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A major battle....

...has been shaping up to determine the front runners in the two-dimensional symbology sweepstakes. Because many industry observers believe that the 2-D technology represents the largest new market opportunity for the near future, we have devoted most of this month's issue to updating this subject. (We will continue our report on this important topic next month with an article on the various application areas and the most successful 2-D symbologies in each.)

In many ways, the vying for position as to which 2-D symbologies will gain the widest industry recognition -- and largest market shares -- is much different than the methods used to select bar codes during the early development of auto ID. During the 1970s and 1980s there was a "natural" selection process. Symbologies were chosen by the users over a period of years and in an orderly fashion -- generally to satisfy a specific need. Few significant disputes arose when UPC/EAN was adopted for retail point-of-sale, followed by Interleaved 2 of 5 for shipping, and Code 39 for most everything else. Later, Code 128 was installed for some new applications because it was recognized as an improvement over the other linear bar codes, providing greater density and security.

In general, those early symbologies were not linked to any "sponsors"; i.e., vendors who might have derived specific benefits from any particular bar code. Quite the contrary, it became an important feature of scanners that they could autodiscriminate among the various symbologies and likewise, that the printers could produce all of them on demand.

But that was then, and this is now! The current market is even more diverse and the potential rewards available to the winners of the 2-D symbology race are much greater.

During the past seven years, ever since they were first introduced, about a dozen 2-D symbologies have been developed. There are stacked (multi-row bar codes), matrix and dot formats. Some have been targeted toward a specific market or application; others are all-purpose. Some that looked good in theory -- and could be readily reproduced on various types of printers -- were slow to reach the market because appropriate reader/scanners were not developed. Most 2-D symbologies were eventually placed in the public domain; some were specifically retained as proprietary; a few were left hanging in limbo between those two designations.



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INCLUDING THE INTERNATIONAL EDITION

The following is a list of the better-known two-dimensional symbologies available today. More detailed analyses of their histories and attributes have appeared in most auto ID books and trade publications (including SCAN May 92; Sept 92) during the past two years.

<u>Symbology</u>	<u>Type</u>	<u>Source</u>
Array Tag	Matrix	Array Tech (Victoria, BC, Canada)
Codablock	Multi-row	ICS Intl (Neu Anspach, Germany)
Code One	Matrix	Laserlight Systems (Dedham, MA)
Code 16K	Multi-row	Laserlight Systems (Dedham, MA)
Code 49	Multi-row	Intermec (Everett, WA)
Data Matrix	Matrix	ID Matrix (Clearwater, FL)
Dot Code A	Dot	Phillips (Eindhoven, Netherlands)
MaxiCode	Matrix	United Parcel Service (Danbury, CT)
PDF417	Multi-row	Symbol Technologies (Bohemia, NY)
Vericode	Matrix	Veritec (Chatsworth, CA)

Three major standards groups -- ANSI (MH10.8 Two Dimensional Symbols with Unit Loads and Transport Packages); AIM/US (Technical Symbology Committee); and CEN TC225 (for the European Union) -- are actively writing specifications for 2-D symbologies. These committees continue to grapple with special issues -- such as public domain status, availability of production scanners and detailed specifications from the inventors. The committees are also concerned about the limited availability of data on actual performance and reliability,

[A caveat should be noted. Although the major groups which set standards are presumed to be independent and unaffiliated with any particular vendors, a large number of the technically competent people, with 2-D symbology expertise, have direct ties to the companies with a vested interest in the results. Thus, many of the most influential committee members are either on the payrolls of the auto ID vendors, or, if they are independent consultants, they have been retained, in one capacity or another, by these same suppliers. Although it is hoped that they leave their prejudices and preferences at the door when they enter the committee meetings, that worthy ideal may be more than should be expected.]

Which brings us to the current state of affairs, and a report on the very fast-moving events of the past two months.

Is it too early....

