



ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

information
systems 



Lecture Series on Relational Database Technology

Introduction into key Concepts of
Relational DataBase Management Systems (RDBMS)

Summer Term 2011

Eberhard Hechler

SCITA, Executive IT Architect
IBM Boeblingen Research & Development Lab

DB2 Information Management Software

© 2011 IBM Corporation



ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

information
systems 



Introduction into RDBMS

DB2 Overview and Editions

Exercises

DB2 Information Management Software

© 2011 IBM Corporation



ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

information
systems 



Introduction into RDBMS

DB2 Information Management Software

© 2011 IBM Corporation

Detailed Content (1 of 4) – Morning Lecture

Day	Lecture Topics
13.05.2011	<i>Introduction & Lecture Objectives/Scope</i>
	<i>Overview of Relational DataBase Management Systems (RDBMS)</i>
	§DB2 <ul style="list-style-type: none">–Overview–Key Concepts–Architecture–Editions
	§Exercises
	<i>Database Security Aspects (Authentication, Authorization, Priviledges, ...)</i>
§Exercises	
...	

Development of RDBMS – „Early“ History

- § 1968 IBM Information Management System
- § 1970 Dr. E F Codd, „Relational Model“
- § 1977 IBM System R (1st relational DB)
- § 1979 Relation Inc. makes Oracle V1 available
- § 1980 Oracle V2
- § 1980 IBM SQL/DS
- § 1982 Oracle V3
- § 1983 DB2/MVS
- § 1985 INGRES (foundation for PostgreSQL)
- § 1986 Sybase and ANSI Standard for SQL
- § 1992 DB2 for Unix

Requirements for any Database System

- § Standard access interfaces
- § Abstraction and transparency of data storage
- § Data security
- § Fault tolerance, disaster recovery, continuous availability
 - Unplanned outages
 - Planned outages
- § Data logistics, backup/restore
- § Scalability
- § Support for multiple users
- § Integration interfaces
 - Replication, WebServices, federation, ...

Requirements for Data Security

§ ACID principle (Haerder, Reuter 1983)

- **Atomicity**
Transactions are executed in its entirety (commit or rollback)
- **Consistency**
DBS keeps data in consistent state (according to data model)
- **Isolation**
Parallel transactions are executed independently
- **Durability**
Commit of transaction will store data safely

Usage of DataBase Systems

§ OLTP (OnLine Transaction Processing)

High # of transactions (several thousand(sec))

Short transaction execution time (~ <1min.)

High # of parallel users

Goal: high transaction throughput

§ OLAP (OnLine Analytical Processing)

Low # of transactions

Long transaction execution time (>10min–several hours)

Low # of parallel users

Goal: high performance of single transactions

Types of DB Systems

§ Hierarchical DB systems

- IBM Information Management System (IMS) à used in large customer environments
- Software AG Tamino XML Database, DB2 9
 - XML is a hierarchical data format

§ Relational DB systems

- IBM DB2, Oracle Postgres, MySQL, Adabas, Informix

§ Object-oriented DB systems

- O2, Poet



ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

information
systems 



DB2 Overview

DB2 Information Management Software

© 2011 IBM Corporation



ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

information
systems 



Introduction into DB2 Editions

DB2 Information Management Software

© 2011 IBM Corporation

Theme: Fully Exploit All Resources

§ **Full exploitation of ALL available resources**

- Within a single query
- Across separate queries

§ **Regardless of resource class/amount**

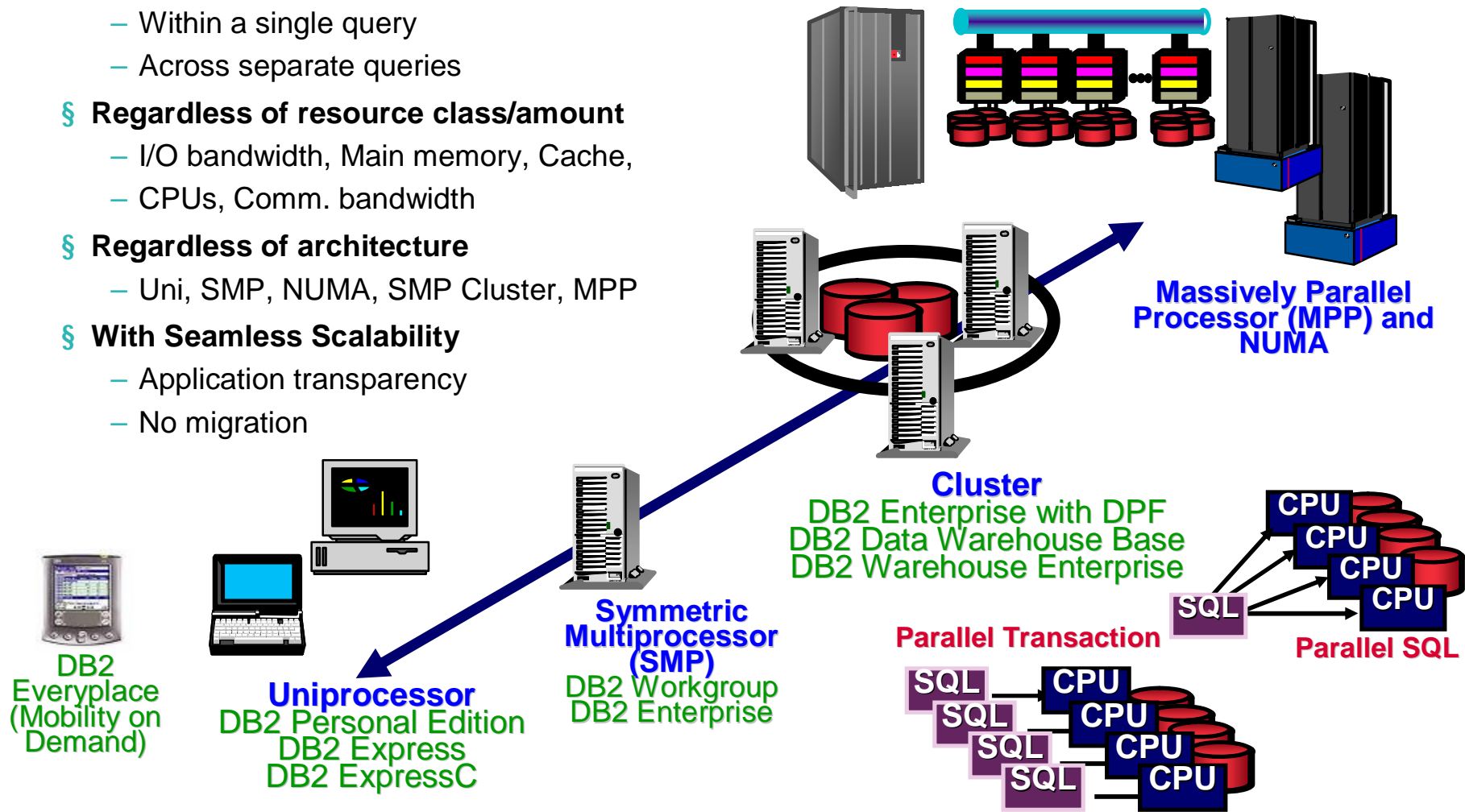
- I/O bandwidth, Main memory, Cache,
- CPUs, Comm. bandwidth

§ **Regardless of architecture**

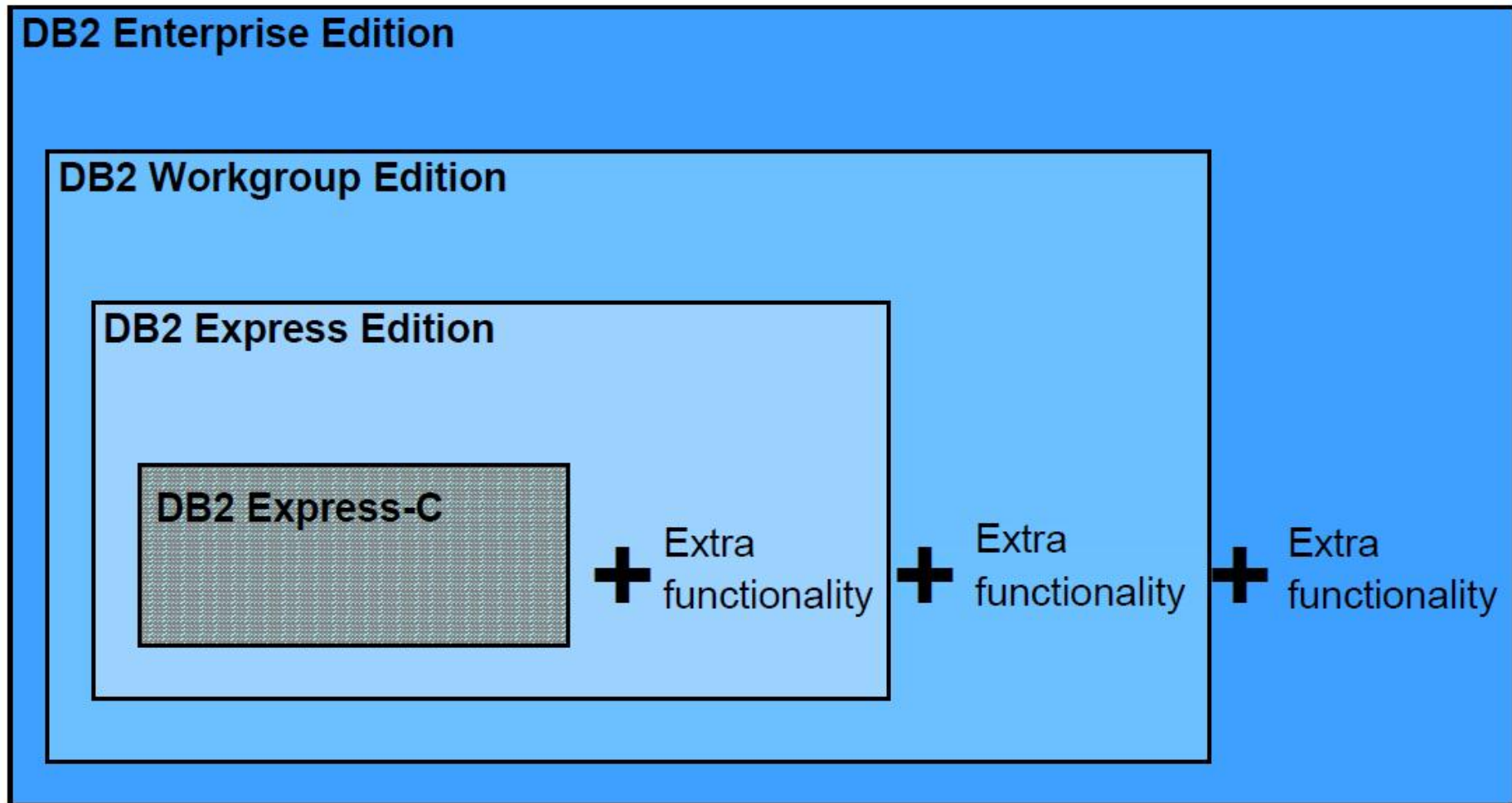
- Uni, SMP, NUMA, SMP Cluster, MPP

§ **With Seamless Scalability**

- Application transparency
- No migration



DB2 Server Editions



DB2 Editions

§ DB2 Editions

- DB2 Everyplace
- DB2 Personal Edition (PE)
- DB2 Express-C
- DB2 Express
- DB2 Workgroup Edition (limited and unlimited)
- DB2 Enterprise Edition
- Data Enterprise Developer Edition (DEDE)

§ DB2 Clients

- DB2 Run Time Client
- DB2 Client
- Java Common Client (JCC)
- DB2 Client Lite

DB2 Editions (*continued*)

§ DB2 Everyplace

- Small footprint (less than 200 KB) for small devices
- Allows mobile workers to access DB2 data sources through handheld devices and a synchronization server to replicate data in both directions
- Application development tool to build handheld apps with drag-and-drop ease

§ DB2 Personal Edition (PE)

- A fully functional database for personal computers on Linux and Windows
- Has all features of DB2 Express, but does not support connectivity to act as database server for remote clients but provides client for other DB2 servers
- Audio, Image, Spatial and Video Extenders (single user)
- For example, you can use DB2 PE to develop DB2 applications and rolling them out into a production environment on DB2 ESE V9, e.g. on AIX.

