THE ATLAS DATA ACQUISITION SYSTEM IN LHC RUN 2

22nd International Conference on Computing in High Energy and Nuclear Physics - October 10-14 2016, San Francisco

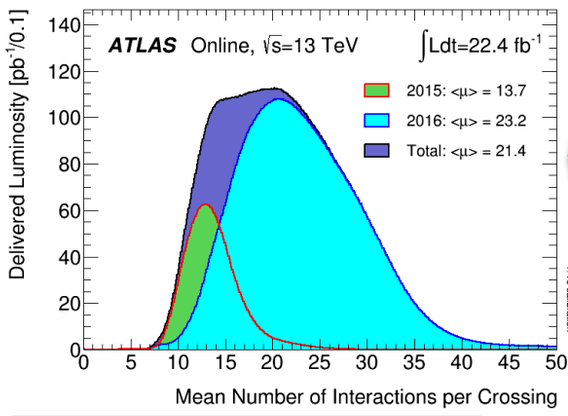
Introduction

During 2013-2015 long shutdown, the Trigger and Data Acquisition system of the ATLAS Detector at CERN underwent a major program of improvements in preparation for the more challenging LHC collision environment at 13 TeV during Run 2.

Challenge driven by increased mean number of interactions per bunch crossing, known as 'pileup'. Results in longer overall processing time and larger data volume.

Run 2 also saw integration of new detector components, as well as expansion of readout bandwidth from existing systems. Input and output rate requirements for the system also increased.

New requirements satisfied using new hardware and software technologies system-wide. Updated system more robust, scalable and performant.



	Run 1	Run 2 (peak)
Pileup	21	40
L1 Trigger Rate (kHz)	70	100
HLT Trigger Rate (kHz)	0.6	1.5
Event Size (MB)	1.5	1.6
Offline Data Recording Rate (GB/s)	1	1.5

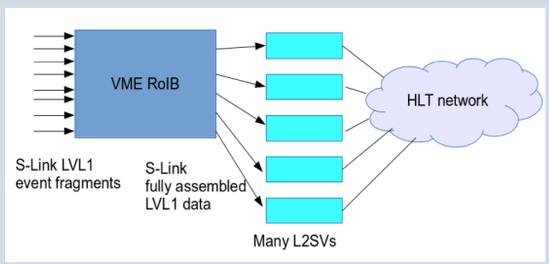
Seeding HLT

High Level Trigger (HLT) processing seeded by detector regions of interest built from Level 1 (L1) trigger results.

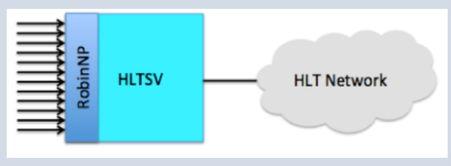
Original VME based Region of Interest Builder (RoIB) migrated to software and integrated with merged HLT Supervisor (HLTSV) using RobinNP.

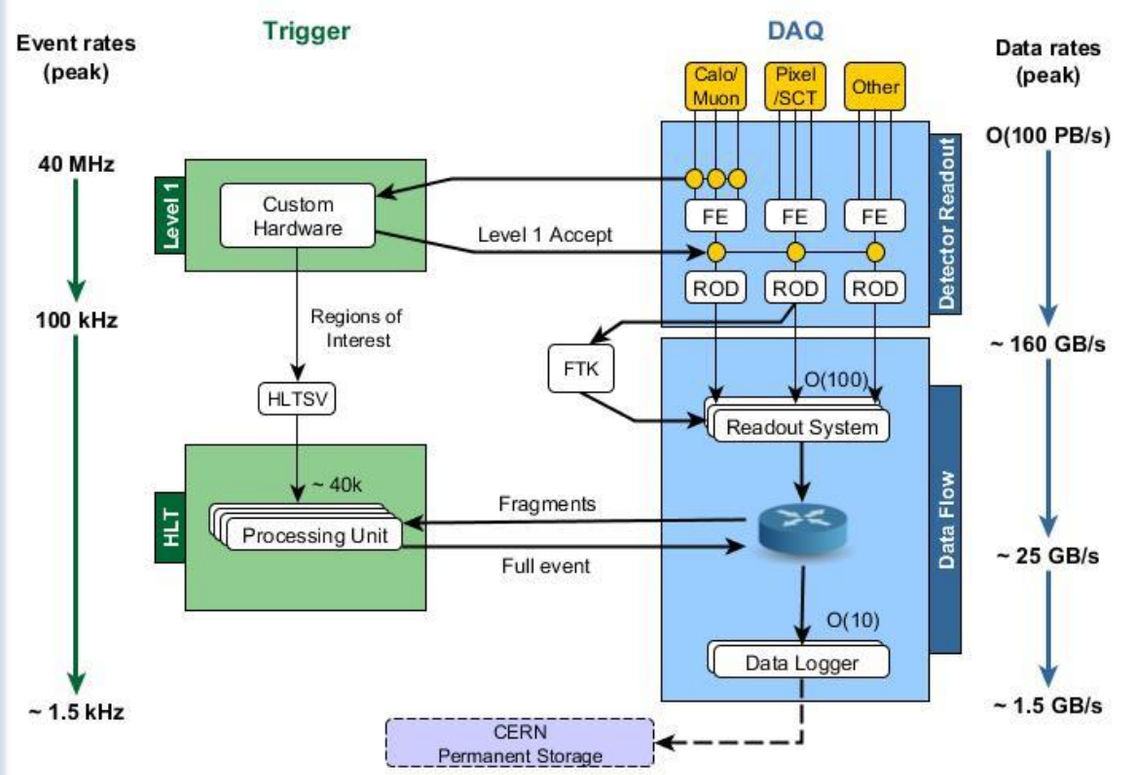
Able to support higher L1 rates while moving to more maintainable hardware.

