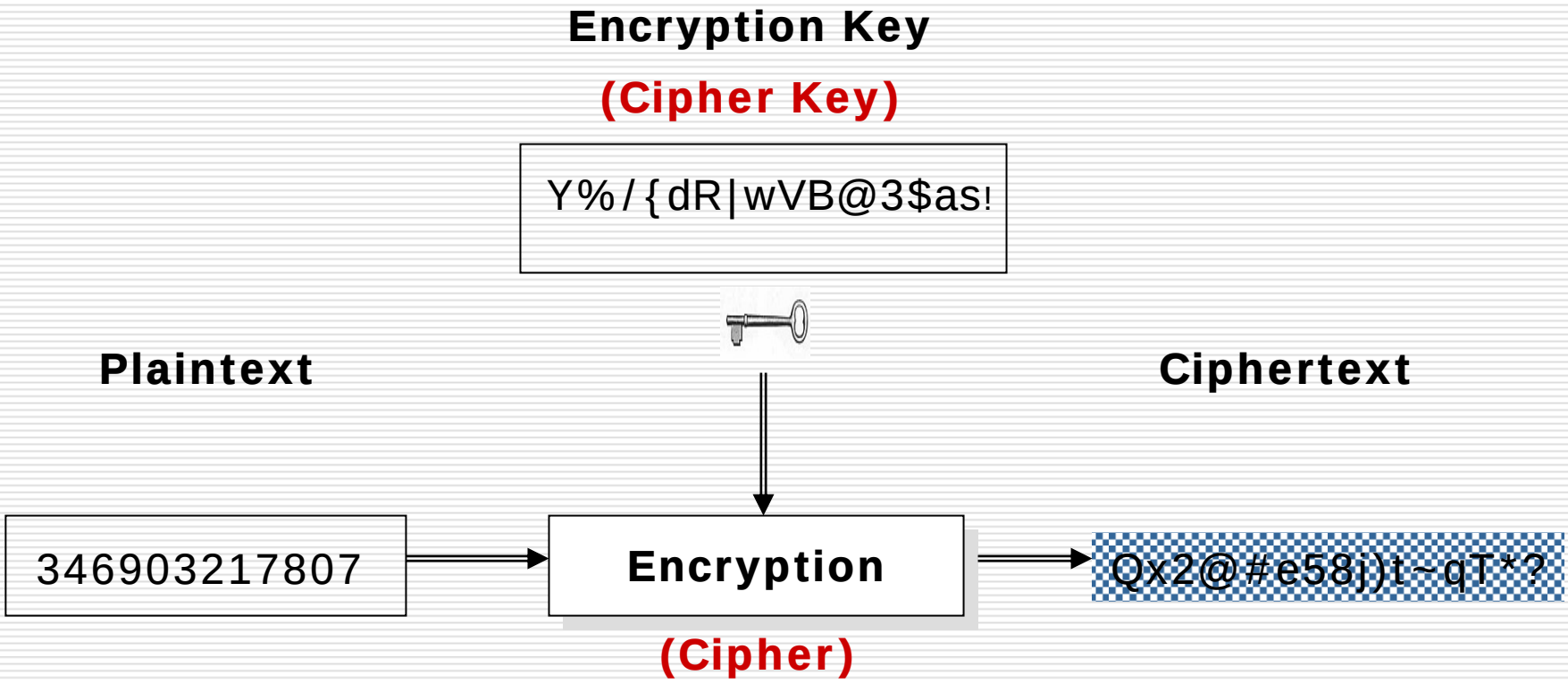
- Flushes local buffered data (commits data) related to the database table

- Usage:

  flag = mrflush (tab, type);

- Three options for *type* :
  - MRFLUSH_NORMAL
  - MRFLUSH_TO_OS
  - MRFLUSH_TO_DEVICE

