Downstream of the Readout Master

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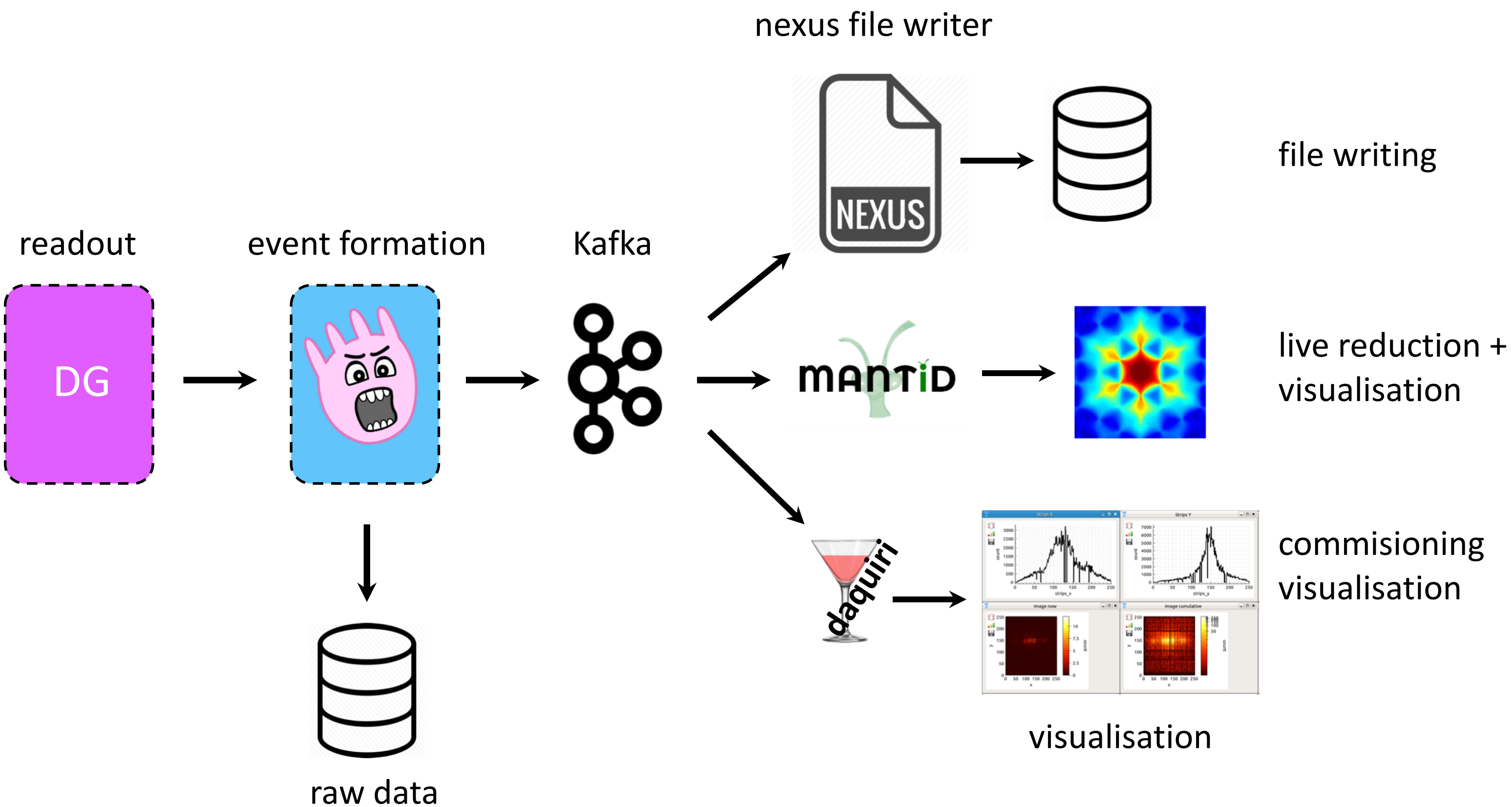
EUROPEAN SPALLATION SOURCE

