

Power Supply Control at NSLS-II

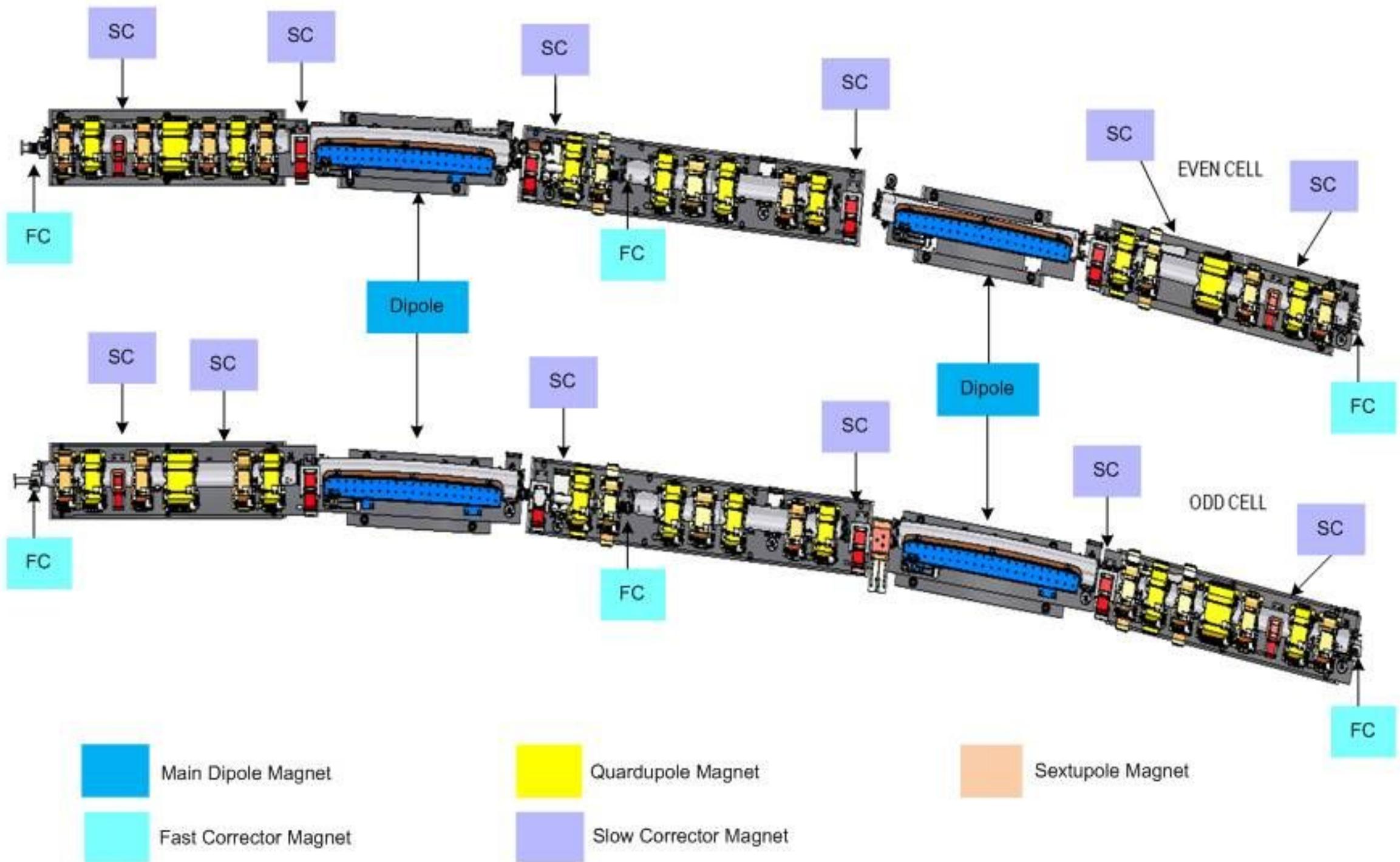


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Outline

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 - Power supply interface (PSI)
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 - Cell controller
3. NSLS-II fast orbit feedback system
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NSLS-II magnets in storage ring



