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Hybrid Transaction/Analytical Processing Will Foster Opportunities for Dramatic Business Innovation

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Hybrid transaction/analytical processing will empower application leaders to innovate via greater situation awareness and improved business agility. This will entail an upheaval in the established architectures, technologies and skills driven by use of in-memory computing technologies as enablers.

Impacts

- The emergence of HTAP means IT leaders must identify the value of advanced real-time analytics, and where and how these enable process innovation.
- By eliminating analytic latency and data synchronization issues, HTAP will enable IT leaders to simplify their information management infrastructure, if they can overcome the challenges of adopting this new approach.
- Technology immaturity and established application environment value and complexity will force IT leaders to plan for long-term coexistence between HTAP and traditional approaches.

Recommendations

- Educate business leaders about HTAP and IMC concepts, and why they are important. Brainstorm with them to identify concrete opportunities to rethink business processes.
- Discuss with your strategic information management and business application providers their vision, road map and technology for HTAP implementation in their products.
- Pilot the use of HTAP architectures in individual "system of innovation" projects.
- Balance the costs of HTAP adoption (hardware and software infrastructure, migration, operational processes, and skills) with the anticipated business and IT benefits.
- Plan for coexistence and interoperability of IMC and traditional technology, mixing products from different vendors, if needed.

- Revisit your information management strategy, including governance, SLAs and life cycle management, to ensure proper organizational alignment and ownership of the information in support of using HTAP architectures along with traditional approaches.

Analysis

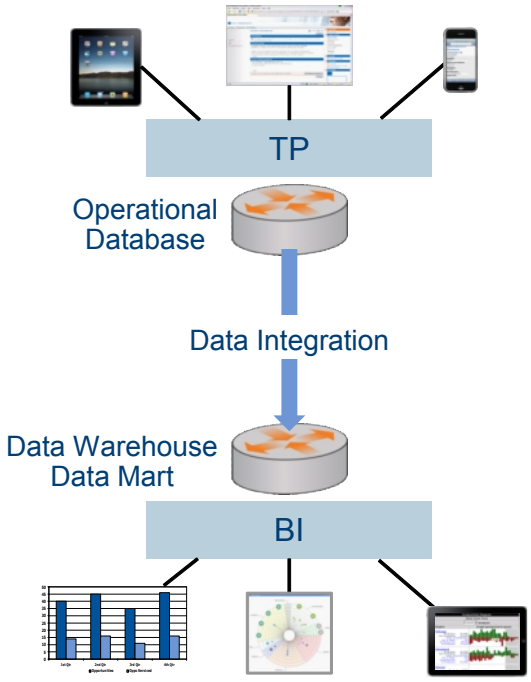
The notion of running transactions and analytics on the same database of record has been around since the early days of computing, but has not fully materialized so far because of a variety of issues, including technology limitations.

Transaction processing systems (see Note 1) are usually supported by operational DBMSs (formerly referred to as online transaction processing [OLTP] DBMSs; see "The OLTP DBMS Market Becomes the Operational DBMS Market") storing data in structures optimized for fast access to single data items ("rows").

Analytical processing systems (see Note 2) were created separately to optimize data structures for massive queries, as well as to avoid access concurrency and the associated performance and scalability impact of analytical queries over business-critical transactional systems. Such a separation also allowed the combining of data from multiple sources into analytical databases to measure enterprise performance across applications.

Therefore, transaction processing and analytical systems are usually based on distinct architectures, thus adding complexity to the information architecture and relevant infrastructure and introducing delay in data analysis (see Figure 1).

Figure 1. Traditional Transaction and Analytical Processing

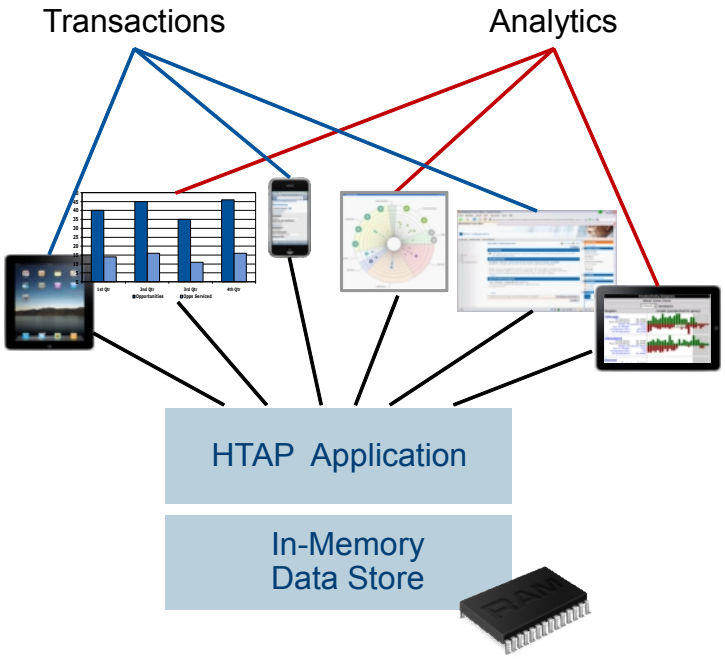


Source: Gartner (January 2014)

