

DAQ-in-a-box

δράση

[transliterated drasi: 'action']

Håkan Johansson, Chalmers, Göteborg

NUSTAR experiments

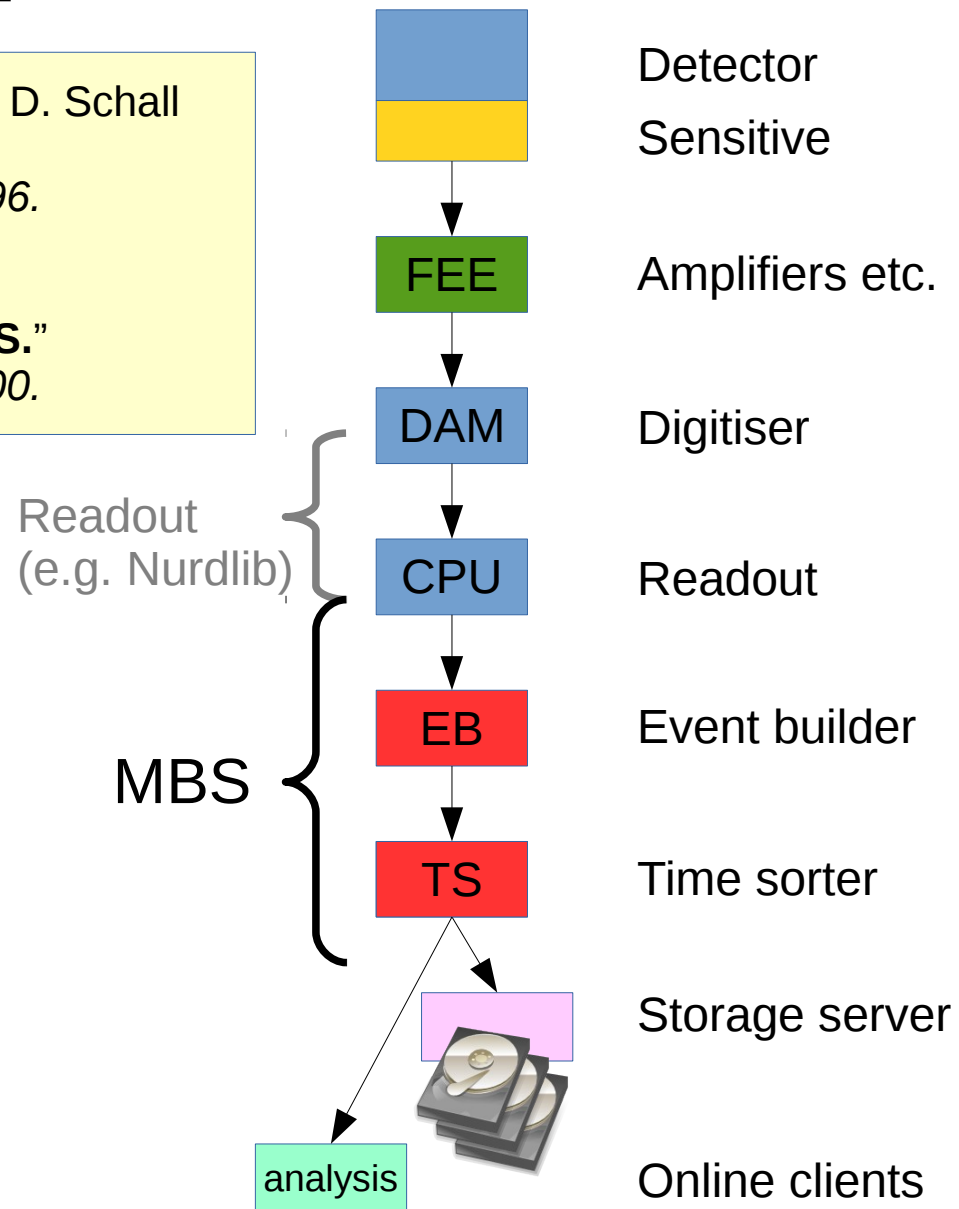
- Many types of detectors
- Short production runs (~1 week)
 - Reconfiguration
- Large distances between detectors
 - (Super-FRS → Caves)
- Triggered (so far)
- Increasing number of electronic channels

MBS is good!

H.G. Essel, J. Hoffmann, N. Kurz, R.S. Mayer, W. Ott, D. Schall
"The new data acquisition system at GSI."
IEEE Trans. Nucl. Sci., vol 43, no 1, pp. 132–135, 1996.

H.G. Essel and N. Kurz,
"The general purpose data acquisition system MBS."
IEEE Trans. Nucl. Sci., vol 47, no 2, pp. 337–339, 2000.

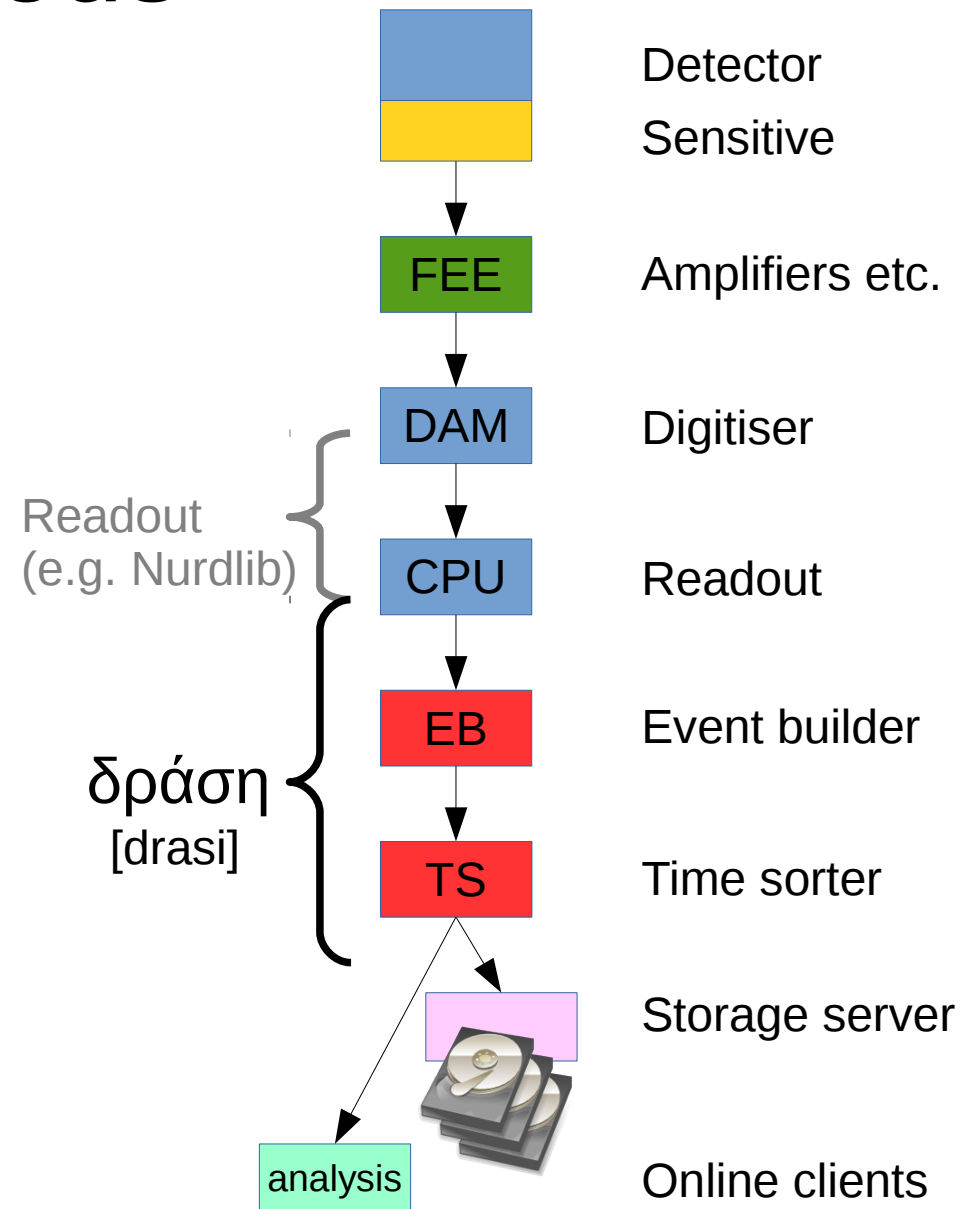
- Rock-solid for > 20 years
 - Standard DAQ @ GSI
 - Many other places
 - Incl. South Pole
- Countless experiments
- Multi-crate sync: TRIVA
- Well-defined scope:
 - Readout by user code.



