SpaceWire Backplanes

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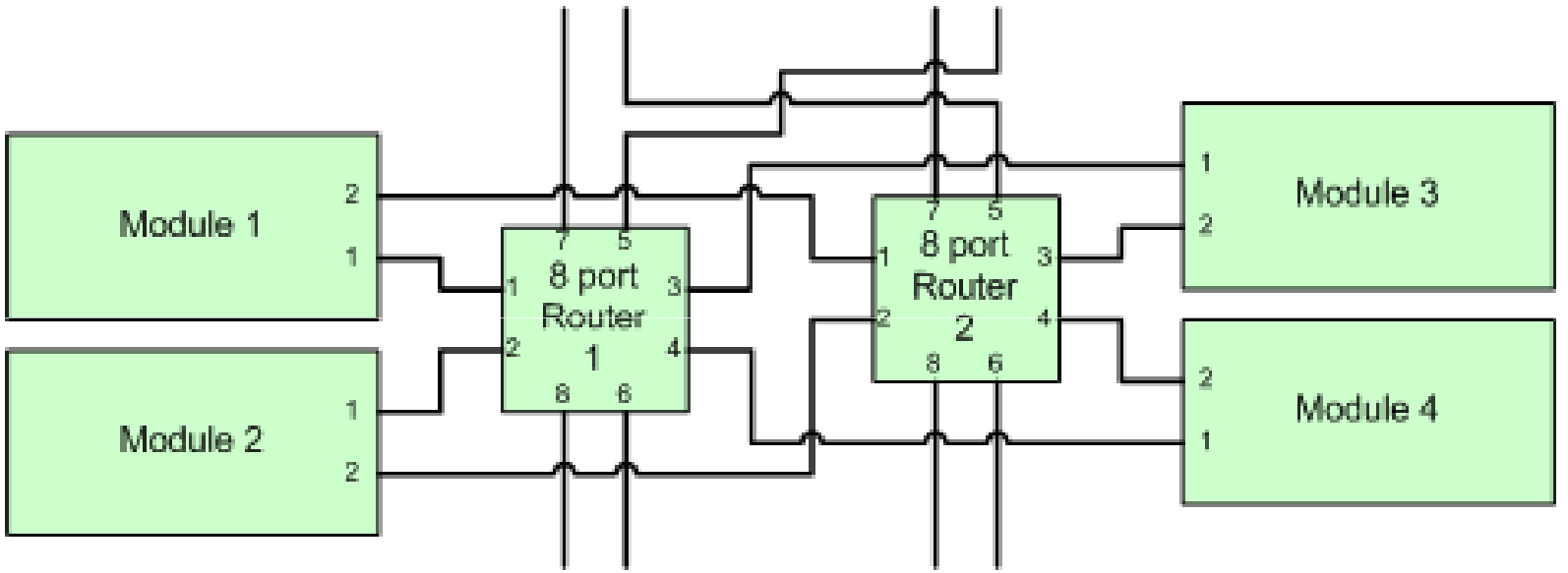
Why a backplane?

- A typical electronics unit or electronics system is comprised of a number of functional modules. Usually these modules need to communicate and they need power.
- It is undesirable to use a set of point to point looms within an electronics unit. Instead the data and control paths can be conveniently routed via a backplane PCB and the modules plug into this PCB.
- Permits modules to be inserted and removed facilitating testing and customisation of the module suite.
- Permits a common backplane interface (like VME, cPCI etc.)

Why an active backplane?

