Deadtime Simulation for ATLAS Level 1 Central Trigger

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ROADMAP

Introduction & Background

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# INTRODUCTION & BACKGROUND

ATLAS' Big Data Problem

- LHC: Proton bunches
  - 3564 bunches per orbit, 25ns time separation → 40 MHz bunch crossing rate
  - Cannot record all this data (time, $$$) →
    - Triggers (select "interesting" events)
    - Deadtime (ignore events)

LHC Bunch Crossings		L1CT (Hardware)		HLT (Software)		Permanent Storage
	$4*10^7$ Hz		$1*10^5$ Hz		$1*10^3$ Hz	

L1CT must be **simple** + **fast**; eliminate background while keeping good events

Deadtime

- Detectors take event data, write to temporary storage ("buffers")

- Trigger system processes event – if fits requirements, issues "Level 1 Accept" (L1A) signal

- Reading information from detector buffers to HLT storage takes time

- Lowering data rate, trying to maintain high efficiency for physics events
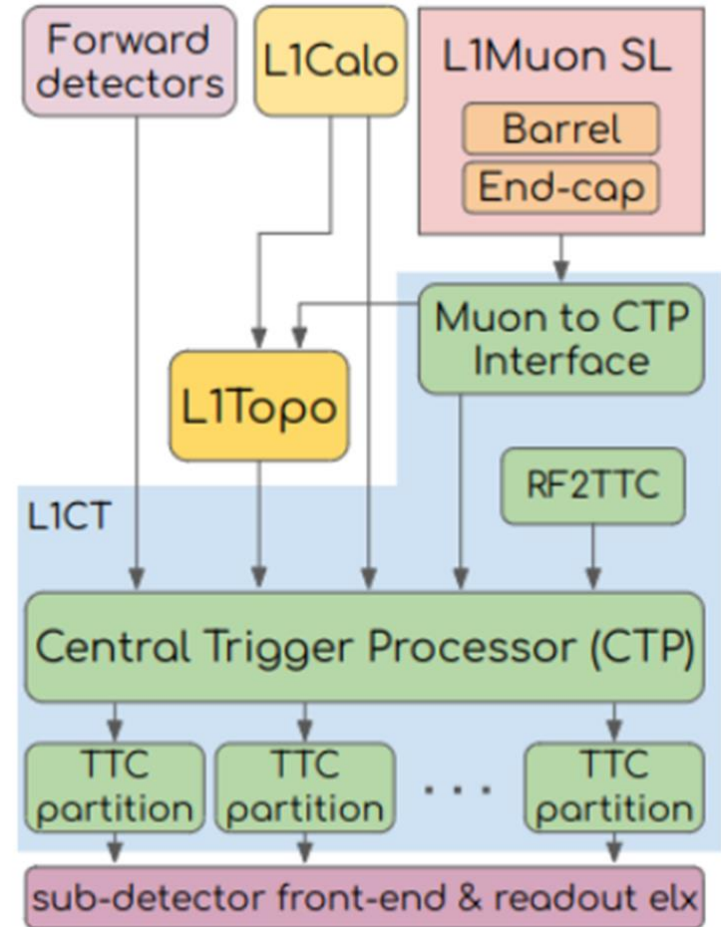
Deadtime Logic

Simple: After L1A, ignore N events
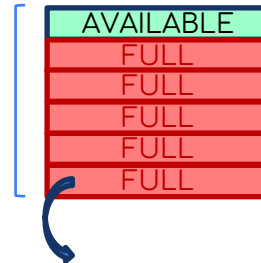
Prevents overlap in events being read out
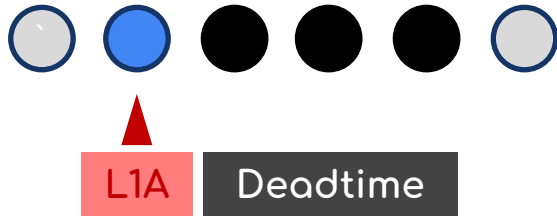
Complex: Sliding Window, Leaky Bucket Algorithms

Prevents buffer overflow
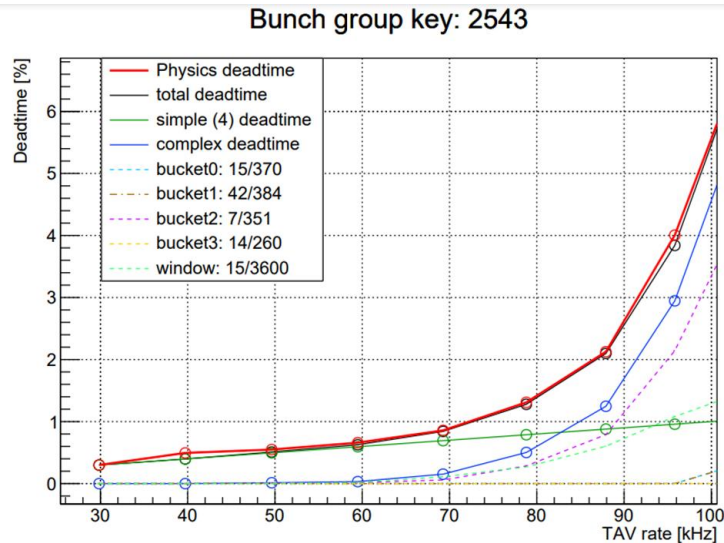
Allow A triggers in a window of length B

