brightness

WP5.1 Kick Off

DMSC April 2016

Tobias Richter

Work Package Leader

BrightnESS is funded by the European Union's Horizon 2020 research and innovation programme under grant agreement No. 676548

brightness

Purpose of this Meeting

- Everyone knows everyone else
- Everyone agrees about what we are trying to do together
- Everyone agrees about how we're trying to move forward
- Establish links to answer future questions and resolve problems

brightness

WP5: Real-time management of ESS data

Objectives

Maximise the scientific output of the ESS by enabling live (real time) processing of the data taken on ESS instruments. This will be achieved by developing the software infrastructure needed to make this data available as a live, publish/subscribe, (data) stream to which data reduction, and analysis, software can subscribe to process the data.

Tasks		
Task 5.1	Creating a standard neutron event data stream for different detector types	ESS, KU
Task 5.2	Creating a standard method for streaming meta-data for fast applied fields	ESS, PSI
Task 5.3	Software to aggregate and make available the neutron event data and sample meta-data	ESS, PSI, Elettra

Deliverables		
5.1	Design report data aggregator software	M12
5.2	Report processing choices for detector types	M21
5.3	Beta-version data aggregator software	M23
5.4	Report filed data acquisition	M24
5.5	Data aggregator software	M35
5.6	Software neutron event data processing	M36
5.7	Software fast field acquisition	M36

brightness

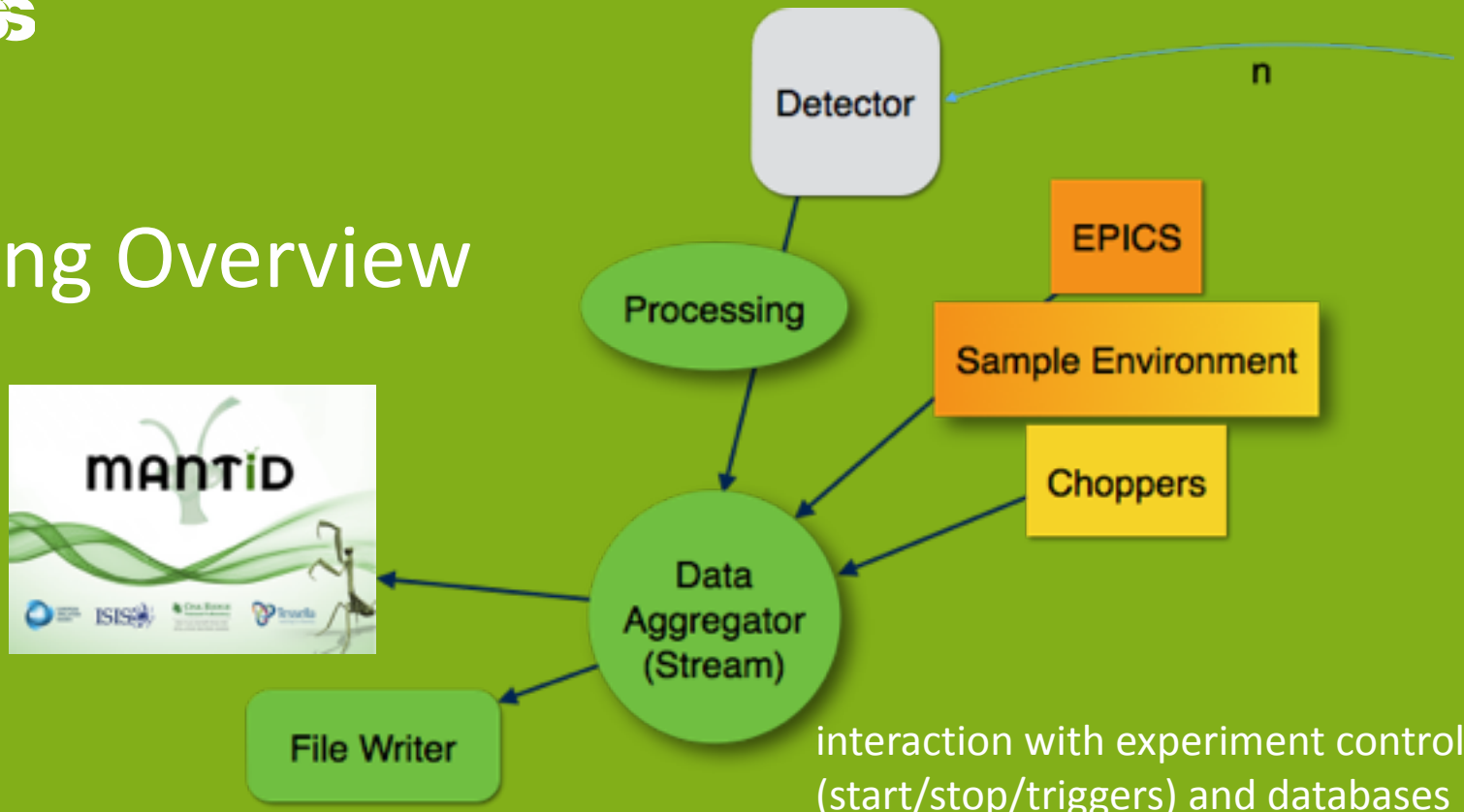
Software to aggregate and make available the neutron event data and sample meta-data

