End-to-End Error Correction and Online Diagnosis for On-Chip Networks

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Error Correction Codes

- **Switch-to-Switch (S2S)**
  - Interleaved SEC Hamming(21,16).
  - 4-degree interleaving provides 4-bit burst correction.

- **End-to-End (E2E)**
  - Interleaved error-locality-aware 2G4L(26,16).
  - 4-degree interleaving provides 16-bit burst correction.
  - E2E approach is four times cheaper than S2S.

Error-locality-aware Codes

- Designing codes for burst, local and random (global) errors.
- BurstCode(26,20):
  - 25% higher code-rate than BCH(26,16).
  - Only reliable against adjacent errors.
- 2G4L(26,16):
  - Same cost as BCH(26,16).
  - More reliable.

Online Diagnosis

- **XY Routing**
  - Packet Name: Suspected Bit Positions
    - Bit Position
    - Line Number
    - Link Number
    - Node Number
  - Expected Value
  - Suspicion Value
  - Number of Routes
  - Usage Probability
  - E2E Defect Observation Escape Rate

Experimental Results

- Expected Values
- Accuracy of Diagnosis
- Conclusion

- A comprehensive end-to-end solution for error correction, data collection, and defect diagnosis and replacement for on-chip networks has been proposed.
- Four interleaved 2G4L(26,16) provide two random and up to 16 adjacent-bit error corrections per fit.
- E2E error pattern information is gathered in a centralized software on the host processor and used for diagnosis of defective wires.
- Under heavy noise, high escape rate, uncertainty about routing, and many other harmful effects, the collected data are still accurate enough for diagnosis.
- The collected data can also be used for other purposes such as diagnosis of defective routers, locating the intermittent faults, and many other interesting system observations.