Ahsay Online Backup Manager v8

MySQL Database Backup & Restore for Linux (CLI)

Ahsay Systems Corporation Limited

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Revision History

Date	Descriptions	Type of modification
3 January 2020	Modified the diagram for the Overview on the Backup Process and added a diagram for the Detailed Process of Periodic Data Integrity Check in Ch. 5	New / Modification
30 July 2020	Updated PDIC diagram in Ch. 5; Updated the XML templates in the Appendix	Modification
23 September 2020	Updated Overview Backup Process and PDIC in Ch. 6;	Modifications
25 January 2021	Updated PDIC diagram in Ch. 5; Added Appendix E	New / Modification
7 April 2021	Updated Ch. 5; Added sub-chapters for the detailed process diagrams in Ch. 5.1, 5.2, 5.2.1, 5.2.2 and 5.3	New / Modifications

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1 Overview

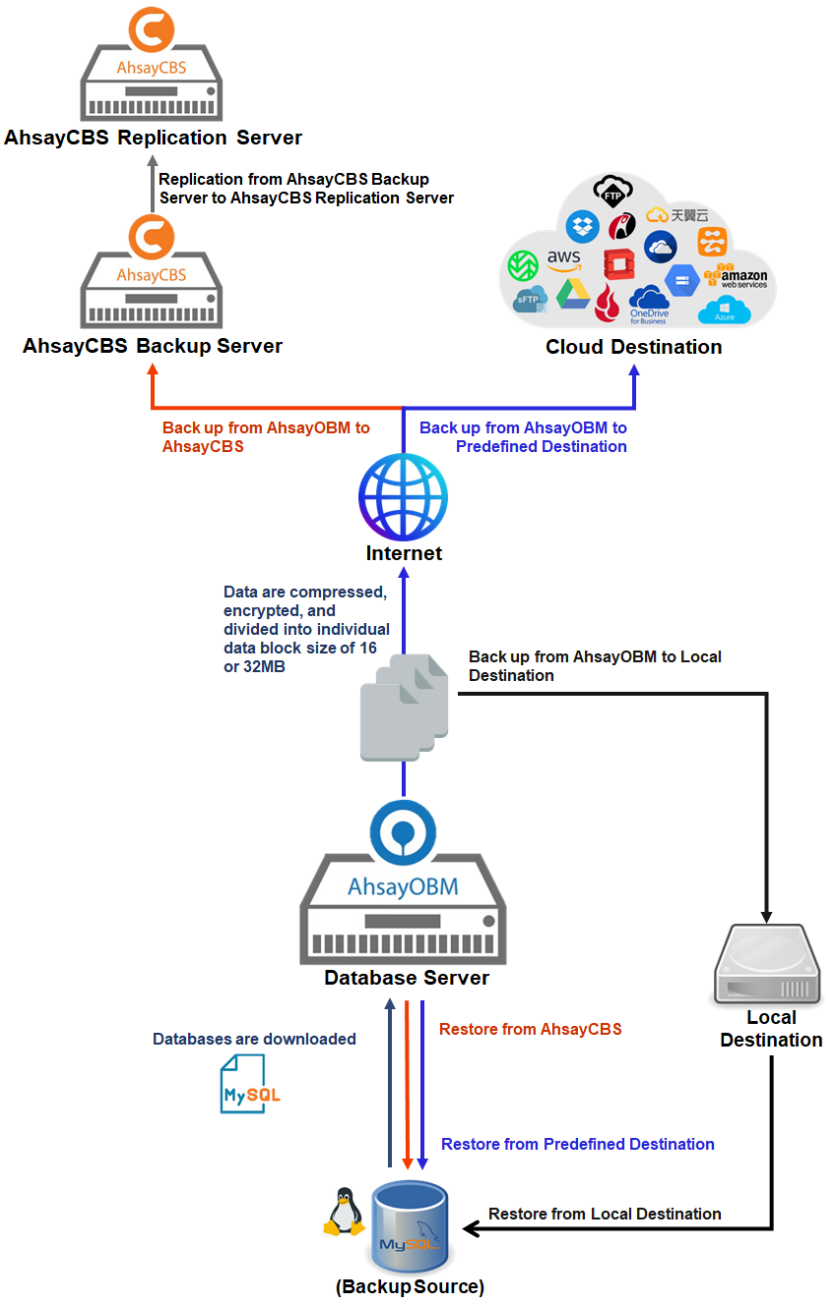
1.1 What is this software?

Ahsay brings you specialized client backup software, namely AhsayOBM, to provide a set of tools to protect your MySQL Database Server.

1.2 System Architecture

Below is the system architecture diagram illustrating the major elements involved in the backup and restore process between MySQL Database Server, AhsayOBM and AhsayCBS.

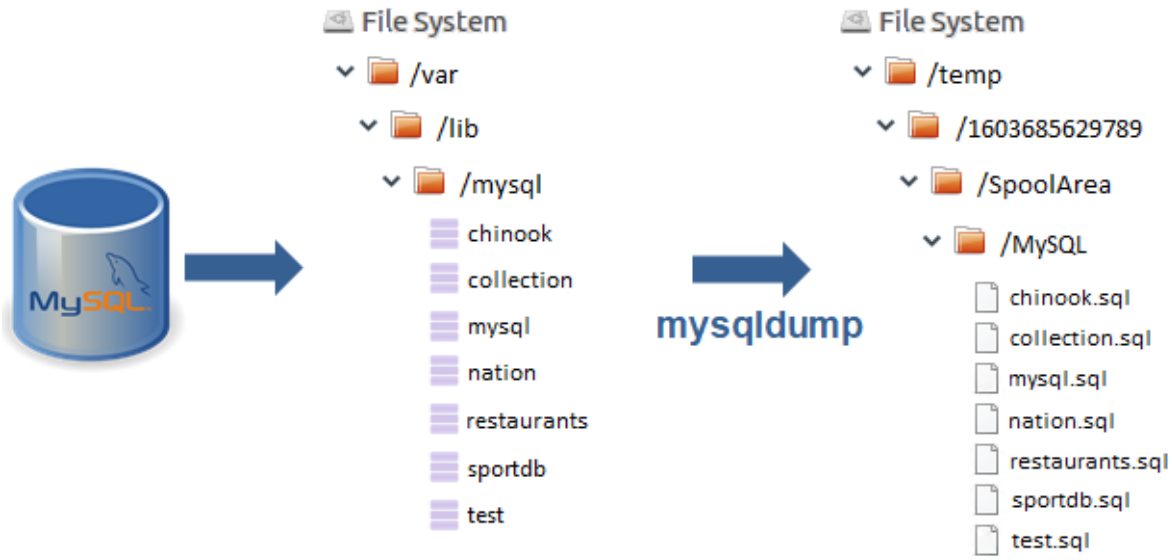
In this user guide, we will focus on the end to end backup and restore process using AhsayOBM as a client backup software.



1.3 MySQL Database Backup Method

AhsayOBM MySQL Database backup uses a spooling method to make a consistent snapshot of the database(s) for backup.

For each database backup job AhsayOBM will trigger MySQL to spool or make a copy of the database (.sql) file to the temporary folder using the mysqldump utility.



1.4 Mysqldump Parameters

Here is the mysqldump parameter list used for generating the spooled dump file:

- --databases
- --password
- --result-file
- --port
- --user
- --host
- --opt
- --quote-names
- --allow-keywords
- --triggers

Example:

For spooling of the “collection” database to /temp folder, the following parameters will be used:
Mysqldump --databases collection --user=user1 --password=qwerty --host=localhost --port=3306 --opt --quote-names --allow-keywords --triggers --result-file=/temp/collection.sql

For details on mysqldump parameters please refer to https://dev.mysql.com/doc/refman/8.0/en/mysqldump.html

2 Preparing for Backup and Restore

2.1 Hardware Requirement

To achieve the optimal performance when AhsayOBM is running on your machine, refer to the following article for the list of hardware requirements.

FAQ: Ahsay Hardware Requirement List (HRL) for version 8.1 or above

2.2 Software Requirement

Make sure the operating system where you have the MySQL Database Server installed is compatible with the AhsayOBM. Refer to the following article for the list of compatible operating systems and application versions.

FAQ: Ahsay Software Compatibility List (SCL) for version 8.1 or above

2.3 AhsayOBM Installation

Make sure that the latest version of AhsayOBM is installed directly on the machine where the MySQL database(s) are hosted.

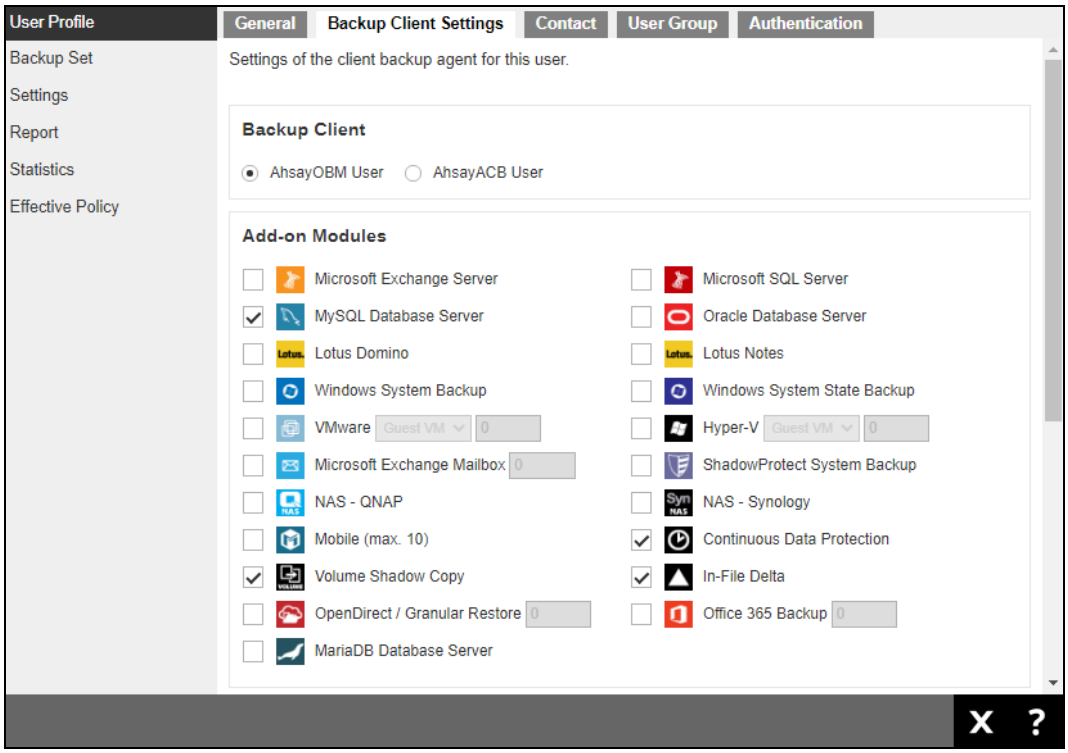
NOTE

Backup and restore of MySQL database(s) running on a remote machine is not supported.

2.4 Add-on Module Requirement

Make sure the MySQL Database Server feature has been enabled as an add-on module in your AhsayOBM user account.

Please contact your backup service provider for more details.



2.5 Backup Quota Requirement

Make sure that your AhsayOBM user account has sufficient quota assigned to accommodate the storage of MySQL Database Server backup set and retention policy.

Please contact your backup service provider for more details.

2.6 MySQL Database Server Requirements

Please ensure that the following requirements and conditions are met on the MySQL database server.

2.6.1 MySQL Version

AhsayOBM is installed on the MySQL version 5.7 or above database server using the root account.

2.6.2 MySQL Database Status

The MySQL database instance is online.

Example: MySQL5.7 on CentOS 7

```
# service mysqld status
Redirecting to /bin/systemctl status  mysqld.service
● mysqld.service - MySQL Server
   Loaded: loaded (/usr/lib/systemd/system/mysqld.service; enabled;
vendor preset disabled)
   Active: active (running) since Wed 2019-01-02 11:42:08 HKT; 2h 46min
ago
     Docs: man:mysqld(8)
           http://dev.mysql.com/doc/refman/en/using-systemd.html
 Main PID: 16952 (mysqld)
   CGroup: /system.slice/mysqld.service
           └─16952 /usr/sbin/mysqld --daemonize --pid-
file=/var/run/mysqld/my...

Jan 02 11:42:00 centos7 systemd[1]: Starting MySQL Server...
Jan 02 11:42:08 centos7 systemd[1]: Started MySQL Server.
```

2.6.3 TCP/IP Port

Check the listening port of the MySQL database instance (default is 3306).

```
# netstat -an|more
Active Internet connections (servers and established)
Proto Recv-Q Send-Q Local Address           Foreign Address         State
tcp        0      0 0.0.0.0:111             0.0.0.0:*               LISTEN
tcp        0      0 0.0.0.0:80              0.0.0.0:*               LISTEN
tcp        0      0 192.168.122.1:53        0.0.0.0:*               LISTEN
tcp        0      0 0.0.0.0:22              0.0.0.0:*               LISTEN
tcp        0      0 127.0.0.1:631           0.0.0.0:*               LISTEN
tcp        0      0 127.0.0.1:60024         0.0.0.0:*               LISTEN
tcp        0      0 127.0.0.1:25            0.0.0.0:*               LISTEN
tcp        0      0 0.0.0.0:443             0.0.0.0:*               LISTEN
tcp       86      0 10.16.30.2:37272        203.186.85.237:443      CLOSE_WAIT
tcp       86      0 10.16.30.2:49302        40.114.13.14:443        CLOSE_WAIT
tcp        0     64 10.16.30.2:22           192.168.12.1:55777      ESTABLISHED
tcp6       0      0 :::111                  :::*                    LISTEN
tcp6       0      0 :::22                   :::*                    LISTEN
tcp6       0      0 ::1:631                 :::*                    LISTEN
tcp6       0      0 ::1:25                  :::*                    LISTEN
```

```
tcp6       0      0 :::3306                 :::*                    LISTEN
tcp6       86     0 10.16.30.2:48396        10.16.30.21:443         CLOSE_WAIT
tcp6       86     0 10.16.30.2:48428        10.16.30.21:443         CLOSE_WAIT
```

2.6.4 Mysqldump Utility

The **mysqldump** utility is installed on the MySQL database server.
To locate the mysqldump utility use the **whereis** command:

```
# whereis mysqldump
mysqldump: /usr/bin/mysqldump /usr/share/man/man1/mysqldump.1.gz
```

2.6.5 Mysqldump Utility Version

The mysqldump utility is the same version as the MySQL database.

To check the mysqldump version use the **mysqldump –version** command

Example: MySQL 5.7 on CentOS 7.3

```
# mysqldump --version
mysqldump  Ver 10.13 Distrib 5.7.23, for Linux (x86_64)
```

To check the MySQL database version either:

i. From the Linux command line, use the **/usr/bin/mysql --version** command.

```
# /usr/bin/mysql –version
/usr/bin/mysql  Ver 14.14 Distrib 5.7.23, for Linux (x86_64) using
EditLine wrapper
```

ii. Log in to MySQL instance and use the **select version();** command

```
# mysql -u root -p
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 3
Server version: 5.7.23 MySQL Community Server (GPL)

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owners.

Type 'help;' or '\h' for help. Type '\c' to clear the current
input statement.

mysql> select version();
+-----------+
| version() |
+-----------+
| 5.7.23    |
+-----------+
1 row in set (0.00 sec)
```

Example: MySQL 8 on CentOS 7.4

To check the mysqldump version use the **mysqldump –version** command

```
# mysqldump --version
mysqldump  Ver 8.0.11 for Linux on x86_64 (MySQL Community Server - GPL)
```

To check the MySQL database version either:

i. From the Linux command line use the **/usr/bin/mysql --version** command.

```
# /usr/bin/mysql –version
/usr/bin/mysql  Ver 8.0.11 for Linux on x86_64 (MySQL Community Server - GPL)
```

ii. Log in to MySQL instance and use the **select version();** command

```
# mysql -u root -p
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 9
Server version: 8.0.11 MySQL Community Server - GPL

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Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql> select version();
+-----------+
| version() |
+-----------+
| 8.0.11    |
+-----------+
1 row in set (0.00 sec)
```

2.6.6 User Account Privileges

A MySQL database user account with the following privileges must be setup for the backup operation.

Example: MySQL 5.7

```
mysql> GRANT ALL PRIVILEGES ON *.* TO 'username'@'localhost' IDENTIFIED BY 'password';
Query OK, 0 rows affected, 1 warning (0.00 sec)

mysql> GRANT ALL PRIVILEGES ON *.* TO 'username'@'localhost.localdomain' IDENTIFIED BY 'password';
Query OK, 0 rows affected, 1 warning (0.00 sec)

mysql> FLUSH PRIVILEGES;
Query OK, 0 rows affected, 1 warning (0.00 sec)

mysql>
```

For MySQL 8 the use of GRANT to define account authentication characteristic is deprecated. For more information, please refer to the MySQL 8.0 Reference Manual. As an

alternative, you must first create the user and set the authentication characteristic by using CREATE USER before setting the privileges of the user using GRANT.

Example: MySQL 8

```
mysql> GRANT ALL PRIVILEGES ON *.* TO 'username'@'localhost';
Query OK, 0 rows affected (0.08 sec)

mysql> CREATE USER 'username'@'localhost.localdomain' IDENTIFIED BY
'password';
Query OK, 0 rows affected (0.46 sec)

mysql> GRANT ALL PRIVILEGES ON *.* TO
'username'@'localhost.localdomain';
Query OK, 0 rows affected (0.22 sec)

mysql> FLUSH PRIVILEGES;
Query OK, 0 rows affected (0.23 sec)

mysql>
```

2.6.7 Localhost

Verify that 'localhost' on the MySQL database server is resolvable using the command **`ping localhost`**.

```
# ping -c 5 localhost
PING localhost (127.0.0.1) 56(84) bytes of data.
64 bytes from localhost (127.0.0.1): icmp_seq=1 ttl=64 time=0.189 ms
64 bytes from localhost (127.0.0.1): icmp_seq=2 ttl=64 time=0.054 ms
64 bytes from localhost (127.0.0.1): icmp_seq=3 ttl=64 time=0.054 ms
64 bytes from localhost (127.0.0.1): icmp_seq=4 ttl=64 time=0.057 ms
64 bytes from localhost (127.0.0.1): icmp_seq=5 ttl=64 time=0.057 ms

--- localhost ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4000ms
rtt min/avg/max/mdev = 0.054/0.082/0.189/0.053 ms
```

'localhost' is allowed to access the MySQL database instance on the MySQL service listening port (default 3306) using the command **`telnet localhost 3306`**.

```
#telnet 127.0.0.1 3306
Trying 127.0.0.1...
Connected to 127.0.0.1.
Escape character is '^]'.
J
5.7.24i6&VeFS!F<t'zmysql_native_password
```

2.6.8 MySQL Virtual System Databases

The 'information_schema' and 'performance_schema' are MySQL virtual system databases which contains information about the user databases on the MySQL instance, are automatically excluded from the backup source. They are read-only and cannot be backed up.

```
mysql> show databases;
+--------------------+
| Database           |
+--------------------+
| information_schema |
| mysql              |
| performance_schema |
| sys                |
+--------------------+
```

```
4 rows in set (0.00 sec)

mysql>
```

2.6.9 Temporary Directory

The databases selected for backup will be temporarily spooled to a temporary directory before being uploaded to the backup server or destination storage.

