INFORMATION SYSTEM FOR ALICE EXPERIMENT DATA ACCESS

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Abstract

The main goal of this paper is the presentation of Dcs ARchive MAnager for ALICE Experiment detector conditions data (DARMA), which is the updated version of the AMANDA 3 software currently used within ALICE experiment at CERN [1].

The typical user of this system is either a physicist who performs further analysis on data acquired during the operation of the ALICE detector or an engineer, who analyses the detector status between iterations of experiments. Based on the experience with the current system, the updated version aims to simplify the overall complexity of the previous version, which leads to simpler implementation, administration and portability of the system without sacrificing the functionality. DARMA is realized as an ASP.NET web page based on Model-View-Controller architecture and this paper provides a closer look at the design phase of the new backend structure in comparison to the previous solution as well as the description of individual modules of the system.

INTRODUCTION

The ALICE experiment studies the ultrarelativistic heavy ion collisions provided by the Large Hydron Collider (LHC). To cope with extreme track densities, many subdetectors based on different technologies have been deployed within ALICE [1]. That is why the ALICE Detector Control System (DCS) has to access many different components and various types of data. A closer look on ALICE DCS can be found in [2], details of the data flow in ALICE DCS are available in [3]. Most of the values monitored by the DCS are stored into the central database, where every detector uses its own schema to prevent possible conflicts.

Over the years, many different ways to access the data from this database were used – from the simple client server tool AMANDA to currently used AMANDA 3 package, which allows the concurrent access to DCS archive using multiple clients. Usage of AMANDA 3 brings to light the need of designing the simplified solution with easier implementation and administration and better portability. The acronym DARMA (Dcs ARchive MAnager) was chosen as the name of this information system. Both AMANDA 3 and DARMA were developed by members of CERN and Center of Modern Control Techniques and Industrial Informatics in the Department of the Cybernetics and Artificial Intelligence, Faculty of the Electrical Engineering and Informatics, Technical university of Košice, so in the design of DARMA, experiences from AMANDA 3 development and usage were used and transferred into the latest version. DARMA respects the main features of the AMANDA 3 solution and has been designed to deal with weak spots of its ancestor with focus on improvement of the functionality along with the reduction of its backend structure.

AMANDA 3 SOFTWARE OVERVIEW

AMANDA 3 is the software solution for the retrieval of the large amounts of DCS data with the main goal of enabling faster access to the multiple users of the system. When compared to previous solutions, AMANDA 3 was designed as a decentralized system, with services running on separate servers in order to deal with the requests traffic and to serve all the users as fast as possible. Windows Communication Foundation (WCF) services system was used to interconnect all decentralized parts of the system to ensure the fast and reliable communication between separate modules. Structure of the AMANDA 3 solution is shown in Figure 1.

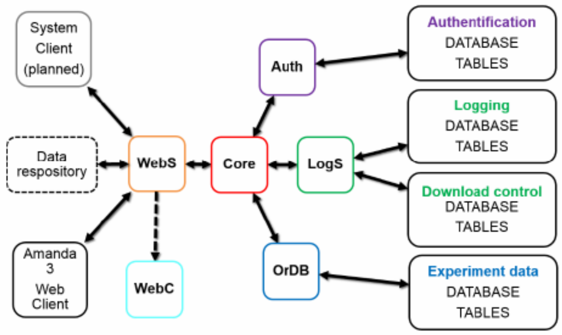


Figure 1: Structure of AMANDA 3.

AMANDA 3 is still used in CERN infrastructure, but with the fast technological changes in IT environment, the development of a new version of the AMANDA 3 was necessary. [4]

OVERVIEW OF DARMA

The new DARMA solution aims to be simpler and more user-friendly than AMANDA 3, but also retains all the benefits of AMANDA 3. In DARMA, separate services are not considered and the entire solution is implemented in the form of an ASP .NET Web site using the Model – View – Controller (MVC) architecture - Figure 2.

