(intel®)

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Intel and Teradata: A History of Joint Innovation

A deep engineering collaboration with roots that stretch back to Teradata's design for the Intel® 8086 processor in the late 1970s

> "We've developed our products specifically for Intel® processors, and we were an early leader in moving the Intel® technology into enterprise computing. We continue to work closely with Intel engineers as early adopters of new Intel® architectures, and the results have been extraordinary! For more than 30 years, Teradata has continued to push the envelope on what the Intel technology enables."
>
> *– Jeff Carter,*
> *Senior Vice President,*
> *Teradata Corporation*

For 35 years, Teradata and Intel have complemented each other's strengths. This collaboration has enabled Teradata and Intel to consistently deliver performance, scalability, and efficiency—and create profound ongoing value for customers.

When the Intel® 8086 microprocessor was introduced in 1978, conventional wisdom discounted the possibility of microprocessors finding a place in enterprise computing. This was the era of hulking mainframes, when the term "client-server" had yet to be coined, and little if any confidence was placed in developing agile, lightweight hardware platforms by the industry as a whole.

Against that backdrop, Teradata's investment and participation in the same emerging direction of microprocessors that Intel championed seems prescient today, and its commitment has never wavered. Generations of co-engineering since have helped build excellence on solid foundations that continue to help define the industry.

This brief describes how the relationship between Teradata and Intel continues that spirit of innovation, a relationship that demonstrates to IT decision makers how the shared history between the companies pays dividends in terms of both capability and cost benefit. The paper further explains how Intel® architecture hardware

and Teradata software continue to complement one another and how customers can capitalize on the resulting successes.

A History of Complementary Design

The evolution of Intel® platforms includes many notable advancements in silicon architecture and manufacturing process technology, and Teradata has continually benefitted from these breakthroughs. As processor capabilities and power envelopes have improved, the tight collaborative relationship between the two companies has fostered ongoing advances in Teradata system performance and total cost of ownership (TCO).

Parallelism is a key aspect of hardware innovation that is intimately tied to the ability to deliver increasing performance and scalability gains. Particularly in cases of large-scale enterprise implementations, supporting multiple simultaneous workflows is essential. As different types of parallelism have emerged in Intel platforms, Teradata's Massively Parallel Processing (MPP) architecture has moved quickly to take advantage of them:

- **Symmetric multi-processor systems.** As Intel architecture became more important to enterprise computing, designs evolved to allow multiple processors per server.

- **Multi-core processors.** Intel continues to provide leadership with up to 18 physical cores per processor with 45 MB last-level cache (LLC) with the Intel® Xeon® processor E5-2600 v3 product family, for unprecedented levels of parallelism.

- **Intel® Hyper-Threading Technology (Intel® HT Technology).** Since 2002, this feature has enabled a single processor core to expose two logical processors to the operating system for every physical core.

- **Memory and I/O advancements.** Keeping pace with processor core advancements, the memory and PCIe I/O controllers have become an integrated part of the processor, supporting next-generation DDR4 for larger memory capacities, along with faster and more I/O with PCIe Gen 3—as well as lower latencies and power levels—to optimize overall system performance and performance per watt.

> "Teradata data warehousing and analytics solutions provide a compelling solution for companies trying to comprehend and generate value from vast amounts of exponentially growing data. Intel is pleased to continue the long history of collaboration with Teradata and to have the Intel® Xeon® processor family, Intel networking products and other key building blocks as chosen ingredients in their powerful business intelligence platforms."
>
> *— Shannon Poulin, Vice President, Intel Data Center Group and General Manager of Intel's Datacenter Marketing Group*

The present generation of Intel® server processors, the Intel Xeon processor E5-2600 v3 product family, incorporates all these types of parallelism. Parallel programming is a complex undertaking, causing some software makers to be slow in adopting these technologies. Teradata, on the other hand, was not only an early adopter of parallelism's performance and scalability advantages but also a fast implementer. The company's software drives each available processor to the limit and utilizes both physical processor cores and the "virtual" cores provided by Intel Hyper-Threading Technology.

Data warehousing solutions from Teradata exemplify how members of the hardware and software ecosystems can benefit directly from each other's advances and collaboration. Intel processors and servers have become more robust as the result of Teradata's direct participation in preproduction product development phases. Key contributions include the following:

- **Platform design-stage feedback.** Design reviews and early engineering feedback from Teradata have helped drive new hardware features for higher reliability and performance.

