Symbol decoder for the mobile phone
- Services and Applications using the symbol decoder-

2006
MEDIASEEK Inc.
Introduction of the Symbol Decoder
Actual Achievement: Barcode Decoder Engine for the mobile phone

We have the largest market share of the barcode decoder for the mobile phone in Japan!
-More than 60% of domestic market share. (researched by MEDIASEEK)

Barcode Decoder Engine for the mobile phone
We provide the barcode reader engine for handsets, which are released by three major Japanese carriers of the mobile phone and a major carrier of the PHS phone.

**KDDI(au)**
We provide the barcode engine for KDDI’s official BREW (Extension) and BREW application.

**NTT DoCoMo**
We provide major vendors with the barcode engine.

**vodafone**
We provide major vendors with barcode engine.

**WILLCOM**
We provide major vendors with barcode engine.

BREW Application “Barcode Reader & Maker”
We developed and provide “Barcode Reader & Maker” as a KDDI’s BREW application. The application is pre-installed in compatible handsets.
•Registration in a phone book, URL reference, Mail to/Phone to, interaction with EZ Navi-Walk (LBS), linkage with the digital terrestrial broadcasting, barcode creation (from profile/phonebook), data folder storage/reading
•Compatible handsets: 49 models (as of Mar. 2006) *It is planned to be built in Brew-based handsets that will be released in the future.
Symbol Decoder: Service examples

When users take barcode images with a camera phone, they can use various services in accordance with the information contained in the barcodes.

Internet access
If a QR code contains a URL, a browser of a mobile phone is started and an appropriate web page is displayed on the screen.

SMS / Phone to
If a QR code contains a telephone number, you can make a phone call or send an short message at this number.

Mail to
If a QR code contains an e-mail address, you can send an e-mail at this e-mail address.

Business Card Reader
If a QR code printed on a business card and others contains the information described in the card, decoding result will be registered in a phone book.

LBS
If a barcode contains a location information, such as mailing addresses longitude, latitude, and so on, it links with GPS and displays an appropriate map.
Symbol Decoder : Specification

<table>
<thead>
<tr>
<th>Software Component</th>
<th>C language function library object, header file</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symbol Object</td>
<td>JAN8/EAN, UPC-A/E, CODE39, QR Code(model2), Micro QR Code, Data Matrix, PDF417</td>
</tr>
<tr>
<td>Decoding speed</td>
<td>About 200ms. (Under the circumstances of 100Mips, an example of the QR Code ver 1.0. It depends on the type of symbol codes and environmental dependency)</td>
</tr>
<tr>
<td>Required resource</td>
<td>ROM:100KB, RAM:130KB</td>
</tr>
<tr>
<td>Image correction</td>
<td>It corrects &quot;elevation-angle error&quot;, &quot;Upside down&quot;, &quot;distortion&quot;, &quot;uneven lighting&quot;, &quot;out of focus&quot;, &quot;feathering on print surface&quot;.</td>
</tr>
</tbody>
</table>

Compatible with various Platforms and operating systems.

Advanced Image Processing Technology

- It decodes codes with the image correction function.
- Out of focus
- Elevation-angle
- Distortion
- Contrast
- Inverted color

© 2005 MEASEKALL RIGHTS RESERVED
Symbol Decoder : Supported Symbols

- JAN8/13.EAN
- UPC
- CODE39
- NW-7(CODABAR)

- QR code(model2)*1
- DataMatrix*2
- PDF417
- Micro QR code

*1: It supports up to Ver.20 and codes whose background color is inverted as well.
*2: It supports ECC200.

It supports other types of code as well.
- Barcode : in about 1 month
- 2D code : in about 2 months
Symbol Decoder: Technical Layer

The symbol decoder consists of two technical layers, an engine and an application. Various services will be available by developing new applications.
Symbol Decoder Engine: Verification Procedure for Development

Basically, we have the following plan for projects relating to the embedding of our decoder software in the mobile phone. (We will adjust it flexibly depending on the situation.)

- Technical requirements to be checked
  - Barcode - “QR M2V20”, “JAN13/8” or others?
  - CPU/ platform - “ARM9/7”, “V850”, “SH-Mobile” or others?
  - Format - Basically library format. Development of a topside application will be examined as an option.
  - API type - Time division or bundled?
  - Image format/ size - Does any of RGB8, RGB 565, YUV420/422 fit in?
  - Is there any requirements, such as JPEG or PNG?
  - Is QVGA available?
  - Optical system - Is the close-up function available?
  - Required resource - It requires 100KB of ROM and 130KB of RAM at a rough estimate.
  - Performance - Past results are approximately 200ms at ARM9/100Mhz.