Encryption



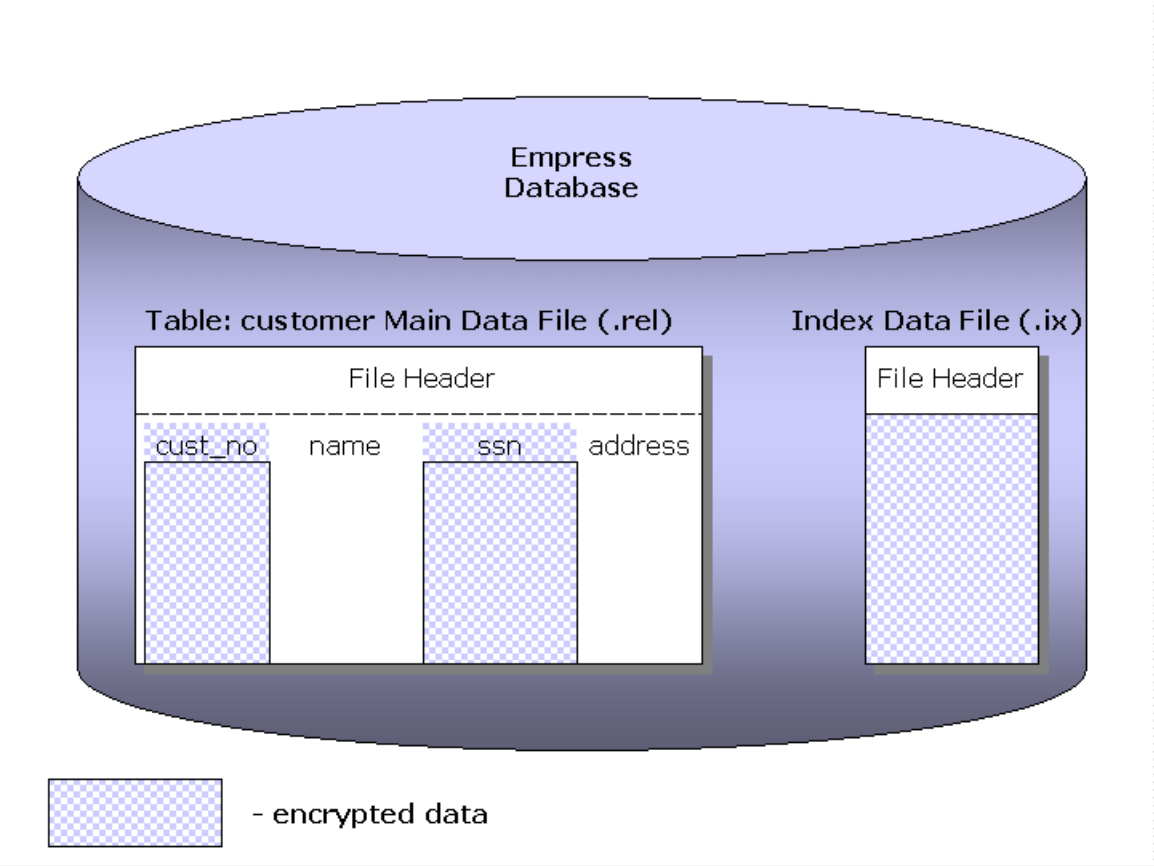
Encryption

- Encryption is done at column level

```
CREATE TABLE customer (
    cust_no INTEGER NOT NULL ENCRYPTED,
    name CHAR(20),
    ssn CHAR(9) ENCRYPTED,
    address TEXT);

CREATE UNIQUE INDEX customer_index ON
    customer(cust_no);
```

