Paper for Consideration by S-101PT

DCEG *Sector Extension* Portrayal Attribute

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Submitted by:	NIWC
Executive Summary:	Summarizes the DCEG issues relating to Light Sector Extension.
Related Documents:	S-101
Related Projects:	S-100

Introduction / Background

This paper is the result of an action from the S-100WG: *S-100WG4-8.2 Resolve the issues relating to Light Sector Extension via recommendations to S-101PT.*

The Data Classification and Encoding Guide (DCEG) itemizes ECDIS System (Portrayal) Attributes in section 30. Remarks are present in section 30 to provide guidance and clarification for data producers. We propose that the *Sector Extension* portrayal attribute:

   a. Definition and indication require disambiguation.

   b. 2nd remark cannot be implemented.

There may be some confusion between *Sector extension* and *27.149 Sector line length.* As a reminder*:*

	Portrayal	**Units**
Sector extension	Arc	Millimetres (screen units)
Sector line length	Line	Metres (ground units)
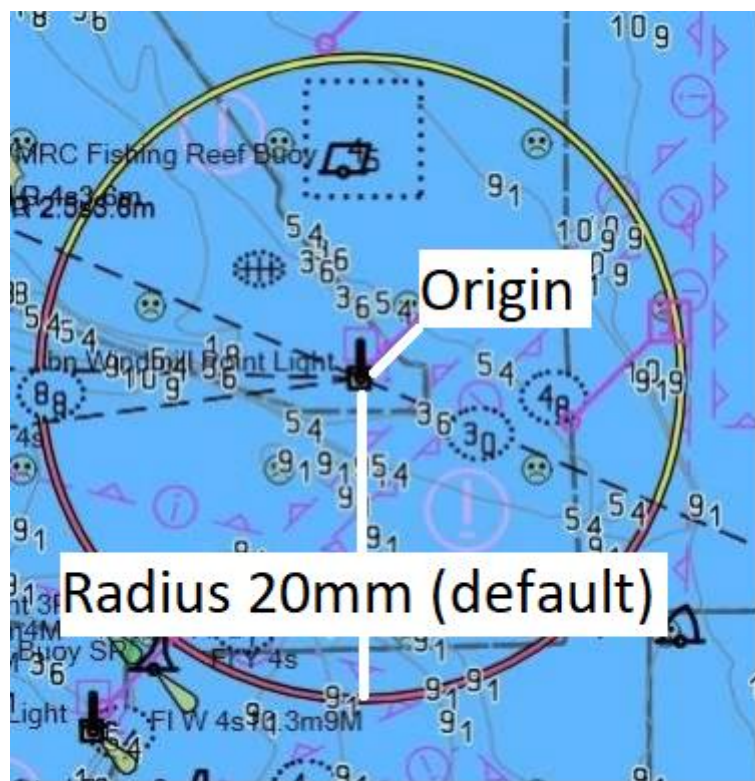
Analysis/Discussion

From the DCEG, with issues highlighted:

30.4 Sector extension

Sector extension: IHO Definition: The distance in screen millimeters (mm) by which a sector is ==extended from its origin==.

Indication: Indicated the distance that a displayed sector arc is to be ==extended beyond the default==. Required where there is more than one light sector covering the same or similar angle.

Unit: Millimetre (mm)

Resolution: 1 mm

Format: xx

Example: 15 for an extension to the sector of 15 mm.

Remarks:

- The sector extension is calculated by ENC production software systems.
- ==The displayed sector must not exceed the nominal range of the light sector on the ECDIS display.==

==**Issue 1: Definition is ambiguous**==

The IHO definition states the sector extension is from the origin; indication states the extension is from the default (assumed 20mm arc per S-52 and as implemented in S-101 Portrayal Catalogue).