NSLS-II power supply technique requirements

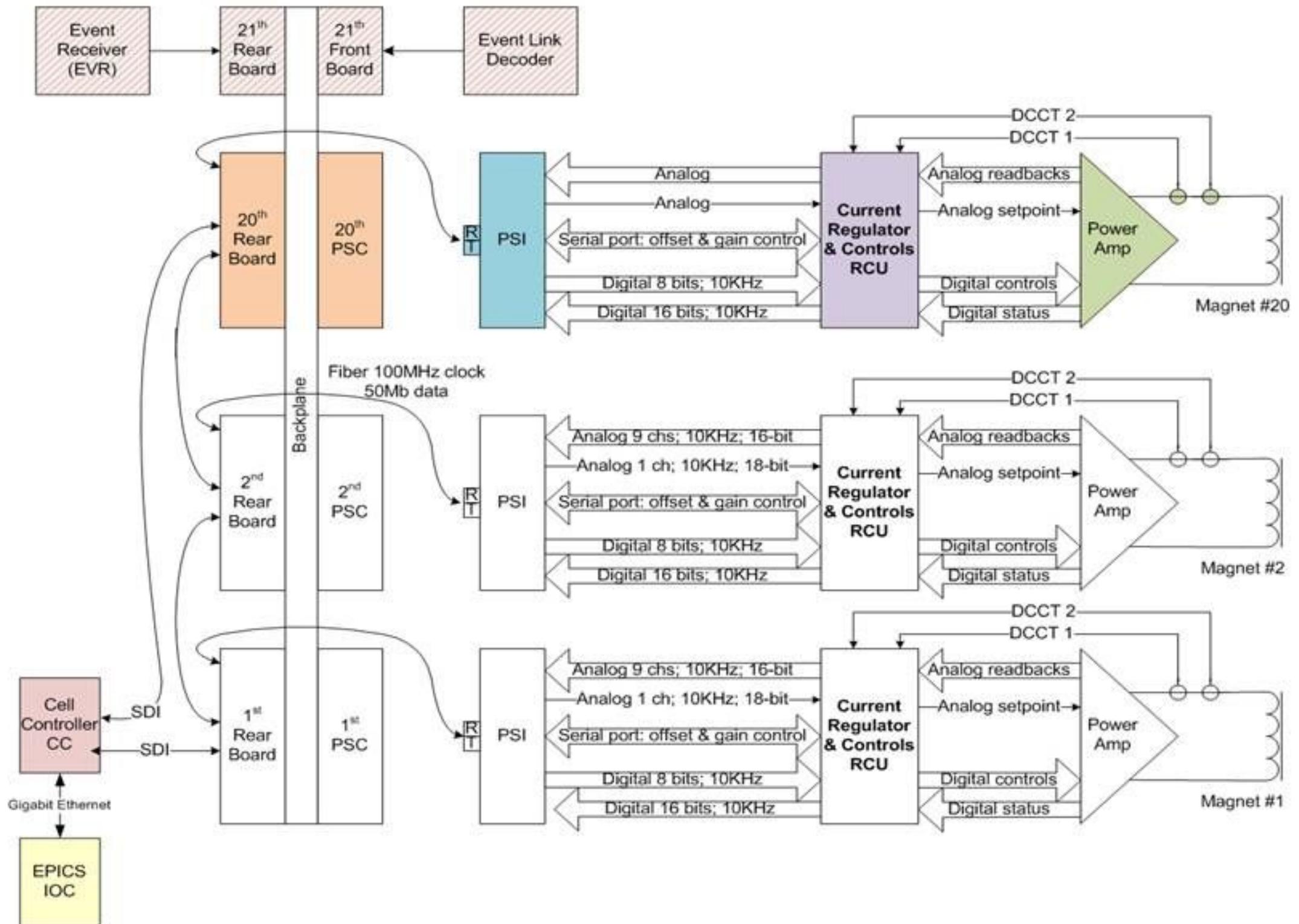
Power Supply -Model	Qty	Max. Voltage	Max Current	Configuration	Stability / Resolution ppm of max	Operation
Main Dipole	1	1200 V	450 A	2 SCR converters , center point tied to GND	25 3.8	DC 2 Quadrant
Large Aperture Trim	1	300 V	13 A	Unipolar Switch-Mode Analog Current Regulator	100 15	DC 1 Quadrant
Quadrupole -A -B -C -D	60 120 60 60	16 V 22 V 30 V 30 V	175 A 175 A 175 A 215 A	Unipolar Switch-Mode Analog Current Regulator 1 PS per Magnet	50 3.8	DC 1 Quadrant
Sextupole -A -B -C -D	35 5 5 12	40 V 60 V 80 V 16 V	120 A 165 A 120 A 120 A	Unipolar Switch-Mode Analog Current Regulator Model A & B = 1 PS per 6 Magnets Model C = 1 PS per 12 Magnets Model D = 1 PS per 2 Magnets	100 15	DC 1 Quadrant
Global Horz. & Vert. Correctors -A	240	45 V	20 A	Bipolar Switch-Mode Analog Current Regulator	25 1	100 Hz 4 Quadrant
Insertion Horz. Correctors -B	12	30 V	30 A	Unipolar Switch-Mode Analog Current Regulator	50 3.8	DC 1 Quadrant
Skew Quad Corrector-C	30	20 A	20 A	Bipolar Linear Analog Current Regulator	100 15	DC 4 Quadrant
Alignment Horz. & Vert. Correctors -D	120	25 V	25 A	Bipolar Linear Using Pre -Regulator Analog Current Regulator	50 3.8	3 Hz 2 Quadrant
Dipole Trim – Corrector -E	60	20 V	10 A	Bipolar Linear Analog Current Regulator	100 15	DC 4 Quadrant

