



IBM Worklight

IBM Worklight and Mobile Platform V6.1.0

Scalability and Hardware Sizing

17 February 2015

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Contents

1	Architecture.....	1
2	Scalability Tests.....	3
2.1	Tests.....	3
2.2	Test Flow.....	3
2.3	Hardware.....	4
2.4	Results.....	4
3	Using the hardware sizing calculator.....	5
3.1	About sizing.....	5
3.2	Sizing parameters.....	5
4	Push Notification.....	9
4.1	What is a push notification?.....	9
4.2	Possible architectures for push notifications.....	9
4.3	Testing assumptions.....	9
4.4	Test results.....	10
4.5	Version notes.....	10
5	Reporting.....	11
5.1	Database-based reports.....	11
5.2	IBM SmartCloud Analytics Embedded.....	11
6	Direct Update.....	12
6.1	What is Direct Update?.....	12
6.2	Direct Update results.....	12
6.3	Direct Update scalable solutions.....	12
7	Geolocation.....	13
7.1	What is geolocation?.....	13
7.2	How geolocation affects the server performance.....	14
8	Database usage and size.....	15
8.1	IBM Worklight database usage profile.....	15
8.2	Database size.....	15
9	Application Center.....	16
	Appendix A - Notices.....	17
	Appendix B - Support and comments.....	19

Figures and Tables

Figure 1-1: Typical IBM Worklight topology	1
Figure 7-1: Location services architecture	13
Table 2-1: Scalability tests performed	3
Table 3-1: Hardware sizing calculator parameters	7

About this document

This document contains information about scalability-related parameters of the IBM® Worklight® Mobile Platform, and the scalability tests performed. It serves as a guide to the included hardware sizing calculator that is used to determine the required hardware for an IBM Worklight deployment.

This document is not a replacement for the IBM Worklight Information Center, which describes an IBM Worklight Server architecture, server setup, and daily maintenance requirements.