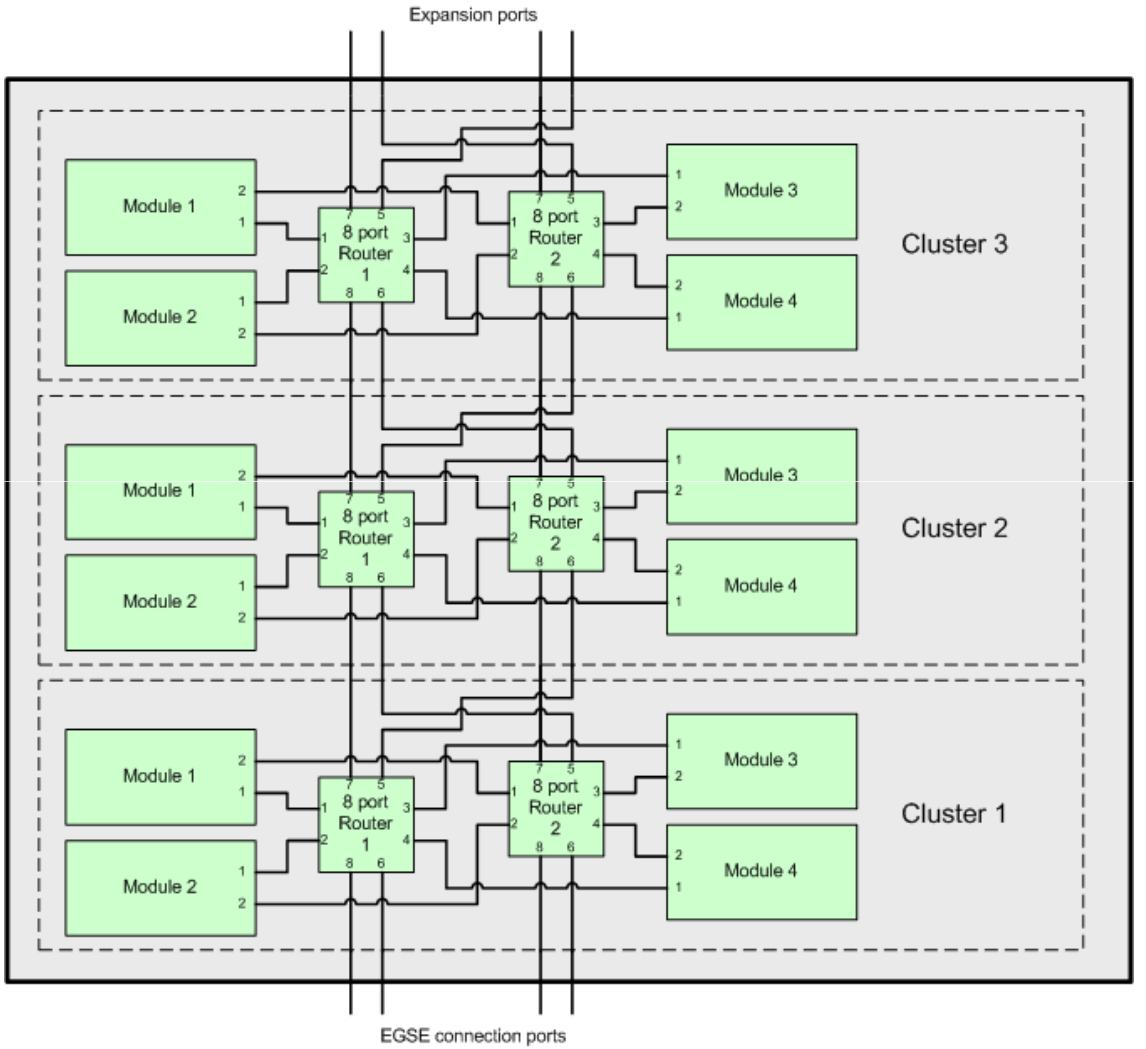
- Decouples SpW network and power distribution architecture from the Module design, so modules do not need to be powered in certain combinations to provide the connectivity required
- Improved FDIR hierarchy: The network reliability is decoupled from the module reliability. This permits network failures to be handled in a consistent manner.
- Permits a modular and scalable architecture to suit module count and bandwidth requirements

Network Cluster



Proposed modular SpaceWire network building block (4:2 Cluster)

Cluster to Cluster connections



Example Cluster SpaceWire network for 12 Modules

Advantages of this architecture

- Single point failure proof
- Expandable in X and Y directions
- Same number of routers in path after a single router failure
- No failure propagation that stops Modules in other clusters communicating on any port
- Good inter-cluster bandwidth (increase at cost of Module:Router ratio)
- Spare ports for expansion, EGSE or to create a Cluster ring
- Opportunity to use Group Adaptive routing to automatically bypass bad links and routers

