Data Synchronization

Synchroization between operating Stations

Content

1 General

This manual describes the process of database and data file synchronization between the BatchXpert Stations. This process is done by the "BatchXpert Synch Service" is used to synchronize data between BatchXpert Stations. This application synchronizes the databases and some important files between all BatchXpert stations. This ensures that any change in the Batch configuration data, such as Recipes and such, are automatically synchronized to all connected stations.

Each BatchXpert station participates in this Synchronization network, and it does not matter where the files or configuration is changed. It is always synchronized between all stations of the network.

The Synchronization Mechanism can be optionally activated in the "BatchXpert Management Console". If started, it imitates the "BatchXpert Synchronization Service" in the Task area that allows for monitoring of the synchronization process.

2 What data is being Synchronized

The synchronization process synchronizes the following data between each station:

- Batch Configuration data such as:
    - Recipes
    - Batch Configuration
- Report Templates
- Material Configuration
- User Configuration (GraphPic)

3 How des Synchronization work

The data Synchronization is being performed by the "BatchXpert Synchronization Service" and operates in an "Peer to Peer" fashion. Each BatchXpert Station connects to all other Stations in the Network. Each Station checks all other station if they have actualized data, and if so, downloads them from the station with the most current data.
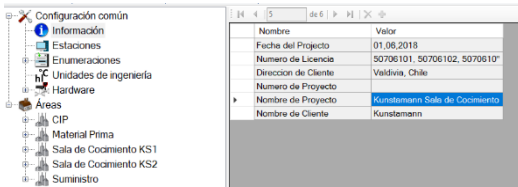

Figure 1 The Project Name is used as Identifying Number

Each Project that is started on a BatchXpert station has an Identifying Number, and only Stations with the same Identifier are allowed to Synchronize data between each other. This allows for various BatchXpert Applications to run on different stations, without mixing data during Synchronization.

3.1 Peer to Peer

The Peer to Peer principle does not need any central server and is a distributed synchronization mechanism, in which each Station is an equal participant. All Stations perform the same synchronization mechanism, and no Station acts as a Server. New Stations can be added at any moment, without restarting the Synchronization mechanism. All stations permanently scan the available network for any other BatchXpert Station and if one is found, they establish a connection to it, to periodically check for data changes. New Stations are detected automatically.

3.2 Network Technology

All peers communicate through an TCP/IP channel with each other. All functionality is handled through these channels, and no further communication is required for the data synchronization to be available. No Network share for data exchange is required.

By default, the Synchronization Service uses TCP Port 8883 for the communication. This port must be enabled in the Networking infrastructure (Firewalls, switches, etc.)
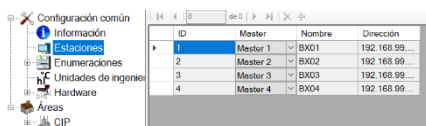
3.3 How do Stations Discover each other

Figure 2 Station Configuration in the Batch Configurator

Each station tries to establish a communication to each of the configured Stations in the Batch Configuration database. In the Batch Configuration Database one can define all stations existing in a network with their corresponding IP Address and Network Names. After connecting the configured stations, the stations start a Discovery mechanism on the network to find Stations that are not configured in the Database. If a Station is discovered, a communication is being establish to this station.

When a Connection is established, the Station first checks if the Stations are compatible for Synchronization, and if not, the connection is rejected and a message is sent to the user. During connection, the following is checked for compatibility:
- System time of both stations is within 1 minute of time difference
- Both Stations have the same SQL-Server Version
- Both Station have the same Project Name

By default, the discovery mechanism is using UDP Port 3702.

3.4 System Time

The system time is very important on the Stations, since this is required for accurate Timestamping of all changed data. To avoid problems during synchronization, the System Time difference between the stations is permanently monitored between them. If any station has a difference of more than 1 minute, it is rejected by the other stations and can no longer participate in the synchronization. In the case of a Time difference, a Message is raised to the operator, to indicate this kind of error.

For this reason, it is important to keep the System time synchronized between the Stations.

3.5 The Synchronization Directory

During Data Synchronization, the Synchronization service needs to copy temporary data to a Synchronization directory, where they are available as "Packages" for the Clients. The Synchronization Service is automatically Maintaining the Synchronization directory.

