BellHawk Job and Materials Tracking Software Overview Data Sheet

Introduction

BellHawk uses technologies such as barcode and RFID scanning and mobile computing to track containers of material and serialized items in multiple different locations, including outdoors. It is primarily used to solve materials tracking problems which cannot be solved using conventional inventory, job, and asset tracking systems, which track materials by location.

In this document, we use the word container to refer to boxes, bags, drums, pallets, and totes of material as well as individually tracked items, such as tools and electromechanical assemblies, which are not in a container. We also use the word container to refer to rolls and reels of material, which hold different lengths and widths of material, as well as sheets of material, which have different lengths and widths.

Applications

BellHawk has been used in a wide-range of applications, some of which are shown above. In many of these applications, BellHawk's ability to track many different characteristics of the materials in each container, such as lot and serial number, expiration date, length and/or width is required. In other applications, it is the ability to track the flow of containers of material between different locations that is required. In yet others, it is the ability to support regulatory or standards compliance.

In warehouses, BellHawk tracks the receipt and put-away of containers of materials as well as the picking, packing and shipping of customer orders. Because of its use of container-based

tracking, and its ability to track many different materials in nested containers, BellHawk is ideal in those situation where mixed pallets of material have to be shipped to customers, along with the advanced shipment data for what was on each pallet.

BellHawk is also able to track the transformation of materials, as work-in-process, through a sequence of manufacturing or processing operations or in assembly, kitting, repacking and relabeling operations in warehouses. As a result, BellHawk is able to capture a complete materials traceability history for each serialized item or container of materials and who it was shipped to.

This traceability data can be used to quickly find the source of defects and to minimize the scope of recalls. It is essential for applications such as food and pharmaceutical processing, as well as medical device and supplies manufacturing and repacking, where there are extensive requirements for regulatory compliance for capturing and sharing materials traceability data.

In addition, BellHawk can add up the incremental labor and materials cost of making each semi-custom or custom product and compare this with the estimated cost. This information can then be used to improve bidding on competitive jobs.

Many applications of BellHawk are driven, directly or indirectly, by regulatory requirements, from agencies such as the FDA, USDA, DOT, DOD, and FAA. BellHawk is CFR 21 Part 11 compliant, enabling its use in pharmaceutical and medical applications, including laboratories. BellHawk can print and read GS1 (Global Standards One) barcode labels, such as those used for DSCSA and GS1 supply-chain compliance. BellHawk is also fully compliant with the GS1 EPCIS standard for both barcode and RFID data capture applications.

What Makes BellHawk Special

Unlike traditional inventory tracking and warehouse management systems, which track the quantity of each item at each location, BellHawk tracks containers of material, analogous to the way that FedEx, UPS, and Amazon track their materials.

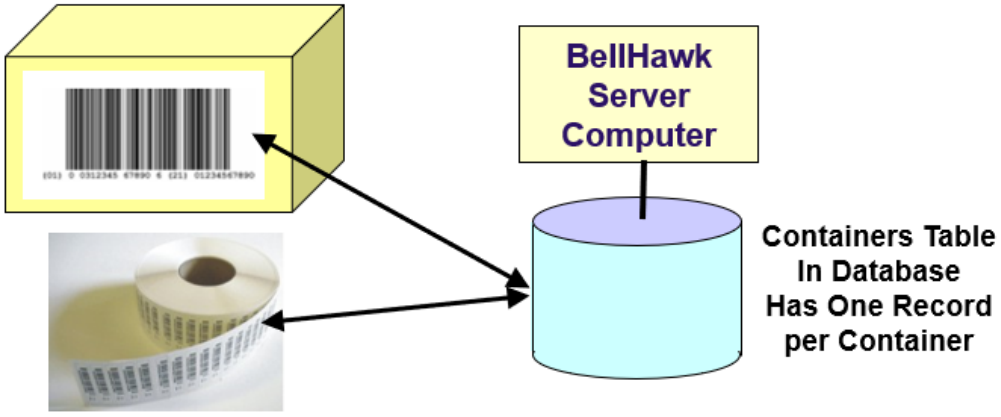
In this method, we place a unique tracking barcode on each container, and then record information about the materials in each container, including:

- Item Number
- Quantity
- Lot and Serial Number
- Expiration Date
- Quality Control Status (needs, passed, failed inspection)
- Supplier/Vendor
- Manufacturer
- Unit Weight and Cost
- Dimensions

Then users can scan the tracking barcode and record the new location whenever the container is moved or materials are added to, or removed from the container. This enables BellHawk to track

many different containers, in many different geographic locations, each containing the same item number, and each with different characteristics. For example, BellHawk can record dimensional information such as the length of wire left on each reel or roll of material or the dimensions of a sheet of steel or wood, as well as user defined information, such as the color.

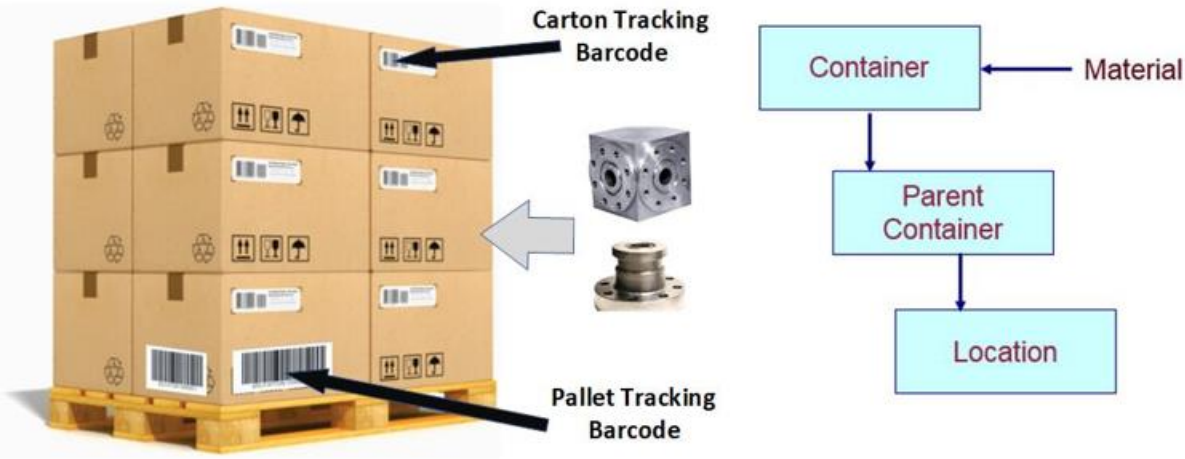
BellHawk stores this information in a containers table in its database, with the tracking barcode on each container being used to reference a container.



This tracking barcode can be as simple as a sequentially numbered barcode peeled off a preprinted roll and attached to the container or a GS1 standard barcode, which can be printed out of BellHawk and used to track each container anywhere in the global supply chain. Alternately, an RFID tag or a barcode tracking label with an embedded RFID tag can be used for tracking each container.

We can also apply tracking barcodes or RFID tags directly to assets, such as tools, as well as other serialized items, and then BellHawk can track these in its containers table, with the additional ability to track who assets were issued to, as well as their location.

BellHawk can also use its containers table to track nested containers, by having each container record able to reference its parent container.



This enables BellHawk to track a mixture of serialized and non-serialized items, as shown above, packed into a carton, with its own tracking barcode, stacked on a pallet, with its own tracking barcode.

Then, when we want to move or ship the pallet, we simply scan the pallet barcode and all the other parts nested within boxes on the pallet are automatically moved or shipped.

Entries in the containers table are not required to have a tracking barcode but are tracked with reference to their parent container. This enables BellHawk to do detailed tracking of a mixture of parts, such as nuts, bolts, and washers, in a barcoded box, without needing to put tracking barcodes on each different part.

BellHawk uses container-based tracking to track work-in-process materials, as well as inventory such as raw materials and finished products. In doing this it can automatically assign temporary part numbers to the work-in-process parts being made, so as to avoid confusion with finished products.

