[S-100WG**3-7.1.1**

Paper for Consideration by S-100WG3/S-102PT

S-102 GDAL Compliance Considerations

Submitted by:	Esri
Executive Summary:	This paper addresses concerns on the BAG 1.6 implementation of variable resolution grids. It provides a description of the GDAL definition of a raster or gridded surfaces and discusses how the BAG 1.6 variable resolution grids does not fulfil the requirements to be supported under GDAL.
Related Documents:	S-102_Product_Spec_v2.0WORKING_020618.pdf, Geospatial Data Abstraction Library (www.gdal.org), Open Navigation Surface (www.opennavsurf.org), Esri Hydrographic Office (http://esriho.maps.arcgis.com)
Related Projects:	S-102 Project Team

Introduction / Background

This paper addresses a concern over a seeming disconnect with Annex H of the proposed S-102 standard. Annex H leaves open the opportunity to discuss variable resolution gridding. Currently, the primary raster data format is based on the Open Navigation Surface's (ONS) Bathymetric Attributed Grid (BAG). At Version 1.6 of the BAG, ONS is introducing a variable resolution gridding technique. While Esri has no contest with the idea of producing multi-resolution S-102 products, Esri believes that introducing variable resolution gridding, as proposed as part of the Open Navigation Surface groups Bathymetric Attributed Grid Version 1.6 into a continuously gridded surface would result in S-102 product being:

(1) Incompatible with open source GIS formats;
(2) Limited to use exclusively within vessel navigation SOLAS applications (Type Approved) and thus limiting to authoritative producer information reaching non-navigation users;
(3) Confusion regarding the 'brand' of Navigation Surface as it relates to S-102.

Analysis/Discussion

When considering whether a gridded data standard is Open Geospatial Consortium standard compliant, the format needs to be Geospatial Data Abstraction Library (GDAL) compliant. GDAL is the international body for raster or gridded data. The major leading geographic and imaging processing software packages on the market all implement GDAL as the basis of the raster processing technologies. (http://trac.osgeo.org/gdal/wiki/SoftwareUsingGdal)

While there are many parts to a raster under GDAL, the most important and central idea of GDAL is the expression of a raster band. A raster band is a single raster band/channel/layer. This raster band has a defined width and height in pixels and lines. To put it in other terms, the central tenet of GDAL is that a single image or raster has a uniform geometry to each pixel that participates. While the height and width of the pixel can be different from other rasters, they cannot be different pixel to pixel within a raster.

The variable resolution gridding technique proposed under the BAG Version 1.6 allows for a systematic refinement of surface using quad tree data structures. This systematic refinement results in a single surface where some areas have a higher resolution than other areas within the same surface. When expressed in a

gridded or raster surface, each segment of the raster may have pixels of various sizes which is no longer GDAL compliant.

The variable resolution BAG, as described by the current BAG Version 1.6 standard, could potentially be supported by GDAL's OGR utilities as vector data. Writing bathymetric datasets in a vector format introduces new challenges that should be considered. Each individual node or sounding location would have to be stored as a discrete object that maintains its own geometry and location, whereas with a raster, it's stored as one object with the geometry and location implied as part of the matrix. This has two practical impacts on an S-102: it increases the file size significantly and slows the rendering of the information.

The variable resolution BAG is intended to address the hydrographic communities need to have higher resolution data in shallower areas of a survey than they need in deeper areas. The need to represent elevation at various resolutions is not unique to the hydrographic community. Accordingly, many of the current leading technologies of the world have created methodologies that allow their users to work with raster datasets with different resolutions while working within the GDAL raster constructs.

Conclusions

Currently, the BAG 1.5 specification is supported by GDAL in both the generic HDF5 driver as well as a specific read-only BAG driver. Since the VR BAG does not fit the definitions of a GDALRasterBandClass, Esri expects that a VR BAG will not be supported as a gridded raster surface under GDAL and will be incompatible as such with the majority of GIS software packages.

The storage, display, and transfer of a GDAL-compliant vector representation of this data could also force a heavy segmentation of data packages to meet Type-approved ECDIS and bandwidth limitations. This segmentation would result in the mariner having to manage more data products than they would if they had a single raster representation. This would negate the benefits of the BAG 1.6 proposed variable resolution gridding technique.

A variable resolution BAG would limit the audience of the data that the S-102 is publishing. It would be limited only to Type-Approved ECDIS (assuming they decide to support it) and a few industry-specific providers, thus opposing the intent of S-100 as a broad user's format.

There is an inherent danger in adopting an industry-specific standard as the basis of an international standard particularly since some of the IHO members are not aware of the implications of ignoring a broadly recognized best practice.

Recommendations

The S-102 project team should incorporate the 1.5.1 BAG standard as a basis for the S-102 standard. The S-102 project team should maintain their own version of the HDF5 raster file format to maintain the greatest variety of potential sources rather than create market confusion by recommending S-102 be based on variable resolution grids as proposed in BAG Version 1.6.

Justification and Impacts

As alluded to in recommendations, the S-102 based on HDF5 and supported by GDAL will encourage its broadest use, the greatest variety of possible software solutions support and will not unnecessarily limit the provision of content. This will reduce the entry threshold and thus increase potential innovation by allowing

other developments in other industries to be configured to meet S-102 requirements quickly. This also reduces the amount of work required of the project team, as no substantial changes will be needed to the current format to prepare bathymetry to meet the needs of S-102 and be useful in S-101 production.

Action Required of S-100WG3/S-102PT

The S-100WG3/S-102PT are invited to:

a. Note this paper.
b. The group is invited to review and discuss the proposed recommendations.