1 Architecture

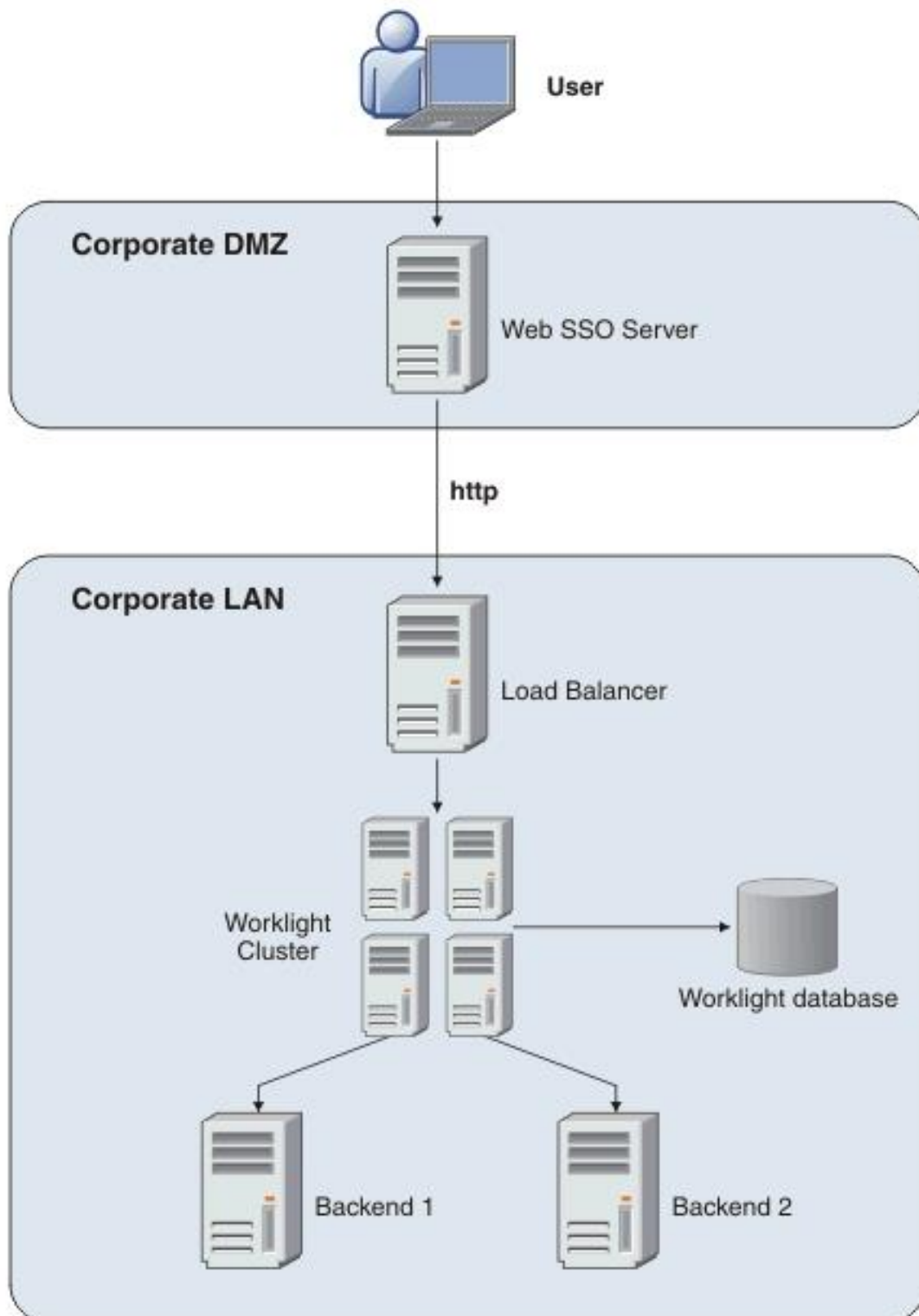


Figure 1-1: Typical IBM Worklight topology

The IBM Worklight topology is based on the following principles:

- Worklight Server is installed in the organization LAN, connecting to various enterprise back-end systems.
- Worklight Server can be clustered for high availability and scalability.
- Worklight Server uses a database. The database is used for storing push notification information, and statistics for reporting and analytics. The database is also used to store metadata required by the server at run time. A single instance of the database is shared by all IBM Worklight servers. It is possible to cluster the database by using the tools and methods that are provided by the database vendor.
- Worklight Server is installed behind a web authentication infrastructure (Web SSO) acting as a reverse proxy, and providing SSL.

There can be different topologies, depending on the corporate network architecture, disaster recovery, different back-end systems, and so on.

2 Scalability Tests

IBM conducted a series of scalability tests before releasing IBM Worklight. The following table contains a short summary of the tests performed.

2.1 Tests

#	Test	Goal
1	Single user performance test	This test creates a performance baseline for future tests by using a typical user scenario.
2	Basic stability	This test checks the basic stability and endurance of the server under some load. No crashes, memory leaks, or errors for 12 hours.
3	Regression from former version	This test verifies that the system performs at least as well as the former version.
4	Multiple user performance test	This test checks the performance of a typical user scenario under typical load.
5	Scalability tests	This test proves that IBM Worklight can linearly scale to multiple servers under a single database.
6	Endurance testing	This test proves that the server can stay up without memory leaks for a duration of 72 hours under a typical load scenario.
7	Stress testing	This test increases the load until the server reaches 100% CPU and starts failing. Reduce the load and see that the server is recovering.
8	Recoverability	This test stops various components of the IBM Worklight solution (internet, database, and back end). It starts components again and ensures that the server recovered.

Table 2-1: Scalability tests performed

2.2 Test Flow

The test, which is run repeatedly, involves the following actions:

1. A typical banking application is simulated. It logs in, makes multiple calls for account list and transaction lists, and then logs out.
2. The IBM Worklight application server uses an HTTP adapter to call a simulated back end. On average, a client-IBM Worklight server call generates 1.1 requests that are sent to the back end.
3. The back end is called via HTTP and returns with a predefined response.

2.3 Hardware

The following hardware was used for IBM Worklight Application Server:

- 2 x Intel (R) Xeon E5540 2.53 GHz (4C, Hyper-Threading)

Note: With the specified number of cores, IBM Worklight performs thousands of transactions per second. If your throughput is low, you can use fewer cores than the specified number.

