

SAMPO

Gaudi-based framework status report

VIII SPD collaboration meeting, November 7, 2024

Project objective

Current offline software SPDRoot:

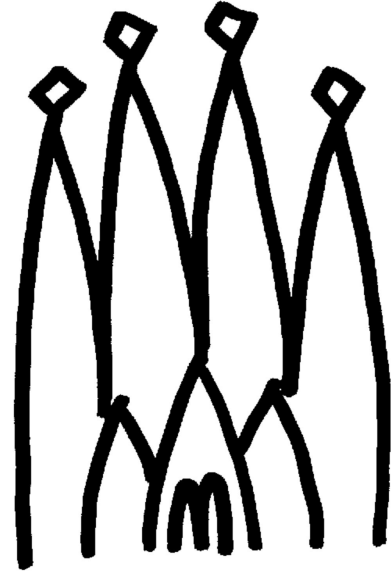
- not reliable enough, a lot of rudimentary code
- inherits ROOT disadvantages
- has no data-oriented functionality
- single-threaded

Thus, it needs to be substituted with something new.

Gaudi framework as alternative:

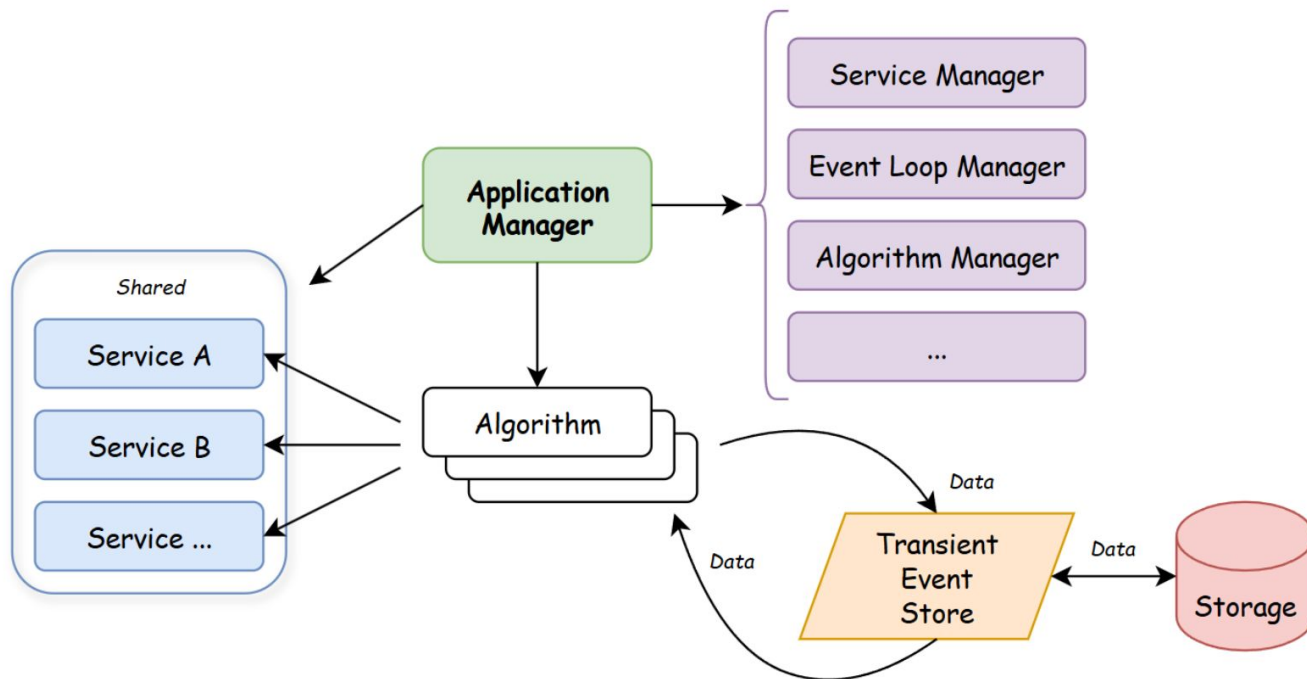
- reliable
- dynamically configurable
- multithreading support

