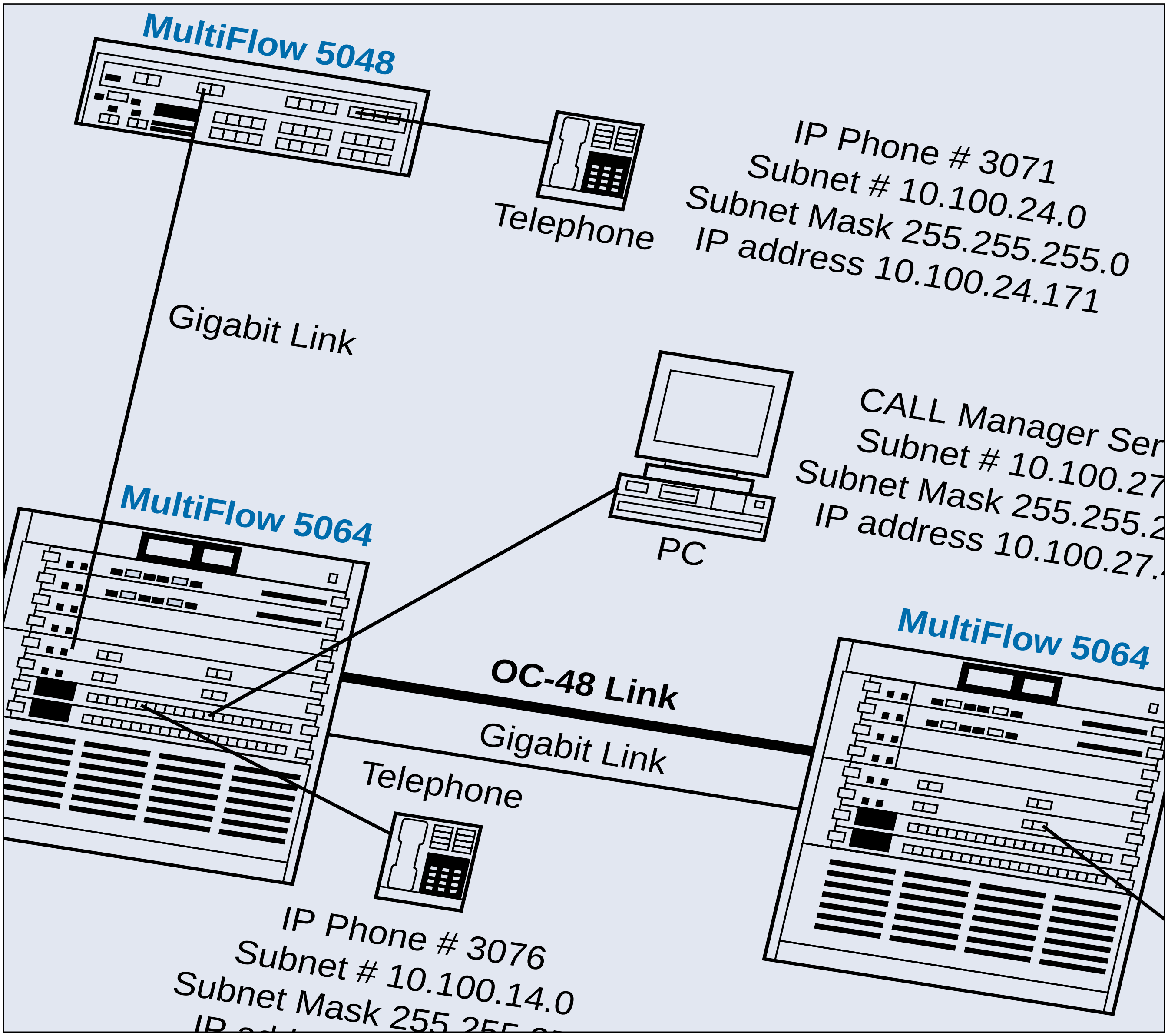
Voice Over IP

Application Note



Introduction

Voice communications over Internet Protocol networks, or Voice over IP (VoIP), has become a reality. The convergence of voice, video, and data communications on an IP network lowers the total cost of ownership and operation by enabling cost savings for long distance calls and by integrating the infrastructure and management operations. However, in order to ensure high quality voice communications, an IP network used for voice communications must have low delay, low jitter, low packet loss, and high reliability even during congestion conditions.

In order to lower the delay, jitter, and loss while carrying VoIP packets, the IP network must be QoS-enabled. Additionally, it must be highly fault tolerant to ensure maximum availability and minimum disconnection.

