

ATLAS L1Calo Trigger Joint Meeting
Emmanuel College, Cambridge, UK
March 23 - 25, 2011

Trigger Operations

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Introduction



- ✘ What it is and who is who
- ✘ Sneak preview of 2011 running

Thanks to B. Petersen
and F. Winklmeier for material

ATLAS Trigger – Who Is Who

Trigger Coordination

Srini Rajagopalan, David Strom

Trigger/DAQ System

Chris Bee, David Francis

Level-1 Trigger

Domenico Della Volpe

Trigger Monitoring

Martin zur Nedden, Valeria Bartsch

Menus & Performance

Olya Igonkina, Brian Petersen

Trigger Core Software

Tomasz Bold, Joerg Stelzer

Trigger Operation

Alessandro Cerri, Martin Wessels

Software Releases & Validation

Simon George, David Strom

Trigger Signature Groups

MinBias, Jet, Tau, MissingEt, Muon,
B-Physics, B-Jets, Electron/Photon

Trigger Detector Software

Online beam spot, calorimeter trigger,
inner detector trigger, muon trigger,
calibration, cosmic ray

Trigger Operations

TrigOps Coordination
2 people



boss



Let's quickly continue ...

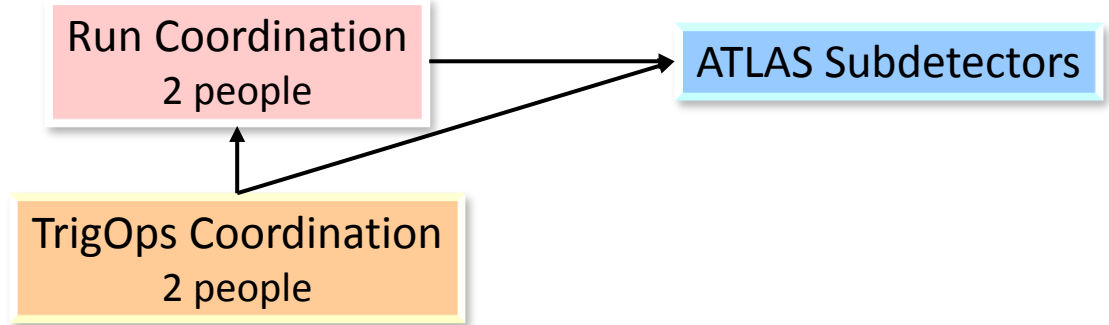
Trigger Operations Mandate

- Responsible for an **efficient online execution** of agreed upon trigger
- Responsible for **appropriate scheduling** for various trigger requests and changes
- **Liaise with Run Coordination**
- Attend Daily run meetings **representing the trigger activities**
- **Day to day operational duties**, including:
 - Deployment of agreed triggers and pre-scale sets
 - Take any **operational decisions** concerning modifications of algorithms and menus that require immediate action (**typically < 24 h**)
 - Ensure **proper monitoring** of online triggers and attend to any problems (directly or through relevant experts as the case requires)
 - Certify that the menus are **tested on CAF** before their online deployment
 - Ensure that the **debug streams** are processed appropriately
 - Ensure that the **initial data quality flags** for triggers are set and reported appropriately at the Data Quality meeting working closely with the monitoring group
- Provide **weekly reports** at the Trigger General meetings
- **Communicate regularly with menu & performance conveners** and provide operational feedback, in particular on actions that have been taken

Trigger Operations

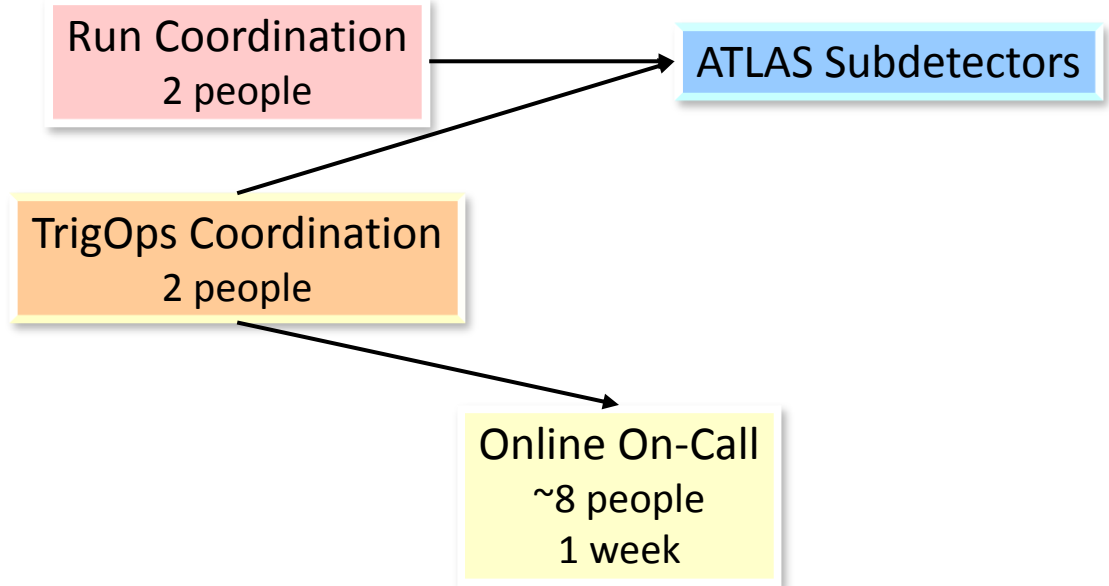
TrigOps Coordination
2 people

Trigger Operations



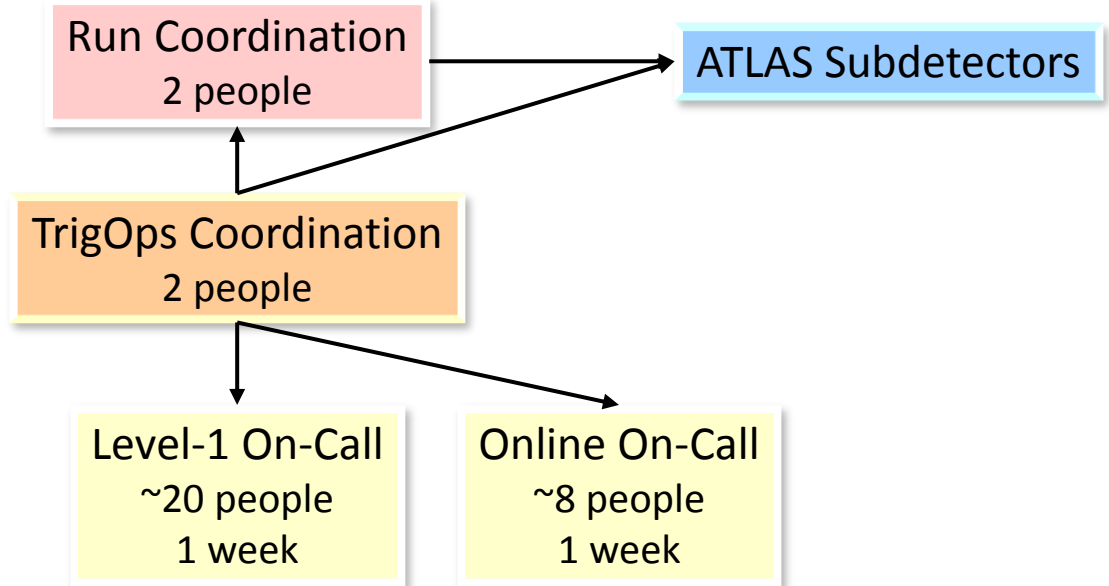
- Responsible for efficient trigger online operation at P1
- Day to day planning and trigger operation at P1
- Liaise with Run Coordination and detector systems
- Represent trigger in daily run meetings
- Responsible for appropriate scheduling for various trigger requests and changes

Trigger Operations



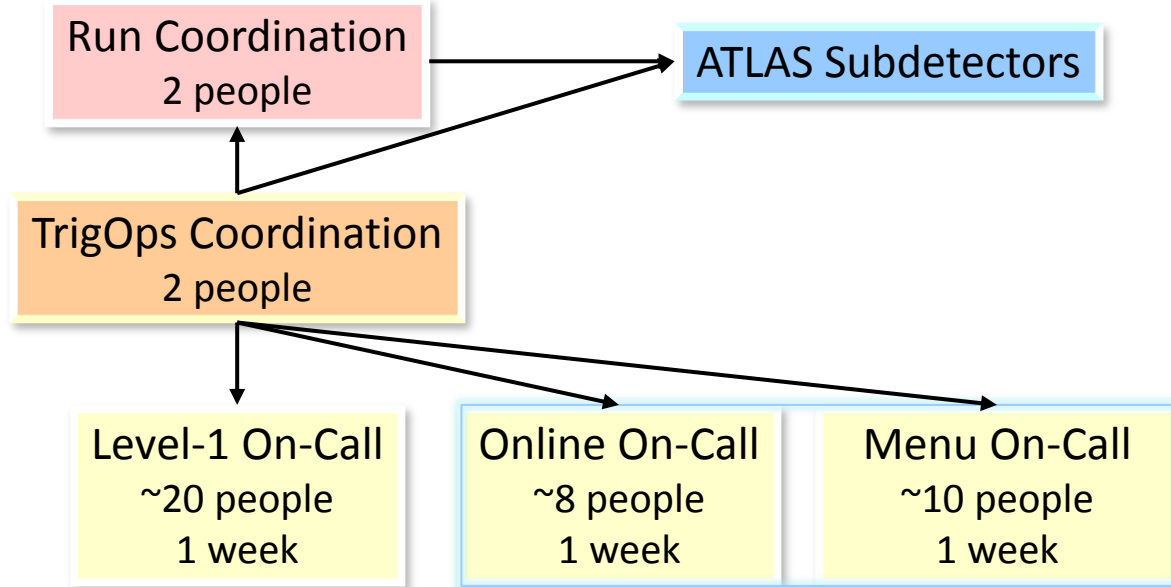
- General executive in P1, main contact for P1 shifter
- First level troubleshooting, implement emergency fixes
- Deploys new trigger software and menus
- 24/7 trigger monitoring
- Demanding job, presence in P1 often required

Trigger Operations



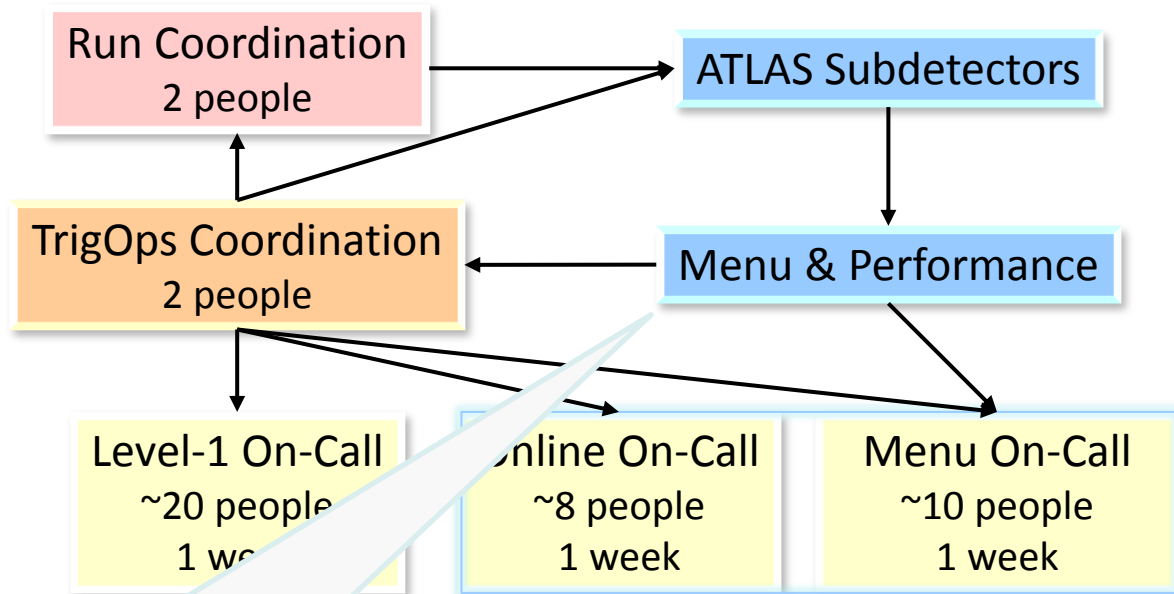
- Represents various L1 subsystems
- L1 contact for shifters and trigger experts
- Data quality contact for L1