Gaudi Tutorial: <https://git.jinr.ru/lsimbir/gauditutorial/-/tree/main>



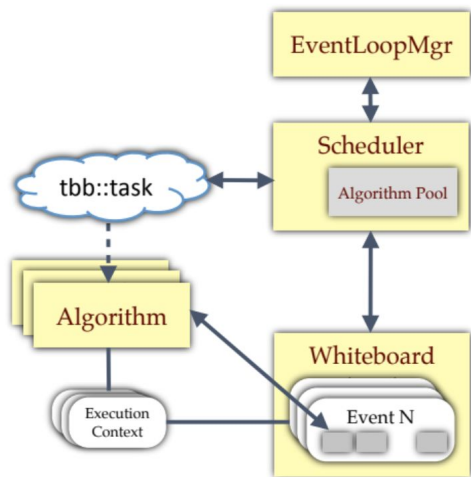
Gaudi architecture (single-threaded)

Concept: Data objects manipulated by Algorithms that are launched on per-event basis. Algorithms, Services and Tools are dynamically configurable via Properties mechanism.

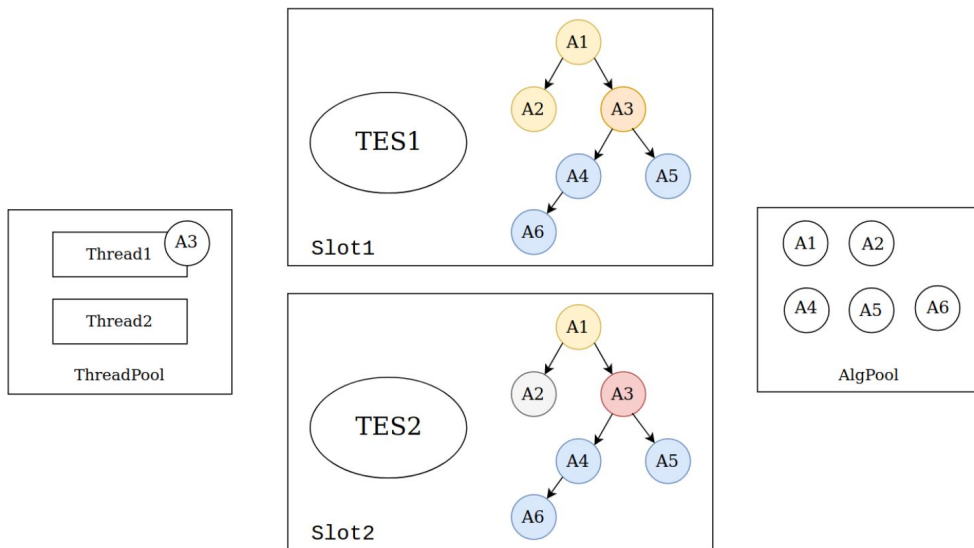


GaudiHive architecture (multi-threaded)

Concept: Many events are processed simultaneously. Scheduler analyzes event execution-state graphs, finds algorithm that can be launched, picks it from AlgPool, packs it with its input data into a task and sends to the task queue.

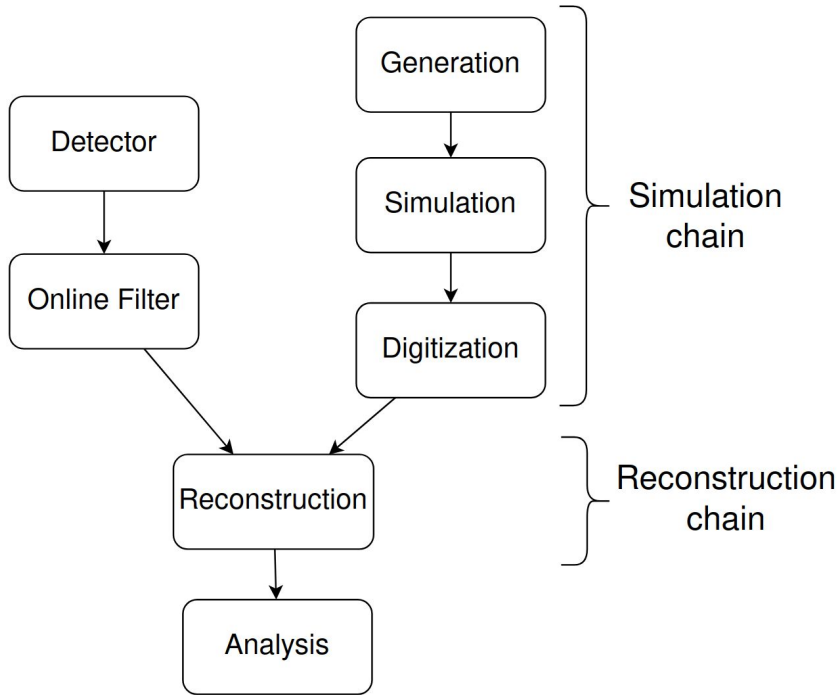


(Taken from GaudiHive paper)



