Vocollect®
a business unit of Intermec®

Print and Data Solutions

Voice Order Selection and the Produce Traceability Initiative

October 2010

Roger G. Byford – Chief Technology Officer, Vocollect, Inc.

with contributions by J.A. Hilzendeger, Giant Eagle

A Vocollect White Paper

Table of Contents

Executive Summary

The Produce Traceability Initiative (PTI) is intended to allow traceability of produce at the case level from source to store. The PTI has adopted the "PTI voice pick code" to permit straightforward implementation of the PTI by warehouses using voice technology for order selection. This paper reviews the PTI and the PTI voice pick code, and makes recommendations for Vocollect Voice users on meeting the PTI traceability goals with minimal software changes, negligible impact on warehouse worker productivity and no additional hardware.

Background – The Produce Traceability Initiative

The PTI web site (www.producetraceability.org) web site says:

> The Produce Traceability Initiative, sponsored by Canadian Produce Marketing Association, Produce Marketing Association and United Fresh Produce Association, is designed to help the industry maximize the effectiveness of current produce trace-back procedures, while developing a standardized industry approach to enhance the speed and efficiency of traceability systems for the future.

The PTI is built on the GS1 Global Traceability Standard, which defines a broad traceability standard that can be applied in a wide range of industries.

The PTI's goal is for all participants in the North American produce supply chain to achieve, by 2012, case level tracking by lot number for all produce, from supplier to store. The PTI is an industry initiative, with no authority to require companies to meet its requirements. Particularly, however, in light of recent highly publicized events showing the difficulty today of determining the source of contaminated produce, it seems reasonable to assume that forward-looking companies in the industry will strive to achieve the PTI's goals.

The PTI has developed an implementation plan for companies to achieve its goal. It has also recommended methods and best practices, which are where possible built on existing standards. The PTI can be applied to any supply chain involving cases of produce, but for the purpose of this paper we will consider a chain in which a packer builds and ships pallets of produce, a warehouse receives the pallets and breaks them down, shipping full cases of items on rainbow pallets, and a store receives the cases. For various reasons the shipper of a pallet or case should be the party responsible for capturing traceability information. The warehouse, therefore, must at a minimum capture traceability information for each case it ships.

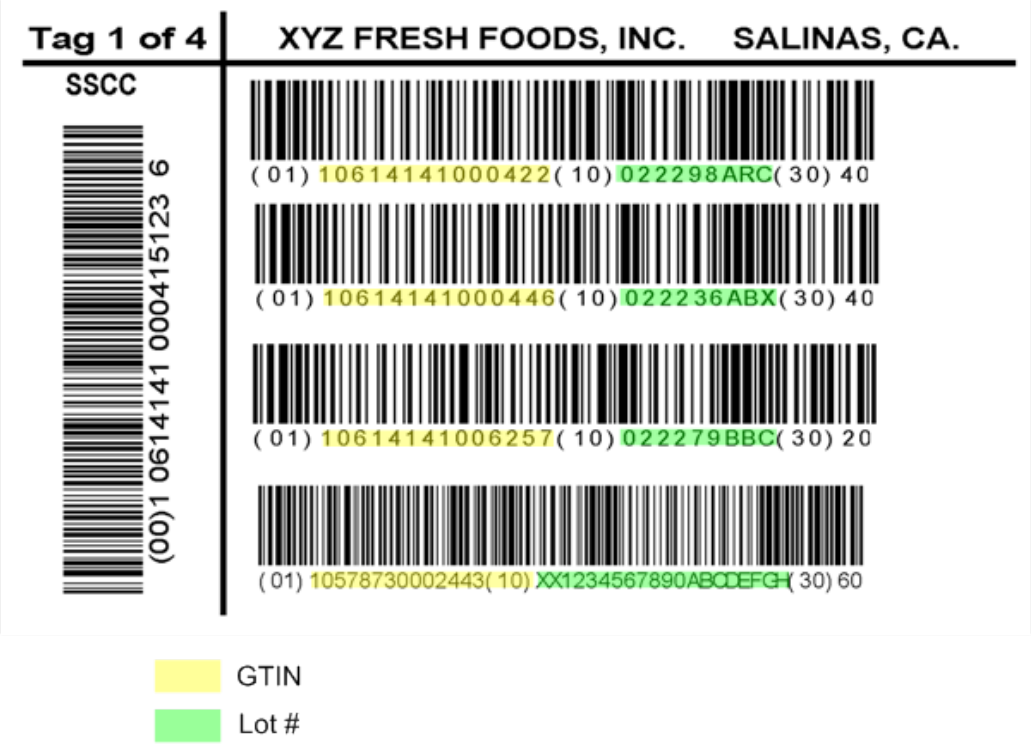
To achieve case level produce traceability the PTI uses three identifiers defined by the Global Traceability Standard:

SSCC The SSCC (Serial Shipping Container Code) uniquely identifies a pallet of produce. The SSCC includes a 7-digit company identifier and a 9-digit "serial reference" (pallet serial number). Pallet serial numbers last only for the life of the pallet, and can therefore be reused.

GTIN The GTIN (Global Trade Item Number) identifies a specific SKU. Various formats are acceptable, but the PTI format includes a 7-digit company identifier and a 6-digit item identifier (SKU number).

Lot/Batch # The lot/batch number is a 5-digit identifier. As with the pallet serial number, lot/batch numbers exist only for the life of a lot, and can therefore be reused.

For pallet labeling, the PTI recommends for the long term using the SSCC (only) on the pallet, with an ASN tying the SSCC to information about the content of the pallet. As an interim solution for those not using EDI, the PTI recommends a "hybrid pallet label" that contains the SSCC and a series of bar codes specifying the GTINs, lot numbers and quantities for each SKU on the pallet. An example appears below. Note that all GS1 bar codes are Code 128.



For case labeling, the PTI recommends a label containing the GTIN and lot number, as shown in the following example.

Note that the PTI recommendations for case (not pallet) labels require the inclusion of the GTIN and the lot number in human-readable form, with a minimum font size of 18 points. This recommendation ensures that in the event of a product recall personnel at all points in the supply chain will be able to readily identify an item and its lot number without requiring equipment such as a bar code reader.

Warehouse Responsibilities

As noted above, it is the responsibility of the shipper of an item to capture traceability information. A warehouse operator can therefore assume that any supplier of produce who wishes to effect a recall of one or more lots of product will be able to specify the SSCC for each pallet containing the affected lot(s). If the pallet is uniform (only contains a single lot of product), then traceability to the store can be achieved if the pallet is identified on receipt, and tracked to the pick location. One could then state, for example, that on July 11 order numbers a, b and c, picked from slot A123 between 08:35 and 12:17, and shipped to stores x, y and z, contained items selected from an affected pallet, and the items in those orders should therefore be recalled.

Unfortunately, not all produce pallets are uniform. A significant percentage contains multiple lots. In the event of a recall affecting a single lot shipped by the supplier on mixed pallets, tracking within the warehouse only to the pallet level would necessitate recalling every lot from any pallet containing the affected lot – potentially a much wider recall than necessary.

To minimize any recall it's necessary for the warehouse to be able to determine not only from which pallet items in each outbound order were picked, but also the lot code of each case. For simple lot codes (five digits, for example), using voice to capture the lot codes during selection would be practical. For suppliers who use longer and/or alphanumeric lot codes, however, the impact of recording each code by voice would be high, and the only direct alternative would be to equip all order selectors with bar code readers – a very expensive proposition. This is where the PTI voice pick code comes in.

Background of the PTI Voice Pick Code

The PTI voice pick code is an implementation of VoiceCode™, developed byYottaMark, a product traceability and authentication company. Yottamark developed VoiceCode specifically to support produce traceability in warehouses using voice technology to support order selection. While YottaMark has applied for patent protection for VoiceCode, they have committed to allowing use of the concepts by all members of the produce supply chain on an entirely royalty-free basis. VoiceCode is a registered trademark of Yottamark, and the PTI is therefore describing its implementation of VoiceCode as the "PTI voice pick code."

