BellHawk® Systems Corporation

Real-Time Work-in-Process and Materials Tracking Systems

www.BellHawk.com 508-865-8070

Exchanging Data with BellHawk

Introduction

BellHawk is specialized software that performs real-time license-plate container and work-in-process tracking using technologies such as barcode scanning and mobile data collection. It is a self-contained materials tracking and traceability system that can be run stand-alone.

It is recognized, however, that using BellHawk on a stand-alone basis will often require duplicate data entry with other systems, which can be time consuming and error prone. For this reason, BellHawk provides a set of interfaces and interface tools, described in this document, which can be used to automate data exchange with BellHawk.

BellHawk provides the capability to import and export both setup and operational data in the form of Excel spreadsheets. This capability can, in many cases, eliminate the need for the development of expensive interfaces. But it is recognized that there are circumstances in which the expense of developing automated data exchange interfaces can be a good business decision from a labor savings and mistake prevention viewpoint.

BellHawk Systems is not in the business of developing interfaces between systems. Our role in the marketplace is to be the experts in real-time operations and materials tracking systems and then to work with IT Departments, systems integrators, and other software developers to assist them in exchanging data with our BellHawk software.

To this end, we have developed a set of interface tools described here, for which we provide on-going support, to facilitate this process.

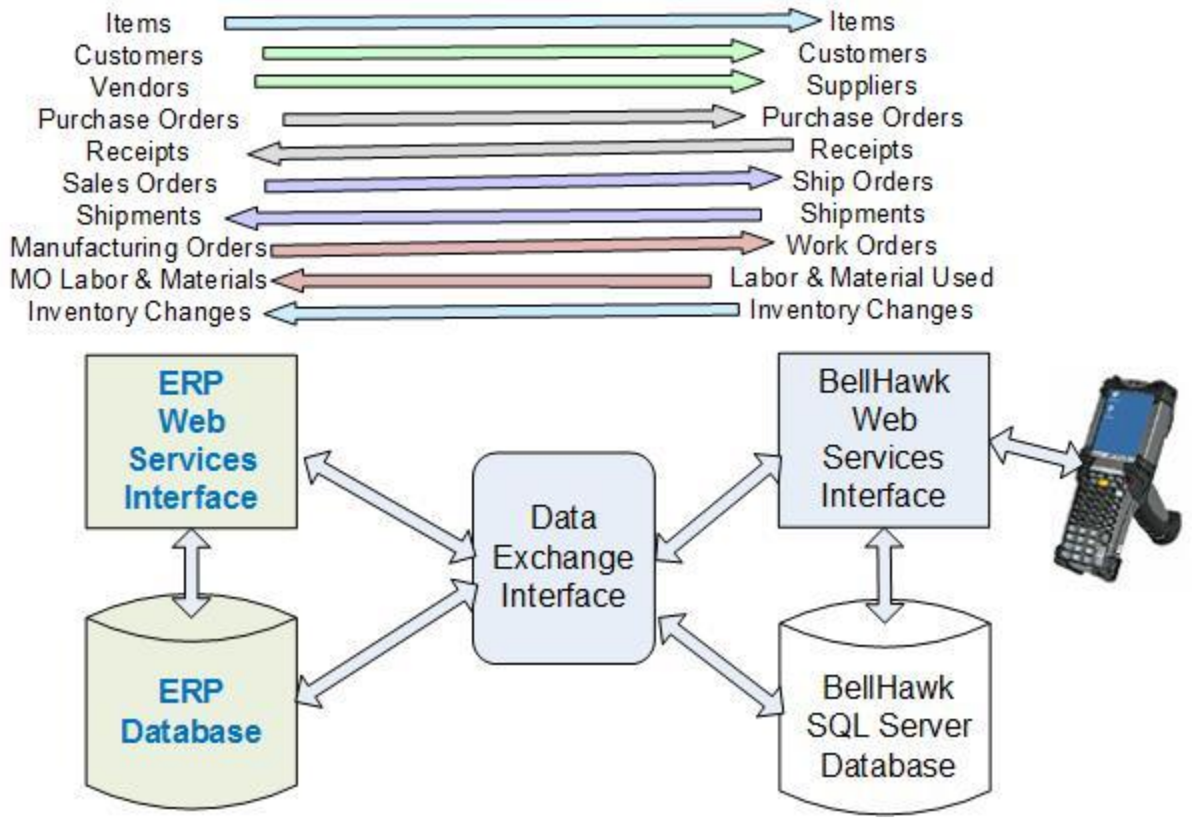
Data Exchange Interfaces Supported by BellHawk