(Self-made)

SAMPO development phases



Data processing pipeline

Libraries to be used:

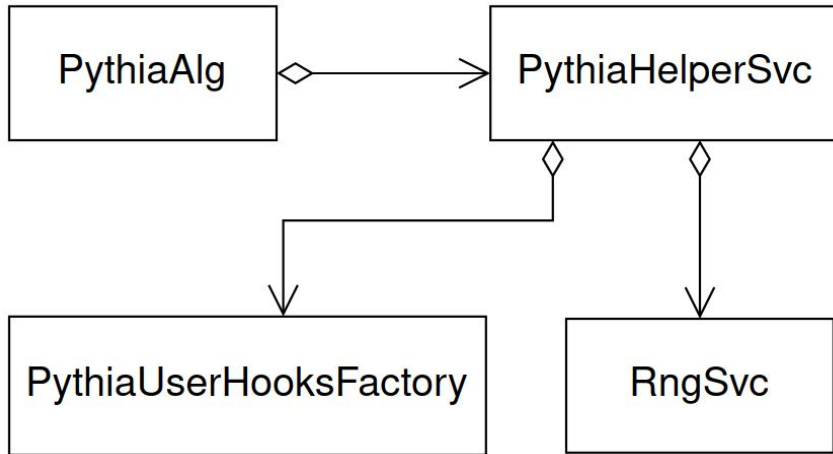
Generation -> Pythia8

Simulation-> Geant4 + GeoModel + HepMC3

Reconstruction-> ?Acts?

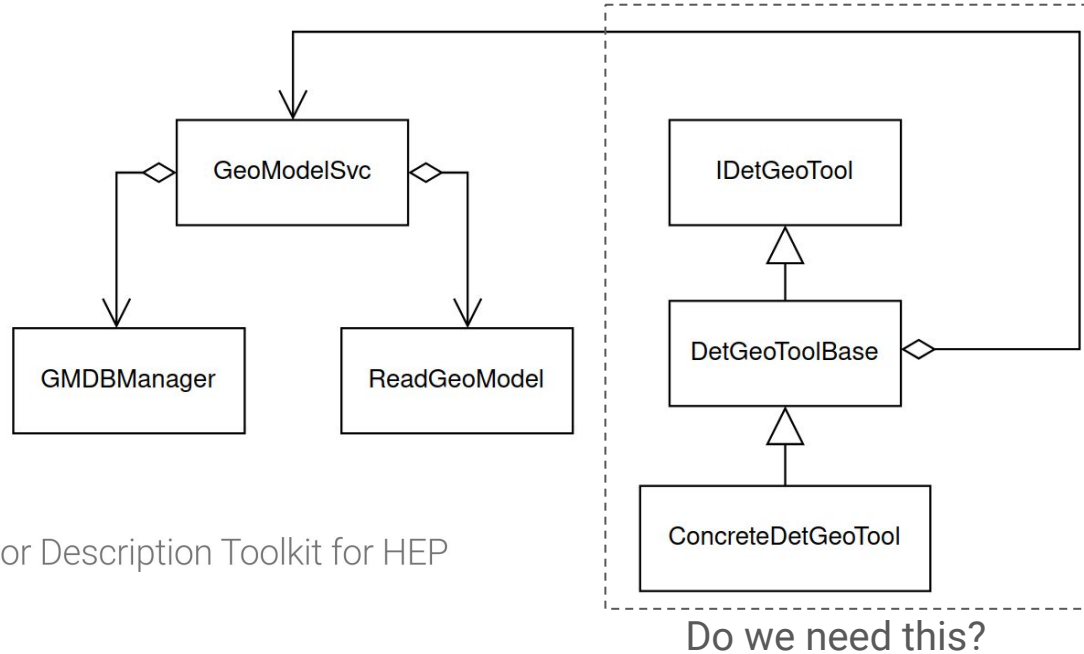
Pythia8 Integration scheme

Concept: PythiaHelperSvc creates Pythia instances, equips them with random number generators and applies all requested user hooks. Pythia8::next() is called in PythiaAlg.



