SEAL and POOL in LHCb

Strategy

Integration of SEAL

Integration of POOL and Status

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Applications Area Meeting, October 8th, 2003

Motivation

- LHCb has invested significantly in LCG
- It’s payback time!
- Retire parts of the Gaudi framework
  - Decrease long term maintenance load
- Test SEAL and POOL in the LHCb environment
  - Give feedback to SEAL and POOL

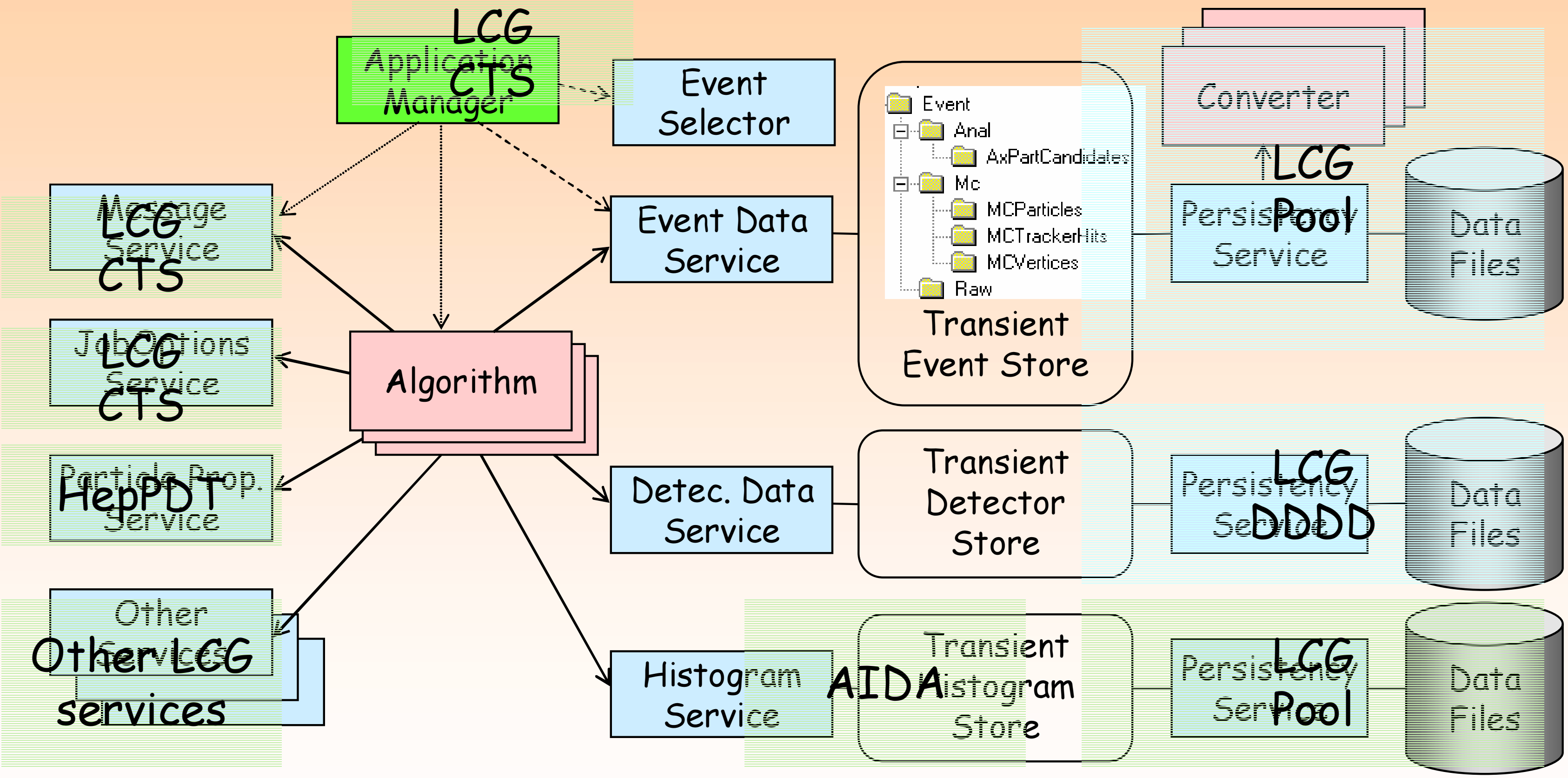
Strategy

- **Adiabatic adaptation of Gaudi to SEAL/POOL**
  - Slow integration according to available manpower
  - Time estimate roughly 1 year for full migration
  - Take advantage for face-lifting of “bad” interfaces and implementations
- **Minimal change to interfaces visible to physicists**
- **Integration of SEAL in steps**
  - Dictionary integration and plugin manager
  - Use of SEAL services later

