JPL Power System Architectures

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Outline

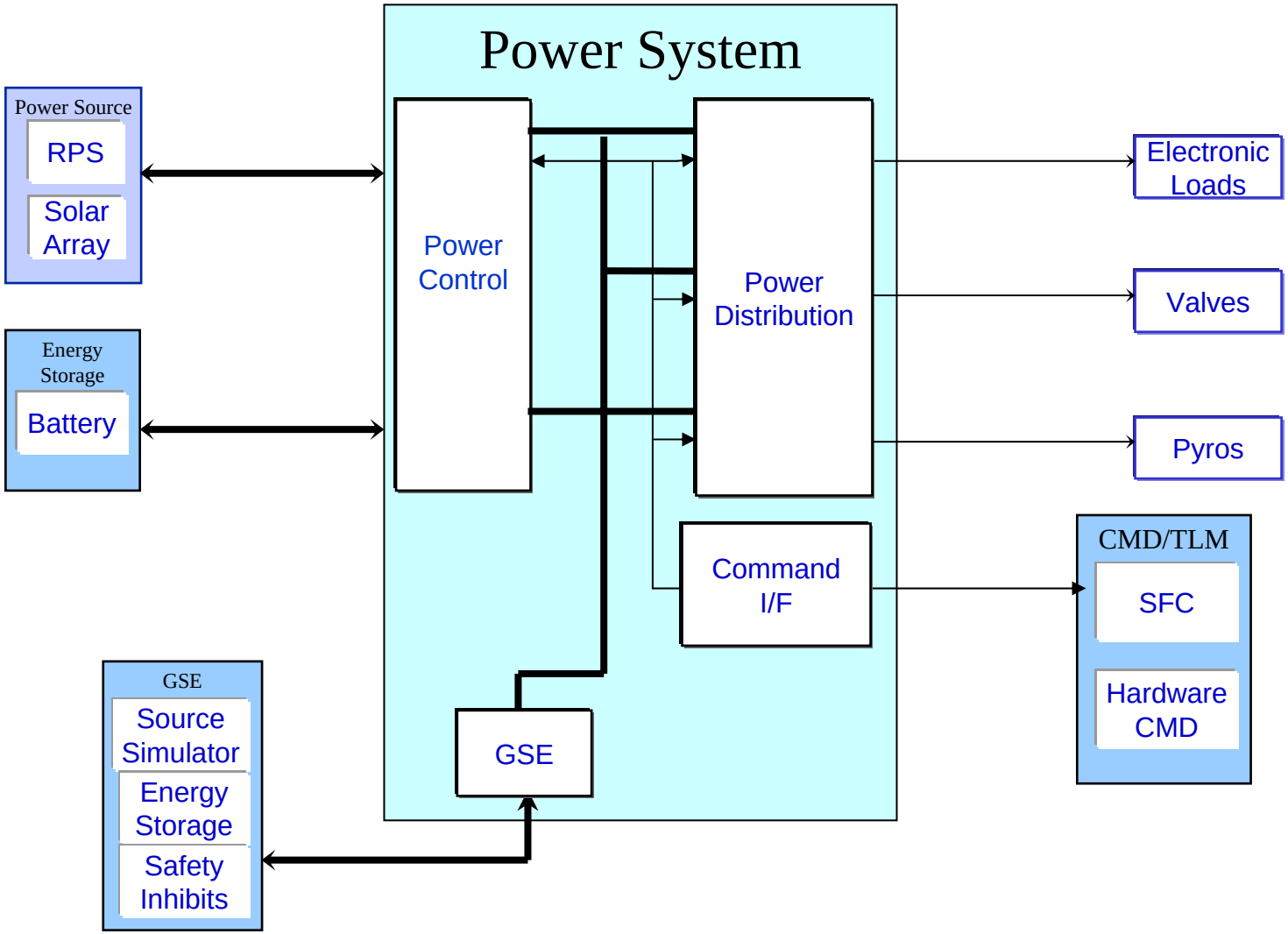
- Introduction
- Generic Power System Architecture
- Cassini Power System
- X2000 Power System
- Mars Exploration Rover (MER) Power System
- Solar Electric Propulsion (SEP) Power System
- Power System Architecture Functions
- Summary
- Acknowledgements

Introduction

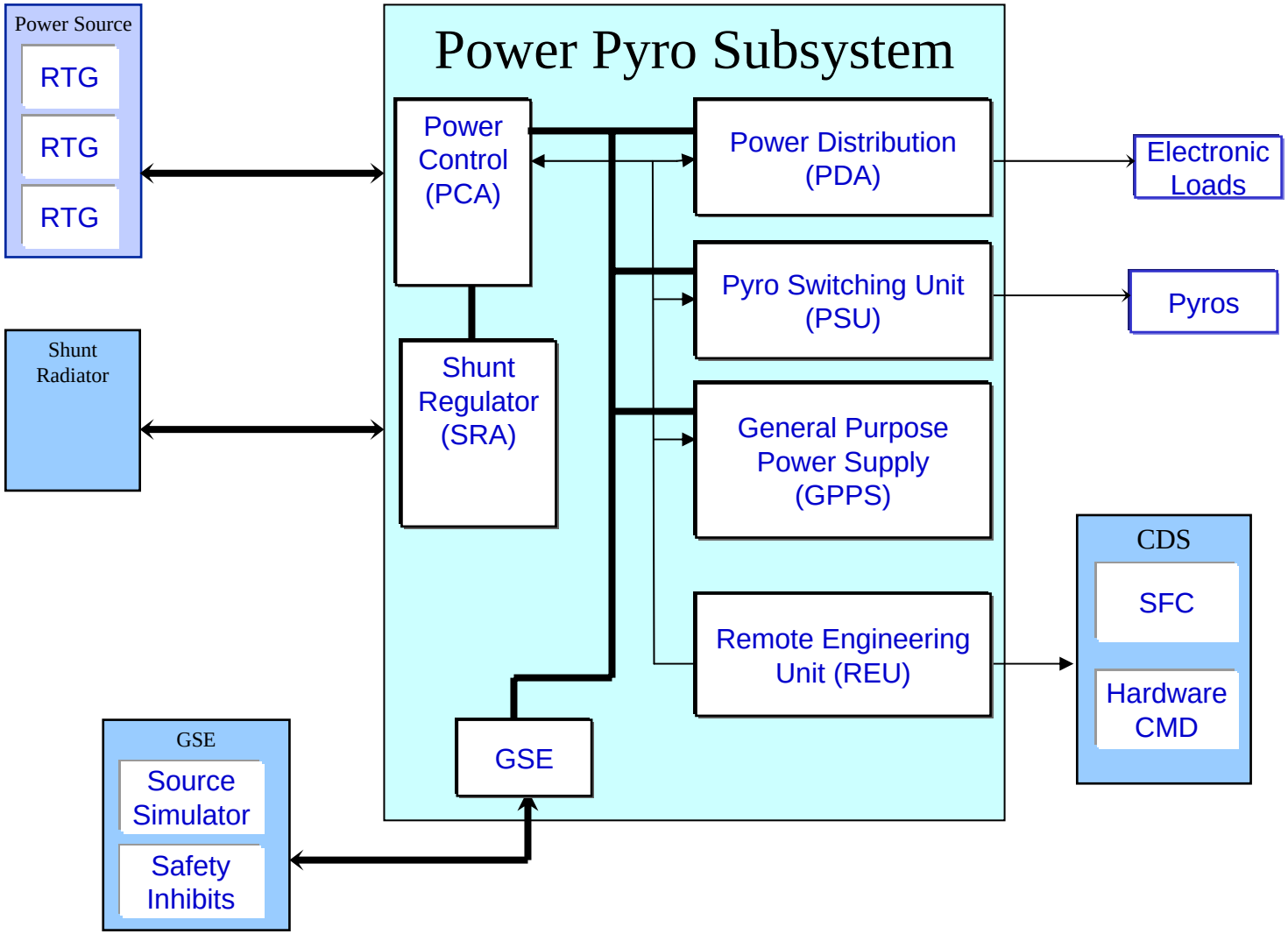
- JPL Power System Architectures:
  - Galileo, Cassini and X2000 were RTG powered systems
  - Pathfinder, MER and MSL are rover power systems
  - Deep Space I and DAWN are Solar Electric Propulsion Power Systems

