ATLAS Level-1 Level-2 Trigger Integration

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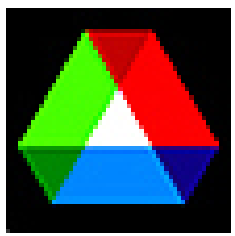
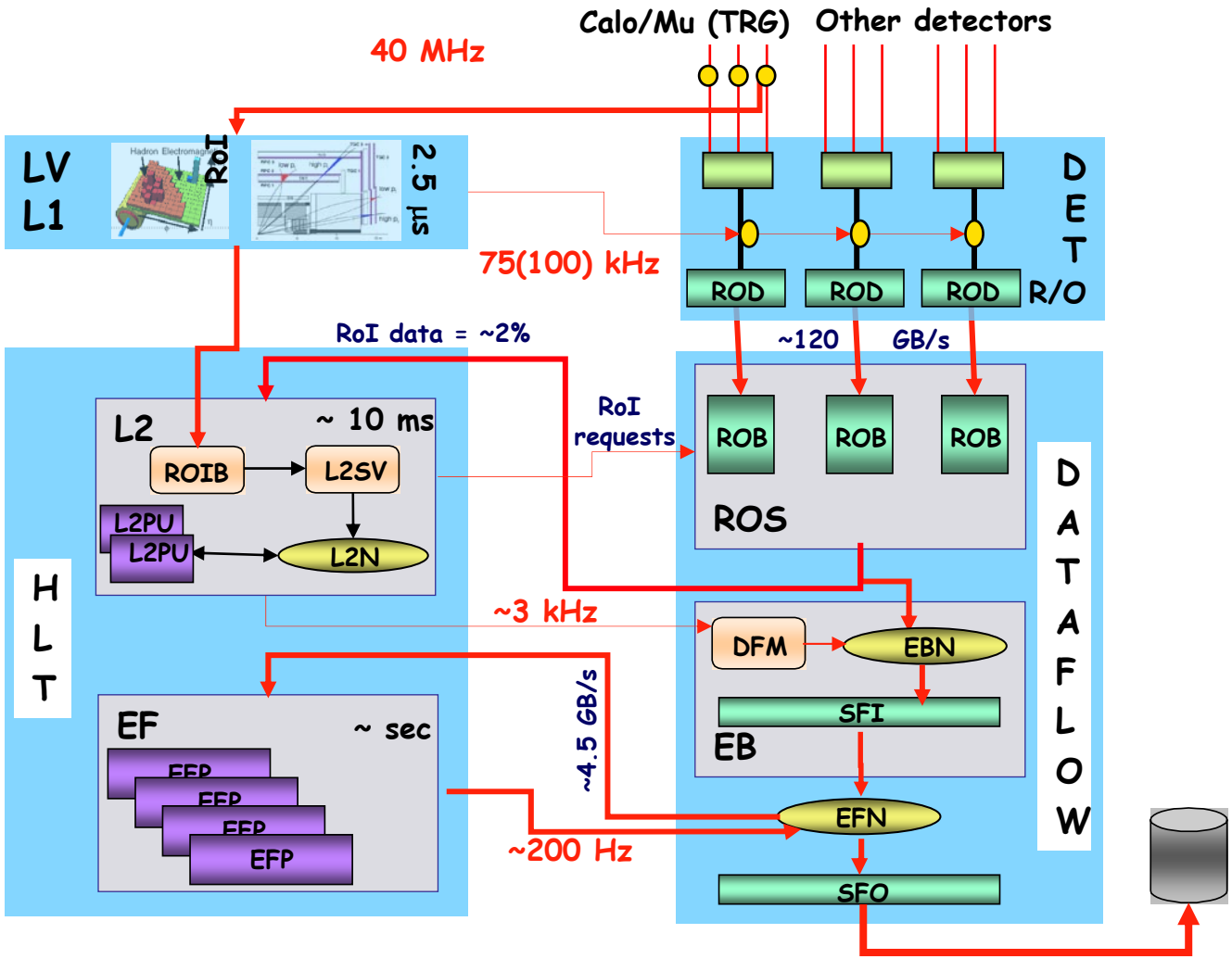
for
ATLAS TDAQ Group

