# IBM* DB2* Universal Database Deployed on Intel® Itanium® Architecture and Linux*

## Scalable and Affordable Solutions for High-End Database Applications

With the emergence of complete, optimized solution stacks, IBM* DB2* Universal Database running on Itanium® 2 processor family-based servers now offers a powerful and cost-effective alternative for enterprise-class database implementations. IBM DB2 is the leading product from IBM Information Management Software and is supported by a wide range of applications. It provides one of most flexible and comprehensive data management solutions in the industry. Intel® Itanium® architecture supports world-class performance, scalability, and availability for these business-critical solutions—using affordable, industry-standard servers. The combination marks a significant breakthrough for memory-intensive applications and for middleware solutions that require large database installations.

The combined platform is now ready for production environments. This configuration guide outlines a basic design methodology. It also defines a set of components and an architecture for a comprehensive solution. By beginning your proof-of-concept and pilot tests now, you will be well-positioned to take advantage of Intel Itanium architecture as it continues to push the envelope of performance and value for enterprise solutions.

*For detailed information about Intel Itanium architecture-based infrastructure solutions, including performance data, visit the Intel Web site at:* http://www.intel.com/eBusiness/products/server/

## IBM DB2 Universal Database on Intel Itanium Architecture

Itanium 2 processor family-based platforms deliver exceptional scalability and availability for IBM DB2 solutions, at much lower costs than traditional, RISC-based platforms. Based on Explicitly Parallel Instruction Computing (EPIC), Intel Itanium architecture supports highly parallel processing, large memory addressability, and innovative, compiler-based optimization that greatly improve performance for database operations. The parallel architecture includes a large number of execution registers that enable efficient, simultaneous processing for up to six instructions. Since the compiler optimizes the software for parallel throughput, the processor can focus all its resources on fast execution—making optimal use of advanced features such as the large on-die cache; predication, which reduces branch delays; and speculation, which preloads essential data for faster processing.

These features deliver substantial performance benefits for large database and business intelligence applications. The database can keep more of its information content and

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structures in memory, and utilize the large memory for extensive database buffer pools. In combination with enhanced parallel execution, the solution can handle more simultaneous users and more complex queries. Intel Itanium architecture also supports flexible scaling options. Platforms with up to 64 processors and 512GB of memory are now available. The high-bandwidth system bus also delivers sufficient I/O bandwidth (6.4GB/s) to support hundreds of smaller nodes in clustered configurations.

## Design Methodology

Intel Itanium architecture is designed to integrate easily into existing environments. Basic design strategies are virtually identical to those used to deploy 32-bit solutions on Intel architecture, so development teams can take advantage of their existing resources, tools, and skill sets. In general, the following steps apply.

1. **Assess Application Requirements**—List all required software components for an end-to-end solution, including the operating system, applications, and third-party tools.
2. **Develop an Integration Table** (see Table 1 on page 5)—Identify which components are best run on Itanium 2 processor family-based systems, and which should be run using 32-bit Intel Xeon™ processor family-based systems.
3. **Determine Software Availability**—Check with your solution provider or software vendors to determine current or planned availability for all components.
4. **Design Your Proof of Concept (POC), Staging, and Production Plan**—In most cases, initial tests can be performed by running core components on a single, 4-way Itanium 2 processor family-based system. This will confirm the viability of the solution, verify performance potential, and prepare your team for designing and deploying a full-scale solution for your production environment.
5. **Assess the Impact on Your Current Environment**—Evaluate network and system management requirements, and develop a plan for efficient integration into your existing infrastructure.

The rest of this paper provides initial guidance for using this design methodology to develop and test your own Itanium 2 processor family-based solutions.

*Note: Intel Solution Services can provide expert consultation and assistance in all phases of planning, POC, design, and integration.*

## Application Description

The functional relationships for a comprehensive IBM DB2 implementation are shown in Figure 1. In this example, two multi-processor Itanium 2 processor family-based servers are added to an existing 32-bit enterprise database solution to support a new database back-end that will accommodate growing resource needs in an expanded SAP application layer. The existing database is hosted on a 40-node cluster of Intel Xeon processor family-based servers powered by IBM DB2 Universal Database for Linux* V8.1. IBM DB2 uses a shared-nothing architecture. Therefore, each node hosts a subset of thedatabase and is fully independent, with its own memory, CPUs, and disks.

