



**F19**

# **DB2 UDB and WebSphere Application Server at Light Speed**

Quentin Presley

A decorative graphic consisting of a horizontal bar with rounded ends, filled with a dark green color and outlined in a lighter green. The bar is surrounded by several smaller, semi-transparent green circles of varying sizes, creating a bubbly, organic effect.

**IBM Data Management Technical Conference**

**Anaheim, CA**

**Sept 9 - 13, 2002**

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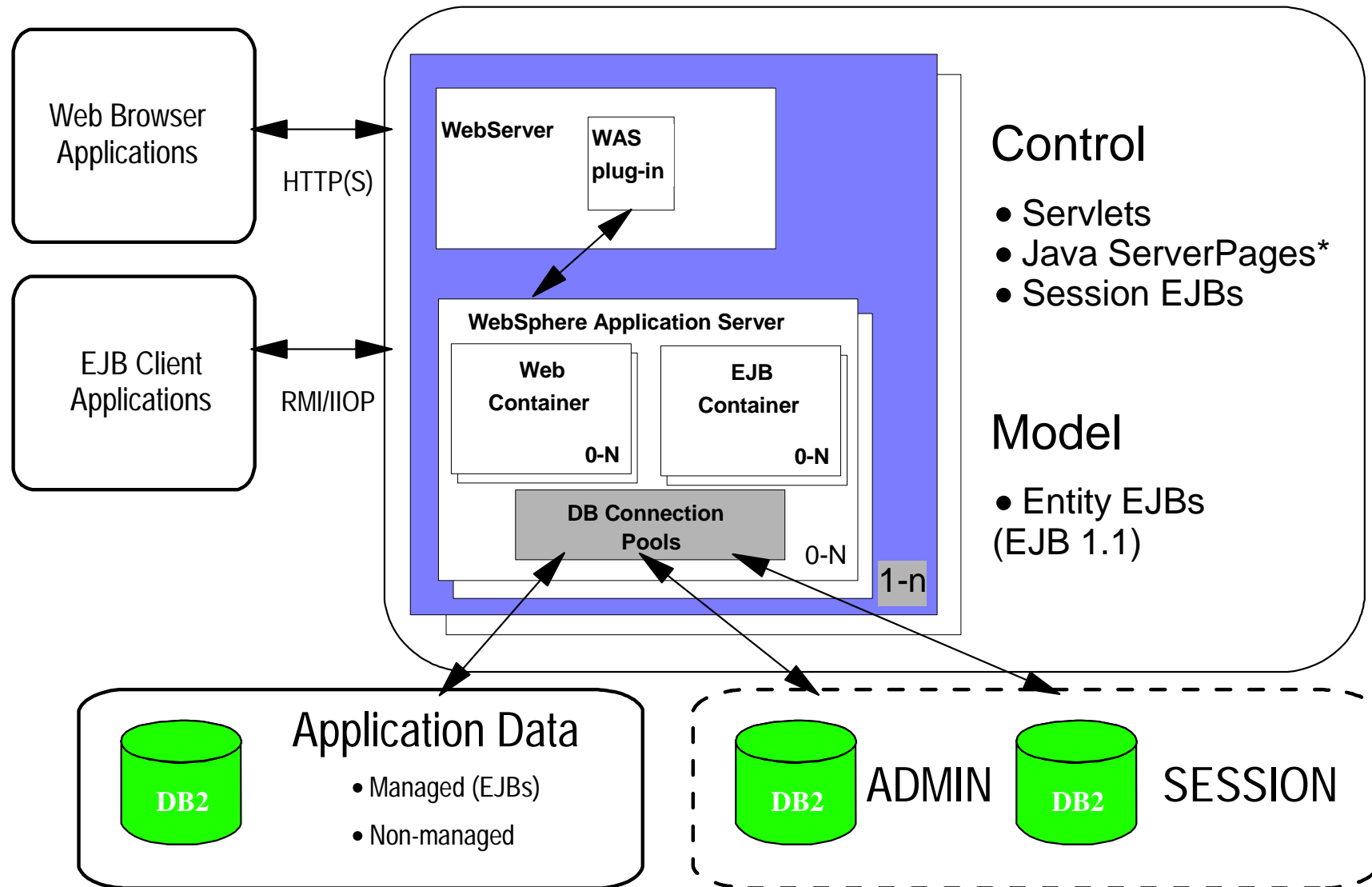
# Agenda

- How does WebSphere access DB2
- Configuring DB2 for performance
- Managing DB2 connections
- WebSphere PreparedStatement caching
- Persistent Session tips for DB2
- High availability considerations
- Benchmarks and Scalability
- Importance of the J2EE certification

# Distributed Application Bottlenecks

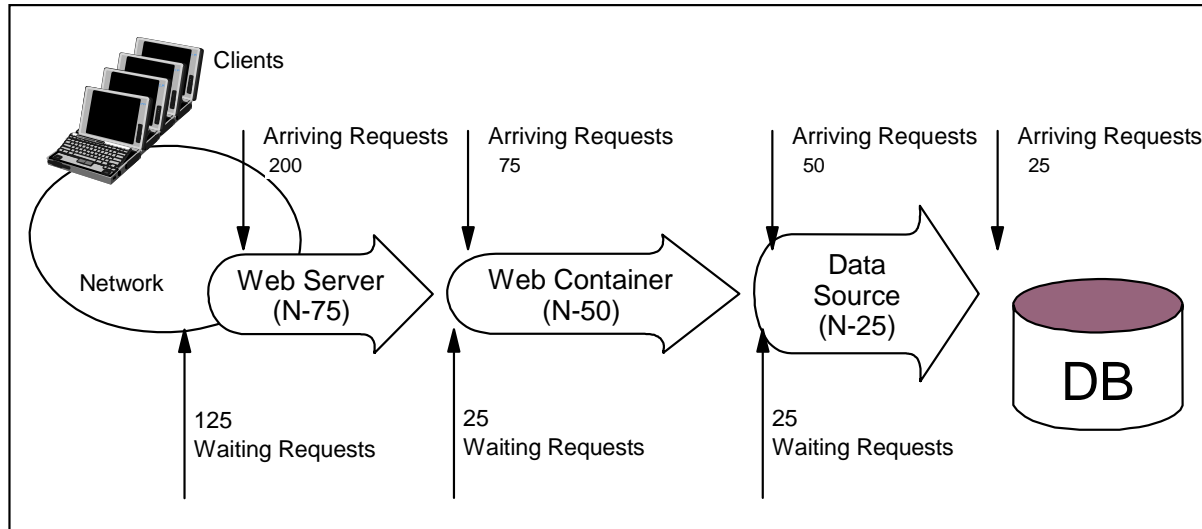
- **Analyze CPU and I/O at each layer**
  
- Application Servers (WebSphere)
  - ▶ CPU
  - ▶ Garbage collection
  - ▶ Application synchronization code
  - ▶ Over allocated memory (paging, I/O)
  
- Database Servers (DB2)
  - ▶ Memory usage
  - ▶ Physical layout
    - Indexes
    - Clustering (Multi-dimensional clusters)
    - Tablespace layout
  - ▶ Access plan
    - Plan selections/Statement caching
    - Optimization
  - ▶ Concurrency
  
- Network traffic between layers (J2EE programming model)

# WebSphere's Usage of DB2 UDB



# Queuing

- Queues are used in each layer of a WAS environment
- Set data sources according to the maximum queue sizes for Web containers
- DB2 does not use queues as all requests are synchronous
- Aggressive queue sizes can lead to resource saturation.



