Hyperloop – The ALICE analysis train system for Run 3

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ALICE from Run 2/LEGO trains to Run 3/Hyperloop trains

The ALICE analysis framework allows the creation and submission of analysis jobs to the Grid. These jobs are monitored and resubmitted using MonALISA. In Run 1 and 2, ALICE developed a system of analysis trains to optimize the usage of computing resources.

**LEGO trains**
- Tool to run and manage analysis trains on AliEn providing a friendly user interface
- Analysis code is contained in an AliEn package, **AliPhysics**
- Analysis tasks (wagons) using the same dataset are run together
- Main workhorse for Run 2 analysis

**2020:** 16 000 trains, 172 million Grid jobs, 39 000 average job slots

**Long-term plan**
- During LS2, ALICE went through upgrades allowing to collect in Run 3 roughly 2 orders of magnitude more data than in Run 2
- Run 3 data analysis uses **ALICE Online-Offline (O²)** framework
- Run 2 data converted to Run 3 format, analysis moves to O²
- **Hyperloop trains** have been developed based on the solid LEGO trains concept and integrated in the O² workflow
- LEGO trains phased out and replaced by Hyperloop trains
LEGO trains

- Analysis train framework for Run 2
- Database: PostgreSQL, backend: MonALISA, frontend: static HTML
- Trains are divided per Physics Working Group (PWG), data type and collision system (87 active)
- Same user interface for all users and train operators
- Requires train operators (per PWG) to test, compose and submit train runs

Hyperloop trains

- Analysis train framework for Run 3
- Database: PostgreSQL, backend: MonALISA + java-based model, frontend: React.js
- Unified trains throughout PWGs
- Personalized user and operator interfaces, saves page configuration
- Analysis defined in JIRA, wagons are defined per analysis
- Wagons (O² workflow) can be enabled for an available O² tag or pull request
- Immediate and automatic wagon test ⌛ → ⏳ → (🌟,❗,💣)
- Wagon and dataset bookkeeping, allows wagons and train runs comparison

1. User
   - Adds wagon(s) (one or more analysis AliPhysics task)
   - Enables wagon(s) for a dataset

2. Composes a train test in a dataset for an AliPhysics tag
3. Generates test files + executes tests
4. Recomposes/submit train run after test

Responsive and interactive performance graphs
• Most train operations are automatic based on available target memory and wagon configuration compatibility
• Requires less and **global train operators**

**Summary**

- Based on the organized analysis trains (LEGO) success, a modern and reactive train framework (Hyperloop) was built which supports the Run 3 software suite
- The Hyperloop train framework has been used during the **ALICE Analysis Challenge** since June 2020
- More than 600 trains successfully submitted to the Grid and Analysis Facilities
- Factor 3-10 higher event throughput, currently being optimized