

Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)

Submission Title: CSK Gray coding

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Re:

Abstract: CSK Gray coding report for the resolution of sponsor ballot comment #71

Purpose:

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Sponsor ballot comment #71

- Comment
 - In the current bit-to-symbol mapping more than one bit error can occur when, due to obscuring noise, a neighboring symbol is demodulated. For example, according to Figure 142, if one demodulates [0111] instead of [1011], two bit errors occurred.
- Suggested remedy
 - Introduce Grey coding (as, for instance, used in QAM-constellation mapping) in order to minimize the bit error (to one) when a neighboring symbol is the accidental result of the demodulation.

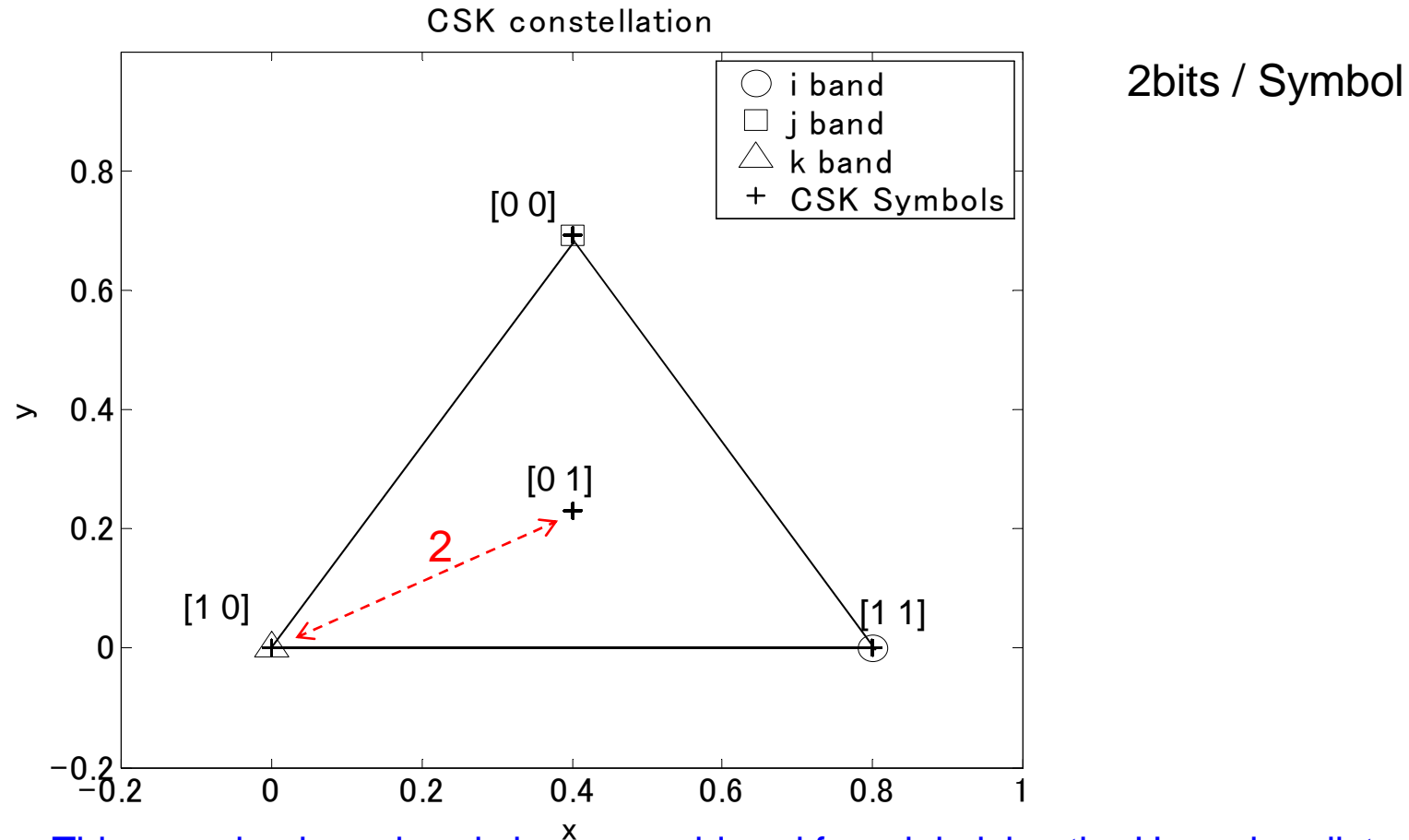
CSK Gray coding

2011.01.10

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Fig.140 - Data mapping for 4-CSK

