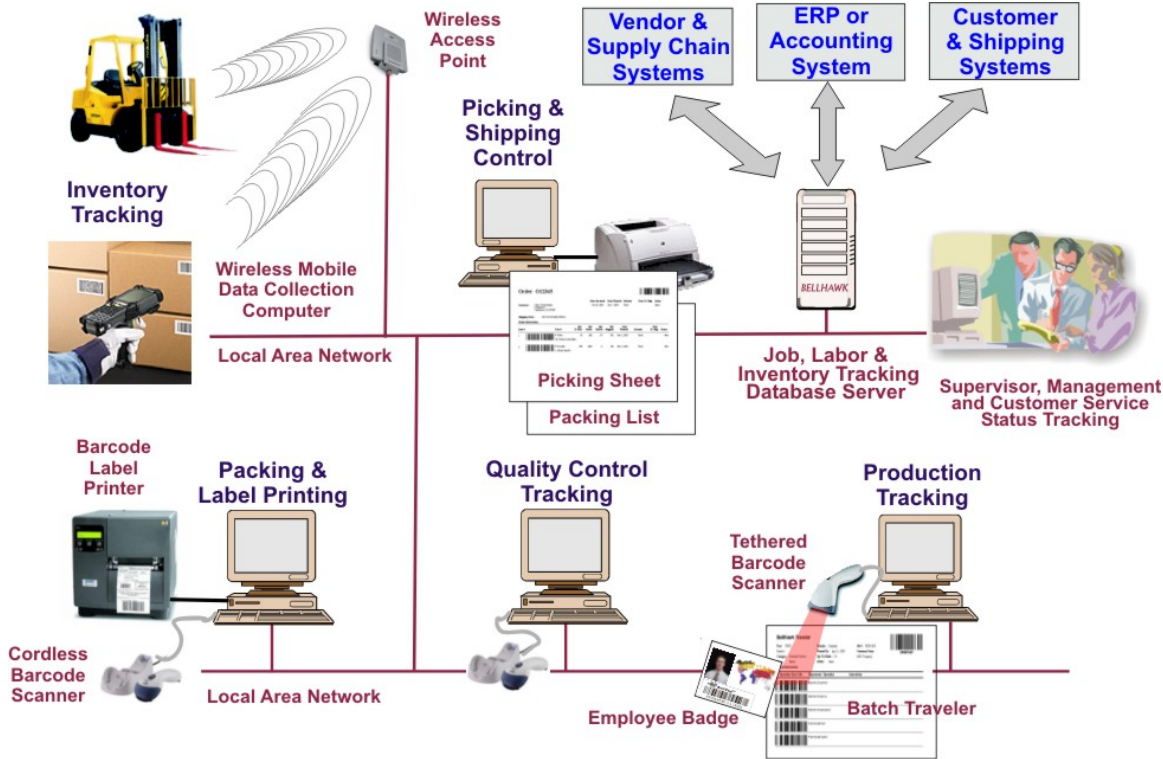




Recommended BellHawk Equipment



The following is a description of the equipment and third party software that is recommended to implement a BellHawk system.

Computer Equipment

The BellHawk software is based on the use of the Microsoft Windows Server, PC and Mobile operating systems and IBM compatible personal computers (PCs) as these are ubiquitous within industrial environments and represent the best value to our customers. BellHawk Systems Corporation (BSC) uses Microsoft's SQL Server as the database server software for BellHawk as this is a good solid stable database server platform with good security features and high proven reliability.

The PCs work in a client-server mode, communicating in real-time with the database server over the local area network. The mobile data collection computers (MCs) use BSC's BSAF (be-safe) store and forward technology to communicate with the server. This technology enables reliable data collection in industrial environments with communication dead-zones and electrical interference from machines. BSAF normally works over wireless LAN or cell-phone data networks but also has support for a secure-cradle mode in those situations where wireless communications is precluded due to security restrictions.