Trigger Operations



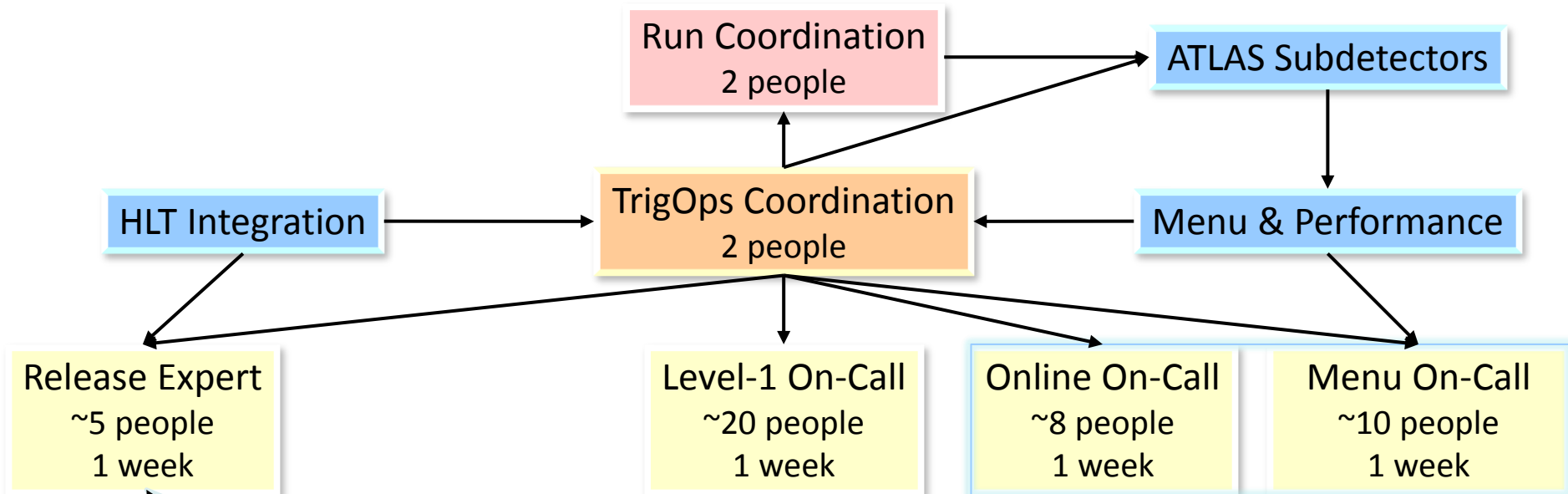
- Prepares trigger menus and prescales for P1
- Close collaboration with Online On-Call
- Similar demanding job, presence in P1 often required
- Prepares menus and prescales for CAF processing

Trigger Operations



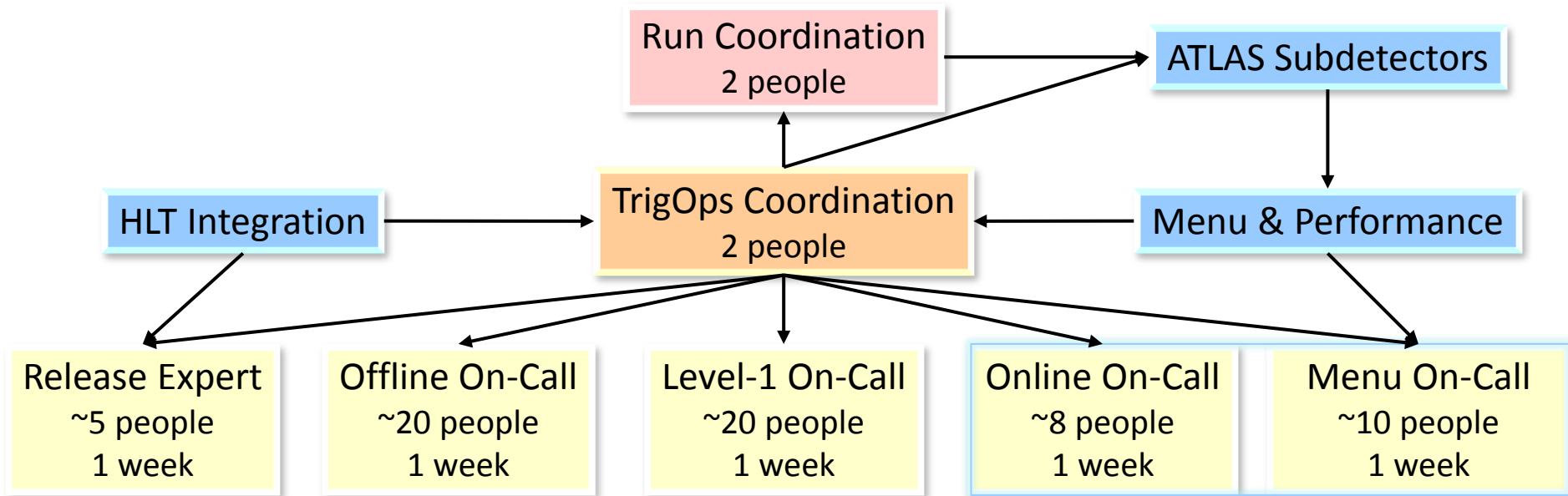
- Trigger menus and prescales are coming from menu & performance coordination
- Implementation at P1 approved and scheduled by trigger operation coordination

Trigger Operations



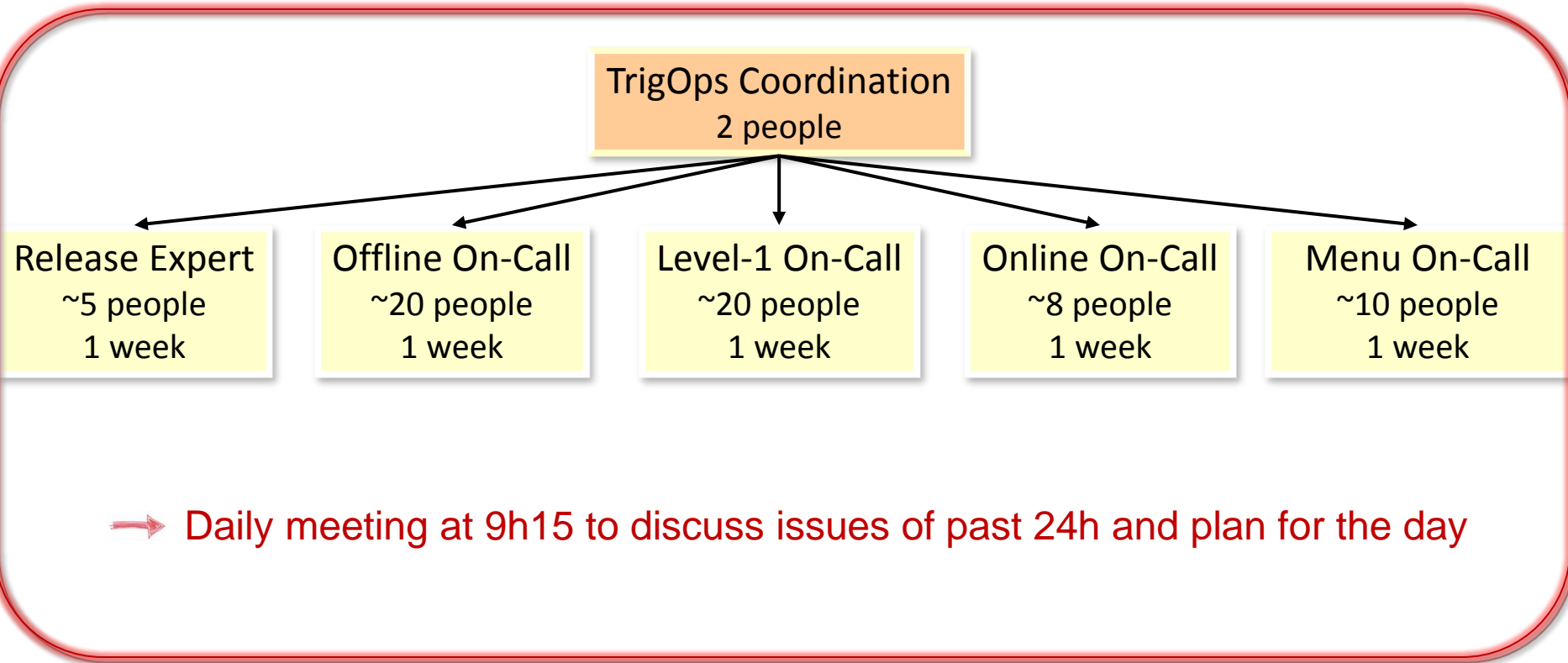
- Reviews, collects and tracks requested software changes for P1 and CAF cache
- Continuous checks on nightly builds
- Contact to offline release builders
- New software validated by HLT Integration to ensure suitability for online running

Trigger Operations

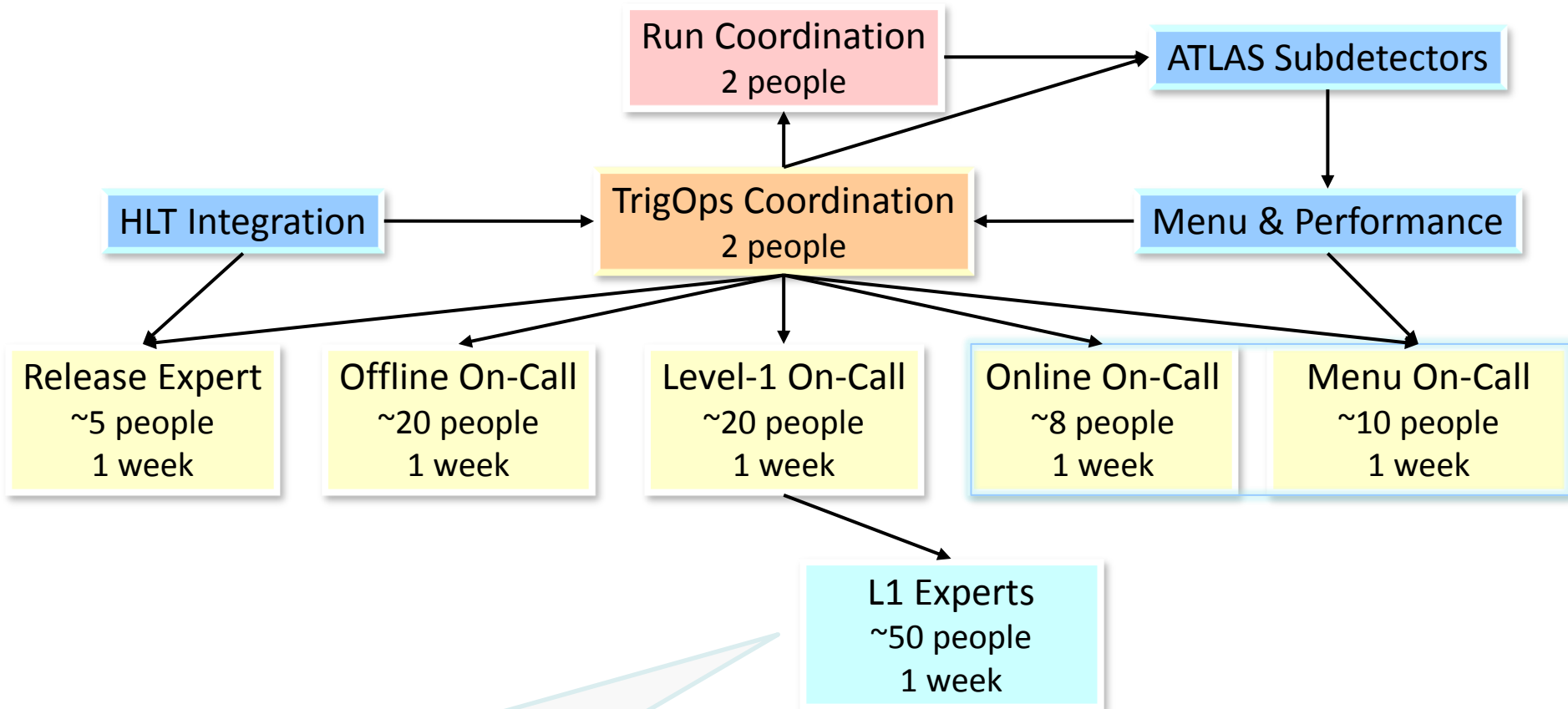


- Main contact for offline shifter
- Collects and reports trigger DQ status
- Runs CAF processing and collect sign-offs

