Hardware and Software Setup Instructions for CMX Test Rig at MSU

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1 Overview

This document records the steps taken to set up a test stand for a prototype CMX module. The stand, consisting of two VME crates (one 6U crate and one 9U crate) was originally constructed at CERN in Fall 2012, following the example of the official L1Calo test stand, also located at CERN. It is meant to serve as a guide for the stand's eventual setup at MSU, although it is expected that some different issues on the software side especially will be encountered in the MSU computing environment. Areas in which these new issues are expected to arise will be marked appropriately.

2 Hardware Setup

2.1 Inventory

The test stand at CERN contains the following hardware:

Item	Comments
9U Cp/Jep Crate	Bare-bones version of a standard L1Calo readout crate
Power supply for 9U crate	All necessary cables should be included
Fan tray for 9U crate	Some heating issues observed with SBC, check airflow
VMM	VME Mount Module, mounts 6U SBC for 9U crate
TCM	Timing Control Module, receives TTC signal from TTCvx via fiber optic cable
CPM	Cluster Processor Module, does cluster summing and sends info to CMM/X
CMM/X	Common Merger Module
6U TTC crate	Provides Trigger Timing and Control (TTC) signals for the readout crate. Built-in power supply and fan tray.
LTP	Local Trigger Processor, emulates Central Trigger Processor (CTP) functionality in order to run a local partition
TTCvi	TTC-VMEbus Interface, interfaces between the LTP and the TTC system
TTCvx	Sends TTC signals to the TCM in the 9U L1Calo Readout crate
Nine 1ns LVDS connectors	For cabling the TTC crate
One fiber optic cable	For connecting the TTCvx to the TCM

Table 1: Crates, modules and connectors required for test stand setup

In addition, a dedicated SLC5 PC is used to run the TDAQ online software and control the partition.

2.2 Physical setup

Going from the bottom of the rack to the top, the crates and their power supplies / cooling sources are ordered as follows (see Fig. 1):

- 6U TTC crate, with built-in power supply and fan tray
- Power supply for 9U L1Calo readout crate
- Fan tray for 9U L1Calo readout crate
- 9U L1Calo readout crate

2.2.1 6U TTC crate setup

Three modules - the LTP, the TTCvi, and the TTCvx - are plugged into the 6U TTC crate, along with the controlling SBC. The base addresses on the LTP and TTCvi modules should already be correctly set and should not need to be changed. Note that the TTCvx module only draws power from the VME backplane and therefore does not need to have a base address set or to be inserted into any particular slot, though for ease of cabling we have placed it immediately to the right of the TTCvi module.

- SBC: slot J1.1, first slot on the left
- LTP module: base address 0xD00000, slot J1.13 (9th slot from right side of crate)
- TTCvi module: base address 0xC00000, slot J1.16 (7th from right side of crate)
- TTCvx module: slot J1.17 (6th from right side)

The cable connections were copied from those in the official L1Calo test stand at CERN. The modules in the TTC crate were designed by CERN (not ATLAS) and are intended to work together such that the outputs and inputs that need to be connected mostly line up horizontally with each other. Some of the connections are also made obvious by labelling, but in any case a complete list of necessary connections is provided below in Tables 2 - 4. A close-up of the relevant TTC modules is also shown in Fig. 2.