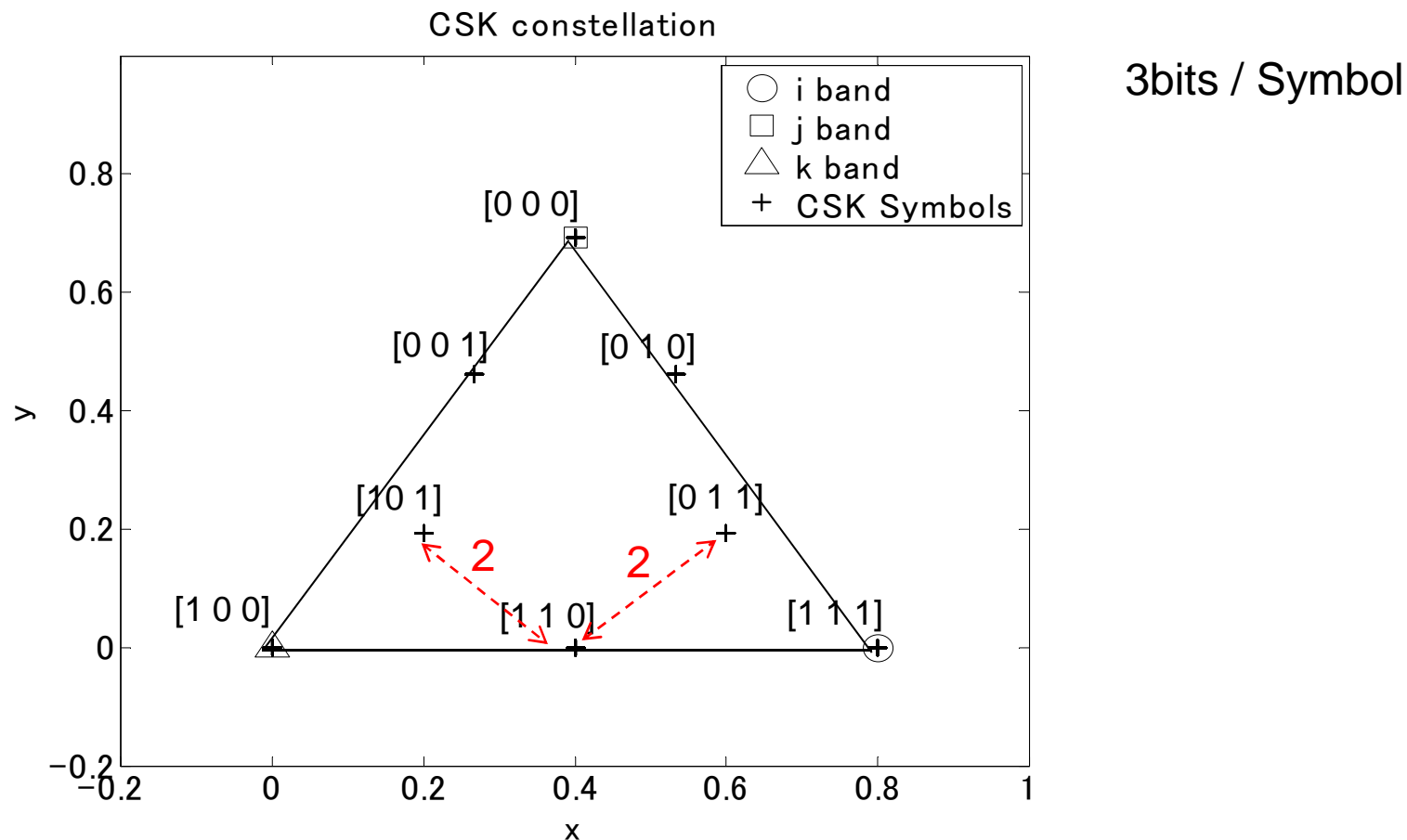


This mapping has already been considered for minimizing the Hamming distance.