# WebSphere DataSources

- WAS provides a Java Naming service JNDI implementation to ease access to DB2.
- DB2 databases must be defined within WAS.
- Port number is not required for use of Type 2 JDBC driver
- Connection attributes such as default userids and passwords can be defined.

**Data Source Properties**

General | Connection Pooling

Please read the help for information on configuring data sources.

Name: \*Sample

JNDI name: jdbc/Sample

Description:

JDBC provider: \*Sample DB Driver

Custom Properties

Name	Value
user	db2was
language	
ID	
password	*****
description	
portNumber	
connectionAttribute	cnode=1

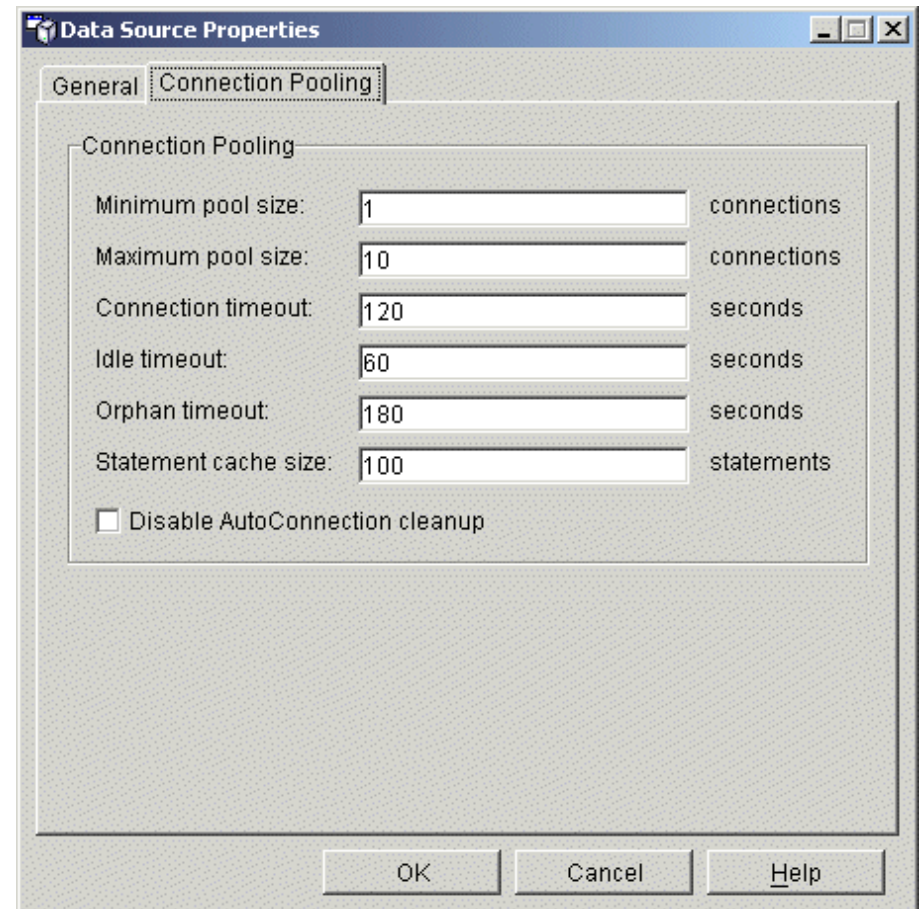
Test Connection

OK Cancel Help



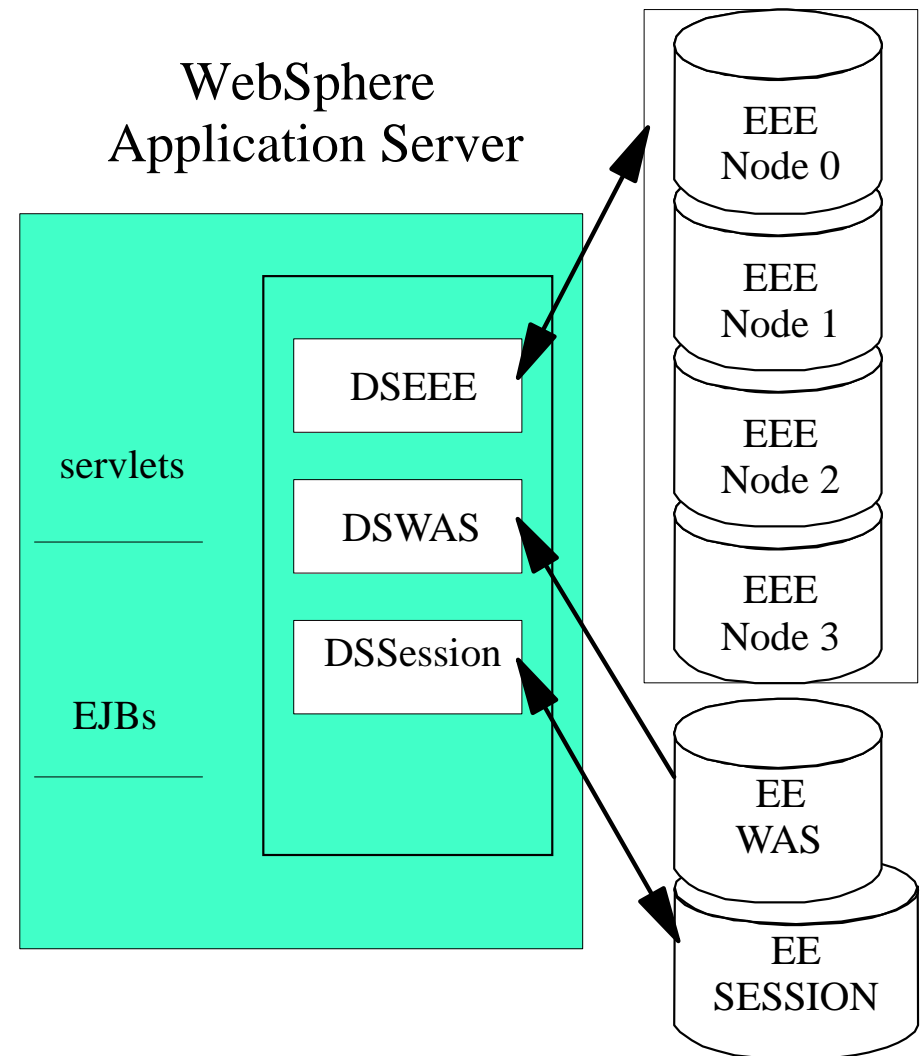
# WebSphere Connection Pooling

- Pool is shared by all apps using this datasource
- Bigger is not always better
- Min/Max can be set to the same value to avoid releasing physical connections
- MAXAGENTS must be at least as big as the sum of all max pool sizes
- Note: ECPperf used maximum pool size of 24