Other Constraints

- **Integration of POOL earlier than SEAL**
  - Plan to have a fully working prototype by end of the year
- **Necessity to read "old" ROOT data**
  - For roughly 1 year
  - Consider data reformatting from Gaudi ROOT to POOL
- **Keep the LHCb event model as is**
  - Event model classes/objects are transient
  - **May, but not must** have a 1:1 persistent correspondence

Standard View of LHCb Software



LCG CTS
Application Manager

Event Selector

Message Service
LCG CTS

JobOptions Service
LCG CTS

Algorithm

Event Data Service

Event
Anal
AxPartCandidates
Mc
MCParticles
MCTrackerHits
MCVertices
Raw

Transient Event Store

Converter

LCG Pool

Persistency Service

Data Files

Particle Prop. Service
HepPDT

Detec. Data Service

Transient Detector Store

Persistency Service
LCG DDDD

Data Files

Other Services
Other LCG services

Histogram Service

AIDA

Transient Histogram Store

Persistency Service
LCG Pool

Data Files

Seal Integration Status

- Dictionary
- Plugin Manager
- Component model

Seal Dictionary

- **LHCb has it’s own approach**
  - Generate code from object model described with XML

- **SEAL dictionary is mandatory for POOL integration prototype**

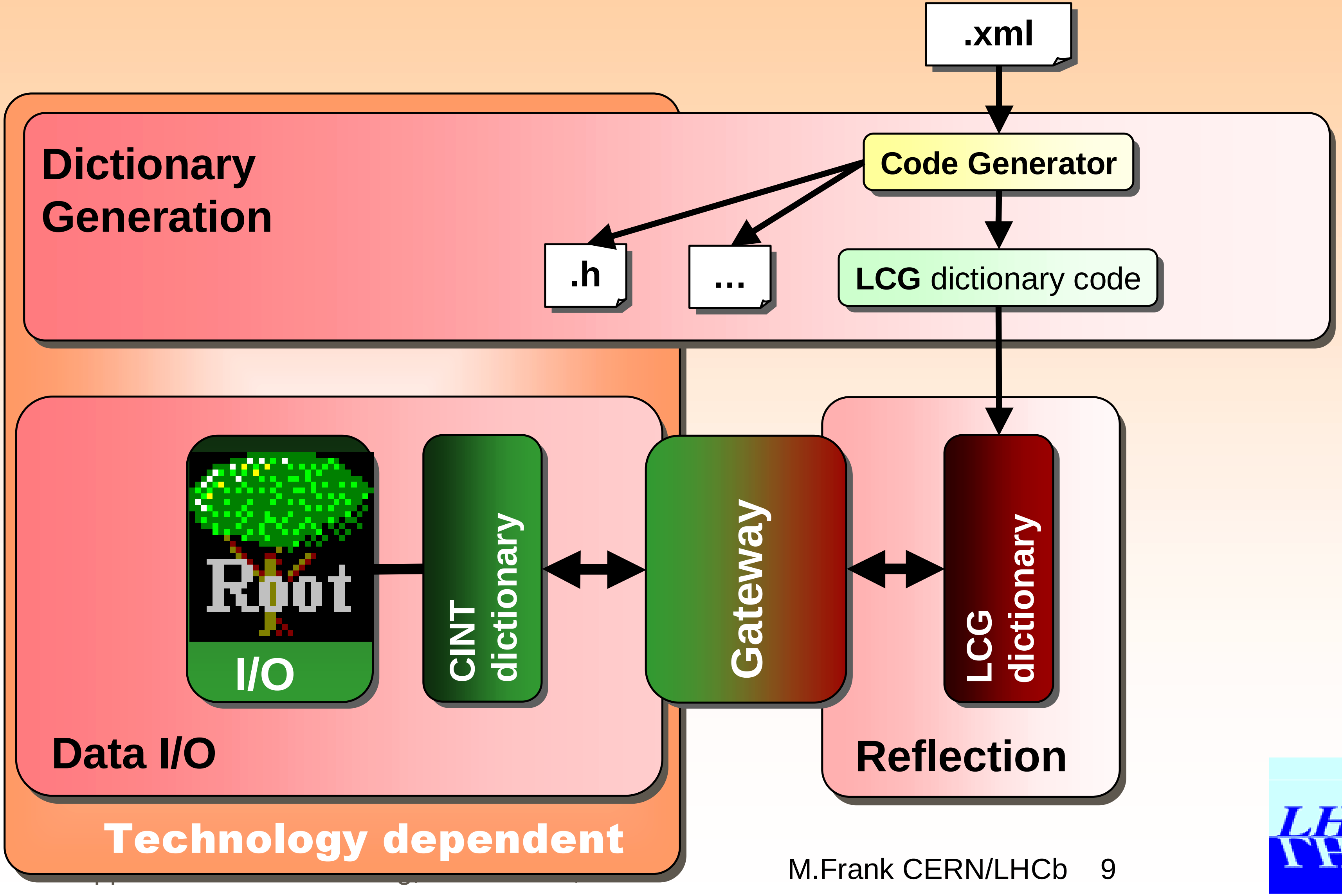
- **Code generator is missing**
  - Work will start [very] soon

