

LCLS Magnet Control

- Challenging Design Issues
 - “How to integrate the legacy system with the new”*
- Subsystem architecture
- Magnet IOC Design
 - Interface to legacy control system - SLC
 - EPICS Record Processing
 - EPICS SNL
 - (EPICS device/driver support)
- Displays

Thank-yous

Interface to legacy SLC control system:

Stephanie Allison, Diane Fairley,

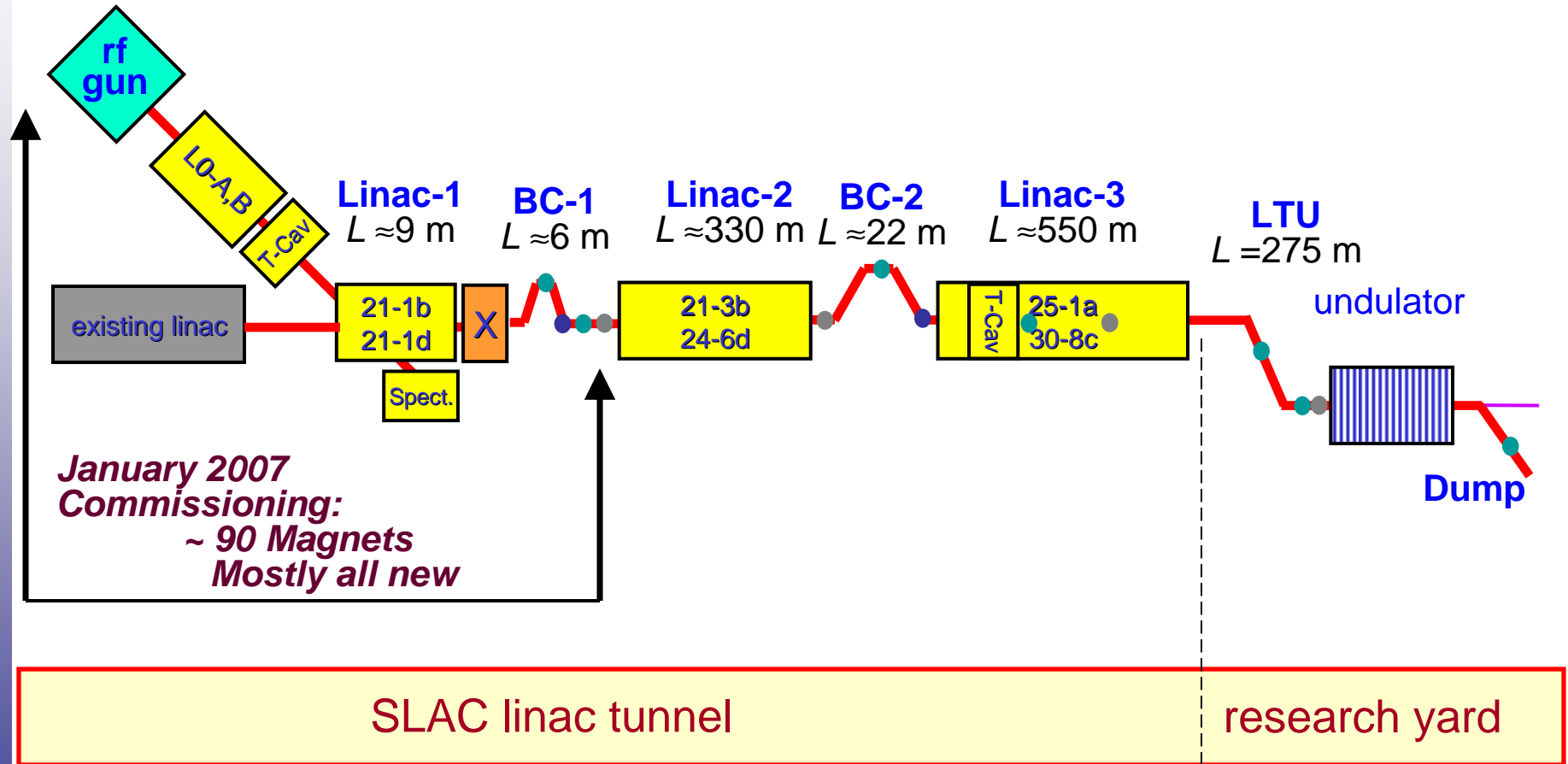
Ron Chestnut and group,

Ron McKenzie

Magnet Control:

Kristi Luchini, Stephanie Allison

LCLS Conceptual Diagram



Design Issues

At least in the “short term”, LCLS wants to leverage the usage of legacy SLC control system high level physics applications ...