Because of technology advances such as in-memory computing (IMC), hybrid transaction/analytical processing (HTAP) architectures, which enable applications to analyze "live" data as it is created and updated by transaction-processing functions, are now realistic and possible. Although not every business process equally benefits by such architectures (for example, in certain cases latency is characteristic of the process itself and not just an induced negative effect stemming from technology limitations), HTAP will, in many cases, enable radical improvements.

Although it is possible to build simple forms of HTAP applications using traditional DBMSs, Gartner believes that most HTAP implementations should and will be IMC-enabled. IMC technologies, such as in-memory DBMSs (IMDBMSs) and in-memory data grids (IMDGs), support a single, low-latency-access, in-memory data store that can process high volumes of transactions. These technologies can also support zero-latency analytics on that same data, including advanced analytics, such as forecasting and simulations, as well as more traditional styles of descriptive analysis (see Figure 2).

Figure 2. IMC-Enabled Hybrid Transaction/Analytical Processing



Source: Gartner (January 2014)

Gartner believes less than 1% of user organizations have implemented HTAP-based applications, and expects this architecture will take five to 10 years to reach mainstream adoption (see "Hype Cycle for In-Memory Computing Technology, 2013"). Nevertheless:

- Some user organizations have already leveraged IMC-enabled HTAP to support transformative business process innovation (for example, see "Application Architecture Next Practices: Lessons Learned From Avanza Bank's Visionary In-Memory Architecture").
- Some packaged application vendors and SaaS providers are already exploiting HTAP architectures in their offerings. Although these are in their early stages and adoption is often limited, vendor marketing efforts will soon bring this approach to business users' attention.

To support their organizations' business strategy, understanding the fundamental tenets of HTAP and defining a relevant strategy will be an imperative for IT leaders involved in the definition of application architecture, information management and business analytic strategies.

Figure 3. Impacts and Top Recommendations for HTAP for Business Innovation

Impacts	Top Recommendations
HTAP means IT leaders must identify the value of advanced real-time analytics for business innovation.	• Identify opportunities to rethink business processes according to HTAP principles. • Evaluate innovative HTAP applications, even if from vendors of uncertain viability.
HTAP enables IT leaders to simplify their information management infrastructure.	• Pilot the use of HTAP architectures in individual system-of-innovation projects. • Balance the costs of HTAP adoption with the anticipated business and IT benefits.
IT leaders need to plan for long-term coexistence between HTAP and traditional approaches.	• Plan for coexistence and interoperability of IMC and traditional technology. • Revisit your information management strategy to ensure proper organizational alignment and ownership of information.

Source: Gartner (January 2014)

Impacts and Recommendations

The emergence of HTAP means IT leaders must identify the value of advanced real-time analytics, and where and how these enable process innovation

HTAP could potentially redefine the way some business processes are executed, as real-time advanced analytics (for example, planning, forecasting and what-if analysis) becomes an integral part of the process itself, rather than a separate activity performed after the fact. This would enable new forms of real-time business-driven decision-making processes (see Note 3 for some examples). Ultimately, HTAP will become a key enabling architecture for intelligent business operations (see "The Trend Toward Intelligent Business Operations").

HTAP will enable business leaders to perform, in the context of operational processes, much more advanced and sophisticated real-time analysis of their business data than with traditional architectures. Large volumes of complex business data can be analyzed in real time using intuitive data exploration and analysis without the latency of offloading the data to a data mart or data

warehouse. This will allow business users to make more informed operational and tactical decisions.

Running more complex diagnostic and predictive analytics in real time (and leveraging very granular transactional data) on the database of record will allow decision makers to be alerted to business trends and situations that may require their immediate attention. HTAP architectures accomplish this by improving business leaders' situation awareness in operations (for example, for applications such as risk management and fraud detection), and by providing constantly updated forecasts and simulations of future business outcomes.

However, figuring out how HTAP can help process innovation is challenging. Business leaders need to think outside of the box to determine how this architecture could transform processes rather than just provide existing styles of analytics faster and without latency. But application architects and developers (and also system integrators and packaged/SaaS application vendors) have little or no experience with how to design, implement, deploy and operate HTAP applications. Hence, it may be difficult for them to assess whether the innovation pushed by business leaders is really possible to implement.

