# Network Reliability and Redundancy

A University / Information Technologies Perspective

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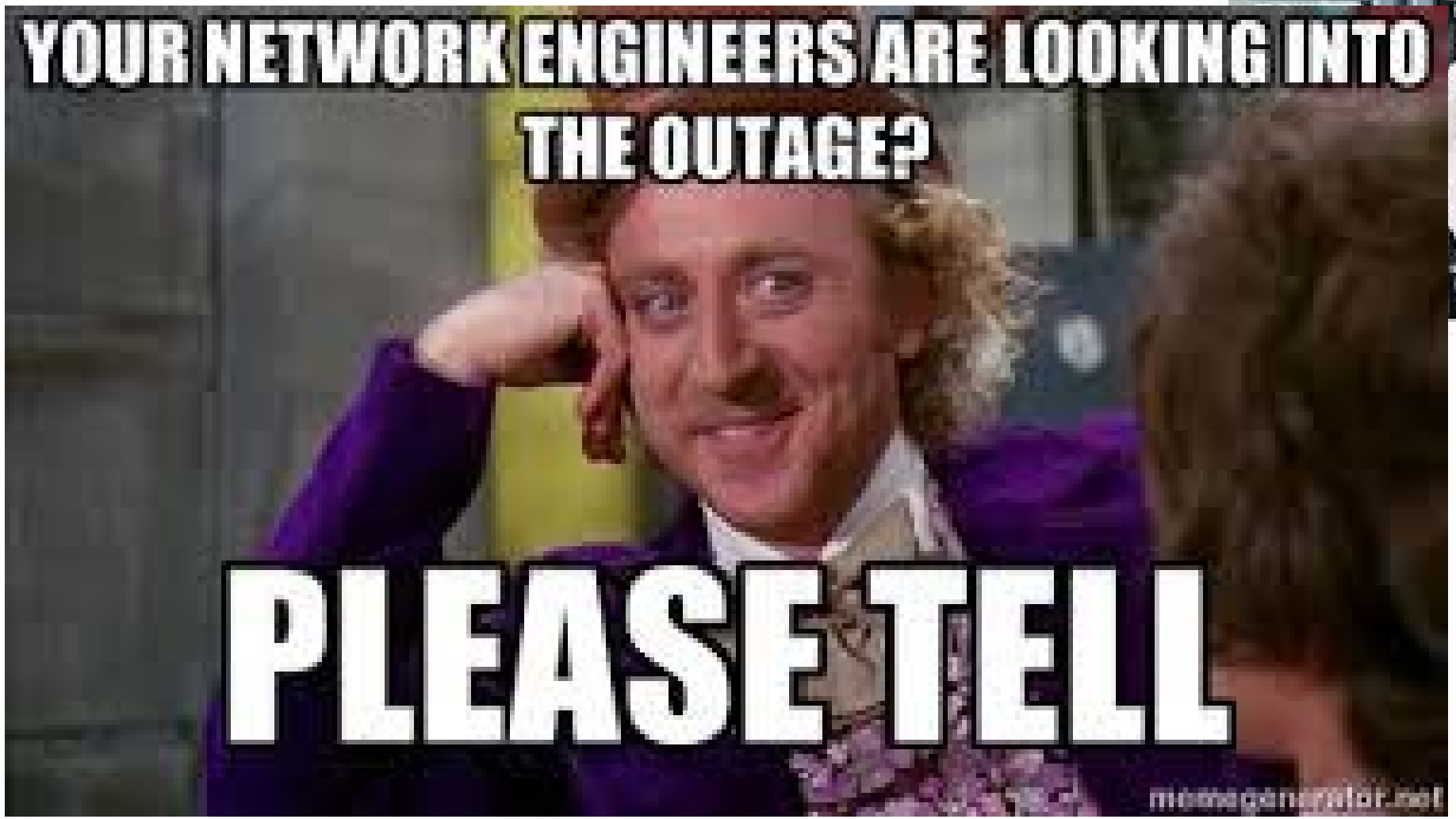
# The CIO’s perspective

