MacPing™ 3.0
User's Guide

A Network Testing Tool

Developed by
Dartmouth College Computing Services

— May 1994 —

Credits: *MacPing* was written by Richard Brown, Bill Fisher, and Brian Xiaoxia Ye of Dartmouth College, Hanover, New Hampshire.

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Paul DuBois
Owen Hartnett

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Conventions

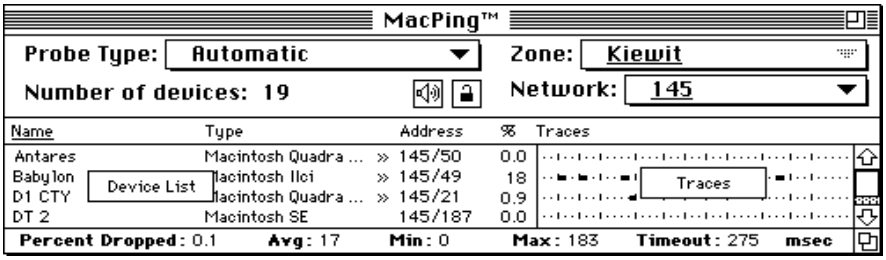
The following conventions are used throughout this document.

command	In text, commands are shown in this bold type.
[**Return**]	In text, keys are indicated in this bold type enclosed in brackets. Combination keystrokes (that is, keys that you press simultaneously) are shown as **⌘-X**; you do not type the hyphen between these keystrokes.
MacPing	In text, program titles and documents are shown in this italic type.

If You Never Read Manuals...

Installation: *MacPing™* is easy to install. Just drag it to your hard drive, and double-click the application. *MacPing* will configure itself for your network hardware and environment.

The *MacPing* window has two important panes, as shown below. The left half of the screen is the *device list*, which shows the names, types, and network addresses of the devices being tested. The right half of the window shows the *traces*, a real-time history of the packet losses for each device. Black marks indicate dropped packets; small dots show a successful test. Hold down the mouse on a device to see the name(s) registered for it. **Option-click** to get system information (Macintosh® or SNMP, if available) for the device.



Testing AppleTalk® devices: Simply select the zone you wish to test from the **Zone** pop-up menu. If you don't see the device you want to test right off, select **All nets in zone** from the **Network** pop-up menu.

Testing IP Devices: Select **Test IP** from the **Network** pop-up menu. Enter a host name or IP address (or a range, to test multiple devices) in the resulting dialog.

Selecting Probe Types: *MacPing* can send several different kinds of packets to devices to stress the network. Use the **Probe Type** pop-up menu to select short or long Echoes (AppleTalk or ICMP), or enter your own data with the **Custom Echo** command.

The "Troubleshooting Networks" section of this manual gives background information about network testing, and ways to use *MacPing* in response to network troubles.

The "Technical Details" appendix to this manual gives a complete description of the techniques used to perform the tests *MacPing* uses. AppleScript commands are described in the final appendix.

Finally, please send in your registration card: we like to know who's using the program!

Welcome to MacPing™

MacPing tests how well your AppleTalk or IP (Internet Protocol) network carries data packets. Just as a sonar or radar system sends a signal and waits for the echo, *MacPing* sends "probe" packets and waits for responses from the various devices connected to that network. If all the responses return, then your network is probably working well. If a few (or many) responses are lost, *MacPing* can help you diagnose what's wrong.

MacPing differs from other network testing programs in that it tests in parallel all the devices on a particular AppleTalk network or zone, or devices in a range of IP addresses. This allows you to compare the responses of different devices on the same network to determine the cause of network problems. Note that *MacPing* will not flood the network with packets: it sends only one packet into the network at any time.

Installing and Running MacPing

MacPing is a Macintosh application. Simply drag it to your computer from the distribution floppy disk. (You should never run *MacPing* from the distribution disk—keep that disk safe as an archival back-up copy.)

MacPing requires at least a Macintosh Plus computer, running System 6.0.5 or newer. It also requires a network connection, either LocalTalk®, EtherTalk®, or dial-up connections such as Apple Remote Access® (ARA), Shiva Dial-In™, or others. *MacPing* is compatible with System 7.0 and works with both Phase I and Phase II AppleTalk software.

If you wish to test IP devices, you must also have a version of MacTCP®. *MacPing* requires MacTCP 2.0.4.

To see SNMP information, you must install *SNMP Manager 1.0.1* or newer.