- 18 GB 1066 DDR3 ECC RAM

Note: Not all RAM was used. Use the accompanying calculator to compute required RAM.

- NetExtreme II BCM5790 Gigabit Ethernet
- 500 GB SAS HDD 6 GB/s

The following hardware was used during testing for the IBM Worklight database:

- 2 Intel Xeon 8C 2.3 GHz/20 MB
- 20 GB DDR3 RAM
- 6-7 500 GB 7.2 Krpm SATA disks
- 1 RAID 5 controller

IBM Worklight Client:

- Simulated by twenty virtual machines that run multiple client threads. Running Ubuntu 10.04 64-Bit 4 GB RAM.
- The client load is achieved with Apache jMeter, an open source server performance testing tool by Apache.

2.4 Results

Tests were successful in achieving the goals that are defined in Table 2.1. Specifically, the final test on a single IBM Worklight server ran for three days, without memory loss or performance loss. Throughput was measured at **2,000** requests per second per server with an average CPU usage of 50%.

3 Using the hardware sizing calculator

3.1 About sizing

The hardware sizing calculator is based on a scenario that was tested in IBM Labs. This scenario is based on a real customer scenario.

However, Worklight Server is a platform that is augmented with server-side developer code. Therefore, the sizing is largely influenced not only by client calls, but also by the efficiency of the server-side code. Hence, you must consider the calculator as a baseline from which you can proceed to customer-specific scalability tests.

3.2 Sizing parameters

This document is accompanied by a [Microsoft Office Excel spreadsheet](#). The purpose of this spreadsheet is to help organizations calculate the required hardware for an IBM Worklight deployment.

The following table lists the main parameters that are required by the hardware sizing calculator:

Category	Parameter	Description	Effect
Application Server	Application Server	Name of the server that is used: <ul style="list-style-type: none"> • “Tomcat” for Apache Tomcat • “WebSphere Application Server” for WebSphere® Application Server Full Profile • “Liberty” for WebSphere Application Server Liberty Profile 	Server memory footprint for Tomcat is smaller.
	Peak Throughput	Peak transactions/sec rate that is required by the customer.	Affects both CPU consumption and server memory.
	Complexity	Worklight Server runs code that is written by the customer by using Worklight Studio. An estimate is required regarding the complexity of the server-side code that is written for the customer, when compared to a baseline.	CPU consumption

Category	Parameter	Description	Effect
Memory	Peak number of active user sessions	<p>A session is an object that is stored in the server memory for each connecting device. Among other things, it stores authentication information. Active sessions are determined by the number of sessions that are opened versus the number of sessions that time out because of a lack of activity. The default session timeout is 10 minutes, and must be configured. Customers typically set this session timeout to anywhere from 5 to 10 minutes.</p> <p>The mobile client has a "heartbeat" property. By using this property, the mobile client can ping the server while the app is in the foreground so that the session does not time out.</p> <p>When a mobile app moves into the background, it no longer interacts with the server or sends a "heartbeat", leading to the server session dropping after the specified server session timeout.</p> <p>Example: If 1,000 users start a session against the server every minute, even if they exit the application after 3 minutes their session remains active on the server for 10 minutes, resulting in $10 \times 1,000 = 10,000$ sessions.</p>	Server memory footprint
	Per-session data added to the server by the developer	Worklight Server runs code that is written by the customer by using Worklight Studio. The server-side code can store per-session data.	Server memory footprint
Server response time	Back-end delay (milliseconds)	Average roundtrip time for a call to the back end of the organization.	Worklight Server latency

Category	Parameter	Description	Effect
Database	Reporting mechanism used	There are two reporting mechanisms in IBM Worklight: 1. The classic reporting mechanism, which is database-based. 2. IBM SmartCloud Analytics Embedded. This reporting mechanism is based on file storage rather than database storage. Only the first mechanism affects the database size.	Database size (reports)
	Reporting history required before purge (days)	IBM Worklight creates significant amounts of raw reporting data that must be purged after aggregation. Otherwise, the system might slow down and disk space consumption might increase dramatically. Typically, the amount of time between purges is 1 - 3 days.	Database size (reports)
	Average Throughput as % of peak	The average throughput as compared to the peak throughput defined earlier. This throughput reflects on the raw reporting data size.	Database size (reports)
	Active hours/day	The number of active hours per day, used to compute the number of transactions per day, and hence the reporting data size.	Database size (reports)
	Number of users that subscribe to push notifications	The number of users that are expected to require push notifications to their device.	Database size (push)
	Average of number of apps per user	On average, the number of apps that the user is allowed to use.	Database size (device licensing)
	The number of users that are using any apps in project (if any)	The device table has an entry per user and per device.	Database size (device licensing)