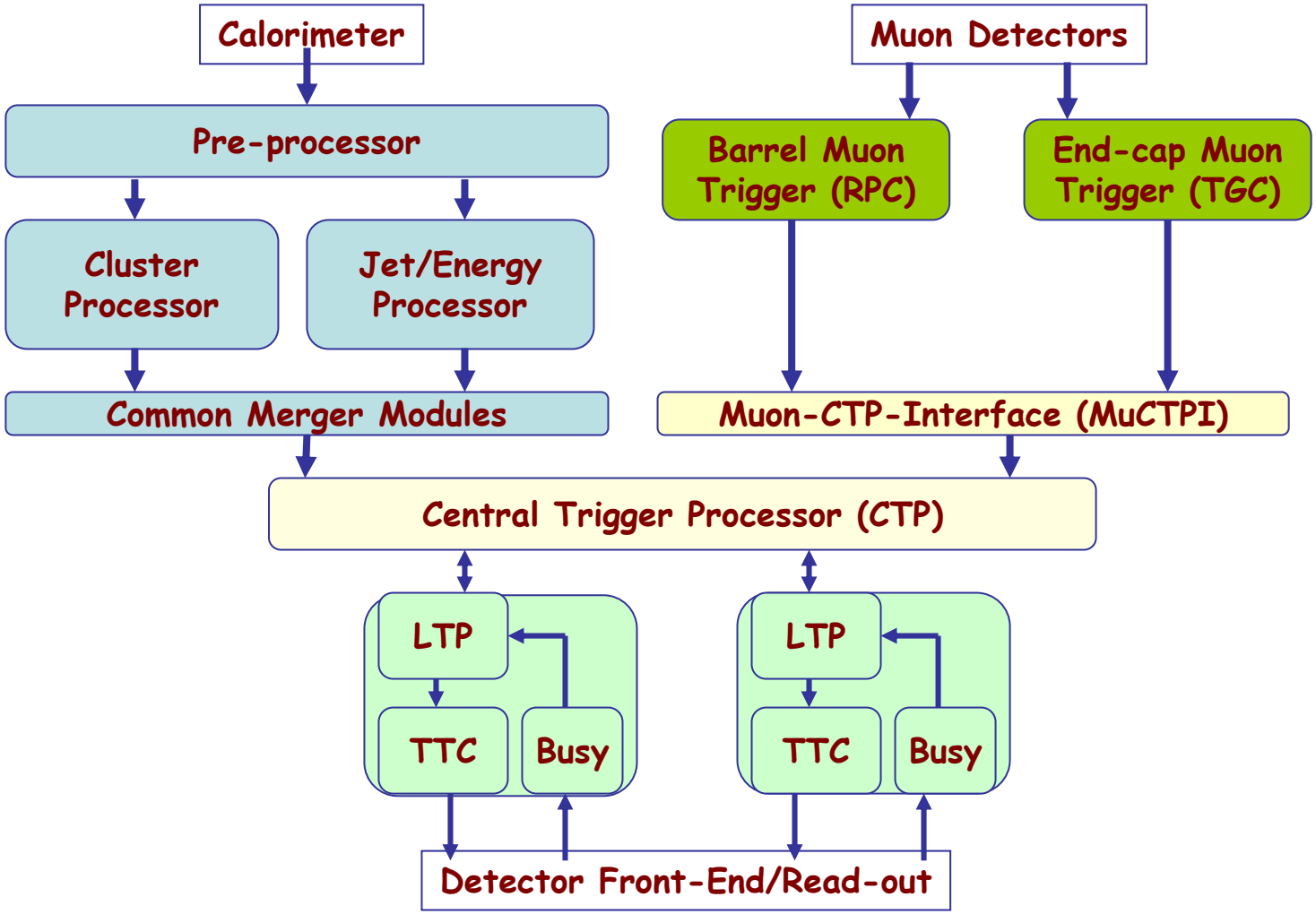
TWEPP 2007, 3-7 September 2007



ATLAS TDAQ System

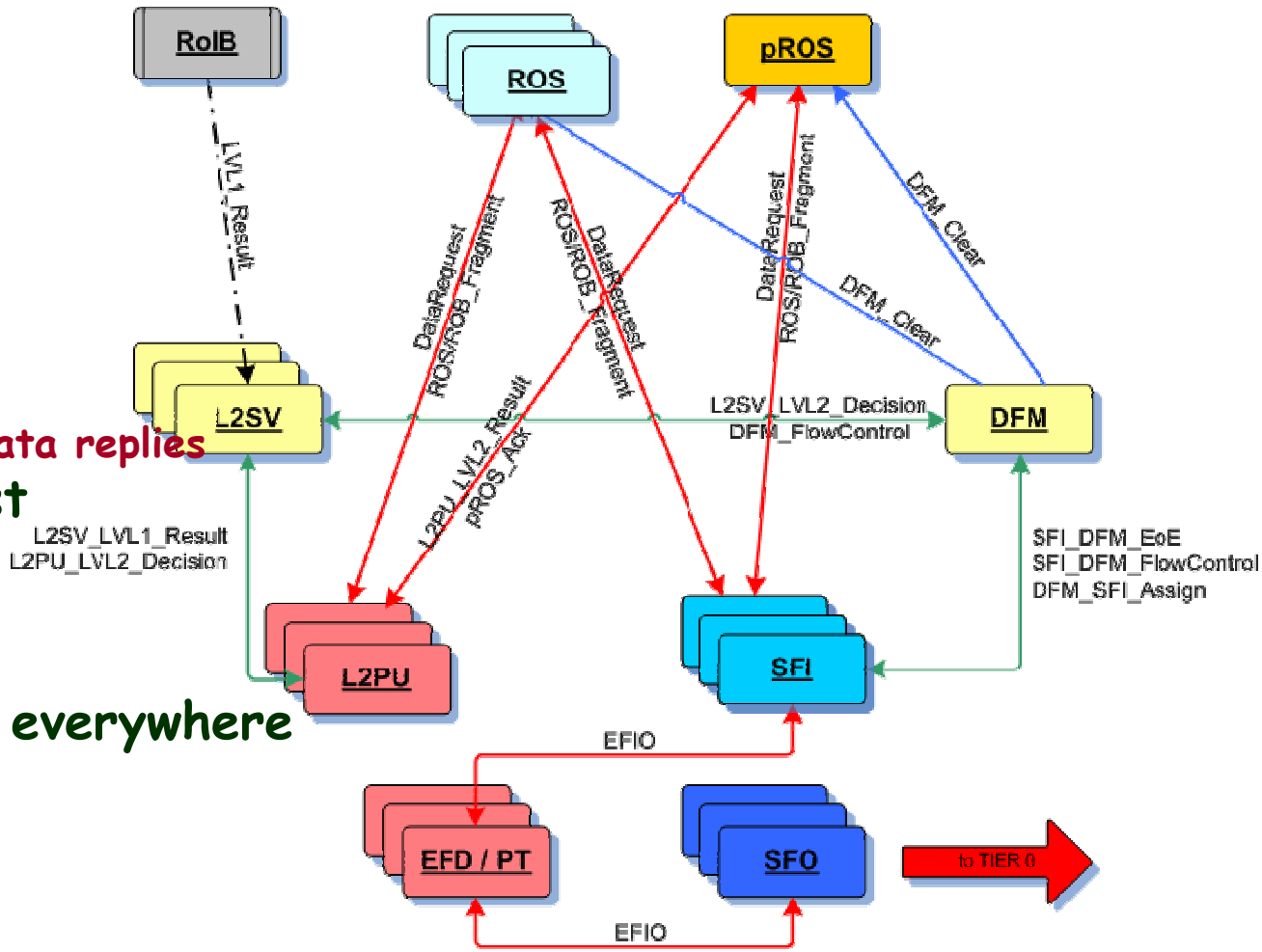


LVL1 Trigger



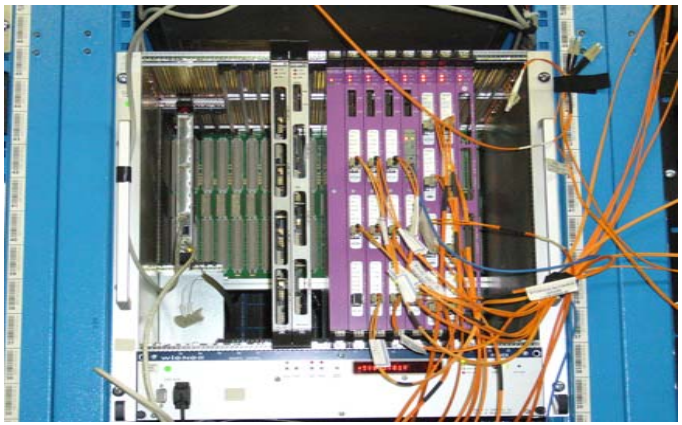
DataFlow Overview

- UDP / IP
  - data requests and data replies
- UDP / IP multicast
  - DFM clear messages
- TCP / IP
  - data flow commands
- Possibly TCP / IP everywhere



DAQ/HLT Components (I)

RoI Builder (RoIB)



Filar

Level 2 supervisor (L2SV)
DataFlow manager (DFM)

CPU: AMD Opteron 252
2.6 GHz
RAM: 2 GB

ROS

ROBIN

CPU: Uni-proc 3.4 GHz Xeon
RAM: 512 MB

DAQ/HLT Components (II)

SubFarm Input (SFI)

CPU: AMD Opteron 252
2.6 GHz
RAM: 2 GB

HLT Farms (L2PU, EFP)