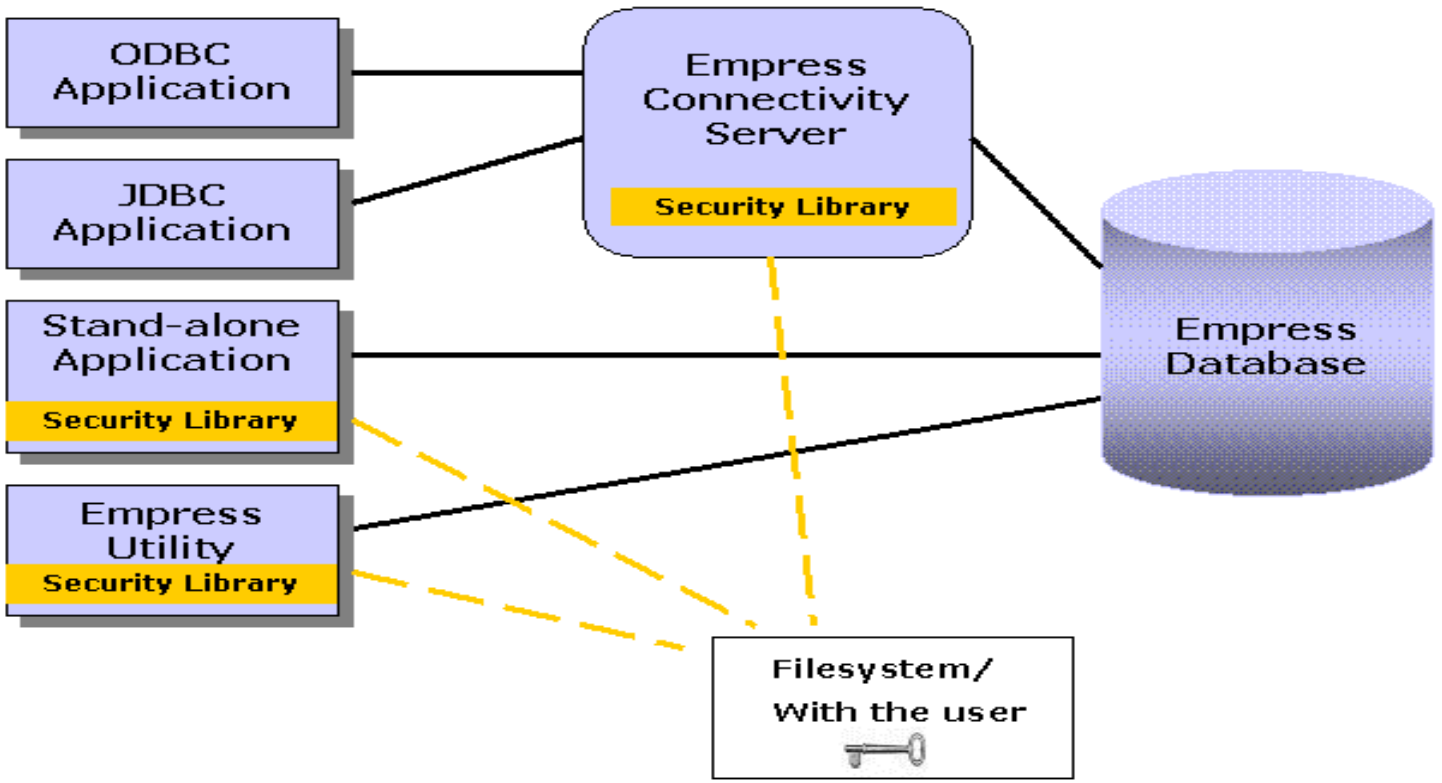
Encryption



Encryption

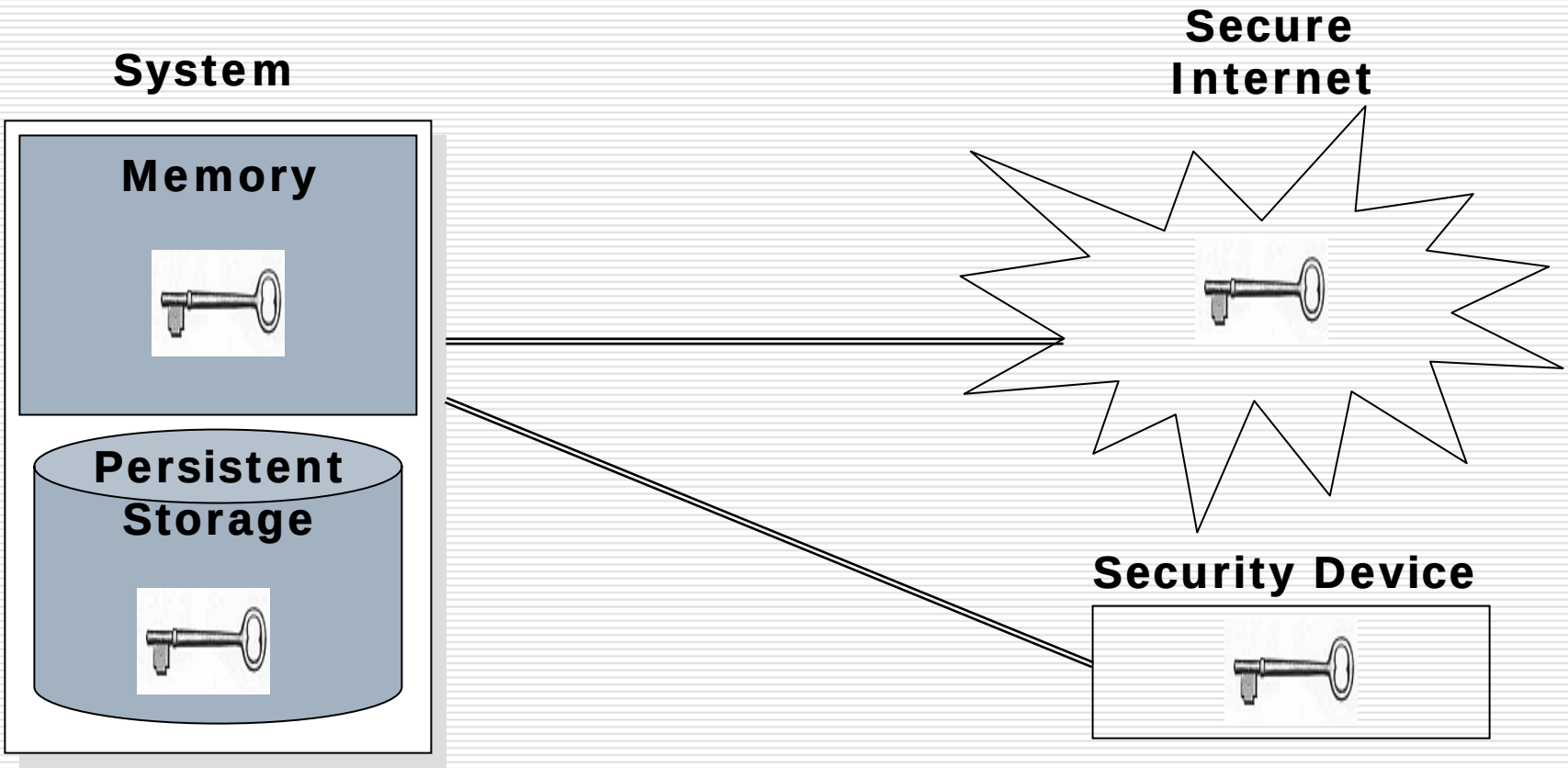
- Secures all database data (includes protection of all logs and backup files)
- Efficient security solution (insignificant performance overhead)
- No need for application code changes
- No need for adding external provisions (e.g. stored procedures, triggers, views, etc.)

