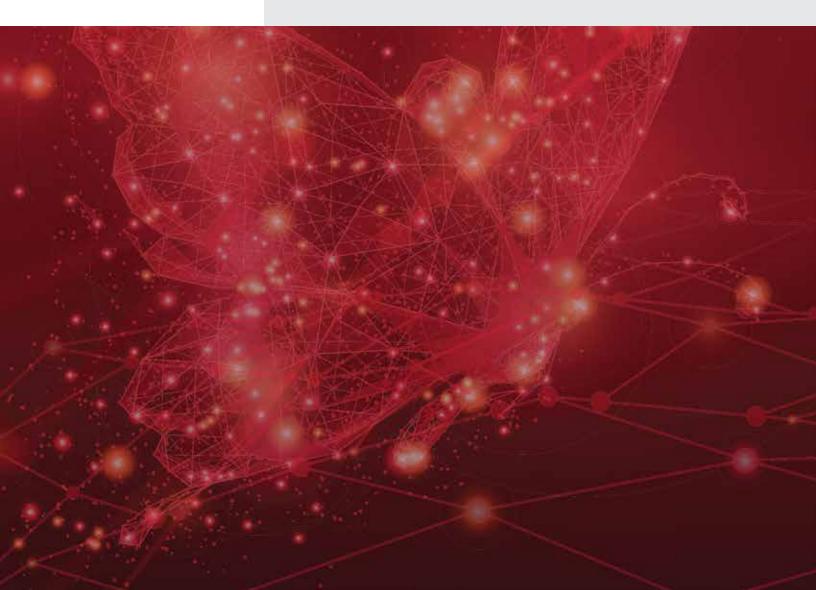# Modernize and Accelerate Payment Solutions with In-Memory Computing

A GridGain Systems In-Memory Computing White Paper

The payments industry is evolving rapidly. The shift to digital payments is taking place on many fronts, from bitcoins and mobile wallets to "tap and go" payment transactions and peer-to-peer money transfer apps. According to Business. com, fewer than 25 percent of U.S. in-store purchases in 2017 are expected to be cash-based transactions. Worldwide, the mobile payments market has grown from $235 billion total revenue in 2013 to projected values of almost $800 billion in 2017 and over a trillion dollars by 2019. Digital and mobile technologies are radically disrupting the ways that payments are initiated and processed—and increasing the potential to mine payments data for actionable insights.

As providers of payment services seek to stand out in an increasingly crowded field, technology is a crucial part of maintaining a competitive edge. With consumers expecting instant, invisible payments and money transfers, providers must be able to process payment transactions at real-time speeds. They must also be able to scale their capacity quickly to meet usage growth. Plus, they need sophisticated analytics capabilities to help them prevent fraud, handle regulatory compliance, and identify revenue-generating insights from the plethora of data they are collecting.

To achieve this level of performance, scalability, and analytical sophistication, many payments providers are turning to in-memory computing solutions. This white paper will discuss changes in the payments industry, the new opportunities and challenges providers are facing, and how providers can gain the edge they need with solutions such as the GridGain in-memory computing platform.

HOW THE PAYMENTS INDUSTRY IS CHANGING

The payments industry has undergone radical changes in recent years, both in visible ways and behind the scenes.

Key changes include the following:

• New digital & mobile payment methods

• Efficient new methods for tracking payments

• Heightened security measures

• Use of data-driven insights to increase profits

The next four sections take a closer look at these changes and how they are presenting new opportunities and challenges for payments providers.

New Ways to Pay

Almost every type of payment situation has been transformed by new methods of making payments digitally. Whether it's consumers paying for goods and services or people sending money to each other, the way money flows from one party to another is looking much different now than it did a few years ago—creating new opportunities and challenges.

Trends and opportunities. New trends in payment methods include the following:

• Instant, invisible payments from digital devices

• Mobile phones and wearables increasingly used as payment devices

• Mobile wallet apps, such as ApplePay, Android Pay, Samsung Pay, Walmart Pay, and Bitcoin gaining wider acceptance

• Embedded payment options allowing payment from within websites and apps, including social media

• Contactless "tap and go" spending via chip-enabled cards (such as transit passes) or NFC-enabled smartphones that communicate with RFID or NFC readers

• Faster ACH payments (through the Automated Clearing House Network in the U.S.)—same-day, in many cases—of payroll direct deposits, mortgage payments, and other authorized transfers

• Peer-to-peer digital payments (remittance)—including across borders and currencies —via apps, instead of through Money Transmitter Operators (MTOs)

• IoT devices initiating payments—for example, an air conditioner automatically requesting air-filter service and paying with credit card information

Innovative trends such as those noted above—and the lower cost of digital technologies in general, compared with cash payments—are creating significant new opportunities for businesses. Many technology firms are specializing in payments and attracting funding from venture capitalists who strongly believe in the future of their technologies. Traditional financial firms are also partnering with fintech firms in ventures such as mobility innovation labs.