NSLS-II power supply control architecture

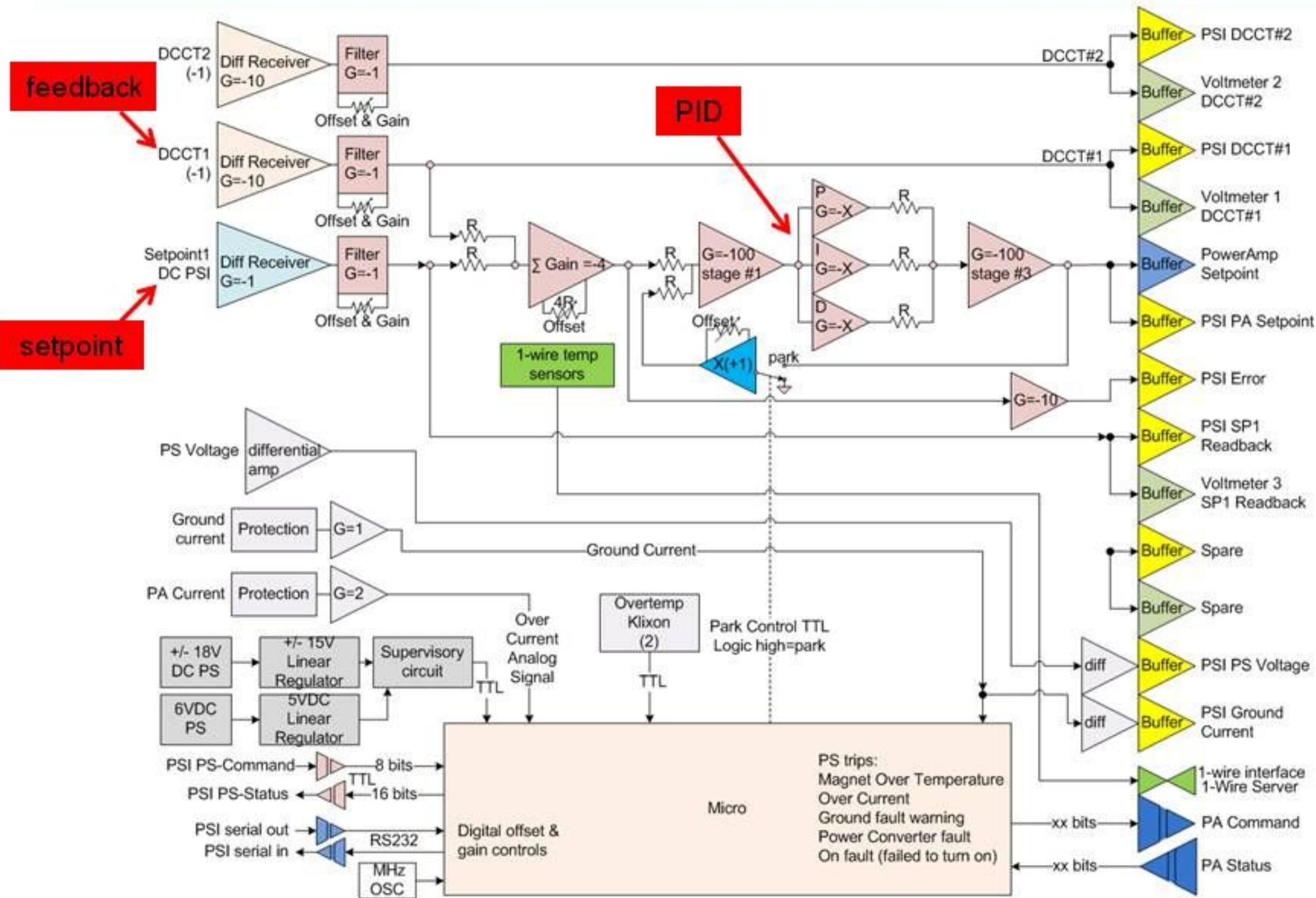
NSLS-II power supply control architecture requirements