DAQ system needs

Focus areas:

- Sticky events
 - Operating modes
 - Triggered
 - Free-running
 - Hybrid
 - Scalable
 - Modular
 - Easy re-configuration
- Not today

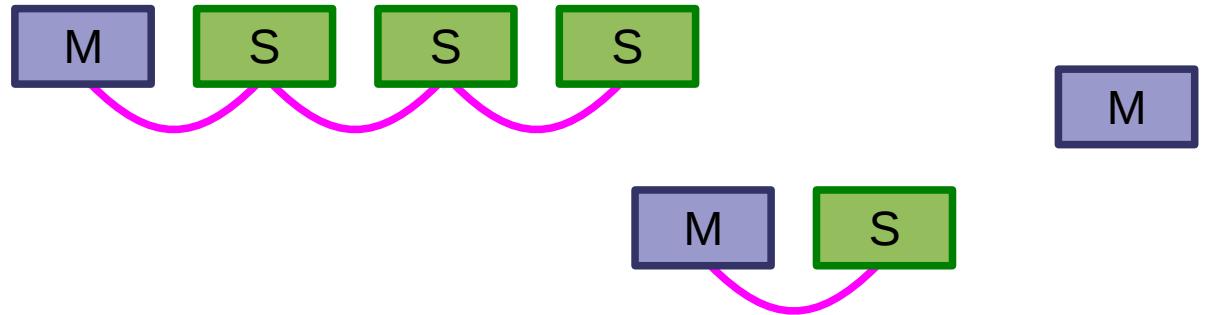


Not new,
same as MBS...

Topology

Building an experiment from individual detectors:

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



Still not new,
same as MBS...

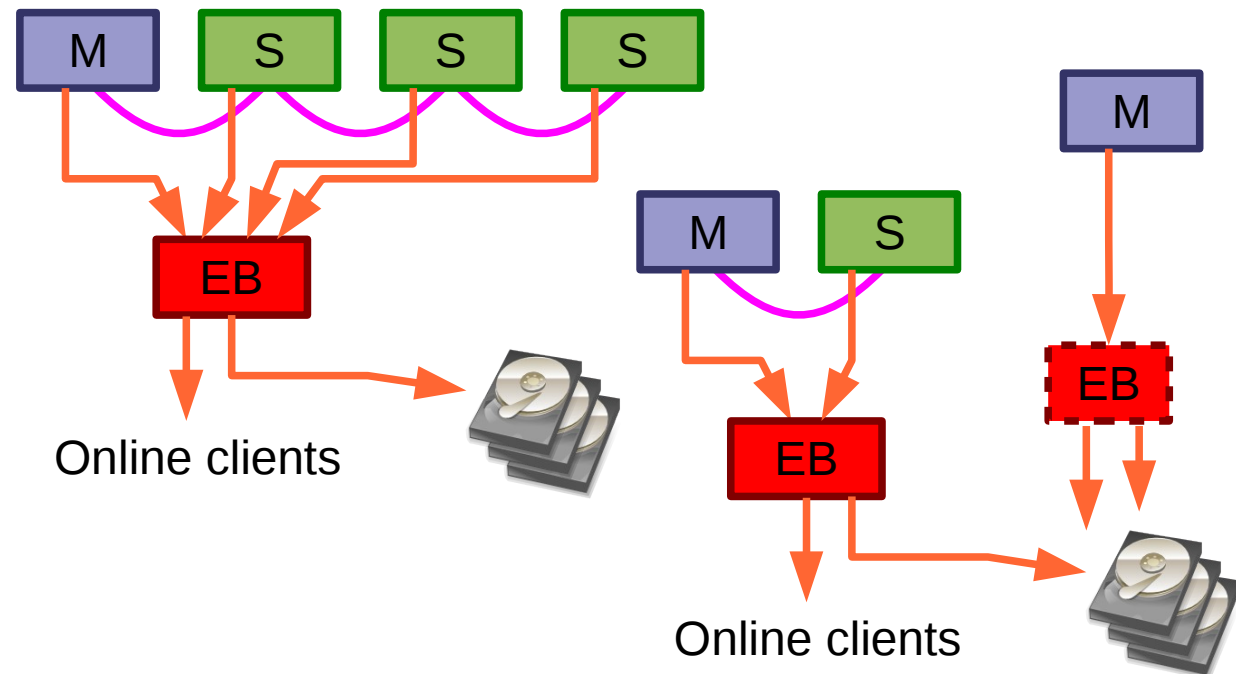
Topology

Building an experiment from individual detectors:

- Multi-crate setup using **trigger bus**

- Master
- Slave(s)

