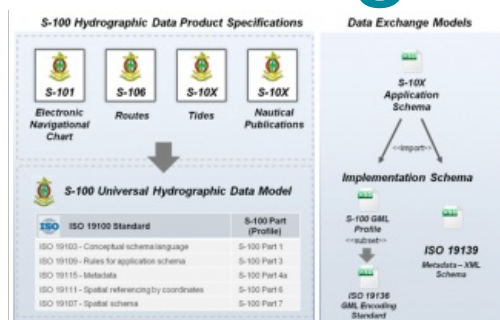


WHAT CAN WE LEARN FROM THE AVIATION AND DEFENCE DOMAINS?

Open Standards for Interoperable Maritime Data Exchange



The adoption of open standards for Maritime data exchange is just the start of a long journey. With increased vendor support, a potential reduction in costs, as well as enabling innovation as some of the benefits, implementing open standards such as S-100 and Geography Markup Language (GML) within the Maritime domain is bringing the industry a step closer to truly interoperable data

exchange.

When it comes to data exchange for the Maritime industry, S-100 is shaping up to be the interoperability stimulus, but it is just the start. S-100 is intended to support a wide variety of hydrographic-related digital data sources, products and customers. This includes, but is not limited to, imagery and gridded data, 3D and time-varying data (x, y, z, and time) and new applications that go beyond the scope of traditional hydrography into value added services such as voyage efficiency management and exploitation via fusion with other data sources and feeds.

Open Standards

S-100 conformance with the International Organization for Standardization Technical Committee 211 (ISO/TC211) geomatics standards, including GML (XML grammar defined by the Open Geospatial Consortium (OGC) to express geographical features) will enable the greater use of commercial-off-the-shelf IT and software applications (without plugins) and provide basic interoperability at the open standards level for marine data and web services.

However, as has been discovered in other domains such as Aviation and Defence, the adoption of open standards for data and web services is just the start of a long journey towards total interoperability. Complete semantic and end to end process interoperability at all levels, in all languages, may not actually even be achievable. However, clear and consistent marine data exchange at the semantic and business process level, via well designed marine Application Programming Interfaces (APIs) and S-100 derived products, will encourage the development of new services and enable the more rapid development of new value-added products. But how can this 'higher level' of exchange be achieved?

The IHO and S100

Within the International Hydrographic Organization (IHO), according to their website, the Transfer Standard Maintenance and Applications Development Working Group (TSMAD DWG), a subsidiary of the IHO Hydrographic Services and Standards Committee (HSSC) has been working towards:

1. a) Maintaining, developing and extending:
 1. the S-57 IHO transfer standard for digital hydrographic data;
 2. the S-100 IHO Geospatial Standard for hydrographic data;
 3. the S-101 IHO ENC Product Specification;

1. b) Monitoring the development of other related international standards.

To this end, the TSMAD and Snowflake Software in support of the UKHO, have developed draft product specifications and an S-100 GML profile. Other TSMAD contributors have worked on [metadata schemas](#), [portrayal](#), [impact studies](#), [test data](#) and [more](#).

Building Further on S-57

Rewinding back to 1996, with updates for temporality and new features up to 2009, S-57 is a decent data exchange and delivery carrier format. Indeed, from a geospatial data exchange perspective it is a heavyweight. S-57 supports version control and Change Only Updates (COU), it is compressed binary, it reuses geometry constructs between features and it is an Open Standard. On the downside, S-57 has a data encoding that is too tightly coupled with the content model – it is too restrictive. S-100, however, separates the content model from the encoding. S-100 was developed primarily to meet the Electronic Navigational Charts (ENC) requirement for an International Maritime Organisation (IMO) compliant Electronic Chart Display and Information Systems (ECDIS). In addition, for S-100 each digital product specification can have its own feature catalogue – enabling rapid realisation for new composite products and compatible value added services.

S-100 also has the constructs to support imagery, gridded bathymetric data as well as time varying information – a neat gridded model with temporality.

Specific use cases for S-100 are:

- Seafloor classification
- 3D and time varying data
- Marine vector information overlays
- Event Driven Architecture for updates and alerts
- Web-based services for exchange, dissemination and automated exploitation.

Interoperability

Conformance with the ISO/TC211 standards will enable the use of commercial-off-the-shelf IT and software applications and provide basic interoperability at the open standards level; however, as mentioned above, other domains such as Aviation and Defence have recognised the need for usage profiles of exchange standards as well as domain specific extensions. The development of these profiles and extensions has, to some extent, reintroduced the complexity that hampered interoperability in the first place, resulting in varying vendor support and understanding.