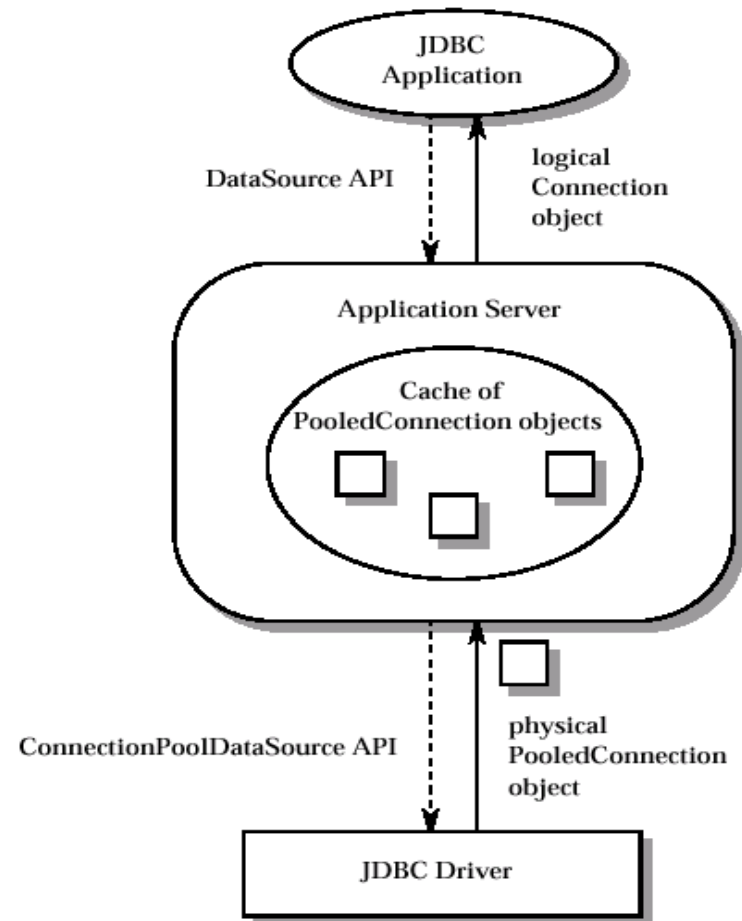
# Considerations with DB2 EEE

- Accessing DB2 UDB Enterprise Extended Edition (EEE) DBs from WAS is supported.
- WAS session and administration DB should be created in a EE instance (can use EEE installation)
- WAS data sources can be directed to specific DB2 partitions using data source properties.



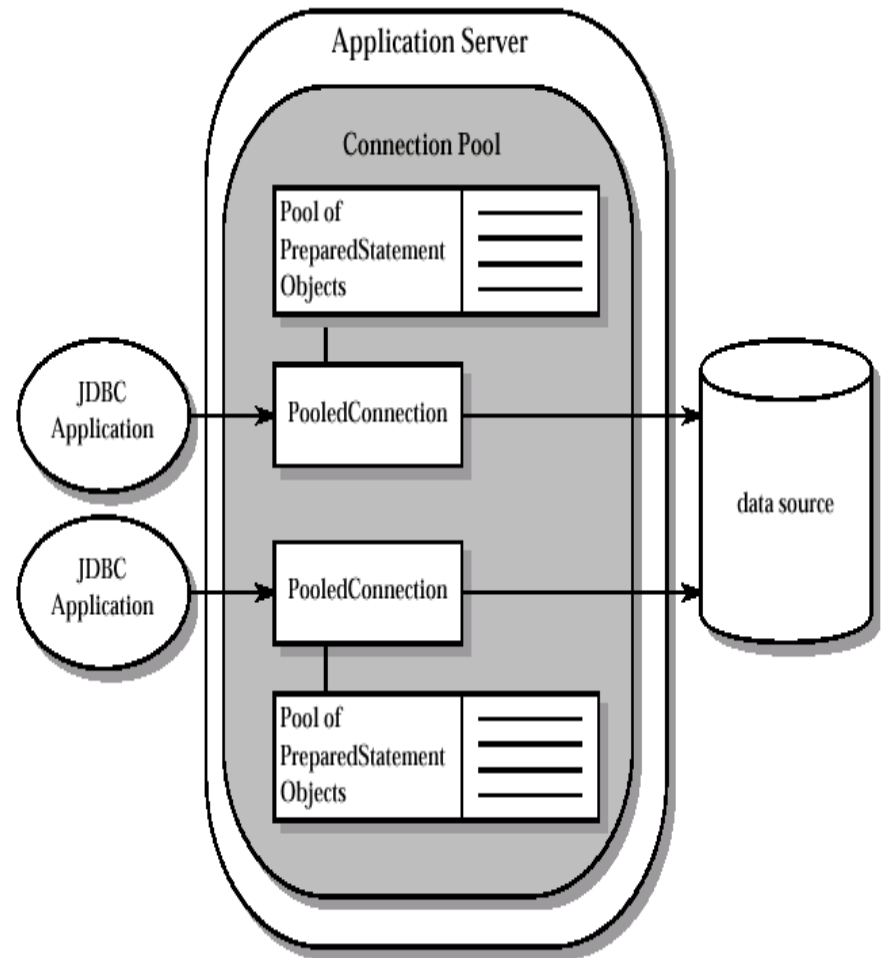
# WAS tuning – Connection Pools

- WebSphere pools connections to DB2.
- A pool for each unique DataSource (userid /password / other properties)
- New physical connection only obtained if none in pool match
- Eliminates network traffic to remote databases



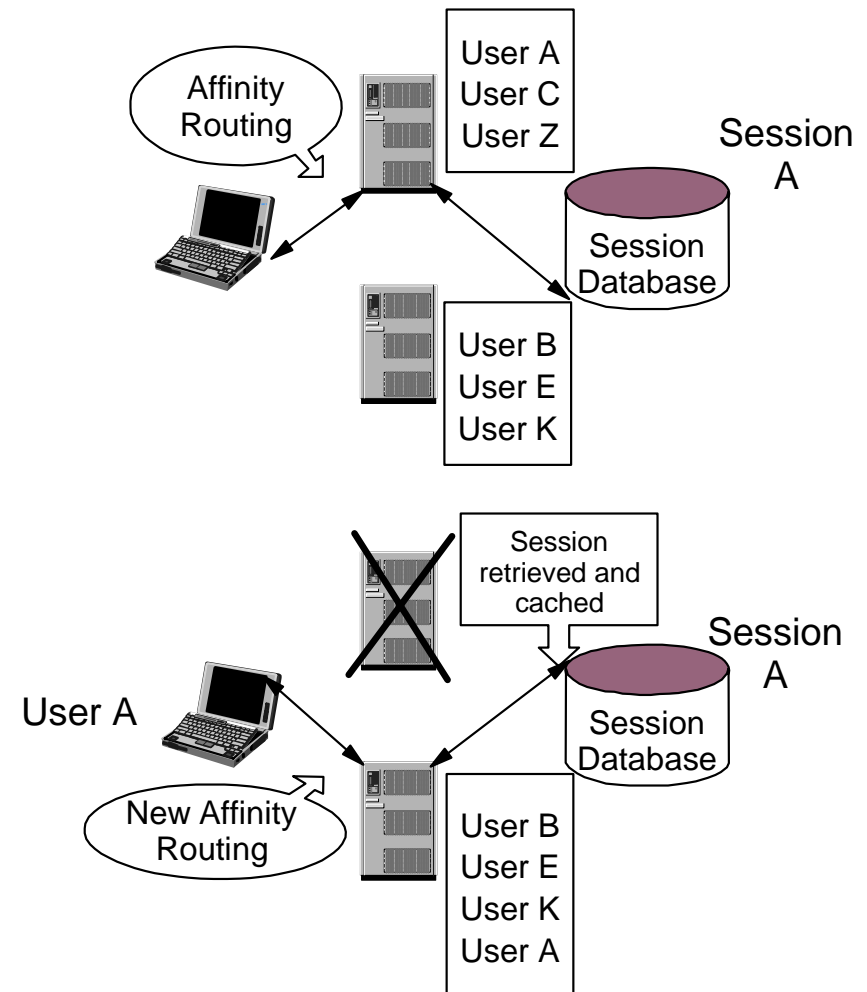
# WebSphere Statement Pooling

- WAS will check its cache before flowing request to DB2
- WAS cache is only used for PreparedStatements
- DB2's PKGCACHE is used for all SQL (dynamic & static).
- Both caches should be monitored and tuned.
- Note: ECPperf had a WAS cache of 1560