The DB2 *common client architecture* (included in IBM DB2 Universal Database V8.1) provides connectivity throughout the DB2 Universal Database family, so there are no connectivity issues or additional configuration elements between 32-bit and 64-bit applications and servers. This greatly simplifies the integration of Itanium 2 processor family-based systems into existing DB2 environments. In this implementation, it enables existing 32-bit applications to access data from both the 32-bit and 64-bit databases using the same client (Figure 2). This allows seamless integration of the 64-bit components, and preserves the value of the existing SAP application servers. It also simplifies the integration of future applications, since it easily supports both 32-bit and 64-bit solutions.

A Network Attached Storage (NAS) utility is added to accommodate a large amount of additional data. Two types of interconnects are used, InfiniBand* Technology and Ethernet. Communications between the two interconnects are handled by Voltaire* nVigor technology-based IP-to-InfiniBand routers and switches.

Backup and restore is provided by IBM Tivoli* Storage Manager and Tivoli System Automation for Linux to ensure 24x7 data protection and availability. IBM TSM provides automated online protection for the database using backup scheduling, auto-changer support, and tape cloning. System management is provided by built-in DB2 utilities. IBM Tivoli is used for system monitoring to integrate with existing enterprise tools and processes.

With proper implementation, the integration of this new database should have no impact (and require no change) to the existing intranet and Internet environment.