This application note describes how to configure a reliable and QoS-enabled network using the MultiFlow 5000 and introduces a sample VoIP network using MultiFlow 5000 with Cisco IP phones and Cisco Call Manager server software.

Priority Capabilities

In order to handle VoIP, a network switch has to process voice packets as quickly as possible to minimize added delay. The MultiFlow 5000 uses priority capabilities to handle voice and other important traffic faster than traffic with low importance. The MultiFlow 5000 has 3 levels of internal packet queues (2 for unicast packets and 1 for multicast/broadcast packets). The high priority unicast queue has the highest priority and widest bandwidth, so the packets buffered into this priority queue are given lower latency and higher bandwidth. In order to associate packet streams with priority queues, you can use Layer 2 (802.1p) and/or Layer 3 (DiffServ, referred to as QoS) priority capabilities.

Using DiffServ for Voice Packet Processing

Since VoIP packets are IP packets and would likely be conveyed across IP segments, Layer 3 prioritization using DiffServ is better than Layer 2 (802.1p) prioritization. This is because Layer 2 priority information, which is contained in VLAN tags, is lost every time the packet is switched via a non-VLAN-trunk link or is routed. In these situations, each switch must re-prioritize the packet.

DiffServ's 6-bit priority information (DSCP: DiffServ Code Point) is contained in the DS (formerly ToS) field of IP packets (Figure 1). The MultiFlow 5000 with DiffServ support maps the DSCP into internal priority packet queues. It makes the conversion directly or via Layer 2 priority conversion. The MultiFlow 5000 can also write or modify the DSCP based on incoming Layer 3/4 information by using its Layer 3/4 filtering function. VoIP packets can be distinguished from others by checking Layer 4 port numbers.

Note: DiffServ is optional software and a software key is needed to activate the function.

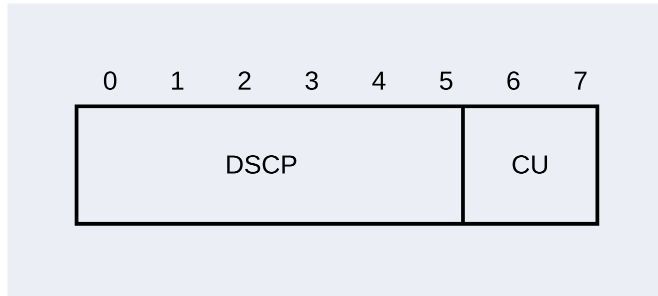


Figure 1: DS Field Structure

Weighted Priority Scheduling (WPS) Benefits

The MultiFlow 5000 enables QoS by using Weighted Priority Scheduling (WPS). WPS ensures that the packet at the head of the highest priority queue will be processed just after the currently processed packet even if the output port is congested, as long as its given credits remain above the threshold level. WPS also guarantees a wider bandwidth for the highest priority queue by giving higher credits, so there is lower potential for loss of voice packets under congestion conditions.

If a switch did not support priority handling and the VoIP packets were processed after a number of long packets such as ftp packets, the voice packets would not reach their destinations within acceptable time, and transmission delays would vary.

Fault Tolerant Capabilities

A telephone connection should not be disconnected even if a single path in the network fails. This means that the primary link should be backed up by at least one redundant link that must take over quickly in case the primary link fails. The MultiFlow 5000 supports several functions that enable fault-tolerant networks:

- Anritsu Quick Reconfiguration (AQR)
- Link Aggregation
- Equal-Cost Multipath (ECMP) Routing
- Virtual Router Redundancy Protocol (VRRP)
- Quick Path Change

Anritsu Quick Reconfiguration (AQR)

The Anritsu Quick Reconfiguration (AQR) feature is an extension to the Spanning Tree Protocol (STP) that shortens the STP recovery time. In normal STP configuration, it takes 14 to 55 seconds to recover from a link-failed condition. AQR, however, finishes reconfiguration and the network recovers in about 2 seconds so telephone calls would not be disconnected. Like STP, AQR works within Layer 2 networks.

Link Aggregation

The Link Aggregation feature handles multiple physical links as a single large logical link and enables wider bandwidth between two switches. The MultiFlow 5000 supports up to 4 aggregation groups that each contain up to 8 aggregation ports.

Link Aggregation provides fault tolerance in addition to a wider bandwidth. The logical link between two switches never fails until all the physical aggregated links fail. Even if one or more of the links fail, the other links immediately take over the calls that were transported on the failed links and no calls will be disconnected. Link Aggregation works within Layer 2 networks.