Double-click the *MacPing* application. *MacPing* will scan the network, and, a few moments later, present you with the window shown on the next page. *MacPing* does not need any configuration (it derives this information from the network). Try it now!

The MacPing Window

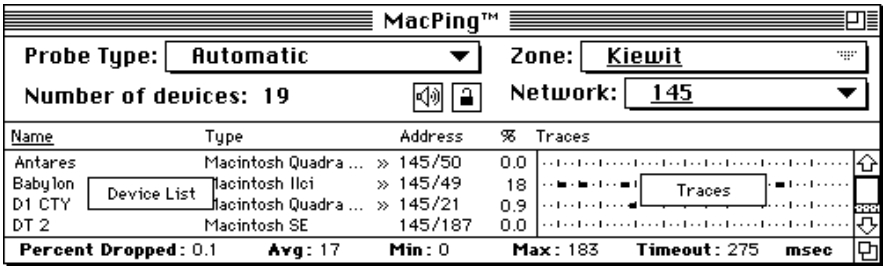


Figure 1. The MacPing window.

Its Features

Device List — The names, types, addresses (shown as *network/node* number, for example: 145/50), and percent dropped for each device on the network being tested. Each device has a separate "trace" (see below).

Traces — A history of the past responses. A line of small dots (such as that for "Antares") shows that all responses returned successfully. Each black mark (see the "Babylon" trace) indicates that the response did not return from the device. The vertical marks indicate five-second intervals.

Percent Dropped — Shows the total percentage of packets dropped for all the selected devices.

Avg, Min, Max — The average (**Avg**), minimum (**Min**), and maximum (**Max**) times (in milliseconds) a response took to return.

Timeout — *MacPing* waits a certain amount of time before deciding that a packet has been dropped. The timeout is normally set to 1.5 times the current maximum.

Probe Type — Allows you to select the type of probe packet to send.

Zone and **Network** — Allows you to select the AppleTalk **Zone** and **Network** to test.

Speaker icon — Allows you to turn on or off the sound when a packet is dropped.

Lock icon — Allows you to start or stop the packet testing.

Testing IP Devices

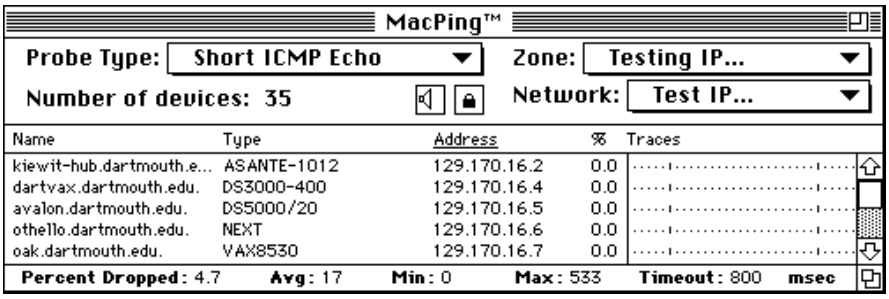


Figure 2. The MacPing window for testing IP devices.

The display for IP devices is much the same as for AppleTalk. The device list shows the device's Domain Name System (DNS) name, system type (if accessible from the DNS), IP address, and percentage of dropped packets.

The **Probe Type** pop-up menu contains short and long ICMP echoes, as well as SNMP requests, custom echo data, and random data in the packet.

> **Note**: When testing IP devices, the **Zone** and **Network** pop-up menus change to **Testing IP** and **Test IP** respectively.

MacPing Quick Start

The best way to discover *MacPing*'s features is to use it. Here are some experiments you can perform to illustrate its most important capabilities.

Testing One or a Few Devices

MacPing normally tests all the devices on a network. Use the standard Macintosh conventions to select specific devices to be tested:

- **Click** on the name of a device to select it.
- **Shift-click** to extend the selection to a continuous range.
- **Command-click** to add or remove a device.

Displaying All Names for a Device

AppleTalk devices may have registered names for multiple services. Click and hold the mouse on a device name for about a half second. A menu of all registered names will pop up. If you choose a different name, it will be shown when you release the mouse.

Displaying SNMP or Macintosh System Information

MacPing can display additional information about devices. **Option-click** on the device's name: *MacPing* will show a Macintosh computer's system information, a LaserWriter's status, or selected SNMP variables from an IP host.

Selecting a New Zone to Test

The **Zone** pop-up menu shows the zone currently being tested. Click the pop-up menu to select another zone to test.