DB2 Editions (*continued*)

§ DB2 Express Edition (DB2 Express)


- Priced for small & medium business
- Supports up to 2 CPUs
- Linux and Windows only
- Same functions as DB2 Workgroup Edition, but different by the amount and value unit (which equate to the power of a server's processor cores) you can have on a server. E.g.
 - Automates administration adaptive memory allocation, automatic storage management
 - Keeps data protected and available 24/7
 - Cuts costs with unique workload management capabilities
 - Powers the next generation of agile SOA applications with pureXML™

DB2 Editions (*continued*)

§ DB2 Express-C

- Freely licensed version for developers and community
- <http://www.channelDB2.com/oncampus> Community
- 64-bit enabled
- Minus some extended features of EE:
 - HADR
 - Replication Data Capture
 - 24x7 Passport Advantage support model

DB2 Express-C Home Page: ibm.com/db2/express

Address  <http://www-01.ibm.com/software/data/db2/express/> United States [change]

IBM Search

Home Solutions ▾ Services ▾ Products ▾ Support & downloads ▾ My IBM ▾

Welcome Raul Chong [Not you?] [IBM Sign in]

Software > Information Management > Data Servers > DB2 Product Family

DB2 Express-C


- About
- Downloads
- Get started
- Subscription
- Partner zone
- Community
- Students
- Forum


Related links

- DB2 for Linux UNIX and Windows
- IDUG: The Worldwide DB2 User Community
- Warranties and licenses

DB2 Express-C

Free to develop, deploy, distribute: No limits, just data.

 **FREE Download**
DB2 Express-C

 **DB2 Express-C**
online forum

DB2 Express-C:

- Full-function relational and [XML](#) data server
- Simple, [flexible](#), powerful, and reliable
- [Download](#) and deploy at no charge
- [Support](#) available for added peace-of-mind

Next steps:
[Learn more](#) | [Get started](#) | [Get Help](#) | [Partner with us](#)

News

- [Morph Labs hosts a DB2 Express-C database in the cloud as part of IBM's "Search for the XML Superstar" contest \(Aug 25, 2008\)](#)
- [Comparing Free Databases: Oracle XE vs DB2 Express-C \(Jun 19, 2008\)](#)
- ➔ [DB2 Express-C for Solaris x64 is now generally available \(Apr 28, 2008\). Download now ...](#)
- ➔ [Previous news](#)

Information Management software

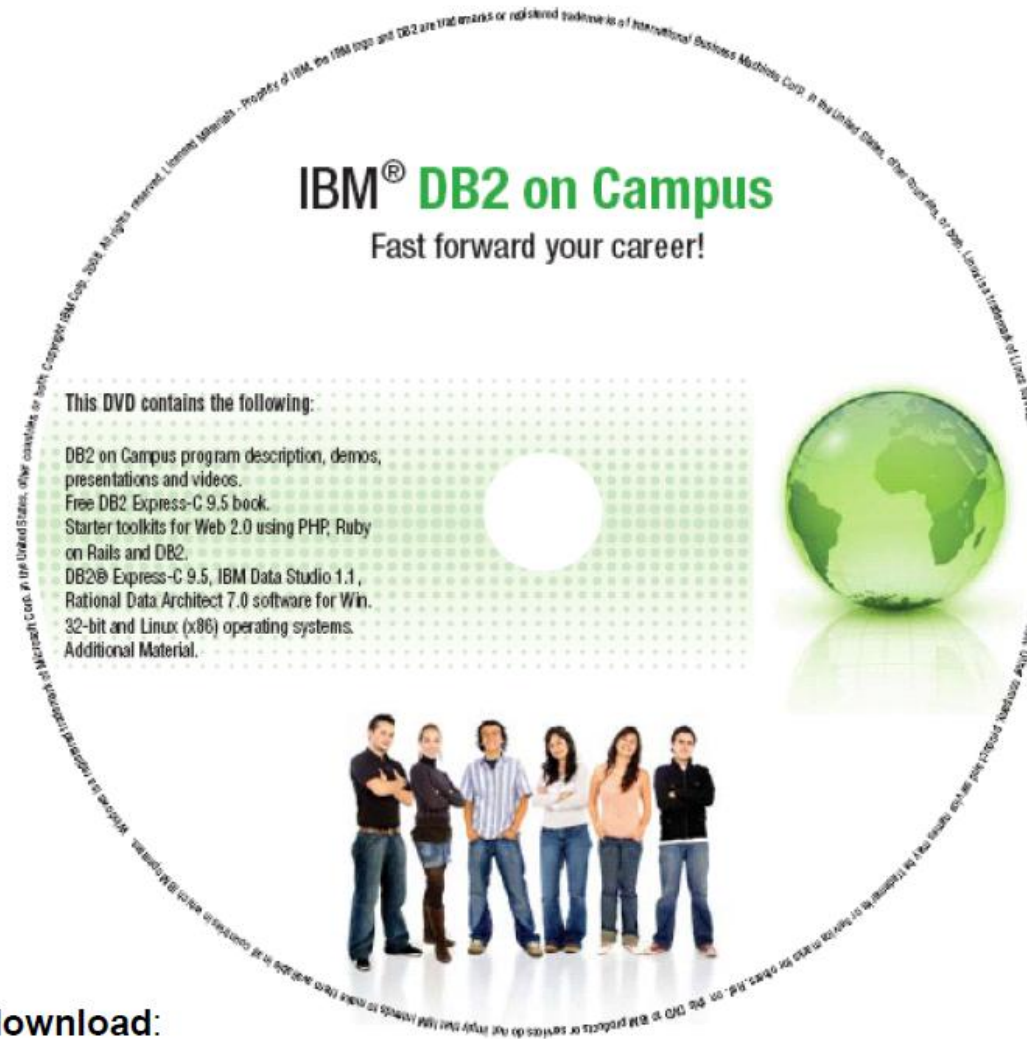
Highlights

- ➔ [NEW! Download DB2 Express-C 9.5](#)
- ➔ [FREE Book: Getting Started with DB2 Express-C](#)
- ➔ [Videos: Learn DB2 Express-C in one day](#)
- ➔ [Get Support and Extra Features](#)

More Information

- ➔ [DB2 Forum](#)
- ➔ [DB2 App Development](#)
- ➔ [DB2 on developerWorks](#)
- [ChannelDB2 Videos](#)
- [PlanetDB2 Blogs](#)
- ➔ [DB2 Info Center](#)

Free DB2 on Campus DVD



DB2 Discovery Kit 9.7 download:

https://www14.software.ibm.com/webapp/iwm/web/preLogin.do?lang=en_US&source=swg-dmpr

DB2 Editions (*continued*)

§ DB2 Workgroup Server Edition (WSE)

- Authorized User (Min. 5 per Server), or Per Processor
- For low user departmental machines using up to 4 CPUs

§ DB2 Workgroup Server Unlimited Edition (WSUE)

- Per Processor Licensing
- Ideal for high user or web use
- Up to 4 CPUs

DB2 Editions (*continued*)

§ DB2 Workgroup Highlights

- Powers the next generation of agile SOA applications with pureXML™
- Minimizes costs with adaptive memory allocation, automatic storage management and more
- Maximizes data availability by reducing planned and unplanned downtime
- Cuts costs with unique workload management capabilities
- Speeds performance of complex query workloads

DB2 Editions (*continued*)

§ DB2 Enterprise Server Edition (ESE)

- Authorized User (min. 25 per CPU) or Per Processor
- Ideal for enterprise environments
 - CRM, ERP, SCM, Data Warehouses
- Includes Host Database Connectivity
- Informix Integration
- Options Available:
 - Database Partitioning Feature (DPF)
 - Reduces storage needs by up to 80% using industry unique data compression capabilities
 - Powers the next generation of agile SOA applications with pureXML™
 - Reduces risk of unauthorized access with an innovative label based security model
 - Avoids unexpected performance problems with proactive query management and predictive analysis
 - Minimizes costs with adaptive memory allocation, automatic storage management and more
 - Scales with your preferred architecture: single-server, clusters of servers, or both with database partitioning and table partitioning
 - Maximizes data availability by reducing planned and unplanned downtime

Which DB2 9 Data Server is the right one?

	DB2 Express	DB2 Workgroup	DB2 Enterprise
Function	DB2 Express is a full-function hybrid data server, which provides very attractive entry-level pricing.	Includes all of the features of DB2 Express with scalability to larger servers.	Includes all of the features of DB2 Workgroup plus features required to provide the scalability to handle high user loads and provide 24x7x365 availability, including:
			<ul style="list-style-type: none"> • High Availability Disaster Recovery (HADR) • Tivoli System Automation
	<ul style="list-style-type: none"> • Simple installation including silent installation capability 		<ul style="list-style-type: none"> • Table Partitioning
	<ul style="list-style-type: none"> • Self managing 		<ul style="list-style-type: none"> • Multi-dimensional data clustering
	<ul style="list-style-type: none"> • Optimized interfaces and tools for application developers 		<ul style="list-style-type: none"> • Materialized Query Tables
	<ul style="list-style-type: none"> • Supports wide array of development paradigms 		<ul style="list-style-type: none"> • Full intra-query parallelism
	<ul style="list-style-type: none"> • Minimal disk space requirements 		<ul style="list-style-type: none"> • Connection concentrator
	<ul style="list-style-type: none"> • Worldwide 24x7 Service and Support 		

Which DB2 9 Data Server is the right one? *(continued)*

	DB2 Express	DB2 Workgroup	DB2 Enterprise
Customizable	Expandable with pureXML and optional enterprise class features to preserve improve performance, workload management, and high availability	Expandable with pureXML and optional enterprise class features to preserve improve performance, workload management, and high availability	Expandable with pureXML and advanced features like storage optimization, performance optimization, advanced access control, scale-out clustering, geodetic data, and more
Scalable	2 CPUs / 4 GB RAM max. (may run on machines with more than 4 GB)	4 CPUs / 16 GB RAM maximum	Unlimited
Platforms	Linux®, Solaris x86 and Windows®	Linux, UNIX® and Windows	Linux, UNIX and Windows
Pricing Metrics	Authorized User (Min 5 per server), or Per Processor	Authorized User (Min. 5 per Server), or Per Processor	(Authorized User (Min. 25 per CPU) or Per Processor