BellHawk can also use its containers table to track kits and assemblies, with sub-assemblies being nested within assemblies, and then nested within parent containers, along with other parts.

By using a containers table, BellHawk is able to handle many tracking situations which are impossible with more traditional systems such as warehouse management, inventory tracking, and ERP systems.

While being special, by virtue of its containers table, BellHawk is still compatible with all of these traditional systems by simply adding up quantities of each part in all the containers, at each location, and reporting this as inventory for accounting and inventory management purposes.

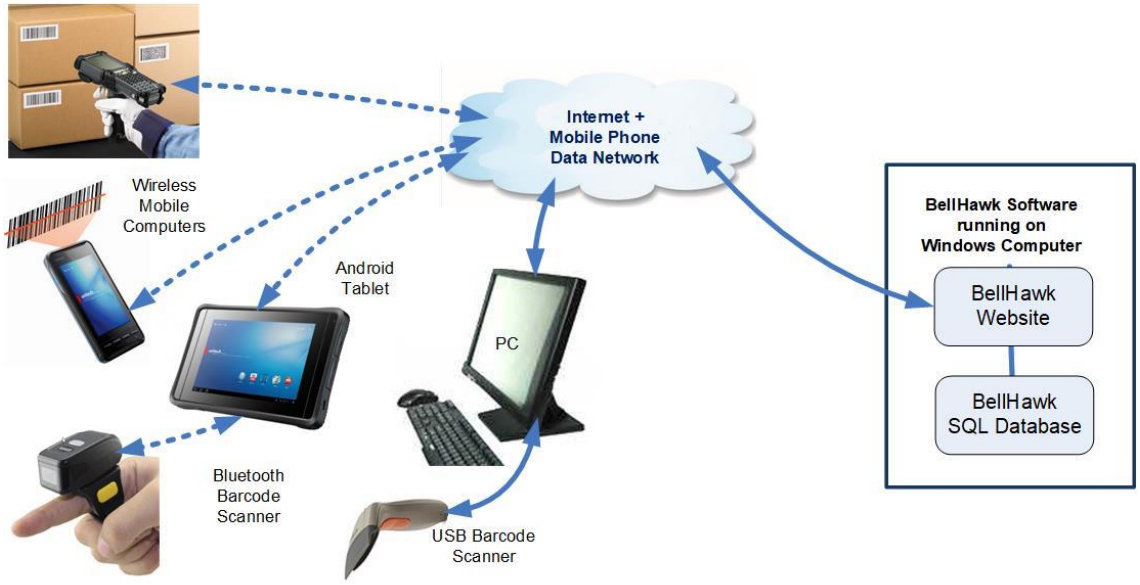
Some BellHawk Operational Benefits

1. **Keeping Track:** Provides a real-time overview of the status of customer orders and related materials, including inventory in warehouses and work-in-process on the factory floor, plus tracks receiving and put-away of raw materials, the transformation of raw materials into finished goods, and their picking, packing and shipping.
2. **Eliminating use of Paper Forms:** Saves labor cost and prevents data collection mistakes by replacing the use of paper forms and manual keyboard data entry, for materials tracking data collection, with automated data collection using technologies such as barcode and RFID scanning, as well as mobile computing.
3. **Preventing Late Customer Order Delivery:** Gives real-time visibility of the status of customer orders, and needed materials, to help ensure that orders get made, shipped, delivered, and/or installed on time. Also does real-time job scheduling and can provide potential late-delivery warnings.
4. **Preventing Operational Mistakes:** Warns operators and materials handlers when they are about to make an operational mistake such as using the wrong materials to make a product, or to put in a kit, or picking the wrong materials for a shipment.
5. **Makes it easy to Capturing Materials Traceability History:** for regulatory compliance as well as rapidly tracking the source of defective products as well as minimizing the scope and cost of recalls.