Trigger Operations

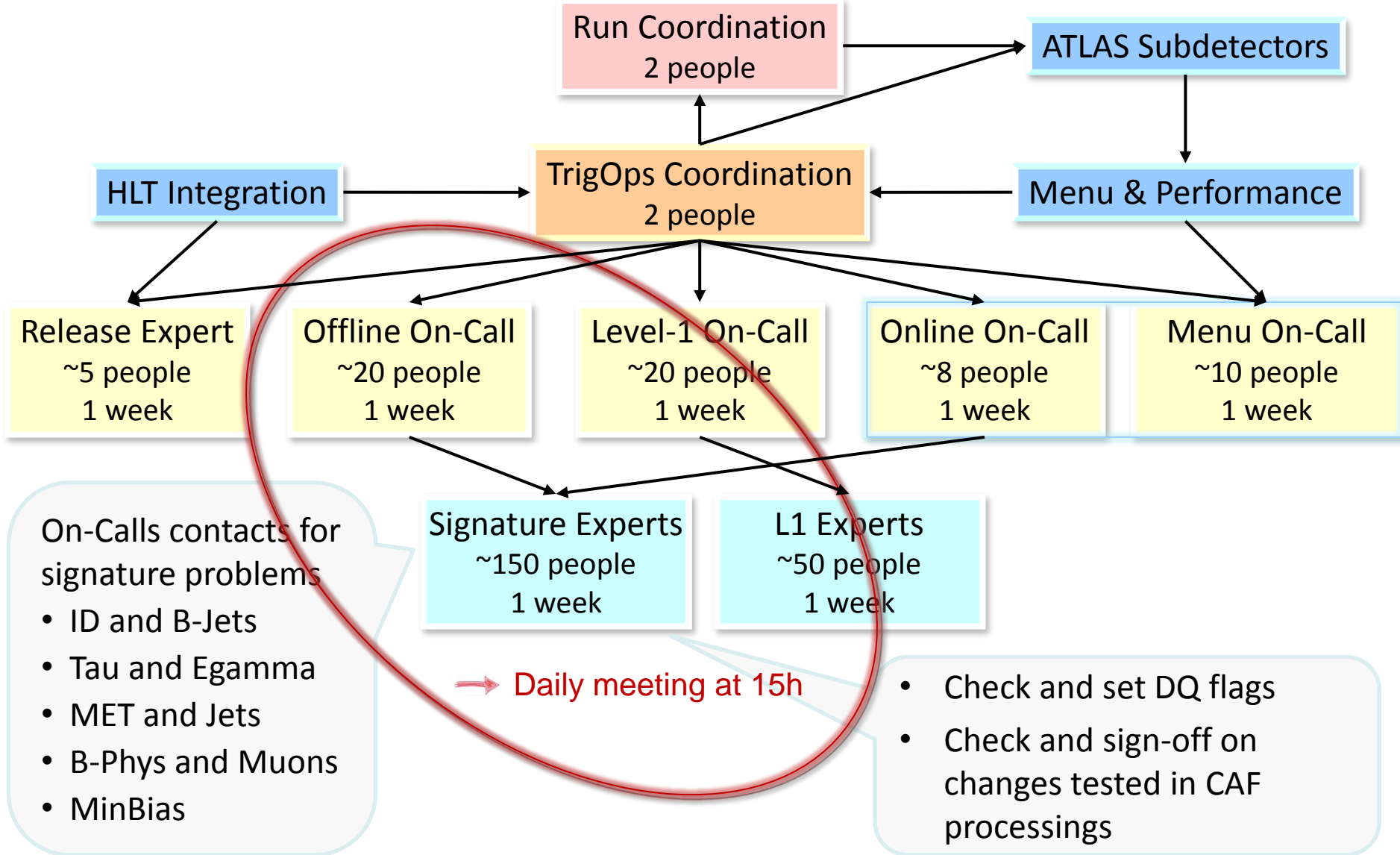


Trigger Operations

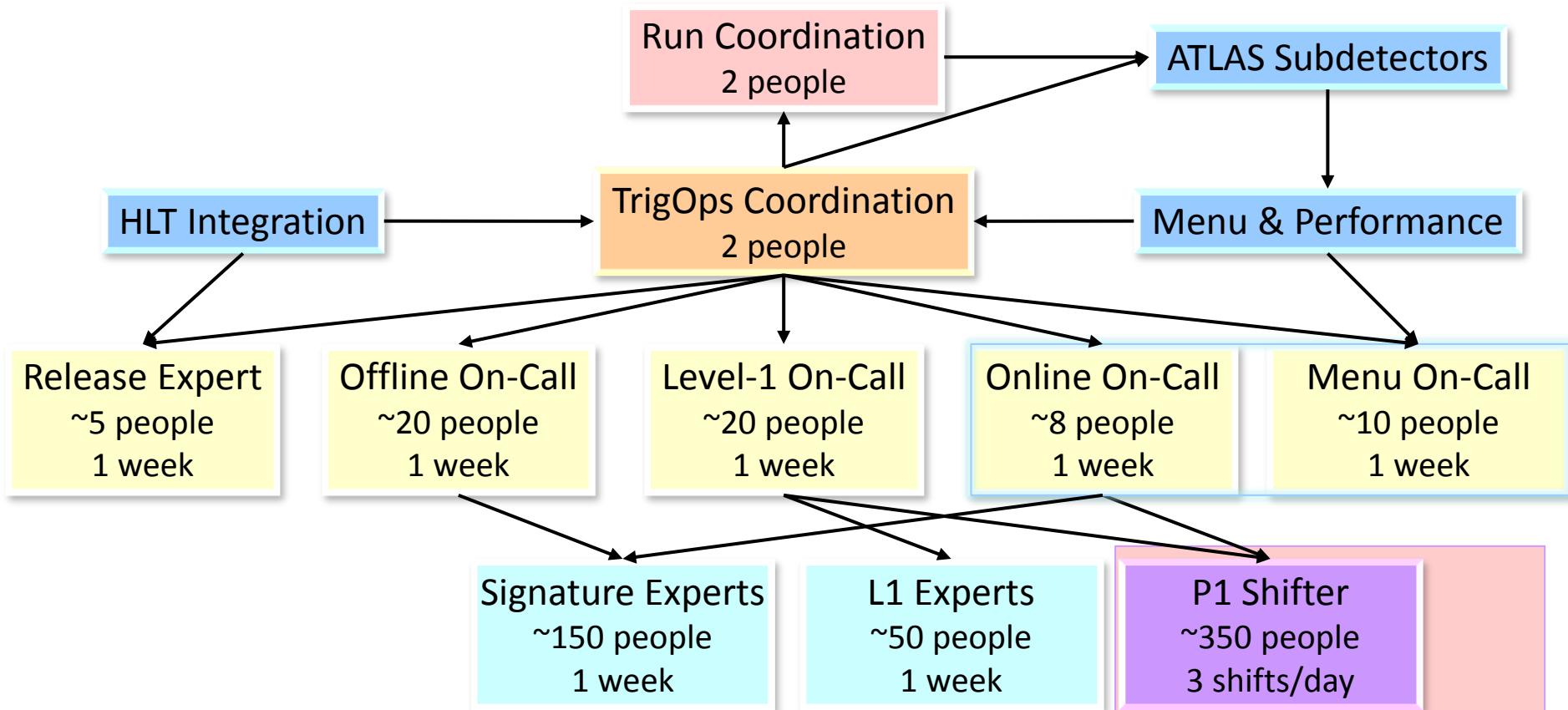


- At least one expert per L1 system
- 24/7 L1 monitoring
- Checks and sets L1 DQ flags

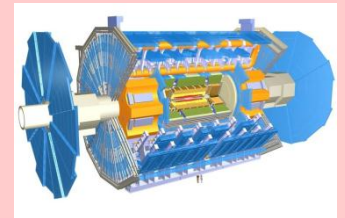
Trigger Operations



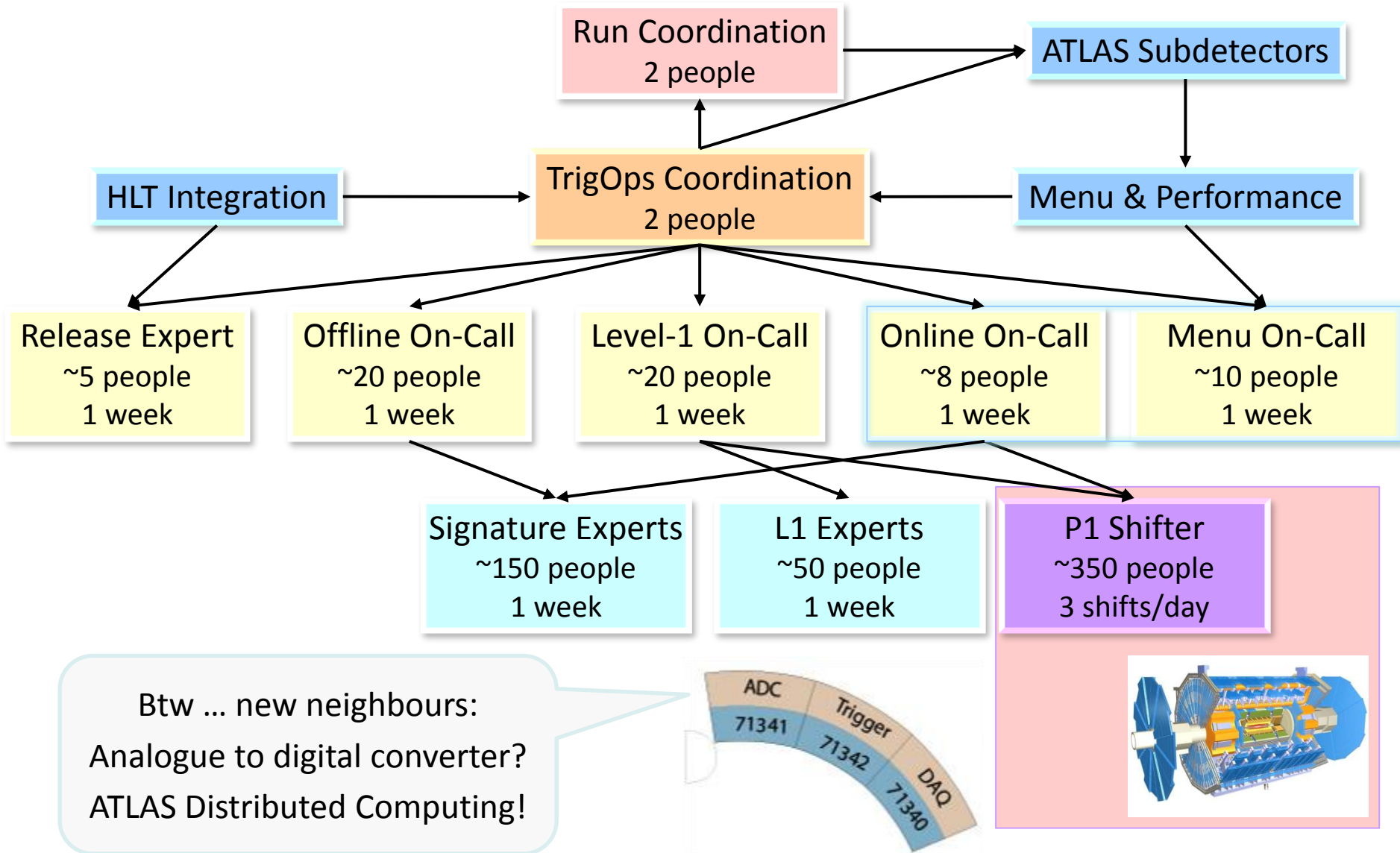
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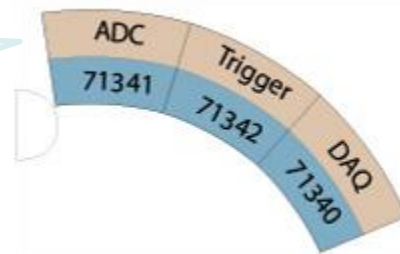
- Routine trigger operation and monitoring at P1
- Bunch group definition and prescale selection
- Trigger rates and data online quality monitoring