- Using ODBC to directly read data from BellHawk database and write data back into the database using stored procedures. This requires detailed knowledge of the BellHawk database.
- Using the .Net BHSDK. This abstracts the interface to BellHawk into loading and storing high-level data objects (HLDOs). It avoids the need to have a detailed knowledge of the BellHawk database.
- Using the BellHawk SOAP/XML web-services interface. This performs to same functions as the BHSDK except that the .Net proxy calls communicate with BellHawk remotely over the Internet.
- Using the Bell-Connector toolset which integrates both the .Net and web-services interfaces into a mechanism that periodically checks systems for changes to designated HLDOs and maps the updates in a source system to changes to be made in a target system.

All of these interfaces, except directly communicating with the BellHawk database, require software development using Microsoft Visual Studio.Net. A possible exception to this is with the use of Bell-Connector and its ability to map parameters from an HLDO from one system into a similar HLDO in another system without writing code for simple data exchange requirements.

All these interface mechanisms are provided at no extra cost with the BellHawk software. However, any and all support needed from BellHawk technical staff in implementing data exchange interfaces must be paid for using Support Services Bundles.

Data Typically Exchanged between BellHawk and an ERP or Accounting System



Listed above are some of the data exchanges that can take place between an ERP or an accounting system and BellHawk. These exchanges typically take place by directly interacting with the systems databases or through their web-services interfaces.

In BellHawk these data objects are represented by High Level Data Objects (HLDOs) which serve as both a documentation of the underlying database and the representation used by the interfaces provided by BellHawk. Please see the user manuals for HLDOs on www.BellHawk.com, which are reachable through the Support Information tab.

The BellHawk Database

BellHawk uses an unencrypted Microsoft SQL Server database that can be read or written (with care) by any external application. The structure of this database is documented in the form of High Level Data Objects (see below).

BellHawk uses a well-structured database with many tables and multiple levels of indirection in storing its data for space efficiency. It also contains a large number of views and stored procedures, which are used to access and store away data in multiple tables in response to transactions.

BellHawk has a User Defined Parameters (UDP) option to allow BellHawk systems administrators to specify their own custom data capture fields for transactions, as well as for data objects such as POs, Sales Orders and Work Orders. This user defined parameter data is stored in special UDP columns in many tables. It is stored in the form of JSON encoded strings.

This use of UDP data enables BellHawk to be used for a wide variety of applications without customizing the database. This has enabled the database to remain relatively stable over long periods of time, with only additions made, when needed, to support new BellHawk features without affecting existing database capabilities.

High Level Data Objects

An important aspect of BellHawk is the use of HLDOs or High Level Data Object representations. These are used to document the contents of the database and to drive interface mechanisms.

HLDO's are an abstraction of data in the BellHawk database which hide all the indirections, as well as the underlying views and stored procedures that are used for retrieving or storing HLDO data in the BellHawk database.

Examples of HLDOs are Item Master records, Purchase Order headers and lines, Sales Order headers and lines, Work Orders, Work Order Operations, Work Order Operation Part-in and Part Out resources, as well as transactional data such as Receipts, Shipments and Inventory changes. Each HLDO consists of a keyword such as "Item", "PO" and "SOLine" and a set of name-value strings parameters, such as for "Item Number" or "Customer Number".

HLDOs can also be used to access transaction history tables, such as those that record inventory, work orders, employee and equipment transactions, which are maintained by BellHawk. This includes the history of shipments and receipts.