- **Data** merged by
 - **Event builders**

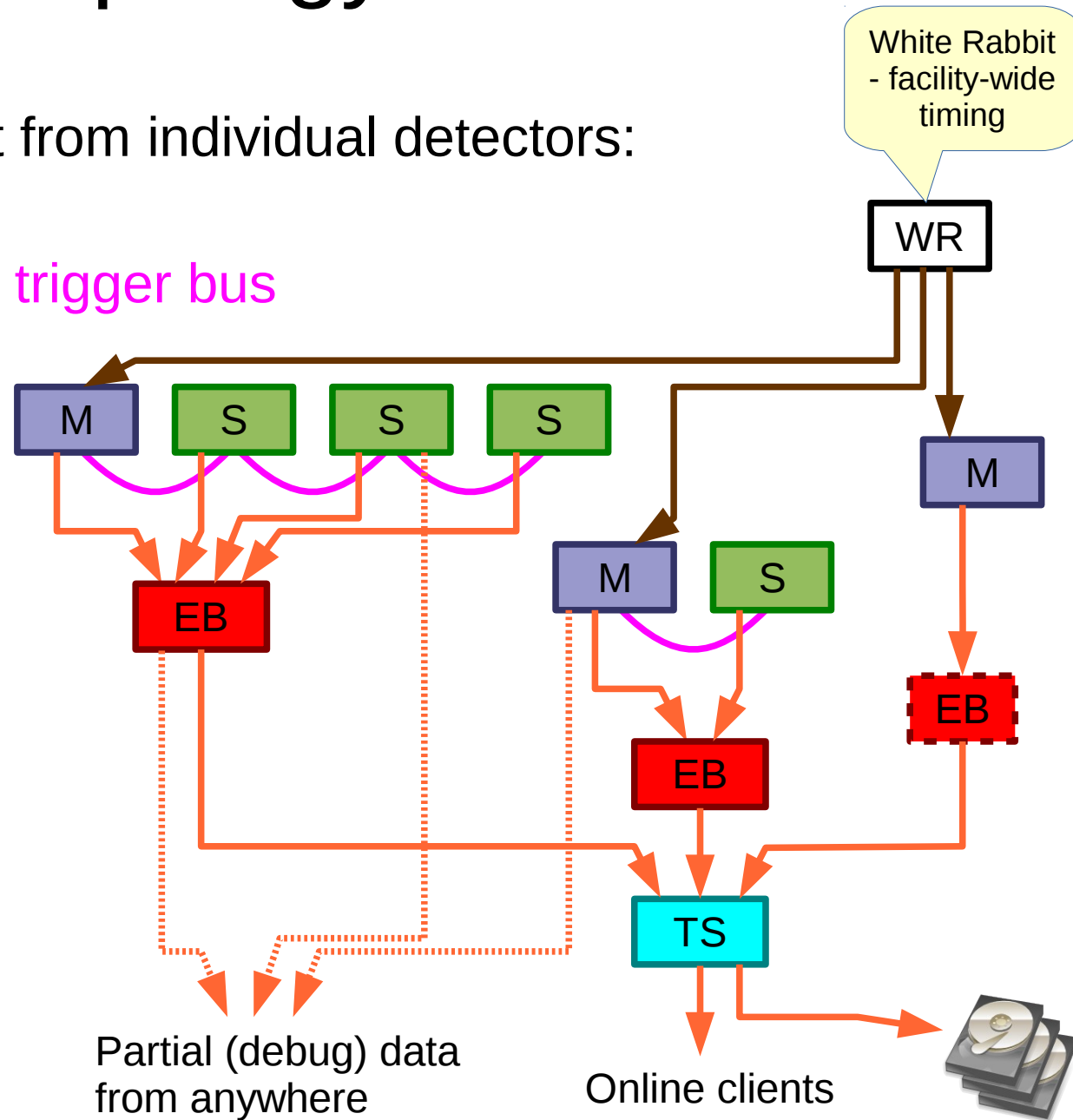


Same as MBS...
(move on...)

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?

Developers,
operators

- 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**

Operators

Analysis

Only one
data stream

Developers

Analysis

Many concepts caused lots of discussion during NDAQ TDR writing. None about 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

- Code is automatically tested on many systems:

CPU
architectures

Compilers

		x86		amd64		ppc	arm
		gcc	clang	gcc	clang	gcc	gcc
GNU/Linux	Debian			✓		✓	
	etch			✓			
	wheezy			✓			
	jessie				✓		✓
Ubuntu	trusty	✓	✓	✓	✓		
	xenial			✓	✓		
	gcc latest			✓			
	ELDK					✓	
	FreeBSD 10			✓	✓		
	Mac (sierra)				✓		

More amd64:

- Fedora ✓✓
- CentOS ✓✓✓
- OpenSuse ✓✓
- Debian:
 - Stretch ✓✓
 - Buster ✓✓
- Ubuntu:
 - Zesty ✓✓
 - Artful ✓

- 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

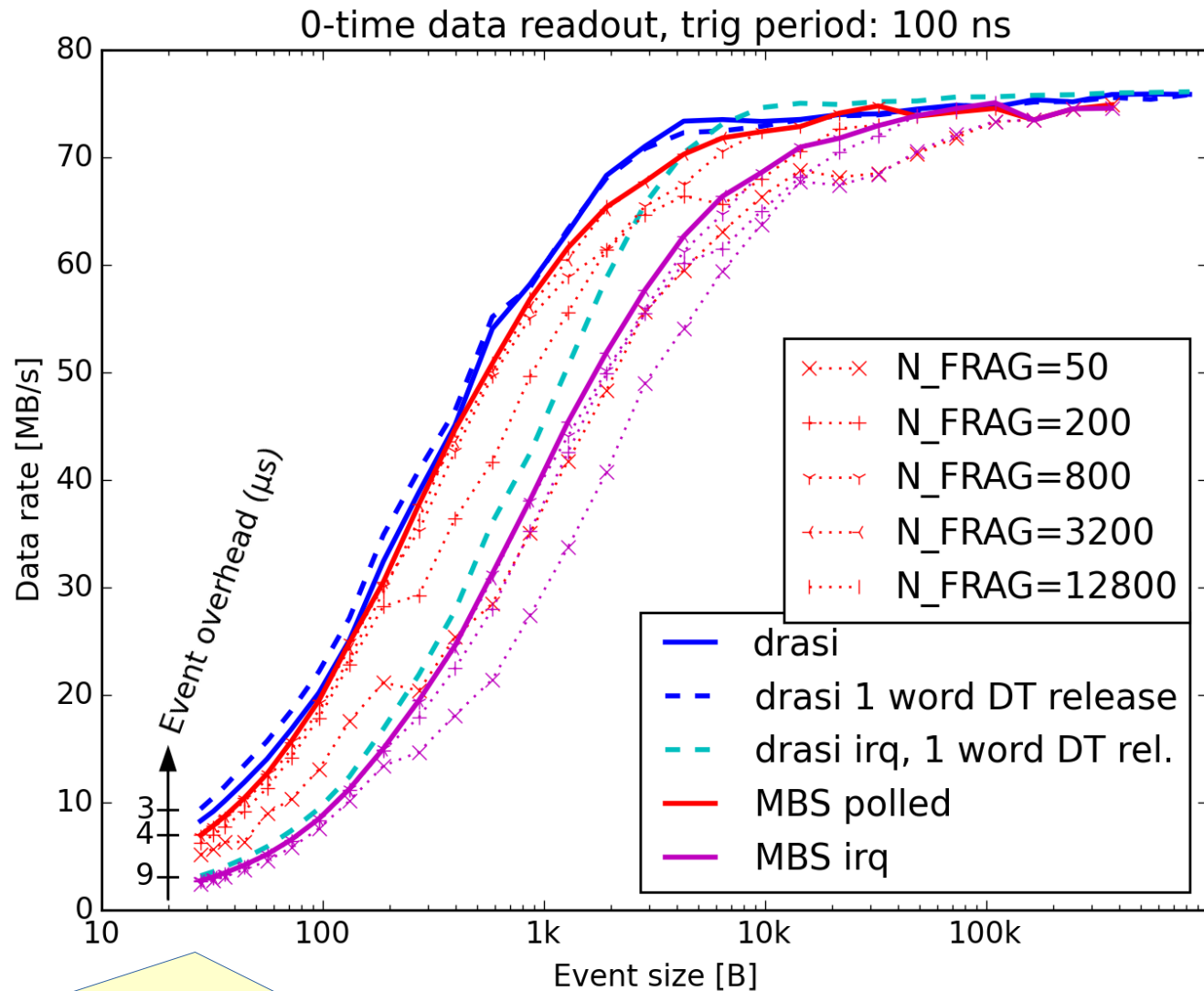
Performance (readout)

