Common ILC Data Format
(From Raw to Physics Data)

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- Introductory remarks
- Calice Testbeam Data Taking
- Status of the ILC Software w.r.t 'real' data
- Role of the EUDET Module
- Summary and Outlook

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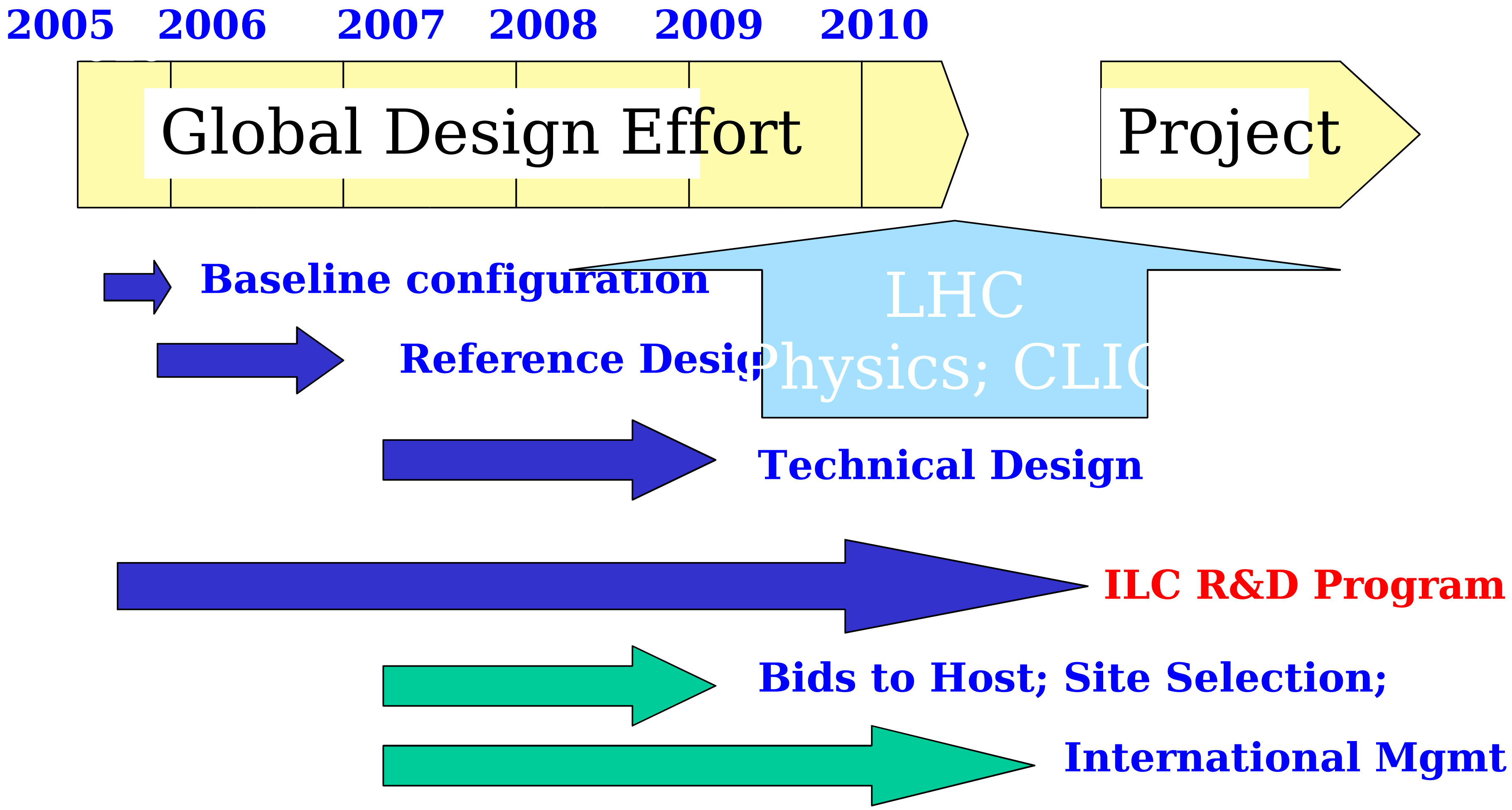
Prologue – Citations from the LDC CDR

