Using DD4Hep through Gaudi for new experiments and LHCb

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Abstract

The LHCb Software Framework Gaudi is a C++ software framework for HEP applications used by several experiments.
Although Gaudi is extremely flexible and extensible, its adoption is limited by the lack of certain components that are fundamental for the software framework of an experiment, in particular a detector description framework, whose implementation is delegated to the adopters.
To enable future experiments to quickly adopt Gaudi, we integrated the DD4Hep toolkit in the existing software framework, and, as a proof of concept, we used it with the LHCb software applications, from simulation to reconstruction and analysis.
We will describe how the DD4Hep toolkit can be used by a new experiment, as well as how we can migrate an existing detector description framework to the new toolkit.

Detector Description for HEP (DD4hep) toolkit

• <u>Full Detector Description</u>
  It includes geometry, materials, visualization, readout, alignment, calibration, etc.
• <u>Full Experiment life cycle</u>
  Detector concept development, detector optimization, construction, operation. Easy transition from one phase to the next
• <u>Consistent Description</u>
  Single source of detector information for simulation, reconstruction, analysis, etc.
• <u>Ease of Use</u>
  Few places to enter information. Minimal dependencies

  From DD4hep web page http://aidasoft.web.cern.ch/DD4hep

Gaudi

The LHCb Software Framework Gaudi is an experiment-agnostic project providing the necessary interfaces and services for building HEP experiment frameworks in the domain of event data processing applications.
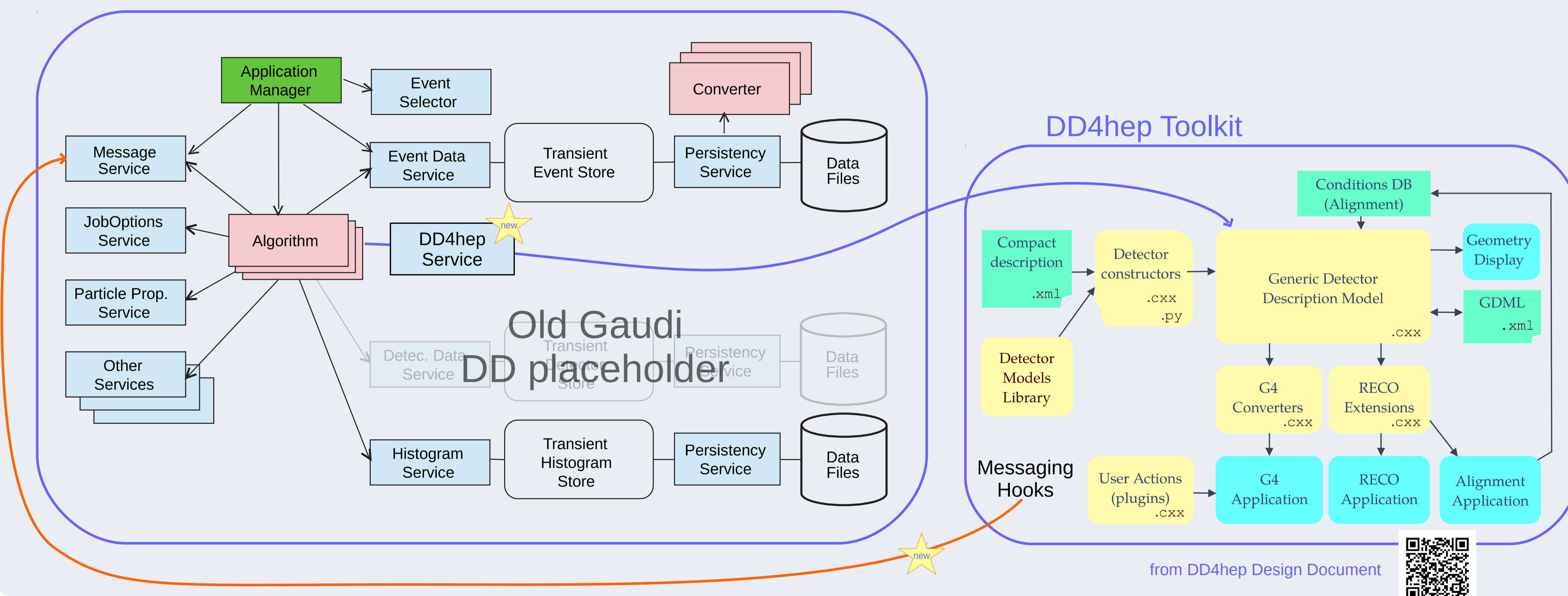
Why DD4hep in Gaudi

Although Gaudi provides the core services required to develop a software framework for an experiment (e.g. messaging, I/O, event processing loop), adopters are required to implement their own Detector Description.

Connecting Gaudi and DD4hep

Gaudi Architecture

DD4hep Toolkit

from DD4hep Design Document

• **Special Gaudi Service**
  • Control lifetime of DD4hep instance
  • Configuration via standard Gaudi job options
  • Entry point for Algorithms

• **Binding of DD4hep messaging hooks to Gaudi IMessageSvc**
  • Use Gaudi verbosity tuning
  • Same channels as Gaudi apps.

• **Gaudi "Hello World" experiment framework**
  • Simplify adoption of Gaudi by new experiments

DD4hep in LHCb

We investigated different approaches to adopt DD4hep in LHCb. Unfortunately, the Detector Description framework used in LHCb is based on a memory model orthogonal to the one used in DD4hep.
LHCb uses weak references, resolved at runtime, between detectors and volumes, while in DD4hep the connection between detectors and volumes must be established at construction time.
This difference practically prevents any possibility of automated migration from the LHCb Detector Description to DD4hep.

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