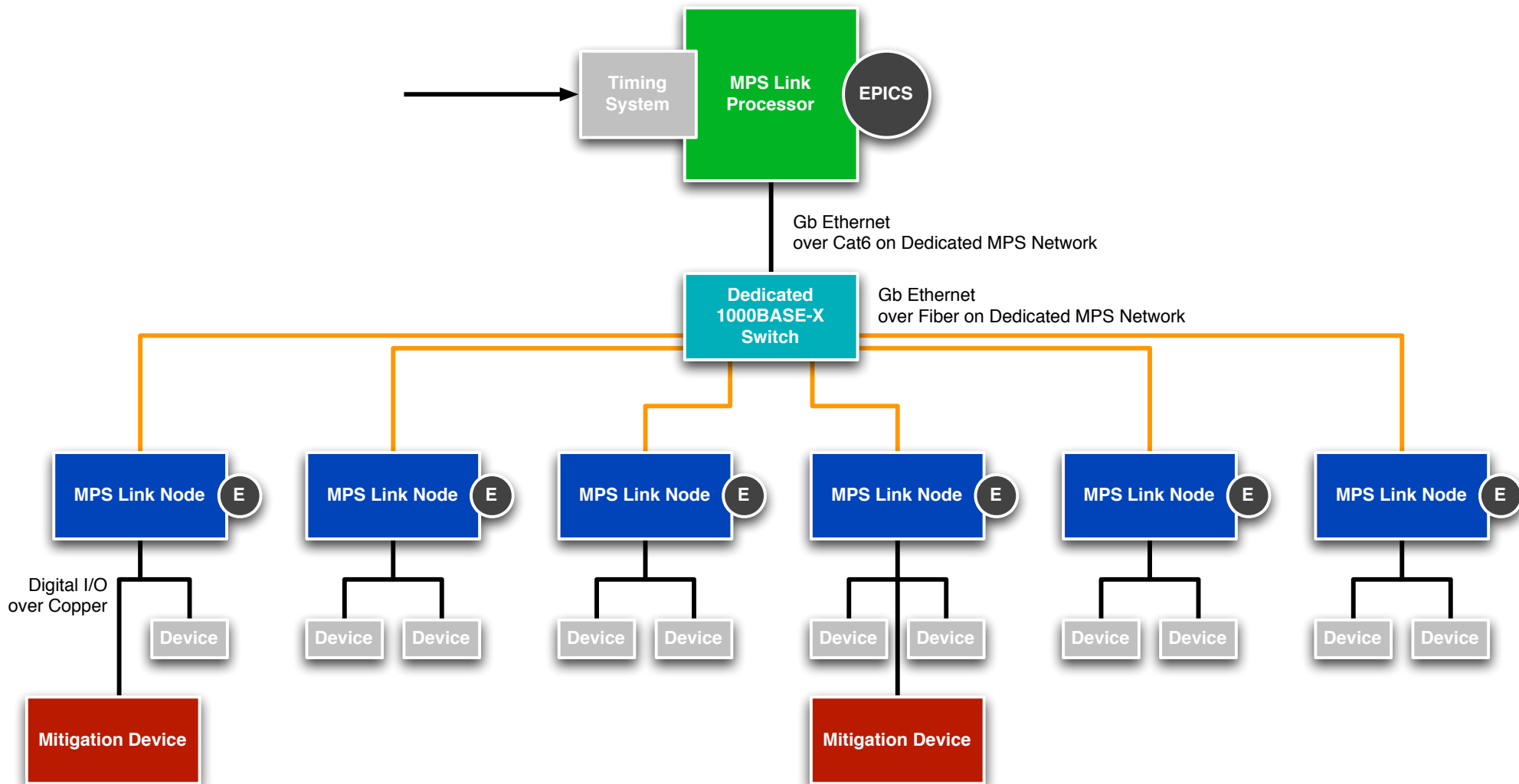


LCLS Machine Protection System

- System Overview
- Completed Work
- Remaining Work
- Schedule

LCLS MPS Overview



Hardware

