ROI Builder Procedure

Procedure description

This document describes the Region Of Interest Builder (ROIB) hardware, its OKS configuration and what status to expect.

Introduction

The RoI Builder (RoIB) belongs to the LVL2 trigger (Figure 1). Linked to the Level 1 trigger, it receives energy sums from the calorimeter trigger and trigger type from the Central Trigger Processor (CTP), on a Level 1 accept.

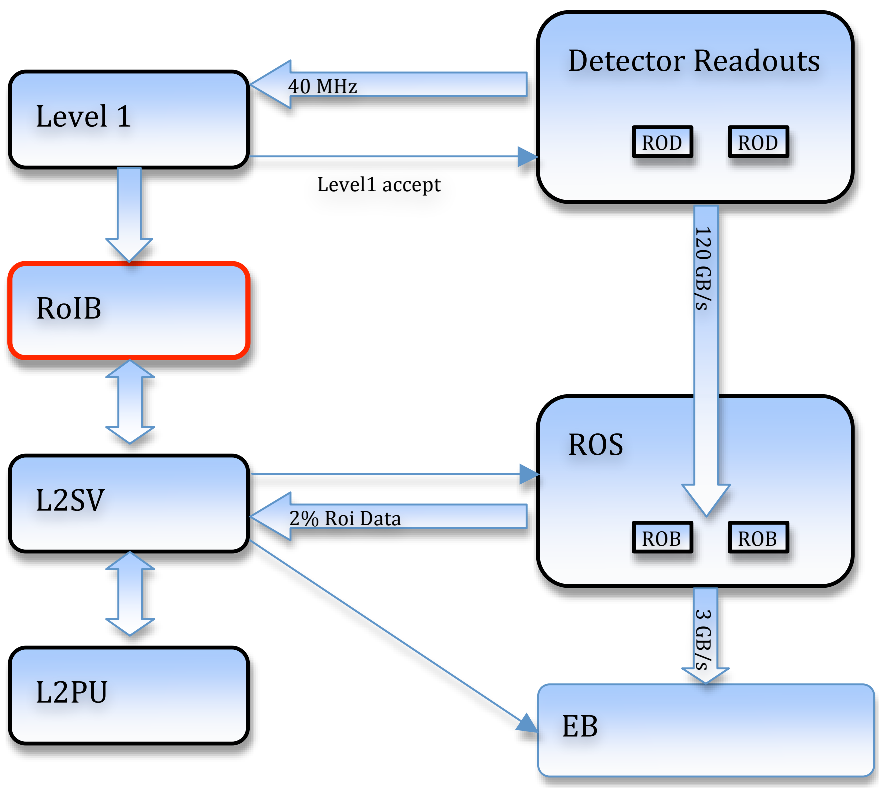

Figure 1: RoIB in its context

The Level 1 trigger system is composed of the calorimeter trigger, the muon trigger and the Central Trigger Processor (CTP), as well as the TTC system (Table 1).

Level 1 system	RoIB input channel number	Description
Muon System	8	single link carries all of the information from the muon trigger to the RoIB
Calorimeter (*e*, γ, τ)	1,3,5,9	four separate physical links carry the electron/photon plus tau/hadron RoI information to the RoIB (each link covers a different geographical region of the detector)
Calorimeter (jet and energy sum)	7,11	two links carry the combined jet and energy-sum RoI information.
Central Trigger Processor (CTP)	4	link carries all of the information from the CTP to the RoIB.
Trigger and Timing Control (TTC)	0	TTC input is foreseen to provide the timing signals to the RoIB.

Table 1: Level 1 trigger and RoIB input channel relations

The Roi Builder is a VMEbus-based system designed to collect data from the Level 1 trigger and assemble the data fragments into a complete record of the Level 1 decision.
This data is passed via S-Link to the Level 2 Supervisor farm. The system is made of input cards and builder cards.
There are 12 possible channels coming into a Builder Card from the 1 to 4 possible Input Cards (3 inputs per card). These 12 possible data channels go to all 4 Builder Card slots via the custom VME crate backplane.
In the final system though, 3 input cards (9 channels) (Table 1) and 1 builder card (4 channels) are used.

The RoIB receives Level 1 RoI fragments asynchronously. It organizes and formats a complete record for each event accepted by LVL1 from these fragments, selects a processor in the LVL2 Supervisor to manage the event through the LVL2 trigger, and transfers via an S-link the assembled RoI record to the target processor. The RoIB performs these tasks at the maximum LVL1 trigger rate of 100 kHz.

References

Twiki: https://twiki.cern.ch/twiki/bin/view/Atlas/RoIB

RoIB Crates

Two systems have been installed and are being commissioned at Point-1: one for use with the pre-series (Figure 2) and the other for the final TDAQ system.

Type	Location
Pre-Series	SDX1
Final TDAQ	USA15

Pre-Series crate

The pre-series crate is equipped with 3 running input boards and 1 builder connected to two level 2 supervisors (Table 2). These boards are spares for the final system at USA15.

