TRIUMF

Midas in SuperCDMS

Ben Smith

Midas Workshop 2019

Discovery, accelerated

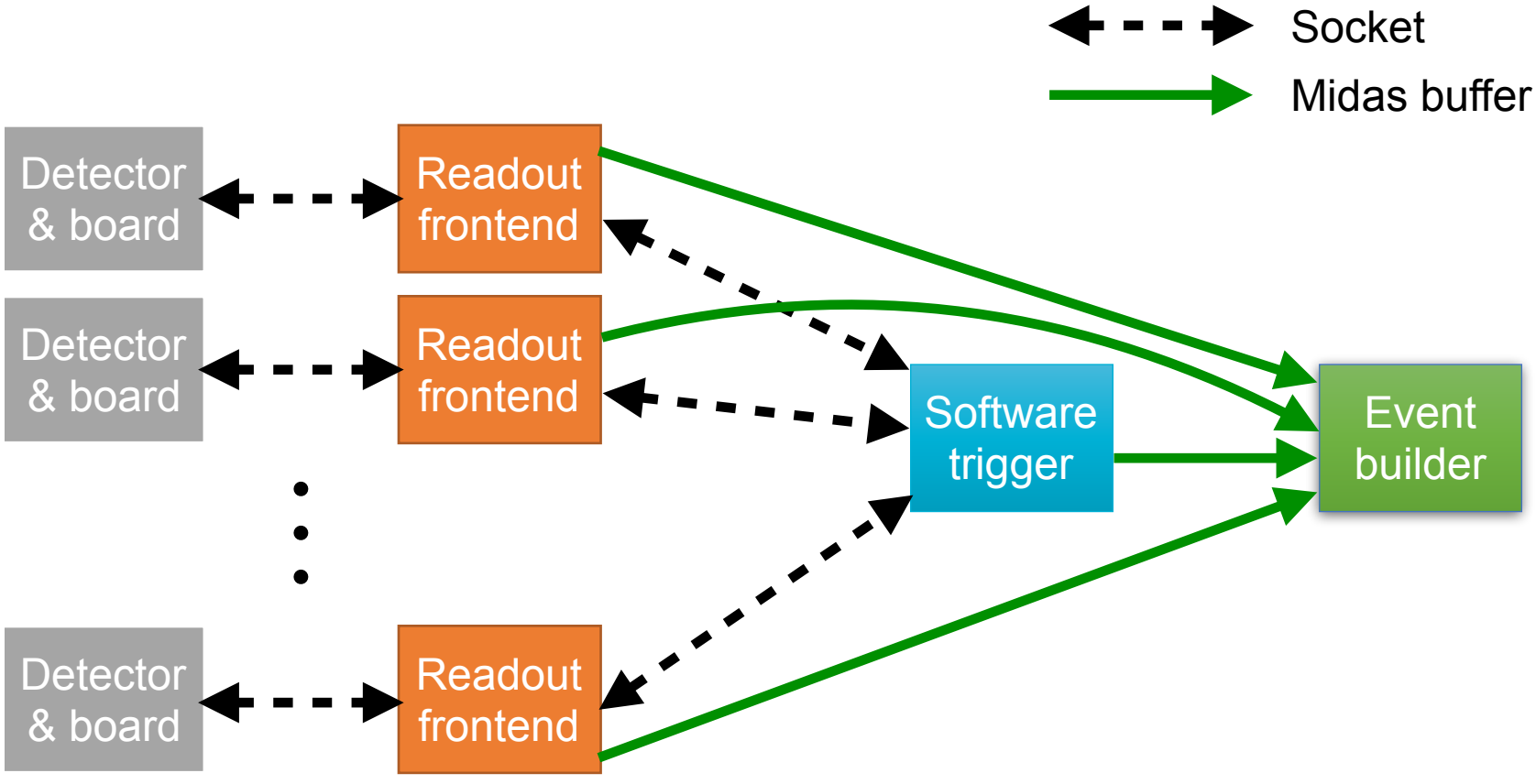
Overview

- About SuperCDMS
- DAQ setup and midas usage
- Other tools
  - Python
  - Program control and logging
  - Web server
- Git