....to run side-by-side evaluation tests of two-dimensional symbologies and scanners? Both the Automotive Industry Action Group (AIAG) and the ANSI MH10.8 committee think not and each has proceeded to run just such trials.

In an attempt to sort out the features, scanability and reliability of the various 2-D symbologies, two "Scan-offs" were scheduled this year: the AIAG completed their test on March 22-23; the ANSI MH10.8 Committee plans to hold theirs in July.

At the AIAG Scan-off in Detroit, presentations were solicited for five 2-D symbols: Code One, Data Matrix, MaxiCode, PDF417 and Vericode. The invitation

was "to demonstrate printing and reading equipment and to show ability to handle symbol damage."

The following summary report of the test was prepared for the April 26-27 meeting of the AIAG Symbology Work Group:

Vericode: Decided to pursue only NASA requirements.
Code One: Prototype scanners only; No high capacity; Failed damage tests.
Data Matrix: Fixed mount & hand-held scanners; Met most requirements; Emphasis: Small Component Marking; Passed damage tests.
MaxiCode: Hand-held & Overhead; Met requirements for Emphasis: Sortation & Tracking. Passed damage tests.
PDF417: Multi-sourced hand-helds (Symbol & Welch-Allyn); Overhead scanner from Accu-Sort. Met all requirements for 10 mil "X" with 50, 100, 500, and 1,000 character messages. Best of show for damage tests.

The AIAG Symbology Work Group then voted to recommend "MaxiCode to ANSI for the Sortation/Tracking application." A second motion was then proposed -- to recommend Data Matrix for small component marking and PDF417 for "quality conveyance, production evidence, production broadcast and configuration management" -- but the motion failed to pass.

At best, the results from the fairly primitive AIAG test can be characterized as inconclusive. Although Symbol's PDF417 was the only symbology to pass all the tests -- including symbols "damaged" with large spots, voids, obscuring patterns, restricted quiet zones, etc. -- there is every reason to believe that upgraded scanning hardware and software would improve the results of some of the other symbologies.

In a separate project, the ANSI MH10.8 committee is sponsoring its own Scan-off this summer which is intended to narrow down its selection to just two of the 2-D symbologies. This trial, to be conducted by the University of Pittsburgh, will be much more elaborate than the one conducted by AIAG, but it will have similar parameters. These will include the handling of damaged symbols and the use of different proprietary scanners supplied by vendors. (The estimated \$15,000 cost of the study will be covered by a "donation" to the university, shared by the companies which will be submitting their symbologies for consideration.)

Comment

It is difficult to see how any worthwhile conclusions can be drawn from any of these test results. Many of these 2-D symbologies and their scanners are still relatively new and unproven in the field. It would be virtually impossible to hold all other variables constant when testing the various symbologies against one another. It is also questionable as to whether ANSI should be in the business of evaluating proprietary scanning devices.

SCAN has obtained a copy of a two-page internal company memorandum, written by Roger Palmer, Intermec's VP Technology, which isolates these very same concerns about the "Proposed MH10.8 2-D Symbology Test." Palmer raises these key issues:

"The unanswered question, is how the determination of 'symbol performance' is to be made, and how it will be separated from differences in equipment performance....The proposed ANSI test covers vastly different symbology types, and greatly differing equipment architectures: it will not be possible to separate symbology differences from equipment differences. The problem is compounded by the fact that there is not a wide range of available reading equipment from multiple vendors for all of the proposed symbologies to be tested....The present plan is fatally flawed. It doesn't test the differences between symbologies!"

We totally agree with Palmer's assessment -- albeit it may be partially motivated by Intermec's self-interest. As important and beneficial as the tests proposed by ANSI could be, they are premature and the inevitable inaccurate and misleading results would be counter-productive. Furthermore, the suspicion that these tests are being pushed by those companies who are best positioned to "win" the Scan-off -- so that the results can be used to market their 2-D products -- is unworthy of ANSI.