Dictionary: Population/Conversion

- **Event model is described in XML**
- **Generator delivers**
  - LCG dictionary
  - C++ Header files
  - …Whatever the future brings
  - Limited need GCCXML: external libraries like CLHEP

- **Much simpler/shorter description**
- **Homogeneous header files with one style**
- **Not all is good what C++ offers**

Dictionary: Population/Conversion



.xml

Dictionary Generation

Code Generator

.h

…

LCG dictionary code

Root

I/O

CINT dictionary

Gateway

LCG dictionary

Data I/O

Reflection

Technology dependent

Seal Component Model

- **We will not jump immediately on what is present**
  - SEAL is evolving and we cannot constantly follow
- **SEAL is used through POOL**
  - Well encapsulated
  - Limited visibility to end users
- **No replacement of Gaudi services foreseen before component model is not mature**

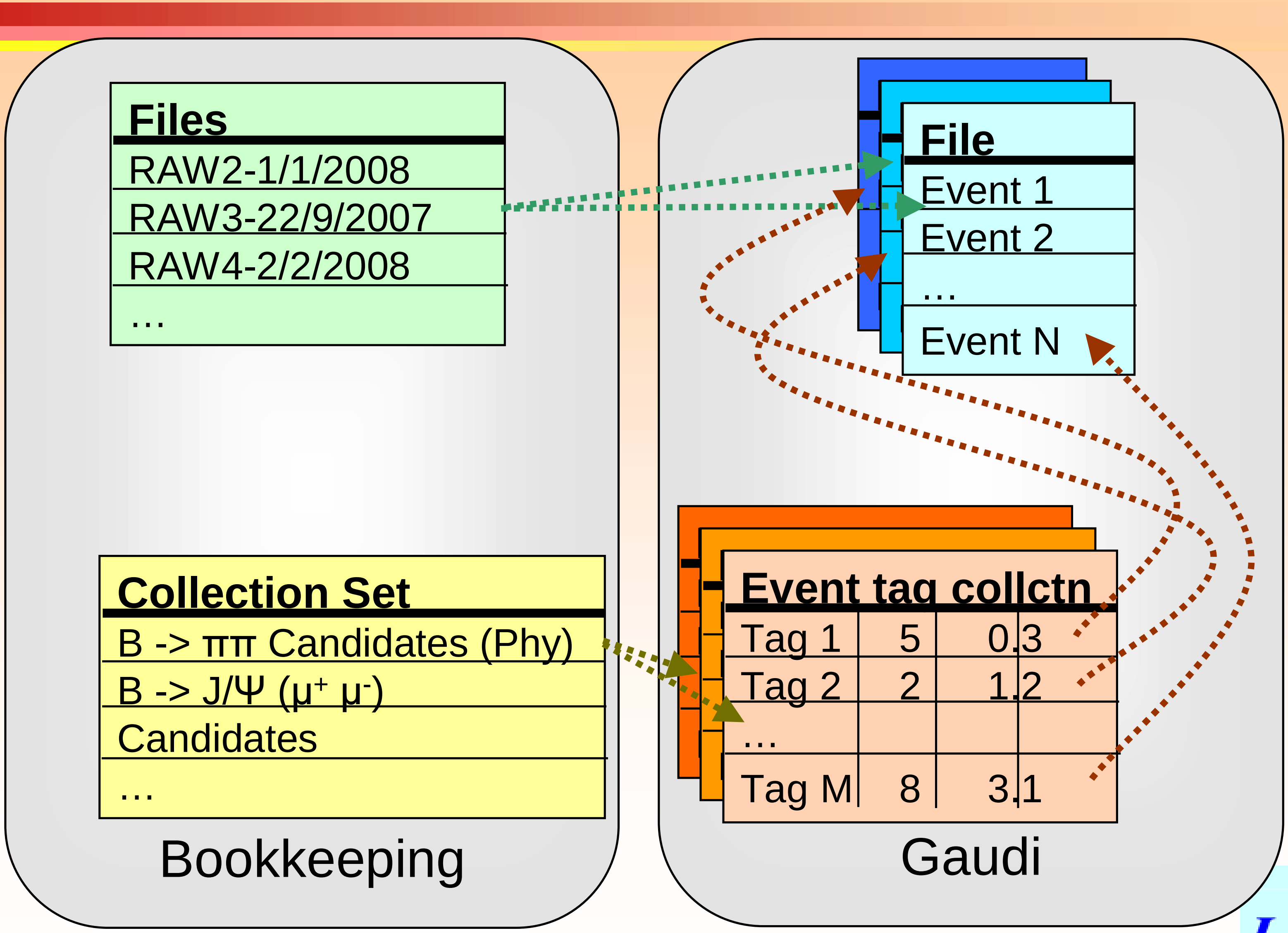
Seal Foundation Libraries

- **Concerns regarding modularity**
  - SEAL foundation libraries depend on many external libraries
  - Example:
    To use the plugin manager the regular expression library (libpcre) must be loaded, which is needed by the SEAL regular expression wrapper
    e.g. also boost has a regular expression wrapper