However, IT leaders don't necessarily need to adopt a big-bang approach to HTAP. Use of IMC technologies provides opportunities for user organizations to adopt HTAP architectures incrementally, through a trial-and-error approach. For example, IM analytics have enabled data discovery capabilities, allowing business users to freely (that is, without much support from the IT department) interact with data. With these tools, business users can explore data and discover new insights without any help from IT. The data used is often the result of a data mashup created by business users outside any governance process. As a result, such a mashup adds yet one more copy of the transactional applications' data. With HTAP, transactional data is directly available for discovery and creating copies is not needed.

This incremental approach to HTAP favors adoption of a rapid and agile method to new application function delivery. It is not necessary to develop detailed requirements or to implement all the analytical features before putting the new system in production. In many cases, it is possible to initially implement the core set of capabilities, incrementally add new analytics, and then let end users develop or customize (by themselves) the features they deem necessary.

Ultimately, HTAP architectures will do for business analytics what data visualization tools have done for query and analysis: put the right tools in the hands of the business users to perform their own analytics, without needing IT support and without creating separate, stand-alone "spreadmarts" to perform those analytics that IT is not providing.

Recommendations:

- Educate business users about the concepts of HTAP and IMC, and why these are important new approaches using simple metaphors (see Note 4).
- Brainstorm with business leaders to identify opportunities to rethink business processes, from an HTAP perspective, to support system-of-innovation initiatives via greater situation awareness, advanced real-time analytics and business-goal-driven decision making.

- Evaluate native HTAP-packaged/SaaS applications targeting process innovation, even those from small vendors of uncertain viability. Don't wait for the megavendors to deliver if you aim for a competitive advantage.

By eliminating analytic latency and data synchronization issues, HTAP will enable IT leaders to simplify their information management infrastructure, if they can overcome the challenges of adopting this new approach

HTAP will help simplify organizations' information management infrastructure by eliminating, or at least reducing, the need to duplicate data and to keep data consistent. HTAP architectures also imply a redefinition of the role of traditional data warehouse architectures.

However, the degree of simplification enabled by HTAP will vary. By not requiring a data mart or data warehouse, HTAP could make it simpler to meet reporting and analytical needs based on operational data from a single instance of an application stack (such as an ERP suite). A small number of organizations are already realizing these benefits. However, HTAP will not have such a beneficial impact on large and complex organizations that need to aggregate data from multiple sources (for example, SaaS applications, cloud information services, social networks and on-premises applications). However, even in these organizations, data marts created just to support analytical and reporting needs from a single application could be eliminated, which will simplify some of the information management landscape.

By definition, at least in the context of a single application stack, HTAP architectures address the four major drawbacks of traditional approaches:

- **Architectural and technical complexity.** In traditional approaches, data must be extracted from the operational database, transformed and loaded into the analytical database, which requires the adoption of database replication; extraction, transformation and loading (ETL) tools; enterprise service buses (ESBs); message-oriented middleware (MOM); and other integration tools.

  In HTAP, data doesn't need to move from operational databases to separated data warehouses/ data marts to support analytics.

- **Analytic latency.** In a classic setting, it can take hours, days or even weeks from the moment data is generated by the transaction processing application to when it can be used for analytics. Although this is adequate for certain types of analytics, and even processes, it may be suboptimal for others. For example, being able to perform financial consolidation at any point in the month can enable a CFO to better evaluate the business impact of economic trends and take early corrective actions.

  The transactional data of HTAP applications is readily available for analytics when created.

- **Synchronization.** If analytical and transactional data storage is separated, when business users want to "drill down" from a point-in-time aggregate into the details of the source data in the operational database, in many cases they find the source of data "out of synch" because of the analytic latency.

In HTAP, drill-down from analytic aggregates always points to the "fresh" HTAP application data.

- **Data duplication.** In a traditional architecture, multiple copies of the same data must be administered, monitored, managed and kept consistent, which may lead to inaccuracies, timing differences and inconsistency.

  In HTAP, the need to create multiple copies of the same data is eliminated (or at least reduced).

However, adopting HTAP has its challenges: The concept is immature, industry experience is still limited to the most-leading-edge organizations in a few industry sectors (primarily financial services), best practices are not yet crystallized, the vendors' landscape is still quite turbulent, and relevant skills are almost impossible to find.