Note: The zone name of the *MacPing* machine is underlined.

Selecting a New Network to Test

The **Network** pop-up menu displays the network currently being tested. Click the pop-up menu to select another network in the zone being tested.

Note: The network number of the *MacPing* machine is underlined.

Selecting a Probe Packet Type

MacPing uses **Automatic** mode as its default mode of testing the network. You can also select a probe type from the **Probe Type** pop-up menu. Select **Long Echo** to perform a more thorough test; use **Name-Binding** to test devices that may not answer echo packets; use **Custom Echo** to fill the echo packet with your own data; use **Random Echo** to specify the length of a packet filled with random data.

Testing IP Devices

To test an IP device, select **Test IP** from the **MacPing** (or **Network** pop-up) menu. Enter the host name or IP address (or the start and end of a range of addresses) for the device(s) to test. You may select **ICMP Echo** (short, medium, or long), **SNMP Request**, a "custom" echo packet with data of your choosing, or **Random ICMP Echo** to fill the ICMP echo packets with random data.

Pausing Testing

Click on the lock icon to pause testing; click again to resume testing. Click on the speaker icon to turn on and off the beeps when a packet is lost.

Troubleshooting Networks

Most network troubles are reported with a complaint of, “I can’t use anything on the network!” or “Everything seems slow!” There can be many causes for these complaints.

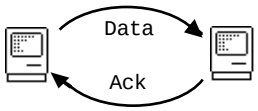
To use *MacPing* effectively, it is useful to have a bit of background about how *MacPing* works.

How Do Networks Work?

When computers communicate across a network, the data (say, of a file being transmitted) is sent in groups called *packets*. Packets can be up to 600 bytes long for AppleTalk services; IP-based services can use larger packets, generally in the range of 500–1,500 bytes, although certain protocols specify packets up to 8,192 bytes.

Whenever data is sent across a link, there is a chance that one or more of the packets will be garbled in transmission. Packets can be garbled from bad connections, faulty wiring, broken wires, and missing terminations. Furthermore, electrical noise from motors, fluorescent lights, etc. can corrupt packet reception just as lightning garbles radio reception. In larger networks, intermediate devices (such as routers or bridges) act as relay stations to pass packets to the ultimate destination. These routers may momentarily be too busy to handle any new packets and will ignore (“drop”) newly arrived packets.

To ensure that its packets arrive correctly, a computer generally sends the packet and waits to receive an acknowledgment or “ack” packet from the intended receiver, which acts as a return receipt for the original data. If no ack has arrived in a reasonable time, the sender re-sends the data to be sure that it arrives eventually.



If occasional packets (fewer than 1–2%) are lost, the data transfer won’t be slowed too much. If packet loss is higher, the frequent waits for acks accumulate and the user sees slow response.

How Can MacPing Help?

While it is testing the network, *MacPing* sends an *echo request* packet and expects to receive an *echo response* packet. Since these echo packets are processed the same way as other packets traveling across the network, the delay and percent loss shown by *MacPing* is representative of the delay and loss of "real" packets. In this way, *MacPing* can measure the actual performance of the network.

Troubleshooting with MacPing

Simply start *MacPing*. After a moment, its window will open. Select the proper zone and network (for AppleTalk) or IP host name or range (for IP devices). Let the program run for several seconds while you watch the screen. Then refer to the steps below to see which symptoms match.

Bad or No Connection

If the complaint was that no network services were working, no zones or networked devices were visible in the Chooser, and if you cannot see the device in the *MacPing* window, consider that the computer might not be connected to the network at all. Make sure that you're testing "All nets in zone" (AppleTalk) or that you're using the proper IP address or range. Use **Find** (in the **Edit** menu) to look for the machine name. Verify the user's connection to a wall outlet. Try exchanging the connector or interface for a known-good one.

Many Dropped Packets

When a network (or several devices on a network) drops a high percentage of packets, the display will show traces with many black marks (see Figure 3 below). View the display by percent drops to see if some devices are significantly worse than others.

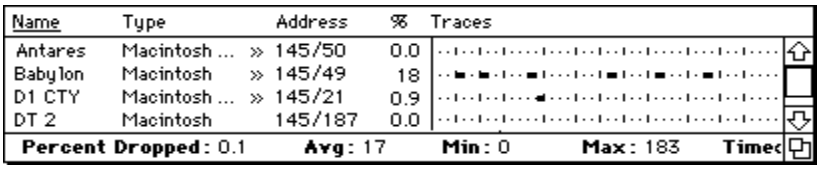


Figure 3. The Babylon device has dropped many packets; D1 CTY has dropped one packet; the others have not dropped any.