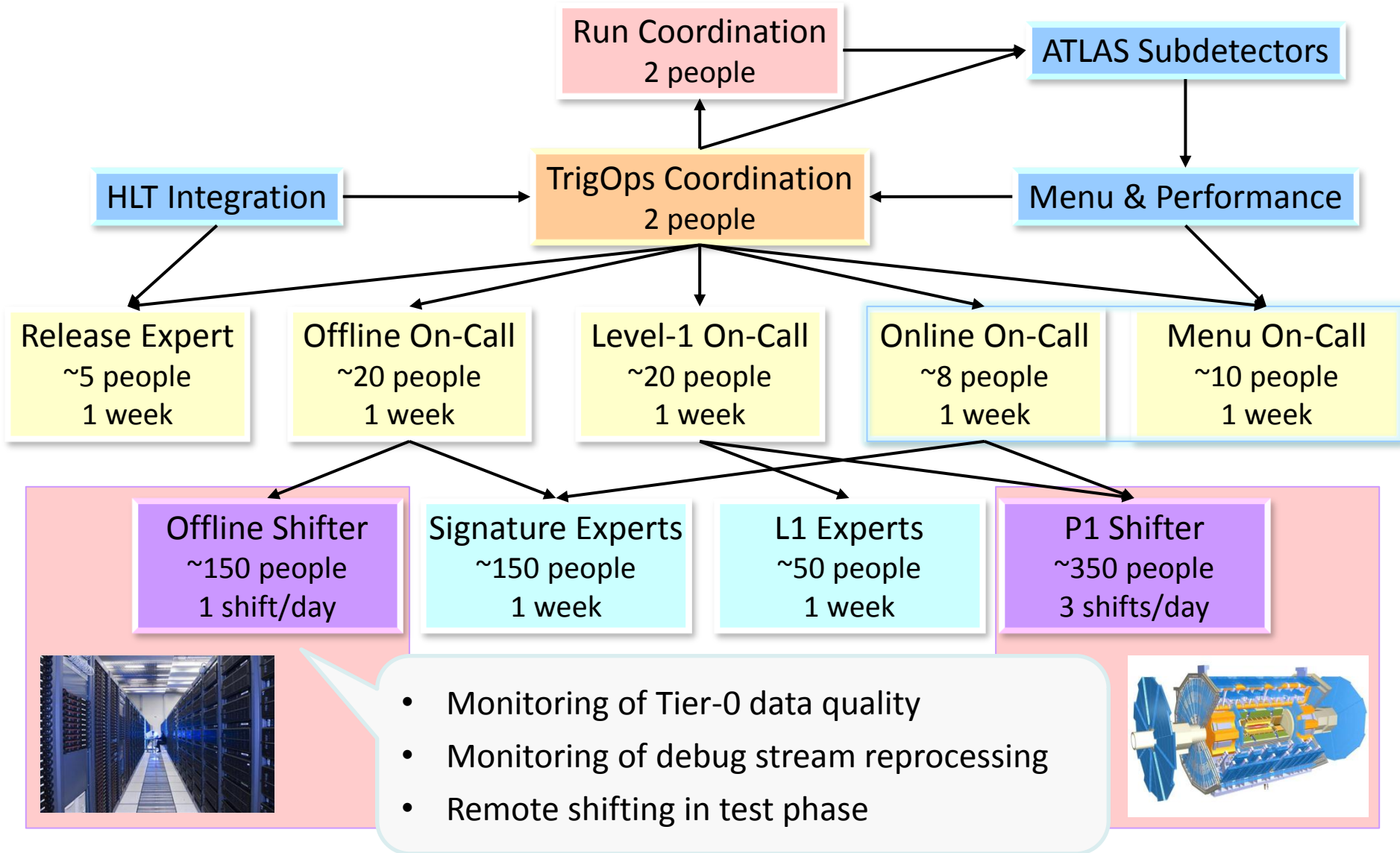
Trigger Operations



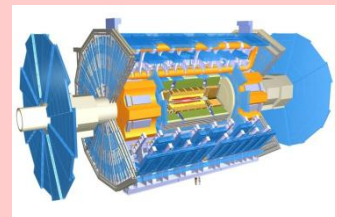
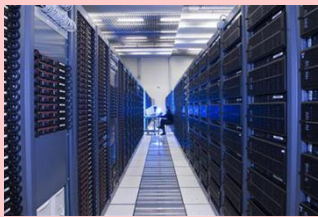
Btw ... new neighbours:
Analogue to digital converter?
ATLAS Distributed Computing!



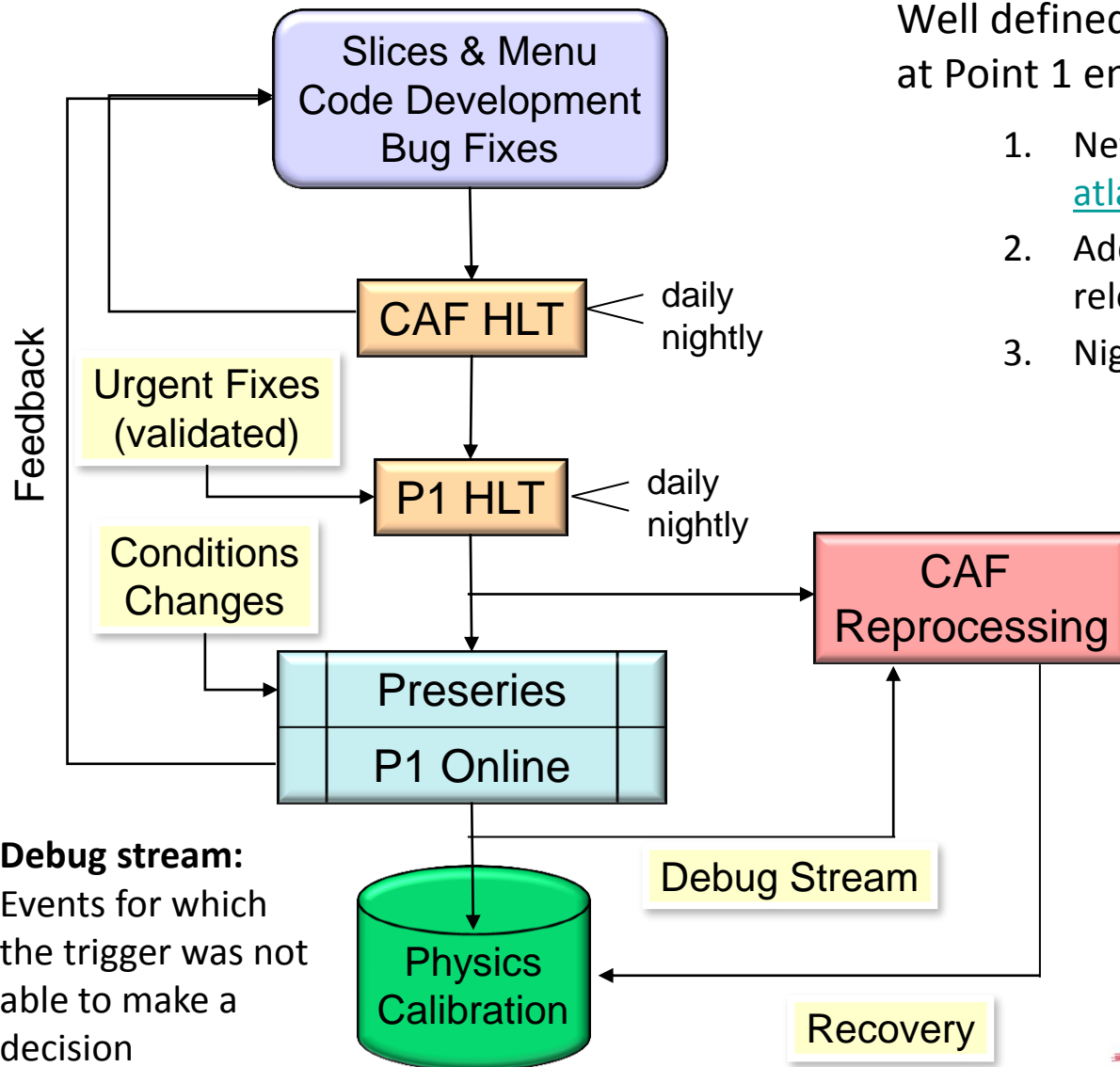
Trigger Operations



- Monitoring of Tier-0 data quality
- Monitoring of debug stream reprocessing
- Remote shifting in test phase



Operating & Changing the Trigger



Well defined procedure for trigger updates at Point 1 ensuring smooth ATLAS operation

1. New tags being requested for P1 at atlas-trig-relcord@cern.ch
2. Added to CAFHLT nightly after check by release expert,
3. Nightly results validated
4. New CAFHLT cache build when sufficient changes
5. Offline expert starts CAF reprocessing
6. Signature experts on-call signs-off
7. Operations signs-off on deployment
8. P1HLT cache build and installed at P1
9. Final test on preseries
10. Switch P1 between fills

➔ Full update cycle: 1-2 days

L1 Contact Points

as seen by a former L1 On-Call person

9h15 meeting

- Daily planning meeting, L1 represented by L1 On-Call
- In praxis: “Is L1 happy?” – “Yes” (L1 On-Call very rarely called)
- Often boring for L1 as HLT changes much more frequent
- Ok for recap of past problems, difficult when it comes to (short-term) planning as on-call person usually not involved in work of “other” L1 systems
- Planning “detoured” via daily 9h30 run meeting (L1 status more like sub-detector rather than trigger)
- Official dataflow via trigger management mailing list in addition

Weekly General Trigger Meeting

- Important meeting for trigger information exchange, dominated by HLT and trigger signature activities (talking about trigger chains)
- L1 underrepresented, but naturally more hardware oriented/interested
- Automatic entrance via more involvement in trigger signature groups?
- Weekly L1 on-call summary talk: Good, but can we make more out of it?