WP5.3 Data Aggregation

- data from different origins are collected in one point
- neutron events are bundled into per proton pulse frames
- consumers can subscribe to data at one authoritative source
- a common protocol that enables live visualisation and data treatment
- reliability is a primary concern

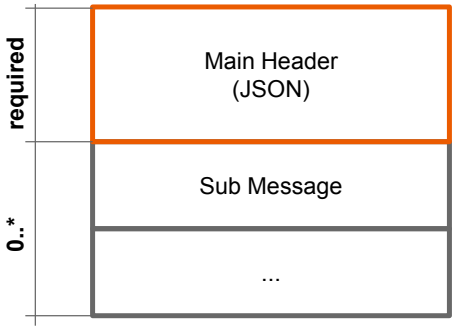
brightness

Streaming Overview



interaction with experiment control (start/stop/triggers) and databases

Potential serialisation lifted from Simon Ebner (PSI):




```
{"htype":"array-1.0",
"shape":[10,20],
"type":"uint16", "frame":0}
```

htype defines content of main header as well as the structure of the whole message (sub messages)

Sub Message(s) can be binary or JSON

EPICS V4

ØMQ

brightness

Slow Sources	Medium Fast Sources	Fast Sources
Motion	Choppers	Detectors
Sample Environments	Sample Environment	Sample Environment
less than 14 Hz on average	less than 20 kHz maximum	
labelled monitor messages	buffered readout	event-type message stream

