The Use of Databases in CMS

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Systems available "on market" in CMS and at CERN

- CRISTAL (Objectivity)

Cooperating Repositories and an Information System for Tracking Assembly Lifecycles.

- ORACLE

Relational Database Management System.

- EDMS

Engineering Data Management System.

- ROOT

An Object-Oriented Data Analysis Framework.

CRISTAL

Now: Prerelease (Prototype 2)

Only for Windows (Later - for Linux)

Phase I
Phase II (Query Facility)
Commercial Product

No documentation

Objectivity $\Longrightarrow$ Other DB (Oracle?)

CORBA $\Longrightarrow$ disributed (Works in 5 centers)

Roles:

- ❑ Coordinator
- ❑ Supervisor
- ❑ Information Manager
- ❑ Physicist
- ❑ Operator

CRISTAL

Integration
$\Downarrow$
All parts have to be defined from very beginning

Closely connected to procedure of checking, testing and assembling of products
$\Downarrow$
Execution of workflows

Entering data $\Longrightarrow$ Typing or Running Instrument
$\Downarrow$
TCP/IP connection to Instrument Agent

User calculations for entered data $\Longrightarrow$ Only in Java

System is not yet stable $\Longrightarrow$ Crashes

Common Databases

- Simulated events - Objectivity
- Design database - Euclid system
- EDMS (Storage of documents) - Oracle
- Slow controls - Oracle
- Not defined:

  Calibration database
  Run database
  Monitoring database
  Geometry database

Subdetector Databases

- ECAL - Cristal (Objectivity)
- ECAL preshower - Cristal (Objectivity)
- ECAL precalibration (test beam) - Root
- Tracker - Oracle

ORACLE

RDBMS - Relational Database Management System.

Information - in **Tables**

Relational theory:

Primary keys
Foreign keys
Normalization rules

SQL - `Structured Query Language`
PL/SQL - `Procedurial Language (stored procedures )`

Precompilers:

PRO*C
PRO*FORTRAN
PRO*COBOL

SQL*Plus - `Interactive session`

ORACLE at CERN

Public Services:

Central Database - General purpose environment
Case Database - Designer/2000 environment
Development Databases (Version 7) -
(Version 8) -
- Test and deployment of new applications

Private Services:

ALARM Oracle database
CHORUS Oracle database
CRYOGENICS Oracle database
EDMS Oracle database
IT/CS Oracle database
LEP logging Oracle database
LEP measurements Oracle database
REMEDY Oracle database
Radio Frequency Oracle database
SL division development Oracle database
SPS measurements Oracle database
Tape Management System Oracle database

ORACLE

Test database for Anode boards in DevDb8: tables and simple procedures

HTP - package of Oracle8

Perl $\longrightarrow$ LWP - LibWWW for Perl

ORACLE

New versions

Oracle8i - Has already object oriented features:

- Pointers
- Nested Tables
- varray - variable array
- User-defined data types (**ADT** - Abstract Data Types)

Unstructured data - **LOB** (Large OBjects (up to 2 Gbytes)):

- **BLOB** (Binary Large Objects)
- **CLOB** (Character Large Objects)
- **BFILE** (Reference to a file)

$\Downarrow$

ORDBMS - Object/Relational Database Management System

Oracle8i - Comparison to **Root:**
takes $\sim 50\%$ more space, but few times faster.

Oracle9i - fully object oriented
- C++ binding

Will be tested at CERN beginning of next year ($\sim$*March*)

Engineering Data Management System

Tools on top of Oracle to collect and to keep engineering documentation and data

Management of data

$\Downarrow$

MP5 of Datastream Systems

ROOT

System for Analysis of Data

HBOOK
PAW $\Longrightarrow$ ROOT
ZEBRA $\Downarrow$
Written in C++

Exhaustive documentation on Web

ROOT files $\Longrightarrow$ Structured files
Data compressed

Comparison of ROOT and Objectivity/DB, LHC++, HBOOK, ZEBRA

$\Downarrow$

ROOT performs better

CONCLUSIONS

- ORACLE - good candidate for Production Database
- EDMS - good candidate to keep final common data
- ROOT - good candidate to store "experimental" information