“The DAQ System will also benefit from the use of common operation system like Linux and high level programming languages already at the event building and finding stage making the separation of online and offline code obsolete and therefore avoids the need to re-write code for on-line and off-line purposes. This results in a more efficient use of common ressources”

“The machine and beam conditions are vital for the high precision physics analysis ... a common data storage model should be used”

What is true w.r.t. the machine is even more true for the detector

GDE Timeline



2005 2006 2007 2008 2009 2010

Global Design Effort

Project

Baseline configuration

Reference Desig

LHC
Physics; CLIC

Technical Design

ILC R&D Program

Bids to Host; Site Selection;

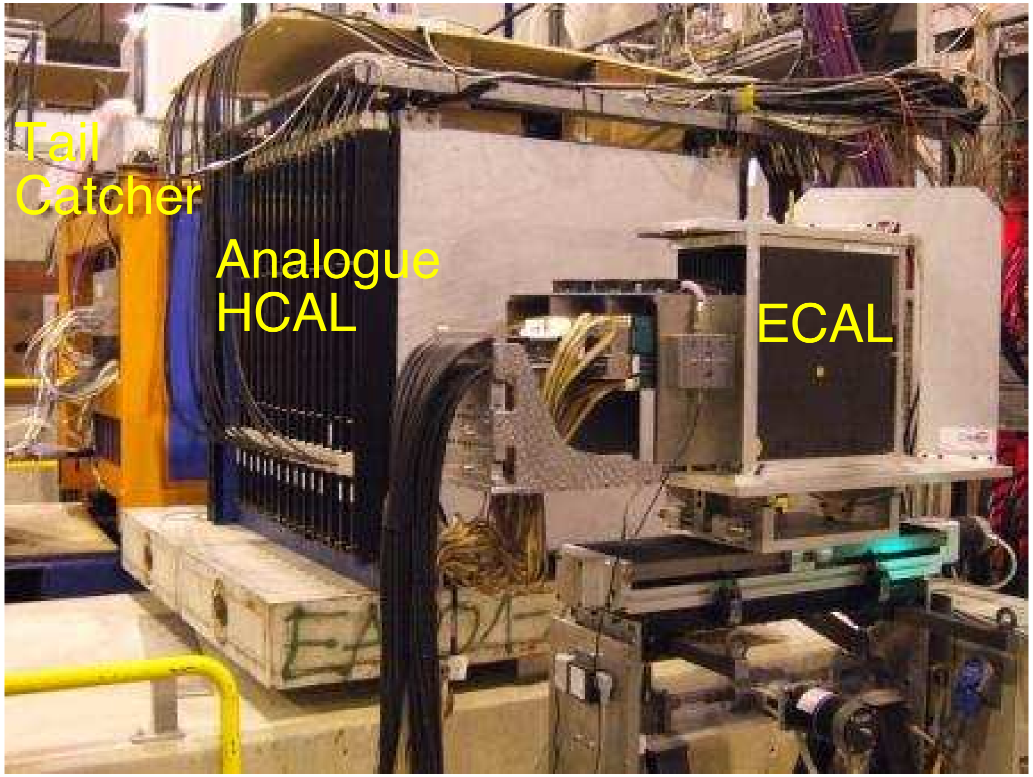
International Mgmt

(Hopefully) tight time line for the ILC demands highly integrated R&D effort

CALICE Testbeam Data Taking

CALICE collaboration is preparing/performing large scale testbeam
'Real' Data are taken as we speak

Testbeam Setup at CERN



Testbeam program poses software "challenges"