Ensure that the temporary directory configured for the MySQL database backup has sufficient disk space for the backup operation, the free space on the temporary directory drive should be at least 130% of the database size. As the temporary directory is also used for storing index files and any incremental or differential delta files generated during the backup job before they are uploaded to the backup destination.

Please bear in mind the size of the databases may grow over time and you may need to review the temporary directory free space requirements on a regular basis.

To calculate for the size of your databases, run the command below.

```
mysql> SELECT table_schema AS "Database", ROUND(SUM(data_length +
index_length) / 1024 / 1024, 2) AS "Size (MB)" FROM
information_schema.TABLES GROUP BY table_schema;
+--------------------+-----------+
| Database           | Size (MB) |
+--------------------+-----------+
| information_schema |      0.16 |
| mysql              |      2.43 |
| performance_schema |      0.00 |
| sys                |      0.02 |
+--------------------+-----------+
4 rows in set (0.04 sec)

mysql>
```

3 Starting AhsayOBM

To startup AhsayOBM and connect to AhsayCBS you need to use the **RunConfigurator.sh** script, to configure the backup server URL, port, and proxy server settings (if applicable) and enter the login name and password. If the user account is enabled with Twilio two-factor authentication, please refer to Appendix E for the login steps.

```
# cd /usr/local/obm/bin
# sh RunConfigurator.sh
Startup Ahsay Online Backup Manager ...
User Configuration file not found
Create a new Configuration file at directory
[/root/.obm/config]


Login Menu (No configuration files found)
-----------------------------------------
  (1). Login
  (2). Free Trial
  (3). Quit
-----------------------------------------
Your Choice: 1

Backup Server URL : 10.90.10.12
Port : 443
Protocol? (1) Http (2) Https : 2
Enable Proxy (Y/N) ? N
Login Name : LinuxTest_1
Password : ********************


Please wait while verifying user account with server...
log4j:WARN No appenders could be found for logger
(org.apache.http.impl.conn.PoolingClientConnectionManager).
log4j:WARN Please initialize the log4j system properly.
log4j:WARN See http://logging.apache.org/log4j/1.2/faq.html#noconfig for
more info.

Your account (LinuxTest_1) is found on server (10.90.10.12:443).
New configuration file has been created

Main Menu
---------
  (1). List Backup Sets
  (2). Delete Backup Set
  (3). Export Backup Set Settings to XML
  (4). Import Backup Set Settings from XML
  (5). Generate new Backup Set Settings Template
  (6). Change Language [English]
  (7). Update Profile Settings
  (8). Quit
---------
Your Choice:
```

4 Creating a MySQL Database Backup Set using ssh

There are two options to create a MySQL Database Backup Set for Linux.

- Using AhsayCBS web console

  For backup set creation on AhsayCBS web console, most backup set preferences may be configured using AhsayCBS except the following:

  - Backup set encryption key settings
  - MySQL login password

  After the backup set preferences are setup on the AhsayCBS web console, to complete the backup set creation process the RunConfigurator.sh script will need to be used on the MySQL machine to do the following:

  - to setup the backup set encryption key settings
  - to export/import the backupSet.xml file to setup the MySQL login password

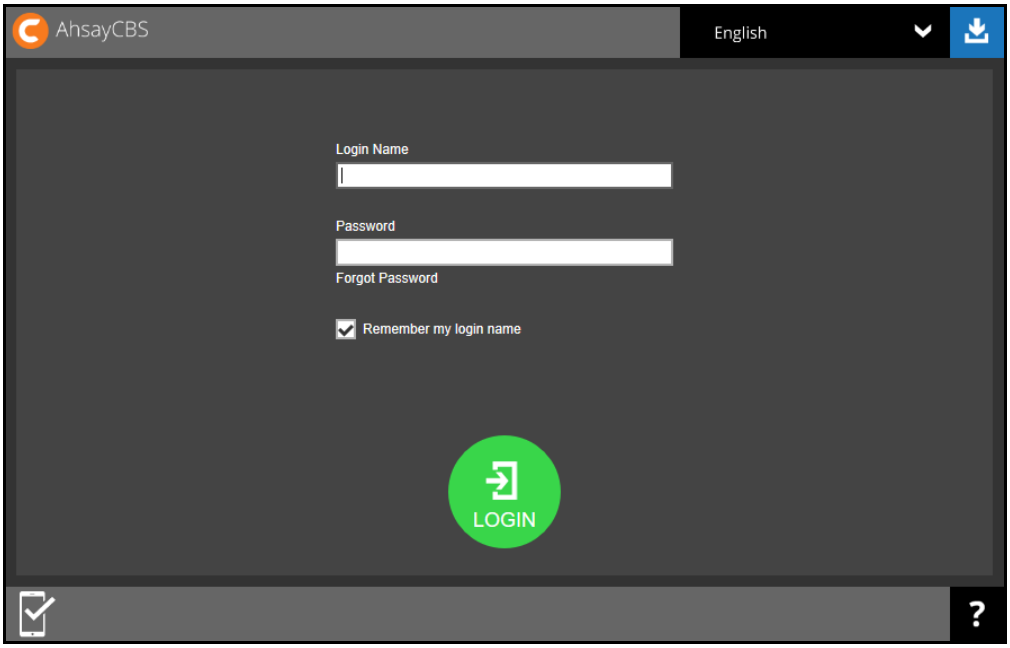
- Using command line

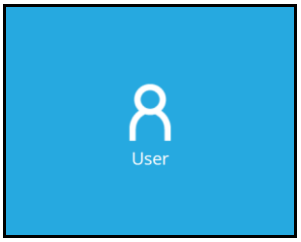
  For backup set creation using command line, most backup set preferences may be configured using the backupSet.xml file.

  To complete the backup set creation process after successfully importing the backupSet.xml file, the RunConfigurator.sh script will need to be used on the MySQL machine to setup the backup set encryption key settings.

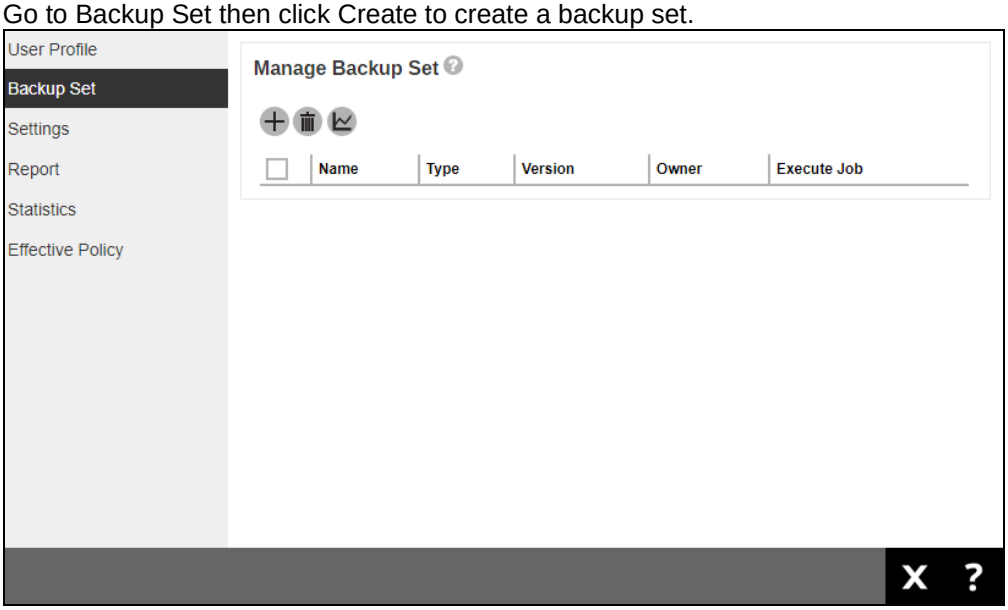
4.1 Create a MySQL Database Backup Set using AhsayCBS

1. Log in to AhsayCBS and go to User.

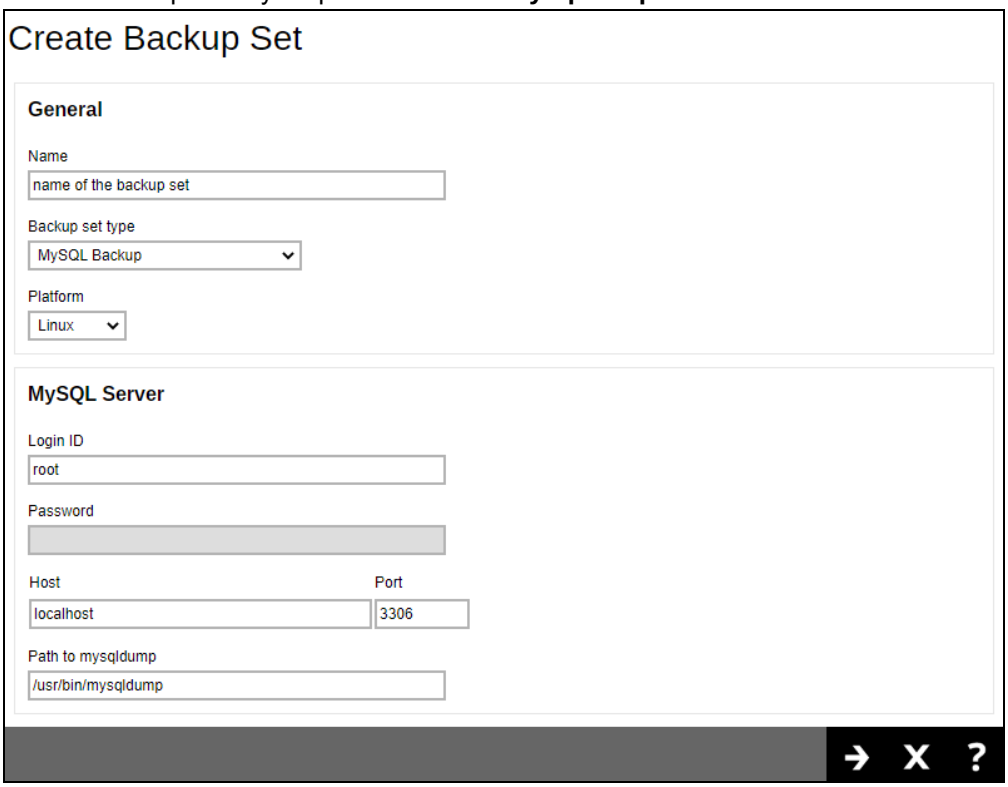




2. Go to Backup Set then click Create to create a backup set.

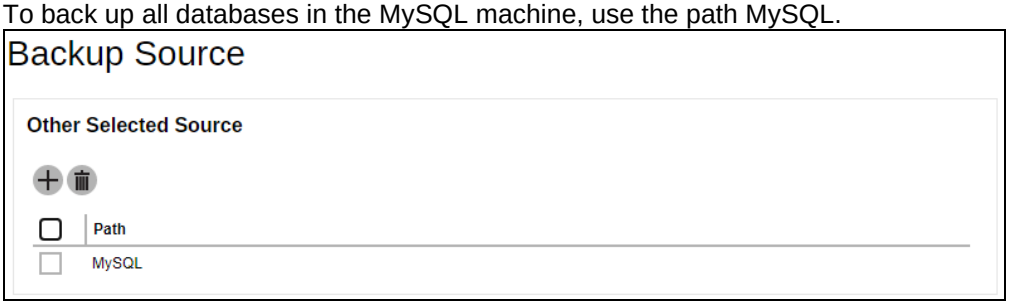


3. Input the **Name**, select the **Type** which should be 'MySQL Backup' and **Platform** which should be 'Linux'. Update the Host and Port. Default settings for these are 'localhost' and '3306' respectively. Input the **Path to mysqldump** then click Next.

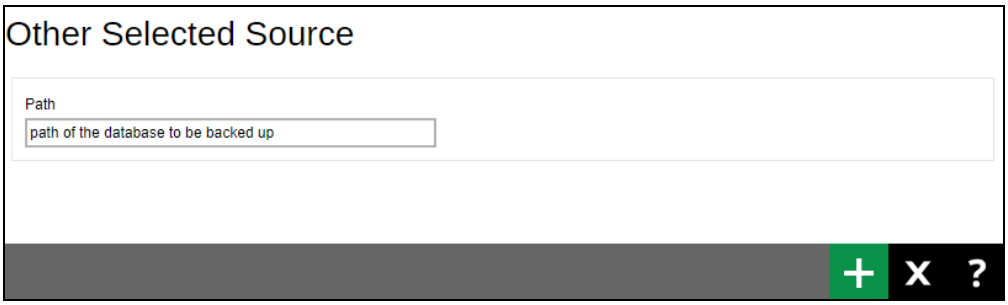


4. Add the backup source in the **Other Selected Source** by clicking the Create button e.g. path is MySQL/employees.

To back up all databases in the MySQL machine, use the path MySQL.



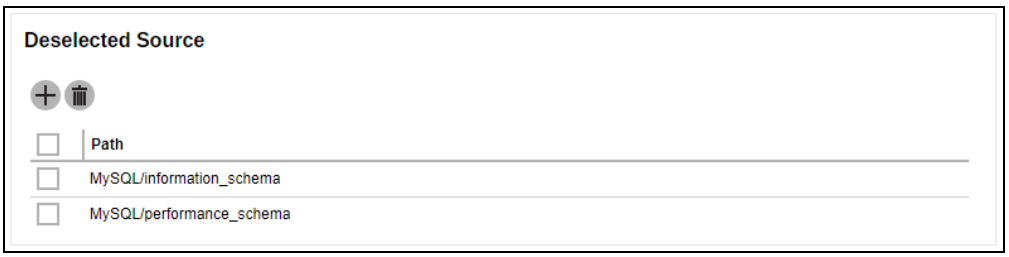
Input the path of the source to be backed up. Click the Add button to add the source. Keep doing this until all the backup source are added.



To exclude a source, you can add it under **Deselected Source** by clicking the Create button.

NOTE

Always add the 'information_schema' and 'performance_schema" databases under **Deselected Source** since they are MySQL virtual system databases. They are read-only and cannot be backed up.

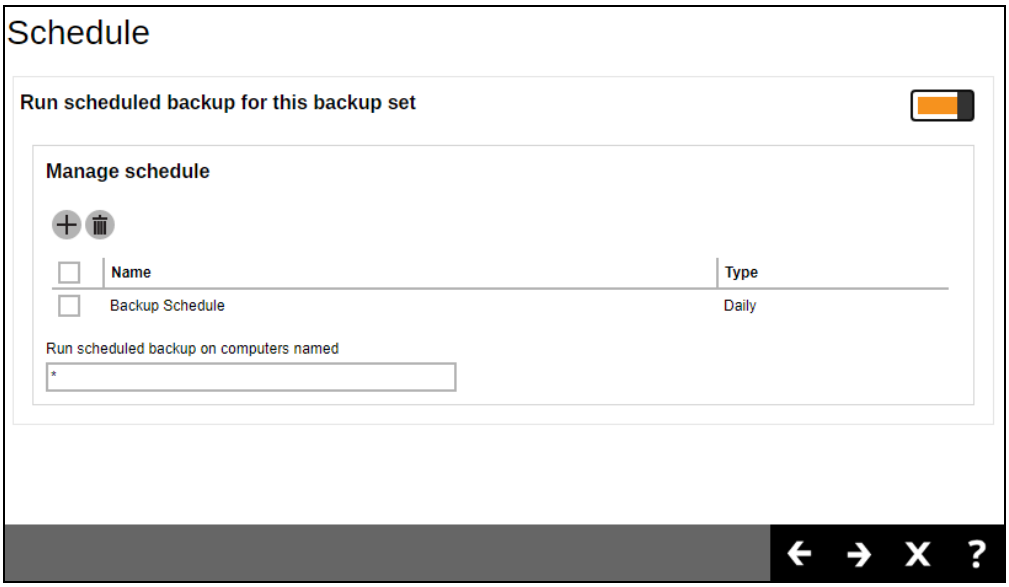


Input the path of the source to be excluded in the backup. Click the Add button to add the deselected source. Keep doing this until all source to be excluded are added. Click Next.

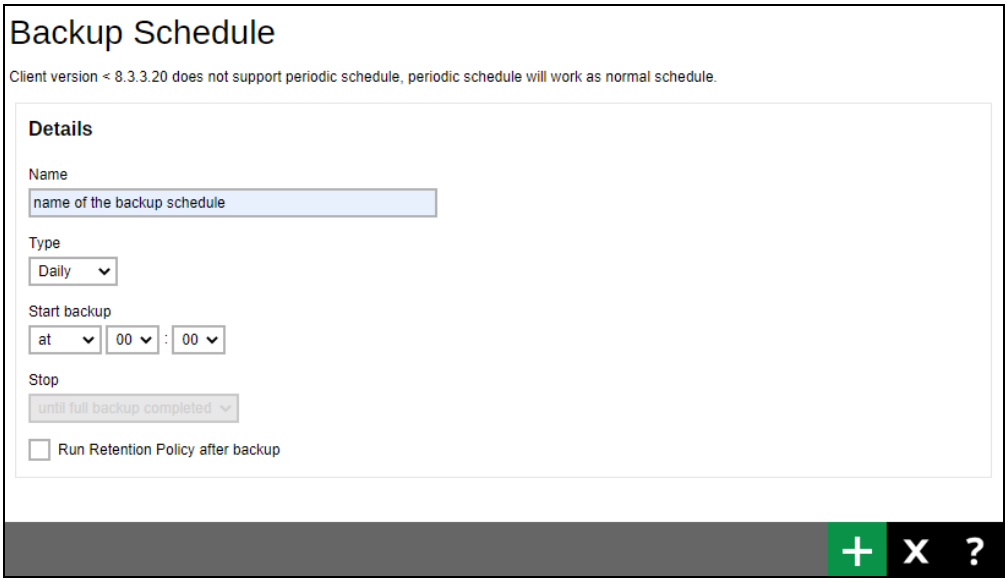
5. The **Run scheduled backup for this backup set** is turned on by default. If you do not want to create a backup schedule you can turn it off by sliding the lever to the left. By default, there is already a backup schedule created that is scheduled to run daily at 3am until full backup is completed. This schedule may either be edited or deleted if you want to create your own backup schedule.