Encryption



Encryption

Key Management - Keys Stored in Different Places



Encryption

- There will be NO data from encrypted columns stored on the disk in plaintext
- Encryption on any column data type is allowed
- Ability to create indexes on the encrypted columns of any Empress data type

Encryption

Empress Database Encryption Solution

- Simple To Use
- No Extra Effort Needed for Application Management
- No Significant Impact on Application Response Time
- Some Extra Effort Needed for Key Management
- Transparent Solution for Different Platforms

SQL Features

- CREATE DATABASE Command
- Cascading UPDATE & DELETE Command
- Scalar Subqueries
- CASE Expressions
- ...

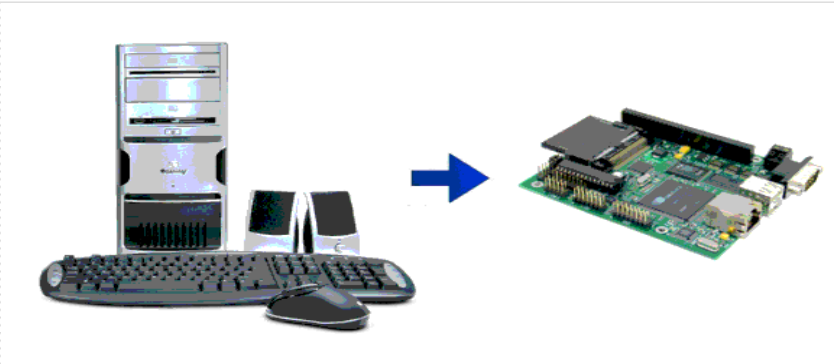
SQL Data Types

- Character Data: CHAR, NCHAR, VARCHAR, VARNCHAR, CLOB, NCLOB, etc.
- Numeric Data: TINYINT, SMALLINT, INTEGER, BIGINT, REAL, FLOAT, DOUBLE PRECISION, DECIMAL, NUMERIC, etc.
- Date & Time Data: DATE, TIME, TIME WITHOUT TIME ZONE, TIMESTAMP, TIMESTAMP WITHOUT TIME ZONE
- Binary Data: BLOB, BINARY LARGE OBJECT
- Boolean Data: BOOLEAN
- Sequence Data: SEQUENCE32, SEQUENCE64

Cross Platform Development

How is the Application developed for the Embedded Market?

- Development is done using development host and the target device (board)
- The development host is typically Linux or Microsoft Windows PC
- Requires host and target to cooperate. Target typically has both serial & Ethernet ports available.