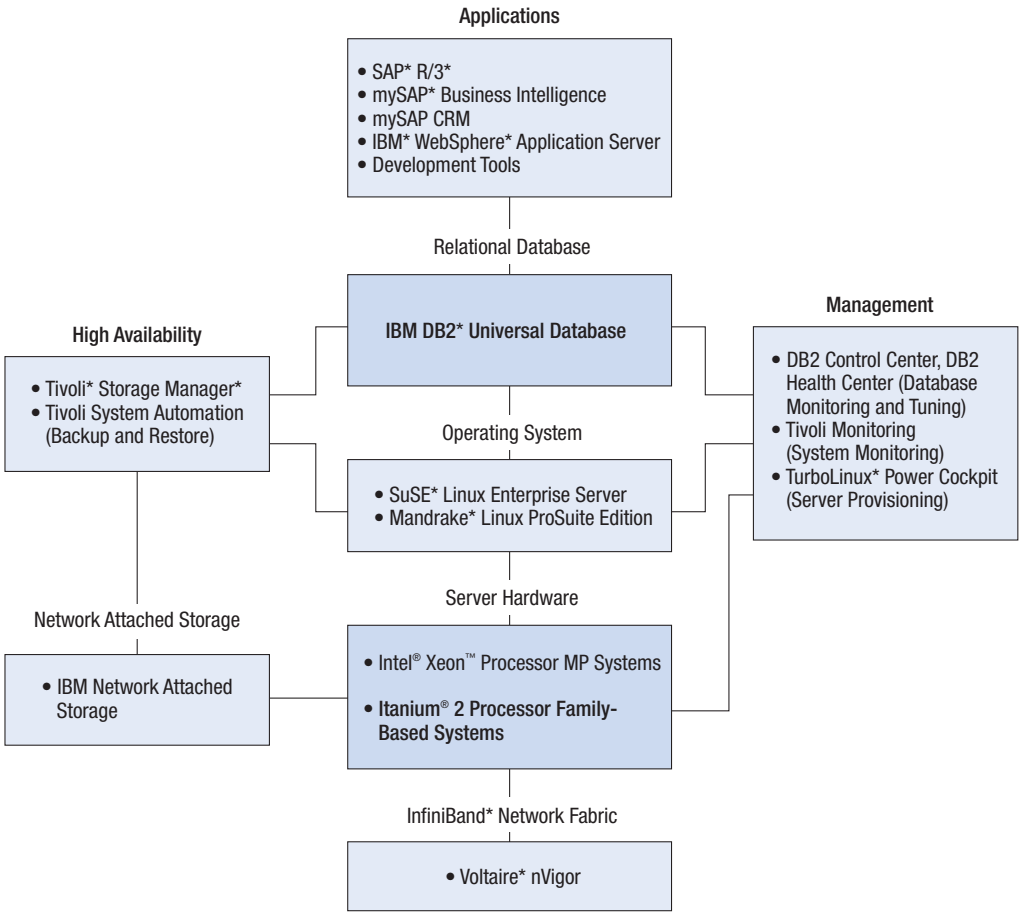


*Figure 1*

*Functional Diagram for IBM* DB2* on Intel® Itanium® Architecture.*

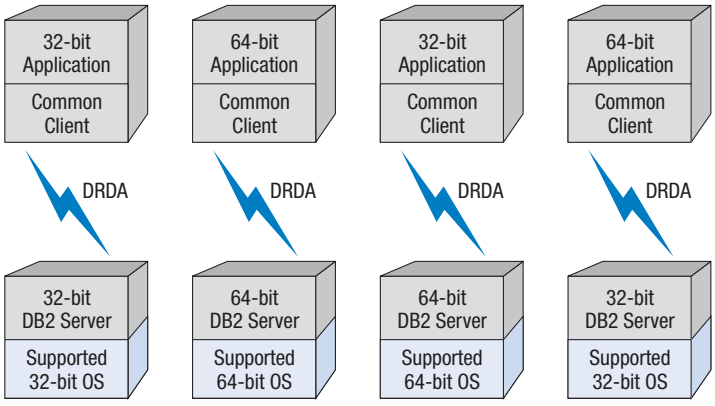


*Figure 2*

*The IBM* DB2* UDB common client greatly simplifies database connectivity, enabling optimized integration of 32-bit and 64-bit applications and databases.*

## Software Architecture

The solution architecture outlined in this configuration guide is designed to provide an agile framework for enterprise integration and growth, with minimal modification to existing applications. Most real-world implementations will include an integrated mix of 32-bit and 64-bit applications.

### Application Requirements—Defining the Solution Stack

A typical solution stack for a comprehensive IBM DB2 solution is shown in Figure 3. It includes the database, development tools, and operational and infrastructure components that are essential for deploying and managing the application in a business-critical enterprise environment. For completeness, SAP ERP (as one example from the SAP product family) is shown at the application layer. A wide variety of other enterprise applications would also be appropriate in this solution stack. The layer components can be a mix of 32-bit and 64-bit applications, and may be distributed across multiple hardware systems (this will be addressed further in the *Hardware Architecture* section of this paper).

Components critical to the database implementation include the following:

1. **The Database**—IBM DB2 Universal Database, the focus of this solution implementation.
2. **DBA and Development Tools**—Components for database administration (DBA) and application development are included with DB2 and directly integrated into the SAP graphical integration tool called Management Cockpit. They provide the functionality needed for configuring and managing the database application directly out of the SAP user environment. IBM also includes a full suite of award-winning tools, such as IBM DB2 HealthCenter, for autonomous operation on Intel Itanium architecture.
3. **Monitoring and Management**—DB2 provides tools for monitoring and managing the application and infrastructure, to ensure high levels of availability and reliability. A variety of third-party tools are also available, to provide additional functionality or to simplify integration with existing tools and processes.