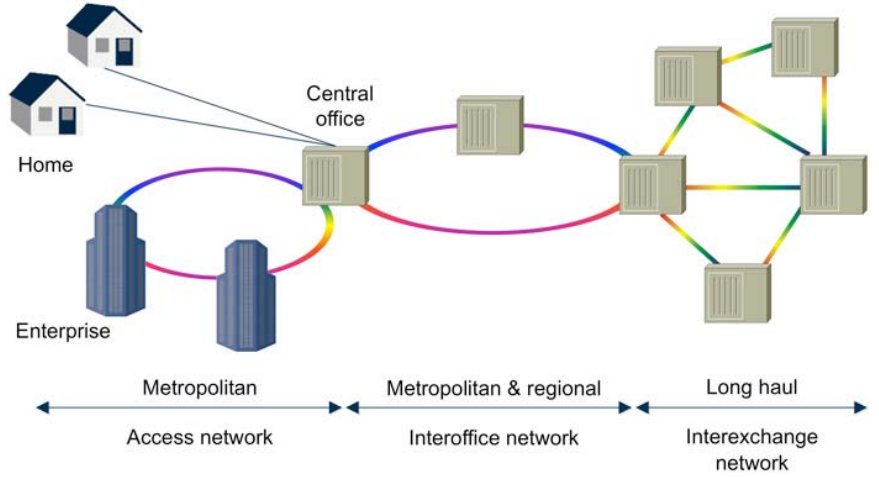


# How reliable is *your* network?

- Reliability “generally” means the ability of a network to consistently perform according to specification … end to end
- Specifications “generally” have to do with
  - Availability
    - Can I get on when I need to?
    - Can I get to where I need to go?
  - Speed/Capacity
    - Can I get my stuff done reasonably?
  - Latency
    - Does it get up and go or is there a lag?
  - Sustainability
    - Can we keep up with operating costs?

# Case Study: Albuquerque Gigapop

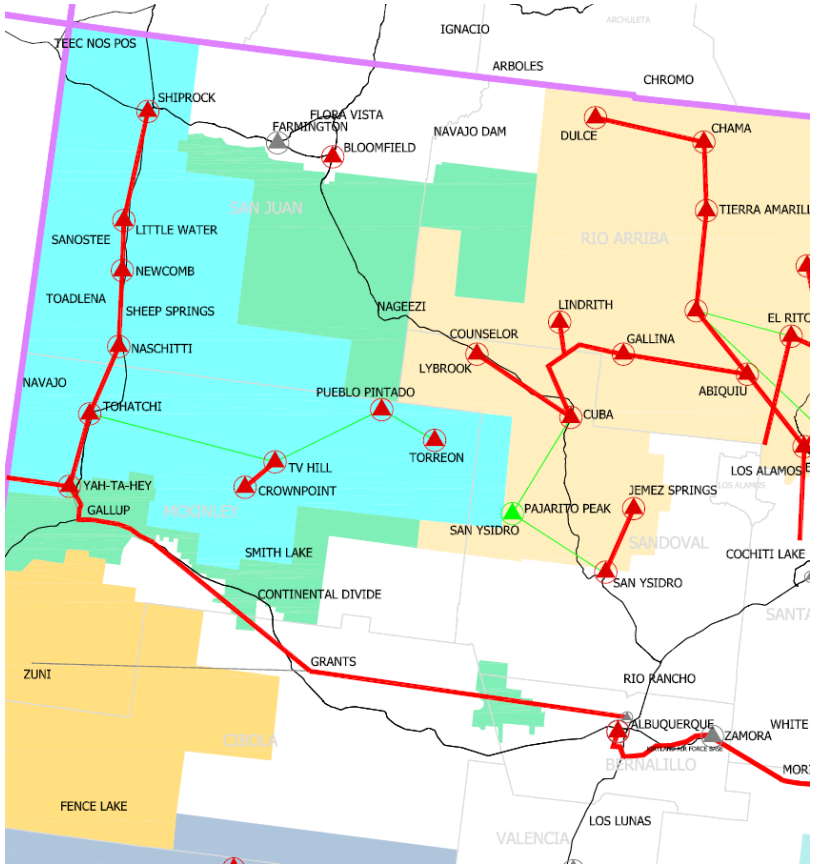
- Organizations that inter-connect at 505 Marquette need assurance that large volumes of traffic could be delivered reliably to the “long-haul” facilities
- DoIT decided certain traffic could not be routed there without “REDUNDANT fiber optic paths”, invested in second path to the long haul facility
- Result: Reliability sufficient for more demanding applications