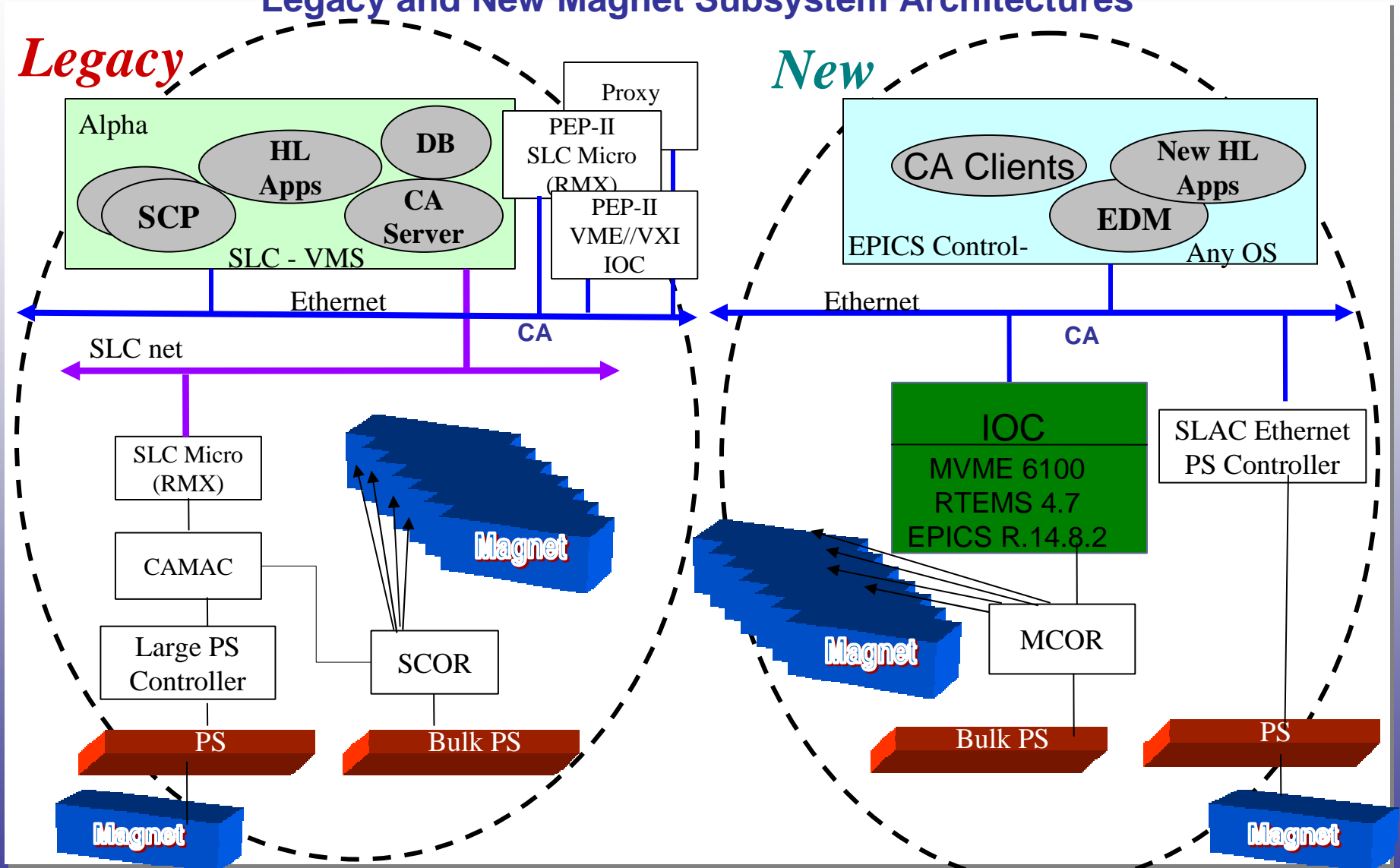
1. New magnets must be controlled and monitored from legacy SLC – with minimal code modification to SLC (VMS, Fortran, assembly etc)
2. New magnets will use EPICS for control

How do we integrate the legacy system with the new EPICS controlled system?

