

# Machine Protection System

- Requirements
- Architecture
  - Subsystem design
- Schedule
  - Procurement
  - Assembly and installation
- E-beam commissioning
- Photon systems MPS integration

## Requirements

- Switch off beam within one pulse
  - Gun laser shutters (Mechanical and Pockels Cell) and
  - LTU single bunch beam dumper
- Distributed fault inputs along the machine
  - Primary: Beam loss monitors, toroids, obstructions
  - Secondary: PVs indicating power supply status, BPMs

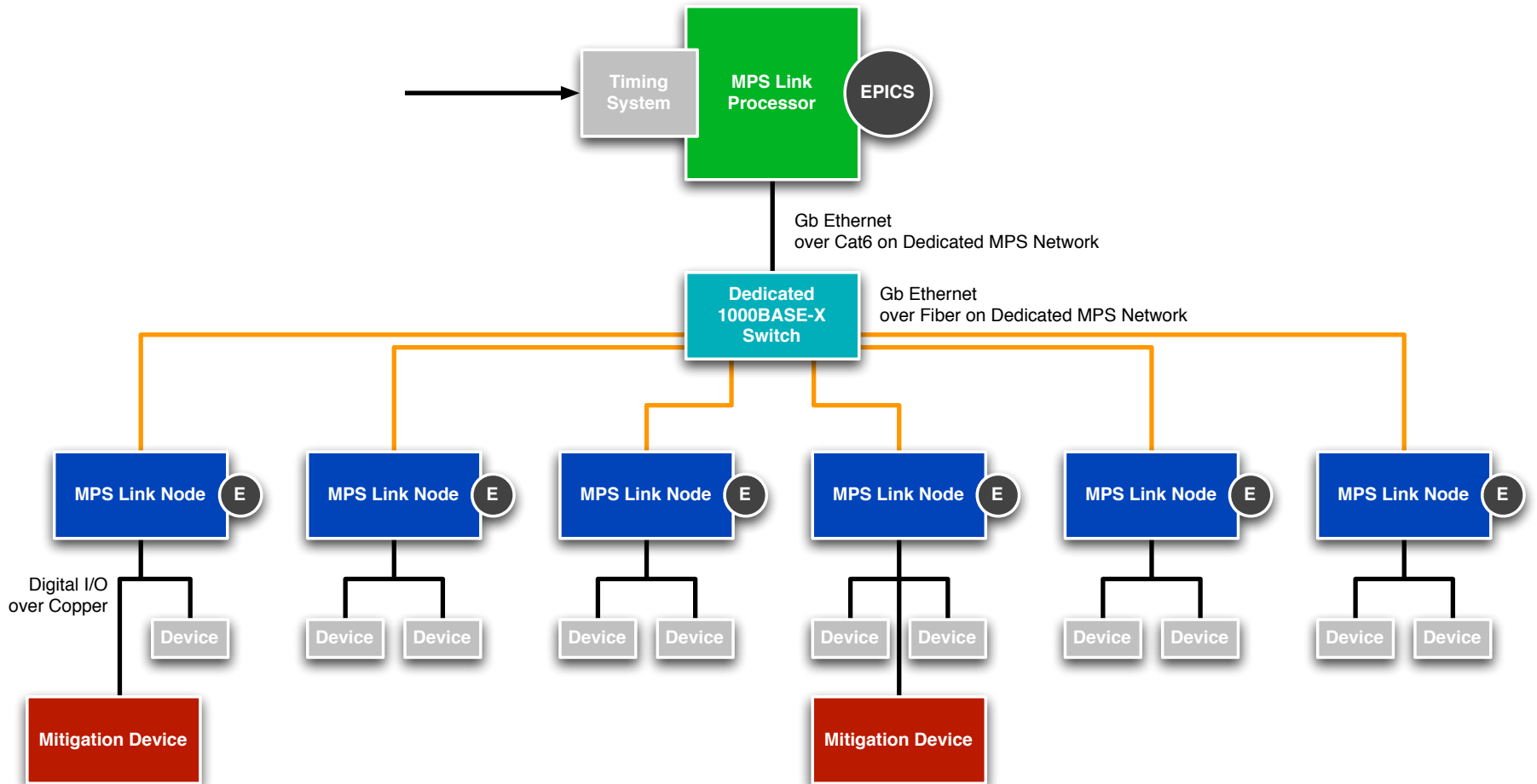
## Undulator Commissioning Requirements

- Since the last FAC the undulator physicists and engineers have converged on a minimum set of protection requirements for undulator commissioning
- A single Beam Loss Monitor (BLM) will be placed at the entrance to each of the 33 undulator magnets
- MPS Link Node chassis interfaces BLMs directly to the Link Processor