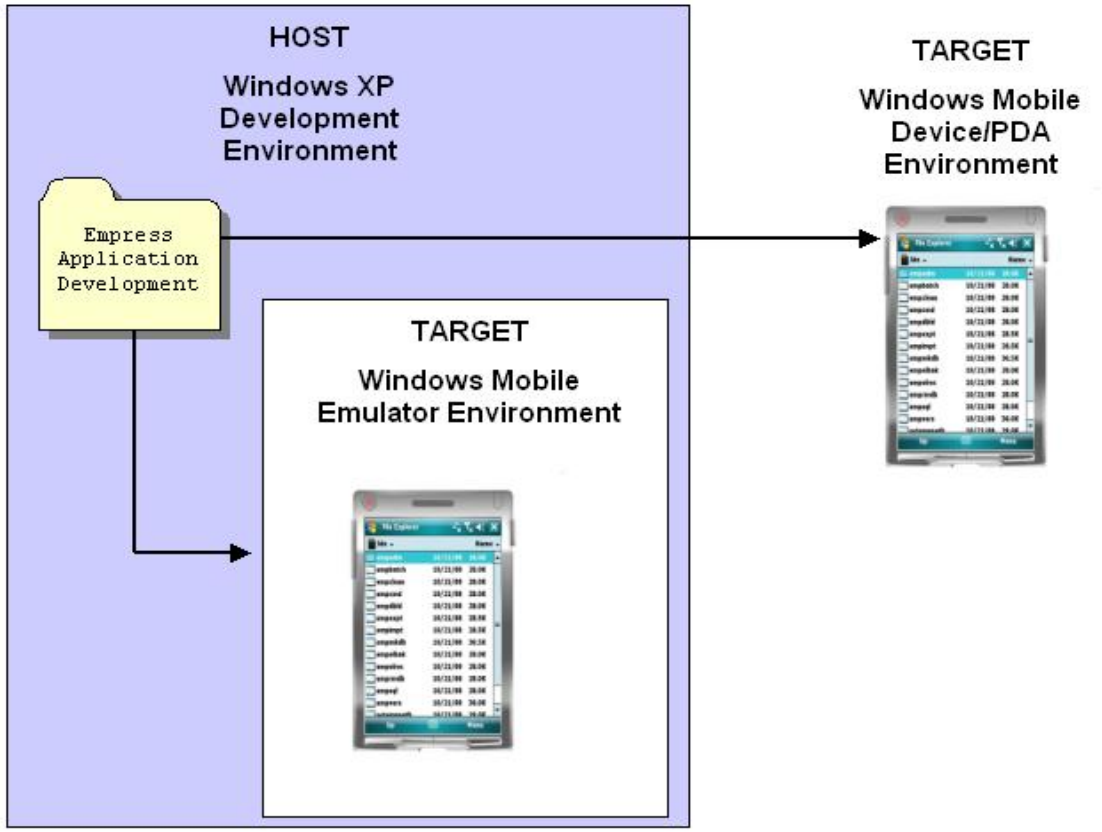
Cross Platform Development

Running Empress

- Build the application using Host Development Environment
- Load Empress modules from Host into Target
- Make/Copy Empress Database
- Run Application

Cross Platform Development

Developing with Empress



Cross Platform Development

Installing Empress Cross Development Package

To install it, you can just un-tar the file to your preferred directory on the host, e.g.

```
Empress_VxWorks6.6/
    |--> README.txt              Special VxWorks related instructions
    |--> version.txt             Version of this package
    |--> docs                    Empress documentation
    |--> samples                 Sample programs
    |--> host                    Host development programs
    |--> xtarget
         |--> vx-ppc             Empress files for PowerPC target
              |--> include/      Empress include files
              |--> load_modules/ Empress loadable libraries
              |--> runtime/      Empress config files (for reference)
              |--> version.txt   Version of this target package
```

Empress Special Searches

- *Text Search Index*
- *Prefix Match Search*
- *Shiborikomi Search*

Empress Text Search Index

- *Implements an efficient search for database records using keywords/tokens/phrases.*
- *Additional set of C calls that are used in conjunction with Empress C/C++ Kernel Level API – mr Routines.*
- *Application would supply the list (array) of tokens/keywords/phrases on insertion in the Empress database in order to create a text search index.*

Empress Text Search Index

Karaoke Machine

- *For the famous Beatles song "I Want To Hold Your Hand" the list of tokens/keywords/phrases could look like as follows:*