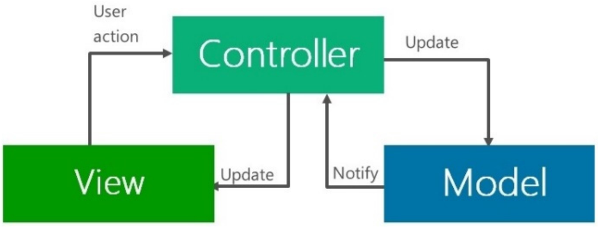


Figure 2: MVC architecture [5].

Stable data settings, such as database connections, are stored in the web.config file, while settings changing during usage of DARMA are stored in the system database, which is implemented as a part of the website. When downloading a file, a separate thread is created that saves the data file to the server disk. The data file is then available for user download. Information about downloaded files and saved files are also stored in the system database. The DARMA solution can be cloned by simply copying the website folder. The website manages disk space automatically and in case of lack of space, it deletes the oldest files.

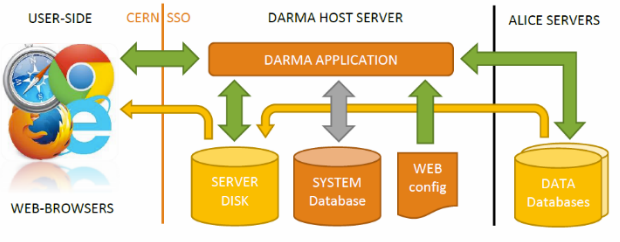


Figure 3: Schema of DARMA architecture.

On the user side, a classic PC, mobile or tablet connected to the Internet can be used. A connection to DARMA can be realized through the web browser. Users can connect to download the data after authentication with the CERN SINGLE SIGN-ON system. According to the role of the user (user / admin), particular options are displayed on the DARMA website page.

On the DARMA HOST SERVER page is the Web server with MS Windows Server 2008 R2 or higher, which provides the DARMA website. The server has a higher capacity on the hard disk, its disk is divided into a partition for a web page with a system database and a partition for storing downloaded data files - SERVER DISK. In WEB config, key settings for connection to the data database and system database are stored, as well as data logging. The system database is in the form of a local database and is located in a web page folder.

In DATA databases, implemented on Alice Servers, are stored the data from many individual subdetectors of the ALICE. Access is read only and it is implemented in the form of procedures compiled by the data model administrators. It is not possible to change or edit these procedures at any time, so they must be designed to be as effective as possible. Reading from a database can be realized via a dedicated user account. Data reading cannot be realized from more than one sub-detector simultaneously.

Database Structure

Structure of the system database of DARMA is quite simple and it consists of 7 tables (CONF, ALERT_SEVERITY, LIST, USERS, DOWNLOAD, LOGENTRY, LOGLEVEL) interconnected through relations. In the off-line CERN database, every detector has its own schema represented as a database user. Within each schema, there are views joining the tables containing values of various elements of the experiment, as well as views joining the alerts related to particular elements. The data diagram of the system database can be seen in Figure 4.