6. **Capturing the cost of making products**: including the cost of materials, labor, and machine time. Enables comparison of expected and actual costs to improve future bidding.
7. **Adding container-based materials tracking and traceability capabilities to ERP systems**: ERP systems track materials by location and do not have the ability to track containers of material. BellHawk can be used to add the needed materials tracking and traceability capabilities.

BellHawk Architecture

Barcode Data Collection



The BellHawk data collection software consists of a specialized website and a SQL Server database that run on a Windows Server, or a Windows Enterprise IIOT based computer. All user interaction is performed using web-browser based devices thereby avoiding the need to install custom software in each device.

Barcode data collection can be performed using devices such as PCs or Android tablets that have external corded or cordless barcode scanners which are used for data capture. Data capture devices can also include ruggedized PDAs with integral barcode scanners as well gun-style units equipped with long-range scanners, which are suitable for scanning from the seat of a fork-lift truck. Data viewing over a secure Internet link can be done using these same devices as well as by using smart phones.

BellHawk is based on a rules-based expert system concept that enables each organization using BellHawk to rapidly configure BellHawk for their own specific data collection requirements. This same rules-based concept is used to make it easy for people such as material handlers and machine operators to use BellHawk to capture data, even if they are not very computer literate.

Organizations are able to configure their BellHawk system to capture application specific data, such as size and color. This includes the ability to capture the lengths, widths, and thicknesses.

This is very beneficial when tracking rolls of material or reels of wire left over from a manufacturing or distribution process.

The data capture screens used by BellHawk are based on filling a form, as this paradigm is familiar to anyone ordering from Amazon or any other Internet site. BellHawk, however, uses “Magic Forms” in which the users are presented with just the information they need to fill out next, with just enough other information on the screen to provide context.

This is in contrast to accounting or ERP systems, which are designed for use by office personnel and typically have dozens of data entry boxes on each screen, requiring the user to know which boxes to fill out and which to ignore in each data entry situation.

Also, each data item is checked by the BellHawk server as soon as it is entered to check whether the user is making a data entry mistake, or even more important, an operational mistake, such as using or picking the wrong materials. This enables users to correct mistakes before they propagate into bad tracking data or even worse, into bad products or wrong shipments. This error checking and warning can be configured by the organization using BellHawk. Also, KnarrTek can add custom error checks for specific applications.

As a result, data capture in BellHawk has been successfully performed by many people who have limited computer literacy and for many of whom, English is a second language.

Cloud vs Onsite Deployment

For operational use, BellHawk needs to be run on a dedicated Windows computer in order for responses to barcode scans to be processed in under 2 seconds, otherwise people doing data collection get very annoyed.

BellHawk can be run on a Windows Server computer at a remote data center, which is ideal when people need to do data capture in the field or from multiple geographic locations over the mobile-phone data network.

But, when scanning is being primarily done within a physical site over a common local area network, BellHawk is best run on a Windows IIOT based ruggedized industrial computer plugged in to the local area network (LAN).

This ensures that barcode scanning can take place rapidly over the high-speed LAN on the dedicated BellHawk box but can still allow remote access to data from an external internet connection. And, by using a ruggedized industrial computer, running Windows IIOT, we can ensure 24x7 operation for months or years at a time, without the need to periodically take the system down to reboot a server.