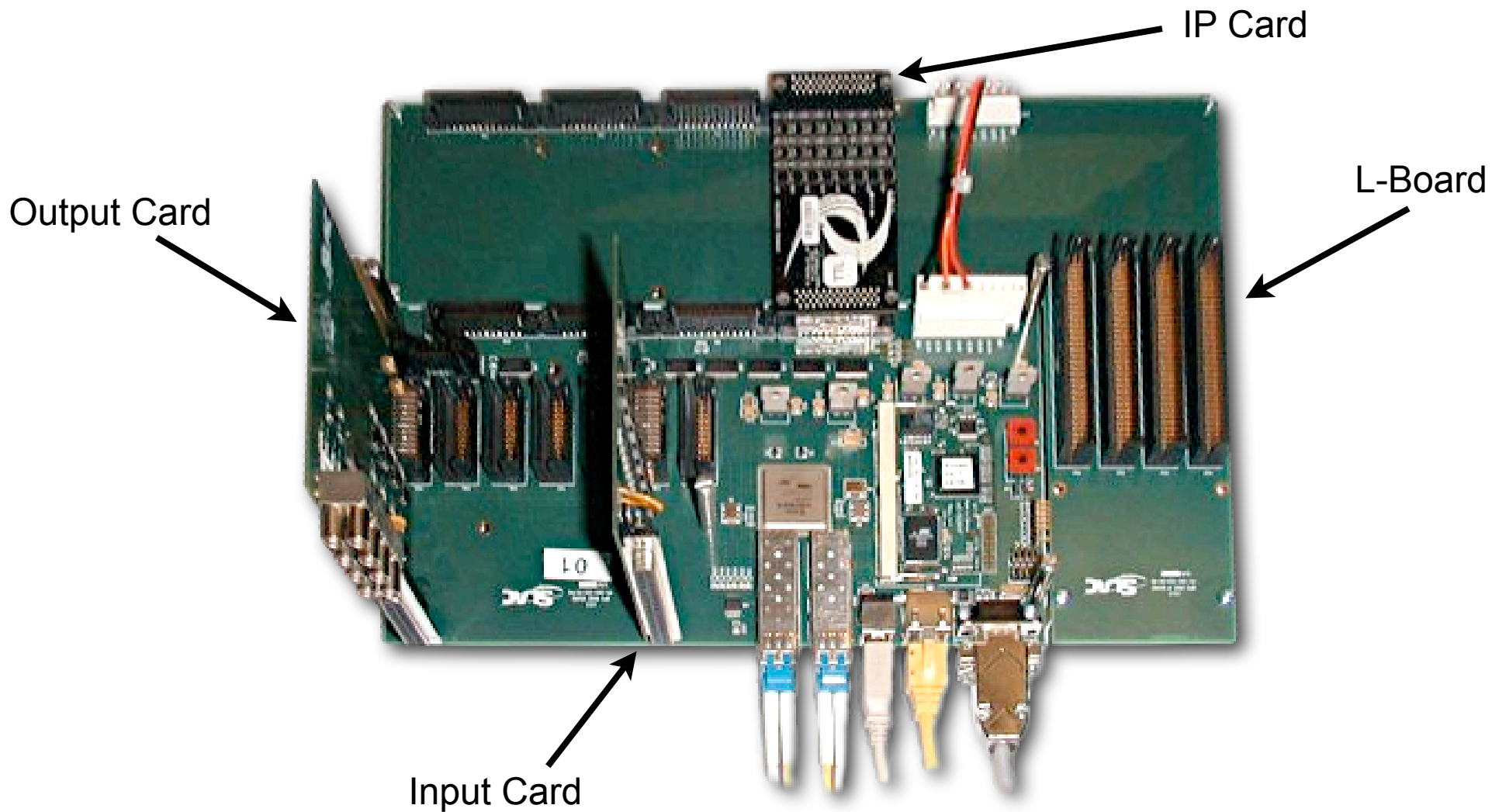
■ Complete

- MPS Link Processor
- MPS Link Node
- GbE Switches
- Beam Loss Monitor
 - QADC and transition boards prototypes complete

