National Synchrotron Light Source II

SAC Controls Program update

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20th September 2018

U.S. DEPARTMENT OF ENERGY | Office of Science

BROOKHAVEN NATIONAL LABORATORY

Controls Program - Outline

- Controls – About
- Previous recommendations – March SAC meeting and IT/Beamlines Review Feb-March.
- Self assessment
- Actions from recommendations
- Appendix: Selected Highlights from Controls program since March

What does the controls program do?

Group	*Service Responsibilities*
ICT:	Servers, Disks, Networks, certain apps,
Beamline:	Motion, Sample, User interfaces,
Accelerator:	Magnet PS controls, feedback, orbits etc.
DAMA:	Data Acquisition, Mgt, Analysis
Core:	Core infrastructure (EPICS, EPS, Techs)

All groups have Operations Responsibilities

Ongoing work, keeping things functional, upgrades to existing systems, getting & keeping SW and HW current, project improvements

and Installations Responsibilities
New beamlines, major upgrade projects

Acronyms: ICT Information and Communications technology, DAMA Date Acquisition and data Mgt and Analysis PS Power supply, EPICS Experimental Physics Control System, EPS Equipment Protection Systems, SW Software, HW hardware

SAC issues/recommendations raised last time (My summary)

Last line of report was: "The SAC wishes to see progress on actions addressing Communications and Management"

SAC recommendations, my numbering:

1 An open evaluation of the PoC system and discussion of improvements to the system

2 An effort to explore commonalities between beamlines on Beamline Controls, opportunities for increasing efficiency

3 Developing adequate structures for defining and requesting, as well as planning and following up on Controls tasks, both short and long term

4 Exploring new ways of cooperation between beamlines and between beamlines and controls in sharing development and responsibility for the controls program

5 An assessment of the motion controls issue and a discussion of proper testing and tuning Protocols

6 The value engineering effort urgently needs to include controls with a clear mandate on establishing an adequate structure, protocol and set of guidelines to address the above-mentioned issues and recommendations.

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Role and Responsibilities of the Point of Contact (POC) for Beamlines Controls.

SAC-1

update Have discussed this multiple venues.

- Be aware of all of the Controls issues around each beamline.
- Understand the similarities across the program beamlines.
- Be able to manage Controls program resources for given beamline upgrade works.
- Be aware of problems on each program and keep notes about how problems were solved.
- Be able to perform small maintenance tasks, first in triage, but not be expected to solve to each one.

Role and Responsibilities of the Point of Contact (PoC) for Beamlines Controls.