Equal-Cost Multipath (ECMP) Routing

The Equal-Cost Multipath (ECMP) Routing feature allows multiple IP routes over any WAN or LAN links that have the same cost factors. Using ECMP, the MultiFlow 5000 automatically distributes routed traffic over all the links. If there is any link failure, it will automatically transport the traffic over the remaining links.

Virtual Router Redundancy Protocol (VRRP)

The MultiFlow 5000's Virtual Router Redundancy Protocol (VRRP) provides rapid failover to one or more backup routes. The backup routes have the same IP addresses as those of the primary router, so nodes such as Cisco IP phones that are neighbors to VRRP routers do not have to change their default-gateway configurations when the primary router fails.

Note: VRRP is optional software and a software key is needed to activate the function.

Quick Path Change

The MultiFlow 5000 Quick Path Change feature provides 1-second recovery from route failures in RIP or OSPF, greatly improving the typical recovery times of 3 minutes or 40 seconds, respectively.

Sample VoIP Network with Cisco IP Phones

We conducted a practical evaluation using the Anritsu MultiFlow 5000 with Cisco IP phones and Cisco Call Manager software. The evaluation was performed for a major city government facility that already had Cisco VoIP products installed.

Figure 2 shows a high-level view of the network configuration. The network comprises 4 subnets. Each subnet contains either an IP phone or the Call Manager server software.