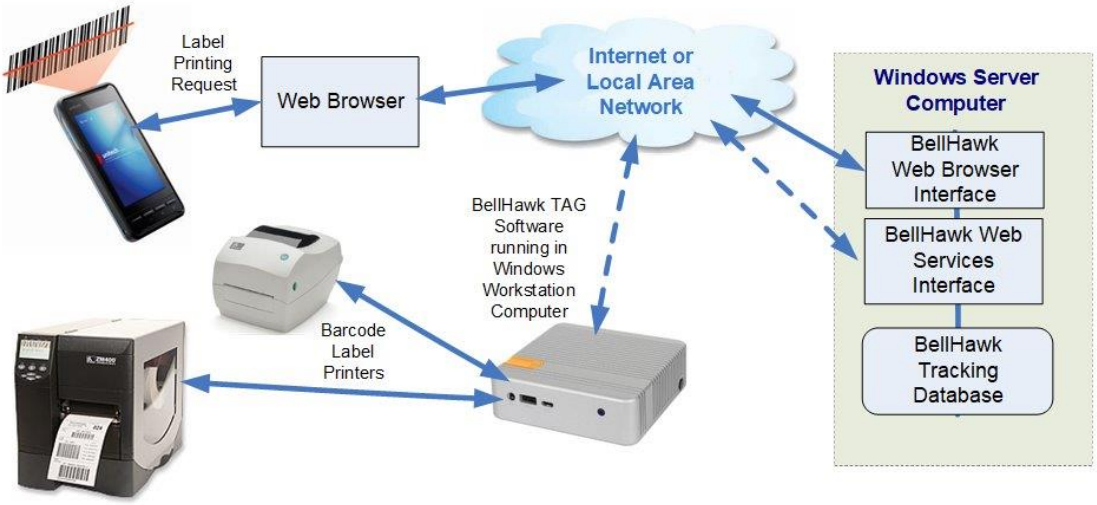
Organizations with multiple sites will typically use a separate BellHawk system for each site so that its users only see inventory and jobs within that site. This avoids confusion and also spreads the processing load across multiple sites so that everyone is able to be able to do scanned barcode data entry.

Barcode Label Printing

BellHawk uses the same container-based tracking methods for tracking materials as FedEx, UPS, and Amazon use to track the delivery of their packages. This tracking can be done without needing to use a barcode printer by simply attaching a unique pre-printed tracking barcode, from a roll of pre-printed barcodes, to each container of materials or serialized item being tracked.

When barcode labels are required, which contain human readable information in addition to a tracking barcode, such as for product, packaging, or shipping labels, then BellHawk has a mechanism to enable custom labels to be printed upon demand in each plant or warehouse.

In this mechanism, a mobile device user typically sends a label printing request to the server, as part of their normal data entry. Rules set up in BellHawk then gather the needed data for the label from the BellHawk database and the label printing request is placed in a print queue on the server.