POOL Integration: Goals

- Save and read the LHCb event model
- No more serializers, let ROOT do the job
  - Object can keep personality in ROOT
- Emphasis on some aspects of the LHCb event model
  - Stress on object relationships
- Dictionary generation for the LHCb event model
- Event tag collections: POOL & Gaudi
- Integration of POOL event tag collections

Event Data Access



Files
RAW2-1/1/2008
RAW3-22/9/2007
RAW4-2/2/2008
…

Collection Set
B -> ππ Candidates (Phy)
B -> J/Ψ $(\mu^+ \mu^-)$
Candidates
…

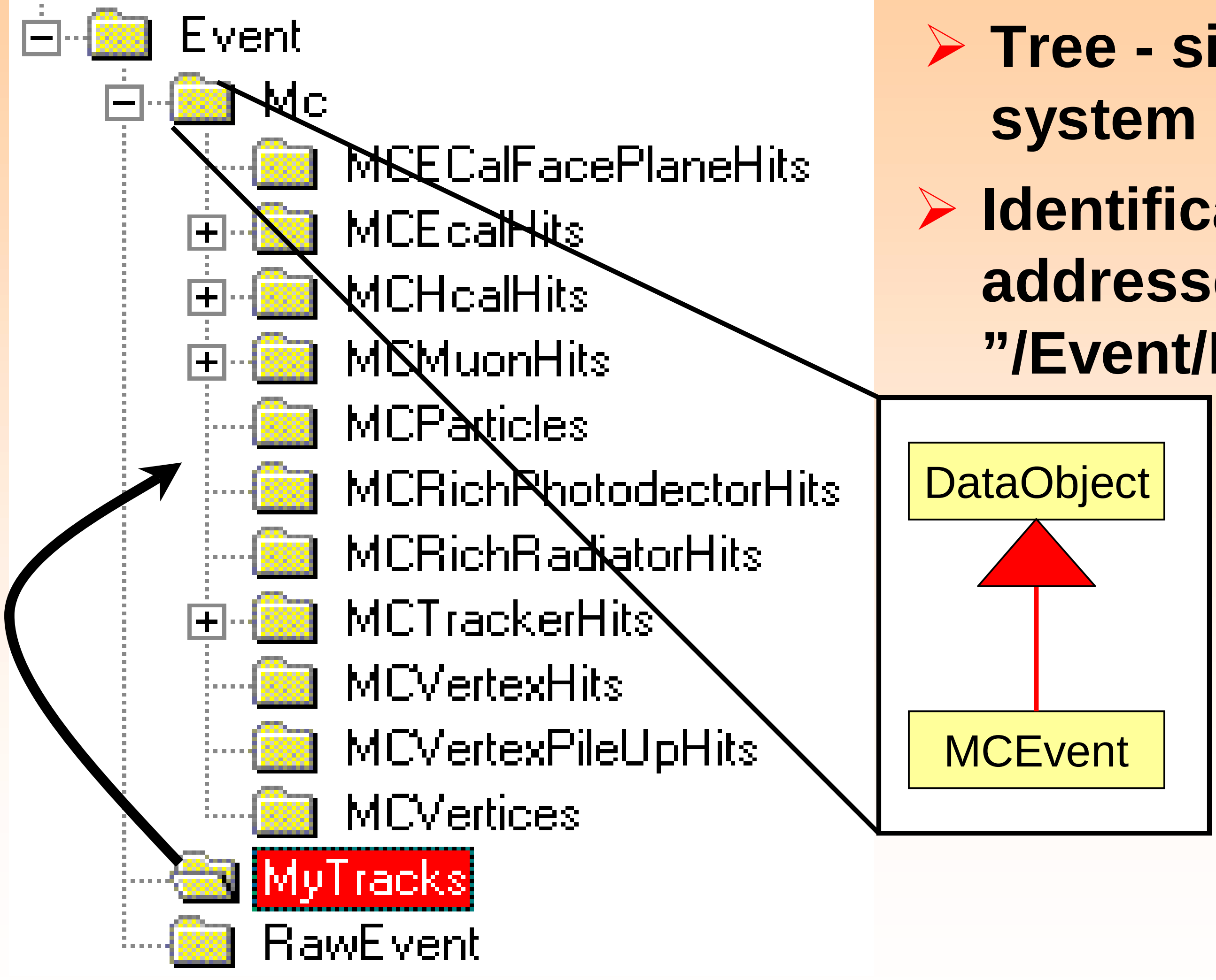
Bookkeeping

File
Event 1
Event 2
…
Event N

Event tag collctn		
Tag 1	5	0.3
Tag 2	2	1.2
…		
Tag M	8	3.1

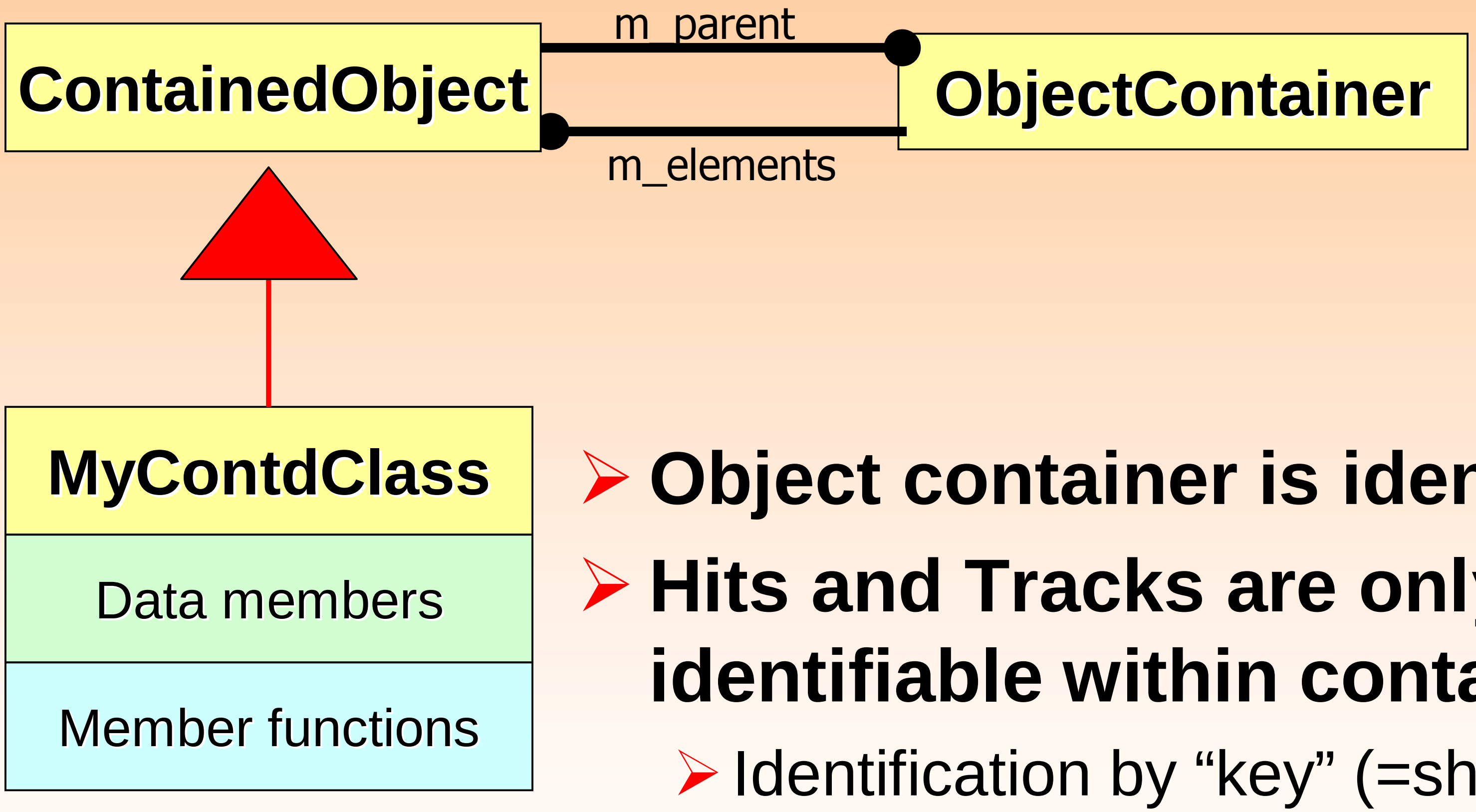
Gaudi

Events in the Gaudi Data Store



- Tree - similar to file system
- Identification by logical addresses: "/Event/MC/MCEcalHits"
- Store item= directory + attributes
- Browse capability