■ In progress

- QADC currently being tested

MPS Link Node



MPS Software

■ Four software projects

■ Link Processor

- MVME 6100 IOC software

■ Link Node

- FPGA firmware
- ColdFire IOC software

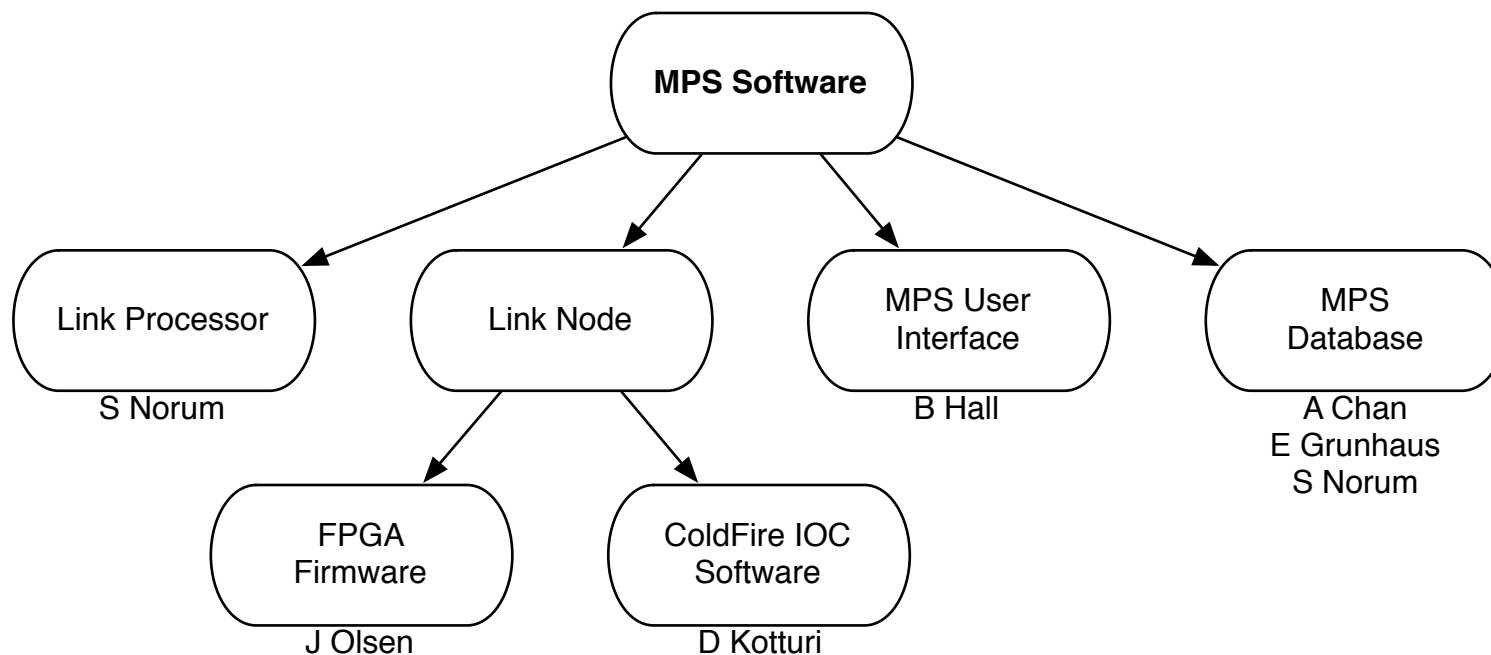
■ MPS User Interface

- Desktop computer

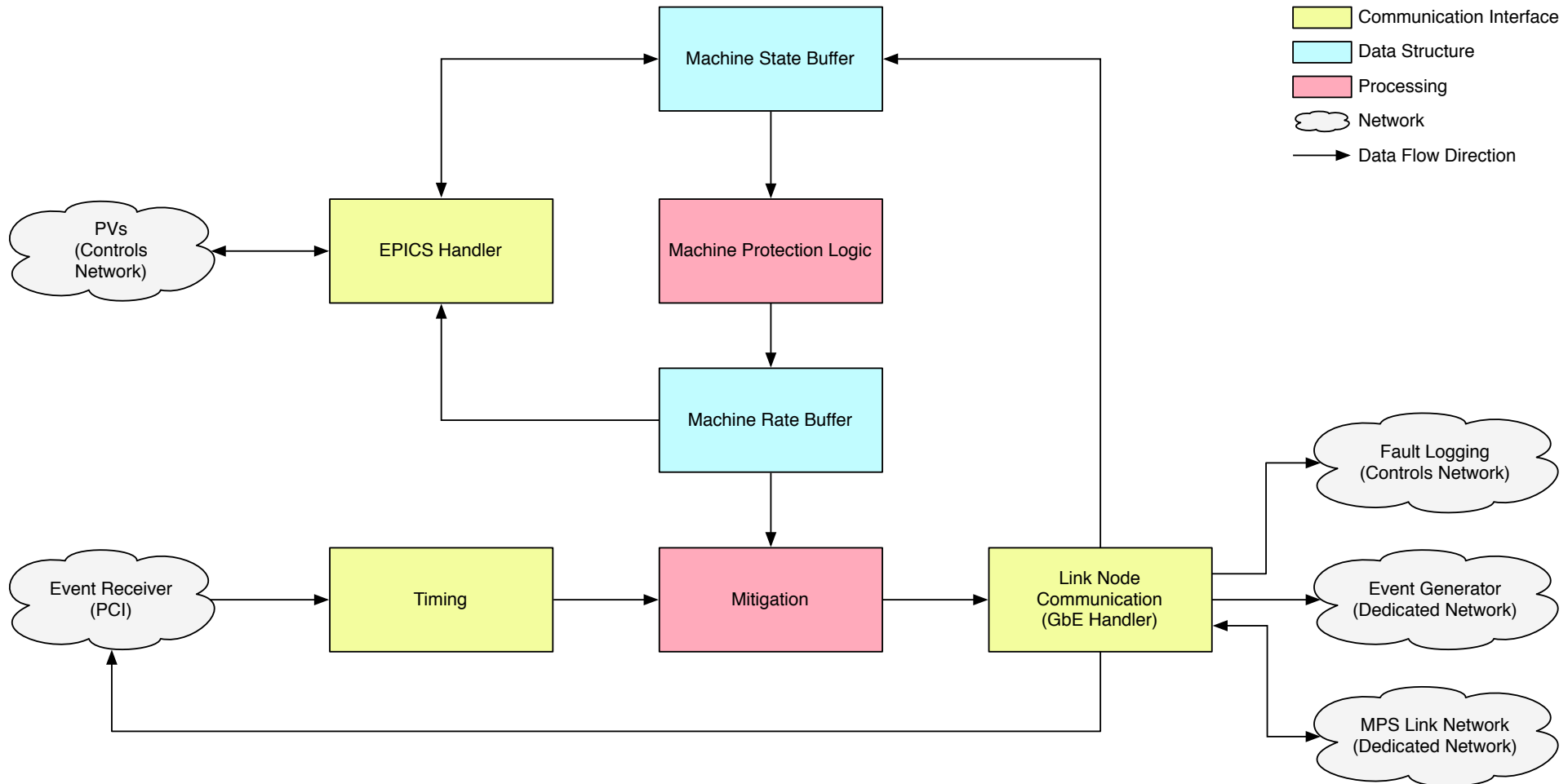
■ MPS Database

- Database

MPS Software



Link Processor Software Overview



Link Processor

■ Complete

- EPICS PVs for fault status, bypass status and value
- Machine state buffer
- Machine protection logic (algorithm) handling
- Machine rate buffer
- Mitigation processing
- ...

Link Processor

- Timing integration
- Initial testing of all these components
- Database conversion to
 - EPICS database substitution files
 - Device name mapping files for algorithms

Link Processor

■ Remaining

- Fault logging for diagnostics and user interface
- Test algorithm and final algorithm
- User interface integration of
 - Bypassing faults
 - Loading and selecting algorithms
- Full system testing

Link Node FPGA

■ Complete

- Reads and clears fault inputs
- Communicates with Link Processor
- Provides registers for ColdFire readback

■ Remaining (J Olsen)

- IP card communication
- Internal fault descriptions
- How to package BLM data for readback

Link Node ColdFire

■ Complete

■ EPICS PVs For

- Control and readback of debounce registers
- Extraction and display of boot environment variables (e.g., firmware version)
- Readouts of voltages and temperatures

■ Remaining (D Kotturi)

- PVs for Link Node Inputs
- Configuration of Link Node outputs

Link Node ColdFire User Interface

MPS Link Node MP10

LCLS MPS Link Node:
EIOC:IN20:MP10

Flash environment variables