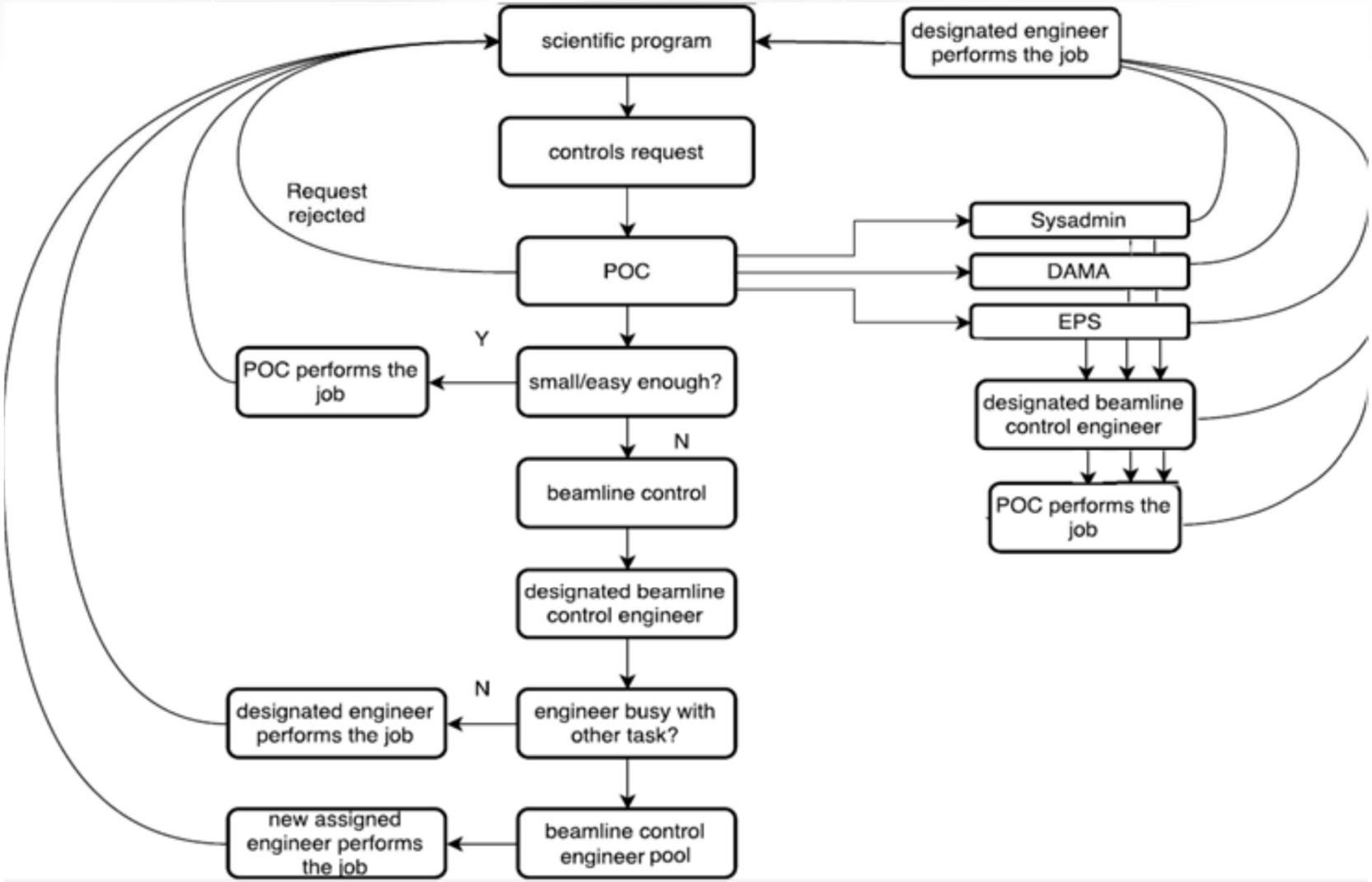
SAC-1 cont

- Have a very general understanding of the science in each program.
- Not to replace other controls individuals with a deeper understanding of the Engineering for specific beamline.
- Produce and maintain a Beamlines program Controls tasks list with:
  Completion date, Activities required , manpower estimate.

update
- Ensure tasks are assigned.

update
- The PoC may take on responsibilities within other beamlines depending on their area of technical expertise. PoC is not intended to be an exclusive role.

Role and Responsibilities of the Point of Contact - Flowchart.



PoC operation and priority setting

SAC1 - Cont

A lot of effort in defining the PoC role and talking it through.

Working to make it less dependent on individuals

Trac as a tool

update Operational and ongoing Priorities set with PoC, fed through via regular PoC support meetings.

Add to that other facility priorities, such as certain projects.

update Now using two individuals – PSD Liaison engineer and Accelerator Engineer to set shutdown plans and therefore priorities.

POC operation and priority setting

SAC1

	Program	Program Manager	POC Controls Engineer	Beamlines
	Soft X-ray	Stuart Wilkins	John Sinsheimer	CSX, IOS, ESM, SIX, FIS/MET
	Imaging and Microscopy	Young Chu	Jun Ma	HXN, SRX, FXI, XFM, TES
	Hard X-ray	Klaus Attenkofer	Chanaka DeSilva	ISS, TES, QAS
	Complex scattering	Ron Pindak	Kaz Gofron	CMS, IXS, SMI, CHX
	Diffraction	Eric Doohyee	Ji Li	XPD, PDF, ISR, HEX
update	Structural Biology	Sean Mc Sweeney	John Skinner	FMX, AMX, LIX, XFP, NYX
update	Experimental Develop	Wah-Keat Lee	Huijan Xu	Mech Eng, Res support, Tech, Optics and Metrology

PoC Program/Beamline table

Commonalities between beamlines Core technologies in use

SAC-2

We have an increasing set of Core technologies; some listed here

- update EPICS and EPICS services
- Ethernet based systems
- Xilinx FPGA for specialist solutions (VHDL to program)
- update Delta Tau motion + Investigating others
- Allen Bradley PLC's
- Common user interfaces (CS-Studio)
- Bluesky and Scientific python
- Puppet/Linux on Commodity hardware
- new Ansible/Snack
- new Linux Debian (Work on reducing variants) and Lab Std Redhat.

Acronyms FPGA – field programmable gate array, VHDL – Very high speed hardware description language, CS-Studio control systems studio, PLC programmable logic controlller, SNACK SiNgular - Application Configuration Kit

Reviews and priorities:
Defining, requesting, follow up Controls tasks

SAC-3

- *Beamline priorities* , managed by PoC
  Weekly all PoC's review;
  Priority Set by PoC with Beamlines PM & Scientists
  Beamlines use **TRAC** to document,
  Follow up – PoC's role in PoC meetings.

- *Accelerator priorities*, managed by Group leader
  Priority Set by Division director, Controls room and GL
  Accelerator uses **TRAC**, follow up by system, Group meeting

Reviews and priorities:
Defining, requesting, follow up Controls tasks

SAC-3 - Cont

update

- *IT Group,* Priorities fed from PoC and other groups. Calls logged via **TRAC** Start with "Sysadmin", then group reassigns longer items to individual at group meetings.
- *DAMA* produce a product and set the priorities for the Bluesky product by one the following:
  - Discussion at the program manager level. This works best with certain program mangers.
  - Constant discussion at the beamlines staff level. For certain programs, this works well.
- DAMA try to keep the same version on all beamlines, and co-ordinate releases during shutdown. DAMA use **Github** and **Basecamp** because they need to manage external collaborations.