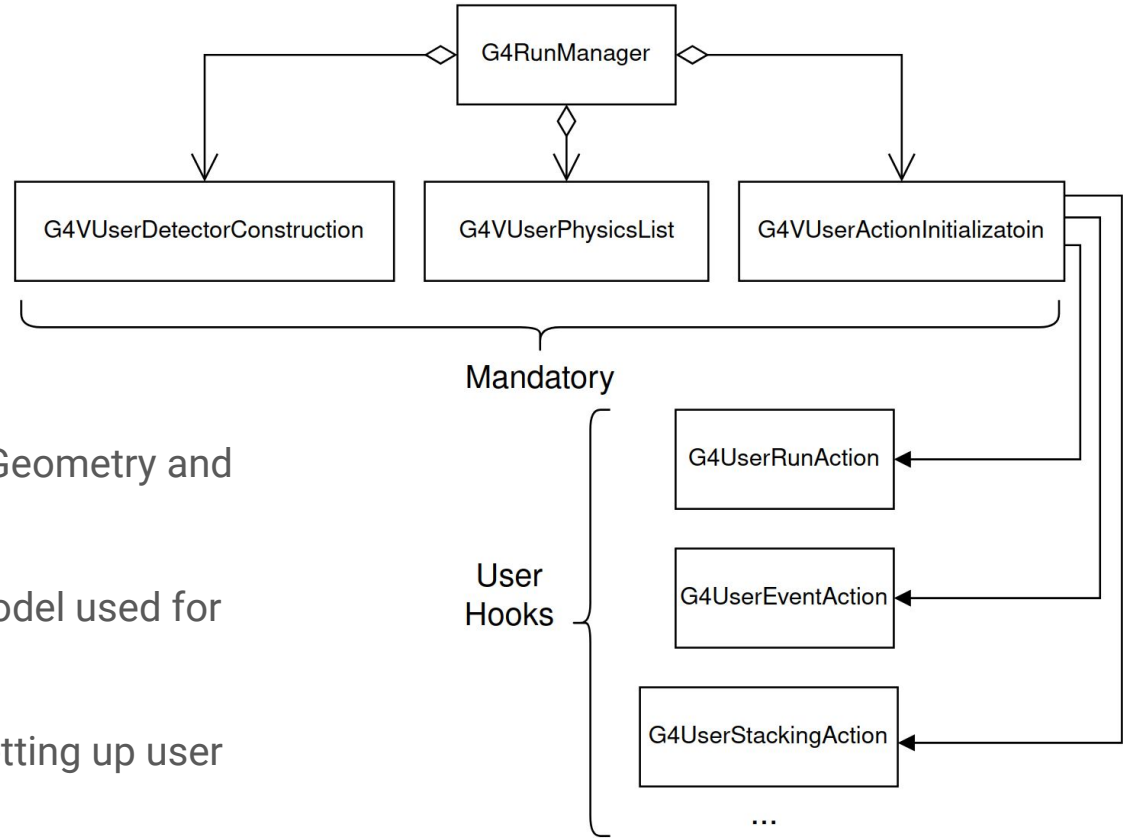
GeoModel Integration scheme

Concept: GeoModelSvc has access to geometry database via GMDBManager. ReadGeoModel is used to build geometry. IDetGeoTools are clients that get their parameters set up based on constructed by GeoModelSvc geometry.



GeoModel - A Detector Description Toolkit for HEP experiments

Geant4: Features



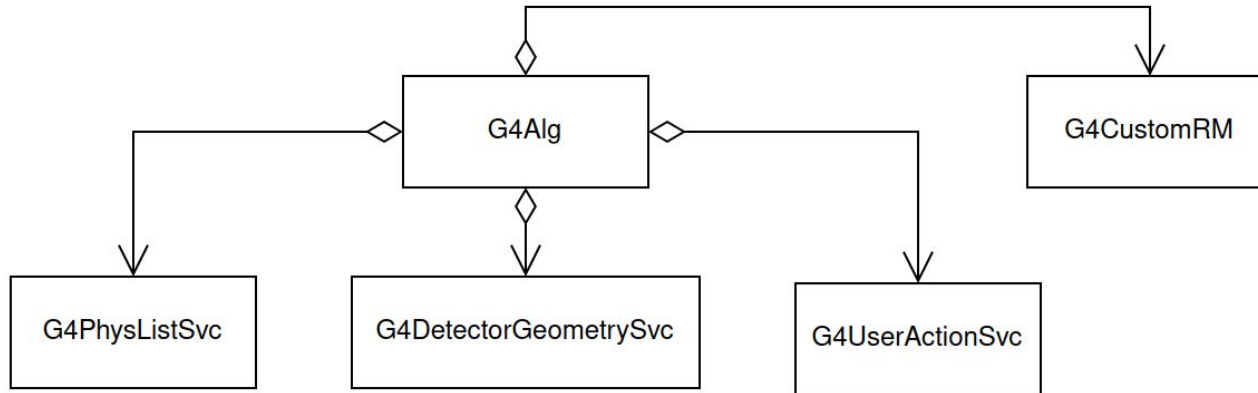
G4VUserDetectorConstruction -> Geometry and sensitive parts of the detector

