

# Online Aspect of LHCb Full Experiment System Test

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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



# Outline

- 1 Specifications
  - Purpose of FEST
  - LHCb Data Acquisition System
  - Purpose of the Injector

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

- 3 Results



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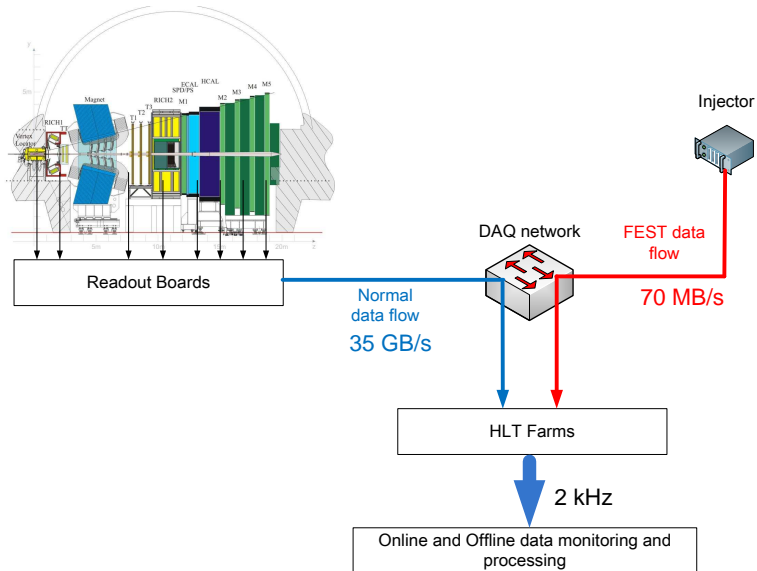
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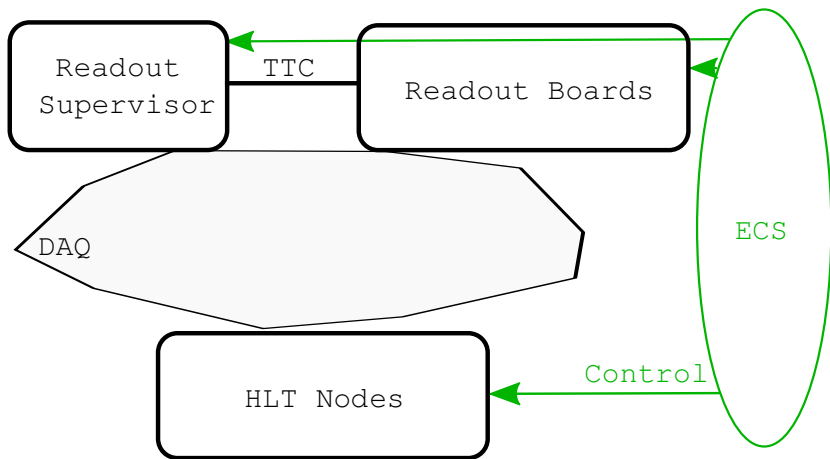
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# Purpose of FEST

