



The Message Network: **Driving Competitive Advantage for Data-Intensive Organizations**

Tervela Inc.
174 Hudson Street, 2nd Floor
New York, NY 10013
info@tervela.com
www.tervela.com
+1 646.586.4200

Table of Contents

<i>Executive Summary</i>	1
<i>The Nature of Information is Changing</i>	2
<i>Information is the “New Money”</i>	3
<i>Defining the Problem</i>	4
<i>Taking a New Approach</i>	5
<i>Message Network Requirements</i>	6
<i>The Solution</i>	7
<i>Introducing the Tervela Message Network</i>	9
<i>The Tervela Message Network in Action</i>	11
<i>About Tervela</i>	12

Executive Summary

The introduction of the message network represents the most significant transformation of the computing and communication paradigm in 20 years. The existing infrastructure—whether at the network layer or at the application layer—continues to suffer due to legacy architectural frameworks that are now congenital deficiencies. Faster networks lead to faster outages; complex applications lead to isolated, inflexible solutions. Middleware, once touted as a panacea, succumbs to complexity and inability to scale; all while forcing application compatibility challenges and debilitating underlying networks. Dynamic, high-volume, time-sensitive information—a cornerstone of data-intensive organizations—exacerbates the problem. Deploying more servers and network gear only attacks a symptom and increases cost and complexity. Driving more intelligence into the existing transport network means driving more incompatibility and latency into the equation, effectively eroding the benefits of a content-neutral medium.

The message network sits at the confluence of the computing and communications flows to address these challenges. As a requisite mezzanine layer that offloads the overburdened layers of the proverbial infrastructure stack, the message network is a catalyst for introducing services and capabilities without a rip-and-replace of the existing network and applications. In fact, it's a performance emancipation and life extension for them. But it's not just about what's already there; it's about what's coming—the dynamic, high-performance enterprise. The Message Network™ from Tervela is a next-generation communications platform designed to deliver information at unparalleled speed and across massive scale—even during the most arduous market conditions.

The Nature of Information is Changing

Information evolution is leading the revolution. Terminal, print and email traffic are giving way to Web 2.0/3.0, Service Oriented Architecture (SOA) and enriched, interactive information flows. One-to-one, pull-based data processing now yields many-to-many, push-based models. Rather than having hundreds of clients ask for information, the new information paradigm on the message network allows thousands to receive it instantaneously and simultaneously. But today's information has an ever-decreasing shelf life. Time—now counted in microseconds—is critical to a growing number of areas such as market data, video and command/control systems. If data fails to get there in time, it may be of no value.

The enterprise messaging market is dynamic, demanding and unforgiving. Escalating data volumes exacerbated by an increasing number of users and services—both human and electronic—are placing demands on existing infrastructure that fundamentally have not been updated in years. The nature of information is changing, and organizations in multiple industries that require real-time access to diverse data resources need message networks to support continually evolving business requirements. Organizations increasingly need to distribute dynamically generated information instead of just downloading static content from the mainframe.

At the same time, the volume of information carried over the network is increasing steadily. Technologies such as Instant Messaging and web chatting are becoming universal on the enterprise network, and video is increasingly being used throughout the enterprise. Some information—such as real-time market data feeds, logistical information or command and control data—is time-sensitive and must be delivered immediately so that consumers of information can swiftly make informed decisions that drive operational results. Organizations are seeing a fundamental shift in information traffic flows, with a greater penetration of bidirectional traffic and a larger need to intelligently filter messaging to improve performance, manage bandwidth and prevent the over-burdening of computational endpoints.

The value of information can no longer be measured in seconds. Message delivery time now needs to be measured in microseconds. The option of downloading content from a server is no longer viable for organizations faced with the need to immediately deliver data to hundreds—or thousands—of information consumers located within a building or across the globe.

Information is the “New Money”

Information has become the lifeblood of organizations in many industries, and the ability to ensure continuous, predictable and high-performance message delivery—even during the most volatile conditions—is a critical business requirement that is a threat to company growth. Information has become the “new money”, and the ability to rapidly and efficiently collect and distribute data will lead to new wealth for corporations that take advantage of message networks.

For example, the world’s most demanding financial services organizations rely on messaging for all critical information dissemination and processing for market data distribution, market making, order routing and other critical applications in both the front and back office. High-performance electronic trading is a significant part of the equation. Escalating data volumes continue to feed the insatiable appetite of today’s trading infrastructure, yet that information is frequently rendered useless by large and erratic message latencies resulting from both market volatility and antiquated software-based messaging systems and message-oriented middleware.

