



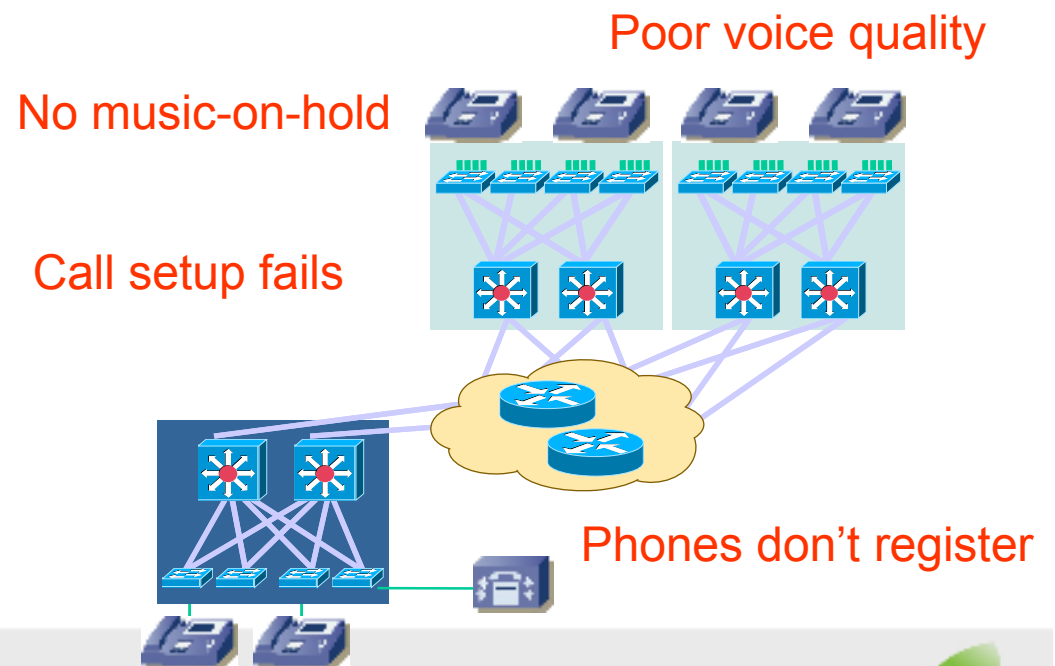
Troubleshooting Converged VoIP and Data Networks

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www.netcordia.com/resources/webinars.asp

Objective: Provide Knowledge

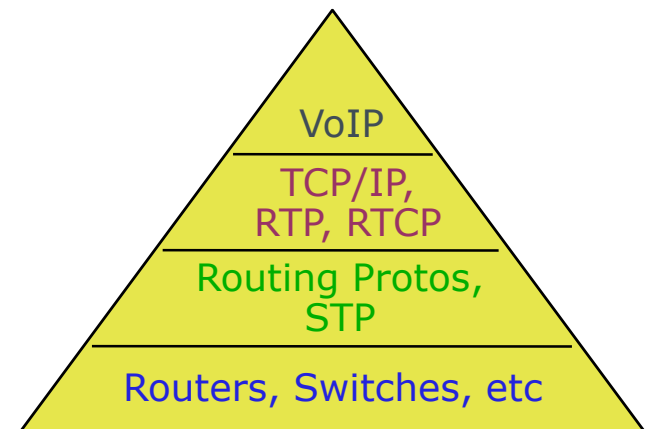
- High-level overview of VoIP operation
- Identify symptoms of common VoIP problems
- Troubleshooting steps to take
- Understand how the network affects VoIP
- Recommendations on remediation



VoIP Operational Steps

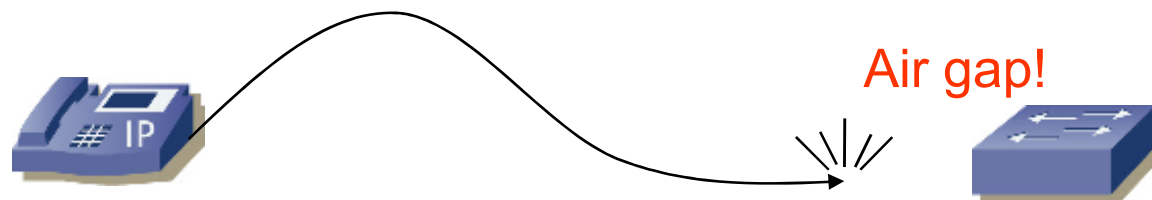
- **Phone connectivity and registration**
- **Call setup**
- **Call operation and factors affecting call quality**
- **Other services - music on hold, local redundancy**