- Points to be checked relating to the operation management
  - Operation schedule
  - Sharing the tasks especially items relating to the verification. Also detailing deliverables, including documentation etc.
    - Black Box Testing (BBT), White Box Testing (WBT)
    - Whether a practical operation of Bread Board (BBB) rental or porting is conducted or not.

- Demo (testing) version
  - PDA and PC version. Targeted platform version can be examined if it’s already existed.

- Development environment
  - It is based on the premise that the tool for cross development is leased as a rule.
  - Compile options will be determined at this point.
Case Studies of the Symbol Decoder
Symbol Decoder : Case Study 1 <Mobile Champaign Solution>

By just peeling off a sticker put on a product and scanning a QR code on it, users can access to a campaign sites for the product in a breeze.

We print stickers and put them on a products that is advertised in the campaign.

Users peel off a sticker and scan a QR code on it.

Users can access to the campaign site.
Special stickers on which a QR code is printed are put on ROMs of Pachinko and slot machine. Parlor staff can check whether a fraud has been committed or not by scanning the barcode with a mobile phone at a parlor.

We produce unreproducible special stickers for anti-counterfeit.

The stickers are put on ROMs of Pachinkos and slot machines.

Parlor staff checks whether there is a trace of fraud on ROMs by scanning barcodes with a mobile phone.
Users can access to an appropriate site by scanning a QR code containing unique numbers without troublesome entry of a URL. Affiliate fee is paid by content providers in accordance with the traffic.
With the solution using encrypted QR codes, you can manage products to and from custom houses. Product traceability and identification are able to be double-checked by scanning the QR codes at stores once again.
Once users scan barcodes printed on paper media and access to mobile commerce sites, it enables them to purchase appropriate goods. Mobile commerce sites pay the affiliate fee to affiliate owners who post QR codes on media according to how many customers purchase the goods.

Affiliate owners post barcodes that link to purchase pages introducing products on paper media.

Users scan a barcode with their mobile phones equipped with a barcode reader.

An appropriate purchase page is displayed and users can buy goods from the page.

Barcodes are issued by mobile commerce sites.
[Reference]
Size and Data volume of the QR Code
The data volume and size of the QR code under the condition that error correction level is M and cell pitch is 0.296. (Mobile phone-readable minimum cell pitch.)

<table>
<thead>
<tr>
<th>Ver.</th>
<th>Cell</th>
<th>Data bit</th>
<th>Numeric</th>
<th>Alphabetic</th>
<th>Binary</th>
<th>Kanji</th>
<th>Sample of QR Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>25 X 25</td>
<td>224</td>
<td>63</td>
<td>38</td>
<td>26</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>33 X 33</td>
<td>512</td>
<td>149</td>
<td>90</td>
<td>62</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>41 X 41</td>
<td>864</td>
<td>255</td>
<td>154</td>
<td>106</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>49 X 49</td>
<td>1232</td>
<td>365</td>
<td>221</td>
<td>152</td>
<td>93</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>57 X 57</td>
<td>1728</td>
<td>513</td>
<td>311</td>
<td>213</td>
<td>131</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>65 X 65</td>
<td>2320</td>
<td>691</td>
<td>419</td>
<td>287</td>
<td>177</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>77 X 77</td>
<td>3320</td>
<td>991</td>
<td>600</td>
<td>412</td>
<td>254</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>97 X 97</td>
<td>5352</td>
<td>1600</td>
<td>970</td>
<td>666</td>
<td>410</td>
<td></td>
</tr>
</tbody>
</table>

Versions up to 10 are guaranteed to be decoded with mobile phones made in Japan.
[Reference] Size and Data volume of the QR Code (2)

<table>
<thead>
<tr>
<th>Size (mm)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data (bits)</td>
<td>29</td>
<td>58</td>
<td>87</td>
<td>116</td>
<td>145</td>
<td>174</td>
<td>203</td>
<td>232</td>
<td>261</td>
<td>290</td>
</tr>
</tbody>
</table>

Note: The above table provides a general guideline for the size and data capacity of QR Codes. Actual performance may vary depending on the QR Code generation software and scanner used. For more detailed information, refer to the QR Code standard specifications.
## Comparison of 2D Codes