Factory: **Arctura Networks Inc**

Revision: **u3232 Rev 1.0 4MB Data**

Serial Number: **64420C-A00-0122C**

Console: **9633**

Kernel: **2700000**

Kernel Args: **root=/dev/ram0**

HW Addr0: **00 00 00 00 00 00**

Firmware Versior: **1.0.0.0**

Start Point: **1120000-400000 FW**

RAM Image: **0x1**

Cache: **0x1**

Bootp enable? Y/N: **0x1**

If bootp disabled, could put other BP_ vars here...

Autoboot after (sec): **5**

MPS Link Node MP10

LCLS MPS Link Node:
EIOC:IN20:MP10

ADC Register contents

Xilinx Temp (deg F): **112.000**

Xilinx Temp (deg C): **44.722**

Board Temp (deg F): **91.500**

Board Temp (deg C): **33.333**

3.3 Volts: **3.298**

5 Volts: **4.980**

12 Volts: **12.450**

24 Volts: **24.411**

MPS Link Node MP10

LCLS MPS Link Node:
EIOC:IN20:MP10

Debounce Register Setpoints and Readbacks

Channel	Debounce time Setpoint (us)	Debounce time Readback (us)	Channel	Debounce time Setpoint (us)	Debounce time Readback (us)	Channel	Debounce time Setpoint (us)	Debounce time Readback (us)
0	0	0	32	0	0	64	0	0
1	0	0	33	0	0	65	0	0
2	0	0	34	0	0	66	0	0
3	0	0	35	0	0	67	0	0
4	0	0	36	0	0	68	0	0
5	0	0	37	0	0	69	0	0
6	0	0	38	0	0	70	0	0
7	0	0	39	0	0	71	0	0
8	0	0	40	0	0	72	0	0
9	0	0	41	0	0	73	0	0
10	0	0	42	0	0	74	0	0
11	0	0	43	0	0	75	0	0
12	0	0	44	0	0	76	0	0
13	0	0	45	0	0	77	0	0
14	0	0	46	0	0	78	0	0
15	0	0	47	0	0	79	0	0
16	0	0	48	0	0	80	0	0
17	0	0	49	0	0	81	0	0
18	0	0	50	0	0	82	0	0
19	0	0	51	0	0	83	0	0
20	0	0	52	0	0	84	0	0
21	0	0	53	0	0	85	0	0
22	0	0	54	0	0	86	0	0
23	0	0	55	0	0	87	0	0
24	0	0	56	0	0	88	0	0
25	0	0	57	0	0	89	0	0
26	0	0	58	0	0	90	0	0
27	0	0	59	0	0	91	0	0
28	0	0	60	0	0	92	0	0
29	0	0	61	0	0	93	0	0
30	0	0	62	0	0	94	0	0
31	0	0	63	0	0	95	0	0