- **The network is the foundation upon which VoIP depends**
- **Use the operational steps to focus troubleshooting efforts**
- **See where automated methods are required**



Phone Connectivity - Power

- **Symptom: No lights, no joy**
- **Not connected to a switch port**
- **Basic cabling problems**
- **Switch without PoE capability**
 - Connected to a data port?
- **The PoE power source is over limits**
 - Monitor power supply capacity

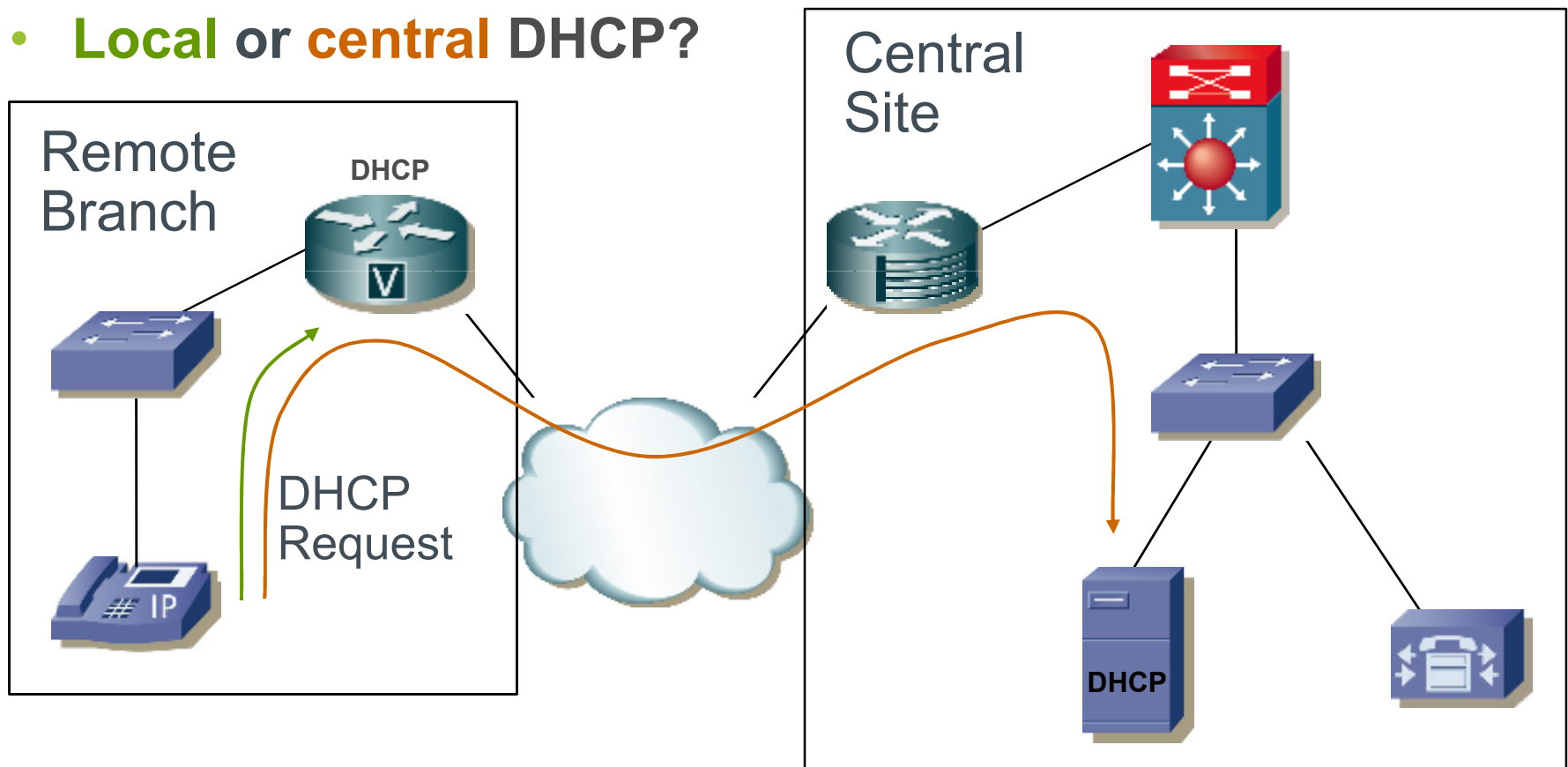


Phone Connectivity - VLAN

- **Symptom: Wrong VLAN & DHCP information in phone**
- **Switch doesn't support voice VLAN**
- **Static configuration set on phone (eBay purchases)**
- **Helper address on local router to forward DHCP requests**
- **Incorrect default gateway in DHCP reply or static configuration**

Phone Connectivity – DHCP

- Symptom: Phones don't get an IP address
- No DHCP server in voice VLAN
- **Local** or **central** DHCP?



Phone Connectivity – DHCP Location

- **Understand the tradeoffs**
- **Central**
 - Multi-day address lease – longer than normal downtime
 - Reduces network equipment configuration
 - Good if many small branches exist
 - Handling long connectivity downtime due to disaster
- **Local**
 - Short address lease
 - Manage network equipment config at each site
 - More appropriate at larger remote sites.