Legacy and New Magnet Subsystem Architectures

Legacy

New



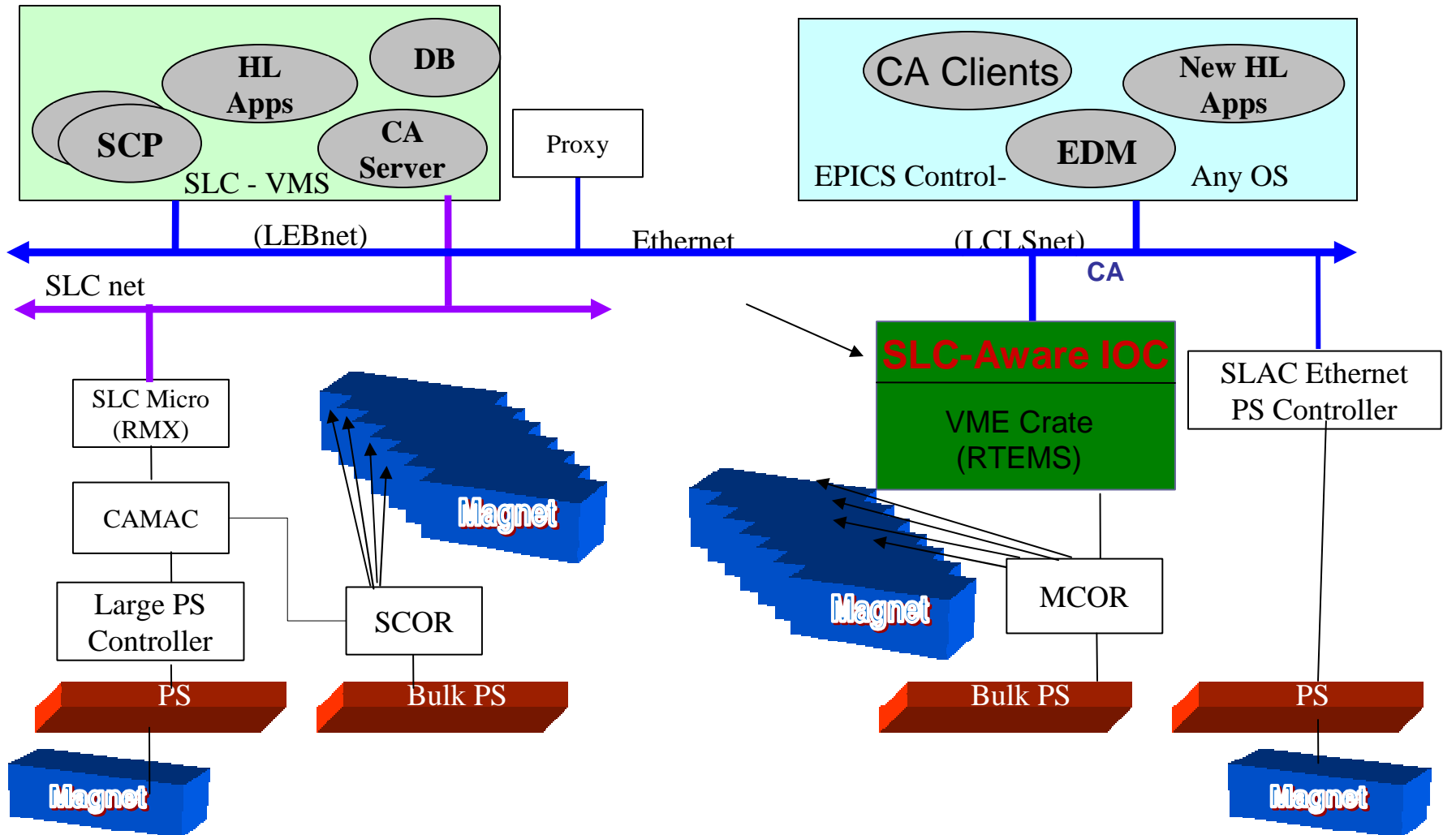
June 15, 2006

LCLS Magnet Control

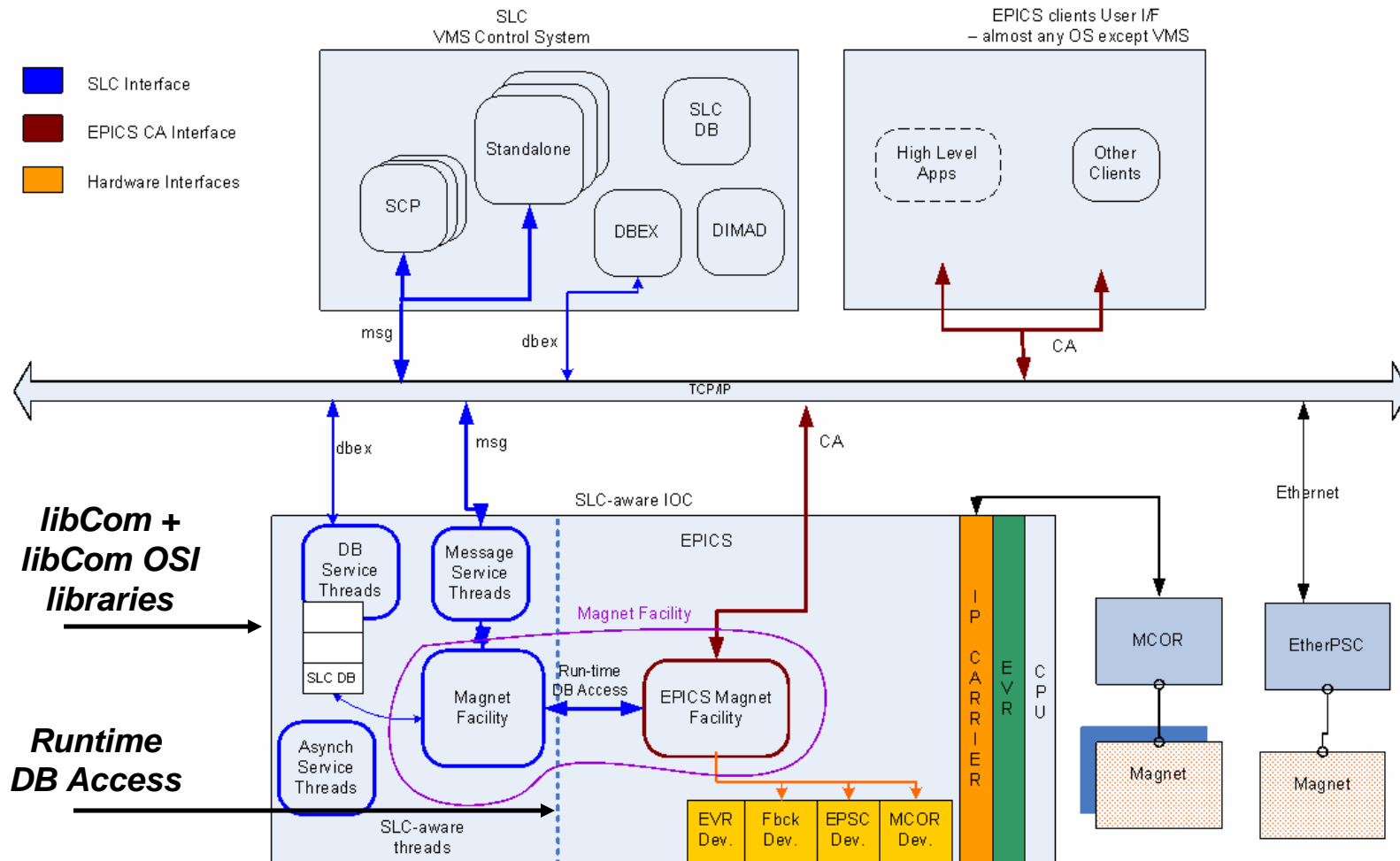
Debbie Rogind

drogind@slac.stanford.edu

Answer: SLC-Aware IOC



