

Binary Repository Manager

White Paper

January 17, 2020

Abstract

A software project of almost any size needs to keep its binary artifacts in a repository, to enable access to them by programmers, tools, and other teams. The quality of the software that manages the repository matters. There are a few categories of such a software, which have their pros and cons, currently on the market. However, none of them fully satisfy the requirements of a large group of software companies. That's why a new product is being created.

1 Introduction

Binary Repository Manager (BRM), according to Wikipedia, is “a software tool designed to optimize the download and storage of binary files used and produced in software development,” for example `.jar` or `.zip` archives. BRM is a critical component of most DevOps toolchains (Erich 2018), residing right after the build pipeline, which is why it is sometimes called “build repository”, “artifact repository”, or “pipeline state repository” (Bass et al. 2015).

A traditional DevOps pipeline, as explained by Humble et al. (2010), expects the source code to be validated, tested, packaged and versioned automatically into an *artifact* (a binary file). Then, the artifact must be stored outside of the source code repository and become available for later stages of the continuous delivery pipeline. The BRM is supposed to host these artifacts,

being “a central point for management of binaries and dependencies, and an integrated depot for build promotions of internally developed software,” as noted by Davis et al. (2016).

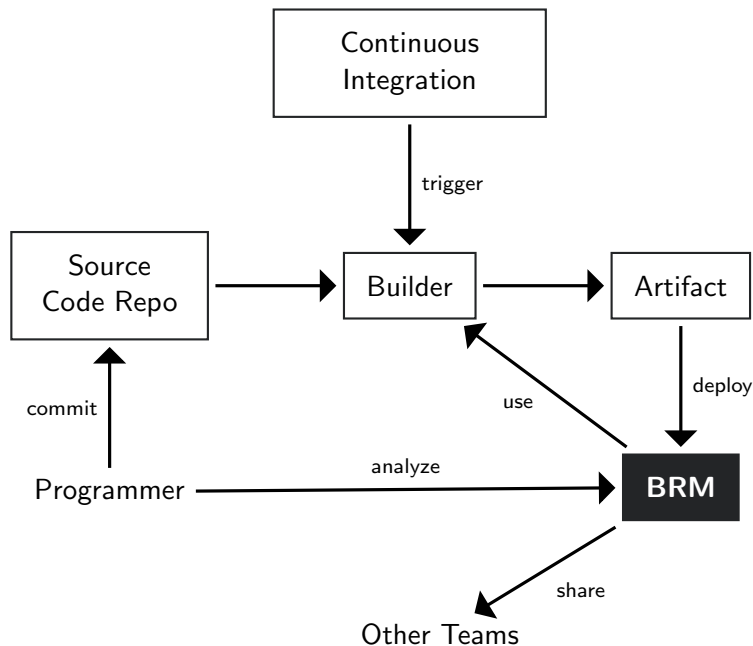


Figure 1: The flow of data in an average software development team.

The Section 2 lists a few categories of existing BRM solutions, analyses requirements their customers may have, and emphasize the most important functional features and non-functional requirements.

2 Requirements

All existing BRM solutions can be categorized as public, commercial, hosted, open source, or surrogate. Even though each of them partially satisfy the needs of a professional software team, neither one is perfect.

Public There are a few hosted BRMs for different programming languages, like [Maven Central](#) for Java or [Rubygems](#) for Ruby, which are free to use,

but do not allow private accounts. This means that all artifacts deployed by some user become available for all other users. This business model is acceptable for open source projects, but is not suitable for software teams that develop proprietary software products.

Commercial There are a few BRMs, like [Artifactory/Bintray](#) of [JFrog](#) and [Nexus](#) of [Sonatype](#), which provide most of the features required by software teams, including fine-grained access control, versioning, seamless integration with build automation software, and many more. However, these tools are pretty expensive¹ and require certain skills to install and manage them. Moreover, their authors (including JFrog and Sonatype) are US-based companies, who may be restricted to sell their products to software teams from certain “sanctioned” countries².