DB2 Host Databases

§ DB2 for i5/OS

- <http://www.ibm.com/servers/eserver/series/db2/>

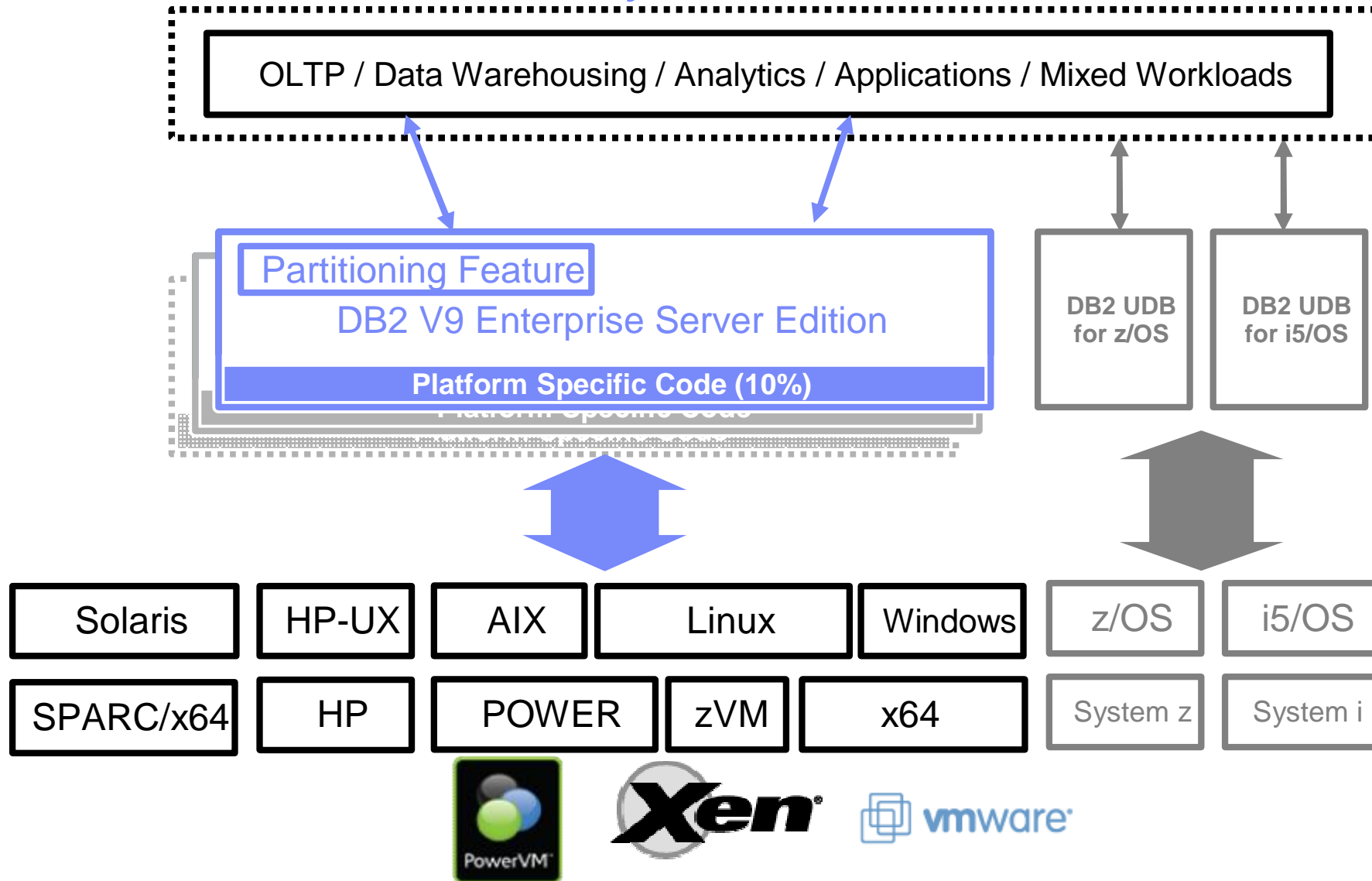
§ DB2 for z/OS

- <http://www.ibm.com/software/data/db2/os390/>
- **also available:** DB2 ESE for Linux on z/OS (just like DB2 for Linux on Intel)

§ DB2 for VSE & VM

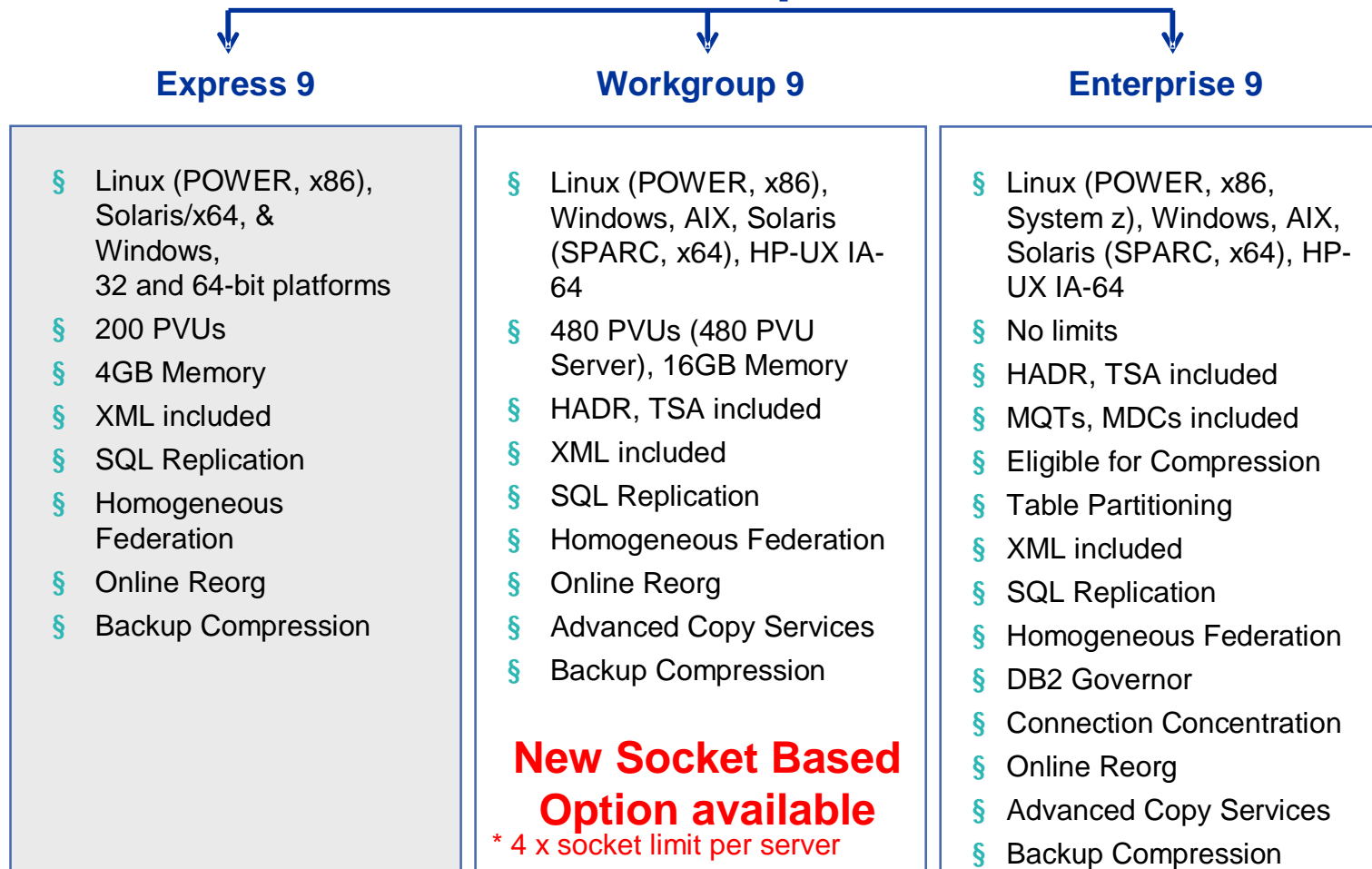
- <http://www.ibm.com/software/data/db2/vse-vm/>

DB2 Platform Availability



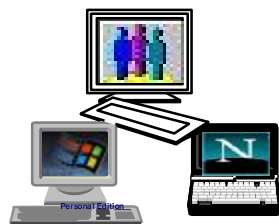
DB2 v9 Family

DB2 Edition Comparisons



DB2 Information Management Software

DB2 Family Platform Support



Personal & Express

- § Windows
- § Linux
- § Solaris



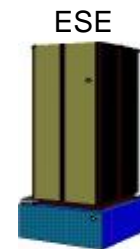
Hosts

- § DB2 for i5/OS
- § DB2 z/OS
- § DB2 VM/VSE



Workgroup

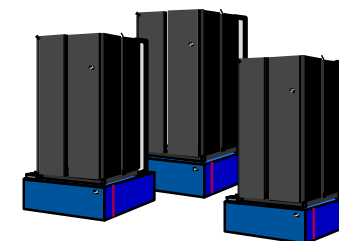
- § AIX
- § HP-UX
- § Solaris
- § Windows
- § Linux



Enterprise Server Edition

- § AIX
- § HP-UX
- § Solaris
- § Windows
- § Linux

ESE + DPF



Everyplace



- § Pocket PC
- § Linux
- § PalmOS
- § QNX Neutrino
- § Symbian EPOC

Autonomic Computing Attributes & Examples with DB2

Increased Responsiveness

Adapt to dynamically changing environments
e.g. Configuration Advisor, Design Advisor

Business Resiliency

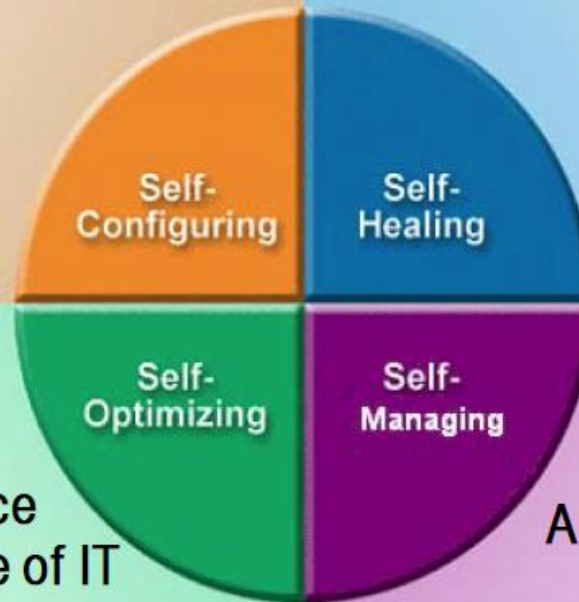
Discover, diagnose, and act to prevent disruptions
e.g. Health Monitor, Fault Monitor

Operational Efficiency

Tune resources and balance workloads to maximize use of IT resources
*e.g. Self-configuring/optimizing utilities, Adaptive utility throttling, **STMM!!***

Reduced Manual Administration

Automatic management of database objects and administrative tasks
e.g. Automatic storage management



DB2 Client Software

§ DB2 Run-Time Client

- Best option if your only requirements are to enable applications to access DB2 9 data servers. They provide the APIs necessary to perform this task, including Java Common Client
- Comes with no management tools

§ DB2 Client

- Includes runtime client
- Provides tools to administer DB2 servers and libraries to develop applications that access DB2 servers

§ Java Common Client (JCC)

- 2 MB fully redistributable client
- Provides JDBC and SQLJ applications access to DB2 data servers without installing and maintaining DB2 client code
- Use the DB2 Connect product for connecting to a DB2 for System i or DB2 for System z data server

DB2 Client Software (*continued*)

