SWATCH: Common Software for Controlling and Monitoring the Upgraded CMS Level-1 Trigger

Alessandro Thea1, Tom Williams1, Christos Lazaridis2, Lukasz Kreczko1, Giuseppe Codispoti4,5, Glenn Dirke6, Simone Bologna3, Karol Bunkowski7, Joschka Lingemann3, Carlos Ghabrous Larrea7

The increased homogeneity of the upgraded CMS Level-1 trigger hardware deployed during the long shutdown of the LHC, prompted the creation of a common framework to exploit the commonalities between the new trigger processors. The SWATCH (Software for Automating the conTroll of Common Hardware) framework provides a set of interfaces for controlling and monitoring the hardware of the trigger system while remaining independent of the driver software, thus reducing code and effort duplication for the subsystems.

5 Distinct Board Designs

- 9 trigger subsystems
- Different algorithms and scales
- O(100) boards & O(3000) links

Common Processor Model

- AMCs following the tCa specification
- Trigger data TuRx via high-speed serial optical links
- Processing logic implemented on Virtex-7 FPGAs

Configuration

- Subsystem-agnostic hardware description
- Factory pattern to create subsystem-specific classes
- Centrally defined Run Control Finite State Machine
- Command Sequences to be executed during transitions customized by subsystems

Monitoring

- All common components represented as monitorable objects
- Optical I/O ports
- TTC block
- Readout block
- ...
- History stored in Oracle database
- Common visualization tools under development

Database

- Common schema for all subsystems
- Distinct XML-based "modules"
- Infra: System description
- Algo: Alignment points etc.
- Run Settings: Masks, monitoring settings

Commissioning & Operations

- SWATCH-independent low-level drivers
- Bridge via "plugin" libraries
- Common hardware between subsystems
- One SWATCH "plugin" per component
- Code validation using "dummy" hardware
- Framework tested by a comprehensive nightly build test suite
- Parallel and centralized software deployment
- Fast detection and treatment of potential problems

SWATCH had a great impact in the successful commissioning of the Upgraded CMS Level-1 Trigger

- Replaced a long-running and stable trigger system
- Despite the short transition time
- Significant gains from SWATCH hardware-agnostic approach
- Less code overhead
- Developers focus on subsystem-specific issues
- High operational efficiency
- Minimal trigger downtime during data taking

References:

[3] I. Magrans de Abri