The risks have never been higher; when a messaging system fails—which happens all too frequently—a firm is out of the market. That’s the ultimate business risk in financial services for example, whether for a top-tier investment bank, an exchange, a hedge fund or any institution that relies on trading for its existence. Because messaging systems are at the core of the vast array of financial services applications, they are often the prime culprit when firms are involuntarily temporarily forced out of the market.

Telecommunications is another industry that relies on instant access to information to grow and prosper. A carrier that cannot instantly identify and correct service outages will lose business to a service provider that delivers the reliability that customers demand. Similarly, manufacturers rely on real-time inventory, warehouse tracking and RFID tracking for logistics management, and energy companies rely on messaging for supervisory control and data acquisition. Corporate dependence on current information is critical, but companies face a major problem—merely expanding existing applications and networking infrastructure is insufficient for meeting evolving corporate requirements for instant access to data.

Defining the Problem

Despite dramatic increases in dynamic information, escalating volumes of traffic carried over the network, expanding demands for time-sensitive data and the need to quickly deliver content to a growing number of users, many organizations still rely on messaging infrastructure originally developed under the client/server architectural model of the 1980s. Client/server infrastructure was initially brought to market to enable distributed computing across the enterprise and to support ubiquitous networking. Information was stored on servers and consumers of information accessed it through desktop clients. The network provided the connectivity, and the applications were designed to support distributed architectures.

Today's networks are not able to deal with the massive onslaught of data that information professionals demand every minute of every day to do their jobs well. A new paradigm is needed that will allow companies to easily leverage message networks designed to support not only the tremendous demands of today, but also continually-evolving requirements.

Merely adding new routers and servers is an expensive band-aid that will not heal legacy networks. Massive CAPEX investments and the increased OPEX involved in deploying and maintaining additional hardware is driving up the cost of doing business. Pushing more intelligence into the network drives more incompatibility and latency into the equation, which effectively erodes the benefits of a content-neutral medium. Networks can no longer be seen as a means of providing content-neutral transport because some content is timelier than other content and organizations need the ability to prioritize traffic according to business rules. New investments in legacy networks at best postpone for tomorrow the need to match information demands with infrastructure delivery capabilities.

Meanwhile, existing enterprise applications will not go away anytime soon. Organizations have invested in enterprise applications for business-critical functions, and they are entitled to leverage existing application infrastructure as long as possible to support business goals and avoid major retrofitting of business functions. And companies continuously add new applications to improve business operations. Web 2.0 offers the promise of second-generation, web-based applications that let workers share information and collaborate in ways that were previously not possible. But new, worthwhile and innovative Web 2.0 applications place increased demands on legacy network infrastructure not designed for using the web as a collaboration platform.

Extending existing infrastructure solutions is not a viable option. Organizations that do not evaluate a new approach will lose a strategic advantage to those that recognize the importance of using a message network to meet current and future information requirements throughout the enterprise. Companies that continue to sink CAPEX and OPEX into solutions that are not equipped to effectively deal with today's messaging challenges will suffer from:

- Increased downtime that prevents firms from engaging in their lines of business
- Loss of revenue from the inability to effectively distribute information throughout the enterprise in time windows that are shrinking to microseconds
- Loss of reputation and brand value due to public awareness of downtime and the inability to act swiftly based on immediate access to timely information

Technology challenges lead to business challenges as organizations struggle with the contrasting demands of efficiently leveraging existing network and applications infrastructure while meeting business requirements for the reliable delivery of dynamic, high-volume and time-sensitive information.

Messaging systems, whether in the form of message-oriented middleware or part of an Enterprise Application Integration (EAI) package, are the foundational elements for distributed applications and computing. Data-intensive industries rely on messaging infrastructure for critical, day-to-day operations. Information and application architects design enterprise systems with messaging at the core because they realize:

- The underlying network is non-deterministic
- Applications are unique and diverse
- The computing environment continually changes

Because of its intrinsic power and flexibility, enterprise messaging is now a core component of contemporary SOA specifications. But there are critical shortcomings to these frameworks, especially when they recycle the shortcomings of legacy approaches. Continual and dramatic increases in information volumes, coupled with mounting time-sensitivity of information, are taxing existing messaging systems to the point that they are vulnerable to outright failure. When messaging systems go down, companies go down.