It is important to understand interoperability at the business process level. Identifying how the information provided within a digital product is validated and used is a vital part of the process of verifying and improving a digital exchange product – overcoming the complexity. The questions to ask the Maritime S-100 stakeholders are:

- How do users and systems actually align with and make the most of this information?
- What is the process by which new products can be tested in an operational or real world context?
- How can the new digital products be validated, their integrity known and be made available to the system and end-user in a form that can be understood?
- Is there a vehicle that can be used to bring together industry, standards bodies, Hydrographic Offices, which also has a track record built around exchange model validation?

Stakeholder Engagement and Support

Digital information and intelligence products can only be judged as fit for purpose when they have been assessed and validated as part of a real world business process – including domain specific use cases with software vendors, standards stakeholders, as well as the national and international domain bodies involved. While there are clear benefits from basic standards interoperability through S-100 utilising the ISO/TC211 family, this is not enough to provide the business process level interoperability, reliability and flexibility required for the added value services and high level interoperability described previously.

Role

In order to achieve this, a co-ordinated group of stakeholders is required. This group needs to include those who can provide funding, requirements, domain and operational expertise, technology experience from a systems and software perspective, information modelling experts and standards experts. Someone to actually do the co-ordinating and facilitate a strong collaborative working environment is also essential. This facilitating body probably has the hardest role, remaining an independent co-ordinating body in order to run a programme of requirements gathering and prioritisation, experimentation and tangible delivery back to the sponsors. And at the same time ensuring that every stakeholder gets a return, whether financial, PR, networking or technical in nature.

Motivational Tool

So, what motivates the industry stakeholders? Is it purely funding? One method that works particularly well for Open Geospatial Consortium experiments is the allocation of two suppliers for each component implementation within the architecture. This, combined with a public demonstration and access to the sponsoring stakeholders and wider industry, fosters a collaborative but also highly competitive environment. There is nothing quite like a public demonstration as a motivating tool for project teams! The public profile and exposure is hugely valuable to small and large industrial players alike - and hence more effort is expended to make the most of the opportunity.

Drawing upon lessons and inspiration from the Aviation domain, where this approach has worked particularly well, Aeronautical information

and intelligence products are encoded using exchange models such as AIXM (Aeronautical Information Exchange Model), WXXM (Weather information Exchange Model) and FIXM (Flight Information Exchange Model).

These models were developed along with GML profiles and best practice, specific extensions and business rules based information validation and interoperability test beds. The models have all been used to prepare the ground and support the development of next generation air traffic management systems in Europe and the US, alongside the SESAR and NextGEN programmes respectively. Open Geospatial Consortium (OGC) working groups such as the Aviation Domain Working Group have facilitated and enabled a healthy constructive engagement process between the leading (sponsoring) stakeholders such as EUROCONTROL and the FAA with academia and industry since 2006. Not surprisingly, some of the problems and challenges in the Aviation domain are similar to those in the Maritime – increasing traffic and rising fuel costs in the context of a safety critical and strict national and international legal construct provide a more challenging operating environment in both domains. Adopting open standards for information exchange increases the likelihood of vendor support and therefore increases competition, reducing costs to the industry as well as adding opportunity for greater innovation.

Future of Maritime Information and Intelligence Exchange

The lessons, processes adopted and methods exploited in the Aviation domain to date represent an excellent opportunity that could be copied and exploited for S-100 derived products in the Maritime domain. The OGC Web Services initiatives have also been shown to provide a 3:1 ratio of research bang to sponsor provided buck. The OGC Meteorology & Oceanography Domain Working Group, the TSMAD and government bodies such as the UK and other Hydrographic Offices have an opportunity to get more involved and co-ordinate, run and sponsor respective OGC initiative threads (or adopt an equivalent model) within the OGC Interoperability Programme to more efficiently realise the benefits of validated product designs, exchange patterns and real world usage of Maritime digital information and intelligence.

As a software supplier and a UK-based SME (Small and Medium Enterprise), Snowflake Software has participated in every OGC Web Services test bed run to date, and has witnessed the transformation first hand from early aeronautical data services interoperability testing to a mature data exchange and dynamic event based platform, that has developed and strengthened the exchange models to the extent that they are now mandated in the US and EU for aeronautical data exchange. This is a scenario that, if repeated for maritime data exchange and used to build on the development of S-100 based products, could benefit the marine data provider, industry and enable as yet unknown innovations and value added services.

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<https://www.hydro-international.com/content/article/open-standards-for-interoperable-maritime-data-exchange>