Since *MacPing* tests for packet loss directly, it can show individual devices (or entire network segments) that are experiencing trouble. On LocalTalk, packet loss over 2.5% indicates trouble. Ethernet (ThinNet, 10Base-T, or ThickNet) uses higher quality cabling—its packet drop rates should be well under 1%. Dial-up links (such as ARA) may have higher loss if the telephone line is "noisy."

Here are some suggestions for diagnosing packet loss problems:

- When a single device is worse than the others, consider that its network connection might be loose or defective. Check its termination. If possible, try replacing the connector or network interface card. Test the failing device continuously by clicking on its name, and try wiggling the wires, connectors, etc.

- When several devices are significantly worse than the others on the network, think about the characteristics they have in common: Are they geographically near each other? Are they on the same repeater or bridge port? Are all terminators installed properly?

- If all devices are equally bad, the network connection of the Macintosh running *MacPing* might be faulty. Run *MacPing* from another device to see if you can determine where the problem lies.

- Compare the percent loss between short and long echo packets. If there's a noisy link in the path, long packets will show a higher error rate, since they are more likely to be garbled. In these cases, try replacing connectors, swapping computers, and checking terminators.

- Certain packet-loss problems are data-sensitive. Use the **Custom Echo** probe type to enter data that may cause failures. (At least one Ethernet chip is prone to fail with data consisting of a long sequence of $00 data bytes followed by a $FF byte.)

Indications of Slow Links

Slow links can obviously cause slow service. Apple Remote Access (ARA) is the most common slow link encountered on an AppleTalk network. SLIP or PPP links (found in IP networks) will have the same problems. Even the highest speed modems are much slower than LocalTalk (230.4 kbps) or Ethernet (10 million bps) speeds.

You can use *MacPing* to show a slow link in the network by comparing the time difference between Short and Long Echo times. On a slow link, Long Echo packets take significantly longer to transmit than Short Echo packets. If the Percent Dropped value remains low, even with the long times, then you can assume the network is working slowly but without dropping any packets.

The two figures below show the effect of switching from Short to Long Echo over a slow, error-free 2,400 bits-per-second (bps) link.

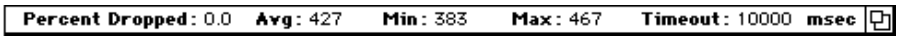


Figure 4. Response times for Short Echo packets on a slow link.

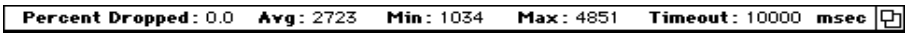


Figure 5. Response times for Long Echo packets on a slow link. Notice that the times are much greater but that no packets have been dropped.

Routing Delays and Other Troubles

MacPing measures the round-trip time between the transmitter and receiver, so you can judge whether the round-trip times can be causing trouble. Delays can arise from having several routers (or slow links) between the transmitter and receiver. Each router takes a finite time (generally 50 µsec to 10 msec) to process and forward a packet. Most commercial network routers are fast enough that the delay doesn't slow the network significantly.

An overloaded router, on the other hand, can give bad response. You will see a large time difference between Long and Short Echo packets. A critical distinction between the reliable-but-slow link (described in the previous section) and an overloaded router is the *variance* between timings. As network equipment approaches its maximum capacity, the delay before a packet is processed gets larger. If a packet arrives while the router is busy, it will be delayed more than when the router is idle. This will be shown as a large spread between the Minimum (**Min**), Average (**Avg**), and Maximum (**Max**) times.

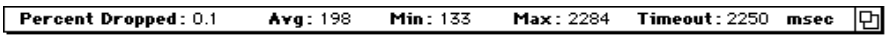


Figure 6. Busy router: Note that the Average (Avg) and Minimum (Min) values are much smaller than the Maximum (Max) value.

In addition to a high variance of round-trip times, a busy router may begin to drop packets. This will occur when packets are arriving faster than the router can send them out. (This can happen to a router with two ports—a wide-area link and an Ethernet—when it receives a burst of traffic from the Ethernet. It may not have enough buffers to hold the packets, and they will be dropped.) This increases the Percent Dropped figure, as well as the variance in numbers.