In addition to being technology driven, much of the opportunity in the payments industry centers around creating a better customer experience. Banks and merchants can gain business by making it easier and faster for customers to access their money (or their credit) and enabling them

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to make payments from all of their devices and apps. New entrants to these markets can also gain a lot of business by being cheaper or providing better service than more established competitors—particularly in areas such as digital remittance, formerly dominated by MTOs such as Western Union and Money Gram.

Challenges for providers. Keeping up with the new trends and staying ahead of the curve on customer experience both pose challenges for payments providers. These challenges include the following:

- Offering payment options from a range of devices and apps—including mobile and wearable devices, social media, and other options mentioned under "Trends and opportunities", above—while maintaining a consistent customer experience

- Easing culture change to help older customers get on board with new ways of making payments

- Maintaining high performance and 24/7 availability wherever possible, in order to meet user expectations of instantaneous payments

- Accessing real-time data on currency conversion rates—and rates that competitors are offering—for payments made across currencies

- Accommodating customer growth through a scalable infrastructure that keeps performance and service from degrading as the number of customers increases

- Cooperating with other players, as new scenarios demand more collaboration among vendors, banks, and fintech

To meet these challenges successfully, providers need technology that meets a critical set of criteria: it should be interoperable, high performance, low latency, and scalable—ideally open source and cloud-based.

For payment situations requiring real-time analysis of large datasets, such as current currency conversion rates for international payments, the technology should also be able to handle big data analytics. We'll discuss these technology needs in more depth after we look at some of the other trends and challenges in the payments realm.

Turbo-Charged Payment Tracking

Behind the obvious changes affecting how people make payments, significant changes are also occurring in how payments are processed and recorded. Multiple trends are creating the potential for a much faster, more efficient process.

- Trends and opportunities. Some key trends in tracking of payments include the following:

- Decentralized, distributed public ledgers based on the blockchain technology behind Bitcoin and able to greatly streamline transaction processing

- Payment hubs, which replace separate, specialized payment services with a unifying central infrastructure that provides a common set of services integrating all payment applications

- Reduced overhead and improved efficiency as a result of both of the above trends

Providers who take advantage of the efficiency improvements available through payment hubs and decentralized public ledgers, or blockchains, can gain a strong competitive advantage through faster, more streamlined processing and lower costs. (For an in-depth discussion of how blockchains can potentially streamline processing even for non-bitcoin transactions, see the GridGain white paper "Enable Bitcoin and Blockchain Technology with In-Memory Computing.") However, these opportunities are accompanied by some challenges.

- Challenges for providers. As the pace of digital payments accelerates, providers face several challenges:

- Processing high volumes of streaming data—particularly with blockchain-based systems, since there is no central data repository; blockchain subscribers must quickly process and store incoming data

- Maintaining high performance as data volumes grow

- Providing high reliability and availability at the level required for financial systems

To meet these challenges, payment-services providers need high-performance, scalable, fault-tolerant data systems with streaming capabilities, high availability, and recoverable transactions. These are some of the same criteria needed to address another important trend in the payments industry: the increase in security risks and regulatory requirements.

Heightened Security Measures

As online, mobile, and cashless transactions fuel the growth in digital payments, the potential for fraud, hacking, and other security risks escalates. Those who want to commit fraud now have ways to do so more easily and on a much larger scale than ever before, as text dumps of credit card information turn into gold mines for enterprising cyber criminals.

Much attention is now focused on figuring out how to protect transaction data and how to detect and prevent fraud quickly enough to avert harm. Increased cybersecurity regulations

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are promoting greater security—but also increasing the challenges for payments providers who must implement them.

- Trends and opportunities. Trends in payment security include the following:

- Increased adoption of card-securing EMV solutions such as chip-enabled credit and debit cards

- Increased payment safety requirements in PSD2, the EU's revised Payment Services Directive, including requirements for stronger identity checks in online payments

- More countries promoting cybersecurity initiatives, both individually and as part of regional bodies, such as initiatives from the Organization of American States and Europe's Organization for Economic Co-Operation and Development

- Focus on encryption requirements for NFC (near field communications) to prevent information theft during contactless payments

- Focus on secure authentication and authorization through techniques such as biometrics and increased requirements for digital signatures.