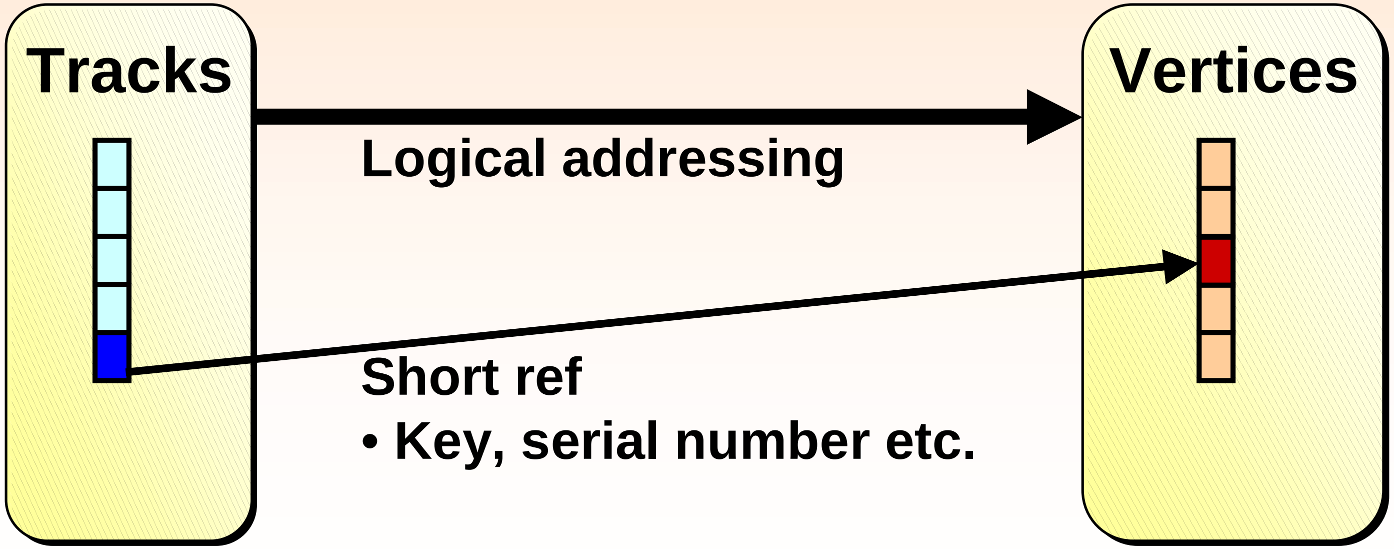
Object Collections (Hits, Tracks etc.)



- **Object container is identifiable**
- **Hits and Tracks are only identifiable within container**
  - Identification by “key” (=short ref)

References between Contained Objs

- Most objects are aggregated in containers
- Identify containers using “logical addressing”
- Internal links between contained objects (Short refs)



Logical addressing

Short ref

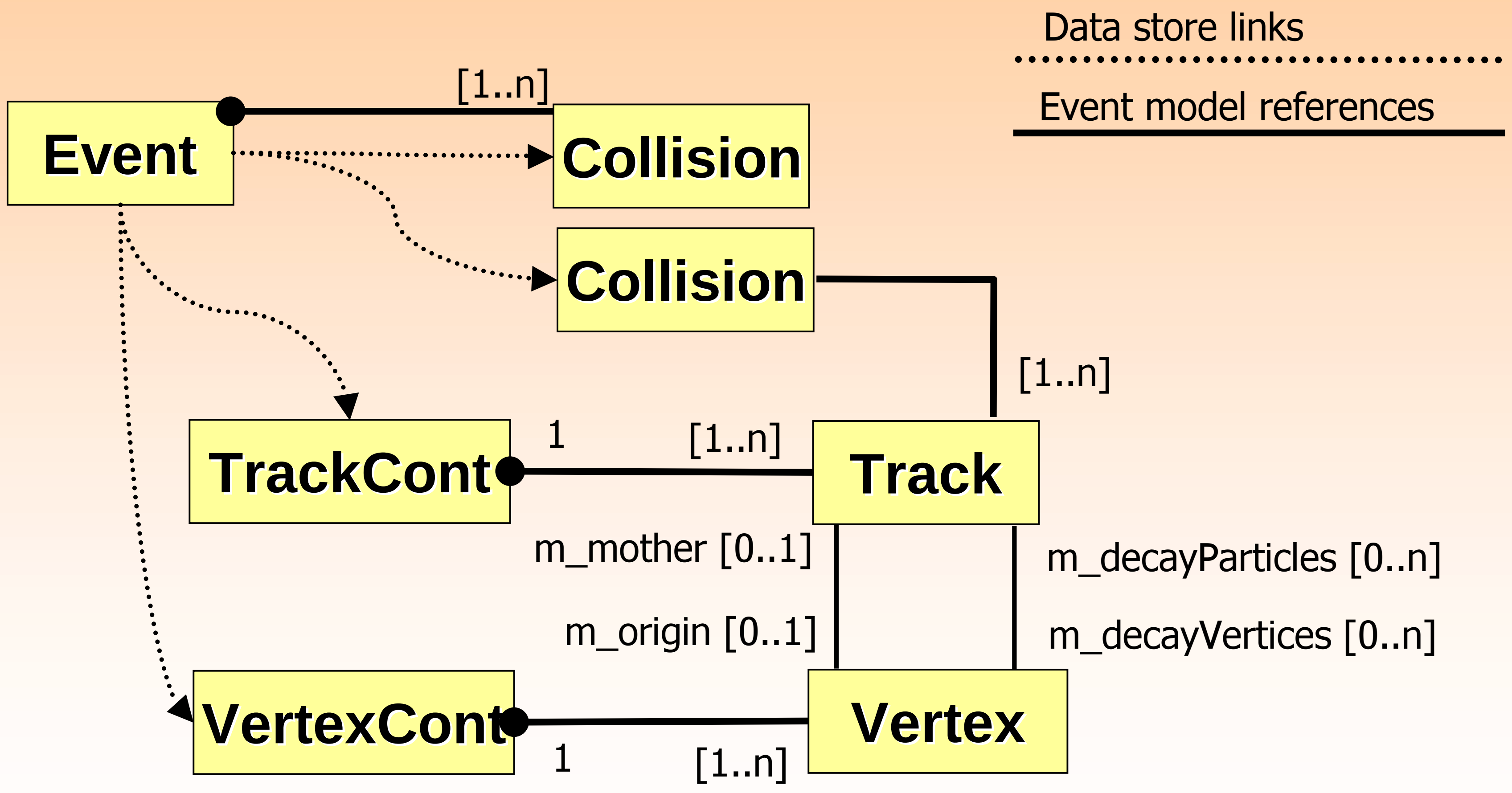
- Key, serial number etc.