- Power System Architecture Functions
  - Power Control
  - Command I/F
  - Power Distribution

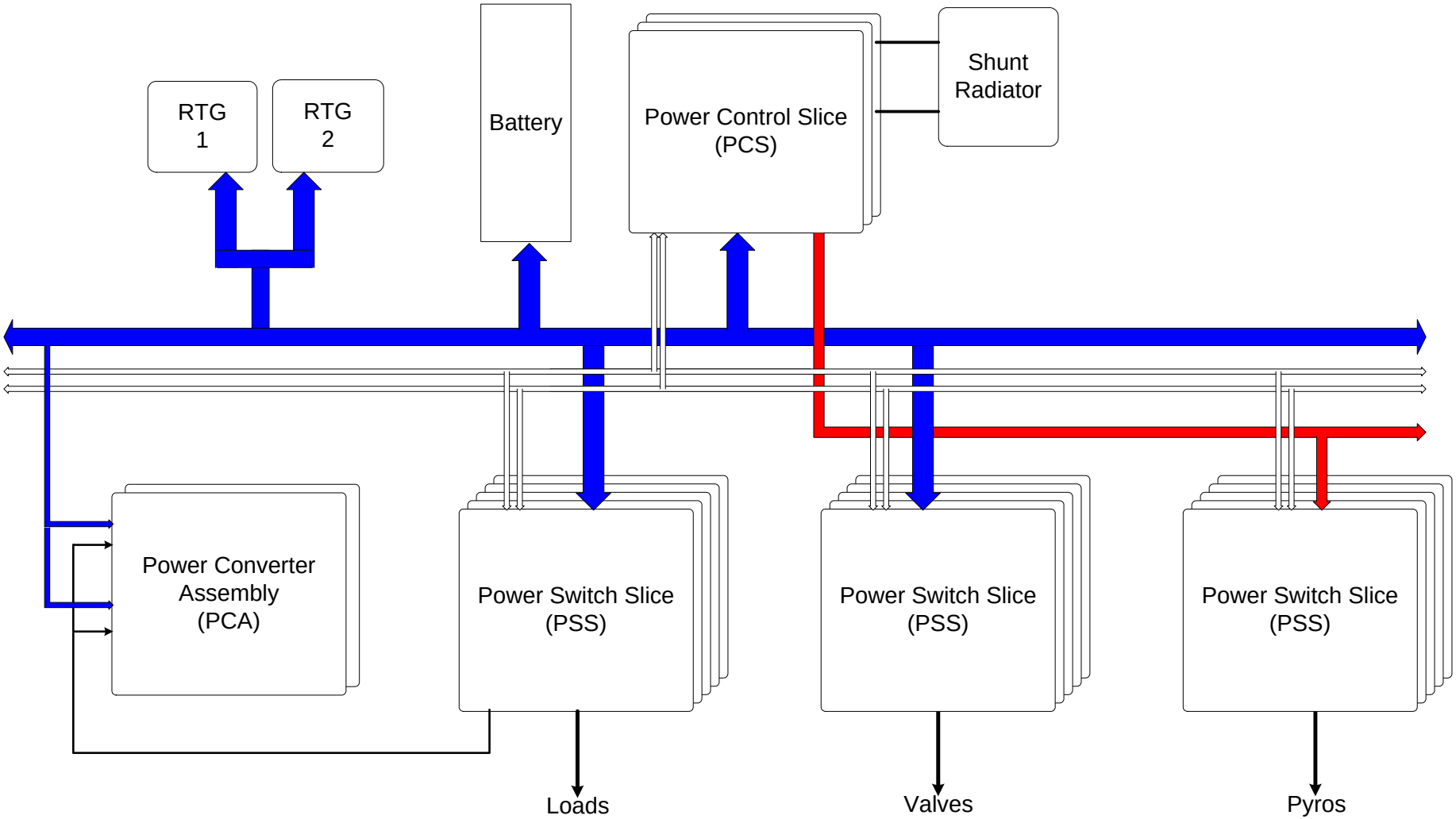
Generic Power System Architecture



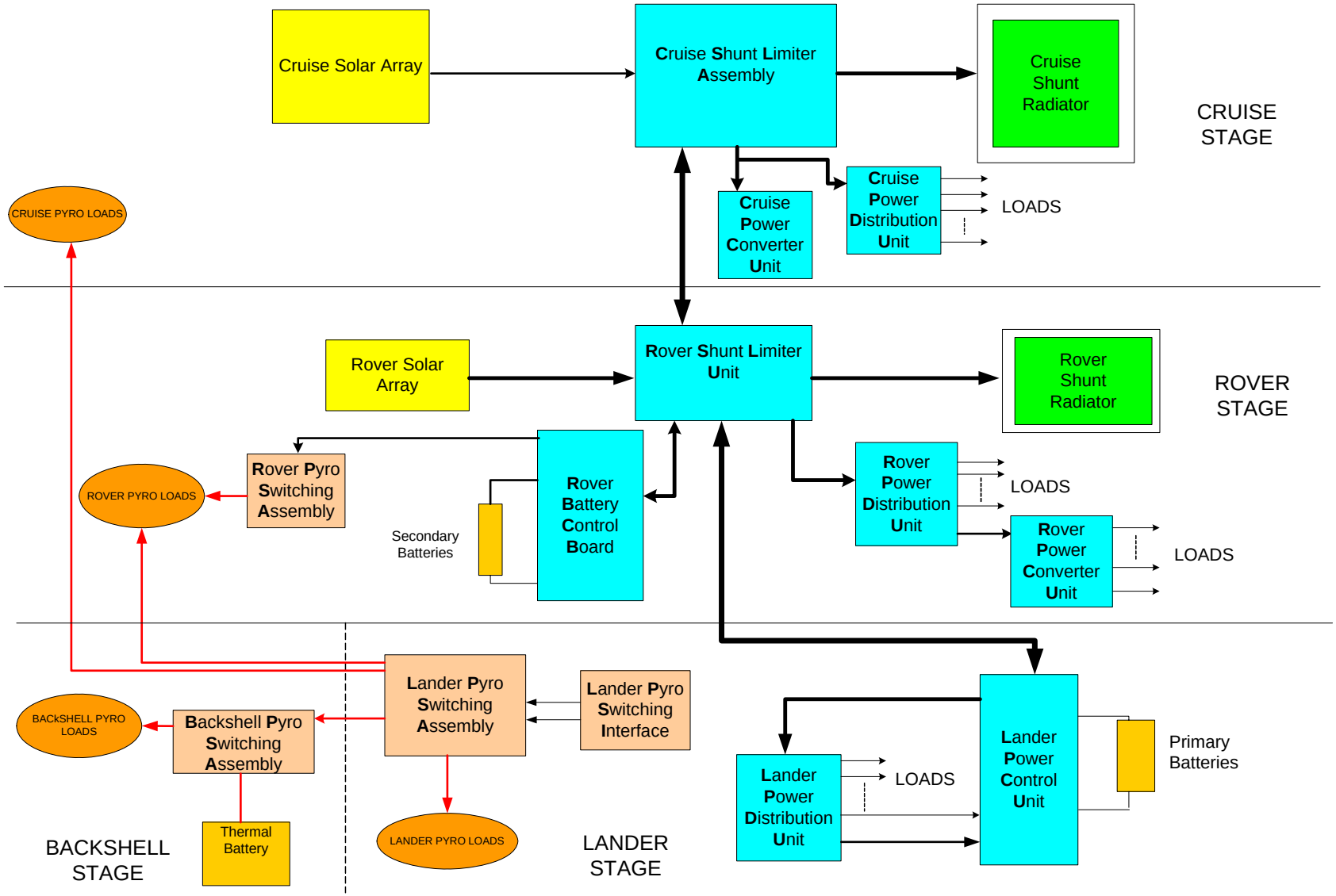
Cassini Power System



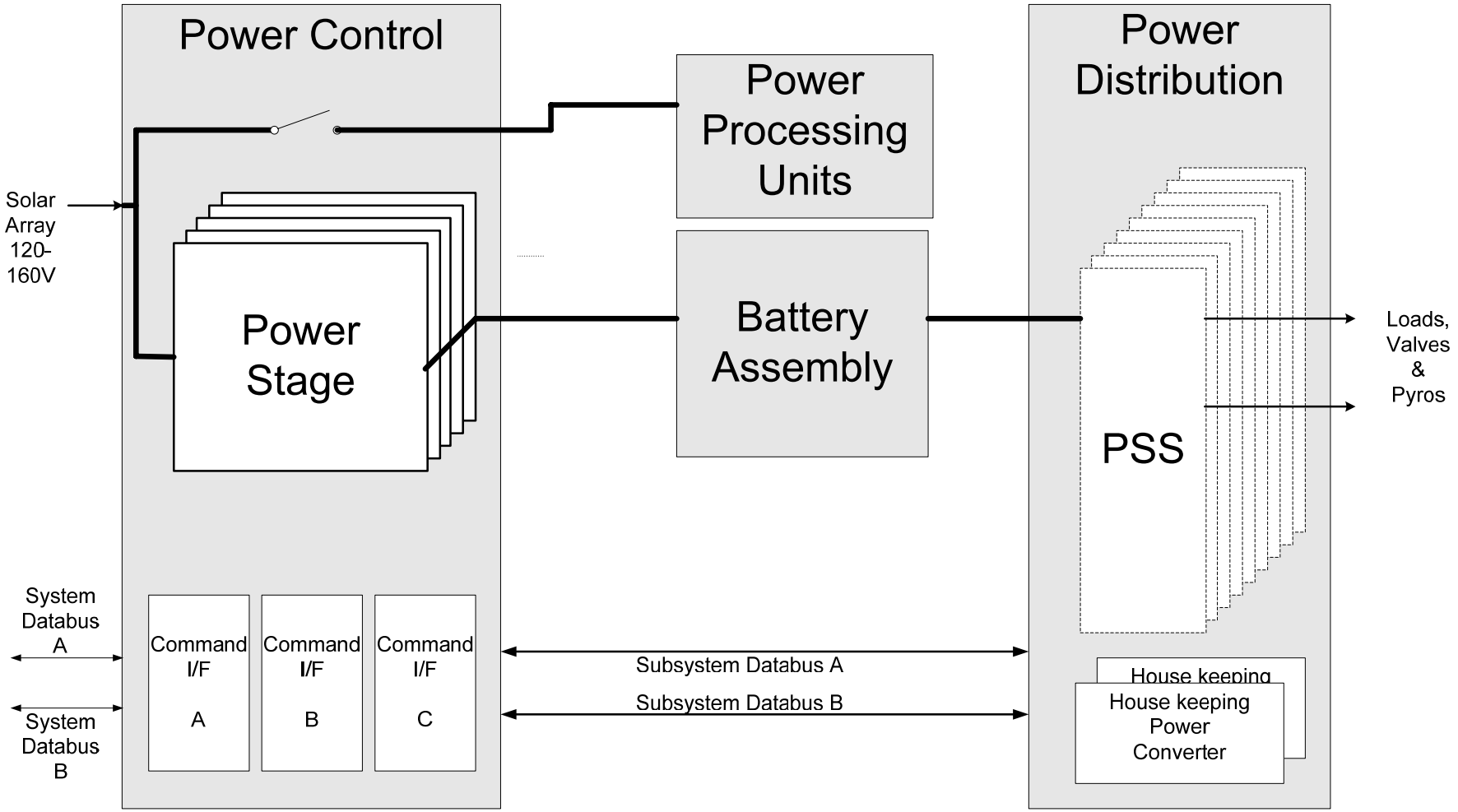