<table>
<thead>
<tr>
<th></th>
<th>QR Code</th>
<th>PDF417</th>
<th>DataMatrix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developer</td>
<td>Denso (Japan)</td>
<td>Symbol Technologies (USA)</td>
<td>Codamatrix (USA)</td>
</tr>
<tr>
<td>Type</td>
<td>Matrix</td>
<td>Stacked barcode</td>
<td>Matrix</td>
</tr>
<tr>
<td>Maximum data volume</td>
<td>Numeric: 7,089</td>
<td>2,710</td>
<td>3,115</td>
</tr>
<tr>
<td></td>
<td>Alphanumeric: 4,260</td>
<td>1,850</td>
<td>2,355</td>
</tr>
<tr>
<td></td>
<td>Binary: 2,953</td>
<td>1,018</td>
<td>1,555</td>
</tr>
<tr>
<td></td>
<td>Kanji: 1,817</td>
<td>554</td>
<td>778</td>
</tr>
<tr>
<td>Code size for 8 digit number (Cell size 0.254mm)</td>
<td>7.3x7.3mm</td>
<td>7.6x22.8mm</td>
<td>3.5x3.5mm</td>
</tr>
<tr>
<td>Main characteristics</td>
<td>QR code has the largest data storage capacity. It can be downsized since it is a type of Matrix code. Also, it supports the high-speed and omnidirectional decoding. It displays Japanese Kani (2 bytes characters) more efficiently than DataMatrix.</td>
<td>Stacked barcode like this type can store large volume of data, but it is difficult to be downsized. It deals with stains, more efficiently than other two types of code. PDF417 can be decoded with the mobile phone, but there is a limitation on the size for decoding due to its aspect ratio.</td>
<td>It is possible to generate the smallest symbol with this code. It has great information density and supports the omnidirectional reading.</td>
</tr>
<tr>
<td>Main way to use</td>
<td>This is widely used in Japan. Japan Automobile Manufacturers Association, Inc. and Japan Auto Parts Industries Association has employed it on their signboards. Also, Japan contact lens association has adopted it for their product labels. In recent years, it can be decoded with the mobile phone and has been posted on advertisement posters for product promotions.</td>
<td>This is widely used in the OA field. American National Standards Institute (ANSI), Alliance of Automobile Manufacturers, Inc. (AAMA), Electronic Industries Alliance and American Association of Furniture Manufacturers have adopted it. This is the most popular code in the world.</td>
<td>This is widely used in the FA field. American National Standards Institute (ANSI) and Electronic Industries Alliance have employed it on the parts marking. This is very popular in the world as the application having no marking space.</td>
</tr>
</tbody>
</table>
The Barcode Decoder for the mobile phone Market Summary
### Market Summary: Market forecast of the camera phone and barcode reader

#### Japanese Market

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Subscribers of mobile phone</td>
<td>73,774,300</td>
<td>80,156,200</td>
<td>85,483,800</td>
<td>87,489,800</td>
<td>90,483,800</td>
</tr>
<tr>
<td>Mobile phone shipment volume</td>
<td>41,075,000</td>
<td>52,197,000</td>
<td>42,573,000</td>
<td>42,673,000</td>
<td>42,673,000</td>
</tr>
<tr>
<td>Camera phone shipment volume</td>
<td>24,193,175</td>
<td>48,403,133</td>
<td>40,539,350</td>
<td>40,539,350</td>
<td>40,539,350</td>
</tr>
<tr>
<td>Percentage of camera phone shipment volume</td>
<td>30.1%</td>
<td>58.9%</td>
<td>88.8%</td>
<td>95.0%</td>
<td>95.0%</td>
</tr>
<tr>
<td>Camera phone user</td>
<td>22,210,000</td>
<td>47,060,000</td>
<td>66,862,950</td>
<td>77,939,643</td>
<td>83,081,869</td>
</tr>
<tr>
<td>Penetration rate of camera phone</td>
<td>30.1%</td>
<td>58.9%</td>
<td>88.8%</td>
<td>95.0%</td>
<td>95.0%</td>
</tr>
<tr>
<td>Barcode reader shipment volume</td>
<td>600,000</td>
<td>5,900,000</td>
<td>20,000,000</td>
<td>30,404,513</td>
<td>32,431,480</td>
</tr>
<tr>
<td>User of barcode reader</td>
<td>600,000</td>
<td>5,300,000</td>
<td>22,300,000</td>
<td>46,014,513</td>
<td>64,641,639</td>
</tr>
<tr>
<td>Penetration rate of barcode reader</td>
<td>0.8%</td>
<td>0.6%</td>
<td>25.1%</td>
<td>52.6%</td>
<td>71.4%</td>
</tr>
</tbody>
</table>

Blue italic indicate the forecast by MEDIASEEK

#### Penetration rates

- **Handsets without camera**
- **Handsets with camera**
- **Handsets with barcode reader**