New trigger after DT release.
(→ 100% DT)

No actual data read out
(fillers inserted)





r4l-11

x86l-80



LMD event+subevent header is 28 bytes.

Orders of magnitude

1 byte/s	0.6 MB/week	1/2 floppy 
↓		
10 MB/s	6 TB/week	"1 disk" 
↓		
100 MB/s	60 TB/week	"1 raid array" 
↓		
1 GB/s	600 TB/week	"half-a-rack" 
↓		

- S034 (1992): 15 kB/s → 16 GB
- S135 (1995): 250 kB/s → 243 GB
- S393 (2010): 4 MB/s → 4.2 TB

Recording: 3200 TB/year

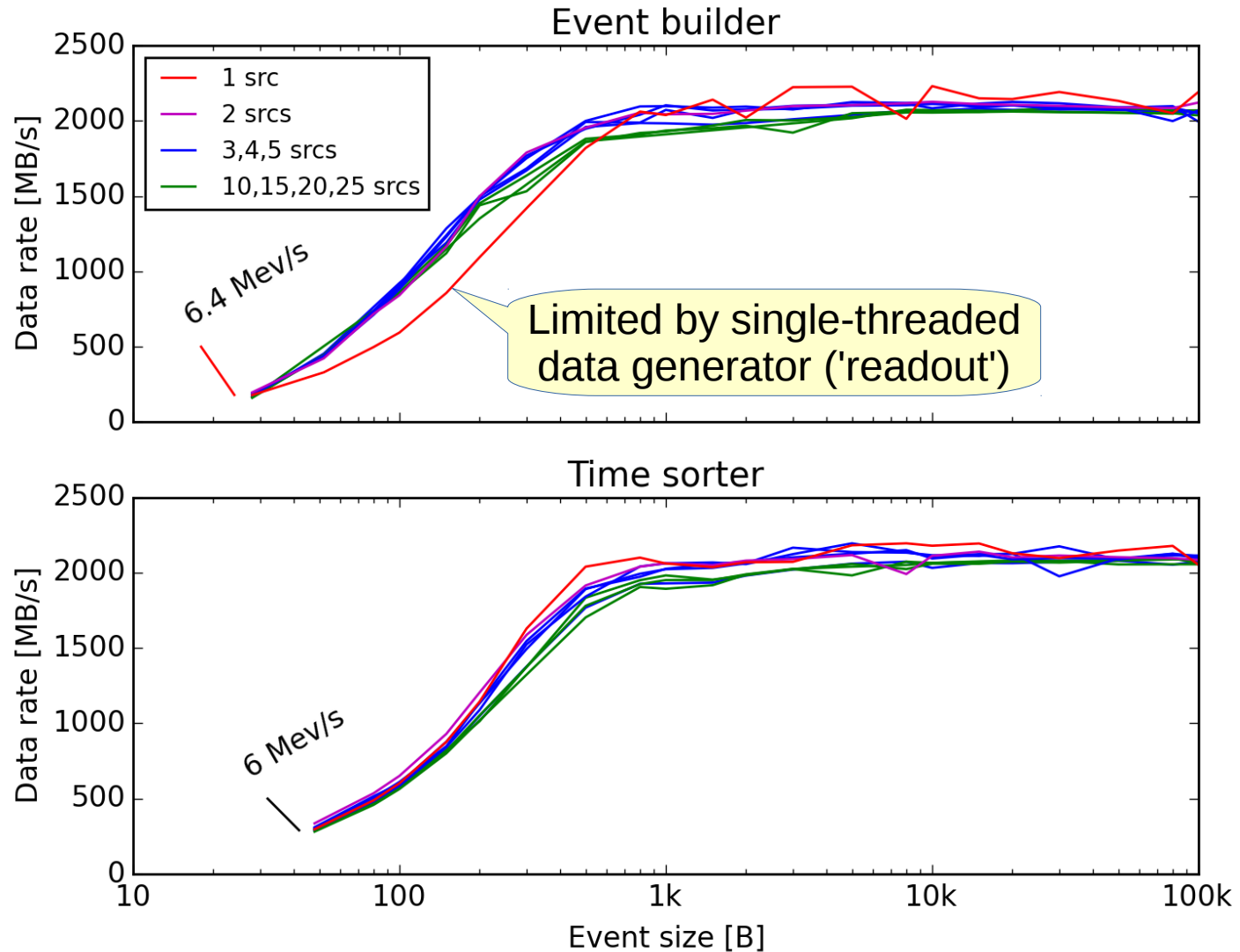
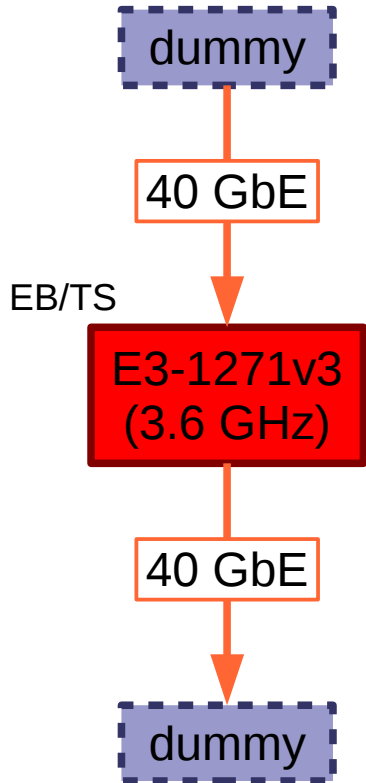
ATLAS level 3 trig: 320 MB/s