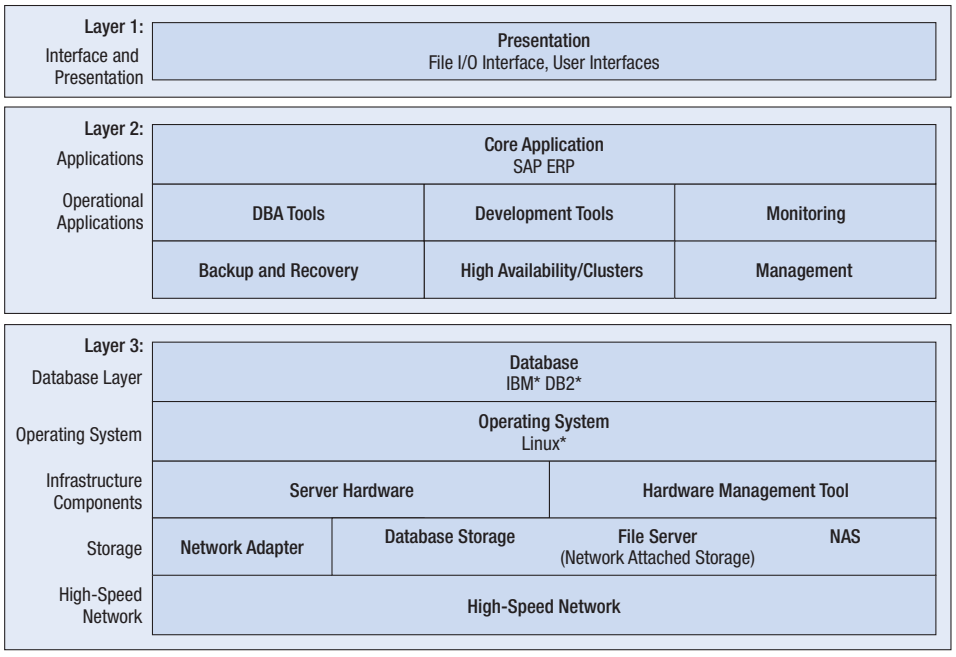


*Figure 3*
*Solution Stack for IBM* DB2* Universal Database Solutions on Intel® Itanium® Architecture. (May be a mix of 32-bit and 64-bit applications distributed on multiple hardware systems.)*

4. **Backup and Restore**—DB2 provides support for backup and restore, but dedicated third-party tools are often used to provide additional functionality for high-end requirements.
5. **High-Speed Network**—For clustered database solutions, a high-speed network is often needed to minimize latencies during server-to-server communications. Though Ethernet may be sufficient for many enterprise implementations, an InfiniBand fabric can be used for the most demanding requirements.

## Software Integration

The sample integration table (Table 1) shows current availability for key software components in a DB2 solution stack. Notice that 64-bit solutions are now available for all required components. A similar table can be developed for the specific components required for integration in your own IT environment. If specific application driver solutions are not available in the required timeframe, Itanium 2 processor family-based application development tools provide comprehensive functionality for IT development teams.

| Application | 64-Bit Version Required | 64-Bit Version Available | Notes |
|---|---|---|---|
| **Presentation Layer** | | | |
| IBM* DB2* and SAP GUI | No | Yes | |
| **Application Layer** | | | |
| SAP ERP | No | Yes | |
| Management | No | Yes | DB2 Control Center and DB2 HealthCenter are included with DB2 |
| Backup/Recovery | No | Yes | Veritas solutions are currently available |
| High Availability/Cluster | No | Yes | SuSE* Linux* and Mandrake* Linux support high-availability clustering |
| Database Tools | No | Yes | DB2 Administration Tool and DB2 Automation Tool are included with DB2 |
| Development Tools | Yes | Yes | C, C++, IBM Java Developer Kit, Perl |
| **Database Layer** | | | |
| IBM DB2 UDB | Yes | Yes | |
| **Infrastructure** | | | |
| Operating System | Yes | Yes | SuSE Linux and United* Linux are currently available |
| Hardware Management Tool | Yes | Yes | Provided by OEM |
| Storage Area Network (SAN) NAS | No | Yes | Solutions are currently available from IBM and EMC |

*Table 1*
*Sample Integration Table for IBM* DB2* Solutions on Intel® Itanium® Architecture. (Additional applications will be available in the future.)*

## Hardware Architecture

A physical diagram of the DB2 solution is shown in Figure 4. The number and size of the servers can be adjusted based on specific workloads and business needs. Database servers can be scaled up as needed to address capacity and performance requirements. Application servers can be scaled out or up as workloads grow and will support the chosen data center strategy of any customer environment. If a scaled-out architecture is desired, Linux clusters can be used to balance workloads across multiple systems, and to provide high availability through automatic failover.