X2000 Power System



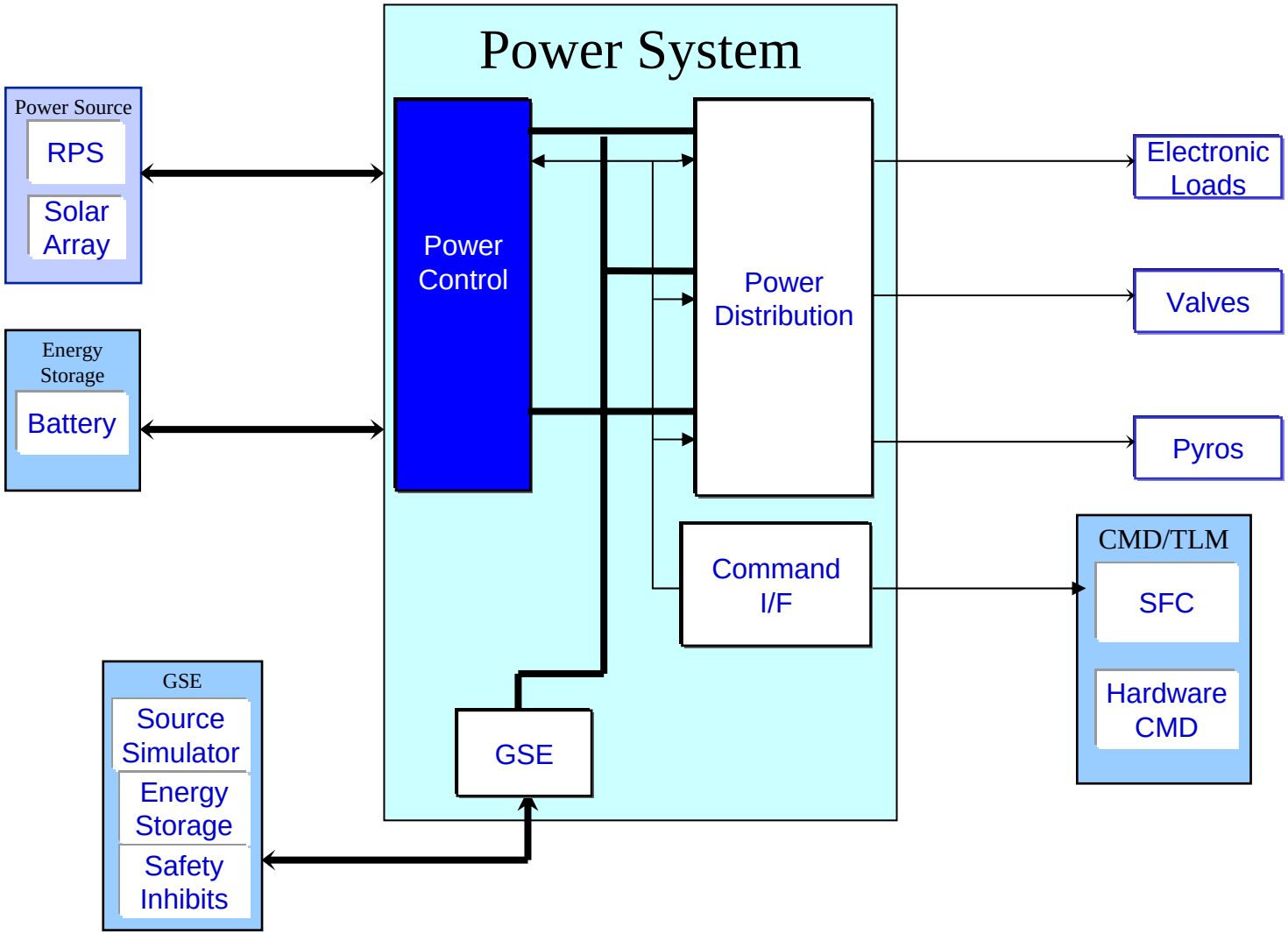
MER Power System



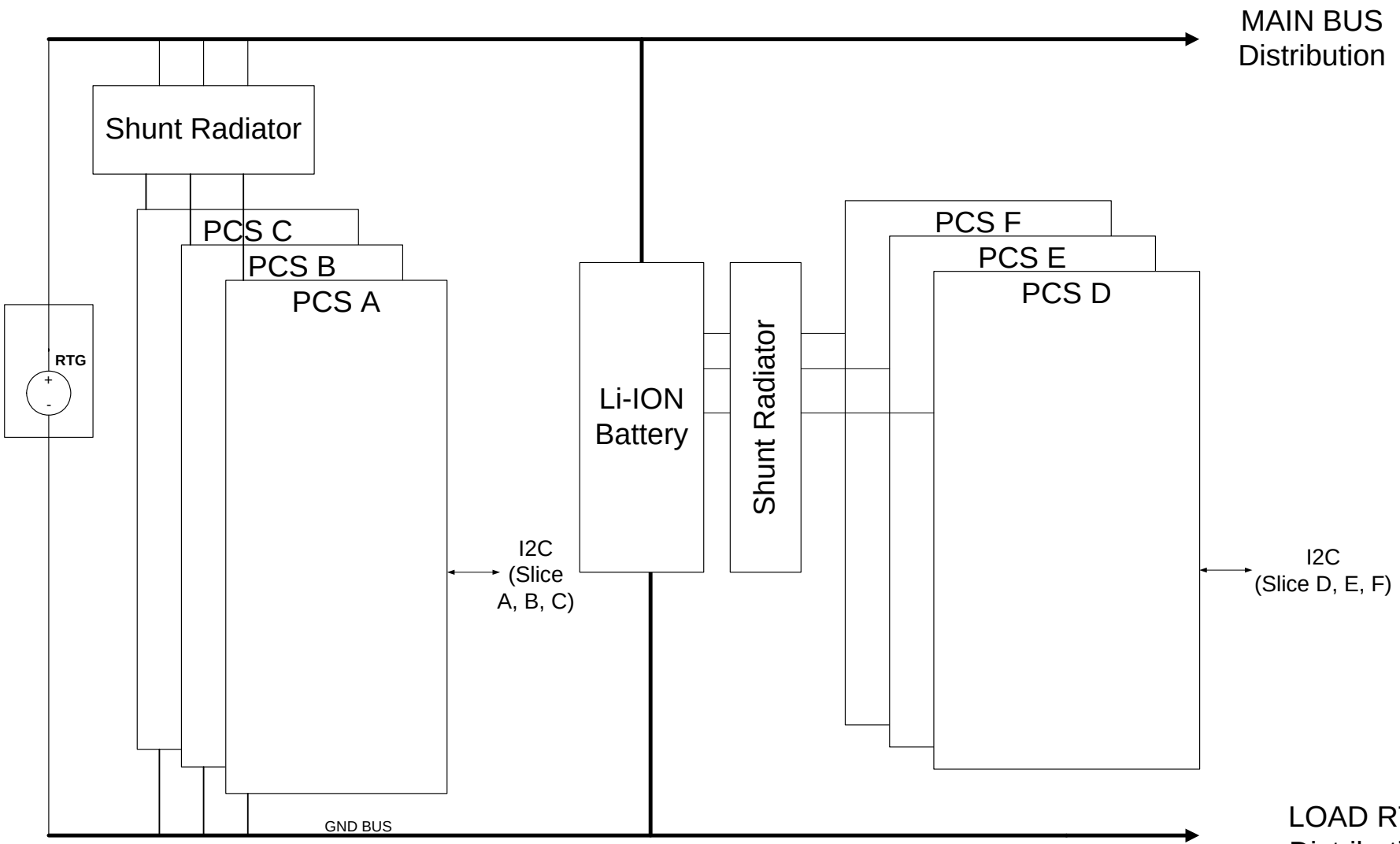
SEP Power System



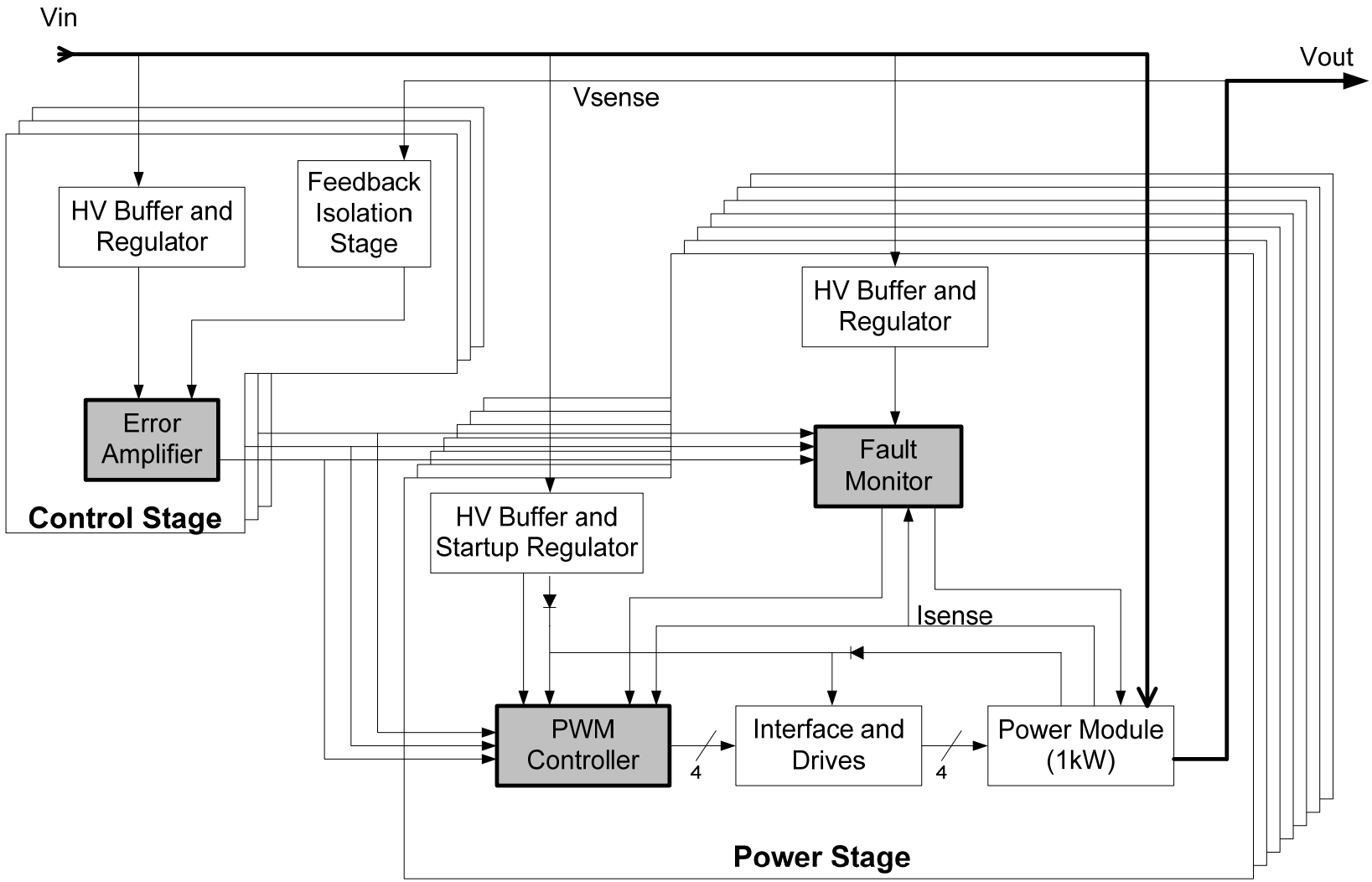
Generic Power System Architecture



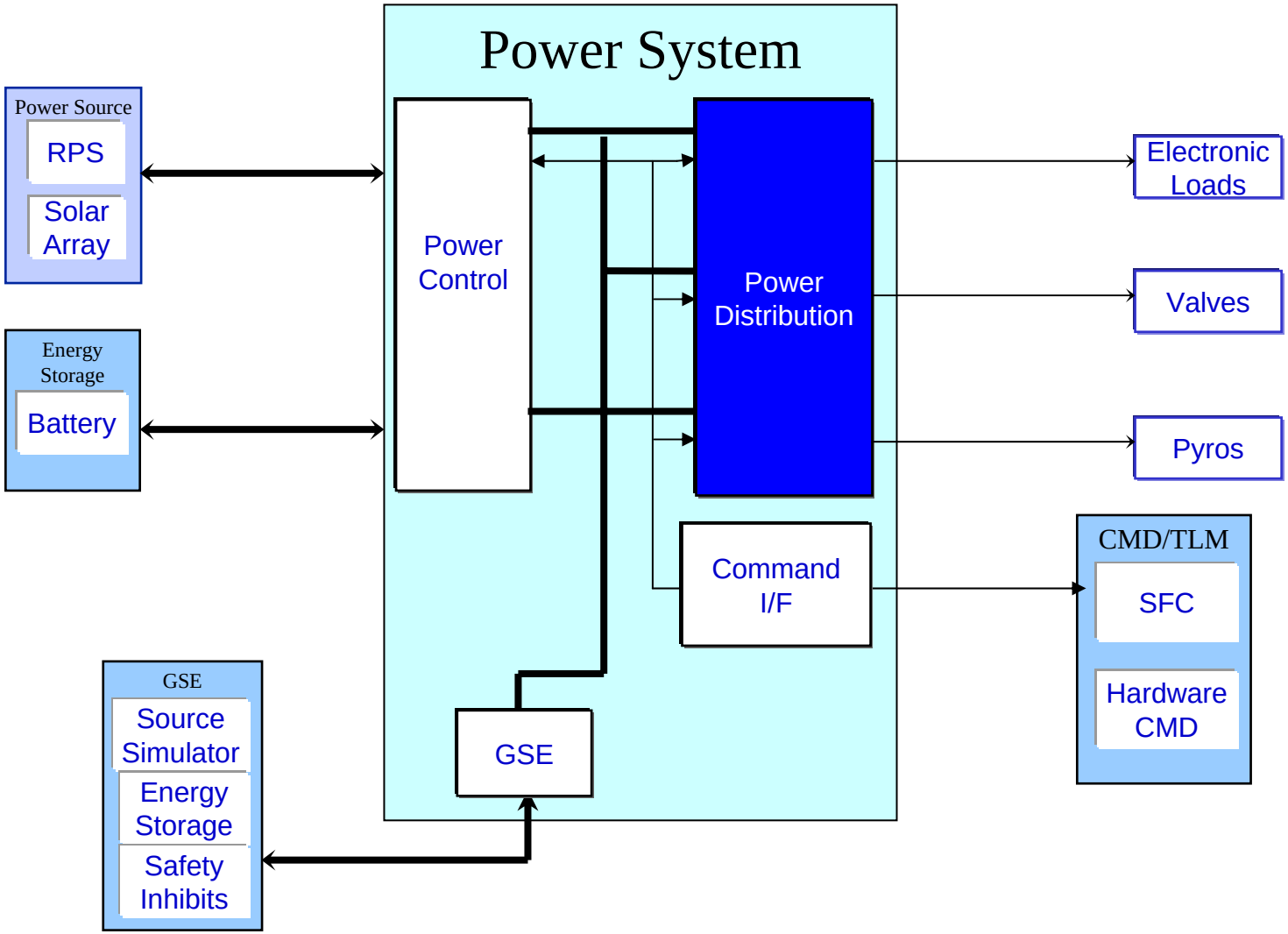
X2000 Power Control System