 - Good if downtime is more extensive
 - Very remote offices (Asia, Europe, South/LatinAmerica?)

Phone Connectivity - System Reboot

- **Symptom: Phones take 20 minutes to boot after power outage**
- **Overloaded DHCP/TFTP servers or call controller**
 - All phones boot simultaneously as power comes up
 - Minimize phone boot and registration time
- **Longer DHCP leases**
- **Store correct OS into phone flash memory**
- **Distributed DHCP/TFTP servers**
 - Reduce the number of eggs in one basket
- **DHCP/TFTP servers that boot slowly**
- **Know how your vendor's system works**

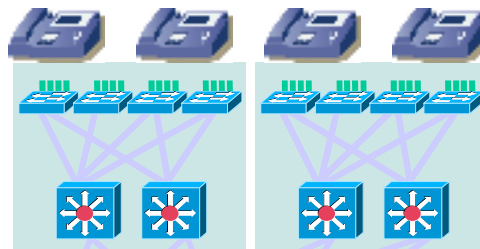
Phone Connectivity - TFTP

- **Symptom: Phones act differently**
- **TFTP server not reachable (routing problem?)**
- **Inconsistent OS or configuration on the phone**
- **Load the OS in phone's flash memory**
- **Regular audit of OS versions**
 - A good idea for any type of device
- **Also applies to Media Gateways (PSTN gateways)**

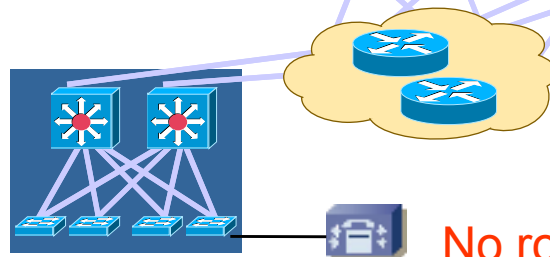
Phone Registration Failure

- **Symptom: Phones can't register**
- **Check configuration of call controller addresses**
- **Call controllers not reachable? (routing, ACL, or switching problem - registration uses TCP)**
- **Call controller can't reach phones (routing problem)**

Wrong call controller address
(controller moved?)



