APPLICATION PROGRAMMING: MOBILE COMPUTING [INEA00112W]

Marek Piasecki PhD

Mobile Databases (W8/2013)

Choose yourself and new technologies

HUMAN CAPITAL
HUMAN – BEST INVESTMENT!

Wrocław University of Technology

EUROPEAN SOCIAL FUND

Project co-financed from the EU European Social Fund

Storing Data on Mobile Devices

- Most mobile applications require data to be stored, organized, and viewed.
- A simple application can simply persist data in a flat file or a record store in device's onboard memory.
- More complex applications can benefit from using a database which supports:
  - organizing data in various tables,
  - providing fast searching using indexes,
  - representing relationships between data in different tables through foreign keys.

Mobile Database Definition

1. Database that can **be connected to** by a mobile computing device **over a mobile network**
2. Local (small memory footprint) data repository **stored in mobile device memory**, which preferably should additionally:
   - download and store information from central/master server (replication)
   - propagate changes (made during the disconnected phase) to the central server so that the master database is updated (synchronization)

Desired features of Mobile Databases

- **Selective replication** – should selectively download the data that maximizes the mobile users' locality of access
- Should provide the user with the needed information **readily available** in a form that is accessible
- **Small size** – database size should be compact enough to fit in the limited storage space available
- **Administration-less** – they should not rely on database administrative tasks

Operational Constraints

- **Disconnected Mode** of operation – disconnection is a norm rather than an exception in a mobile environment.
  This mode of operation is preferred to conserve expensive **network bandwidth** and **batery life**.
- Unreliable network – **Access to the server** should be **minimized** to cope up with the high error rate experienced in a mobile environment.
- **Limited** availability of **memory** – the processing requirements shouldn't place a significant burden on the limited system resources.

Why Develop Mobile Database Applications?

- Mobile database applications are an effective way to **streamline business** processes and ensure that end users **always have access** to the critical corporate information they need to do their jobs.
- Mobile applications work best when they include some kind of **local data store**.
- Data operations are **faster** and can occur at **any time**.

Several Competing Products

- Sybase Inc.'s SQL Anywhere
- IBM's DB2 Everyplace
- Microsoft SQL Server Compact Edition
- Oracle9i Lite
- Borland JDataStore
- HanDBase from DDH Software Inc
- SQLBase from Gupta Technologies
- MobiSnap

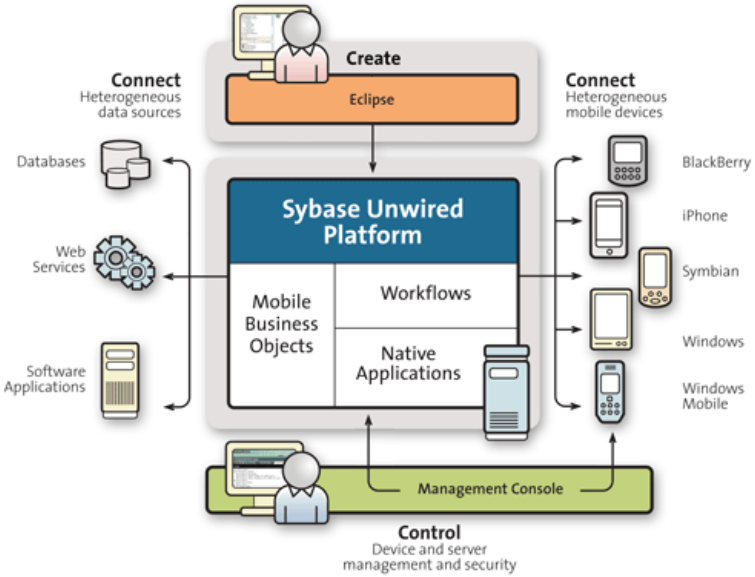
SYBASE | An SAP Company

Market Share About 70% !

Sybase is recognized as the **leader in mobile device management** (MDM) enterprise software market for the **ninth consecutive year**.