The tools used to manage, monitor, and control the solution can be deployed on Itanium 2 processor family-based systems for high performance and availability in enterprise environments. Compatible 64-bit applications are currently available covering most key components. However, if a preferred vendor does not yet support Intel Itanium architecture, standard 32-bit versions can be deployed, running on Intel Xeon processor MP-based systems. Integration is straightforward, and these systems can then be upgraded if desired when 64-bit versions become available.

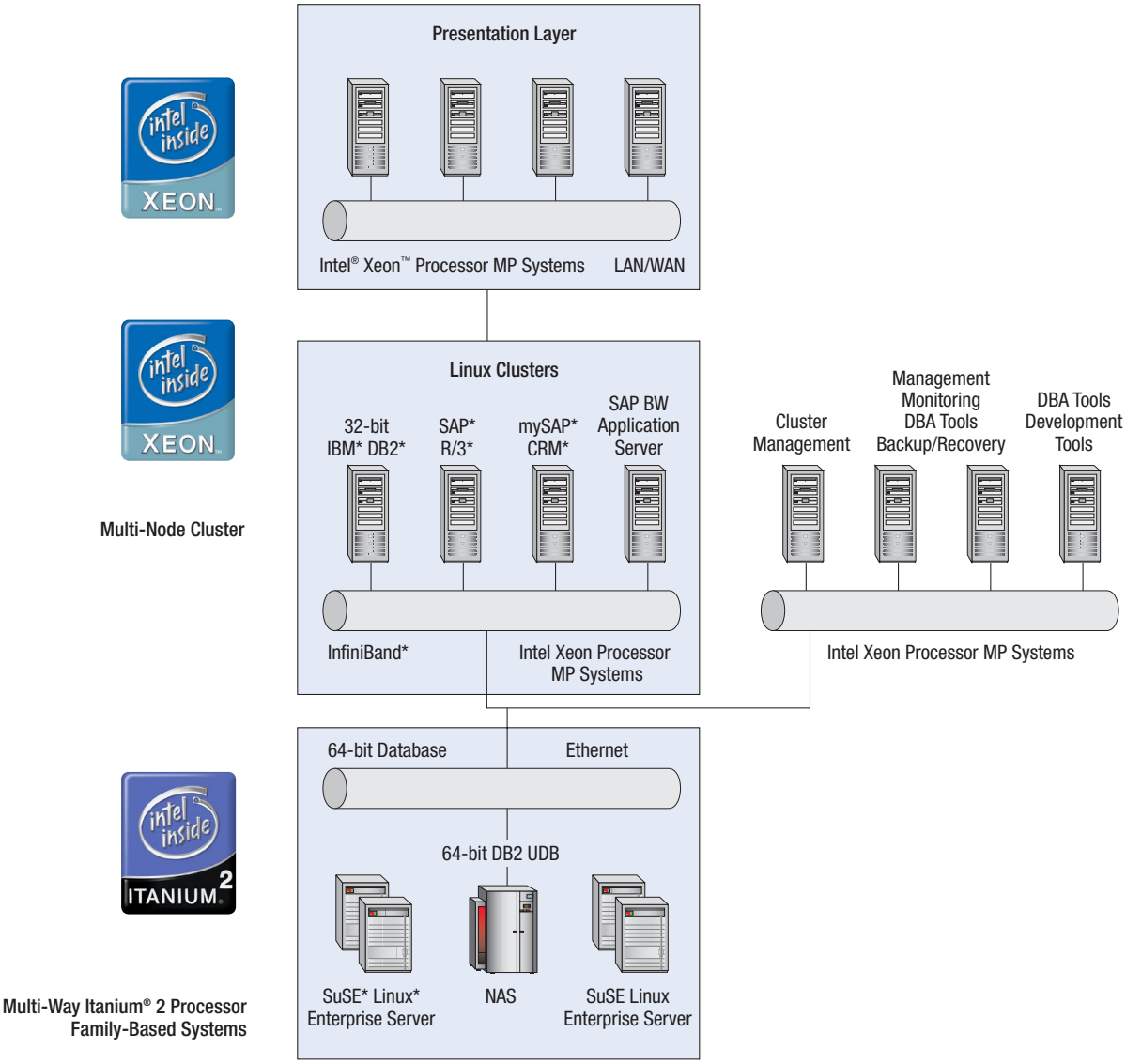


*Figure 4*
*Example of a Physical Design for IBM* DB2* on Itanium® 2 Processor Family-Based Platforms.*