Model detector buffer as a bucket with size C and leak rate D, don't allow triggers when full

AVAILABLE
FULL
FULL
FULL
FULL
FULL

L1A   Deadtime

# PROJECT SCOPE & SPECIFICATIONS

Deadtime Simulation

- **Existing Deadtime Simulation Program**

  ○ Take real LHC bunch group filling patterns, randomly assign triggers at different frequencies

  ○ Calculates **simple, complex, total, and "physics" deadtime**

    ○ Deadtime per bucket/logic mechanism

    ○ How many triggers/important events missed?

Bunch group key: 2543

Legend:
- Physics deadtime
- total deadtime
- simple (4) deadtime
- complex deadtime
- bucket0: 15/370
- bucket1: 42/384
- bucket2: 7/351
- bucket3: 14/260
- window: 15/3600

Areas for Improvement

- Only accessible via terminal: secure copy program files, run

- All configuration must be directly edited in code

- Bunch group input mode: ATLAS TriggerTool Bunch Group Keys only

- No flexibility for simulating triggers for bcids outside of bunch group 1
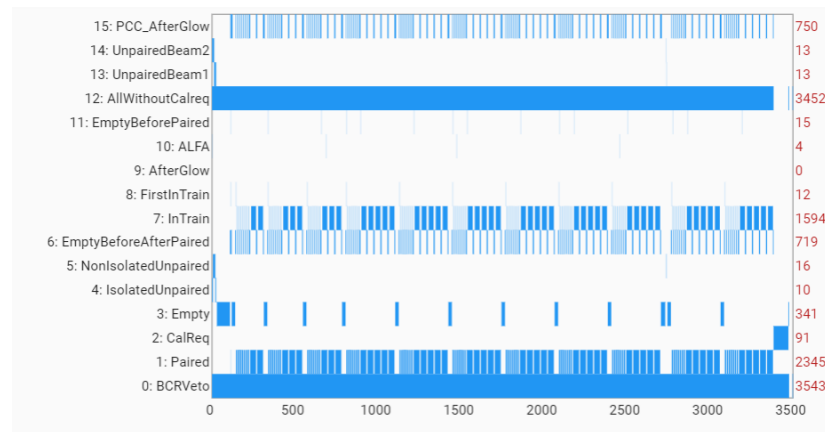
TriggerTool visualization of bcids and corresponding bunch groups (information accessible via BGK)

My Project

- Phase 1: Enable online monitoring, adjustable parameters
  - Full original functionality, but online and with user-friendly display
- Phase 2: Additional simulation capabilities
  - Bunch Group 15 triggering – trigger events that affect deadtime but aren't interesting for physics
  - Add input sources
    - LHC fill schemes (user file upload)
    - Get current bunch group key being used in ATLAS (via WebIS)
  - Random seed number for repeatability

PROJECT DEMO

Links

Project Site

http://pc-adt-04.cern.ch/CtpWebMonitoring_Sarah/www/MainPage.php?url=Deadtime

Demo Video

FUTURE STEPS

Next Steps

- Short term (me)
  - Patch security holes
  - Validate form entries
  - Improve documentation
- Long term (someone else?)
  - Multithreading for faster simulation speed
  - Merge production branch into official ATLAS Web Monitoring Site
  - Connect WebIS to active ATLAS information (vs. current pc-adt-04 setup)
  - Incorporate tool into ATLAS control room display?

Acknowledgements
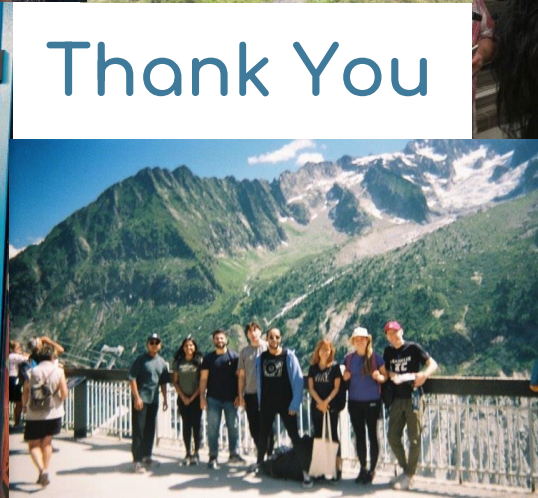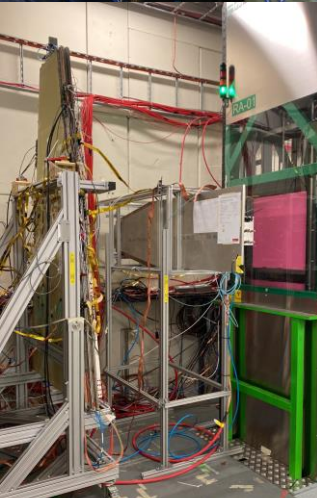
Thank You

Sources

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