Mjolnirr. A Hybrid Approach to Distributed Computing

Dmitry Savchenko, Gleb Radchenko
dmitry.savc@gmail.com, gleb.radchenko@susu.ac.ru
Faculty of Computational Mathematics and Informatics, South Ural State University, Chelyabinsk, Russia.

1. Introduction
Nowadays there are a lot of serious concerns about data security in cloud computing systems. User data can be accidentally or intentionally modified, accessed or deleted. Private cloud systems is a way to ensure the data security in the cloud. There are several private IaaS solutions, but IaaS provides too low level of abstraction.

We propose a private cloud platform called "Mjolnir" for development of a private PaaS cloud infrastructure.

The main goals of our project:
• develop Mjolnir platform architecture;
• implement Mjolnir platform prototype;
• evaluate the message passing performance of the Mjolnir platform.

2. Architecture
The Mjolnir solution provides a platform for cloud applications development, including SDK, message brokering system and client-side applications interface support.

For a developer, a Mjolnir application is a collection of independent components communicating by message passing interface. This approach allows to develop flexible and scalable cloud applications.

For a user, applications are provided via internal Mjolnir web site or third-party applications, which are connecting to the Proxy interface.

Typical Mjolnir installation consists of following components:
• Proxy provides access to the cloud system for the external clients and manages the communication between cloud application components;
• Containers are deployed on computing nodes and responsible for hosting of cloud application components and message transmission;
• Components are custom applications, developed to run in Mjolnir cloud environment using Mjolnir API;
• Clients (web site or 3rd party software) are applications, that render components interfaces. They should use encrypted channel and client certificates to communicate with the proxy.

Mjolnir features
• Reduction of the enterprise information system cost
• New resources integration ease
• Containers can be run both on server nodes and on end-user PCs

3. Implementation
Mjolnir platform is implemented on Java to provide cross-platform set of tools.
Mjolnir Containers subscribe to Message Channels that operate as a broadcast delivery – any message sent to the Message Channel will be transmitted to the subscribers of this channel.

Any Mjolnir-based application consists of independent components, which use a Mjolnir messaging API. Components are represented as a package that contains the following information:
• component interface description – exported class name, component global name and list of method to expose (annotated class);
• executables to handle incoming requests (for Java – compiled classes);
• static files, used in pages rendering (images, page layout descriptions and scripts) for UI provisioning;
• permissions list (network usage, disk usage etc).

4. Evaluation

Word frequency counter. Execution time (left) and acceleration (right).

Mjolnir platform was evaluated in big text processing experiment. 1 gigabyte of text data was divided on 100 parts and sent to all available worker components for processing. Each worker divided text on words and counted frequency for each unique word. Pieces of work were distributed automatically – each worker polled Message Bus to receive new task.

Experiments have shown that the platform is stable. Average execution time on 10 containers was 219 seconds. Thus, acceleration of parallel word frequency counter task was 5.3.

5. Conclusions
As a development of this project, we are planning to provide:
• Messaging system evaluation;
• Application-level migration support to provide system stability;
• Resource monitoring for flexible load balancing;
• Component store to reduce the number of the duplicate applications;
• Better component isolation to provide system security.

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In this study, we described the design and implementation of a private cloud platform called Mjolnir, which allows development of distributed cloud applications on private computing resources. Main features of the described platform are advanced messaging system and distributed computing support.