F10: A FAULT-TOLERANT ENGINEERED NETWORK

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• Ambient Backscatter: Wireless Communication Out of Thin Air (Best Paper, SIGCOMM, August 2013)

• Expressive Privacy Control with Pseudonyms (SIGCOMM, August 2013)
MOTIVATION

• Failures in Data Centers
  • Short-term
  • Some failures have long downtimes
  • Network faults impact network efficiency
  • Existing failure detection mechanisms are to coarse-grained
• Heartbeats to detect failures
• Centralized controller
• Exploits path redundancy
UNSOLVED ISSUES

• Slow detection

• Slow Recovery

• Suboptimal Flow Assignment
F10

- AB FatTree
- Cascading protocols for optimal recovery
- Fine-grained failure detector
• FatTree Recovery is slow
  • Lots of redundancy on the upward path
  • No redundancy on the way down
  • Alternatives are many hops away
• Only the end hosts have alternative paths
TYPE A SUBTREE

• Consecutive parents
TYPE B SUBTREE

- Strided Parents
FATTREE
AB FATTREE
CASCADED FAILOVER PROTOCOL

• 3 protocols at different timescale
• Local rerouting mechanism
• Pushback notification scheme
• Epoch based centralized scheduler
LOCAL REROUTING

- Rapid response to around the failure (less than TCP timeout)
- Local rerouting for upward link is simple
- Route to a sibling in opposite-type subtree
PUSHBACK NOTIFICATION

- Happen after the local rerouting to find direct paths.
- Broadcast the message the closest node that has alternative direct path.
CENTRALIZED SCHEDULER

- Related to existing work (Hedera, MicroTE)
- Gather traffic matrices
- Place long-lived flows based on their size
- Place shorter flows weighted ECMP
FAILURE DETECTION

- Heartbeats is slow
- Congestion
- Gray failures
- Don’t want to waste too many resource
HOW DOES F10 DO

• Send traffic to physical neighbors when idle
• monitor incoming bit transitions and packets
• stop sending and reroute the very next packet
EVALUATION

• Methodology
  • Click implementation
  • 24-port switches
  • Traffic model from Benson IMC2010
  • Failure model from Gill et al. SIGCOMM 2011
REROUTE QUICKLY

- Failure happens at 10ms
• F10 can recover from failures in under a millisecond before TCP timeout
CONGESTION LOSS

- Portland has 7.6x the congestion loss of F10 under realistic traffic and failure conditions.
IMPROVE APP PERFORMANCE

- Jobs in Mapreduce finish much quickly compared with Portland under the same traffic and failure pattern
CONCLUSION

• F10 is a co-design of topology, routing protocols, and failure detector

• Significant benefit to application performance on typical workloads and failure conditions
REFERENCE


THANKS