BellHawk Client PCs

1. These PCs should preferably be Windows XP-Pro or Vista Business systems for maximum security, although the BellHawk software does support XP-Home and Vista-Home operating systems. They should have adequate processors and memory for running the XP-Pro or Vista operating systems. Please note that we only support the 32 bit operating system version of XP (Kernel Version 5) and the 64 bit operating system version of Vista (Kernel Version 6). Microsoft is no longer fully supporting the 64 bit version of kernel 5 or the 32 bit version of kernel 6 and the upcoming Windows 7 (kernel version 7) will only be supported in 64 bit.
2. Please note however that the 32 bit (kernel 5) operating system runs very well on 64 bit and multi-core processors. So you can use these PCs to run the 32 bit version of XP-Pro.
3. Each PC should have an Ethernet card for connecting to the local area network (LAN) and, optionally, a CD-ROM drive for software loading. We recommend the use of at least a 17 inch LCD color monitor and a keyboard plus mouse.
4. The client PCs do not need Access installed on them as an Access runtime is provided with the BellHawk software installation disk. The software will, however, run just fine if Microsoft Office XP or later is already installed. The BellHawk software can be installed on each PC from a CD or can be downloaded over the network from the BellHawk server.
5. It is required that only binary versions of the BellHawk software be installed on PCs that used for operational purposes, so as to control the distribution of the software.
6. If the customer has purchased a source code license for BellHawk, then the customer's technical staff can customize the Access/VBA PC software. In this case, the customer needs to purchase a copy of Microsoft Office Professional Developer edition (available as an upgrade from Microsoft Office Professional) so that the customer's technical staff can generate binary versions of the PC software for distribution to PCs used by operations personnel.
7. It is recommended that each PC be rebooted at least once a week so as to recover resources that it loses as a result of running the Microsoft operating system.
8. It is highly recommended that each PC be equipped with an uninterruptible power supply (UPS) that isolates the PC from AC power surges, spikes and outages. The UPS should be capable of shutting down the PC in an orderly manner when its battery power gets low. We personally like the units from APC that come with the Power-Chute power management software.
9. Please note that currently we only support Access 2002 or 2003. If you want to run BellHawk on a PC that has Office 12 loaded, then you need to load the Access 2003 runtime (available from BellHawk Systems) as well and make sure that the BellHawk desktop shortcut runs this .exe file with the appropriate BellHawk .ade file as a parameter, so as to prevent Windows from running the .ade file with Access 12.

BellHawk Server

1. The recommended server is a Windows 2003 Server or Windows 2008 based computer. It should have at least a 2 GHz processor and have 2 GByte of memory. It should be capable of fully supporting the operation of a Microsoft Windows 2003 or 2008 operating system. Please note that one client access license (CAL) is required per PC user of the system.

2. Please note that we only support the 32 bit version of Windows 2003 Server (kernel 5) and the 64 bit version of Windows 2008 (kernel 6) as Microsoft is not effectively supporting the 64 bit kernel 5 or 32 bit kernel 6 Windows Server operating systems.
3. For small departmental installations or for training-room pilot installations, a Windows XP-Pro or Vista Business based computer may be used. This is typically only suitable if there are 5 or less simultaneous users of the database. It requires no user CALs and should be used with SQL Server Express, which also requires no CALs.
4. For reliability, the server should have at least a mirrored hard drive as this is the most frequent point of failure in these servers. It should preferably have a RAID 1 or RAID 5 disk drive array. It is recommended that each disk drive have at least 120GBytes capacity.
5. Please note that the average life of server hard drives is between 3 and 5 years. So if you get a failure in a hard drive during this time, then it is generally recommended to replace both hard drives and rebuild or replace the server.
6. The server should be equipped with at least a 100 MHz Ethernet card for connection to the LAN and a CD drive for loading software. It also requires a monitor, keyboard and mouse, which can be provided through a KVM switch in a server room setup.
7. It is recommended that the BellHawk server run stand-alone for reliability reasons although, it can be run on a shared server. One of the biggest points of failure in running a BellHawk System 24x7 is that the server has to be rebooted due to failure in some other program.
8. BellHawk uses a Microsoft SQL-Server database (SQL Server 2005 standard or express edition on kernel 5 or SQL Server 2008 standard or express edition on kernel 6 machines). With SQL Server Standard Edition, one SQL Server CAL is required for each user plus one CAL is required for the wireless service. SQL-Server Express is now available as a free download from the Microsoft website and does not require a per-CAL license fee. This is suitable for use in smaller installations having less than a dozen or so simultaneous PC users of BellHawk. It cannot be used if the database size is expected to exceed 2 GBytes.
9. The BellHawk stored procedures are provided in binary (machine readable only) format unless the user has purchased a source code license. They are loaded into the server from a database backup file once the BellHawk database has been created. The licensing of software modules and number of PC seats and mobile computers is controlled by encrypted stored procedures. These can be updated in the field by BellHawk Systems issuing a one-time execute program to perform the update.
10. It is essential that a mechanism be provided to regularly backup the BellHawk database. This can be done by setting SQL Server to periodically dump a backup file. This backup file can then be copied to disk or tape using a backup utility program. Alternately, we now recommend "Cloud" based backup services, such as Jungle Disk, as these will automatically backup the BellHawk database backup file to a secure off-site data center from which it can be quickly retrieved and restored.
11. Unless there are security restrictions, we highly recommend that BellHawk Systems technical staff be granted remote desktop access over the internet to the BellHawk Server. This enables us to rapidly diagnose and fix problems that can occur when someone enters bad data into the BellHawk system that are not caught until it is too late.