Event Formation Unit



EFU receives readouts
EFU transmits events {t, pixelid}

EFU Input / Output

Readout Data

```
0000000 0000 0001 0001 1010 0010 0001 0004 0128
0000010 0000 0016 0000 0028 0000 0010 0000 0020
0000020 0000 0001 0004 0000 0000 0000 0000 0000
0000030 0000 0000 0000 0010 0000 0000 0000 0204
0000040 0004 8384 0084 c7c8 00c8 4748 0048 e8e9
0000050 00e9 6a69 0069 a8a9 00a9 2828 0028 fdfc
0000060 00fc 1819 0019 9898 0098 d9d8 00d8 5857
0000070 0057 7b7a 007a bab9 00b9 3a3c 003c 8888
0000080 8888 8888 8888 8888 288e be88 8888 8888
0000090 3b83 5788 8888 8888 7667 778e 8828 8888
00000a0 d61f 7abd 8818 8888 467c 585f 8814 8188
00000b0 8b06 e8f7 88aa 8388 8b3b 88f3 88bd e988
```

+

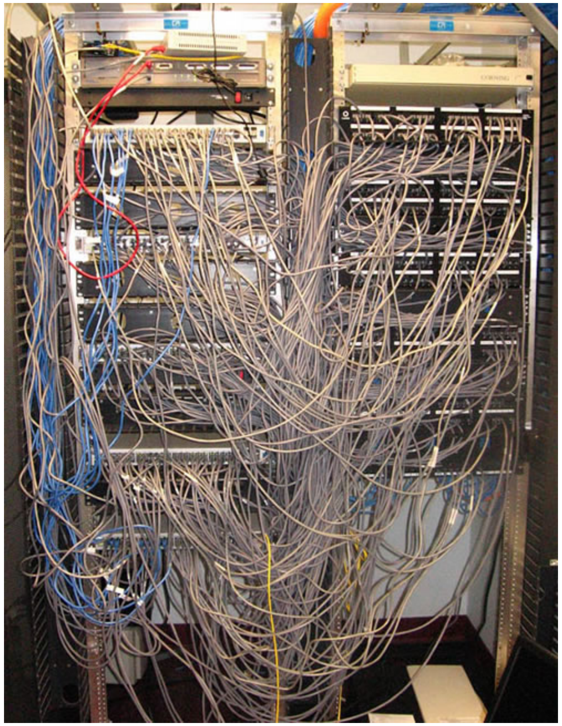
```
//==========================================================================
int NMXClusterer::AnalyzeHits(int triggerTimestamp, unsigned int frameCounter, int fecID,
    int vmmID, int chNo, int bcid, int tdc, int adc, int overThresholdFlag)
{

  bool newEvent = false;
  double triggerTimestamp_ns = triggerTimestamp * 3.125;
  double deltaTriggerTimestamp_ns = 0;

  if (m_oldTriggerTimestamp_ns != triggerTimestamp_ns)
  {
    AnalyzeClusters();
    newEvent = true;
    m_subsequentTrigger = false;
    m_eventNr++;
  }
```