Conclusions – Part A

- Trigger Operation responsible for efficient day-to-day online operation and scheduling of the ATLAS trigger
- More than 20 people (experts/shifters) involved 24/7 to ensure this (still)
- Chairs/represented in 3 daily meetings (9h15, 9h30, 15h operation meetings) and 2 weekly meetings (Trigger General and Weekly Run Meeting)



What time is it?

Trigger Menu 2011

Trigger menu design

- Assume peak luminosity will be $5 \cdot 10^{32} - 2 \cdot 10^{33} \text{ cm}^{-2} \text{ s}^{-1}$
- Use $L=10^{33} \text{ cm}^{-2} \text{ s}^{-1}$ as *baseline* with output bandwidth of 200 Hz
- What is the physics gain with 400 Hz output bandwidth ?

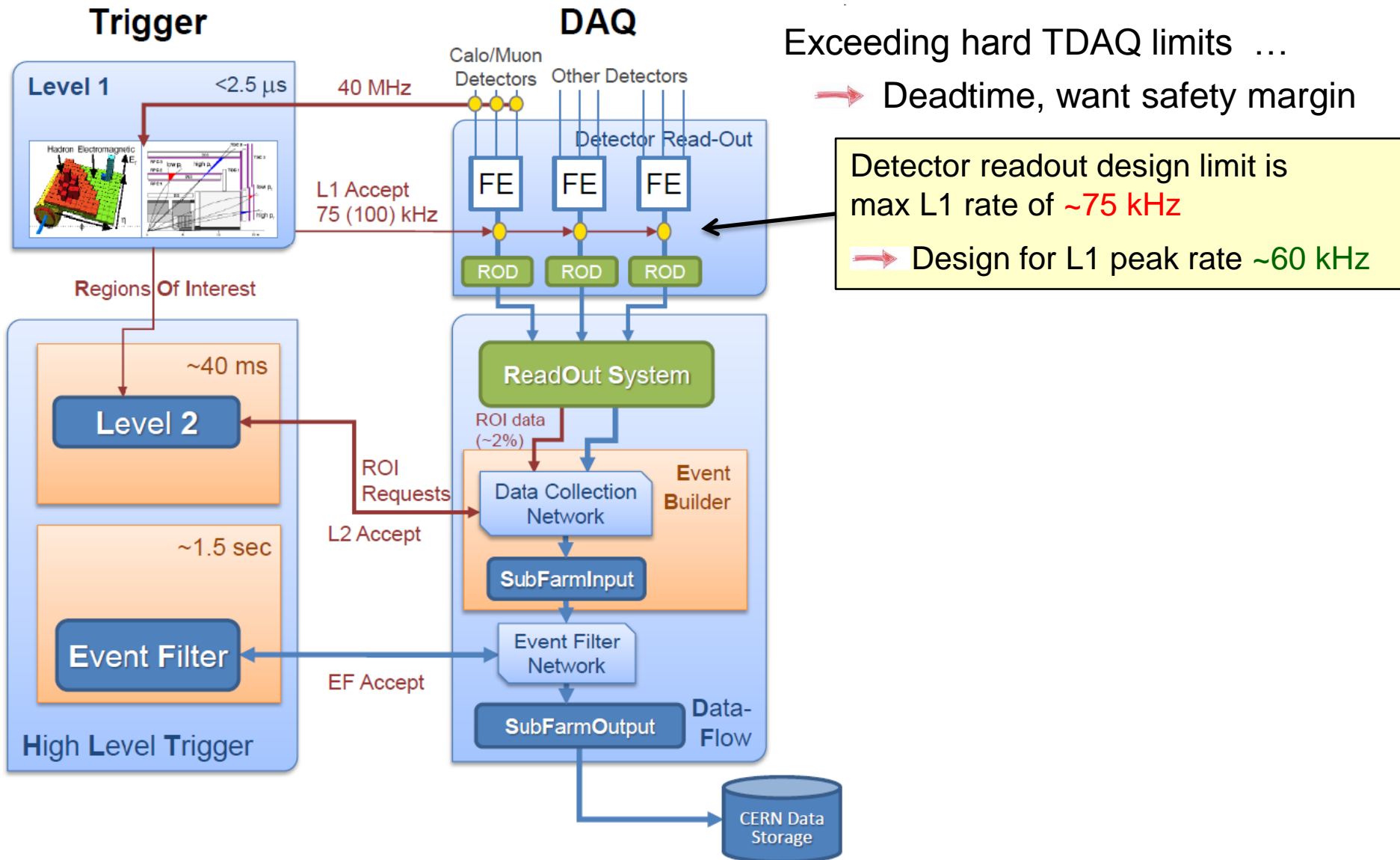
Baseline menu

- Collected inputs from physics and trigger groups at Amsterdam trigger workshop and follow-up meetings
- Trigger rates have been extrapolated to $L=10^{33} \text{ cm}^{-2} \text{ s}^{-1}$ taking into account expected trigger improvements
- Based on physics requirements and DAQ limitations on triggers, a baseline menu for $L=10^{33}$ has been designed

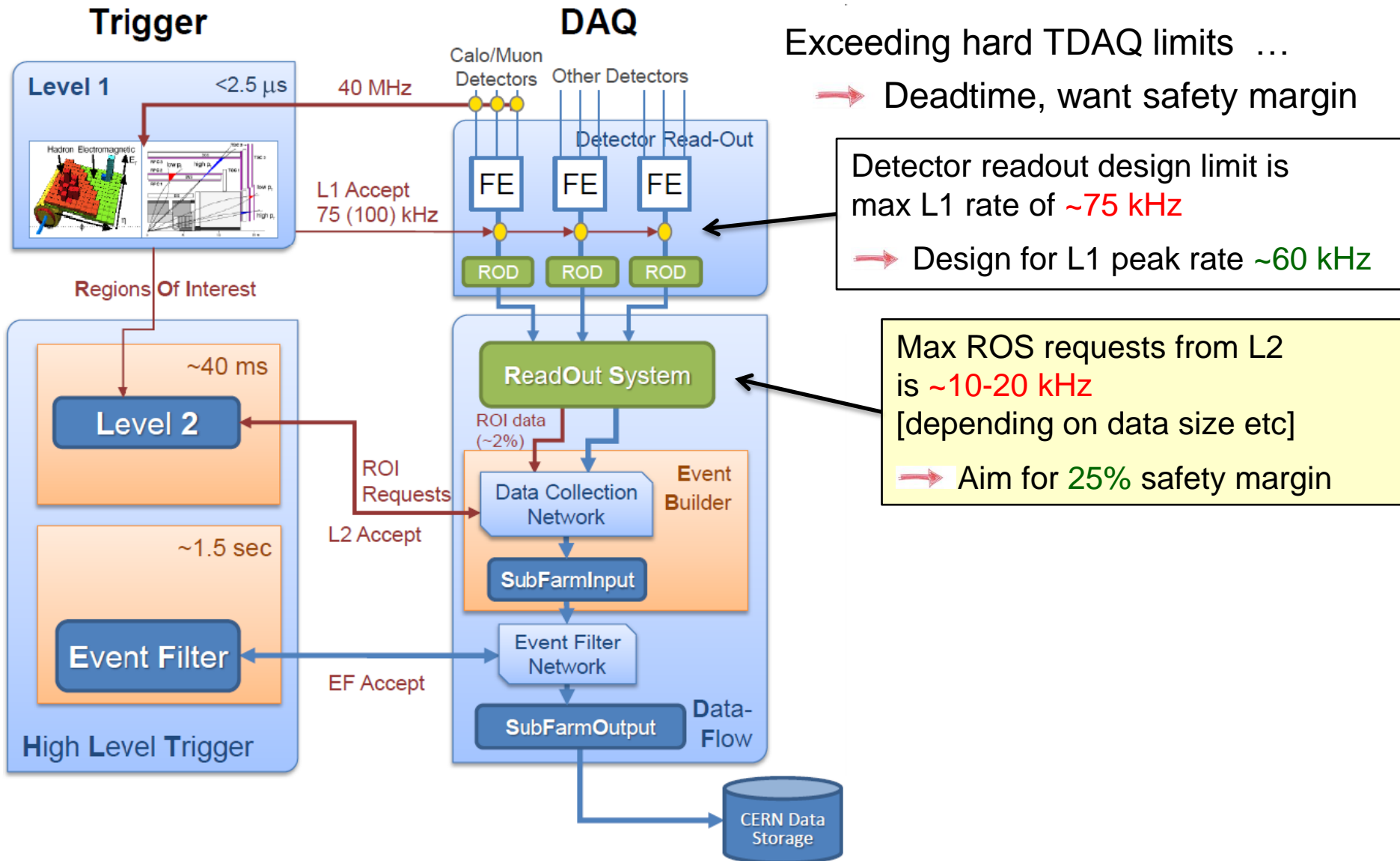
Results presented at the ...

- [Joint Physics-Trigger Meeting \(Feb 1st\)](#): *Triggering at 10^{33}*
- [ATL-COM-DAQ-2011-007](#): *Proposal and Motivations for 2011 Trigger Menu*