Providers who can successfully navigate these trends and maintain security and privacy for their customers can gain a significant edge in reputational integrity. As PayPal CEO Dan Schulman noted in a recent radio interview, "When it comes to financial services, the single most important brand attribute you can have is trust."

Preventing fraud and hacking also decreases financial loss and improves a company's financial competitiveness. However, meeting fraud-prevention goals can be quite challenging.

- Challenges for providers. Maintaining secure and compliant payment transactions involves significant challenges, including the following:

- Implementing effective security and encryption techniques for user authentication and protection of transaction data

- Understanding and complying with security regulations—often highly complex ones—and doing so in real time

- Accessing large amounts of relevant data—both structured and unstructured—such as historical behavior data that can help predict future fraud

- Identifying and stopping fraudulent transactions in real time through predictive modeling, machine learning, and other techniques for flagging suspicious behavior

Making effective use of data is crucial in helping providers to meet these challenges. They need systems that can analyze massive amounts of data, so they can leverage everything they can find out about customer identity and historical behavior and then use sophisticated algorithms to help them spot behavior that is abnormal and potentially fraudulent. They also need these types of big-data analytics to help them comply with increasingly rigorous security regulations. Plus, they need all this to happen at real-time speeds, to stop fraud in its tracks.

(For more detail on processing requirements for fraud detection and regulatory compliance, see the GridGain white papers "Powering Financial Fraud Detection and Prevention with In-Memory Computing" and "Achieving Real-Time Financial Regulatory Compliance with In-Memory Computing.")

The same fast-data analytics capabilities that help providers maintain security and prevent fraud can also be a boon with respect to another emerging trend in the payments industry: mining payments data for "actionable insights" that can increase profits.

Profitable Data-Driven Insights

As data mining becomes an increasingly important source of profit for companies, payments providers are uniquely situated to benefit. They have access to payment data not just for one company, but across a wide range of vendors, services, and payment recipients. They may also have access to other illuminating information about customers—such as the comments with which many users tag their payments when they use Venmo to transfer money to others.

With this unprecedented degree of access, payment-services providers are well positioned to use their data to generate insights that can drive new business opportunities.

- Trends and opportunities. Trends in leveraging payments data include the following:

- Combining payments data with other data sources such as geolocation data, customer history data, and social media information that can provide insights into what is going on in a customer's mind

- Incorporating better and faster analytics to hone in on a customer's state of mind, predict possible future customer behavior, and identify "actionable insights"—that is, opportunities to increase profits or customer satisfaction—in real time

- Using payments data to identify actionable insights in real time can provide tremendous strategic advantages. Providers can use payments data to identify in-the-moment opportunities for selling a customer additional products or services (upselling), selling related products or services (cross-selling), or taking actions that can lead to improved customer retention.

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- Challenges for providers. As with preventing fraud, generating actionable insights from payments data is a knowledge-intense activity that must be performed at real-time speeds to be effective. It requires accessing large amounts of data—including potentially unstructured types of data from a variety of sources—and analyzing it quickly enough to identify and seize business opportunities in the moment of time when they are relevant. For these reasons, a high-performance system capable of fast-data analytics, machine learning, and other A.I. techniques is essential.

MEETING PAYMENT CHALLENGES WITH STATE-OF-THE-ART DATA TECHNOLOGY

In the new world of digital and mobile payments that must be tracked with high efficiency and tight security—and that can be profitably mined for data-driven insights—providers need a state-of-the-art data technology to meet their new challenges successfully.

This data solution must be above all fast and scalable, as well as secure, reliable, flexible, and capable of sophisticated big-data analytics. In other words, it should have the following characteristics:

- High-performance and low latency: Speed is essential for providing the instant payment services that customers expect, processing high volumes of streaming transaction data, and providing the real-time analysis needed to identify both potential fraud and actionable insights for immediate business opportunities.

- Scalable: The ability to easily scale a system up is essential for accommodating fast growth and maintaining high performance even as payment volumes increase.

- Flexible and interoperable: Flexibility (for example, being open source and cloud-capable) and interoperability are important for offering payment options from a range of devices, coordinating payment services via hubs, and enabling access to diverse data sources for fraud prevention and greater customer insight.

- Fault-tolerant and highly available: Payments data must be maintained with the high level of reliability, availability, and recoverability required for all financial data.