12. It is recommended that the server be rebooted once a week so as to recover resources that it loses as a result of running the Microsoft operating system.
13. It is highly recommended that the Server be equipped with an uninterruptible power supply (UPS) that isolates the server from AC power surges, spikes and outages. The UPS should be capable of shutting down the Server in an orderly manner when its battery power gets low. I personally like the UPS units from APC that come with the Power-Chute power management software.
14. If you are planning on running the BellHawk server in a virtual machine, please contact us first. Some of our clients have experienced problems with clock-jitter due to running the BellHawk database and server applications in a virtual environment. BellHawk depends on time stamping to decide which data objects to exchange with the mobile computers and other systems. Running BellHawk on a virtual server can introduce lags of several seconds between an action and its time stamp being recorded due to the virtual server being “swapped out”, which may cause missed data transfers.
15. The above problem does not apply to client applications being run in a virtual environment, such as Terminal Services or Remote Desktop that use a “Citrix” mechanism to enable the running of the BellHawk desktop application over low bandwidth VPN or T1 links. In this case, the desktop applications can be run on the same server as is used for the BellHawk database and server applications.

Network

1. It is recommended that the PCs and the Server be connected with a LAN that has at least a 10 MBits/sec bandwidth. It is possible to operate over a full T1 link (1.4 MBits/sec bandwidth) with reduced performance. If these or other reduced bandwidth links, such as Fractional T1 or VPN links, are to be used to connect remote plants, then the PCs in these remote plants should be operated using Terminal Server or Remote Desktop (“Citrix”) mode, so that all the processing is performed on the same server as the database. Mobile computers, however, can be operated in remote plants over limited bandwidth links using the BSAF protocol. All they need is access to the wireless server UDP port and the IP address of the server computer over the VPN used to run the BellHawk wireless server software through any firewall devices in use.
2. While the BSAF protocol used for the mobile computers is designed to work in industrial environments with limited and intermittent communications, use with communications networks with very low-bandwidths and long outage times can result in undesirable operational problems with long delays in synchronizing data between the mobile computers and the main database.
3. All the PCs and the wireless access points and the server and any network printers all need to be able to communicate over the LAN and need to have appropriate Domain access privileges.
4. It is recommended that switches rather than hubs be used to connect the PCs to the server to avoid the network being flooded with repeated messages which can substantially reduce performance.
5. It is highly recommended that shielded Cat 5 cable or better be used for network connections in a factory or warehouse or that the network cable be run in conduit. This is to avoid electrical interference from motors, welders, and other equipment.

Laser Printers

It is highly recommended that travelers and picking sheets be printed on a laser printer rather than an ink-jet printer. This is because we find that the ink runs and smudges in industrial use, making the barcodes difficult or impossible to use. Laser printers use heat-fusing of the imaging powder to produce a smudge-proof product. The laser printers used with BellHawk can be either connected to individual PCs or connected as network printers to the LAN.