This Directory by default is located at: C:\Daten\Transfer\Data Sync\

It is NOT required that this directory is accessible through an "Windows Network Share". The data transfer and access are handled internally without the need for Network Shares.

3.6 Database Synchronization

Data base Synchronizations are always performed as "Solid" or "Full" synchronizations. This means, that always the full database is synchronized, and not only parts of the database. This ensures that data integrity is maintained at all times. This also means that the Synchronization is done by the "Last Change wins" principle. If two people are editing the database at the same time, then the last one to change the database "wins".

Data Synchronization of one database takes about 5 minutes to propagate through the stations. This is because after a database has changed, the data is not synchronized immediately, but after a delay time of a few minutes. This is done because usually databases are changed multiple times in short orders, and this delay time helps to avoid multiple repeated data synchronizations.

3.7 File Synchronization

The File synchronization is done in a similar manner as the Database Synchronization. It is to mention, that files are never deleted during Synchronizations. Only new files are added and existing files are updated.

4 How to Set Up synchronization

4.1 Requisites

- BatchXpert Version 1.6 or above
- Same BatchXpert Version on all Stations
- Same SQL Server Versions on all Stations
- TCP Port 8883 must be available and not be blocked by the Firewall
- UDP Port 3702 must be available for Discovery to work
- The "BatchXpert Sync Service" must be allowed in the Firewall settings
- Read and Write Access to "C:\Daten\Transfer\Data Sync\"

Generally speaking, the requirements for the Data synchronization are very modest. Basically, it is required that all stations have the same BatchXpert and SQL Server Versions. If not, data synchronization may not work as intended.

Also, the "BatchXpert Sync Service" and TCP port 8883 must be allowed in any Firewall settings. For the discovery mechanism to work, the UDP port 3702 must be unlocked in the Firewall settings. If this port is blocked, only configured stations can be connected, and the discovery mechanism does only work for the Station configured in the "Batch Configurator".

Since the Data transfer is handled through the TCP channel, no Windows Network shares are required. Only normal local Read and write access to the Synchronization Directory is required. As stated above, it is not necessary that this directory is accessible as a Network share.

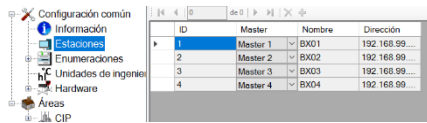## 4.2 Configure Stations in Batch Configuration

*Figure 3 Station Configuration in the "Batch Configurator"*

The "BatchXpert Batch Configurator" allows for the configuration of the BatchXpert Stations that exist in a given Project. This configuration allows the configuration of the Stations "Network Names" and "IP-Addresses".

These Configured stations are constantly being checked by the Stations, and if they are found, a communication is established. Apart from the Configured stations, the system also constantly executes an "Discovery" process, which optionally also discovers non configured stations.

It is recommended to always configure all BatchXpert Stations and to not relies on the Discovery mechanism, since this discovery mechanism may easily be blocked by firewall settings.

4.3 Assign a Valid Project ID

Figure 4 Project Settings in the "Batch Configurator"
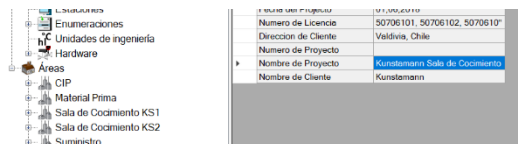
In order for the Stations to identify if the same project is running on both stations that are trying to synchronize, the same Project Identifier must be set on all Stations. As Identifier, the "BatchXpert sync Service" uses the "Project Name" from the Project settings which can be adjusted in the "Batch Configurator". If a Station with a different Project name tries to connect, the connection is refused and the Synchronization is not being executed.

