

Online Testbench for LHCb High Level Trigger Validation

Markus Frank, Jean-Christophe Garnier, Clara Gaspar,
Guoming Liu, Niko Neufeld and Alba Sambade Varela

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Introduction

- LHCb aim: Use first 2008 low-energy beams for Online and Offline system commissioning
 - Full Experiment System Test (FEST)
- Problem: LHC breakdown :-(
 - Currently no data
 - Fast start-up expected, not so much time for commissioning
- Solution: Do not wait for the LHC
 - Minimum bias simulated event injection
 - FEST results: See poster 278 from Marco Cattaneo



Outline

- 1 Specifications
 - Purpose of FEST
 - Purpose of the Injector

- 2 Implementation
 - System
 - Architecture
 - Integration in the ECS

- 3 Results



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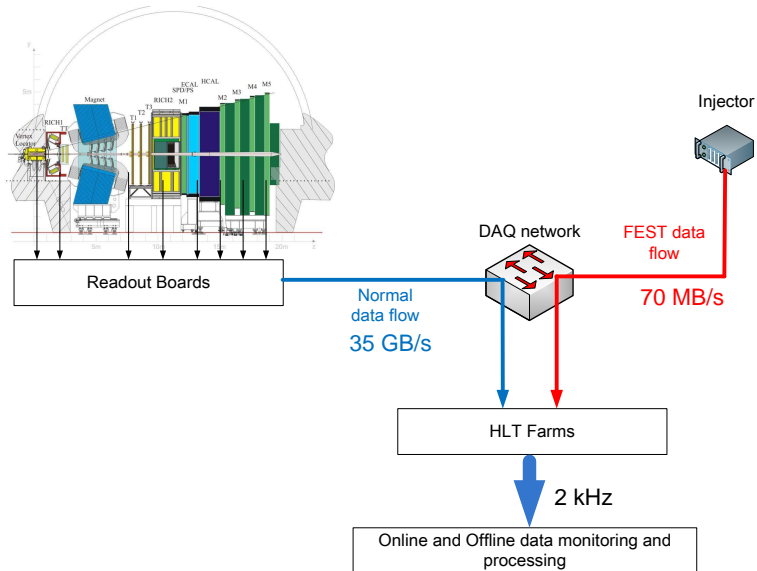
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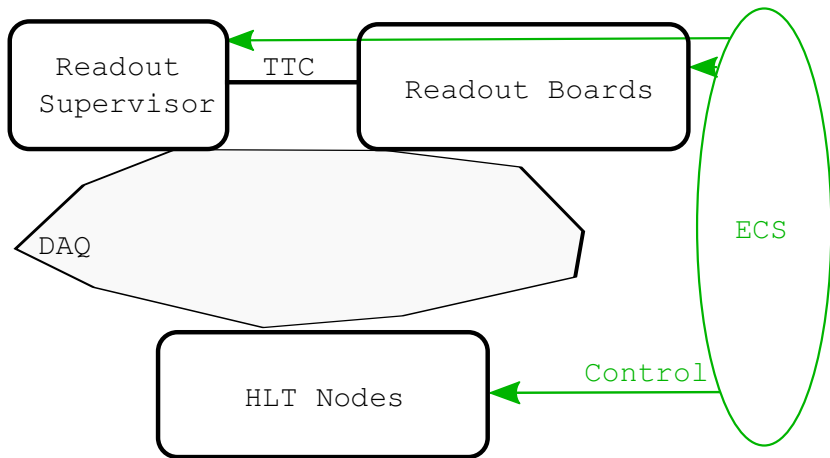
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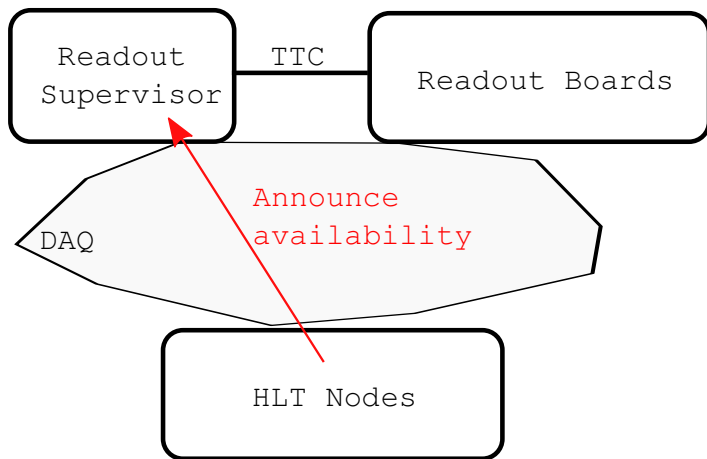
Purpose of FEST