Barcode Scanning Equipment

BellHawk Systems Corporation (BSC) continuously evaluates barcode and RFID equipment to determine the "best of breed" equipment that represent the most cost-effective solutions to the problem of tracking materials and managing operations in an industrial environment. The following equipment represents our current choice as best-of-breed. This is the equipment that is supported "out-of-the-box" by the BellHawk software. BSC will provide a quotation to modify the BellHawk software to work with other equipment, if requested.

Barcode Scanners for Use with PCs

The BellHawk client software will work with Barcode scanners that automatically place the data from the scanned barcode in the keyboard buffer of the PC. Most tethered scanners do this and come with either a keyboard wedge (older technology) or USB (recommended) cable.

Please note that the barcode scanners may need to be programmed to emit the appropriate keyboard function (F key) code sequences for BellHawk when navigational (Forward, Back, escape, etc) barcodes are scanned.

Also 2D scanners may need to be programmed to remove control characters from 2D barcodes before the data is input to BellHawk. All scanners need to be programmed to emit a return code at the end of the barcode sequence, if this is not the default setting for the model purchased.

BSC recommends the following types of barcode scanners for use in capturing transactional data with PCs:

1. Contact scanners, such as the Unitech 210 that plug into the USB port of a PC. These scanners read linear 1D barcodes using a CCD imager and convert these to an ASCII character stream that is inserted into the keyboard buffer of the PC as if this had been typed in. These scanners typically come with a 6 foot cord and are very rugged and reliable:
This is a contact scanner with a 6 foot coiled cord. The big benefit of this type of scanner is that the user places the barcode scanner over the barcode to be scanned and pulls the trigger. There is no mistake about which barcode was scanned. The unit beeps if the scan is successful and relays the scanned data to the computer. Street price for these units is typically less than \$100 each.
2. Hand-held laser scanners such as the Motorola LS2200. These units have a short range laser scanner that can scan one-dimensional barcodes out to a range of about 2 feet. These units scan the barcodes with a red laser beam and convert the contents to an ASCII character stream that is inserted into the keyboard buffer of the PC as if this had been typed in. Some of these units,



such as the LS2200, can work in two modes. They can work as a regular triggered barcode scanner or can be placed in a cradle, when the scanner automatically switches to hands-free mode. This makes it very useful for those situations where both modes need to be used and the unit quickly switched between them. These scanners typically come with a 6 feet long USB cable. Street price is typically under \$225 depending on features.

3. Cordless scanners such as the Motorola 3578. These units are equipped with laser scanners and communicate with a base station using Bluetooth communication. The base station connects to the PC by a USB cable. These units scan the barcodes with a red laser beam and convert the contents to an ASCII character stream that is transmitted to the base station and then inserted into the keyboard buffer of the PC as if this had been typed in. These scanners can work up to 150 feet from the base station but practical use is limited to about 15 feet by the need to interact with the screen on the PC to handle data entry tasks. These are very useful in large open areas, such as a receiving dock where dragging a long cord on a tethered scanner to scan material is not advisable. They are typically not useful in stock rooms or warehouses where metal racking interferes with communications and makes interaction with a fixed PC impractical. These units typically come equipped with a lithium-ion battery that can be recharged by placing the scanner in the base station as shown above. These units cost between \$650 and \$1,000 street price depending on the features and the range of the laser scanner itself.



Mobile Computers

The BellHawk Software runs on mobile computers that support the Windows Mobile 6 or Windows CE 5 operating systems. BellHawk also supports Pocket PC and Windows Mobile 5 on a legacy basis.

BellHawk stores its local SQL Server 2005/2008 Compact Edition database on an SD Card that is plugged into these units (may require removing the keyboard). These SD cards are purchased separately and should be high speed memory units such as the San Disk Ultra II units with a capacity of at least 1GByte that are typically used in high quality digital cameras for saving images. Street price for these is around \$50 each.