Software-based middleware messaging platforms have become a bottleneck within enterprise infrastructures, and are unable to keep pace with the growing demands of message volumes and the increasing need for those volumes to be processed with reduced latency.

Taking a New Approach

A new approach is needed, one that respects the need to leverage existing investments in network and applications infrastructure, but relieves companies of the limitations of legacy infrastructure. It is as impractical to replace existing infrastructure as it is to deny information workers of the ability to instantly access the resources they need to do their jobs. Slowing down the evolution of emerging applications restricts collaboration and information sharing, and despite the messaging challenges organizations face today there is only one certainty that IT faces in evaluating how to solve the problem—if you merely build out existing infrastructure the problem will only get worse in the near future because timely information will only become more valuable.

Enterprise messaging systems are increasingly failing and putting organizations, their customers and their stakeholders at risk. Tervela is stepping up to solve the messaging challenge head-on with the delivery of the next-generation communications infrastructure—the Message Network. Many of the world’s most demanding corporations rely on Tervela to ensure continuous, predictable and high-performance operations—even during the most volatile conditions.

Continual and dramatic increases in information volumes, coupled with increasing time-sensitivity of information, are taxing existing messaging systems to the point where they outright fail. When messaging systems go down, companies go down. One blue-chip financial services firm was recently out of the market for thirty-six hours because market data volumes exceeded the capacity of its message systems. However, this is not unusual since most messaging systems are software-based and the volume of information outstrips legacy

systems even on the fastest, most powerful servers. Many organizations attempt to partition their messaging information flows, only to find that they have:

- Undermined the flexibility of the messaging capabilities
- Lost operational visibility into the messaging and computing fabric
- Exhausted precious rack space in their data centers

Message Network Requirements

To understand the advantages of a message network, it is important to compare and contrast against a transport network when evaluating fundamental messaging requirements. These requirements include:

- **Scale**—Traffic volumes will only continue to increase, and buying additional servers and switches is an expensive alternative that cannot accommodate continuous volume increases. Message networks need the flexibility to efficiently support the demands of a small workgroup while having the ability to scale high-performance messaging across multiple enterprise locations.
- **Performance**—Existing messaging systems are largely based on publish/subscribe models, with one publisher distributing content to any number of subscribers. But if even one of the subscribers gets overrun with traffic, it will request a resend and the publisher will distribute the same content again to all of the subscribers on a multicast transmission—forcing a spiraling pattern of delivery delays and increased and unnecessary network traffic. Message networks need the ability to decouple publishers from subscribers and deliver high-performance messaging regardless of consumption patterns so that information workers can rely on continuous availability of up-to-the-minute information. A message network eliminates multicast storms by controlling slow consumers and retransmitting via direct, unicast transmissions to problem subscribers.
- **Predictable Low Latency**—While even peer-to-peer messaging solutions will generally deliver acceptable performance when messaging volumes are stable across the spectrum, latency will increase as traffic volumes increase. Bursts of data and volatility will increase latency (sometimes exponentially) because software-based solutions lack the ability to deal with spikes in traffic and increased volatility.
- **Integration Flexibility**—A message network needs the ability to accommodate the demands of widely deployed enterprise applications without demanding additional software development investments. This requires the ability to seamlessly carry legacy applications and enable smooth integration at both the network and the application layers.
- **Service Provisioning**—New capabilities and application support functions must neither impact hundreds (or thousands) of endpoints nor operational processing of information flows. New services should be provisioned into a message network.
- **Quality of Service**—all messaging traffic is not equal, and organizations need the ability to recognize and prioritize traffic according to policies. Critical data flows must not be hampered by administrative traffic either.
- **Storage**—Compliance regulations, corporate policies and infrastructure operational conditions increasingly require organizations to protect and store message traffic. But organizations concurrently want to avoid creating islands of information and need the option to centrally store message traffic for historical reference.
- **Resiliency/Self Healing**—Fault-tolerant, high-availability message networks are needed to reroute traffic in response to unplanned outages such as power failures, fires or natural disasters. The message

network needs the ability to immediately self-heal. With Level 2 feeds, for example, a trader that loses a tick can be out of market and done for a day. Even worse, they may not know they are out of the market and may continue to trade on stale data.