Data Aggregator

ØMQ

brightness

Creating a standard neutron event data stream for different detector types

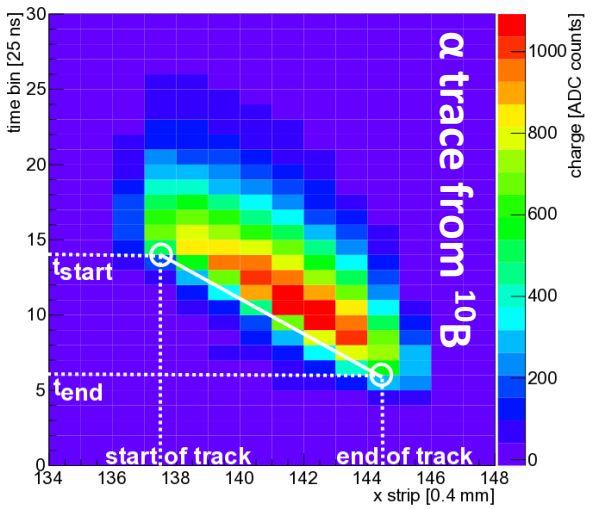
WP5.1 Neutron Event Processing

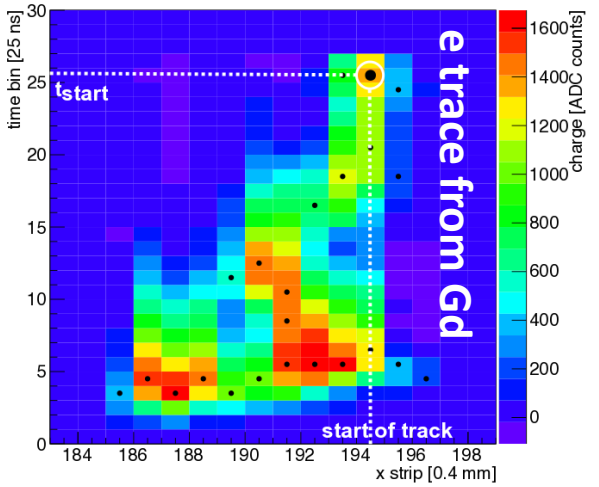
- post ^{3}He problems
- background rejection, discrimination and accurate locating and time stamping of neutron events is not easy for all novel detector types
- software processing is more flexible than putting solutions in readout electronics
- processing can be tailored for requirements (high count rate vs high resolution)
- we need a framework for this kind of event formation

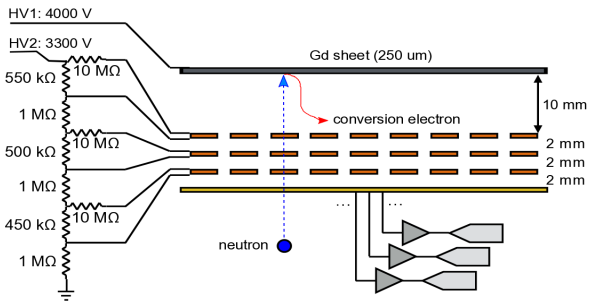
brightness

Example: TPC Detectors

- detector electronics emits timestamped information on secondary particle traces
- neutron scattering only needs time and location of the neutron conversion process
