



# RED HAT ENTERPRISE MRG MESSAGING POWERFUL, OPEN SOURCE MESSAGING FOR THE ENTERPRISE

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This whitepaper outlines the power of Red Hat's message-oriented middleware platform and its ability to deliver the power of distributed computing to the modern enterprise.

## WANTED: APPLICATIONS THAT CONNECT

To compete effectively in their markets, today's enterprises are under pressure to eliminate the barriers imposed by distance, time, and technology. They must be able to create value for their customers – whether businesses or consumers – by delivering a broad array of information to employees, customers, and downstream systems. And to do this, they must execute transactions securely, efficiently, and regardless of origin, and they must take action in real time.

To these ends, companies small and large must reach outside the boundaries of their organizations and connect with suppliers, partners, and customers. For example:

- An investment bank conducts increasingly complex trades with clients throughout the world. The bank's ability to integrate with a broad range of systems and execute a high volume of clearing and settlement transactions with minimal latency is critical to competing in a global market.
- A power utility purchases electricity on the open market for its industrial customers. By monitoring customers' power consumption via sensors, the company can anticipate power requirements more accurately, thus reducing power acquisition costs and allowing the utility to offer competitive prices while maintaining margins.
- A major retailer looks to distribute promotional offers to their customers' mobile devices, with the capacity to receive orders from those devices, and executes the transactions through back-end secure ordering and fulfillment systems. With this capability, the company can capture a larger number of orders, take advantage of individualized up-selling opportunities, and maintain mindshare with the customer.

While each of these scenarios is quite different, they have a common theme – the need to reach across multiple systems with robust, secure connections and complete a business-critical process as efficiently and securely as possible. Businesses that are able to put these robust connections in place quickly and easily, and take full advantage of them day after day, can respond effectively to changing market conditions and maintain competitive advantage.

## ARCHITECTS UNDER PRESSURE

To meet these requirements, system architects are under continuing pressure to create high-performance, distributed architectures. Whether they are integrating systems to support new business processes, enhancing and extending legacy systems, or integrating the operations from merger/acquisition activities, the challenges are the same – diverse platforms and languages, often complex application semantics, and limited time with rising expectations for service delivery.

## A NEW APPROACH TO MESSAGING

Application messaging long has been a mechanism for connecting distributed systems in a loosely coupled manner. Once simply called middleware or message-oriented middleware (MOM), messaging software offered the potential to coordinate the wide range of processes within an organization in a way that allows a business to act as one organization rather than myriad individual systems.

But each advancement in enterprise messaging's sophistication also bred complexity that has allowed vendors to lock enterprises into proprietary architectures that encumber their abilities to create flexible and interoperable solutions. Integration was often complex, time consuming, and expensive. Rapid change, new regulatory requirements, and proliferation of proprietary architectures that must be supported for each relationship are exacerbating these challenges for companies in a wide variety of markets. To develop systems that can grow and scale as needed, companies need a secure means of transmitting business messages without the challenge of proprietary formats and technology incompatibilities.



## THE AMQP INITIATIVE

Fortunately, industry innovation holds promise to eliminate many of these challenges. In a bid to streamline the process and gain greater flexibility and control, an industry working group composed of leading enterprises and vendors is developing the Advanced Message Queuing Protocol (AMQP). AMQP is a messaging specification that provides both a common wire-level messaging protocol and a set of messaging semantics. Designed to meet the needs of even the most demanding applications by drawing on the industry's collective experience from the past two decades, AMQP is rapidly emerging as a de facto business messaging standard.

AMQP's objective is to meet the needs for communication between commercial computing systems, and do so in an efficient manner that could be embedded in the network infrastructure. Because AMQP specifies a wire-level protocol (not simply API-level integration), AMQP-conformant systems can exchange messages spanning different languages, operating systems, and platforms. By adhering to an accepted underlying protocol, AMQP messaging promises to enable a new level of interoperability within and across organizations, giving companies a valuable way to future-proof their application architectures. Given the degree to which interoperability requirements are exploding, this messaging innovation has arrived just in time.

