Card Slice approach to SpaceWire Standardized Backplane

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Background

- Many studies have been performed to compare different avionic enclosures solutions; evaluated studies considered here were performed by
    - NASA/LaRC; NASA/GSFC; and industry proprietary studies to name a few
- Evaluated studies have shown that card slice (stackable) designs have advantages over traditional backplane enclosures
    - Less mass & volume
    - Better thermal conduction
    - Less stringent mechanical tolerances
    - Less assembly difficulties/issues
- NASA Constellation Program is currently evaluating a card slice avionic approach using SpaceWire for intra-box communications to
    - facilitate reuse between Altair (Lunar Lander) and Lunar Surface Systems (LSS) because
    - ease of disassembly and re-integration (reconfiguration of avionics boxes)
- Card Slice approach should be considered by SpaceWire Backplane WG for standardization

Card Slice Model

- Card Slice approach has a backplane but it is not implemented in the typical fashion
  - Backplane is a specific Card Slice in the avionics enclosure card stack that is
  - interconnected via a flex circuit rather than a stackable connector
    - Allows more component headroom on cards
    - Mechanical tolerances less stringent
    - Provides ability to have more choices for connectors
    - Provides ability to have better signal integrity
- Modular Architecture for Robust Computation (MARC)* has many features that are applied to this proposal
  - Active backplane, i.e., router on backplane, but use specific card slice (Common Slice) instead of backplane for this approach
  - Single supply to all board from Common Slice with Point of Load (PoL) converter on each board
    - Power switch for card slice either on Common Slice or on respective Card Slice
  - Central (common) controller and box level interface on Common Slice
    - Local FDIR for enclosure and processor resource for different card slices

* See "SpaceWire Active Backplane"; Alan Senior; 11th SpaceWire Working Group Meeting

Conclusion

- A card slice avionics enclosure using flex circuit interconnects offers many technical advantages over the traditional backplane avionics enclosure

- SpaceWire Backplane WG should consider this approach for possible standardization

End.
Thank you

Back-up

- Ratio of board level components to Printed Wiring Board (PWB) and enclosure mass is approximately
  - 1/4 for traditional backplane approach
  - Almost 1/2 Card Slice approach
- I/O connector space is larger for Card Slice approach than for backplane approach
  - Potentially 3 sides for Card Slice approach versus 1 side for backplane approach
- Mechanical tolerance for backplane connector can be difficult to match +/- .002 inches
  - X & Y (connection matching) directions
  - Z (contact depth) direction, i.e., don't want contact to bottom out but want contact to have adequate
- Backplane approach reliant upon wedge locks for thermal conduction
  - wedge locks have been susceptible to losing pre-load and hence thermal conduction and
  - "bind-up" causing difficulty when removing boards from enclosure
- Backplane is unique for each enclosure but
- Card Slice allows the ability to adapt flex circuit for different card lengths
  - multiple size flex circuits or
  - cut and terminate for specific length