EUROPEAN ORGANISATION FOR NUCLEAR RESEARCH

ATLAS DAQ – DCS
Communication Software

User Requirement Document

Authors: R. Hart (NIKHEF, Amsterdam),
V. Khomoutnikov (PNPI, St.-Petersburg)
Note Number: 164
Version: 1.1
Date: November 13 2000
Reference: http://atddoc.cern.ch/Atlas/Notes/164/Note164-1.html

1 Introduction

1.1 Purpose of the document

This document presents the user requirements for the DAQ–DCS Communication (DDC) software of the ATLAS HLT/DAQ/DCS system.

1.2 Overview of the document

Chapter 1 of the document introduces the scope of the DDC. Chapter 2 presents a general description of the project. Chapter 3 describes some terms and user characteristics. Chapter 4 contains the essence of this document: a list of the user requirements. Chapter 5 contains the list of references.

1. 3 Scope, function and considerations of the DDC

The DDC service is meant to be the connecting element between DAQ and DCS. It has been outlined in HLT/DAQ/DCS Technical Proposal document [1] and ATLAS DCS IWN8 [2]. Its main function is to provide communication between DAQ and DCS, this implies the exchange of data and the transportation of messages, like alarms, from DCS to DAQ. Furthermore the DDC also provides a way to issue commands from DAQ to DCS. The three functions of the DDC are listed once more below:

1. Bi-directional exchange of data like parameters and status values;
2. Transmission of DCS messages, like alarms, to DAQ;
3. Ability for DAQ to issue commands on DCS.

The transmission of messages and passing of commands to DCS are uni-directional. It is not foreseen that there is a necessity to have the opposite capability as well. However, in future it may not be excluded.

Any manipulation with the physics data is beyond the scope of the DDC project.

Both DAQ and DCS are partitioned and should be compatible in terms of boundaries and locking of resources. However, the DDC is unaware of partitions and therefore the concept is not covered. It remains the responsibility of DAQ and DCS themselves.

The DAQ and DCS use a configuration database to set up their systems. Loading the databases at startup is not the responsibility of the DDC. The DDC itself uses also a configuration database, containing the information it needs for the functions listed above.

A basic difference between DAQ and DCS is the concept of time. DCS events are tagged with time-stamps, DAQ uses event numbers. To synchronize these two, there should be a “common” time. However, the DDC does not cover this issue.

2 General description

The DAQ and DCS systems of the ATLAS HLT/DAQ/DCS project shall operate independent from each other providing they fulfil the functionality defined in [1]. The DAQ system is responsible for treating all aspects of physics-event data, while the DCS accesses the detector parameters, monitors the environment parameters and provides the information exchange with other systems external to DAQ and DCS like LHC accelerator, safety system, etc.

At the same time, in order to provide the consistency of the experimental data and the possibility of correct off-line event handling and interpretation, these two systems must be capable of interacting with each other. The following list summarizes the DAQ-DCS communication, which will be fulfilled by the functions of the DDC, mentioned in chapter 1.3.

- The DAQ system needs certain information from DCS to know the state of the detector and to be able to change or save the mode of physics event data taking (including stopping the run in case of inappropriate conditions). Some information should be stored for reference during off-line event handling.
- DCS should receive status information from the DAQ system, which are necessary for the DCS expert and shift operator.
- DCS alarms, warnings and errors have to be reported to the DAQ system. Faulty detector conditions have to be transmitted to DAQ, which may decide to pause or stop the run.
- The DAQ system should be capable of issuing commands to change parameters controlled by DCS in accordance with data taking needs or during calibration. For example, to change the high-voltage setting of a sub-detector. The result of the command is passed back to the caller.

The DCS is implemented by a SCADA system and the DDC will communicate with it. On the DAQ side the Back-end packages [3] are the interface points with the DAQ.

Figure 1a, 1b, 2 and 3 are the scenario diagrams each representing a function of the DDC.

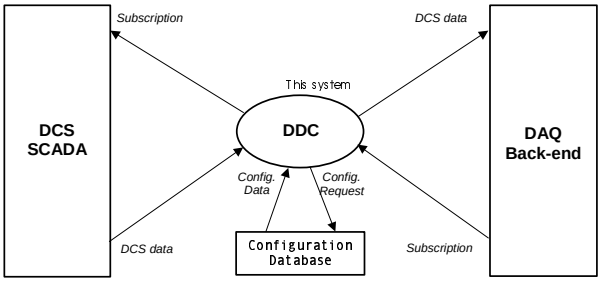

Figure 1a. Data exchange from DCS to DAQ.