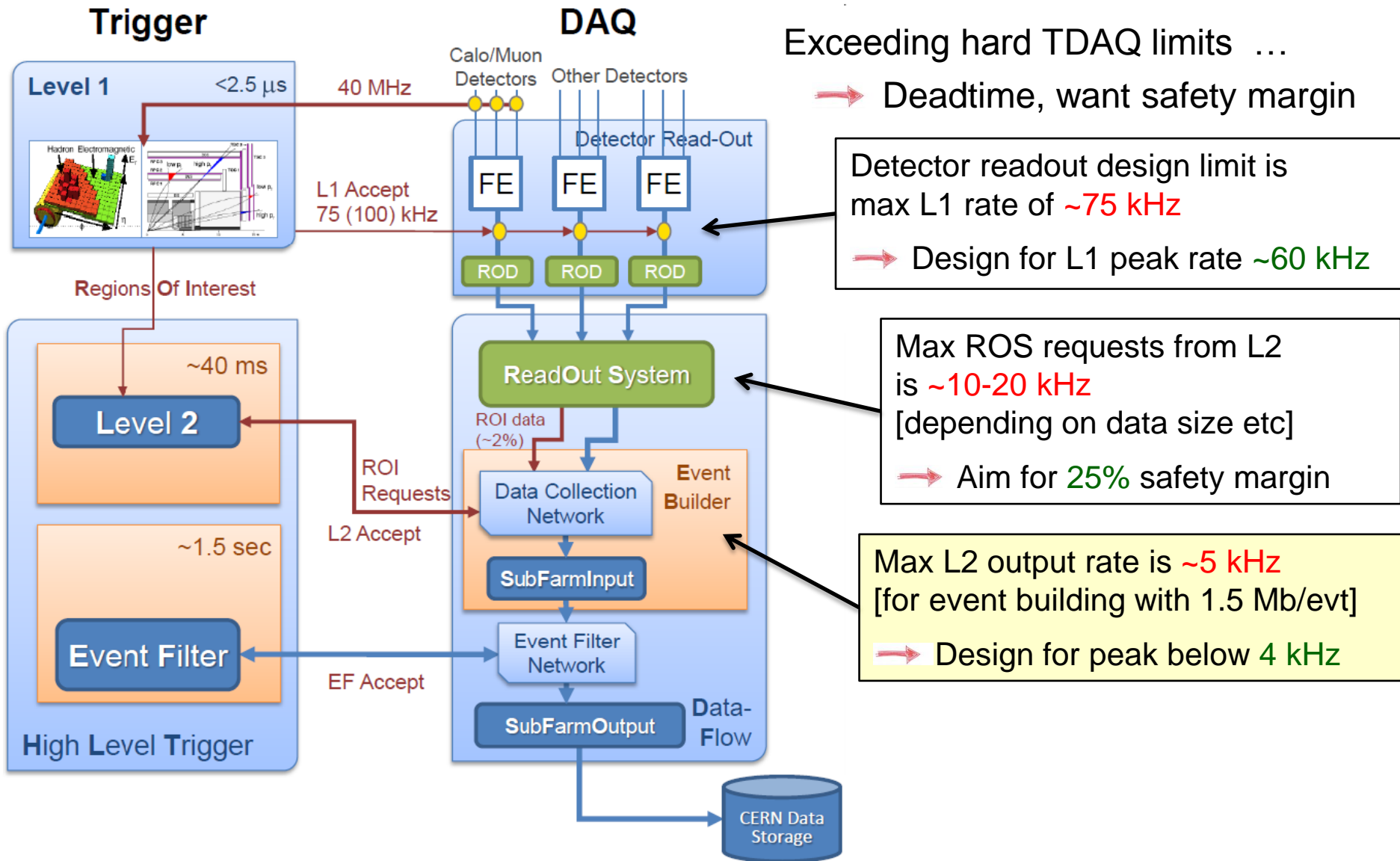
TDAQ Rate Limits in a Nutshell



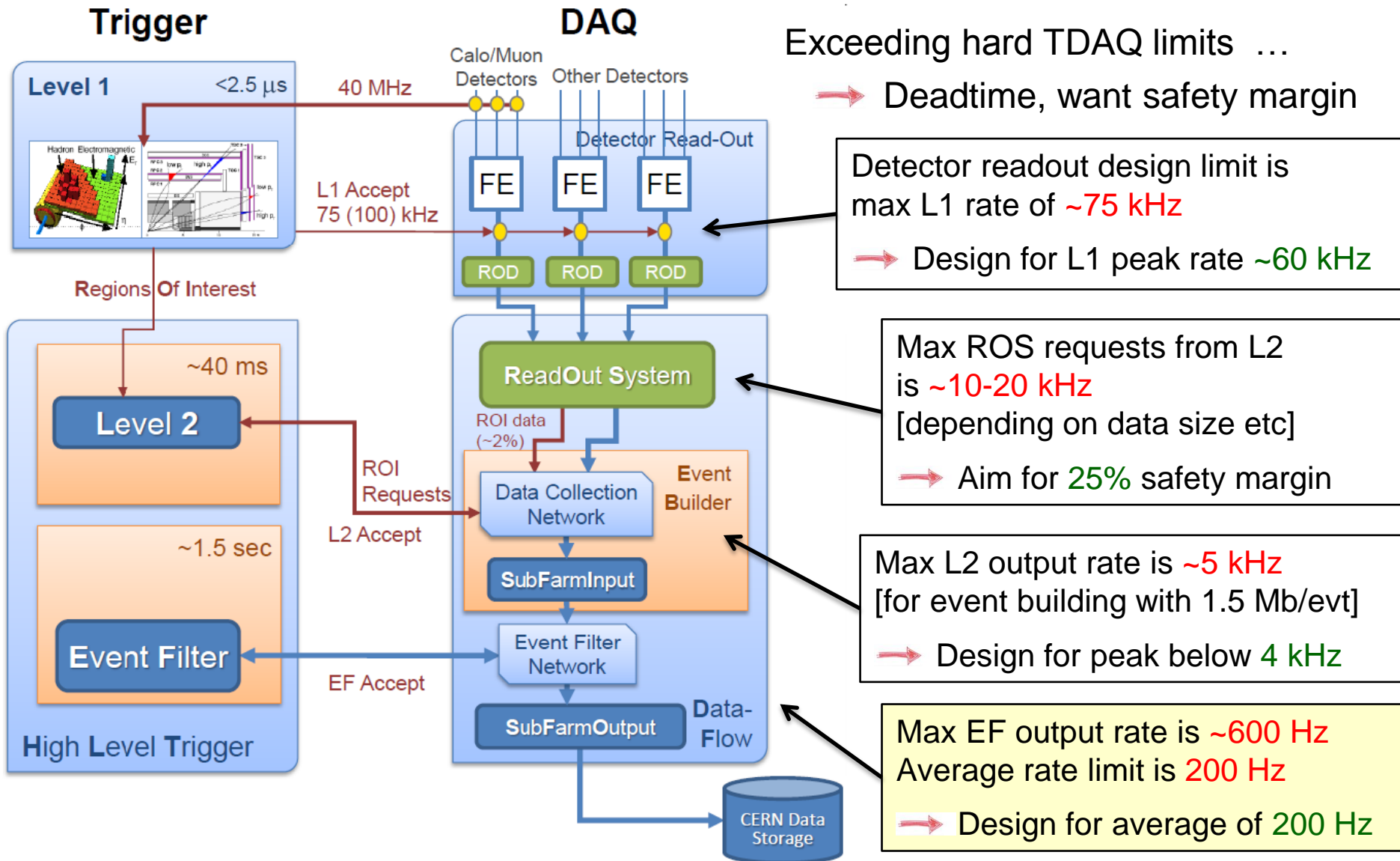
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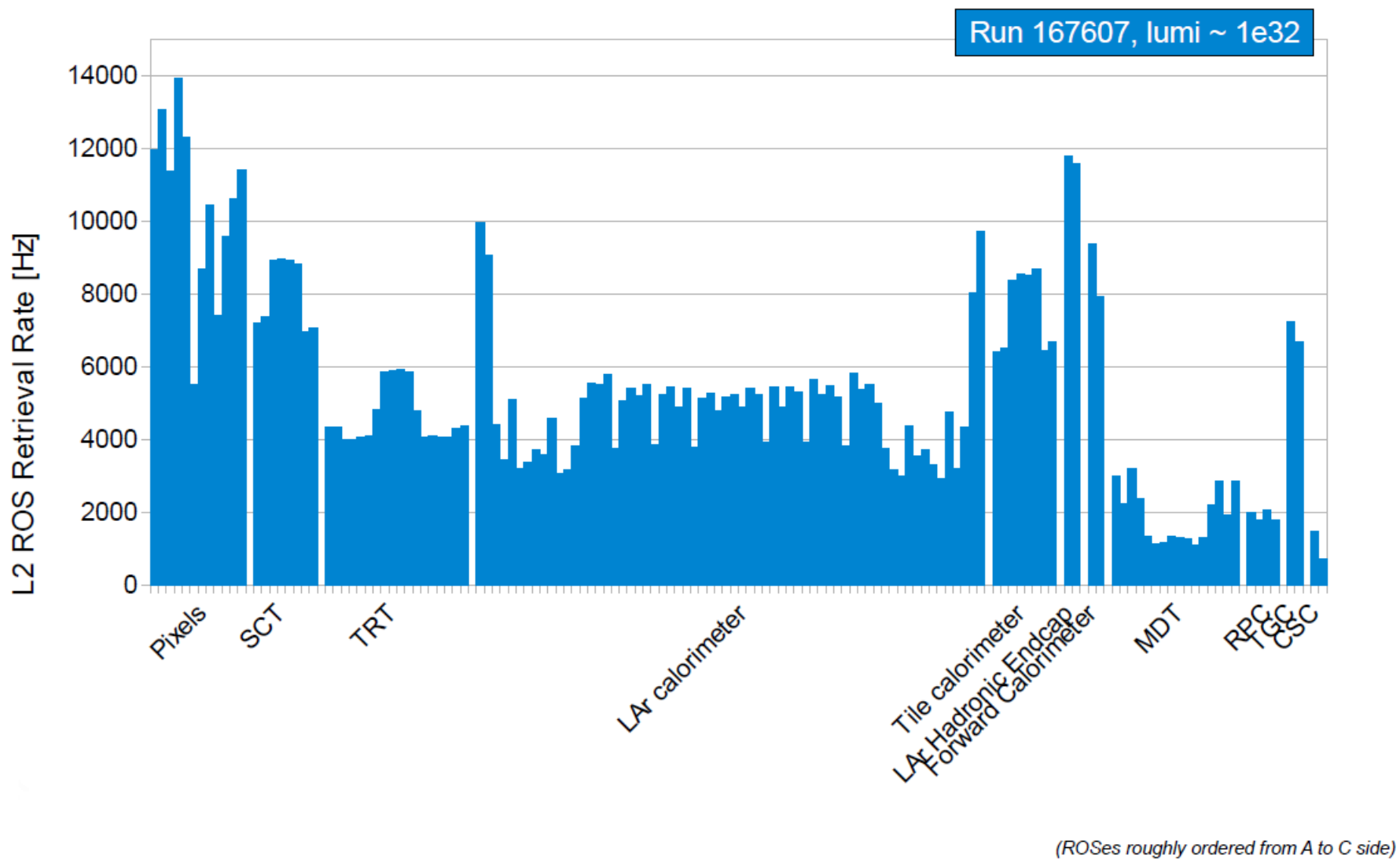
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TDAQ Rate Limits in a Nutshell