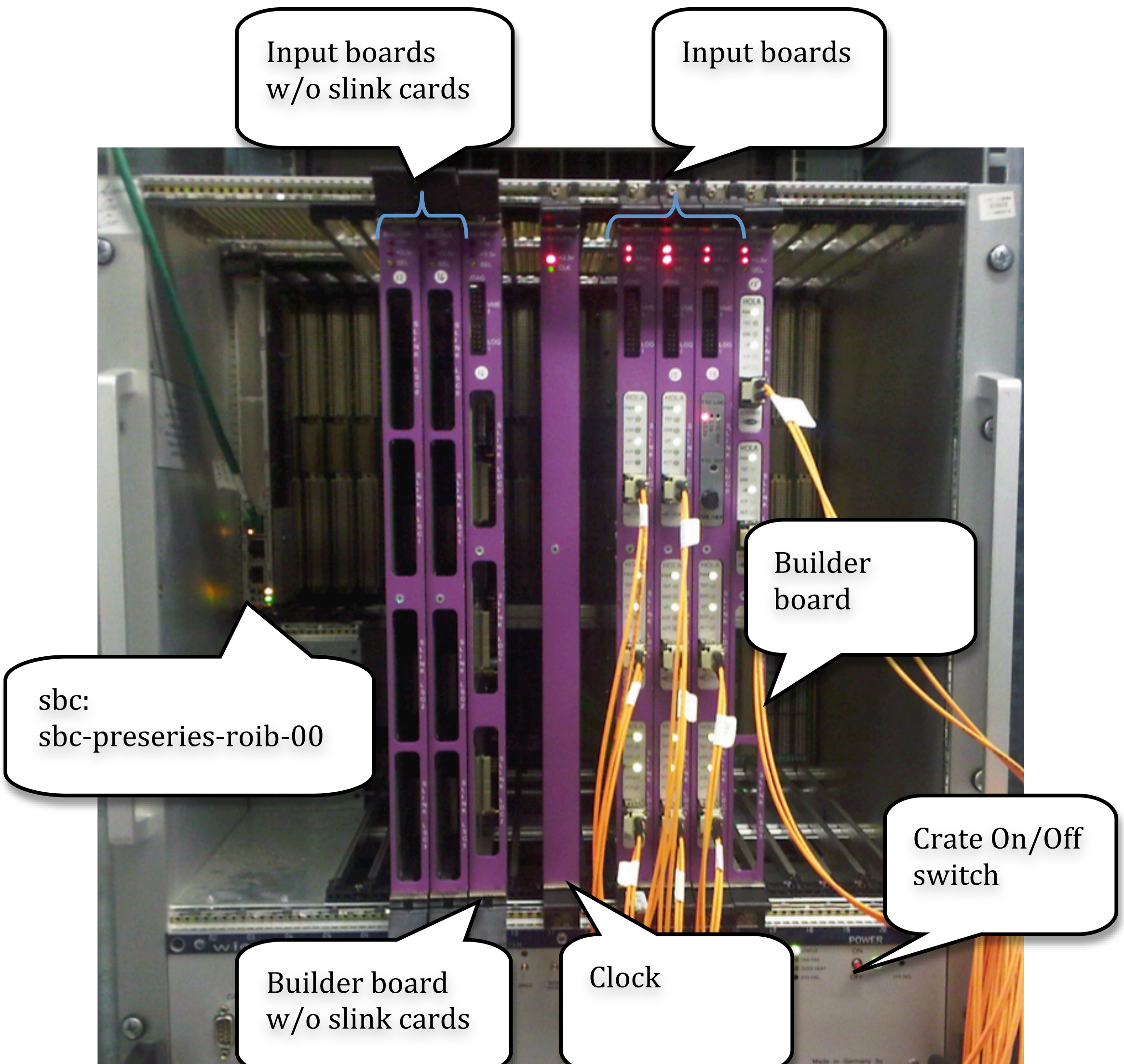

Figure 2: Preseries RoIB crate

Input	7	Input board without daughter boards
Input	8	Input board without daughter boards
Builder	9	Builder board without daughter boards
Clock	11	
Input	13	Input board connected to L1SRC
Input	14	Input board connected to L1SRC
Input	15	Input board connected to L1SRC
Builder	16	Builder board connected to 2 L2SV

Table 2: pre-series crate boards

The other boards respectively at slot 7,8 and 9 are not fully engaged in the VME crate and the s-link daughter boards are not present.
[Are the boards working]?
[How to get daughter boards? Yuri?]

A test partition "df_roib" (database file: /atlas-home/1/fellmann/partition/partitions/df_roib.data.xml) is running constantly. Level 1 ROI fragments are loaded from data files on a feeder hosted on pc-preseries-l1src-01. Thus, this level 1 source can feed the RoIB up to 8 links.
The test partition is close to the final ATLAS partition. RoIBConfiguration object is identical but the LiveChannel field holds a 2 bytes mask allowing to select between the feeder's links. On the final system it is set to 0xFF.

Final TDAQ Crate

The final crate is equipped with 4 running input boards and 2 builders connected to eight level 2 supervisors. Two live spares are available: one input board (slot 13) and one builder board (slot 17).