- Secure: Fully implemented security features are vital for keeping customer financial data safe.

- Capable of sophisticated big-data analytics: The ability to effectively use predictive modeling, complex event processing (CEP), machine learning, and statistical and A.I. techniques is extremely important for supporting fraud prevention and data-driven business intelligence in real time.

Fortunately, there is a data technology that is available with these features and is well suited to this type of high-speed, big-data use case: in-memory computing, as implemented in the GridGain in-memory data platform. Let's look at why in-memory computing makes sense for providers of payment services

WHY NOW IS THE TIME FOR IN-MEMORY COMPUTING

In-memory computing has become the technology of choice for applications such as payments that require high-speed data processing and analysis. Because in-memory computing involves keeping data in RAM for extremely fast access, with no disk-related slowdowns, it is faster than any other storage-based computing method.

For applications that require heavy analytics and real-time (or near real-time) transaction processing of hundreds or even millions of transactions per second, the market is now moving from disk to in-memory computing. The reasons for this trend involve both performance and Return On Investment (ROI).

1000x Faster. The move from disk to memory is a key factor in improving performance. However, simply moving to memory is not sufficient to guarantee the extremely high memory-processing speeds needed at the enterprise level. Enterprise-level speed requires cluster computing, with multiple machines performing analyses at the same time, and parallel distribution of data. These capabilities are important for providing high availability, disaster recovery, and concurrency across systems—and they are all provided in the GridGain in-memory computing platform. Clients who have implemented the GridGain In-Memory Data Fabric have found that they can process transactions about 1000 times faster.

10x ROI Improvement. The cost of memory has dropped roughly 30% per year since the 1960s, so memory has become much more affordable in recent years. While it may still be slightly more expensive than disk, the performance is so much better that it improves ROI significantly. Clients who have implemented the GridGain in-memory computing platform have seen a tenfold or more improvement in their ROI.

Customer Case Study: Sberbank. One of the most noteworthy GridGain Systems financial services customers is Sberbank, the largest bank in Russia and the third largest in Europe. Sberbank was faced with a similar problem to the one currently facing companies who are transitioning from person-to-person, cash-and credit card-based payments to 24/7 digital, online payment environments. The bank was switching from a more traditional, brick-and-mortar setup—one in which people would come into their offices and manually process a limited number of financial transactions each day, during a limited time period—to a new world with online and mobile customers transacting with them 24/7.

The company forecasted future throughput requirements and determined that it needed to move to a next-generation data-processing platform to handle the expected transaction volume. Sberbank analyzed more than ten potential solutions from vendors in the in-memory computing space and found that the GridGain in-memory computing platform was the most comprehensive solution. The bank concluded that GridGain would provide the next-generation platform with a significant improvement in performance and scalability.

The GridGain in-memory computing platform provided several other important capabilities that Sberbank's next-generation platform would require such as machine-learning and analytics, flexible pricing, artificial intelligence, ease of deployment, hardware independence of cluster components, and a rigorous level of transactional consistency. Of particular importance was the ability to conduct integrity checking and rollback on financial transactions. Sberbank could not find that level of consistency with other in-memory computing solutions.

In a January 2016 article in RBC, Herman Gref, the CEO of Sberbank, said that the bank selected the GridGain Systems technology to build "a platform that will enable the bank to introduce new products within hours, not weeks." He went on to state that the GridGain in-memory computing platform enables Sberbank to provide "unlimited performance and very high reliability" while being "much cheaper" than the technology used previously. Sberbank is using GridGain's in-memory computing platform to implement capabilities that could not be provided by the other vendors evaluated—a group that included Oracle®, IBM® and others.

GRIDGAIN SYSTEMS: A LEADER IN IN-MEMORY COMPUTING

With many companies grappling with the challenges of processing and analyzing increasing volumes of data for real-time, individualized customer interactions, demand for the GridGain in-memory computing platform is growing dramatically. This comprehensive platform contains a complete feature set that surpasses the capabilities of in-memory database point solutions, making it well suited to financial use cases like payments involving data streaming, machine learning, risk analysis, real-time analytics, complex event processing, and other capabilities needed in the new world of digital and mobile payments.

As a complete in-memory computing platform, GridGain helps users consolidate onto a single high performance and highly scalable big-data solution for transactions and analytics, resulting in lowered TCO. Advanced SQL functionality and API-based support for common programming languages enable rapid deployment. These features, along with the rapidly decreasing cost of memory, boost ROI for inmemory computing initiatives, enabling financial services companies to build less expensive systems that perform thousands of times better. Sberbank, Barclay's, and Citi realized such benefits with the GridGain in-memory computing platform.