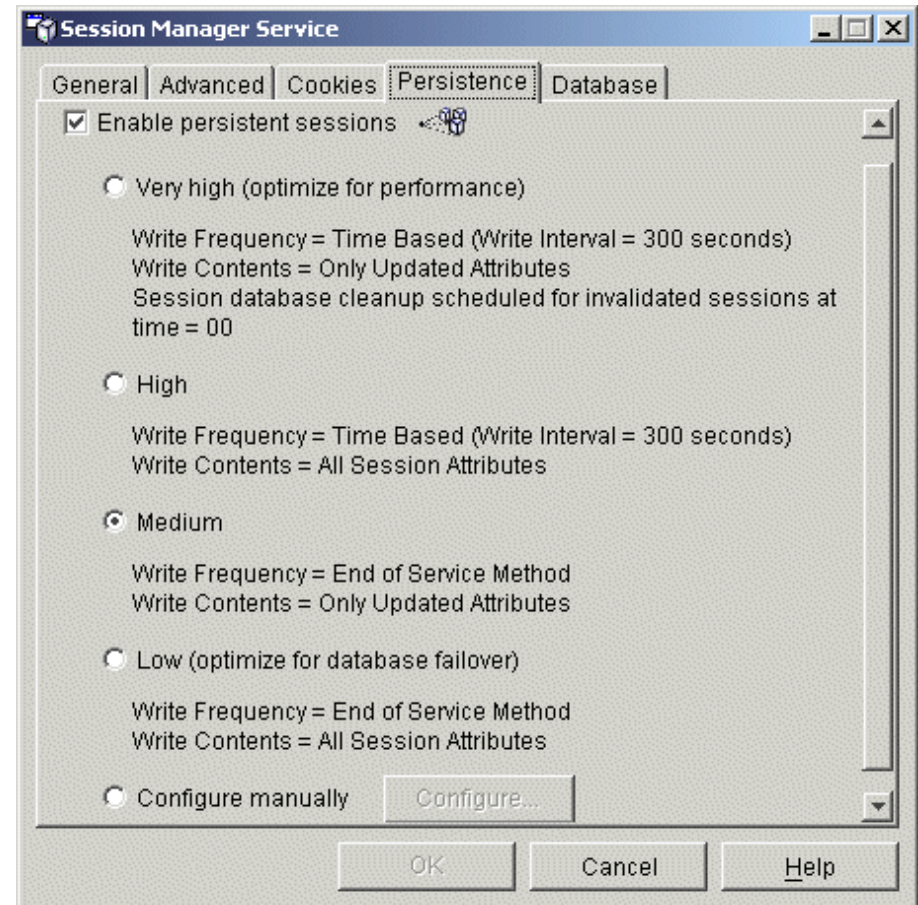
# WebSphere Session Affinity

- DB2 can provide the session persistence service to allow continuous operation for applications.
- User applications are dynamically rerouted to an available WAS node and the session data is retrieved.



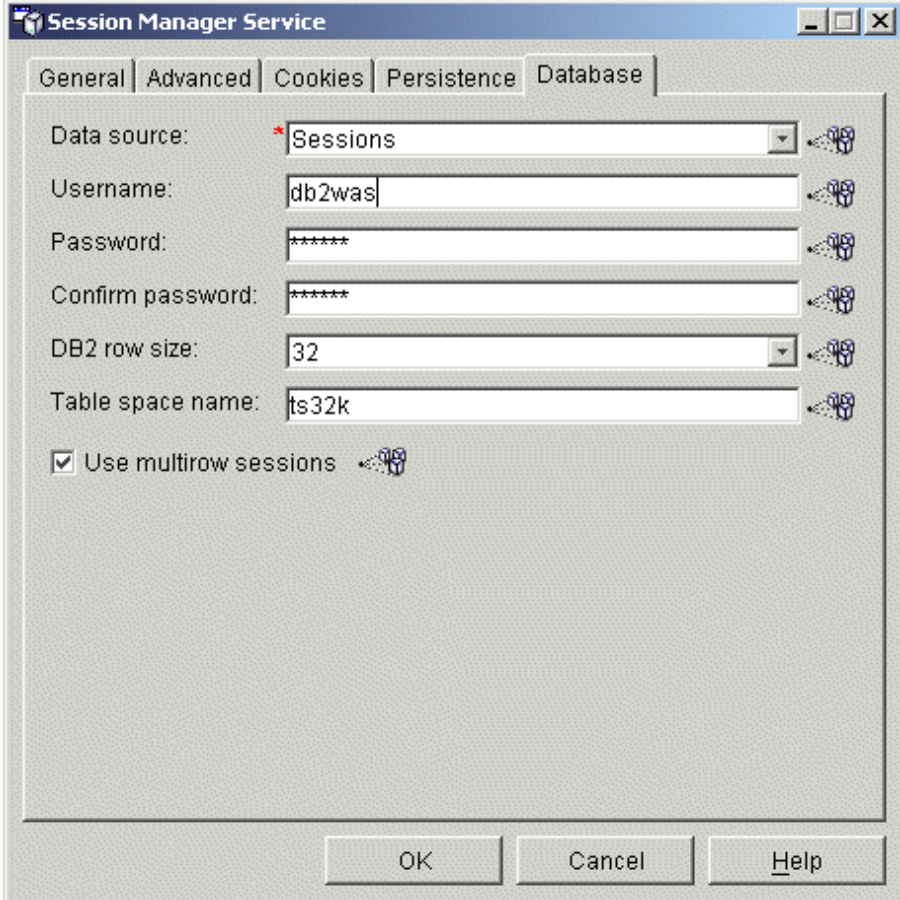
# Enabling Persistent Sessions

- Purpose:
  - ▶ WAS will managed HTTP session objects on behalf of the application to enable high availability (failover)
- Single session persistence table is highly updated and volatile in size
- Use DB2 SQL snapshots to understand access patterns
- Update activity is controllable.



# Session DataSource Properties

- Uses the same WAS Connection Pooling
- Single or multiple rows used to represent HTTPSession data
- Large tablespaces can be used for performance.