Given that the attribute can be omitted when there is a single light sector with the resultant sector drawn at 20mm, we feel that the definition should be changed to match the indication: *"The distance in screen millimeters (mm) by which a sector is extended beyond the default."*

This ambiguity was manifested in earlier versions of the S-57 converter which populated every *Sector Extension* attribute with a value of 20 resulting in the S-101 Portrayal Catalogue generating 40mm light sector arcs.

==**Issue 2: Second remark (highlighted above) cannot be implemented**==

Firstly, we assume the remark is not intended to be an ECDIS / portrayal requirement. ECDIS / portrayal requirements should not be present in the DCEG, and the restriction is not present in S-52. Even if this was intended to be a portrayal requirement it could not be implemented.

It is impossible for the data producer (or ECDIS) to guarantee that the displayed sector will not exceed the nominal range; the sector extension is constant (fixed size on screen) regardless of display scale. As the display is zoomed the displayed light sector along with any sector extension remains a fixed size, while the nominal range on the ECDIS display grows or shrinks.

Without a specified display scale the sector extension is unrelated to the nominal range, and the restriction cannot be guaranteed. Even if we assume that the intent is to only enforce the restriction at a given display scale, the following analysis applies:

The equation for the displayed nominal range in screen units is:

(A) $nominal\ range_{mm} = \frac{nominal\ range_{meters}}{display\ scale} * 1{,}000\ \frac{mm}{m}$

If the intent is to enforce the restriction at the *maximumDisplayScale* of the *DataCoverage* then (A) becomes:

(B) $nominal\ range_{mm} = \frac{nominal\ range_{meters}}{maximumDisplayScale} * 1{,}000\ \frac{mm}{m}$

The equation for the displayed light sector is:

(C) $displayed\ sector_{mm} = default\ sector\ extension_{mm} + sector\ extension_{mm}$

The 2nd remark states that the displayed sector (C) must not exceed the nominal range on the display (B). Substituting for (B) and (C) results in:

(D) $default\ sector\ extension_{mm} + sector\ extension_{mm} \leq \dfrac{nominal\ range_{meters}}{maximumDisplayScale} * 1,000\dfrac{mm}{m}$

Using 20mm for the default sector extension and rearranging results in:

(E) $sector\ extension_{mm} \leq \dfrac{nominal\ range_{meters}}{maximumDisplayScale} * 1,000\dfrac{mm}{m} - 20mm$

Equation (E) limits the number of sector extensions which can be used. More importantly, at smaller display scales (larger values of *maximumDisplayScale*) the restriction causes the encoded sector extension to approach the opposite of the default sector extension:

(F) $\displaystyle\lim_{maximumDisplayScale\to\infty}\left(\dfrac{nominal\ range_{meters}}{maximumDisplayScale} * 1,000\dfrac{mm}{m} - 20mm\right) = -20mm$

When the *maximumDisplayScale* has a value of *50 * nominal range* equation (E) becomes:

$$sector\ extension_{mm} \leq \dfrac{nominal\ range_{meters}}{50 * nominal\ range} * 1,000\dfrac{mm}{m} - 20mm$$

$$sector\ extension_{mm} \leq \dfrac{1m}{50} * 1,000\dfrac{mm}{m} - 20mm$$

$$sector\ extension_{mm} \leq 20mm - 20mm$$

$$sector\ extension_{mm} \leq 0mm$$

So, assuming the intent is to enforce the restriction at the *maximumDisplayScale* of the *DataCoverage* results in limiting the range of *maximumDisplayScale* values which can be used. This is clearly not intended, and therefore the remark should be removed.

Conclusions
1. Sector extension definition is ambiguous.
2. The highlighted remark cannot be implemented as written.

Recommendations
1. Change sector extension definition: *"The distance in screen millimeters (mm) by which a sector is extended beyond the default."*
2. Remove the second remark.

Justification and Impacts
Justifications are presented above, impacts are:
- Requires two minor changes to the DCEG

Action Required of S-101PT
The S-101PT is invited to:
   a.   Endorse / decline recommendation 1.
   b.   Endorse / decline recommendation 2.