Magnet SLC-Aware IOC Architecture



Design Issues

1,2, Solved: Communication bridges in place between the old and the new

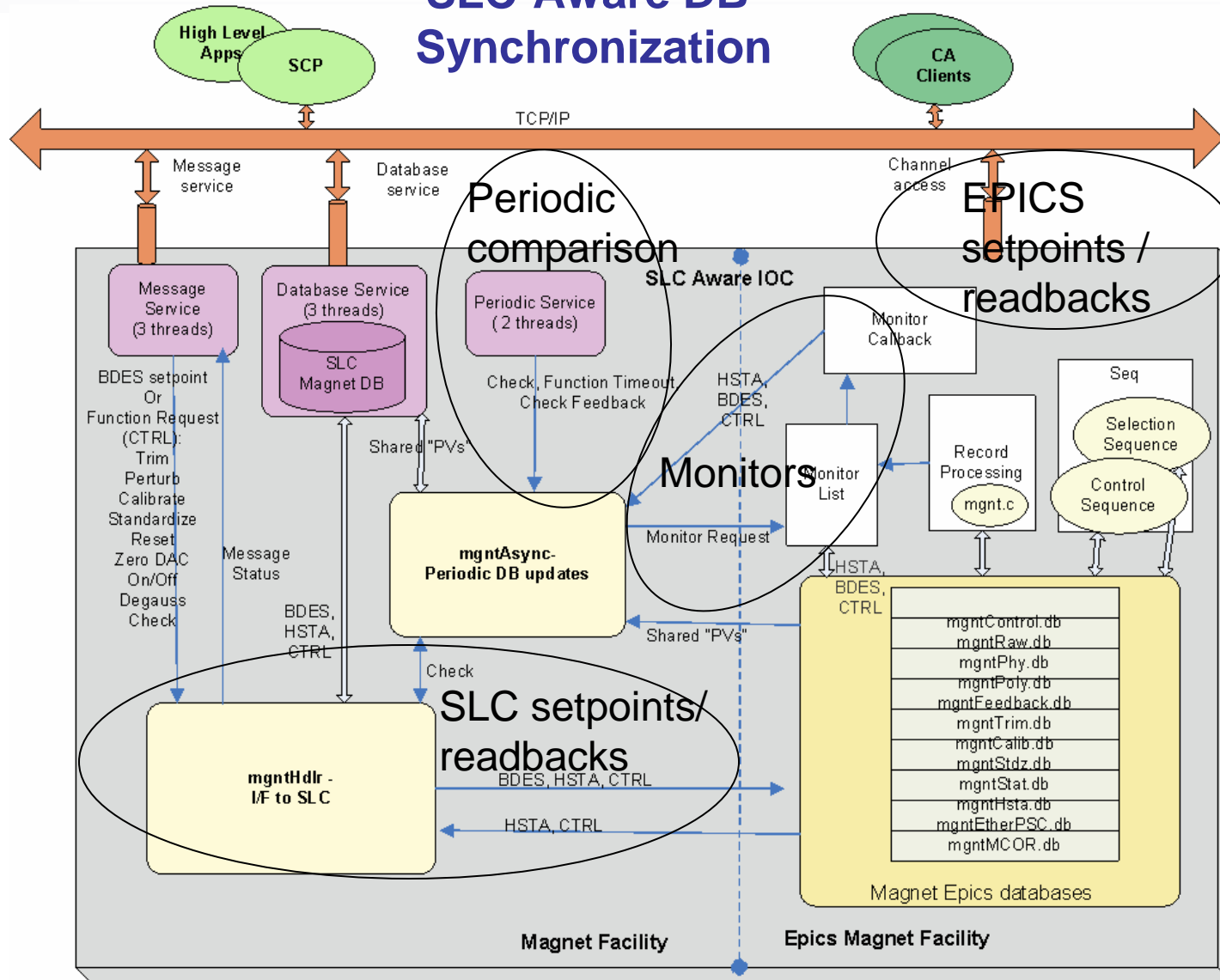
3. There are two distinct databases:

- **SLC**

- **EPICS**

How to synchronize?