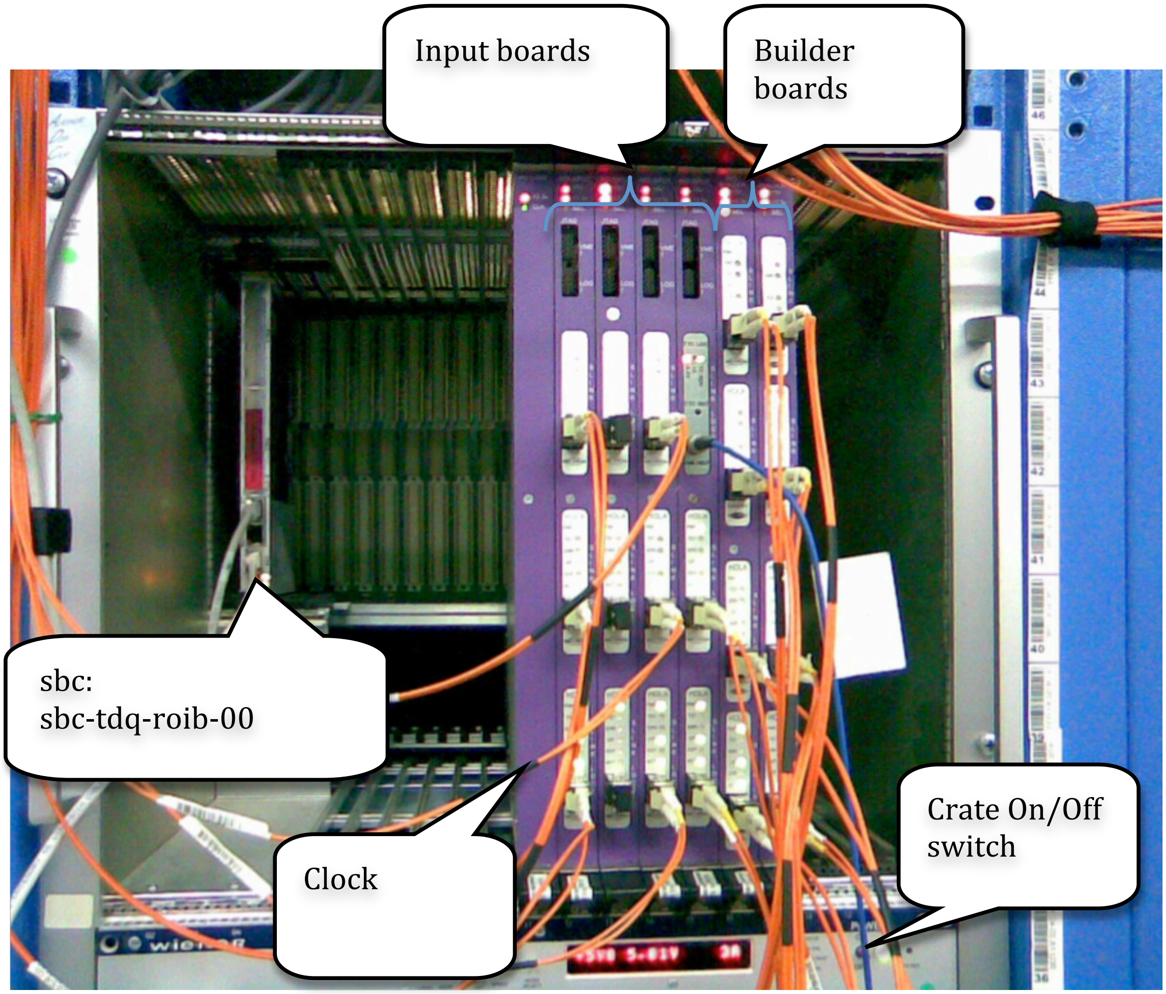

Figure 3: Final RoIB crate

The RoIB input channels and their Level 1 relations are described in Table 3. There are 3 active spares available, which are respectively represented in the database as: InputChannel_2, InputChannel_6 and InputChannel_10. Green arrows on Figure 4 show the input's numbering schema.

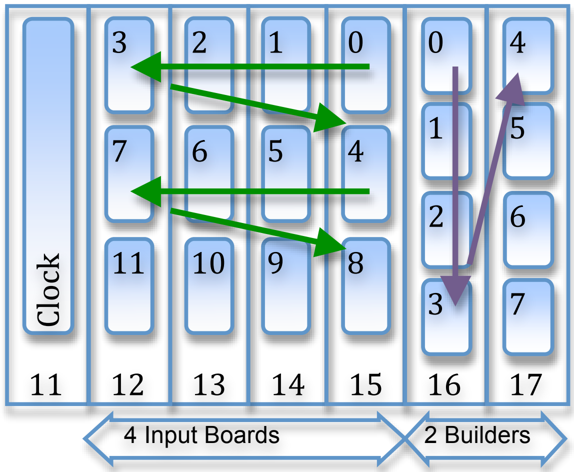

Figure 4: RoIB's channel numbering schema

OKS Object	Description	RoIB Input-channel number	VME slot number
L1CALO_cp3	Calorimeter (*e*, γ, τ)	3	12
L1CALO_jep0	Calorimeter (jet and energy sum)	7	12
L1CALO_jep1	Calorimeter (jet and energy sum)	11	12
InputChannel_2	spare	2	13
InputChannel_6	spare	6	13
InputChannel_10	spare	10	13
L1CALO_cp0	Calorimeter (*e*, γ, τ)	1	14
L1CALO_cp1	Calorimeter (*e*, γ, τ)	5	14
L1CALO_cp2	Calorimeter (*e*, γ, τ)	9	14
TTC_disabled	Trigger and Timing Control	0	15
MUCTPI	Muon System	8	15
CTP		4	15

Table 3: RoIB input channel settings

Similar to the input boards, one of the builder boards is an active spare. Table 4 describes valid output channels, its OKS object and the appropriate level 2 supervisor host. Note that the output channel numbering differs from the input ones (Figure 4).

OKS Object	Level 2 supervisor host	RoIB Output Channel number	VME slot
L2SV_1	pc-tdq-l2sv-03	0	16
L2SV_2	pc-tdq-l2sv-04	1	16
L2SV_3	pc-tdq-l2sv-05	2	16
L2SV_4	pc-tdq-l2sv-06	3	16
OutputChannel_5	pc-tdq-l2sv-07	5	17
OutputChannel_6	pc-tdq-l2sv-08	6	17
OutputChannel_7	pc-tdq-l2sv-09	7	17

Table 4: RoIB output channel settings

Spares

There is a total of 10 input boards and 5 output boards at CERN. Table 5 lists the type of boards available and where to find them. There are 7 spares for the input boards, 3 of which are not equipped with s-link cards. As far as the builder boards, 4 are spares, 2 without s-link cards.

Board	Daughter board	Location	Number
input	yes	Final crate	4
input	yes	Pre-series crate	3
Input	no	Pre-series crate	2
Input	no	Argonne office	1
Builder	yes	Final crate	2
Builder	Yes (2 of 4)	Pre-series crate	1
Builder	no	Pre-series crate	1
Builder	no	Argonne office	1

Table 5: RoIB boards

Spares at Argonne

[need to find out how many working input and builder boards]

Roib Configuration

The Roib configuration is done via OKS (Figure 5). To change a parameter at Point 1, the user must first check out and then the corresponding xml file can be set Active.