In spite of the mounting pressures from the automotive, electronic and semiconductor industries to select 2-D symbologies standards now, there are still many unresolved technical and legal problems. We urge the MH10.8 committee to abandon -- or at least postpone -- these tests.

On May 3, 1994....

....Symbol Technologies issued the following statement signed by Chairman/CEO Jerome Swartz and President Raymond Martino:

PDF417 Policy Statement

"This policy paper to the auto ID community is provided to define Symbol's patent position related to PDF417 so that customers can feel free to implement this powerful technology to serve their application needs. Symbol shall comply with the patent policies of the industry standards organizations, without any deviation. Accordingly, the public domain status of PDF417 is identical in all respects to the existing industry standard bar codes.

"In compliance with ANSI's patent policy, 'under any invention whose use would be required for compliance with the proposed ANSI standard,' Symbol agrees that 'a license will be made available without compensation to applicants desiring to utilize the license for implementing the standard.'

"In compliance with the AIM intellectual property requirements, Symbol represents that the PDF417 symbology present in the AIM specification 'is entirely in the public domain and free from any use restrictions, licenses and fees.'"

Comment

Thank goodness this messy issue has been put to bed. Symbol was getting mired deeper and deeper into a series of carefully worded statements that danced around the public domain controversy and made everyone progressively more nervous about their real motives.

We believe that the policy outlined in this May 3 statement was what Symbol's management and marketing staffs probably intended all along. We suspect they were scared off from acting sooner by their attorneys, who may have feared that if they did not build some protection around the PDF417 symbology, the company may have surrendered some of its rights to the proprietary hardware and special decode algorithms that Symbol had developed.

PDF417 is the only symbology ever introduced by Symbol. We detected two themes running through the strong objections raised by AIM's TSC and others about how Symbol had handled the public domain issue. First, the company underestimated the fervor of many industry leaders who believe that the successful development of auto ID was largely dependent on the free, open and unrestricted use of all bar code symbologies. Second, this was an opportunity to slow down Symbol's PDF juggernaut and, for some, it was a chance to "get even," in a small way, for all the patent victories that Symbol has won over the years.

It's time to move on.

In an important development....

...that could open the market wider for 2-D applications, Intermec has been quietly and selectively demonstrating a new scanner for these symbologies.

The device has been described to SCAN as a "high-speed, hand-held, digital camera with a decoder in the handle" which is "designed to read any 2-D symbology." The equipment does not yet have an official name, but is informally referred to as an "imager." A working prototype -- actually not much more than a bench model -- was demonstrated at the Intermec Users Group meeting in Toronto in April and also, with some trepidation, at the AIAG "Scan-off" in March (see above). (Intermec felt it was premature to show such a primitive model to the important automotive group, but it was the only scanner that could read Code One -- so Intermec decided to participate.)

Product Manager Chris Wiklof emphasized to SCAN that "the technology is in its infancy" and that this imager "is not yet a product." Intermec reports that the new device will scan a Code One symbol in .2 seconds: .05 seconds to read and .15 seconds to decode. Wiklof would not confirm the expected introductory price of the unit, but his target is clear. "It will fall somewhere between significantly under, at, or just above [Symbol's] PDF1000," he predicted. Wiklof said Intermec plans to introduce this new scanner in the Fall, probably at Scan-Tech 94 (Nov 1-3, Chicago).

One important feature of this new CCD array-type scanner is that it has been designed to read and decode any 2-D symbology -- both the stacked bar code and matrix types. Until now, the 2-D scanners on the market could only read one symbology -- usually the one being promoted by the hardware manufacturer; e.g., Veritec for Vericode, Symbol for PDF417, UPS for MaxiCode, etc.

The selection process at Intermec -- to decide which symbology to read and decode when introducing their CCD imager -- is indicative of other forces at play. Sprague Ackley, Intermec Principle Engineer (and a member of AIM's

Technical Symbology Committee), told SCAN that Symbol's PDF417 had originally been picked as the symbology of choice for the introduction of Intermec's CCD imager -- and development of the decode algorithm was under way last year. "When Welch Allyn withdrew their [linear] CCD scanner from last year's SCAN-TECH," Ackley said, "because there was some question as to whether they were free to decode PDF417 (SCAN Dec 93), we decided to abandon PDF and go with Ted Williams' Code One."