Table 3-1: Hardware sizing calculator parameters

The calculator computes:

- The number of required servers. The server hardware baseline spec is defined in the preceding test.
- The amount of RAM required for each server.

- The Worklight Server average request latency.
- The required database size.
- The push notification throughput.

4 Push Notification

4.1 What is a push notification?

A push notification is an alert that indicates a change or an update that the Worklight Server sends to users' mobile devices. Push notifications are popular with all mobile operating systems. IBM Worklight has APIs that maintain the lists of users and mobile devices, and send push notifications. IBM Worklight supports push notifications for the following vendors:

- Android – [GCM](#)
- Apple – [APNS](#)
- Microsoft, Windows Phone – [MPNS](#)

IBM Worklight does not currently support push notification API for BlackBerry or Windows 8.

4.2 Possible architectures for push notifications

Two architectures are possible for push notifications, which differ by the method that the enterprise backend uses to provide push notification data to the Worklight Server:

- The Worklight Server pulls data by using a Worklight JMS adapter. The enterprise backend puts the push notifications in the JMS queue.
- Push notifications are sent to the Worklight Server by invoking an IBM Worklight procedure.

For more information about these alternate architectures, see [the IBM Worklight blog](#).

The primary difference between the two methods is that the first method is limited to a single server, which is pulling data from the JMS queue. With the second method, invoking procedures in the Worklight Server is done through a load balancer. Therefore, the architecture can scale to more than one server.

4.3 Testing assumptions

- Push providers were simulated with a delay that is typical to these services:
 - APNS: 1-2 milliseconds
 - GCM: 20-25 milliseconds
 - MPNS: 20-25 milliseconds
- IBM Worklight can associate multiple devices per user. On average, each user is assumed to have 1.1 devices.

4.4 Test results

A server can push 350 notifications per second when it is under load. The load includes 2,400 regular transactions per second, as well as proportional device calls for subscribing and unsubscribing from the push service.

The CPU and the memory are mostly unaffected. The database is also unaffected, except for the storage of users and devices, as mentioned in section 6. *Database usage and size*.

4.5 Version notes

The testing data that is provided in this document relates to IBM Worklight V6.0.0 and onwards. Customers who use earlier versions of IBM Worklight must be aware of a number of known scalability issues. Some of these issues have workarounds. Therefore, if you intend to use push notifications with earlier versions of IBM Worklight, contact IBM customer support or see the technote about improving performance of IBM Worklight push notifications at <http://www-01.ibm.com/support/docview.wss?uid=swg21644161>.

5 Reporting

IBM Worklight contains the following reporting mechanisms:

- Database-based reporting.
- Reports that are based on IBM SmartCloud Analytics Embedded.

You can find a comparison between the two options in section [Comparison of operational analytics and reports features](#) in the Information Center.

Note: These reports are not enabled by default. Customers must decide which of these mechanisms they want to use.

5.1 Database-based reports

Database-based reports are the older IBM Worklight reports. The database-based reports use a single table to store large quantities of raw data in the database. This table is then aggregated periodically to produce reports.

Sizing for these reports is provided in section 6, *Database usage and size*.

5.2 IBM SmartCloud Analytics Embedded

IBM SmartCloud Analytics Embedded is an IBM product that is bundled with the Worklight Server.

The IBM SmartCloud Analytics Embedded runs on a different server, and is based on file-system storage rather than database storage.

The section [Installing and configuring the IBM SmartCloud Analytics Embedded](#) in the IBM Worklight Information Center describes the system requirements of the IBM SmartCloud Analytics Embedded.

The basic production-ready architecture requires the following equipment:

- Two servers that run in “stand-alone” mode and that are load-balanced via an HTTP load balancer.

Note: the documentation in the IBM Worklight Information Center might propose more servers.

