Store, process and visualize large datasets in real time – Mapping Cloud

Terje Haga Pedersen
Kongsberg Maritime Subsea
Mapping, Positioning and
Communication, MPC
Norway
terje.haga.pedersen@km.kongsberg.com

***Abstract*— KONGSBERG supports commercial and non-commercial customers with technical products and services to collect various types of data to map the seafloor. Today's workflow is very much structured around collecting data offshore and performing processing and analysis of this data once the vessel is docked to shore. This imposes limitations with respect to collection and use of resources in general. To solve this, Kongsberg introduced the Cloud based platform Kognifai, an open digital ecosystem. The purpose of Kognifai is to level the playing field and let everyone participate; customers, partners, vendors, ISVs, industry clusters, and entrepreneurs alike, to ensure the best possible analysis of collected data. The platform is open to everyone who wants to contribute and transform the industry through digitalization. With Kognifai, sonar data collected with multibeam echosounders and other sensor systems can be stored and managed in this secure environment. The data can be processed in near real-time and made available for immediate distribution to personnel and teams with multidisciplinary skills and expertise. Consequently, various decision support information can be produced by combining sonar data with data from other sources giving the end-user a complete understanding of the mapped environment. This information can be available to everyone with permission, from anywhere in the world. It also enables true remote control of an ongoing operation and access to results from previous operations.**

I. INTRODUCTION

(2)Kongsberg Maritime (KM) is a leading provider of solutions that require sound-in-water. Our product portfolio is significant and include amongst others underwater communication, positioning, surveillance, autonomous vehicles (e.g. Hugin, Munin, and Remus), single and multibeam echosounders, sonars, sidescan and sub-bottom profilers.

(3)KMs Multibeam Echosounders are capable of doing surveys to the highest standards at all ocean depths, 0.5m to full ocean depth (extending 11000 meters). These EM-systems can produce large datasets including seafloor, watercolumn and seabed image ("sidescan") measurements. The amount of data can be more than 1Gb per minute, so efficient real-time software is required to do processing on board.

(4)The software that comes with the EM™-systems has developed over the years with increasing demands for accuracy, user friendliness, and integration across platforms and organizations. Today the demand for truly distributed access to data is increasing. They- clients, customers, academia, public services- all want easy access to data in near real-time from any geographical location. The data produced by EM™-systems are thus being used in many different business areas, not only the traditional hydrographic map. The data quality has reached a level where the need for lengthy post-processing has been reduced to a minimum: tide, geoid etc. are still needed.

II. KOGNIFAI

(5)Kognifai is Kongsberg's solution for a truly open cloud-based digital environment. Kognifai supports collaboration and knowledge sharing between and within organizations, enabling them to interact with each other in ways never previously possible. With the platform, customers, clients, academia, domain experts and developers are all invited to participate in finding good solutions to common problems.

(6)Large datasets can be stored in Kognifai. The user is the exclusive owns all data uploaded to Kognifai unless otherwise arranged. Nobody else can read or make use of it unless the user grants them access. Additionally, access can be restricted to a user or a group of users, for a limited time or for a particular purpose. Large datasets makes Machine Learning possible, providing the customer allows access to the data. Secure storage, secure archiving and hybrid cloud solutions are all available.

(7)Kognifai is runs on Microsoft Azure, and this makes it easy for developers to create applications that can run in Kognifai. In addition to this, Kongsberg Digital offers several Software Development Kits, SDKs, to further assist in software development. These SDK provides excellent examples to show how common tasks are easily solved so the road to deploying applications in Kognifai is rather easy for most developers. The Kognifai portfolio contains edge connectors, 3d tools, application framework support, authentication and authorization systems, dashboard widgets, database solutions, routing and queue support features.

III. EXISTING KOGNIFAI USAGE

(8)Kongsberg has a footprint on more than 18000 ships. Our Kongsberg Division for Vessel & Fleet Performance alone has more than 1000 ships from Europe, USA and Asia in their portfolio. Reports are generated on demand for the ship owners

making it possible to monitor the ship's status from any web-browser at any geographical location.

(9)Kongsberg's Windmill control system is also powered by Kognifai.