No route to call controller

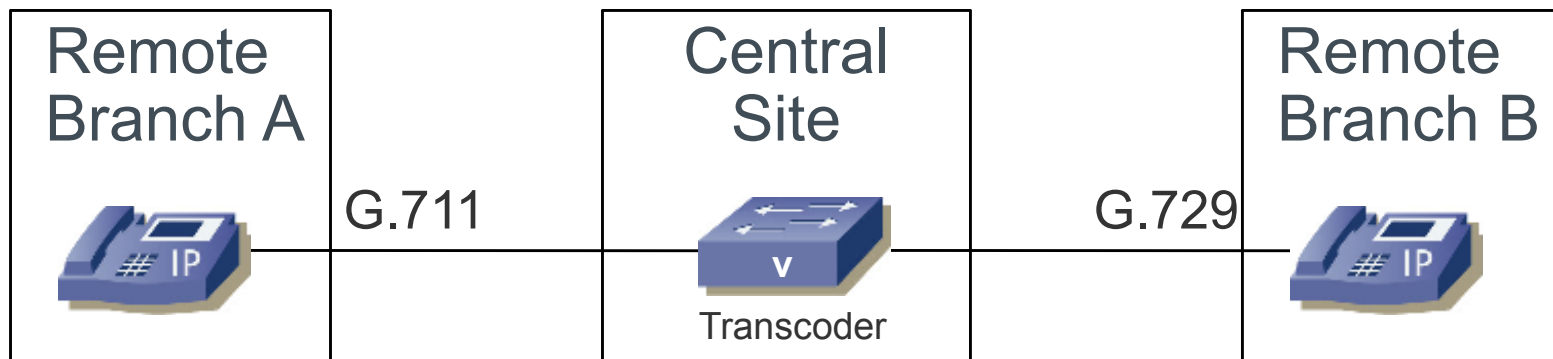


Firewall, ACL, or routing problem

No route to phones

Call Setup Failure

- **Symptom: Some phones can't talk to selected phones**
- **Codecs must match on each call leg**
- **Transcoding can perform the match**
- **Symptom: Calls fail to connect at high call volumes**
- **Limited transcoding resources (DSP pool)**
- **Codec configuration incorrect across sites**



Call Setup Failure

- **Symptom: Phones suddenly can't communicate**
- **Redundancy failure**
 - Redundant router pair failed; first failure went unnoticed
 - Phones suddenly isolated
- **Symptom: Phones fail in power outage**
- **Network infrastructure lacking power backup**
 - UPS must power network devices and phones
 - Monitor battery health - know when to replace them
- **Symptom: Calls to specific numbers always fail**
- **Dial plan error**
 - Destination number maps to an invalid phone
 - Periodically check call controller logs to detect failures

Call Operation - Delay, Jitter, Packet Loss

- **Symptom: Choppy voice quality**
- **Call stats (vendor dependent)**
 - Call Data Records: who called, when, duration
 - Call Maintenance Records (Cisco)
 - Real-time control protocol (RTCP) stream (Avaya)
 - ISO standard: 150ms delay, 30ms jitter, 1% pkt loss
- **Inconsistent QoS configuration**
- **Proactively monitor call stats and QoS queue drops**
 - Know when phones are reporting poor call quality
 - Queue drops indicate bandwidth oversubscription
- **Packet loss and errors**
 - Duplex mismatch and bad cabling - interface error stats

