

Frame Relay Network Design Fleet Call, Inc.

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Company Overview

Fleet Call, Inc., is a rapidly-expanding wireless communication company, located in the major market areas across the United States. Fleet Call is currently the nation's second largest provider of specialized mobile radio services. Starting August 1993, Fleet Call intends to provide high-quality all-digital mobile communication services such as mobile telephone, dispatch, paging, and data services to customers. In February of 1991, Fleet Call received authorization from the FCC to build Digital Mobile networks. This will allow Fleet Call to begin the process of building a single, nationwide, all-digital network, using compatible technologies and providing compatible services across all geographic areas. The move to digital technology will provide enhanced service and superior operation for mobile radio customers.

Fleet Call plans to commence its operation of the advanced Digital Mobile network, beginning in Los Angeles in August 1993, San Francisco, New York, and Chicago in 1994 and Dallas/Fort Worth and Houston in 1995.

Business Need

To support the business services, Fleet Call is installing a series of HP 9000 UNIX[®] systems. These systems will run subscriber maintenance and financial applications critical for Fleet Call's day-to-day operations. The HP 9000 systems are housed in a centralized data center.

All remote Fleet Call sites will need real-time access to the host systems. To achieve this connectivity, Fleet Call has designed a robust and high-performing wide area and local area topology.

Applications

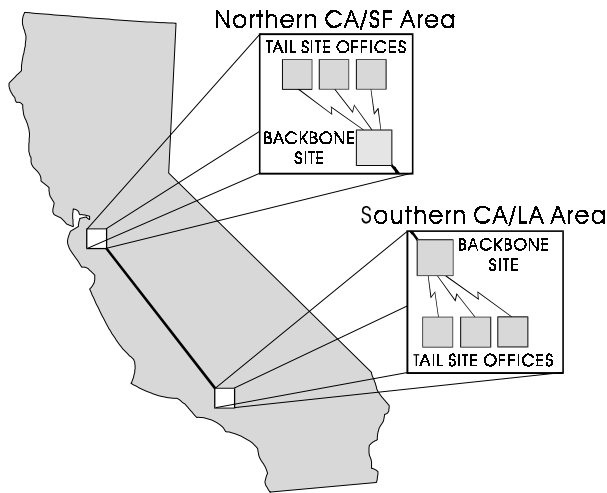
Fleet Call's host systems will run several applications. In addition to the subscriber and financial applications, a number of engineering applications are also under investigation. Users will access the host applications from PC and Macintosh workstations distributed across the network. The workstations will be equipped with network software and hardware to allow Telnet access to the host systems over TCP/IP for terminal emulation. Host printing will also be spooled over the network to TCP/IP-equipped HP LaserJet printers. It is Fleet Call's goal to provide a completely transparent network, with 100% uptime.

Network Topology

Fleet Call's network focuses principally at providing connectivity to the HP 9000 systems. A two-tiered network topology is used: First, a network backbone interconnects a key site in each of the principal market areas. This backbone will provide a "data highway", allowing data communication between the remote sites and the data center at high bandwidths.

At the second tier, each of the backbone sites concentrates wide area connections from the remote offices located in that market area. These nearby offices or "tail sites" will rely on the backbone connection for communication to other market areas or the data center. This topology is summarized in figure 1.

Figure 1



Two-Tiered Topology

Each tail site will be equipped with a small network router that allows connection of the local PC network to the backbone through wide area links. Routers were chosen rather than bridges because routing technology provides a greater level of network traffic filtering. The Fleet Call network will grow to incorporate many hundreds of nodes, and optimizing the bandwidth utilization of the wide area links is essential to preserve high performance and minimize cost.

The backbone sites are equipped with a larger network router that concentrates the lines from all the tail sites and also provides a connection to the backbone network. The backbone router will also concentrate the local LAN subnets within the building itself.

This network design offers several advantages. By using routers at each remote site, the network traffic will be filtered and localized to the specific workgroups. Two levels of filtering are used: first, at the local site itself, and second, at the backbone. Thus, any network traffic with destinations within a particular office, or within offices in that specific market area, will be filtered from transmission onto the backbone. This preserves the backbone bandwidth for essential traffic.

Second, using the backbone/tail-site approach, the cost of the wide area links can be optimized. The tail-site links will fall principally within a LATA (Local Access and Transport area--the service area) boundary, allowing a local operating company, such as Pacific Bell, to provide the link service. The link costs are usually based on distance between connection points, and the short intra-LATA links from the backbone to the tail sites will be much more cost effective than providing multiple inter-LATA links directly to the data center on the backbone. Since network traffic will be concentrated at the backbone router, Fleet Call can take

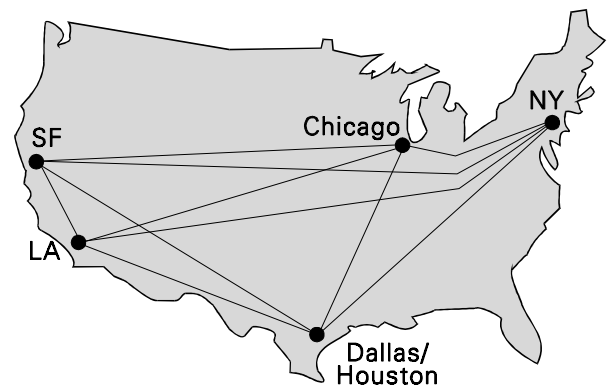
advantage of lower-bandwidth lines out to the tail sites and higher-bandwidth lines on the backbone itself.

