A Federated Marine Data Management And Decision Support System For South Africa

The Architectural Tale Of An Open Standards, Open Source And Open Data Stack

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An unfortunate elephant metaphor...

Created by TRAVIS BIRD from the Noun Project
• overall strategic & policy direction, leadership, management and support of integrated coastal management;

• set up and implement ocean conservation strategies & advancement of South Africa’s interests in the high seas and Antarctica;

• provide specialist support for Oceans & Coastal monitoring, reporting and evaluation policies
• Enhance oceans, coastal and maritime governance and sustainable utilisation through
  – monitoring of environmental variables and human socio-economic activity,
  – compliance and enforcement,
  – planning and assessment,
  – information dissemination.
Oceans and Coasts IMS provides facilities for
a) publishing of,
b) discovery of,
c) access to,
d) interaction with
e) and management of:

1) data and content services,
2) decision support tools and applications
3) information dissemination channels
4) information technology services
• Turns out, there’s much complexity
  - Multiple organisations and stakeholders
  - Only sometimes are there existing systems or components
  - Existing systems not really interoperable or even available
  - Some systems suffer the common problems of being run by scientists ... (fit-for-purpose, data hoarding, overly detailed, non-production quality, etc.)
To start making sense of this complexity

- describing and understanding the properties of the system
- describing principles of the system
- supporting the planning, construction and ongoing evaluation of the eventual system
- the communication about the system amongst stakeholders
• Utilised the architectural viewpoints of RM-ODP*, with emphasis on distributed services rather than just distributed objects of computation
  
  – User requirements for a multi-organisation hosted system, rather than a greenfields cloud system, for e.g.
  
  – But this was not a deep formal exercise in waterfall system design, rather a guide and reminder to look at OCIMS from a multitude of angles

*http://www.rm-odp.net/
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Architectural Description

- Enterprise viewpoint
- Information viewpoint
- Computational viewpoint
- Engineering viewpoint
- Technology viewpoint

System & environment
<table>
<thead>
<tr>
<th>Viewpoint</th>
<th>Concerns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterprise</td>
<td>Functional, non-functional requirements, users, stakeholders, policies</td>
</tr>
<tr>
<td>Information</td>
<td>Information assets (formats, schemas) and constraints on their use</td>
</tr>
<tr>
<td>Computation</td>
<td>Computational elements - service/resource endpoints, databases, data</td>
</tr>
<tr>
<td></td>
<td>transports, processing engines</td>
</tr>
<tr>
<td>Engineering</td>
<td>Deployment and distribution descriptions</td>
</tr>
<tr>
<td>Technology</td>
<td>Specific software, algorithms, hardware that realise operation over</td>
</tr>
<tr>
<td></td>
<td>information instances using deployment topology</td>
</tr>
</tbody>
</table>
## Interaction Layer
- Search & discover
- Publish
- Access
- Decide
- Visualise
- Disseminate
- Query

## Production Layer
- Models
- Simulations
- (Meta)Data Accumulations
- Mediation services - e.g. data transforming or data cascade/proxying.
- Harmonisation processes - e.g. combining data from different sources into integrated and consistent information products.
- Generation services - e.g. event processing and notification services, reports

## Acquisition Layer
- Acquiring data from:
  - Databases
  - Files
  - Data Streams e.g. from sensors or sensor networks
  - Direct Readout Services
  - Data Services
  - Download Services
Providing insight into:
- Choosing (hopefully) sustainable Tools & Services;
- Linking them together;
- Orchestrating their execution over local, remote and distributed compute resources

Principles of:
- Interoperability
- Reuse
- Accessibility
- Protocol
- Industry Good Practice
- Openness

Applied To:
- Data
- Software

Deployed to:
- Impactful Applications
- Large data holdings
• Glue is open standards based systems based on
  – OGC,
  – Unidata,
  – WMO
  – Plus a few de facto e.g. ESRI

• Historically the marine IT community from science to application has been fragmented and this represents a farily bold attempt at interoperability.

• And a chance for FOSS4G tools to shine!
Impactful Applications

Integrated Vessel Tracking
Impactful Applications

Harmful Algal Bloom & Aquaculture
Impactful Applications

Coastal Operations Support
Impactful Applications

Coastal Hazard
Impactful Applications

Marine Spatial Planning
Coastal data viewer
CKAN Core – single access point to data from organisations in the OCIMS federation
Sets

Arrays

Graphs

Streams

{ aa, bb, cc, 1, 2, 3 }
• Several teams, but similar softwares
• Different development cycles
• Frequent releases to client
• Hosted environments
• Some dependency on data tiers e.g. SANs
• Architectural principles
DevOps

- Not a microservices approach, but ...
- Multiple reusable, reconfigurable, removable containers
- Federation via standard interfaces and metadata in CKAN/CSW, incl. Harvesting
- Support technologically weaker organisations:
  - Easy to stand up and support IT infrastructure
  - Facade legacy systems with standard services and harvestable endpoints – i.e. smaller instances of the overall architecture
Some Concerns

- This is a system that echoes “good” practices from the 2000’s and 2010’s
  - Technology white elephant hopefully avoided ;-)  
- But what of the inevitabilities of working in the cloud, how does one describe such a system? Is this kind of architecture increasingly invalid?  
- No toys!! Users need to have tools and data in their hands – massive stakeholder focus always needed.
Thanks for hearing me out

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