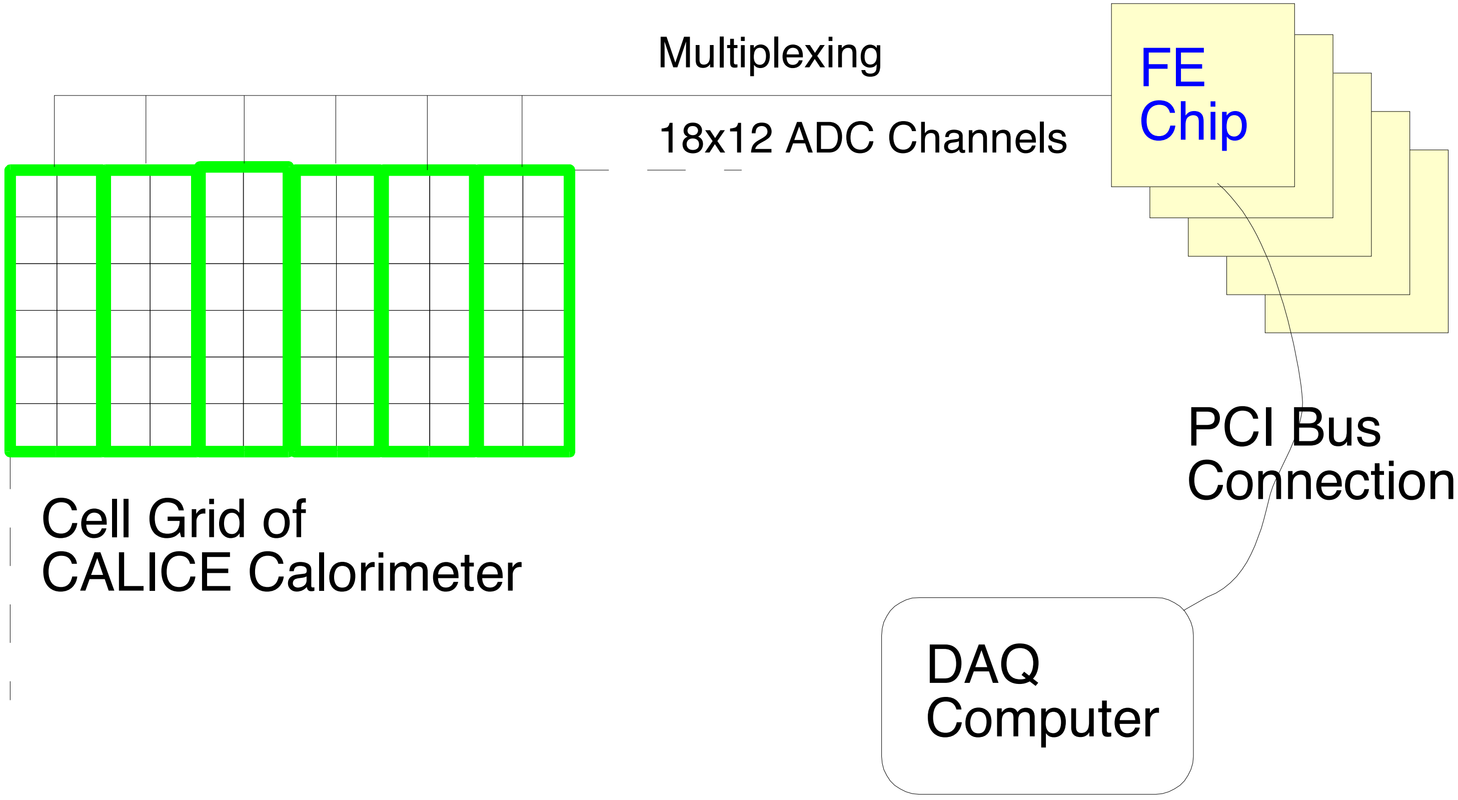
- Data processing from Raw Data to final Clusters in user coherent way

- Handling of Conditions Data Detector Configuration Calibration, Alignment etc.

-Comparison with simulated data 'Physics' Output

O(15000) calorimeter cells
readout by Calice DAQ
No Zero Suppression

CALICE DAQ Scheme – Poor Man's View



- DAQ is organized 'hardware friendly' – optimized for Speed
  Data received and stored as sequence of 32 bit integers