Red Hat has been part of the AMQP initiative from its beginnings, jointly driving the creation and refinement of this open standard by working closely with both practitioners and thought leaders. This process has expanded Red Hat's insight into the challenges enterprise architects face with respect to business messaging. To meet ambitious goals, organizations must not only expand open interoperability and simplify the implementation of high-performance connections among systems, but also gain control over what is a highly strategic element of system architecture. Open source middleware is an increasingly popular choice that enables organizations to control costs while taking advantage of the collective wisdom of a vibrant open source community.

## RED HAT ENTERPRISE MRG MESSAGING

Red Hat® Enterprise MRG Messaging (pronounced "merge") is a powerful, flexible business messaging platform that is offered by Red Hat on an open source subscription basis. Based on the AMQP protocol, Red Hat Enterprise MRG Messaging enables application architects to:

- Support a variety of application environments with a single messaging platform
- Choose from a range of messaging patterns to meet diverse application requirements
- Deliver the high levels of performance, availability, and security that their businesses and applications demand
- Control the cost and complexity of integration projects, improving application total cost of ownership (TCO)
- Gain greater control over a strategic element of critical business processes

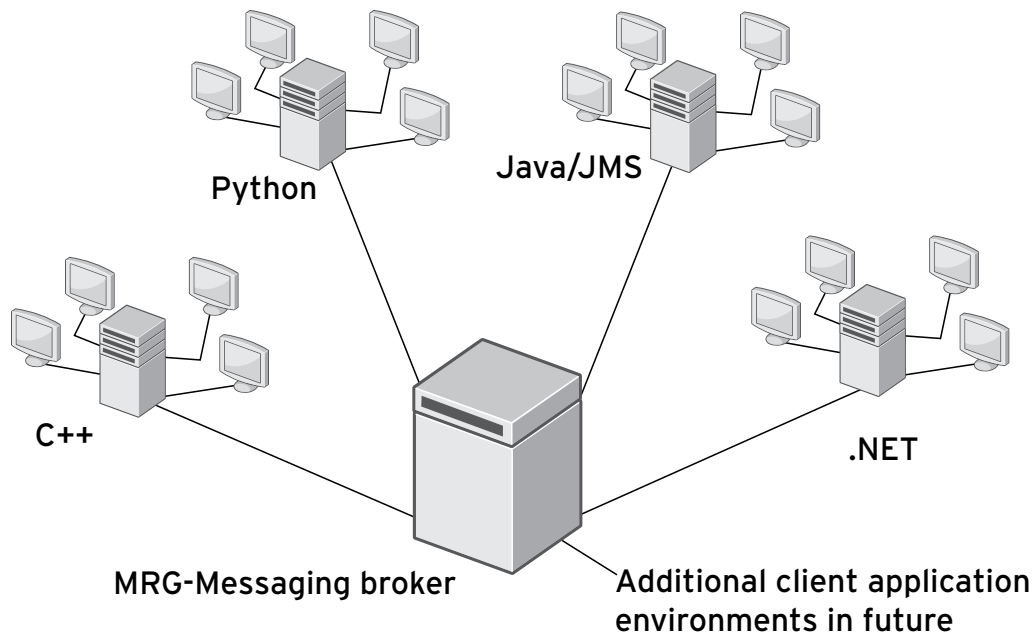
Rooted in the Apache Qpid project, an open source project that has implemented the AMQP standard, Red Hat Enterprise MRG Messaging also includes many additional optimizations and features – such as a management console – that are not found in the Qpid implementation. It also includes specific optimizations for the Red Hat Enterprise Linux® platform that give it significant performance enhancements over vanilla implementations of the AMQP specification. Lastly, Red Hat has added additional functionality in terms of a range of messaging patterns that enhance implementation by removing the burden from the application developer to incorporate the specifics of such patterns within their code.