There is one pair whose Hamming distance is 2.

It cannot avoid the existence of the pair whose Hamming distance is not 1, because of the triangle constellation.

Fig.141 - Data mapping for 8-CSK

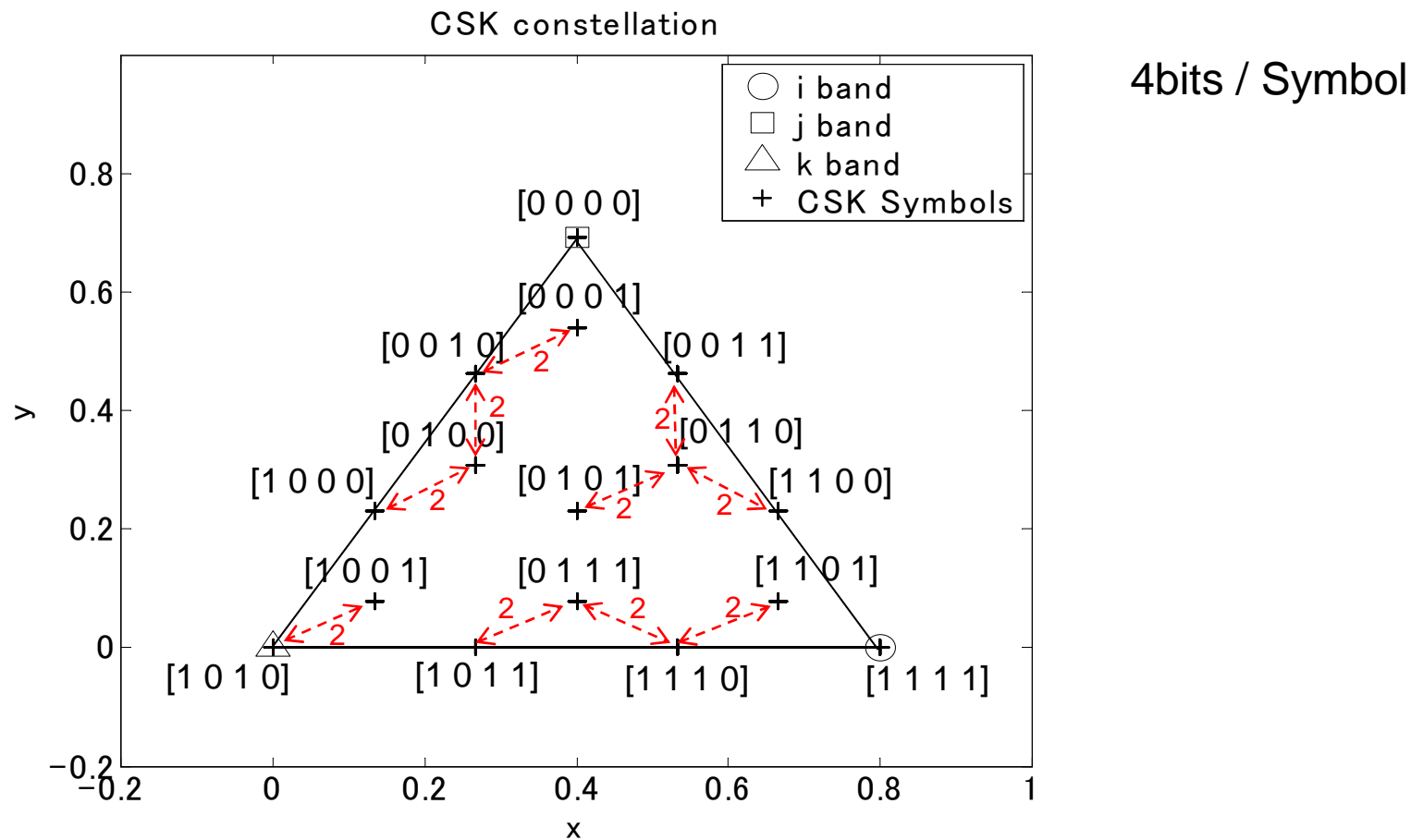


This mapping has already been considered for minimizing the Hamming distance.

There are two pairs whose Hamming distance is 2.