- probably the most raw data we will see







http://dx.doi.org/10.1088/1748-0221/10/04/P04004

brightness

WP5.1 Goals

- Convert detector output to unique pixel id and timestamp for representative detector types
- Framework to allow processing for all detector types
  - Cope with all expected input types and formats
  - Determine right processing models for different problem types
  - Output in the format expected by the aggregator

brightness

Design Considerations

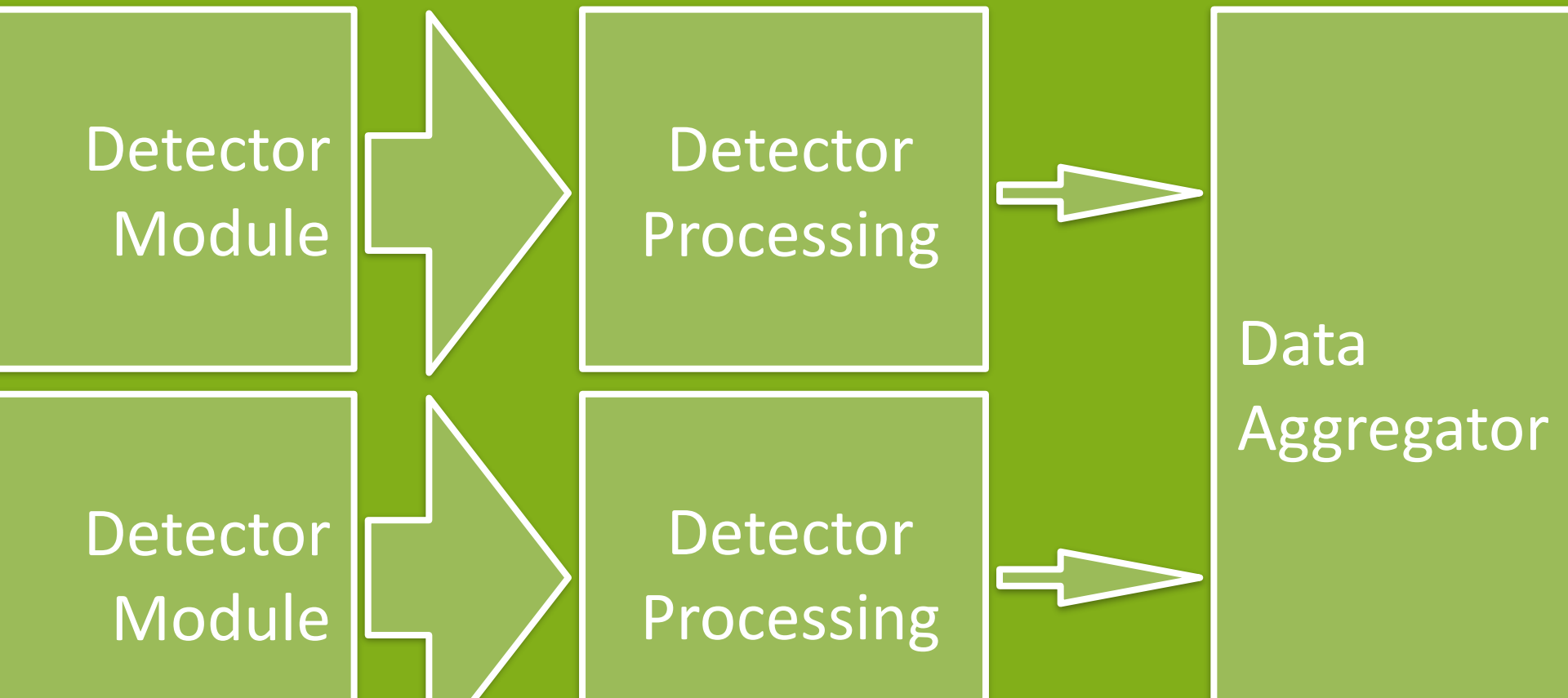
- Data might be best consumed in frames (per proton pulse)
- Processing may need information from adjacent module
- Switching algorithms could be done dynamically
- There should be a route to get to the full raw input data for debugging
- Reliability, reliability, reliability