G4VUserPhysicsList -> Physics model used for calculations

G4VUserActionInitialization -> Setting up user hooks

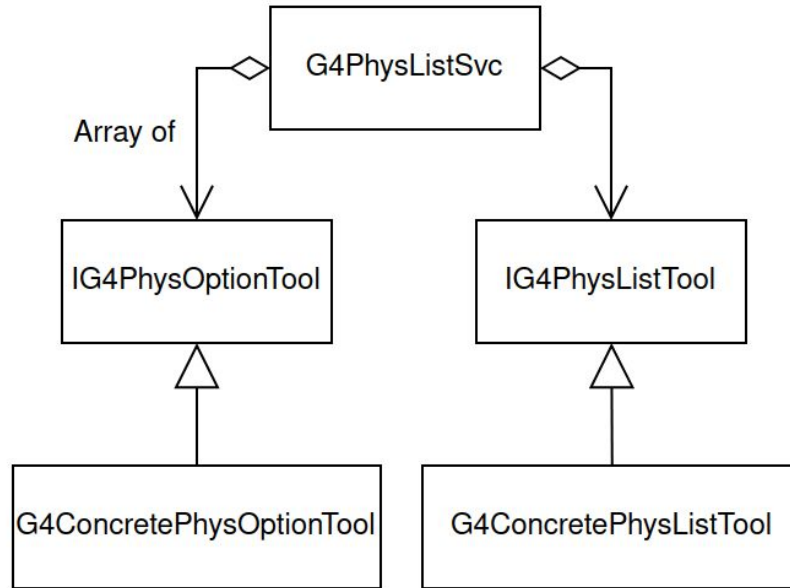
Geant4 Integration scheme

Concept: Mandatory Geant4 classes are represented by configurable services. Events are generated in G4Alg.