- **Comprehensive validation.** By testing their products thoroughly well before product launch with prerelease Intel® processors, network adapters, RAID products, server boards, systems, and other technologies, Teradata has contributed to making Intel products more resilient.

- **Robust utilization of hardware capabilities.** Teradata products push the capabilities of Intel platforms on many levels, including processor, memory, I/O, systems, and motherboards that help drive continual product improvements.

- **Large-scale, real-world proving grounds.** Teradata products are installed at some of the largest, most demanding corporations in the world, raising the bar in terms of quality and reliability.

The ongoing benefits of highly tuned performance for each processor generation continue to accumulate for customers, with the resulting increase in energy efficiency compounding that value.

Teradata Workload-Specific Data Warehousing Platforms

As companies of all types and sizes consider their business intelligence needs, Teradata stands ready with a full range of products that span from departmental workgroups to large enterprise data warehouse databases. Teradata brings purpose-built solutions to its customers rather than offering a "one-size-fits-all" approach.

Optimizing specifically for Intel platforms helps ensure high performance and low overall TCO. The available range of products meets the varying needs of different customers with dependable, richly featured data warehouses. The common foundation of those products on the Teradata® Database provides a rich, seamless upgrade path for businesses as their data store and business intelligence needs grow (see Figure 1).

These solutions help minimize the risks associated with implementation and prepare customers for additional functionality in the future based on Intel Xeon processors:

- **Teradata® Active Enterprise Data Warehouse (EDW)** is the foundation for active data warehousing to support operational and strategic intelligence and decision making, with capabilities for extremely rapid analysis of enterprise-scale customer data stores.

- **Teradata® Data Warehouse Appliance** is a fully integrated and scalable platform purpose built for enterprise-scale business intelligence implementations where a ready-to-run, easy-to-use solution is desired.

Teradata® Purpose-Built Platform Family					
FAMILY MEMBER	**DATA MART EDITION**	**DATA MART APPLIANCE**	**INTEGRATED BIG DATA PLATFORM**	**DATA WAREHOUSE APPLIANCE**	**ACTIVE ENTERPRISE DATA WAREHOUSE**
Purpose	Teradata software on any Intel symmetric multi-processor (SMP) platform	Entry-level EDW, single node of Teradata	Comprehensive data storage, integration, big data analytics	Flexible data warehouse	Balanced active data warehouse
Scalability	Up to 6 TB	Up to 8 TB	Up to 234 PB	Up to 21 PB	Up to 61 PB
Workloads	Departmental analytics, entry-level EDW, deploy in production	Test/development, small data warehouse	Contextual analytics, resource flexibility, always on, corporate memory	Strategic intelligence, DSS, fast scan, low concurrency active, less than 10 applications	Strategic and operational intelligence, high concurrency active, 10+ applications, real-time update

Figure 1. Teradata provides a range of integrated data warehousing products and solutions for business needs of any size or complexity, with a clear upgrade path as those needs grow.

- **Teradata® Integrated Big Data Platform** is designed to cost-effectively analyze extremely large amounts of detailed data to gain deep strategic intelligence from all of the data.

- **Teradata® Data Mart Appliance** provides rich data warehouse functionality to smaller organizations, meeting entry-level and departmental requirements, and is well suited for test and development for the Active EDW.

Customers can be confident that this full range of solutions is thoroughly tested and certified for optimized results from Teradata software platforms on Intel Xeon processors. For more information about data warehousing solutions based on Teradata and Intel solution stacks, see the brochure, "Teradata Purpose-Built Platform Family."[1]

The Intel Xeon Processor E5-2600 v3 Product Family: The Heart of an Agile Data Center

This new generation of processors delivers significant benefits in performance, power efficiency, virtualization, and security. Data warehouses from Teradata are tuned and optimized specifically to run best on the Intel Xeon processor E5-2600 v3 product family and previous-generation families.

The components of this combined hardware and software stack bring out the best in each other. Particular value comes from intelligent performance and automated energy efficiency.

Intelligent performance refers to innovative processor design that delivers outstanding throughput and the ability to change its operating frequency dynamically in response to changing workloads. Intelligent performance features of the Intel Xeon processor E5-2600 v3 product family and the real-world benefits they deliver to Teradata customers include the following:

- **Intel® QuickPath Interconnects.** Direct CPU-to-CPU and CPU-to-chipset bandwidth supports up to 9.6 gigatransfers per second, which provides fast and consistent data movement, calculations, and queries for more timely business intelligence.