The screenshot shows the 'Session Manager Service' configuration window, specifically the 'Database' tab. The window has a title bar with standard minimize, maximize, and close buttons. Below the title bar are five tabs: 'General', 'Advanced', 'Cookies', 'Persistence', and 'Database', with 'Database' being the active tab. The configuration area contains several fields and a checkbox:

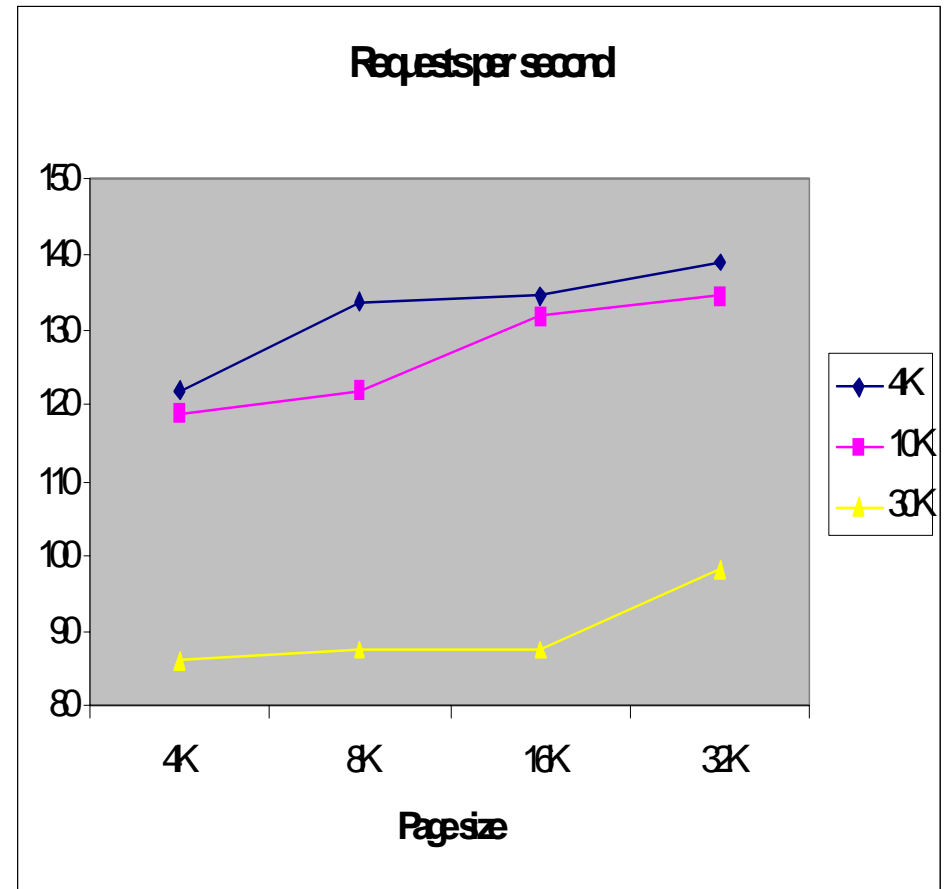
- Data source:** A dropdown menu with 'Sessions' selected.
- Username:** A text field containing 'db2was'.
- Password:** A text field with masked characters '\*\*\*\*\*'.
- Confirm password:** A text field with masked characters '\*\*\*\*\*'.
- DB2 row size:** A dropdown menu with '32' selected.
- Table space name:** A text field containing 'ts32k'.
- Use multirow sessions:** A checked checkbox.

At the bottom of the window are three buttons: 'OK', 'Cancel', and 'Help'.



# WAS exploitation of DB2's Larger Page Sizes

- Persisting HTTP Session data is important for failover of J2EE applications
- WAS v4 provides the ability to store session data as VARCHAR values using DB2's 16KB or 32KB pages
- Overall system performance improves approximately 15%

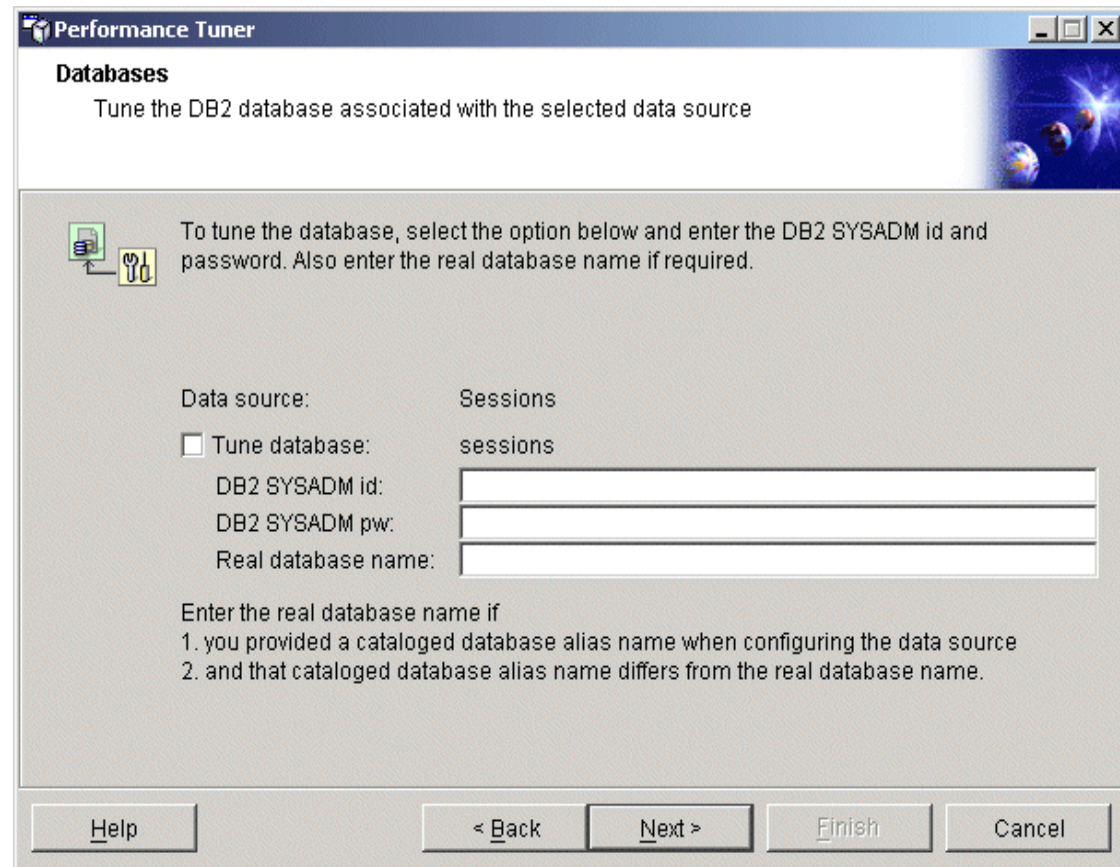


Source: Tuning DB2 UDB for Session Persistence, IBM white paper (2002)



# WAS Integrated Performance Wizard - DB2 only

- DataSource is associated with an Application Server
- Can be run over a network
- Tunes database for OLTP access
- Provides easy point and click tuning of datasources



The screenshot shows a window titled "Performance Tuner" with a "Databases" section. The text reads: "Tune the DB2 database associated with the selected data source". Below this, there is a small icon of a database and a text box with instructions: "To tune the database, select the option below and enter the DB2 SYSADM id and password. Also enter the real database name if required." The form includes a "Data source:" label with "Sessions" selected, a "Tune database:" checkbox (unchecked), and three input fields for "DB2 SYSADM id:", "DB2 SYSADM pw:", and "Real database name:". Below the input fields, there is a note: "Enter the real database name if 1. you provided a cataloged database alias name when configuring the data source 2. and that cataloged database alias name differs from the real database name." At the bottom, there are buttons for "Help", "< Back", "Next >", "Finish", and "Cancel".