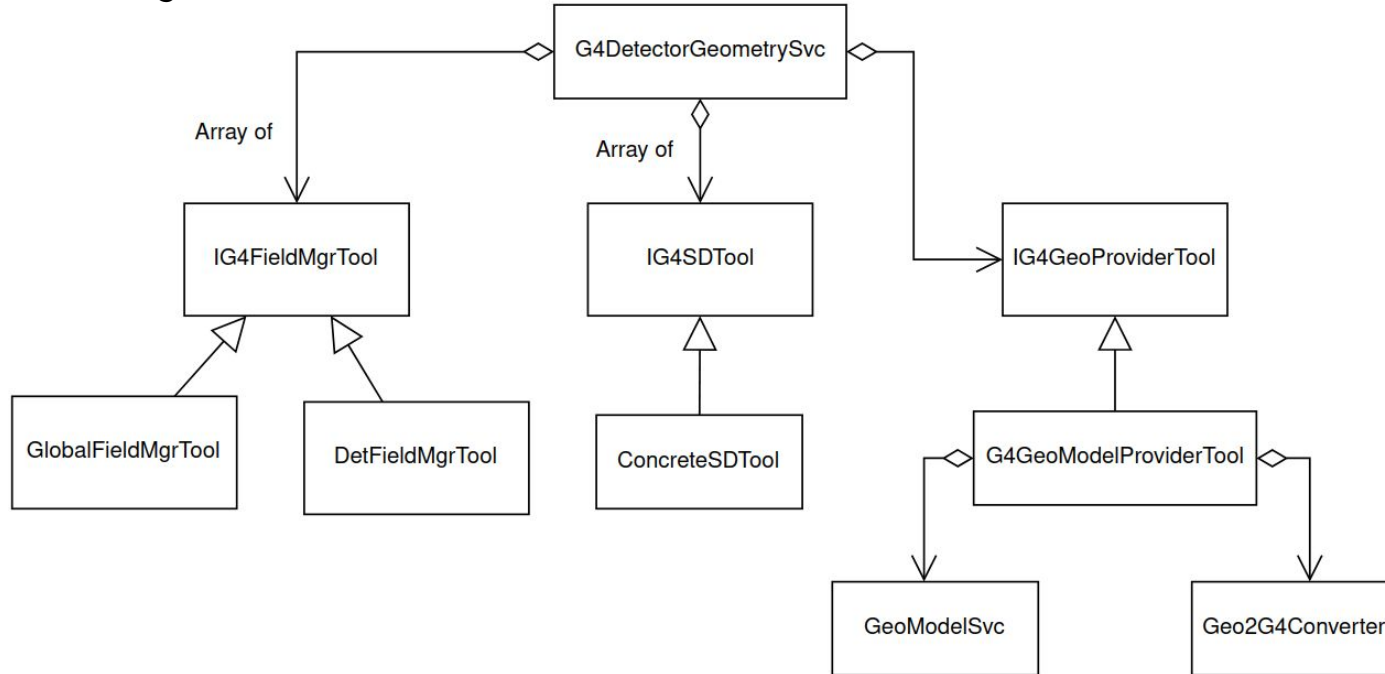
G4PhysListSvc scheme

Concept: G4PhysListSvc is used to construct G4VUserPhysicsList. G4ConcretePhysListTool constructs PhysList itself and then hooks constructed by G4ConcretePhysOptionTools are applied.



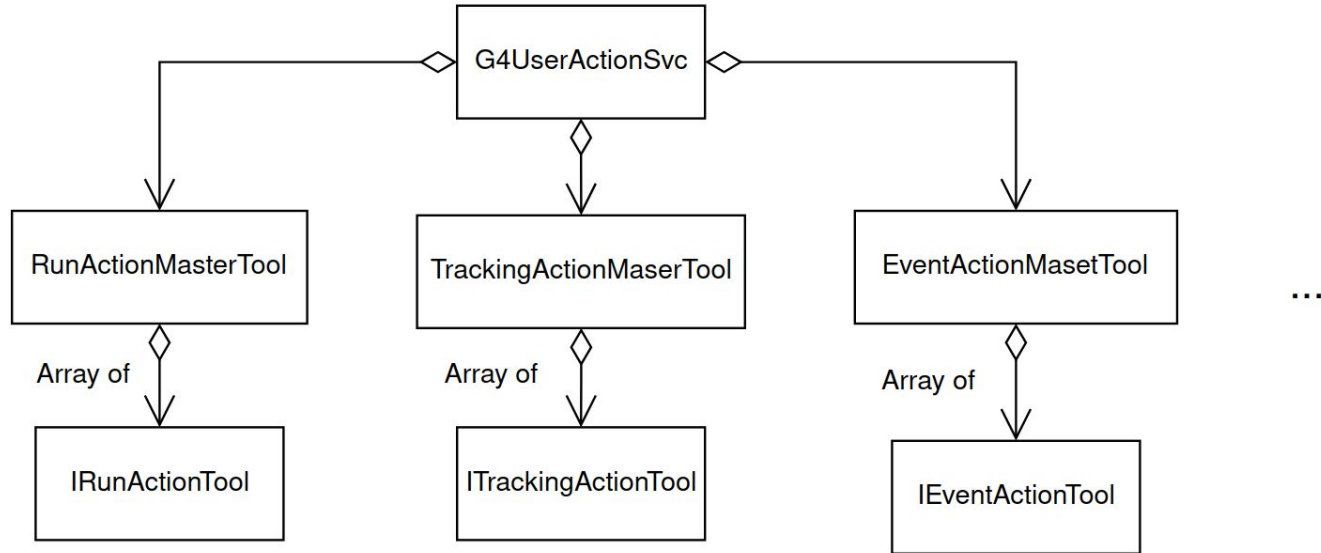
G4DetectorGeometrySvc scheme

Concept: Geant4 geometry is constructed by concrete component implementing IG4GeoProviderTool interface. ConcreteSDTools construct sensitive detectors and assign them to pre-appointed logical volumes.



G4UserActionSvc scheme

Concept: G4UserActionSvc has links to MasterTools, responsible for user hooks production. Each hook itself is composed of corresponding ActionTools.



Status

- > Simulation chain designed
- > Pythia8 integrated, but not tested
- > GeoModel integrated, but not tested
- > Geant4 is now being integrated
- > No design for reconstruction chain, research required



The Forging of the Sampo, Akseli Gallen-Kallela, 1893

Plans for next 6 months

- > Integrate and test all simulation chain components
- > Design reconstruction chain
- > Start integrating reconstruction chain components