As standard, the BellHawk software supports the Motorola MC9000 (Windows Mobile 5 and 6) and MC3000 (Windows CE 5) lines of wireless mobile computers. For an additional fee BellHawk can be ported to other Windows Mobile and Windows CE based mobile computers provided that they are able to support an SD-RAM card or equivalent non-volatile memory of at least 1 GBytes capacity. We will be supporting the MC7090 (Windows Mobile 6), which is a PDA like unit, for use in medical and laboratory and like applications as standard by Q4 of 2009

We have done a port to the Motorola 4090 (Windows CE) wearable computer unit but felt that the operational limitations imposed by its lack of a touch screen and its limited keyboard were such as not to warrant its inclusion in our best of breed list. We also support the Honeywell 9500 series (Pocket PC) on a legacy basis. Both these latter units have specific applications where they are appropriate but in general are not recommended for most industrial applications.

For warehousing and general material handling, we now recommend the Motorola MC9090G with a Lorax auto-ranging 4" to 40' long-range laser scanner. This unit has the advantage that it does not need a fork-lift truck cradle attachment with an external long-range scanner to scan overhead barcodes and will also function as a short range scanner for hand-truck and similar work. This unit is a true mobile computer with a built-in Intel X-scale processor, 64MB of RAM and 64 MB of flash memory, a color touch screen and a full alpha numeric keyboard. It runs the Windows Mobile operating system and the BellHawk Visual Basic program runs in a .Net environment.



The street price for an appropriately configured MC9090G is about \$3,000. Please note that, as standard, the BellHawk software is configured for a specific hardware and software configuration of the MC9090G. Please contact BellHawk Systems for the model number to order for this configuration. The MC 9090G comes in many different configurations with street prices as low as \$2,000. Please be aware that BellHawk will not run on some of the lower cost configurations and that there may be a porting charge of several thousand dollars to get it to run on other configurations.

BellHawk Systems also supports the Motorola MC3090 unit as a lower cost alternative to the MC9090G for use in stock-rooms and similar locations. This unit comes with a short-range laser scanner and so is unsuitable for use in scanning directly from fork-lift trucks. Its smaller form factor, however, makes it easier to use for scanning in those situations that do not need a long-range scanner.



The street price for an MC 3090 is around \$1,700 depending on options. Again, please check with BellHawk for supported configurations before ordering these units.

The Motorola mobile computers are sealed against dust and moisture. The MC3090 units are rated for repeated 5 foot drops onto concrete and the MC9090 is rated for 6 foot drops, although we have seen these units survive much more serious punishment. The MC9090 has a two stage battery. We have found that the interchangeable primary battery will last at least one 8 hour shift in normal operation. The built-in secondary battery will last for 30 minutes and enables the primary battery to be replaced with a charged battery without losing the current state of the software program.

Both Motorola units have an integral IEE 802.11a/b/g wireless communications unit.

BellHawk Systems resells both these units and supplies them complete with SD card and all the BellHawk and database software pre-loaded, ready for use.

Mobile Computer Ancillary Equipment

The following support equipment is recommended for use with the Motorola mobile computers:

1. Spare battery. The batteries can be rapidly changed without needing a screwdriver. They are clip-in clip-out. The batteries use Lithium Ion technology and so do not suffer from the loss of power due to "memory" effects of the older Nickel Cadmium Technology. Street price is under \$80 each depending on model and capacity.

2. **Battery Charger.** This is supplied as a 4 slot charger that is capable of rapidly recharging the Lithium Ion batteries while ensuring a long battery life by carefully controlling the recharging cycle. It can be ordered for different AC supply voltages, with North American 120V being the standard. Street price is around \$250 each.
3. **Cradle.** This unit provides a one slot cradle for the mobile computer that will recharge the batteries in the mobile computer from the AC supply. It will charge both batteries mounted in the mobile computer. It will also recharge a spare battery in a separate battery charging slot. The cradle also provides a USB connector to enable the mobile computer to communicate with a PC when it is placed in the cradle. This is used, if needed, to reload software into a mobile computer. It is recommended, for this reason, that at least one home-base cradle is included in each system. Typical street price is between \$200 and \$330 each depending on model of mobile computer.
4. **A 4 slot charging cradle.** This has 4 slots for mobile computers and will recharge the batteries inside the mobile computers when they are placed in the cradle from the AC supply. It has no capability to charge spare batteries or to act as a USB communications cradle. It is, however, a convenient place to store a group of mobile computers that can be picked up and used as needed by a number of people. Street price is around \$250 each.
5. **Belt Holster.** This is a useful way to carry a mobile computer unit and includes a spare battery clip. Street price is under \$80 each.