NOTE

It is optional to input the computer name in the **Run scheduled backup on computers named** field since it will be updated once backup set creation is completed in the AhsayOBM client. In Step 15, the computer name can be checked as the Owner.



Click Create to add a new schedule or double click on the existing schedule to change the values. Click Next to proceed.

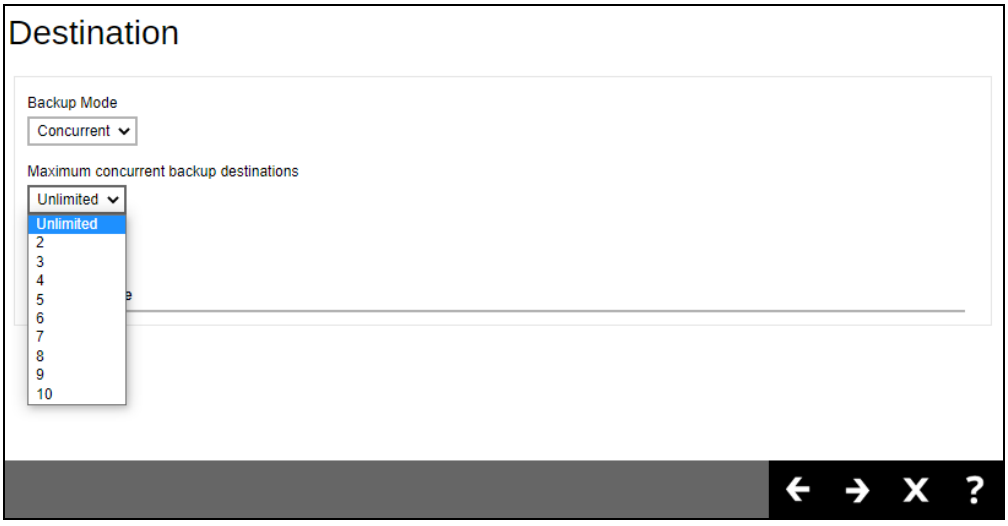


6. Select the **Backup Mode** if Concurrent or Sequential. By default, **Sequential** is selected. In Sequential backup mode, if there are multiple destinations configured in the backup set, AhsayOBM will back up to one destination at a time. In **Concurrent** backup mode, if there are multiple destinations configured in the backup set, AhsayOBM will backup to all destinations at the same time or concurrently.

NOTE

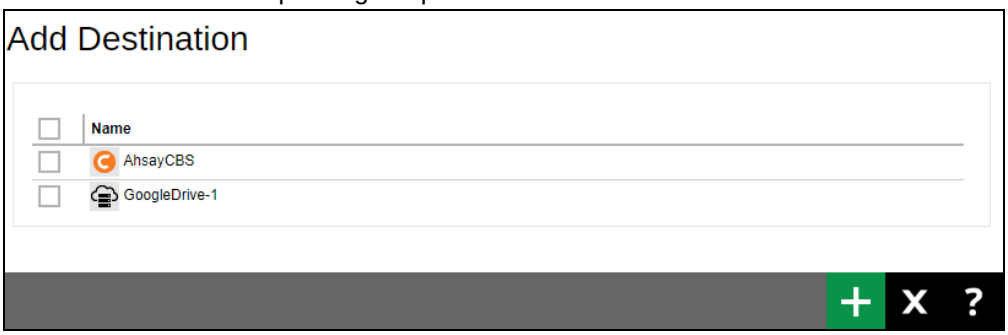
For backup sets with multiple destinations, sequential backup mode will take longer compared with concurrent backup mode.

If **Concurrent** is selected, specify the maximum number of backup destinations.

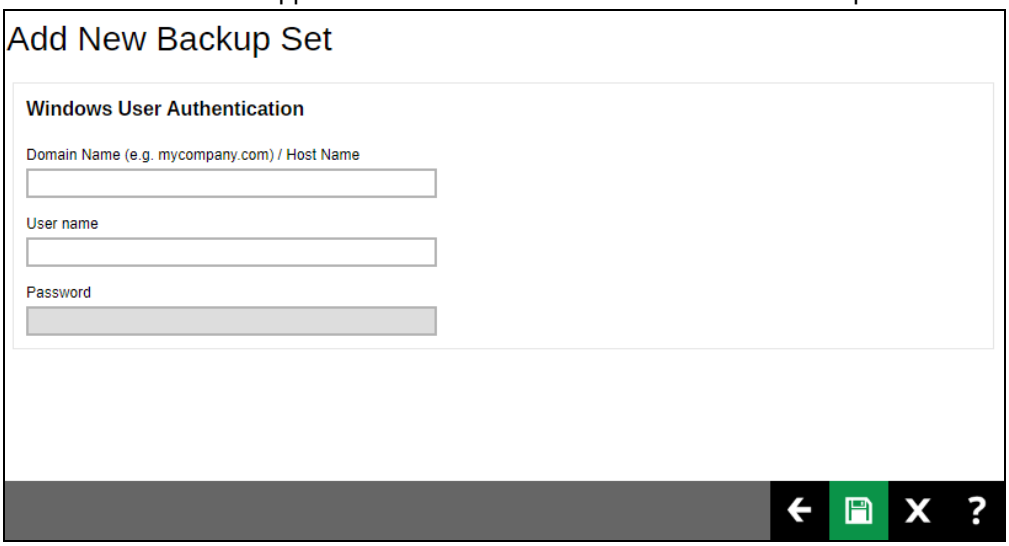


Click the plus button or **"+"** sign to be able to add the standard or predefined destinations.

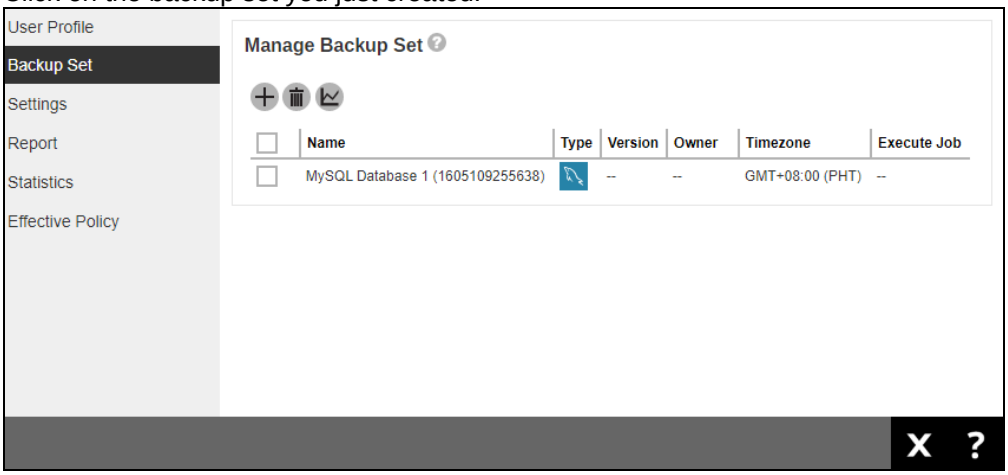
Select your desired destination, it could be one or both displayed destinations. Tick the checkbox and click the plus sign to proceed. Click Next.



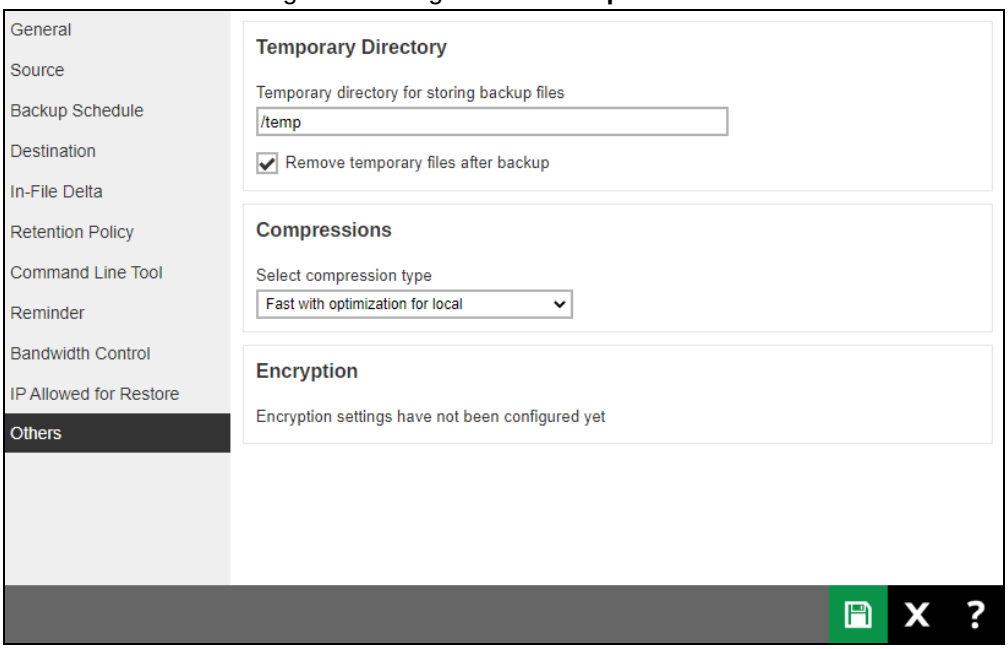
7. Leave the **Domain Name** and **User name** fields blank since Windows User Authentication is not supported in Linux. Click Save to create the Backup Set.



8. Click on the backup set you just created.



Go to **Others** and input the path of your temporary directory. It is recommended to check the box beside **Remove temporary files after backup** to make sure the spooled database files are cleaned up after each backup job to free up space on the temporary drive. Otherwise, if the temporary drive runs out of space the database backup job will not run. You can also change the settings for the **Compressions**. Click Save once done.



9. Open ssh session in the Linux machine and execute the RunConfigurator.sh script. The Login Menu will be displayed. Select **(1). Login** then press Enter to login. Input your Login Name and Password. Set the encryption setting for the backup set.

```
# cd /usr/local/obm/bin
# sh RunConfigurator.sh
Startup Ahsay Online Backup Manager ...
Config file found

Login Menu
----------
  (1). Login
  (2). Change Network Settings
  (3). Forgot Password
  (4). Quit
----------
Your Choice: 1
```

```
Login Name : LinuxTest_1
Password : ******************


Please wait while verifying user account with server...
Your profile has been downloaded and updated.

Encryption setting has not been defined for backup set "MySQL Database
1"
Do you want to set the encryption setting for this backup set? (Y/N) ? Y
Enable Encryption (Y/N) ? Y

Choose Encryption Type
----------------------
  (1). Default
  (2). User password
  (3). Custom
----------------------
Your Choice: 2
```

10. Edit the backup set created from AhsayCBS to add the MySQL Password. Select **(1). List Backup Sets** to list the backup set.

```
Main Menu
---------
  (1). List Backup Sets
  (2). Delete Backup Set
  (3). Export Backup Set Settings to XML
  (4). Import Backup Set Settings from XML
  (5). Generate new Backup Set Settings Template
  (6). Change Language [English]
  (7). Update Profile Settings
  (8). Quit
---------
Your Choice: 1
```

11. Select the backup set to show the details by selecting **(1). Name of your backup set**

```
Select a Backup Set to show more details
----------------------------------------
  (1). MySQL Database 1
----------------------------------------
Your Choice: 1

Name                 : MySQL Database 1
Owner                : mysql8x-centos74
Type                 : MySQL
Selected Source      : MySQL/employees
Selected Source      : MySQL/test
Deselected Source    : MySQL/information_schema
Deselected Source    : MySQL/performance_schema
Destination Name     : AhsayCBS, Type: OBS
Encryption Key       : abc123$%
Encryption Algorithm : AES
Encryption Mode      : CBC
Encryption Key Length: 256


Press Enter to continue...
```

12. Export the backup set to XML by selecting **(3). Export Backup Set Setting to XML**

```
Main Menu
---------
  (1). List Backup Sets
  (2). Delete Backup Set
  (3). Export Backup Set Settings to XML
  (4). Import Backup Set Settings from XML
  (5). Generate new Backup Set Settings Template
  (6). Change Language [English]
  (7). Update Profile Settings
  (8). Quit
---------
Your Choice: 3


Choose your backup set to generate XML file
-------------------------------------------
  (1). MySQL Database 1
-------------------------------------------
Your Choice: 1

XML file successfully exported to /root/.obm/config/backupSet.xml
```

13. Exit from the Main Menu then edit the XML file by using an editor like vi. Add the Value data for **MySQL Password** to the file then save.

```
# cd /root/.obm/config
# vi backupSet.xml

<!-- MySQL Password -->
    <Value data="abc123$%" name="Password" type="string" />
```

NOTE

Please refer to Appendix B for details on the field to be configured.

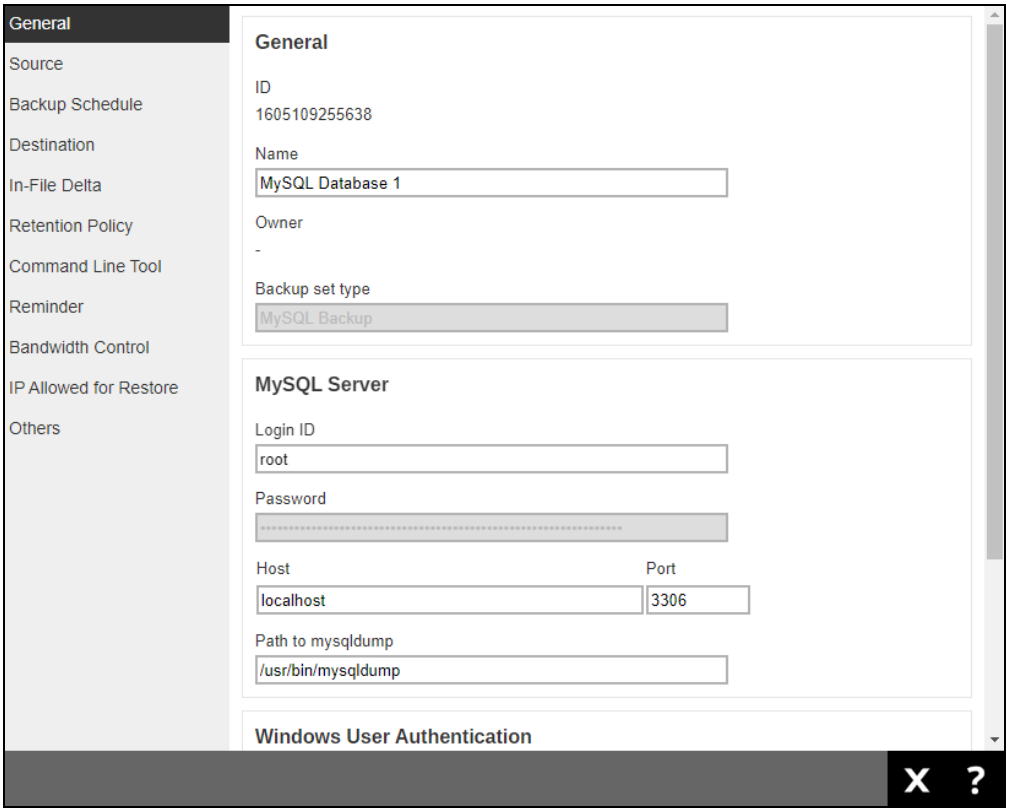
14. Import the backup set by selecting **(4). Import Backup Set Setting from XML**. Confirm overwrite of file.