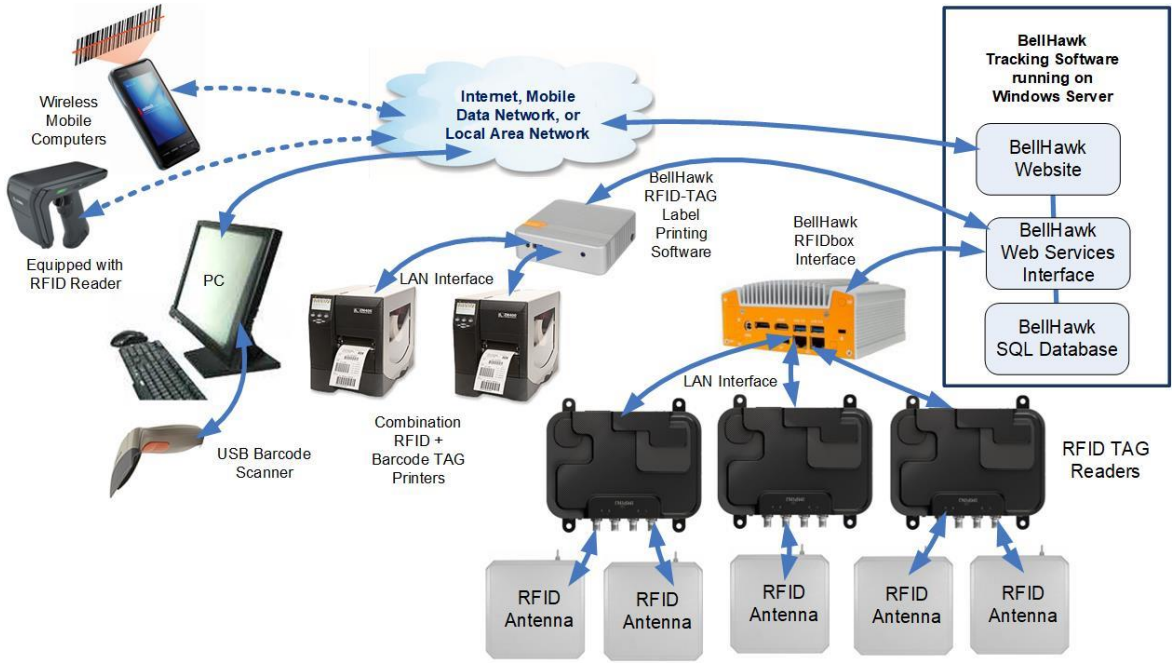


This label printing request is then picked up by software running on a Windows IIOT (Industrial Internet of Things) computer in the designated facility and printed out at high speed on a barcode label printer located near to where the label printing request was made (which can be to a wireless connected printer mounted on the requesting user's belt).

The selection of the label format, data to be printed, and the printer on which the label is to be printed are made by a rules-based expert system, to avoid users needing to select the format or printer or manually enter the data, which can help prevent many costly mistakes.

This same mechanism can be used for printing barcode labels with embedded RFID tags.

Tracking Containers of Material using RFID



BellHawk enables the location of containers to be tracked using both their attached barcodes and RFID tags. This is made possible because the BellHawk software uses the principle of container tracking using either the unique EPC code embedded in an RFID tag by its manufacturer or an attached unique tracking barcode, which may have different tracking numbers.

Through its barcode label printing software, BellHawk can print out tracking barcodes on a wide variety of barcode label printers, in each manufacturing plant, over the Internet. This includes printing combination tracking barcode (2) and RID tags (1) on a combination barcode label printer and RFID tag encoder.

The BellHawk RFIDBox remotely connects BellHawk to a set of RFID tag readers within a plant or warehouse, each of which can support 4 or 8 antennas, up to 100 feet from the reader.

When an RFID tag comes within range of an antenna, the unique EPC code within the RFID tag is read automatically, and then translated by the RFIDBox into the movement of the container or item, to which the Tag is attached, to its movement to the location (such as a work-center) where the antenna is.

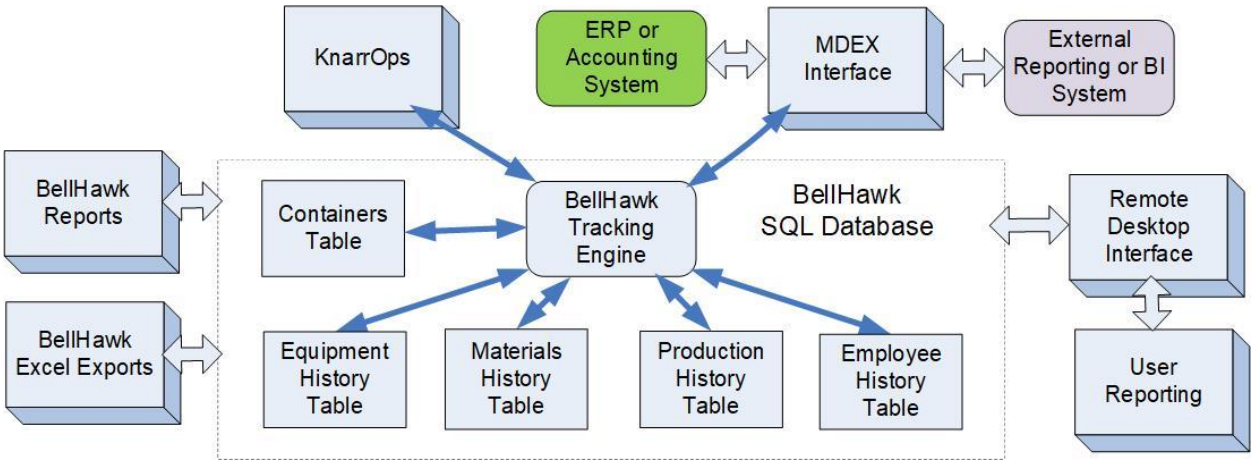
In this way, as a container moves through a plant or warehouse, its movement can be tracked as the Tag is “seen” by different antennas. This movement is used to update the BellHawk tracking

database so the location of materials can be tracked in real-time whether the tracking is done by barcode or RFID tag scanning or a mixture of both.