CPU: 2 x Intel E5320 quad-core
1.86 GHz
RAM: 1 GB / core

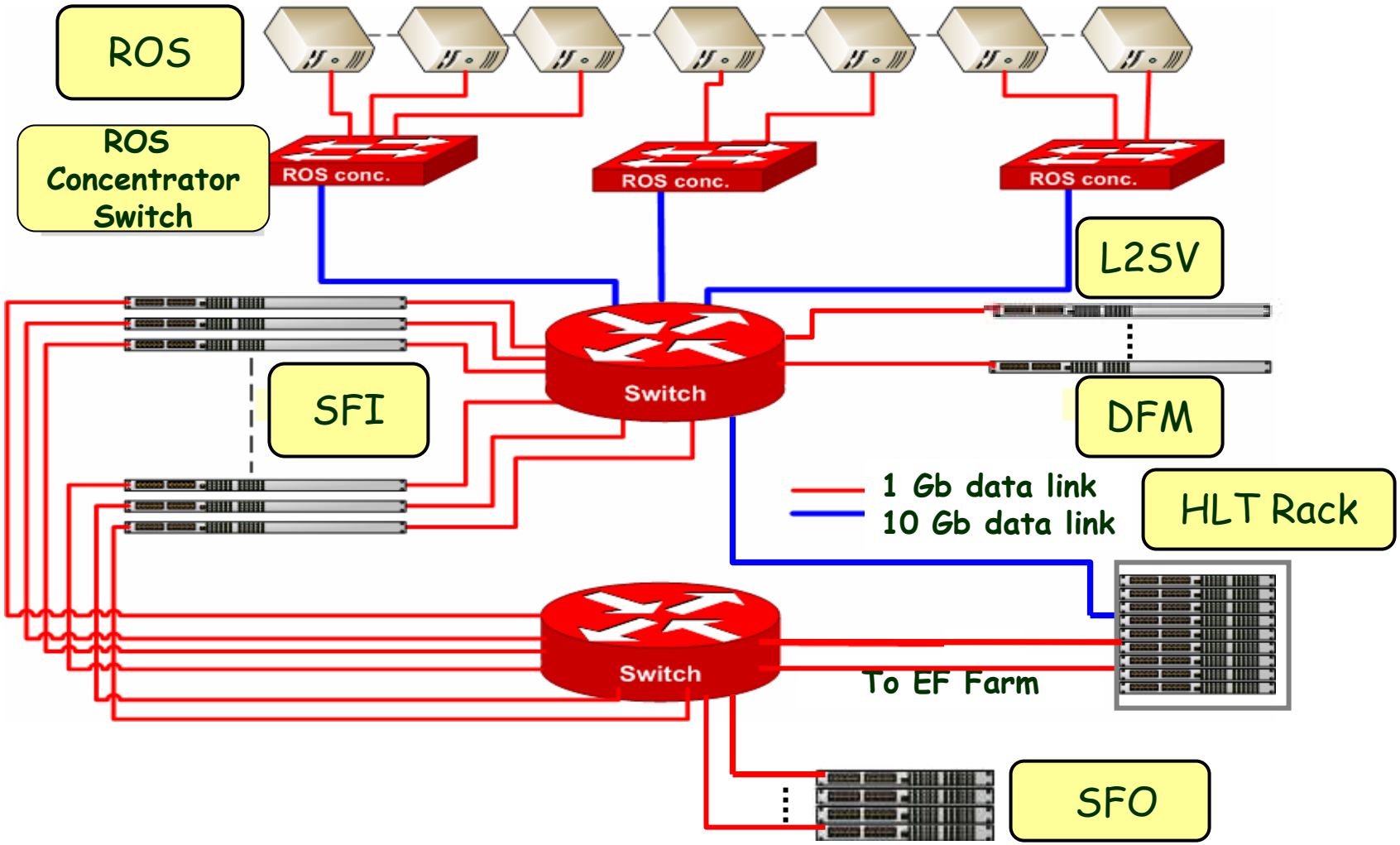
SubFarm Output (SFO)

CPU: 2 x Intel E5320 dual-core 2.0 GHz
RAM: 4 GB
3 RAID controllers
500 GB X 24 disks

DAQ/HLT Installation Status

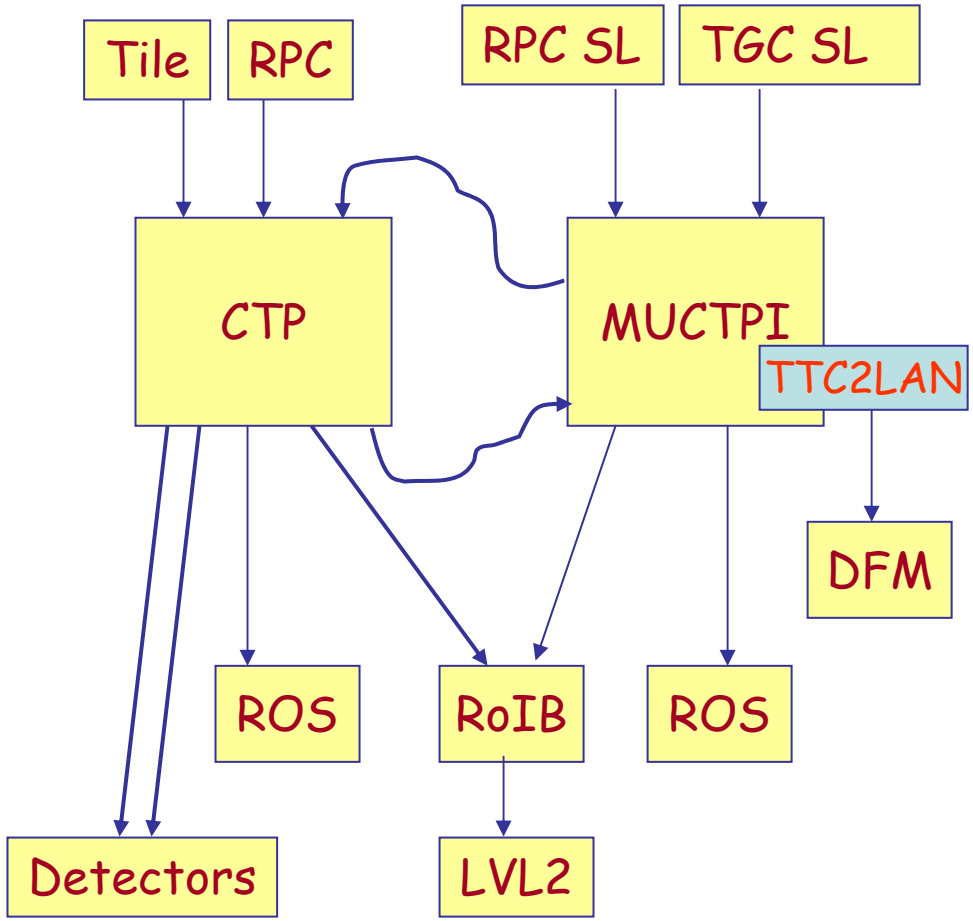
Component	Current	Final
ROIB	1	1
L2SV	2	12
L2PU node	~130	~500
DFM	12	12
SFI	32	~100
SFO	6	6
EF node	0	~1500
ROS	153	153

Network Topology



Integration with Cosmic Run

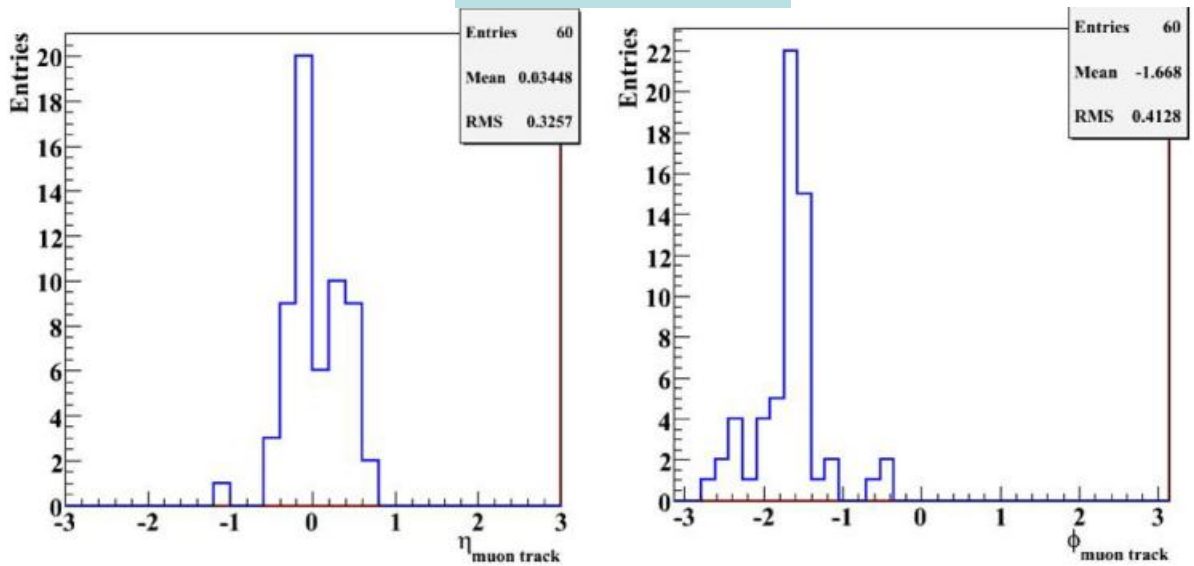
- Trigger input
  - Tile cosmic (< 1 Hz)
  - MUCTPI:
    - RPC (~120 Hz)
    - TGC (few Hz)
  - Fixed freq. (11 KHz)
  - Pseudo-random
- TTC2LAN can be used to bypass LVL2