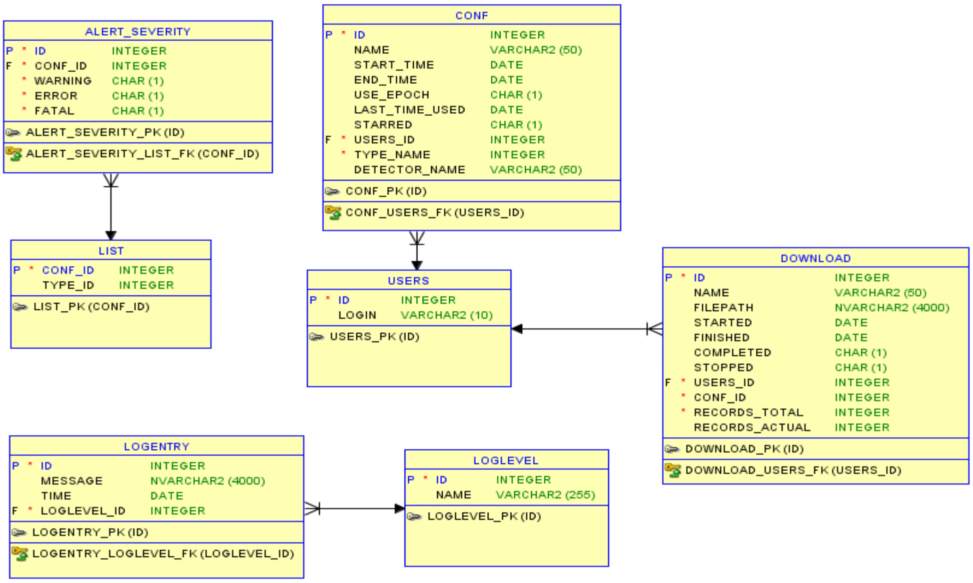


Figure 4: Diagram of DARMA system DB structure.

Functionality Description

The main purpose of DARMA is to provide its users with the values and alerts of the various elements through the experiment. Before defining the parameters of the request, DARMA user has to be authorized via CERN SSO login. After this procedure, the user login is saved into the system database and the user is eligible to create requests.

The process of downloading files with DARMA can be summarized in these steps:

1. Signing into DARMA
   a. Definition of user's role
   b. Loading of the available detectors
   c. Summary of the previous downloads and favorite configurations
2. Choosing the detector and type of requested data
   a. Choosing the detector
   b. Choosing the type of the requested data (ALIAS, ELEMENT, ALERT)
   c. Choosing the time interval
3. Specification of selection and data format
   a. Searching for data identifiers
   b. Choosing the data format (UTC, EPOCH)
4. Automatic download process
   a. Checking the disk space
   b. Displaying the progress of download
   c. Possibility of logging out any time
   d. Possibility of stopping the download
5. Making the data available
   a. Data download via browser
   b. Data can be displayed by graphs
   c. Possibility of deleting the data

After creating the request and downloading of requested file, the log of this request is added into the request screen, where the user can see the details of the request, see basic analysis of the request, share this request with other users or delete this request. Via the analysis panel, the user can check the data density and maximum, minimum and average values during the specified time period.

Administrators of DARMA can use DARMA in the same way as other users. Among this, they have also privileges to see the logs of ongoing downloads, they can stop the ongoing download, they can change the system settings and control the SERVER DISK. They are eligible to see the logs of the system, which can be used for DARMA diagnostics.

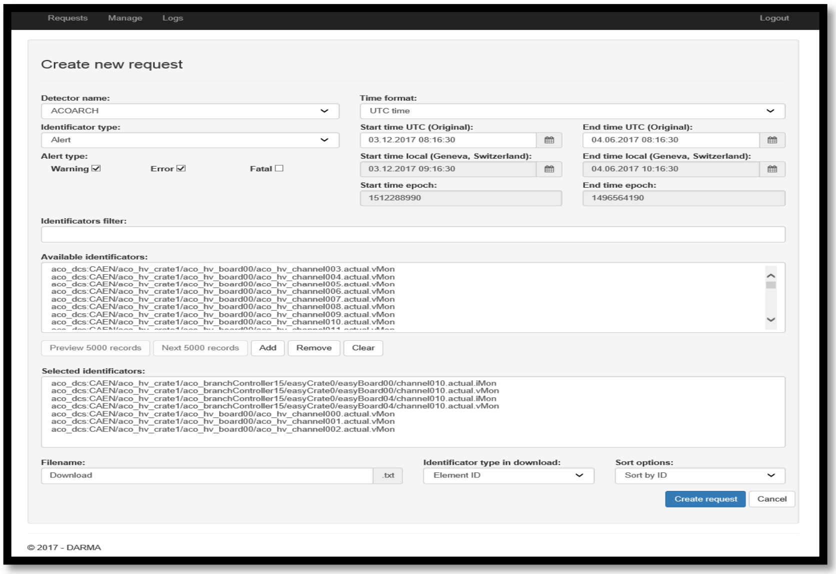
CHANGES BETWEEN AMANDA 3 AND DARMA

Change of the Backend Structure

As was already mentioned, DARMA provides the data to the users using significantly reduced backend structure. It is realized as a web page designed on the base of MVC architecture, while the AMANDA was realized as decentralized system with WCF services. Changes of the backend structure can be clearly seen when comparing Fig.1 and Fig.2.