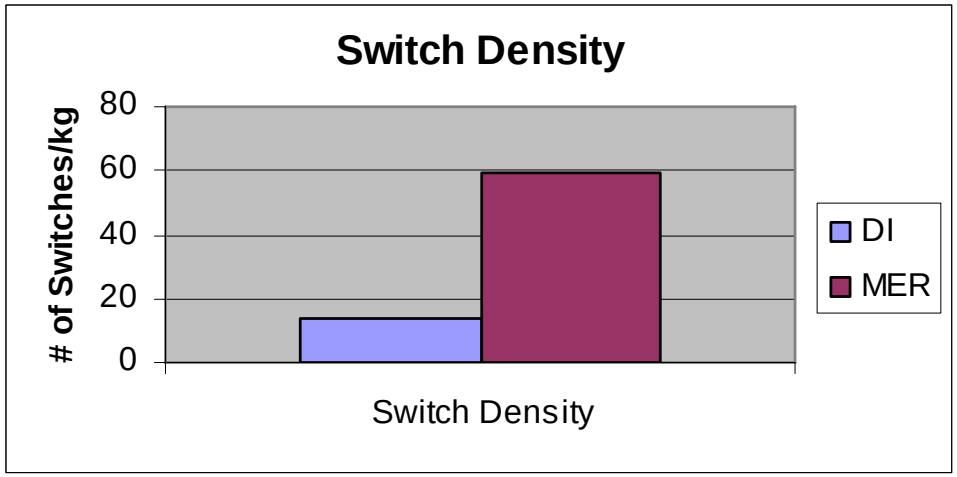
N+K Fault Tolerant Application

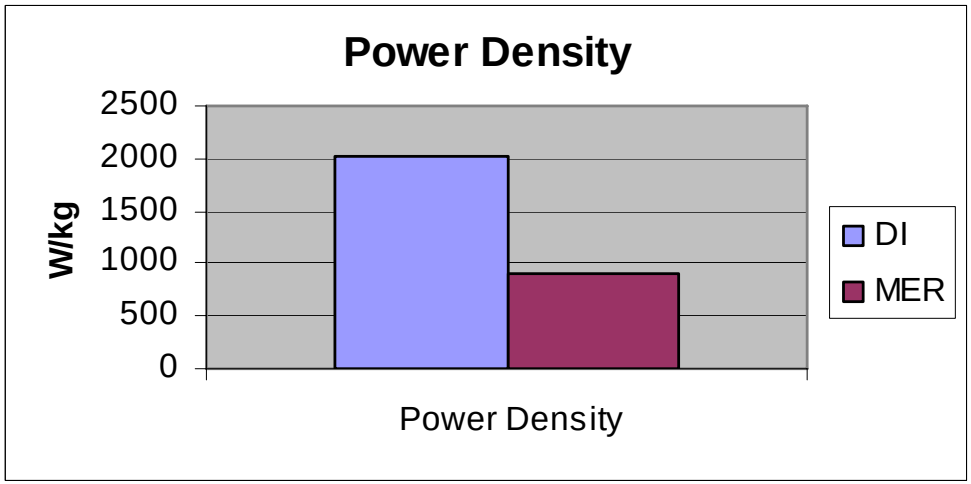


Generic Power System Architecture



Switch Density vs. Power Density



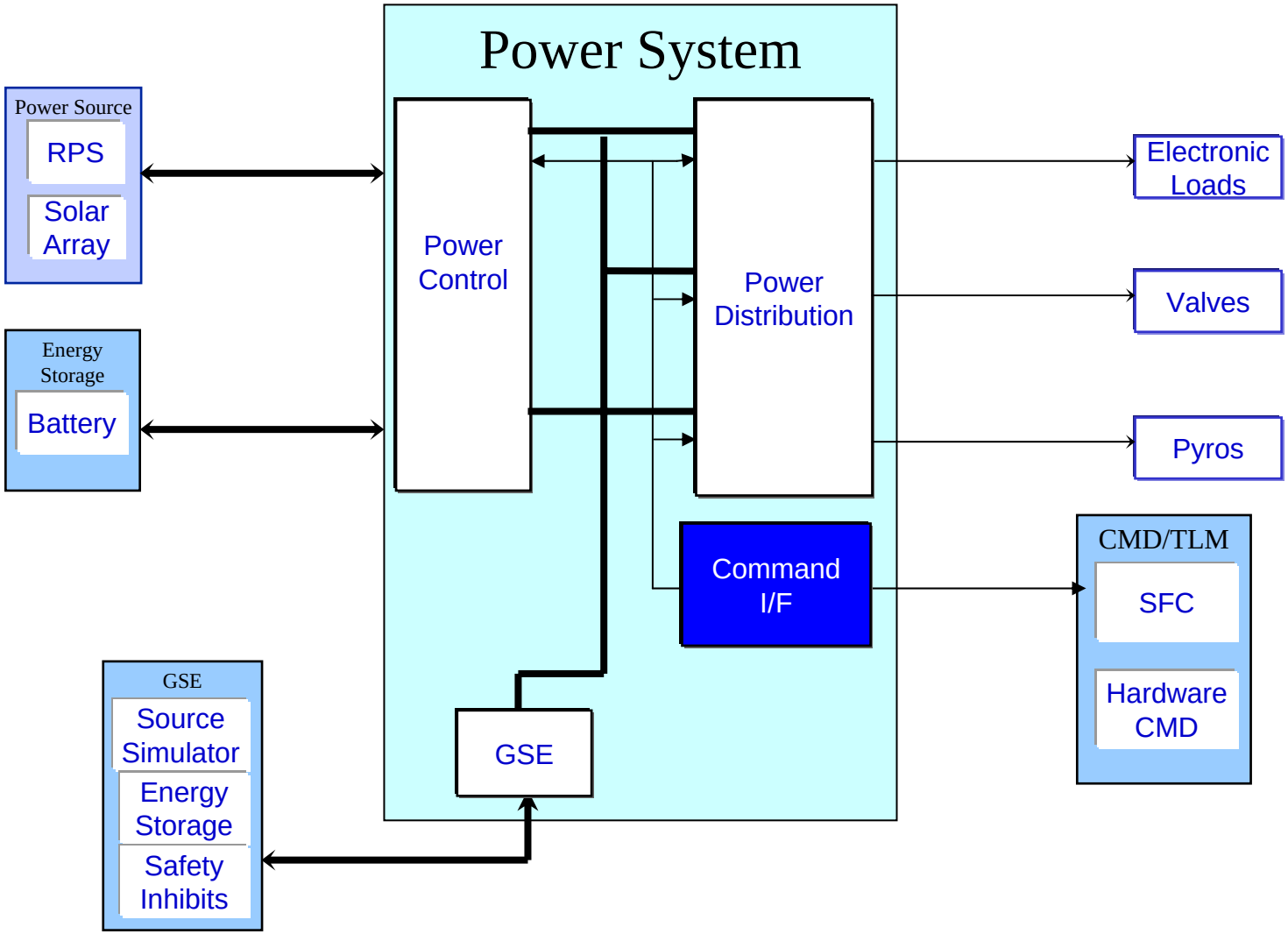


- Sample of two mature systems
  - Deep Impact