Using some of the interface mechanisms described below, this HLDO representation makes it possible to exchange data with BellHawk without the developer needing to understand the structure of the BellHawk database or, in the case of storing data to the database, which stored procedures to use or indirections to maintain. This use of sets of strings by HLDOs also makes it possible to exchange data with systems using very different data representations from those used by BellHawk in its SQL database.

The HLDO definitions for a BellHawk database are maintained as an XML metadata file, which is used by the BellHawk software itself for reading and writing its database. The DEXEL utility, provided as part of the BellHawk System Admin functionality, enables HLDO definitions to be exported in the form of Excel spreadsheets, thus providing a self-documenting feature for the BellHawk database.

For more information please see the document "Bell-Connector High Level Data Object User Manual" which is available in the User Manual section of www.BellHawk.com.

Interfacing Alternatives

Directly Interfacing to the BellHawk Database

The BellHawk database is an unencrypted SQL Server database, with a well-defined table structure that can be read directly by an external program or can be accessed using one of the large number of Views that are available as part of the database.

Writing data back to the database requires detailed knowledge of how BellHawk updates its database, as there are often multiple tables that need to be updated at the same time. For this reason it is recommended that these updates be performed using Stored Procedures which are designed to handle these multiple simultaneous updates.

Clients can use Transact SQL commands to:

1. Export data objects such as Item Master records, POs, Sales Orders, and Work Orders from other systems into the BellHawk database.
2. Read the transaction history tables in order to produce custom reports, website portals, and exports to "Big Data" databases for subsequent analysis.
3. Extract the transaction history data for use in ERP or accounting systems. This typically includes receipts, shipments, and work order cost data.

It is important to recognize that BellHawk does not track "inventory" as such. Instead it has a containers table in which BellHawk tracks the contents, in real-time, of every barcoded box, bag, barrel, reel, and roll as well as individually barcoded items and assemblies.

There are inventory snapshot stored procedures that will add up the inventory of available parts but BellHawk does not store or track inventory totals like an accounting or ERP system. So if you want to know the inventory at a specific date, then you need to export this data to another database or system, from which this historical inventory data can be extracted.

It is also possible to used stored procedures within the database to take transactions from external systems (such as process control and test systems) and to feed these to BellHawk. While there are HLDO definitions to support these actions, it is recommended that interface developers consult with the BellHawk staff (or carefully read through the whole chain of underlying stored procedures that are called as a result) before coding these transaction interfaces.

Excel Imports and Exports

HLDOs can be imported manually into BellHawk using the Excel Setup screen on BellHawk. These can be in .xlx, .xlxs, or .CSV format. These must be in the standard HLDO format with the column headers corresponding to parameter names defined for the HLDO data items, as described in the "BellHawk Setup User Manual".

Excel imports can also be used for importing BOMs, POs, customer orders, and work orders into BellHawk from external systems. Excel exports for use by other systems can be used for the export of shipments, receipts, and inventory snapshots.

Excel or CSV exports from other systems will probably be in a different format from the BellHawk standard HLDO format. These exports will need to be converted to the BellHawk standard HLDO format before imports can be performed into BellHawk. Alternately, for imports done on a repetitive basis, BellHawk Systems staff can modify BellHawk to directly import the data exported from an external system.

BellHawk has a number of manual Excel exports available, such as for receipts and shipments and inventory snapshots, based on specified parameters for the export. These will typically not be in a format that is suitable for directly importing into another program and will need to be converted. BellHawk Systems staff can modify BellHawk to directly export the data in a format that can be directly imported by an external system.