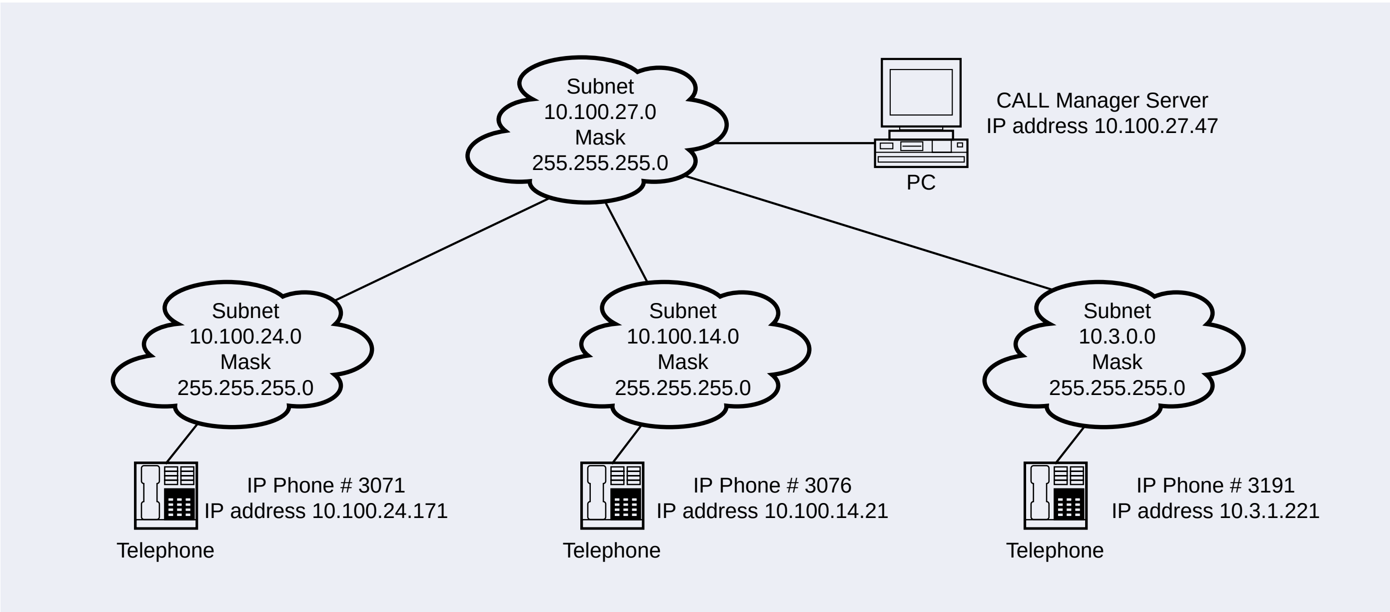


Figure 2: Network Subnet Configuration for IP Phone Evaluation

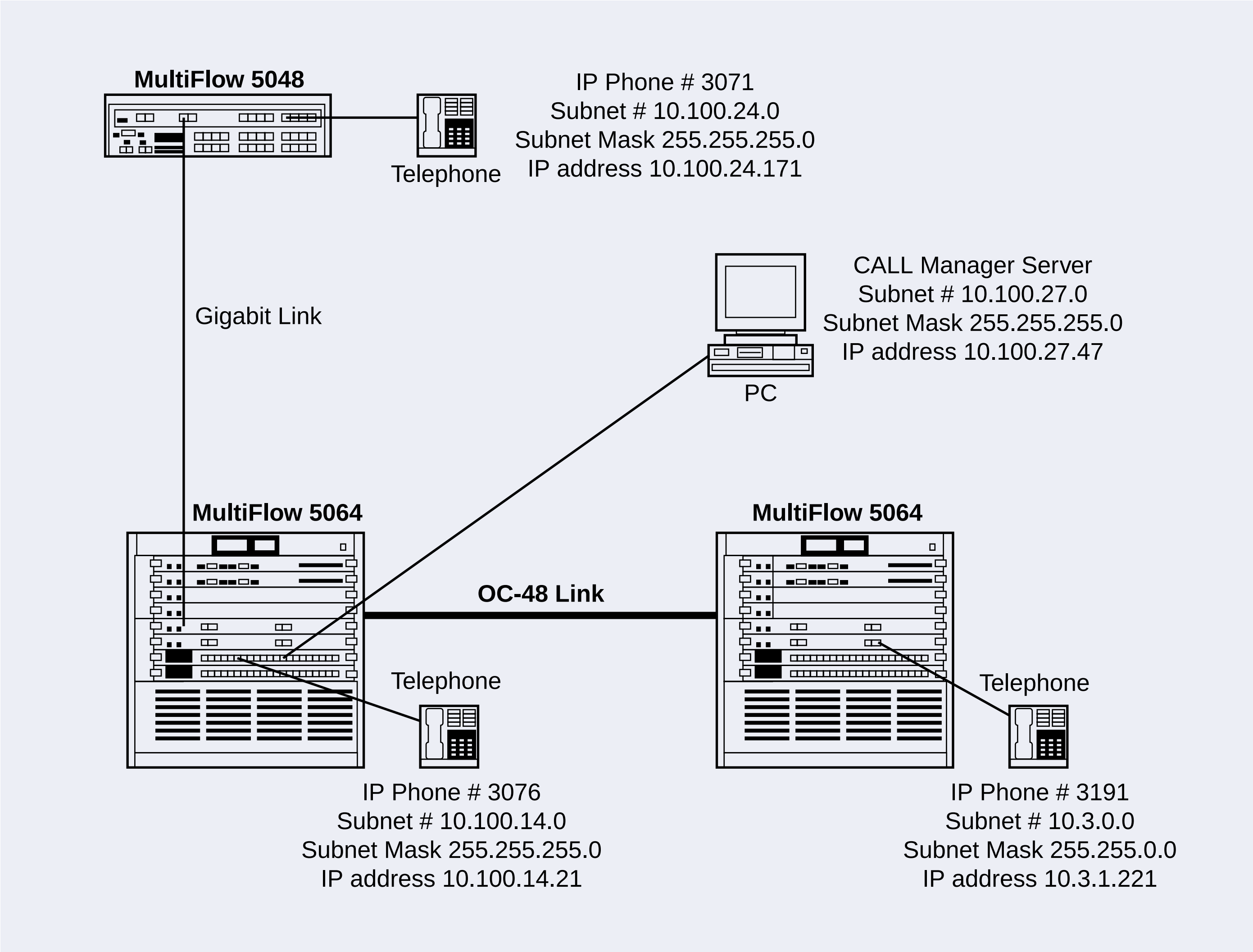


Figure 3: Network Physical Configuration for IP Phone Evaluation

RIPv2 was used for dynamic routing. Figure 3 shows the basic physical connection of the network.

In this test, we evaluated Layer 2 fault tolerant capabilities by enabling AQR or Link Aggregation.