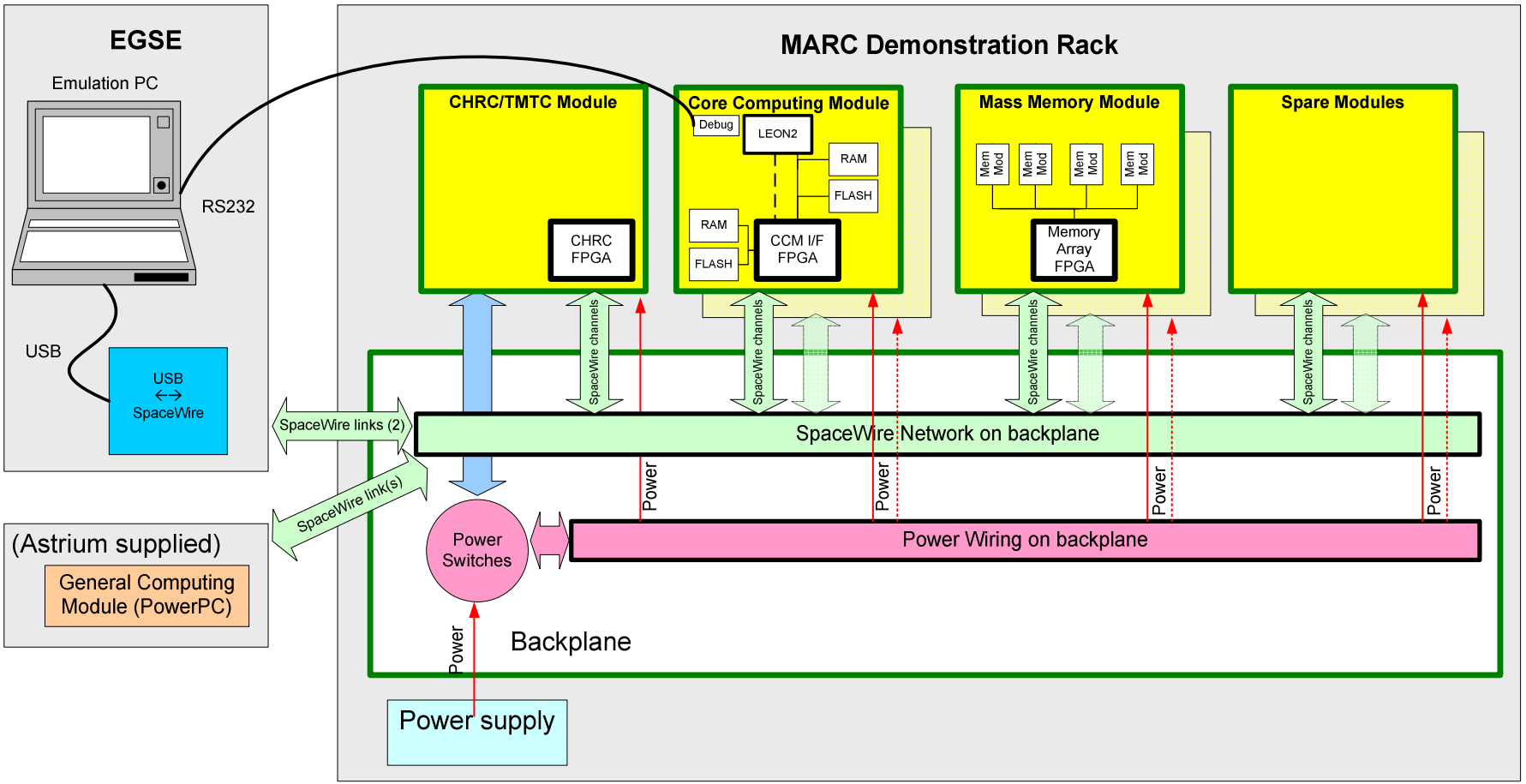
Power distribution

- In a modular SpaceWire backplane based we need to have some power control over each Module; this permits failed or unneeded Modules to be powered off
- The power architecture has to be similar to the Network architecture and take into account the potential need to switch off Routers
- The electronics on each Module will have different power and voltage needs so a generic architecture needs to take this into account
- The current thoughts are that a regulated voltage (12-24V) will be supplied to each Module and that Point Of Load (POL) converters will be employed on each Module to provide the voltage rails they need
- It is anticipated that a Module would need less than 20 watts
- The POL approach is a typical of commercial hardware due to the range of logic supply rails needed and the availability of high efficiency compact power modules
- The Module power switches need to be under centralised control
- If no master processor appears to be in control then hardware must power up a backup processor