BHSDK

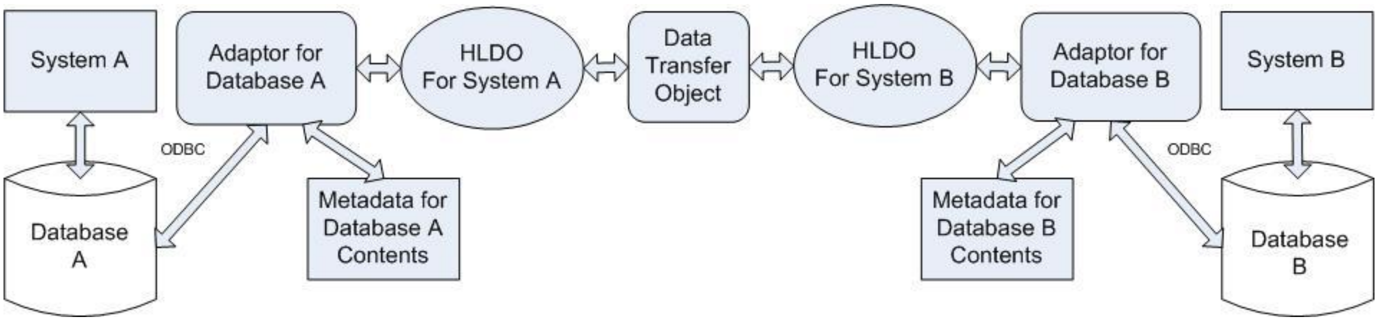
This is a .Net DLL that can be used within a Visual Studio development environment to lookup and store HLDOs in the BellHawk database using an ODBC connection to the BellHawk database. It is typically used by VB.Net programmers to implement software to exchange data between BellHawk and an external system. It incorporates extensive data checking to make sure that data being stored in the BellHawk database is correct and will not corrupt BellHawk.

Please see the "BHSDK User Manual" on the BellHawk Website for details.

BellHawk Web Services Interface

BellHawk has a SOAP/XML interface that provides similar functionality to the BHSDK except that BellHawk is accessed over the Internet rather than through a local ODBC connector. BellHawk Web Services has a WDSL interface that can be used to generate proxy remote procedure calls that enable BHSDK functions, such as Store and Lookup, to be invoked on a remote basis.

Bell-Connector



Bell-Connector was developed as a software platform that would provide, or automatically generate, over 90% of the code needed for implementing automated data exchange interfaces between systems that could run 24x7, without human intervention, for long periods of time.

The Bell-Connector platform provides features such as a website interface to be able to schedule and monitor data transfers, a launcher for automatically running data transfer functions, interface adaptors to a wide range of databases and other systems interfaces, extensive error detection and correction capabilities, and Email alerting to a system's administrator when problems arise.

Bell-Connector also has capabilities such as automated character conversion, automated 1:1 mapping between tables in systems, and the ability to store, correct, and resubmit rejected transfers.

The Bell-Connector platform itself is fully supported code by BellHawk Systems that runs on a Windows Workstation or Server platform. It is provided at no additional cost with the BellHawk software. However, any and all support required in its use must be paid for in the form of pre-paid Support Services Bundles.

The Bell-Connector toolset is an extension to the Visual Studio IDE. It enables the development of data transfer objects (DTOs) in VB.Net (or C#) that transfer between one or more source HLDOs and one or more target HLDOs. It includes an extensive BCclass DLL for manipulating HLDOs.

The Bell-Connector is designed to be used by a team. One person in that team may be an expert in the system that BellHawk will exchange data with, another person may be an expert in BellHawk and yet a third person may be a programmer-analyst or systems integrator concerned with the translation of the HLDOs between the different systems.

Bell-Connector also has features that enable it to be used for generating intelligent alerts by Email and for delivering data by FTP to remote sites when events are detected within the BellHawk database.

There is a full set of user manuals for the Bell-Connector and its various extension, including overview and architecture documents in the User Manuals section of www.BellHawk.com, which can be reached through the "Find" tab on this website.

Standard Interfaces

BellHawk Systems does not provide standard interfaces to third party software. This is because it would be impossible to have experts on its staff who are knowledgeable in each of the many hundreds of ERP and accounting systems in common use and which could be interfaced with BellHawk. Instead BellHawk Systems can refer clients to systems integrators who are knowledgeable in a specific ERP or accounting system and who can assist the client with implementing an automated data exchange interface with BellHawk.