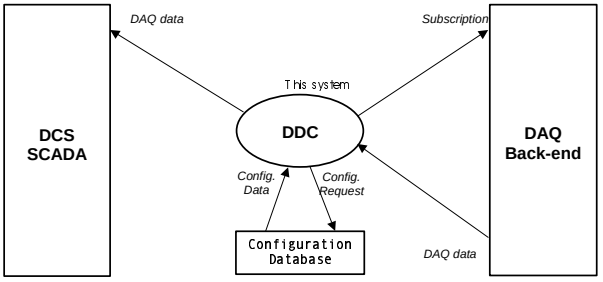

Figure 1b. Data exchange from DAQ to DSC.

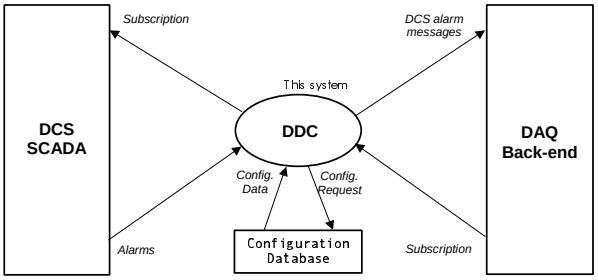

Figure 2. Message transport from DCS to DAQ.

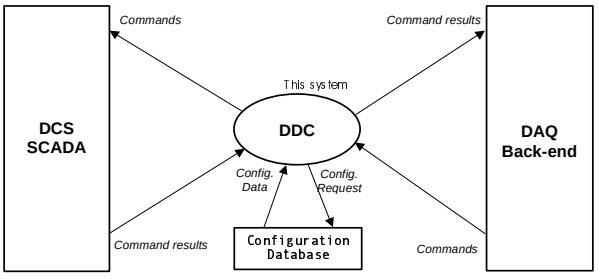

Figure 3. Issue commands by DAQ on DCS

The term *data* is regarded as a value belonging to a DAQ or DCS variable (parameter or status). In the case of DCS being the source the data is transferred with the time stamp.

A *message* is regarded as a piece of information packed into a string. The time stamp will also be packed within the message. Message contents examples can be DCS alarm, DCS operator action, a spontaneous change of the state of a detector element, etc. DAQ might use this information either by triggering an action (e.g., stop the current run) or keeping-in in the database for reference offline.

Subscription is a way of asynchronous reading. The current value is returned during subscription and then each change of the value is notified. SCADA system has no means to subscribe for anything in an external application. That is why, there is no “subscription” arrow in fig.1b being issued from DCS. DDC will do this instead basing on the configuration data (see below).

The commands issued by DAQ, to be carried out on DCS, are executed by the DCS itself. The DCS checks the validity of the command, the permission and authorization. DCS should also produce a response code indicating the command results. The response code shall be delivered by DDC to the DAQ application having issued the command.

The DDC configuration database contains for each function different information. For the data exchange it contains a list of DAQ and DCS variables to support. For the message transportation a list of DCS alarms and DCS text data to be exported for DAQ whenever changed. It contains also parameters how to convert the DCS message into a format known by DAQ. For the command transmission function the configuration is a list of possible commands and their attributes.

The DCS should always be operational and is in the view of the DAQ system a server. The DAQ itself is the client. Therefore, the DDC has to run whenever a DAQ application becomes active. A graphical user interface, which can start/stop the DDC, will be a part of the DDC project.

3 Definitions and User Characteristics

3.1 Definitions

Physics Data

Data taken from detector equipment representing physics or calibration events.

DAQ Run

A continuous period in time of data taking using a given hardware and software configuration and a defined set of run parameters. It is identified by a unique run number. The run begins when the DAQ, detectors and other subsystems are correctly configured and the machine conditions are acceptable. A run terminates either cleanly when the predefined goals of the run are met (e.g. a certain number of events has been taken) or aborts when a serious unexpected problem occurs (e.g. loose the beam or the machine conditions are unacceptable etc.) or when the configuration of the partition changes.

Data Taking Period

A succession of DAQ runs in which no major changes are made to the detector and DAQ configurations.

3.2 User characteristics

There are several types of DDC users that can be identified:

Shift operator

The shift operator shall be capable to determine whether the DDC software is working correctly or not and to restart it if the communication has crashed. He only needs to know the DDC user interface for that purpose.