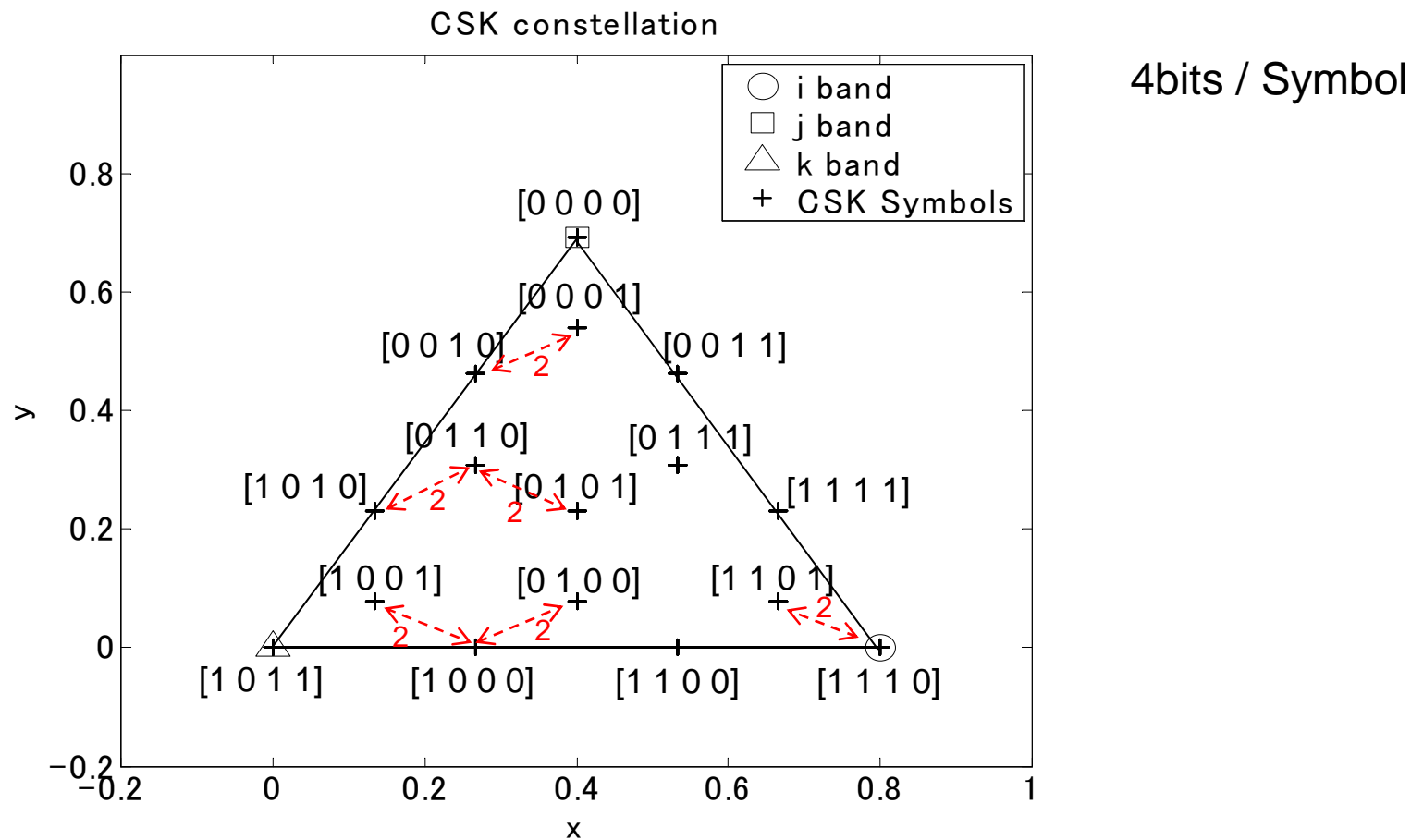
It cannot avoid the existence of the pairs whose Hamming distance are not 1, because of the triangle constellation.

Fig.142 - Data mapping for 16-CSK (Current)



There are 10 pairs whose Hamming distance is 2.
 Although this mapping has already been considered for minimizing the Hamming distance, we can expect less pairs by using Gray coding algorithm.