SuperCDMS

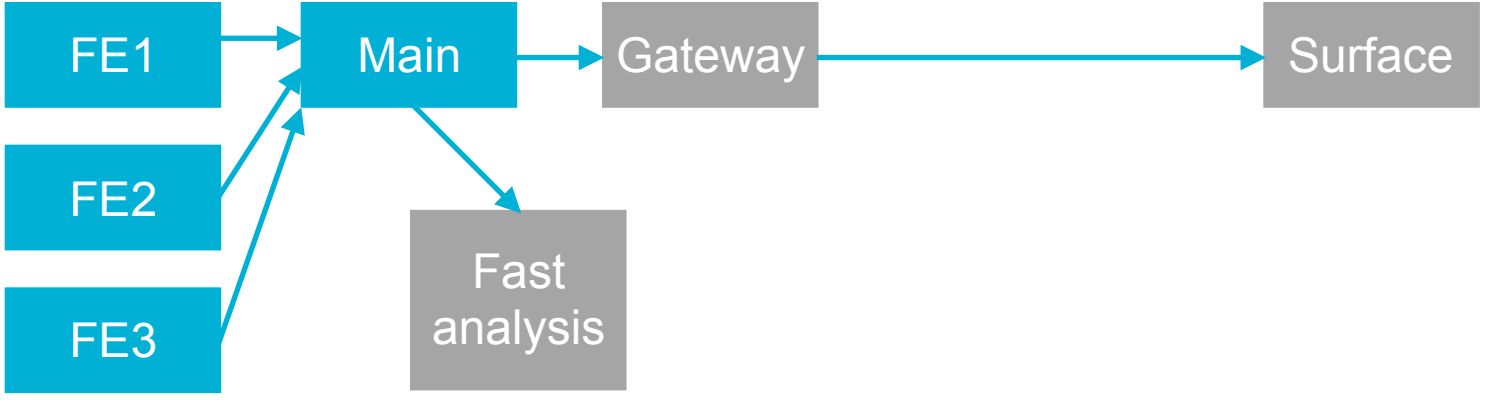
- Dark matter experiment that will be installed at SNOLAB
- Will have 24 detectors; up to 50MB/s data rate
- Detectors tested and calibrated at *test facilities* before sending to SNOLAB
  - 5+ locations using the same DAQ software
  - For reproducibility/sanity we make *releases* of software that test facilities can pull

DAQ software structure



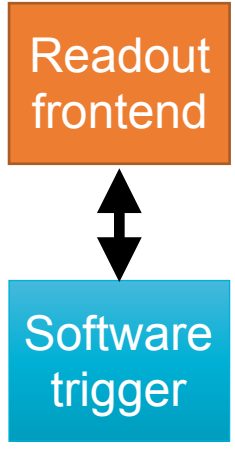
DAQ cluster

- Can run in multiple modes
  - Lots of data from a few detectors
  - A bit of data from all detectors (24 planned; might be 90 in future)
- Cluster of servers; can scale easily in future



Midas limits we pushed/broke

- Legacy version of DAQ used ODB hotlinks for inter-frontend communication
  - Not recommended
  - Perhaps could have used midas RPC calls, but simple socket seemed easier
- Max number of hotlinks
  - Follow wiki procedure
- Max number of clients
  - Edit `MAX_CLIENTS` in midas.h



Testing C++ code

- Custom readout boards are... somewhat delayed
  - Wanted to develop/test DAQ software before we had physical boards
  - Wrote a program that simulates the custom boards
  - Only 2 minor issues when first real board arrived
- Use Catch2 to write unit tests for complex bits of C++
  - Useful for testing logic, and avoiding regressions
- Use sequencer for running long-term stability tests

Python

- Many grad students (and postdocs!) only use python now
  - ROOT used to be gateway to C++; analysis now done in numpy
- All our non-C++ tools are written in python
  - Lots of monitoring scripts
  - Store full ODB dumps in our own MySQL table
  - Copy midas messages from midas.log to MySQL
  - Orchestrate rapid processing of data to produce plots
  - Web server for finding runs, viewing settings/plots etc
- Midas interactions use a little module that POSTs to mjsonrpc
  - Thoughts on "official" python support in midas?