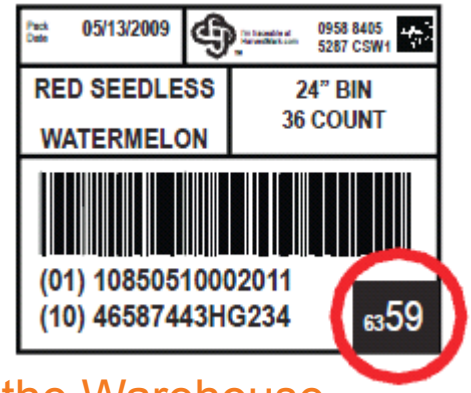
VoiceCode is fully described in the YottaMark White Paper included in the references at the end of this document. In brief, however, VoiceCode combines the GTIN, lot number and (if present) date code to create a four-digit "hash code."

A hash code condenses a large amount of information into a much smaller "digest." For a simple example, one could generate a single-digit hash code from a zip code by adding the five digits and taking the least significant digit of the sum as the hash code (12345 → 15 → 5). Obviously many zip codes will have the same hash code, but if we select a random pair of zip codes the odds that they will have the same hash code are only one in ten (such an event is called a "collision"). Nine times out of ten, therefore, if we wanted to determine whether a letter was destined for zip code A or zip code B, we could make the decision based solely on a single-digit hash code.

For tracking produce in the warehouse, assume that a) we track pallets within the warehouse (as described above), and b) we record during order selection the voice pick code for each case picked. In the event of a recall we first determine which pallet(s) contained the affected lot(s), then for any mixed pallets we calculate the voice pick code for each of the lots, and recall all cases with voice pick code(s) corresponding to the affected lot(s).

For "perfect" traceability we must consider the case of a hash code collision, with two lots of produce on the same pallet sharing a voice pick code. YottaMark's suggested complete implementation of VoiceCode suggests recording no information during selection if a pallet is known to be uniform, recording the two least significant digits of the VoiceCode on a mixed pallet if the system "knows" that there are no collisions on the pallet using only two digits (most of the time), recording all four digits of the VoiceCode if four digits, but not two, are sufficient to avoid collision, and recording complete information (lot code, plus date code if necessary) in the event of a collision of four-digit lot codes on a single pallet (very rare). In the following section we will make recommendations for "best practices" implementations of the PTI voice pick code.

The PTI-endorsed format for displaying the voice pick code on case labels is shown in the following example. The digits shown in the bottom right hand corner of the label are the voice pick code, with the two least significant digits in the substantially larger font.



PTI Implementation in the Warehouse

The goal of the PTI is to achieve full traceability of produce, at the case level, from source to store. Use of the voice pick code permits warehouses to reach near-perfect traceability without significant productivity or equipment cost impact. Moving from near-perfect to perfect, however, involves substantial complexity, and cost, that may not be justified. In what follows we'll explore the trade-offs and make recommendations. Later sections of the paper will discuss the work required by the WMS and voice system suppliers.

Perfect traceability requires the following data collection:

Condition	Data Required
Uniform (non-mixed pallet)	**None**
Mixed pallet, no collisions of two-digit VoiceCodes	**Two-digit voice pick code**
Mixed pallet, two-digit collusions, no four-digit collusions	**Four-digit voice pick code**
Mixed pallet, four-digit VoiceCode Collusions	**Lot number (and date code if present)**

Recording the necessary data for all conditions requires that either the WMS or the voice system calculate the voice pick code for all lots on a mixed pallet and determine whether any collisions exist, either at the two-digit or four-digit level, then direct the selector to enter the appropriate information. Furthermore, recording the lot number could be challenging if lot numbers are long and/or alphanumeric. Alphanumeric characters, requiring operators (like pilots) to use phonetic representations (alpha, bravo, …) are particularly challenging if used rarely, as operators may not remember the phonetic representations.

A much simpler implementation would require the WMS only to notify the voice system whether the pallet being picked from is mixed. For mixed pallets, the voice system would require the operator to capture two-digit voice pick codes. This implementation would accept that on occasion the two-digit code will be unable to distinguish between two lots on the pallet, because their two-digit voice pick codes are the same. Let us consider the implications of this simplification.