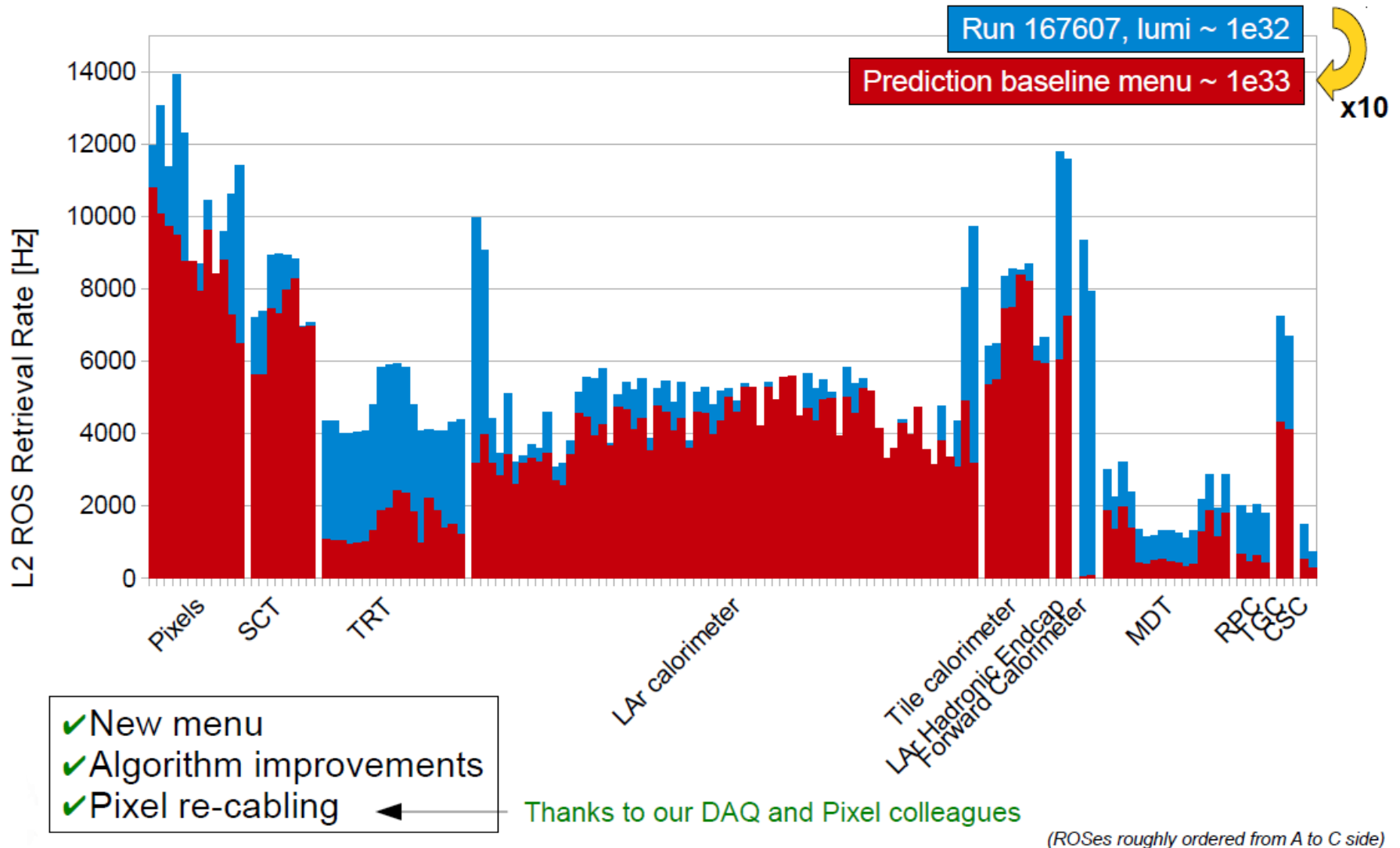


L2 ROS Request Rates 2010



Preliminary L2 ROS Request Rate Predictions

For more details on this method: <http://indico.cern.ch/event/127276>



Trigger Menu Design

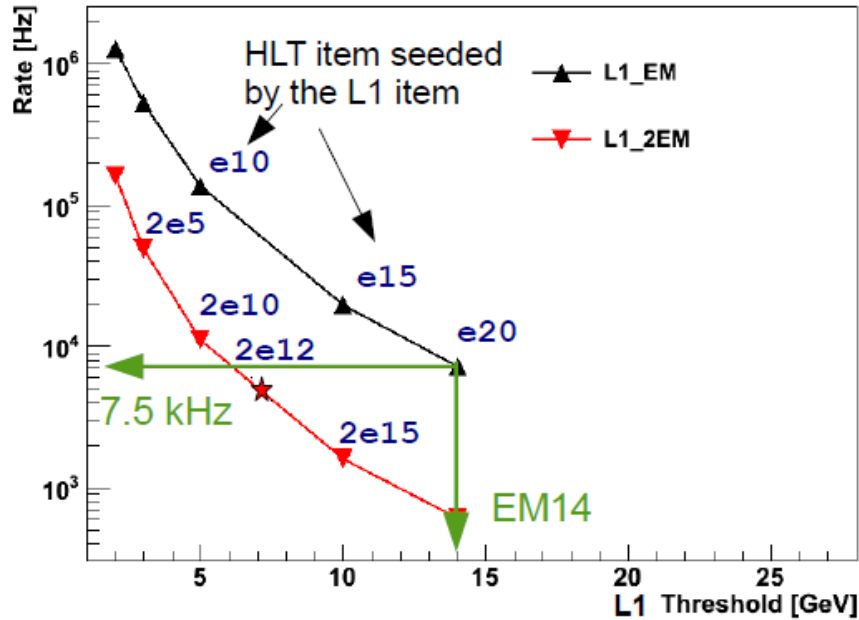
Example: Trigger rates for 20 GeV electron trigger

→ 99% efficiency plateau reached at $E_t \sim 25$ GeV

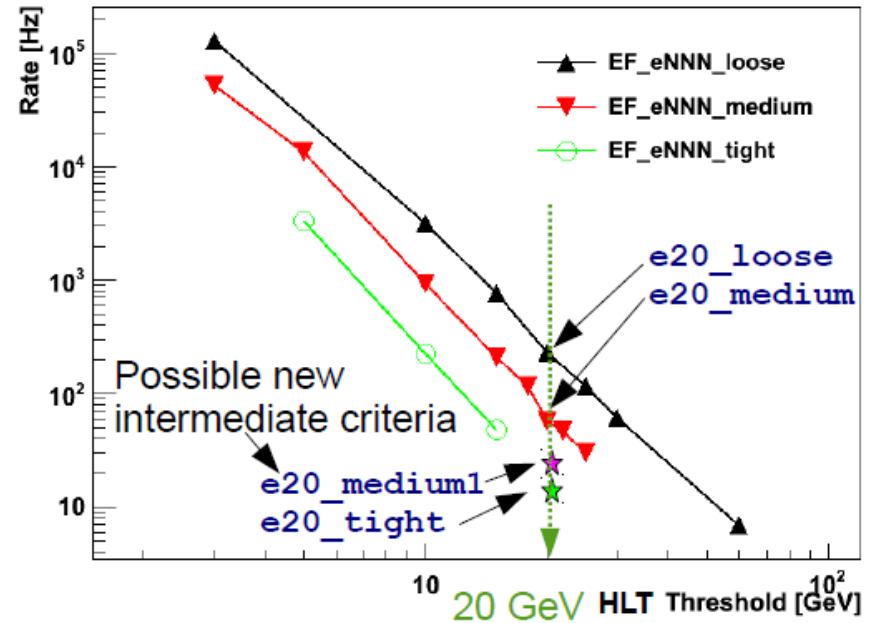
L1 sets minimal possible E_t threshold

Adjust EF rate with tightness and E_t cut

L1_EM* rates at $10^{33} \text{ cm}^{-2}\text{s}^{-1}$ as a function of threshold



EF electron rates at $10^{33} \text{ cm}^{-2}\text{s}^{-1}$ as a function of threshold



2011 Baseline Menu @ 10^{33}

Main unprescaled primary triggers

Trigger	L1 Item	L1 Rate	L2 Rate	EF Rate (peak)		
mu20	MU10	6000	120	25		
2mu10	2MU0	2000	50	3	Similar sized list of more specialized triggers for very high- p_T physics or other "exotic" physics (~30 Hz)	
2mu4_Jpsi/Upsilon/B mumu	2MU0	2000	40	15		
e20_medium1	EM14	7500	400	20		
2e12_medium	2EM7	4000	30	0.5		
e10_medium_mu6	EM5_MU0	1000	20	3.5		
g80_loose	EM14	7500	5	1		
2g20_loose	2EM14	700	50	1.5		
tau100_medium	TAU30	1200	60	3		About 35 Hz of support/monitoring triggers
2tau29_medium1	2TAU11	2500	30	4		
tau29_medium_xs80	TAU11_XS35	4000	300	4		
tau29_loose_xs45_3J10	TAU11_XS15_3J10	1000	100	8		
tau16_loose_e15_tight	2TAU6_EM10	6000	200	3		
tau16_loose_mu15	TAU6_MU0	500	15	5		
j75_xe55	J50_XE20	500	400	7		
ht400	3J10_J50	200	150	4		
j250	J75	250	240	4		
fj100	FJ50	50	40	4		
b10_4jXX	4J10_JE100	300	100	4		
b10_JE140	JE140	1000	50	4		
2b10_L13J10	3J10	1200	60	5		
Total (includes other triggers)		43000	3400	230		
Maximum allowed		75000	5000	600	200	

2011 Baseline Menu @ 10^{33}

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Trigger	L1 Item	L1 Rate	L2 Rate	EF Rate (peak)		
mu20	MU10	6000	120	25		
2mu10	2MU0	2000	50	3	Similar sized list of more specialized triggers for very high- p_T physics or other "exotic" physics (~30 Hz)	
2mu4_Jpsi/Upsilon/B mumu	2MU0	2000	40	15		
e20_medium1	EM14	7500	400	20		
2e12_medium	2EM7	4000	30	0.5		
e10_medium_mu6	EM5_MU0	1000	20	3.5		
g80_loose	EM14	7500	5	1		
2g20_loose	2EM14	700	50	1.5		
tau100_medium	TAU30	1200	60	3		About 35 Hz of support/monitoring triggers
2tau29_medium1	2TAU11	2500	30	4		
tau29_medium_xs80	TAU11_XS35	4000	300	4		
tau29_loose_xs45_3J10	TAU11_XS15_3J10	1000	100	8		
tau16_loose_e15_tight	2TAU6_EM10	6000	200	3		
tau16_loose_mu15	TAU6_MU0	500	15	5		
j75_xe55	J50_XE20	500	400	7		
ht400	3J10_J50	200	150	4		
j2						
fj						
b10_4jXX	4J10_JE100	300	100	4	EF (avg)	
b10_JE140	JE140	1000	50	4		
2b10_L13J10	3J10	1200	60	5		
Total (includes other triggers)		43000	3400	230	185	
Maximum allowed		75000	5000	600	200	

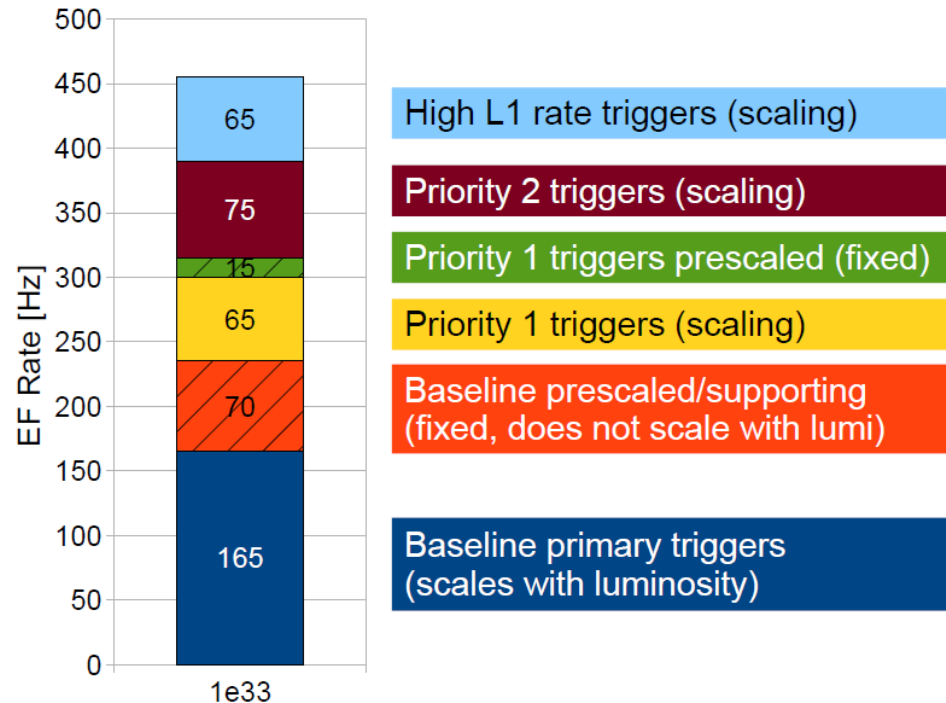
Good safety margin for L1/L2

Very close to 200 Hz EF limit.