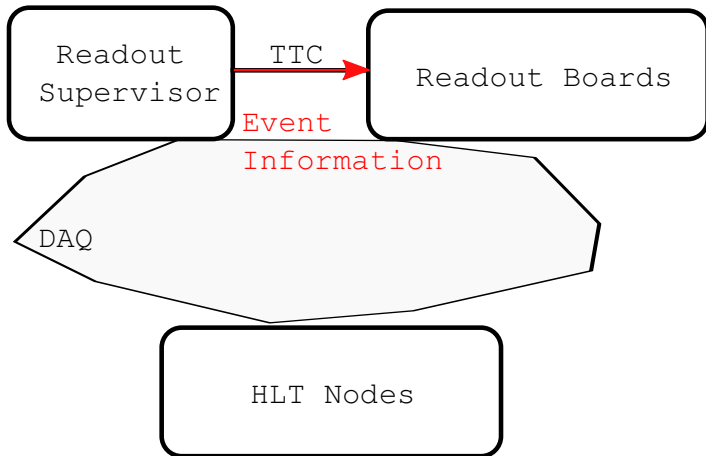
LHCb DAQ Main Entities



LHCb Run Operation



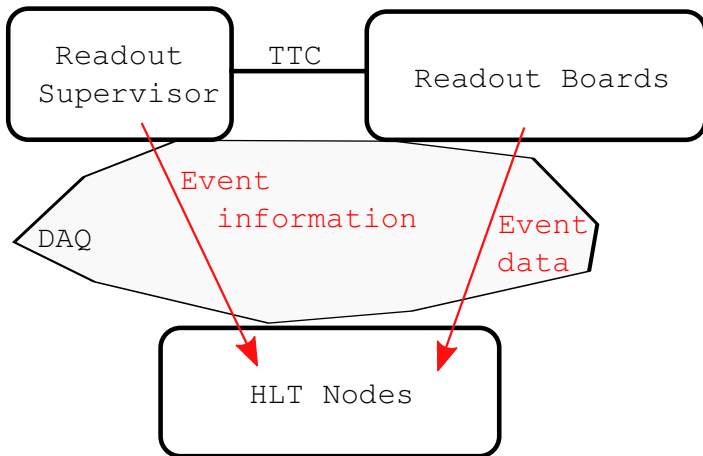
LHCb Run Operation



- Distribute clock, trigger decisions and HLT destination node



LHCb Run Operation



- Typically 35 kB per event



Generate FEST data-flow

- Read simulated events from data storage
- Convert data in DAQ format, as real readout boards data format
- Inject data at a minimum rate of 2 kHz = 70 MB/s
- Farms accept these events: The normal processing starts



Integration

- In the Online System
 - Respect the LHCb DAQ protocol
 - Use Readout Supervisor as director
 - Answer HLT availabilities
- In the Experiment Control System (More information in talk 313 from Clara Gaspar)
 - Monitored
 - Easy to operate
 - Other run activities in parallel
 - Independent partition ID



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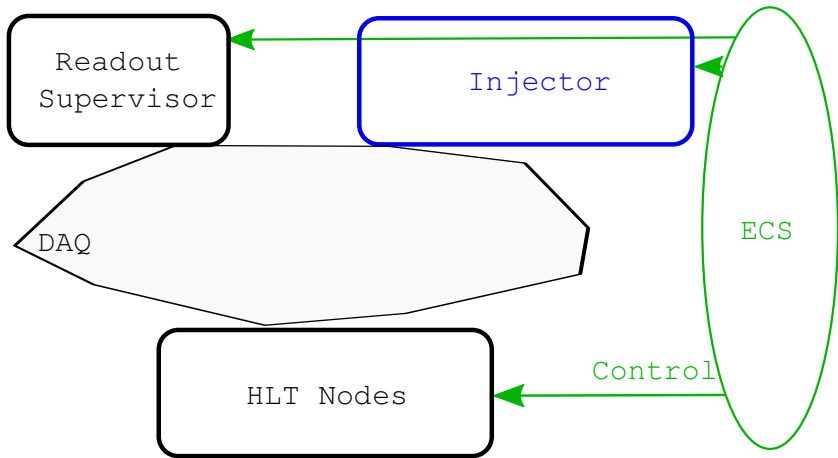
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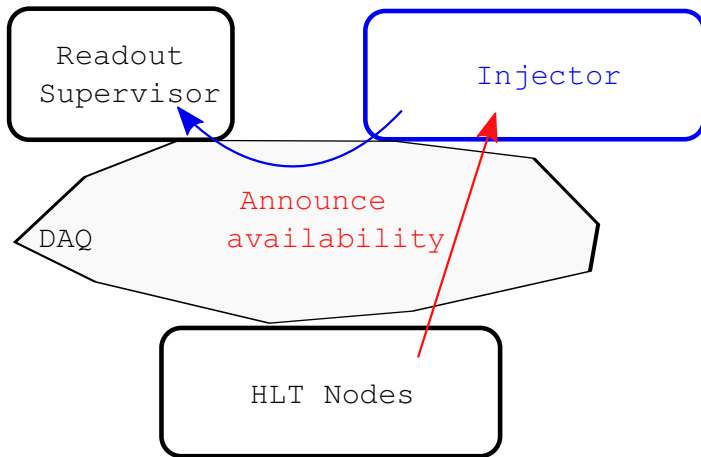
FEST Main Entities



