Common Challenges of the Constituency Groups

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Aerospace Challenges

- Widening gap between mil/aero and commercial parts
- Design for worst case environment
- Multidimensional optimization problem
- Testing botteneck
- Parts vs. system reliability
- Fixed capabilities
- Security

Consumer Electronics Challenges

- Models and abstractions for errors and variation
- A general framework for multi-level reliability/resilience
- Testing/verification strategies for reliable systems
- Improved recovery/rollback mechanisms
- Lightweight detection
- Interfaces and abstractions for reliable system-on-chip design
- Scalable approaches to and abstractions for reliability

Large-Scale Computing Challenges

- **Understand and control the complex effects of faults on systems**
  - Develop a detailed understanding of how faults propagate through systems and manifest themselves as errors in other components
  - Develop tools and frameworks to enable individual components to participate in global fault reliability strategy
- **Enable users to reduce the vulnerability of systems and applications to faults**
- **Measure the reliability and fault vulnerability aspects of real systems**

Life-Critical Computing Challenges

- **Providing end-to-end system reliability**
- **Exceeding current silicon performance**
- **Meeting standards**

Infrastructure Challenges

- **Physical distribution of the system**
- **High cost of maintenance/inaccessibility**
- **Security**

Common Challenges/Needs/Discussions

- (Aero, Cons, LS) : better error/fault modeling needs
- (Aero, Cons, LS): testing/validation challenges
- (Aero, Infra): security challenges
- (Aero, Life, Infra): accessibility/cost of manual repair challenges
- (LS, Infra): system size challenges
- (Aero, Life): system reliability
- (Aero, Life): meeting standards
- (Cons, LS): rollback
- (Cons, LS): lightweight detection

The Challenge with the Challenges

- **We are reaching for solutions, instead of problems**
  - We need more information!
  - We need more tools!
  - We need to solve a second problem at the same time!
  - We need to meet our regulated standards!
- **We need to reach for the problems and allow researchers reach for solution**

Common Challenges (1 of 2)

- **Varying demands, workloads, environment (and uncertainty about the environment) means worst-case design is over design for most uses. This motivates adaptive solutions.**
- **Worst-case design independent of the application and its needs is too expensive. Similarly, worst-case design for uncommon, but potentially avoidable, worst-case scenarios is also a large, unnecessary cost. These motivate cross-layer, application-aware solutions and/or models/middleware that support management of operational aspect of application.**
- **Fully custom/unique construction of all components is not viable (costs, manpower) for anyone. Some domains see more acute versions of this, but no domain is really able to do everything custom themselves these days. This motivates interfaces, metrics, and tools to perform composition, analysis, optimization, or validation of separately sourced (sub)components.**

Common Challenges (2 of 2)

- **Across the board, there is considerable conservative over design. This motivates system assessment methodology, tools support energy-delay-area-reliability-thermal-mechanical space.**
- **Environment, energy demands, deployed system context, and even technology noise and maturity are all late bound, possibly not known during design, and maybe not known until deployment. This motivates modes and configuration options that allow the component to tune what it spends on reliability. This could allow commercial devices to enhance yield or operate at extremely low energy levels while also making the same parts more usable in larger scale systems or harsher environments.**
- **(Pia) Lack of information means that there is not enough direction is on what the worst-case scenario is**

Discussion

- **The pathogens are active and not well known, but we need to determine the immunology to resist the pathogen.**
- **Doctors only see the successful outcome. We need to prepare to meet the challenge to stop the spread of the reliability problem into smaller systems/market.**
- **System design is open loop right now. We need to move away from design worst case to design for the current case.**
- **Early warning systems can help determine how to immunize the rest of the system populations.**
  - Security has a system already in place for malware and viruses
  - We lack a center to provide information on what is causing reliability failures
  - Share on the “physics level” will be easier for industry to share at, instead of at the “secret sauce level” (Nick)

Discussion

- **Talking at the “physics level” is less important now, because the problems exceed the “physics level.” (Sani)**
- **(Pia) Data will be made public only on a customer-proprietary manner**
- **www.youtube.com/watch?v=KnTeu5M4rHc Oracle data integrity case. A simple Immuno example**