TRAC sample – Discussion

SAC 3 - cont

Ticket	Summary	Component	Type	Owner	Reporter	Status	Priority	Created	Modified
#2518	HXN: install Tomviz	HXN	task	tsmith	hyan	new	high	Aug 28, 2018	Sep 1, 2018
#2530	Upgrade debian on xf06bm-ws1 and xf06b	BMM	configura	tsmith	bravel	assigned	normal	Aug 31, 2018	Aug 31, 2018
#2482	[XPD-CTXRD]: motion for Beamstop stage	XPD	task	oksana	zyin	new	low	Aug 17, 2018	Aug 30, 2018
#2441	Request of Beamline Control Account, Proj	unspecified	task	control-sysadmins	Christopher.Klose@...	reopened	normal	Aug 7, 2018	Aug 28, 2018
#2516	Reset Password Request for Susheng Xin	unspecified	passwordi	control-sysadmins	sxin@...	reopened	normal	Aug 27, 2018	Aug 28, 2018
#2262	[SRX] Setup Dexela IOC	SRX	task	jma	jma	new	normal	Jun 7, 2018	Aug 27, 2018
#1815	Set up IOC and data acq for mobile Eiger	Controls - E	task	desilva	jkeister	reopened	normal	Jan 25, 2018	Aug 27, 2018
#2515	[CSX] cannot access jupyterhub with not	CSX	problem r	control-sysadmins	abarbour	new	normal	Aug 27, 2018	Aug 27, 2018
#2514	area detector 'hangs' in acquire state	CHX	problem r	kgofron	lwiegart	new	high	Aug 27, 2018	Aug 27, 2018
#2505	PE2 test.	XPD	task	hzhong	liji	assigned	highest	Aug 22, 2018	Aug 24, 2018
#2511	[XFP] MC03/MC04 rationalization (XFP inte	XFP	task	efarquhar	efarquhar	accepted	normal	Aug 24, 2018	Aug 24, 2018
#2125	Active feedback for MCM motors	IXS	task	kgofron	kgofron	new	high	May 11, 2018	Aug 24, 2018
#2509	[SRX] Minor CSS Updates	SRX	task	jma	akiss	new	normal	Aug 23, 2018	Aug 23, 2018
#2508	[SRX] Mirror stripes	SRX	task	jma	akiss	new	normal	Aug 23, 2018	Aug 23, 2018
#2507	Setup controls for the aromatic sample ch	PDF	task	oksana	abeykoon	new	high	Aug 23, 2018	Aug 23, 2018
#2167	Setup OCM scintillator detector controls	PDF	task	oksana	abeykoon	new	highest	May 21, 2018	Aug 23, 2018
#2170	Activate OCM Slit stray current measuring	PDF	task	oksana	abeykoon	new	high	May 21, 2018	Aug 23, 2018
#2178	Implement XPD white beam-stop camera s	PDF	task	oksana	abeykoon	new	low	May 21, 2018	Aug 23, 2018
#2176	Connect VFM cameras and implement the	PDF	task	oksana	abeykoon	new	low	May 21, 2018	Aug 23, 2018
#2172	Implement OCM vertical jack close loop m	PDF	task	oksana	abeykoon	new	low	May 21, 2018	Aug 23, 2018

Color – Highest, High, Normal, Low, lowest
Component - defaults goes to owner (Poc)
update Control-sysadmins – individuals after a week.
Status – new, assigned, accepted, closed, reopened
new Permission to close now in use
Emails person who logged it
We can define some of the workflows – continue to refine.

TRAC Statistics

SAC-3 - cont

Stable at 300-350 odd tickets open. Brought down from 450
Used for multiple purposes:
- Projects, Defects, Low priority improvements, notes etc

About 40 per tickets month “turnover”
Most younger than 3-4 months

Average response time < 1 hour* for High/highest priority .
Average (median) resolutions time – Same day, however some take long time – e.g. NFS problems.

About one sixth (40-50) logged as “Defect”, remainder are requests for work. Some defects are low priority.

Some very old and are “historical notes”. Some people still use this as a “to do” list and to keep notes, non recurring items.

* Business hours

Cooperation - Beamlines and Controls

SAC-4

Our Mission is: To enable productive scientific research by making specialist controls and computing technology work for both the facility and the user community. To create controls, data collection, analysis and storage systems that are reliable, standardized, customizable and secure to enable the scientific productivity of the facility for infrequent and expert users.

To deliver this, we need good communications:

- PoC is one key – stabilizing relationship. Some minor changes.
- Cultural changes
- new Better Communications e.g. Monthly Controls "Town Hall meetings"
- Service/Collaboration combination and emphasis
- Motivation
- Staff Retention.

