

Survivability for Public Safety Networks

Dr. Vanu G. Bose
CEO Vanu, Inc.



Commercial Reliability ≠ Public Safety Survivability

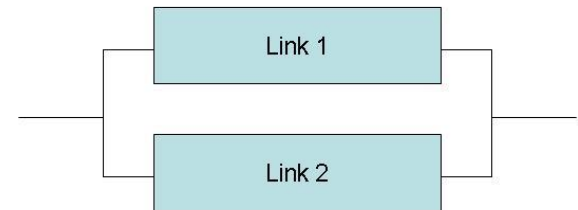
- 5 9's is a metric for network *availability* under **random, independent** failures.
 - Therefore: the probability of multiple simultaneous failures is near zero.
- In a disaster, failures are **not** independent, and multiple simultaneous failures are common

Lessons from Katrina & 9/11

- FCC report on Katrina identified power and backhaul as the primary failure mechanisms
- Best example of survivability was a power company that had redundant heterogeneous backhaul connections (one terrestrial, one wireless)
- 9/11 showed us that time to total network failure in a disaster is inversely related number of sites (public safety, commercial, Wifi)
 - Also Wifi deployed heterogeneously, with different backhaul and power solutions.

Cost Effective, Survivable Backhaul

- Redundant heterogeneous backhaul with different modes of failure



- *Parallel Availability: $A_c = 1 - (1 - A)^2$*
- If each link has an availability of 3 nines, 99.9%, then the availability of the two combined links is 6 nines under normal operation
- If links have different failure modes, then survivability is also increased

Network Architecture Implications

- We don't have redundant power grids
 - Best approach is to minimize power consumption at site to extend battery life.
 - Diesel is impractical and expensive
 - Example: Vanu has created a cellular base station for rural developing markets that consumes only 50W of power.
- Large number of lower cost sites lead to better survivability
 - Even if each site is less reliable
 - A greater number of smaller sites is compatible with lower power consumption per site.

Summary

- The primary commercial challenge is high availability and capacity at busy hour
- The primary public safety challenge is communications during a disaster

By thinking about Survivability rather than Availability we can build a public safety network that is more survivable in disasters at lower cost than a highly available commercial network.