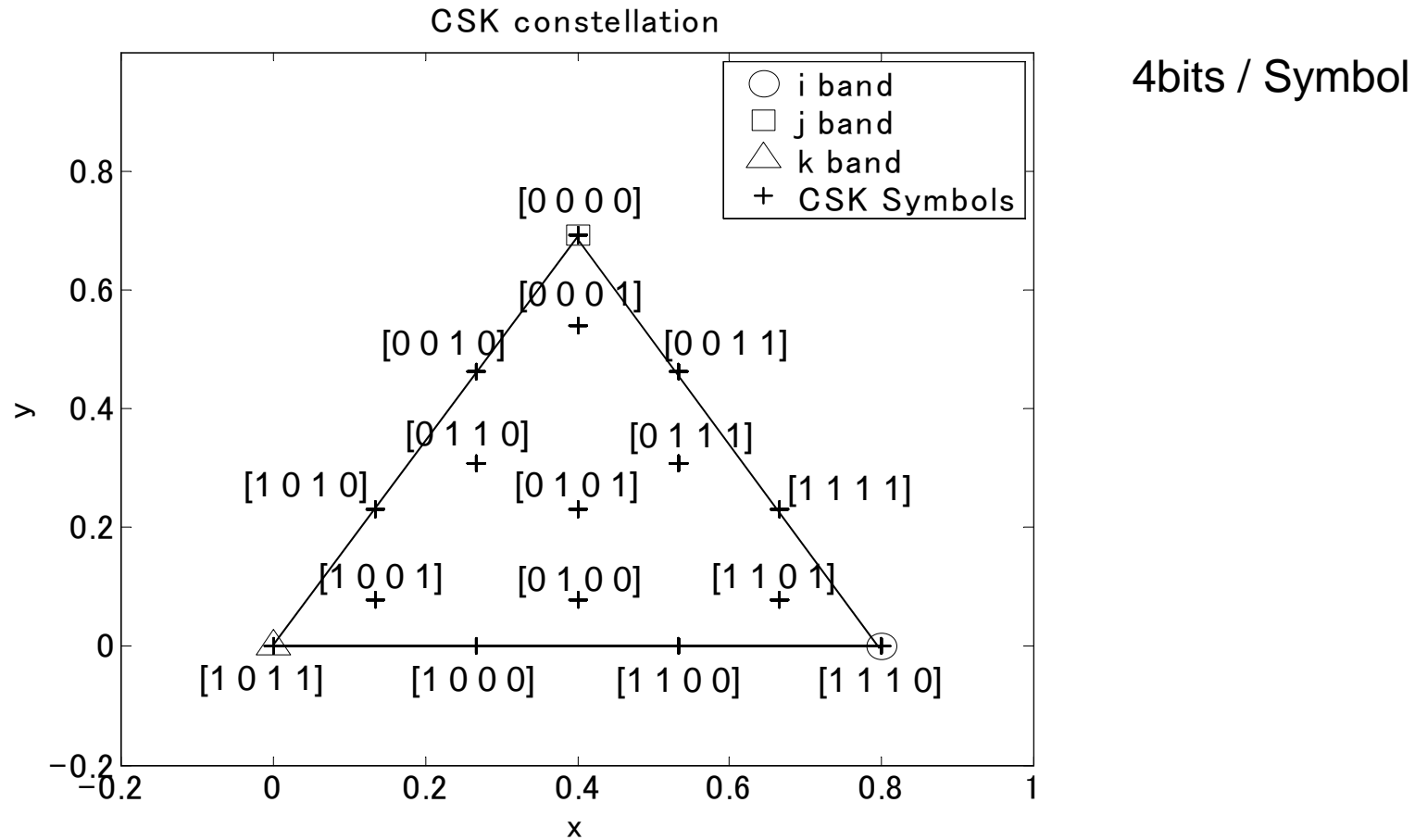
Fig.142 - Data mapping for 16-CSK (Revised)



There are 6 pairs whose Hamming distance is 2.

We can reduce the pairs from 10 to 6 using Gray coding algorithm.

Fig.142 - Data mapping for 16-CSK (Revised)



(For revised standard draft)

Suggested resolution

- Accept comment #71 in principle
- Add gray coding for 16-CSK as shown in previous figure
- Keep 4-CSK and 8-CSK constellations as is.