#### DAQ-in-a-box



#### [transliterated drasi: 'action']

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#### **NUSTAR** experiments

- Many types of detectors
- Short production runs (~1 week)
  - Reconfiguration
- Large distances between detectors
  - (Super-FRS  $\rightarrow$  Caves)
- Triggered (so far)
- Increasing number of electronic channels

### MBS is good!

- Rock-solid for > 20 years
  - Standard DAQ @ GSI
  - Many other places
    - Incl. South Pole
- Countless experiments
- Multi-crate sync: TRIVA
- Well-defined scope:
  - Readout by user code.



### DAQ system needs

Not today

Focus areas:

- Sticky events
- Operating modes
  - Triggered
  - Free-running
  - Hybrid
- Scalable
- Modular
- Easy re-configuration





Topology

Building an experiment from individual detectors:

- Multi-crate setup using trigger bus
  - Master
  - Slave(s)



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Topology

Building an experiment from individual detectors:

- Multi-crate setup using trigger bus
  - Master
  - Slave(s)
- Data merged by
  - Event builders



Same as MBS... (move on...)

Topology

Building an experiment from individual detectors:

- Multi-crate setup using trigger bus
  - Master
  - Slave(s)
- Time-stamped
- Data merged by
  - Event builders
  - Time sorter



#### New features

- Mostly automatic, much faster, recovery
- Simplified configuration

- Use full input bandwidth of event-builder
  - Deep event-builder input buffers
- Easy gdb (debugger) access to readout
- Sticky events

## Something for everyone?

**Operators** 

Developers, operators

Analysis

Developers

Only one data stream

- Mostly automatic, much faster, recovery
- Simplified configuration

- Use full input bandwidth of event-builder
  - Deep event-builder input buffers
- Easy gdb (debugger) access to readout
- Sticky events



### Backwards compatibility (MBS-style)

- Produce LMD files
  - (extensions/modifications planned)
- f\_user\_readout() interface to readout
  - Built upon lower-level interface with more control
- Stream and transport protocols supported

### Portability

#### Set up by Michael Munch, Aarhus

CPU

• Code is automatically tested on many systems:

Compilers
lore amd64:
<ul> <li>Fedora</li> <li>CentOS</li> </ul>
OpenSuse VV
• Stretch
<ul> <li>Buster</li> <li>Ubuntu:</li> </ul>
<ul> <li>Zesty</li> <li>Artful</li> </ul>
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• Some other systems at irregular intervals

#### Status: advanced beta-stage

- Used in experiments:
  - IS561b @ ISOLDE (few weeks ago)
  - IS561 @ ISOLDE (last autumn)
  - In Aarhus
- Being tested at:
  - Cave C @ GSI multiple systems

#### Performance (readout)



### Performance (readout with livetime)



### Orders of magnitude

1 byte/s	0.6 MB/week	1/2 floppy	
			S034 (1992): 15 kB/s → 16 GB
¥			S135 (1995): 250 kB/s -> 243 GB
10 MB/s	6 TB/week	"1 disk"	S393 (2010): 4 MB/s → 4.2 TB
100 MB/s	60 TB/week	"1 raid array"	► Recording: 3200 TB/year
1 GB/s	600 TB/week	"half-a-rack" 🏼 🖓 🆓	ATLAS level 3 trig: 320 MB/s
¥			ATLAS level 2 trig: 5 GB/S Fact sheets 7 & 8 ATLAS level 1 trig: 150 GB/S

#### Performance EB / TS



### Performance EB / TS









So far...

### **Only Happy Users**



- Problem?
  - → Tell!
- Suggestion?
  - → Tell!



The fine print:

- Regularly keep your version up-to-date.
- Read the documentation.



#### Outlook

Short-term todo:

• Release as open-source (LGPL)

#### Contributors:

#### Michael Munch, Aarhus

#### Bastian Löher, Hans Törnqvist TUD / GSI



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# Thank you!