Class: RoIBConfiguration

Objects:

UID	roibTtype	liveChannel	eventrate	EnableStandalone	EnableFlowControl	MaxInputSkew	UsesTestFiles
ROIBConfig	TRG_ROD	0xff	0	false	true	100	()

Figure 5: RoIB configuration

On the final system, the RoIB configuration is defined as in Figure 5. **RoIBtype** is always set to TRG_ROD. **LiveChannel** field is only used with a feeder source. It is not relevant in the ATLAS partition. The system needs to run as fast as possible. **Eventrate** is therefore set to 0.
A value of 0 indicates that the system will run as fast as possible regulated only by flow control.

One parameter that might be changed i.e for L1Calo test is the maximum skew time:
MaxInputSkew
The default value is set to100 since we want to achieve 100kHz. As soon as one of the active channel's 'Fragment' has been written, a timer is started. When the timer reaches a predetermined time (set via VME), only the active channels that have their Channel Ready set will have their 'Fragment' included in the output 'Record'. If a 'Fragment' comes late after its 'Record' was already written to the Output, then that 'Fragment' will be cleared from the Input.

The maximum allowed skew is equal to the maximum allowed latency of one RoI fragment. There is a limit to the amount of skew the RoIB can tolerate between the first RoI fragment of an event and the last RoI fragment of that event received at the RoIB.

RoIB segments and resources

There are two main segments regarding the RoIB (Figure 6):

- RoIB_Connections which defines RoIBInputChannel objects and their respective S-link connection (Figure 7).
- ROIBSegment which defines the RoIB inputs and outputs physically in the VME crate (Figure 8).

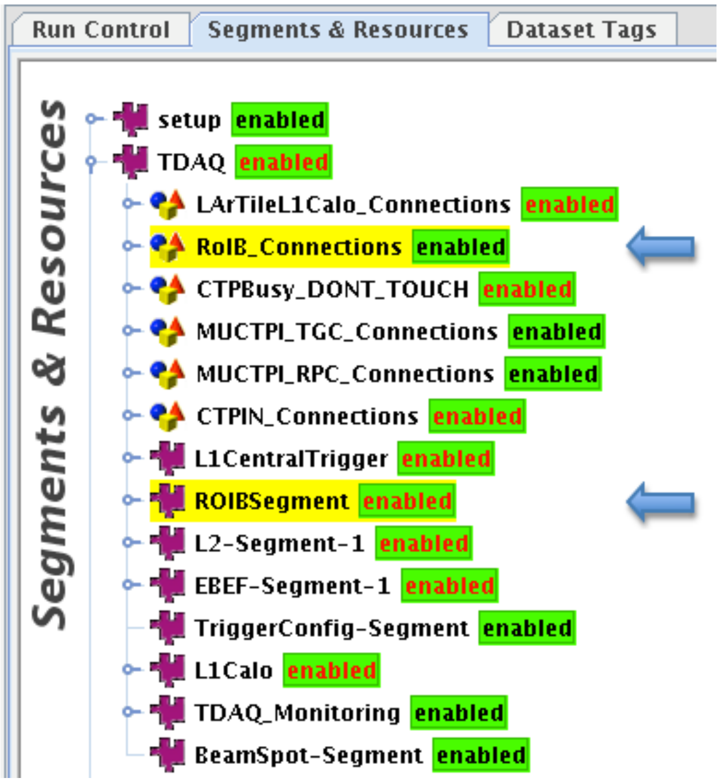

Figure 6: RoIB segments and resources

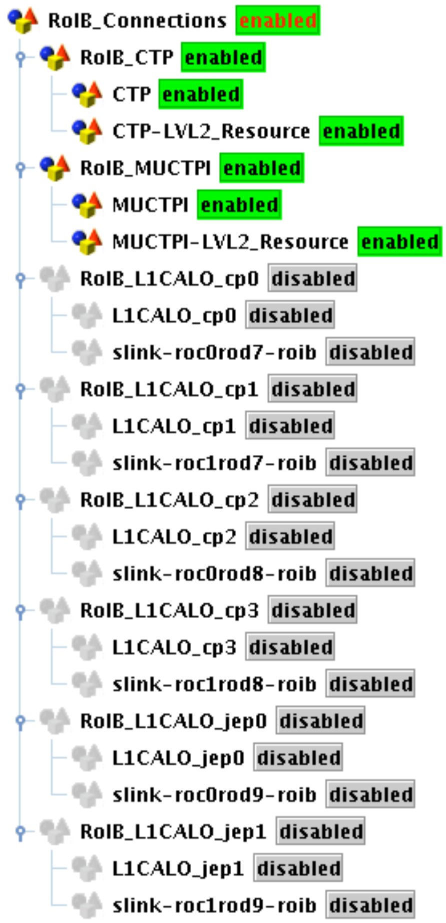

Figure 7: RoIB input channels – s-links connections

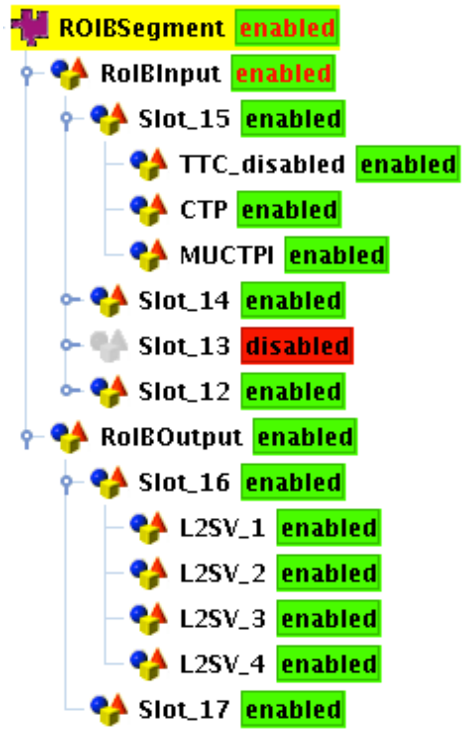

Figure 8: RoIB Inputs and Outputs

ROIB-1 (Figure 9) is the id of the RoIB application binary “roib_main“ running on sbc-tdq-roib-00 host.