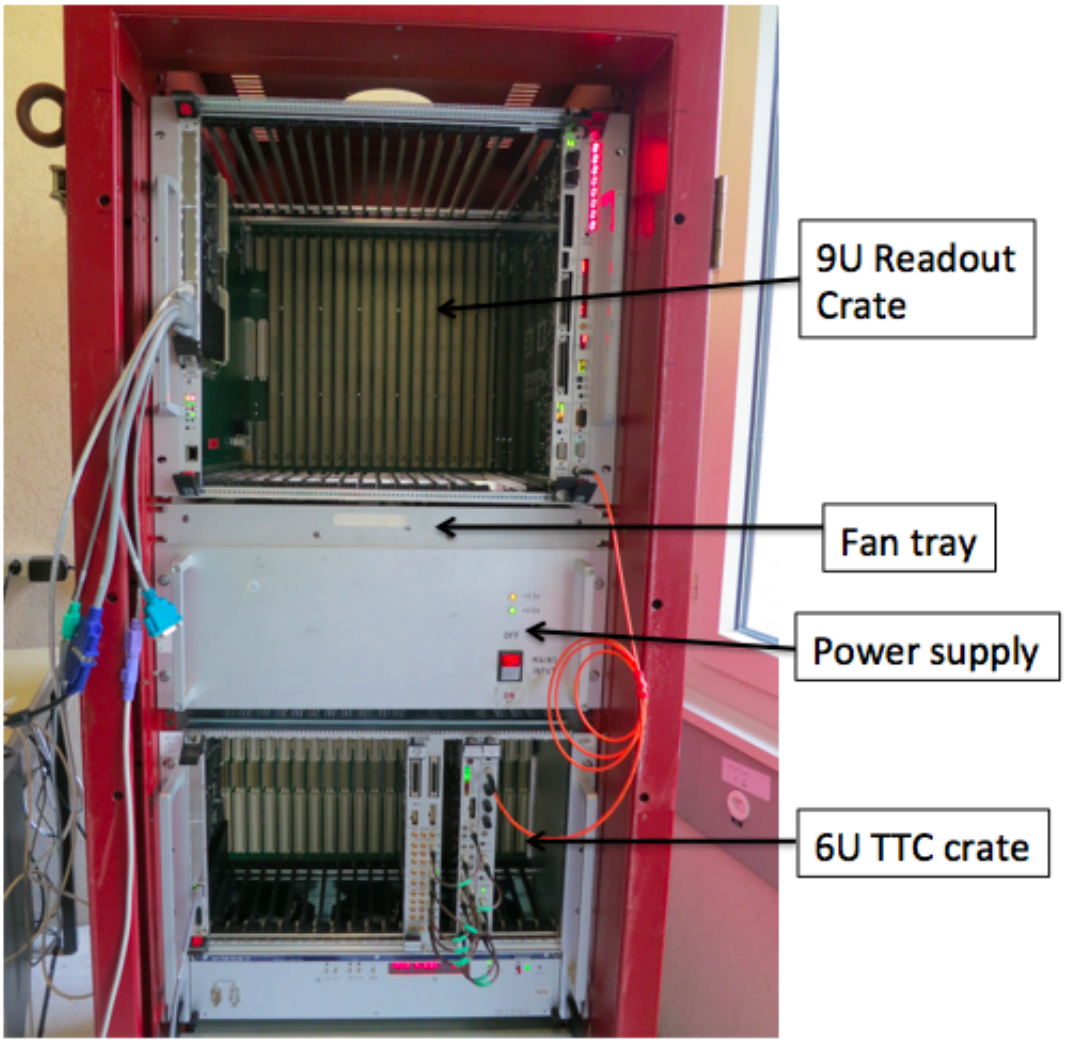

Figure 1: The MSU Test Stand

Table 2: LTP - TTCvi connections

LTP	**TTCvi**
TEST TRIGGERS - TTcvi op/nim - 1	L1A in - 1/nim
ORBIT - TTCvi - op/ecl	ORBIT - in/ecl
B-Go - TTCvi - op/nim - 1	B-Go IN/nim - 1
B-Go - TTCvi - op/nim - 2	B-Go IN/nim - 2
B-Go - TTCvi - op/nim - 3	B-Go IN/nim - 3

Table 3: LTP - TTCvx connections

LTP	**TTCvx**
BC/CLOCK - TTCvx - op/ecl	CLOCK IN - ecl

Table 4: TTCvi - TTCvx connections

TTCvi	**TTCvx**
CLOCK IN - bc/ecl	CLOCK OUT - ecl
CHANNEL OUT - A/ecl	CHANNEL IN - A/ecl
CHANNEL OUT - B/ecl	CHANNEL IN - B/ecl

Finally, a fiber optic cable runs from any of the FIBER OPTICS OUT optical emitters on the TTCvx to the TTC OPTO I/P connector on the TCM in the 9U crate (see next section).

2.2.2 9U L1Calo Readout crate setup

In addition to the VMM which mounts the SBC, there are three modules in the L1Calo Readout crate: a CPM, a TCM, and a CMM (eventually this