  - MER
- Switch Density
  - MER needed more switches per kg
- Power Density
  - Deep Impact needed more power density
- X2000
  - Focused on power density not switch density
- MSL
  - Balanced between power and switch density

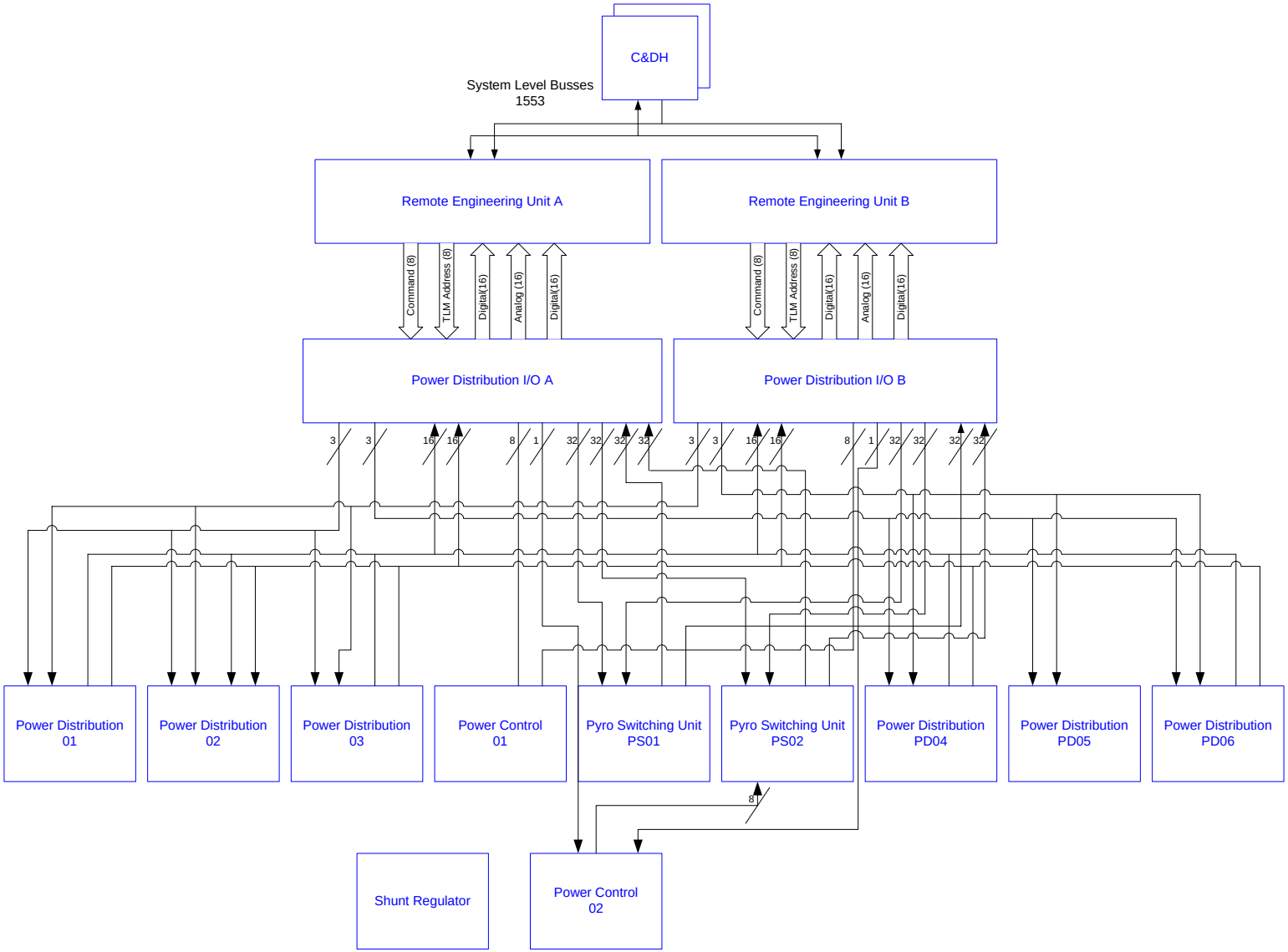
Switching Functions

- Relay combinations (Pathfinder, MER)
  - Lowest power
  - Requires fault protection
  - Dead-facing, High Power Bus Configuration Changes
  - Isolated commanding, Non-volatile status
- Dedicated High or Low Side (MSL)
  - Low power
  - Requires fault protection (fuses or current trip)
- Dedicated, Fault Protected (Cassini)
  - Medium Power
  - Includes fault protection and in-rush limiting
  - Dedicated high switch and low switch
- Floating, Fault Protected (X2000)
  - Highest power
  - Includes fault protection, in-rush limiting and telemetry