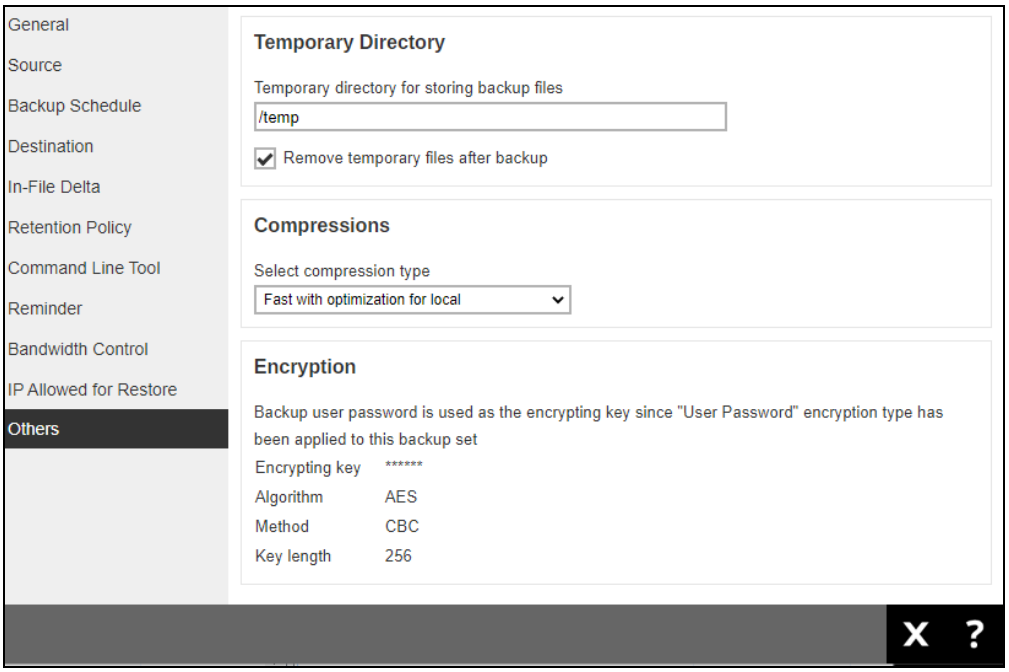
```
Main Menu
---------
  (1). List Backup Sets
  (2). Delete Backup Set
  (3). Export Backup Set Settings to XML
  (4). Import Backup Set Settings from XML
  (5). Generate new Backup Set Settings Template
  (6). Change Language [English]
  (7). Update Profile Settings
  (8). Quit
---------
Your Choice: 4

Backup Set 'MySQL Database 1' already exist. Confirm overwrite? (Y/N) ?
Y
XML imported, uploading to server...

XML successfully uploaded to server
```

15. Check in AhsayCBS web console if MySQL Password and Encryption setting was successfully added.


General
Source
Backup Schedule
Destination
In-File Delta
Retention Policy
Command Line Tool
Reminder
Bandwidth Control
IP Allowed for Restore
Others
General
ID
1605109255638
Name
MySQL Database 1
Owner
-
Backup set type
MySQL Backup
MySQL Server
Login ID
root
Password
Host
Port
localhost
3306
Path to mysqldump
/usr/bin/mysqldump
Windows User Authentication


General
Source
Backup Schedule
Destination
In-File Delta
Retention Policy
Command Line Tool
Reminder
Bandwidth Control
IP Allowed for Restore
Others
Temporary Directory
Temporary directory for storing backup files
/temp
Remove temporary files after backup
Compressions
Select compression type
Fast with optimization for local
Encryption
Backup user password is used as the encrypting key since "User Password" encryption type has been applied to this backup set
Encrypting key ******
Algorithm AES
Method CBC
Key length 256

4.2 Create a MySQL Database Backup Set using command line

1. To create a MySQL database backup set, select **(5). Generate new Backup Set Settings Template** from the menu.

```
Main Menu
---------
  (1). List Backup Sets
  (2). Delete Backup Set
  (3). Export Backup Set Settings to XML
  (4). Import Backup Set Settings from XML
  (5). Generate new Backup Set Settings Template
  (6). Change Language [English]
  (7). Update Profile Settings
  (8). Quit
---------
Your Choice: 5
```

2. Select **(2). MySQL Database** to generate a MySQL Database Backup Set template file to **/root/.obm/config** directory.

```
Choose a template from a backup set type
----------------------------------------
  (1). File
  (2). MySQL Database
  (3). MariaDB
  (4). Oracle Database Server
  (4). IBM Domino
----------------------------------------
Your Choice: 2

XML file successfully exported to /root/.obm/config/backupSet.xml

Main Menu
---------
  (1). List Backup Sets
  (2). Delete Backup Set
  (3). Export Backup Set Settings to XML
  (4). Import Backup Set Settings from XML
  (5). Generate new Backup Set Settings Template
  (6). Change Language [English]
  (7). Update Profile Settings
  (8). Quit
---------
Your Choice:
```

3. **Configuring MySQL Backup Set Settings**.

   To configure the MySQL backup set setting you need to edit the **/root/.obm/config/backupSet.xml** file using a text editor, for example vi

   You can either quit the RunConfigurator.sh script or open a new ssh session to edit the backupSet.xml file.

   Please refer to Appendix A, B, C, and D for details and examples on how to create backup sets using the **backupSet.xml** file.

NOTES

i. Before importing the backupSet.xml file please remove any unused destinations and backup schedule settings. Otherwise, the following error will be displayed "**Failed to import XML file (Reason: Value of name is empty!)**" when trying to import the backupSet.xml file.

ii. Setup of the following cloud storage destinations: OneDrive, OneDrive for Business, DropBox and Google Drive are not supported in Linux CLI environment, as these cloud

storage destinations require authentication using a web browser.

4. **Importing the updated backupSet.xml file to AhsayOBM**

   After you have edited the backupSet.xml file with your chosen backup settings you need to import the settings back to AhsayOBM, so they can be uploaded to AhsayCBS backup server to create the backup set.

   For example: to create a new MySQL backup set called “MySQL Database 1” with encryption enabled and default encryption settings.

```
Main Menu
---------
  (1). List Backup Sets
  (2). Delete Backup Set
  (3). Export Backup Set Settings to XML
  (4). Import Backup Set Settings from XML
  (5). Generate new Backup Set Settings Template
  (6). Change Language [English]
  (7). Update Profile Settings
  (8). Quit
---------
Your Choice: 4

New backup set created.
Enable Encryption (Y/N) ? y

Choose Encryption Type
----------------------
  (1). Default
  (2). User password
  (3). Custom
----------------------
Your Choice: 1

XML imported, uploading to server...

XML successfully uploaded to server
```

5. **Verify the Backup Set Settings**

   To verify the uploaded backup set settings are correct select **(1). List Backup Sets** and then select the backup you wish to verify, for example backup set named “MySQL Database 1”.

```
Main Menu
---------
  (1). List Backup Sets
  (2). Delete Backup Set
  (3). Export Backup Set Settings to XML
  (4). Import Backup Set Settings from XML
  (5). Generate new Backup Set Settings Template
  (6). Change Language [English]
  (7). Update Profile Settings
  (8). Quit
---------
Your Choice: 1


Select a Backup Set to show more details
----------------------------------------
  (1). MySQL Database 1
----------------------------------------
Your Choice: 1

Name                    : MySQL Database 1
```

```
Owner                : mysql8x-centos74
Type                 : MySQL
Selected Source      : MySQL/employees
Selected Source      : MySQL/test
Deselected Source    : MySQL/information_schema
Deselected Source    : MySQL/performance_schema
Deselected Source    : MySQL/mysql
Destination Name     : AhsayCBS, Type: OBS
Encryption Key       : abc123$%
Encryption Algorithm : AES
Encryption Mode      : CBC
Encryption Key Length: 256

Press Enter to continue...
```

Congratulations! The backup set configuration is now complete!

NOTES

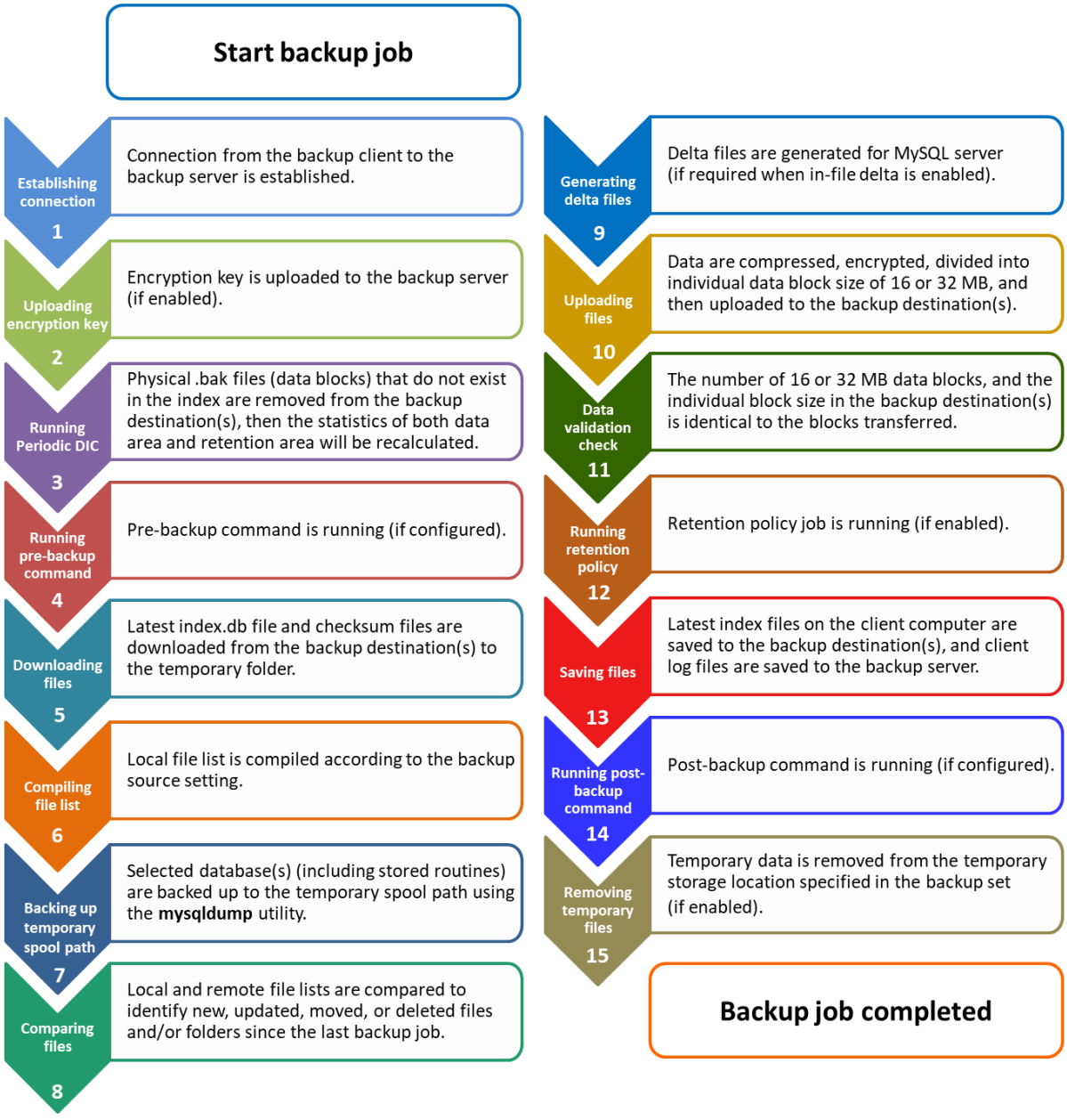
i. We would like to stress that it is very important to keep a separate record of your encryption key in a safe place, as you will not be able to restore your data without the correct key.

ii. If you re-install AhsayOBM or install AhsayOBM on another machine, the encryption key will be required for restoring data from the backup set.

5 Overview on the Backup Process

The following steps are performed during a MySQL Database backup job. For an overview of the detailed process for Steps **3**, **5**, **11**, and **13**, please refer to the following chapters.

- Periodic Data Integrity Check (PDIC) Process **(Step 3)**
- Backup Set Index Handling Process
  - Start Backup Job **(Step 5)**
  - Completed Backup Job **(Step 13)**
- Data Validation Check Process **(Step 11)**



5.1 Periodic Data Integrity Check (PDIC) Process

For AhsayOBM v8.3.6.0 (or above), the PDIC will run on the first backup job that falls on the corresponding day of the week from **Monday to Friday**.

To minimize the impact of the potential load of large number of PDIC jobs running at the same time on the AhsayCBS server, the schedule of a PDIC job for each backup set is automatically determined by the result of the following formula:

PDIC schedule = ***%BackupSetID% modulo 5***
or
%BackupSetID% mod 5

The calculated **result** will map to the corresponding day of the week (i.e., from Monday to Friday).

0	**Monday**
1	**Tuesday**
2	**Wednesday**
3	**Thursday**
4	**Friday**

NOTE: The PDIC schedule cannot be changed.

Example:

Backup set ID: 1594627447932

Calculation: 1594627447932 mod 5 = ***2***

2	**Wednesday**

In this example:

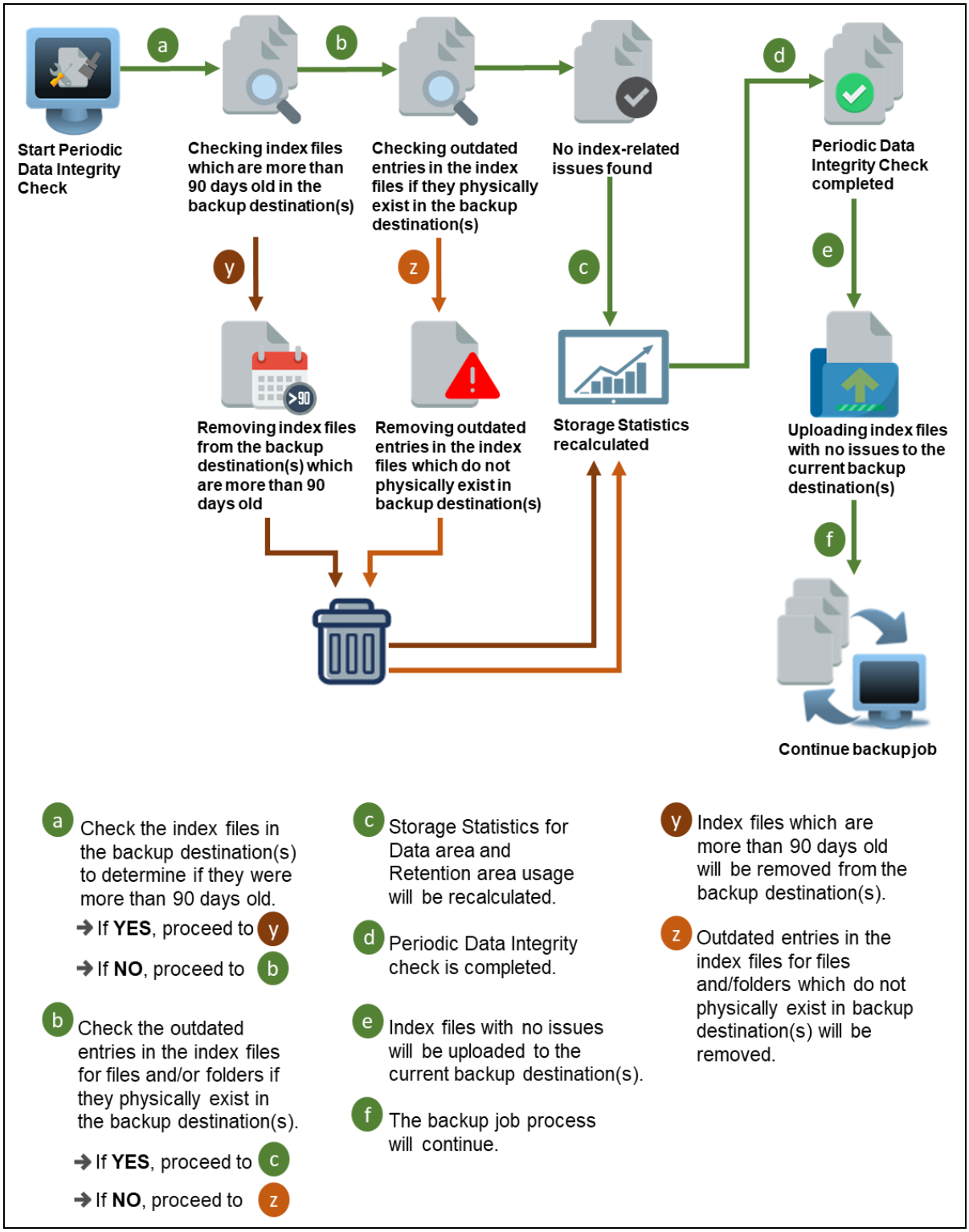
- the PDIC will run on the first backup job that falls on Wednesday; or
- if there is no active backup job(s) running from Monday to Friday, then the PDIC will run on the next available backup job.

NOTE

Although according to the PDIC formula for determining the schedule is ***%BackupSetID% mod 5***, this schedule only applies if the previous PDIC job was actually run more than 7 days prior.

Under certain conditions, the PDIC may not run strictly according to this formula. For example:

1. If AhsayOBM was upgraded to v8.5 (or above) from an older version v6, v7, or pre-8.3.6.0 version. In this case, the PDIC job will run on the first backup job after upgrade.
2. If backup jobs for a backup set are not run on a regular daily backup schedule (for example: on a weekly or monthly schedule), then the PDIC job will run if it detects that the previous PDIC job was run more than 7 days ago.



a Check the index files in the backup destination(s) to determine if they were more than 90 days old.

→ If **YES**, proceed to y

→ If **NO**, proceed to b

b Check the outdated entries in the index files for files and/or folders if they physically exist in the backup destination(s).

→ If **YES**, proceed to c

→ If **NO**, proceed to z

c Storage Statistics for Data area and Retention area usage will be recalculated.

d Periodic Data Integrity check is completed.

e Index files with no issues will be uploaded to the current backup destination(s).

f The backup job process will continue.

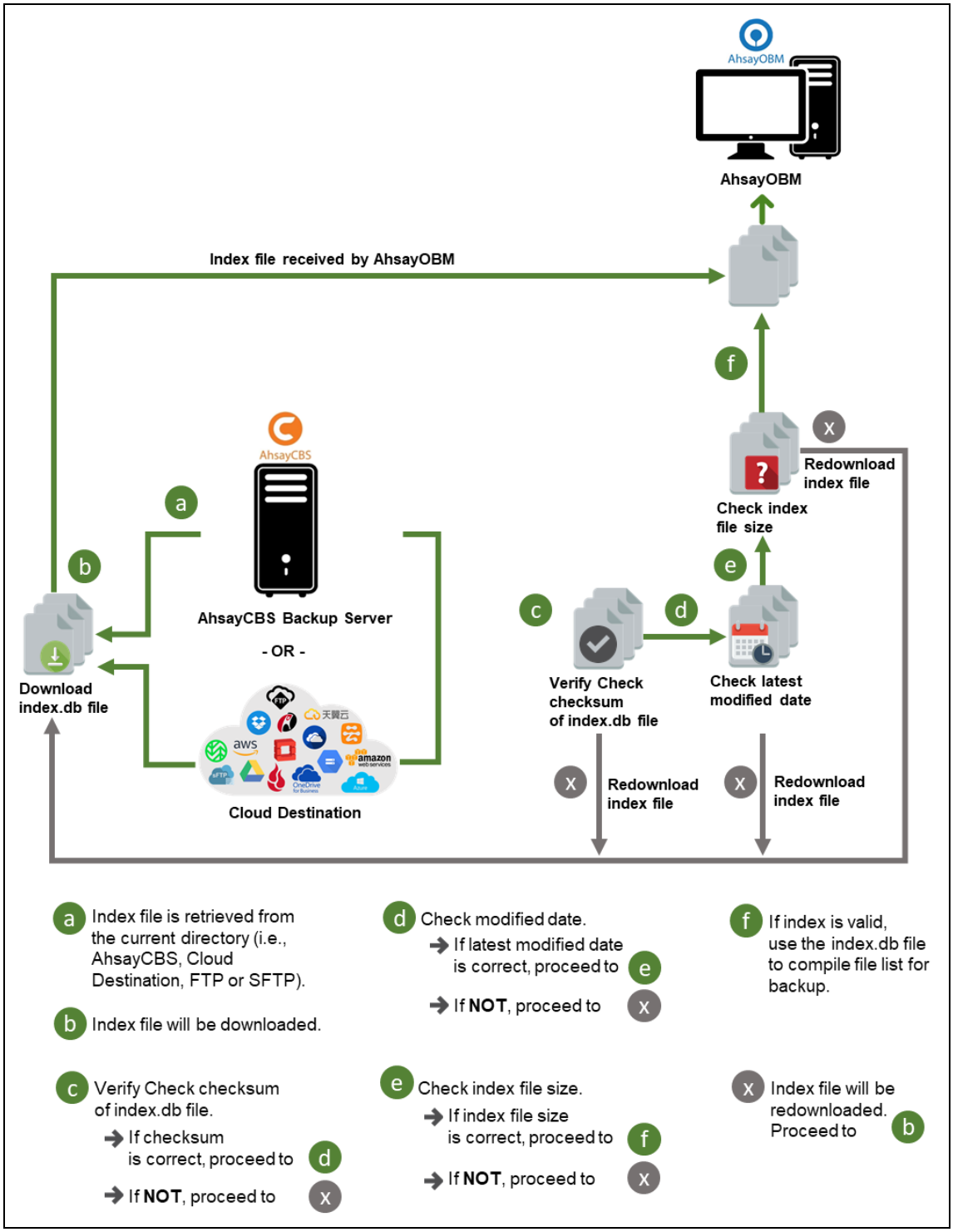
y Index files which are more than 90 days old will be removed from the backup destination(s).

z Outdated entries in the index files for files and/folders which do not physically exist in backup destination(s) will be removed.