# DB2 Tuning - Memory Usage

- Database Manager configuration
  - ▶ MAXAGENTS
    - The maximum number of agents that can be started
    - Must be high enough to handle maximum pools for all WAS connection pools
  - ▶ NUM\_INITAGENTS
    - Number of agents started when **db2start** is issued
    - Used to avoid initial connection setup time
  - ▶ NUM\_POOLAGENTS
    - Specifies maximum size of the agent pool (idle and in-use agents)
- Database configuration
  - ▶ APPLHEAPSZ
    - Holds application related information on the DB2 server
  - ▶ PKGCACHE
    - Set according to WAS statement cache + other SQL
  - ▶ LOGBUFSZ / DBHEAP / MINCOMMIT
    - The LOGBUFSZ is used along with the MINCOMMIT parameter to improve I/O wait conditions on DB2's transaction log files

# DB2 Tuning - Access Plans

- Volatile tables
  - ▶ Table size varies frequently
  - ▶ Forces DB2 to perform index scans
- Optimization level
- Database Manager Configuration Parameters
  - ▶ INTRA\_PARALLEL
    - For use in SMP systems
    - Specifies whether a database manager can use parallel process for processing queries
  - ▶ MAX\_QUERYDEGREE
    - Specifies the maximum degree of intra-parallelism used for any SQL statement
- Database Configuration Parameters
  - ▶ AVG\_APPLS
    - Specifies the average number of active applications
    - Optimizer uses this to determine the amount of bufferpool that will be available at runtime
    - Database Configuration parameter

# DB2 Tuning - Concurrency

- Database Configuration Parameters
  - ▶ LOCKLIST
    - Specifies the maximum storage in pages allocated to the lock list
    - Larger LOCKLIST size avoids lock escalation
  - ▶ MAXLOCKS
    - Specifies the maximum percentage of the lock list that any single application can use
    - This parameter needs to be carefully tuned
    - A large value could cause lock escalations as any one application could use too much of the lock list
    - A small value could cause lock escalations since each application could run out of locking space quickly
- JDBC Isolation levels and DB2 Isolation Levels have different definitions

JDBC Isolation Levels	DB2 Isolation Levels
TRANSACTION_SERIALIZABLE	Repeatable Read (RR)
TRANSACTION_REPEATABLE_READ	Read Stability (RS)
TRANSACTION_READ_COMMITTED	Cursor Stability (CS)
TRANSACTION_DIRTY_UNCOMMITTED	Uncommitted Read (UR)

# DB2 Tuning - Physical Layout

- Indexes
  - ▶ ensure they are defined
  - ▶ Clustering indexes for improved access
  - ▶ Multi-dimensional clusters (MDC)
- Large page
  - ▶ Large page sizes improve I/O (as shown in session persistence)
- Buffer pools
  - ▶ Use available memory on DB2 server
  - ▶ Proper bufferpool sizes can reduce I/O
- Tablespaces
  - ▶ Multiple containers to reduce I/O

# DB2/WAS Best Practices

- Don't use DriverManager ( no pooling )
  - ▶ ~~java.sql.DriverManager.getConnection ( url, user, pwd)~~
- Use DataSources (WebSphere v4 syntax)
  - ▶ WebSphere implements javax.sql.DataSource based on
    - javax.sql.ConnectionPoolDataSource
    - javax.sql.XADataSource
- Create an Initial Naming Context (JNDI) for ds lookup

```
javax.sql.DataSource ds = (javax.sql.DataSource) ctx.lookup java:comp/env/jdbc/SAMPLE");
java.sql.Connection con = ds.getConnection();
```
- Programming Model - catch and release

```
catch ( java.sql.SQLException sqle)
{
finally
{
    rs.close();
    stmt.close();
    conn.close() ;
}
```

# Monitoring DB2 and WebSphere

- DB2
  - ▶ Snapshot monitor – operational, connections, statements, bottlenecks (locks, logging)
  - ▶ Event monitor – deadlocks
  - ▶ Explain – poor access plans
  - ▶ JDBC trace analysis
- WAS
  - ▶ Resource analyzer can be used to monitor connection pools, statement caches, queues
- OS level facilities – netstat, iostat, vmstat, etc....

# Monitoring WebSphere Access to DB2 for OS/390

The screenshot displays the WebSphere Advanced Administrative Console interface. The left-hand tree view shows the hierarchy: WebSphere Administrative Domain > Resources > JDBC Providers > Sample DB Driver > Data Sources. The main panel shows the configuration for the selected 'sample' data source. It includes a table of existing data sources, a 'General' tab with fields for User ID, Password, and Confirm password, and a 'Custom Properties' table with entries for ClientWrkstnName, ClientAppName, and Clientuserid. At the bottom, an event log shows a 'Console Ready' message from 4/4/02 at 9:24 AM.

Name	Database Name	Description	JDBC Provider
SampleDataSource	was40	Example Data Source	Sample DB Driver
sample	SAMPLE	The AppServer Sampl...	Sample DB Driver

General | Connection Pooling

User ID: WSDemo  
Password: \*\*\*\*\*  
Confirm password: \*\*\*\*\*

Custom Properties

Name	Value
ClientWrkstnName	WebSphere-Wkstn
ClientAppName	WebSphere-Samples
Clientuserid	WebSphere-User