Overloaded Servers

Overloaded servers will operate well when used by a few people but slow down when lots of people are using them. For example, a Macintosh Plus running the AppleShare file server software may seem quite slow. The slowness is caused by the time it takes the server machine to respond to the multitude of requests coming from each of its clients. *MacPing* won't help you detect an overloaded server. Instead, you may be able to estimate the change in responsiveness as you add additional users.

The best fix for an overloaded server is selecting a more powerful processor; since this may be expensive, you should make sure the rest of the network is working properly before investing in new hardware. It's also important to note that using a faster processor will not make up for any of the other problems listed above; their effect is cumulative.

Command Reference

The MacPing Window

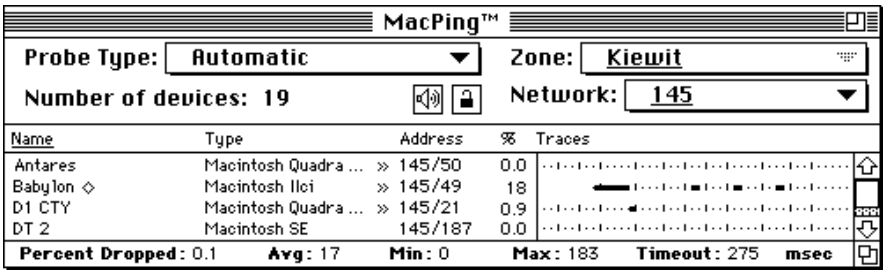


Figure 7. The MacPing window. This display shows that Antares successfully answered all probes; D1 CTY dropped one packet; Babylon is no longer being tested because it dropped five packets in a row.

Device List

The device list shows devices in the zone and network being tested. AppleTalk devices are identified by name, NBP type, node number and percent dropped. IP devices are identified by DNS name, System type (if available from a DNS server), and IP address.

Expand the space for the device list by dragging the split bar (the vertical line that separates the device list from the traces). The left and right arrow keys also move the split bar.

Test a single device by clicking on its name; extend the selection with **Shift-click**; and add (or remove) devices to the selection with **Command-click**. Clicking in the traces area selects (and tests) all devices. Hold the [**Shift**] or [**Command**] keys to change the “Number of Devices” legend to “Number Selected.” **Option-clicking** “Number of Names” will show the total number of names in the device list.

Device List Pop-up Menus

The "»" in a device-list entry indicates that the device has many network names. To show them all, click on a device for about a half-second. A pop-up menu will appear that shows all the names for the device. The number in parentheses is the AppleTalk socket for that name. Figure 8 below shows the popped-up names.

Option-clicking shows version numbers for the System, Finder, and AppleTalk driver as well as the type of network connection.

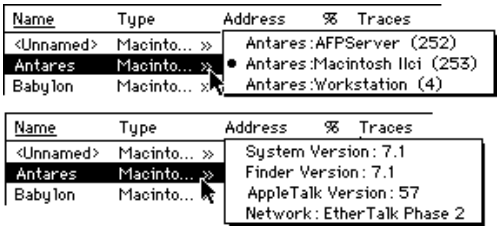


Figure 8. Clicking (top) and Option-clicking (bottom) on a device name.

MacPing will also show selected Management Information Base (MIB) variables for devices that support SNMP. The examples below show the selected values from the Macintosh MIB and the MIB-II for an IP device.

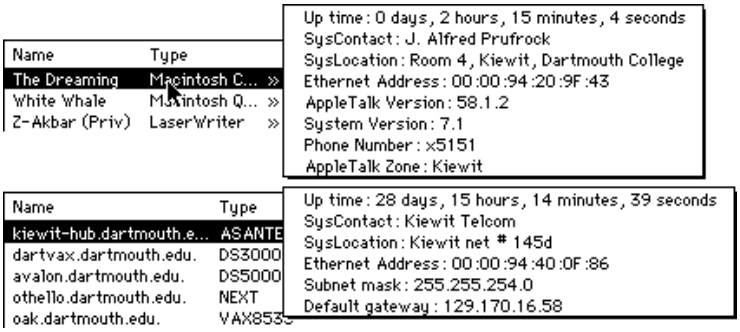


Figure 9. Option-clicking on devices that support SNMP. The top shows the AppleTalk MIB; the bottom, the IP MIB.

Traces

The traces show the history of the probes for each device. *MacPing* probes each of the devices, and then advances the screen to the right. Thus, each dot represents a single test of all devices.