ATLAS level 2 trig: 5 GB/s

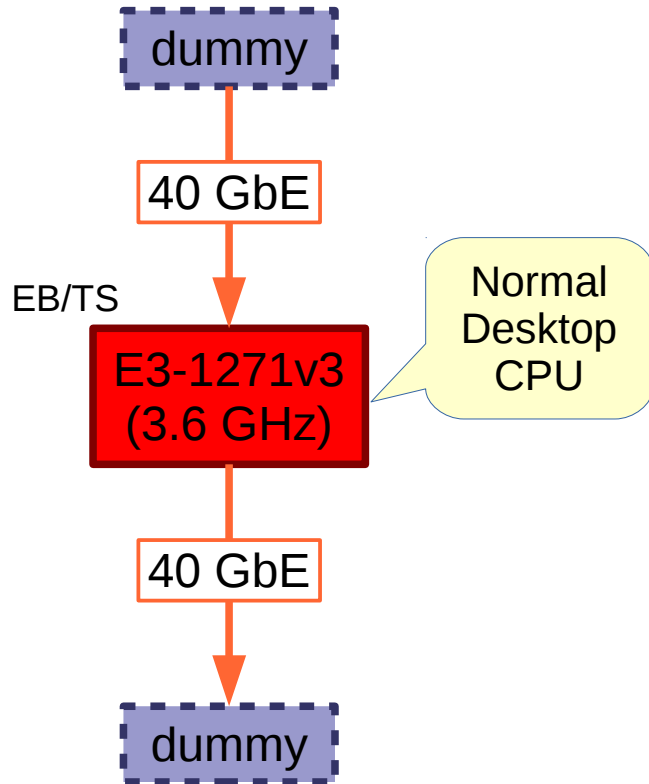
ATLAS level 1 trig: 150 GB/s

ATLAS
Fact sheets
7 & 8

Performance EB / TS



Performance EB / TS



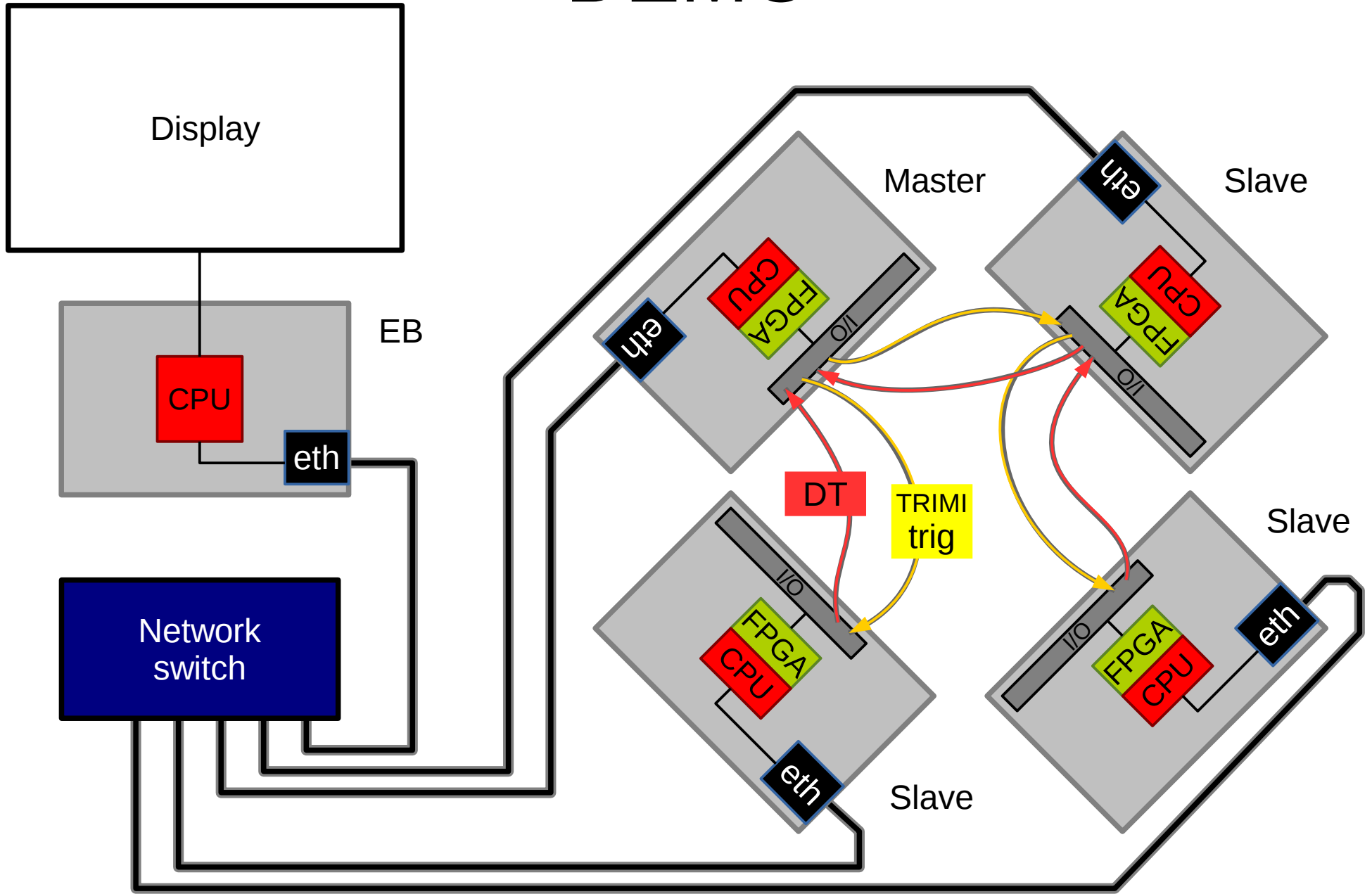
CPU clock cycle consumption

Measured non-saturated
(i.e. not at peak performance)

		clk/frag	clk/event	clk/byte
Input (net)		20	20	1.1
Merger	EB	205	175	0.9
	TS	33/src	340	
Output (net)			38	0.9