- **Decoupling Publishers and Subscribers**—Consumers of information need to be decoupled from publishers of information so organizations can scale message traffic and effectively manage peak periods. A comparison can be made to the need to include shock absorbers in automobiles. When a driver without shock absorbers hits a pothole, each bump is felt by the driver. Decoupling publishers and subscribers smoothes message flows so the message network can absorb the impact of bursty traffic so information workers don’t have to absorb the pain of lost or late messages.
- **Filtering**—Information flow economics demand the ability to intelligently filter traffic to avoid broadcasting messages to consumers that do not need or want them. The ability to know which users need which messages and centrally develop and enforce policies to filter traffic is essential for managing high-volume message traffic.

	Legacy Messaging	Message Network
Dynamic Transport Optimization	No	√
Decoupled Publishers from Subscribers	Some	√
Persistence and Storage	Some	√
Built-In Fault Tolerance	No	√
Seamless Slow Consumer Management	No	√
Sub-Microsecond Latency	Some	√
Predictable Latency at Peak Load	No	√
Distributed Message Fabric	No	√
JMS Support	Some	√
Millions of Messages Per Second	Some	√
Predictable and Deterministic Information Flow	No	√
Message Fabric Capacity Scaling	No	√
Dynamic Service Provisioning	No	√

Table 1 – Legacy vs. Message Network

Message networks overcome the limitations of legacy messaging systems

The Solution

A message network is a unified data fabric that includes the intelligence and performance necessary for supporting increasing volumes of time-sensitive and dynamic message flows. As a mezzanine layer that bridges the existing transport network and application infrastructure, a message network adds substantial logic to event-driven data communications, increases interoperability between distributed applications and decouples network protocols from application logic in diverse communications environments. A message network is an intelligent information distribution platform that consistently and predictably delivers targeted information to interested parties with the specific quality of service levels that they require.

Message processing must be moved out of the application stack into its own transport layer, a function too critical to be left to conventional software approaches. A message network seamlessly integrates with both the existing transport network and the existing messaging applications, and it moves message processing logic from the application layer into the network layer—where it belongs. A message network allows the enterprise to deliver extraordinary performance to users, and it allows the enterprise to move large volumes of information rapidly and effectively throughout a single workgroup or across a global network. It successfully addresses the business challenges of the most demanding customers in the world for:

- High-performance
- Low latency
- Infinite scalability

Point solutions lack the performance, resilience and scalability needed to accommodate today's messaging demands and they can't deliver the low latency required for messaging traffic. They put organizations at risk of having a single point of failure for messaging traffic, and since they are largely based on software implementations they lack the performance and scalability needed to support dramatic increases in enterprise message traffic.

Traditional network equipment vendors will encourage companies to select higher-performance routers and switches with an increasing array of security, administration and business policy functions, but this is an expensive and temporary fix to the problem and it forces companies to add complexity to already-complex networks, thereby increasing the OPEX of managing, updating and monitoring network infrastructure. One of the reasons why Internet growth has exploded over the past several years is because packet networks are indifferent to the content of the packets they transport. Merely adding complexity to existing transport platforms does not serve the enterprise as much as it serves switch vendors who are trying to sell higher-margin platforms and professional services.

Message networks allow you to leverage your existing transport networks and enterprise applications by relying on a mezzanine layer custom-built to support the evolving demands of message traffic. You can seamlessly deploy a message network that integrates with your existing transport network and leverage legacy applications while future-proofing your network and improving performance, resilience, quality of service and reliability. Implementing a message network allows you to gain a competitive advantage in the marketplace by reliably delivering the high-performance messaging that allows your organization to swiftly make informed decisions. Through a combination of hardware acceleration and a software architecture optimized for messaging, the Tervela Message Network introduces a next-generation framework for a message-based middleware infrastructure. This platform has not only proven to be a highly stable and scalable solution, but more importantly, one which drastically reduces the latency introduced into the operating environment.

Introducing the Tervela Message Network

Tervela created the Message Network to not only solve today’s messaging challenges, but also to provide a powerful next-generation platform for emerging computing environments. At the heart of the message network is the Tervela TMX Message Switch™, a purpose-built, silicon-accelerated messaging solution that overcomes all the inherent deficiencies of legacy, software-based message-oriented middleware and EAI messaging systems.

The TMX follows the natural, evolutionary path of handling enterprise information flows in hardware, while simultaneously delivering the requisite intelligence to address the unique demands of messaging, networking and computing. The broader message network, in turn, facilitates the easy migration of applications from legacy platforms and supports the development of new ones.

