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TRAINING SESSION

READOUT FROM FPGA TO ONLINE

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DAQ concepts

Data acquisition software are applications designed to read data from front-end units and store on a medium. For some application DAQ software needs more functionalities such as monitoring and on-line processing.

When the number of front-end units and channels become large the DAQ software needs to scale. Multi-process applications running on different nodes are preferred and take advantage of shared resources i.e.: CPU, storage, network, bandwidth, etc.

Data fragments are read out of different front-ends. Fragments that belong to the same event are collected together and stored in a data frame that identifies the specific event with timestamp information. Such a process, called event building, can be performed across network on many DAQ nodes.
DATE (Data Acquisition and Test Environment) is a software system that performs data-acquisition tasks in a **multi-processor distributed environment**. DATE fulfils the requirements of the ALICE data acquisition, therefore it has been designed with scalability features that **make it suitable for large systems**, involving hundreds of computers. Nevertheless, DATE can cope with a large variety of configurations; in particular, **it is well adapted to small laboratory systems** as well, where only few machines are used, or even just one [*ALICE DAQ and ECS Manual*].

- DATE was developed by the ALICE Collaboration and was adopted by RD51 to complement the SRS hardware platform.
- DATE can be installed on any machine running Linux connected on standard Ethernet networks.
- Installation based on pre-compiled packages (RPMs) is available.
- After DATE installation a minimal configuration is available readily to the user.
- DATE is a turnkey DAQ system.
The DATE Architecture [1]

- DATE architecture is based on **multiple processes** that can be distributed over different working nodes.
- Data flow based on inter-process communication via fast shared memory and software FIFOs.
- Control and synchronization between processes is implemented using the DIM client/server communication protocol.

- **LDCs** Local Data Collector read out data from the Front-End readout Electronics **FEE** (i.e.: SRS units).
  - **Readout** process reads data from FEEs
  - **Recorder** process sends data to GDCs and records locally
  - The **edmAgent** process provides a load balancing algorithm to distribute events from the LDCs to the GDCs.

- **GDCs** Global Data Collector collects event fragments from the LDCs and assembles the full event.
  - **eventBuilder** process builds the whole event merging fragments from the LDCs
  - **mStreamRecorder** records data
DATE Control [1]

- The DATE run control interface sends commands to a Logic Engine running a Finite State Machine (FSM)
- The Logic Engine propagates commands, using DIM, to all DATE hosts on which a server process named `rcServer` is running
- `rcServer` starts and stops the DATE processes
- `rcServer` controls a shared memory segment for inter-process communication in which run status informations are constantly updated.
DATE Data Format [1]

- DATE Data Format is scalable
- Nested data structure reproduces the full tree of hardware:
  - nodes (LDCs, GDCs)
  - equipments (FFE) attached to each LDC.
- Data format is binary
- Monitoring library for data extraction is available
- Many higher level monitoring tools are available to perform off-line and on-line monitoring
  - AMORE framework and plug-ins for SRS system (follow training with Kondo Gnanvo).

[ALICE DAQ and ECS Manual, ALICE Internal Note/DAQ ALICE-INT-2010-001]
DATE medium size configuration with SRS system

SRS Front End Concentrator (FEC) cards

DATE DAQ domain
DATE Configuration

DATE provides a system to host the DAQ system configuration including the readout electronics connected to it.

- MySQL based configuration
- Text file based configuration

The database editor application (editDb) allows users to edit part of the system settings:

- Roles: LDC, GDC, detectors
- Detectors: composition of detector
- Memory banks: memory configuration for each Role
- Event building: event building policy
- Readout equipments: type, parameter for each LDC.

![DATE Configuration Database Editor - Host:localhost DB:DATE_CONFIG](image)

DATE servers

MySQL or text files
DATE Configuration for UDP equipment

- UDP based FEE equipment is supported by DATE [4]
- UDP equipment allows SRS system readout
- Main UDP configuration parameters are:
  - EqId: an ID form 0 to 11
  - portHost: host port number
  - ipHost: LDC IP address related to the NIC connected to the SRS
  - portBoard: SRS board port number used for data streaming
  - ipBoard: SRS board IP address

![DATE Configuration Database Editor](image)
DATE run control has a user friendly GUI to control and configure the run operations such as:

- Run Start/Stop
- Run status display
- Set number of connected nodes LDCs and GDCs as described in the database
- Set file naming scheme and output directory
- Set maximum file size
- Set recording options
- Set maximum event size
- Dynamic status display configuration
- and many more …
DATE Logbook

- DATE provides a logbook system based on a MySQL database.
- The *infoBrowser* application allows to access the logs in both on-line mode and off-line mode. Query expression are extremely useful to retrieve information about past runs and operations on the system.
Example of DB query using infoBrowser

- Time min: 2014-01-21 10:50:00
- Severity: F
- Hostname: localhost

It will retrieve all FATAL error logs generated by the localhost node after 21 Jan 2014 10:50:00
Conclusions

1. DATE is a turnkey scalable data acquisition software
2. DATE supports the readout of UDP front-ends such as the SRS system
3. DATE is able to scale from small size laboratory set-up to large experiment DAQ systems.
   • From one machine to several hundreds
4. Small size DAQ set-ups still profit from all DATE facilities:
   • Configuration database
   • Runs history
   • Logbook


3. ALICE DAQ and ECS Manual, ALICE Internal Note/DAQ ALICE-INT-2010-001

Thanks for your attention, let’s get our hands-on DATE!