Usually the Project Name is set once during Engineering, and an initial backup is restored to each Station. This inherently already ensures that the Project Name is the same on all Stations. This means that usually one does not have to worry about this setting. Nevertheless, it is mentioned here, because it may be important if different projects are started on the BatchXpert Stations, or if an Engineering PC with a different Project is connected to the system. Since the Project name will be different, the Synchronization will be rejected.
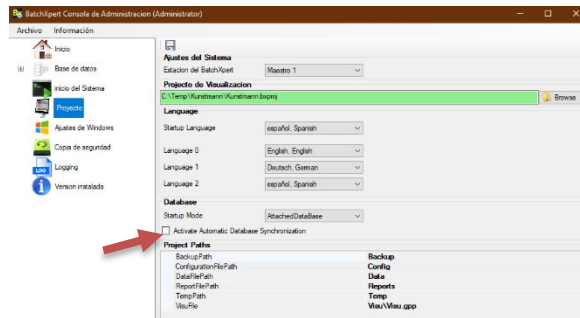
4.4 Activate Synchronization

Figure 5 Project Settings in the "Management Console"

To activate the Synchronization, one has to enable the "Automatic Database Synchronization" in the Project settings of the BatchXpert Project file. This can be easily done in the "BatchXpert Management Console" under the "Project" settings.

After activating the Synchronization, the BatchXpert Project has to be Shut down and Restarted, in order to start up the Synchronization service. After Restarting, please review the BatchXpert Sync Service in the Windows Task Bar.

Figure 6 "Sync Service" in the Task bar

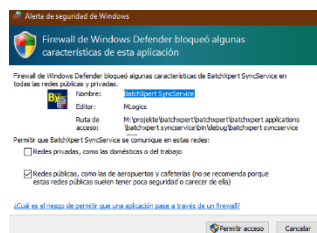## 4.5 Allow Network Access

Figure 7 Firewall Message to Allow Access to the Network

When Synchronization is first started, the Windows Firewall normally asks the user to consent for the "BatchXpert Sync Service" to access the Network. This Message must be confirmed. If Confirmed, this already creates all necessary "Firewall Exceptions" for the application to run, so no further settings on the Windows Firewall are needed.

This Action Requires Administrator Privileges, and cannot be performed by a non-elevated User.

5 Important Considerations

5.1 Time Synchronization

The Synchronization system constantly compares "Timestamps" of the databases and Files between the different "BatchXpert Stations", it is very important that the System Time of the Stations are accurate. If the System time of two stations would be different, for example due to a Summer/Winter Time change, the Time Stamps would result with a time difference and the database changes might be detected erroneously.

To compensate for this, one must take special precautions to keep the System time of the Stations in Synchronization. Usually this can be done by Settings "Windows Time sources" or similar settings. More details can be found in the Manual "Manual BatchXpert Time Synchronization".

5.2 SQL Server Versions

The database Synchronization is based around the concept that on any change the full database is backed up and restored on the requesting station. This ensures that the synchronization always transfers Consistent data between Stations, and completely eliminates the possibility of Configuration conflicts.

However, in general SQL Server databases do not allow for "Downgrading" of database files. This means, that a database may be "upgraded" to a newer SQL version, but never downgraded to an older version. If a Database was once upgraded to a newer SQL version, it can never again be used with previous Sql versions.

To ensure that all databases can be restored on all stations, every station in the BatchXpert System must have the same SQL-Server version, otherwise the aforementioned problems may arise. The "BatchXpert Sync Service" checks for the SQL Server version and does not allow for Synchronization of different versions.

If a Different SQL Version is detected in the system, a Message is sent to the Notification area of the Windows Operating System.

5.3 Firewall access

The "BatchXpert Sync Service" requires that TCP and UDP connection can be established between the Stations. If only the windows Firewall is used, the application can be easily unlocked the first time it is started.

However, if external Firewall solution are used, one must allow for the TCP and UDP connections to be available between the stations. The Synchronization mechanism does not require Windows Filesharing. It requires the following ports to be available on each "BatchXpert Station":

- TCP Port 8883 must be available and not be blocked by the Firewall
- UDP Port 3702 must be available for Discovery to work
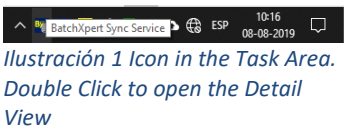
6 Check Synchronization

The easiest way to check the data Synchronization is by opening the "Detail" windows of the "BatchXpert Sync Service". The "Sync Service" can be found in the Task area with the icon named "BatchXpert Sync Service", and the detail window can be opened by double clicking on the icon or via the context menu that open when right clicking.
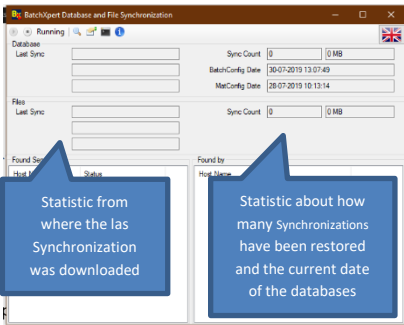

Ilustración 2 Detail View of the "BatchXpert Sync Service"

The Detail view already gives a very good insight in the current status of the Synchronization. The upper part of the Application gives statistics about the current Status of the Database and File synchronizations.