## Architecture

- The MPS architecture went through several design iterations but has now matured to a simplified system that meets all our requirements:
  - A central Link Processor is based on a COTS system used through out the LCLS control system
  - Distributed Link Nodes are based on FPGA and COTS ColdFire processor used elsewhere in LCLS

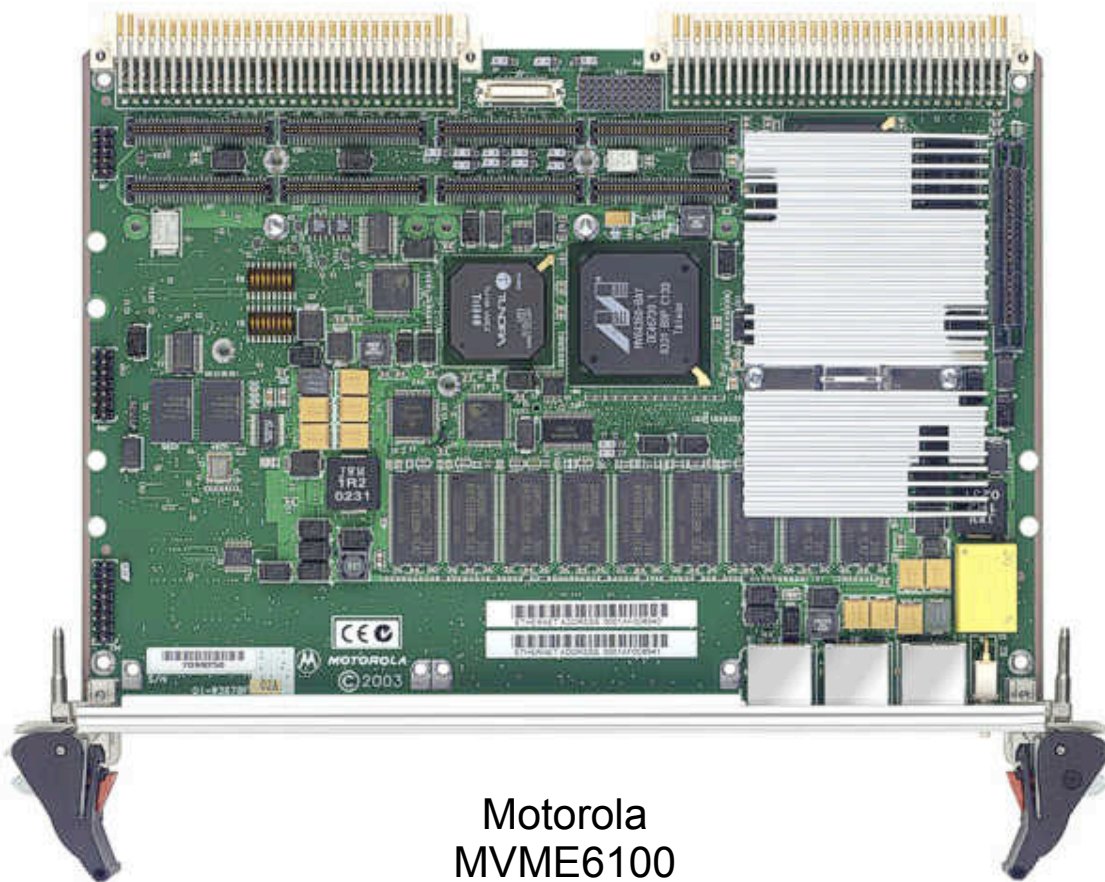
# LCLS MPS Overview



## Link Processor

- Private fiber network for MPS data
- Runs the MPS logic algorithm
  - C code similar to SLC MPS processor
- Interfaces to the EPICS control system
- Interfaces to the timing system EVR and EVG
  - Synchronizes the beam rate limiting with the timing system
- Motorola MVME 6100 and PMC-EVR-200