- Each node must use 4 CPU Cores. 2 CPU cores can be considered for smaller loads.
- At least 100 GB of disk space.

6 Direct Update

6.1 What is Direct Update?

When the administrator redeploys an app to the Worklight Server without changing its version, the Worklight Server updates the web resources folder. Then, when an app connects to the Worklight Server, the Worklight Server directly pushes the web resources (HTML, JavaScript™, and CSS) of the newly deployed app to the device. The push happens only when an app contains different web resources and the same native code.

6.2 Direct Update results

The Worklight Server can push 250MB/Sec. For example, if the application size is 5MB, the Worklight Server can serve 50 direct updates per second. This means that if the cluster contains 4 Worklight Server nodes, the cluster can serve 200 direct update per second.

Note: You must validate that the network bandwidth is not the bottleneck.

6.3 Direct Update scalable solutions

The best scalable solution for Direct Update is to use a content delivery network (CDN) in front of the Worklight Server. When caching the direct update URL, the request is served from the CDN, and does not get to the Worklight Server. The expiration policy must be specified in the CDN.

7 Geolocation

7.1 What is geolocation?

Location services in IBM Worklight provide you with the opportunity to create differentiated services that are based on a user location, by collecting data about geolocation and WiFi, and by feeding the location data and triggers to business processes, decision management systems, and analytics systems.

Application code on the mobile device controls the collection of data from device sensors. The collected data is referred to as the device context. When a change occurs in the device context, such as a change in the geolocation of the device, or the fact that it has just entered a WiFi zone, triggers can be activated. The triggers specify that an action should occur: either a call-back function is called, or an event is sent to the server, based on the device context.

Events are created by triggers and application code, and include a snapshot of the device context at the time of their creation. Events are buffered on the client, and are transmitted to the server periodically.

To handle the events, the server uses IBM Worklight adapter application code. This code sets up event handlers on the server, which filter event data and pass matching events to a call-back function. The code also accesses the client's device context (its location and WiFi network information) and sets an application context. Server activities and received events are logged, together with the device and application contexts, for future reporting and analytics.