## MAXIMIZING INTEROPERABILITY

The goal of application messaging systems is to support a distributed computing environment over a network and throughout an organization – or even across organizational boundaries – without being constrained by differences in operating systems, languages, or network protocol incompatibilities.

Increasingly, business processes reach into the systems of suppliers, customers, or other trading partners. And to accomplish this goal of seamless operation without labor- and skill-intensive (and expensive) integration, it must be possible for applications to send and receive messages in the language of the application. Red Hat Enterprise MRG Messaging eases this process by offering application clients in a variety of languages across several platforms, including Java (JMS), C++, Python, .NET, and more. This allows enabling integrators to easily interoperate their applications, using the common wire protocol defined by the AMQP specification. Given its relationship with the open source Qpid project, MRG-Messaging benefits from a vibrant developer community that can quickly expand client support (e.g. Ruby, PHP, etc).

FIGURE 1



Taking advantage of the Red Hat Enterprise MRG Messaging client API for language and platform-of-choice, developers can create applications that act as message producers and consumers using the application's native language, while taking full advantage of the underlying transactional power of the AMQP-based wire protocol. Client libraries will ensure that the message is transformed to the appropriate AMQP format as it is transmitted across the wire, so that a consuming application will be able to interpret that message in its native mode. For example, a .NET Dictionary can become a Java HashMap automatically, without the application developer having to code the transformation explicitly.

## DELIVERING MESSAGING FLEXIBILITY FOR DIVERSE APPLICATION REQUIREMENTS

With a mix of pre-defined structures that save time, and an open, extensible architecture that can support virtually any type of message processing, Red Hat Enterprise MRG Messaging delivers the flexibility that architects need to meet the requirements of today's and tomorrow's applications. At the same time Red Hat Enterprise MRG Messaging helps reduce the time, effort, and skill level needed to complete integration projects.

Red Hat Enterprise MRG Messaging supports a wide range of powerful messaging patterns and queuing semantics, and is highly extensible. The routing models in most legacy messaging architectures are fixed and their definitions not exposed, which makes it difficult for architects to change or extend them. One of the design goals of the Red Hat messaging platform has been to support multiple routing models in an extensible way through explicitly-defined semantics. Through straightforward, declarative definitions of exchanges, queues, and bindings, you can compose simple or complex routing models that address the diverse requirements of your applications, such as:

- An exchange receives messages from producing applications and routes them to queues based on certain criteria.
- A queue stores messages until they can be safely processed by one or more consuming applications.
- A binding defines the relationship between an exchange and a queue and provides the required message routing criteria.