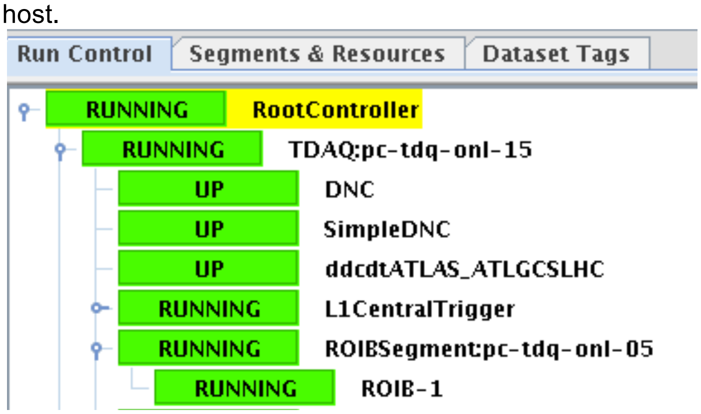

Figure 9: RoIB application resource

One builder board is enough to reach a rate of 100kHz. Slot 16 holds the builder board which links to 4 Level 2 supervisors. Slot_17 is a spare

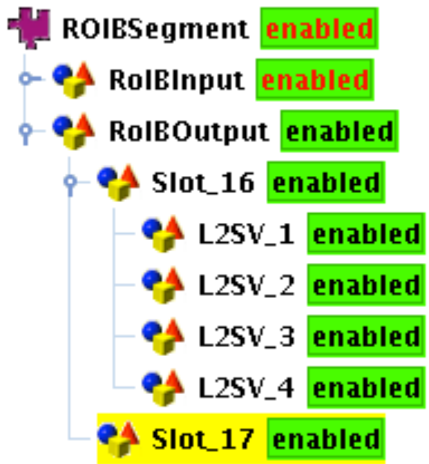

Figure 10: RoIB outputs

OKS configuration

At Point 1, the ATLAS partition has to be checked-out in order to be writable and active. The followings classes: RoIBApplication, RoIBConfiguration, RoIBInputBoard, RoIBInputChannel, RoIBOutputBoard, RoIBOutputChannel are defined in RoIBInfrastructure_LVL1.data.xml.

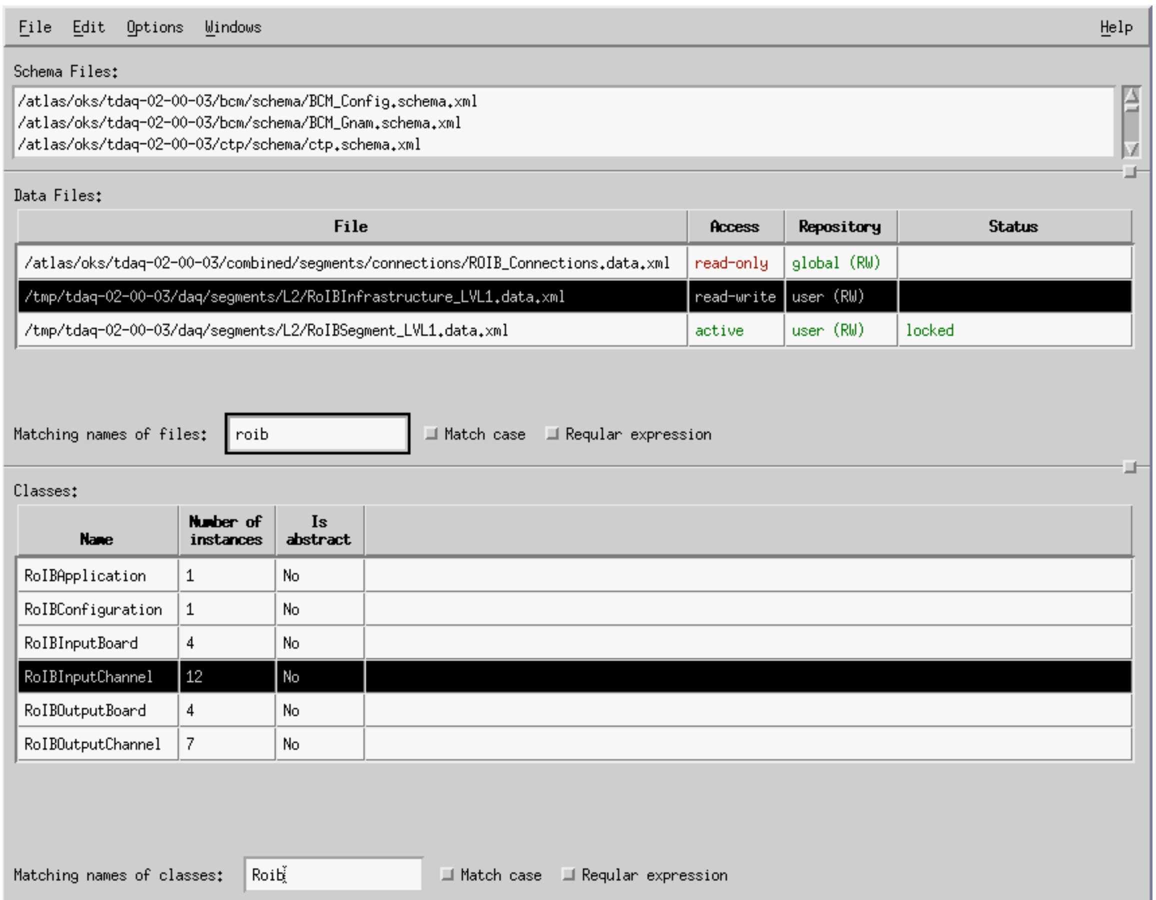

Figure 11: oks data editor

All changes can be done via oks_data_editor. Note that enable and disable actions can be done directly using the igui.