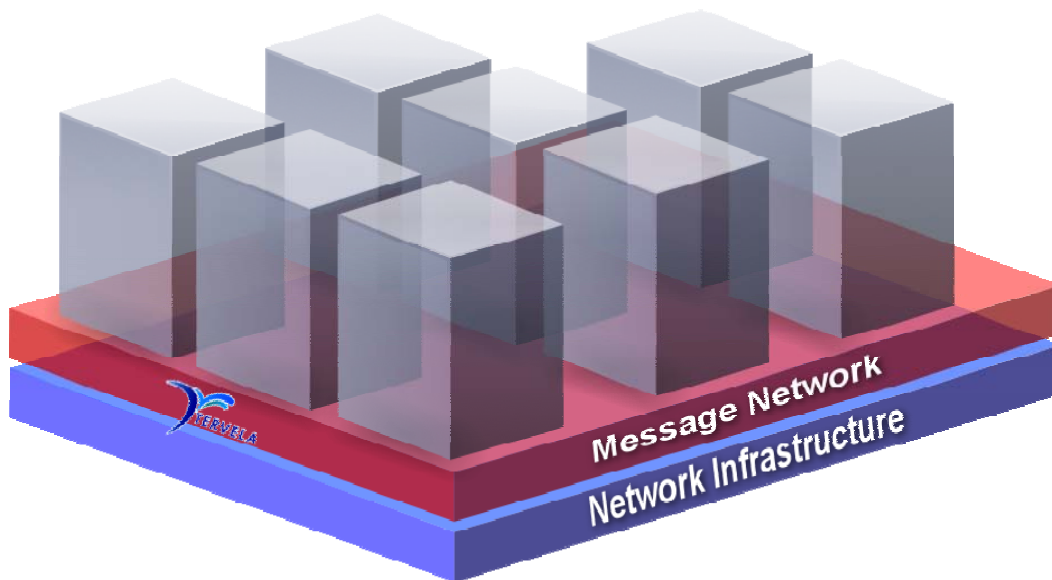


Figure 1 – Tervela Message Network

The Tervela Message Network is a unified data fabric that includes the intelligence and performance required to support increasing volumes of time-sensitive and dynamic message flows

As the core component of the Message Network, the TMX’s primary role is to intelligently route messages from publishers to subscribers throughout the enterprise. The TMX has been designed to optimize the use of network and system resources in order to increase message throughput and decrease end-to-end latency. By leveraging a series of hardware-based design innovations, the message switch is able to route hundreds of thousands to millions of messages per second with just microseconds of hop latency. Tervela’s unique approach allows the Message Network to maintain an unparalleled level of routing performance even as volume levels fluctuate.

The high-performance, data-driven enterprise has changed and so should its messaging infrastructure. By building a mezzanine layer above existing transport networks, organizations can immediately—and cost-effectively—solve immediate pain points while enabling high-performance messaging across the enterprise.

Tervela Breaks 10 Million Messages per Second Barrier

Tervela's TMX hardware-accelerated message switch was designed to provide consistent performance regardless of underlying data patterns, network instabilities or distribution scale. Working with AMD and Woven Systems, Tervela constructed the first large-scale infrastructure for properly evaluating messaging performance. The tests involved over 100 systems and employed message sizes commensurate with financial services environments. The tests demonstrated consistent and stellar benchmarking performance, including one test that showed 10,000,000 messages-per-second with sub-100 microseconds mean latency. Even more importantly, standard deviation of latency remained consistently low, demonstrating the predictable performance that is only possible with a message network solution.

These tests were designed to emulate real-enterprise environments and to simulate real-world error conditions. By taking these results and applying them to any business use case, customers can architect a world-class messaging system and eliminate deployment performance surprises. Beyond benchmarks, these performance indicators represent a channel to greater business continuity, competitive advantage and new service delivery. Messaging is an increasingly critical component of the enterprise infrastructure, justifying an increased focus on the far-reaching implications of benchmark data based on real-world assumptions. For more information on this benchmark testing, visit www.tervela.com.

Messaging systems don't exist in isolation; they are part of a broader ecosystem of publishers, subscribers and networks—all with diverse and evolving operational characteristics. Not only does an intelligent message switch offload much of the core messaging functionality of these other constituents, it continually monitors and adjusts its message processing based on the state of these constituents, recognizing such issues as:

- Bursty, volatile publishing volumes
- Slow consumers of information
- Underlying data network saturation and capacity issues

The Tervela Message Network decouples publishers of critical information from the consumers, thereby removing any operational dependencies and increasing responsiveness, resiliency and availability. The result is extremely high performance, predictable ultra low-latency and continuous operations—even during the most volatile periods.