In evaluating an appropriate backbone technology for Fleet Call, the following basic requirements were considered:

- high-bandwidth transmission media
- built-in link redundancy
- easy growth and reconfiguration
- cost-effective operation

The traditional design for wide area networks uses point-to-point dedicated circuits. Dedicated circuits provide guaranteed bandwidth with high performance. With point-to-point circuits, Fleet Call could still implement the two-tiered network described above. However, the point-to-point circuits offer only a single circuit on the backbone, so Fleet Call would need to implement a meshed network of multiple point-to-point circuits to achieve any kind of link redundancy. A sample mesh network is shown in figure 2.

Figure 2

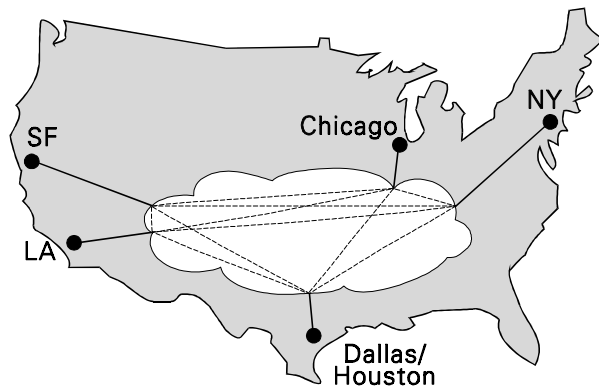


Point-to-Point Meshed Network

Circuit costs are based on distance, and Fleet Call's wide geographic dispersion would mean sizable monthly circuit costs to effectively run a meshed network between the backbone sites. In addition, Fleet Call would be solely responsible for the troubleshooting and problem isolation in a point-to-point circuit network. This requires a higher level of technical sophistication and knowledge from the Fleet Call network staff.

A number of alternative backbone technologies are emerging in the industry. Long-distance carriers have made the most progress in providing frame relay services. Frame relay bases its design on packet-switching technology, as does X.25. However, unlike X.25, frame relay provides its control through only OSI layers 1 and 2, which preserves network performance. The design of a frame relay network provides a fully meshed network that compensates for point failures with automatic rerouting. Customers have a single point of entry to the frame relay network, and all

Figure 3



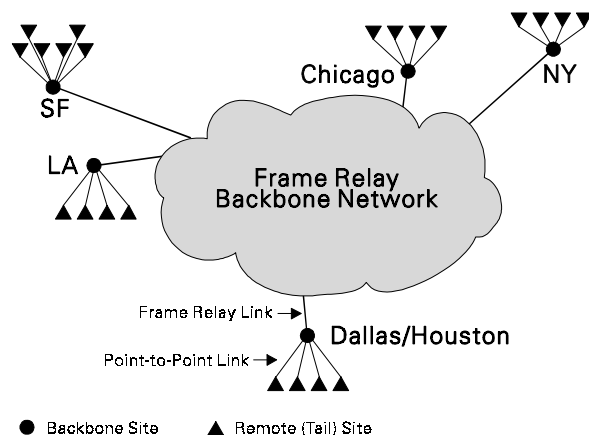
Frame Relay Network

network routing happens transparently. This is depicted in figure 3.

Frame relay is also very suitable for bursty data networks, where irregular traffic patterns cause variable bandwidth demands. A frame relay backbone network would provide Fleet Call with built-in redundancy and high performance. Compared to a meshed topology with dedicated circuits, frame relay is more cost-effective. In addition, the selected long-distance carrier assumes total responsibility for failures within the meshed network, thereby relieving Fleet Call of this responsibility.

Both the dedicated circuit and frame relay approaches have merit. For the final wide area topology, Fleet Call selected a combination of these solutions. For the high-speed network backbone that provides mission-critical connections, a frame relay network is used. For links to the tail sites, point-to-point dedicated circuits running back to the backbone are suitable. The wide area design is shown in figure 4.

Figure 4



Fleet Call WAN Topology

Each office site is equipped with 10Base-T networks running Novell NetWare to provide local file and disk sharing. Except for electronic mail transfer, the NetWare traffic is localized within each office, preserving the bandwidth of the WAN for the TCP/IP host-directed traffic.

Fleet Call will use the HP OpenView Network Management system. It allows Fleet Call to monitor and manage all the network devices that have IP addresses or can be queried with SNMP. This includes the routers, network hubs, print spoolers, PCs running the PC/TCP software, UNIX workstations, and Macintoshes running TCP software.

Performance

As of mid-1993, Fleet Call continues to roll out the network to remote sites. Performance will depend on the bandwidth of the remote links. Fleet Call is closely monitoring the utilization of the network and can add bandwidth to the frame relay backbone link as required. The WAN carriers also offer specialized reporting to provide a detailed view of circuit utilization.

Issues

Fleet Call employed the services of HP Network Consultants in the design and initial rollout of the network. However, as with any network implementation, unanticipated issues surfaced. When implementing a new network, remember the following:

1. When planning a frame relay network, make sure the network equipment has been completely certified by the circuit provider. This will aid in troubleshooting and support.
2. When purchasing newly released equipment, plan the rollout of the equipment after suitable testing has been performed.
3. Never underestimate the time and effort required to bring up a new WAN link.
4. In remote-site installations, perform site walkthroughs to determine any unforeseen obstacles that may delay or impair installation of the network components.
5. Plan ahead and purchase early. You never know when network equipment production lead times will be suddenly longer than needed.
6. Keep everyone informed. Develop a mutually agreed-upon schedule of implementation tasks and responsibilities. Set expectations correctly.