Chapter 2 – Designing a Network

An efficient network that will serve your long term
needs requires thorough research and planning. This
chapter begins with a review of some key network
design considerations, and then explains how devices
such as gateways and PhoneNET StarControllers let
you create networks to suit different needs. The last
section outlines some wiring guidelines for PhoneNET
System cabling.

If you plan to install a small network with a few devices
in one room, you may find this chapter has all the
information you need. If you plan to implement a large
network with hundreds or thousands of devices, this
chapter may only serve as a starting point.

Network design considerations

Since every network is unique, it is impossible to list
the exact steps involved in network design. Listed
below are some general guidelines.

- **Assign a network manager**
  The network manager coordinates the design and
  installation of the network. The network manager is
  also responsible for adding new users to the
  network and troubleshooting problems. For small
  installations, the network manager's duties may
  only require a few hours a week. For larger
  installations, the network manager's position may
  be a full-time job.

- **Create a network map**
  A **network map** is a visual record of your network
  configuration. Create a network map by copying a
  floor layout diagram and adding graphics
  representing devices and cabling. You can modify
  the map as you change your plans, and use the
  completed map during installation. It is a good
  idea to create the map on a computer so you can
  easily modify it.
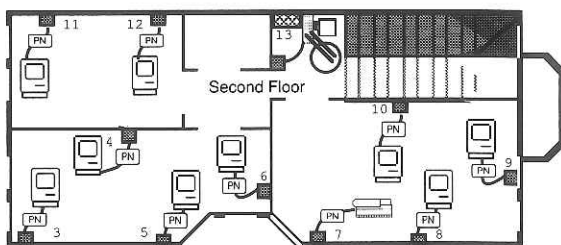
A network map showing floor layout, devices and cabling.

- **Determine if you can use existing wiring**
  The physical limitations or regulations on the use of
  your building's wiring can greatly affect your choice
  of network layouts. Have the building manager or a
  telephone installer determine whether you can use
  existing wiring in your office. In general, you can
  use existing wiring if you have an unused wire pair
  going to each office. See Chapter 4, *"Using
  Existing Wiring"* for more information.

- **Choose an appropriate network topology**
  The existing wiring scheme of your office and your
  particular network needs will determine which
  topology is appropriate. For example, if you plan to
  use existing telephone wiring, you will probably
  want to select a star topology.

- **Leave room for growth**
  As your network needs grow, your network should
  also grow. Hasty additions to your network will make
  network maintenance difficult and time-consuming.
  Plan to install more cabling than you think you will
  need. With adequate preparation, adding another
  device to the network can often be as simple as
  plugging in another PhoneNET Connector.

- **Do some research**
  Familiarize yourself with the numerous network
  hardware and software options available to you.
  See *"Recommended reading"* in Chapter 6.

Adding bridges, gateways, PhoneNET Repeaters and PhoneNET StarControllers

Designing a large internet involves a close look at how
some key network hardware components can expand a
network and improve performance.

- **Add bridges to reduce traffic in a network**
  Consider adding a bridge if your network appears to
  by slowed down by traffic. Use TrafficWatch to see
  the traffic patterns of your network and to find out   ·
  which devices generate the most traffic.

- **Add gateways to create an Ethernet backbone**
  An Ethernet backbone provides a high-speed link
  between networks on a large internet. If one
  network requires frequent use of a device on
  another network, make sure both networks are
  contiguous or linked by an Ethernet backbone.
  Otherwise the networks placed between them will
  be slowed down by constant through traffic.
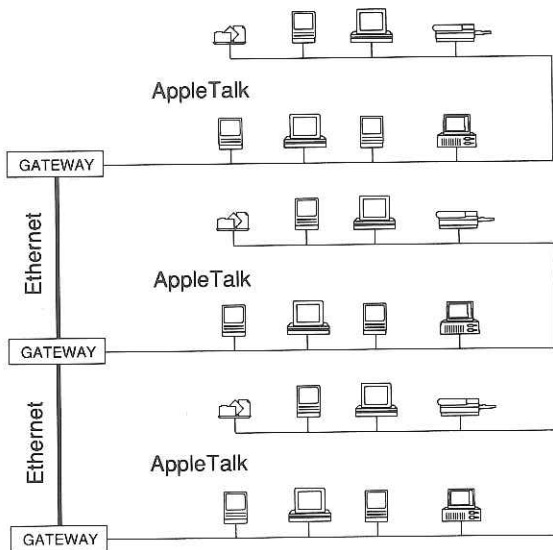
Add an Ethernet backbone to reduce through traffic and improve network performance.

- **Use PhoneNET Repeaters for extended network distances**

  For spanning distances of 4000 feet or more, such as multi-building networks, consider using PhoneNET Repeaters. You can install multiple PhoneNET Repeaters to carry a network signal several miles.

- **Add PhoneNET StarControllers to expand network size and improve performance**

  A PhoneNET StarController extends the total network length, improves performance, and provides convenient network management control functions.

Two network design examples

The following sections describe two example network installations. These examples are designed to give an overview of the decisions involved when designing a network.

Example 1 – L&B Packaging

L&B Packaging occupied a 2-story building. The sales and marketing departments had offices on the first floor; the research and accounting departments were on the second floor. Each floor had their own network of Macintoshes connected to a LaserWriter. L&B's warehouse was located in a building a mile and a half away. Although most L&B employees had Macintoshes, they spent quite a bit of time hand-delivering telephone messages, routing invoices, and exchanging floppy disks. After growing to 40 employees, L&B decided it was time to install a company-wide network so they could access electronic mail, centralize inventory, and improve communications.