Design Changes

Since AMANDA 3 has already been used at CERN for some years, its design can be considered old-fashioned. Some changes in the design were made in order to make DARMA look fresher and more up-to-date. The GUI of DARMA can be seen in Figure 5.



Create new request

Detector name: ACOARCH

Identificator type: Alert

Alert type: Warning ☑ Error ☑ Fatal □

Time format: UTC time

Start time UTC (Original): 03.12.2017 08:16:30

End time UTC (Original): 04.06.2017 08:16:30

Start time local (Geneva, Switzerland): 03.12.2017 09:16:30

End time local (Geneva, Switzerland): 04.06.2017 10:16:30

Start time epoch: 1512288990

End time epoch: 1496564190

Identificators filter:

Available identificators:

```
aco_dcs:CAEN/aco_hv_crate1/aco_hv_board00/aco_hv_channel003.actual.vMon
aco_dcs:CAEN/aco_hv_crate1/aco_hv_board00/aco_hv_channel004.actual.vMon
aco_dcs:CAEN/aco_hv_crate1/aco_hv_board00/aco_hv_channel005.actual.vMon
aco_dcs:CAEN/aco_hv_crate1/aco_hv_board00/aco_hv_channel006.actual.vMon
aco_dcs:CAEN/aco_hv_crate1/aco_hv_board00/aco_hv_channel007.actual.vMon
aco_dcs:CAEN/aco_hv_crate1/aco_hv_board00/aco_hv_channel008.actual.vMon
aco_dcs:CAEN/aco_hv_crate1/aco_hv_board00/aco_hv_channel009.actual.vMon
aco_dcs:CAEN/aco_hv_crate1/aco_hv_board00/aco_hv_channel010.actual.vMon
```

Selected identificators:

```
aco_dcs:CAEN/aco_hv_crate1/aco_branchController15/easyCrate0/easyBoard00/channel010.actual.iMon
aco_dcs:CAEN/aco_hv_crate1/aco_branchController15/easyCrate0/easyBoard00/channel010.actual.vMon
aco_dcs:CAEN/aco_hv_crate1/aco_branchController15/easyCrate0/easyBoard04/channel010.actual.iMon
aco_dcs:CAEN/aco_hv_crate1/aco_branchController15/easyCrate0/easyBoard04/channel010.actual.vMon
aco_dcs:CAEN/aco_hv_crate1/aco_hv_board00/aco_hv_channel000.actual.vMon
aco_dcs:CAEN/aco_hv_crate1/aco_hv_board00/aco_hv_channel001.actual.vMon
aco_dcs:CAEN/aco_hv_crate1/aco_hv_board00/aco_hv_channel002.actual.vMon
```

Filename: Download .txt

Identificator type in download: Element ID

Sort options: Sort by ID

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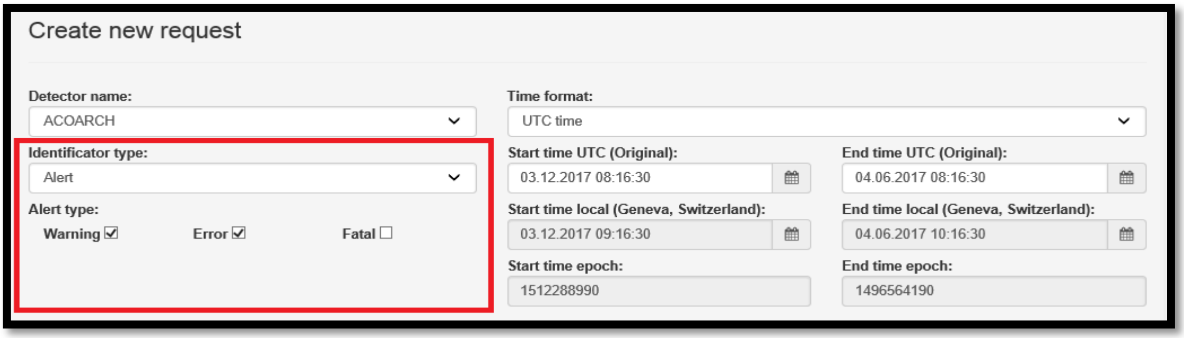
Figure 5: DARMA user interface.