- **Very high reliability and minimal repair time**
 - Most power supply control failures are caused by harsh environments such as moisture, dust, high temperature etc. NSLS-II equipment racks will have chilled water to air heat exchangers to maintain a constant air temperature with $\pm 1^{\circ}\text{C}$ stability.
 - Power supply control failures are also caused by communication failure and IC parts failure. NSLS-II power supply control system use redundant, fault tolerant communication protocol.
 - Large memory to save diagnostic data. Build-in DSP for ripple detection.
- **Apply standard communication for power supply control**
 - Choose Ethernet because it is a long lasting, well supported standard.
 - Choose fiber optic link to avoid group loop.
- **Provide a generic control architecture for all NSLS-II power supplies in storage ring, Booster and transfer lines. It should also provide corrector power supply control for fast/slow orbit feedback system.**

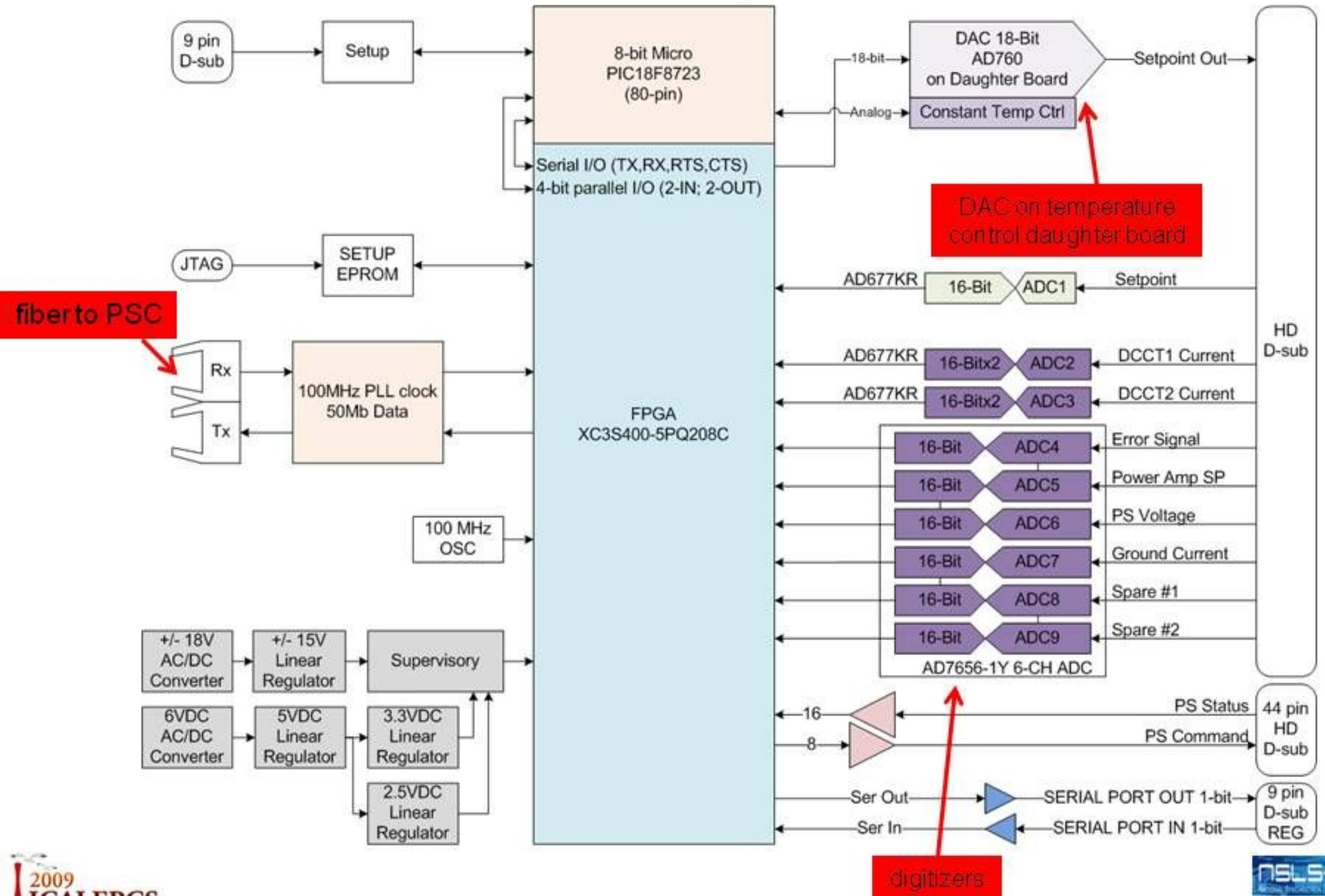
NSLS-II power supply control architecture