1st LVL1-LVL2 Integration

- Ran the full trigger chain with RPC+ MUCTPI&CTP + ROIB + LVL2 + EB
- Triggered cosmic ray at 30 Hz (RPC setting) in LVL1 and "forced accept" in LVL2 to record all events
- Selected downward muons with LVL2 algorithm
- Stored accepted events after event building

Feb 2007



Cosmic Run in Large Scale

June 2007

Muon Detector

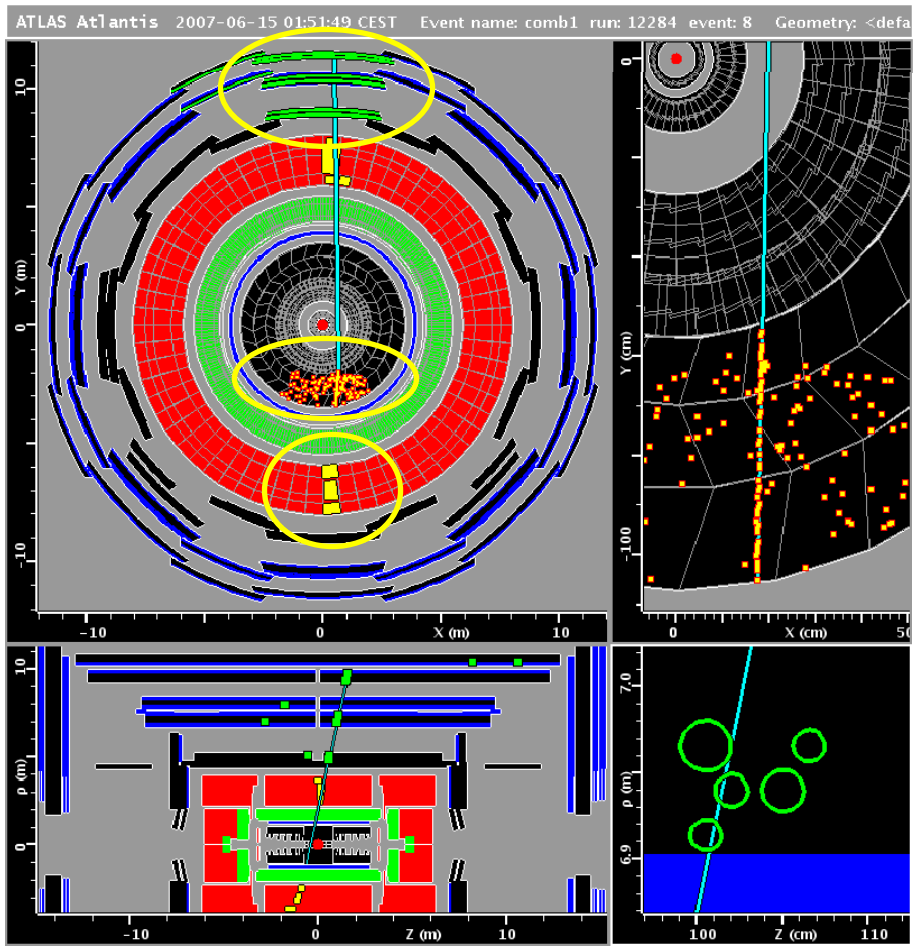
RPC (1/32)
MDT (1/16)
TGC (1/36)

Calorimeter

LAr (~50%)
Til (~75%)

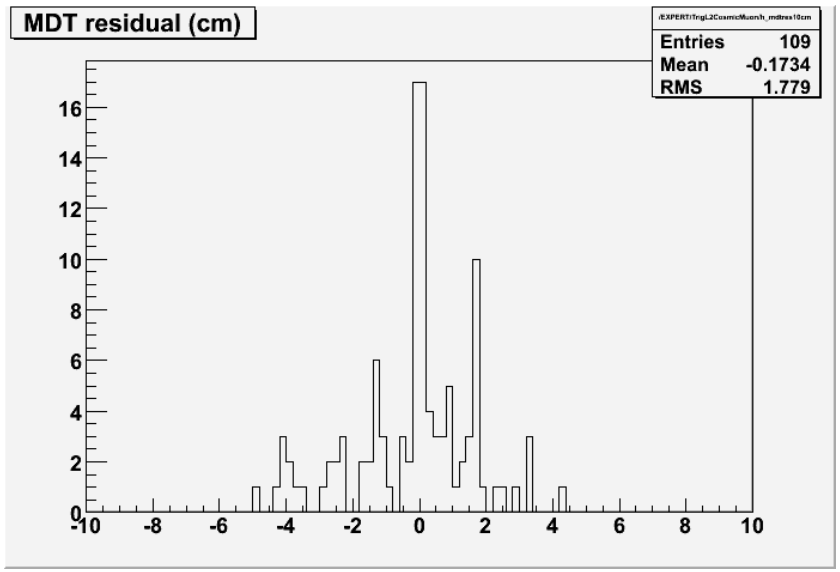
Tracking

TRT (~6/32 of the barrel)

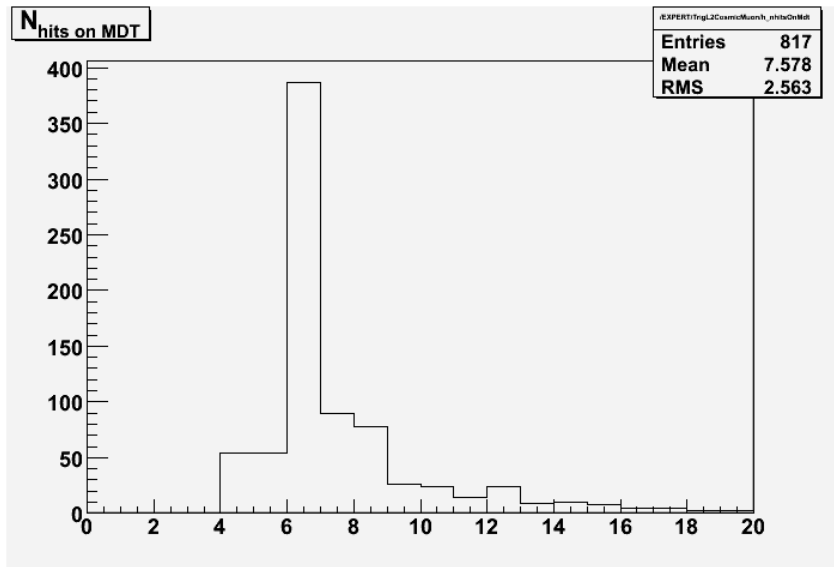


Cosmic Algorithm

- Start with muon RoI
- Reconstruct muon in two ways
  - Seeded by RPC hits to find track and associate MDT hits with it
  - Seeded by MDT hits to find track