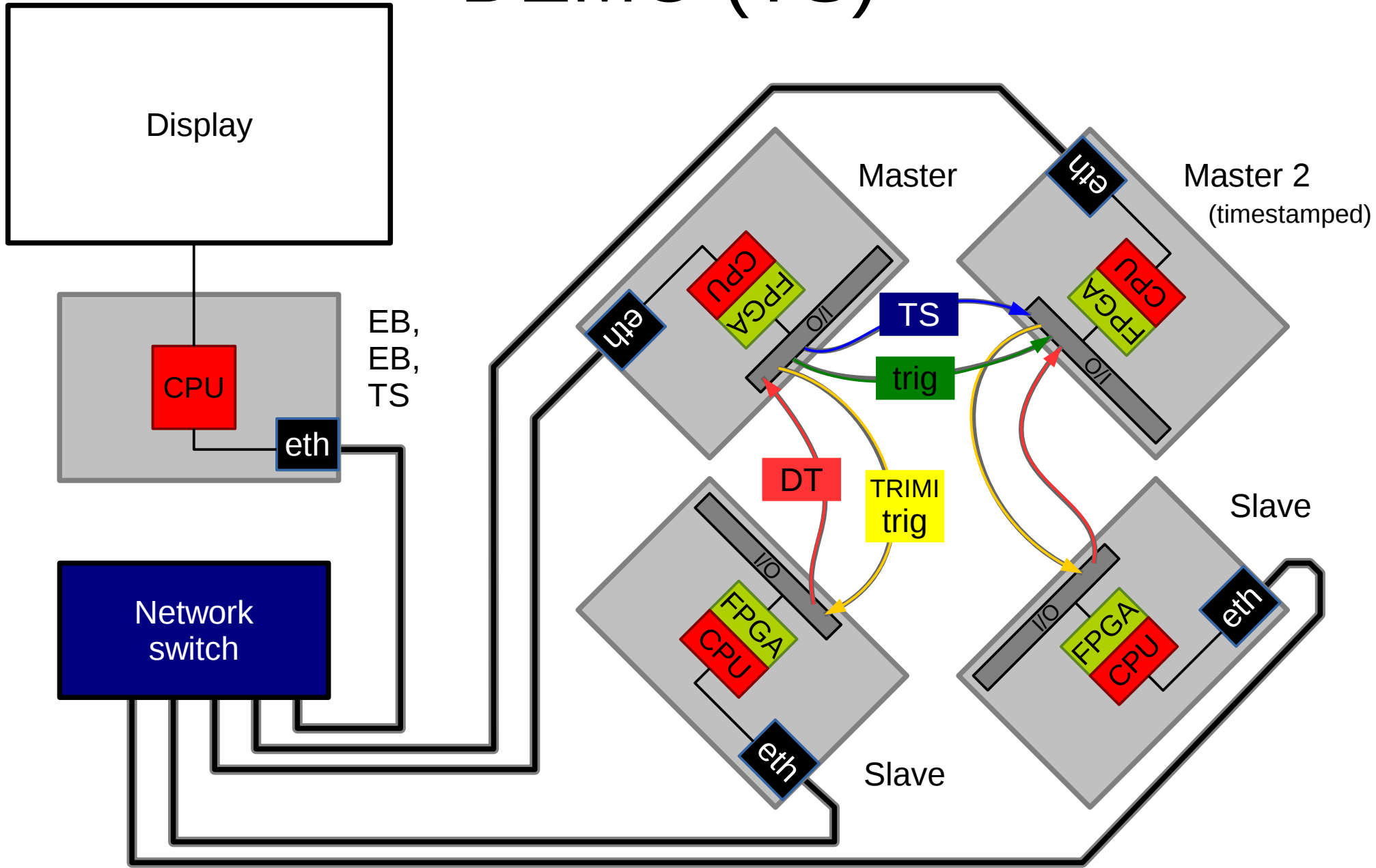
DEMO

FPGA: TRLO II (firmware)
CPU: drasi

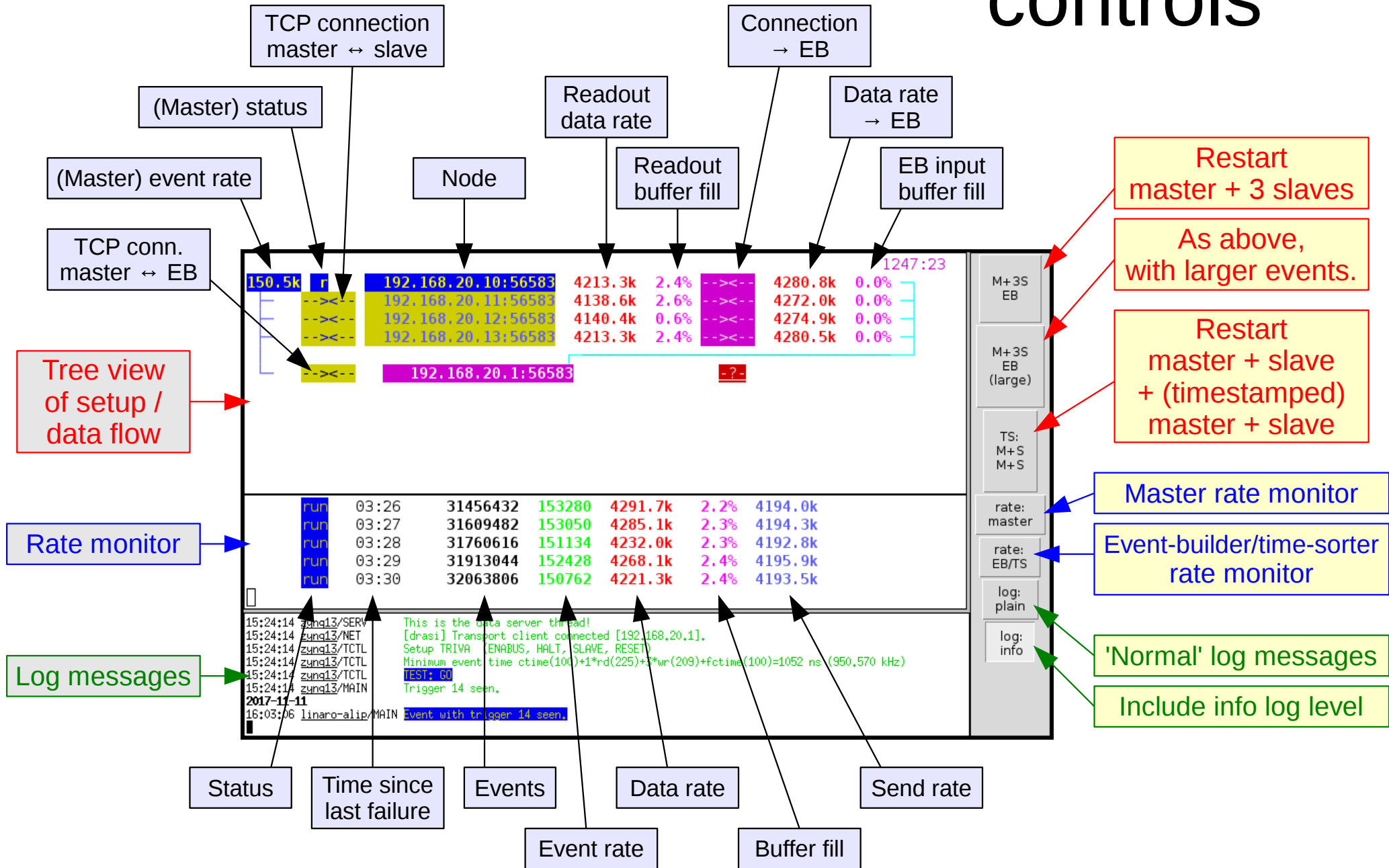


DEMO (TS)

FPGA: TRLO II (firmware)
CPU: drasi



DEMO controls

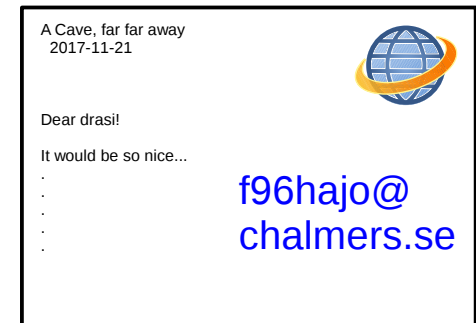


So far...