Please order support equipment that is compatible with the specific make and model of mobile computer in use.

Wireless Access Points and Antennas

Each wireless mobile computer communicates to the BellHawk server by relaying microwave (2.4 GHz) radio waves from its internal antenna to an external antenna that is connected to a wireless access point. Each mobile computer receives communications from the server by receiving signals broadcast by the external antennas connected to a wireless access point on its internal antenna. The external antennas are either connected directly to the access point or are connected by means of coaxial cable.

The wireless access points are connected to the local area network and require DC power. This power is either supplied by an AC adaptor or is fed through the LAN cable using a power-over-Ethernet adaptor (for those access points that support this mode).

Using a low-power access point like a Linksys unit, a line-of-sight range of up to 100 feet can be achieved. With an industrial access point, such as a Cisco 1240 unit, line-of-sight ranges of up to 300 feet can be achieved.

The radio waves used by the mobile computers are blocked and absorbed by:

1. Metal racking, such as that found in warehouses
2. Rebars in concrete walls



3. Any conductive materials such as barrels and many fluids
4. Metal products and foil products
5. People (walking bags of conductive saline solutions)
6. Fork–lift trucks

Also the reception of radio waves is interfered with by electric–arc "splash" noise from electric motors and welding equipment as well as radio wave emissions by cell–phones, process control equipment, intercom radios, and radio controlled equipment.

For this reason, the BellHawk software works in store–and–forward mode as opposed to terminal server mode. Terminal–server mode applications require continuous communications between a mobile computer and the antenna/access point equipment. This is very hard to achieve even with a large number of access points and antennas. Even then, communications can easily be interrupted, with attendant loss of data or the need to reboot the mobile computer or even the server.

The BellHawk software performs extensive point–of–capture real–time validation of data as it is scanned or entered into the mobile computer. This operational data validation is performed against the contents of the local SQL data base in the mobile computer and so does not depend on the mobile computer being in communications with the server at the time scanning takes place. This validation prevents material handlers from making expensive mistakes such as picking the wrong materials for a job or a customer shipment or loading materials onto the wrong truck.

After validation, BellHawk stores all the transactional data it captures into the local database. Then, when it comes within range of an access point/antenna it automatically uploads the transactions into the BellHawk database server. Then, it downloads all the information it needs to validate data entry transactions into its local database. In this way, the mobile computer is able to perform all its scanning and data validation when not in range of an access point/antenna.

In store–and–forward mode all the transactions are saved up in the local database in the mobile computer and are then only relayed to the server when communications can be established to the server through an access point and its antenna. Transactions are not removed from the mobile computer until an acknowledgement is received that they are safely stored away on the server. The store–and–forward technology is also used to download status information to the local database. This is so that operators can perform all their scan data checking against data stored in the local database. This considerably speeds transaction processing and also enables each item to be validated in real–time as soon as the data is entered rather than waiting for a response from the server. Store and forward is also a lot more secure because all the transmission takes place as encrypted UDP packets rather than as a terminal session to an organization's ERP system, which is vulnerable to hackers.

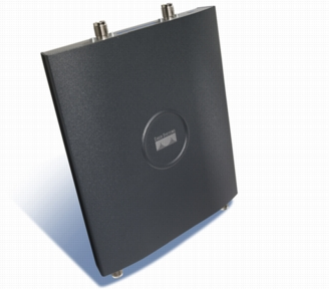
For security purposes, it is essential that the access point support the following (at a minimum):

1. WPA Encryption
2. MAC Address Filtering
3. SSID Suppression

It is also beneficial (if the wireless access points are only to be used for BellHawk) to be able to turn off all protocols except UDP to stop access to the organization's network using higher-level protocols.

For use in a heated and air conditioned environment, low cost wireless access points, such as those available from Linksys can be used. These units come with attached antennas and can be configured remotely over the LAN using a web browser. Many of these units are designed for home office use and have limitations about sub-net routing to connect to the server. They are ideal for use in a training-room pilot installation prior to full deployment of a system.