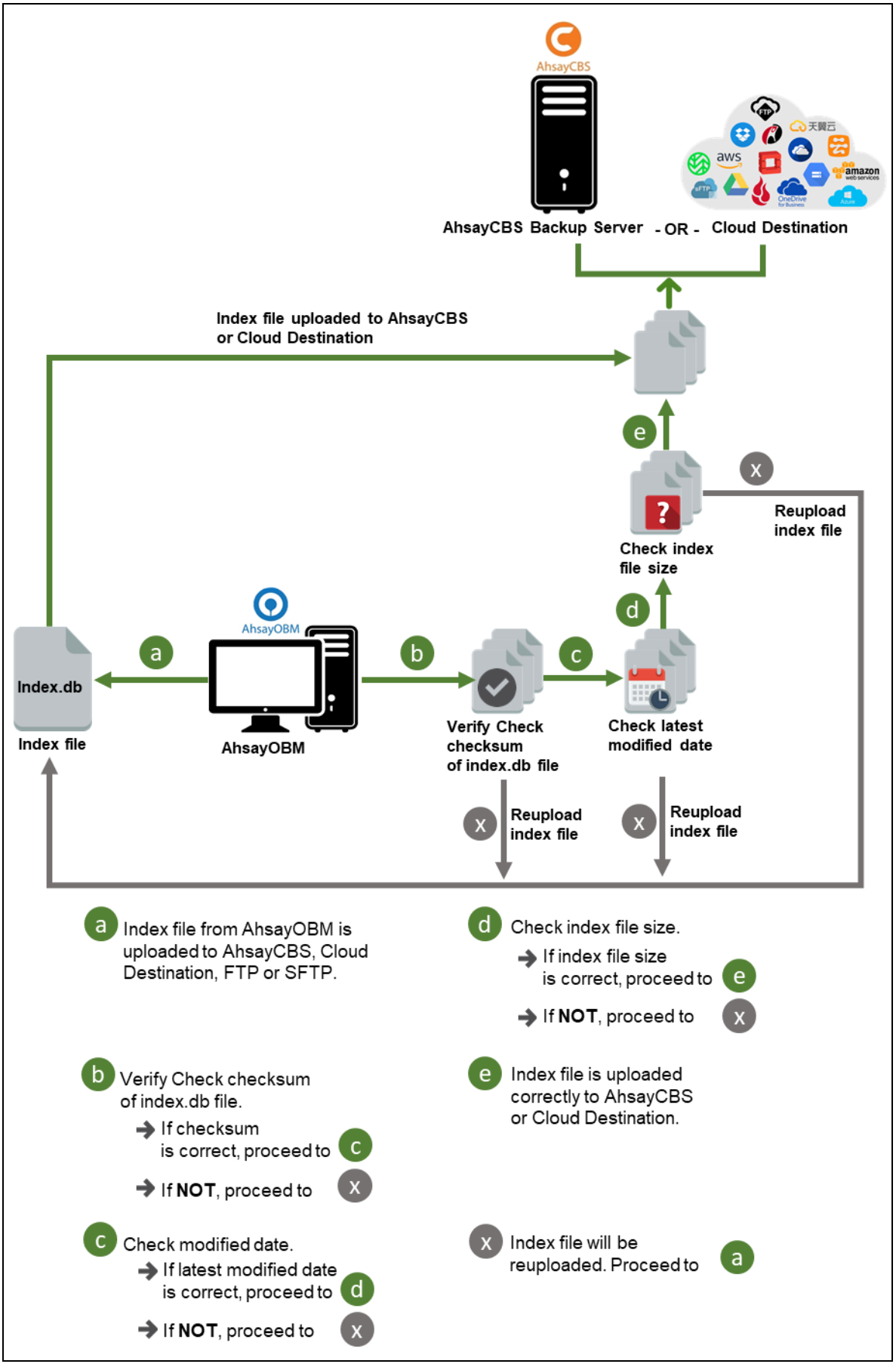
5.2 Backup Set Index Handling Process

To minimize the possibility of index related issues affecting backups, each time index files are downloaded from and uploaded to backup destination(s); the file size, last modified date, and checksum is verified to ensure index file integrity.

5.2.1 Start Backup Job

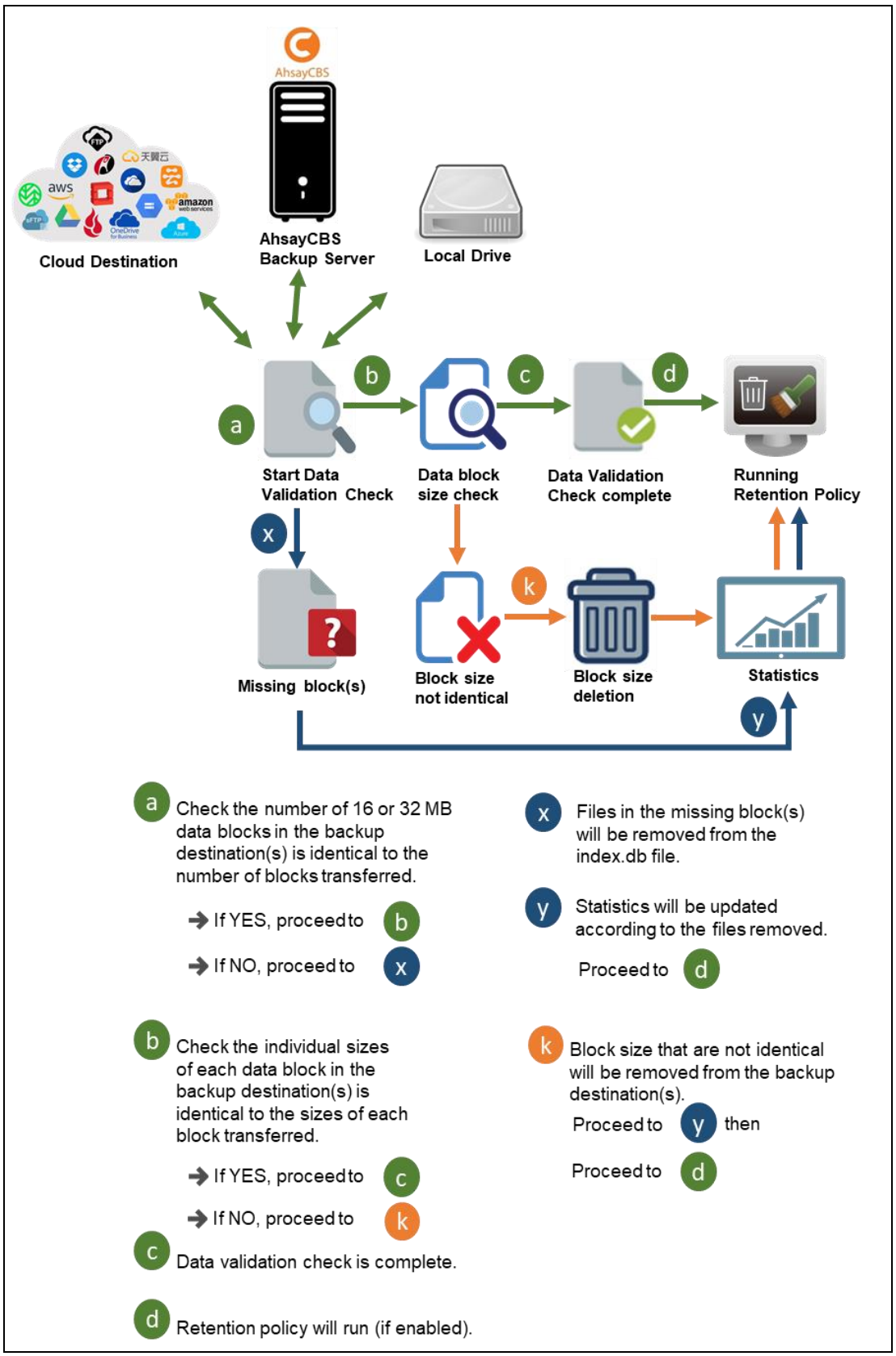


5.2.2 Completed Backup Job



5.3 Data Validation Check Process

As an additional measure to ensure that all files transferred to the backup destination(s) are received and saved correctly, both the number of 16 or 32 MB data block files and the size of each block file are checked again after the files are transferred.



6 Running Backup Jobs

Use the **RunBackupSet.sh** script to start a backup job manually.

Example: RunBackupSet.sh

```
#cd /usr/local/obm/bin
#sh RunBackupSet.sh "MySQL Database 1"
-
Using APP_HOME      : /usr/local/obm
Using SETTING_HOME  :
Using JAVA_HOME     : /usr/local/obm/jvm
Using JAVA_EXE      : /usr/local/obm/jvm/bin/java
Using JAVA_OPTS     : -Xrs -Xms128m -Xmx768m -XX:MaxDirectMemorySize=512m -
client -Dsun.nio.PageAlignDirectMemory=true
Using JNI_PATH      : -Djava.library.path=.
Using CLASSPATH     : .:./cb.jar
-
Running Backup Set - 'MySQL Database 1' ...
log4j:WARN No appenders could be found for logger
(org.apache.http.impl.conn.PoolingClientConnectionManager).
log4j:WARN Please initialize the log4j system properly.
log4j:WARN See http://logging.apache.org/log4j/1.2/faq.html#noconfig for
more info.
Start [ Linux 3.10.0-514.10.2.el7.x86_64 (centos7), AhsayOBM v8.1.0.24 ]
Saving encrypted backup set encryption keys to server...
Start Backup ... Database [In-File Delta: Incremental]
Using Temporary Directory /root/temp/1546504071551/OBS@1546504071985
Start running pre-commands
Finished running pre-commands
Backing up database "employees" to
"/root/temp/1546504071551/SpoolArea/MySQL/employees.sql"
Backing up database "test" to
"/root/temp/1546504071551/SpoolArea/MySQL/test.sql"
Start running post-commands
Finished running post-commands
Downloading server file list...
Downloading server file list... Completed
Reading backup source from hard disk...
Reading backup source from hard disk... Completed
[New Directory]... MySQL
[New File]... 100% of "MySQL/employees.sql"
[New File]... 100% of "MySQL/test.sql"
Total New Files = 2
Total New Directories = 1
Total New Links = 0
Total Updated Files = 0
Total Attributes Changed Files = 0
Total Deleted Files = 0
Total Deleted Directories = 0
Total Deleted Links = 0
Total Moved Files = 0
Deleting temporary file /root/temp/1546504071551/SpoolArea
Saving encrypted backup file index to 1546504071551/blocks at destination
AhsayCBS...
Saving encrypted backup file index to 1546504071551/blocks/2019-01-03-16-33-
09 at destination AhsayCBS...
Deleting temporary file /root/temp/1546504071551/OBS@1546504071985
Backup Completed Successfully
```

7 Restoring Data

There are two options to restore a MySQL Database Backup Set for Linux using the **Restore.sh** script.

- Automatic MySQL Database Restore

  This is recommended for restore of MySQL databases on the original MySQL server.

  For this option, the RESTORE_TO="" parameter in the Restore.sh script should be left blank or empty.

  The MySQL database .sql files are restored from your backup destination to the MySQL database server. The restored MySQL database .sql files are then automatically applied to the MySQL database server.

- Manual MySQL Database Restore

  This is recommended for restore of MySQL databases on a different MySQL server.

  For this option, the RESTORE_TO="" parameter in the Restore.sh script should contain a location on the MySQL server.

  The MySQL database .sql files are only restored from your backup destination to the location specified in RESTORE_TO="" parameter, e.g. RESTORE_TO="/restored_file". The restored MySQL database .sql files then need to be separately applied to the MySQL database instance using the "source" command.

7.1 Automatic MySQL Database Restore

1. To restore files from your backup destination and automatically apply them to the MySQL database server.

   You need to use the Restore.sh script by using a text editor like vi to configure the restore settings like :

   - Backup Set Name -> BACKUP_SET=""
   - Backup Destination -> DESTINATION=""
   - Files/Folders to be Restored -> RESTORE_FROM=""
   - Snapshot to be restored ->POINT_IN_TIME=""
   - Applying the original permission to the restore files ->RESTORE_PERMISSION=""
   - Verifying the in-file delta file checksum ->VERIFY_CHKSUM=""

NOTES

- RESTORE_TO="" settings must be blank
- To configure the shell script, press **Esc + I**. You will see this `-- INSERT --` on the lower left corner of the terminal.

```
# cd /usr/local/obm/bin
# vi Restore.sh

# !/bin/sh

################################  Restore.sh  ################################
# You can use this shell script to restore backup files using command-line.#
# Just customize the "User Define Section" below with values for your      #
# restore action.                                                          #
############################################################################

########################  Start: User Defined Section  ######################

# ----------------------------  BACKUP_SET  ----------------------------
# | The name or ID of the backup set that you want to restore.           |
# | If backup set name is not in English, please use ID instead.         |
# | e.g. BACKUP_SET="1119083740107"                                      |
# |  or  BACKUP_SET="FileBackupSet-1"                                    |
# |                                                                      |
# | You can leave this parameter blank if you have only 1 backupset.     |
# ----------------------------------------------------------------------
BACKUP_SET="MySQL Database 1"

# ---------------------------- DESTINATION  ----------------------------
# | The name or ID of the backup destination that you want to restore from.|
# | If backup destination name is not in English, please use ID instead. |
# | e.g. DESTINATION="1740107119083"                                     |
# |  or  DESTINATION="Destination-1"                                     |
# |                                                                      |
# | You can leave this parameter blank if you have only 1 destination.   |
# ----------------------------------------------------------------------
DESTINATION=""

# ------------------------------  RESTORE_TO  ----------------------------
# | Directory to where you want files to be restored                     |
# | set to "" to restore files to original location                      |
# | e.g. RESTORE_TO="/tmp"                                               |
# ----------------------------------------------------------------------
RESTORE_TO=""

# ------------------------------  RESTORE_FROM  ----------------------------
# | File/Directory on the backup server that you would like to restore   |
# | e.g. RESTORE_FROM="/Data"                                            |
# ----------------------------------------------------------------------
RESTORE_FROM="MySQL"

# ------------------------------  POINT_IN_TIME  ----------------------------
# | The point-in-time snapshot (successful backup) that you want to restore|
# | from the backup server. Use "Current" for the latest backup snapshot |
# | e.g. POINT_IN_TIME="2006-10-04-12-57-13"                             |
# |  or  POINT_IN_TIME="Current"                                         |
# |                                                                      |
# | You can retrieve the point in time by using the ListBackupJob.sh     |
# ----------------------------------------------------------------------
POINT_IN_TIME="Current"

# --------------------------  RESTORE_PERMISSION  ----------------------------
# | set to "Y" if you want to restore file permissions                   |
# | set to "N" if you do NOT want to restore file permissions            |
# ----------------------------------------------------------------------
RESTORE_PERMISSION="N"

# ------------------------------  SKIP_INVALID_KEY  ----------------------------
# | set to "Y" if you want to skip restore file with invalid key         |
# | set to "N" if you want to prompt user to input a correct key         |
# ----------------------------------------------------------------------
SKIP_INVALID_KEY="N"
```

```
# ------------------------------  SYNC_OPTION  ------------------------------
# | Delete extra files                                                       |
# | set to "Y" if you want to enable sync option                             |
# | set to "N" if you do NOT want to enable sync option                      |
# | set to "" to prompt for selection                                        |
# --------------------------------------------------------------------------
SYNC_OPTION="N"

# -------------------------  REPLACE_EXISTING_FILE  -------------------------
# | set to "--all" to replace all existing file(s) of the same filename    |
# | set to "--none" to skip all existing file(s) with the same filename    |
# | set to "" to prompt for selection                                      |
# --------------------------------------------------------------------------
REPLACE_EXISTING_FILE="--all"

# ------------------------------  SETTING_HOME  ----------------------------
# | Directory to your setting home.                                        |
# | Default to ${HOME}/.obm when not set.                                  |
# | e.g. SETTING_HOME="${HOME}/.obm"                                       |
# --------------------------------------------------------------------------
SETTING_HOME=""

# ---------------------------------  FILTER  -------------------------------
# | Filter out what files you want to restore                              |
# | -Pattern=xxx-Type=yyy-Target=zzz                                       |
# | where xxx is the filter pattern,                                       |
# |       yyy is the filter type, whice can be one of the following:       |
# |           [exact | exactMatchCase | contains | containsMatchCase|      |
# |            startWith | startWithMatchCase | endWith | endWithMatchCase]|
# |       zzz is the filter target, which can be one of the following:     |
# |           [toFile | toFileDir | toDir]                                 |
# |                                                                        |
# | e.g. FILTER="-Pattern=.txt-Type=exact-Target=toFile"                   |
# --------------------------------------------------------------------------
FILTER=""

# ---------------------------------  TEMP_DIR  -----------------------------
# | Directory to where you want to store restore files temporarily         |
# | set to "" to use the temporary directory in the backup set             |
# | e.g. TEMP_DIR="/tmp"                                                   |
# --------------------------------------------------------------------------
TEMP_DIR="/root/temp"

# ------------------------------  VERIFY_CHKSUM  ---------------------------
# | set to "Y" if you want to verify in-file delta file checksum during
restore|
# | set to "N" if you do NOT want to verify in-file delta file checksum
during |
# | restore                                                                |
# --------------------------------------------------------------------------
VERIFY_CHKSUM="N"

########################  END: User Defined Section  ########################

###########################################################################
#      R E T R I E V E           A P P _ H O M E          P A T H        #
###########################################################################
```