IT leaders also will face the issues associated with the use of IMC technology, which is a key enabler for HTAP initiatives:

- Often, the code of traditional applications must be re-engineered to take maximum advantage of IMC technologies and to enable integration with advanced analytics tools.
- Migrating to the IMC-enabled version of a traditional packaged application doesn't necessarily lead to an HTAP architecture if the vendor didn't go through the process of optimizing its product code for IMC and adding real-time analytics.
- In-memory data management technologies (IMDBMS and IMDG) are not fully proven in support of HTAP use cases.
- Data governance policies and processes will have to be revised to cover in-memory data. For example, data quality checks need to happen in the application itself, rather than when data is being moved into the data warehouse.
- A combination of data sources in the HTAP in-memory data store may be required to perform advanced analytics. This is a challenge in its own right, but it is further exacerbated by the fact that data integration tools that feed in-memory data stores from other data sources are still few and are not fully proven in real-life production deployments.

Therefore, HTAP adoption may require significant costs and risks, which would make it hard to justify only on the basis of information and application infrastructure cost reductions, although these considerations should be factored into the business case for HTAP-based application projects.

Recommendations:

- Discuss with your strategic data management and business application providers their vision, road map and technology for HTAP implementation in their products.
- Experiment with IMC technologies to assess the suitability of these products for your HTAP requirements.
- Pilot the use of HTAP architectures in individual, high-risk/high-reward system-of-innovation projects (as opposed to enforcing HTAP as an architectural principle across the board). This will help identify challenges that will need to be addressed once the high-impact potential use cases have been identified as candidates for a more extensive deployment.

- Evaluate the costs of HTAP adoption (skills acquisition, application and hardware infrastructure refresh, application migration, and operations and management process updates), and balance those with the anticipated business and IT benefits.

Technology immaturity and established application environment value and complexity will force IT leaders to plan for long-term coexistence between HTAP and traditional approaches

Gartner believes HTAP adoption will grow significantly over the next five years because of its significant business impact. Nonetheless, IT leaders should plan for a coexistence of traditional and HTAP-based systems. As discussed previously in this research, data warehouse architectures will remain necessary to support extended analysis that involves large amounts of historical data/big data that comes from multiple internal and external, structured and unstructured data sources. Individual HTAP systems will be contributors to those (logical or physical) data warehouses, but will not fully replace them.

Moreover:

- In many instances, a traditional approach meets business requirements, and migrating to an HTAP architecture would not be justified and, often, not even desirable or possible.
- Even if theoretically possible, it will be practically impossible to migrate many established applications toward HTAP due to the massive organizational and technical efforts, and because of the inertia of packaged business application vendors.

Recommendations:

- Plan for coexistence and interoperability of traditional and HTAP-enabling technologies, possibly procuring products from different vendors, if needed. A single-supplier strategy is premature, as today, none can provide a comprehensive and mature portfolio of HTAP-enabling products.
- Identify the role of HTAP in the evolution of your data warehouse toward the logical data warehouse.
- Revisit your information management strategy, including governance, SLA and life cycle management, to ensure proper organizational alignment and ownership of the information in support of HTAP architectures along with traditional approaches.

Gartner Recommended Reading

Some documents may not be available as part of your current Gartner subscription.

"Hype Cycle for In-Memory Computing Technology, 2013"

"Taxonomy, Definitions and Vendor Landscape for In-Memory Computing Technologies"

"Who's Who for In-Memory DBMSs"

"Application Architecture Next Practices: Lessons Learned From Avanza Bank's Visionary In-Memory Architecture"

"The Trend Toward Intelligent Business Operations"

"The OLTP DBMS Market Becomes the Operational DBMS Market"

"The Information Capabilities Framework: An Aligned Vision for Information Infrastructure"

Note 1 Transaction Processing Application Systems

These systems:

- Enable fast access to data to support business processes, such as order entry, banking operations, travel reservation systems, e-commerce and myriad other day-to-day activities in every industry sector.
- Collect, process and manage data in support of critical business processes.
- Must support the SLAs that are defined by the business and ensure that all transactions are processed reliably.

Note 2 Analytical Processing Systems

These systems:

- Support efficient analysis of data for reporting, business intelligence and other initiatives that require the fast scanning of large databases to create data summaries and aggregations.
- Address organizations' needs to monitor the business, measure performance and identify trends by combining multiple sources of data from multiple applications.

Note 3 Examples of How HTAP Can Improve Business Processes

HTAP can improve business processes by:

- Deciding on how to fulfill a purchase order on the basis of its impact on profitability or customer satisfaction.
- Using predictive analytics to inform decision makers that business and financial targets are unlikely to be met by financial period end, so they can take corrective action (instead of providing diagnostic analysis after the event).
- Notifying logistics companies that shipments may miss their delivery timelines. Thus, business analysts can adjust the itineraries or renegotiate shipping alternatives with clients in real time via what-if analysis.

Note 4 Example of How to Sell HTAP to the Business

One CIO was able to "sell" HTAP to his business executives by suggesting that, while their traditional BI approach allowed them to instantly see what happened yesterday, HTAP would give them real-time visibility into what was happening now.

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