[Worldwide Mobile Device Management Enterprise 2010 – 2014 Forecast 2009 Vendor Shares report, August 2010]

- founded in 1984 (Watcom SQL)
- 1988: partnership with Microsoft
  to port SQL Server to Windows and OS/2
- 1995: Renames the main product SQL Server
  to its current name Adaptive Server Enterprise
- **2000: iAnywhere Solutions** Inc. (subsidary of Sybase)
  SQL Anywhere became flagship relational database management system
  (MobiLink data synchronization, UltraLite mobile database for **Palm OS** and **Windows CE**)
- 2006: SQL Anywhere ver. 10. (**Symbian** support)
- 2008: SQL Anywhere ver. 11 (**BlackBerry** support)
- 2010: SQL Anywhere ver. 12 (**iPhone** support)



Sybase SQL Anywhere Components

(for mobility)

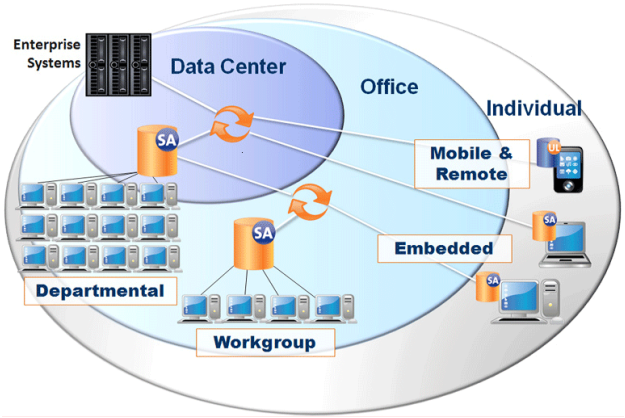
- **SQL Anywhere Server** – Small-footprint, self-managing relational database with high reliability, high performance out of the box, and a full range of SQL features across a variety of platforms scalable from handhelds to large server installations.
- **UltraLite** – Database system for small devices, including Windows Mobile/ Pocket PC, Symbian, iPhone and Palm OS devices, providing full transaction-processing support, a choice of development models, and synchronization with enterprise data stores.
- **MobiLink** – Synchronization and mobile messaging technology for sharing information among relational databases while maintaining the integrity of transactions across the entire system.
- **UltraLiteJ** – Pure Java database system for small devices, specifically for Blackberry and other J2ME environments. SQL, full transaction-processing support, and synchronization with enterprise data stores.
- **QAnywhere** – Application-to-application messaging solution that delivers secure and assured message delivery for distributed and mobile users.

Sybase SQL Anywhere Server

(full range of SQL features across a variety of platforms scalable from handhelds to large server installations)

Broad Platform Support:

- Windows x86, x64 and Itanium
- **Windows Mobile**
  Windows Mobile 5.0 for PocketPC and Smartphone
  Windows Mobile 6.x Classic, Professional, and Standard
  Windows CE 5.x and 6.x
- Novell NetWare
- Linux x86, x64 and Itanium
- Sun Solaris SPARC and x64
- Mac OS X on Intel
- IBM AIX
- HP-UX PA-RISC and Itanium



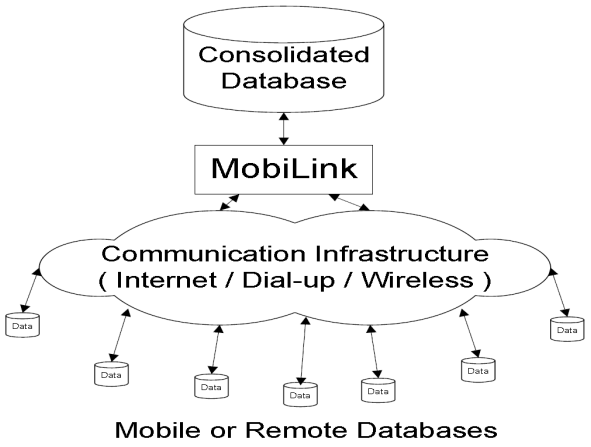
Sybase **SQL Anywhere** Server

Comparison to other → databases

Product Feature	SQL Anywhere 11 Standard Edition	Oracle 11g Standard Edition	IBM DB2 9 Workgroup Edition	Microsoft SQL Server 2005 Workgroup Edition	MySQL Enterprise 5.1
Advanced SQL including OLAP functions	✓	×	✓	✓	×
Full transaction processing	✓	✓	✓	✓	~
Built-in referential integrity with cascading updates/deletes & data integrity	✓	✓	✓	✓	~
Row-level locking	✓	✓	✓	✓	~
Snapshot isolation	✓	✓	✓	✓	✓
Materialized views	✓	✓	✓	×	×
Table encryption	✓	✓	~	✓	×
Column compression	✓	×	×	×	×
External triggers& stored procedures for SQL, Java, .NET and Perl	✓	✓	✓	~	~
Job scheduling and event monitors	✓	✓	✓	✓	✓
Parallel back-up and recovery features	✓	✓	✓	✓	×
Database mirroring & fail-over clustering	✓	~	✓	×	~
XML support	✓	✓	✓	✓	~
Produce/consume Web Services using SOAP, JSON, XML and HTML	✓	×	×	~	×
Performance tuning wizards	✓	×	✓	×	×
Support for 64-bit operating systems	✓	✓	✓	×	✓
Full text search	✓	✓	✓	✓	~
Database files can be moved between all supported operating systems	✓	×	×	×	~
Supports Windows, Linux, Unix and Mac O.S. families	✓	✓	×	×	✓