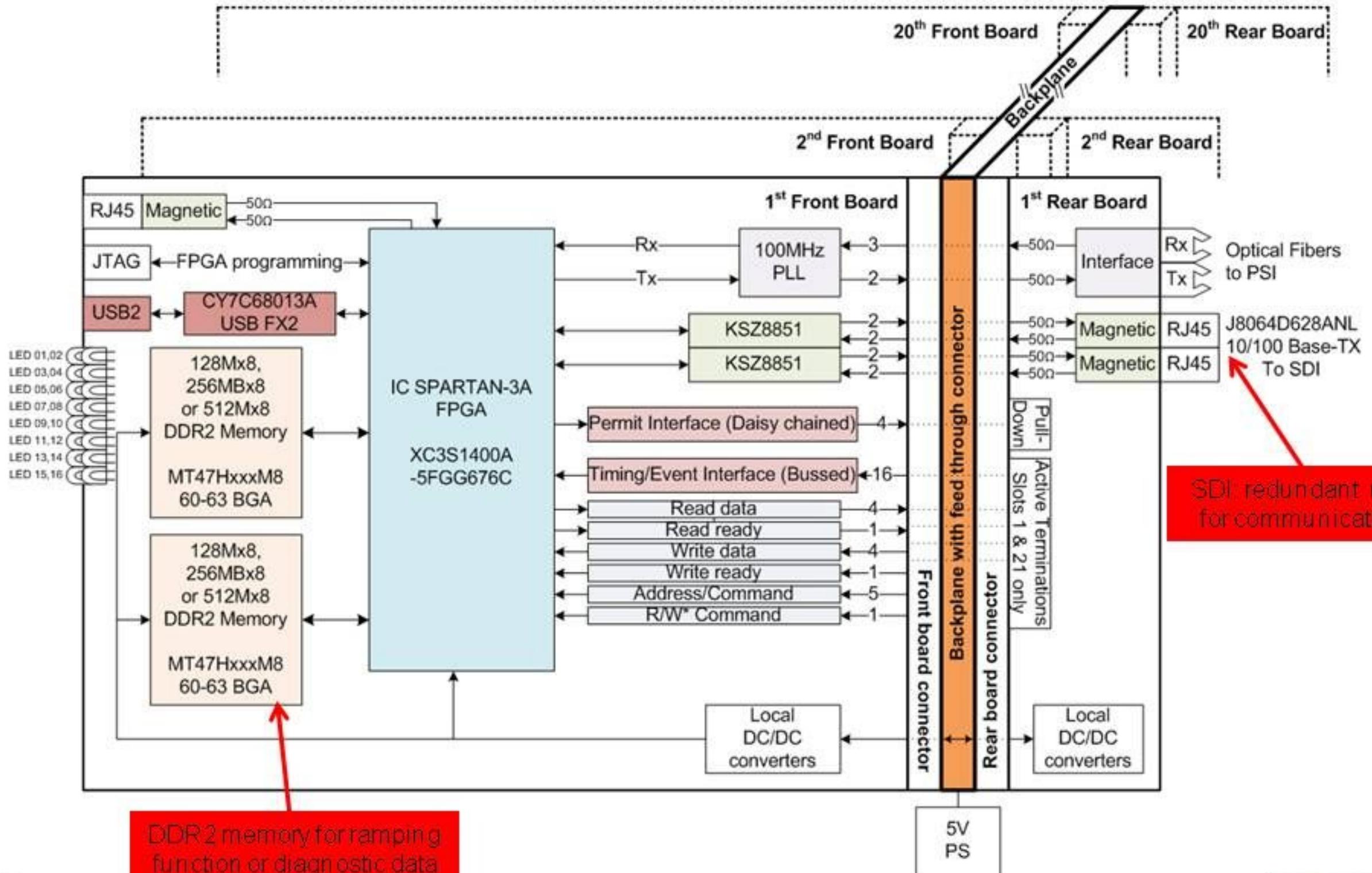
Current regulator module: provide analog feedback and PID control