SLC-Aware DB Synchronization



EPICS Databases

- Per device
 - Polynomial Coefficients (provided by MMF)
 - B field settings: user, feedback, HLApps; tolerance, limits settings; B->I conversions
 - Raw Current settings; I->B conversions
 - Power Supply Controller I/Fs: interlocks, setpoints, readbacks
 - Control functions
 - Master Control DB (incl. on/off, reset, zero current)
 - Supporting DBs: Trim, Standardize, Calibrate, Feedback
 - Status – SLC, EPICS, and Summaries
- Per IOC - Multi-selection of devices; multi-function, *(new!)*
- Template and substitution files using macros

Sequencer SNLs

Per device, handles -

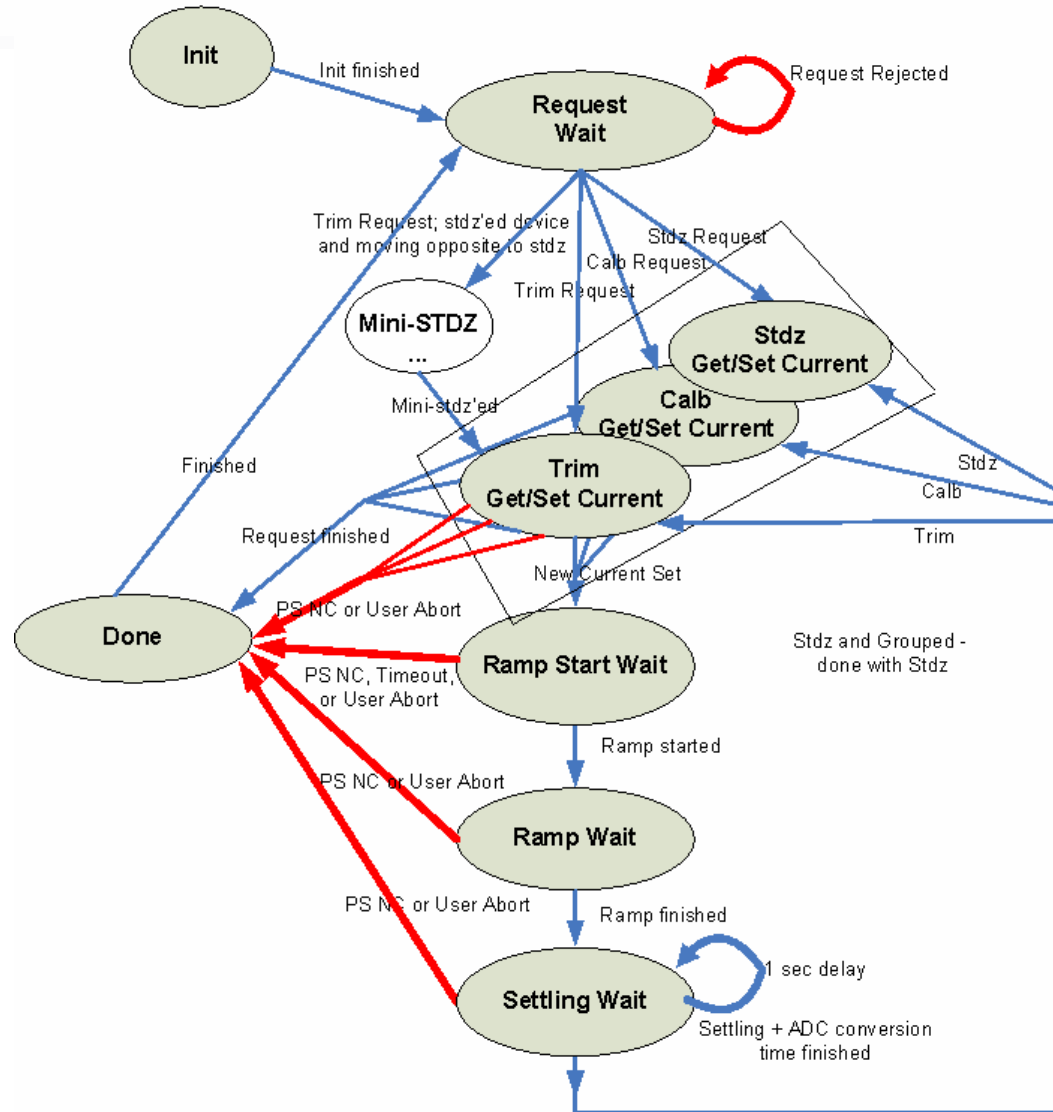
- “More complicated” control functions
 - Trim, Calibrate, Standardize,...
- Transitions between steady states
- Timeouts
- User Abort
- Error conditions and message reporting