Sybase **MobiLink**

- A two-way **synchronization** technology (server) for large scale mobile database deployment:
  - **Remote** database (mobile, embedded, or workgroup database server)
  - **Consolidated** database (enterprise, workgroup, or desktop database)
- Heterogeneous consolidated database
- Conflict detection and resolution
- Secure
  - Built-in authentication
  - 28-bit encryption of communication streams
- Scalable to thousands of remote users



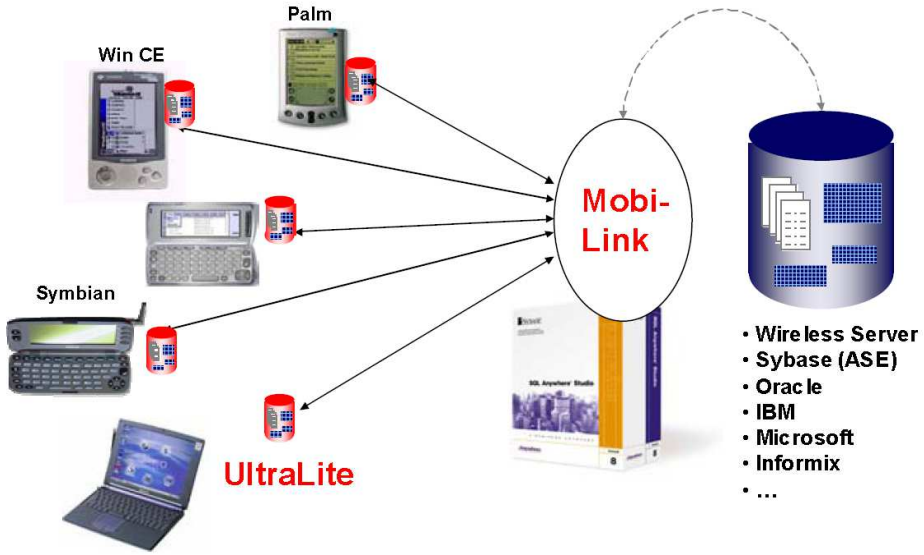
Sybase **MobiLink**

Remote Databases:

- **SQL Anywhere Server**
  - Windows
  - Windows Mobile
  - Linux
  - Solaris
  - MAC OS/X
- **UltraLite**
  - Palm Computing Platform
  - Windows CE / Smartphone
  - Windows 200x / XP
  - Symbian OS
- **UltraLiteJ**
  - BlackBerry

Consolidated Databases:

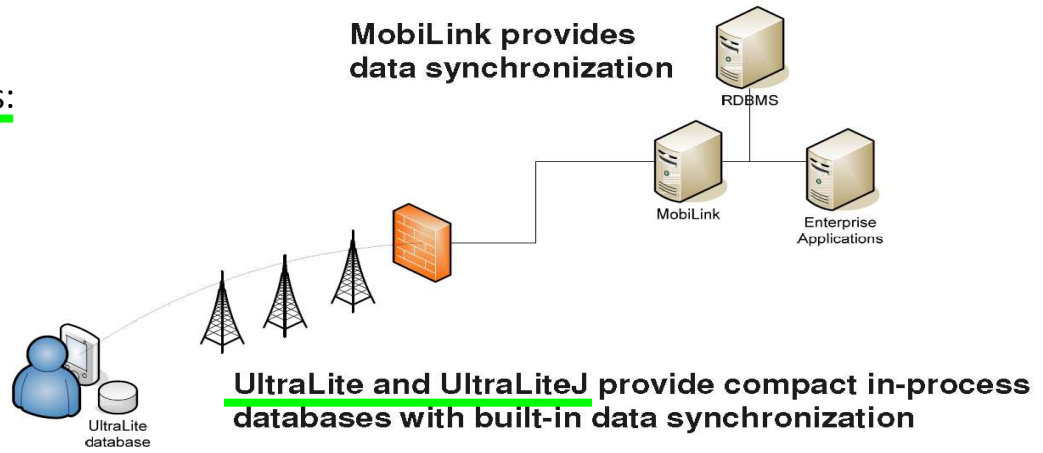
- Oracle
- Microsoft SQL Server
- IBM DB2 UDB
- Adaptive Server Enterprise
- SQL Anywhere Server