Toy Event Model

- Identifiable objects (DataObject)
- Non-identifiable objects (ContainedObject) hosted by "Keyed Containers"
- 0..1 Associations
- 0..n Associations

- All combinations of these relationships must work

Toy Event Model

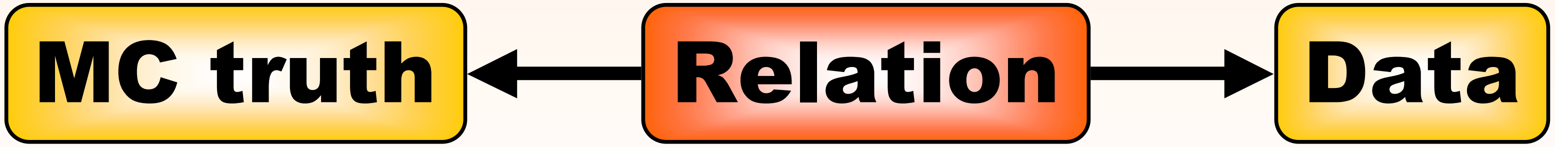


Status of Event Data Storage

- **Mechanics for data persistency of event data is partially implemented**
  - New Gaudi Plugin created: package GaudiPoolDb
  - New Gaudi “conversion service” capable of dealing with POOL technologies: Root Tree
  - New EventSelector service to access implicit POOL collections for reading files
  - One converter class for all object types