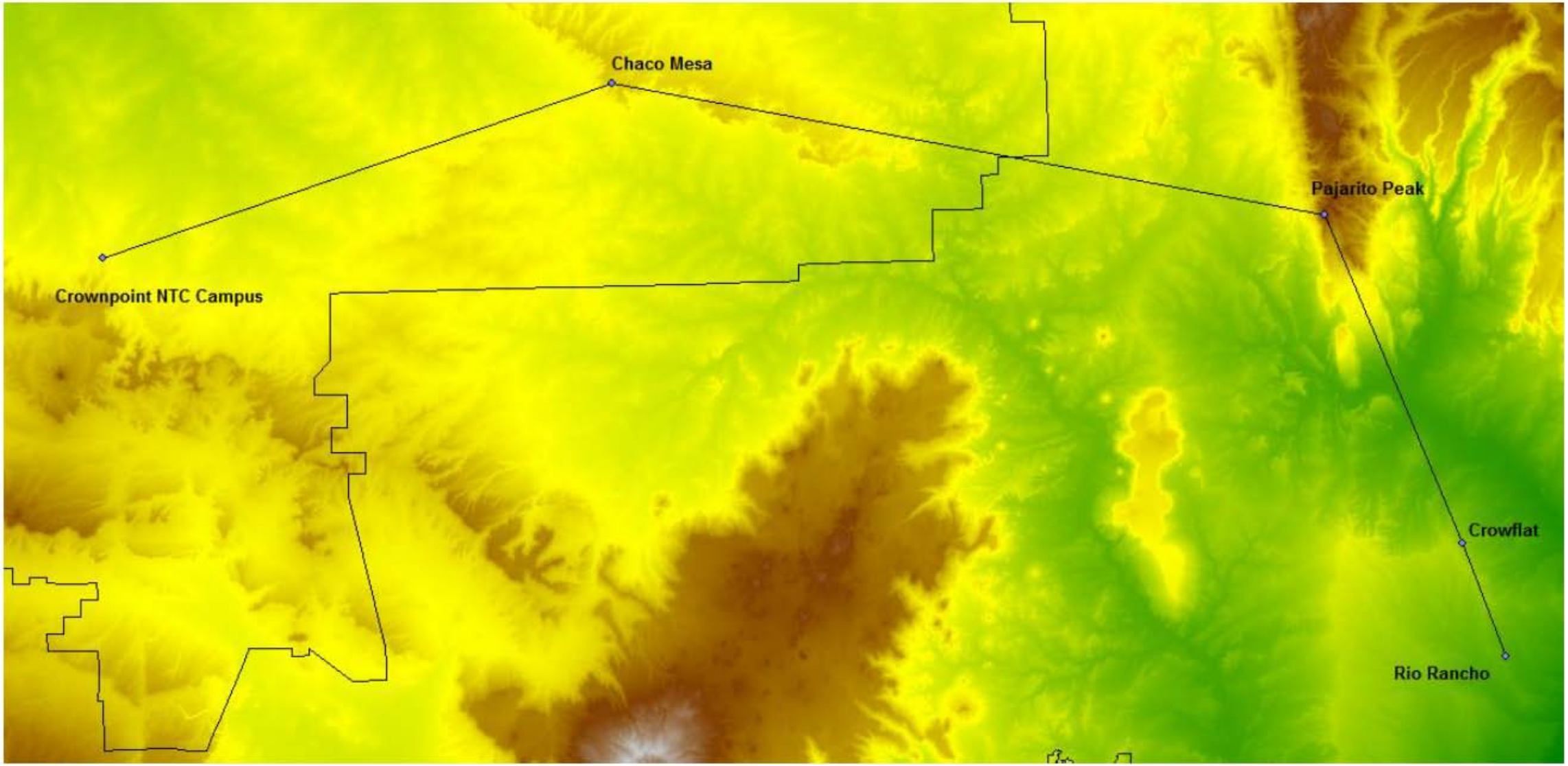
# Albuquerque Gigapop Dual Paths to Long Haul

# Case Study:  Gallup Part One

- All commercial broadband for Gallup is delivered via a single physical path from Albuquerque to Gallup—there is only one middle mile solution with adequate capacity
- Life is busy on Route 66.  When that route is disrupted [insert quote from Harold Skow, Navajo Nation CIO]
- A REDUNDANT but lower capacity, slightly lower availability path is in place, but would require an upgrade to use as a failover
- Collaborative efforts the City of Gallup, Navajo Technical College, and UNM Main and Gallup to upgrade redundant path and “interoperate” our networks to enable both paths
- Result: Network will stay up if/when either path fails—improved reliability