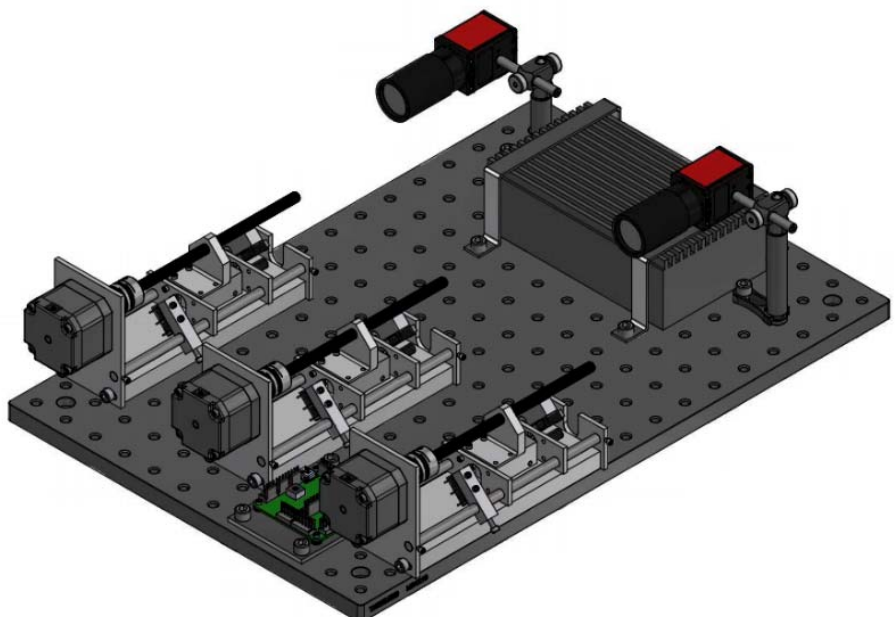
Motion Controls

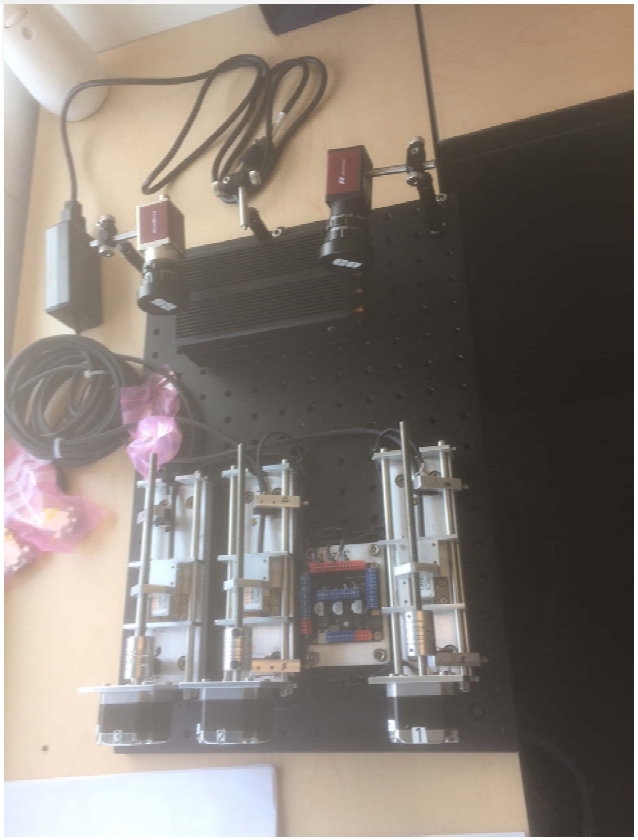
SAC-5

- Working a lot better. Most issues with tuning are resolved.
- Working to develop path forward
  - Delta Tau (DT) is the current standard, but it's big, complex and for simple problems overkill.
- Two solutions - The future will use DT for complex issues, and for simple motion, will use a simple one.
- Allows for "Easy 'self' tuning where conditions change (i.e. mechanical wear etc.)
- Just one simple solution to be chosen (We are looking at several). Prototype on next slide

Motion Controller $375 prototype

SAC-5





ITEM	QTY	ESTIMATED COST	PART NUMBER	DESCRIPTION
11	1	$7000	Total Cost	
10	22		ANSI B18.3 - 1/4 - 20 UNC - 1/2 HS HCS	Hexagon Socket Head Cap Screw
9	12		ANSI B18.22.1 - No. 2 - Regular - Type B	Plain Washer (Inch)Type A and B
8	4		ANSI B18.3 - No. 2 - 56 UNC - 7/32 HS HCS	Hexagon Socket Head Cap Screw
7	1	$60	PD-DAMA-TB-1014	Adapter plate for EZ4AXIS PCB
6	1	$375.00	EZ4AXIS PCB	All motion 4 axis motor controller
5	1	$550	qem	Quad-Electrometer(Peter SIddons type)
4	2	$851.29	PD-DAMA-TB-2000	Camera mount assembly
3	3	$1500	PD-DAMA-TB-1000	Stepper motor assembly
2	2	$30	PD-DAMA-TB_3001	Qem mounting strap
1	1	$188.00	MB1218	ThorLabs optics breadboard

PARTS LIST

Value engineering effort to include controls

SAC 6

Preliminary discussions concerning setting up a session on Controls within value Engineering effort within the construction practice have commenced.

Erik Johnson will report, should be asked next time.

Reviews of beamlines controls and IT

NSLS-II management instituted two external overlapping reviews of Beamlines controls and IT on the 30th and 31st January 2018.

The review was made up of presentations by, and discussion sessions with staff. The report was delivered in March, just after SAC last met, and turned into an **action plan** with milestones, a series of Action/Recommendations (next two slides) Significant intersection with SAC recommendations. Report and and Action plan are posted.

Review team Members were:

- Jen Bohon – Case Western Reserve University (NSLS-II UEC/SAC) (BL)
- Kevin Brown – Relativistic Heavy Ion Collider, Brookhaven National Laboratory
- Daniel Flath – Linac Coherent Light Source, SLAC National Accelerator Lab
- Nick Hauser – Australian Nuclear Science and Technology Organization
- Mark Heron – Diamond Light Source
- John Maclean (Chair) – Advanced Photon source, Argonne National Laboratory
- Andrew Ferguson, ITD, Brookhaven National Laboratory (IT)

IT action plan summary

1. Establish bi-directional communication with stakeholders.
2. Configuration management, incident response, change management, release management
3. Self-help “how-to’s”, standards
4. IT steering group with ITD + stakeholders
5. Financial model proposed for use of CSI resources
6. IT group de-scope by offloading selected services
7. Deliver on critical unsolved issues
8. Take more advantage of COTS software packages
9. DAMA should be responsible for data management
10. Options to add additional staff to IT
11. Clear objectives for the IT
12. Investing in software and computing
13. Develop and resource a data management plan

IT action plan Self Assessment

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Beamline action plan summary

1 Talent-pool in core EPICS/software
2 Explore and implement talent-retention strategies.
3 Engage the tech staff in embracing & advancing facility goals
4 Is staffing model optimum to being world leading facility
5 Provide strong support to the POCs
6 More simple motor control solutions than Delta Tau
7 Robust development processes
8 Improve group interactions
9 Multi-disciplinary teams for appropriate projects
10 Priorities that are aligned with the strategic direction
11 Resolve the problems with the NFS server (IT)
12 Determine common pain points for beamlines
13 Level-1 support (simple tasks) performed by junior staff
14 Not duplicating functionality across the organization
15 Create a working environment, career opportunities
16 Set clearly defined objectives and priorities

Beamline action plan self Assessment

1 Talent-pool in core EPICS/software
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Self assessment:
80% of the recent issues are:

- IT related. “Network” – you will hear “The Network” as if it were a single thing…

  There have been separate issues with the following:

- Core network - Upgraded in Jan, some bugs;
- NFS servers – this has been a ***Total disaster***;
- GPFS – Not as good as it should be; Performance is spotty, sometimes good, other time not so good.
- Specific instances with workflows e.g ; CHX issues
- External access – ongoing work;
- Aging infrastructure – Five years for some equipment

Issues with NFS - Details

NFS is the root cause of many problems people call “network”

- NFS is used to distribute software, to keep configurations consistent, i.e. User home, the graphical user interface, widely used by accelerator physics, Sometimes by Beamlines for data
- Has caused knock on failures in servers, e.g. Jupyterhub. The old NFS servers started failing last year, became unmaintainable. Five years old, disks failed, Motherboards failed, caching stopped working and more.
- The user load increased with more beamlines
- Replaced with IBM C-NFS servers, showed promise on paper and with testing – good in theory. IBM Stated support for Debian
- Uses GPFS as backend

Issues with NFS - Details

- *CNFS did not work well in practice as implemented , kept failing, rebooting, many production issues, not consistent response times.*
  To the user looked like the “Network” was not reliable.
- Became conflated with the “Core” upgrade, which had a few teething issues.