EF (avg)

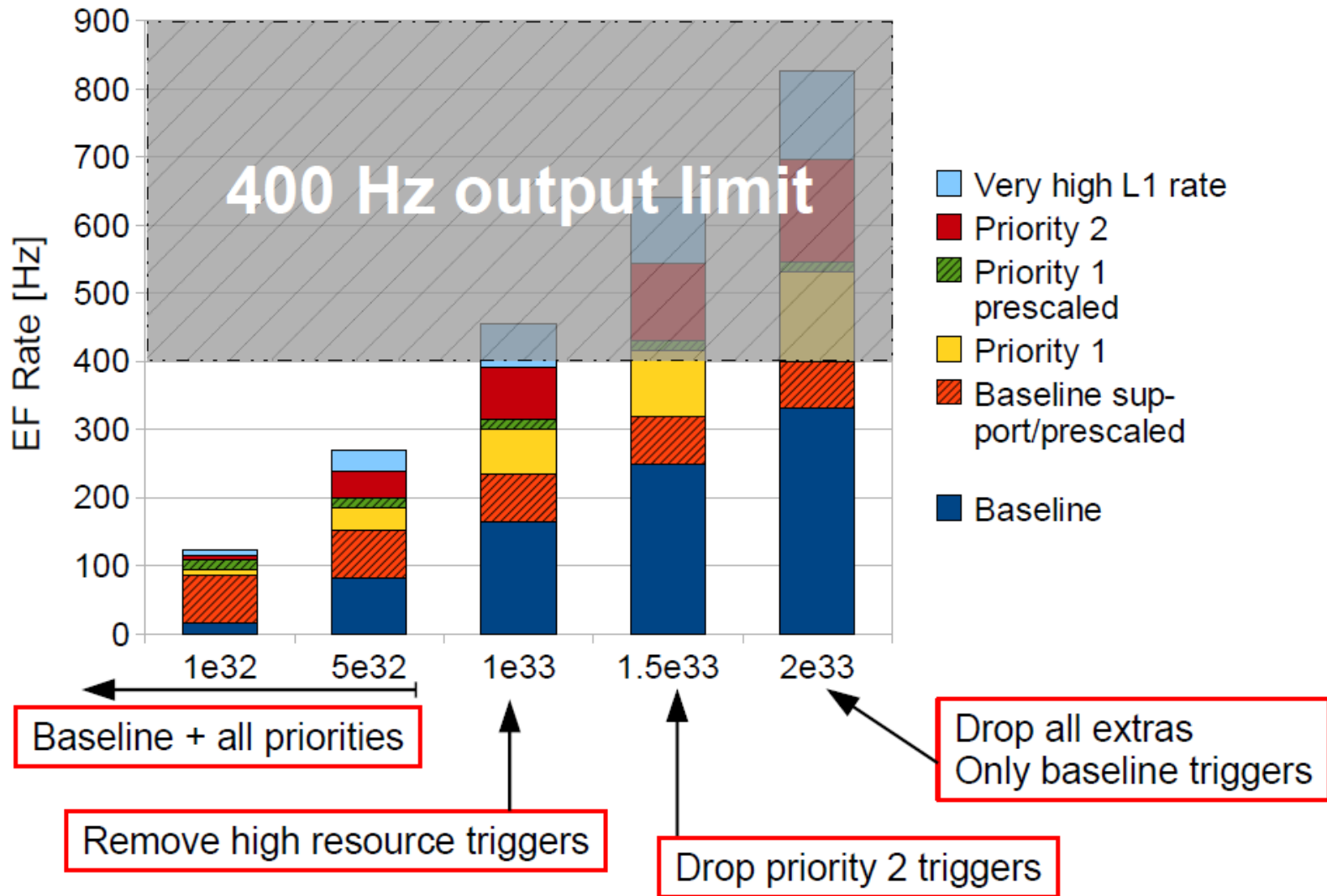
Higher EF Output Rate?

- Beyond 10^{33} , will have to cut significantly into physics (e.g. 25 GeV leptons) without more dedicated (analysis specific) triggers
 - No room for physics triggers that haven't been thought of yet
 - Almost no safety margin on EF output rate
 - Trigger and physics community have been asked to provide feedback on physics gain with increased EF rate of 300 – 400 Hz
- Two lists of priority triggers compiled (priority 1 and 2)
- Each category adds about 100 Hz on top of 200 Hz baseline menu

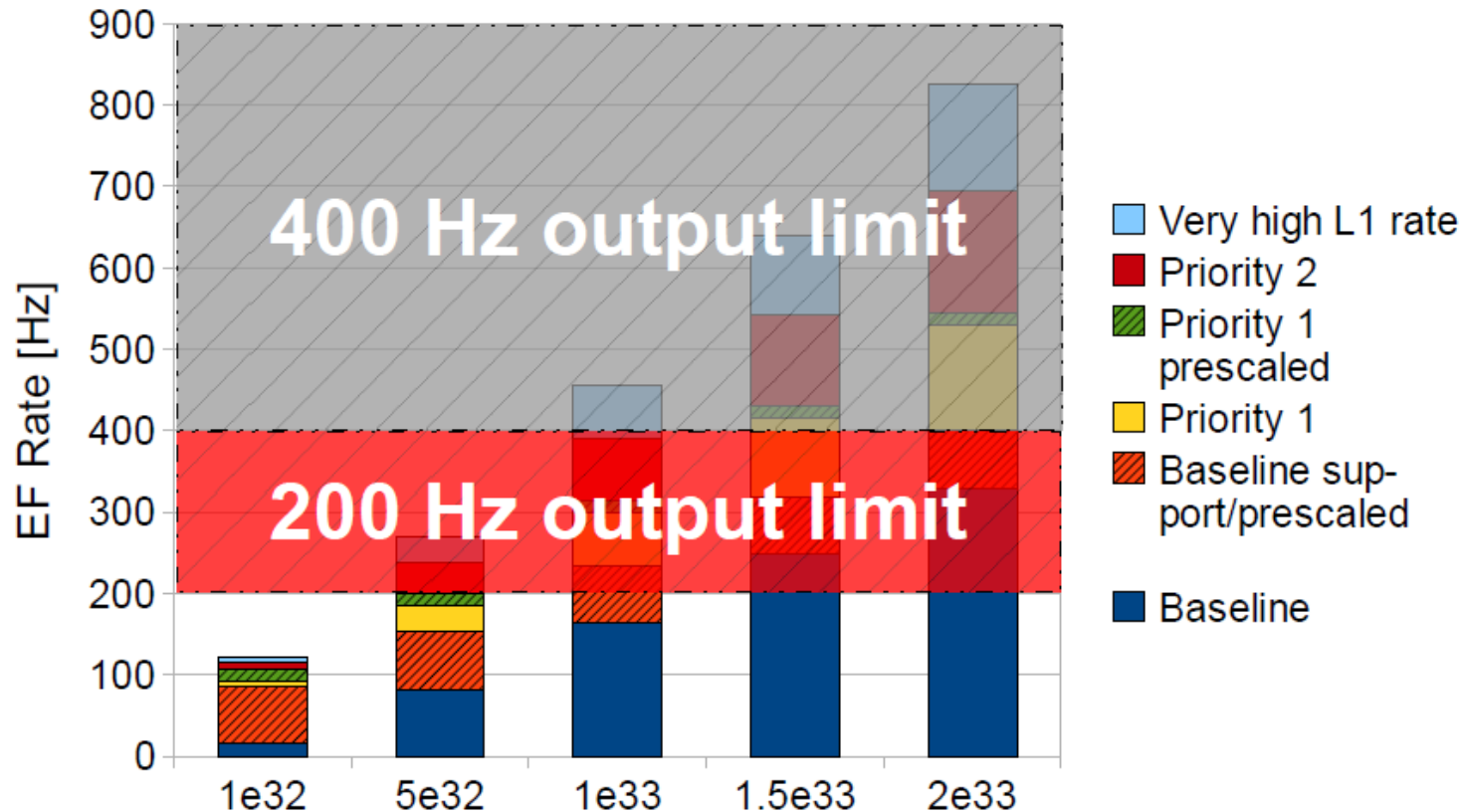


Trigger categories and peak rate @ 10^{33}

Rate Evolution and Bandwidth Limits



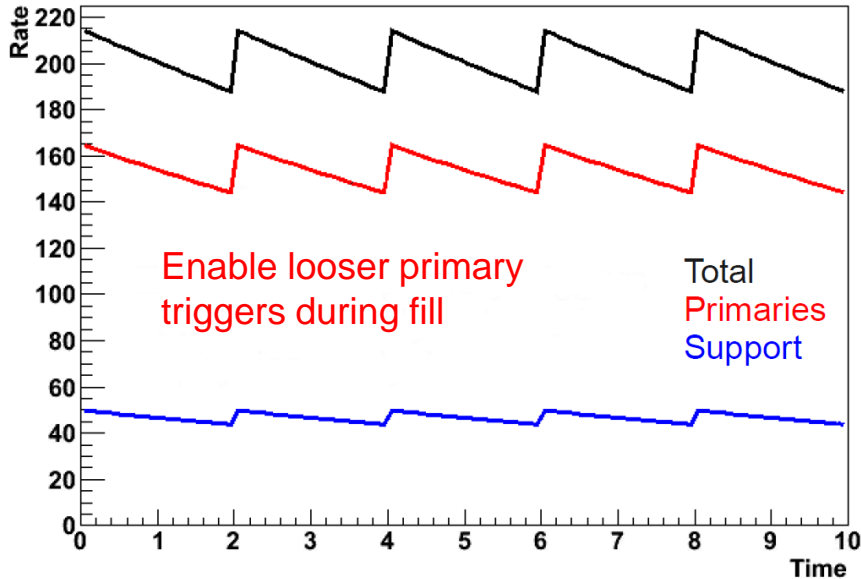
Rate Evolution and Bandwidth Limits



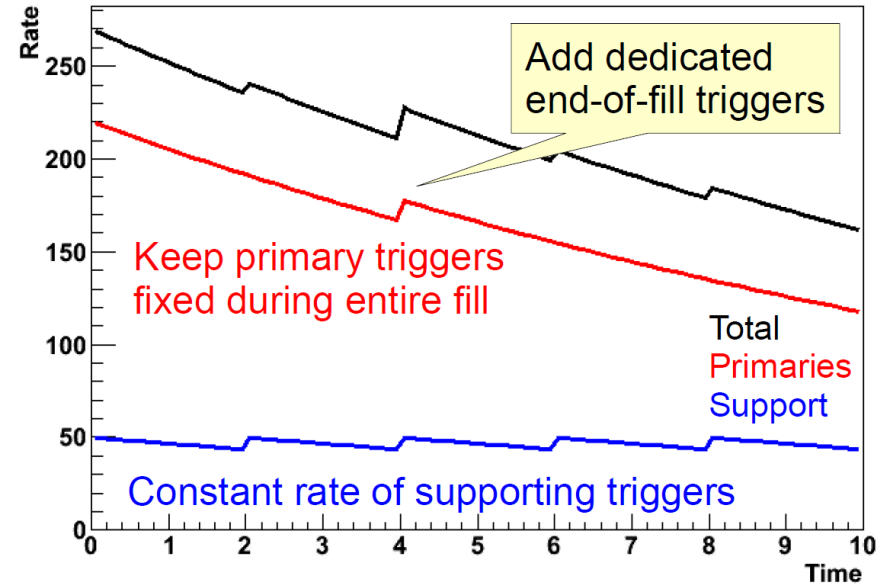
- ➔ If having to stay below 400 Hz will have to drop extra triggers earlier, raise thresholds and tighten selections without prior testing with new high pile-up data
- ➔ Major reoptimisation of menu needed if luminosity exceeds 10³³ cm⁻² s⁻¹ level, work starting now

Prescale Strategy

2010



2011



- 2010 strategy best with very loose primary triggers and rapidly increasing luminosity
- Loose triggers enabled during fill in the end mostly not used in physics analysis
- 2011 allows higher peak rate of primary items
- End-of-fill triggers which require low luminosity only, prefer low pile-up conditions or require large L1 or L2 resources (e.g. high track multiplicity triggers)

Conclusions & Outlook

- Trigger Operation responsible for efficient day-to-day online operation and scheduling of the ATLAS trigger
- More than 20 people (experts/shifters) involved 24/7 to ensure this (still)
- Chairs/represented in 3 daily meetings (9h15, 9h30, 15h operation meetings) and 2 weekly meetings (Trigger General and Weekly Run Meeting)

- A baseline 10^{33} trigger menu is available with an EF rate close to 200 Hz
- Various areas can be improved with additional EF output rate, a prioritised list of additional physics triggers available
- Major reoptimisation of menu needed if having to stay at 200 Hz for luminosity beyond $10^{33} \text{ cm}^{-2} \text{ s}^{-1}$

- Online recommissioning of the trigger started successfully two weeks ago
- Revise trigger menu during technical stop based on experience from initial running period, plan to freeze menu shortly after