G729

Good



60ms Jitter

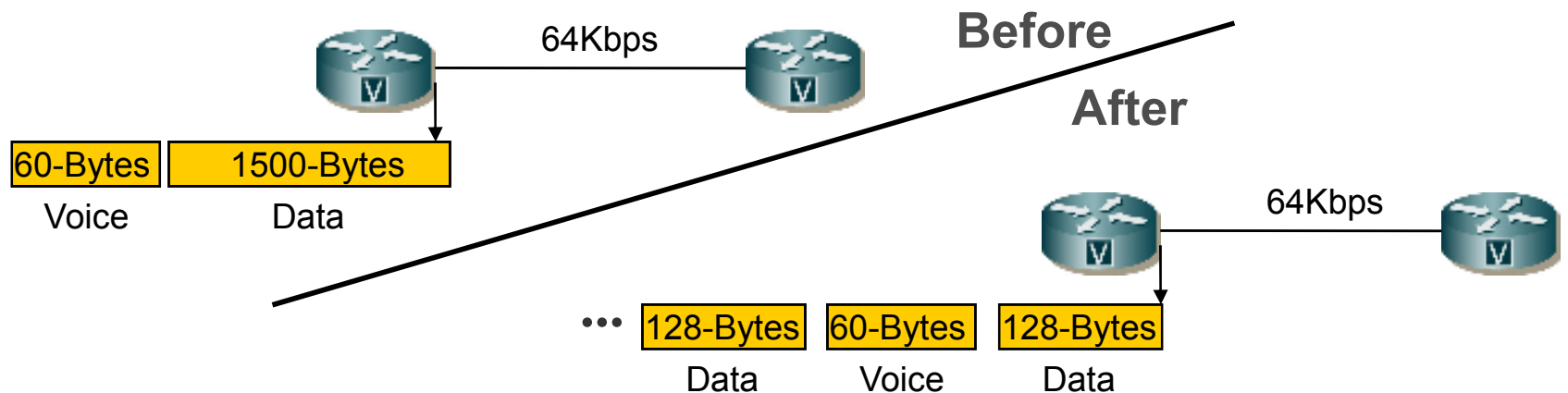


10% packet loss



Call Operation - Jitter

- **Symptom - Choppy audio over low speed links**
- **Serialization delay**
 - Time to transmit a packet on an interface
 - 64Kbps link:
 - 1500Bytes: 187ms 128Bytes: 16ms 60Bytes: 8ms
- **Configure Link Fragmentation and Interleaving (LFI)**
- **Configure smaller link MTU**

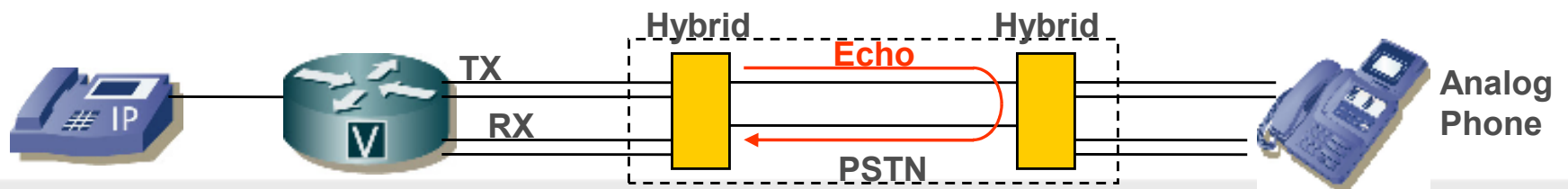


Call Operation - One-Way Audio

- **Symptom: One-way audio on calls**
- **Typical IP routing problems**
 - Default route not set
 - Routing changes (route flaps, interface problems, etc)
 - IP routing disabled on gateways (Cisco)
 - Two-way, then one-way: network change in the path
- **DSP crash (!)**
- **NAT and Firewalls**
 - Cisco Skinny protocol carries IP addr in payload - NAT must know to change the embedded address
 - Unidirectional ACLs blocking flow in one direction
 - TCP for signaling; UDP for audio