FIGURE 2

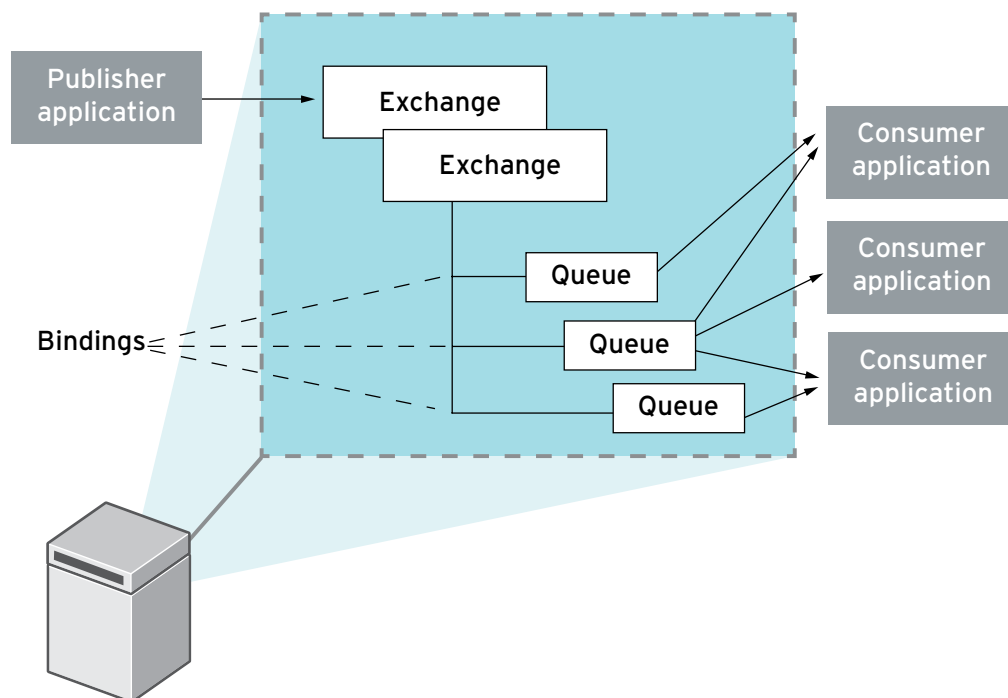
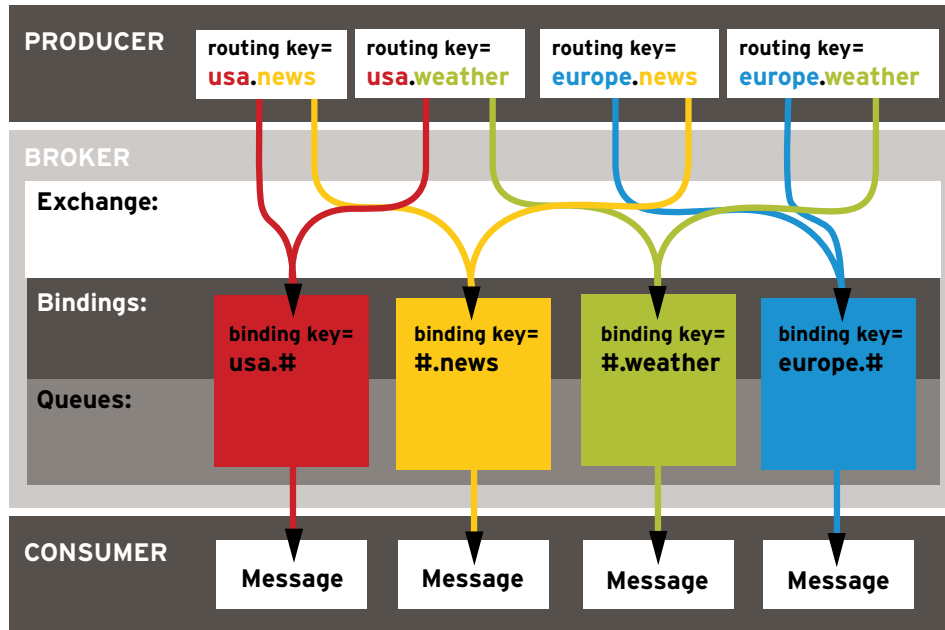


FIGURE 3



The introduction of the exchange as an abstraction that encapsulates a message delivery pattern or approach (such as XML routing, publish-and-subscribe processing, or direct point-to-point delivery) is a key driver of flexibility in Red Hat Enterprise MRG Messaging, as illustrated above. By extending the variety of message patterns that can be supported, exchanges reduce the coding work for developers. The logic of message processing is encapsulated in the definitions of exchanges, bindings, and queues. As a result, a producer needs to know only the identity of the exchange to which it is sending a message (and the arguments it requires or expects), while a consumer needs to know only the queue from which it is taking a message.

Red Hat Enterprise MRG Messaging has built-in exchange types that support processing found in typical enterprise applications. In addition to typical processing such as point-to-point, fan out, and publish-and-subscribe, Red Hat Enterprise MRG Messaging contains built-in transaction support so that you can easily implement XA-compliant distributed transaction processing to ensure the integrity of business processes and data. For XML-based data, Red Hat Enterprise MRG Messaging supports dynamic routing based on XQuery expressions. Beyond the standard built-in exchange types, you can define your own exchange types, so you can create and reuse the simple or complex messaging patterns needed by your applications. Because message processing does not need to be coded explicitly in application code, integration of all types is easier to set up and maintain.