The Left part gives information about what database/File was transferred from where and when. The right part gives information about how many Synchronizations where restored on this machine and how much data was loaded from other Stations.
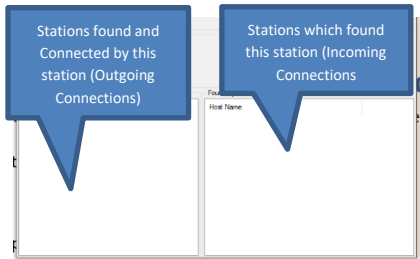
In the Lower part one can view the Servers that have been connected by this station, and the Stations that have found this station. This helps to identify eventual access problems caused for example due to "Firewall" or similar software. Normally each server should appear in both lists, meaning that this station found the server, and was also found by the other server.
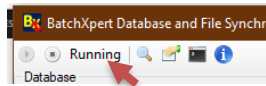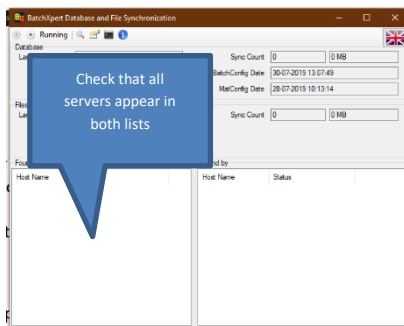
6.1 How to check if it is working

Ilustración 3 Current Status of the Service

The first thing to check is that the "BatchXpert Sync Service" is actually running. If it encounters some error during Startup, it will fail to fully start up and, shut down again. It will generate log messages about the exact nature of the problems. The Error can be found in the "Error logs".

Another thing to check is that all other "BatchXpert Stations" in the network have been found and that the Stations has been found by all other stations. For this one has to check the "Found Servers" and "Found by" lists, and confirm that all servers appear in both lists. This means that all servers could be connected by the local stations, and also that all server where able to establish a connection to this station.

When a Station only appears in one of the two lists, this usually indicates a problem with some firewall settings, that block the connections on one side of the Synchronization.
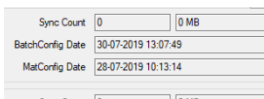

Ilustración 4 Sync Count

When the Server is "Running" and the stations appear in the list, the Synchronization is running correctly. To check if it is really working, the easiest way to accomplish is to make some database change in one of the

stations and then observe the "Sync Count" in all other stations. Usually it takes about 5 minutes for a Database change to be synchronized to the other stations. When the database was synchronized on a station, the "Sync count" should increase by one synchronization and the Current Database date should reflect the same timestamp than the server where the change was made.
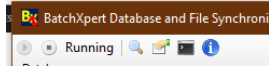
6.2 Error logs

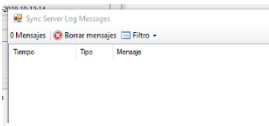*Ilustración 6 Menu in "BatchXpert Sync Servicie"*

To check what the system is doing, one can open the "Message log" from the

Toolbar of the "BatchXpert Sync Service". This window shows all new incoming Log messages from the Synchronization Service. WARNING! It will only show messages that where logged since the window was opened.

Ilustración 5 "Log File Viewer" in Windows Start Menu

Ilustración 7 Log Messages in "BatchXpert Sync Service"

To check for historic log messages, the "Log file viewer" is available in the Windows Start menu. In this application one has to select the "BatchXpert Sync Service.exe" log entries.
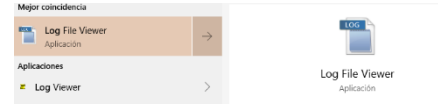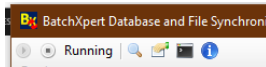
6.3 Shutdown and Restarting the Service

To restart the "BatchXpert Sync Service" one can Shut down and start up the server from the "Details" window of the Service. The Toolbar provides an "Stop" and "Start" button to perform the required action.