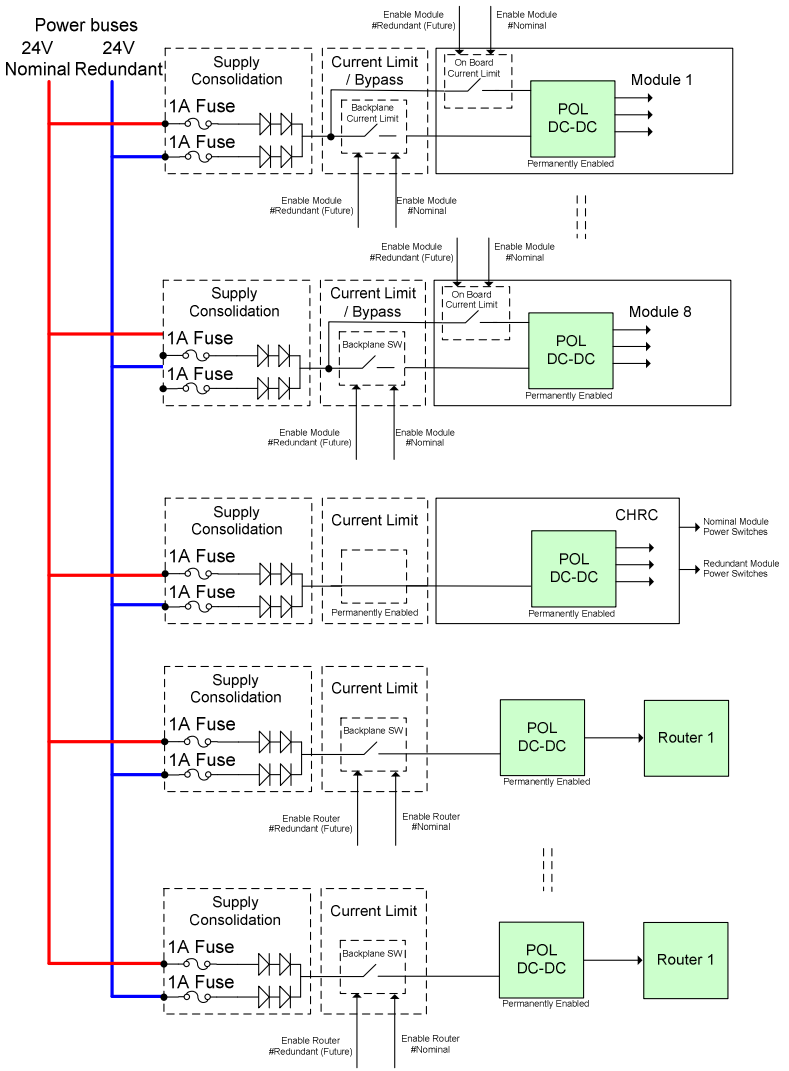
The MARC project

- This SpaceWire backplane presentation is based on work performed on the MARC (Modular Architecture for Robust Computation) project
- SEA is a member of the MARC team involving SciSys and Astrium UK.
- SEA is responsible for the hardware architecture and detailed design
- The objective of the MARC project is to design and develop a demonstration system with a HW distributed architecture based on a SpaceWire network as the communication medium
- The MARC project is currently in the detailed design phase