# MPS Link Processor



Motorola  
MVME6100



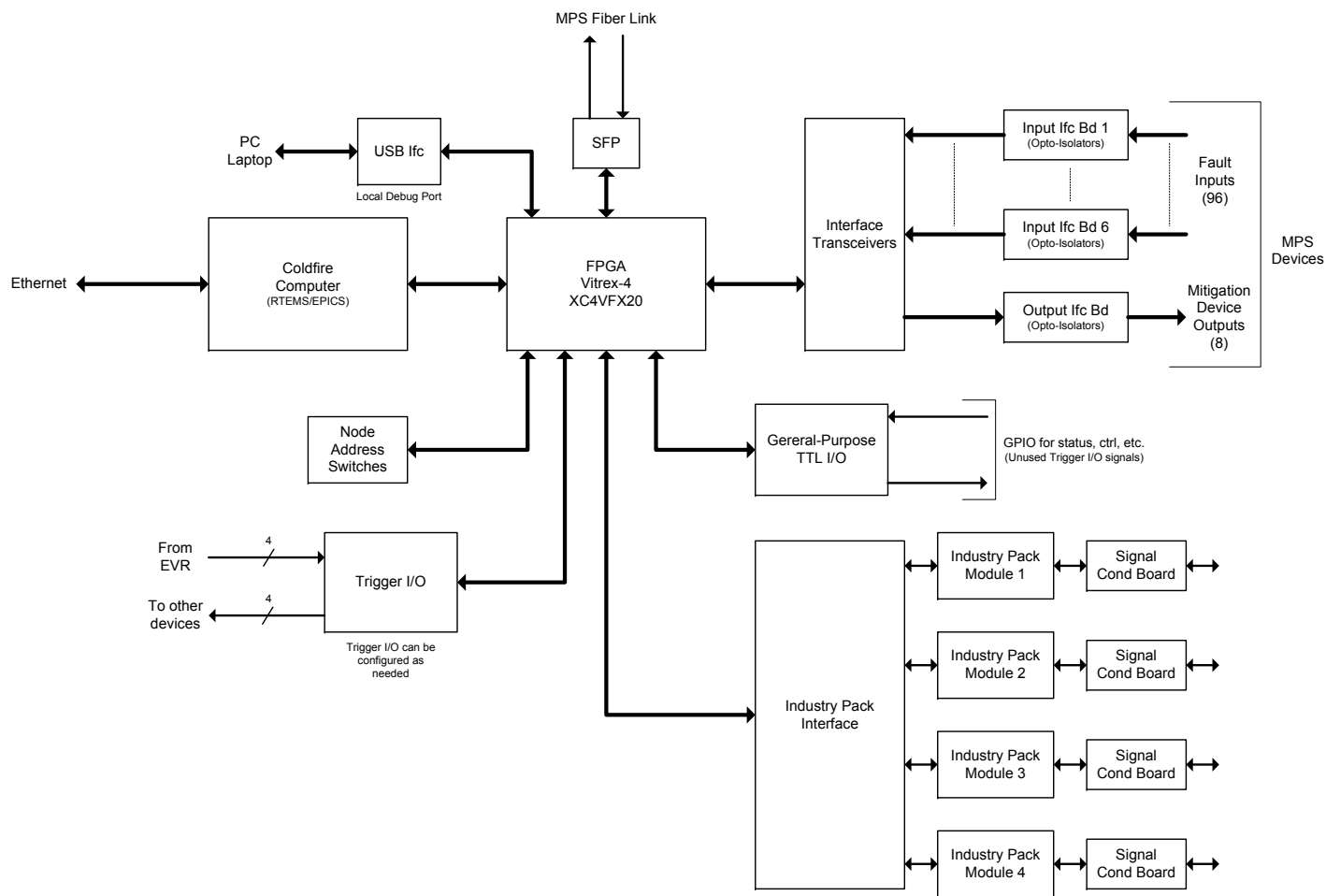
Micro-Research  
PMC-EVR-200

## Link Node

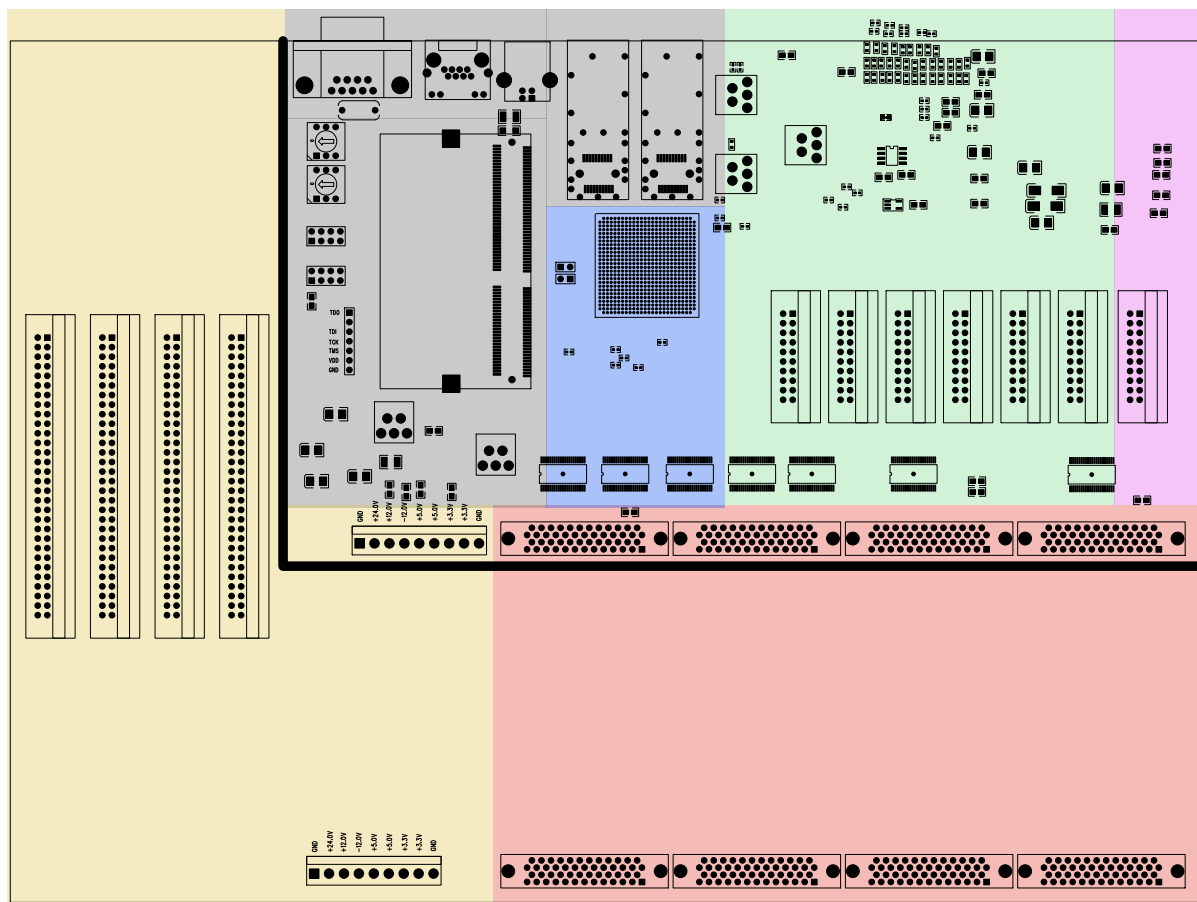
- Distributed along the machine
  - Fast, dedicated link to Link Processor
- Takes input signals from BLMs and other devices
- Outputs signals to mitigation devices—gun laser shutters and LTU dumper
- Slower EPICS interface for control and readback of devices.