Per IOC -

- Multi-select devices/functions, abort

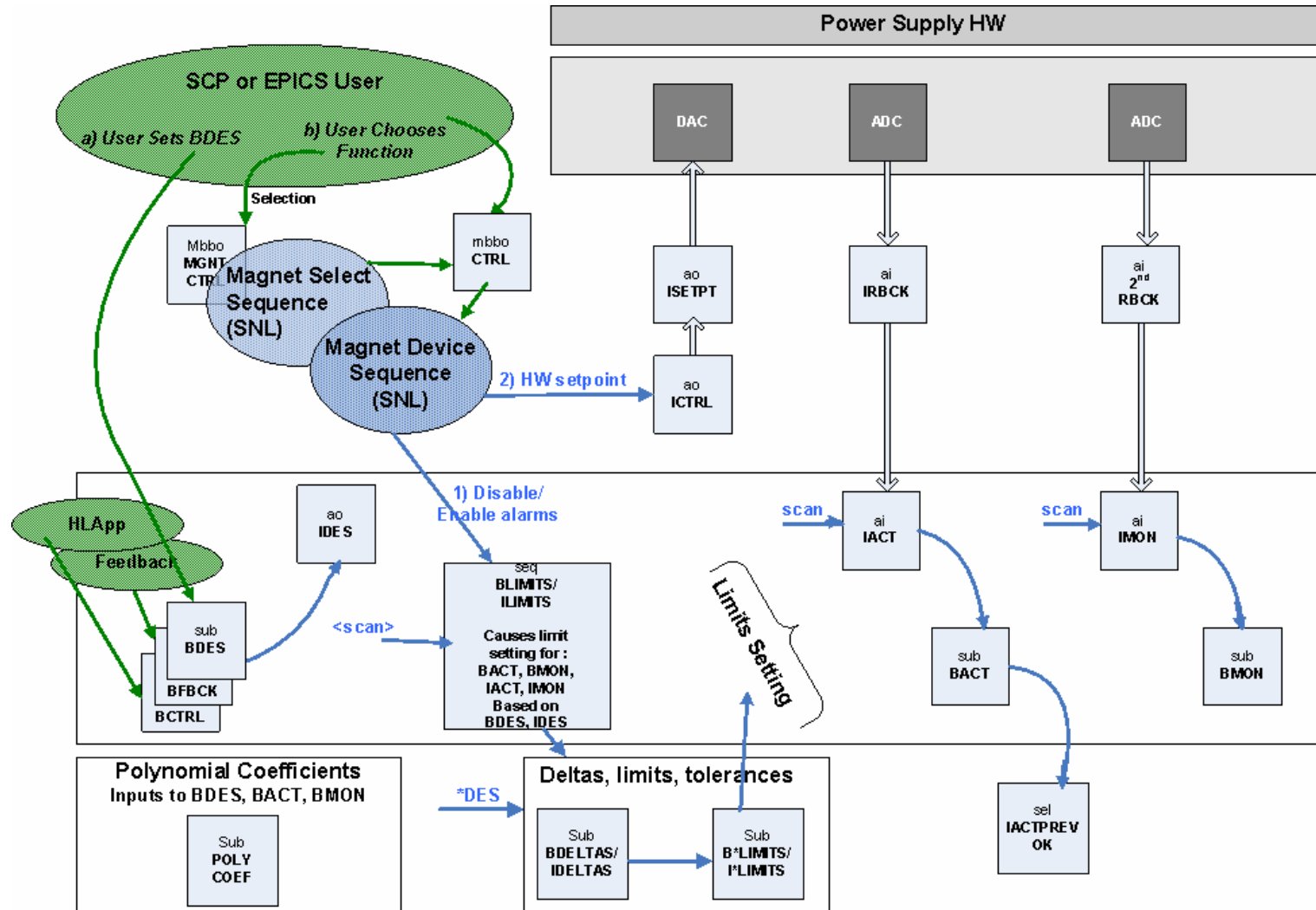
Magnet Device
SNL for:

- Trim
- Calibration
- Standardize



* PS NC = Power Supply No Control

EPICS Magnet Facility- Record Processing / SNL



Displays – for January 2007 Commissioning

- **Legacy SLC SCP Displays**
 - Control and monitor all magnets
 - Correlation plots, orbit fit, orbit display, orbit correction, bump calculation, power steering, multi-knobs, ...
- **EPICS EDM Displays**
 - Control and monitor new magnets; monitor existing
 - Perform more than one function at a time
 - More status available
- **Legacy and EDM overlap functionality**
 - Status color code maintained
 - SLC Status, SLC DB maintained
 - Magnet functions controlled similarly, except for multi-function
 - SLC DB name annotations are on EDM

Sample legacy control display

TP_DEV CALF23							
LCLS Magnet Index	XL01 MAGNET PANEL	XL02 MAGNET PANEL	XL03 MAGNET PANEL	XL05 MAGNETS	HELP	RETURN MGNTXLXX	INDEX
QUAD 201	QUAD 301	QUAD 401	QUAD 501	QUAD 601	QUAD 701	QUAD 801	QUAD 901
XCOR 202	XCOR 302	XCOR 402	XCOR 502	XCOR 602	XCOR 702	XCOR 802	XCOR 900
YCOR 203	YCOR 303	YCOR 403	YCOR 503	YCOR 603	YCOR 703	YCOR 803	YCOR 900
LGPS 1	LGPS 2						
TURN OFF LGPS	TURN ON LGPS	CHANGE BDES	START-STOP BPHDAT	ALL QUAD	ALL XCOR	ALL YCOR	ALL MAGNET
CALI-BRATE	STAND-ARDIZE	ENTER BDES	TRIM	ZPLOT DISPLY ALL	DISPLY ALL UNITS	DISPLY BAD UNITS	DISPLY SINGLE UNIT
ASSIGN MAGNET KNOB 0	ASSIGN MAGNET KNOB 1	ASSIGN MAGNET KNOB 2	ASSIGN MAGNET KNOB 3	RESTOR KNOB	DISPLY NEXT PAGE	PRINT All Text SLCPRINT	DIAG-NOSTIC PANEL