So… What did we do about it…?

Issues with NFS - Details

Tried many things, opened support tickets with IBM (No luck). Spend much time rebooting and fault finding without result.

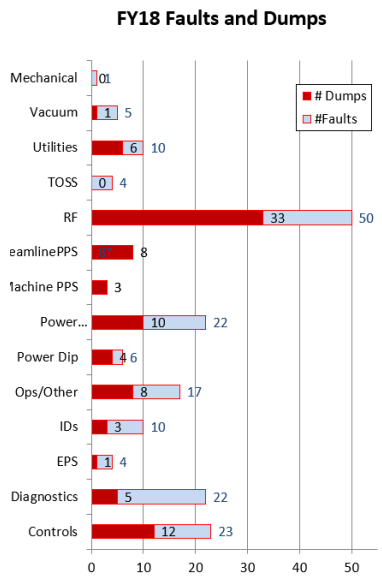
Called for independent consultants scheduled in summer shutdown;

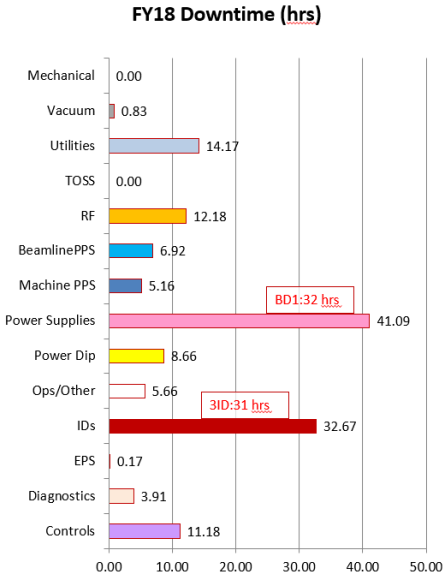
We now have made significant improvements – Changed OS to RedHat, and fixed reliability. Now working on performance, Will have it solved soon.

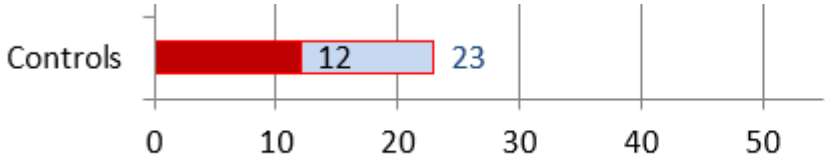
We will/have solved this, but it's late and will take time to recover good will/confidence.

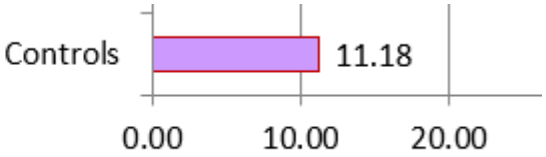
Accelerator Fault statistics

The NFS issues controls have contributed to faults.
Once the NFS is proven fixed the controls reliability will be substantively improved









Controls communications

IT-1

- new Controls “Town Hall meetings” now monthly, attendance spotty, but not far off divisional meetings (Same venue).
- update Controls program meetings – now regular, also monthly
  Agenda: Both an information and a social component – some technical, some awards, some Instructional/Mgt.
- new Controls newsletter – “The controls loop”.
- Pending change of groups to accommodate greater group responsibility – PoC collected, “core” expanded.
- new More Controls internal training (together) – Rivers(Synapps), Mooney (EPICS base),
- update More conferences EPICS, PcAPAC, ICALEPCS, Jypitercon, Hackathons
- new Engineers rotation scheme commenced (Three months at a time)
- Weekly Group leaders meeting
- new Weekly PoC Support meeting
- Hard to quantify effectiveness, not perfect, trying…

Config Mgt, Incident reponsnse, Change Mgt, release mgt

IT 2

- Config Mgt in IT is via a tool and a defined process lead by “PUPPET”. Puppet is an automatic way to inspect, deliver, operate all infrastructure and software, no matter the platform.
- Change Mgt process are still in the early stages of definition.
- new Release management is via a new tool called “SNACK” built on top of Ansible.
- new Plans to improve written process and procedures are being drafted. Builds on existing BNL, NSLS and ITD engineering processes.

IT Steering Group

IT-4

new

- An IT steering group has been formed:

  1/ Oversee new infrastructure purchases
- 2/ Comment on performance issues
- 3/ Review IT policies and the IT strategic plan
- 4/ Help set priorities
- 5/ Help with headcount and assignments

The group does not set the technical architecture, or make detailed decisions, but reviews such proposals put to it before purchase.

Looks at the staff and the workload.
A body intended to ensure that the larger priorities of the NSLS-II and the lab are reflected in the day to day operations of the IT group.

Members from CSI, SDCC, NSLS-II beamlines, ITD and Controls
Beamline Scientist Chair (Garth Williams)

Acronyms: CSI – Computer Science Inititive, SDCC - Scientific data and Computing center (aka RACF), ITD BNL IT department

Network assessment

IT-6

Held an external assessment of NSLS-II core network, by BNL's ITD:

- Scope of assessment = Core network – Routers, Switches, Fibre/wires etc.
- Summary of Assessment:

  Over 400 NSLS-II devices looked at.
  Minor Issues identified with:
  - Core failover;
  - BGP (Border Gateway Protocol) – Routing;
  - Some devices;
  - Some obsolescence looming;
  - Some link utilization issues;
  - Some configuration inconsistencies

  No single issue "ah-ha"

- **Decision**: Will outsource network operations to ITD – Commencing FY19, complete CY19

Outsource network to ITD – Why?