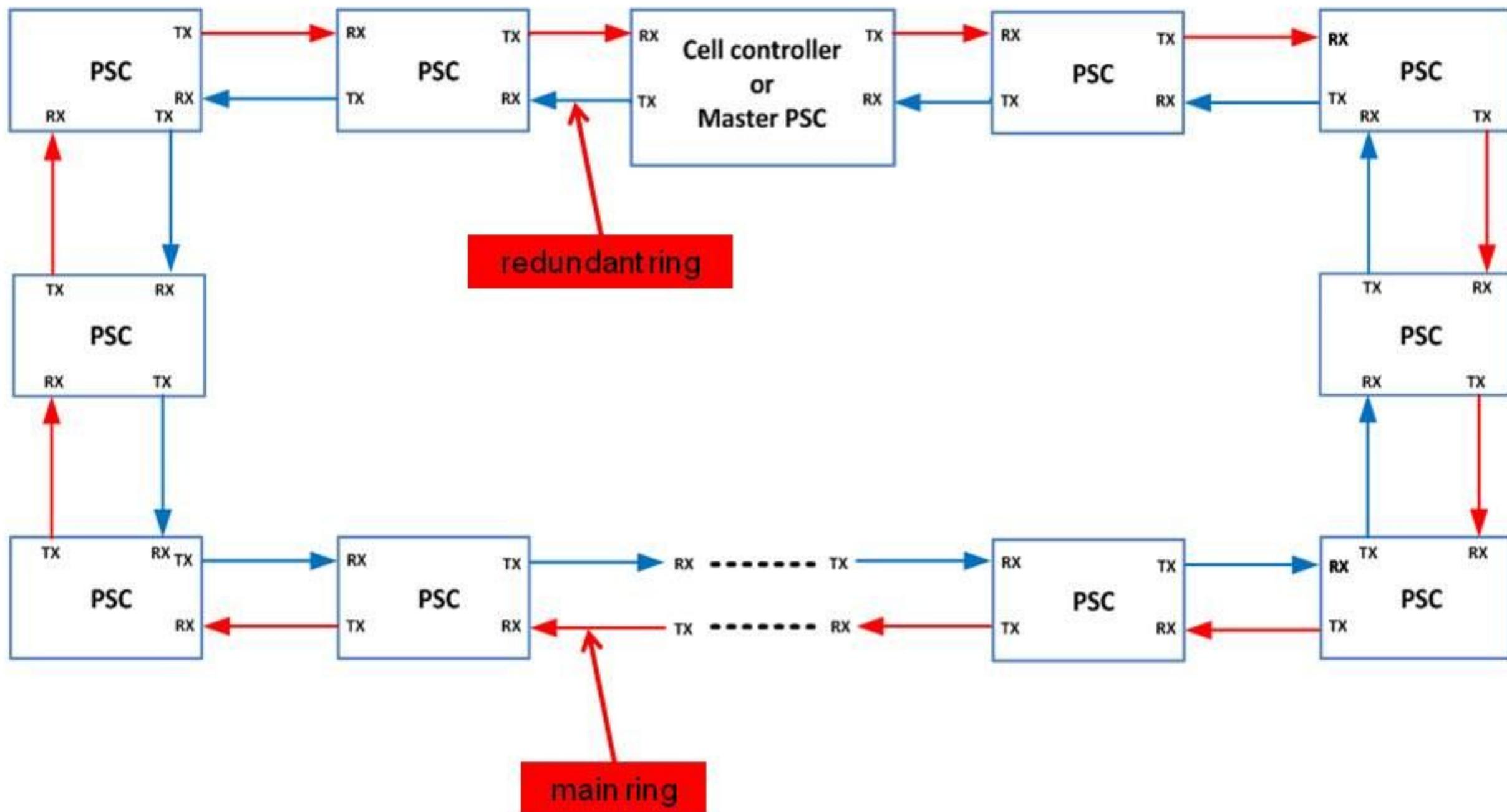
Power supply interface (PSI): provide stable DAC setpoint and ADC readbacks