Algorithms

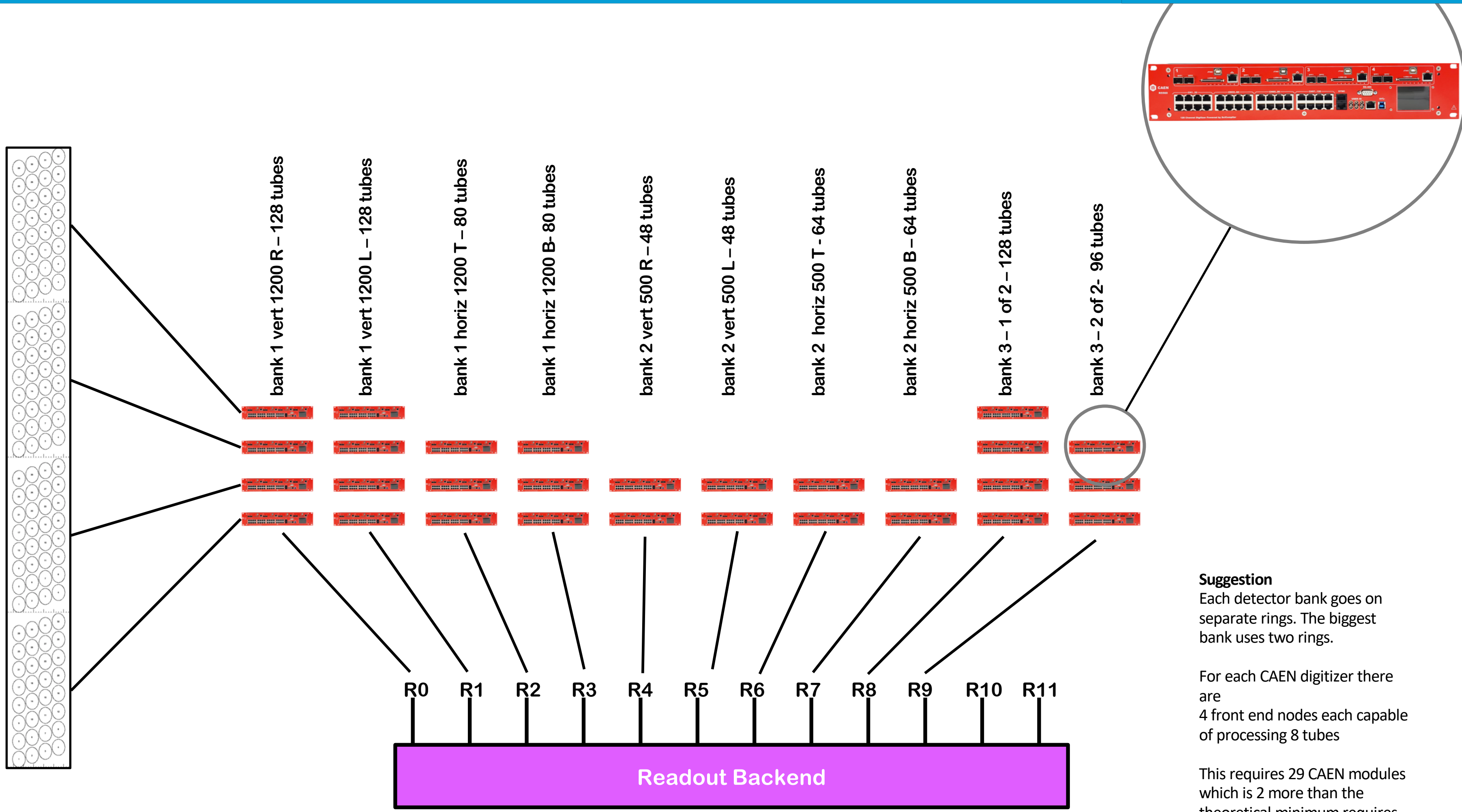
Neutron Events

$$= \ldots \{t_n, p_n\}, \{t_{n+1}, p_{n+1}\} \ldots$$

Instrument Mapping



Instrument Mapping



Suggestion
Each detector bank goes on separate rings. The biggest bank uses two rings.

For each CAEN digitizer there are
4 front end nodes each capable of processing 8 tubes

This requires 29 CAEN modules which is 2 more than the theoretical minimum requires.

Readout data format

Also covers Diagnostic Mode noise

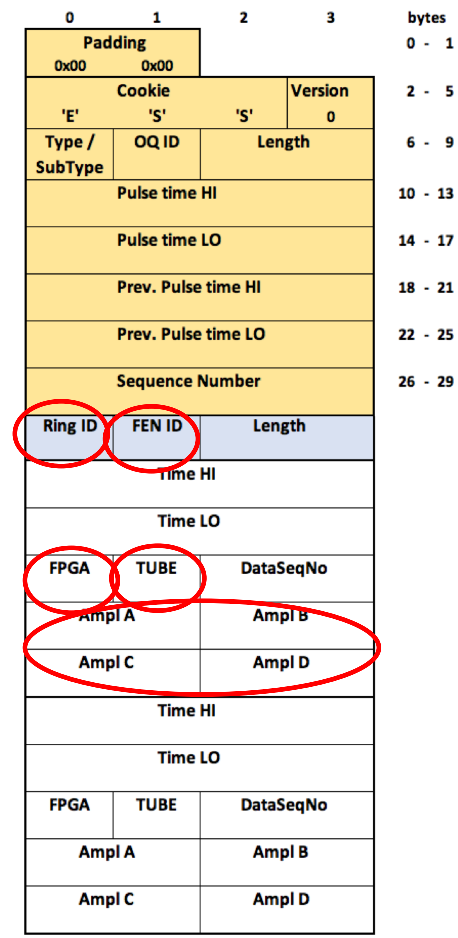
- Diagnostic Mode four amplitudes (117 bits – 4x32 bits packets)