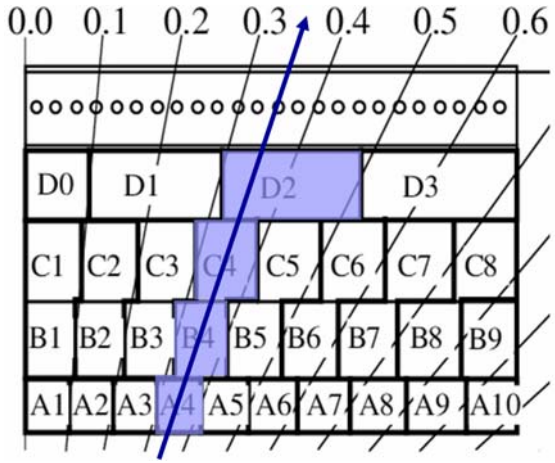
Resolution of MDT track wrt RPC track

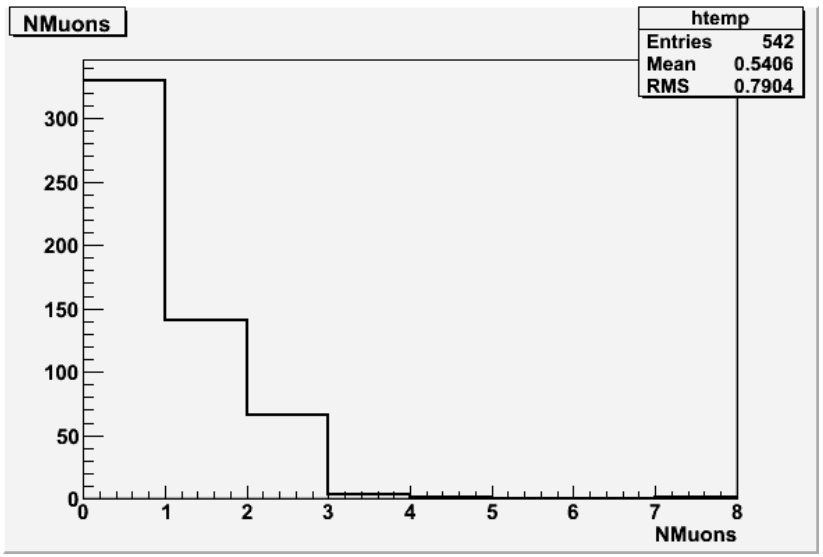


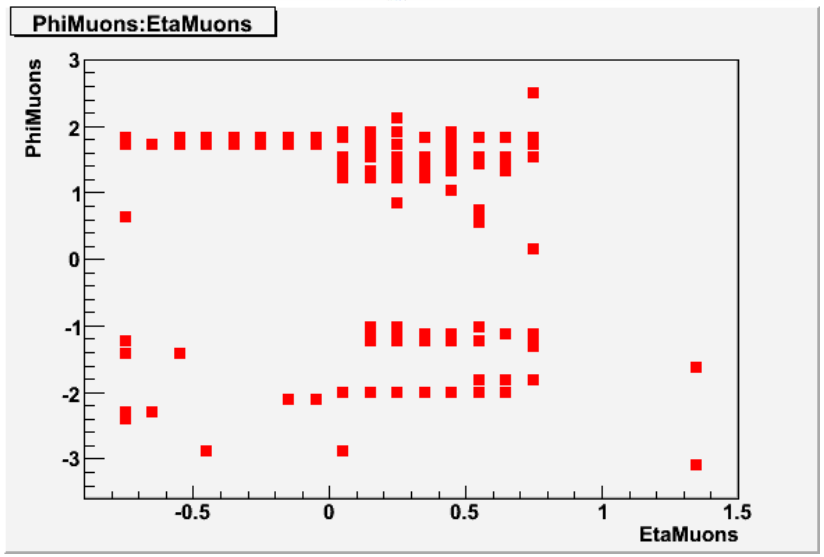
# of MDT hits per muon track

Cosmic in TileCal

- Search for muons in the TileCal cells following projective patterns in η
- Typical muon signature: ETILE<3 GeV
- Energy thresholds defined for each cell: $thr_{low} < E_{cell} < thr_{high}$, and stored in a LUT

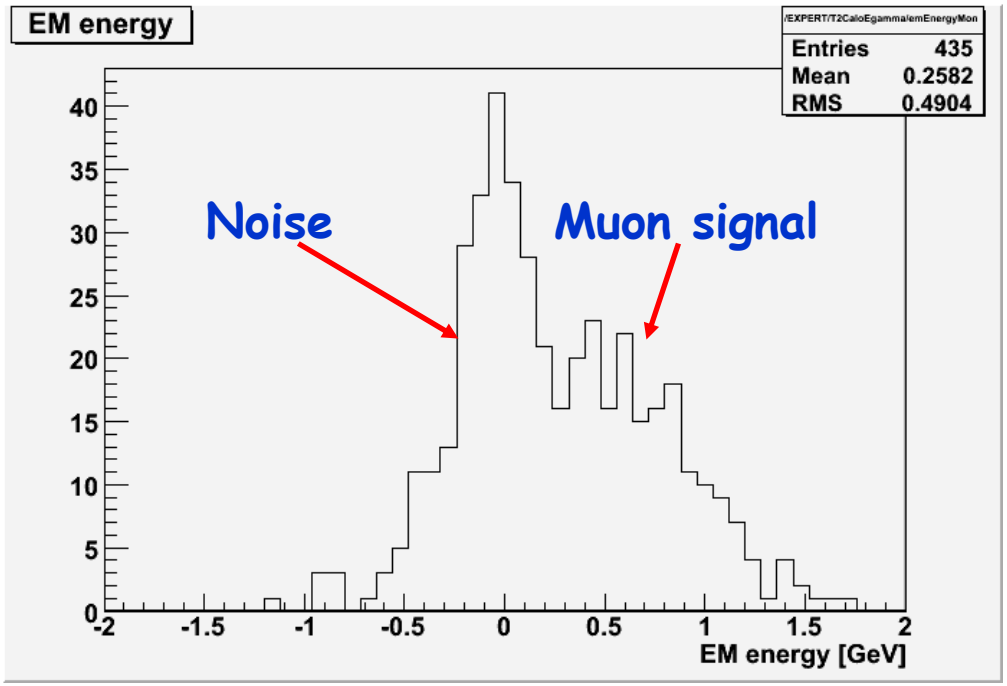


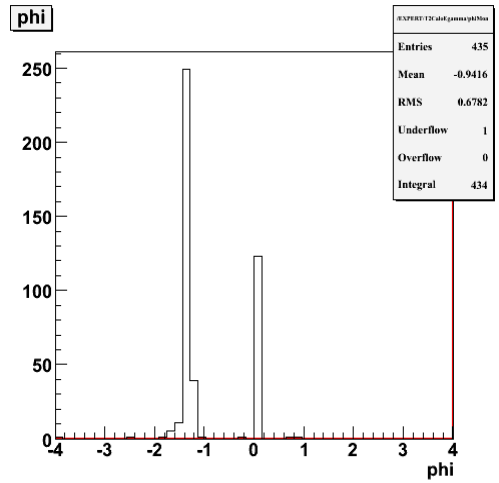


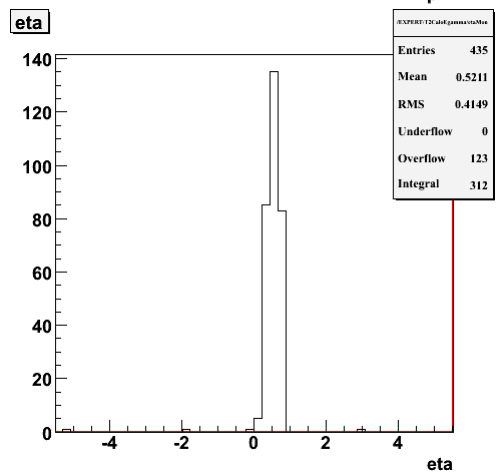


Cosmic in LAr

- Run on muon RoI from LVL1 triggered by other detectors
- Process data only in the region of interest
- Obtain η, ϕ distributions
- Reconstruct LAr cell energy etc