# Link Node Block Diagram

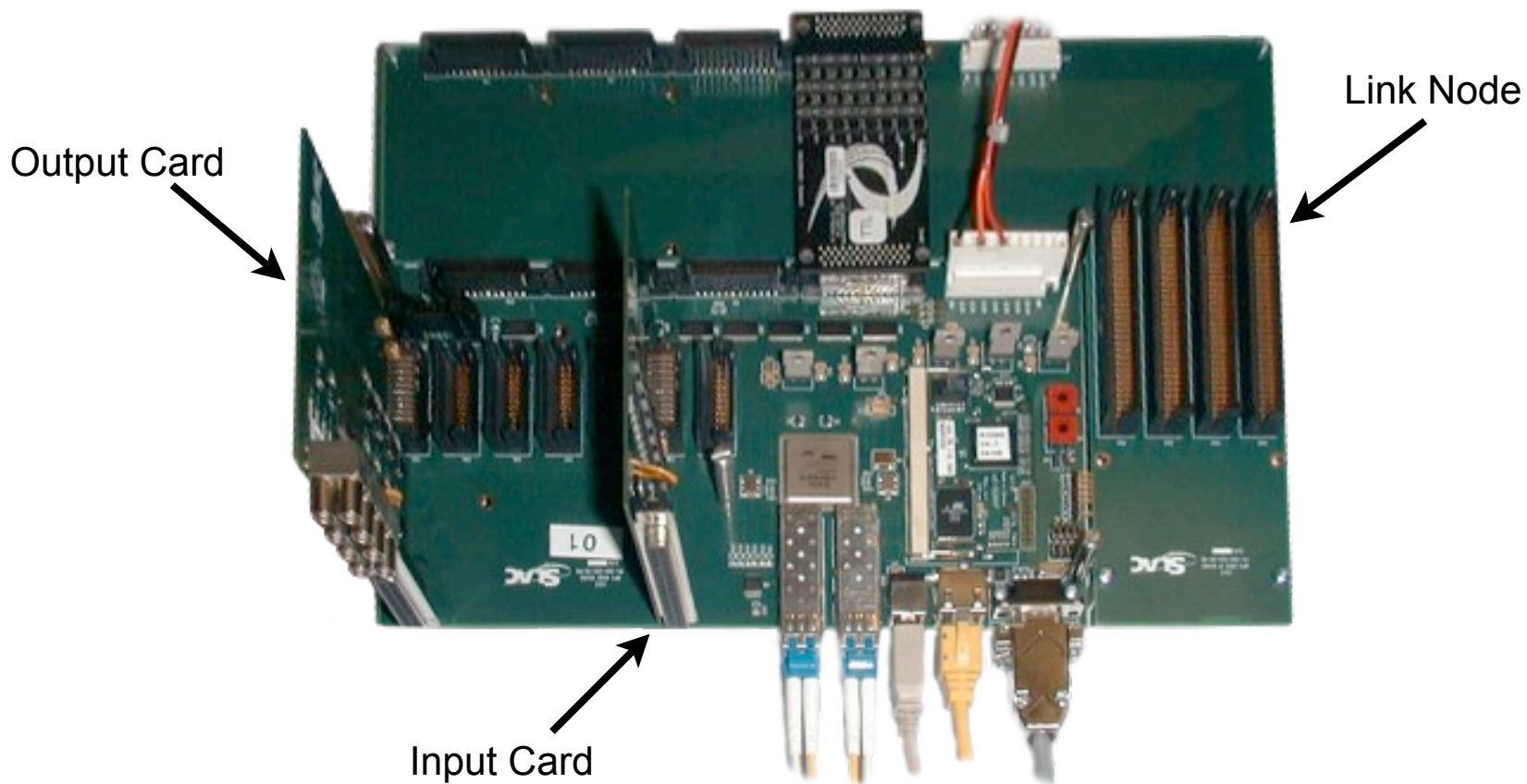


# Link Node PCB



- Output Card
- Input Cards
- FPGA
- ColdFire/Network
- IP Cards
- IP Signal Cond.