Functionality Changes

When compared to its ancestor, AMANDA 3, DARMA brings out some new features which can be helpful for its users in many ways. Most important changes are the following ones:

Alerts downloading Apart from downloading values of elements and aliases within a selected interval, DARMA also provides users with the possible download of list of alarms for particular elements or aliases within selected time period. (Figure 6). Various information about the alerts are shown, like its severity, description, direction etc.



Create new request

Detector name: ACOARCH

Identificator type: Alert

Alert type: Warning ☑ Error ☑ Fatal □

Time format: UTC time

Start time UTC (Original): 03.12.2017 08:16:30

End time UTC (Original): 04.06.2017 08:16:30

Start time local (Geneva, Switzerland): 03.12.2017 09:16:30

End time local (Geneva, Switzerland): 04.06.2017 10:16:30

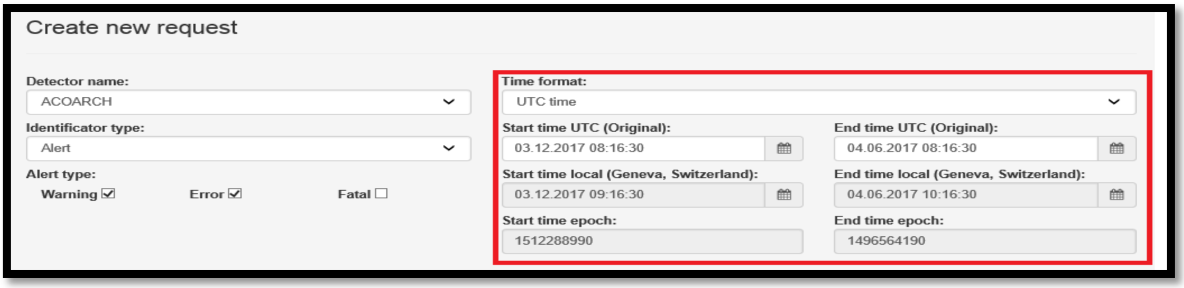
Start time epoch: 1512288990

End time epoch: 1496564190

Figure 6: Alert downloading in DARMA.

Download progress bar DARMA provides the progress bar informing the user about the status of his request. It is displayed in “My requests” screen. The progress bar shows the percentage of downloaded data.

Automatic time conversion In DARMA, users can choose from 3 time formats defining the interval of request (UTC TIME, LOCAL TIME, EPOCH TIME). In the downloaded file, users can choose between displaying the timestamp either in UTC time or in EPOCH time (Figure 7).



Create new request

Detector name: ACOARCH

Identificator type: Alert

Alert type: Warning ☑ Error ☑ Fatal □

Time format: UTC time

Start time UTC (Original): 03.12.2017 08:16:30

End time UTC (Original): 04.06.2017 08:16:30

Start time local (Geneva, Switzerland): 03.12.2017 09:16:30

End time local (Geneva, Switzerland): 04.06.2017 10:16:30

Start time epoch: 1512288990

End time epoch: 1496564190

Figure 7: Time format conversion in DARMA.

Filter upgrade: In comparison to the previous version, the filter used for searching the element names or aliases is now able to search for any part of the element name or alias.

Sharing requests: Users are now able to share their requests with other users in order to make sharing the data with co-workers more comfortable. Data can be shared through the “My requests” section.

CONCLUSION

DARMA (Dcs ARchive MAnager) is the information system used for downloading the historical data from the DCS experiments and provide them for further analysis. The system was developed with respect to the main features of its previous version – AMANDA 3, which was introduced into CERN infrastructure in 2014. In comparison to AMANDA 3, DARMA is running with significantly reduced backend structure, designed using the MVC architecture. Besides these changes, new structure of the system database was developed, and some functionality changes were also realized with the goal of make using of DARMA intuitive and simple.

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