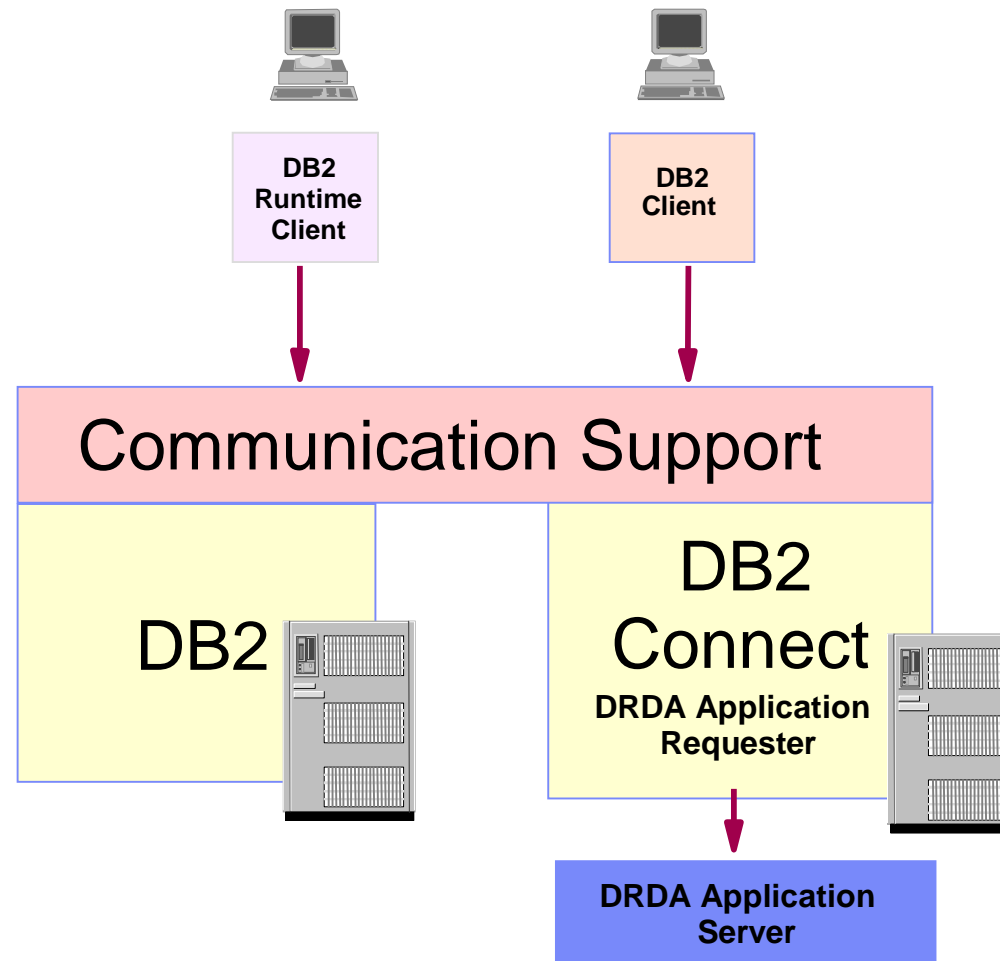
§ DB2 Client Lite

- Small footprint
- Provides similar functions as the JCC client and is used for CLI/ODBC applications.
- Especially well suited for ISVs that want to embed connectivity in their applications without redistributing and maintaining DB2 client code.

DB2 Connect Editions

- § DB2 Connect Enterprise Edition
- § DB2 Connect Personal Edition
- § DB2 Connect Unlimited Edition
- § DB2 Connect Unlimited Edition for iSeries
- § DB2 Connect Application Server Edition

Overview of DB2 Clients and Server Connectivity



Getting Help via DB2 Information Center

<http://publib.boulder.ibm.com/infocenter/db2luw/v9/index.jsp>

The screenshot shows a Mozilla Firefox browser window displaying the IBM DB2 Database for Linux, UNIX, and Windows Information Center. The browser title is "DB2 Database for Linux, UNIX, and Windows - Mozilla Firefox". The address bar shows the URL "http://publib.boulder.ibm.com/infocenter/db2luw/v9/index.jsp". The page features the IBM logo and a navigation menu with links for Home, Products, Services & solutions, Support & downloads, and My account. A search bar is located at the top right. The main content area is titled "IBM DB2 Database for Linux, UNIX, and Windows Information Center" and includes a welcome message, a list of updates, and several sections of links:

- In this information...**
 - Getting started**
 - [Highlights of DB2 Version 9.1](#)
 - [Release Notes](#)
 - [System requirements](#)
 - [Sample files](#)
 - [DB2 Connect enhancements](#)
 - [Updating a locally installed information center](#)
 - Native XML data store (pureXML™)**
 - [Overview](#)
 - [Information roadmap](#)
 - [Tutorial](#)
 - [SQL and SQLXML support](#)
 - [XQuery language support](#)
 - Label-based access control (LBAC)**
 - [Overview](#)
 - [Tutorial: basics](#)
 - [Tutorial: protecting sensitive data](#)
 - Tell me more...**
 - [Row compression tutorial](#)
 - [Self-tuning information roadmap](#)
 - [Table partitioning overview](#)
 - WebSphere Information Integration**
 - [Enhancements](#)
 - [Support site for release notes and system requirements](#)
 - [Migration](#)
 - Migration**
 - [Migrating DB2 database systems](#)
 - [Migrating DB2 Connect](#)
- ibm.com and related resources**
 - Support and assistance**
 - [DB2 Database for Linux, UNIX, and Windows](#)
 - [DB2 Connect](#)
 - [WebSphere Information Integration](#)
 - Training and certification**
 - [Information Management](#)
 - Communities**
 - [DB2 Express online forum](#)
 - [Information Management user groups](#)
 - [International DB2 User Group \(IDUG®\)](#)
 - developerWorks**
 - [IBM developerWorks for Information Management software](#)
 - Redbooks**
 - [DB2 Information Management](#)

Google Support

- § Google indexes the DB2 UDB Technical Library
- § Look for search results from the “/infocenter/”
- § Search is also possible through the DB2 News Groups



The screenshot shows a Google search interface. At the top right is a link for 'Anmelden'. Below it are navigation links: 'Web', 'Bilder', 'Groups', 'News', 'Froogle', and 'Mehr »'. The search bar contains the text 'DB2 V9 +\"add contact\"' and a 'Suche' button. To the right of the search bar are links for 'Erweiterte Suche' and 'Einstellungen'. Below the search bar, there are radio buttons for 'Suche: Das Web Seiten auf Deutsch Seiten aus Deutschland'. A horizontal bar below the search bar indicates 'Web' and 'Ergebnisse 1 - 10 von ungefähr 51 für DB2 V9 +\"add contact\". (0,84 Sekunden)'. The first search result is titled 'ADD CONTACT command using the ADMIN_CMD procedure' and includes the URL 'http://publib.boulder.ibm.com/infocenter/db2luw/v9/topic/com.ibm.db2.udb.admin.doc/doc/r0023566.htm'. Below the URL, there is a green link 'publib.boulder.ibm.com/infocenter/db2luw/v9/topic/com.ibm.db2.udb.admin.doc/doc/r0023566.htm - 8k'.

DB2 on Campus Group in facebook.com

The screenshot shows the Facebook interface for the 'DB2 on Campus' group. The top navigation bar includes 'Profile', 'Friends', and 'Inbox'. The group name 'DB2 on Campus' is displayed at the top right of the main content area, with a 'Global' location setting. Below the name is an 'Information' section with an 'edit' link. The 'Basic Info' section lists the group's type as 'Internet & Technology - Software' and its description as 'This group is for people interested in the DB2 on Campus program'. The 'Contact Info' section provides an email address 'db2univ@ca.ibm.com' and a website 'http://www.ibm.com/db2/express/students...'. A 'Recent News' section follows, containing three items: 'Fun viral videos about pureXML' with three YouTube links, '*** DB2 on Campus Tour 2008 schedule ***' with a list of dates and locations (India, Portugal, Italy, Poland, Romania, Bulgaria, Turkey), and '*** Learn DB2 Express-C quickly with these FREE resources ***' with a link to developer forums. On the right side, there is a blue banner with the group logo and a list of actions: 'View Discussion Board', 'Message All Members', 'Edit Group', 'Edit Members', 'Edit Group Officers', 'Invite People to Join', 'Create Related Event', and 'Leave Group'. Below this is a 'Share' button and an 'Events' section showing '7 past events' and two upcoming events: 'Faculty Training' in Ho Chi Minh City, Vietnam on Wednesday, August 20 at 9:00am, and 'Faculty training - DB2, RDA, I...' in Hue, Vietnam on Monday, August 18 at 9:00am. The left sidebar features a search bar, application links (Photos, Events, Groups, Marketplace, ChannelDB2 Videos), and an advertisement for 'Stella Artois Challenge'.



ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

information
systems 



DB2 Instances

DB2 Information Management Software

© 2011 IBM Corporation

DB2 Instances

- § A DB2 instance is an environment in which DB2 commands and functions are executed
- § It is also referred to as a DB2 database manager
- § More than one instance can be defined on a server machine and each of them can be managed independently
- § To start an instance
 - db2start
 - Starts the instance remotely
 - db2start REMOTE <instance node name>
 - Starts the instance in quiesced mode for administration purposes
 - db2start ADMIN MODE
- § Terminate all database connections and stop an instance
 - db2stop force

Creating and Dropping DB2 Instances

§ An instance is created on install by default

- db2inst1 (UNIX and Linux)
- DB2 (Windows)

§ To create additional instances

- db2icrt -u <fenced user ID> <instance name>
 - must specify fenced user ID for UNIX and Linux platforms
- db2icrt <instance name>
 - for Windows platforms

§ Terminate all database connections and drop an instance

- db2idrop -f <instance name>

§ To list existing instances defined in a server

- db2ilist

Upgrading DB2 Instances

- § To update a DB2 instance for access to functions associated with installation or removal of certain product options or fixpaks
 - db2iupdt <instance name>
- § To migrate an existing instance, for UNIX and Linux platforms only
 - db2imigr <instance name>
upgrades existing instance from older to newer version
- § To create, drop, update, or migrate an instance, root or administrative access is required



ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

information
systems 



DB2 Environment

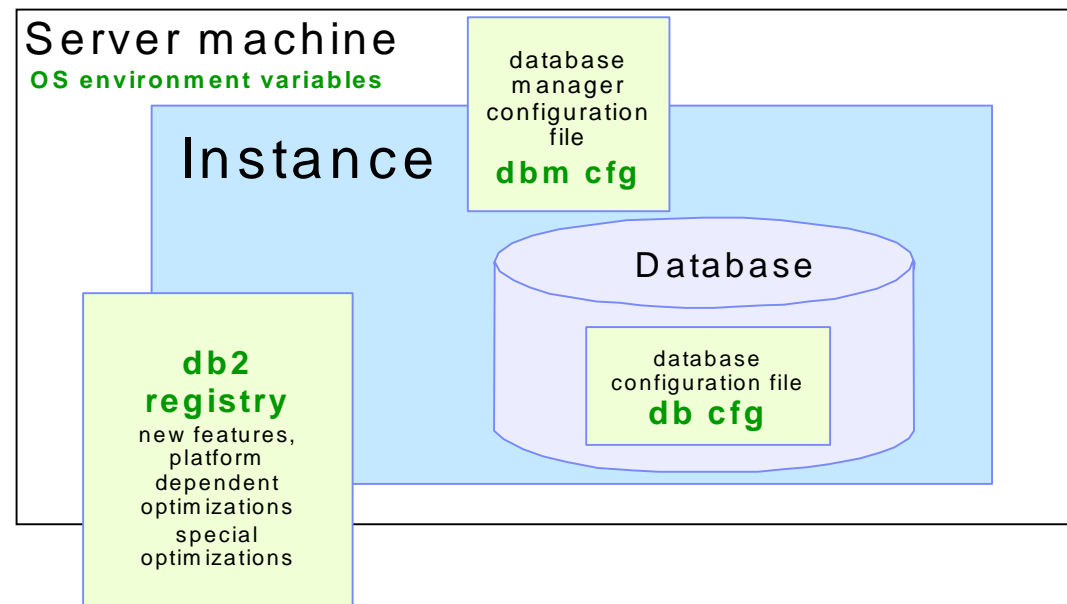
DB2 Information Management Software

© 2011 IBM Corporation

DB2 Environment

§ Configure the DB2 environment via:

- DB2 Profile Registry
- Operating System (OS) Environment Variables
- DB2 Database Manager Configuration Parameters
- DB2 Database Configuration Parameters



DB2 Profile Registry (1)

- § DB2 profile registry allows for centralized control of the DB2 environment settings
- § Usually platform-specific settings are configured using the DB2 profile registry
- § No need to reboot the system after making changes to DB2 Registry, but may need to stop and restart the instance
- § At its various level, controls many aspects of the DB2 UDB environment

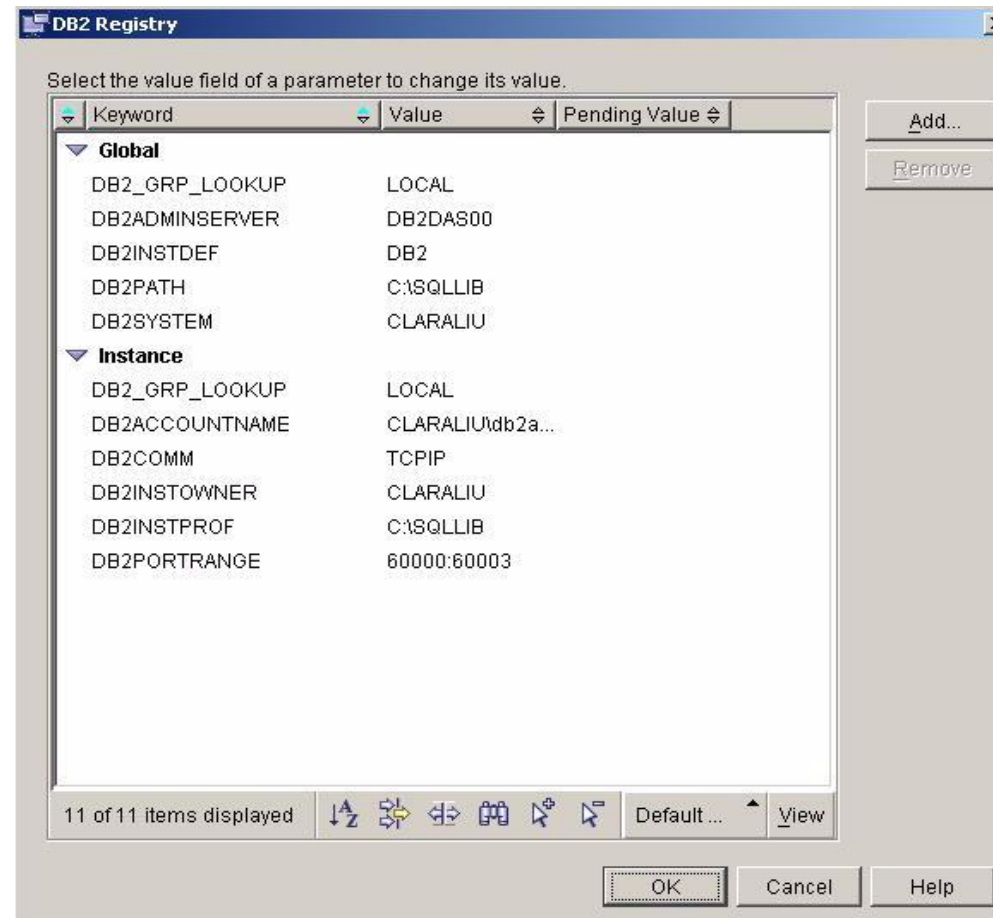
- | | |
|--|---------------------|
| – DB2 Instance-Level Profile Registry | à for 1 instance |
| – DB2 Global-Level Profile Registry | à for all instances |
| – DB2 Instance-Node-Level Profile Registry | à for 1 node |
| – DB2 Instance Profile Registry | à list of instances |

DB2 Profile Registry (2)

- § To list all DB2 registry variables currently set
 - `db2set -all`
- § To display global registry variables
 - `db2set -g`
- § To display instance registry variables
 - `db2set -i <instname>`
- § To list all supported registry variables
 - `db2set -lr`
- § To set a DB2 registry variable
 - `db2set <parm>=<value>`
 - e.g. `db2set DB2COMM=TCPIP`
 - Restart the instance for new changes to be in effect

Display DB2 Registry Variables

§ Display with the DB2 Configuration Assistant



Operating System Environment Variables

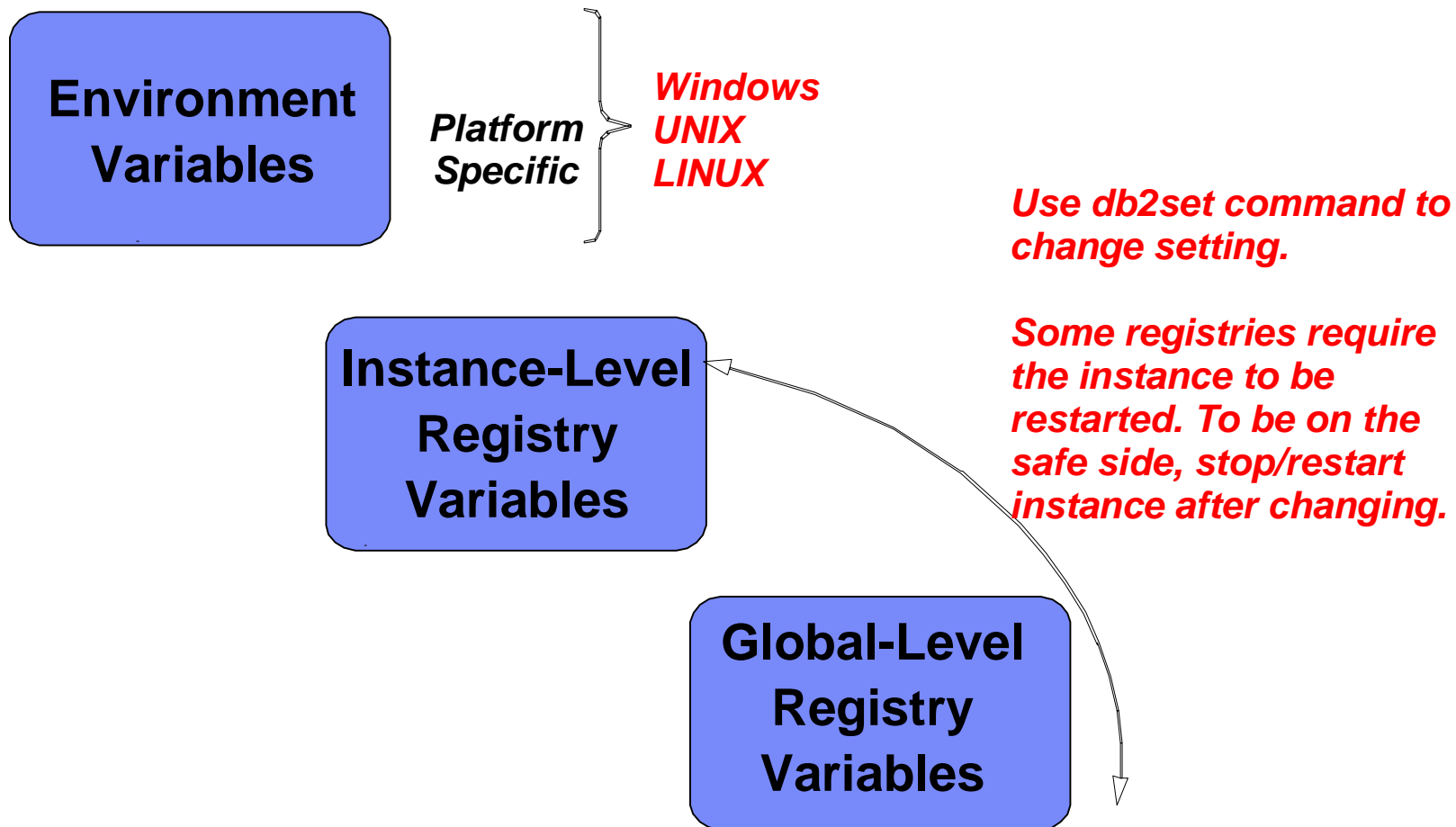
§ Most environment variables are controlled by the DB2 Profile Registry - those not stored in the DB2 Profile Registry can be referred to as system environment variables, and are set in a location where the platform stores its system variables:

- Windows- Control Panel -> System -> Environment Variables
- UNIX - .profile or .kshrc or .cshrc, they are typically incorporated with db2profile (Bourne or Korn shell) or db2cshrc (C shell) found in the instance owner's home directory

§ Examples:

- Windows - set DB2INSTANCE=PROD
- UNIX - export DB2INSTANCE=PROD

Setting DB2 Environment Variables



DB2 Configuration Parameters

§ Get/Set/Reset the Database Manager Configuration

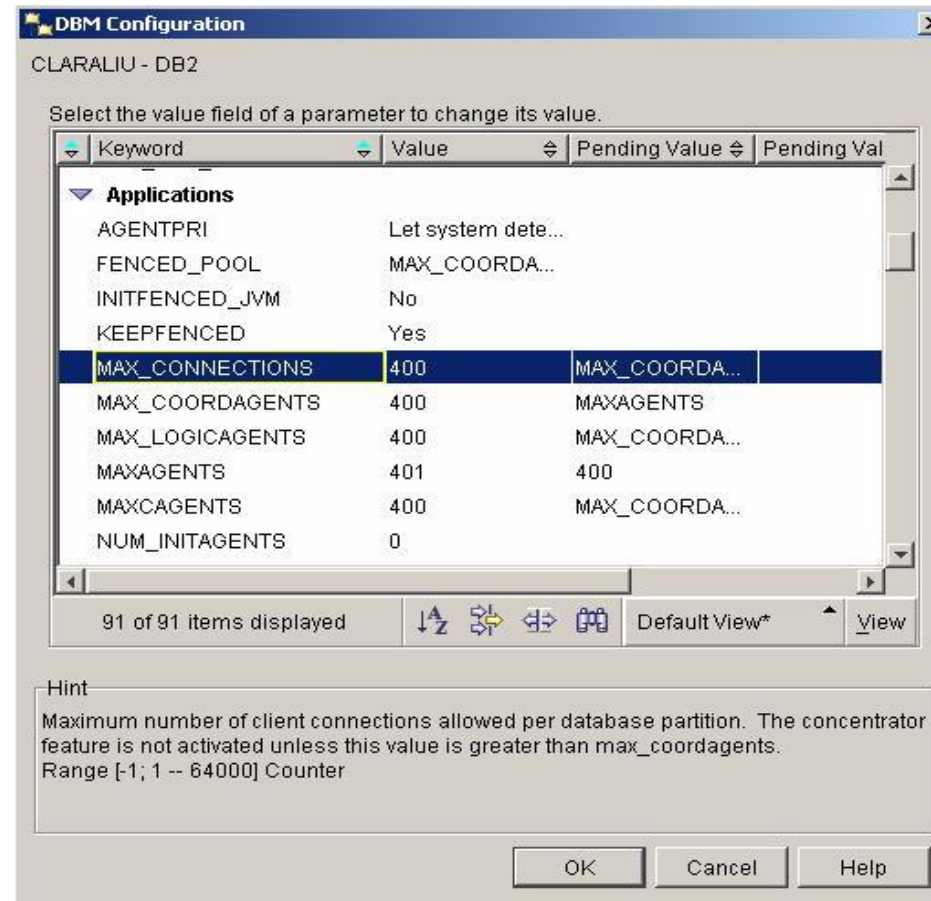
- GET DBM CFG [SHOW DETAIL]
 - show detail displays current and delayed values
- UPDATE DBM CFG USING <param> <value>
- RESET DBM CFG