Sample legacy status display

GRAPHICS CALF24

MAGNETS Sector= LI23 Primary= ALL* Unit= ALL* Display Group= LINAC

LI23 LGPS	UNIT	BCON	BDES	BACT	HDSC	HSTA	STAT	
	1			0.0	0	4810	1058	TURNEDOFF
LI23 QUAD	UNIT	BCON	BDES	BACT	HDSC	HSTA	STAT	
	201	65.623	65.623	.54513	0	4801	1848	OUT-RANG
	301	-68.305	-68.305	-.54512	0	4801	1848	OUT-RANG
	401	64.588	64.588	.54499	0	4801	1848	OUT-RANG
	501	-63.669	-63.669	-.54499	0	4801	1848	OUT-RANG
	601	63.504	63.504	.54500	0	4801	1848	OUT-RANG
	701	-64.115	-64.115	-.54497	0	4801	1848	OUT-RANG
	801	66.543	66.543	.54496	0	4801	1848	OUT-RANG
	901	-63.015	-63.015	-.54505	0	4801	1848	OUT-RANG
LI23 XCOR	UNIT	BCON	BDES	BACT	HDSC	HSTA	STAT	
	202	-1.786e-3	-1.786e-3	-1.732e-3	0	801	41	
	302	-1.631e-3	-1.631e-3	-0.056e-3	0	801	1048	OUTOFTOL
	402	-1.760e-3	-1.760e-3	-1.706e-3	0	801	41	
	502	2.302e-3	2.302e-3	0.014e-3	0	801	1048	OUTOFTOL
	602	7.100e-3	7.100e-3	6.872e-3	0	801	1048	OUTOFTOL
	702	0.980e-3	0.980e-3	5.948e-6	0	801	1048	OUTOFTOL
	802	-7.496e-3	-7.496e-3	-7.250e-3	0	801	1048	OUTOFTOL
	900	-2.987e-3	-2.987e-3	0.026e-3	0	801	1048	OUTOFTOL
LI23 YCOR	UNIT	BCON	BDES	BACT	HDSC	HSTA	STAT	
	203	-0.846e-3	-0.846e-3	0.016e-3	0	801	1048	OUTOFTOL
	303	-0.577e-3	-0.577e-3	-0.590e-3	0	801	41	
	403	2.069e-3	2.069e-3	0.011e-3	0	801	1048	OUTOFTOL
	503	5.694e-3	5.694e-3	5.501e-3	0	801	1048	OUTOFTOL
	603	2.249e-3	2.249e-3	5.465e-6	0	801	1048	OUTOFTOL
	703	-0.439e-3	-0.439e-3	-0.454e-3	0	801	41	
	803	-3.831e-3	-3.831e-3	6.780e-6	0	801	1048	OUTOFTOL
	900	-8.844e-3	-8.844e-3	-8.587e-3	0	801	1048	OUTOFTOL

21-MAR-05 14:57:01

Sample EDM displays ...