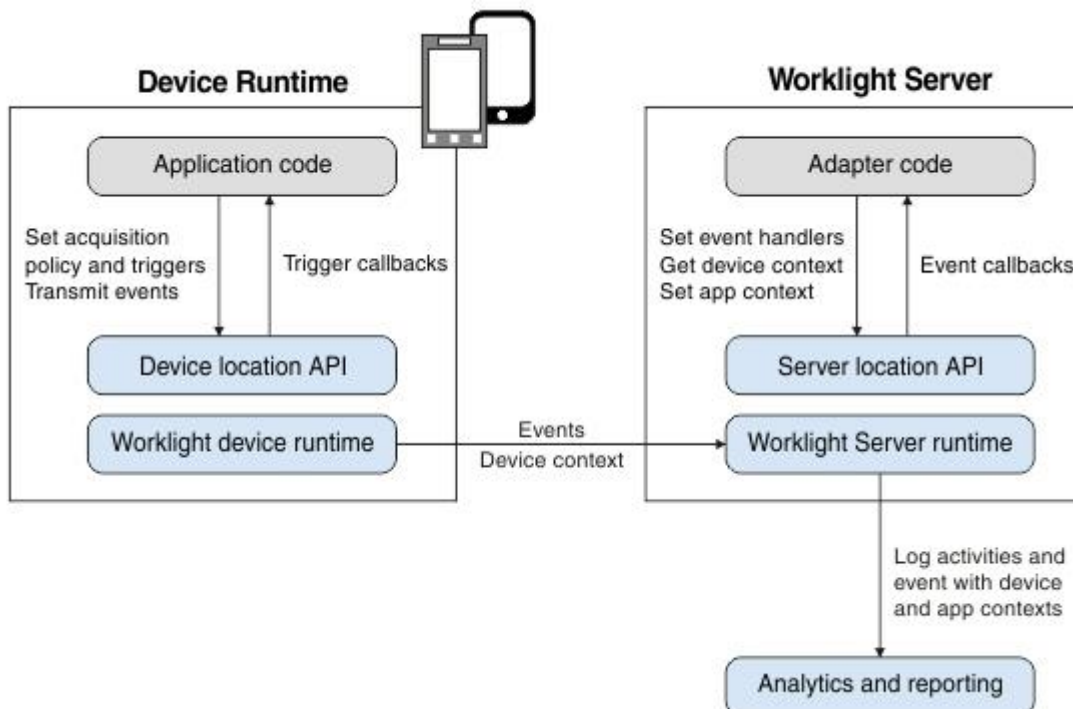


Figure 7-1: Location services architecture

7.2 How geolocation affects the server performance

7.2.1 Analytics and reports

Additional entries go to analytics and reports. There are additional entries each time an event handler is run.

7.2.2 Additional data passed when calling `invokeProcedure`

Additional data is passed when calling `invokeProcedure` from the device, to transfer the device context of the client to the server. The amount of data that is transferred is usually in the tens of bytes. This amount of data might be larger, depending on how the WiFi acquisition of the device is configured and what WiFi access points are visible to it. Events are also transmitted occasionally, according to the event transmission of the client.

7.2.3 Adapters implementing event handlers

One or more event handlers might be run each time a geolocation event is received.

8 Database usage and size

8.1 IBM Worklight database usage profile

An IBM Worklight project is a set of apps, adapters, and project-specific configuration. A project is associated with a WAR file.

IBM Worklight requires one database schema per project, which is called `WRKLGHT`, with optionally an additional database schema for database-based reports, which is called `WLREPORT`. The reports database is used only with the classic IBM Worklight reports. For more information, see section 5, *Reporting*.

In addition, when using the Application Center, there is an additional database schema, which is called `APPCNTR`. This database schema is global, which means that it is not project-dependent.

For Oracle and DB2, the default is to use three schemas instead of three actual database instances.

The IBM Worklight database contains mostly metadata and is rather small, with a number of exceptions:

- Push notification information: the list of users and devices who registered for push notification.
- SSO state information: SSO (Single Sign-On) is the ability for business customers to have multiple apps from the same organization. When they log in with one app, they automatically log in to the other device. Turning on the SSO feature puts a larger load on the database because SSO state information is read and updated to the database at the start of each client access to the server.
- The Reports database contains a single table that is called `APP_ACTIVITY_REPORT`, which is append-oriented. Each transaction that is called from a mobile device generates an `INSERT` statement into this single table. This data feed accumulates a large amount of data on what the user does. The data is aggregated at specific intervals (by default, the interval is 20 minutes).
- Device licensing is used to count licenses and control user access to applications. This feature is used with B2E customers (internal enterprise Apps) but is enabled by default for all customers and must be explicitly disabled for B2C. The feature uses a few more database queries and stores additional information in the database.

8.2 Database size

Database size is determined almost solely by the size of the data feed that is described earlier. The hardware sizing calculator attempts to help you determine the expected size of this feed, as well as push notifications and SSO.

Notes on the report tables:

- The application developer might also choose to add custom log messages, in which case the table size becomes bigger.
- The size of the aggregated tables is negligible when compared to the raw data.

Important note: It is the responsibility of the customer to purge reporting data regularly, typically every 1-2 days.

9 Application Center

The Application Center is the IBM Worklight application store. The concept of the Application Center is similar to the concept of the Apple public App Store or the Google Play Store, except that it targets only private usage within a company. By using the Application Center, users from the same company or organization download applications to mobile phones or tablets from a single place that serves as a repository of mobile applications.

The Application Center can be installed on a different system than the Worklight Server. This action ensures that the setup of the Application Center app store does not affect the performance of the IBM Worklight applications on the server, when installed on a different hardware.

The performance of the Application Center is mainly tied to the quality and bandwidth of the network, and the number of users. The distribution of large mobile applications must rather be done through 3/4G or WiFi networks. On low networks, the Application Center client tries to solve problems that are related to timeout. If the Application Center cannot reach the server, it tries again several times. The download of an application might also be interrupted when the network is lost. In such case, the download can restart from where it stopped (for Android, iOS).

The Application Center requires one database schema to store the application catalog and the user information. The size of the database depends mainly on the average size of the applications that are stored in the catalog and the number of users that are connected to the system. This is reflected in the Hardware Calculator document.

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