The risk of being unable to distinguish between two lots (A and B, say) is that if lot A is recalled, and we haven't captured enough data to know whether given cases came from lot A or lot B, then we will have to recall both lots. In other words, we would have to recall an unaffected lot if:

1. A recall occurs, and
2. An affected lot is on a mixed pallet, and
3. An unaffected lot on the same pallet has the same two-digit voice pick code as the affected lot.

We can calculate the odds of a wider than necessary recall by estimating the following (example values in parentheses):

Value	Example	Comments
% of pallets that are mixed	**10%**	**The percentage of mixed pallets may vary by facility and by product.**
Average # of lots on mixed pallets	**4**	**The odds that another lot on a pallet will share a two-digit code with a recalled lot on the pallet are about 1% for each additional lot on the pallet beyond the affected one.**
Odds that on a mixed pallet with a recalled lot, a different lot on the same pallet is not subject to recall	**50%**	**Likely pessimistic (high). It seems reasonable to assume that in many instances either all or none of the lots on a pallet will be affected by a recall.**

With the example values given, the odds that if a recall occurs we would have to recall an extra lot are then:

$$10\% * (4 - 1)\% * 50\% = 0.015\%$$

In other words, roughly one time in every six hundred recalls (once every three hundred years if a facility experiences an average of two recalls per year) we will have to recall some or all of an extra lot of product because we can't distinguish an affected lot from an unaffected one on the same pallet.

If we were to extend the logic to request four-digit voice pick codes if the system knows that two lots on a pallet share a two-digit code, we could reduce the likelihood of an excessive recall by a factor of about one hundred. There would likely be significant implementation and ongoing cost impact, however, as operators would have either to enter four-digit VoiceCodes for all mixed pallets, or would have to enter different / additional information for roughly one in every 30 pallets (assuming an average of 4 lots per mixed pallet). The benefit seems very unlikely to justify the cost. Requiring full lot number entry in the event of a collision among four-digit codes would have an even less attractive cost-benefit ratio, as the additional complexity would be addressing the issue of preventing the recall of one additional lot of product every 60,000 years (using the example values from the table).

Super Slots

Some warehouses store fast-moving produce items in "super slots" (also known as bulk floor slots or drive-in rack slots). These slots may contain 30 or more pallets of goods. In this case the odds of a collision for two-digit pick codes become unacceptably high. In addition, since we can't know from which pallet a selector will pull cases, we must use the pick code even for uniform pallets. The simplest solution to these challenges is to require selectors to enter the four-digit pick code for all products pulled from super slots. If we assume a reasonable worst case, in which there are fifty pallets in a super slot, and every pallet is mixed, containing four different lots, the odds of a collision between four-digit codes are just under 2%. Here again the added complexity of forecasting a collision, and requiring entry of what may be an extended alphanumeric lot number, seems unwarranted.

Residuals

In many instances a slot will be replenished before it is completely empty, with the "left over" cases (residuals) from the nearly-empty pallet placed on or in front of the newly installed full pallet. If a lot present on the first pallet but not the second is recalled, there is a risk that using a pick-time based algorithm to find orders pulled from the affected pallet will miss affected cases that were residuals, and therefore picked after the affected pallet had been replaced. To correct for this condition when mixed pallets are involved one could modify the search for affected orders to cover any cases with th relevant PTI voice pick code known to have been pulled from either an affected pallet or the pallet that immediately followed the affected pallet in the slot. The odds of a pick code collision would rise slightly, but given the earlier calculation we would still have a wider than necessary recall only about once every 150 years. Resolving this issue for uniform pallets, when we are not recording voice pick codes, is discussed below under "WMS Implications."