MPS User Interface

- Complete
 - Requirements document
 - Requirements review
 - Development UI
- Remaining (B Hall)
 - Implementation

LCLS Engineering Specifications Document #	DOC # HERE	System Name Here	Revision 0
LCLS Machine Protection System (MPS) User Interface Requirements			
Robert C. Sass Author		_____ Signature	_____ Date
NAME GOES HERE System Manager		_____ Signature	_____ Date
NAME GOES HERE System Physicist		_____ Signature	_____ Date
Darren Marsh Quality Assurance Manager		_____ Signature	_____ Date
John Galayda Director, LCLS Construction		_____ Signature	_____ Date

Brief Summary: The Machine Protection System (MPS) User Interface is the set of displays and user interactions that enable accelerator operators and physicists to monitor and control the MPS in order to maximize beam delivery characteristics without damage to any accelerator devices or structures.

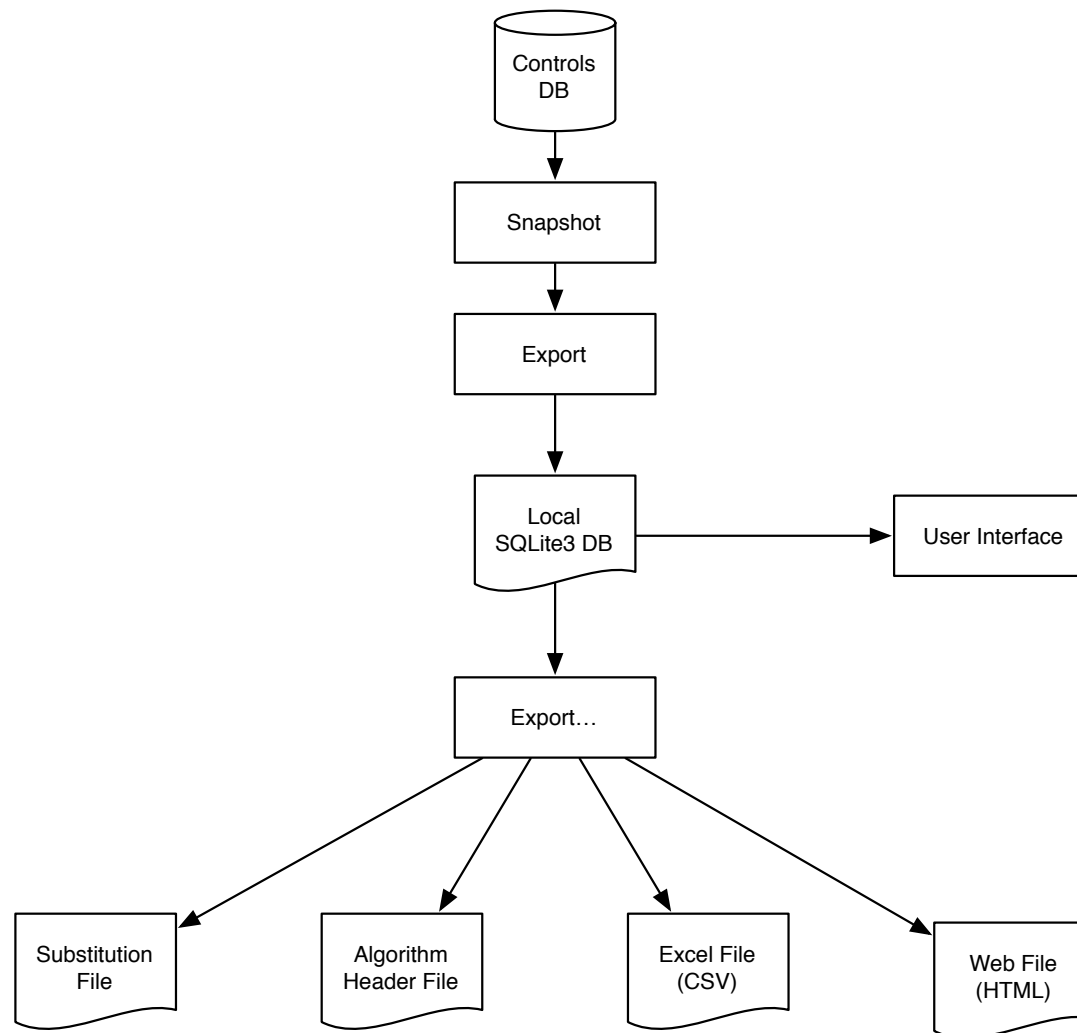
Change History Log

Rev Number	Revision Date	Sections Affected	Description of Change
000		All	Initial Version

