DATA VISUALIZATION WITH DATA BROWSER SOFTWARE

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Abstract

Scientific facilities need to visualize a large amount of data through several dedicated applications. These applications can monitor variables from a PLC, visualize data acquisition or browse them offline. Thus, an intuitive GUI (**G**raphical **U**ser **I**nterface) tool is necessary to handle multiple data sources.

In 2012, the computing team of SOLEIL[1] started the development of the Data browser tool. This software uses modular and extendable frameworks on which several institutes collaborated:

- CDMA (**C**ommon **D**ata **M**odel **A**ccess), initially developed by ANSTO, unifies the data access regardless of its physical container (files, database …), and its logical organization.

- COMETE (**COM**munity of **E**xtendable **T**oolkit for **E**xperiment) graphical framework, initially developed by SOLEIL, which provides a set of data visualization widgets and unifies the way there are connected to the data they represent regardless of the source of this data.

Since then, SOLEIL developed several plugins for Data browser: HDF/Nexus, TANGO. In addition, a collaboration with IRFU [2] control software team which is using EPICS has been created. To fit Irfu needs, Data browser tool is integrating new plugins: EPICS Channel Access, EPICS Archiver Appliance.

CONTEXT

Today in scientific institutes, our end users require that GUI applications display data coming from various sources. Live data from control system as EPICS [3] process variables, TANGO [4]'s attributes or archived data stored in a database as TANGO archiving system and scientific measurement data stored in files, as NeXus [5]/HDF5 [6] files or EPICS archiver appliance [7] Google protocol buffers files[8]. Users would like to use the same collection of widgets for displaying the different data sources (see Fig.1). Furthermore, it is convenient for them to have a single tool to explore those data.

To address this issue, the computing team of SOLEIL developed the Data browser tool. This software is based on two main frameworks explained in the following chapters, CDMA [9] and COMETE [10].

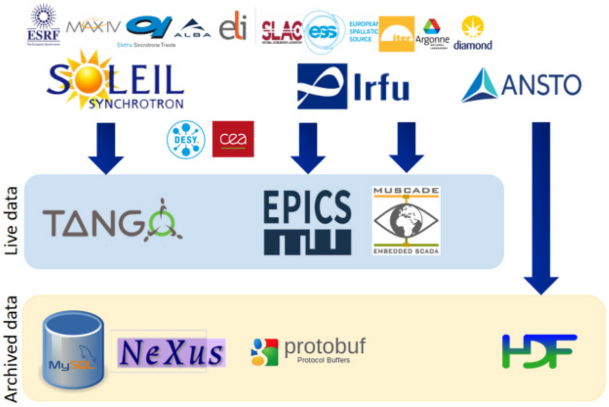

Figure 1: Project context.

COMMON DATA MODEL ACCESS

Working independently, SOLEIL and ANSTO [11] software development focused on the design of frameworks for data processing, operating on top of a HDF data format. ANSTO worked on a Gumtree Data Model [12] abstracting data file access of the underlying HDF files (the standard data format at ANSTO) by designing a data model with a set of Java interfaces. This seemed to be a very promising development to share. SOLEIL became interested in the concept as it was coincidentally looking for a unified data access layer based on NeXus (the standard data format used at SOLEIL). The collaboration started between ANSTO and SOLEIL in January 2010, after a meeting between the authors at ICALEPCS 2009. The work started from the data access layer of ANSTO's GumTree project, written in Java.

Common Data Model Access (CDMA) framework proposes a solution and allows separation of responsibilities between data reduction developers and the institute. Data developers are responsible for data reduction code; the institute provides a plug-in to access the data.

The CDMA is a core API that accesses data through a data format plug-in mechanism and scientific application definitions (sets of keywords) coming from a consensus between scientists and institutes. Using an innovative "mapping" system between application definitions and physical data organizations, the CDMA allows application development independently of the data file container and schema (see Fig. 2). Each institute develops a data access plug-in for its own data file formats along with the map-ping between application definitions and its data files.

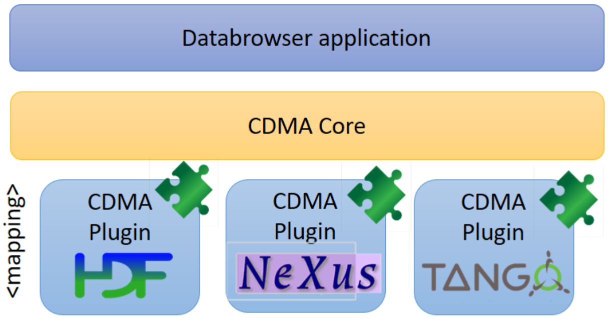

Figure 2: CDMA general usage schema.

The next step was to display the data provided by CDMA into a tool regardless the favorite Java GUI Framework.

COMETE GRAPHIC FRAMEWORK

To fulfil these goals, SOLEIL GUI developers propose the COMETE framework, to build high quality, modular and reusable scientific oriented GUI applications, with consistent look and feel for end users. COMETE offers some key features to software developers:

- A data connection mechanism to link a widget to any data source
- Easy-to-use and succinct API
- Graphical widgets in SWT, AWT and SWING flavors.

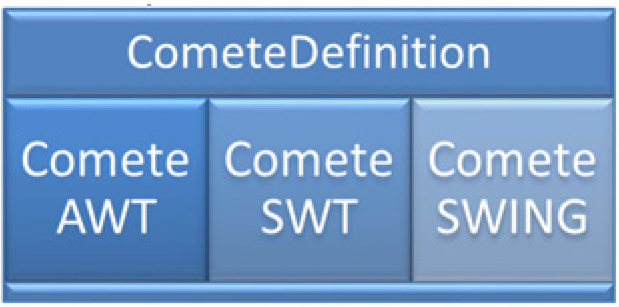

Figure 3: COMETE implementations.