Wiklof added: "We have adopted what we believe to be a 'righteous' position. Intermec will support any symbology so long as it is clearly in the public domain and free of any licensing requirements." (These decisions by Intermec occurred before Symbol released their May 3rd statement -- see above.)

Having made the choice to sponsor Code One rather than PDF417, Intermec is now actively pushing Code One as the superior symbology. Although Code One did not score as well as PDF417 at the AIAG tests (see above), Ackley attributed that performance to incomplete software in their CCD imager, rather than to any deficiency in the symbology. "Code One can pack more data into a smaller area than PDF417, has built-in error correction and a very efficient 'finding' pattern," he stated.

[One interested party not yet heard from is Norand. That company holds a group of patents with many claims that purport to cover just about all applications of CCD scanners -- including 2-D symbologies (SCAN Feb 94). Norand already has notified the manufacturers of linear CCD scanners that they infringe; there is every reason to believe that Norand will take steps to protect their intellectual property rights in the 2-D symbology applications as well.]

The opportunity....

....to obtain a first-hand view of the automatic data capture market in China drew us to Beijing for SCAN CHINA 94 (April 15-17).

[SCAN CHINA 94 was sponsored by the Article Numbering Center of China (ANCC) -- the EAN-designated numbering agency -- and was billed as the first auto ID exhibition in that country. (Actually, Business & Industrial Trade Fairs Ltd, a Hong Kong-based organization, ran Auto ID China in Shanghai in 1992, but ANCC chose to ignore that event.) ANCC, which administers the EAN program through 44 branch offices located throughout the country, has issued 10,000 EAN manufacturer's numbers to member companies. ANCC also reports that there are currently 66 scanning retail stores in China, but few details are available about the size of these stores, types of scanners or extent of automation.]

This was our first visit to China. After spending just one week in Beijing, we will resist the temptation to offer our "expert" opinions and advice about the country. Instead, we will report on what we saw and heard, and relay the responses of some of the more experienced "China-hands" we interviewed.

The Show: On the exposition floor, at the modern Exhibition Hall of the China World Trade Center in Beijing, there were approximately 25 foreign exhibitors present from Canada, France, Hong Kong, Japan, Singapore, Taiwan, US and UK.

There were only a few manufacturers who had their own booths, and most of the Western companies were represented by their Asian distributors and joint venture partners. The products shown were mostly familiar scanners, terminals, printers and supplies for the non-retail auto ID market.

In a separate, adjoining area, 75 Chinese companies also exhibited a variety of auto ID products and services. These booths were staffed by local agents of foreign companies, since there is virtually no manufacturing of auto ID products in China today -- other than film masters, mostly for exported consumer goods. (Based on the company names, it was sometimes difficult to determine just what auto ID products were being offered for sale by these Chinese firms; e.g., Dalian General Cereals & Foodstuffs Industry Plant, Almond Milk Factory in Aohan Mongolia, DeYi Braised Chicken Ltd, and at least three regional wineries.)

When judged in terms of exhibitor expectations, SCAN CHINA 94 was disappointing on three counts:

1. The early promotional material sent to potential exhibitors promised 40,000 visitors. Although no official count was issued by the ANCC, it is doubtful that more than four thousand visitors showed up. And most of these visitors attended on Friday, April 15, the first day of the show. The low turnout was blamed on two main factors: An inadequate promotional program advertising the event; and a new national policy of five-day work weeks -- to be held twice a month -- which was announced by the Chinese government in March. Unfortunately for the event, April 16-17 was the first holiday weekend under this new plan -- and Chinese workers eagerly took advantage of it rather than attend the conference.
2. There were two days of educational seminars for the Chinese presented by foreign experts. Only about 40 people actually attended these sessions -- a small fraction of what had been anticipated. The presenters received no indication about the makeup of the audience or their primary interests. With the language barrier and few direct questions from the audience, it was difficult to evaluate the results.
3. Many Westerners went to SCAN CHINA to learn about the market and the best ways to establish a foothold. The ANCC was supposed to conduct separate seminar sessions for these business representatives, but these seminars were cancelled without notice and left many disappointed foreign visitors.