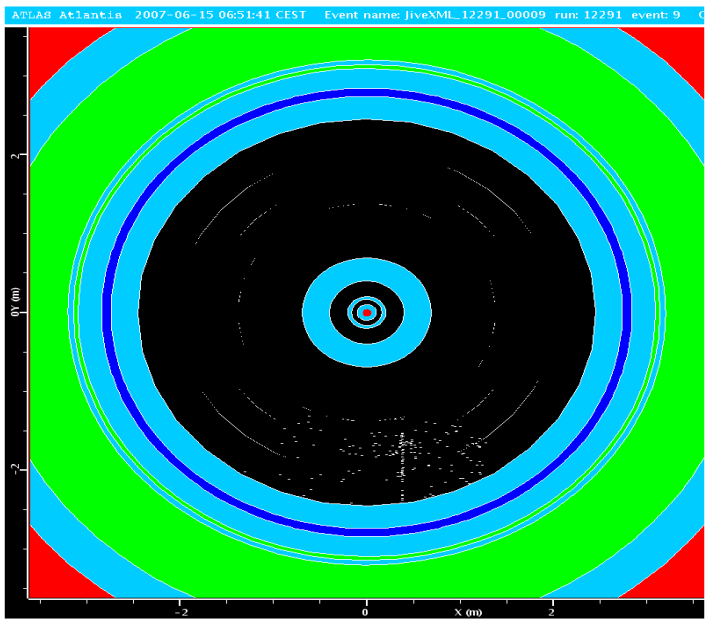


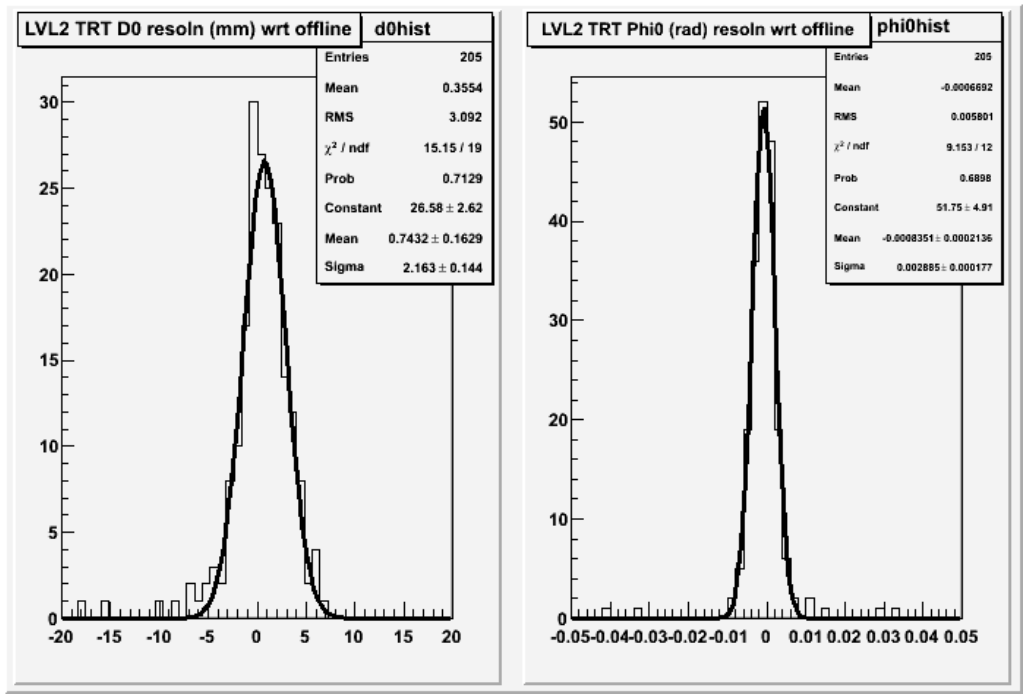




Cosmic in TRT

- Resolution of the tracks found by LVL2 wrt offline tracks
- Resolution of 2mm in d0 and 3mrad in ϕ are consistent with simulation





Integration without Detector

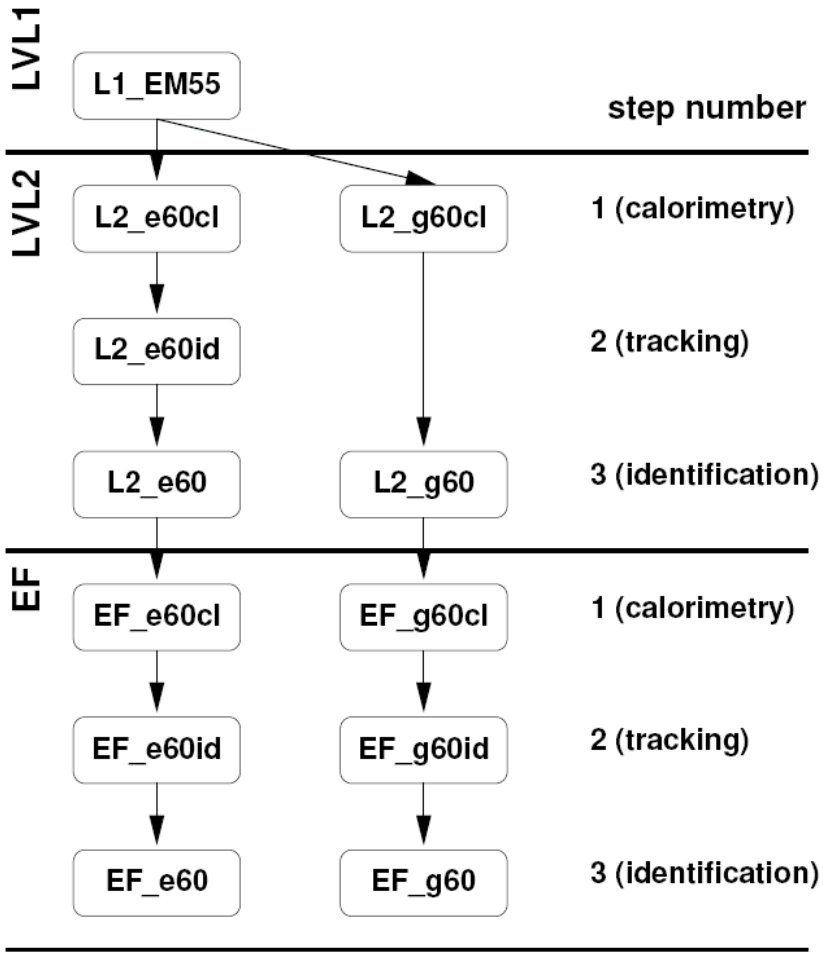
- Generate events by subsystem internally
- Use simulated events or replay cosmic events taken with detectors
- Preload ROIB/L2SV and ROS
- Deploy subsystem functionality (HLT(LVL2/EF), EB, etc)
- Improve subsystem performance
- Perform Stress tests
- Integrate subsystems toward to ATLAS operation mode

HLT Requirement

	LVL2	EF
Rates	Full System	Full System
	Input 100 KHz ~500 nodes 200 Hz per node	Input 3 KHz ~1500 nodes 2 Hz per node
	Current Hardware	Current Hardware
	8 L2PUs / node ~40 ms/event per L2PU (Data Collection+Processing time)	8 PTs / node ~4 s/event per PT
Data Size	~2% of data ~ 30 ROBs / event	Full Event ~1.5 MB

HLT Concept

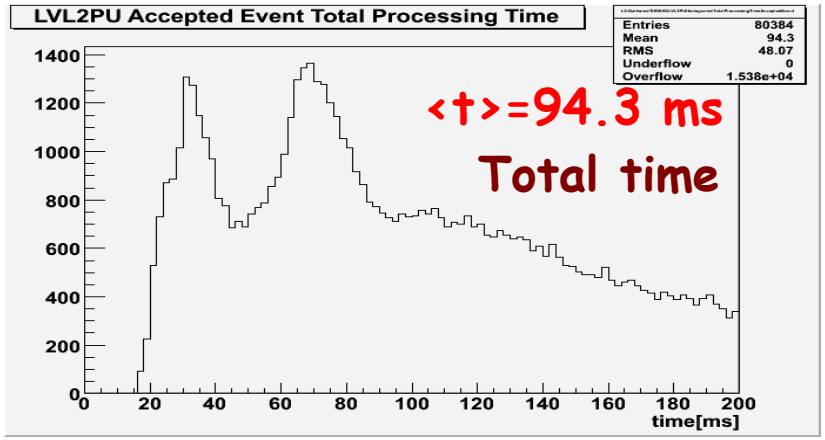
- Algorithms are executed based on trigger chains
- Chains are activated based on result of previous level
- Each chain is divided in steps
- Each step executes an algorithm sequence (one or more algs)
- A step failed to produce an expected result ends the chain
- Any chain can pass the event