Red Hat Enterprise MRG Messaging supports a variety of message queue types, including private or shared, durable or transient, permanent or temporary. In addition to basic queue properties, Red Hat Enterprise MRG Messaging has also incorporated advanced queuing semantics that support emerging application best practices. Examples include:

- **Last value queue.** Replaces an existing message containing stale data with a newer message containing updated data. An example would be to ensure that an application uses the most current market price information (e.g., for equity, bond, or commodity prices) or that a web store has accurate inventory information.
- **Initial value queue (IVQ).** Stores the value from the first message in a sequence so that later values can be compared with an initial value. This might be used to provide opening and closing prices for a financial instrument or capture the range of temperature/moisture changes over a particular period of time.
- **Ring queue.** Queue with a configurable depth and ring buffer that will override the oldest messages as the buffer fills.

#### MAXIMIZING PERFORMANCE FOR TRANSIENT AND DURABLE MESSAGING

To meet requirements of even very basic applications, messaging systems must deliver messages quickly, efficiently, and reliably. Many of today's applications require extremely low latency in order to meet even minimum service levels. Red Hat Enterprise MRG Messaging offers the enterprise-strength performance required for today's demanding applications. For example, Red Hat Enterprise MRG Messaging has achieved over six million options price reporting authority (OPRA) messages/second throughput on an eight-core system using Gigaset Ethernet. Native RDMA support over either Infiniband or 10 Gig Ethernet enables Red Hat Enterprise MRG Messaging to achieve extremely low end-to-end latency in the microsecond range.<sup>1</sup>

For organizations that require deterministic latency (a guaranteed upper bound for message latency), Red Hat Enterprise MRG Messaging can take full advantage of Red Hat Enterprise MRG Realtime capabilities to gain new levels of determinism by optimizing kernel codepaths within the Red Hat Enterprise Linux operating system, ensuring they are not bottlenecks. This allows better prioritization of messages, and delivers consistent, predictable response times.

Red Hat Enterprise MRG Messaging combines the enterprise-strength performance required for the most demanding applications with the enterprise reliability that you have come to expect from the provider of the Red Hat Enterprise Linux operating system. While use of transient messaging can improve system performance, many systems require the reduced risk offered by durable (persistent) messaging, which ensures that messages and queues are restored in the unlikely event of a broker crash or an operating system crash. Absolute reliability is required in the case where financial loss or other business damage could occur if a message is lost, does not arrive in a timely manner, or is improperly processed. For this reason, Red Hat Enterprise MRG Messaging strives to deliver the best possible performance in either durable or transient messaging configurations.

<sup>1</sup> More specific performance information and detailed benchmarking data are available from your Red Hat representative and from [www.redhat.com](http://www.redhat.com).



## EXPLOITING OPERATING SYSTEM AND HARDWARE SYNERGY

Red Hat Enterprise MRG Messaging is designed to take full advantage of Red Hat Enterprise Linux and the hardware platforms on which it runs. And as provider of the platform, Red Hat has developed close technical and business partnerships with hardware vendors. Red Hat understands these platforms inside and out, testing and optimizing system software.

Intimate knowledge of these evolving hardware platforms – including testing on pre-release versions – has contributed to Red Hat's ability to optimize the performance of Red Hat Enterprise MRG Messaging. This results in sustained durable messaging throughput rates of 1.5 million messages/second. Red Hat Enterprise MRG Messaging achieves these rates through the inclusion of an AIO journal specifically optimized for persistent messaging storage on Red Hat Enterprise Linux. These optimizations allow the software to deliver dramatically better performance while consuming fewer system resources, enabling Red Hat Enterprise MRG Messaging to deliver durable messaging at performance levels otherwise found only in transient messaging configurations.