Apply Reset Help

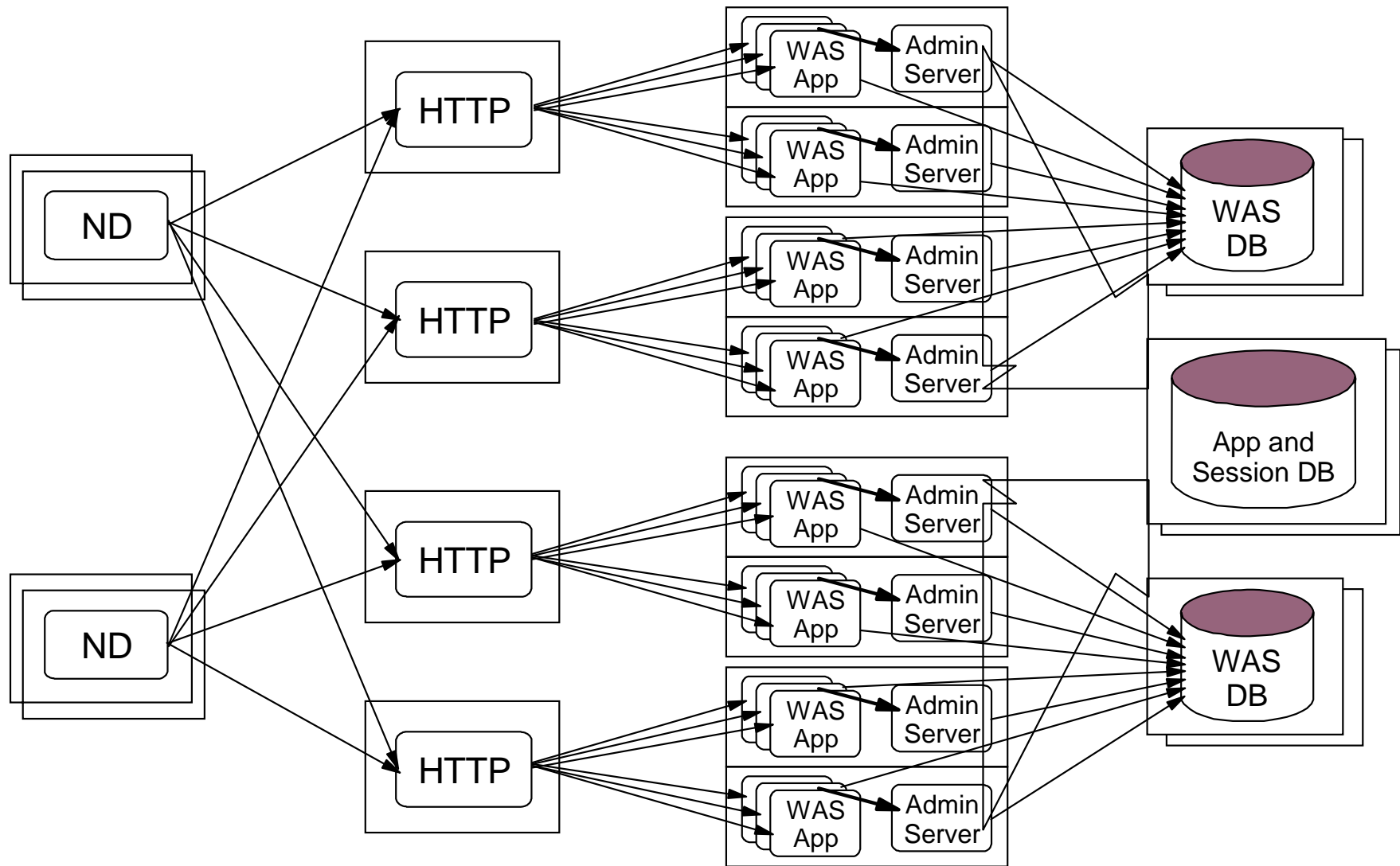
Type	Time	Event Message	Source
Info	4/4/02 9:24 AM	Console Ready.	



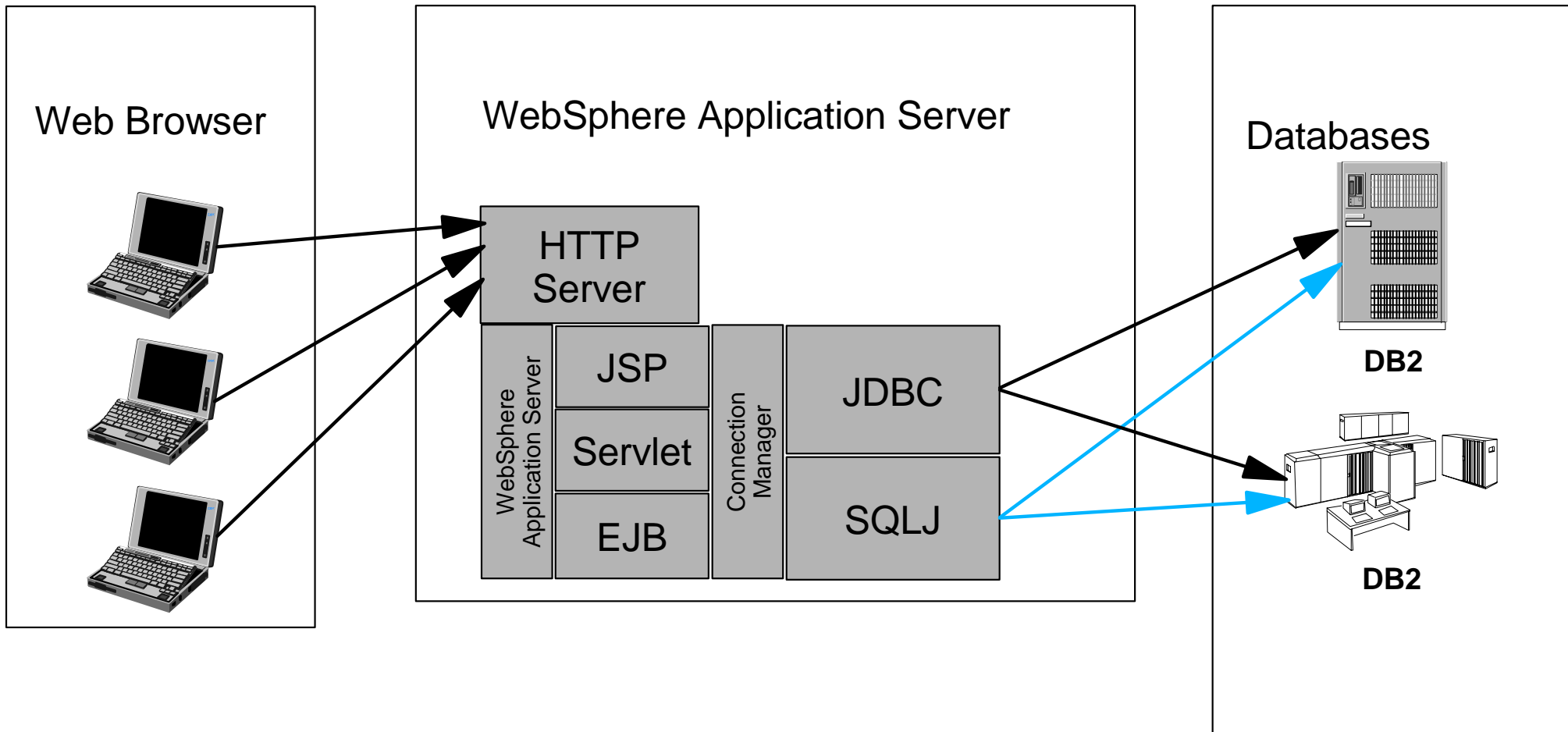
# Monitoring WebSphere Access to DB2 for OS/390 cont.

```
Session A - [24 x 80]
File Edit Transfer Appearance Communication Assist Window Help
PrtScrn Copy Paste Send Recv Display Color Map Record Stop Play Quit Clipbrd Support Index
DSNV401I -NSLU DISPLAY THREAD REPORT FOLLOWS -
DSNV402I -NSLU ACTIVE THREADS -
NAME      ST A   REQ ID      AUTHID     PLAN      ASID  TOKEN
SERVER    RA *   406 java     TS11642    DISTSERV  0058   618
V437-WORKSTATION=huron, USERID=ts11642,
APPLICATION NAME=java
V445-G91A33A7.090A.54A304143838=618 ACCESSING DATA FOR 9.26.51.167
SERVER    RA *   2113 java    TS11642    DISTSERV  0058   611
V437-WORKSTATION=WebSphere-Wkstn, USERID=WebSphere-User,
APPLICATION NAME=WebSphere-Samples
V445-G91A33A7.0903.020404143842=611 ACCESSING DATA FOR 9.26.51.167
SERVER    RA *   2002 db2bp   TS11642    DISTSERV  0058   551
V437-WORKSTATION=huron, USERID=ts11642,
APPLICATION NAME=db2bp
V445-G91A33A7.08AA.020403212504=551 ACCESSING DATA FOR 9.26.51.167
SERVER    RA *    7 db2bp    TS11642    DISTSERV  0058   117
V437-WORKSTATION=huron, USERID=ts11642,
APPLICATION NAME=db2bp
V445-G91A33A7.0626.45FD29184206=117 ACCESSING DATA FOR 9.26.51.167
TSO      T *    3 TS11642    TS11642    005B    619
DISPLAY ACTIVE REPORT COMPLETE
DSN9022I -NSLU DSNVDT '-DIS THREAD' NORMAL COMPLETION
***
MA a 23/006
Connected to remote server/host torolabm using port 23
```

