Discussion Paper for Mobile ORM
based on the presentation at SC31/WG6 Jeju Meeting

– Specification and implementation guideline for
Optically Readable Media (ORM) reader
incorporated in a mobile device and
display method of ORM on mobile device –

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Data Capacity and Symbol Size

Data capacity of QR Code (excerption)

Version	No. of modules/side	Error correction level	Data capacity			
			Numeric	Alphanumeric	Byte	*Kanji*
1	21	L	41	25	17	10
		M	34	20	14	8
		Q	27	16	11	7
		H	17	10	7	4
2	25	L	77	47	32	20
		M	63	38	26	16
		Q	48	29	20	12
		H	34	20	14	8
3	29	L	127	77	53	32
		M	101	61	42	26
		Q	77	47	32	20
		H	58	35	24	15
4	33	L	187	114	78	48
		M	149	90	62	38
		Q	111	67	46	28
		H	82	50	34	21

:

Up to 40

■ **The larger the data capacity is, the larger the symbol size becomes.**

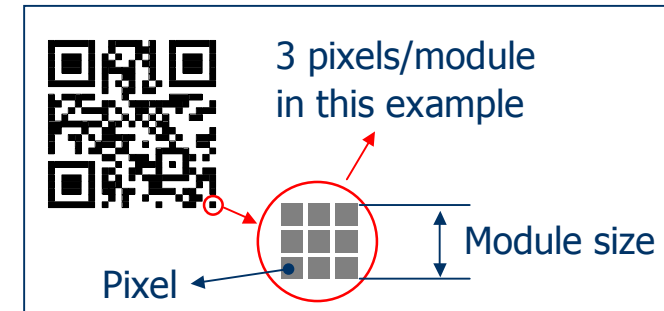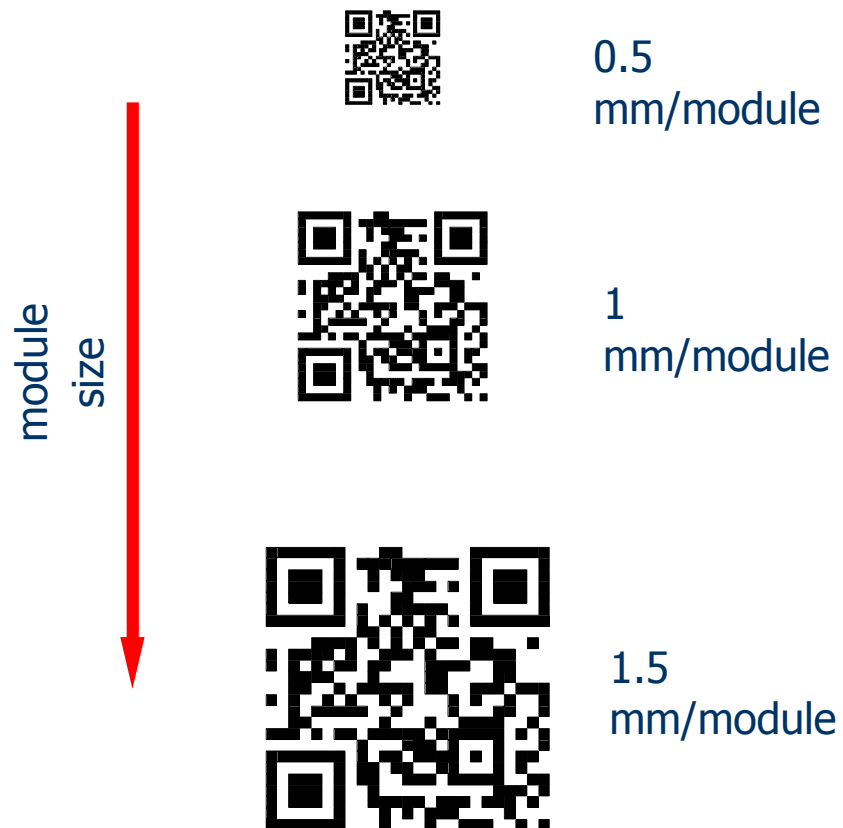# Parameters Affecting the Symbol Size(1)

Example

Character type

→

	Numeric	Alphanumeric	*Kanji*
	01234567890123456789	abcdefghijklmnopqrst	漢字漢字漢字漢字漢字漢字漢字漢字漢字漢字