Run 1

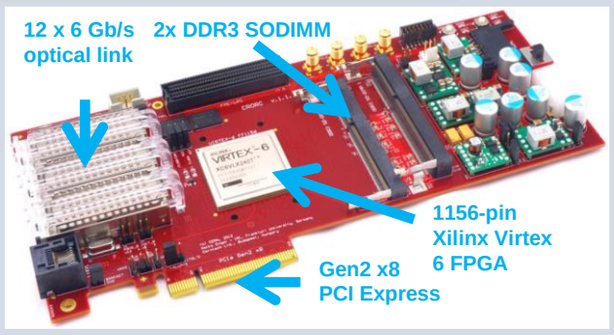


Run 2





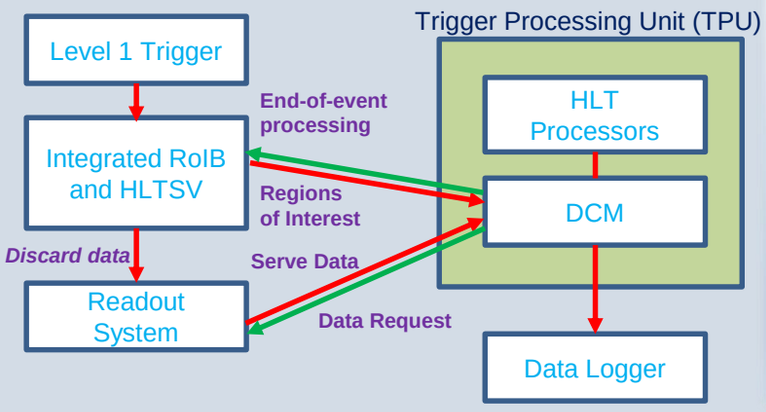
Readout



Updated Readout System (ROS) based on RobinNP PCIe card

3 x Link Density increase
20 x Output bandwidth increase
10 x Buffer capacity increase
Improved monitoring and diagnostics

Dataflow



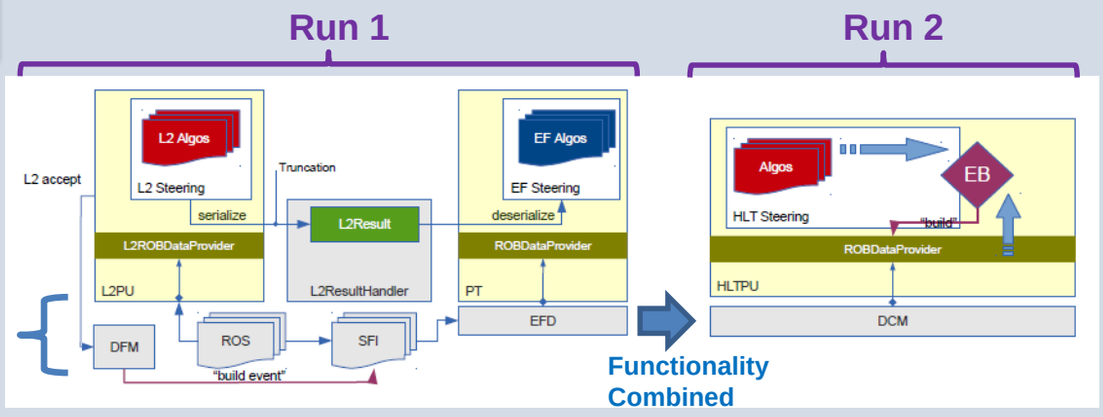
Overhauled dataflow infrastructure supporting new merged HLT and evolved RoIB.