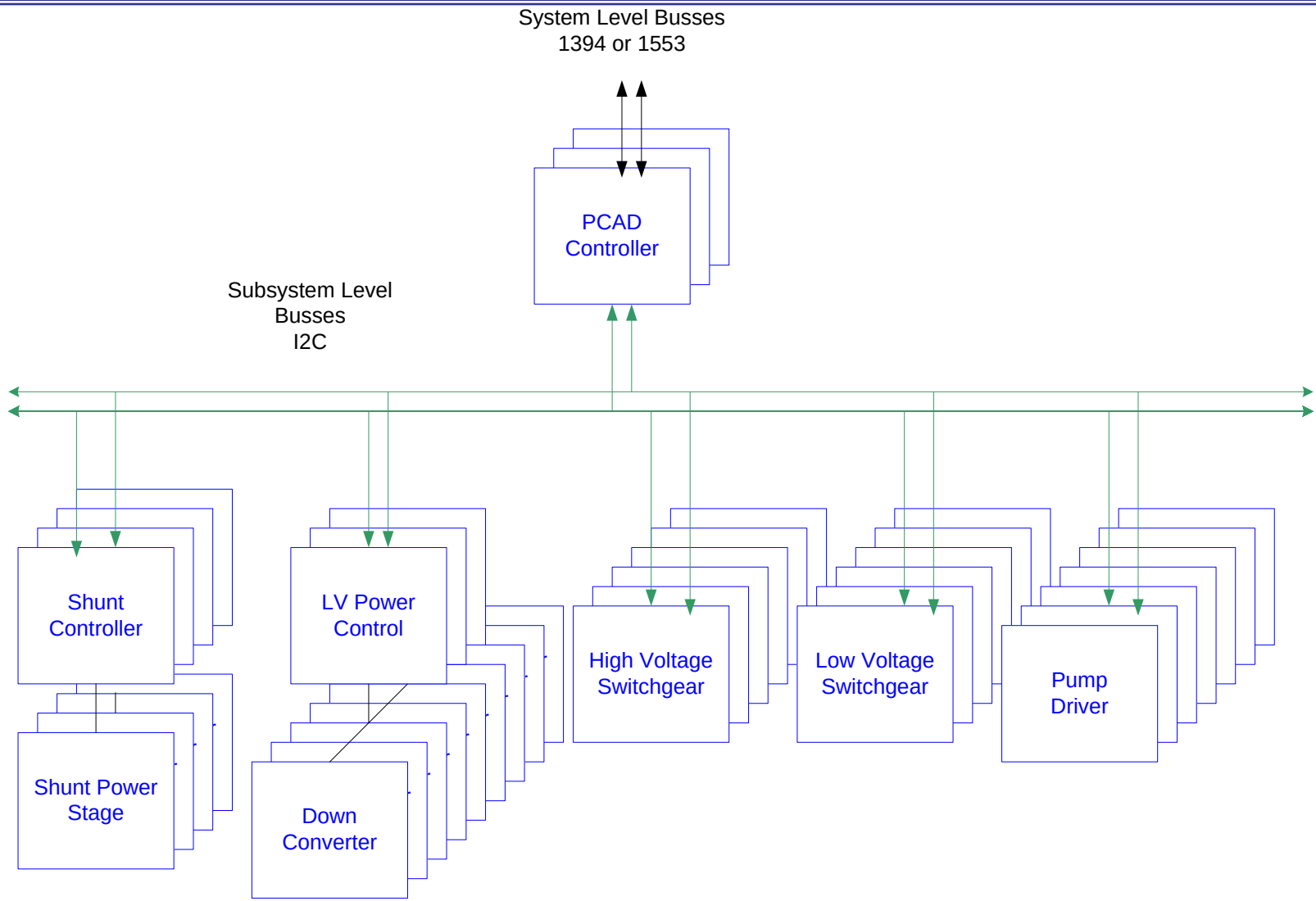
Generic Power System Architecture



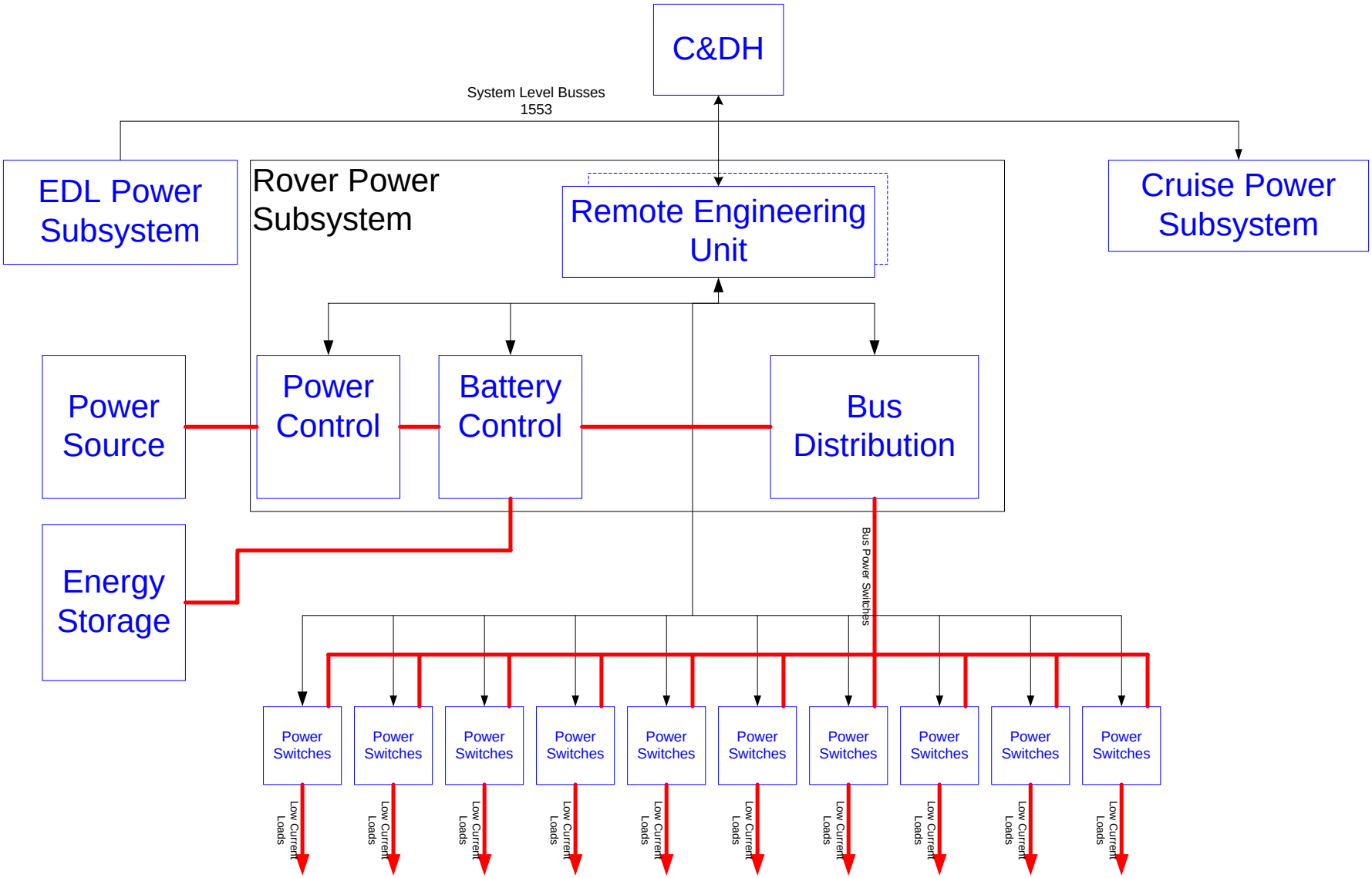
Cassini PPS Data Interface



Distributed Control Architecture



Power System Architecture



Summary

- **JPL Power System Architectures**
  - **Driven by mission specific requirements**
  - **Power source is key to developing the architecture**
  - **Fault tolerance requirements depends on the mission**

- **Power System Architecture Functions**
  - **Power Control**
    - "N+K" Fault Tolerant Architectures
  - **Power Distribution Switching**
    - Power Density vs. Switch Density
  - **Command I/F**
    - Distributed data bus interface and point of load power conversion

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