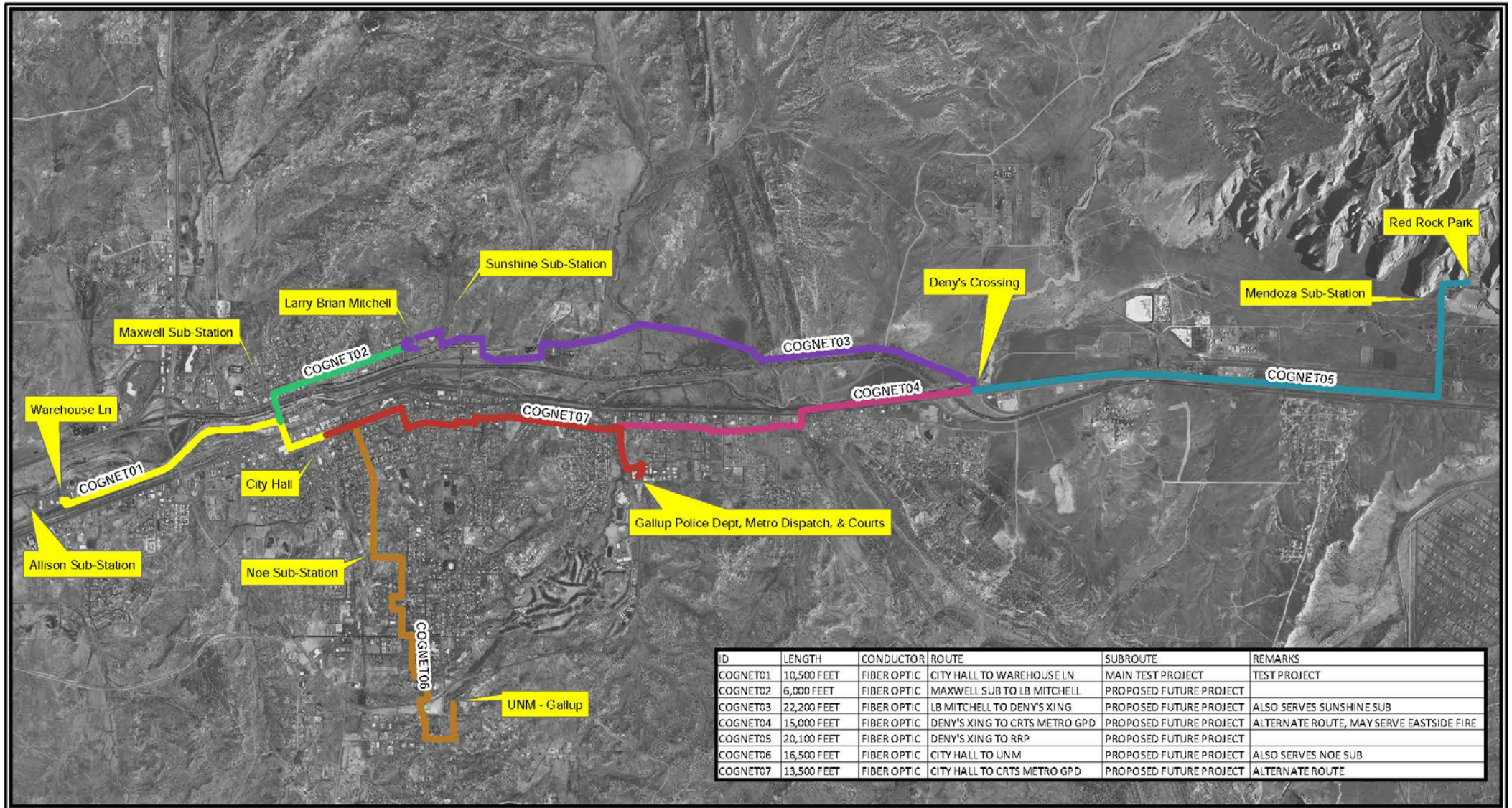


# NTC Microwave Path Upgrade (half-way there!)



# Case Study:  Gallup Part Two

- City Facilities far flung each like a spur on the network, ripe for failure
- City plans to leverage it utility poles to create one or more fiber rings
- Fiber path between City and UNM Gallup Branch will allow sharing of both paths back to Albuquerque
- Result:  Improved reliability and lower operating costs