- 'Many' people should get involved in calibration/monitoring

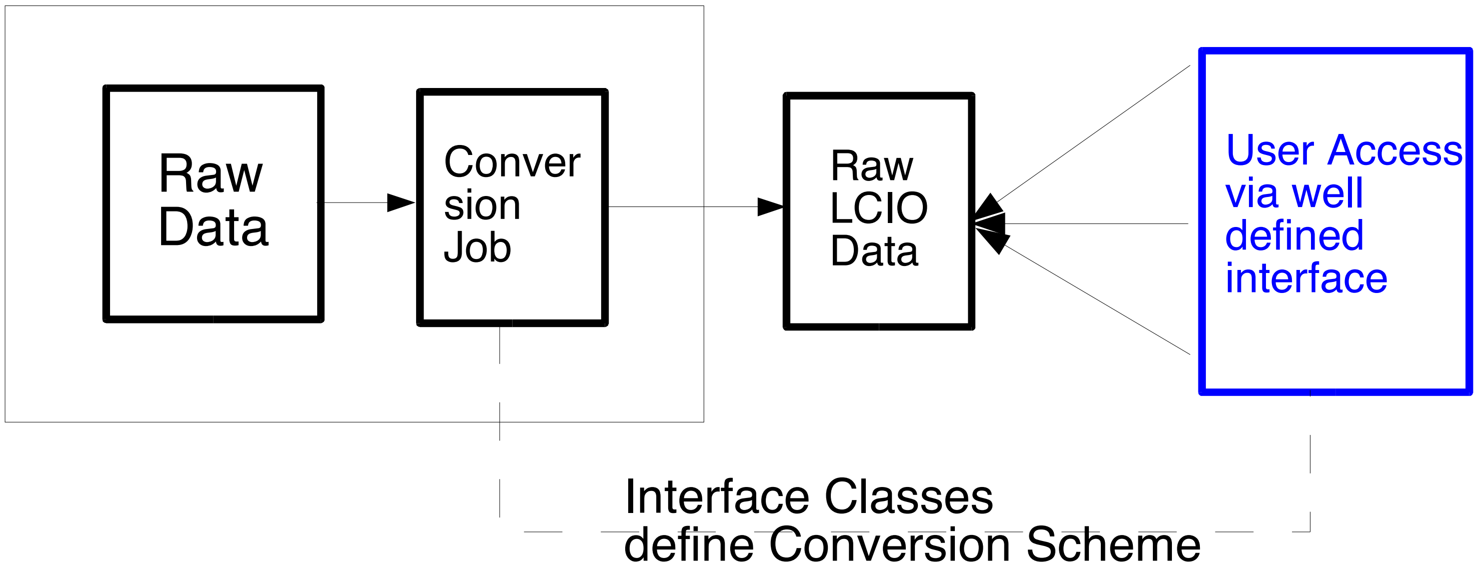
- Idea is/was to process data using existing ILC software tools
  benefit from global development and
  deliver input for improvement of ILC software!!!

Raw Data Conversion to LCIO

LCIO is data model widely used in ILC Studies

Main Strategic Decision: Raw Data should be available in LCIO Format

Requirements: - 'Intelligent' Conversion from Raw Data to LCIO Raw Data
- Provide all Info on Raw Data also in LCIO Raw Data in a user friendly way


Raw Data
Conver sion Job
Raw LCIO Data
User Access via well defined interface
Interface Classes define Conversion Scheme