Sybase **UltraLite**

(Small footprint Relational DBMS for resource constrained environments)

- Provide **advantages of SQL**
  (transaction processing, different data types, built-in functions and operators, multi-table joins, indexing)
- Provide **synchronization** to industry standard **enterprise databases** (robust and secure)
- Aimed at small, mobile and embedded devices:
  - Personal organizers, PDA
  - smart phones, pagers
  - Point-of-sale devices
- Typical constraints
  - No hard disk
  - Limited memory
  - Slow processors
  - Limited (battery) power
  - Wireless connection
- Maintain **good speed on limited devices**



UltraLite supported platforms

UltraLite Version	Status (see below)	Windows Versions	Windows Mobile Versions [1]	iPhone Versions	BlackBerry Versions	J2SE Versions	Symbian OS Versions	Palm OS Versions
12.0.0 More Info	Active	XP, XP Embedded, XP Tablet PC Edition Vista Windows 7 Windows Server 2003, 2008 (x86 and x64) and 2008 R2 (x64)	WM 5 for Pocket PC and Smartphone (Windows CE 5.0) running on the ARMv4i processor architecture WM 6.x Classic, Professional, and Standard (Windows CE 5.x) running on the ARMv4i processor architecture	3 or later	4.1 or later	1.5	*not supported*	*not supported*
11.0.1 More Info	Active	XP, XP Embedded, XP Tablet PC Edition Vista Windows 7 Windows Server 2003, 2008 (x86 and x64) and 2008 R2 (x64)	WM 5 for Pocket PC and Smartphone (Windows CE 5.0) running on the ARMv4i processor architecture WM 6.x Classic, Professional, and Standard (Windows CE 5.x) running on the ARMv4i processor architecture	*not supported*	4.1 or later	1.5	*not supported*	4.1 or 5.0
10.0.1 More Info	Active	XP, XP Embedded, XP Tablet PC Edition Vista Windows 7 Windows Server 2003, 2008 (x86 and x64) and 2008 R2 (x64)	5.0 running on the ARMv4i processor architecture 4.1, 4.2 running on the ARMv4 or ARMv4T processor architecture 3.0 running on the ARMv4 processor architecture Smartphone 2002 and 2003 running on the ARMv4 processor architecture	*not supported*	*not supported*	*not supported*	7.x and 8.x (S60 2nd Edition, S80, UIQ 2.0 and 2.1)	4.1 or 5.0

Emerging Platforms:

UltraLiteJ, UltraLiteC

UltraLiteJ:

- **Blackberry** (J2ME/CLDC) uses Blackberry object store or J2ME RMS
- Pure Java implementation, in process with application
- 400KB JAR file for deployment
- JDBC like interface, guaranteed transactions, flexible indexing
- MobiLink Synchronization
  - Automatic change tracking
  - Secure communications
  - Conflict detection and resolution
- Full datatype support including autoinc, uniqueid
- DDL API to create and manage database

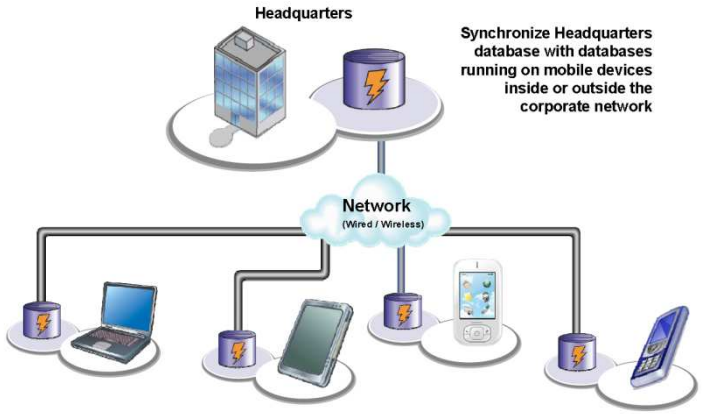
UltraLiteC:

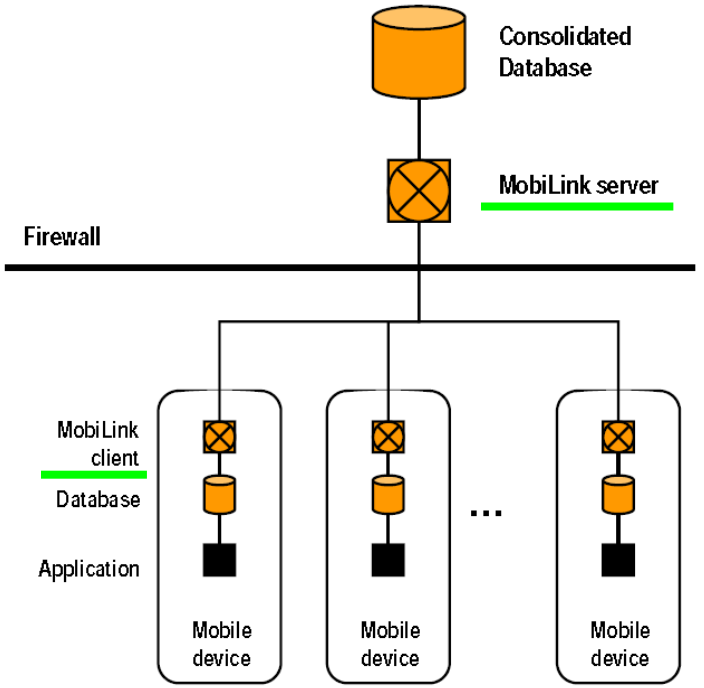
- Embedded **Linux** (C++ API only)

Example application scenarios

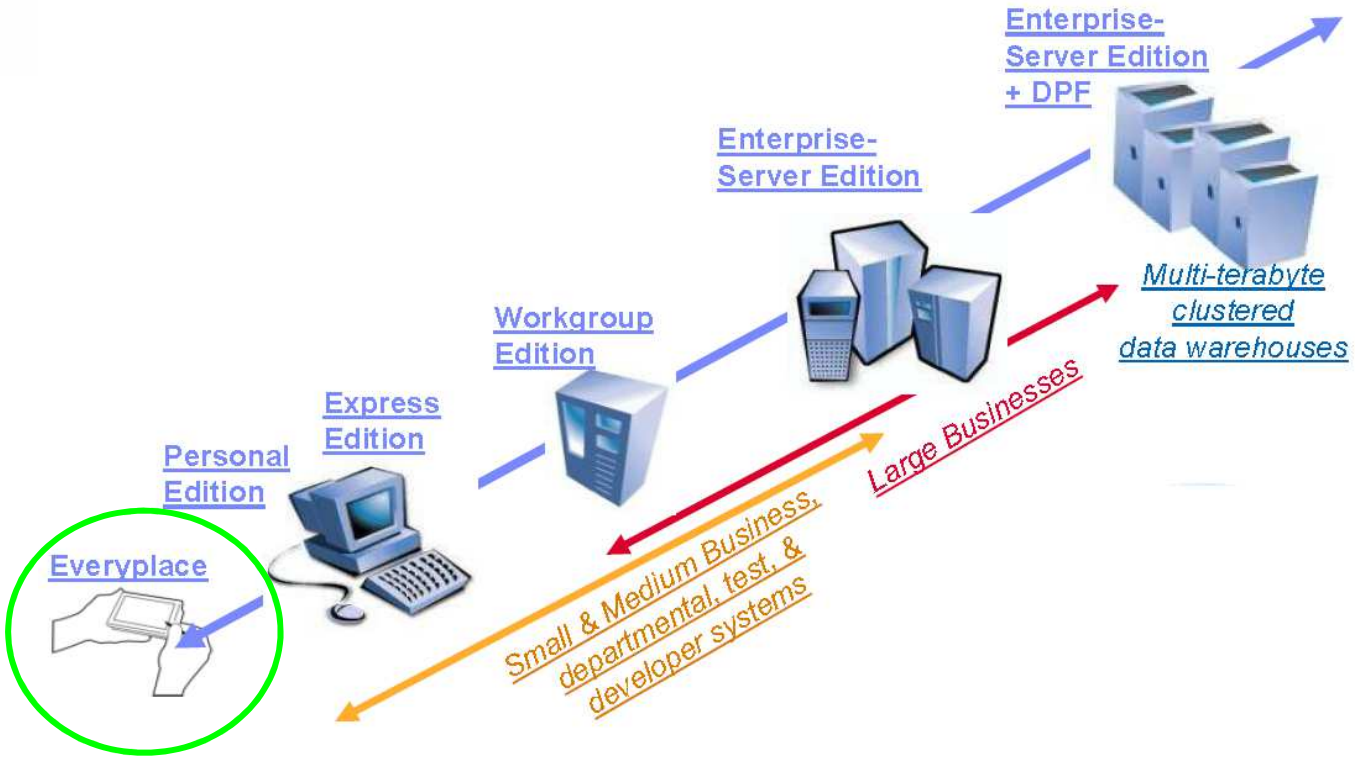
Possible Mobile Architectures:

- **Database & synchronization**
- Database & synchronization with mobile messaging
- Mobile messaging





DB2 Database Editions



DB2 Everyplace Characteristics

(RDBMS especially made for mobile devices and embedded systems)

- Small footprint (180-220Kb)
- Broad platform support
- Zero Administration
- Supports a subset of SQL
- Expression and Aggregate functions
- Transaction support
- Remote Stored Procedure Call support
- Local Data Encryption (allows table-level data encryption)
- Secondary Storage support (Allow connection to databases stored in:
  - Palm main memory,
  - IBM Microdrive or Compact Flash card
  - Sony Memory Stick
  - SD MemoryCard or MultiMediaCard)
- Secure communication support with Sync Server
- DBCS (double byte character set) and NLV support National Language Support

DB2 Everyplace features

Supported Datatypes:

- INTEGER
- SMALLINT
- DECIMAL
- CHARACTER
- VARCHAR
- BLOB
- DATE
- TIME
- TIMESTAMP

Supported popular languages:

- Java
- Visual Basic
- C/C++
- .NET

Supported subset of SQL instructions:

- CREATE TABLE / INDEX
- DROP TABLE / INDEX
- INSERT with subselects
- UPDATE
- DELETE
- SELECT (JOIN (up to 8 tables), GROUP BY, ORDER BY, LIMIT (integer) for result set
- IN predicate
- Default values
- CHECK constraints
- Multi-column primary key, foreign key
- Scrollable Cursors (SQL_FETCH_NEXT, _PRIOR, _FIRST, _LAST, _ABSOLUTE, _RELATIVE)
- REORG TABLE (compresses the data)
- GRANT / REVOKE (manage privileges required to manipulate encrypted tables)
- CALL procedure (for Remote Stored Procedures)

DB2 Everyplace features

Supports all popular IDE:

- Rational
- Websphere
- Eclipse
- Visual Studio .NET

On Device Tools and Utilities

- CLP - Command Line Processor
- Query By Example – Visual Table Browser

Table View | Filter Dialog | Command Line Processor (CLP)

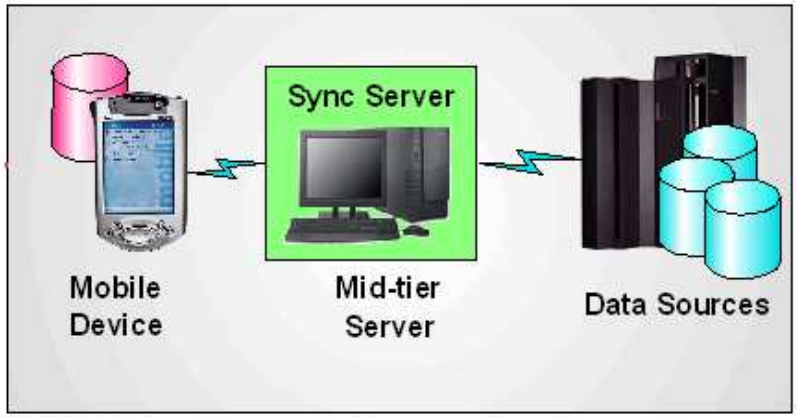
Secured with:

- Authentication:
  - MD5 authentication for standalone
  - LDAP authentication with WEA
- Communication data encryption
  - 56-bit and 128-bit DES for standalone
  - SSL with WEA
- Local data encryption on devices setup through central administration

Encryption levels:

- Table level encryption
- End-to-end transaction encryption
- Password protection with encryption
- Removable memory card support