- No TTC interface for event information



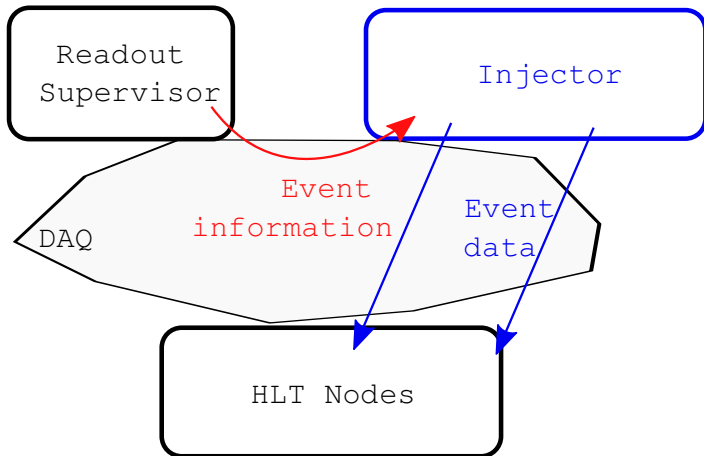
FEST Run Operation



- Be the farm node for the supervisor
- Be the supervisor for the farm nodes



FEST Run Operation



- DAQ protocol unchanged



Tasks

- Emulating Readout Supervisor data-flow
 - Pretend to be a Readout Supervisor
 - Managing HLT availabilities
 - Sending event information
 - Pretend to be a HLT farm node
 - Forwarding HLT availabilities
 - Managing event information
- Emulating Readout boards
 - Mix different event types according to the Trigger Type
 - "Translate" file formatted events to DAQ format data
 - 300 Readout board packets
 - Send them all from Readout boards IP addresses

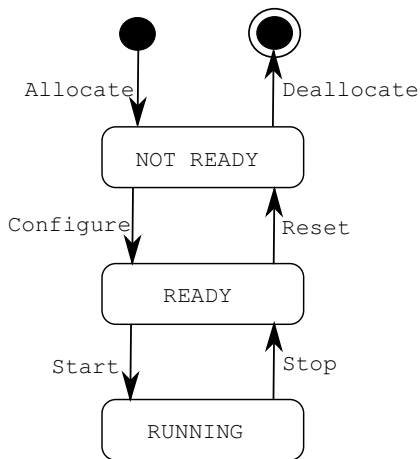


Multithreaded Gaudi Services

- Use of the standard LHCb framework Gaudi
 - One instance of event reader service for each event type
 - Injector tasks encapsulated in a unique service
- 1 Injector task = 1 Thread
- Communication tools
 - Standard Online Buffer Managers
 - Semaphores
 - Mutexes



Injector Finite State Machine



- Transition on ECS commands

- Standard in Gaudi Framework
- Manage propagation through threads



Injector Control Panel

FESST_Injector:TOP

System: Injector (RUNNING) | State: RUNNING | Thu 12-Mar-2009 11:17:20 | root

Sub-System: Injector01 (RUNNING)

Injector Configuration:

Injector MEP Req. Address: inj01.d2 | Injector Data Address: inj01.d1

Import Full TELL1/UKL1 List: [Browse]

Inject Data from Partitions:

- VELOA
- VELOC
- IT
- IT
- OTA
- OTC
- FBCH1
- FBCH2
- PRS
- ECAL & TCALO
- HCAL
- MBJONH & TMRJ
- MBJONC & TMRJ
- LBDU
- TPU

Read Data from Directory: /daqarea/lhcb/data/INFEST2_NOLUMI [Select Files]