MPS Database

- Database for
 - central storage of MPS input and Link Node information and configurations, and
 - versioning of MPS inputs and configurations

MPS Database



MPS Database

■ Complete

- Database stores MPS input and Link Node information and configurations

■ Remaining (E Grunhaus)

- Snapshot current state
- Local database export
- Macro creation and editing

Local MPS Database

- Complete
 - Exports following file types
 - CSV
 - HTML
 - Substitution
 - Algorithm Header
 - Test database created

MPS Database Screenshot

The screenshot shows a web browser window with the URL `https://oraweb.slac.stanford.edu/apex/slacdev/f?p=178:63:3918224437255390:NO`. The page title is "Inputs". The navigation menu includes "MPS Upload", "MPS Upload Results", "Link Nodes", "Inputs", and "Admin". The "Inputs" section is active, showing a "Create Input" button and search filters for Link Node Id, Status, Input Name, Card, Cable Number, Location, State 0, State 1, and Debounce Time. A table of 10 input records is displayed, each with an "Edit" button.

Edit Input	Input Name	Link Node Id	Card	Channel	PV Name	Status	Auto Recoverable	Cable Number	Channel
Edit	VV02_OUT_LIMIT	24	6	1	VVPG:IN20:155:MPSOUTLIMIT	Inactive	TRUE	L117397	IN2
Edit	TD11_OUT_LIMIT	27	4	8	DUMP:LI21:305:MPSOUTLIMIT	Active	TRUE	L117398	LI2
Edit	TD11_IN_LIMIT	27	4	9	DUMP:LI21:BL305:MPSINLIMIT	Active	TRUE	L117399	LI2
Edit	DUMMY NAME	24	6	1	DUMMY PVNAME	Active	TRUE	- No Cable -	- N
Edit	VV02_OUT_LIMIT2	24	6	1	VVPG:IN20:155:MPSOUTLIMIT2	Inactive	TRUE	L117400	IN2
Edit	TD11_OUT_LIMIT2	- Unassigned To Link Node -	4	8	DUMP:LI21:305:MPSOUTLIMIT2	Inactive	TRUE	L117401	LI2
Edit	TD11_IN_LIMIT2	27	4	9	DUMP:LI21:BL305:MPSINLIMIT2	Inactive	TRUE	L117402	LI2
Edit	VV02_OUT_LIMIT20	24	6	1	VVPG:IN20:155:MPSOUTLIMIT20	Inactive	TRUE	- No Cable -	IN2
Edit	TD11_OUT_LIMIT20	- Unassigned To Link Node -	4	8	DUMP:LI21:305:MPSOUTLIMIT20	Inactive	TRUE	- No Cable -	LI2
Edit	TD11_IN_LIMIT20	27	4	9	DUMP:LI21:BL305:MPSINLIMIT20	Inactive	TRUE	- No Cable -	LI2

Local Database Export



Database.mps

```
Terminal — bash — 120x28
[dhcp-216-104] snorum 1024> ./createMappingHeaders.py -h
Usage: createMappingHeaders.py DATABASE EXPORT_TYPE... [options]

DATABASE          SQLite3 file containing MPS data
EXPORT_TYPE       One or more of the following types:
                  -s, --substitution substitution file
                  -m, --mapping mapping header file
                  -c, --csv CSV file
                  -w, --www HTML file

Options:
  --version show program's version number and exit
  -h, --help show this help message and exit
  -v, --verbose print verbose output

File Export Paths:
Use the following options to set destinations of exported files.
  -S FILE, --substitution_path=FILE substitution file path
  -M FILE, --mapping_path=FILE mapping file path
  -C FILE, --csv_path=FILE CSV file path
  -W FILE, --www_path=FILE HTML file path
[dhcp-216-104] snorum 1025> |
```