Configuration modification example

Example: swap an active input L1CALO_jep1 with InputChannel_10 (from the spare input board in slot 13).

1) In OKS select RoIBinputChannel L1CALO_jep1 L1source (Figure 12).

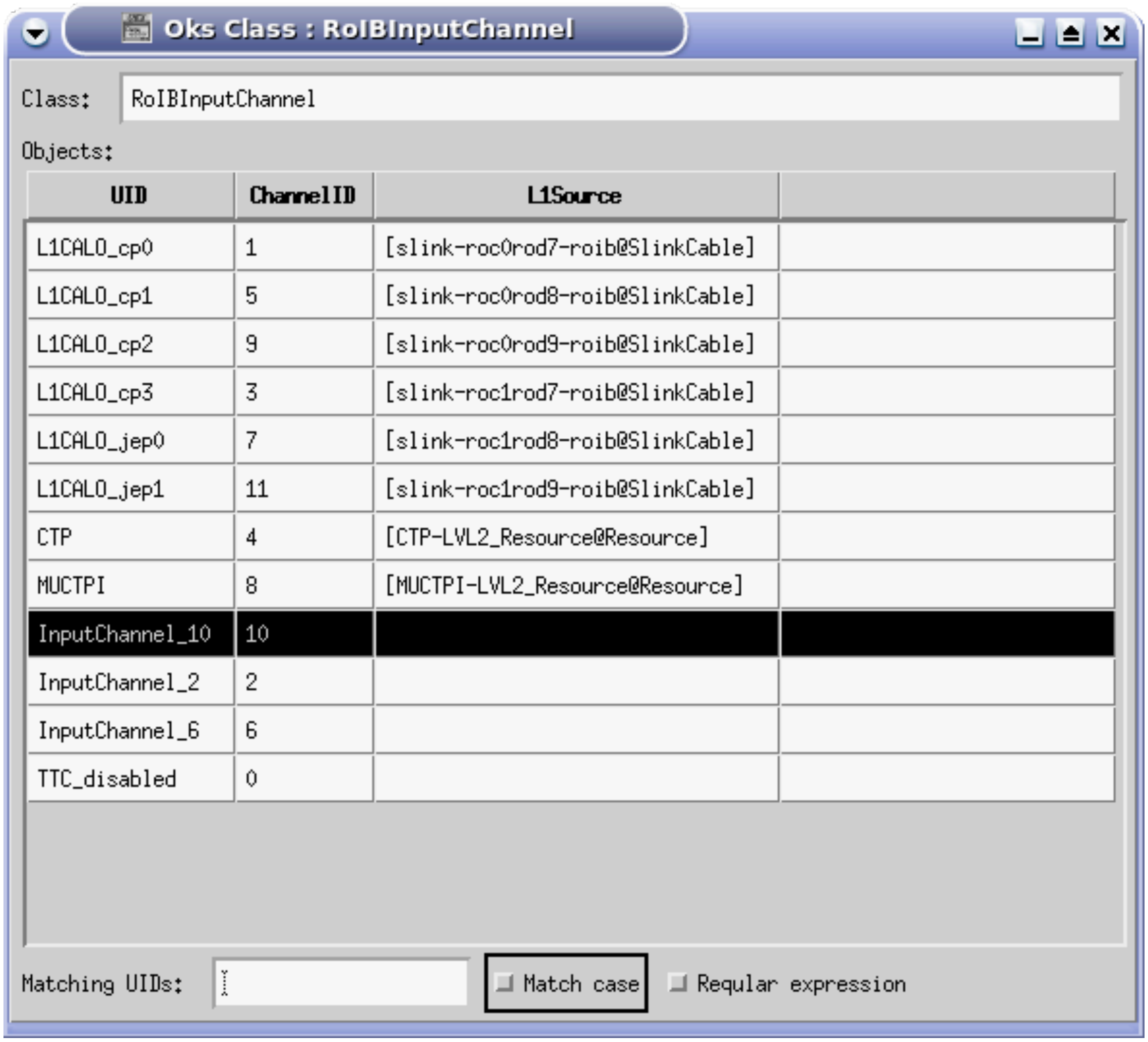

Figure 12: RoIB input definition

2) Copy the L1Source Object (Figure 13)

Figure 13: Input channel 11, L1Source object

3) Select InputChannel_10 object and paste the L1Source object

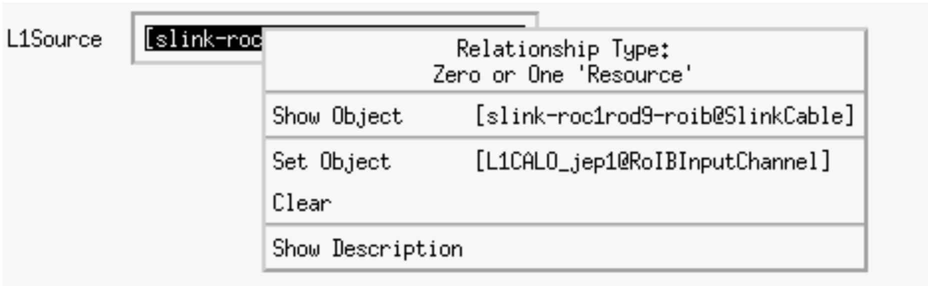

Figure 14: Set destination Object with selected L1Source

4) Input channel 10 belongs to VME slot 13. Verify if it is enabled in the RoIB input tree in the IGUI (Figure 15)