File List: N Files: 1174

```

/daqarea/lhcb/data/INFEST2_NOLUMI/00004314_00000001_1
/daqarea/lhcb/data/INFEST2_NOLUMI/00004314_00000002_1
/daqarea/lhcb/data/INFEST2_NOLUMI/00004314_00000003_1
/daqarea/lhcb/data/INFEST2_NOLUMI/00004314_00000004_1
/daqarea/lhcb/data/INFEST2_NOLUMI/00004314_00000005_1
/daqarea/lhcb/data/INFEST2_NOLUMI/00004314_00000006_1
/daqarea/lhcb/data/INFEST2_NOLUMI/00004314_00000007_1
/daqarea/lhcb/data/INFEST2_NOLUMI/00004314_00000008_1
/daqarea/lhcb/data/INFEST2_NOLUMI/00004314_00000009_1
/daqarea/lhcb/data/INFEST2_NOLUMI/00004314_00000010_1
/daqarea/lhcb/data/INFEST2_NOLUMI/00004314_00000011_1
/daqarea/lhcb/data/INFEST2_NOLUMI/00004314_00000012_1
/daqarea/lhcb/data/INFEST2_NOLUMI/00004314_00000013_1

```

Partition ID: 17FFF

Fake "Conditions":

Fill Number: 123 | Beam Energy: 4000 | VELO X RC: 0.02
 LHC State: SIMULATION | Magnet Current: 5890 | VELO X LA: -0.02
 VELO Y: 0

Send Conditions to DB Only from "FEST" Partition

- Unique partition ID
- Configure subpartitions enabling Readout boards emulation



Partition Control Panel

System State: **FEST** RUNNING

Time: **Tue 12-Mar-2009 11:14:41**

Sub-System State:

Sub-System	State
RunInfo	RUNNING
TFC	RUNNING
HLT	RUNNING
Storage	RUNNING
Monitoring	RUNNING
Reconstruction	NOT_ALLOCATED
Calibration	NOT_READY
Injector	RUNNING

Run Number: 45557 Activity: INJECTOR Save

Run Start Time: 12-Mar-2009 11:09:50 Trigger Configuration: XP/NanolytVE prescale = 1_Rand Change

Run Duration: 00:04:47 Time Alignment: TAE half window L0 Gap

Nr. Events: 530663 Max. Nr. Events: Run limited to Events

Nr. Steps Left: 0 Automated Run with Steps: Step Run with Steps

L0 Rate: 1.87 kHz HLT Rate: 1.88 kHz Dead Time: 0.00 %

Data Destination: LOCAL Data Type: FEST Run DB

File: /dsquare/hcb/data/2003/RAW/FULL/FEST/FEST45557

Messages:

- 12-Mar-2009 11:09:50 - FEST executing action 00
- 12-Mar-2009 11:09:50 - FEST_TFC executing action START_TRIGGERER
- 12-Mar-2009 11:09:55 - FEST in state RUNINFO

Buttons: TFC Control, TELL1s, FEST Elog, Close

- Run information
- Sub-system configuration



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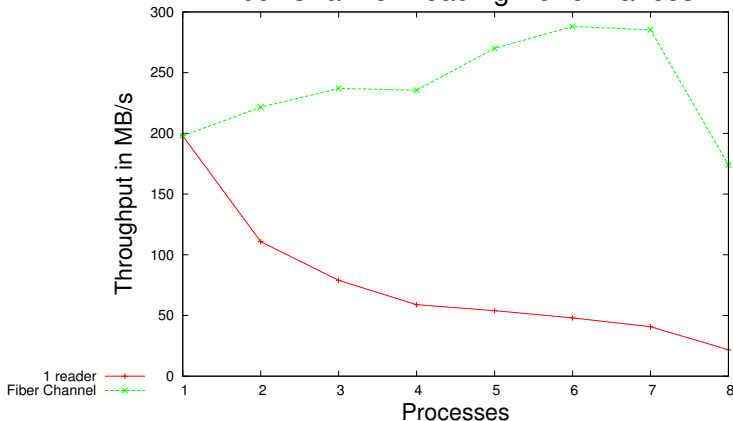
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Performance Results

Fiber Channel Reading Performances



- Input rate

- Maximum input rate can be reached
- Reader throughput aggregation = Throughput of Fiber Channel

- Output rate follows the Readout Supervisor rate



Results/Requirements

- Stable 2 kHz HLT input rate
 - Injection rate configured with ECS and regulated by HLT availabilities
- Perfect emulation of the readout board outputs
- Same way of operating as normal run
 - Except some configuration options
- Tool easy to configure and run via ECS
 - Same way as any other detector or sub-detector



Summary

- Already an **invaluable debugging tool**
 - Lifetime is expected to be as long as the LHCb experiment's
- Full System Tests held regularly
 - 1 FEST week each month
 - Reminder: FEST results developed in Poster 278 from Marco Cattaneo