## Proving the Solution Stack

Initial proof-of-concept testing for IBM DB2 solutions on Intel Itanium architecture can be performed with relative ease. Table 2 shows a basic configuration for validating the solution in your own environment. Linux and all core DB2 components are run on a single 4-way Itanium 2 processor family-based server. This test is appropriate for the first stage of integration, and will provide your development teams with the information and experience they need to build a more extensive, production-quality solution.

| Application | System Configuration |
|---|---|
| SuSE* Linux* Enterprise Server for Itanium | • 4-Way Itanium 2 Processor Family-Based Server, 1-4GB Memory<br>• 2 NICs (for Dual Network Connections) |
| IBM* DB2* for Itanium® V8.1 | |
| Benchmark, Performance Tools: IBM DB2 Performance Expert | |
| Hardware Management Tool | |

*Table 2*
*Recommended Configuration for Basic Proof-of-Concept Testing.*

Following the initial POC, additional tests can be run to evaluate how easily the solution can be integrated into your specific IT environment. Table 3 shows a sample configuration that could be used for this purpose. It includes key infrastructure tools in addition to the core IBM DB2 and application software.

| Application/Development Tools | System Configuration |
|---|---|
| SuSE* Linux* Enterprise Server for Itanium | • 4-Way Itanium 2 Processor Family-Based Server, 1-4GB Memory<br>• 2 NICs |
| IBM* DB2* for Itanium® V8.1 | |
| SAP ERP (Optional) | |
| C, C++, IBM Java Developer Kit, Perl | |
| Veritas* NetBackup, Legato* NetWorker | • 4-Way Intel Xeon Processor Family-Based Server, 1GB Memory<br>• 2 NICs |
| IBM Tivoli* Monitoring | |
| Network Attached Storage (NAS) | IBM TotalStorage NAS100 |

*Table 3*
*Extended Configuration for Integration Testing.*

### Notes for Table 3

1. Additional Intel Itanium architecture-compatible Linux versions are available, including (but not limited to) TurboLinux*, Red Hat* Linux*, and SuSE.
2. SAP ERP is used for this evaluation, but other applications could be used instead.
3. Development tools include: C (GNU/Linux gcc version 3.0.2); C++ (GNU/Linux g++ version 3.0.2); Java* (IBM Developer Kit and Runtime Environment for Linux, Java 2 Technology Edition, Version 1.3.1, 64-bit version); Perl (Perl 5.6).

### Tips for Infrastructure Migration

When updating a 32-bit instance to a 64-bit instance on IBM DB2 Universal Database V8.1:

- Remote databases that are cataloged at the 32-bit instance are skipped. The local database directories for these databases will not be migrated. However, because of the IBM DB2 common client, these cataloged remote 32-bit databases will remain accessible after the instance migration.
- All databases local to the instance that you intend to update must be cataloged before the instance is updated.
- A 64-bit database image cannot be restored into a 32-bit instance.
- In a DB2 UDB ESE partitioning environment, all partitions must be 64-bit partitions (not a mix of 32-bit and 64-bit partitions).
- IBM Performance Expert integrates performance monitoring, reporting, buffer pool analysis, and a Performance Warehouse function into one tool. It provides a single-system overview that monitors all subsystems and instances across many different platforms in a consistent way.

## Getting Started

Discover the advantages IBM DB2 solutions running on Intel Itanium architecture in your own environment. Performance already challenges or exceeds the performance of proprietary RISC-based systems for a variety of IBM DB2 benchmarks—and can be expected to increase with the next-generation of Intel Itanium processors and platforms. Optimized applications and tools are available now, and are supported by one of the industry's largest communities of solution providers.

*Call your server vendor or Intel representative today to find out more, and to begin defining a proof-of-concept test that addresses your unique business and IT requirements.*

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