JSON in MySQL

- We use MySQL for midas history DB, and for data quality monitoring DB
- MySQL 5.8 introduced a JSON field type
- We use it to store full begin- and end-of-run ODB dumps
- Can query for subsections
  - Get `/A/B/C` using `SELECT my_col->'$.A.B.C' FROM ...`
- Mild pain to upgrade to 5.8
  - If you only ever want to retrieve full JSON values, could just store as TEXT in any version of MySQL

Controlling programs

- Midas programs page works for controlling midas clients
  - We want to control all our python programs too
- Also want "log rotation"
  - Want to be able to debug problems operators see
    - Seeing stdout/stderr can be invaluable
    - Better if we can debug a crash that already happened, rather than "pipe output and wait for it to happen again"
  - Don't want to fill disk with huge logs from programs
  - Nice to keep e.g. last 50MB of logs
- Solve both problems with same tool...

Controlling programs - supervisord

- Supervisord is a tool for controlling processes
  - Can control any program
  - Can enable log rotation
  - Can auto-restart failed programs (and notify by email)
  - Has an RPC server, python lib, command line tool
- Add one systemd service to start it at boot, then it starts all other DAQ programs
- I wrote a web interface for CDMS

Controlling programs - web interface

Home Series info Data acquisition Data quality Data flow Help Administration bsmith Dark mode Log out

Control DAQ and DQM programs

Show help Add new program

▸ Group actions

▾ Program status and control

Groups	Program	Actions	Server	State	Uptime	View logs
dqm	delayed_image_generator	Start Stop Restart Edit	cdms-dqweb	RUNNING	14 days, 0:27:47	stdout stderr
dqm	delayed_trend_generator	Start Stop Restart Edit	cdms-dqweb	RUNNING	13 days, 19:03:57	stdout stderr
dqm	delete_from_cdmsback	Start Stop Restart Edit	cdms-back	RUNNING	14 days, 0:27:40	stdout stderr
dqm	delete_from_cdmsdqweb	Start Stop Restart Edit	cdms-dqweb	RUNNING	14 days, 0:27:48	stdout stderr
dqm	event_viewer	Start Stop Restart Edit	cdms-dqweb	RUNNING	14 days, 0:27:46	stdout stderr
dqm	eventbuilder_monitor	Start Stop Restart Edit	cdms-dqweb	RUNNING	14 days, 0:27:52	stdout stderr
dqm	msg_to_mysql	Start Stop Restart Edit	cdms-back	RUNNING	14 days, 0:27:43	stdout stderr
dqm	processing_scheduler	Start Stop Restart Edit	cdms-dqweb	RUNNING	7 days, 0:25:07	stdout stderr
dqm	transfer_from_cdmsback	Start Stop Restart Edit	cdms-back	RUNNING	14 days, 0:27:41	stdout stderr
dqm	transfer_from_cdmsdqweb	Start Stop Restart Edit	cdms-dqweb	RUNNING	14 days, 0:27:49	stdout stderr

More on the web interface

- Gateway machine runs nginx, which proxies to our web server (implemented in python)
  - We then proxy to mhttpd

- Python layer has per-user permissions
  - Untrained people can't see any midas pages
  - Some people can only use custom pages (plus their mjsonrpc calls)
  - Experts can see everything
- Same auth for midas proxy and other interfaces (program control, data processing, run search, plot viewing etc)

Git

- SuperCDMS has all code in git
- Use semantic versioning and git flow to organise
  - Develop in `feature/xyz` branches; merge into `develop`; release and tag (e.g. v3.2.1) in `master`
- Share code using submodules
  - E.g. IOLibrary is used by DAQ to package data into DWORDs, and by analysis to parse that data
  - DAQ repo defines which commit of IOLibrary to use
  - Need to use "git submodule update" after pulling...

Git with midas

- We keep a fork of midas in our own git repo (midas_fork)
  - Allows us to include midas as a submodule
  - Apply our own patches before release
    - e.g. increasing max number of clients
- Upgrading midas is a pain
  - Something usually breaks
  - Always worry about changes that are "silent"
  - Would like to see more tests performed *before* versions are tagged

Summary

- SuperCDMS likes modern tools and tries to impose good software practices
- Core DAQ written in C++; most other tools in python
- Midas is working well as a DAQ in our multi-machine cluster
- Upgrading versions is a pain