Only Happy Users



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

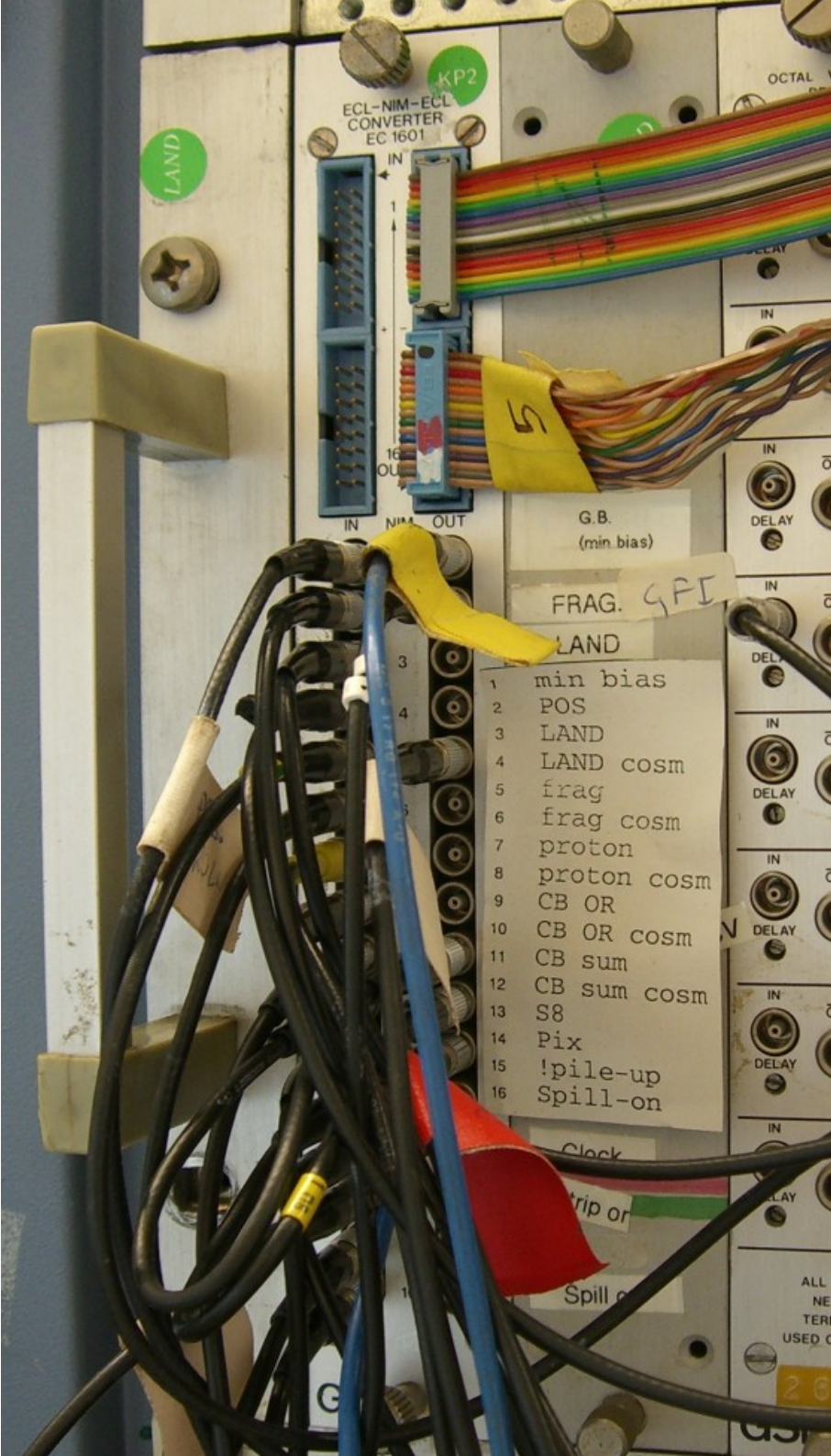


The fine print:



In return, you will:

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



Outlook

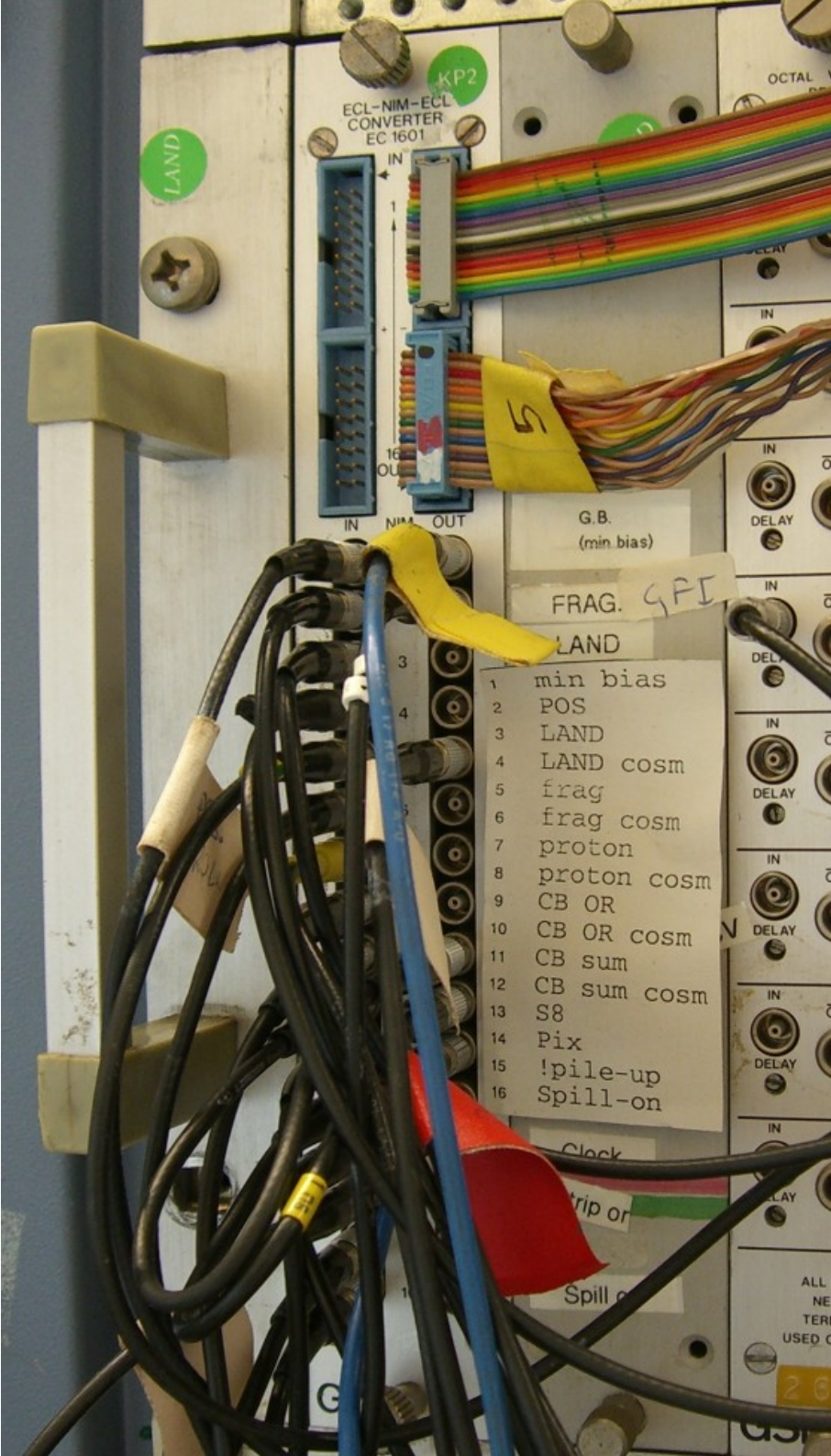
Short-term todo:

- Release as open-source (LGPL)

Contributors:

Michael Munch, Aarhus

Bastian Löher, Hans Törnqvist
TUD / GSI



Outlook

Short-term todo:

- Release as open-source (LGPL)

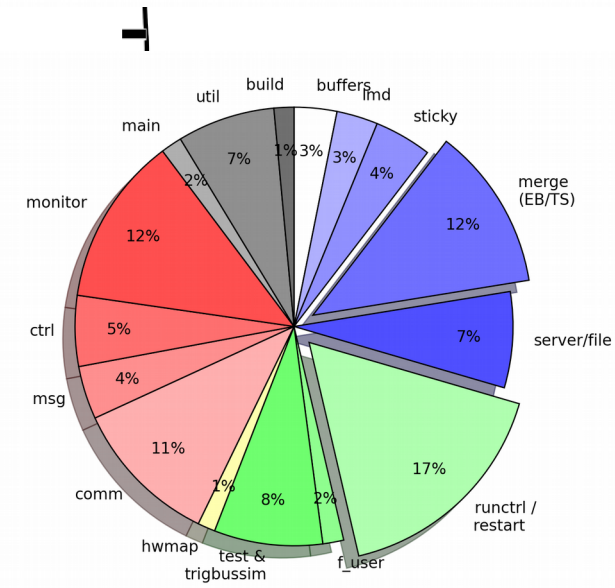
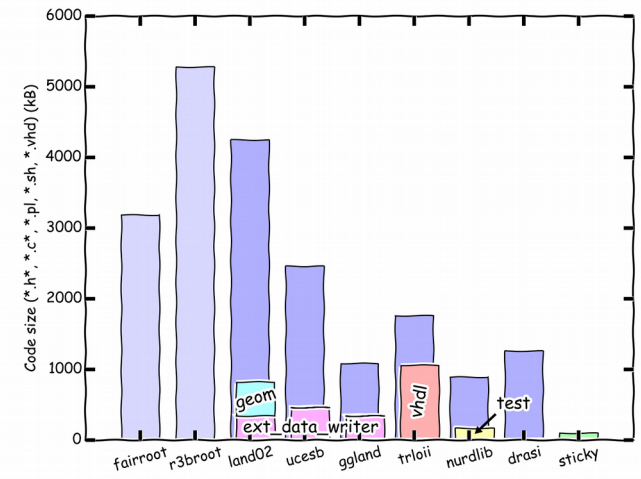
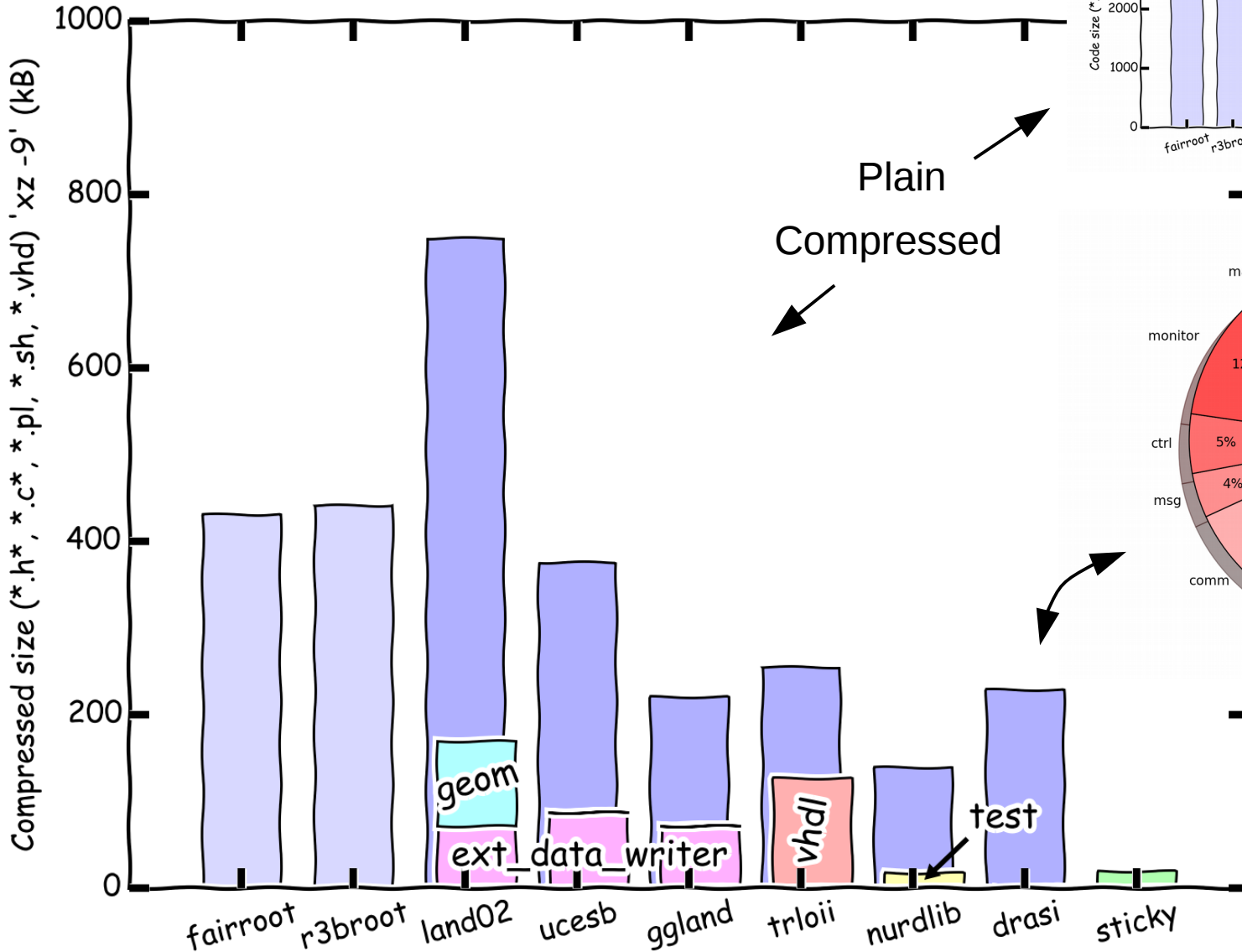
Contributors:

Michael Munch, Aarhus

Bastian Löher, Hans Törnqvist
TUD / GSI

Thank you!

Complicated?



← Data from april 2017 →