brightness

A picture

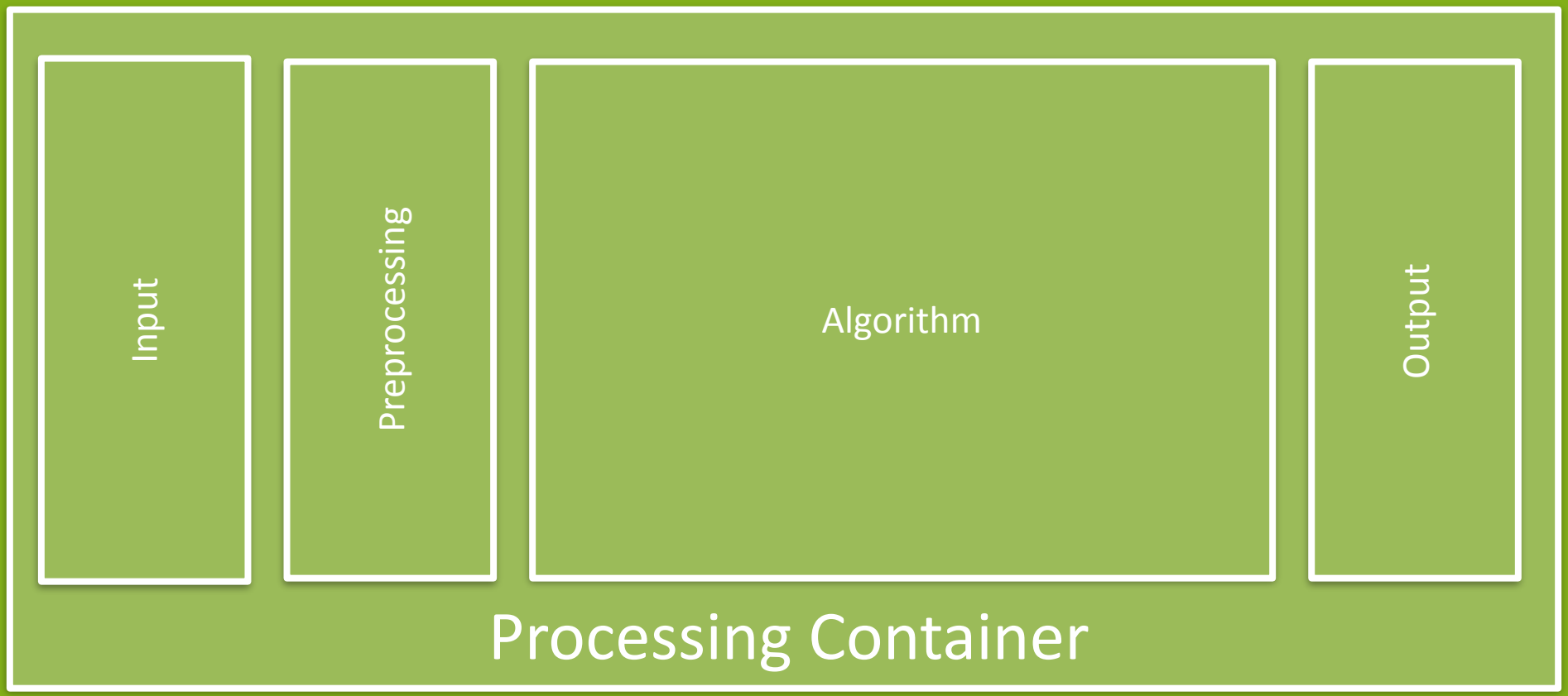
brightness

A picture



brightness

A picture



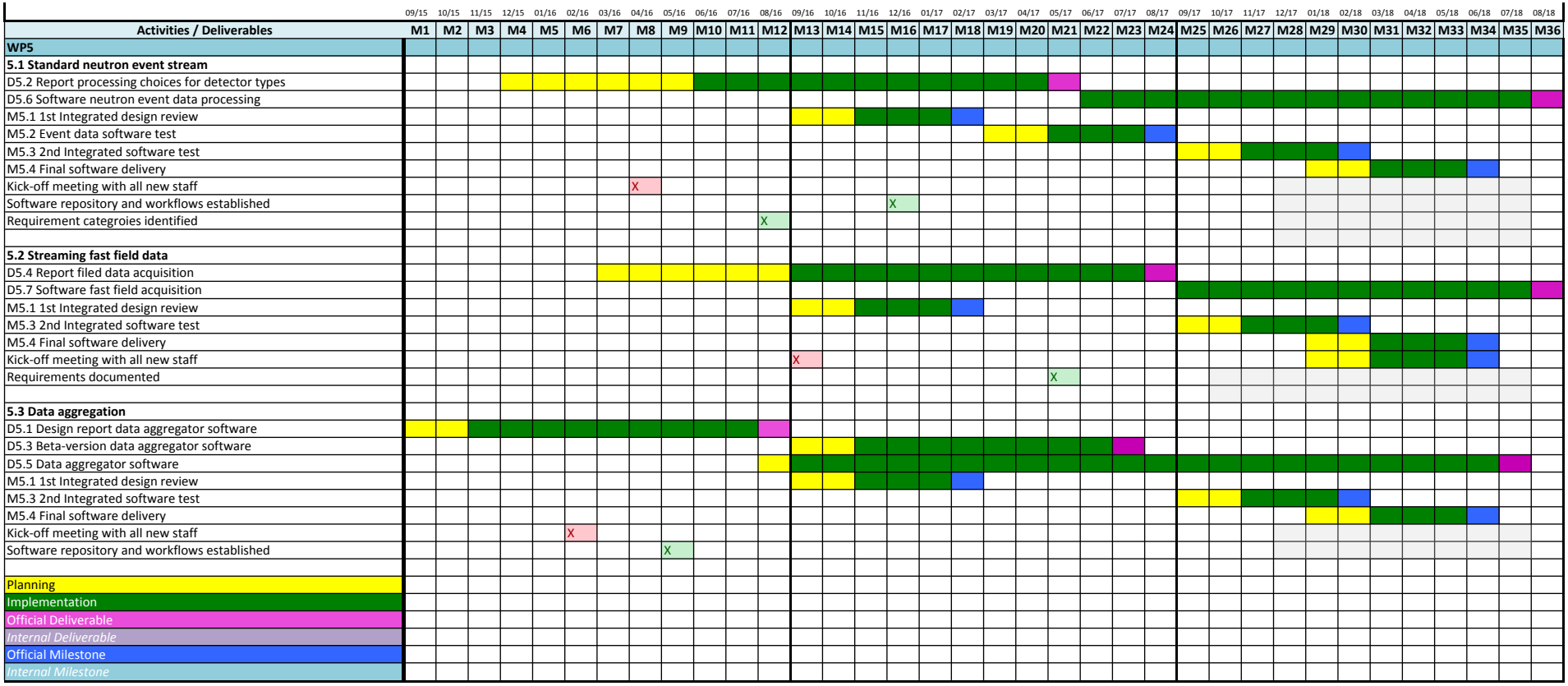
brightness

Construction Roadmap

- **2015**
  - Roadmap planning
  - In-Kind agreements
  - Startup of BrightnESS & Recruitment
- **2016**
  - Recruitment & more In-Kind
  - Transition from planning into implementation
  - Evaluate feasibility of technology choices
  - Begin development of necessary frameworks
  - Start working on lab demonstrator of data readout and streaming (Lund office)
- **2017**
  - Implementation phase
  - Hardware performance tests
  - Deployment and reliability tests
  - Worry more about transition into operations
- **2018**
  - Real instrument devices may become available for integration
  - **BrightnESS finishes (August)**
- **2019**
  - Bug fixing
  - Cold commissioning
  - End of year: First neutrons

brightness

WP5 Milestones and Deliverables



Activities / Deliverables	09/15 M1	10/15 M2	11/15 M3	12/15 M4	01/16 M5	02/16 M6	03/16 M7	04/16 M8	05/16 M9	06/16 M10	07/16 M11	08/16 M12	09/16 M13	10/16 M14	11/16 M15	12/16 M16	01/17 M17	02/17 M18	03/17 M19	04/17 M20	05/17 M21	06/17 M22	07/17 M23	08/17 M24	09/17 M25	10/17 M26	11/17 M27	12/17 M28	01/18 M29	02/18 M30	03/18 M31	04/18 M32	05/18 M33	06/18 M34	07/18 M35	08/18 M36
WP5																																				
5.1 Standard neutron event stream																																				
D5.2 Report processing choices for detector types																																				
D5.6 Software neutron event data processing																																				
M5.1 1st Integrated design review																																				
M5.2 Event data software test																																				
M5.3 2nd Integrated software test																																				
M5.4 Final software delivery																																				
Kick-off meeting with all new staff								X																												
Software repository and workflows established																X																				
Requirement categroies identified												X																								
5.2 Streaming fast field data																																				
D5.4 Report filed data acquisition																																				
D5.7 Software fast field acquisition																																				
M5.1 1st Integrated design review																																				