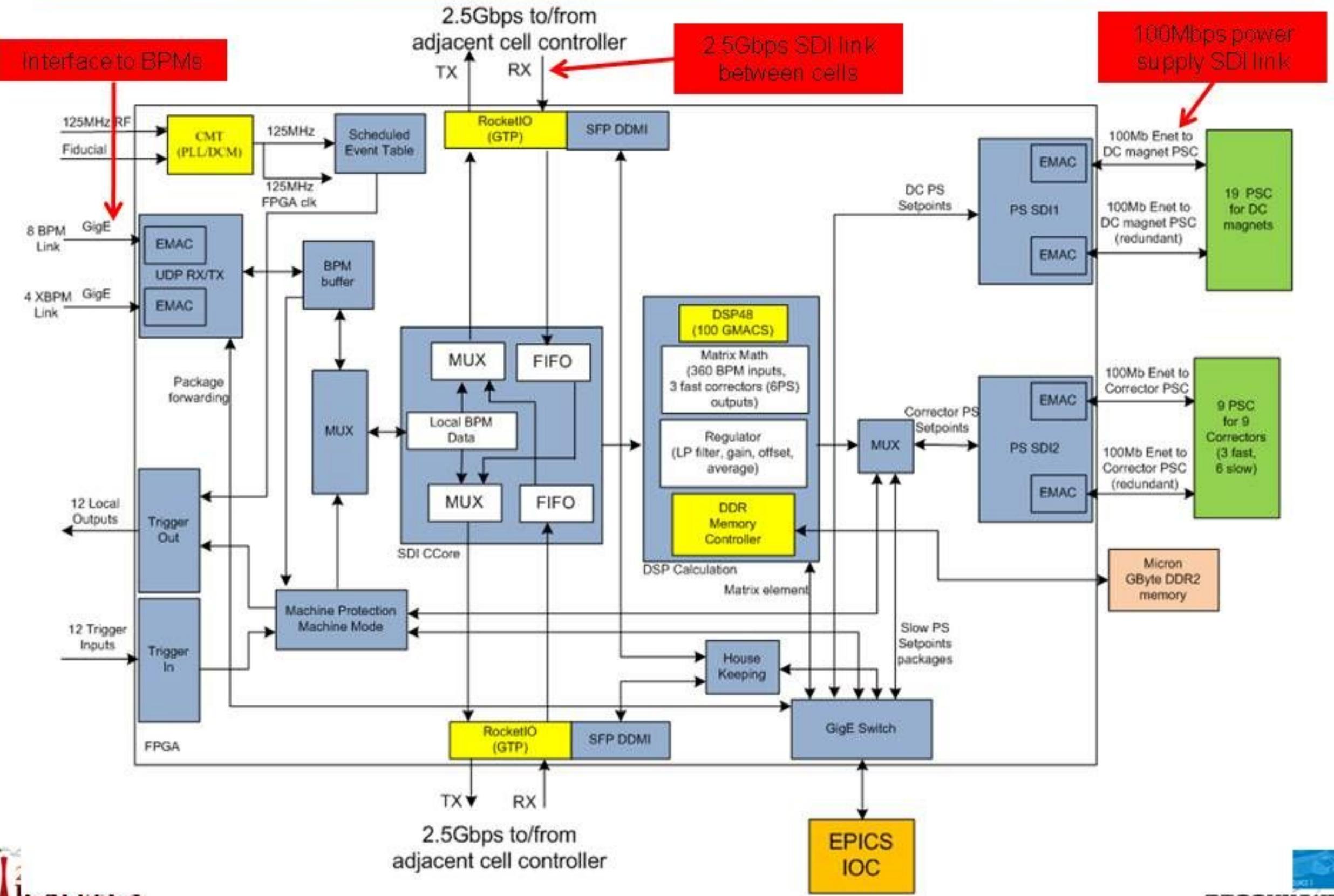
Power supply Controller (PSC): provide data link and diagnostics memory



