



**BRNO UNIVERSITY OF TECHNOLOGY**

VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ

**FACULTY OF INFORMATION TECHNOLOGY**

FAKULTA INFORMAČNÍCH TECHNOLOGIÍ

**DEPARTMENT OF INFORMATION SYSTEMS**

ÚSTAV INFORMAČNÍCH SYSTÉMŮ

## **MONITORING THE OPENSTACK SWIFT OBJECT STORE USING BEANSTALK EVENTS**

SLEDOVÁNÍ OBJEKTOVÉHO ÚLOŽIŠTĚ OPENSTACK SWIFT POMOCÍ BEANSTALK UDÁLOSTÍ

**MASTER'S THESIS**

DIPLOMOVÁ PRÁCE

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**BRNO 2021**

## Master's Thesis Specification



Student: **Vasiljević Nemanja, Bc.**

Programme: Information Technology

Field of study: Information Systems and Databases

study:

Title: **Monitoring the OpenStack Swift Object Store Using Beanstalk Events**

Category: Databases

Assignment:

1. Explore OpenStack Swift object storage, especially its architecture and activities. Study also MinIO object storage. Learn about the object storage OpenIO Software Defined Storage and in which way it uses Beanstalk to monitor and distribute events over the storage.
2. Design a service that will monitor activities in OpenStack Swift and, following the pattern of OpenIO, publish Swift events using the Beanstalk protocol. Consider also the ability to monitor and publish events from MinIO.
3. After consulting with the supervisor, implement the proposed service over OpenStack Swift/MinIO so that compatibility with OpenIO is guaranteed. For verification, also implement a sample client that will be able to subscribe to events using Beanstalk from both OpenIO and OpenStack Swift/MinIO.
4. Test the solution, evaluate and discuss the results. Publish the resulting software as open-source.

Recommended literature:

- Raúl GRACIA-TINEDO, Josep SAMPÉ, Gerard PARÍS, Marc SÁNCHEZ-ARTIGAS, Pedro GARCÍA-LÓPEZ and Yosef MOATTI: Software-defined object storage in multi-tenant environments. *Future Generation Computer Systems*. 99, 54-72, 2019. ISSN 0167-739X. Available at [<https://doi.org/10.1016/j.future.2019.03.020>]
- OpenStack Docs: Object Storage monitoring. The OpenStack project [online]. 2021 [seen 2021-09-29]. Available at [<https://docs.openstack.org/swift/ussuri/admin/objectstorage-monitoring.html>]
- Send notifications on PUT/POST/DELETE requests - swift-specs 0.0.1.dev82 documentation. OpenStack Foundation [online]. 2016 [seen 2021-09-29]. Available at [[https://specs.openstack.org/openstack/swift-specs/specs/in\\_progress/notifications.html](https://specs.openstack.org/openstack/swift-specs/specs/in_progress/notifications.html)]

Requirements for the semestral defence:

- Items 1 and 2 finished and item 3 in progress.

Detailed formal requirements can be found at <https://www.fit.vut.cz/study/theses/>

Supervisor: **Rychlý Marek, RNDr., Ph.D.**

Head of Department: Kolář Dušan, doc. Dr. Ing.

Beginning of work: November 1, 2021

Submission deadline: May 18, 2022

Approval date: October 21, 2021

## Abstract

The goal of this thesis is to create software that is able to monitor and publish event notification from Openstack Swift as well as from OpenIO Software Defined Storage (SDS) to Beanstalk queue. This thesis also proposes solution for publishing event notifications from MinIO to Beanstalk queue.

To accomplish this goal, new middleware is proposed that can be run inside pipeline of Proxy Server in OpenStack Swift and as (filter) part of asynchronous service Event-Agent inside OpenIO SDS.

Proposed middleware allows users to specify if they are interested in publishing event notifications for specific objects/containers using metadata. User can specify set of rules involving object properties, such as name (prefix, suffix, substring) and size, and only events satisfying those rules will be published.

The contribution of this thesis is unique software capable of event monitoring from both OpenIO SDS and Openstack Swift.

## Abstrakt

Cílem této práce je vytvořit software, který je schopen monitorovat a publikovat notifikace o události z Openstack Swift i z OpenIO Software Defined Storage (SDS) do fronty Beanstalk. Tato práce také navrhuje řešení pro publikování notifikací o událostech z MinIO do fronty Beanstalk.