| ID | LENGTH | CONDUCTOR | ROUTE | SUBROUTE | REMARKS |
|---|---|---|---|---|---|
| COGNET01 | 10,500 FEET | FIBER OPTIC | CITY HALL TO WAREHOUSE LN | MAIN TEST PROJECT | TEST PROJECT |
| COGNET02 | 6,000 FEET | FIBER OPTIC | MAXWELL SUB TO LB MITCHELL | PROPOSED FUTURE PROJECT | |
| COGNET03 | 22,200 FEET | FIBER OPTIC | LB MITCHELL TO DENY'S XING | PROPOSED FUTURE PROJECT | ALSO SERVES SUNSHINE SUB |
| COGNET04 | 15,000 FEET | FIBER OPTIC | DENY'S XING TO CRTS METRO GPD | PROPOSED FUTURE PROJECT | ALTERNATE ROUTE, MAY SERVE EASTSIDE FIRE |
| COGNET05 | 20,100 FEET | FIBER OPTIC | DENY'S XING TO RRP | PROPOSED FUTURE PROJECT | |
| COGNET06 | 16,500 FEET | FIBER OPTIC | CITY HALL TO UNM | PROPOSED FUTURE PROJECT | ALSO SERVES NOE SUB |
| COGNET07 | 13,500 FEET | FIBER OPTIC | CITY HALL TO CRTS METRO GPD | PROPOSED FUTURE PROJECT | ALTERNATE ROUTE |

CITY OF GALLUP

# Other Proposed Fiber Optic Routes

Legend

Proposed Route

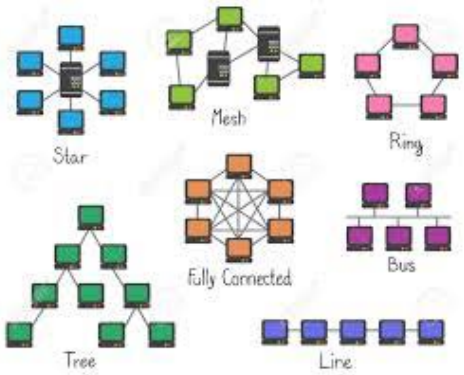
- CITY HALL TO CRTS METRO GPD
- CITY HALL TO UNM
- CITY HALL TO WAREHOUSE LN
- DENY'S XING TO CRTS METRO GPD
- DENY'S XING TO RRP
- LB MITCHELL TO DENY'S XING
- MAXWELL SUB TO LB MITCHELL

1 inch = 3,000 feet

# How reliable do you NEED your network?

- Do you have “real-time” activities that requi low latency / lag
  - Public Safety
  - Medical
- Do you have high utilization:  lots of users who need to be consistently productive?
  - UNM consistently at 50-100K connections/day
- Do you need to move lots of data around?
  - Research data sets, as an example
- Capacity (maximum throughput rate)
  - Add it all up and at the peak points of the day, can your network do it?

