The Run-2 ATLAS Trigger System
Savanna Shaw (University of Manchester)
on behalf of the ATLAS collaboration

Introduction

The ATLAS trigger system successfully operated during the LHC Run-1. Many upgrades were implemented for Run-2 to cope with the increase in rate from higher center-of-mass energy while preserving efficiencies for physics processes of interest.

Run-2 Trigger System

Overview
- Two-stage system to select events containing objects of interest to physics analyses (photons, electrons, muons, jets, $E_T^{miss}$, etc.).
- Most of bandwidth dedicated to generic single object triggers.
- Also include multi-object and analysis specific triggers.
- Decreases high rate of low $p_T$ jets, muons.
- Improved handling of pile-up due to dynamic pedestal subtraction.
- Reduction of missing $E_T$ trigger rates.

L1 Calo
- New Multi-Chip Modules.
- Improved handling of pile-up due to dynamic pedestal subtraction.
- Reduction of missing $E_T$ trigger rates.

L1 Topo
- Input from L1Calo and L1Muon.
- Topological selection based on Level-1 objects.
- Angular separation between objects, invariant masses, sums of object $p_T$, etc.
- Commissioning.

Hardware based; builds events using information in RoIs or full detector.

FTK
- Hardware based Fast Tracking (FTK).
- Uses highly parallel processor and banks of track patterns to build tracks within $\sim 10\mu s$ of L1 accept.
- Tracks then used directly by HLT.
- Commissioning during 2016.

Two stage system in Run-1 merged to single HLT farm.
- Algorithms updated to more closely match offline reconstruction algorithms.
- Increased acceptance and higher rejection for physics analyses.

High Level Trigger (HLT)

- Software based; builds events using information in RoIs or full detector.
- Reduce rate from $\sim 100$ kHz to $\sim 1$ kHz.

- Two stage system in Run-1 merged to single HLT farm.
- Algorithms updated to more closely match offline reconstruction algorithms.
- Increased acceptance and higher rejection for physics analyses.

L1 Muon
- New coincidence logic with detectors before end-cap toroid.
- Decreases high rate of low $p_T$ out-of-time protons in end-cap.
- $\sim 50\%$ rate reduction for muons with $p_T > 20$ GeV, and $1.3 < |\eta| < 1.9$.
- New trigger chambers around support structure operational.
- $\sim 4\%$ gain in efficiency.

Summary

The ATLAS trigger has undergone many upgrades to handle the increased rates due to the higher center-of-mass energy in Run-2.

The trigger ran smoothly and performed well in 2015, and trigger strategies are in place for continued smooth running in 2016.