Status of Event Data Storage

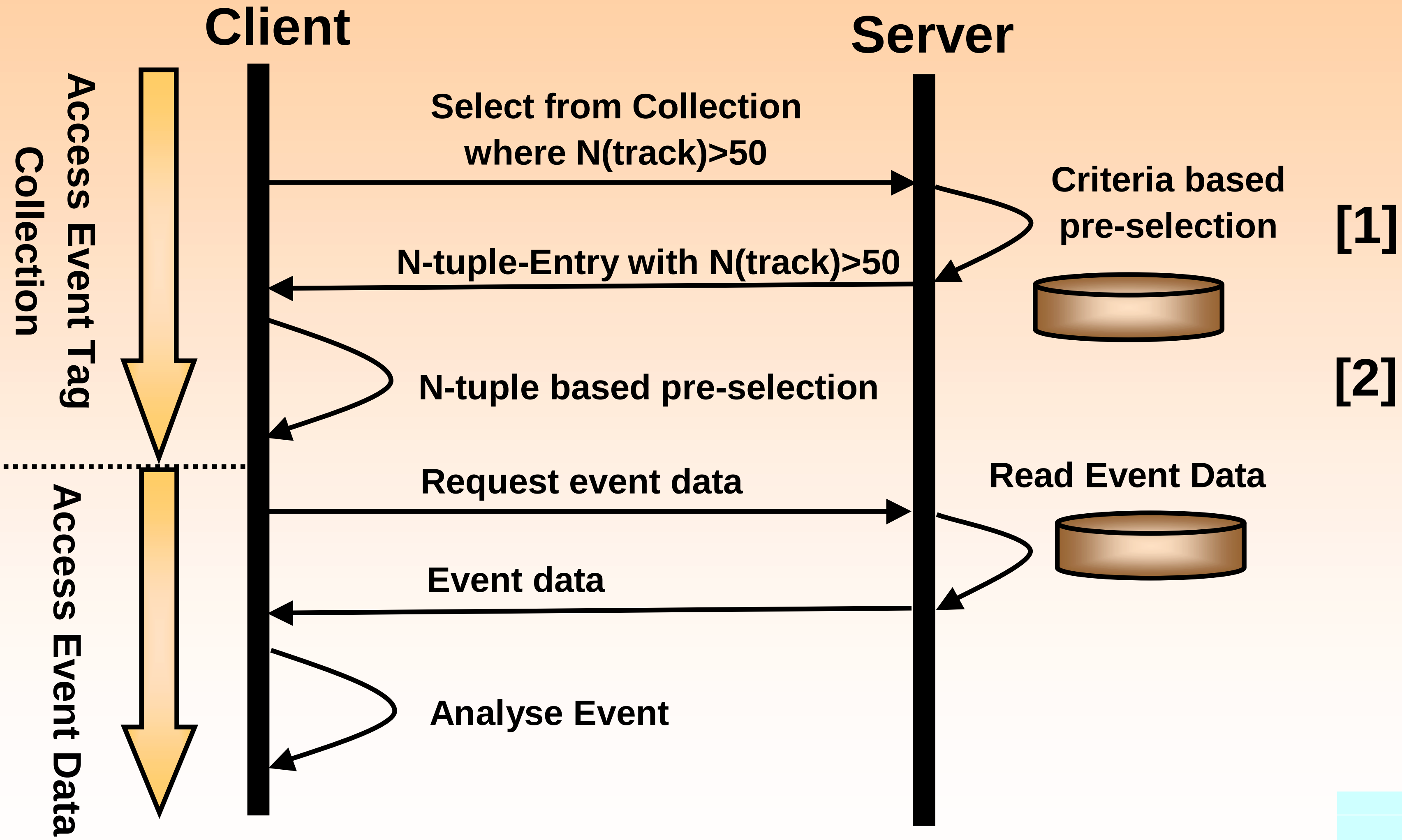
- Dictionary generation is missing
  - Use generated dictionaries for the time being
- MC truth relationships still missing
  - Remove MC truth information completely from data
  - Objects containing arrays of reference pairs



Event Tag Collections: LHCb view

- **N-tuples, but with references to external objects**
- **Data content as for column wise N-tuples**
  - Scalars, arrays, matrices
- **Writing is equivalent as for N-tuples**
  - Simple, intuitive, fast
  - Interface identical to N-tuples
  - The physicists, which used them are enthusiastic

Data Access For Event Processing


Client
Server
Access Event Tag Collection
Access Event Data
Select from Collection where N(track)>50
Criteria based pre-selection
[1]
N-tuple-Entry with N(track)>50
N-tuple based pre-selection
[2]
Request event data
Read Event Data
Event data
Analyse Event

Gaudi Event Tag Collections

- **Note the subtle difference:**
  - Gaudi event tag collections using POOL
  - POOL event tag collections in Gaudi
- **Implemented Gaudi Event Tag Collections**
  - Backwards compatibility with existing implementation
  - Use POOL as a mechanism to populate Gaudi N-tuple structures with data
  - Usage of lower level POOL interface
  - Can also be used to store pure N-tuples
- **Required some interaction with low level interfaces**
  - Access to pool::IPersistencySvc interface

POOL Event Tag Collections

[Carmine Cioffi LHCb/Oxford]

- **To be used by the “EventSelector” component**
- **Take advantage of interface redesign**
  - Interface proposal is out
  - Waiting for implementation
- **Use POOL explicit collections for the implementation**
  - No major technical obstacles foreseen

Conclusions

- **SEAL dictionary will have to be fully integrated**
- **SEAL services can only be integrated when manpower is present**
- **POOL will soon be integrated in Gaudi**
  - Event data storage *~working*
    [dictionary generator missing]
    [MC truth relationships missing]
  - Gaudi event tag collections *working*
  - POOL event tag collections *coming*

Additional Personal Remarks

- **Integrated LCG software development environment is suboptimal**
  - In clear text: it is close to not existing
  - Situation is only marginally better than 12 years ago on CERNVM
- **Debugger does not work properly on public platforms**
  - Cannot save state, hangs, spurious error messages about RTTI missing, problems with dynamic loading….
  - Ask whom you want: Rado, Pere, me…
  - Something is wrong with Lxplus installation of gcc 3.2, gdb or other components
- **No windows built available: Cannot use VC++**
  - Could maintain a strip down version until this summer: Gone by now…
- **I have 2 hats: This will also affect the POOL development Root implementation of POOL was developed with VC++**