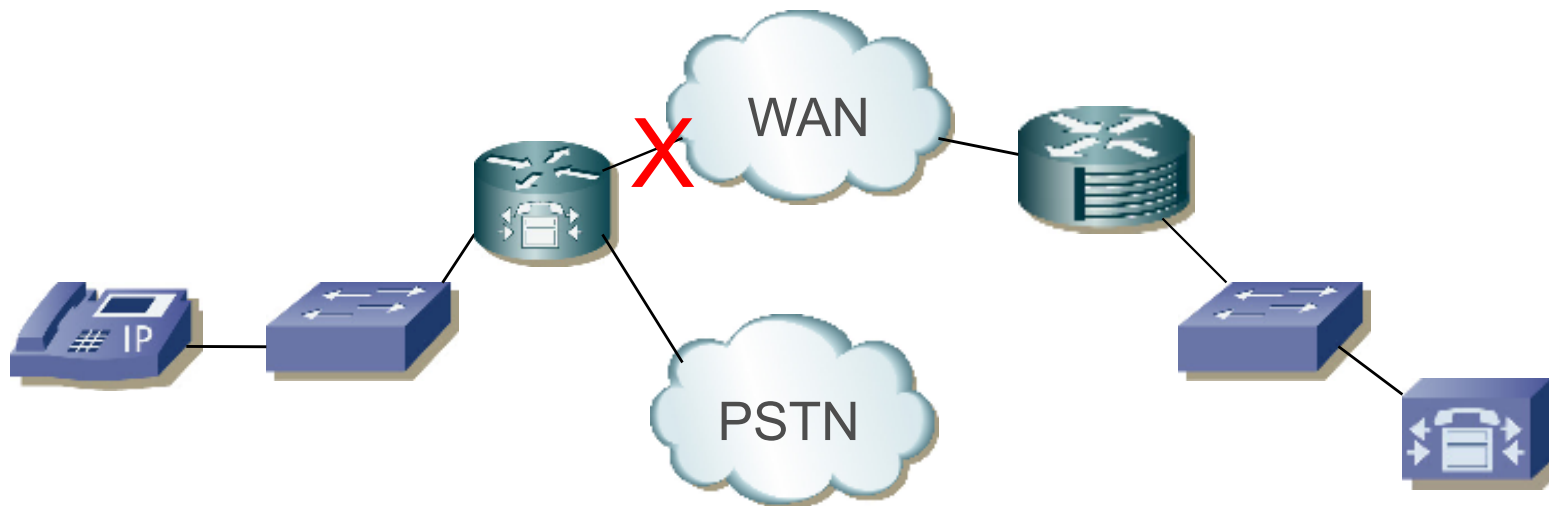
Call Operation - Echo

- **Symptom: Excessive talker echo (the most common)**
- **Acoustic echo**
 - Speaker phone on remote end
 - Increase echo processing timer
- **Electrical echo**
 - Connection to analog PSTN via two-wire to four-wire *hybrid*
 - Reduce output gain & input attenuation to PSTN in small steps
- **Delays inherent in IP telephony contribute to echo**
 - Adjust echo cancellation delay but keep as low as possible



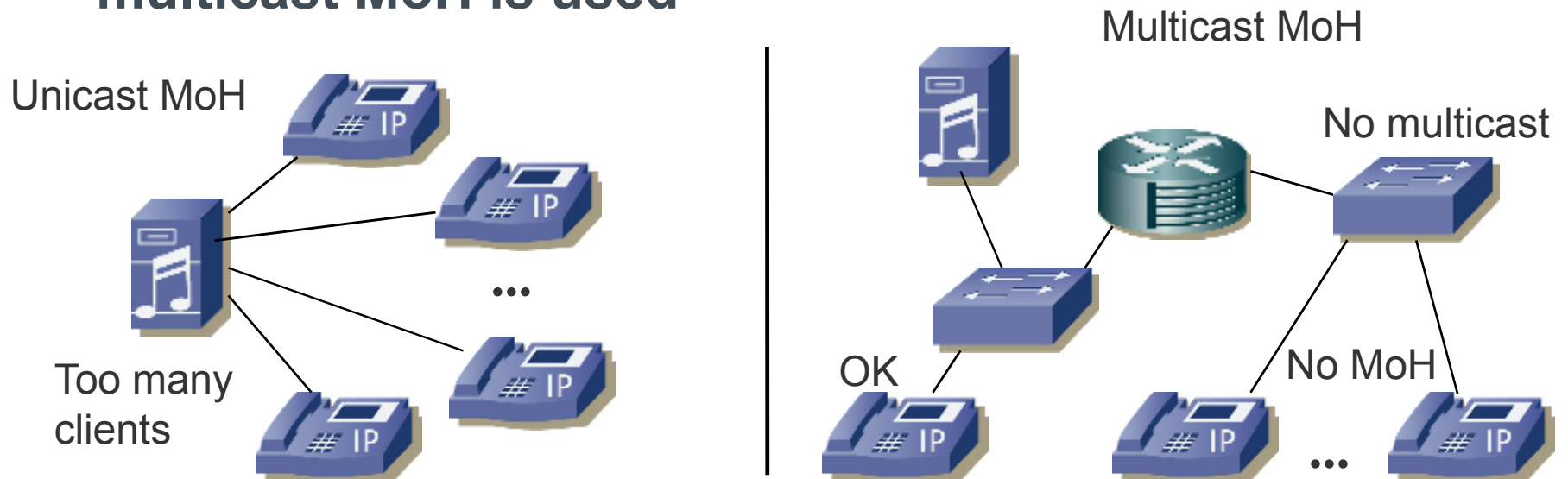
Survivable Remote Site Telephony (SRST)