Based on the preceding, **Vocollect's recommendation for implementation of the Produce Traceability Initiative using PTI voice pick codes is to require operators to enter two-digit codes for all cases on mixed pallets. For super slots the requirement should be to enter the four-digit code for all items.**

WMS and Voice System Implications

To implement a "minimum scope" recall (i.e. only the affected lot(s)), we must determine which stores received produce from an affected lot. This requires three steps:

1. The supplier of the recalled product must be able to specify which pallets (by SSCC) contained the affected lot(s).
2. The warehouse software systems must track pallets within the warehouse so that we know which store shipments contained product from a given pallet.
3. For mixed pallets the warehouse software systems must further be able to determine which store shipments contained cases from specific lots on the pallet.

To meet requirement #2, the WMS must track pallets, with time stamps, into pick locations, so that we can say (for example) that all product picked from slot A123 between 10:17 and 16:39 on January 4 came from pallet #12345. We discussed above "residuals" – cases that remain in a slot from the previous pallet if the slot is replenished before it goes empty. If we do not record voice pick codes for cases on uniform pallets, we must use another mechanism to "catch" residuals from an affected pallet if the following pallet is not affected. A relatively simple mechanism for addressing the issue would be to determine RMAX – the maximum number of residual cases in a slot (based on the replenishment algorithm). If a pallet containing product to be recalled was replaced in the pick slot with an unaffected pallet at 16:39, one would then include in the recall the first RMAX cases picked from the slot **after** 16:39.

Requirement #3 can be met by turning on lot tracking (a standard feature in most WMSs and in Vocollect voice systems) for all mixed pallets. Selectors will record the two-digit PTI voice pick code as the lot number. A subsequent search for cases from a specific lot would use the pick code algorithm (simple and freely published) to determine the code(s) for the affected lot(s), and could then examine pick records to find items picked from pallet #12345 and having pick code 73.

Note that typical lot tracking, which records an entire lot number during selection, does not require the implementation of pallet tracking. In this case, however, we are using pallet tracking as a more-efficient substitute for lot tracking for all uniform pallets.

To implement the recommendation in the preceding section, therefore, the following is required of the WMS and voice system:

1. Track pallets to pick slots.
2. Enable lot tracking, using the two-digit PTI voice pick code, for all mixed pallets.
3. If super slots are in use, an additional mechanism should be used to "flag" super slots to the voice system, so that selectors will be required to enter all four digits of the voice pick code for items in super slots.

A related but separate question involves the level of reporting provided by the warehouse management system. If the required data is recorded in the system, then at one level tracing product involved in a recall might involve manual "data mining" to figure out which stores received the affected lot(s) and when. At another level the WMS could be programmed to provide such reports automatically.

Fallback Positions

If it is impossible, for whatever reasons, to make some or all of the required modifications to the WMS to meet the requirements above, Vocollect can provide guidance and support in modifying the voice system to perform some or all of the required tracking functionality, while maintaining full compatibility with the WMS.

Conclusion

With careful deployment the PTI voice pick code can be used to meet the PTI goals with only minor modifications to existing software, with negligible impact on productivity, and without any expense for additional equipment for selectors. Vocollect will be pleased to assist our customers in achieving the goals of the Produce Traceability Initiative.

Improved Accuracy. Increased Productivity. Real Business Results.

In the complex supply chain industry, accuracy and productivity are of paramount importance. The proven track record of voice in driving quantifiable performance improvements has made it a natural fit for process reengineering efforts to solve key business challenges. Vocollect, a business unit of Intermec, is the number one provider of end-to-end voice solutions for mobile workers worldwide, helping customers achieve a higher level of business performance. Together with our partners, we enable over 400,000 workers at almost 2,000 companies around the globe to distribute US$4 billion in goods every day. Contact us today to learn how we can help you transform your operational and workforce performance.

Print and Data Solutions
3140 La Playa Court
Lafayette, CA 94549-2214

925-658-1496
www.PrintandData.com
Sales@PrintandData.com

Print and Data Solutions

As a leader in the bar code industry, Print and Data Solutions provides professional services at a fraction of the cost – saving you both time and money. With more than 10 years experience and expertise in hardware, software and solutions, we help organizations deploy custom developed solutions from leading companies to save time, money and increase return on investment.

Vocollect
a business unit of Intermec