Error correction level ↓

- **The symbol size increases as the error correction level goes up even for the same data.**
- **The symbol size may vary depending on the character type even for the same number of characters.**

Parameters Affecting the Symbol Size(2)

Example 01234567890123456789

0.5 mm/module

1 mm/module

1.5 mm/module

module size

3 pixels/module in this example

Module size

Pixel

■ **The symbol size is determined by the module size.**

Minimum Resolution and Read Range

Example: QK-12 (mobile reader) specification

Resolution	2D symbol	0.33 mm
	Bar code	0.25 mm (0.26 mm for EAN, UPC)
Read area	Backlight ON	50 x 38 mm
	Backlight OFF	40 x 30 mm
Optimal reading position	7 mm	
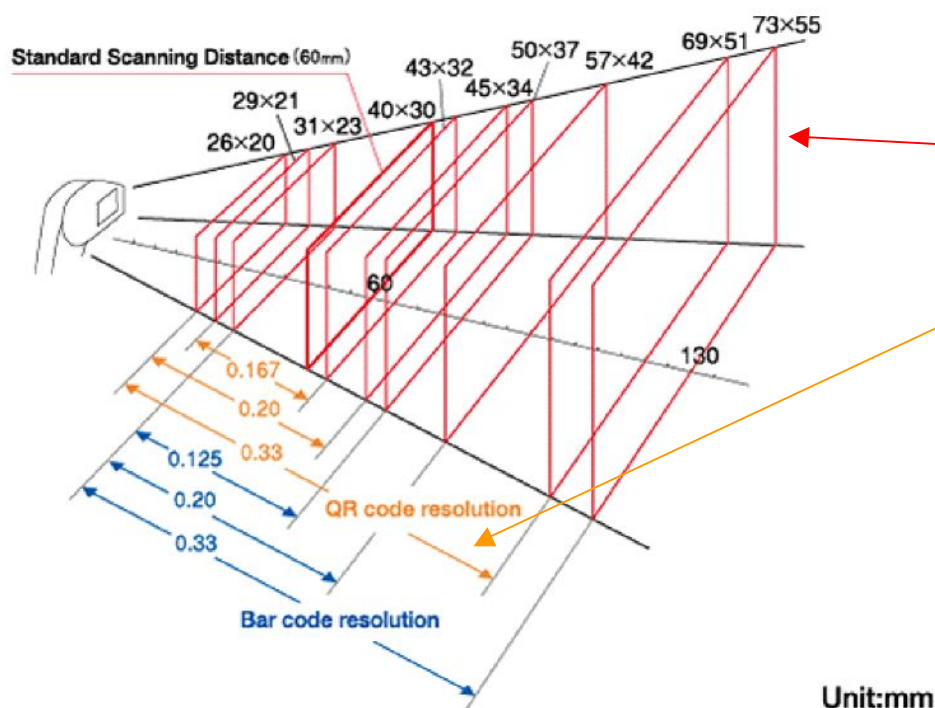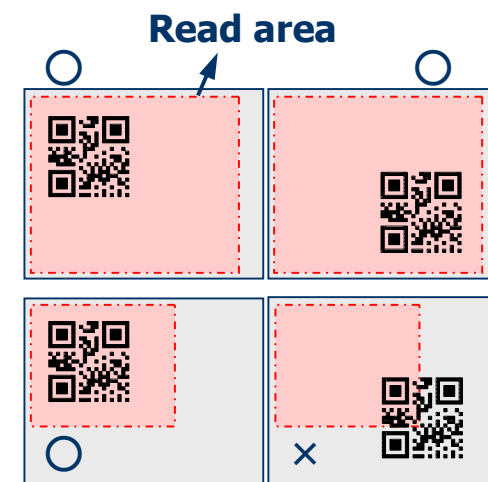
Read area

Read range:
Determined by the distance form the camera.

Depth of field:
Determined by the module size.

■ **The size of 2D symbol affects the performance of reader.**

Interrelation between the read area and the reader's resolution is important.

Color and Reflectance Difference

Factors affecting the reader's performance

• Spectral sensitivity of the sensor built in the camera

• Reflectance difference representable in binary form

• Ambient brightness and illumination color

We need to study the evaluation method on the factors that will affect the reading performance and compile it as a standard.

Brightness and reflectance difference

... to what extent reading is possible?

Note: "White=R_{on} G_{on} B_{on}" and "Black=R_{off} G_{off} B_{off}" are used for symbol colors.
However, there will be a big difference in the readability depending on the reader's camera, i.e., whether it is color or black/white.