- **Symptom: Phones can't register with SRST Router**
- **SRST not configured on phone & router**
- **More phones or directory numbers than SRST router supports**
- **Short DHCP lease (increase to 8 days)**



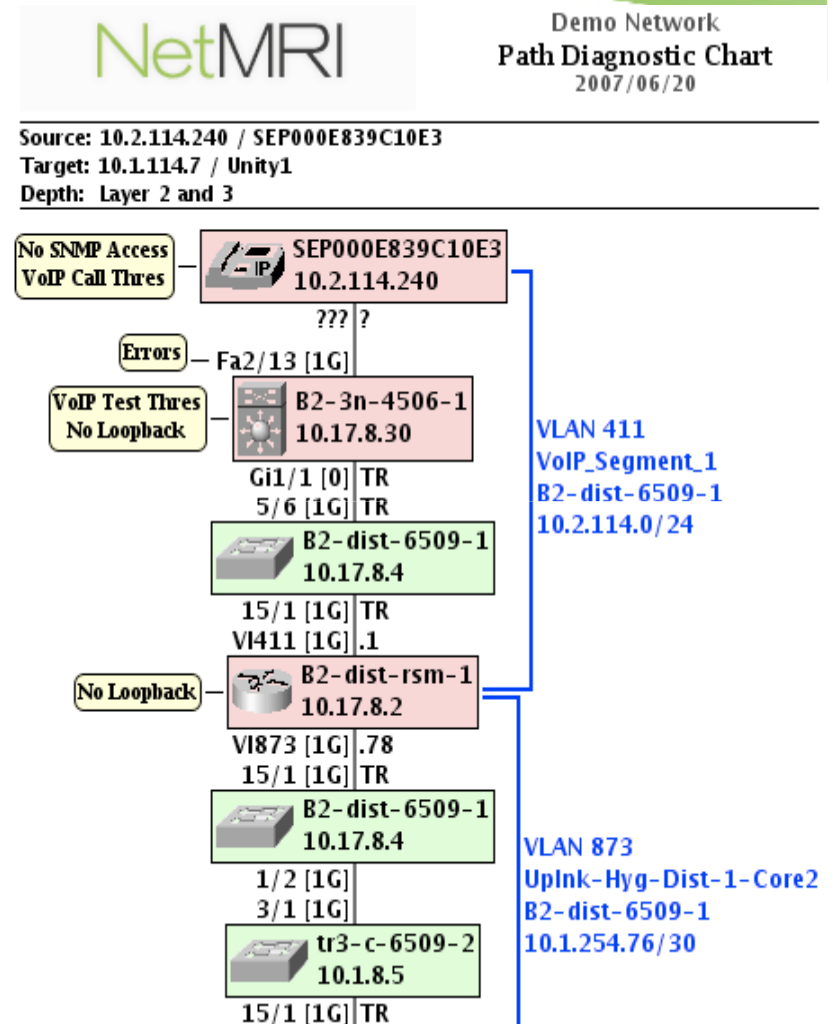
Music on Hold

- **Symptom: Music on Hold not on some phones**
- **No MoH resource defined for the phones**
- **MoH resources exhausted, typically when unicast playback is selected**
- **Multicast routing not consistently configured when multicast MoH is used**



Call Operation - Path Problems

- **Problem: Identifying problems in the path**
- **Determine the path**
 - Layer 2 & Layer 3
- **Identify problems**
- **Provide useful troubleshooting info**
 - Problem identification by device and subsystem



Summary

- VoIP systems are complex
- The underlying network must be a stable foundation
- Comprehensive network visibility is required: routing, switching, link errors, redundancy, QoS
- Minor problems compound to create instability and inefficiency
- Manual methods don't scale