# Scalability of DB2/WAS



# J2EE Architecture Overview



# DB2 Developing Applications with Java

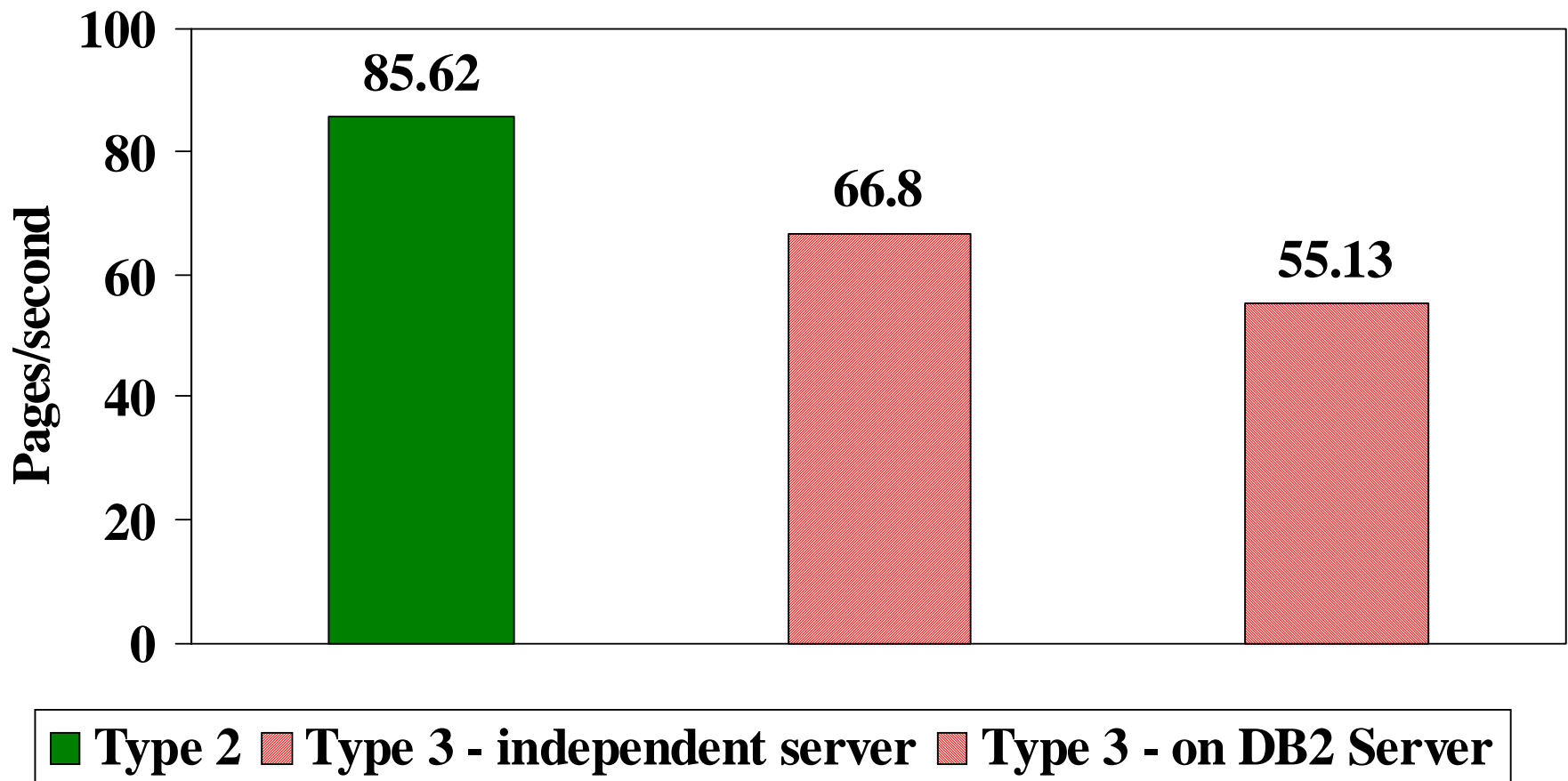
- JDBC – Dynamic SQL interface
  - ▶ Subset of Java™ 2 Platform, Standard Edition (J2SE 2)
    - JDBC 2.x
    - JDBC 3.x
    - Defined by Sun Microsystems
- SQLJ – Embedded SQL in Java language
  - ▶ Defined by SQLj.org and ANSI
    - SQLJ: Embedded SQL in Java methods – Part 10:SQL/OLB standard (ANSI)
    - SQLJ: SQL Routines - calling Java static methods as SQL stored procedures and user-defined functions – Part 1
  - SQLj: SQL Types – Part 2

# DB2 JDBC Driver Architecture

- Type 2 – J2EE 1.3 Certified
  - ▶ As of DB2 UDB Version 7 FixPak 5
    - API changes have been made in FixPak 5 to fit J2EE specifications
  - ▶ Used for WebSphere Applications
  - ▶ High performance
  
- Type 3 – Ease of use
  - ▶ Native Java driver
  - ▶ Requires DB2 JDBC applet server running
  
- DRDA-based JDBC drivers coming
  - ▶ Type 2 – highly optimized for DB2
    - Based on DRDA
  - ▶ Type 4 – coming to a DB2 near you !!
  
- <http://www.opengroup.org/dbiop/>

# DB2 JDBC Architecture - Performance

## DB2 UDB v7 JDBC Driver/WebSphere Comparison (Trade2)



# Coding around Network traffic

- The **Statement** interface has two methods that can be used to provide hints to the JDBC driver
  - ▶ **setFetchSize**
    - setFetchSize should be tuned to match DB2's record blocking parameter (RQRIOBLK)
    - FetchSize attributes works with FORWARD ONLY and SCROLLABLE ResultSets (as of FP7)
  - ▶ **setFetchDirection**
- The values supplied to these methods are applied to each result set produced by the Statement object
- The ResultSet interface contains the same methods that can be used to supply hints for just that result set

# Additional Information

## ■ DB2 links

### – Developer Domain / Samples

– <http://www-3.ibm.com/software/data/developer/samples/video/> - IBM Video Central Sample

– <http://www.ibm.com/software/data/developer> - Great articles on DB2 Development

### – Integration

– <http://www.ibm.com/software/data/integration/websphere> (external)

– <http://www.ibm.com/software/data/webservices>

### – J2EE 1.3 Certification - 12/20/2001

– <http://java.sun.com/j2ee/compatibility.html>

### – DB2/WebSphere benchmark result (Trade2)

– <http://www-4.ibm.com/software/data/bi/teraplex/scaleebus.pdf>

## ■ Redbooks (<http://www.redbooks.ibm.com>)

▶ DB2 UDB/WebSphere Performance Tuning Guide (SQ24-6417-00)

▶ DB2 e-business Guide (SG-246539-00)



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