Interface is to be completely decoupled from online software

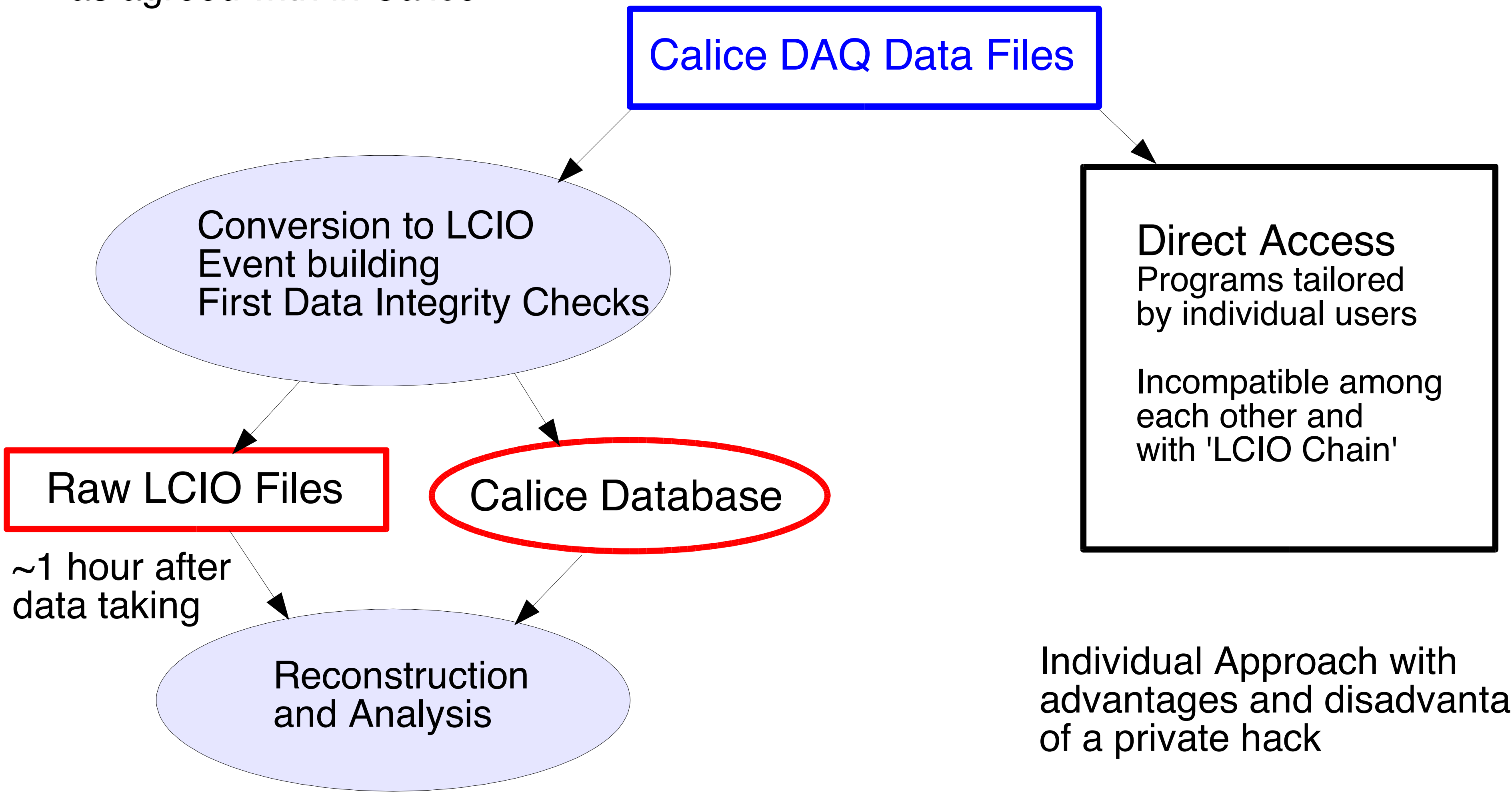
Dedicated Interface Classes are defined using LCIOGenericObjects

Mainly LAL, LLR, DESY

CALICE Dataprocessing

The desired chain
using LCIO and MARLIN
as agreed with in Calice

(Part of the) Reality



Calice DAQ Data Files

Conversion to LCIO
Event building
First Data Integrity Checks

Raw LCIO Files

Calice Database

~1 hour after
data taking

Reconstruction
and Analysis

Direct Access
Programs tailored
by individual users

Incompatible among
each other and
with 'LCIO Chain'

Individual Approach with
advantages and disadvantages
of a private hack

Complex chain with advantages
and disadvantages of a strucutered
approach

Calice DAQ and ILC Software framework

- CALICE DAQ was designed as ILC Software was at its real infancy (~2004)

No concept to treat DAQ data types in a way compatible to the ILC Software concepts, 'LCIO' (or whatever) was not part of the DAQ Concept

- Changes to LCIO Conversion can/do happen only after DAQ changes

Severe changes to the DAQ need to be integrated carefully into the the Conversion

Conversion has to run permanently and has to treat millions of events without crashing

Delay of availability of converted data

- Converted files might not contain all data types needed for analysis

Iterative process

Pros and Cons using ILC Software Software for Calice Testbeam Data

Pros

Benefit from existing
tools/features for/of ILC Software
e.g. LCEvent allows to
gather information on event

Newcomers can work
in one software framework
for testbeam and physics studies

Define at an early stage the
of the ILC R&D the needs
for a coherent data processing
Coherent s/w concept at time
of ILC Detector TDR
Not just guesswork!!!

Is in the spirit of the LDC CDR!!!!