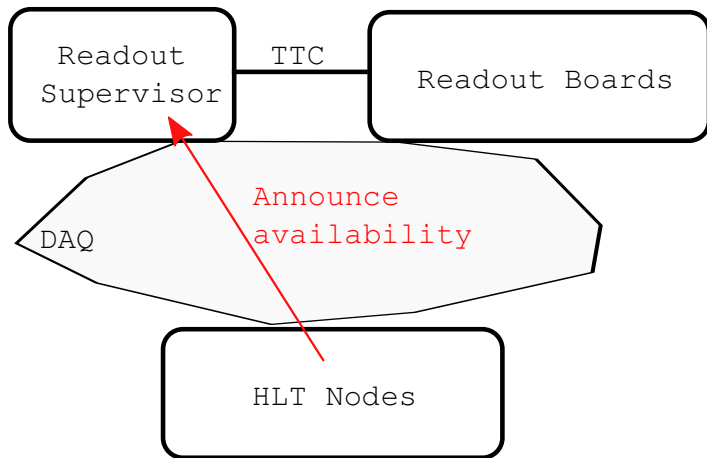


# LHCb DAQ Main Entities

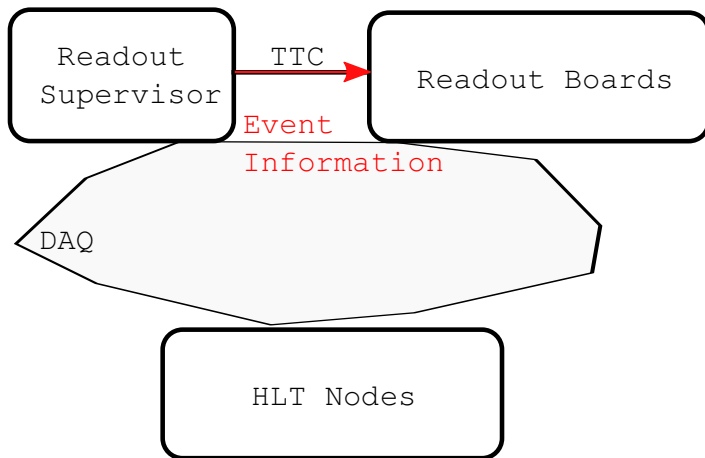




# LHCb Run Operation



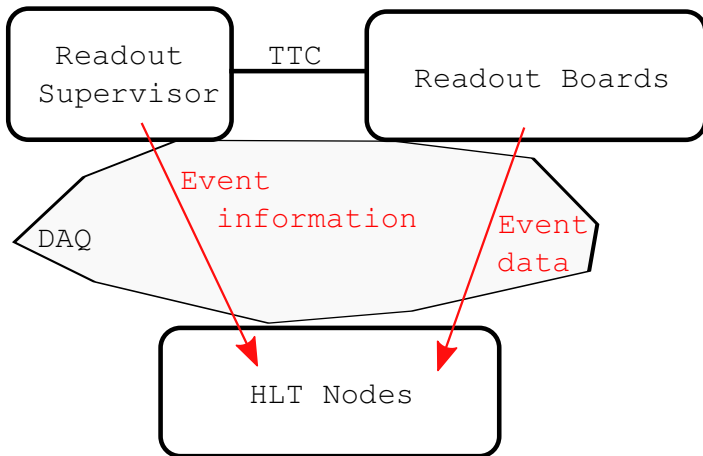
# LHCb Run Operation



- 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
  - Monitored
  - Easy to operate
  - Other run activities in parallel



# Outline

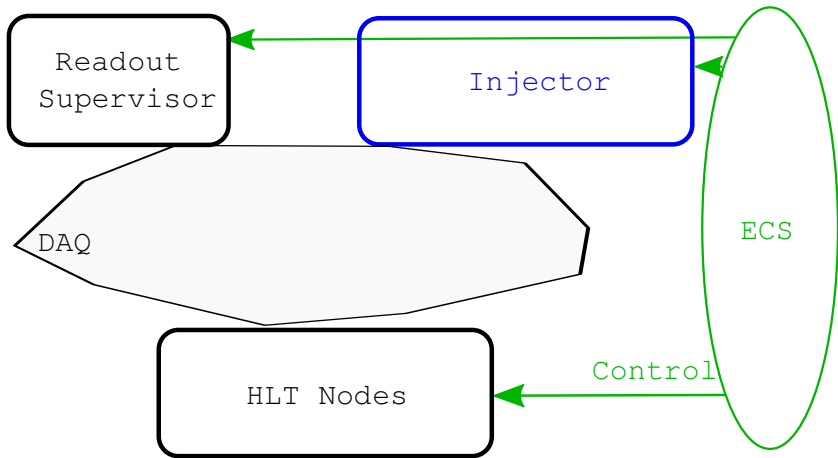
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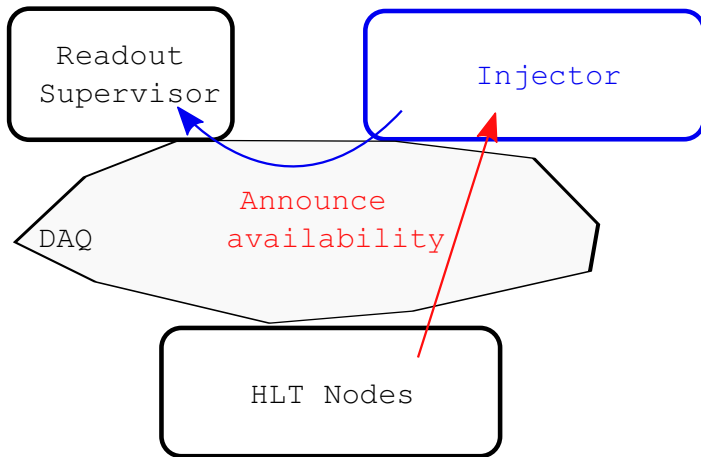
# FEST Main Entities