Legacy, software-based messaging systems and message-oriented middleware no longer have the capability—regardless of the number of servers thrown at the problem—to ensure that an organization can effectively share information during the most volatile conditions. In the financial services industry for example, times of volatility

are precisely the times where fortunes are won and lost. Tervela's Message Network ensures sustainable speed, continuous stability and unlimited scalability for the most demanding, data-intensive organizations.

The Tervela Message Network in Action

When one of the world's leading firms in the options market making business concluded that its legacy messaging infrastructure was insufficient, it deployed a fault tolerant pair of Tervela TMX Message Switches with a Tervela TPM Provisioning & Management System™ to construct a message network upon which it put its options market making infrastructure. By leveraging the Tervela Message Network, the customer was able to:

- Maintain options market making leadership and preserve trading reputation
- Process higher volumes of options data from OPRA and six options exchanges
- Ensure message processing continuity and consistency during frequent periods of volatility
- Overcome loss of critical ticks that disrupt options business

The organization was also able to address the following technical challenges:

- Handle increasing amounts of time-sensitive market data and trades while maintaining business continuity
- Replace legacy software-based message-oriented middleware
- Reduce the number of servers that were outpacing data center rack space
- Accurately model traffic flow and latency to enable full algorithmic analysis
- Stop messaging systems from failing during frequent periods of extreme market volatility

The options market making project at one of the world's premier investment banks represented a major attack on the debilitating deficiencies of legacy message-oriented-middleware and its increasing unsuitability for high-volume, latency-sensitive financial data distribution and transactions. The customer, well versed in messaging technology, experienced diminishing benefit from adding more servers to help overcome the growing volumes of data. In fact, adding more hardware not only exacerbated operational issues, but exhausted important data center real estate.

Furthermore, as message volumes increased, these legacy systems (regardless if they're running on state-of-the-art servers) fell behind or failed, leaving the business unit's applications either behind the market or out of the market entirely, sometime for as long as a day. Being out of the market resulted in estimated profit losses of approximately \$10 million per incident, with occurrences happening more frequently as a result of escalating message volumes.

The options market maker was extremely concerned with reputational impact and its effect on long-term revenue opportunities. Simply replacing the messaging infrastructure for options market making was not a viable alternative. Integration points of legacy systems with feed handlers, market adapters, algorithms, FIX engines and other critical financial services applications is a non-trivial endeavor. Transitioning to Tervela's hardware-accelerated message switches was straightforward, solving immediate problems while delivering a platform for future, more demanding applications. As such, the firm introduced message switches in parallel



with its legacy messaging infrastructure, initially channeling a subset of traffic to the Tervela TMX Messages Switches.

The Tervela Message Network quickly yielded the following major benefits:

- Sub-100 microsecond latency that ensures trade efficiency and accuracy
- Capacity to easily handle increasing option data volumes and trades
- Reduction in data center footprint, addressing both power and environmental concerns
- Straightforward integration with existing messaging systems and applications
- Business continuity through fault-tolerant message switches
- Greater application and server performance as message processing was shifted to the message network
- Decoupling of publishers from subscribers, further eliminating business disruptions from fast producers and slow consumers
- Increased efficiency and performance of the underlying network since intensive message processing was conducted in the TMX Message Switches and not across servers on a saturated network

With Tervela, the customer was able to successfully migrate its options market making business from legacy, message-oriented middleware to the Message Network—fundamentally changing its options market making business. While this sample customer is a leading financial services company, all data-intensive organizations relying on messaging infrastructure can seamlessly achieve similar benefits through the Tervela Message Network.

About Tervela

Founded in 2004, Tervela delivers the next-generation communications infrastructure—the message network—designed and engineered to exceed the information dissemination and processing requirements of the world’s most demanding financial services institutions. Addressing the challenges of market volume, volatility and visibility, Tervela invented the message switch to enable investment banks, hedge funds, exchanges and other data-intensive organizations to deliver consistent, outstanding and predictable performance—even in the most demanding market conditions. The company is funded by Goldman Sachs, Sigma Partners, Acartha Group and North Hill Ventures. For more information, please visit www.tervela.com or call +1 646.586.4200.

Tervela Inc.
174 Hudson Street, 2nd Floor
New York, NY 10013
info@tervela.com
www.tervela.com
+1 646.586.4200

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