M5.3 2nd Integrated software test																																				
M5.4 Final software delivery																																				
Kick-off meeting with all new staff													X																							
Requirements documented																					X															
5.3 Data aggregation																																				
D5.1 Design report data aggregator software																																				
D5.3 Beta-version data aggregator software																																				
D5.5 Data aggregator software																																				
M5.1 1st Integrated design review																																				
M5.3 2nd Integrated software test																																				
M5.4 Final software delivery																																				
Kick-off meeting with all new staff						X																														
Software repository and workflows established									X																											
Planning																																				
Implementation																																				
Official Deliverable																																				
Internal Deliverable																																				
Official Milestone																																				
Internal Milestone																																				

brightness

Milestones

Core	Stream IK	BrightnESS	Date	Title
	x		2016-03	Kickoff Meeting
	x		2016-06	Roadmap Choice on Streaming
		x	2016-08	Design Report Aggregator
x			2016-09	Software Design for Raw Data
		x	2017-02	Design Report Event Processing
	x		2017-06	Prototype Performance Test
		x	2017-07	Aggregator Beta Test
		x	2017-08	Fast SE Design Report
		x	2017-08	Event processing Beta Test
x			2017-10	Software Design Cataloguing
		x	2018-02	Integrated test Event Processing
	x		2018-06	Functional Test at ISIS
		x	2018-06	Final Software Delivery for Event Processing
		x	2018-08	Software Delivery Data Aggregator
		x	2018-08	Software Delivery Fast Sample Environment
x			2018-09	Software Design Archiving
	x		2019-08	Roadmap Document for Operations

brightness

Successful Development and Operations

Aim: Everything runs reliably, but bug fixes can be deployed easily

In case of problems there are automated mechanisms in place to resume service or alert people.

We will have facilities to monitor that detect buildup of bottlenecks and backlogs and warn us appropriately.

Automatic testing before deployment, best software engineering practices and project management will be used.