- **Integrated memory and I/O controllers.** DDR4 memory up to 2,133 MHz and PCIe Gen 3 I/O connects locally to each processor, decreasing access latency, which helps improve system responsiveness and prevent demanding computations from becoming memory and I/O-bound.

- **Per-core P states.** New per-core P states (PCPS) dynamically adapt and improve power for each core, resulting in optimized workload processing.
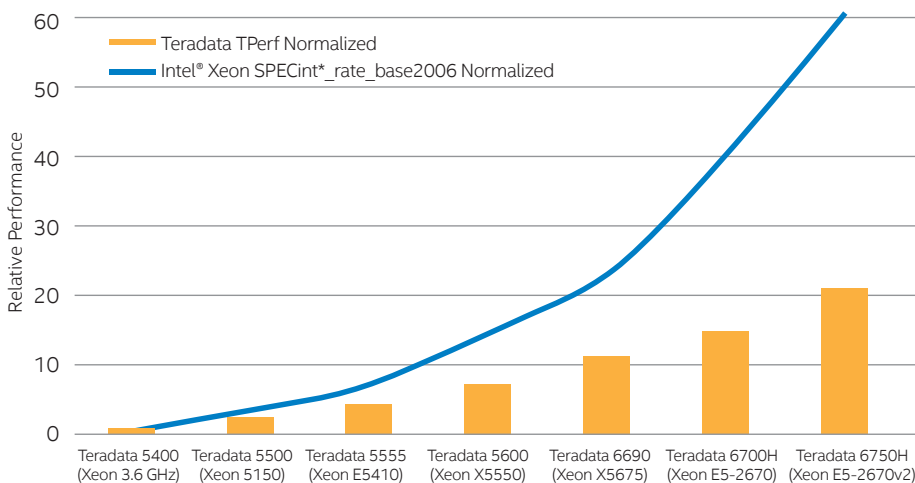

Figure 2. Successive generations of Teradata products have driven up system performance (as indicated by TPerf*) by taking advantage of the escalating performance of multi-core Intel® Xeon® processors (as measured by SPECint*).[2]

- **Intel® Turbo Boost Technology.** Processors increase operating frequency on demand according to the needs of the Teradata software, delivering headroom when it matters most, such as addressing usage peaks during the day and batch data reconciliation at night.

In addition, the automated energy-efficiency features of the Intel Xeon processor E5 series enable it to change power states seamlessly, as well as control system power on a per-core basis in real time. At any given time, only the minimum level of processor components is powered up, decreasing overall energy use. These features will be able to deliver direct benefits to data warehouse solutions from Teradata.

The platform can automatically power up and shut down individual components when they are not needed, which can result in substantial power savings. Specifically, improved power state capabilities exist at the levels of execution cores and system memory.

Together, intelligent performance and automated energy efficiency deliver high value to Teradata solutions of all sizes. By getting very high performance out of each server, Teradata solutions save on capital expense, and high-energy efficiency helps save on operating costs associated with power and cooling.

Collaboration for the Present and the Future

Both Intel and Teradata provide best-of-breed solutions, and the collaboration between the two creates an extremely robust solution stack for customers, while the high degree of integration and testing also decreases the risks associated with implementation. Figure 2 demonstrates that the continuing progression of performance across Teradata product generations is directly a result of the capabilities of the Intel processor generations across the same time frames.

The normalized TPerf ratings depicted in Figure 2 are shown relative to the Teradata Active EDW 5300 generation of products released in 2001, running on a server based on the Intel® Pentium® III processor at 1.4 GHz. TPerf is Teradata's trusted metric for the potential of an Active EDW system to perform data warehouse work. SPECInt*2000 is an industry-standard performance benchmark.

The collaboration between Teradata and Intel positions companies of all sizes for successful data warehouse implementation with extremely high levels of performance, scalability, and energy efficiency. The end result is a smarter route to business intelligence.

For more information about the Intel Xeon processor E5-2600 v3 family, visit: **www.intel.com/xeon**

For more information about Teradata data warehouse solutions, visit: **www.teradata.com/t/products-and-services**