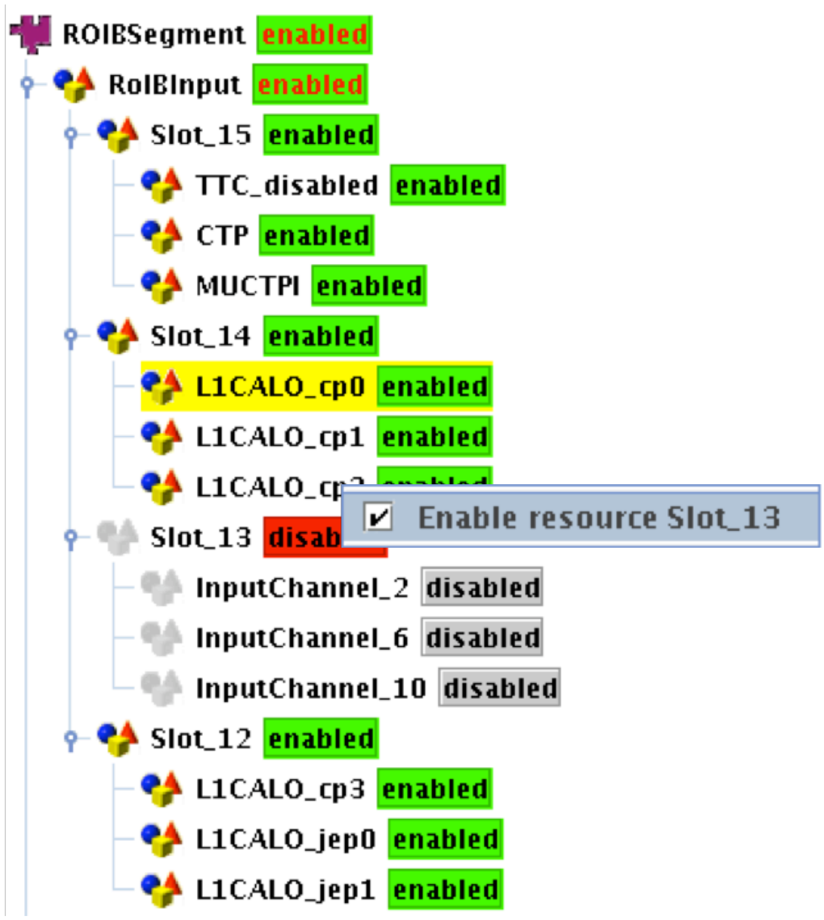

Figure 15: enable RoIB segment with IGUI

5) Commit modified files into the repository, reload the database.

ROIB Monitoring

Relevant RoIB runtime information is displayed on the information service tools (is_monitor or web_is https://atlasop.cern.ch/atlas-point1/tdaq/web_is/)

Input Channel Status: -00 000 --- 000
Output Channel Status: 00-0 ---- ---- ----
Last LVL1_ID: 3992977507
Checksum errors count: 0
Data sample count: 646201
Seconds since last sample: 0

Figure 16: RoIB information service

Input Channel Status

Summary of Inputs. There are 3 different values; a "-" represents an inactive channel, "0" means at that time there are no data going through that channel. A "1", a that time, data are present in the channel.

Output Channel Status

Summary of Outputs. Like the inputs summary, there are 2 different (- inactive, 0 empty) L2pu, some L2sv may have events, at that time, config like 1101

Last LVL1_ID

Last LVL1 ID sampled, lvl1 id not always increasing because of ECR, Event Counter Reset launched by CTP
U32 => LVL1ID top 8bits is ECR, lower part.

Checksum error count

The count of checksum errors detected should always be 0. It is a hardware checksum; in the case of a count greater than 0, it means that corrupted data are send to the backplane, assembled fragments will be corrupted as well.

Data sample count

Count of data samples, reset

Seconds since last sample

Number of seconds since last data sample, in seconds. This is a time stamp for reference use.

Daughter board replacement

The following figures describe how to replace a daughter board. Note that the crate has to be turned off before pulling any VME board!