- **End of 2002**
  - Handsets without camera: 69.9%
  - Handsets with camera: 30.1%
  - Handsets with barcode reader: (0.8%)

- **End of 2003**
  - Handsets without camera: 40.3%
  - Handsets with camera: 59.7%
  - Handsets with barcode reader: (6.6%)

- **End of 2004**
  - Handsets without camera: 21.8%
  - Handsets with camera: 78.2%
  - Handsets with barcode reader: (26.1%)

- **End of 2005**
  - Handsets without camera: 11.6%
  - Handsets with camera: 88.4%
  - Handsets with barcode reader: (52.6%)

- **End of 2006**
  - Handsets without camera: 8.2%
  - Handsets with camera: 91.8%
  - Handsets with barcode reader: (71.4%)
Market Summary: Adoption status of the barcode reader by each carrier

<table>
<thead>
<tr>
<th>Carrier</th>
<th>Number of supported handsets</th>
<th>Number of supported models</th>
<th>Supported models</th>
</tr>
</thead>
<tbody>
<tr>
<td>NTTDoCoMo</td>
<td>About 30.6 million (End of Feb. 2006)</td>
<td>60 models</td>
<td>FOMA 900i series or later models</td>
</tr>
<tr>
<td>KDDI</td>
<td>Undisclosed</td>
<td>49 models</td>
<td>BREW handsets except for a part of two-end handsets</td>
</tr>
<tr>
<td>vodafone</td>
<td>6.21 million (End of Jan. 2005)</td>
<td>28 models</td>
<td>All handsets except for ones released by Sony Ericsson, NOKIA, and Motorola</td>
</tr>
<tr>
<td>WILLCOM</td>
<td>Undisclosed</td>
<td>2 models</td>
<td>WX310SA and WX310K</td>
</tr>
</tbody>
</table>

Comments by major carriers in an interview regarding the barcode reader

(Excerpt from "Practice! Use of 2D codes, mobile phone promotion" issued in Feb. 2005 by Sendenkaigi Co., Ltd.)

NTT DoCoMo
We adopted the barcode reader intending to increase i-mode access. Not only that, we thought it was excellent way to realize our primary concept “Anywhere in Life/ Mobile phone in all scenes of your life” and to link with information in real time. The QR code is open-priced and can be embedded without any negotiation or partnership agreement. That's the reason that we chose it.

KDDI (au)
au looks on the barcode as "an entrance of the mobile phone". It saves the effort of direct entry of URL, at the same time, it improves user-friendliness. Also, we think the linkage of 2D code and our product “EZ Navi-Walk”, which is a navigation system using GPS, boosts up the market growth. We have been posting 2D codes in four magazines listing a variety of shop information, leisure spots and so on. Once those 2D codes are scanned with a camera phone, "EZ Navi-Walk" starts immediately. Users can view a map or direction to the place they wish to go. We have win-win relationship with these magazine media. Not only readers of magazines can use the information more conveniently, but we can increase the utilization ratio of “EZ Navi-Walk”. Moreover, it enables us to make a public appeal of our product.

Vodafone
We think that use of mobile phone can be increased by accessing to websites using the 2D code. Because there is no need for text entry and the registration of the information in business cards to phone books. We have been posting the QR code on catalogs or content guides since we released supported models for this function. Since the barcode service requires the cooperation with paper media and others to ensure success, we expect that market itself will grow by combining various types of media with the QR code. We intend to include the 2D codes and other codes, which have been internationally standardized, into handset specifications and promote them through our own market.
Market Summary: Recognition rate of the QR code
[survey result on “QR code” researched by INFO PLANT CO., LTD. in Aug. 2005]

[Respondents of 7,660 i-mode users, researched by INFO PLANT CO., LTD. in Aug. 2005]

The recognition rate of the QR code is 96.5%. 73.3% has used the QR code as a practical manner. Nearly 90% of respondents who are under 19 years and younger has used it. (The recognition rate was 91.4% and usage experience rate was 53.8% in a survey conducted in February 2005)
58.5% want the barcode reader next time they replace their mobile phone. This increases by 5% compared to the previous survey conducted two month ago. It placed third behind the camera and music player same as previous time.
Great many respondents answered “Magazines” and more than 80% of both genders use the QR code posted on magazines. By gender, while the number of males who answered “PC sites” surpassed females' answer, the number of females who answered “catalogs of mail order” is larger than males answer.
“Scanning URL and accessing to a site” is the most popular answer in both genders. Meanwhile, respondents intend to use various services, such as “use of QR code as a ticket or membership card, and for a mobile shopping.