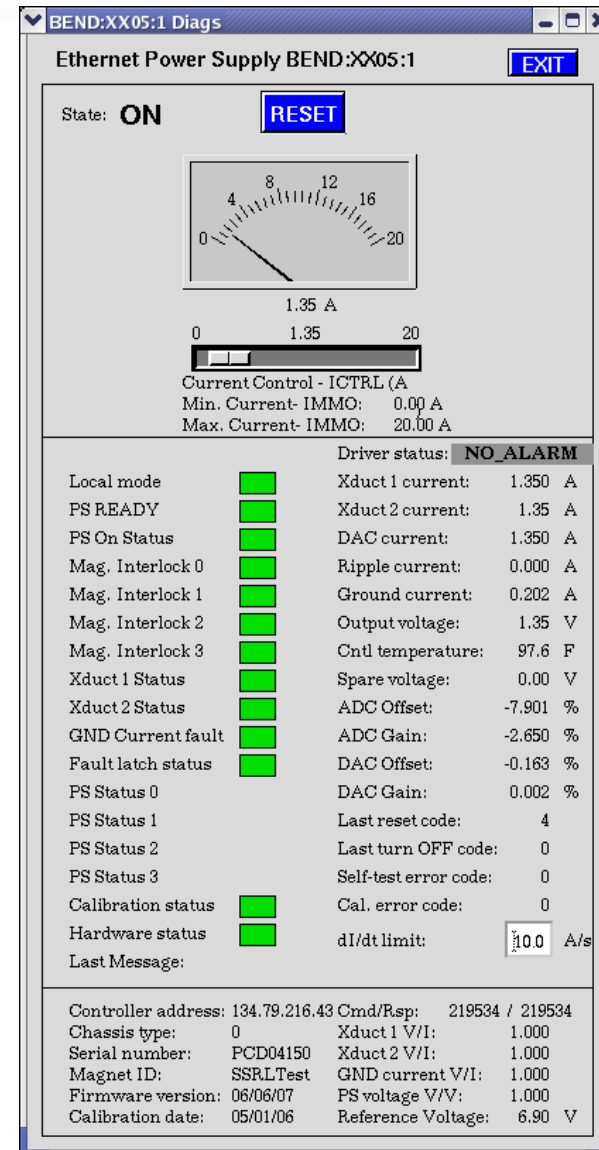
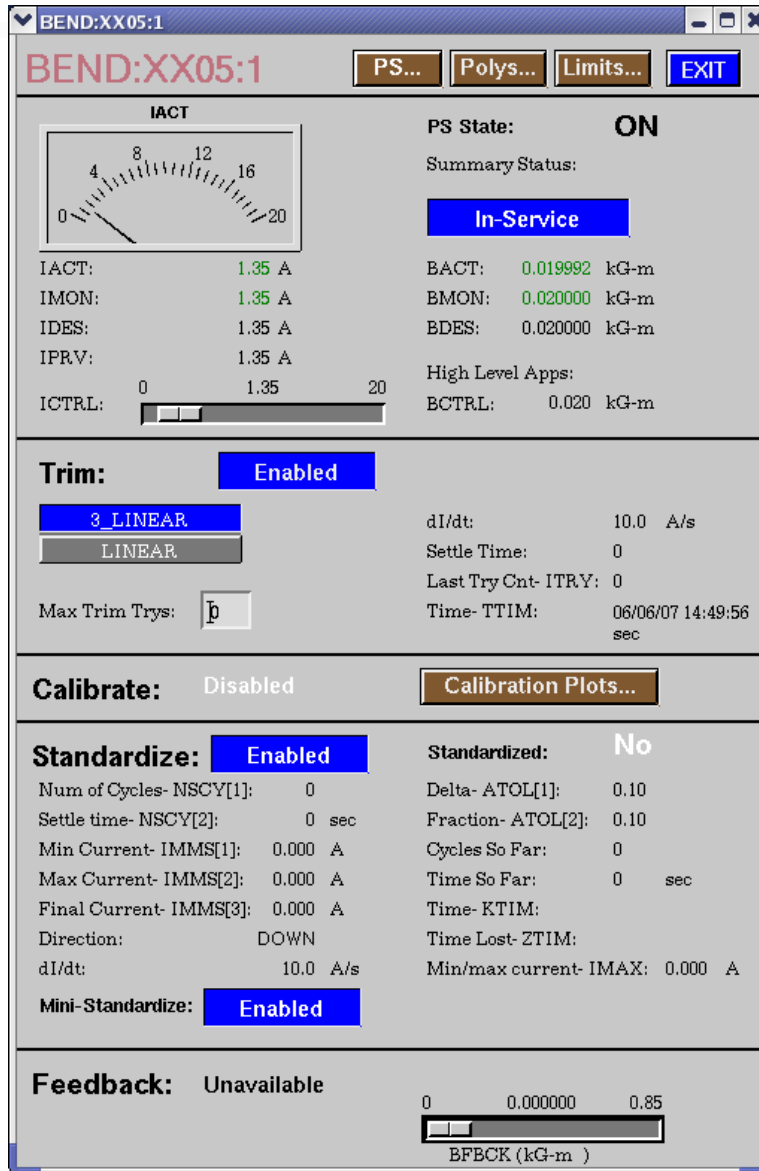
XX05 Magnets

All XX05 Magnets

SOLN... QUAD... All COR... XCOR... YCOR... BEND... LGPS... HELP... EXIT

All* Selected: Control Abort Control Status
Ready Not Done

MAD name	Magnet	Perturb	BDES	BDES	BACT	BCON	Control	Abort	Control Status	Summary Status
* BEND05001	BEND:XX05:1	0	0.85	0.020000	0.019992	0.000000	Ready	<input type="checkbox"/> <input checked="" type="checkbox"/>	Request Wait	ON
* BEND05002	BEND:XX05:2	0	30.9329	2.379359	0.000000	0.000000	Ready	<input type="checkbox"/> <input checked="" type="checkbox"/>	Request Wait	OFF
QUAD05201	QUAD:XX05:201	0	106.177	8.172135	8.178556	0.000000	Ready	<input type="checkbox"/> <input checked="" type="checkbox"/>	Request Wait	OFF
XCOR05202	XCOR:XX05:202	-0.06243	0.06243	-0.016328	-0.016328	0.000000	Ready	<input type="checkbox"/> <input checked="" type="checkbox"/>	Request Wait	OFF
YCOR05203	YCOR:XX05:203	-0.06243	0.06243	0.016482	0.016482	0.000000	Feedback	<input type="checkbox"/> <input checked="" type="checkbox"/>	Request Wait	OFF
LGPS05001	LGPS:XX05:1	0	225	10.383750	10.383750	0.000000	Ready	<input type="checkbox"/> <input checked="" type="checkbox"/>	Request Wait	OFF



Conclusions

- SLC-Aware IOC will pay off for LCLS
 - Integrates legacy system to new
 - Allows usage of a rich set of existing legacy HLApps
 - Buys time
 - Made possible by the EPICS OSI libraries
 - Endian issues were a pain
- Users are excited for EPICS controlled magnets
 - Better GUIs
 - Multi-function magnet control

Thank-you for being a magnetic audience!