## PROVIDING FOR SCALABLE AND MAXIMALLY AVAILABLE APPLICATIONS

Red Hat Enterprise MRG Messaging also provides high-availability message clustering, failover, and broker federation capabilities that enable you to provide for continuity if a broker, operating system, LAN or WAN connection, or an entire datacenter shuts down. These features also enable your applications to scale in workload volumes and geographically.

Ideally, your applications will never encounter problems. But Red Hat Enterprise MRG Messaging gives your architects and administrators the flexibility to configure your messaging network in ways that best address the risk tolerance of your business process, the technical realities and geographic distribution of your organization and systems infrastructure, and your specific application requirements. Maximum business process continuity and optimal use of system resources will deliver continuing benefits to your organization's bottom line.

High-availability messaging clusters enable message brokers running on different systems (though typically within the same LAN) to operate as a unit. Message producers and consumers can be connected to any broker in the cluster, and state is replicated dynamically across all brokers in the cluster. Clusters enable workloads to scale, facilitate load balancing, and provide resilience in the face of a single broker or operating system crash.

In addition to clustering, multiple local or geographically distributed brokers may be federated (or linked together) through message routes. In this case, the brokers contain formally distinct queues and exchanges, though functionality may be replicated through parallel definitions. Organizations can federate brokers to meet a diverse range of requirements, including:

- Allocating more responsive systems to high-value customers
- Directing processing to occur as geographically close to the customer as possible
- Balancing workloads across systems dynamically
- Providing for resilience and recovery in the face of interruptions in WAN connectivity or a site-wide disaster



Typically, federation and message clusters are used together. While clusters provide high availability on each LAN, federation enables routing of messages among the clusters. These capabilities enable architects and administrators to provide resilient connections that optimize the availability of their applications and the continuity of business processes, while at the same time enabling system workloads to scale without compromising performance.

### ENSURING MESSAGE SECURITY

In today's highly connected business operations, companies' reputations rest on their ability to protect the confidentiality of all information in their systems – from routine business information to highly sensitive customer and patient data. Red Hat Enterprise MRG Messaging provides comprehensive security features based on industry standards, including SSL support, role-based access control, SASL authentication, and more.

### REDUCING THE COST AND COMPLEXITY OF INTEGRATION

One goal of both the AMQP initiative and Red Hat Enterprise MRG Messaging is to minimize the work required to take advantage of powerful and flexible messaging capabilities. As developers and architects create, integrate, and manage applications, Red Hat Enterprise MRG Messaging eases integration in several ways:

- By providing client libraries and APIs for a wide range of languages and platforms, Red Hat Enterprise MRG Messaging enables straightforward integration with many different systems both inside and outside of your company.
- By encapsulating message processing logic in explicit queue and exchange definitions, Red Hat Enterprise MRG Messaging enables you to create reusable messaging patterns and avoid custom coding.
- With an extensible set of messaging definitions and explicit semantics, you can use one messaging system to address a wide range of application requirements.
- Red Hat Enterprise MRG Messaging also incorporates a web-based management console that enables administrators to instrument their systems, configure messaging options, and perform related management tasks, during development and testing phases and once the system is in production. In addition, a set of command-line configuration and management tools can be used to manage your Red Hat Enterprise MRG Messaging configuration from other clients.

### AN ENTERPRISE-READY OPEN SOURCE SOLUTION

Unlike other business messaging solutions, many of which are proprietary, Red Hat Enterprise MRG Messaging is delivered as open source software that blends the collaborative efforts of an open source community with the unparalleled expertise of Red Hat software professionals. Red Hat Enterprise MRG Messaging begins with an Apache Qpid foundation, adds capabilities that address enterprise requirements, and creates products that are tested, proven, and ready for enterprise production environments.