2. After the **Restore.sh** script is configured the files can be restored automatically to the MySQL Database Server.

```
# cd /usr/local/obm/bin
# sh Restore.sh
Using APP_HOME:          : /usr/local/obm
Using BACKUP_SET         : MySQL Database 1
Using RESTORE_FROM       : MySQL
Using RESTORE_TO         :
Using POINT_IN_TIME      : Current
Using RESTORE_PERMISSION : N
Using TEMP_DIR           : /root/temp
Filter Pattern not set, filter would not apply to restore
log4j:WARN No appenders could be found for logger
(org.apache.http.impl.conn.PoolingClientConnectionManager).
log4j:WARN Please initialize the log4j system properly.
log4j:WARN See http://logging.apache.org/log4j/1.2/faq.html#noconfig for
more info.
[2019-01-04 14:53:46] Start [ Linux 3.10.0-514.10.2.el7.x86_64 (centos7),
AhsayOBM v8.1.0.24 ]
[2019-01-04 14:53:46] start,"Start [ Linux 3.10.0-514.10.2.el7.x86_64
(centos7), AhsayOBM v8.1.0.24 ]",0,0,0,,0,0

[2019-01-04 14:53:46] Initializing decrypt action...
[2019-01-04 14:53:46] Initializing decrypt action... Completed
[2019-01-04 14:53:48] Creating new directory...
"/root/temp/RestoreSet/1546504071551/RestoreDatabase/MySQL"
[2019-01-04 14:53:48] Downloading...
"/root/temp/RestoreSet/1546504071551/RestoreDatabase/MySQL/employees.sql"
(Total 5k bytes)
[2019-01-04 14:53:48] Downloading...
"/root/temp/RestoreSet/1546504071551/RestoreDatabase/MySQL/test.sql" (Total
5k bytes)
[2019-01-04 14:53:49]
file,/root/temp/RestoreSet/1546504071551/RestoreDatabase/MySQL/test.sql,555
0,5551,1546571876000,,1546584829226,1546584829231

[2019-01-04 14:53:49]
file,/root/temp/RestoreSet/1546504071551/RestoreDatabase/MySQL/employees.sq
l,5662,5650,1546571876000,,1546584829227,1546584829231

[2019-01-04 14:53:50] Start restore files to MySQL Server... "test"
[2019-01-04 14:53:50] Restoring to MySQL Server Database... "test"
[2019-01-04 14:53:50] End restore files to MySQL Server... "test"
[2019-01-04 14:53:50] Start restore files to MySQL Server... "employees"
[2019-01-04 14:53:50] Restoring to MySQL Server Database... "employees"
[2019-01-04 14:53:50] End restore files to MySQL Server... "employees"
[2019-01-04 14:53:51] Restore Completed Successfully
[2019-01-04 14:53:51] end,RESTORE_STOP_SUCCESS,0,0,0,,0,0
```

3. Log in to MySQL server to check the database status.

   Example: Listing the tables in the database using **show tables**

```
mysql> show databases;
+--------------------+
| Database           |
+--------------------+
| information_schema |
| employees          |
| mysql              |
| performance_schema |
| sys                |
| test               |
+--------------------+
6 rows in set (0.00 sec)

mysql> show tables in employees;
```

```
+----------------------+
| Tables_in_employees |
+----------------------+
| address              |
| contact_no           |
| department           |
| designation          |
| employee_no          |
| name                 |
+----------------------+
6 rows in set (0.00 sec)

mysql> show tables in test;
+----------------+
| Tables_in_test |
+----------------+
| sample         |
| sample1        |
| sample2        |
| sample3        |
| sample4        |
| sample5        |
+----------------+
6 rows in set (0.01 sec)

mysql>
```

7.2 Manual MySQL Database Restore

To restore files that have been backed up from your backup destination, you need to use the Restore.sh script by using a text editor like vi to configure the restore settings like:

- Backup Set Name -> BACKUP_SET=""
- Backup Destination -> DESTINATION=""
- Location of Restored Files -> RESTORE_TO=""
- Files/Folders to be Restored -> RESTORE_FROM=""
- Snapshot to be restored ->POINT_IN_TIME=""
- Applying the original permission to the restore files ->RESTORE_PERMISSION=""
- Verifying the in-file delta file checksum ->VERIFY_CHKSUM=""

```
# sh Restore.sh
Using APP_HOME:          : /usr/local/obm
Using BACKUP_SET         : MySQL Daily
Using RESTORE_FROM       : MySQL
Using RESTORE_TO         : /root/restored
Using POINT_IN_TIME      : Current
Using RESTORE_PERMISSION : N
Using TEMP_DIR           : /root/temp
Filter Pattern not set, filter would not apply to restore
log4j:WARN No appenders could be found for logger
(org.apache.http.impl.conn.PoolingClientConnectionManager).
log4j:WARN Please initialize the log4j system properly.
log4j:WARN See http://logging.apache.org/log4j/1.2/faq.html#noconfig for
more info.
[2018-08-20 15:15:16] Start [ Linux 3.10.0-514.10.2.el7.x86_64 (centos73),
AhsayOBM v8.1.0.24 ]
[2018-08-20 15:15:16] start,"Start [ Linux 3.10.0-514.10.2.el7.x86_64
(centos73), AhsayOBM v8.1.0.24 ]",0,0,0,,0,0

[2018-08-20 15:15:16] Initializing decrypt action...
[2018-08-20 15:15:16] Initializing decrypt action... Completed
[2018-08-20 15:15:17] Creating new directory... "/root/restored/MySQL"
[2018-08-20 15:15:17] Downloading... "/root/restored/MySQL/employees.sql"
(Total 1k bytes)
[2018-08-20 15:15:17] Downloading... "/root/restored/MySQL/test.sql" (Total
1k bytes)
[2018-08-20 15:15:18]
file,/root/restored/MySQL/employees.sql,510,1355,1534748296000,,15347493182
62,1534749318262

[2018-08-20 15:15:18]
file,/root/restored/MySQL/test.sql,510,1340,1534748296000,,1534749318258,15
34749318259

[2018-08-20 15:15:19] Restore Completed Successfully
[2018-08-20 15:15:19] end,RESTORE_STOP_SUCCESS,0,0,0,,0,0
```

Verify the files are restored on the machine.

```
# ls -la /root/restored/MySQL
total 16
drwxr-xr-x. 2 root root   43 Jan  4 11:19 .
drwxr-xr-x. 3 root root   19 Jan  4 10:35 ..
-rwxr-xr-x. 1 root root 5650 Jan  4 11:17 employees.sql
-rwxr-xr-x. 1 root root 5551 Jan  4 11:17 test.sql
```

7.2.1 Recovering MySQL Databases

1. Log in to MySQL server.

```
# mysql -u root -p
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 108
Server version: 5.7.24 MySQL Community Server (GPL)

Copyright (c) 2000, 2018, Oracle and/or its affiliates. All rights
reserved.

Oracle is a registered trademark of Oracle Corporation and/or its
affiliates. Other names may be trademarks of their respective
owners.

Type 'help;' or '\h' for help. Type '\c' to clear the current input
statement.

mysql> show databases;
+--------------------+
| Database           |
+--------------------+
| information_schema |
| mysql              |
| performance_schema |
| sys                |
+--------------------+
4 rows in set (0.09 sec)

mysql>
```

2. Create the database names that need to be recovered.

   Example: employees, and test

```
mysql> create database employees;
Query OK, 1 row affected (0.00 sec)

mysql> create database test;
Query OK, 1 row affected (0.00 sec)
```

3. Recover Databases

   Repeat the following steps for all databases you wish to restore.

```
mysql> use employees;
Database changed
mysql> source /root/restored/MySQL/employees.sql;
Query OK, 0 rows affected (0.00 sec)

Query OK, 0 rows affected (0.00 sec)

Query OK, 0 rows affected (0.00 sec)

mysql> use test;
Database changed
mysql> source /root/restored/MySQL/test.sql;
Query OK, 0 rows affected (0.00 sec)

Query OK, 0 rows affected (0.00 sec)

Query OK, 0 rows affected (0.00 sec)
```

4. Check the database status

   Example: Listing the tables in the database using **show tables**

```
mysql> show databases;
+--------------------+
| Database           |
+--------------------+
| information_schema |
| employees          |
| mysql              |
| performance_schema |
| sys                |
| test               |
+--------------------+
6 rows in set (0.00 sec)

mysql> show tables in employees;
+----------------------+
| Tables_in_employees |
+----------------------+
| address              |
| contact_no           |
| department           |
| designation          |
| employee_no          |
| name                 |
+----------------------+
6 rows in set (0.00 sec)

mysql> show tables in test;
+----------------+
| Tables_in_test |
+----------------+
| sample         |
| sample1        |
| sample2        |
| sample3        |
| sample4        |
| sample5        |
+----------------+
6 rows in set (0.01 sec)

mysql>
```

8 Contact Ahsay

8.1 Technical Assistance

To contact Ahsay support representatives for technical assistance, visit the Partner Portal:
https://www.ahsay.com/partners/

Also use the Ahsay Wikipedia for resource such as Hardware Compatibility List, Software Compatibility List, and other product information:
https://wiki.ahsay.com/

8.2 Documentation

Documentations for all Ahsay products are available at:
https://www.ahsay.com/jsp/en/downloads/ahsay-downloads_documentation_guides.jsp

You can send us suggestions for improvements or report on issues in the documentation by contacting us at:
https://www.ahsay.com/partners/

Please specify the specific document title as well as the change required/suggestion when contacting us.

Appendix

Appendix A MySQL Backup Set XML Template (Raw)

```
<?xml version="1.0" encoding="UTF-8"?>
<Setting>
	<!-- This is the backup set setting -->
	<Key name="Backup Set Setting" allowMultiple="Y">
		<!-- Backup set type (Read Only) -->
		<Value data="MySQL" name="Type" type="string" />
		<!-- Backup set name -->
		<Value data="" name="Name" type="string" />
		<!-- Temporary directory for storing backup files -->
		<Value data="" name="Temporary Working Directory" type="string" />
		<!-- Remove temporary files after backup -->
		<!-- Y: Yes -->
		<!-- N: No -->
		<Value data="Y" name="Delete temporary files after backup"
		type="boolean" />
		<!-- Select compression type -->
		<!-- GzipDefaultCompression  : Normal -->
		<!-- GzipBestSpeedCompression: Fast (Compressed size larger than
normal) -->
		<!-- SnappyDefaultCompression: Fast with optimization for local -->
		<!-- Leave the field blank for no compression -->
		<Value data="" name="Compression Type" type="string" />
		<!-- This shows the MySQL Database setting -->
		<Key name="MySQL Database Setting">
			<!-- MySQL Login Name -->
			<Value data="" name="Username" type="string" />
			<!-- MySQL Password -->
			<Value data="" name="Password" type="string" />
			<!-- MySQL Host -->
			<Value data="" name="Host" type="string" />
			<!-- MySQL Port -->
			<Value data="" name="Port" type="string" />
			<!-- Path to mysqldump -->
			<Value data="" name="mysqldump path" type="string" />
		</Key>
		<!-- This includes the database you want to backup -->
		<!-- Copy and paste the whole <Key> to add more selected sources -->
		<Key name="Selected Source">
			<!-- Please enter the path in the format of
		"MySQL/_YOUR_FILE_NAME_" -->
			<Value data="" name="Path" type="string" />
		</Key>
		<!-- This excludes the database from the included source -->
		<!-- Copy and paste the whole <Key> to add more deselected sources --
>
		<Key name="Deselected Source">
			<!-- Please enter the path in the format of
		"MySQL/_YOUR_FILE_NAME_" -->
			<Value data="" name="Path" type="string" />
		</Key>
		<!-- Settings for your scheduled backups -->
		<Key name="Schedule Settings">
			<!-- Enable scheduled backup on this computer -->
			<!-- Y: Yes -->
			<!-- N: No -->
			<Value data="N" name="Enable" type="boolean" />
			<!-- Daily settings -->
			<!-- Copy and paste the whole <Key> to add more daily
schedules -->
			<Key name="Daily Schedule Settings">
				<!-- Name of schedule -->
```

```
                        <Value data="Daily-Schedule" name="Name" type="string"
/>
                        <!-- Start hour -->
                        <!-- 0, 1, 2... 23 -->
                      <!-- This value will be ignored if the schedule is set to
be periodic ("Interval" field contains value other than -1) -->
                        <Value data="21" name="Hour" type="integer" />
                        <!-- Start minute -->
                        <!-- 0, 1, 2... 59 -->
                      <!-- This value will be ignored if the schedule is set to
be periodic ("Interval" field contains value other than -1) -->
                        <Value data="0" name="Minute" type="integer" />
                      <Value data="0" name="Minute" type="integer" />
                      <!-- Interval -->
                      <!-- 1  : 1 minute -->
                      <!-- 2  : 2 minutes -->
                      <!-- 3  : 3 minutes -->
                      <!-- 4  : 4 minutes -->
                      <!-- 5  : 5 minutes -->
                      <!-- 6  : 6 minutes -->
                      <!-- 10 : 10 minutes -->
                      <!-- 12 : 12 minutes -->
                      <!-- 15 : 15 minutes -->
                      <!-- 20 : 20 minutes -->
                      <!-- 30 : 30 minutes -->
                      <!-- 60 : 1 hour -->
                      <!-- 120: 2 hours -->
                      <!-- 180: 3 hours -->
                      <!-- 240: 4 hours -->
                      <!-- 360: 6 hours -->
                      <!-- 480: 8 hours -->
                      <!-- 720: 12 hours -->
                      <!-- A value of -1 means a non-periodic normal schedule --
>
                        <Value data="-1" name="Interval" type="integer" />
                    </Key>
                    <!-- Weekly settings -->
                    <!-- Copy and paste the whole <Key> to add more weekly
                          schedules -->
                    <Key name="Weekly Schedule Settings">
                          <!-- Name of schedule -->
                          <Value data="Weekly-Schedule" name="Name" type="string"
/>
                          <!-- Start hour -->
                          <!-- 0, 1, 2... 23 -->
                        <!-- This value will be ignored if the schedule is set to
be periodic ("Interval" field contains value other than -1) -->
                          <Value data="21" name="Hour" type="integer" />
                          <!-- Start minute -->
                          <!-- 0, 1, 2... 59 -->
                        <!-- This value will be ignored if the schedule is set to
be periodic ("Interval" field contains value other than -1) -->
                          <Value data="0" name="Minute" type="integer" />
                        <!-- Interval -->
                        <!-- 1  : 1 minute -->
                        <!-- 2  : 2 minutes -->
                        <!-- 3  : 3 minutes -->
                        <!-- 4  : 4 minutes -->
                        <!-- 5  : 5 minutes -->
                        <!-- 6  : 6 minutes -->
                        <!-- 10 : 10 minutes -->
                        <!-- 12 : 12 minutes -->
                        <!-- 15 : 15 minutes -->
                        <!-- 20 : 20 minutes -->
                        <!-- 30 : 30 minutes -->
                        <!-- 60 : 1 hour -->
                        <!-- 120: 2 hours -->
                        <!-- 180: 3 hours -->
```

```
                        <!-- 240: 4 hours -->
                        <!-- 360: 6 hours -->
                        <!-- 480: 8 hours -->
                        <!-- 720: 12 hours -->
                        <!-- A value of -1 means a non-periodic normal schedule --
>
                        <Value data="-1" name="Interval" type="integer" />
                           <!-- Backup on these days of the week -->
                           <!-- Y: Yes -->
                           <!-- N: No -->
                           <Value data="Y" name="Sunday" type="boolean" />
                           <Value data="Y" name="Monday" type="boolean" />
                           <Value data="Y" name="Tuesday" type="boolean" />
                           <Value data="Y" name="Wednesday" type="boolean" />
                           <Value data="Y" name="Thursday" type="boolean" />
                           <Value data="Y" name="Friday" type="boolean" />
                           <Value data="Y" name="Saturday" type="boolean" />
                     </Key>
                     <!-- Monthly settings -->
                     <!-- Copy and paste the whole <Key> to add more monthly
                           schedules -->
                     <Key name="Monthly Schedule Settings">
                           <!-- Name of schedule -->
                           <Value data="Monthly-Schedule" name="Name"
type="string" />
                           <!-- Start hour -->
                           <!-- 0, 1, 2... 23 -->
                           <Value data="21" name="Hour" type="integer" />
                           <!-- Start minute -->
                           <!-- 0, 1, 2... 59 -->
                           <Value data="0" name="Minute" type="integer" />
                           <!-- Schedule date of month -->
                           <!-- 1, 2, 3... 31 -->
                           <!-- 32: Last -->
                           <!-- Set to 0 if you want to use the format of
occurrence + criteria, e.g. Third Wednesday, instead -->
                     <Value data="1" name="Schedule Date" type="integer" />
                           <!-- Backup occurrence -->
                           <!-- First / Second / Third / Fourth / Last -->
                           <!-- If "Schedule Date" is not zero, this value will be
ignored -->
                     <Value data="First" name="Occurrence" type="string" />
                           <!-- Backup criteria -->
                           <!-- Sunday / Monday / Tuesday / Wednesday / Thursday /
                                 Friday / Saturday / Weekday / Weekend -->
                           <!-- If "Schedule Date" is not zero, this value will be
ignored -->
                     <Value data="Friday" name="Criteria" type="string" />
                     </Key>
                     <!-- Custom settings -->
                     <!-- Copy and paste the whole <Key> to add more custom
                           schedules -->
                     <Key name="Custom Schedule Settings">
                           <!-- Name of schedule -->
                           <Value data="Custom" name="Name" type="string" />
                           <!-- Start hour -->
                           <!-- 0, 1, 2... 23 -->
                           <Value data="21" name="Hour" type="integer" />
                           <!-- Start minute -->
                           <!-- 0, 1, 2... 59 -->
                           <Value data="0" name="Minute" type="integer" />
                           <!-- Date for performing custom schedule backup -->
                           <!-- Input in the format of YYYY-MM-DD -->
                           <Value data="2016-5-4" name="Schedule Date"
type="string"                              />
                     </Key>
               </Key>
               <!-- This is the collection of destinations -->
```

```
                <Key name="Destination Settings">
                        <Value data="1" name="concurrency-level" type="integer" />
                        <!-- AhsayCBS destination is where the files are backup to
server -->
                        <Key name="AhsayCBS Destination Settings" allowMultiple="Y">
                        </Key>
                        <!-- Local destination means backup files are stored in your
computer -->
                        <!-- Copy and paste the whole <Key> to add more local
                              destinations -->
                        <Key name="Local Destination Settings">
                              <!-- Name of your destination -->
                              <Value data="" name="Name" type="string" />
                              <!-- Directory to store your backup files -->
                              <!-- e.g. /tmp -->
                              <Value data="" name="Local Path" type="string" />
                        </Key>
                <!--  This shows the in-file delta setting -->
                <Key name="In-file Delta Setting">
                        <!-- Enable in-file delta backup -->
                        <!-- Y: Yes -->
                        <!-- N: No -->
                        <Value data="Y" name="Enable" type="boolean" />
                        <!-- Default in-file delta type -->
                        <!-- D: Differential -->
                        <!-- I: Incremental -->
                        <Value data="" name="Default Delta Type" type="string" />
                </Key>
        </Key>
</Setting>
```

Appendix B MySQL Backup Set XML Template (with explanation)

This appendix explains all configurable items with their available options, highlighted in red, in this file backup set XML scripts.