New Data Collection Manager (DCM) combining and streamlining functionality of multiple components.

HLT Processing

Merger of previous Region of Interest based Level 2 farm with full event 'filter' farm into one. Processing merged at HLT algorithm level.

Streamlined processing with reduced data transport needs facilitating better load balancing and eliminating need to distribute resources manually between farms.



Software

Software infrastructure updated for fully 64 bit processing, making use of new technologies and standards such as C++11 and boost. Migrating throughout 2016 to modern build and management tools such as Git and CMake.

Multiple updates across control and monitoring software. Also presented at CHEP 2016:

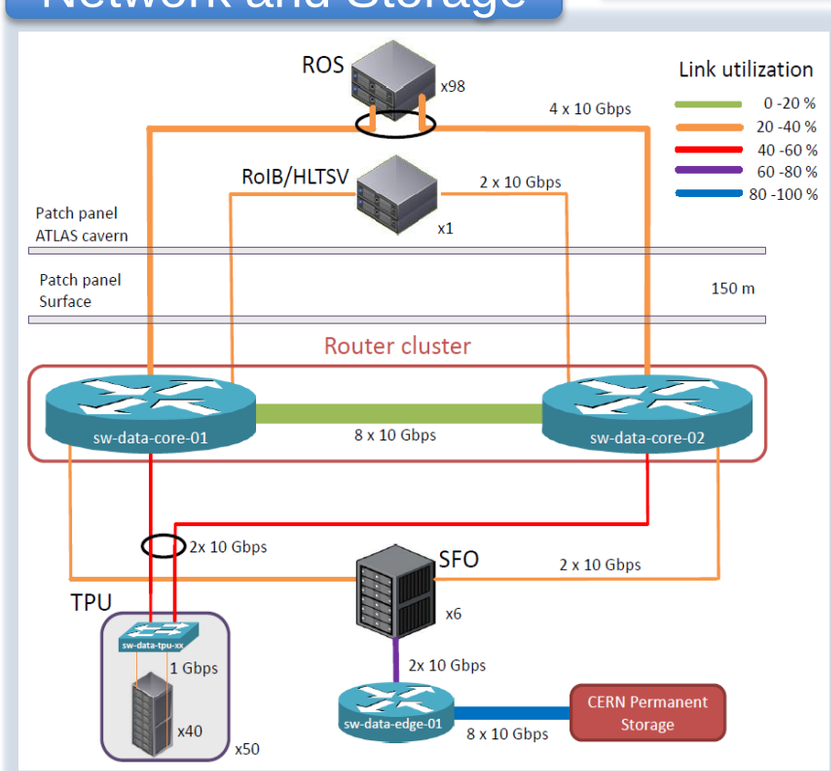
A web-based solution to visualize operational monitoring data in the Trigger and Data Acquisition system of the ATLAS experiment at the LHC. ***I. Soloviev, G. Avolio.***

The Resource manager of the ATLAS Trigger and Data Acquisition system. ***I. Alexandrov.***

Integrated monitoring of the ATLAS online computing farm. ***D. Fazio.***

Master of Puppets. ***C. Lee.***

Network and Storage



Redesigned dataflow network combining two previous networks into one. Making use of new multi chassis trunking technology to providing 40 GbE capability to each ROS PC with active-active redundancy.

Deep buffer top-of-rack switches installed significantly reducing event building time by reducing rate of packet drops and retransmissions.

Evolved data logger (SFO), making use of state-of-the-art storage and processing technology and reworked multi-threading processing model.

Capable of meeting new output bandwidth and availability requirements, with large buffer able to store up to 24 hours of collision data.

William Panduro Vazquez, Royal Holloway, University of London, on behalf of the ATLAS Collaboration

https://twiki.cern.ch/twiki/bin/view/AtlasPublic