TOF (64)	FPGA ID (2)	Tube ID (3)	A (12)	B(12)	C(12)	D(12)

- Diagnostic Mode noise (117 bits – 4x32 bits packets)

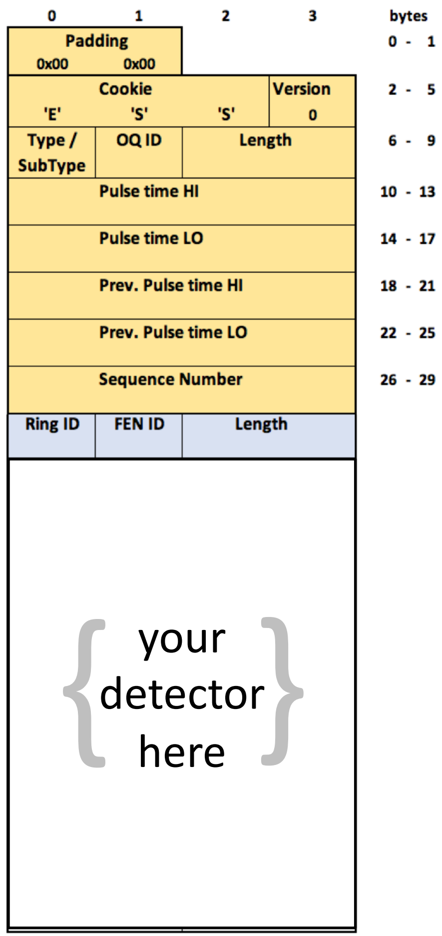
TOF (64)	FPGA ID (2)	Tube ID (3)	A (12)	B(12)	C(12)	D(12)

RingId	identifies detector bank
FENId	identifies sub bank (group of 32 tubes?)
FPGA	identifies group of subsub bank (8 tubes?)
TUBE	identifies tube within subsub bank
Amp A-D	encodes straw and position along straw



Your detector

- Common header and data headers for all detectors
- Detector specific readout fields must be defined



Reference Data

”a reference dataset is a **collection** of digitized **data** from a detector readout which has a **well defined interpretation**”

”**we need** reference datasets in order to **deliver software** for event processing”