Database.substitution



Database.html



Database.csv



Database.h

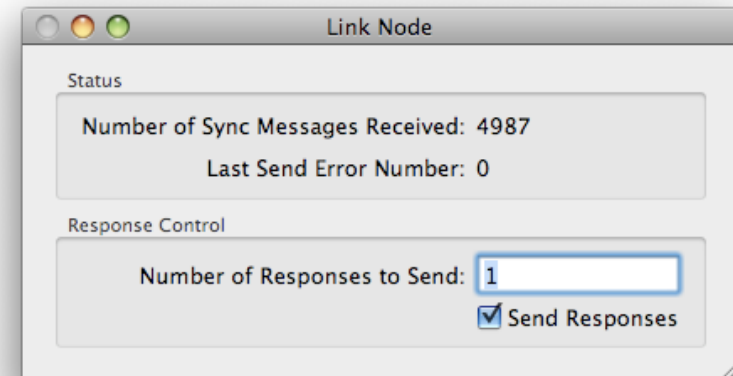
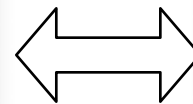
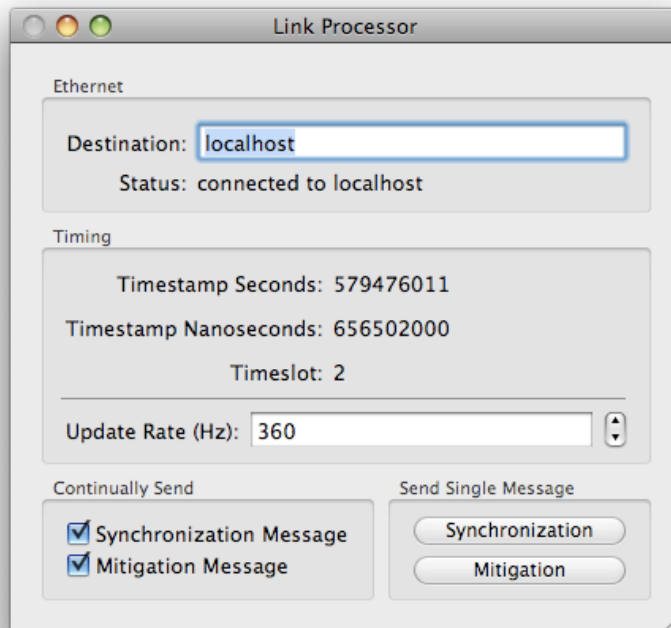


Testing

- Test apps
- Preliminary Test

Testing Apps

- Emulators for Link Processor and Link Node
- Wireshark



Preliminary Test

■ Overview

■ Four Link Nodes

- Two in sector 20
- Two in sector 24

■ One Link Processor in MCC

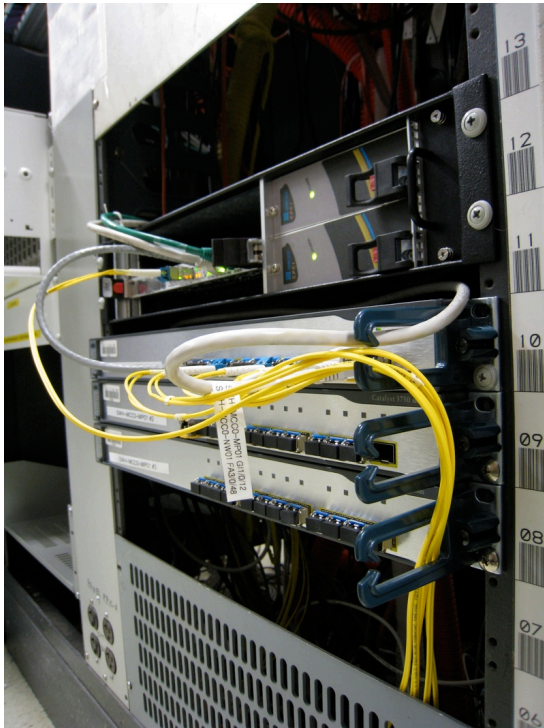
■ MPS signals are connected to terminal blocks

■ Link Nodes have network, MPS fiber, and console ports

■ Link Processor is installed in MCC

■ All IOCs have host names

Preliminary Test



Preliminary Test

```

iocegr@lcls-builder:~ — ssh — 120x28
10: Total Duration      (us, ticks): 54.42, 1814

12: Send/Receive Duration (us, ticks): 42.6, 1420
12: Receive/Process Duration (us, ticks): 3.63, 121
12: Total Duration      (us, ticks): 46.08, 1536

Full Send/Receive Duration (us, ticks): 47.34, 1578
Full Receive/Process Duration (us, ticks): 7.5, 250
Full Total Duration      (us, ticks): 54.12, 1804

0x00000039 (57)
Cexp>spcomm()
Link Node Communication
-----
10: Send/Receive Duration (us, ticks): 46.5, 1550
10: Receive/Process Duration (us, ticks): 7.89, 263
10: Total Duration      (us, ticks): 53.7, 1790

12: Send/Receive Duration (us, ticks): 42.42, 1414
12: Receive/Process Duration (us, ticks): 3.6, 120
12: Total Duration      (us, ticks): 46.92, 1564

Full Send/Receive Duration (us, ticks): 46.95, 1565
Full Receive/Process Duration (us, ticks): 7.47, 249
Full Total Duration      (us, ticks): 53.58, 1786

0x00000039 (57)
Cexp>