COMETE widgets are available in three implementations (Swing, SWT & AWT) and therefore integrate well into any existing JAVA software (see Fig. 3). Anyone can use this set of widgets because it's based on the three major toolkits. In fact, a COMETE Widget is a standard component with some code that makes it connectable to any data source. COMETE components are dedicated to scientific data but anyone can easily add new widgets or use the existing components in another context.

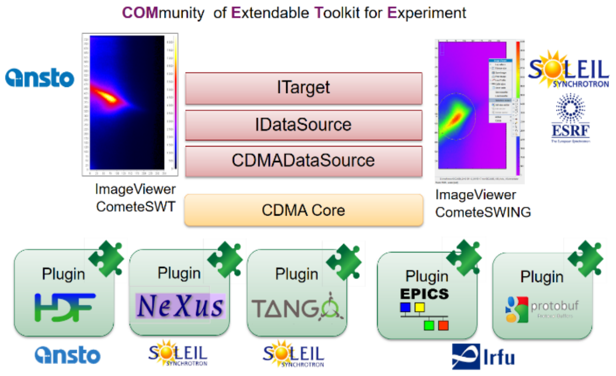

Figure 4: COMETE software architecture.

The software architecture of COMETE is consisted of three interfaces (see Fig.4), corresponding to MVC (**M**odel **V**iew **C**ontroller) design pattern paradigm:

- **IDataSource** interface that corresponds to the model of the MVC design pattern, thanks to CDMA framework a CDMADataSource implementation allows the connection with all the existing plugins developed in CDMA framework (such as TANGO, Nexus, HDF…)
- **ITarget** interface is the view part of MVC design pattern. A Target can be a graphical widget or a functional class. All implemented targets are available in COMETE widget project explained in the previous chapter.
- **CometeBox** provides utility class to connect a data source to a target. It represents the controller of the MVC design pattern.

PLUGIN DEVELOPMENT

Initially ANSTO developed the first CDMA plugin based on GumTree Data Model and NetCDF library. It was a plugin in Eclipse RCP. At ICALEPS 2009 SOLEIL and ANSO software teams decided to collaborate in developing a common solution to any kind of data source regardless its format or its localization. The first CDMA framework was delivered in 2010, and presented by SOLEIL on ICALEPS 2011. The two first plugins were for HDF then for Nexus format. Then in 2012, SOLEIL high-level application developers wanted to display Tango real time data, Tango archiving data and Nexus acquisition data into the same tool. Therefore, the Databrowser software was born in 2012. It allows end-users of SOLEIL to work into a single environment instead of the many tools installed on their computer. SOLEIL developed TANGO and TANGO archiving plugins.

In 2017, Mrs Katy SAINTIN leaved SOLEIL and joined control software team of IRFU institute at CEA. IRFU's control system is mainly based on EPICS and MUSCADE [13] solution, therefore three new plugins are developed in 2019, MUSCADE (live data) EPICS (live data), and Archiving Appliance's google protocol buffer file plugin. See the timeline development in the following figure (see Fig. 5).

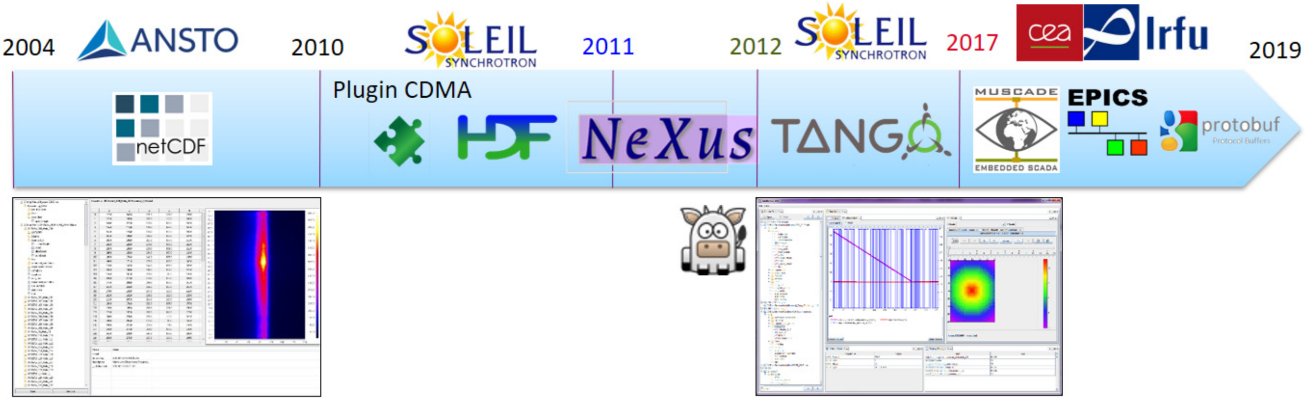

Figure 5: Plugin development historic.

CONCLUSION

In conclusion, Databrowser software is a free software published under GPL public license by SOLEIL software team. Further progress in the project has continued in 2019, and offer regular updates on the architecture or in the library behind it. SOLEIL developers are encouraging strongly other institutes to contribute on this project. It is possible to help, on many different topics such as CDMA plugin development for a new data format, COMETE new widgets implementation or simply for a new feature.

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