The BellHawk software inside an RFID box need not be co-located with the BellHawk server, as it can use the BellHawk web-services interface to communicate over the Internet with a BellHawk server located at a remote data center.

There are many places where the precision of barcode scanning is essential, such as recording the receipt and put-away of materials or recording which materials went into each batch of a product. But there are many cases where an assembly or tote needs to be recorded into and out of a work center or a pallet moving between buildings or shipped on a truck. In these cases, the use of RFID scanning can avoid the need for people to do any barcode scanning.

Reports and Interfaces



Reports

As well as tracking containers of material in real-time and maintaining this data its containers table, BellHawk captures the history of materials transactions as well as associated jobs, people, and equipment. This data is available directly in the form of reports and Excel spreadsheets through the BellHawk web-browser interface.

These reports are designed for immediate operational use by production and warehouse supervisors and are not intended for in-depth analysis of captured historical data. Even then, it is important that supervisors do not run long reports, while barcode scanning is taking place, otherwise the computer resources consumed can have a negative impact on the time taken to respond to barcode scans and other data entry.

For running longer reports, there are three possible mechanisms available:

1. The remote desktop interface (RDI), which creates a copy of the needed BellHawk tables in a database on the user's PC, ready for reporting using a wide-variety of desktop reporting applications.

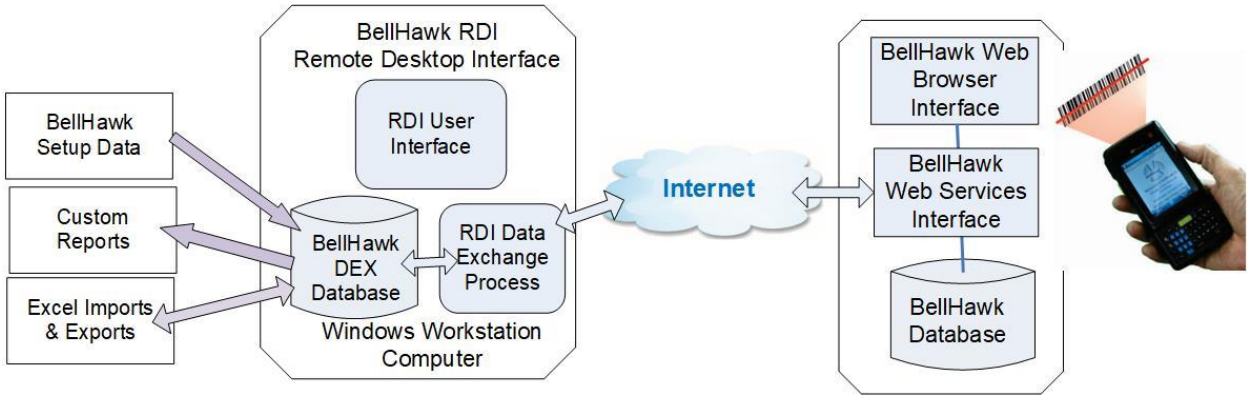
2. MDEX, which automatically maintains a simplified mirror of the BellHawk database on a server at a remote data center. This can be used to generate reports using and external reporting or business intelligence applications.

MDEX is also used for interfacing BellHawk with other systems, such as ERP or accounting systems, and computer aided design systems.

Please note that it is important that third party reporting or interfaces to other software do not directly access the BellHawk database, as this may interfere with the speed of barcode scanning or other data capture. Data transfers between the RDI and MDEX are all carefully throttled so as not to interfere with barcode scanning and, as a result, can take place during normal operational use of BellHawk.