```

Preliminary Test

```

.edm/LinkNode10.edl
LN010: CARD1: CHAN01: STATE FAULT
LN010: CARD1: CHAN02: STATE FAULT
LN010: CARD1: CHAN03: STATE FAULT
LN010: CARD1: CHAN04: STATE FAULT
LN010: CARD1: CHAN05: STATE FAULT
LN010: CARD1: CHAN06: STATE FAULT
LN010: CARD1: CHAN07: STATE FAULT
LN010: CARD1: CHAN08: STATE FAULT
LN010: CARD1: CHAN09: STATE FAULT
LN010: CARD1: CHAN10: STATE OK
LN010: CARD1: CHAN11: STATE OK
LN010: CARD1: CHAN12: STATE FAULT
LN010: CARD1: CHAN13: STATE OK
LN010: CARD1: CHAN14: STATE OK
LN010: CARD1: CHAN15: STATE OK
LN010: CARD1: CHAN16: STATE FAULT

LN010: CARD2: CHAN01: STATE FAULT
LN010: CARD2: CHAN02: STATE FAULT
LN010: CARD2: CHAN03: STATE FAULT
LN010: CARD2: CHAN04: STATE FAULT
LN010: CARD2: CHAN05: STATE FAULT
LN010: CARD2: CHAN06: STATE FAULT
LN010: CARD2: CHAN07: STATE FAULT
LN010: CARD2: CHAN08: STATE FAULT
LN010: CARD2: CHAN09: STATE FAULT
LN010: CARD2: CHAN10: STATE FAULT
LN010: CARD2: CHAN11: STATE FAULT
LN010: CARD2: CHAN12: STATE FAULT
LN010: CARD2: CHAN13: STATE FAULT
LN010: CARD2: CHAN14: STATE FAULT
LN010: CARD2: CHAN15: STATE FAULT
LN010: CARD2: CHAN16: STATE FAULT

LN010: CARD3: CHAN01: STATE FAULT
LN010: CARD3: CHAN02: STATE FAULT
LN010: CARD3: CHAN03: STATE FAULT
LN010: CARD3: CHAN04: STATE FAULT
LN010: CARD3: CHAN05: STATE FAULT
LN010: CARD3: CHAN06: STATE FAULT
LN010: CARD3: CHAN07: STATE FAULT
LN010: CARD3: CHAN08: STATE FAULT
LN010: CARD3: CHAN09: STATE FAULT
LN010: CARD3: CHAN10: STATE FAULT
LN010: CARD3: CHAN11: STATE FAULT
LN010: CARD3: CHAN12: STATE FAULT
LN010: CARD3: CHAN13: STATE FAULT
LN010: CARD3: CHAN14: STATE FAULT
LN010: CARD3: CHAN15: STATE FAULT
LN010: CARD3: CHAN16: STATE FAULT

LN010: CARD4: CHAN01: STATE FAULT
LN010: CARD4: CHAN02: STATE FAULT
LN010: CARD4: CHAN03: STATE FAULT
LN010: CARD4: CHAN04: STATE FAULT
LN010: CARD4: CHAN05: STATE FAULT
LN010: CARD4: CHAN06: STATE FAULT
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LN010: CARD5: CHAN01: STATE FAULT
LN010: CARD5: CHAN02: STATE FAULT
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LN010: CARD5: CHAN08: STATE FAULT
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LN010: CARD5: CHAN13: STATE FAULT
LN010: CARD5: CHAN14: STATE FAULT
LN010: CARD5: CHAN15: STATE FAULT
LN010: CARD5: CHAN16: STATE FAULT

LN010: CARD6: CHAN01: STATE FAULT
LN010: CARD6: CHAN02: STATE FAULT
LN010: CARD6: CHAN03: STATE FAULT
LN010: CARD6: CHAN04: STATE FAULT
LN010: CARD6: CHAN05: STATE FAULT
LN010: CARD6: CHAN06: STATE FAULT
LN010: CARD6: CHAN07: STATE FAULT
LN010: CARD6: CHAN08: STATE FAULT
LN010: CARD6: CHAN09: STATE FAULT
LN010: CARD6: CHAN10: STATE FAULT
LN010: CARD6: CHAN11: STATE FAULT
LN010: CARD6: CHAN12: STATE FAULT
LN010: CARD6: CHAN13: STATE FAULT
LN010: CARD6: CHAN14: STATE FAULT
LN010: CARD6: CHAN15: STATE FAULT
LN010: CARD6: CHAN16: STATE FAULT

```

Remaining Work