The exception to this is QuickBooks Enterprise for which BellHawk Systems does support a standard interface based on the use of Bell-Connector. This interface is provided at no additional cost with BellHawk but BellHawk Systems charges its clients on an hourly rates basis for all support and any modifications needed to this interface.

For all other systems, BellHawk Systems provides technical support for its clients IT staff, and their consultants and systems integrators in developing data exchange mechanisms which use the interfaces that are provided at no additional cost with BellHawk. This support is done on an hourly rates basis, as part of pre-paid Support Services Bundles.

Commentary on Interface Development

Cost and Time Required for Interface Development

The least expensive way to exchange data with BellHawk is in the form of Excel spreadsheets. There is no cost if the standard BellHawk HLDO import and export formats are used. Also it is relatively inexpensive for BellHawk Systems' technical staff to add custom Excel import and export formats to BellHawk that match those used by external systems.

The cost and complexity of interface development rises significantly as soon as the development of automated data exchange interfaces is needed. While tools such as Bell-Connector can provide over 90% of the needed code, interface development can still be a lengthy and expensive process due to the potentially large number of data objects to be exchanged and the extensive amount of testing required.

BellHawk Systems is not in the business of developing interfaces. Our role in the marketplace is to be the experts in real-time operations and materials tracking systems and then to work with IT Departments, Systems Integrators, and other software developers to assist them in exchanging data with our BellHawk software.

Our technical staff can write custom code for clients to implement interfaces between BellHawk and other systems. It is important, however, to recognize that our technical staff cannot be expert in the wide variety of different systems with which BellHawk can exchange data and that this expertise needs to come from our clients and their expert consultants.

It is our preference, wherever possible, to enable our clients or their systems integrators to implement these interfaces themselves with the BellHawk Systems staff simply providing technical support and guidance in the development process.

Caveats

It should be recognized that, for real-time data collection performance reasons, BellHawk only keeps limited history data. Thus, for example, while BellHawk tracks every "inventory" transaction it has ever made, there is no easy way to query the BellHawk database for the inventory status at last year end. If this type of “status at a point-in-time” data is important for reporting or other export purposes, then it is important to use a tool like Bell-Connector to periodically export the needed status “snapshot” data to an external database.

If clients want to perform “Big Data” analysis on the BellHawk database then we recommend that the needed data be periodically be exported to a MySQL or other database in a format suitable for Big Data analysis and subsequent reporting and graphing. This will avoid negatively impacting the real-time data collection performance with these analysis and reporting functions.

By providing a wide variety of interfaces to BellHawk, we recognize that there is no one-size-fits-all approach. As a result, an interface may be implemented by something as simple as a few lines of SQL code or as complex as a Bell-Connector application that may transfer dozens of different data objects between multiple systems, at scheduled times, and be expected to keep running 24x7 for many years.

It is also important to remember that, while we attempt to provide comprehensive documentation for our interfaces, the scope and complexity of interface development inevitably means that there may be gaps in the documentation provided and that frequently factual information is not supported by an explanation or examples.

For this reason, it is important to recognize that development of automated data exchange interfaces to BellHawk will inevitably require the purchase of support services from BellHawk Systems in the form of Support Services bundles.

Location of Interface Code

Excel imports and exports will work equally well irrespective of whether BellHawk is hosted in the Cloud or on a Windows Server in the client's own plant. The same applies to the other standard interfaces provided by BellHawk but with more complexity for remote access. BellHawk Systems can also enable encrypted remote access to a client's BellHawk database when hosted in the Cloud.

When developing interfaces to ERP or accounting systems that are located in the client's plant, it is generally beneficial (or technically necessary) for the interfacing code to reside on the same server as the ERP system. This means that Bell-Connector may run on the same server as the ERP system even if BellHawk is hosted in the Cloud.

Finally, it is important to recognize that there are a wide variety of tools now on the market for the implementation of interfaces between systems, which may present a better alternative than the Bell-Connector interface provided with BellHawk. Some of these tools run in the Cloud and some are provided with the ERP or accounting software.