DB2 Everyplace Supported Platforms



Client platforms:

- Pocket PC / .NET
- Palm OS
- Symbian OS
- Java 2 Micro Edition
- QNX Neutrino
- Embedded Linux
- Desktop platforms
  - Linux
  - Win32

Server platforms:

- Windows
- AIX
- Linux
- Solaris
- Linux for iSeries
- IXA (integrated xSeries Adapter) for Windows

Sync Server data sources:

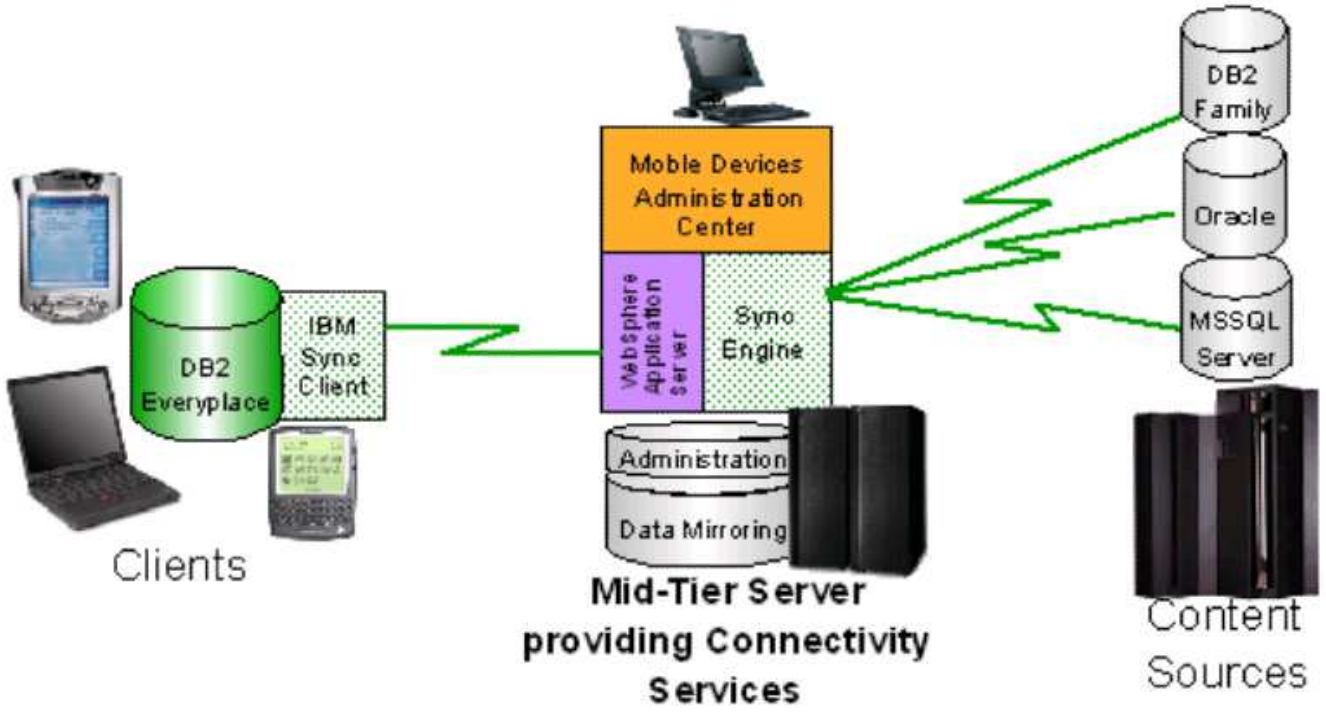
- Informix Dynamic Server, Cloudscape, DB2 UDB
- JDBC sources
  - Microsoft SQL Server
  - Oracle
  - Other JDBC Compliant sources

DB2 Everyplace Subscriptions

A replication subscription provides specifications for how the information
in a source system (an enterprise server)
is to be synchronized with a target system (the mobile device).

- **JDBC subscriptions** provide users with access to data in source tables on a data source with a JDBC interface, including Oracle, DB2, Microsoft SQL Server, Informix, Sybase, and Lotus Domino.
- **Upload subscriptions** only allows the user to directly insert rows into a table on a source database. Related tables on the mobile devices are not refreshed during synchronization.
- **File subscriptions** allow replication of any type of file stored at the source server and are not bi-directional

DB2E: Single Server Architecture



DB2E: Multiple Server Architecture