Red Hat Enterprise MRG Messaging is thoroughly tested, hardened, and productized through a process that anticipates enterprise challenges – and it is backed by expert Red Hat technical support. Because the Red Hat open source approach brings benefits in implementation, troubleshooting, and collaborative problem-solving at all levels – while also offering a budget-friendly business model. More companies are standardizing on Red Hat enterprise open source software as they upgrade their systems and application infrastructures.



### EXAMPLE: DEUTSCHE BÖRSE SYSTEMS AND EUREX CLEARING

Eurex is one of the largest derivatives exchanges in the world. Given the recent financial crisis, the entire securities trading industry has placed a high priority on finding better ways to discover, track, and manage transaction risks. To improve Eurex Clearing's ability to provide risk data to client banks, Deutsche Börse sought to replace an older system, based on encrypted email that updated every ten minutes, with a new system that would offer near-realtime risk information and support secure delivery of FIXML data.

Rather than design its own messaging protocol, which would have required extra integration effort from client banks, Deutsche Börse selected Red Hat Enterprise MRG Messaging. Standards-based interoperability, XML support, solid performance, and the quality of Red Hat support were key factors in the decision. Now, client banks can take advantage of the AMQP standard and Red Hat Enterprise MRG client libraries to integrate their systems easily with the Deutsche Börse backend. Formerly, they had been required to use expensive decryption software and manual data transfer to their own systems.

Eurex Clearing's Enhanced Risk Solution addresses these demands, providing a real-time risk data distribution service that allows clients to monitor changes to their risk profile when they occur, therefore optimising their intra-day risk monitoring and treasury management.

- The Banker 2010 Award for Innovation in Risk Management Technology

### CONCLUSION

Red Hat Enterprise MRG Messaging is an ideal messaging solution for the enterprise that is facing integration challenges due to the need to support new business opportunities, take advantage of mergers and acquisitions, automate supplier and partner connections, or fulfill other requirements for connecting within and across organizational boundaries. Red Hat Enterprise MRG Messaging promises to make your business easier for partners to work with and easier for you to run, while helping you control costs and the future of your distributed application architectures.

An enterprise-ready open source solution, Red Hat Enterprise MRG Messaging offers the scalable performance, high availability, and security required by a broad range of enterprise applications – from simple distributed data access to complex transaction processing systems. With optimizations that take full advantage of synergy with Red Hat Enterprise Linux and its underlying hardware platforms, Red Hat Enterprise MRG Messaging helps implement reliable, high-performance messaging without compromise. Built on an emerging standard designed to meet the needs of today's most demanding applications, Red Hat Enterprise MRG Messaging will give your organization a robust foundation on which your application architectures can grow and scale.



## ABOUT RED HAT ENTERPRISE MRG

Messaging is one component in Red Hat Enterprise MRG, a next-generation IT infrastructure incorporating high-speed, reliable, interoperable messaging, realtime performance, and high throughput computing (HTC) grid technology.

Red Hat Enterprise MRG delivers increased performance, reliability, interoperability, and faster computing to help enterprise architects maximize their ROI in distributed infrastructures. Other components of Red Hat Enterprise MRG include:

- **Red Hat Enterprise MRG Realtime** - For most organizations, a properly tuned Red Hat Enterprise Linux system meets and exceeds performance requirements. But with some time-sensitive workloads, milliseconds can make the critical difference between a successful transaction and a lost customer. Red Hat Enterprise MRG Realtime provides the highest levels of predictability for consistent low-latency response times, addressing the needs of organizations for whom consistently fast response time is a competitive advantage.
- **Red Hat Enterprise MRG Grid** - Red Hat Enterprise MRG Grid provides the most advanced, scalable platform for high throughput and high performance computing. Facilitating the shift to a utility model of computing, Red Hat Enterprise MRG Grid helps enterprises achieve both higher peak computing capacity and higher IT utilization by leveraging existing infrastructure to build high performance grids. With Red Hat Enterprise MRG Grid, applications can execute across a diverse set of environments, including local grids, remote grids, virtual machines, idle desktop workstations, and dynamically provisioned cloud infrastructure.

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