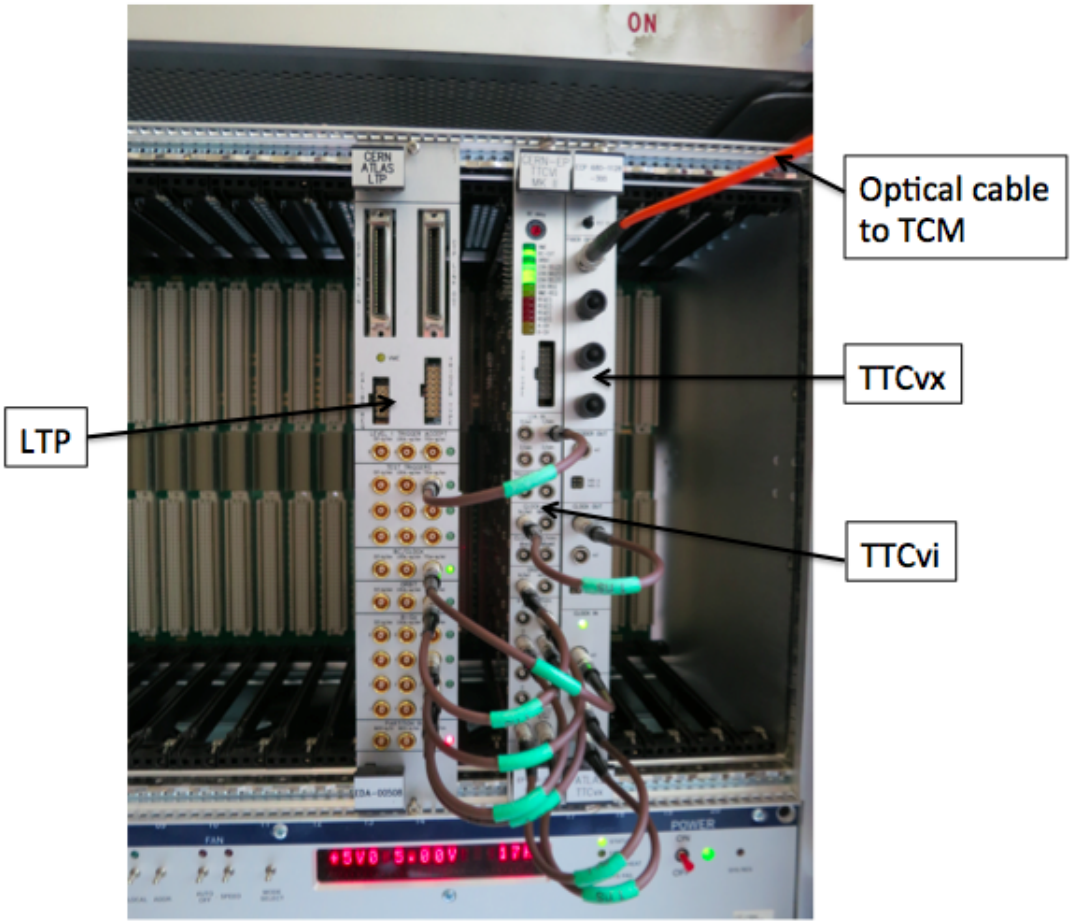

Figure 2: TTC crate setup

will be replaced by the CMX prototype). In contrast to the 6U crate, the 9U crate has a custom backplane with labelled slots.

- VMM with mounted SBC: first slot on left side, labelled "CPU 0"
- CPM: Can go in any slot labelled "CPM/JMM," particular choice must be reflected in OKS database and possibly in hardware address
- CMM/X: Base address 0x780000. Can go in slot labelled "CMM 0", second from left; or in slot labelled "CMM 1," second from right. We chose the CMM 1 slot to provide more space for the SBC, which appeared to have some cooling issues upon initial startup, though these concerns have not re-appeared with subsequent testing. Again, the choice must be reflected in the OKS database.
- TCM: Base address 0x680000. First slot on right side, labelled "TCM."

The L1Calo Readout Crate is shown in Fig. 3.

3 Software Setup

3.1 Computing Environment

The TDAQ software must run applications not only on the PC from which the partition is being run, but also on both of the SBCs which control the VME crates. It does so via ssh between the various machines, and at CERN this resulted in several authentication problems during the various stages of run control. *For the computing environment at CERN*, the following steps resulted in smooth running:

- A local ∼/.ssh/config file on the PC must have these lines:

  ```
  host sbccmx0*
  Protocol 2,1
  StrictHostKeyChecking no
  ```

- Must generate public ssh-rsa keys on the various machines with ssh-keygen and add the keys to .ssh/authorized_keys on the other machines in order to enable ssh without a prompt for a password.