- No TTC interface for event information



# FEST Run Operation

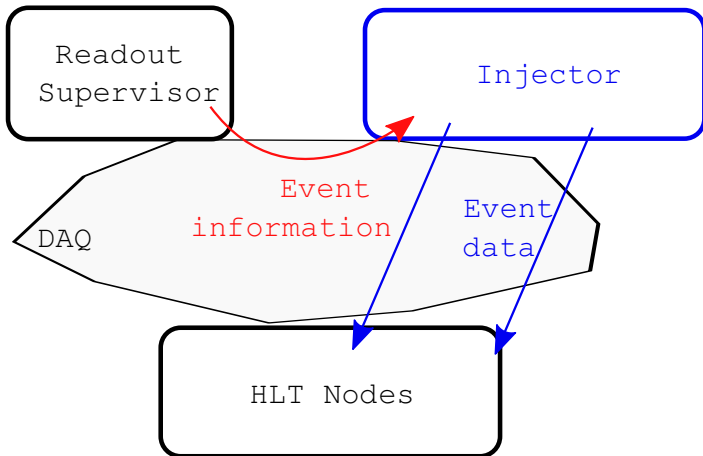


- Be the farm node for the supervisor
- Be the supervisor for the farm nodes





# FEST Run Operation



- DAQ protocol unchanged

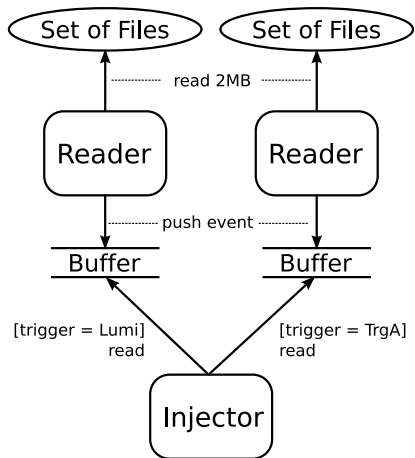


# Tasks

- 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



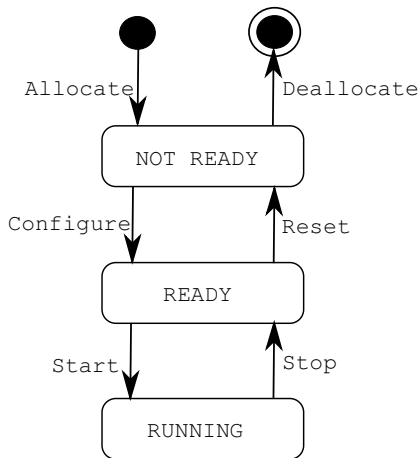
# Multithreaded Gaudi Services



- Standard LHCb Framework: Gaudi
  - Services
  - Each injector task = 1 thread
- Standard Online Buffer Managers
- POSIX InterProcess Communication



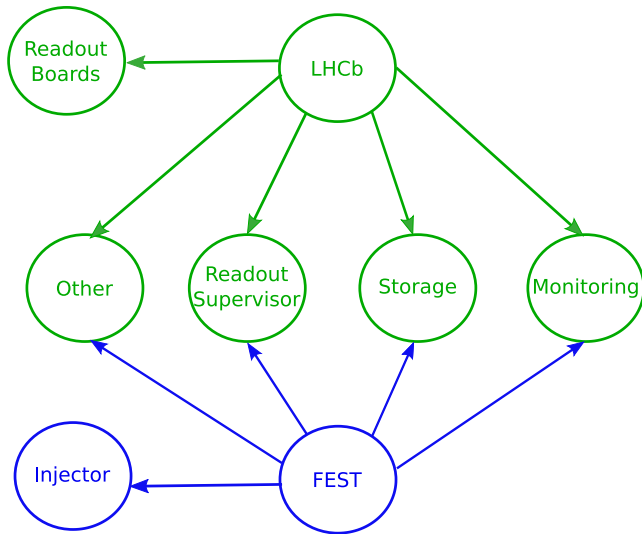
# Injector Finite State Machine



- Standard in Gaudi Framework
  - Transition on ECS commands
  - Manage propagation through threads



# New Partition Identity



- Run = Get a Readout Supervisor, some HLT Farm, etc.



# Injector Control Panel

**FEST\_Injector: TOP** Thu 12-Mar-2009 11:17:20

System: Injector (RUNNING) | State: 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
- MBONCA & TMUA
- MBONC & TMUC
- 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

- Configure subpartitions enabling Readout boards emulation
- Fake conditions for FEST runs



# Partition Control Panel

**FEST: TOP** Tue 12-Mar-2009 11:14:41

System: FEST State: **RUNNING**

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

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

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: 0.99%

TFC Control TELL1s FEST Elog

Data Destination:  Data Type: FEST

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
  
```

- Run information
- Sub-system configuration



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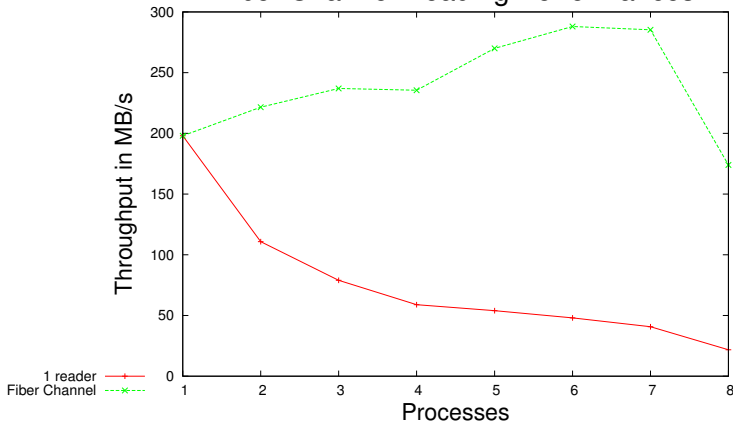
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# Performance Results

## 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

- **Reliable** emulator of the LHCb data flow
- 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



# What next?

- Maintenance of the injector
- On-going 10GB Ethernet NIC performance tests for storage area network upgrade
- Supervision of a 6-month internship for the study of a 10GB Ethernet injection hardware solution
- Maintenance and further development of storage services