Hosted There are a few BRMs, which maintain artifacts on their servers, like [CloudRepo](#) for Java or [PyDist](#) for Python. Some BRM creators, like JFrog, provide their products in hosted versions too. However, some software teams may not find this option acceptable due to security reasons—eventually the data may be lost, if the company gets out of the market³ or due to sanctions.

Open source There are also a few entirely free and open source products, like [Archiva](#), which software teams must install, configure and use on their own risk. Even though this may sound like a good solution for a small team, it may not be acceptable for a larger group of software developers, who expect their artifact repository to be reliable and available.

Surrogate It is possible to organize a BRM without any software, for example, on top of [Amazon S3](#) or a simple FTP server. With the right plugin Maven can deploy to Amazon S3 and then fetch artifacts from there via their built-in HTTP interface. However, such a solution gives

¹The annual cost of a license for a mid-size team of 50-100 developers is: around \$30,000 for Artifactory and around \$50,000 for Nexus. There are less expensive products too: [ProGet](#) for \$10,000,

²[29th of July, 2019](#): GitHub, the world’s largest host of source code, is preventing users in Iran, Syria, Crimea. [22nd of December, 2018](#): Slack confirms it will now block all activity in Iran and other sanctioned countries.

³[13th of March, 2015](#): Google Code, one of the largest source code repository managers, closed its doors.

very little or no control for a DevOps person and may only work for rather small software teams.

2.1 Features

There are many important qualities and features software developers and DevOps engineers expect a BRM to have, in order to be useful in a continuous delivery pipeline. The most critical [non-functional requirements](#) are:

Integrability There are plenty of build automation tools for each programming language, like [Maven](#) for Java, [Npm](#) for JavaScript, or [Rake](#) for Ruby. There are also many continuous integration tools, like [Jenkins](#) or [Travis](#). Since automation is the most important aspect of DevOps, as noted by Kerzazi et al. (2016), it is expected to have plugins for each or most of them, to enable seamless integration with the BRM.

Availability Artifacts are important components of a software development process and they must be available right when they are needed by a programmer or a build tool, without even small delays and delivered at the highest possible speed.

Scalability Most build artifacts are large binary files. Some of them may even be larger than 1Gb, for example [Docker](#) images or `.war` production-ready Java archives. The BRM must be able to maintain large data sets, up to almost no limits.

Extensibility It is highly desirable to have full access to the source code of the BRM and to have an ability to extend it with new plugins and modules. Moreover, vendor independence is important.

Reliability An ability to corrupt the data due to software or hardware failures must be eliminated, as much as it is possible.

2.2 Non-functional Requirements

The most important [functional requirements](#) are:

Versions and Tags New artifacts must not replace previously deployed ones. Instead, older versions must always be accessible. However, it is not expected that the BRM would assign version tags automatically, this is done at the pipeline’s side.

Access Control Larger teams may need to control who is allowed to use certain artifacts. Moreover, such teams may need to require the integration of authentication mechanisms of the BRM with the existing enterprise access-control system, via [LDAP](#), for example. On top of regular access control, encryption mechanisms must be in place in order to prevent data leakage in case of software/hardware failures or human mistakes, as noted by Paule (2018).

Analytics Traceability between software artifacts is considered a very important factor in today development process, as noted by Palihawadana et al. (2017). BRM must make it possible to visualize dependencies between artifacts and operate on them.

There are many other essential features required, including authentication and authorization, deployment, publishing, download, removal, usage tracking, email notifications, mirroring, and so on.

2.3 Expected Metrics

In a large enterprise it is expected to have the following numbers, in terms of load, size, and speed:

Users, total	80K
Artifacts hosted	100M
New artifacts uploaded, daily	10K
Data hosted	100Tb
Data uploaded, daily	10Gb
Concurrent connections, peek	10
Upload bandwidth, peek	10M/s
Download bandwidth, peek	100M/s

Smaller companies may have lower expectations.

3 Architecture

4 Conclusion

To be written...

4.1 Acknowledgements

The document was originally created by Yegor Bugayenko (y00538675).

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