MARC demonstrator architecture

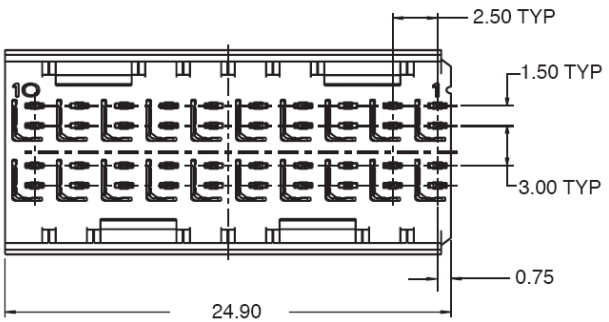


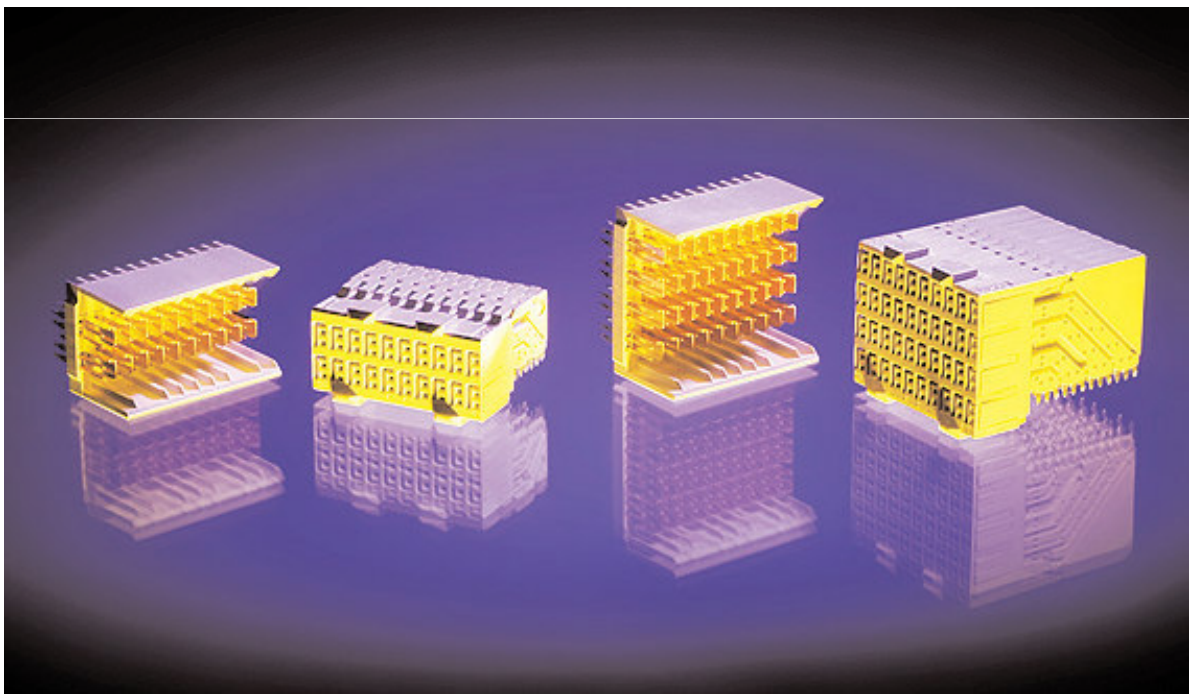
MARC demonstrator power distribution architecture