IV. Mapping Cloud

(10)The first application we have deployed in the Mapping Cloud solution is Storage. Storage looks like a file manager on a PC to ensure ease of use. However, there are a few additional Storage tricks:

- Data upload. The file manager has cloud connectors that can be installed on ships, automatically pushing data to the cloud. It also makes it is easy to copy large volumes of data from an office PC to a data storage in Kognifai.
- Data sharing. Sharing between Kognifai users. Others may be allowed to read data and process them, and to put the results back. This is performed in a few clicks, there is no need to send physical hard drives or set up ftp-servers to share large volumes of data between clients.
- Archiving. Data stored in Microsoft can be "hot", in which case data can be accessed immediately like a hard drive. However, this has a higher cost than "cold" storage. Data in "cold" storage are cheaper than "hot", but cannot be accessed directly. This option is great for saving money on storing large data volumes that do not have to be online at all times.

Virtual PCs is also available in Kognifai. Users can install existing processing software and process the data just like before. This solution makes it easy to benefit from using a cloud solution while still using familiar software. Collaboration between several people during the processing, distribution of the results to clients and customers, access from any geographical location will still be there.

Partners play an important role in Cloud computing. We want to offer the best solutions to the customers, and that means close collaboration with the technology leaders. Efficient data sharing is part of Mapping Cloud which enables easy access to data for everybody.

Remote Control of EM-systems is now part of Mapping Cloud. The survey vessel can do realtime data processing and send only the necessary data into Mapping Cloud. This works for any Internet carrier: satellite, 4G, wifi, MBR. The user can control how much data to send from ship into Mapping Cloud. The communication goes both ways enabling the operator in Mapping Cloud to even set specific parameters in the EM, in real time.

(11)Mapping Cloud differs from many other cloud-solutions in that it is a truly open digisystem. Anyone can get a Mapping Cloud account, and any kind of data can be uploaded and stored in Mapping Cloud. Also any kind of processing can be done on the VMs.

V. Remote Operations

(12)Ship-to-Ship Internet communication is today available in many different ways. Data from autonomous vehicles (e.g. USV) relatively close to the mother-ship can send large amounts of data during a survey operation, enabling one surveyor to be physically located on the mother-ship while controlling data from several other survey vessels. This makes the total survey operation both more cost-effective and safer as USVs can go where others cannot.

Ship-to-Shore Internet communication is also available, but typically more expensive and with less bandwidth. However, this does mean that with clever processing on the boat, enough data can be sent to shore to allow one surveyor to control the operation from the office.

(13)This access to ongoing survey operations through an Internet connection will also allow the end-user of the survey to monitor progress and quality, and to take immediate action if needed. In this way the overall customer satisfaction improves and the feedback latency is reduced.

(14)One recent project between Kongsberg Maritime, iSURVEY and Earth Analytics demonstrated how realtime information from tug-boats and an oilrig can be sent into Mapping Cloud, processed, and then passed on for display in Google Chrome. The tracks of the tug-boats shows how they move to place the anchors for the oilrig at the correct locations. EIVA NaviPac is used to acquire the positions from the vessels and then passed on to Mapping Cloud.

(15)Data sent to Mapping Cloud in near real time can be made available to 3rd party software vendors for additional processing and display. In these cases the Mapping Cloud is used as a jump-station for data storage and distribution, and additional processing for quality enhancement. Earth Analytic, a partner of Kongsberg, has several times demonstrated how to integrate real-time data into map-services and improve situation awareness. Cloud-to-Cloud connection is also possible, allowing seamless dataflow from Mapping Cloud into other systems such as PostgreSQL-databases and further processing in ArcGIS.

VI. Stronger together

(16)Future development will continue the integration between Kognifai's and ESRI's Cloud solutions. Interfaces between the two clouds will be standardized, more datatypes will be made available (depths, sidescan, processed watercolumn measurements, terrain models, real-time data), and new processing tools will be developed. The need for VM's will decrease as new applications will be web-applications in the Cloud, taking full advantage of the extended possibilities Cloud computing has to offer: multiple cores, RAM, and all this available when needed.

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