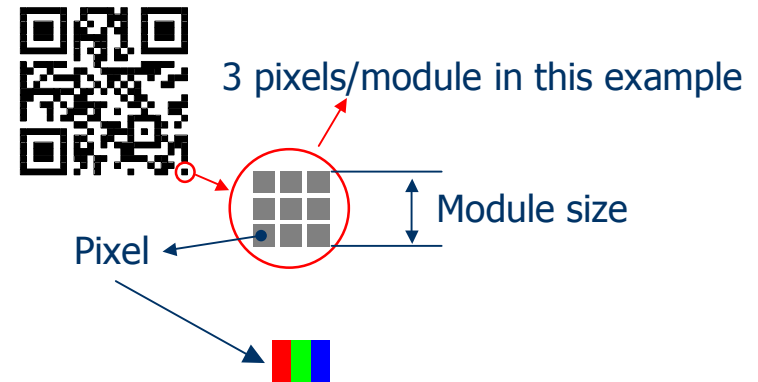# Specification and Capability of Display(1)

2D symbol on a cell phone

■ Symbol size / module size

3 pixels/module in this example

Module size

Pixel

Symbol size is too large

Module size is too small

Notes:

1. A pixel may be in a oblong shape.

2. A single pixel has "R,G,B" colors. A square shape is usually composed of these three colors.

■ **Selecting an appropriate symbol size and module size complying with the LCD specification is critical.**

* The number of pixels assigned to one module is normally determined by the model information of the cell phone.

Specification and Capability of Display(2)

Display capacity by the cell phone models

■ The display capacity depends on the LCD specification, such as the size of display area and the number of pixels.

A

B

C

Pixel size: 0.19 mm
No. of pixels: 128 x 128

Pixel size: 0.09 mm
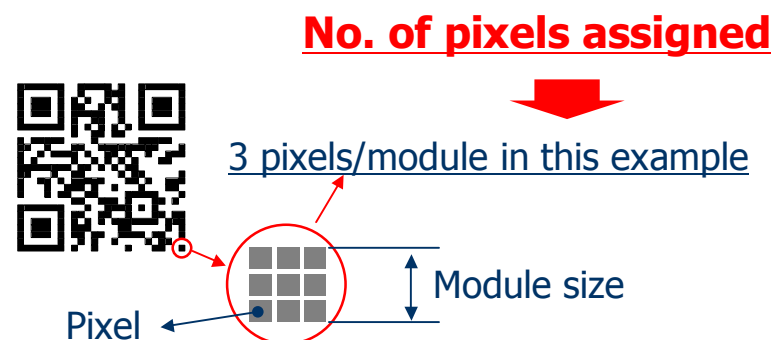No. of pixels: 416 x 352

Pixel size: 0.08 mm
No. of pixels: 640 x 480

Specification and Capability of Display (Pixel Count)

Example: Data capacity calculation of 2D symbol on a cell phone

As per reader spec.

■ Conditions
  1) Minimum module size $\geqq$ 0.33 mm
  2) 2D symbol: QR Code
  3) Error correction level: M

No. of pixels assigned

3 pixels/module in this example

Module size

Pixel

Cell phone	No. of pixels	Pixel size (*)	Recommended module size	Maximum No. of modules (**)	Data capacity (alphanumeric)
A	128 x 128	0.19 mm	0.38 mm (2 pixels/module)	64 x 64	262
B	416 x 352	0.09 mm	0.36 mm (4 pixels/module)	88 x 88	600
C	640 x 480	0.08 mm	0.33 mm (4 pixels/module)	120 x 120	1,248

(*) Partially presumption
(**) Includes 4-module quiet zone

■ **Specification of the symbol shall be consistent with that of the pixel.**

Specification and Capability of Display (Pixel Count)

No. of pixels assigned

OK   NG

Brightness and Contrast

■ Evaluation of symbols printed on a paper media has been established. This can be conducted with a dedicated verifier.

→ ISO/IEC 15415,15416

■ Whether or not the method to evaluate the brightness and contrast of symbols displayed on a LCD panel is available, is unknown.

→ We need to make investigation into the methods currently implemented in other industries to assess their potential and applicability.

Backlight and Display Position

Backlight ON/OFF

Display position

- Examine the impact of the backlight on the contrast.
- Examine the impact of a difference in the display positions on the readability of 2D symbols.