Question 3

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Advantages of Multilevel Solutions

- Provides opportunity global optimization.
- Decomposition enables repair, adaptation, and flexibility.
- Allows simultaneous optimization of multiple cost functions and objectives, e.g. QoS vs power vs reliability.
- Enables adaptation to environmental changes.
- Decomposition into layers provides opportunities for post-deployment changes.
  - A software patch easier to deploy than a hardware patch.

Disadvantages of Multilevel Solutions

- Optimization across levels often implies cooperation across corporations, which is problematic.
- Optimization easy to say, difficult to do.
- Testing and validation are far more complex.
- Difficult to strike and maintain layer contracts.
- Is part of the contract a FIT rate?
- What happens when people break their contract?
- Are duties blurred if contacts are blurred?

Where are Multilevel Solutions Viable?

- Does it work for all situations?
- Are there cost differences for different layers?

How is Multilevel Implemented?

- Must formalize layer interfaces.
  - Parameterized fault models are needed for each layer
  - Must specify how exceptions are handled.
  - Must specify what data passes bidirectionally between layers.
  - Schedule the right part of the application on the appropriately reliable h/w
  - How are legacy systems handled?
- Can we leverage control theory to help us?
  - Computer systems are non-linear but classical control theory deals with linear systems.

How is Multilevel Implemented?

- Implementation of fault analysis, detection and recovery needed for each layer.
  - Classify hardware into types to ease to detection and recovery.
  - Easier to detect and respond to hard failures
  - Consider incorporating reliability monitors, e,g.
    - Error rate reporting from ECC
    - Local temperature reporting
- Timeliness of response
  - Responses should be timely and precise – detection and diagnosis
  - Depends on level, components, and fault type and severity.

How is Multilevel Implemented?

- Metrics
  - Good metrics to make good models.
  - Metrics are layer dependent.
  - Roadmap metric criteria may help drive research.
  - Reliability is important at all levels.

- How is error in a system defined?

- Imprecise vs. unreliable computation
  - High error rate may be tolerable for some applications
  - Computation must not halt

- Implementation Approaches
  - Transaction-based hardware facilitates checkpointing.
  - Can layers be short-circuited?
  - Predictive vs real time error correction?