L&B decided to install an AppleTalk network with two
PhoneNET StarControllers, one bridge, two PhoneNET
Repeaters, and an AppleShare file server. A star
topology allowed them to use existing telephone wiring
and gave them the flexibility to reorganize the network
as their needs changed. PhoneNET StarControllers
added reliability to the network and provided useful
network management functions. A bridge between the
PhoneNET StarControllers reduced unnecessary traffic
between the networks on each floor. Using PhoneNET
Repeaters allowed them to have a high-speed
AppleTalk network between headquarters and the
warehouse. All employees had access to the file
server, so they could send electronic mail to one
another and check the inventory database from any
computer.
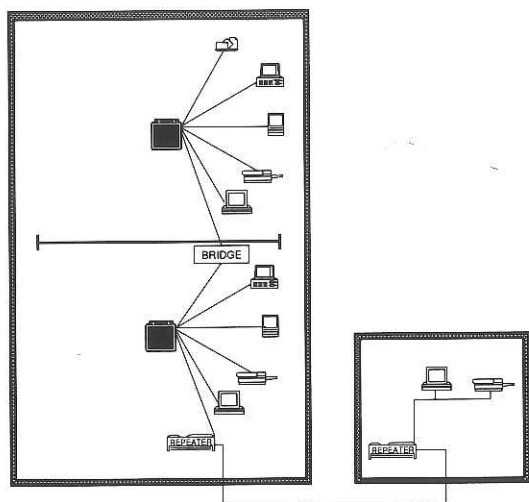
L&B Packaging's network

Example 2 – HiTech Engineering

HiTech Engineering was a small, but fast-growing engineering design firm. They occupied a large one-story building which they expected would meet their needs for the next several years.

HiTech employees used IBM PCs and Macintoshes for their design work and document processing. Only a few of these computers were networked. HiTech employees used the network primarily for printing and transferring files between the PCs and Macintoshes. HiTech finally decided to invest in a VAX to assist with the design work. They planned a network that would link all of the workstations to make the most efficient use of this new corporate asset.

HiTech installed new telephone wall cable to all existing and future workstations. At each workstation they installed dual wall jacks: one jack dedicated to the telephone system and the other for the network. In the telephone closet they installed two StarControllers. One StarController was for 7 Macintoshes, 2 PCs, a plotter, and a LaserWriter in the Finance department. The second StarController was for 7 Macintoshes, 2 PCs, and a LaserWriter in the Sales department. Each StarController was connected to the Ethernet backbone with its own Kinetics FastPath. HiTech put 8 Macintoshes and the VAX on Ethernet.
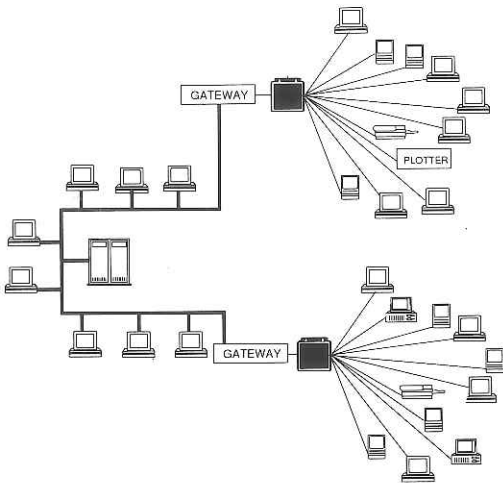
HiTech's network

HiTech installed file service software on the
VAX to provide all users with access to archival
storage. The network manager installed Timbuktu on
each Macintosh so that he could assist users with the
new network services without leaving his desk. With
Timbuktu he could also install and manage an
electronic mail server in a Macintosh II without a
keyboard, monitor or video card. Over time, HiTech
employees began to use the network to work together
more effectively, sharing ideas and information with
their computers.

Wiring guidelines for PhoneNET System cabling

This section outlines some conservative guidelines for wiring PhoneNET System cabling. These guidelines will produce reliable networks under most circumstances. Deviations from the guidelines may also produce properly operating networks. Because you can create an almost infinite number of topological variations with PhoneNET System cabling, and because installation quality cannot be assured, it is impossible to provide definitive wiring rules.

The tables below list the recommended maximum amount of cabling and number of devices for various wire gauges and network topologies. The first table lists guidelines for networks operating at normal LocalTalk speeds (230.4 kbps), and the second table lists guidelines for networks operating at higher speeds (such as FlashTalk at 768 kbps).

Topology (230.4 kbps)	22 gauge	24 gauge	26 gauge	Max # nodes
daisy chain	n/a	n/a	1800 ft	24
backbone	4500 ft	3000 ft	1800 ft	48
3-branch passive star (each branch)	1500 ft	1000 ft	600 ft	16
4-branch passive star (each branch)	1125 ft	750 ft	450 ft	12

PhoneNET System wiring guidelines at LocalTalk speeds (230.4 kbps)

Topology (768 kbps)	22 gauge	24 gauge	26 gauge	Max # nodes
daisy chain	n/a	n/a	600 ft	18
backbone	1500 ft	1000 ft	600 ft	36
3-branch passive star (each branch)	500 ft	333 ft	200 ft	12
4-branch passive star (each branch)	375 ft	250 ft	150 ft	9

PhoneNET System wiring guidelines at higher speeds (such as FlashTalk at 768 kbps)

Cabling hints

- Each branch of a star is treated as a separate length of cable. You cannot borrow cable from one branch of a star to exceed the recommended limits on another branch of the same star.

- When wiring backbone and star networks, always install wall boxes or line taps as close as possible to each device location. Use as little modular extension cable between the device and the wall jack or line tap as possible. The length of any one piece of modular extension cable connected to a backbone or star should not exceed 50 feet.

- For every one foot of modular extension cable attached to a backbone or branch of a star, diminish the recommended maximum lengths given in the tables by four feet.