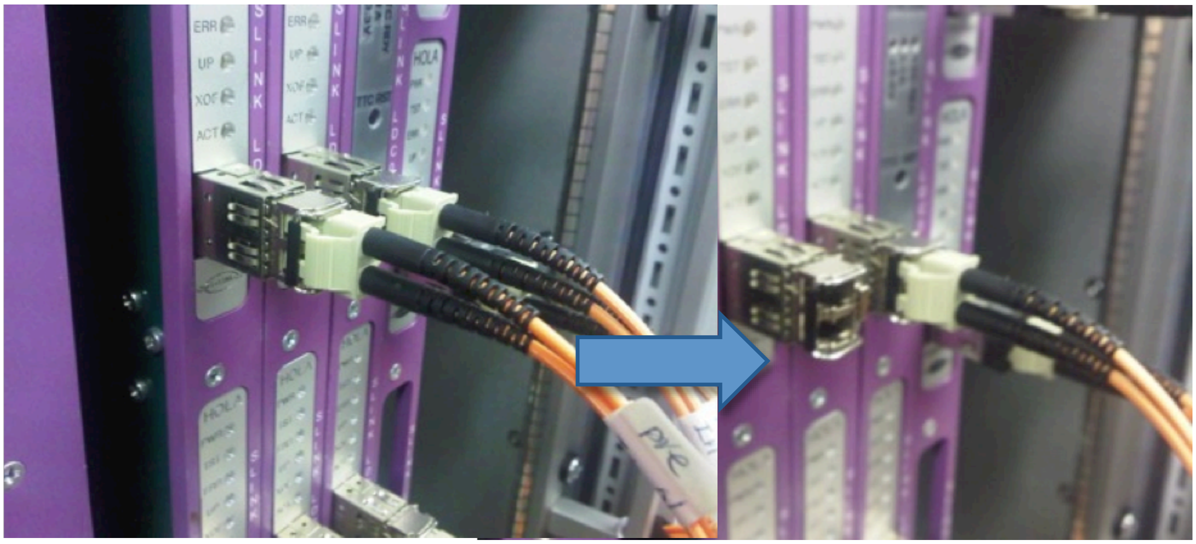

Figure 17: disconnect fiber

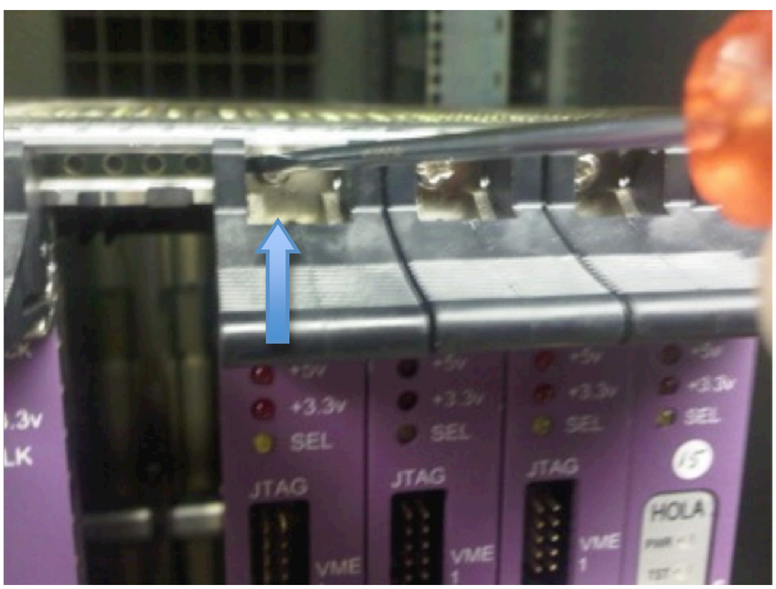

Figure 18: unscrew and lift levers (top and bottom)

Figure 19: LDC daughter board top view

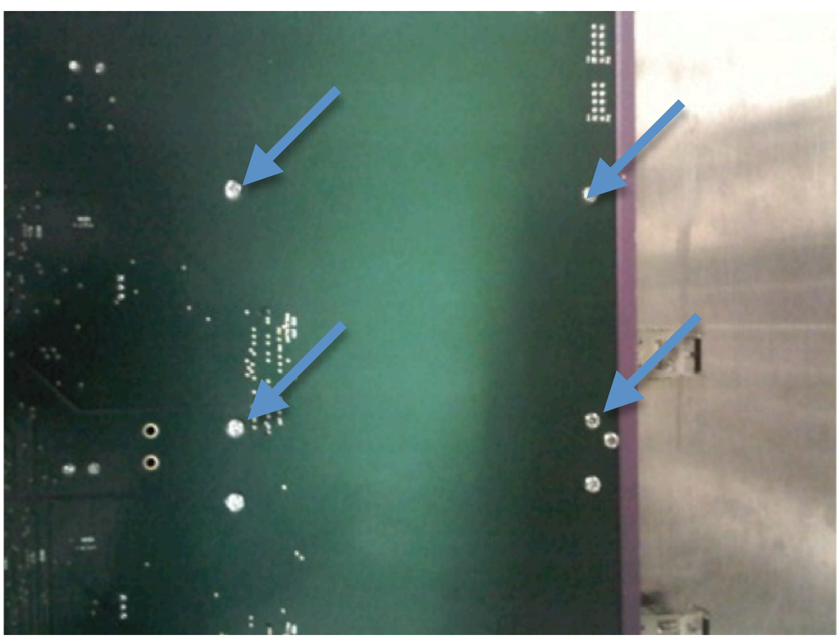

Figure 20: 4 screws per daughter board (bottom view)

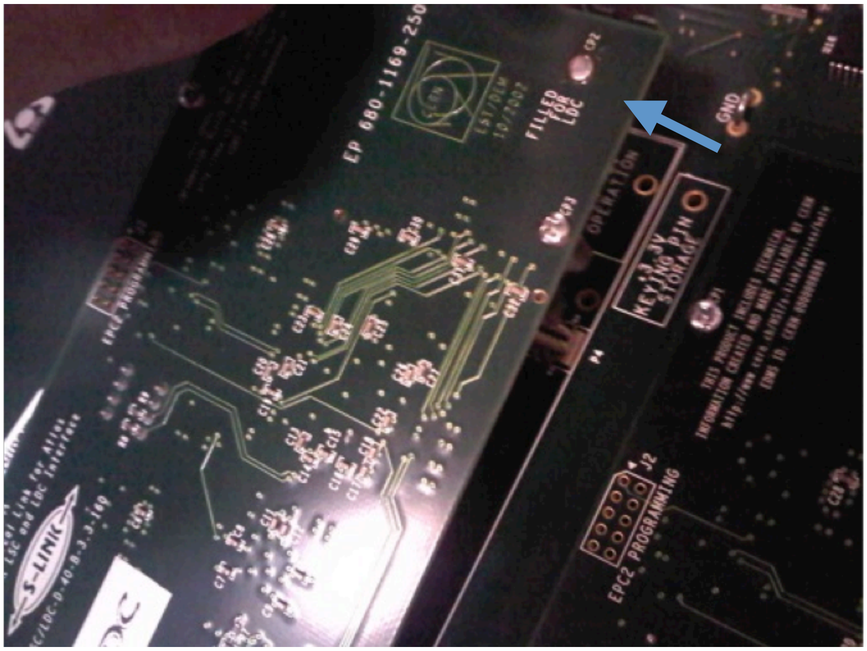

Figure 20: pull to disconnect daughter board

Figure 21: daughter board removed