A line of dots (such as that for “Antares” in Figure 7) shows that the device has successfully responded to all the probes. The black marks in the trace (such as those for “Babylon”) indicate that the probes (or the responses) were dropped.

Every five seconds, *MacPing* draws a small vertical mark. This indicates that probing is in progress, and it allows you to estimate the rate of probing. The marks generally won’t be spaced evenly across the screen; they are closer together when:

- testing many devices
- testing with long packets
- many devices fail to respond (*MacPing* waits for each one)

Percent Dropped

The **Percent Dropped** field shows the percentage of packets dropped for all the selected devices. Click on the words **Percent Dropped** to reset the measurement back to zero.

Average, Minimum, Maximum, and Timeout

The **Average** (**Avg**) field shows the average round-trip time for the selected devices. The **Minimum** (**Min**) and **Maximum** (**Max**) fields display the shortest and longest round-trip time seen during the test. Click on any of the times to reset the **Minimum** and **Maximum** to the current **Average** value.

The **Timeout** is the time *MacPing* waits for a response to return. In automatic timer mode, *MacPing* sets the timeout to 1.5 times the current **Maximum**. You may also set the timeout manually with the **Adjust Timers** command (in the **Settings** menu) or by double-clicking the **Timeout** value.

Zone and Network Pop-up Menus

When testing an AppleTalk network, the **Zone** and **Network** pop-up menus show the zone and network being tested. Make a selection from these pop-up menus to choose a different zone or network.

The **Network** pop-up menu contains the networks that are part of the zone under test. If you change the **Zone** pop-up menu, the entries in the **Network** pop-up menu will be updated automatically. The **All nets in zone** choice tests the devices from all networks that comprise the selected zone.

The **Network** pop-up menu contains a **Test AppleTalk** and **Test IP** choice. These function identically to the commands with similar names in the **MacPing** menu (described on page 18).

> **Note**: When dialing in with Apple Remote Access (ARA), the **Network** pop-up menu will contain two unusual network numbers: 0 (zero) and 65,535 (see Figure 10 on the next page). Devices shown as network 0 (zero) are connected to the Macintosh computer's (LocalTalk or EtherTalk) network. Devices shown on network 65,535 are those that are on the same AppleTalk network as the ARA server. The "real" network number is not visible to *MacPing*, since ARA re-maps network numbers.

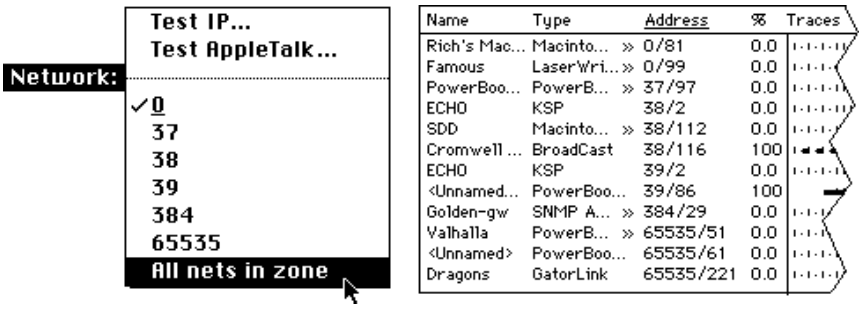


Figure 10. The Network pop-up menu (left) and the device list (right) while dialed in with ARA. Note the existence of networks 0 and 65,535 in each.

Probe Type Pop-up Menu

When testing AppleTalk devices, you can select from **Automatic**, **Short Echo** packets (8 data bytes), **Long Echo** packets (580 data bytes), **Name-Binding** packets, **Printer Status** packets, LocalTalk **RTS-CTS** packets (if *MacPing* is directly connected to the LocalTalk network under test), **Custom Echo** packets, or **Random Echo** packets.

In **Automatic** mode, *MacPing* alternates between sending **Short Echo** packets and **Printer Status** packets until the device answers a particular packet type. *MacPing* then continues to probe with that packet type.

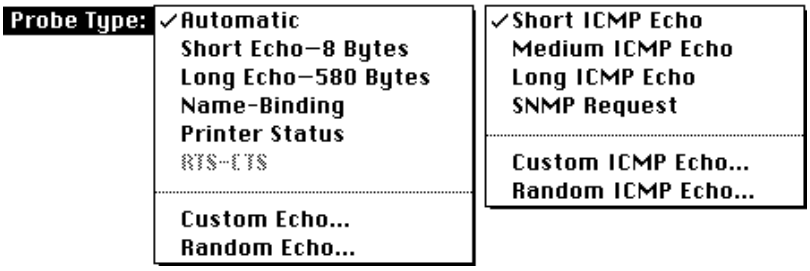


Figure 11. Probe Type pop-up menus for AppleTalk and IP types.