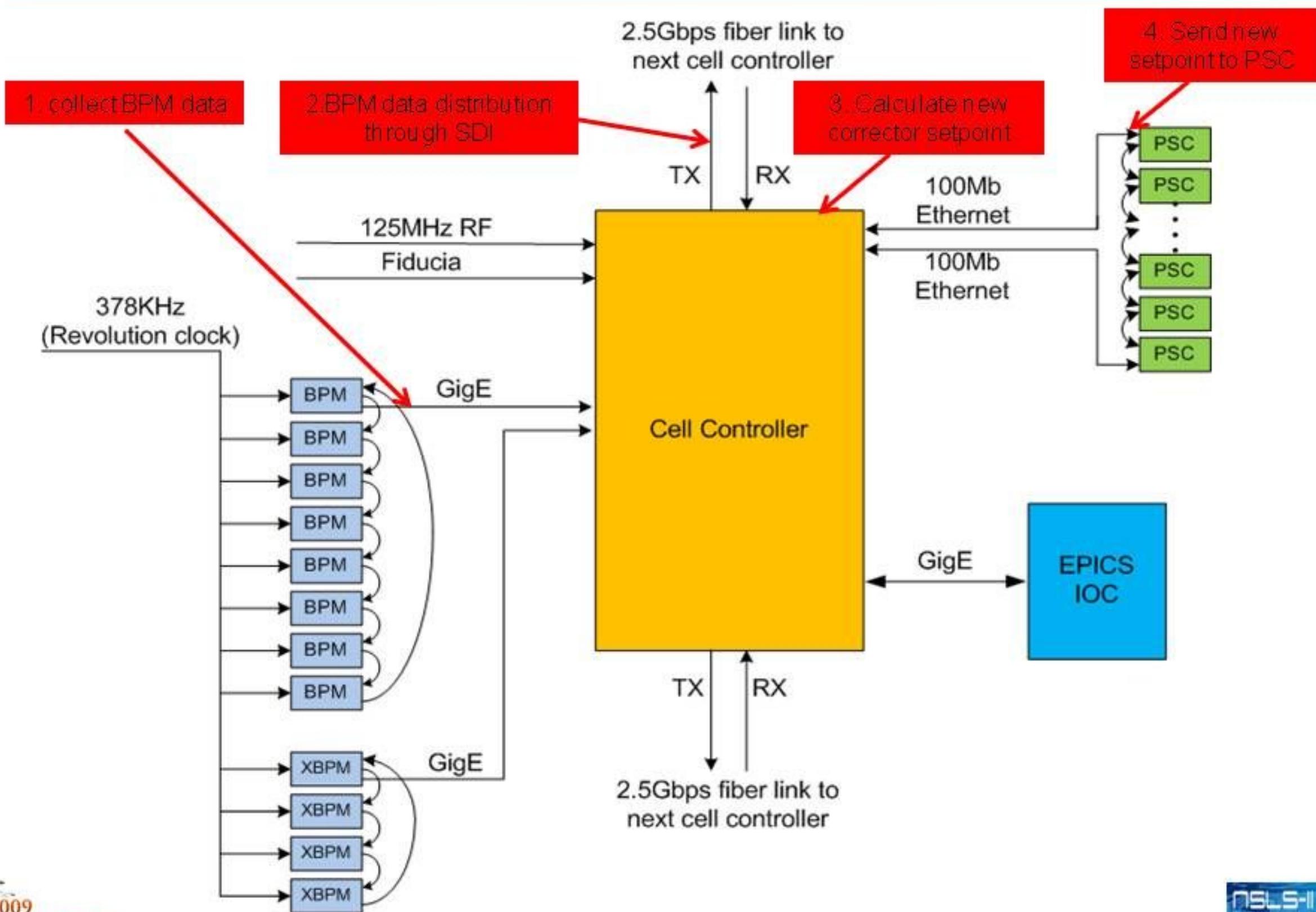
Power supply SDI link



Cell controller: link BPM and power supply system in orbit feedback



NLS-II fast orbit feedback system



NSLS-II power supply control system status



Regulator module prototype



PSI prototype

- Regulator module and PSI prototype were tested
- With regulator module and standard DAC, obtained 5ppm long term stability
- Integrated system (including regulator module, PSI, power amplifier and magnet) is under test
- PSC and cell controller is design stage

Summary

- NSLS-II power supply control system is designed for high reliability, easy diagnostics, and easy integration.
- NSLS-II power supply control is based on a generic architecture using standard communication links such as Ethernet and fiber optics.
- We are making good progress in subsystem design and test. The whole power supply control system will be ready within six month.