CFEngine puppet labs PalletOps ANSIBLE CHEF SALTSTACK

brightness

Tools and Infrastructure

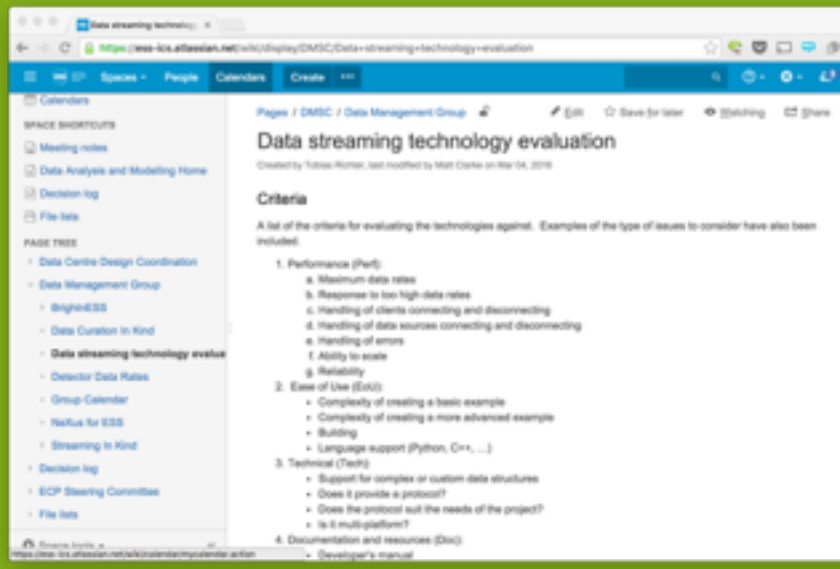
- JIRA and Confluence (Issue Tracking and Wiki)
  provided by ESS hosted by Atlasssian
  accounts via Tobias or Afonso

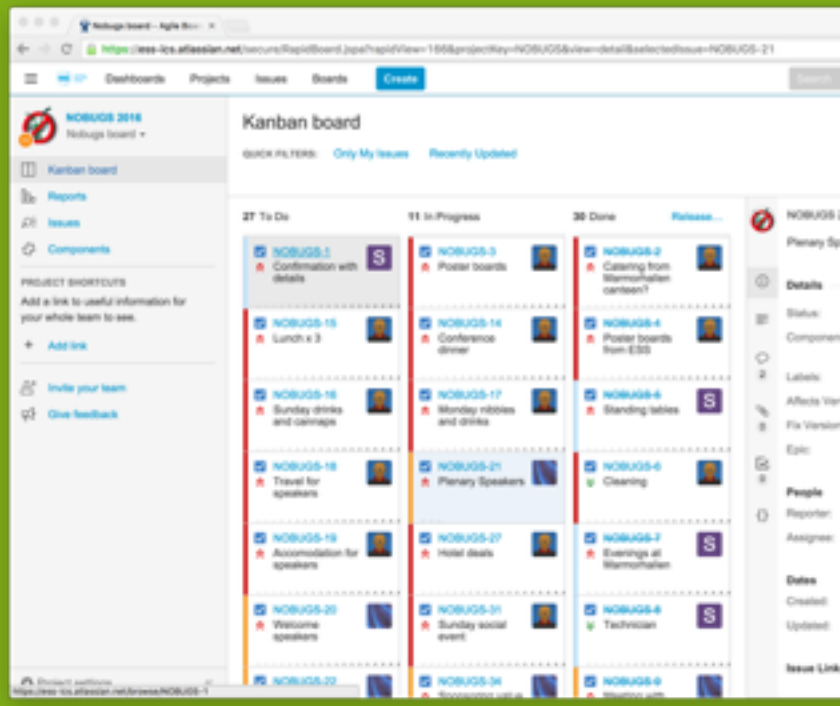
- Git, Github, Bitbucket
  ESS has private repositories at Bitbucket
  Github could be perceived as more open

- Vagrant and Virtualbox
  tools for easy provisioning of (networked) VMs
  for development and testing
  ICS EPICS development standardised this way

- DMSC Cluster & Storage

- ESSIIP Lab





brightness

Outlook

This meeting

See what Carsten has achieved so far.
Talk to Thomas and Richard on their input.
Gather tasks and prioritise.
Identify open questions and when we need answers by.

Near future

More staff should arrive at DMSC.
We will have common office space in COBIS soon.

brightness