- Leverage lab wide resources;
- More efficient – ITD are specialists;
- Expect 50% improvement in “raw” efficiency;
- ITD are better qualified (Industry certified);
- Allows NSLS-II staff to concentrate on other issues;
- Effectively adding staff;
- Better process for Network Change and Config mgt;
- Better spread of expertise (there are eight staff in lab org);
- Moves to Lab standards;
- Better out-of-hours coverage;
- Service level agreement; and
- Can back out

Data retention policy and Practices

IT-13

As part of the light sources data* working group, we have been working together to have a common template for the data retention policies and practices across all of the light sources. This common language has just been approved and the policy on the NSLS-II website has been updated.

Reproduced next slide or

https://www.bnl.gov/ps/userguide/data-management.php.

* Group was ALS,LCLS, SSRL, APS and NSLS-II

NSLS-II Data Retention Policy

IT13 cont

Date retention policy

- The user community and its sponsoring organizations are very diverse with differing requirements for data retention. The NSLS-II cannot guarantee indefinite data archival.
- Users of the NSLS-II are responsible for meeting the data management requirements of their home institutions and funding agencies. Once data have been provided to the user group, the user group is responsible for managing the long-term retention of their data.
- The ownership of data generated at the NSLS-II is governed by the User Agreement in place between the user group and the facility. Refer to your User Agreement for more details.

Data Retention Practices

- The NSLS-II is committed to providing its users with their data in a timely and convenient fashion. Experiment data and metadata collected at the NSLS-II may be stored at and retrieved from the facility for at least 1 year.

Talent pool in EPICS

BL-1

- Three EPICS Training sessions: Detectors, Synapps and EPICS base. (Rivers/Mooney)
- EPICS core developers Hackathon here
- Active Member of the EPICS council
- Expertise technical area details follow:

EPICS core libraries

- EPICS 7 core library upgrades to support Images with unsigned data types, optimize data copying, simplified array operations

CS-Studio & Phoebus

- A new extensible and pluggable framework for developing controls applications. It addresses the main concerns from eclipse and swt by replacing then with core java technologies and the use of modern UI toolkits like javafx.
- Improved performance and scalability
- Reduction of code base and simplification of build system to improve the ease of collaboration

ChannelFinder

- Version 3 release moved to a noSql backend, elastic search, with a 2 orders of magnitude improvement in query performance
- With the use of recsync, the directory service maintains live status of the epics IOC's

Olog

- Developing of new viewers and applications to facilitate the various use cases the logbook now servers (A shift report, Operational log, fault Log, experiment meta data store, etc...)

Talent Retention Strategies

BL-2

- Training
- Conference attendance
- Spotlights Awards (BNL financial recognition)
- LCLS stopped hiring
- Better communications
- Career development sessions

Have lost two staff (Both DAMA) since last met. No controls or IT staff.

Staffing Model

IT4,9,5,8

About to change groups structure (reorg)

Beamline Controls – PoC to cover each beamlines program area, namely :
Soft X, Hard X, Complex Scattering, Imaging, Diffraction, Structural Biology, Exp development

Accelerator Controls to cover sub systems, namely:
RF systems, Insertion devices, Diagnostics, Vacuum, Front Ends, Timing

Staffing Model

IT4,9,5,8 Cont

IT to be called ICT – Information and communications Technologies.

Cyber, Computing servers, License Mgt, Commercial apps, Storage Hardware, Sysadmin, Offsite data access.

DAMA to cover Experimental controls (Bluesky), Data Mgt, Data analysis, HPC computing Software, Jupyterhub, database

Staffing Model

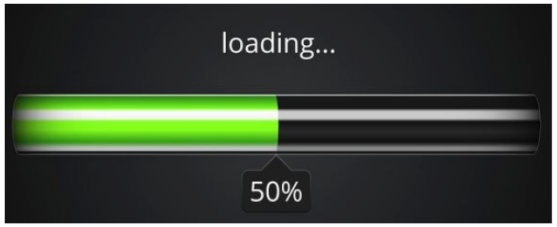
IT4,9,5,8 Cont 2

Controls common systems will cover

- EPICS Base and extensions
- User interfaces (GUI)
- Equipment protection
- Motions Controls
- Hardware support (Pizzabox)
- Cable Mgt
- Detector support
- EPICS driver support
- Controls services (e.g. MASAR, BEAST)
- OPHYD (Bluesky interface to EPICS)

Conclusion

- Much work to go,
- Estimate about 50% of the review items are either complete or in an advanced state.
- Many elements in place, and others scheduled
- Next IT/BL review in Jan/Feb next year
- Have made many changes.