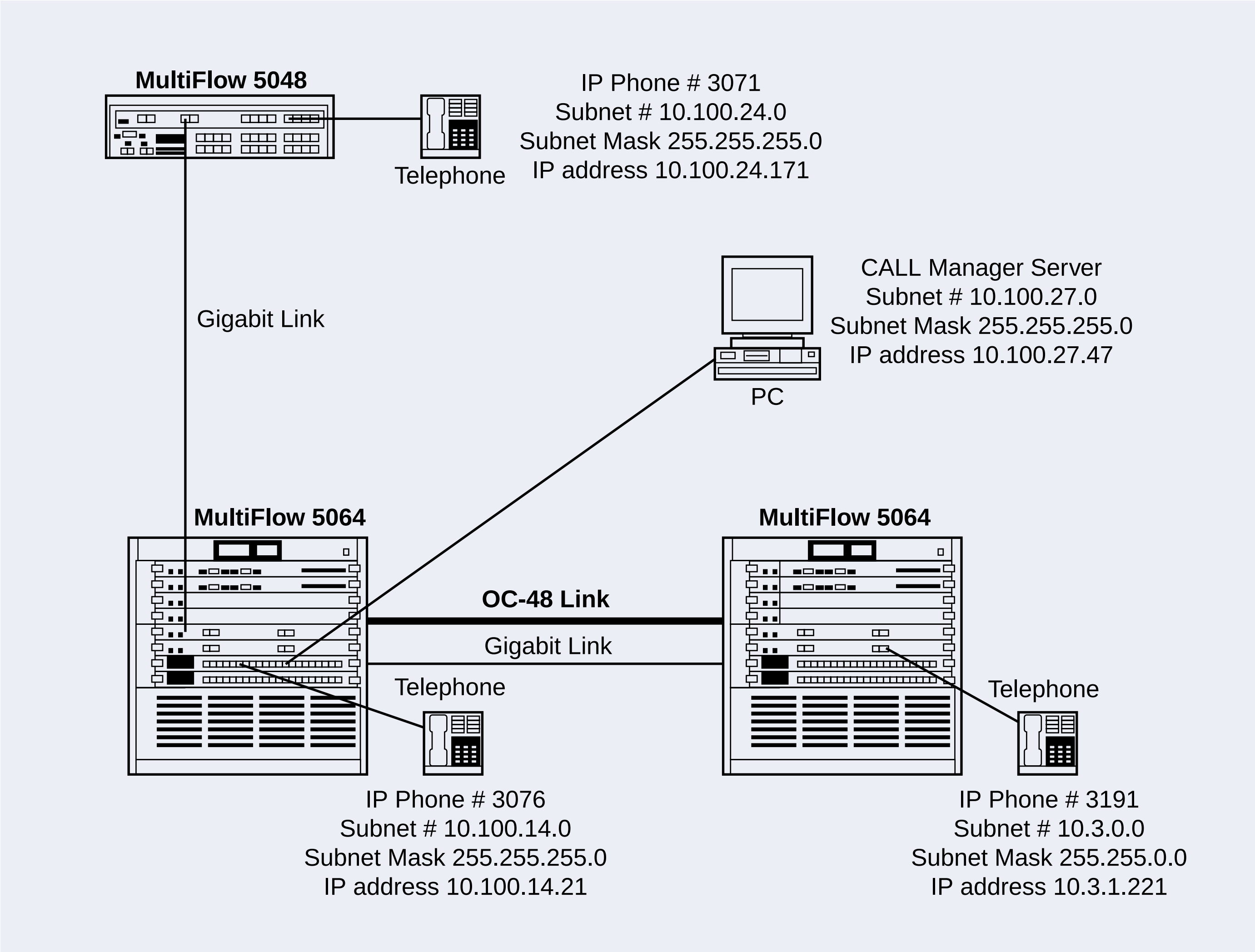


Figure 4: Configuration for Fault Tolerance Evaluation by AQR

Figure 4 shows the configuration used for the AQR evaluation. A Gigabit Ethernet link was added between the two MultiFlow 5064s as a backup link. In the normal condition, phone calls were transported only on the OC-48 link that had been configured as a primary link.

Once the OC-48 link was disconnected, the entire traffic was transported on the Gigabit Ethernet link and no calls were disconnected. We noticed a very short interruption during the link failure, but it scarcely bothered the conversations.