The Market: It's not just that there are an overwhelming 1.3 billion people in the country. The recent accomplishments, vitality and desire of the Chinese people become readily apparent to any visitors. (A running gag in Beijing is that the crane has become the national bird of China -- because there are hundreds of angular building cranes visible throughout the city.)

Although the show's attendance may have disappointed many Western visitors, they nevertheless came away favorably impressed with the cadre of very sharp, modern, knowledgeable Chinese personnel working for some of the local distributors.

[Which brings us to the QUANGO experience. It took us a few days to stop asking the question of the Chinese entrepreneurs: "Are you a government agency or a private enterprise?" Several foreigners experienced in the Chinese market finally convinced us that it is almost impossible to tell

-- and it really doesn't matter. The answer is almost always "QUANGO": A Quasi Non-Government Organization -- and no one can provide a better definition. The point is that deals are made, contracts signed, and the Chinese partners scrupulously hold up their end of the arrangements -- no matter what their businesses are called.]

No reliable statistics were available from ANCC for China's current auto ID market size but no one we spoke with, unofficially, thought that it was greater than \$3-5 million per year. Those foreign companies committed to the Chinese automatic data capture market understand that these are still small pickings. They are concentrating on the size and direction of the economy, however, and are determined to hang in there for the long haul -- while keeping their expenses and commitments under control.

The Timetable: Estimating how quickly the market will grow and in what direction remains a crapshoot. Although most China-watchers anticipate that the market explosion for auto ID products will happen, few agree on when.

In the March 1994 issue of *ID Systems/Industry Scan*, Frost and Sullivan's Senior Research Analyst Girish Rishi wrote: "Unfortunately, the available statistics [from China] are skimpy, and the research being conducted is suspect. The variables are infinite." Nevertheless, these caveats did not stop Rishi from predicting later in this same report: "Frost and Sullivan's forecast shows that the Pacific Rim [including China] will account for an impressive 18 percent of the world bar code equipment market in 1999." [One straw in the wind: A large Japanese supermarket chain is rumored to be committed to opening 1,000 large, scanning supermarkets in China during the next five years.]

One savvy US auto ID executive summed up his Chinese experiences this way: "Pricing is soft and very competitive. The ANCC are tough bargainers. There is still a great deal of corruption around. I would compare the current situation to the American 'Wild West.'"

A final point. On April 18, 1994, in a special 14-page section dedicated to "Asian Infrastructure," the Asian Wall Street Journal reported: "Without huge spending on infrastructure, Asia is condemned to traffic jams, power outages and overloaded phone circuits....Such bottlenecks will slow economic growth, infuriate the public and endanger political careers."

With this in mind, we asked several Chinese officials and knowledgeable Westerners this question: "Given this necessary dedication of time and resources to building the infrastructure, and recognizing the enormous manpower reserves available in China to perform routine tasks, what will be the incentive to install automatic data capture systems on a large scale?"

There were no definitive answers, of course. In one small corner of the Chinese economy, however, there is a group of entrepreneurial, kindred spirits who have become enamored of this technology and will strive to bring as much of it as possible into the retail and industrial sectors. It's a fascinating experience.

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PUBLISHER/EDITOR: George Goldberg • ASSOCIATE EDITOR: Jeff Goldberg • CIRCULATION DIRECTOR: Teddy Allen
INTERNATIONAL EDITOR: Paul Chartier • United Kingdom Office P.O. Box 7 • Cirencester GL7-1HY England
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