# MPS Link Node



## MPS for Photon Systems

- Will be integrated with the e-beam MPS
  - Fast response of inhibiting beam within one pulse can only be implemented on the e-beam side
- MPS fault processing for photon system:
  - Limit switches indicate obstruction in photon line
  - E-beam inhibited by LTU kicker on next pulse
  - Slow photon stopper is inserted automatically
  - E-beam is re-enabled when stopper reports “IN” state

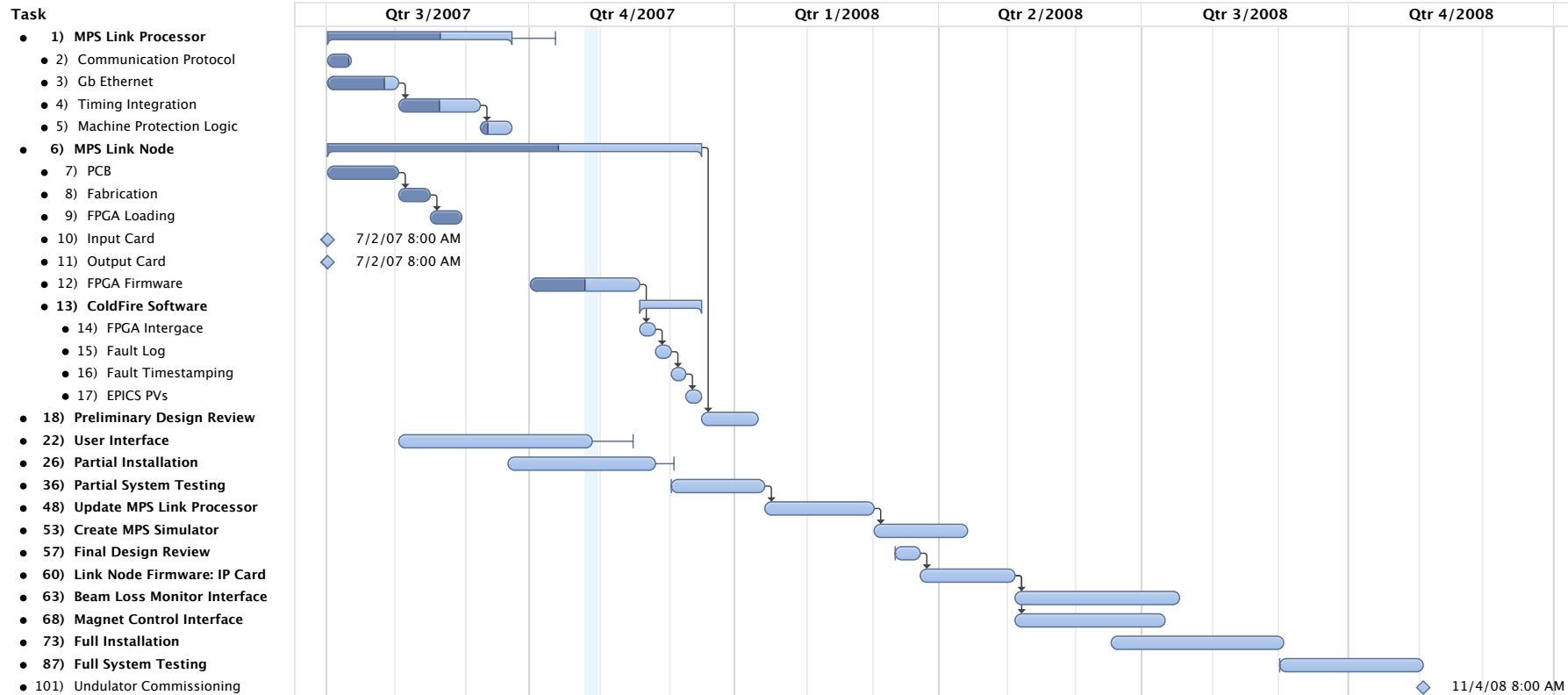
## Electron Beam Commissioning

- 2008 BC2 commissioning will continue to rely on the existing, slower SLC MPS system for protection
  - Inputs from LCLS devices: obstructions, magnets, toroids
  - Output to the gun laser shutters through SLC timing system