For use in warehouses, factories and other industrial environments we recommend units such as the Cisco 1240AG units, which provide support in A, B and G modes. These industrial units are dust and heat sealed and will work from below freezing to above 120 degrees Fahrenheit. Units such as the LinkSys fail in these environments because moisture condenses on the circuit boards as these units cool after being heated and this shorts-out the electronics which destroys the units.



The Cisco industrial units are much more expensive than units such as the LinkSys access points. To maximize the effectiveness of these units, BSC recommends the use of:

1. A Cisco 1240AG Industrial Access Point
2. Two High Gain Industrial Antennas
3. Pole mounts for the antennas. These enable the antennas to be clamped to 1 inch conduit that is clamped to the metal rafters of the factory or warehouse. This enables the antennas to be positioned at the same height as the ceiling lights (20 to 30 feet above ground level) for maximum effectiveness.
4. Two 75 foot (or less) low loss coaxial cables with reverse TNC connectors to connect between the antennas and the input terminals on the wireless access point. This shielded cable is stiff and should not be bent with less than a two foot radius.
5. Flexible pigtail cables to connect from the N-Type connectors on the antennas to the coaxial cables. These enable the coaxial cable to run down the antenna mounts and then the pigtails to loop around and attach to the antennas. The pigtails also isolate the antenna connectors from building vibration stress.
6. A power-over-Ethernet adaptor that enables power to be fed to the access point over the LAN cable from a tap that is located adjacent to an existing AC power outlet.

With this kit, customers are able to cover two disparate parts of a building with a single access point and two antennas. For example we might place one antenna over the loading bay doors and another adjacent to the entrance to the production floor. These two antennas can be nearly 150 feet apart providing that the access point is placed high up (hence the need for the power-over-Ethernet adaptor). This essentially halves the cost of covering each area.

The street price for such a setup is under \$1,500 per access point, including antennas, cables, connectors etc.

We have found that we can cover most buildings for store-and-forward use with 2 access points and 4 antennas and have been able to use only one access point and two antennas for smaller factories or warehouses.

It is highly recommended that the power for each access point come an uninterruptible power supply (UPS) that isolates the access point from AC power surges, spikes and outages.

Barcode Printers

BSC recommends the use of industrial thermal transfer printers such as those from Datamax or Zebra, preferably with a 200 dpi or higher resolution to produce high resolution barcodes that are easy to scan. For those applications requiring the printing of small 2D DataMatrix barcodes, or other high resolution barcodes, we recommend using a 300 dpi printer.

For packing operations, where each barcode is printed individually, we recommend the use of a strip-and-peel attachment with a backing-material rewind that will automatically present the user with a barcode ready to put on the carton without manually peeling off the backing.

For those applications requiring a composite barcode/RFID tag, we currently recommend the use of the Datamax or Zebra combination RFID/barcode printers. This unit will test and encode the RFID tag and then print the barcode label.

Barcode Labeling Software

As standard, the BellHawk TAG module works with the Bartender Enterprise software from Seagull Scientific. The reason for this choice is as follows:

1. It has the features needed to seamlessly integrate the use of this package into BellHawk.
2. It is easy to use, with a point-and-click label layout feature.
3. It supports a wide-range of barcode printers.

Bartender Enterprise comes as standard with licenses for three barcode printers. This enables the BellHawk software to be able to automatically choose which printer and media to use based on customer or product specific label formats. Licenses for additional printers can be added as needed.

A special version of this software, BarTender RFID, supports encoding RFID tags in combination barcode label/RFID tag smart labels on barcode printers equipped with RFID encoding heads.

Street price for Bartender Enterprise is under \$800 with licenses for 3 barcode printers.

Other Equipment

Interfaces to other equipment, such as electronic weighing scales and RFID portals are supported through BellHawk subroutine packages that are customized to the specific needs of the application. Through this mechanism BellHawk Systems supports a wide range of weighing scales, from those used in laboratories to those used to weigh trucks. It also supports the Motorola line of RFID portal equipment using a subroutine package.