Appendix
Selected program highlights follow

- DAMA
- Soft X
- Diffraction
- Structural Biology
- Hard X
- Imaging
- Complex Scattering
- Experiment Development
- Accelerator
- New WBS

Appendix Contents: Programs highlights:

- DAMA
- Soft X
- Diffraction
- Structural Biology
- Hard X
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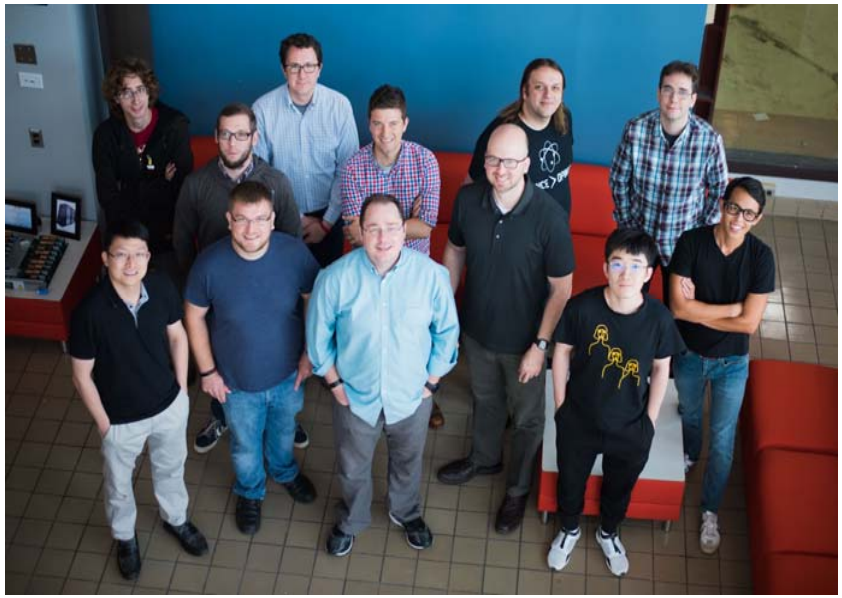
DAMA

- Bluesky collaboration is working well, contributions from outside collaborators (APS, SLAC) are increasing.
- APS/NSLS-II collaboration is working well. Initial focus on XPCS, kicking off fluorescence mapping soon.
- New versions of bluesky suite released and deployed.
- Contributions from SLAC in GUI "space"



The ExFaC Data Management Coordination Meeting and Hack-a-thon, August 13 - 17, 2018, at Brookhaven National Laboratory, Group Photo.

Soft X program – Controls

- CSX/IOS: Worked with many different controls staff to repair failing server and upgrade other servers to Debian 8, and work with beamline staff to rebuild several customized IOCs.
- SIX: Work with contractors, technicians, electrical eng group to finish configuring spectrometer arm and safety system, and prepare equipment and wiring for triple rotating flange (waiting on delivery now).
- ESM: Work with controls staff and EE group to move/upgrade wiring for new shared deposition chamber in collaboration with Yale user group – making progress
- New IOC for LEEM-PEEM endstation. Now in use but development continuing.

(In progress) developing a new IOC for a complex electron spectrometer and should have some basic control within a few weeks.

- All beamlines: Changed motor record setting to enable autosave/restore of motor positions, where previously high resolution encoders would not restore reliably.

Diffraction & In Situ Scattering

- PDF, major controls work was finished to enable the construction project to pass IRR.
- PDF and XPD deployment of Perkin Elmer detectors with EPICS support in Windows 10 environment, which is among the earliest deployment of such detectors
- PDF The IOCs were built based on EPICS R7 and areaDetector R3.2 to takes advantage of PV access for better performance. The detectors have been used during XPD cycle with access to GPFS system.
- XPD, created EPICS support for Hei-FLOW Precision pump
- XPD PID controls of the furnace;
- ISR We returned motors for the Six circle diffractometer and support for commissioning at 4-ID.

Structural Biology highlights

- Remote operations (AMX and FMX)
- Unsupervised overnight operations (AMX and FMX)
- Automation/Robotics advances (reliable operations, sub 40-second exchange time) (AMX and FMX)
- Fast Forward Goniometer for Raster Scanning Serial Crystallography on FMX (Serial Crystallography is solving structures by taking partial data on many crystals)
- Installation and operation of a High Viscosity Extrusion Injector (AKA
- "Jet") on FMX - (this is used for high viscosity Serial Crystallography)
- SynchWeb integration progress (AMX and FMX) - (We now have a web-based interface to data that's been collected, including some processing results)
- Automatic data processing and pipelining on AMX and FMX.
- LIX solution scattering GUI based on the AMX/FMX LSDC GUI.

Hard X-ray

- QAS. Completed our scientific commissioning with great success. Users were very pleased with the data acquisition system's performance
- Successfully integrated area detector and fluorescent detectors at the EPICS level
- ISS not running for the past several months due to crystal mounting issues
- NIST beamlines successfully completed IRR and detected first light at the experimental station.

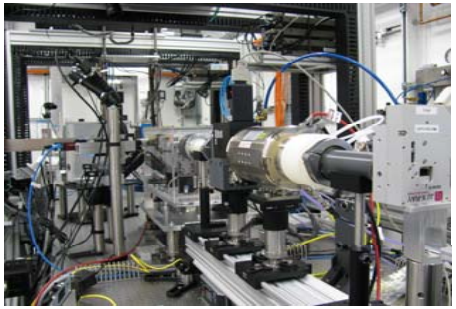
Imaging and Microscopy

- [3ID-HXN] vendor monochromator IOC upgrade with NSLS-II standard IOC server to void intermittent performance drop. (was an embedded IOC)

- [3ID-HXN] implement NSLS or for high speed PID loop.

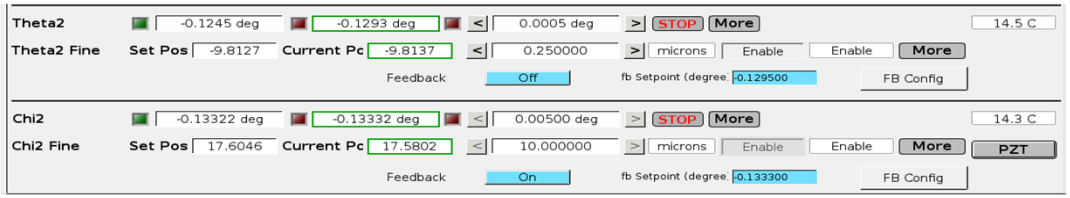
Imaging and Microscopy

[4BM-XFM] Perkin Elmer XRD 1621 detector IOC setup under windows 10 with areaDetector v3.2 and EPICS V4



[5ID-SRX] KB system replacement project which including 8 axes KB mirror and 4 axes low current slits

[5ID-SRX] chip imaging stage setup and flying scan system configuration



[18ID-FXI] DCM Theta2/Chi2 fine Piezo motion position stabilizing PID control implementation.