## Electron Beam Commissioning

- In 2008 we will begin parallel operation of the LCLS MPS
  - Link Processor will be installed with timing
  - Long haul fibers to linac MPS Link Nodes installed
  - Test link node chassis with linac inputs from:
    - Obstructions
    - Beam loss monitors (PICs)
    - And outputs to a laser shutter
- Bench test the interface to the kicker magnet prior to undulator commissioning in 2009

# Schedule









## Task Assignment

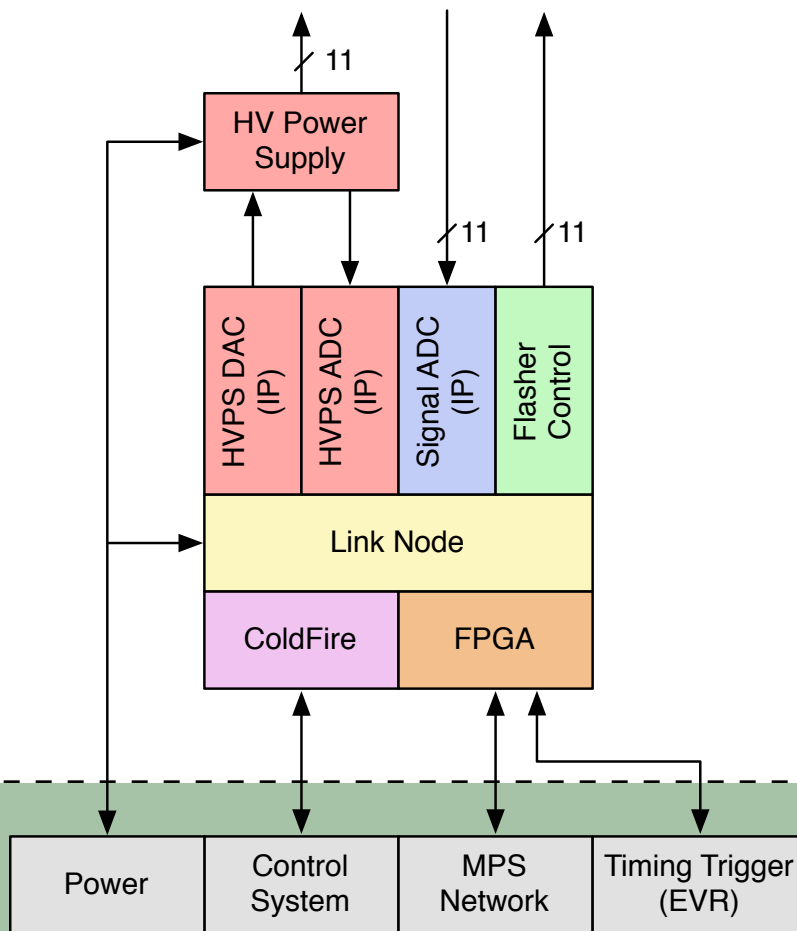
Task/Position	Assignment
1) Project Lead	P. Krejcik
2) Technical Lead	S. Norum
3) User Interface	TBD, A. Alarcon
4) Interlock Hardware Testing	A. Tilghman
5) MPS Link Processor Software	S. Norum
a) Communication Protocol	T. Straumann
b) Gb Ethernet	T. Straumann
c) Timing Integration	S. Allison
6) MPS Link Node Hardware	J. Olsen
7) MPS Link Node FPGA	J. Olsen, S. Norum
8) MPS Link Node ColdFire	D. Kotturi
9) EVG Software	S. Allison

# Beam Loss Monitors

## Beam Loss Monitors

- Link Node provides a standard interface for the two loss monitors types, PMTs and PICs
- An IndustryPack card mounted on Link Node
  - Digitizes signal from loss monitor
  - Compares this value to configurable thresholds
  - Provides fault information to Link Node to send to Link Processor
- Fault thresholds are set via the Link Nodes' controls network interface

# Undulator BLM Link Node Hardware



In Undulator Hall

Long Haul Cables

# Protection Ion Chambers and Link Node