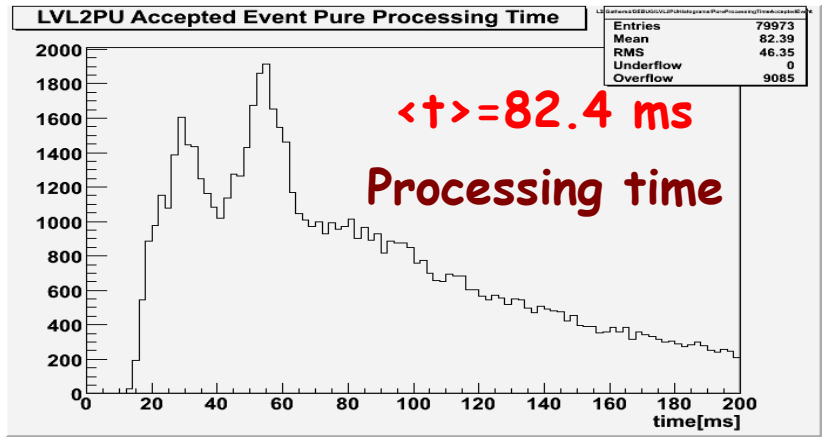


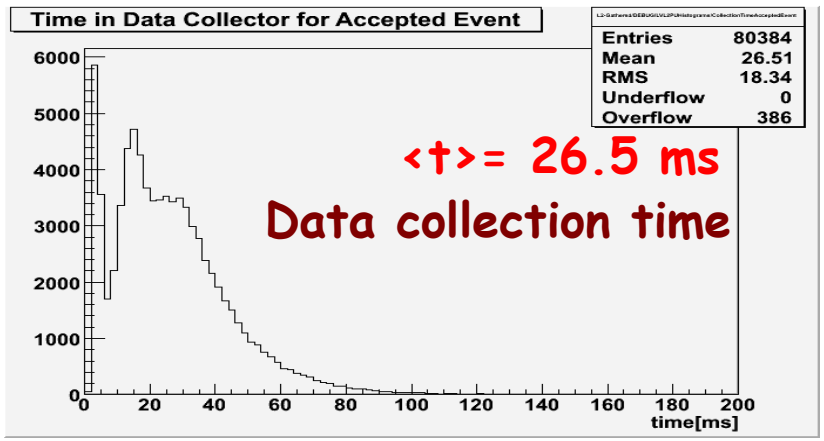
Main Algorithms

	Electron	Tau	Muon	Jet
L2 sequence	• T2CaloEgamma • L2CaloHypo • IdScan • TrigSiTrack • L2IDCaloHypo	• T2CaloTau • L2CaloTauHypo • IdScan • L2IDTauHypo • T2TauFinal • T2TauHypo	• muFast • muFastHypo • IdScan • muComb • muCombHypo	• T2CaloJet • TrigL2JetHypo
EF sequence	• TrigCaloCellMaker • TrigCaloTowerMaker • TrigCaloClusterMaker • SCTClustering • PixelClustering • TRTDrifCircleMaker • SiTrigTrackFinder • TRTTrackExtAlg • TrigVxPrimary • TrigEFTrackHypo • TrigEgammaRec • TrigEFEgammaHypo	• TrigCaloCellMaker • TrigCaloTowerMaker • TrigCaloClusterMaker • SCTClustering • PixelClustering • TRTDrifCircleMaker • SiTrigTrackFinder • TRTTrackExtAlg • TrigVxPrimary • TrigTauRec • EFTauHypo	• TrigMoore	• TrigCaloCellMaker • TrigCaloTowerMaker • TrigJetRec • TrigEFJetHypo

LVL2 Time

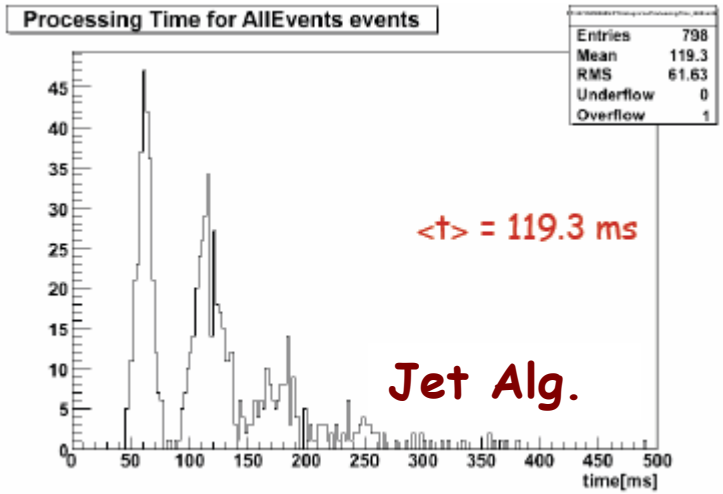


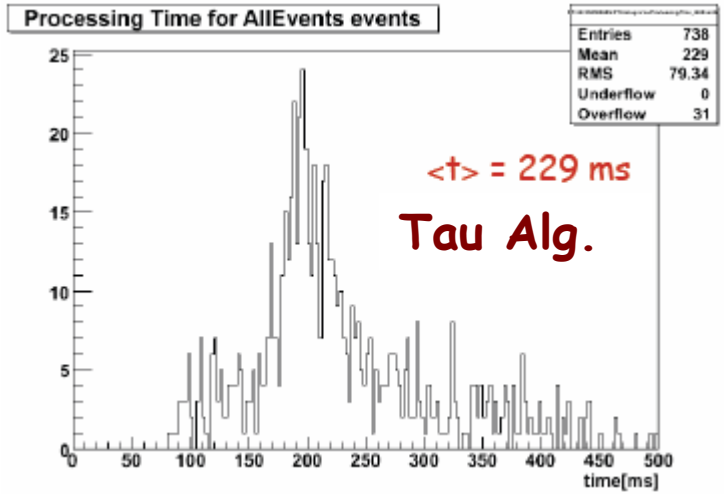


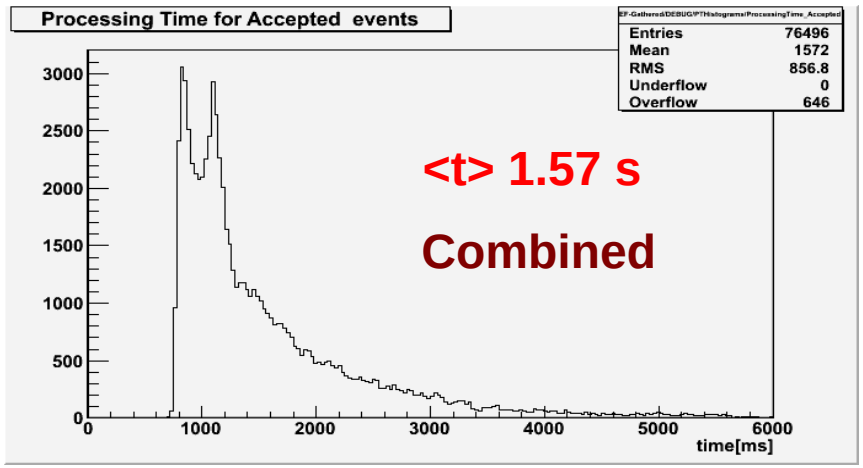


Accepted events
Combined Alg.