§ Get/Set/Reset the Database Configuration

- GET DB CFG FOR <db> [SHOW DETAIL]
 - show detail displays current and delayed values
- UPDATE DB CFG FOR <db> USING <param> <value>
- RESET DB CFG FOR <db>

§ DB2 Control Center can be used to display, update, and reset the DBM and DB configuration parameters

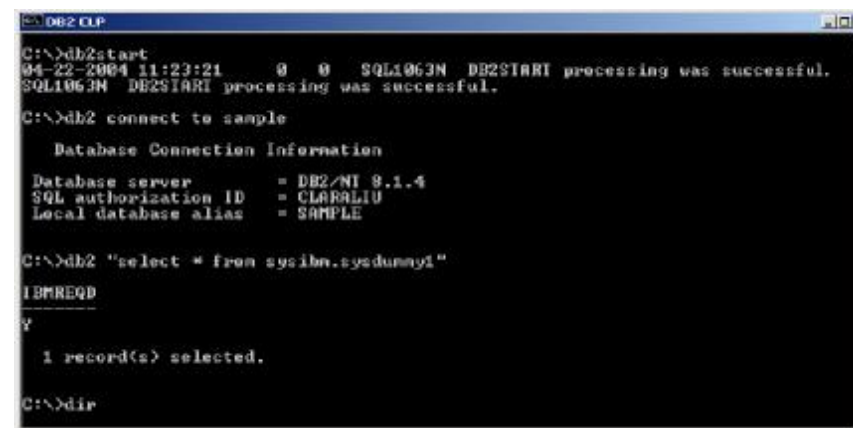
Display DBM Configuration Parameters with DB2CC



DB2 Command Window (Windows Only)

§ DB2 Command Line Window (Windows Only)

- click on the DB2 Command Window entry in the menu
- invoke the interpreter by prefacing commands and SQL with 'db2'
 - e.g. db2 connect to sample
 - e.g. db2 "select * from employee"
 - e.g. db2 -tvf createtab.db2



```
C:\>db2start
04-22-2004 11:23:21      0      0      SQL1063N  DB2START processing was successful.
SQL1063N  DB2START processing was successful.

C:\>db2 connect to sample

      Database Connection Information
      Database server        = DB2/NT 9.1.4
      SQL authorization ID   = CLARALIU
      Local database alias   = SAMPLE

C:\>db2 "select * from sysibm.sysdummy1"

IBMREQD
*
1 record(s) selected.

C:\>dir
```

- to end command line mode and terminate the DB2 backend process (db2bp), enter db2 terminate
- all OS commands can be issued from the DB2 Command Window

DB2 Command Line Processor (CLP)

- § click on the DB2 Command Line Processor icon or enter db2 at a command prompt in the DB2 Command Window
- § an interactive input prompt appears:
 - db2 =>
- § no need to prefix commands with 'db2'
 - e.g. db2 => connect to sample
- § to end the interactive mode, enter quit
- § to disconnect from the database and terminate the DB2 backend process (db2bp), enter terminate
- § to execute OS commands, enter
!`<OS command>`

Command Line Options

db2 list command options

```

C:\> DB2 CLP - DB2COPY1
C:\>db2 list command options

      Command Line Processor Option Settings

Backend process wait time (seconds)          (DB2BQTIME) = 1
No. of retries to connect to backend         (DB2BQTRY)  = 60
Request queue wait time (seconds)           (DB2RQTIME) = 5
Input queue wait time (seconds)             (DB2IQTIME) = 5
Command options                             (DB2OPTIONS) =

Option  Description                               Current Setting
-----  -----
-a      Display SQLCA                                  OFF
-c      Auto-Commit                                  ON
-d      Retrieve and display XML declarations      OFF
-e      Display SQLCODE/SQLSTATE                    OFF
-f      Read from input file                       OFF
-i      Display XML data with indentation          OFF
-l      Log commands in history file              OFF
-m      Display the number of rows affected        OFF
-n      Remove new line character                  OFF
-o      Display output                             ON
-p      Display interactive input prompt          ON
-q      Preserve whitespaces & linefeeds          OFF
-r      Save output to report file                 OFF
-s      Stop execution on command error            OFF
-t      Set statement termination character        OFF
-v      Echo current command                      OFF
-w      Display FETCH/SELECT warning messages     ON
-x      Suppress printing of column headings     OFF
-z      Save all output to output file            OFF

C:\>

```

Getting Help

§ Obtain syntax and information for DB2 commands from the command line

- db2 ? list of all DB2 commands
- db2 ? <db2-command> get syntax help for a specific command
- db2 ? Sqlnnnn get message and brief description of a specific SQLCODE
- db2 ? db2nnnn get message and brief description of a DB2 error code

§ For example:

- db2 ? catalog tcpip

```
CATALOG [ADMIN] TCPIP NODE node-name REMOTE hostname  
[SERVER service-name] [SECURITY {SOCKS}]  
[REMOTE_INSTANCE instance-name] [SYSTEM system-name]  
[OSTYPE os-type] [WITH "comment string"]
```



ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

information
systems 



Tools

DB2 Information Management Software

© 2011 IBM Corporation

DB2 Governor and Query Patroller

§ DB2 Governor Utility

- A governor instance consists of a front-end utility and one or more daemons.
- Collect information about the applications that run against the database.
- Check the information collected against the rules in the governor configuration file.
- Takes actions if specified.
- The governor logs any actions that it takes.

§ DB2 Query Patroller is a query management system.

- It is included in DB2 Data Warehouse Enterprise Edition. It is also available separately.
- Allow you to regulate your database's query workload so that small queries and high-priority queries can run promptly.
- Track and cancel runaway queries.
- Collect and analyze information to determine trends across queries, heavy users, and frequently used tables and indexes.

DB2 GUI Tools

§ Control Center

- Central point of administration

§ Command Center

- GUI wrapper for command line processor (CLP)

§ Journal

- Central point for logging DB2 Activities

§ License Center

- Central point of DB2 license management

§ DB2 Developer Workbench

- Central point for developing

§ Task Center

- Central point for scheduling database jobs

§ Health Center

- Central point for DB2 Health Monitoring
- Memory Visualizer

§ Configuration Assistant

- Tool to configure the client
- A light-weight version of the Control Center

§ Replication Center

- A GUI tool to set up and administer a replication environment and to run the Capture and Apply programs

DB2 Administration Server (DAS)

- § A background process to support instance administration
 - db2as on UNIX and Linux (default)
 - DB2DAS service on Windows (default)
- § Provides support services for DB2 tools such as the Control Center, Configuration Assistant, Replication Center, and Development Center
- § Some DAS commands:
 - `db2admin create`
 - `db2admin` (to obtain the name of the DAS on the machine)
 - `db2admin start`
 - `db2admin stop`
 - `db2 get admin cfg`
 - `db2 update admin cfg using <parm> <value>`



ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

information
systems 



System Catalog

DB2 Information Management Software

© 2011 IBM Corporation

Roadmap to Catalog Tables (1)

§ Schema: Table = SYSIBM View = SYSCAT

TABLE	VIEW	DESCRIPTION
SYSDBAUTH	DBAUTH	Authorities on database
SYSCHECKS	CHECKS	Check constraints
SYSCOLUMNS	COLUMNS	Column definitions
SYSCOLCHECKS	COLCHECKS	Columns referenced by check constraints
SYSCOLDIST	COLDIST	Detailed columns statistics
SYSKEYCOLUSE	KEYCOLUSE	Columns used in keys
SYSCONSTDEP	CONSTDEP	Constraint dependencies
SYSDATATYPES	DATATYPES	Datatype definitions (built-in & UDT)
SYSEVENTMONITORS	EVENTMONITORS	Event Monitor Definitions
SYSEVENTS	EVENTS	Events currently monitored
SYSFUNCPARMS	FUNCPARMS	Definitions of Parameters/ Results of UDFs
SYSFUNCTIONS	FUNCTIONS	UDF definitions
SYSINDEXAUTH	INDEXAUTH	Index privileges
SYSINDEXES	INDEXES	Index definitions

Roadmap to Catalog Tables (2)

§ Schema: Table = SYSIBM View = SYSCAT

TABLE	VIEW	DESCRIPTION
SYSPACKAGEAUTH	PACKAGEAUTH	Authorities on packages
SYSPACKAGEDEP	PACKAGEDEP	Package dependencies
SYSPACKAGES	PACKAGES	Package definitions
SYSREFERENCES	REFERENCES	Referential constraints definitions
SYSSTATEMENTS	STATEMENTS	Details of package SQL Statements
SYSTABAUTH	TABAUTH	Table Authorities
SYSTABCONST	TABCONST	Table constraint definitions
SYSTABLES	TABLES	Table definitions
SYSTABLESPACES	TABLESPACES	Table Space Definitions
SYSTRIGDEP	TRIGDEPEVENTS	Trigger dependencies
SYSTRIGGERS	TRIGGERS	Definitions of triggers
SYSVIEWDEP	VIEWDEP	View dependencies
SYSVIEWS	VIEWS	View definitions



ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

information
systems 

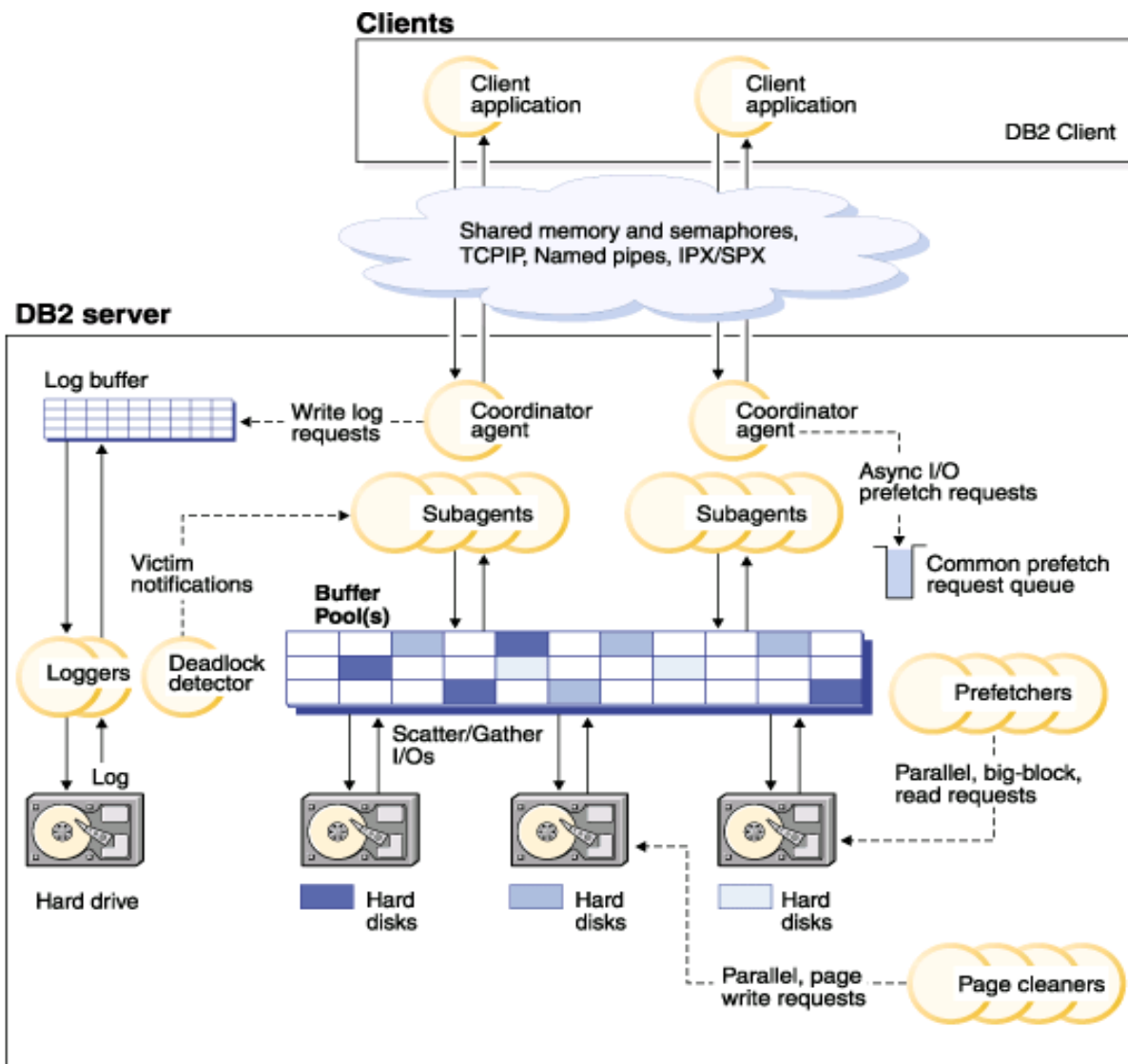


Process and Memory Model

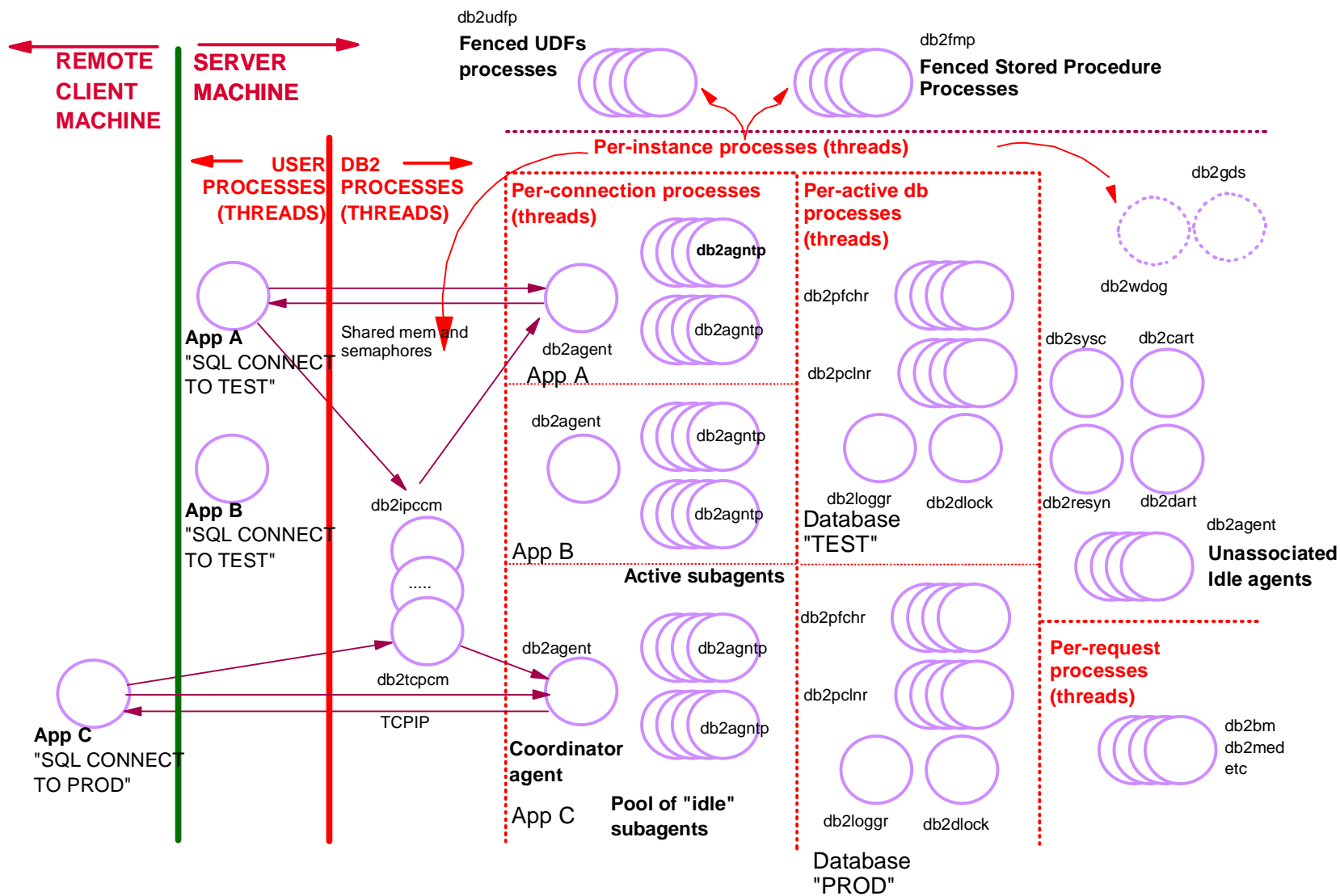
DB2 Information Management Software

© 2011 IBM Corporation

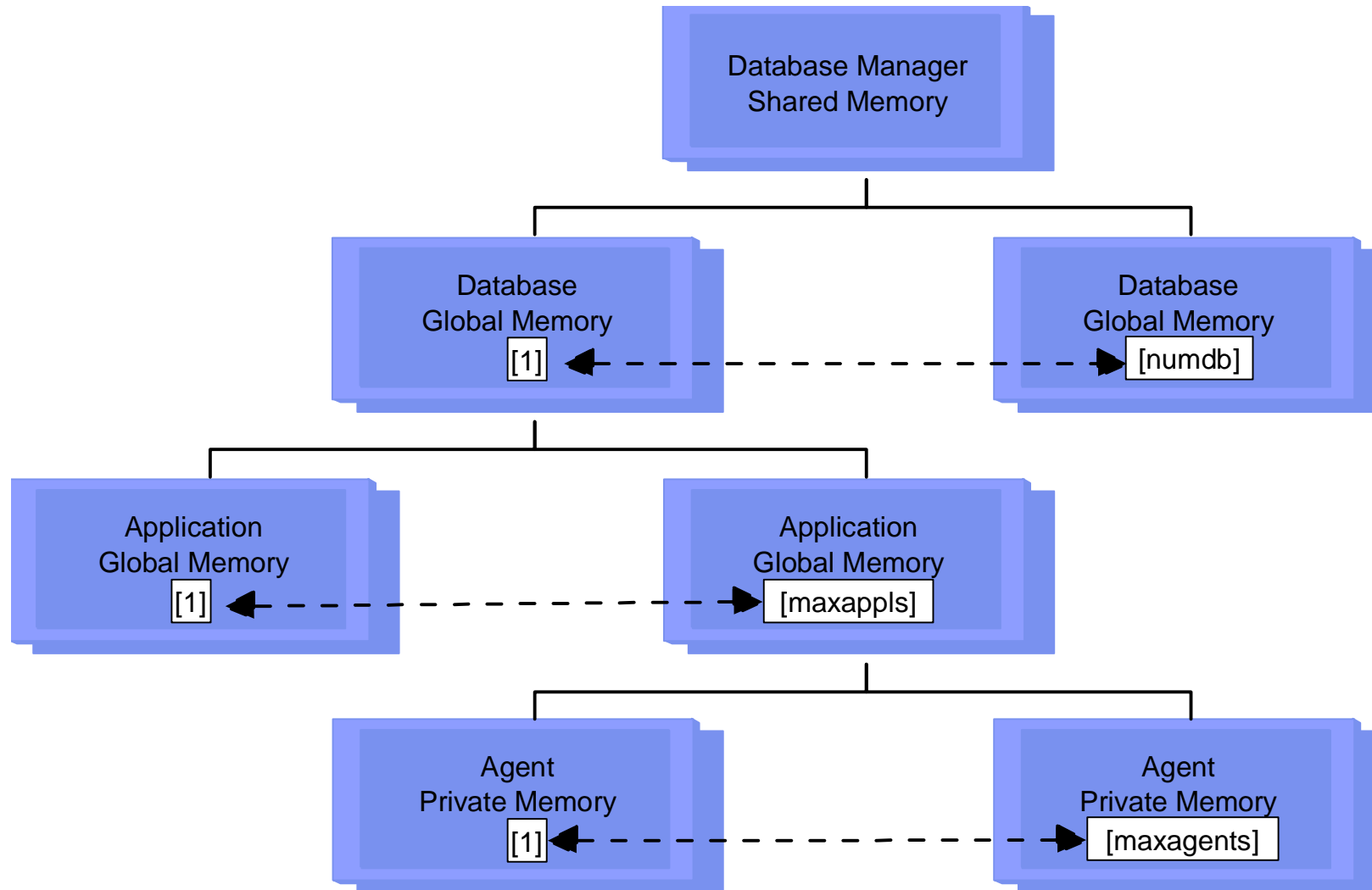
DB2 Architecture and Process Overview



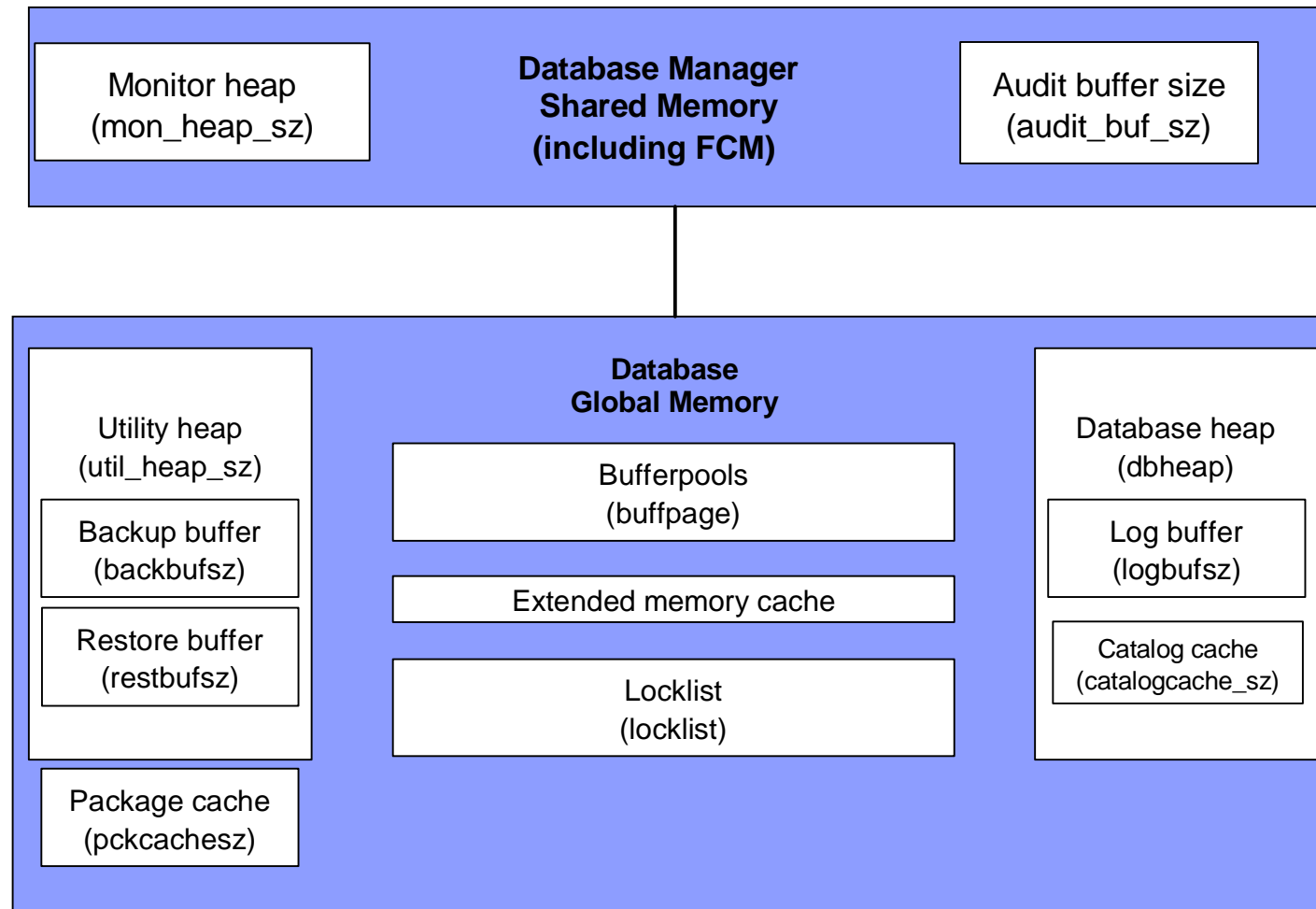
DB2 Process Model



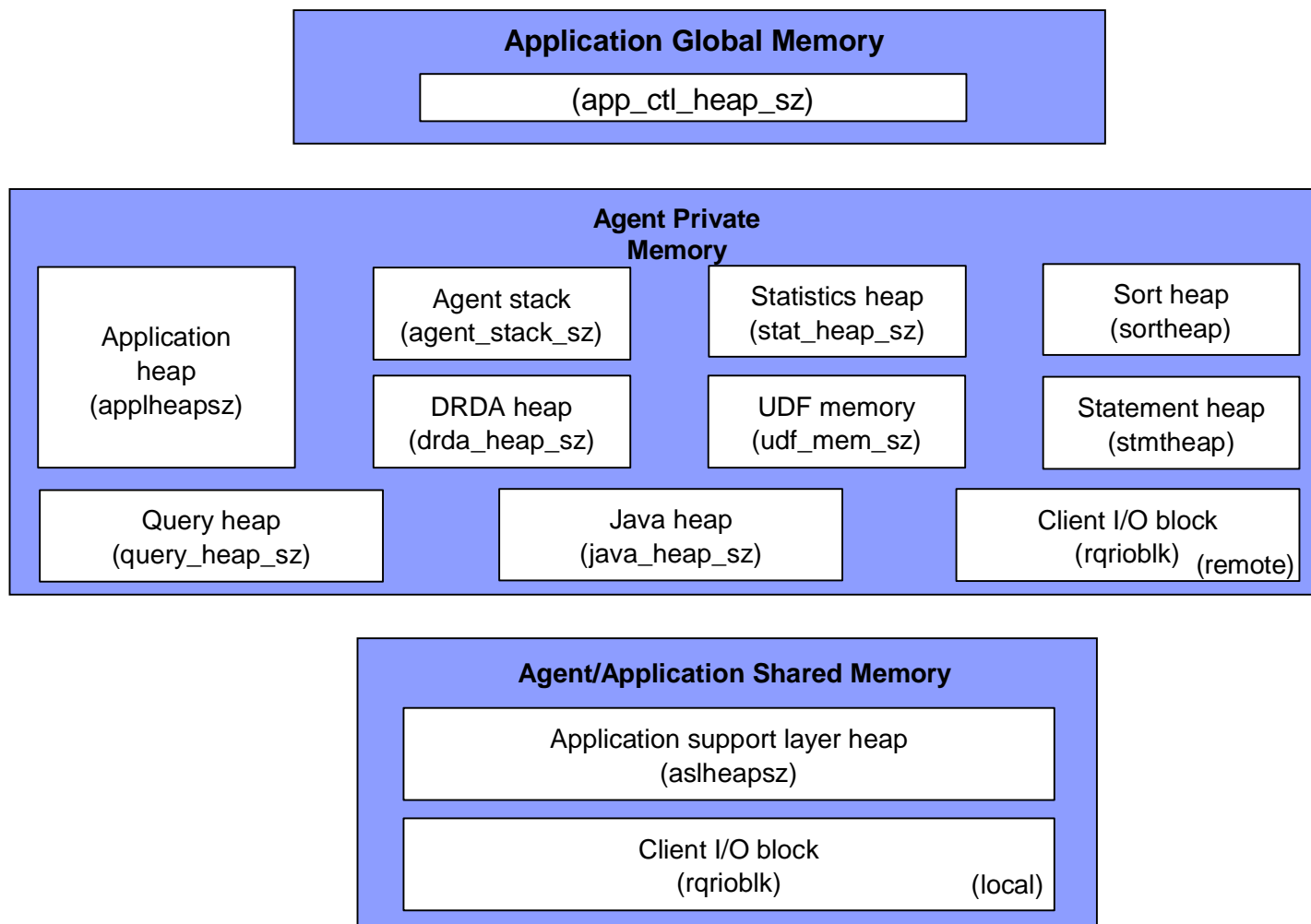
DB2 Memory Model (1)



DB2 Memory Model (2)



DB2 Memory Model (2) – (continued)





ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

information
systems 



Database Security Aspects

DB2 Information Management Software

© 2011 IBM Corporation

DB2 Security Overview

§ There are three main mechanisms within DB2 that allow a DB2 to implement a security plan

– **Authentication**

- DB2 works closely with the security features of the underlying operating system to verify user IDs and passwords. In other words “you are who you say you are”

– **Authorization**

- Determines the operations that users and/or group authorities can perform and the data objects that they may access
- Examples of authorities: SYSADM, DBADM, SECADM

– **Privileges**

- Privileges are more granular than authorities and can be assigned to users and/or groups. Privileges help define the objects that a user can create, access and drop, etc. New in DB2 9 is LBAC which provides a more granular approach to granting privileges!

Changes to Authorities in DB2 9.7

§ **System Monitor (SYSMON) authority scope has been extended**

- Now able to use the db2 memory tracker (db2mtrk) for a report of memory status
- Now able to use the LIST commands to better monitor the system. Affected list commands:
 - LIST DATABASE PARTITION GROUPS, LIST DRDA INDOUBT TRANSACTIONS, LIST PACKAGES, LIST TABLES, LIST TABLESPACE CONTAINERS, LIST TABLESPACES, LIST UTILITIES

§ **System Administrator (SYSADM) authority scope has been reduced**

- No longer has implicit DBADM authority
- They are automatically grant DATAACCESS, ACCESSCTRL, SECADM and DBADM for that database, which gives them the same abilities as in Version 9.5
- No longer able to grant any authorities or privileges except tablespace privileges

Changes to Authorities in DB2 9.7

§ Security administrator (SECADM) abilities have been **extended**

- Now grant and revoke all authorities and privileges, including DBADM and SECADM
- Now grant SECADM authority to roles and groups
- SECADM authority is no longer necessary to run the audit stored procedures and table functions
 - AUDIT_ARCHIVE AUDIT_LIST_LOGS AUDIT_DELIM_EXTRACT

§ Database administrator (DBADM) authority scope has been **reduced**

- No longer automatically grants : BINDADD, CONNECT, CREATETAB, CREATE_EXTERNAL_ROUTINE, CREATE_NOT_FENCED_ROUTINE, IMPLICIT_SCHEMA, QUIESCE_CONNECT, LOAD
- When the security administrator grants DBADM authority, they can choose whether to give the database administrator the ability to perform the following operations:
 - Accessing data within the database.
 - GRANT option WITH DATAACCESS or WITHOUT DATAACCESS
 - Granting and revoking privileges and authorities.
 - GRANT option WITH ACCESSCTRL or WITHOUT ACCESSCTRL

