Dependable Multiprocessing with the Cell Broadband Engine

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Dependable Multiprocessor Technology

- **Desire - -> 'Fly high performance COTS multiprocessors in space'**

  - **To satisfy the long-held desire to put the power of today's PCs and supercomputers in space, three key issues, SEUs, cooling, & power efficiency, need to be overcome**

    - Single Event Upset (SEU): Radiation induces transient faults in COTS hardware causing erratic performance and confusing COTS software

      DM Solution { **- robust control of cluster**
      - enhanced, SW-based, SEU-tolerance

    - Cooling: Air flow is generally used to cool high performance COTS multiprocessors, but there is no air in space

   **DM Solution** { **- tapped the airborne-conductively-cooled market**

    - Power Efficiency: COTS only employs power efficiency for compact mobile computing, not for scalable multiprocessing

      DM Solution { **- tapped the high performance density mobile market**

This work extends DM to the Cell Broadband Engine and PowerPC 970FX cluster in Honeywell's Payload Processing Lab

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Cell Processor Development System (CPDS) and 970FX Cluster DM Configuration

- **System Controller node mimics functionality of rad hard SBC in flight system**
- **Data Processors are heterogeneous mix of 970FX and CPDS**
- **DM runs on Cell PPE, doesn't need to know about Cell SPEs**
  - **Perfect fit for Cell/PPE, since PPE typically dedicated to management tasks, and usually has compute cycles to spare for tasks related to DMM**
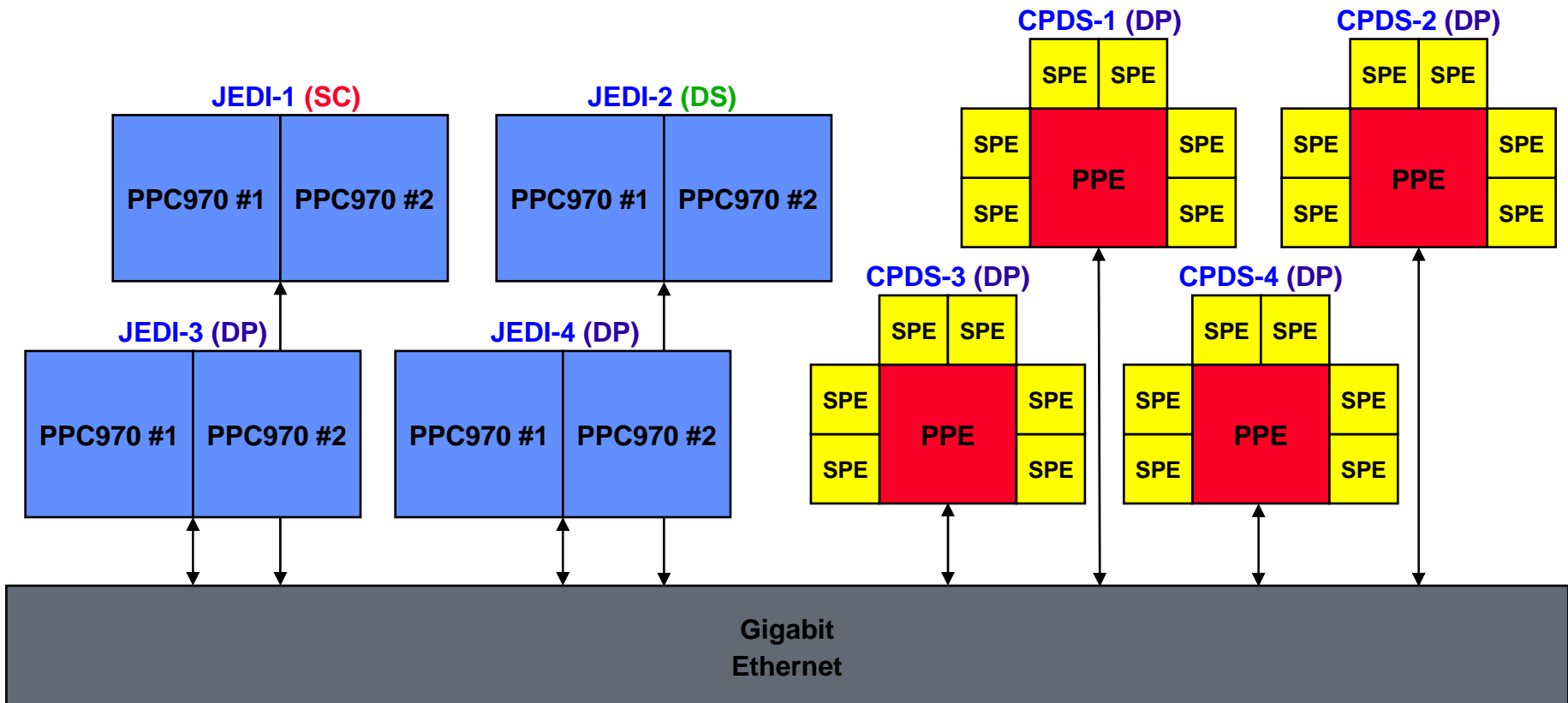
(SC)=System Controller (DS)=Data Store
(DP)=Data Processor

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Poster Summary

- **DM provides a low-overhead approach for increasing availability and reliability of COTS hardware in space**
  - DM easily portable to any Linux-based platform, even on an exotic architecture such as Cell
  - DM well-suited to Cell PPE, which is used primarily as a management processor for most Cell applications
  - Future Cell platforms expected to improve power consumption and will be aided in advances in cooling technology

- **Cell provided impressive overall speedups in UF SAR benchmark with low development effort**
  - But, much higher speedups for sections of code that primarily leverage existing optimized libraries

- **Future Work**
  - Augment DM to provide enhanced, Cell-specific functionality
    - Spatial replication across SPEs

Poster Includes Details on DM/Cell Performance Benchmarking with SAR Application

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