During startup and shutdown, it is recommended to open the "Message log" to check for eventual error and status messages. Be advised that the Message log view only shows messages since the window was opened, so it is recommended to open the Message log before shutting down or restarting the service.
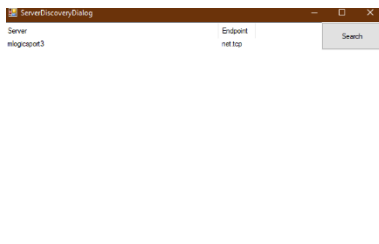
6.4 Check "Discovered Servers"

When error related to the Stations discovery are detected, meaning when stations do not appear either in the "Found servers" or in the "Found by" list, then one can check the discovery system directly to check if the servers are reachable by the discover mechanism in the first place.

Ilustración 8 Window to Find all available stations, not just the compatible ones

This window allows for the search of all "BatchXpert Sync Servers" in the Network, and also shows servers that might have been rejected due to System Time differences, SQL server version conflicts or due to other issues.

If a Station is found by the discover mechanism, but not by the Service, then the station is most likely rejected due to incompatibility of the Synchronization Service. To find out exactly what the problem is, one must check the "Error Logs" of the system and ensure the perquisites are met.

7 Troubleshooting

7.1 Firewall is blocking incoming Connections

If a connection cannot be established between two stations, one has to check if the Stations are "Pingable". If so, the most likely reason for the error is that the incoming (or even the Outgoing) connections are blocked by a Firewall.

If the Windows Firewall is used, then one can temporarily deactivate the Firewall on both stations to see if the connection is established. If this resolves the Problem, please check the "Firewall Exception" settings for the "BatchXpert Sync Service".

It is not recommended to use the system without Firewall.

7.2 System Time is different

Another common problem for Connection problems is that the System Time is different on the stations. When connecting, the system time of both stations is checked. If the difference is more than one minute, then the connection is rejected.

When a connection is rejected, a Message is sent to the user in the Windows Notification area. Please check the "Error Logs" if there are Rejected messages. These are Log entries marked with "Error" or "Warning", stating System Time issues.

To resolve this problem, please adjust the System time in a way that it is the same on all stations.

7.3 System Time has changed

In some cases, it may happen, that the connection is initially without problem, but then suddenly it does not work anymore. This is most likely due to a change in the System Time. When the System Time changes, the "BatchXpert Sync Service" of the station automatically restarts and thus drops all incoming and outgoing connections.

Sometime this may happen due to Summer/Winter time period changes.

8 Consideration for Updating BatchXpert

One of the Requirements for the Synchronization to work is that all Stations must have the same BatchXpert version installed. When updating the BatchXpert version on the system, one will unavoidably create a situation where the Versions are different. Basically, the same procedure must be taken to update the SQL-Server version on the Stations. When an Update is installed, it must be installed on all Stations. Mixed Versions are not supported.

To account for that, the following procedure is recommended.

1. Shut down the BatchXpert Project on the station. This will also shut down the Sync Service
2. Install the Update of BatchXpert/SQL Server
3. Start up the BatchXpert Project and confirm any Upgrade Warnings
4. Close the "BatchXpert Sync Service" manually. This can be done by opening the "Details" Menu of the Service.
5. Proceed to the Next Station and repeat step 1 to 4 until all stations are updated
6. When all stations are updated, start up the "BatchXpert Sync Service" Again on all Stations

9 Consideration for Restoring a Backup

When restoring a Back to a BatchXpert Station, one has to keep in mind that the Synchronization service is meant to update an older database with a newer one. Since an Restore inevitably will restore an old version, the Sync service would update it as soon as it detects the older version.

If you want to Restore and distribute an old backup, then you can proceed the following way:

1. Shut down the BatchXpert project, this will also shut down the Sync Service
2. Restore the Backup
3. Start up the BatchXpert Project, and immediately stop the Synchronization Service.
4. Make any Change to the Database, so that the data is newer. For example, Change the name of some recipe, save, and then change it back.
5. Start the Synchronization Service again.
6. Know your restored database is the most current one, and will be Synchronized to all other stations.

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