Authority: SQLADM

- § SQLADM authority can be granted by the security administrator (who holds SECADM authority) or a user who possesses ACCESSCTRL authority
- § SQLADM authority can be granted to a user, a group, a role, or to PUBLIC
- § SQLADM authority gives a user the ability to perform the following functions:
 - Execution of the following SQL statements:
 - CREATE EVENT MONITOR
 - DROP EVENT MONITOR
 - EXPLAIN
 - FLUSH EVENT MONITOR
 - FLUSH OPTIMIZATION PROFILE CACHE
 - FLUSH PACKAGE CACHE
 - PREPARE
 - REORG INDEXES/TABLE
 - RUNSTATS
 - SET EVENT MONITOR STATE
 - Execution of certain clauses of the workload manager SQL statements

Authority: WLMADM

- § WLMADM authority can be granted by the security administrator (who holds SECADM authority) or a user who possesses ACCESSCTRL authority
- § WLMADM authority can be granted to a user, a group, a role, or to PUBLIC
- § WLMADM authority gives a user the ability to perform the following operations:
 - Create, alter, comment on, and drop the following workload manager objects:
 - Histogram templates
 - Service classes
 - Thresholds
 - Work action sets
 - Work class sets
 - Workloads
 - Grant and revoke workload privileges
 - Execute the system-defined workload management routines

Authority: EXPLAIN

- § EXPLAIN authority can be granted by the security administrator (who holds SECADM authority) or by a user who possesses ACCESSCTRL authority
- § The EXPLAIN authority can be granted to a user, a group, a role, or to PUBLIC
- § It gives the ability to execute the following SQL statements:
 - EXPLAIN
 - PREPARE
 - DESCRIBE on output of a SELECT statement or of an XQuery statement

Authority: DATAACCESS

- § DATAACCESS authority can be granted only by the security administrator (who holds SECADM authority)
- § It can be granted to a user, a group, or a role. PUBLIC cannot obtain the DATAACCESS authority either directly or indirectly
 - For all tables, views, materialized query tables, and nicknames it gives these authorities and privileges:
 - LOAD authority on the database
 - SELECT privilege (including system catalog tables and views)
 - INSERT privilege
 - UPDATE privilege
 - DELETE privilege
 - In addition, DATAACCESS authority provides the following privileges:
 - EXECUTE on all packages
 - EXECUTE on all routines (except audit routines)

Authority: ACCESSCTRL

- § ACCESSCTRL authority is the authority required to grant and revoke privileges on objects within a specific database. ACCESSCTRL authority has no inherent privilege to access data stored in tables, except the catalog tables and views.
- § ACCESSCTRL authority can only be granted by the security administrator (who holds SECADM authority). It can be granted to a user, a group, or a role. PUBLIC cannot obtain the ACCESSCTRL authority either directly or indirectly. ACCESSCTRL authority gives a user the ability to perform the following operations:
 - § Grant and revoke a subset of administrative authorities:
 - NOT DATAACCESS
 - § Grant and revoke the following database authorities:
 - § Grant and revoke all privileges
 - § This authority is a subset of security administrator (SECADM) authority.