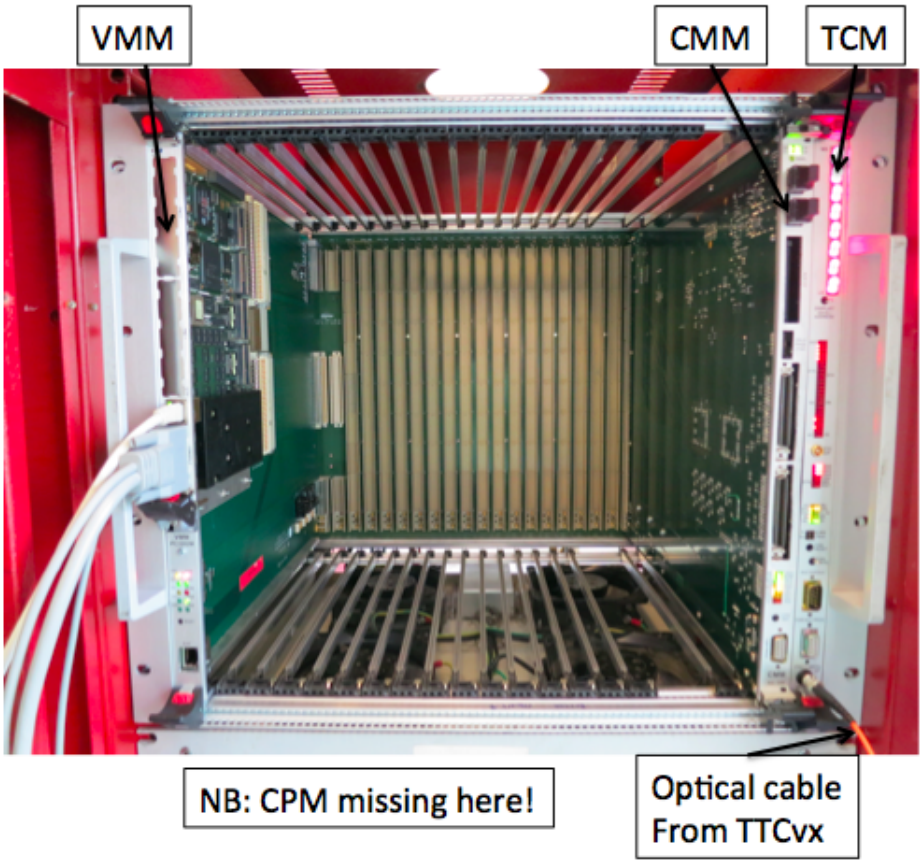

Figure 3: L1Calo Readout crate setup (sans CPM)

- It was necessary to ssh to sbccmx01 from the PC, then do kinit -f. Without this (admittedly sub-optimal) setup, sbccmx01 did not have permission to access needed compiled L1Calo libraries. Note that this should only have to be done for sbccmx01 and not for sbccmx00. It is thought that putting the L1Calo code (see next section) in a public area may solve this problem.

3.2 L1Calo and TDAQ Software

The L1Calo online software should be checked out and built locally, as CMX development will likely require updates to several L1Calo packages. General instructions for setting up the L1Calo online software can be found here: https://twiki.cern.ch/twiki/bin/viewauth/Atlas/LevelOneCaloOnlineSetup.

Among the packages that are checked out by l1calo/scripts/getallpkg, there should be cmxServices (the online control software) and cmxSim (the online simulation software). These have simply been cloned from the existing CMM packages, and have not yet been updated for CMX functionality. This work is ongoing.

On lxplus at CERN, the login script l1calo/scripts/login/.lxplus_bashrc correctly sets up all environment variables needed for running the general TDAQ software in addition to the L1Calo-specific software. How this will be accomplished remotely from MSU is a subject which will require some investigation.

3.3 OKS Database

TDAQ relies on xml databases (or to use the ATLAS terminology, OKS databases) to tell it what hardware, simulation and monitoring to include in a partition. Various examples of L1Calo partitions sit in the directory l1calo/dbFiles. Among these is a partition named MsuTest which describes the setup of the test stand. The database files which are needed to build and install a complete OKS database are:

- dbFiles/gen/msuTest.desc
- dbFiles/partitions/MsuTest.data.xml
- dbFiles/hw/msuTest_cables.data.xml
- dbFiles/hw/msuTest_datafiles.data.xml
- dbFiles/segments/msuTest_runtypes.data.xml

- dbFiles/segments/msuTest_segments.data.xml

All of these files are in the L1Calo SVN repository, though of course they are to some extent tailored to the setup at CERN. It may be the case that the only file requiring modification for the setup at MSU is gen/msuTest.desc, as many other files are generated and installed from this one using the L1Calo script buildpkg. Other necessary changes will likely just have to wait to be discovered during testing at MSU.

3.4 Running the Partition

A setup script like this must be executed first on the PC which is controlling the partition:

```
source LVL1/l1calo/scripts/login/.lxplus_bashrc
export TDAQ_DB_DATA=$L1CALO_ROOT/database/v15/l1calo/partitions/MsuTest.data.xml
export TDAQ_DB=oksconfig:$TDAQ_DB_DATA
export TDAQ_PARTITION=MsuTest
```

At which point the TDAQ software can be run:

```
setup_daq -p $TDAQ_PARTITION
```

At which point, debugging and development can commence.