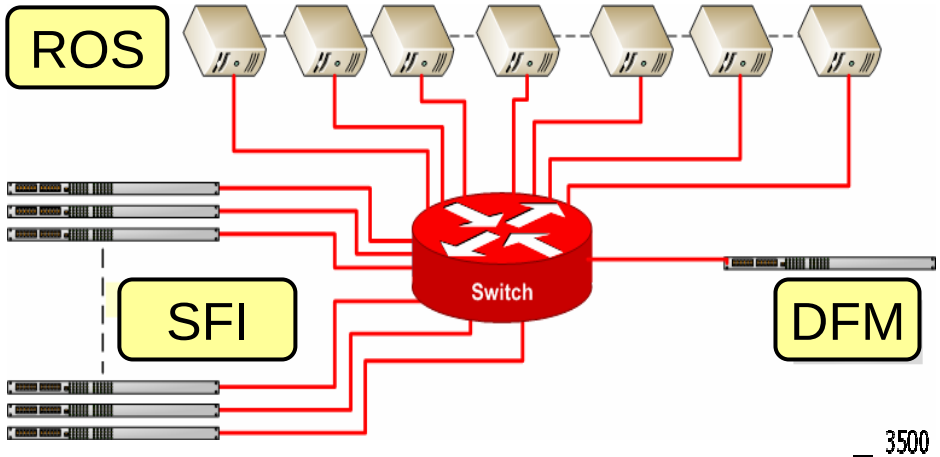
EF Time


Processing Time for AllEvents events
Entries 798
Mean 119.3
RMS 61.63
Underflow 0
Overflow 1
<t> = 119.3 ms
Jet Alg.
time[ms]


Processing Time for AllEvents events
Entries 738
Mean 229
RMS 79.34
Underflow 0
Overflow 31
<t> = 229 ms
Tau Alg.
time[ms]

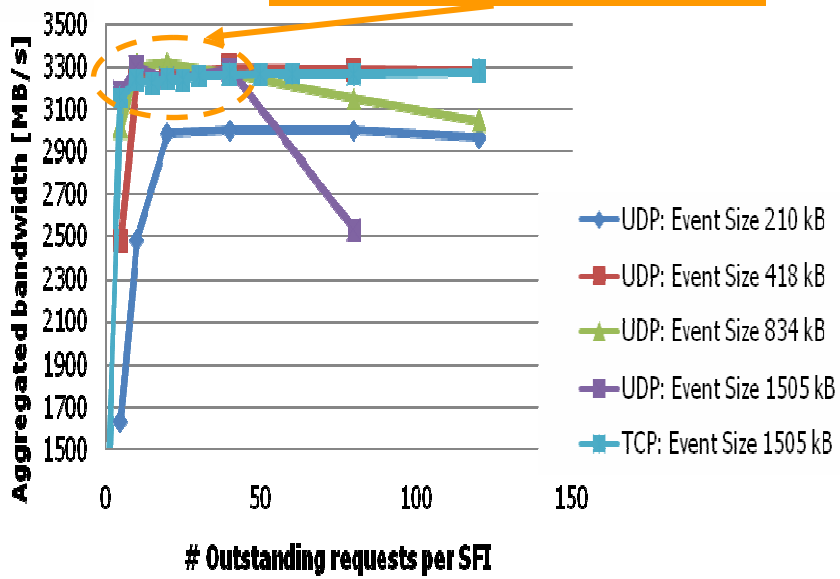

Processing Time for Accepted events
Entries 76496
Mean 1572
RMS 856.8
Underflow 0
Overflow 646
<t> 1.57 s
Combined
time[ms]

EB Traffic



ROS-SFI & ROS-DFM
UDP vs TCP

TCP: long plateau
UDP: optimal range

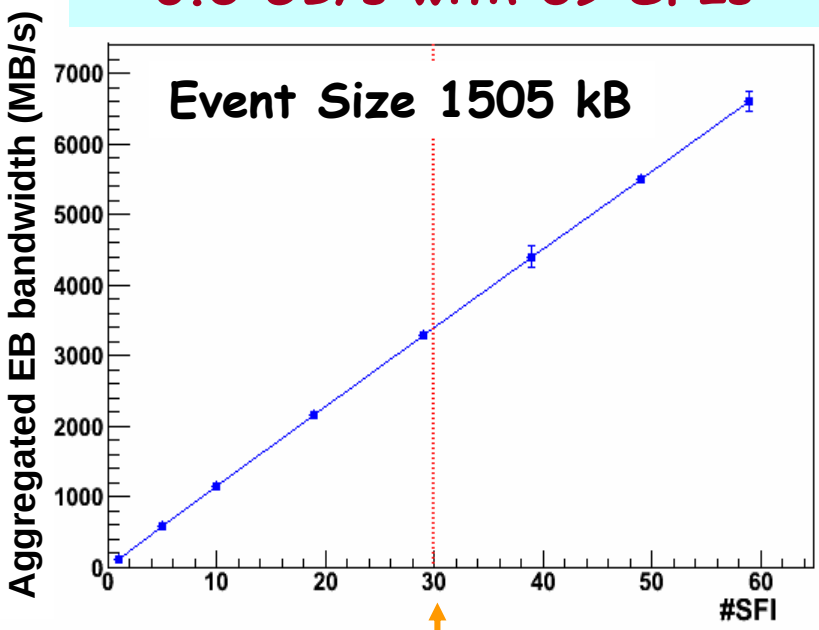


Traffic Shaping parameter
# of outstanding requests of ROS fragments from each SFI

- Active control of the EB rate
- Limited rate with large traffic shaping (loss & reasking)

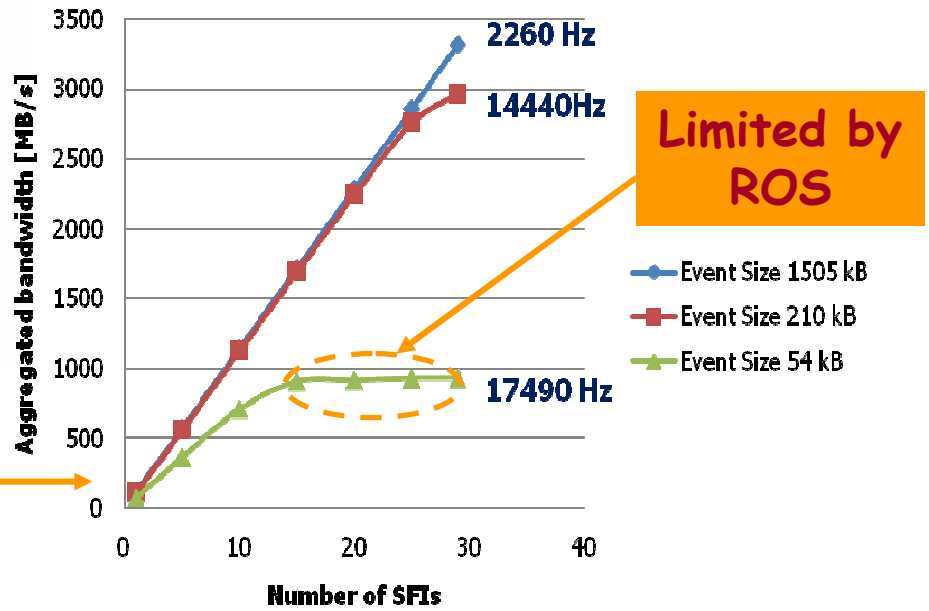
EB Rate Scaling

6.5 GB/s with 59 SFIs



no LVL2 traffic

Final system OK
for 1.5 MB/event at 3 kHz



Limited by ROS

Summary

- ATLAS TDAQ system is being deployed
- Partially installed TDAQ system is functional
- Integration of Level-1, Level-2 system have been started
- Level-1 system is triggering real cosmics consistently and being completed
- Level-2 algorithms are in time budget and being improved
- ATLAS commissioning continues before LHC data comes