DCS expert

The DCS expert is responsible for the definition of the set of DCS data that can be exported, the set of alarms to be issued and the available set of commands to be issued by DAQ. He should be capable of editing the definitions and restarting the DDC software.

4 User Requirements

4.1 General requirements

UR DDC-1 The DDC software shall provide bi-directional exchange of data between DAQ and DCS.

UR DDC-2 The DDC software shall provide the capability to transmit DCS messages to DAQ.

UR DDC-3 The DDC software shall pass commands from DAQ to DCS. The validity, legality, permission and authorization are checked by DCS and are not the responsibility of the DDC.

UR DDC-4 The DDC software shall run as soon as DAQ is operational.

UR DDC-5 Any DAQ application shall, whenever it starts, be able to use all DDC facilities.

UR DDC-6 The DDC software or a part of it shall be available for manual restarting during a data taking period without interfering the functionality of DCS or DAQ.

Note: This may be necessary in case of failures of the DDC software or of a necessity to change the set up.

UR DDC-7 The DDC software shall provide a graphical user interface allowing to shut down the DDC software, to start it and to observe its current status.

4.2 General Constraints

UR DDC-8 The DDC software shall be available for any DAQ or DCS application, what implies that it shall be available on those platforms the DAQ and DCS applications are supported on.

UR DDC-9 The DDC software shall restrict the option of manually shutting down the DDC (followed by restart) for debugging or reconfiguration purposes by the DCS expert.

UR DDC-10 The DDC software shall communicate with DAQ exclusively via the Back-end package.

UR DDC-11 The DDC software shall be independent of the operational parameters and control algorithms of the DCS and DAQ.

UR DDC-12 The functionality of the DDC software shall be independent of the set and contents of data to be transmitted between DCS and DAQ components.

UR DDC-13 While shutting down or restarting, the DDC shall not cause the DAQ components to re-establish the connection, including subscription. The DAQ shall only be influenced by that restart with an interruption in receiving parameters, messages or sending commands.

Note: It should be noted however that only current state of alarms and DCS text data foreseen for messages are available for DDC after its restart. This means that if, e.g., an alarm has arisen and then disappeared during unavailability of DDC, it will be unknown for DDC and consequently for DAQ.

UR DDC-14 A DDC failure must not affect the internal functionality of DAQ or DCS.

UR DDC-15 DDC shall take care of informing DAQ and DCS about its working state

Note: Using "watch dogs" might do this.

UR DDC-16 All changes of state of the DDC software shall be logged.

UR DDC-17 The contents of the DDC configuration database shall be editable with a text editor or an appropriate database editor.

UR DDC-18 A possibility of dynamical change of the DDC configuration should be provided

Note: It means changing configuration without shutting down the DDC software.

UR DDC-19 DDC software shall report the shift operator if any DDC function is unavailable.

4.3 Specific Requirements

4.3.1 DDC Data Exchange

UR DDC-20 DDC software shall be capable to export to external applications the current values and changes of any variable controlled by DCS.

UR DDC-21 DDC software shall be capable to get the current values and changes of any DAQ variable and transmit them to DCS.

4.3.2 Reporting DCS Messages

UR DDC-22 The DDC software shall transmit to DAQ the DCS alarms and DCS text data (on change) specified by DDC configuration.

4.3.3 Passing of DAQ Commands to DCS

UR DDC-23 DDC shall pass commands from DAQ applications to DCS and return the result of the commands.

UR DDC-24 The DDC software shall log all issued commands.

5 References

[1] ATLAS high level Triggers, DAQ and DCS Technical Proposal, CERN/LHCC/2000-17, http://atlasinfo.cern.ch/Atlas/GROUPS/DAQTRIG/SG/TP/draft_tp.html.

[2] H.Burckhart, M.Caprini, R.Jones "Connection DCS – DAQ in ATLAS", ATLAS DCS IWN8, Nov 1999, http://atlasinfo.cern.ch/ATLAS/GROUPS/DAQTRIG/DCS/dcs_daq_0.6.pdf.

[3] ATLAS DAQ Back-End Software. User Requirement Document. http://atddoc.cern.ch/Atlas/DaqSoft/document/draft_1.html

APPENDIX

Acronyms and Abbreviations

DAQ
Data Acquisition System

DCS
Detector Control System

DDC
DAQ-DCS Communication System

SCADA
Supervisory Control and Data Acquisition