When testing IP devices, the **Probe Type** pop-up menu has **Short**, **Medium**, and **Long ICMP Echo** packets (8, 544, and 1,472 bytes respectively), as well as **SNMP Request**, **Custom ICMP Echo** packets, and **Random ICMP Echo** packets.

Custom Echo Data

Custom Echo packets may be constructed by selecting **Custom Echo** or **Custom ICMP Echo** from the **Probe Type** pop-up menu. You will see the dialog shown in Figure 12. The values entered become the data of the AppleTalk or ICMP Echo packet. The data may be entered in either hexadecimal or ASCII. The length of the data (in bytes) is shown in the lower left corner.

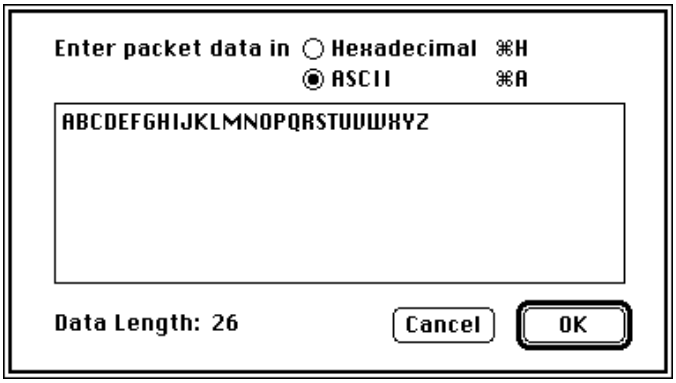


Figure 12. Custom data entry dialog.

Random Echo Data

MacPing will construct echo packets whose data consist of random values. Each echo packet *MacPing* sends will contain different data. Select **Random Echo** or **Random ICMP Echo** from the **Probe Type** pop-up menu. You will see the dialog shown in Figure 13. Enter the length of the data to be sent in each packet.

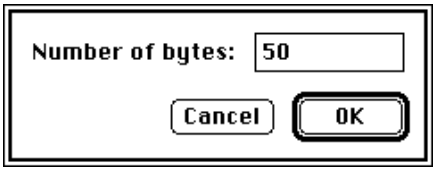


Figure 13. Random data packet length dialog.

Node Conflicts

During its normal AppleTalk testing, *MacPing* may detect that two devices are responding to a single echo packet. This is an indication that the devices have the same network address. Although a rare occurrence, this situation will guarantee that each of the machines with conflicting addresses will receive bad service.

When *MacPing* locates a node conflict, it highlights an indicator on the right side of the screen, as shown in Figure 14. Click the **Node Conflict** indicator to select the conflicting nodes (or choose **Select Node Conflicts** from the **Edit** menu).

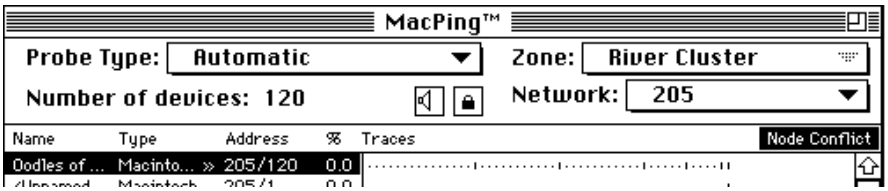


Figure 14. Node Conflict indicator, at right edge of the window. Clicking on it selects all the nodes that appear to have conflicts.

To see the names associated with those nodes, click and hold the mouse on the selected device. A list of the names associated with that address will pop up. You can use these names to identify the owners of the conflicting computers, as shown in Figure 15 below.

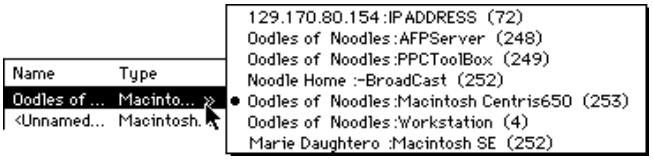


Figure 15. Device pop-up menu showing a node conflict. Notice that two different Macintosh types (Centris 650 and SE) are registered on a single network address.