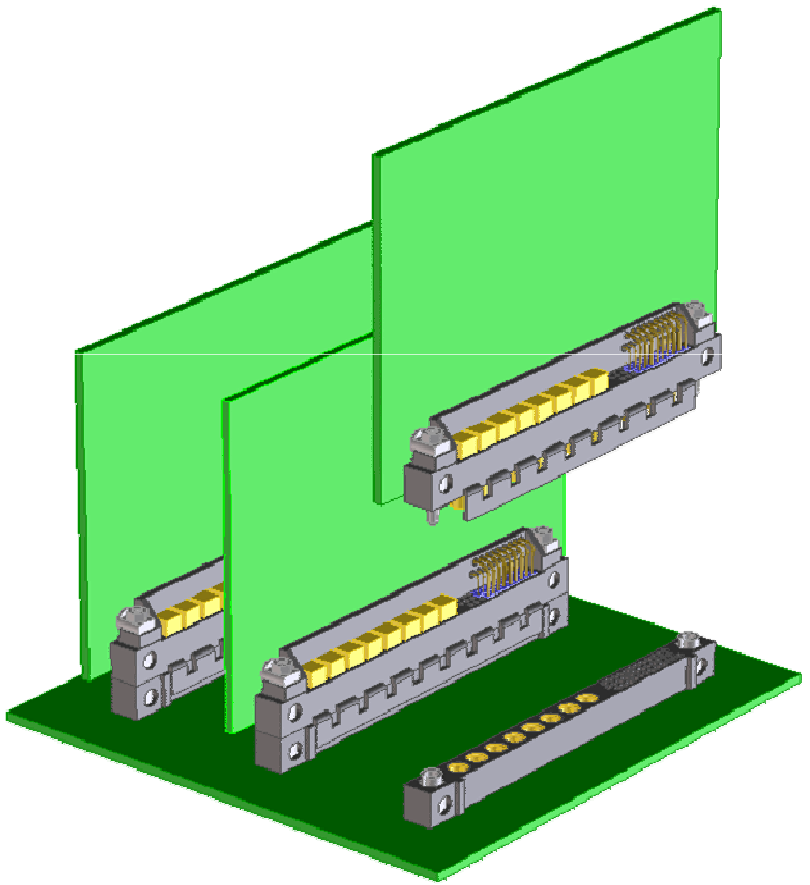
Commercial grade backplane connectors

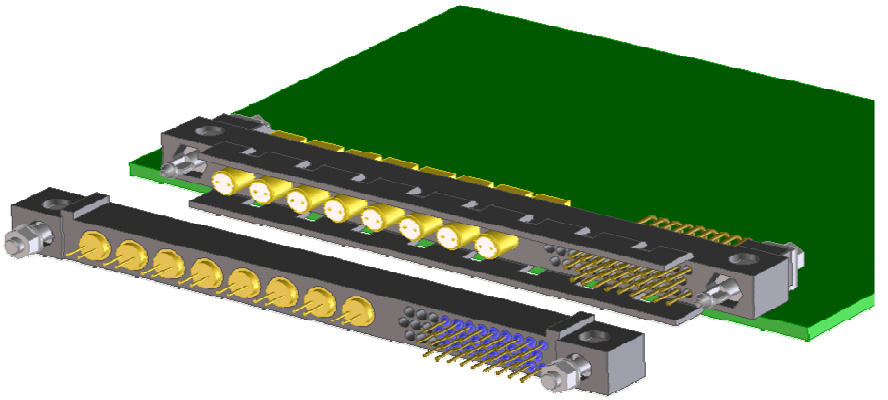
- **Ideally we need a controlled impedance connector to avoid SpaceWire signal degradation**
- **COTS connectors: Tyco AMP HmZd offer solutions up to 10GHz**





Hypertac proposed twinax based flight solution





- Hypertac based on HPH connector
- Twinax based contacts for SpW

- Do we really need controlled impedance contacts, would a standard HPH connector suffice?

Aims for a SpW Backplane specification

- **To create a open specification that defines the backplane electrical and mechanical* interfaces required that will support the data handling and power distribution needs of the functional modules necessary to support future spacecraft missions.**

<u>To do this we need to:</u>

- **Document and agree the specification with all interested parties.**

***Mechanical interfaces at level of electrical support, not unit box design**

Why a SpW backplane specification?

- **A SpW backplane open specification will:**
  - Allow development of a set of compatible modules that permit re-use across many missions
  - Enable modules from different suppliers to be compatible
  - Assist with the development of plug and play modules
  - Simplify integration and test activities
  - Encourage a common approach to software handling of the system configuration
  - Permit hot swap systems
  - Ensure FDIR at SpW and power interface levels to be handled in a consistent manner
  - Prevent proliferation of incompatible approaches
  - Prevent unnecessary parallel development efforts

But, we must de-risk the adoption of the specification by validation!

Your role is to.....

- **Tell me if you think it is a good idea!**
- **Provide critical and constructive comments on proposed scheme**
- **Tell me what you need, for example:**
  - Module power requirements
  - Bus bandwidths needed
  - Number of SpW links needed
  - Is there a need for a “public” network and a “private network”
  - What is needed to support plug and play?
  - Are special provisions needed for hot swapping?
- **Tell me via email, my address is on the front page!**

Question time

Any Questions?