Also, the BellHawk database is structured for high-speed data capture and is not in a suitable format for reporting or interfacing to another system. By contrast the extracted "mirror" databases used by the RDI and MDEX are all in a format designed for ease of reporting and interfacing.

Remote Desktop Interface



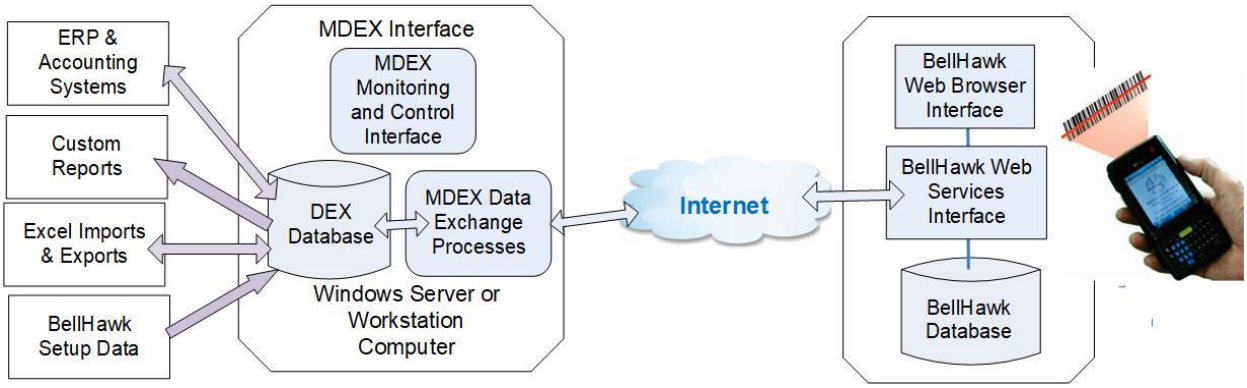
The Remote Desktop Interface (RDI) consists of a SQL Server database (typically the free SQL Server Express version) and an RDI data exchange process, which is based on the use of the MilramX software.

Data transfers to and from BellHawk are manually controlled through the RDI desktop interface on the user's PC. This makes it ideal for extracting data from BellHawk for custom reporting and also for sending initial setup data to BellHawk from Excel spreadsheets.

Data written into tables in the DEX database are automatically transferred to the corresponding tables in the BellHawk database by the RDI data exchange process. Similarly, data entered into BellHawk is automatically transferred to corresponding tables in the DEX database.

The tables in the DEX database are structured in a well-documented tabular format (think Excel spreadsheet), with a set of self-contained records and no indirect references. This makes it easy for users to develop their own custom reports, using the contents of the DEX database.

MDEX Interface



MDEX uses the same DEX data exchange database as the RDI but MDEX is based on KnarrTek's MilramX automated data exchange software. MDEX typically runs as a service on a Windows Server at a remote data center and is designed to run unattended and reliably exchange data 24x7 for long periods of time. It has a web-browser interface for remote monitoring and control.

Users can start out using the RDI to develop custom reports and/or interfaces and then transition to using MDEX for operational use. This is especially valuable when implementing shared reports using business intelligence software which requires the DEX database to be continuously updated without human intervention. It is also essential when implementing automated data exchange interfaces with ERP, accounting, CAD and other systems.

MDEX communicates with BellHawk over the Internet, using the BellHawk web-services interface. This enables the DEX database to be located in a data center that can be thousands of miles away from the manufacturing plant or warehouse in which the BellHawk software and database is running.

MDEX is ideal for integration with corporate Business Intelligence software as the DEX database is automatically updated whenever changes occur in the BellHawk database. MDEX can also be used for implementing interfaces to a wide-variety of ERP and accounting, as well as other systems, with the data exchange taking place through the DEX store and forward interface.

One major advantage of the MDEX interface is that it isolates and protects the BellHawk database from possible damage from reporting and data exchange software which would be possible if they directly interacted with the BellHawk database. This also helps ensure compliance with requirements such as CFR 21 Part 11, which require that users not be able to modify data once it is captured without an audit trail being present.

For More Information

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