Backup Set Setting

The following items define the basic configurations of the file backup set.

- **Backup set type** – enter the backup set type, for instance, File, MySQL etc.
- **Backup set name** – name your backup set.
- **Temporary directory for storing backup files** – Enter the directory path where you would like to have the backup files stored temporarily. The temporary directory is used for various purposes, such as storage of temporary spooled file (for database specific backup type in AhsayOBM), remote file list, local file list, temporary delta file and other files of temporary nature.
- **Remove temporary files after backup** – choose whether to remove temporary files after you finish backup.
- **Select compression type** – choose the backup compression mode among Normal, Fast, Fast with optimization for local or No compression.

```
<?xml version="1.0" encoding="UTF-8"?>
<Setting>
<!-- This is the backup set setting -->
    <Key name="Backup Set Setting" allowMultiple="Y">
    <!-- Backup set type (Read Only) -->
        <Value data="MySQL" name="Type" type="string" />
        <!-- Backup set name -->
        <Value data="" name="Name" type="string" />
        <!-- Temporary directory for storing backup files -->
        <Value data="" name="Temporary Working Directory"
        type="string" />
        <!-- Remove temporary files after backup -->
        <!-- Y: Yes -->
        <!-- N: No -->
        <Value data="Y" name="Delete temporary files after backup"
        type="boolean" />
        <!-- Select compression type -->
        <!-- GzipDefaultCompression  : Normal -->
        <!-- GzipBestSpeedCompression: Fast (Compressed size larger
        than normal) -->
        <!-- SnappyDefaultCompression: Fast with optimization for local-->
        <!-- Leave the field blank for no compression -->
        <Value data="" name="Compression Type" type="string" />
```

MySQL Database Setting

- Configure the login and network settings for the MySQL Database.

```
        <!-- This shows the MySQL Database setting -->
        <Key name="MySQL Database Setting">
            <!-- MySQL Login Name -->
            <Value data="" name="Username" type="string" />
            <!-- MySQL Password -->
            <Value data="" name="Password" type="string" />
            <!-- MySQL Host -->
            <Value data="" name="Host" type="string" />
```

```
        <!-- MySQL Port -->
        <Value data="" name="Port" type="string" />
        <!-- Path to mysqldump -->
        <Value data="" name="mysqldump path" type="string" />
    </Key>
```

Selected Source

- Enter the file path where the files you would like to backup are located.

```
    <!-- This includes the files you want to backup -->
    <!-- Copy and paste the whole <Key> to add more selected
    sources -->
    <Key name="Selected Source">
        <!-- Please enter your file path, e.g. /root/Documents -->
<Value data="" name="Path" type="string" />
    </Key>
```

Deselected Source

- Enter the file path where files you would like to exclude from the backup.

```
    <!-- This excludes the files from the included source -->
    <!-- Copy and paste the whole <Key> to add more deselected
    sources -->
    <Key name="Deselected Source">
        <!-- Please enter your file path, e.g. /root/Documents -->
        <Value data="" name="Path" type="string" />
    </Key>
```

Schedule Settings

- Choose whether you would like backup jobs to be run at the scheduled time you set.

```
    <!-- Settings for your scheduled backups -->
    <Key name="Schedule Settings">
        <!-- Enable scheduled backup on this computer -->
        <!-- Y: Yes -->
        <!-- N: No -->
        <Value data="N" name="Enable" type="boolean" />
```

Daily Schedule Settings

Set backup jobs to run daily at the time you specified (start backup “at” or normal backup schedule) or at intervals of minutes/hours (start backup “every” or periodic backup schedule).

- **Start hour** – the starting hour of the backup, from 0-23. This value will apply for normal backup schedule or start backup “at”.
- **Start minute –** the starting minute of the backup, from 0-59. This value will apply for normal backup schedule or start backup “at”.
- **Interval –** frequency in minutes or hours when the backup would start, from 1-30 in minutes and 60-720 in hours. This value will apply for periodic backup schedule or start backup “every”.

```
        <!-- Daily settings -->
        <!-- Copy and paste the whole <Key> to add more daily
        schedules -->
        <Key name="Daily Schedule Settings">
            <!-- Name of schedule -->
            <Value data="Daily-Schedule" name="Name" type="string" />
            <!-- Start hour -->
```

```
                <!-- 0, 1, 2... 23 -->
                <!-- This value will be ignored if the schedule is set to be
periodic ("Interval" field contains value other than -1) -->
                <Value data="21" name="Hour" type="integer" />
                <!-- Start minute -->
                <!-- 0, 1, 2... 59 -->
                <!-- This value will be ignored if the schedule is set to be
periodic ("Interval" field contains value other than -1) -->
                <Value data="0" name="Minute" type="integer" />
                <!-- Interval -->
                <!-- 1   : 1 minute -->
                <!-- 2   : 2 minutes -->
                <!-- 3   : 3 minutes -->
                <!-- 4   : 4 minutes -->
                <!-- 5   : 5 minutes -->
                <!-- 6   : 6 minutes -->
                <!-- 10  : 10 minutes -->
                <!-- 12  : 12 minutes -->
                <!-- 15  : 15 minutes -->
                <!-- 20  : 20 minutes -->
                <!-- 30  : 30 minutes -->
                <!-- 60  : 1 hour -->
                <!-- 120: 2 hours -->
                <!-- 180: 3 hours -->
                <!-- 240: 4 hours -->
                <!-- 360: 6 hours -->
                <!-- 480: 8 hours -->
                <!-- 720: 12 hours -->
                <!-- A value of -1 means a non-periodic normal schedule -->
                <Value data="-1" name="Interval" type="integer" />
            </Key>
```

Weekly Schedule Settings

Set backup jobs to run weekly at the time you specified (start backup “at” or normal backup schedule) or at intervals of minutes/hours (start backup “every” or periodic backup schedule).

- **Start hour** – the starting hour of the backup, from 0-23. This value will apply for normal backup schedule or start backup “at”.
- **Start minute –** the starting minute of the backup, from 0-59. This value will apply for normal backup schedule or start backup “at”.
- **Interval –** frequency in minutes or hours when the backup would start, from 1-30 in minutes and 60-720 in hours. This value will apply for periodic backup schedule or start backup “every”.
- **Backup on these days of the week** – choose to enable or disable backup on each day in week.

```
            <!-- Weekly settings -->
            <!-- Copy and paste the whole <Key> to add more weekly
            schedules -->
            <Key name="Weekly Schedule Settings">
                <!-- Name of schedule -->
                <Value data="Weekly-Schedule" name="Name" type="string"       />
                <!-- Start hour -->
                <!-- 0, 1, 2... 23 -->
                <!-- This value will be ignored if the schedule is set to be
periodic ("Interval" field contains value other than -1) -->
                <Value data="21" name="Hour" type="integer" />
                <!-- Start minute -->
                <!-- 0, 1, 2... 59 -->
                <!-- This value will be ignored if the schedule is set to be
periodic ("Interval" field contains value other than -1) -->
                <Value data="0" name="Minute" type="integer" />
```

```
        <!-- Interval -->
        <!-- 1   : 1 minute -->
        <!-- 2   : 2 minutes -->
        <!-- 3   : 3 minutes -->
        <!-- 4   : 4 minutes -->
        <!-- 5   : 5 minutes -->
        <!-- 6   : 6 minutes -->
        <!-- 10  : 10 minutes -->
        <!-- 12  : 12 minutes -->
        <!-- 15  : 15 minutes -->
        <!-- 20  : 20 minutes -->
        <!-- 30  : 30 minutes -->
        <!-- 60  : 1 hour -->
        <!-- 120: 2 hours -->
        <!-- 180: 3 hours -->
        <!-- 240: 4 hours -->
        <!-- 360: 6 hours -->
        <!-- 480: 8 hours -->
        <!-- 720: 12 hours -->
        <!-- A value of -1 means a non-periodic normal schedule -->
        <Value data="-1" name="Interval" type="integer" />
        <!-- Backup on these days of the week -->
        <!-- Y: Yes -->
        <!-- N: No -->
        <Value data="Y" name="Sunday" type="boolean" />
        <Value data="Y" name="Monday" type="boolean" />
        <Value data="Y" name="Tuesday" type="boolean" />
        <Value data="Y" name="Wednesday" type="boolean" />
        <Value data="Y" name="Thursday" type="boolean" />
        <Value data="Y" name="Friday" type="boolean" />
        <Value data="Y" name="Saturday" type="boolean" />
    </Key>
```

Monthly Schedule Settings

Set backup jobs to run monthly at the time you specified.

- **Start hour** – the starting hour of the backup, from 0-23.
- **Start minute –** the starting minute of the backup, from 0-59.
- **Schedule date of month** – set exact date in a month when you would like the backup to perform. Set to 0 if you would like the backup performed in a specified occurrence + criteria format, e.g. the third Wednesday in month.
- **Backup [Occurrence + Criteria] format**
  You can set the backup to perform on a specified week (**Occurrence, First / Second / Third / Last**) and on a specified day of the week (**Criteria, Sun thru Sat**), for instance, the third Wednesday in a month.
  - **Backup occurrence –** set the week, i.e., First / Second / Third / Last. If you have set an exact date in the previous “Schedule date of month” configuration, this setting will be ignored.
  - **Backup criteria –** set a day of the week, i.e., Sunday thru Saturday. If you have set an exact date in the previous “Schedule date of month” configuration, this setting will be ignored.

```
        <!-- Monthly settings -->
        <!-- Copy and paste the whole <Key> to add more monthly
        schedules -->
        <Key name="Monthly Schedule Settings">
            <!-- Name of schedule -->
            <Value data="Monthly-Schedule" name="Name" type="string" />
            <!-- Start hour -->
```

```
            <!-- 0, 1, 2... 23 -->
            <Value data="21" name="Hour" type="integer" />
            <!-- Start minute -->
            <!-- 0, 1, 2... 59 -->
            <Value data="0" name="Minute" type="integer" />
            <!-- Schedule date of month -->
            <!-- 1, 2, 3... 31 -->
            <!-- 32: Last -->
            <!-- Set to 0 if you want to use the format of
            occurrence + criteria, e.g. Third Wednesday, instead -->
            <Value data="1" name="Schedule Date" type="integer" />
            <!-- Backup occurrence -->
            <!-- First / Second / Third / Fourth / Last -->
            <!-- If "Schedule Date" is not zero, this value will be
        ignored -->
            <Value data="First" name="Occurrence" type="string" />
            <!-- Backup criteria -->
            <!-- Sunday / Monday / Tuesday / Wednesday / Thursday /
        Friday / Saturday / Weekday / Weekend -->
            <!-- If "Schedule Date" is not zero, this value will be
        ignored -->
            <Value data="Friday" name="Criteria" type="string" />
        </Key>
```

Custom Schedule Settings

Set backup jobs to run at the date and time you specified.

- **Start hour** – the starting hour of the backup, from 0-23.
- **Start minute –** the starting minute of the backup, from 0-59.
- **Date for performing custom schedule backup -** enter a specific date when you would like the backup to perform. The date format should be in YYYY-MM-DD.

```
        <!-- Custom settings -->
        <!-- Copy and paste the whole <Key> to add more custom
        schedules -->
        <Key name="Custom Schedule Settings">
            <!-- Name of schedule -->
            <Value data="Custom" name="Name" type="string" />
            <!-- Start hour -->
            <!-- 0, 1, 2... 23 -->
            <Value data="21" name="Hour" type="integer" />
            <!-- Start minute -->
            <!-- 0, 1, 2... 59 -->
            <Value data="0" name="Minute" type="integer" />
            <!-- Date for performing custom schedule backup -->
            <!-- Input in the format of YYYY-MM-DD -->
            <Value data="2016-4-30" name="Schedule Date"
            type="string" />
        </Key>
    </Key>
```

Destination Settings

- **AhsayCBS Destination Settings** – this option allows backup files to be stored on the server
- **Local Destination Settings** – this option allows backup files to be stored in your local computer. Enter the directory path where you would like the backup files to be stored.

```
        <!-- This is the collection of destinations -->
        <Key name="Destination Settings">
            <Value data="1" name="concurrency-level" type="integer" />
```

```
            <!-- AhsayCBS destination is where the files are backup to
            server -->
            <Key name="AhsayCBS Destination Settings" allowMultiple="Y">
            </Key>
            <!-- Local destination means backup files are stored in
            your computer -->
            <!-- Copy and paste the whole <Key> to add more local
            destinations -->
            <Key name="Local Destination Settings">
                <!-- Name of your destination -->
                <Value data="" name="Name" type="string" />
                <!-- Directory to store your backup files -->
                <!-- e.g. /tmp -->
                <Value data="" name="Local Path" type="string" />
            </Key>
```

In-file delta setting

In-File delta technology is an advanced data block matching algorithm with the intelligence to pick up changes (delta) of file content between two files. You can choose between **Differential** and **Incremental** in this setting.

- **Differential** - The delta is generated by comparing with the last uploaded full file only. Delta generated with this method will grow daily and uses more bandwidth. However, for restoration, the full file and a single delta is required to be restored and merged.
- **Incremental** - The delta is generated by comparing with the last uploaded full or delta file. Delta generated with this method is smaller and uses the least bandwidth. However, for restoration, the full file and all deltas chain up to the required point-in-time are required to be restored and merged. This is prone to data lost (e.g. broken delta chain).

```
        <!-- This shows the in-file delta setting -->
        <Key name="In-file Delta Setting">
            <!-- Enable in-file delta backup -->
            <!-- Y: Yes -->
            <!-- N: No -->
            <Value data="Y" name="Enable" type="boolean" />
            <!-- Default in-file delta type -->
            <!-- D: Differential -->
            <!-- I: Incremental -->
            <Value data="" name="Default Delta Type" type="string" />
        </Key>
    </Key>
</Setting>
```

Appendix C Example of MySQL Database Backup Set with normal backup schedule

Backup set configurations:

Backup Set Name	MySQL Database 1
Temporary Working Directory	/tmp
Remove temporary files after backup	Yes
Compression Type	Fast
Daily schedule	7:30 PM
Destination	AhsayCBS, Local Drive (/localbackup)
Backup Source	MySQL/classicmodels, MySQL/employees, MySQL/sakila, MySQL/world
Exclude	MySQL/information_schema, MySQL/performance_schema
In-File Delta Type	Differential

MySQL database settings:

ID	root
Password	pwd123
Hostname	localhost
Port	3306
Mysqldump path	/usr/bin/mysqldump