Complex Scattering beamlines

- Lambda detector EPICS driver written and tested 10ID, ...
- EPICS driver for USB Video Class (UVC) devices.
- FXI - ID18: TXM microscope
  - TXM 1st paper on 1 minute data acquisition
- Standards
  - Nomenclature standard signed
  - CSS screens for AreaDetector standardized and tied to releases
  - CSS screens for EPICS modules including synApps
  - areaDetector ioc standardization - ongoing
  - areaDetector upgrade

Experiment Development

- Controls work for Beamline Engineering Program (Wah-Keat):
- Controls for Laser-based ptychography microscope Work with Mechanical Engineering on testing alternative motion control (Hybrid motor/controller)
- Repair deposition lab (ITD messed it up)

Accelerator control Update

- Overall: the NSLS-II accelerator reached 95% reliability during 2017-2018 run. The accelerator control system's reliability is over 99.9%.
- BPM development:
- New zynq-based DFE board development. This is an upgrade of NSLS-II virtex6-based BPM digital front-end (DFE) board. It has two ARM CPU cores which provide a faster and more reliable BPM to IOC communication. It also provide much more FPGA logic. The control engineer is responsible for the firmware and EPICS IOC development for the BPM upgrade. All the functions have been successfully tested during user operation.
- Modified analog front-end (AFE) board for APS test. This is a collaboration between BNL and Argon National Lab. The goal is to modify NSLS-II BPM with different filter and with Peltier temperature control to test the BPM performance on APS. This includes modification of the PCB of AFE, modification of firmware and new design of TEC cooling system for the AFE board. All tasks are on schedule. The APS beam test is scheduled in late November.
- PPS integration to EPICS: during commission of NSLS-II accelerator, the front-end PPS and beamline PPS systems are not integrated into EPICS. It is desirable to bring these systems into EPICS so that PPS system experts can easily troubleshoot the faults. The two PPSs have about 50K EPICS records.
- Front-end PPS: softioc is done. EPICS record is generated for each bit of the Chain A and chain B for each front-end PLC system. CSS pages are developed.
- Beamline PPS: softioc is done. EPICS record is generated for each bit of the Chain A and Chain B for each beamline. CSS page is under development.
- Dedicated archive appliance for PPS system. Due to the large amount of epics records in PPS system, we are in the progress of deploying 2nd achieve appliance to archive the PPS records.
- Uniform software configuration and deployment tools: SNACK (SiNuglar Application Configuration Kit)
- More than 250 EPICS softioc are configured and deployed with SNACK. The software tool kit provides a simple and uniform procedure to configure and deploy EPICS softioc. It uses NSLS-II gitlab for revision control, and use ansible for software provisioning, configuration management and deployment.

Accelerator control Update - II

- SNACK is also applied for configuration and deployment for areaDetector and software developed by NSLS-II DAMA group.
- SNACK is applied to deploy all the high level applications software, such as RF feedback, local bump, BTS trajectory, etc.
- Control system for 3rd RF cavity: the 3rd RF cavity will be installed in the near future. Many preparation work have been done.
- Prepare 3rd RF cavity EPICS softIOC, OPI pages and network architecture design.
- Study of redundant IOC for cryogenic system: study has been done to deploy redundant IOC for the critical cryogenic system control.
- Build a test system (sandbox) for accelerator physicists to practices FPGA and motion control
- Build a small scale of fast orbit feedback system in control lab. It consists of 4 BPMs, 1 cell controller, 4 PSC and 1 PSI. It is used as a test-bed for a fast orbit feedback system.
- Build a motion control system in control lab. It consists of Delta-Tau motion controller, step motor, encoder. It is used as a test-bed for motion control.
- Additional system control for the accelerator new installation or maintenance
- Storage ring DCCT temperature monitoring and cooling control with PDU.
- Control system for Booster quad power supplies.
- Control system for ID correctors.
- Support for high level application/integrated system operation and optimizations
- Fast orbit feedback (FOFB) system: deployed new photon local feedback system for ID17 to control the drift caused by vehicle tunnel. Studied the beam stability improvement from the new fast corrector compensation.
- Active interlock (AI) system: modified the AI system to including newly commissioned beamliens.
- Top-off system: modify top-off algorithm to support different filling pattern during beam study and user operation.
- Top-off safety (TOSS): support the regular verification of TOSS system.
- Beamline support: accelerator control personals provide support to beamlines with expertise in MASAR, archive appliance, BEAST alarm system, pizzaBox etc.

Accelerator Goals

1. Greatly reduce the faults caused by control infrastructure.
   - Optimize the overall IT Accelerator control infrastructure by taking necessary modifications such as separation of accelerator and beamline from sharing common network, file systems and other IT resources.
   - Establish an IT monitoring system for control room to check the overall status of control infrastructure.

2. Control hardware and software upgrade:
   - Hardware:
     - Upgrade the IOC servers step by step.
     - Move some critical software running on virtual machine (VM) to physical machine. One of the most critical one is the alarm server which can hardly support future accelerator installation. We need to install a dedicated server for the alarm system.
     - Working with other technical groups to update control devices: PSC, PSI, BPM, xBPM, cell controller, etc.
     - Test the simple, low cost integrated motor controller for one-axis motion control application.
   - Software:
     - Upgrade control servers to newer Debian 8 and 9.
     - Update EPICS control software to EPICS 7 when suitable.
     - Deployment and manage EPICS softioc using SNACK as a standard deployment procedure