Cons

Need to wait for
converted files
No quick turnaround in
particular during development
of DAQ and tests
Needs tight communication between
DAQ and s/w developpers

Some overhead generated
by usage of ILC Software

Soruce of (potential)
errors unclear

Status of and of ILC Software w.r.t 'Real' Data

- Existing software mainly developped for simulation studies

For more information on ILC Software packages
see ilcsoft.desy.de

- LCCD

conditions data framework was/is first
approach to store data like
Calibration Constants, Detector Configurations
Currents Temperatures and to read them back into
e.g. your MARLIN Analysis

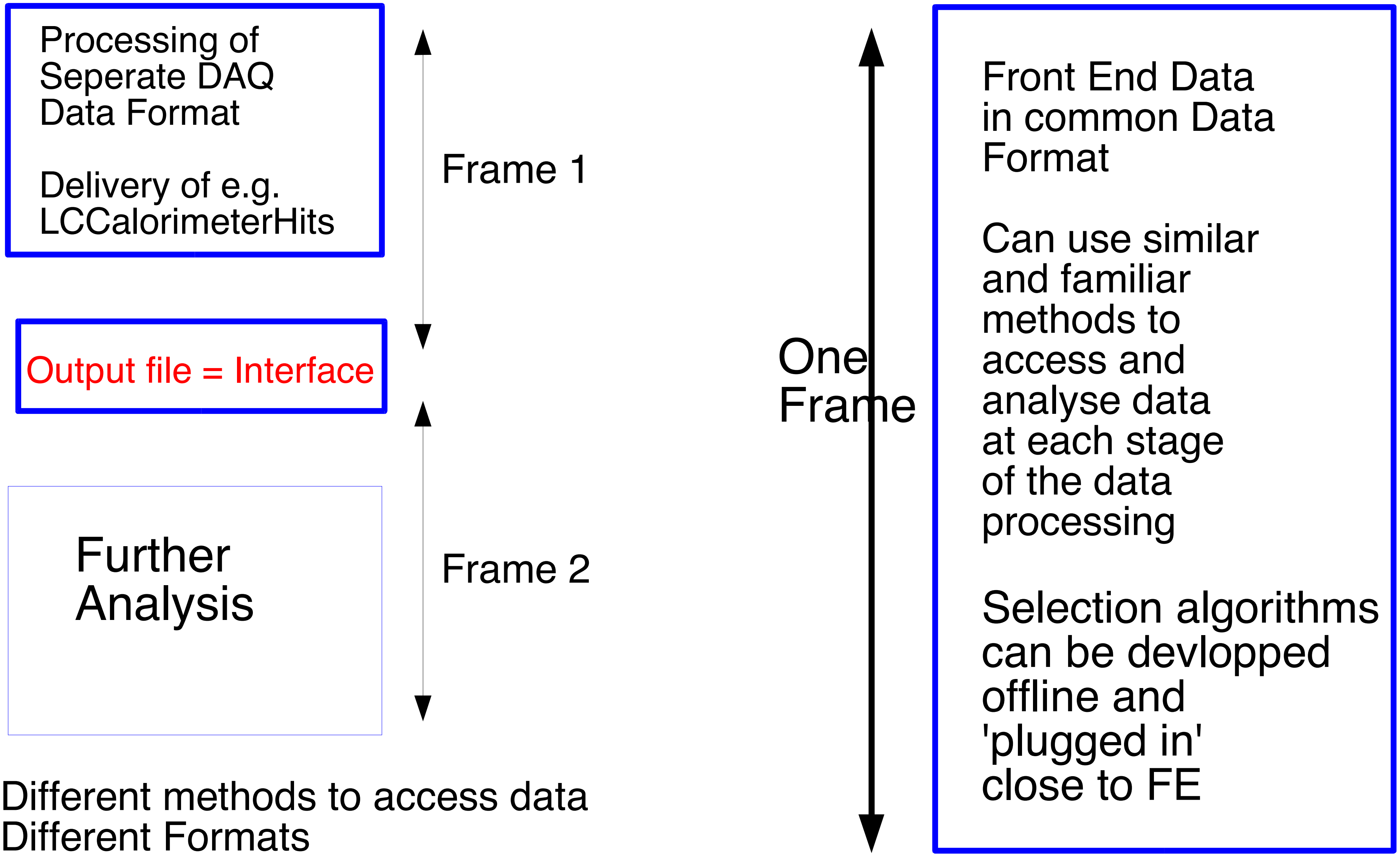
- LCGenericObjects

Allow for an arbitrary defintion of
user defined classes within LCIO
Application should be the exception
Extensive use in calice LCIO conversion
Lack of type safety, 'no' official LCIO DataType

Not much though ...