Configurable items are highlighted in red.

```
<?xml version="1.0" encoding="UTF-8"?>
<Setting>
    <!-- This is the backup set setting -->
    <Key name="Backup Set Setting" allowMultiple="Y">
        <!-- Backup set type (Read Only) -->
        <Value data="MySQL" name="Type" type="string" />
        <!-- Backup set name -->
        <Value data="MySQL Database 1" name="Name" type="string" />
        <!-- Temporary directory for storing backup files -->
        <Value data="/tmp" name="Temporary Working Directory"
        type="string" />
        <!-- Remove temporary files after backup -->
       <!-- Y: Yes -->
       <!-- N: No -->
       <Value data="Y" name="Delete temporary files after backup"
        type="boolean" />
       <!-- Select compression type -->
       <!-- GzipDefaultCompression  : Normal -->
       <!-- GzipBestSpeedCompression: Fast (Compressed size larger than
    normal) -->
        <!-- SnappyDefaultCompression: Fast with optimization for local -->
       <!-- Leave the field blank for no compression -->
       <Value data="GzipBestSpeedCompression" name="Compression Type"
        type="string" />
       <!-- This shows the MySQL Database setting -->
       <Key name="MySQL Database Setting">
            <!-- MySQL Login Name -->
            <Value data="root" name="Username" type="string" />
            <!-- MySQL Password -->
            <Value data="pwd123" name="Password" type="string" />
           <!-- MySQL Host -->
           <Value data="localhost" name="Host" type="string" />
```

```
            <!-- MySQL Port -->
            <Value data="3306" name="Port" type="string" />
            <!-- Path to mysqldump -->
            <Value data="/usr/bin/mysqldump" name="mysqldump path"
             type="string" />
         </Key>
        <!-- This includes the database you want to backup -->
        <!-- Copy and paste the whole <Key> to add more selected sources --     >
         <Key name="Selected Source">
             <!-- Please enter the path in the format of
             "MySQL/_YOUR_FILE_NAME_" -->
             <Value data="MySQL/classicmodels" name="Path" type="string" />
         </Key>
         <Key name="Selected Source">
             <!-- Please enter the path in the format of
             "MySQL/_YOUR_FILE_NAME_" -->
             <Value data="MySQL/employees" name="Path" type="string" />
        </Key>
         <Key name="Selected Source">
             <!-- Please enter the path in the format of
             "MySQL/_YOUR_FILE_NAME_" -->
             <Value data="MySQL/sakila" name="Path" type="string" />
         </Key>

         <Key name="Selected Source">
             <!-- Please enter the path in the format of
             "MySQL/_YOUR_FILE_NAME_" -->
             <Value data="MySQL/world" name="Path" type="string" />
         </Key>
        <!-- This excludes the database from the included source -->
         <!-- Copy and paste the whole <Key> to add more deselected sources     -->
         <Key name="Deselected Source">
             <!-- Please enter the path in the format of
             "MySQL/_YOUR_FILE_NAME_" -->
             <Value data="MySQL/information_schema" name="Path"
             type="string" />
         </Key>
         <Key name="Deselected Source">
             <!-- Please enter the path in the format of
             "MySQL/_YOUR_FILE_NAME_" -->
             <Value data="MySQL/performance_schema" name="Path"
             type="string" />
         </Key>
         <!-- Settings for your scheduled backups -->
         <Key name="Schedule Settings">
             <!-- Enable scheduled backup on this computer -->
             <!-- Y: Yes -->
             <!-- N: No -->
             <Value data="Y" name="Enable" type="boolean" />
             <!-- Daily settings -->
             <!-- Copy and paste the whole <Key> to add more daily schedules
    -->
             <Key name="Daily Schedule Settings">
                 <!-- Name of schedule -->
                 <Value data="Daily-Schedule" name="Name" type="string" />
                 <!-- Start hour -->
                 <!-- 0, 1, 2... 23 -->
                 <!-- This value will be ignored if the schedule is set to be
periodic ("Interval" field contains value other than -1) -->
                 <Value data="19" name="Hour" type="integer" />
                 <!-- Start minute -->
                 <!-- 0, 1, 2... 59 -->
                 <!-- This value will be ignored if the schedule is set to be
periodic ("Interval" field contains value other than -1) -->
                 <Value data="30" name="Minute" type="integer" />
                 <!-- Interval -->
                 <!-- 1  : 1 minute -->
                 <!-- 2  : 2 minutes -->
```

```
                <!-- 3  : 3 minutes -->
                <!-- 4  : 4 minutes -->
                <!-- 5  : 5 minutes -->
                <!-- 6  : 6 minutes -->
                <!-- 10 : 10 minutes -->
                <!-- 12 : 12 minutes -->
                <!-- 15 : 15 minutes -->
                <!-- 20 : 20 minutes -->
                <!-- 30 : 30 minutes -->
                <!-- 60 : 1 hour -->
                <!-- 120: 2 hours -->
                <!-- 180: 3 hours -->
                <!-- 240: 4 hours -->
                <!-- 360: 6 hours -->
                <!-- 480: 8 hours -->
                <!-- 720: 12 hours -->
                <!-- A value of -1 means a non-periodic normal schedule -->
                <Value data="-1" name="Interval" type="integer" />
                </Key>
        </Key>
        <!-- This is the collection of destinations -->
        <Key name="Destination Settings">
            <Value data="-1" name="concurrency-level" type="integer" />
            <!-- AhsayCBS destination is where the files are backup to server -->
            <Key name="AhsayCBS Destination Settings">
            </Key>
            <!-- Local destination means backup files are stored in your
    computer -->
            <!-- Copy and paste the whole <Key> to add more local
            destinations -->
            <Key name="Local Destination Settings">
                <!-- Name of your destination -->
                <Value data="local" name="Name" type="string" />
                <!-- Directory to store your backup files -->
                <!-- e.g. /tmp -->
                <Value data="/localbackup" name="Local Path" type="string"
        />
            </Key>
        </Key>
        <!-- This shows the in-file delta setting -->
        <Key name="In-file Delta Setting">
            <!-- Enable in-file delta backup -->
            <!-- Y: Yes -->
            <!-- N: No -->
           <Value data="Y" name="Enable" type="boolean" />
           <!-- Default in-file delta type -->
           <!-- D: Differential -->
           <!-- I: Incremental -->
           <Value data="D" name="Default Delta Type" type="string" />
        </Key>
    </Key>
</Setting>
```

Appendix D Example of MySQL Database Backup Set with periodic backup schedule

Backup set configurations:

Backup Set Name	MySQL Daily
Temporary Working Directory	/tmp
Remove temporary files after backup	Yes
Compression Type	Fast
Weekly schedule	Every 8 hours from Monday to Friday
Destination	AhsayCBS
Backup Source	All MySQL databases
Exclude	MySQL/information_schema, MySQL/performance_schema
In-File Delta Type	Incremental

MySQL database settings:

ID	root
Password	pwd123
Hostname	localhost
Port	3306
Mysqldump path	/usr/bin/mysqldump

Configurable items are highlighted in red.

```
<?xml version="1.0" encoding="UTF-8"?>
<Setting>
    <!-- This is the backup set setting -->
   <Key name="Backup Set Setting" allowMultiple="Y">
        <!-- Backup set type (Read Only) -->
        <Value data="MySQL" name="Type" type="string" />
        <!-- Backup set name -->
        <Value data="MySQL Daily" name="Name" type="string" />
        <!-- Temporary directory for storing backup files -->
        <Value data="/tmp" name="Temporary Working Directory"
        type="string" />
        <!-- Remove temporary files after backup -->
       <!-- Y: Yes -->
       <!-- N: No -->
       <Value data="Y" name="Delete temporary files after backup"
        type="boolean" />
       <!-- Select compression type -->
       <!-- GzipDefaultCompression  : Normal -->
       <!-- GzipBestSpeedCompression: Fast (Compressed size larger than
    normal) -->
        <!-- SnappyDefaultCompression: Fast with optimization for local -->
       <!-- Leave the field blank for no compression -->
       <Value data="GzipBestSpeedCompression" name="Compression Type"
        type="string" />
       <!-- This shows the MySQL Database setting -->
       <Key name="MySQL Database Setting">
            <!-- MySQL Login Name -->
            <Value data="root" name="Username" type="string" />
            <!-- MySQL Password -->
            <Value data="pwd123" name="Password" type="string" />
            <!-- MySQL Host -->
            <Value data="localhost" name="Host" type="string" />
            <!-- MySQL Port -->
            <Value data="3306" name="Port" type="string" />
```

```
            <!-- Path to mysqldump -->
            <Value data="/usr/bin/mysqldump" name="mysqldump path"
            type="string" />
        </Key>
        <!-- This includes the database you want to backup -->
        <!-- Copy and paste the whole <Key> to add more selected sources -     ->
       <Key name="Selected Source">
            <!-- Please enter the path in the format of
            "MySQL/_YOUR_FILE_NAME_" -->
            <Value data="MySQL" name="Path" type="string" />
        </Key>
       <Key name="Deselected Source">
            <!-- Please enter the path in the format of
            "MySQL/_YOUR_FILE_NAME_" -->
            <Value data="MySQL/information_schema" name="Path"
            type="string" />
        </Key>
        <Key name="Deselected Source">
            <!-- Please enter the path in the format of
            "MySQL/_YOUR_FILE_NAME_" -->
            <Value data="MySQL/performance_schema" name="Path"
            type="string" />
        </Key>

        <!-- Settings for your scheduled backups -->
       <Key name="Schedule Settings">
            <!-- Enable scheduled backup on this computer -->
            <!-- Y: Yes -->
            <!-- N: No -->
            <Value data="Y" name="Enable" type="boolean" />
            <Key name="Weekly Schedule Settings">
                <!-- Name of schedule -->
                <Value data="Weekly-Schedule" name="Name" type="string"       />
                <!-- Start hour -->
                <!-- 0, 1, 2... 23 -->
                <!-- This value will be ignored if the schedule is set to be
periodic ("Interval" field contains value other than -1) -->
                <Value data="21" name="Hour" type="integer" />
                <!-- Start minute -->
                <!-- 0, 1, 2... 59 -->
                <!-- This value will be ignored if the schedule is set to be
periodic ("Interval" field contains value other than -1) -->
                <Value data="0" name="Minute" type="integer" />
                <!-- Interval -->
                <!-- 1   : 1 minute -->
                <!-- 2   : 2 minutes -->
                <!-- 3   : 3 minutes -->
                <!-- 4   : 4 minutes -->
                <!-- 5   : 5 minutes -->
                <!-- 6   : 6 minutes -->
                <!-- 10  : 10 minutes -->
                <!-- 12  : 12 minutes -->
                <!-- 15  : 15 minutes -->
                <!-- 20  : 20 minutes -->
                <!-- 30  : 30 minutes -->
                <!-- 60  : 1 hour -->
                <!-- 120: 2 hours -->
                <!-- 180: 3 hours -->
                <!-- 240: 4 hours -->
                <!-- 360: 6 hours -->
                <!-- 480: 8 hours -->
                <!-- 720: 12 hours -->
                <!-- A value of -1 means a non-periodic normal schedule -->
                <Value data="480" name="Interval" type="integer" />
                <!-- Backup on these days of the week -->
                <!-- Y: Yes -->
                <!-- N: No -->
                <Value data="N" name="Sunday" type="boolean" />
```

```
                <Value data="Y" name="Monday" type="boolean" />
                <Value data="Y" name="Tuesday" type="boolean" />
                <Value data="Y" name="Wednesday" type="boolean" />
                <Value data="Y" name="Thursday" type="boolean" />
                <Value data="Y" name="Friday" type="boolean" />
                <Value data="N" name="Saturday" type="boolean" />
            </Key>
        </Key>
        <!-- This is the collection of destinations -->
        <Key name="Destination Settings">
            <Value data="-1" name=" concurrency-level " type="integer" />
            <!-- AhsayCBS destination is where the files are backup to server -->
            <Key name="AhsayCBS Destination Settings">
            </Key>
        </Key>
        <!-- This shows the in-file delta setting -->
        <Key name="In-file Delta Setting">
            <!-- Enable in-file delta backup -->
            <!-- Y: Yes -->
            <!-- N: No -->
            <Value data="Y" name="Enable" type="boolean" />
            <!-- Default in-file delta type -->
            <!-- D: Differential -->
            <!-- I: Incremental -->
            <Value data="I" name="Default Delta Type" type="string" />
        </Key>
    </Key>
</Setting>
```

Appendix E Login using Twilio

If Multi-Factor Authentication is enabled, press Enter to continue then provide your country code, phone number and email. A passcode will be sent to the phone number provided. Enter the passcode to continue logging in. The MFA Configuration screen will only be displayed when you login for the first time.

```
MFA Configuration
Multi-Factor Authentication is enabled for helping safeguard access to your
account.  Please provide a phone number to setup in the first-time login.
Press Enter to continue...

-------------------------------------------
Supported Country List:
Andorra (+376)
United Arab Emirates (+971)
Afghanistan (+93)
Antigua and Barbuda (+1268)
Anguilla (+1264)
Albania (+355)
Armenia (+374)
Angola (+244)
Argentina (+54)
American Samoa (+1684)
Austria (+43)
Australia, Christmas Island, Cocos (Keeling) Islands (+61)
Aruba (+297)
Åland Islands, Finland (+358)
Azerbaijan (+994)
Bosnia and Herzegovina (+387)
Barbados (+1246)
Bangladesh (+880)
Belgium (+32)
Burkina Faso (+226)
Bulgaria (+359)
Bahrain (+973)
Burundi (+257)
Benin (+229)
Bermuda (+1441)
Brunei (+673)
Bolivia (+591)
Brazil (+55)
Bahamas (+1242)
Bhutan (+975)
Botswana (+267)
Belarus (+375)
Belize (+501)
DR Congo (+243)
Central African Republic (+236)
Republic of the Congo (+242)
Switzerland (+41)
Ivory Coast (+225)
Cook Islands (+682)
Chile (+56)
Cameroon (+237)
China (+86)
Colombia (+57)
Costa Rica (+506)
Cuba (+53)
```

Cape Verde (+238)
Cyprus (+357)
Czechia (+420)
Germany (+49)
Djibouti (+253)
Denmark (+45)
Dominica (+1767)
Dominican Republic (+1809)
Algeria (+213)
Ecuador (+593)
Estonia (+372)
Egypt (+20)
Eritrea (+291)
Spain (+34)
Ethiopia (+251)
Fiji (+679)
Falkland Islands, South Georgia (+500)
Micronesia (+691)
Faroe Islands (+298)
France (+33)
Gabon (+241)
Grenada (+1473)
Georgia (+995)
French Guiana (+594)
Guernsey, Isle of Man, Jersey, United Kingdom (+44)
Ghana (+233)
Gibraltar (+350)
Greenland (+299)
Gambia (+220)
Guinea (+224)
Guadeloupe, Saint Barthélemy, Saint Martin (+590)
Equatorial Guinea (+240)
Greece (+30)
Guatemala (+502)
Guam (+1671)
Guinea-Bissau (+245)
Guyana (+592)
Hong Kong (+852)
Honduras (+504)
Croatia (+385)
Haiti (+509)
Hungary (+36)
Indonesia (+62)
Ireland (+353)
Israel (+972)
India (+91)
Iraq (+964)
Iran (+98)
Iceland (+354)
Italy (+39)
Jamaica (+1876)
Jordan (+962)
Japan (+81)
Kenya (+254)
Kyrgyzstan (+996)
Cambodia (+855)
Kiribati (+686)
Comoros (+269)
Saint Kitts and Nevis (+1869)

South Korea (+82)
Kuwait (+965)
Cayman Islands (+1345)
Kazakhstan (+76)
Laos (+856)
Lebanon (+961)
Saint Lucia (+1758)
Liechtenstein (+423)
Sri Lanka (+94)
Liberia (+231)
Lesotho (+266)
Lithuania (+370)
Luxembourg (+352)
Latvia (+371)
Libya (+218)
Morocco, Western Sahara (+212)
Monaco (+377)
Moldova (+373)
Montenegro (+382)
Madagascar (+261)
Marshall Islands (+692)
Macedonia (+389)
Mali (+223)
Myanmar (+95)
Mongolia (+976)
Macau (+853)
Martinique (+596)
Mauritania (+222)
Montserrat (+1664)
Malta (+356)
Mauritius (+230)
Maldives (+960)
Malawi (+265)
Mexico (+52)
Malaysia (+60)
Mozambique (+258)
Namibia (+264)
New Caledonia (+687)
Niger (+227)
Norfolk Island (+672)
Nigeria (+234)
Nicaragua (+505)
Netherlands (+31)
Norway (+47)
Nepal (+977)
Niue (+683)
New Zealand, Pitcairn Islands (+64)
Oman (+968)
Panama (+507)
Peru (+51)
French Polynesia (+689)
Papua New Guinea (+675)
Philippines (+63)
Pakistan (+92)
Poland (+48)
Saint Pierre and Miquelon (+508)
Puerto Rico (+1787)
Palestine (+970)
Portugal (+351)

```
Palau (+680)
Paraguay (+595)
Qatar (+974)
Romania (+40)
Serbia (+381)
Russia (+7)
Rwanda (+250)
Saudi Arabia (+966)
Solomon Islands (+677)
Seychelles (+248)
Sudan (+249)
Sweden (+46)
Singapore (+65)
Slovenia (+386)
Slovakia (+421)
Sierra Leone (+232)
San Marino (+378)
Senegal (+221)
Somalia (+252)
Suriname (+597)
SouthSudan (+211)
São Tomé and Príncipe (+239)
El Salvador (+503)
Syria (+963)
Swaziland (+268)
Turksand Caicos Islands (+1649)
Chad (+235)
Togo (+228)
Thailand (+66)
Tajikistan (+992)
Timor-Leste (+670)
Turkmenistan (+993)
Tunisia (+216)
Tonga (+676)
Turkey (+90)
Trinidad and Tobago (+1868)
Taiwan (+886)
Tanzania (+255)
Ukraine (+380)
Uganda (+256)
United States, Canada (+1)
Uruguay (+598)
Uzbekistan (+998)
Saint Vincent and the Grenadines (+1784)
Venezuela (+58)
British Virgin Islands (+1284)
United States Virgin Islands (+1340)
Vietnam (+84)
Vanuatu (+678)
Samoa (+685)
Kosovo (+383)
Yemen (+967)
Mayotte, Réunion (+262)
South Africa (+27)
Zambia (+260)
Zimbabwe (+263)
-------------------------------------
The list above shows all the supported countries and corresponding country
code
```

```
Please enter your country code.
Country code : +63
Enter Phone number : 1234567890

There is no contact email address defined in your account.
Please enter an email address for account recovery.
Email : sample@email.com
We will send you a SMS message with passcode to your entered phone number:
Philippines (+63) - 1234567890. Continue?
(1). Yes, send SMS message
(2). Change country code
(3). Modify phone number
(4). Cancel
Your Choice : 1

A SMS message with a passcode was already sent to the phone number
Philippines (+63) - ******7890 (Expiry time: 07/04/2019 09:39)
Please enter the passcode with AWKQ prefix to continue login.
Passcode  : 722458
```

This will be the screen displayed for subsequent log ins. Select option (1) to receive the passcode.

```
MFALogin
--------
Please select phone number to receive passcode via SMS message to continue
login.
(1). Philippines (+63) - ******7890
(2). Need help logging in

Your Choice : 1

A SMS message with a passcode was already sent to the phone number
Philippines (+63) - ******7890 (Expiry time: 04/06/2019 09:51)
Please enter the passcode with FCAK prefix to continue login.
Passcode : 481267
```

If you need help logging in select option (2). Provide your email address.

```
MFALogin
--------
Please select phone number to receive passcode via SMS message to continue
login.
(1). Philippines (+63) - ******7890
(2). Need help logging in
Your Choice : 2

Please enter contact email address to receive email with login instruction.
Email : sample@email.com

An email with link sent to sample@email.com. Please follow the instruction
from email to continue login
```