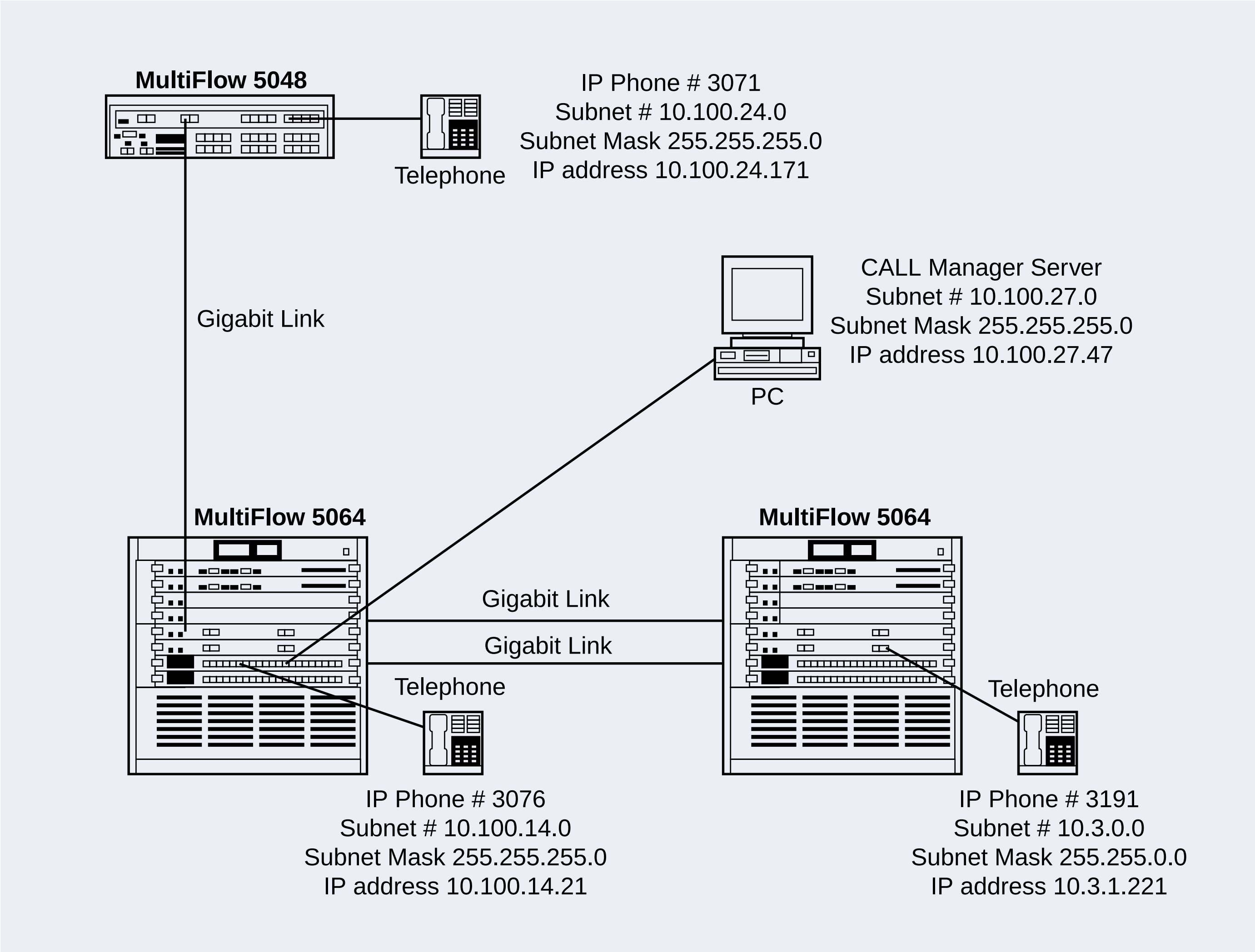


Figure 5: Configuration for Fault Tolerance Evaluation by Link Aggregation

Figure 5 shows the configuration used for evaluating fault tolerance via Link Aggregation. In this test, we used two Gigabit Ethernet links between two MultiFlow 5064 switches as a 2 Gbps logical aggregation trunk. Telephone calls were transported on both links in the normal condition. As soon as one of the links was disconnected, all the calls were transported on the other link and no calls were disconnected. In this test, we did not even detect a noticeable interruption.

Conclusion

In our evaluations, the Anritsu MultiFlow 5000 handled VoIP packets properly with its QoS functions. It enabled reliable network operation by using Anritsu Quick Recovery (AQR) or Link Aggregation without disconnecting any calls when an active link was disconnected. Overall, the MultiFlow 5000 worked well with Cisco IP phones and the Cisco Call Manager server software.

US Sales Center:
Tel: +1-800-ANRITSU (800-267-4878)
or +1-972-644-1777
Fax: +1-972-671-1877

Anritsu Company • 1155 East Collins Boulevard • Richardson, TX 75081
www.us.anritsu.com/networking

March, 2001

80302-00137 Rev. A
Voice Over IP / GIP-E