Aerospace Brief Out

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Clarifications from Yesterday's Discussions

- **Radiation environments from sea level to space**
  - For avionics, for the most, the radiation environment is made of the same particles as sea level but more
  - For space, the radiation environment is completely different – protons and heavy ions
    - Protons have a very similar reaction to silicon as neutrons, but the flux is much higher than atmospheric neutrons
    - Heavy ions are not as common as protons, but devices are more sensitive to heavy-ion-induced radiation upsets (5-7 orders of magnitude more sensitive)
- **We do not actually want TMR**
  - We want systems that work and TMR is generally easy to use and can solve a lot of problems – not all problems, but enough

Commonality with Other Groups

- **Large-scale systems**
  - Parts that could be manufactured with different modes could be useful to both groups
  - Stabilization problem is common to both groups – it can take a few months to stabilize a small satellite
  - There is a certain amount of momentum for putting national asset satellites and HPC on the same hardware and software – should we embrace that?
    - Combine design groups with HPC
    - Similar platforms will allow more adaptability
    - Would we get better hardware or would HPC get worse hardware?
- **Automotive/Military**
  - Devices with a wider operating temperature range on devices might be helpful to automotive and military industry
  - Would collapse part of the problem for space
- **Consumer Electronics**
  - Despite the “100% tax”, trying to find a common ground where increased fault tolerance would solve our reliability problems and solve some other problem for manufacturing consumer electronics (yield, degraded modes)
  - Use consumer electronics as the dem/val and not space experiments – FPGA in space programs started only after a decade of experimentation and usefulness for ground systems
  - Question for the consumer group: why was ECC adopted?

Discussion Points Around Adaptability

- **We are interested in adaptability, but understand that the hosts might not be**
- **Agreed that some aerospace organization should attempt an adaptable payload experiment to prove to the hosts that adaptability would be useful for payloads**
  - Leave control out of the discussion until a flight experiment is done
- **Discussion around when would adaptability be useful and how to do it**
  - As a group, we could embrace differential reliability spectrum better
    - Not all payloads are equal
    - Not all parts of the satellite subsystems are equal
  - As a group, we need to do or have work done on ways for software assist hardware and vice versa
    - Many satellites are light on software, maybe more software stack would be useful
    - Are interested in hardware that had input ports for different types of monitors (NBTI, space weather, etc) and output ports that inform software of problems

Discussion Points Around System-Level Designs

- **How does software reliability fit into the system?**
  - Looking at model-based validation or state-based software might be interesting
  - Software integration is as bad as hardware integration, because every organization chooses their favorite tool
- **Would high level managers help?**
  - The current systems are very stripped down – removes complexity, improves reliability (?), but also removes some avenues for adding adaptability or system-level reliability situations
- **Would abstraction help?**
  - Would software or programming language support help us abstract problems to a higher level?
  - Would solving things at a higher level be easier?