K dosažení tohoto cíle je navržen nový middleware, který lze spouštět uvnitř pipeline proxy serveru v OpenStack Swift a jako (filtr) součást asynchronní služby Event-Agent uvnitř OpenIO SDS.

Navržený middleware umožňuje uživatelům určit, zda mají zájem o publikování notifikací o události pro konkrétní objekty/kontejnery pomocí metadat. Uživatel může specifikovat sadu pravidel zahrnující vlastnosti objektu, jako je název (prefix, přípona, podřetězec) a velikost, a budou publikovány pouze události splňující tato pravidla.

Přínosem této práce je unikátní software schopný monitorování událostí z OpenIO SDS i Openstack Swift.

## Keywords

OpenIO Software Defined Storage, Openstack Swift, MinIO, Beanstalk queue, Event monitoring, Event notification, Amazon S3 event notification, Object storage

## Klíčová slova

OpenIO Softwarově definované úložiště, Openstack Swift, MinIO, Beanstalk fronta, Monitorování událostí, Oznámení o událostech, Amazon S3 oznámení o události, Objektové úložiště

## Reference

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# Monitoring the OpenStack Swift Object Store Using Beanstalk Events

## Declaration

Prohlašuji, že jsem tuto bakalářskou práci vypracoval samostatně pod vedením pana X... Další informace mi poskytli... Uvedl jsem všechny literární prameny, publikace a další zdroje, ze kterých jsem čerpal.

.....  
Nemanja Vasiljević  
December 27, 2021

## Acknowledgements

V této sekci je možno uvést poděkování vedoucímu práce a těm, kteří poskytli odbornou pomoc (externí zadavatel, konzultant apod.).

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# Chapter 1

## Introduction

In the current world, cloud computing became the most popular way of delivering different types of services through Internet. One of the most popular cloud service is cloud storage, which allows users to store data in remote locations maintained by third party. Based on how cloud storage manages data, cloud storage can be divided into 3 types: Block storage, File storage and Object storage. Object storage manages data as objects, each object typically includes data itself and some additional informations stored in objects metadata. Since data are stored in remote locations, to which users don't have direct and complete access, some users or external services might want to receive informations about certain events (for example change of content) in storages where their data are located.

Importance of this thesis is to provide event informations to users in OpenIO SDS and OpenStack Swift, which will allow user to react on those events and possibly prevent/detect unwanted actions. Providing event notifications will allow users to have better picture on what is going on in their storage and improve monitoring in these object storages.

There was two attempts[1][2] to solve this issue within OpenStack Swift which were not officially accepted and their solution is outdated. Currently there is no official solution for publishing event notification in OpenStack Swift nor OpenIO Software-Defined Storage (hereinafter SDS).

My interest in this topic stems from its possible impact to extensive amount of users that OpenStack Swift and OpenIO have. Contributing to open source projects is something that I always wanted to be part of. Possibility to improve user experience in OpenStack Swift and OpenIO SDS and allow those storages to be even more competitive against commercial storages (Amazon, Google, ...) is another reason why I choose this topic.

The goal of this thesis is to create program/middleware which will publish event notification to user specified destination. One of supported destination will be Beanstalk queue, but program will allow to easily add other types of destinations (for example Kafka) using predefined interface. Proposed program will allow user to specify, using objects metadata (such as name prefix/suffix and object size) and type of event, which event notification should be published. Program will be able to run within OpenStack Swift as well as OpenIO SDS. This thesis will strive to find such solution that could be officially accepted as part of OpenStack Swift and OpenIO SDS.

Structure of thesis - TODO - there will be probably change in chapters structure

## Chapter 2

# Background

### 2.1 Object storage

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Figure 2.1: TODO figure

## 2.2 Software-defined storage

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Figure 2.2: TODO figure

## 2.3 Event notifications

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### **2.3.1 Amazon S3 event notifications**

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Figure 2.3: TODO figure

### 2.3.2 Oracle event notifications

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Figure 2.4: TODO figure

## Chapter 3

# Object Storages

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### 3.1 OpenIO SDS

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Figure 3.1: TODO figure

## 3.2 OpenStack Swift

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Figure 3.2: TODO figure

### 3.3 MinIO

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Figure 3.3: TODO figure

## Chapter 4

# Solution draft

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## 4.1 Current state

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## 4.2 Middleware for OpenStack Swift and OpenIO SDS

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Figure 4.1: TODO figure

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### 4.3 Adapter for MinIO

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Figure 4.3: TODO figure

## Chapter 5

# Implementation, experiments and assessment



## Chapter 6

## Conclusion

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