Algorithms

```cpp
#include <algorithm>
#include <cmath>
#include <gdgem/dg_impl/NMXClusterer.h>
#include <common/Trace.h>

//#undef TRC_LEVEL
//#define TRC_LEVEL TRC_L_DEB

NMXClusterer::NMXClusterer(int bc, int tac, int acqWin, std::vector<int> xChips,
    std::vector<int> yChips, int adcThreshold, int minClusterSize,
    float deltaTimeHits, int deltaStripHits, float deltaTimeSpan,
    float deltaTimePlanes) :
    pBC(bc), pTAC(tac), pAcqWin(acqWin), pXChipIDs(xChips), pYChipIDs(
        yChips), pADCThreshold(adcThreshold), pMinClusterSize(
        minClusterSize), pDeltaTimeHits(deltaTimeHits), pDeltaStripHits(
        deltaStripHits), pDeltaTimeSpan(deltaTimeSpan), pDeltaTimePlanes(
        deltaTimePlanes), m_eventNr(0)
{}

NMXClusterer::~NMXClusterer()
{}

//==========================================================================================
int NMXClusterer::AnalyzeHits(int triggerTimestamp, unsigned int frameCounter, int fecID,
    int vmmID, int chNo, int bcid, int tdc, int adc, int overThresholdFlag)
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```

Algorithm Description

- *Email, paper, report, whiteboard walk-through*

Prototype implementation

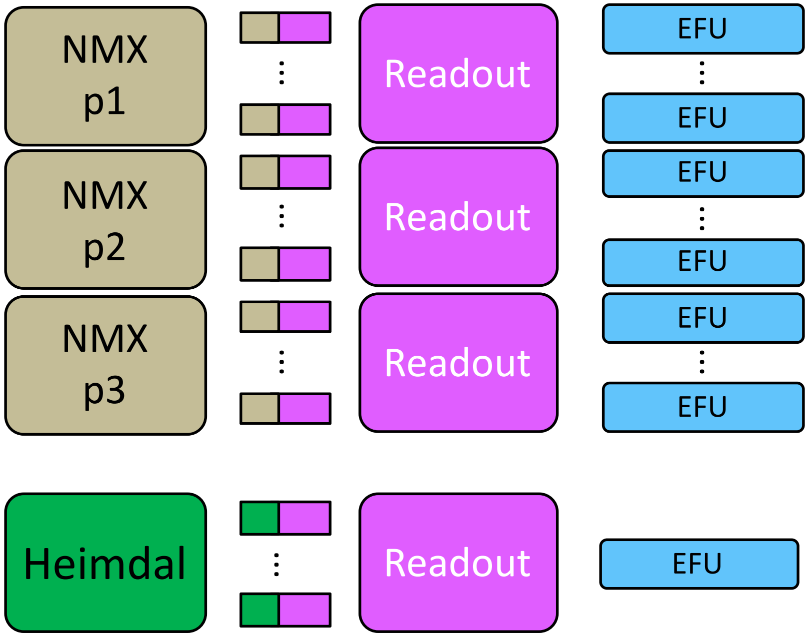
- C/C++, Python

Analyzed reference data

- Text/binary files, wireshark captures, C or C++ arrays

Speed Up

System scalability



”With high flux comes high data rates. Multiple EFUs will be needed for most instru-ments . We need to consider how to speed up processing by parallelisation”

Integration Readiness Assessment

Glasgow Coma Scale

TABLE 38-2

Glasgow Coma Scale

BEHAVIOR	RESPONSE	SCORE
Eye opening response	Spontaneously	4
	To speech	3
	To pain	2
	No response	1
Best verbal response	Oriented to time, place, and person	5
	Confused	4
	Inappropriate words	3
	Incomprehensible sounds	2
	No response	1
Best motor response	Obeys commands	6
	Moves to localized pain	5
	Flexion withdrawal from pain	4
	Abnormal flexion (decorticate)	3
	Abnormal extension (decerebrate)	2
	No response	1
Total score:	*Best response*	15
	Comatose client	8 or less
	Totally unresponsive	3

Detector Coma Scale

Example - LoKI

Detector Coma Scale

FEATURE	STATE	SCORE	
Dialogue	Meetings, agreed decisions	4	4
	Initial meeting/discussion	3	
	Interest in meeting/discussion	2	
	No contact established	1	
Integration Model	Defined, understood, agreed	4	4
	IM Intention stated	3	
	IM Undecided	2	
	Implicit/unspecified	1	
Logical Geometry	Agreed (Inst/ECDC/DRAM)	4	4
	Under negociation	3	
	Acknowledged	2	
	Unspecified	1	
Digital Mappings	Documented revision control	4	3
	Being defined	3	
	Aware	2	
	Not started	1	
Total score:	*Best response*	16	15
	Comatose	11 or less	
	Totally unresponsive	4	

Discussions among DMSC (ECDC + DRAM), Instrument Scientist, Detector Group, In-Kind partner

Integration Model B decided

Logical geometry defined and agreed

Detector Readout Data format specified
Details of detector mappings still being refined

Not quite, but nearly ready for integration

Talk to

DMSC

EUROPEAN SPALLATION SOURCE

ECDC

Experiment Control and Data Curation
Tobias Richter

Provides software for

- Instrument and readout control
- Readout data reception and parsing
- Event Formation calculations
- Fast sample environment
- Data aggregation
- Nexus file writing
- Detector commissioning tools
- Live detector statistics

DRAM

Data Reduction Analysis and Modelling
Thomas Holm Rod

Provides software for

- Mantid
- SasView
- SpinW
- BornAgain
- McStas
- ....

- There is a lot of stuff to specify/do downstream the Readout Master

- That stuff should go in a Interface Specification (ICD)

- The ICD is the ‘contract’ that helps all parties moving forward most efficiently

- Use the Detector Coma Scale to assess and progress integration readiness

The End