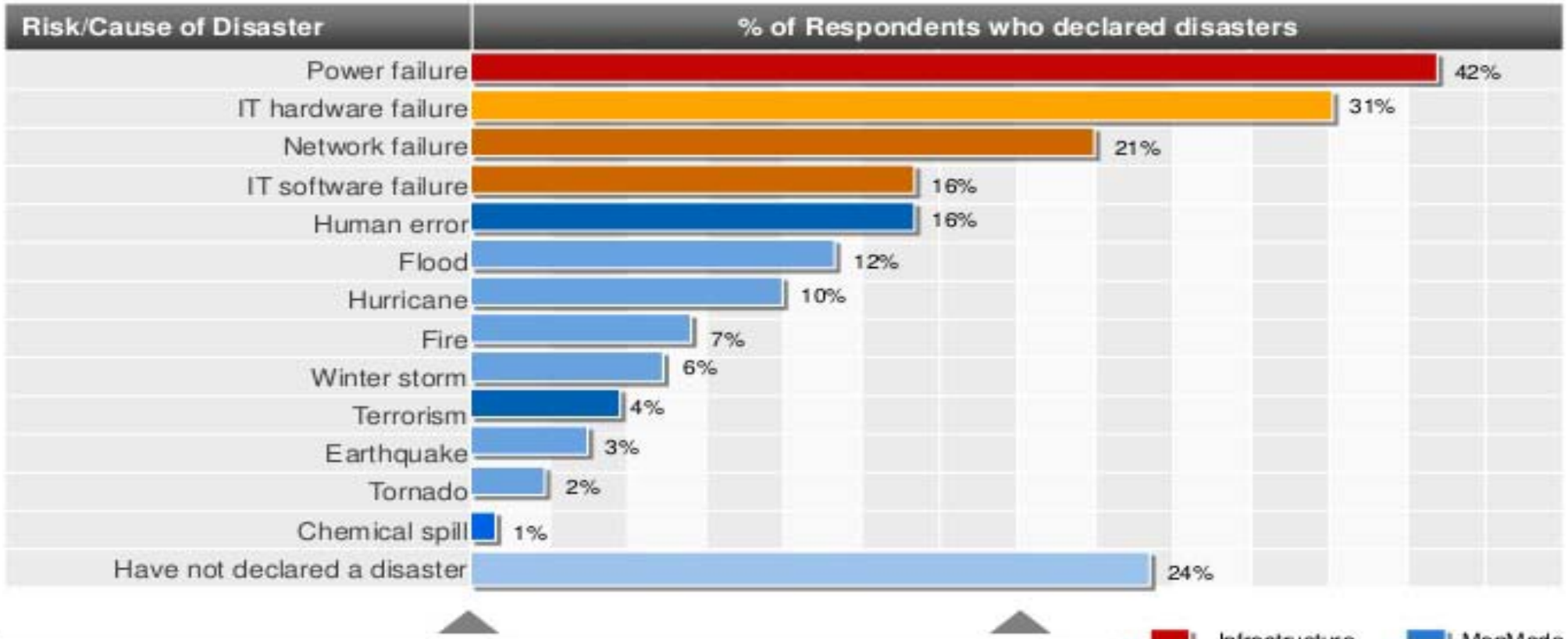
# Networks are as reliable as they are designed




- For Schools
  - Does it matter if testing is interrupted?
  - Are students expecting to be able to turn in homework at 3am?
  - Do you need to stream video consistently?
- For a typical business
  - How much down time can you afford on your point of sale?
  - Do you expect your network to be up at 7am in Japan?
- For hospitals?
- Film industry and $ transactions usually don’t tolerate delays
- For the home… it depends:  telework?  Students? Grandkids? Security?
- And what can you afford????