A Unified High-performance Architecture

The GridGain in-memory computing platform consists of multiple grids connected by a clustered in-memory file system. The In-Memory Data Grid, In-Memory Compute Grid, In-Memory SQL Grid and In-Memory Service Grid are interconnected. Computations occur as close as possible to the data used in the computation. Additional features such as high throughput, low latency, load balancing, caching, in-memory indexing, streaming, Hadoop acceleration and other performance improvements are crucial to success in real-time modeling, processing, and analytics.

Scalability

The GridGain in-memory computing platform excels in terms of scalability, allowing companies to add cluster nodes and memory in real-time with automatic data rebalancing. As a hardware-agnostic solution, clients can choose their preferred hardware for scaling up.

Full SQL Support

GridGain is ANSI SQL-99 compliant and the In-Memory SQL Grid supports DML users can leverage their existing SQL code using the GridGain JDBC and ODBC APIs. For users with existing code bases which are not based on SQL, they can leverage their existing code through supported APIs for Java, .NET, C++, and more.

High Availability

The GridGain in-memory computing platform provides essential high availability features such as data-center replication, automatic failover, fault tolerance, and quick recovery on an enterprise-level scale.

Transaction Processing

The GridGain in-memory computing platform supports ACID-compliant transactions in a number of user-configurable modes.

Security Features

The GridGain in-memory computing platform supports authentication, authorization, multiple encryption levels, tracing, and auditing.

Open Source Framework

GridGain is based on Apache® Ignite™, a popular open source project with many contributors that has been tested globally. GridGain Systems was the original creator of the code contributed to the Apache Software Foundation that became Apache Ignite and fully supports the technology behind Apache Ignite. The GridGain Enterprise Edition extends the features in Apache Ignite to provide enterprise-level capabilities and services, such as additional security, data center replication, auditing mechanisms, a GUI for management and monitoring, network segmentation, and a recoverable local store.

Production Support

GridGain Systems Support is available for GridGain Community Edition, GridGain Enterprise Edition and GridGain Ultimate Edition users. The Enterprise and Ultimate editions include rolling updates, faster availability of all releases and patches, and 24/7 enterprise-level support.

A TECHNOLOGY BET CERTAIN TO PAY OFF

The rapid changes in the payments industry in recent years have brought a host of new challenges to providers, along with new opportunities. To successfully navigate the competitive new terrain, providers need to accommodate a wide variety of digital and mobile payment methods for instantaneous payments. They also need to make strategic use of options such as payment hubs and distributed public ledgers that can help them track payments efficiently. Plus, they need to use sophisticated big-data analytics to help them prevent fraud as it happens and leverage their wealth of data into real-time business opportunities. These changes demand a new level of transactional speed and analytical power.

Fortunately, in-memory computing solutions can now provide the level of performance these companies need. Combining an open source framework with enterprise-level features, the GridGain in-memory computing platform offers a scalable, comprehensive, secure, and affordable solution—an elegant and efficient way to give payment providers the high-performance edge they need.

Contact GridGain Systems

To learn more about how GridGain can help your business, please email our sales team at sales@gridgain.com, call us at +1 (650) 241-2281 (US) or +44 (0)208 610 0666 (Europe), or complete our contact form at www.gridgain.com/contact and we will contact you.

About GridGain Systems

GridGain Systems is revolutionizing real-time data access and processing with the GridGain in-memory computing platform built on Apache® Ignite™. GridGain and Apache Ignite are used by tens of thousands of global enterprises in financial services, fintech, software, e-commerce, retail, online business services, healthcare, telecom and other major sectors, with a client list that includes ING, Raymond James, American Express, Societe Generale, Finastra, IHS Markit, ServiceNow, Marketo, RingCentral, American Airlines, Agilent, and UnitedHealthcare. GridGain delivers unprecedented speed and massive scalability to both legacy and greenfield applications. Deployed on a distributed cluster of commodity servers, GridGain software can reside between the application and data layers (RDBMS, NoSQL and Apache® Hadoop®), requiring no rip-and-replace of the existing databases, or it can be deployed as an in-memory transactional SQL database. GridGain is the most comprehensive in-memory computing platform for high-volume ACID transactions, real-time analytics, web-scale applications, continuous learning and hybrid transactional/analytical processing (HTAP). For more information on GridGain products and services, visit www.gridgain.com.