Interface between 'Online' and 'Offline' World

Decision to be taken on first data format visible to the world



Processing of Seperate DAQ Data Format

Delivery of e.g. LCCalorimeterHits

Frame 1

Output file = Interface

Frame 2

Further Analysis

One Frame

Front End Data in common Data Format

Can use similar and familiar methods to access and analyse data at each stage of the data processing

Selection algorithms can be devlopped offline and 'plugged in' close to FE

Different methods to access data
Different Formats
Impossible to access information created/used by the other frame

(Basic) Issues for common Data Processing Chain

'High' level data are well addressed CaloHits, Clusters, Tracks etc.

Need to develop a software concept for treatment of low level data

- Avoid several (incompatible) chains on analysis
  One source of information

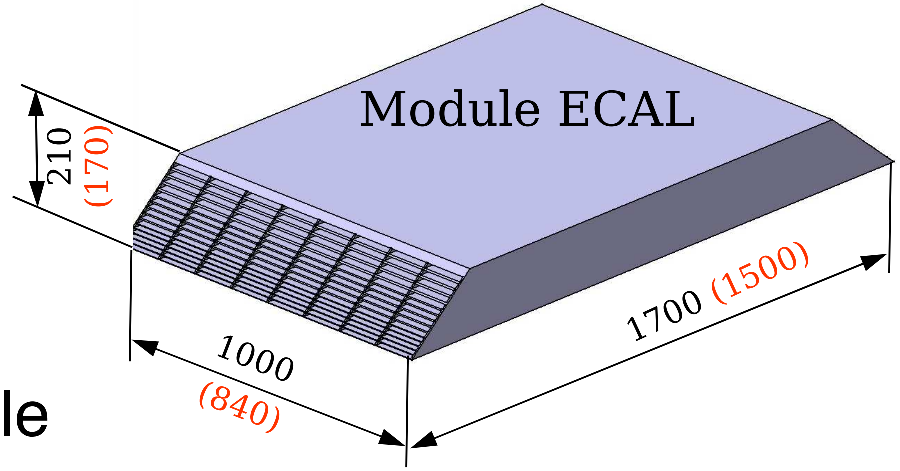
- 'Model for 'close to detector' data
  Hardware information needed to judge on data quality
  Extension
  LCIO as backbone ?!

- Software models flexible enough to react on changes
  in DAQ system

- DAQ has to be developped true to an agreed scheme
  and embedded into overall software development

Coming close to the ILC – The EUDET Module(s) and a common Calo DAQ

EUDET module of Ecal
is ~1st Modules of ILC
Detector



Common DAQ for EUDET module
(and other EUDET Calos)
may be ~ (Calo) DAQ Concept for ILC Detector

Ideal testing ground to qualify concepts for whole
ILC Dataprocessing
There will be also Testbeams!!

Develop and optimize ILC Software e.g. LCIO for 'Real Data'

Items to be Studied

- Where to implement the (LC)Event building?

Data could be written into a shared memory and of a DAQ PC
read e.g. by a event builder software (e.g. the lcioconverter)
This part could then also be used for online monitoring

Speed is an issue, 'High' level software should not compromise
Data taking rate

Building of LCIO Events with calice lcioconverter
~ 100 Hz (on a standard grid worker node)
no event selection but first quality flagging.

Input from experts needed

- General Concept of Event Building?

SubEventBuilder i.e. Passing 'prebuilt' subdetector information to a
General Event Builder or one Event Builder
Possible to test if more than two units are put in a test beam

- Development of event selection algorithms and implementation in event building

Testbeams have 'rich' structure, double events etc.
Event Selection would be studies with MC but need maybe
further input from detector data

- accommodate the needs of a well designed software to the necessity to implement changes and fixes

In particular during the devlopment of both DAQ and ILC Software

Summary and Outlook

- Calice uses ILC Software framework for processing of Testbeam Data
  LCEvent allows for gathering event information which arrive
  a bit as a jigsaw
  Runs stable over millions of events but success/acceptance
  suffers from non-integration into Calice DAQ Concept
  'Newcomers' can participate easier in Testbeam analysis

- EUDET DAQ and EUDET Modules allow for developmen of
  and real life tests of coherent scheme for ILC data processing
  DAQ Development and Software Development NOT seperate
  entities

- Integration of high level analysis algorithms into DAQ is part of
  LDC Detector Concepts
  All relevant detector data must be available in one format

- Needs tight communication between 'online; and 'offline' world
  Let's start today