# Common Causes of Downtime

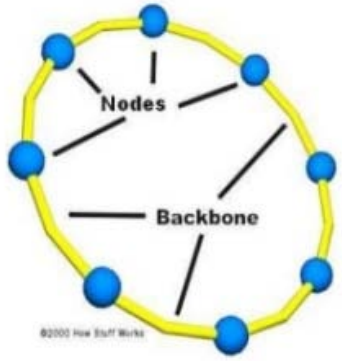
Source: Forester Research, Inc. 2007

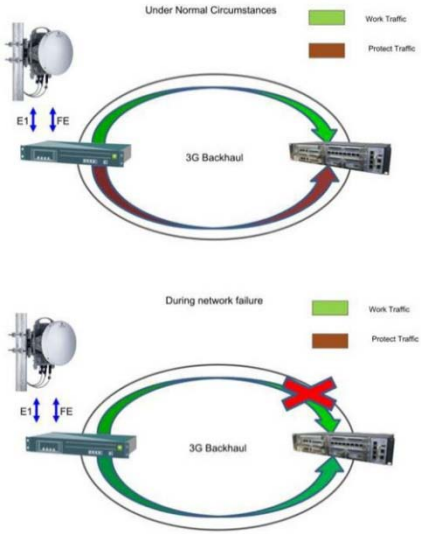


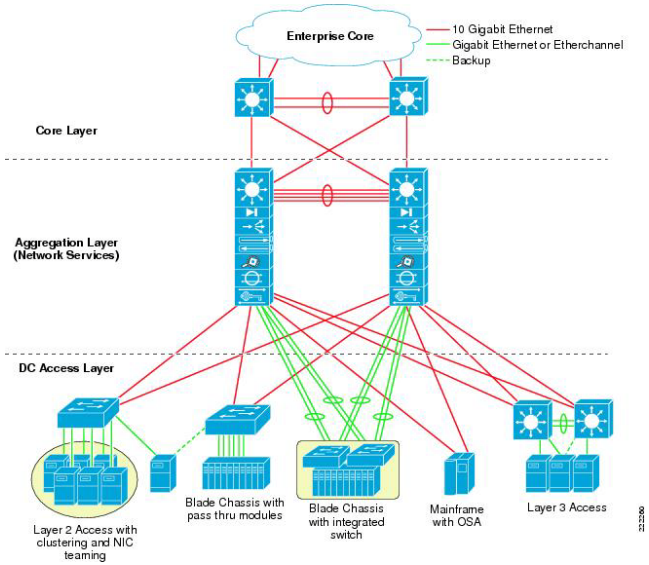

- 27% of respondents declared at least one disaster in the past five years
- 42% of respondents indicated that a power failure was the cause of their most significant disruption

# Physical Design Countermeasures (single points of failure are the enemy!)

- Redundant Power
  - Generators (100+at UNM!)
  - Two transmission feeds
  - Dual A/B paths into data center/core routers
- Redundant Fiber Paths
  - Create rings
  - Which enable dual paths
- Equipment Failure
  - Duplication
  - Spares/hot spares
  - Care (Management)
- Isolation
  - No conduit or sheath sharing

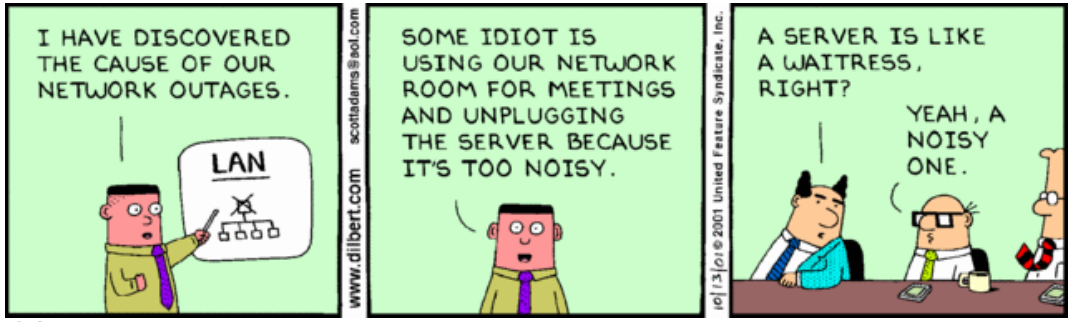


# Biggest Threats to Network Reliability

- Physical Damage
  - Power feed disrupted
  - Usually fiber/line cuts
  - Equipment damage, usually water or heat
  - Equipment Failure
- Cyberattacks or other software “damage”
  - Denial of Service attacks
  - Bad changes:  the oops
- Scarcity
  - Causes prices to rise
  - Increases risk through single points of failure



# Case Study:  Espanola

- Northern New Mexico College is participating with the New Mexico Research Partners (UNM, NMSU & NMT) and it's peers at Western, Eastern, Highlands and Navajo Technical College and now sponsored by the National Science Foundation to participate in what will become a New Mexico Science Network—requiring greater capacity and reliability
- Northern received $300K to address the internal/campus network
- As Northern connects to the science network, incremental capacity AND reliability via a second connection could be provided by REDI-net which invested in a REDUNANT fiber path

# Design Countermeasures for Affordability

- Volume Purchasing … if City of Gallup and the branch share, a better rate is achieved with less overhead
- Encourage competition!
- Consider “owning” rather than “renting” some assets (current FCC strategy for e-rate)
- Caching … software that minimizes your internet bill by storing regularly used content
- Aggregation … meeting at a “point of presence” or “regional hug” physically enables volume purchases
- Peering … eliminates the need for traffic to go to the internet if it stays among “interoperating” networks—a student at Albuquerque High taking on on-line class gets the content direct from UNM and not through the “external” network, saving on the internet bill and getting better response!

# In Conclusion

- IT professionals deliver reliability as necessary to meet the needs of the users of the network
- Redundancy is an important tool in network design as a counter measure to risk of network failure
- Case studies show the value of investments in what might be considered “extra” but turns out to be necessary
- Public network managers are working together to implement the better reliability for our constituents through sound network design principles which sometimes requires investment in “redundant” network capacity