  Want
  Hold
  Hand
  I
  Hold Your
  Your Hand
  Hold Your Hand

Empress Text Search Index

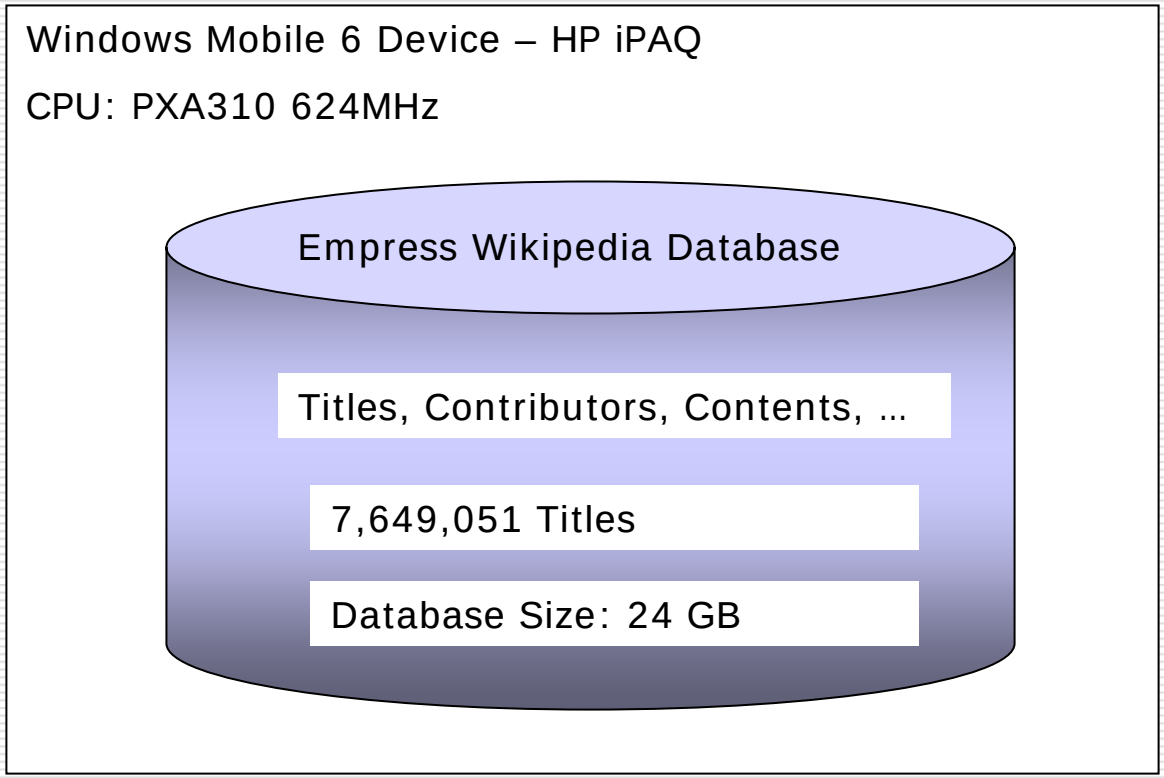
Karaoke Machine

- *Search using either token Mc or Mac to get a song title "Old Macdonald".*
- *Search using token Hold to get a song title "I Want To Hold Your Hand", the result list may include:*

You Really Got A Hold on Me (Beatles)
If We Hold On (Diana Ross)
I Want To Hold Your Hand (Beatles)
Hold Me Back (Ac/Dc)
Hold Me, Thrill Me, Kill Me (U2)

Empress Text Search Index

Wikipedia "The Free Encyclopedia" Database



Empress Text Search Index

Wikipedia Database

- *Search Wikipedia DB for titles having **Embedded** keyword:*

  SELECT id, title FROM pages WHERE title LIKE '%Embedded%'

- *Without Text Search Index:*
  *35.314 seconds with 131 **titles** in the result set.*

- *With Text Search Index:*
  *0.077 seconds with 131 **titles** in the result set.*

Empress Reliability Live Test 24/7

Empress Live DB

Empress Live DB

This Empress database system was set off on **August 8, 2005**. Since then:

Maintenance routines: **ZERO**

Operational for: **1264** days, **0** hours, **55** minutes, **36** seconds

Operations performed: **490,140,476,451** operations.

It took **1.94889** seconds to perform first 5,000 operations.
It took **1.171168** seconds to perform the last 5,000 operations.

Instead of Conclusion

- ***Empress Ultra Embedded v10.20*** is one of the most powerful and cost-effective database management systems available for organizations developing embedded, real-time applications using Linux, FreeBSD, UNIX, Windows, VxWorks, QNX, LynxOS or other Real-Time operating systems.

Instead of Conclusion

- ***Empress*** brings new features to address the growing needs of embedded systems.
- ***Empress*** is the perfect fit for those embedded systems that require it all: rich functionality, reliability and performance.

Contact Information

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