Node conflicts generally occur if two devices cannot “hear” each other when they choose a network address while starting up. Running *MacPing* on each device can help diagnose the problem.

Speaker and Lock Icons

The Speaker and Lock icons in the *MacPing* window indicate the current state of the settings **Beep When Drops Occur** (in the **Settings** menu) and **Pause** (in the **MacPing** menu). Compare Figure 1 and Figure 2 to see the active and inactive states for each icon. Clicking on either icon will toggle its state.

Menus

Apple (🍎) Menu

The **Apple** (🍎) menu contains **About MacPing**, **MacPing Help**, and the normal set of **Apple** menu items. The About box (Figure 16) displays the *MacPing* version and information about the network: the AppleTalk address, the IP address, the IP subnet mask, the Ethernet address, and the AppleTalk version.

If more than one Ethernet interface is installed, the Ethernet address field will contain the words “Many Addresses»”. Click on the field to see a pop-up menu showing all the addresses.

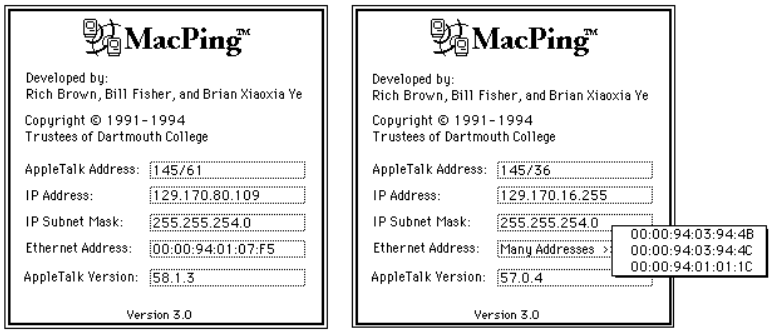


Figure 16. The About box.

Choosing **MacPing™ Help** will open the window shown in Figure 17. The Help window shows a list of topics in a pane on the left of the window. Click on a topic to see the associated text on the right.

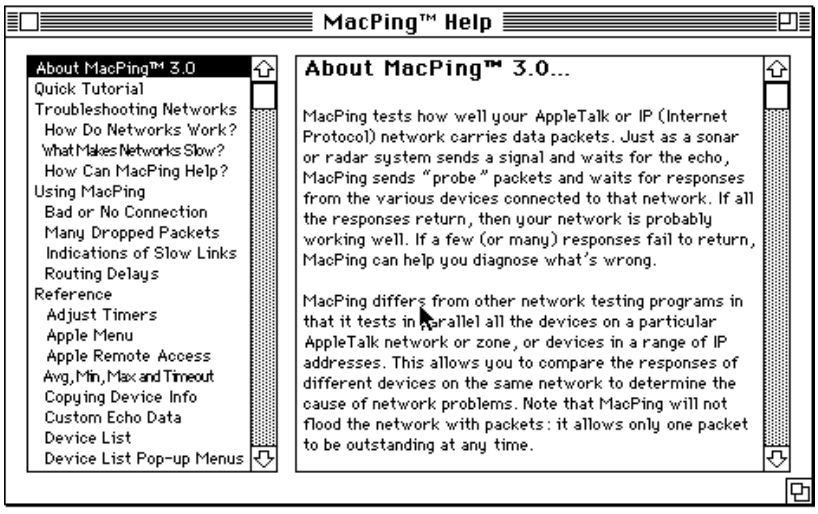


Figure 17. MacPing Help window.

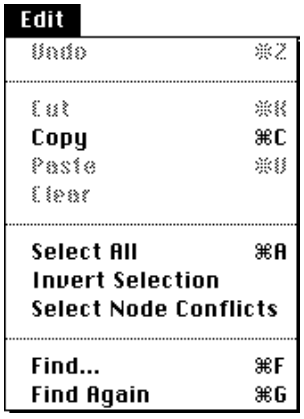
File Menu

Save As: With the **Save As** command, *MacPing* will save the device list to a TEXT file. The file data consists of a header showing the test conditions (date and time, probe type, number of devices, testing and tested zones) followed by the device list, in tab-separated columns.

Page Setup: *MacPing* supports the standard **Page Setup** dialog.

Print: *MacPing* will print the device list and the traces for all the devices shown on the screen.

Edit Menu



Cut, Paste, and Undo: The **Cut, Paste,** and **Undo** choices in the **Edit** menu are standard with all Macintosh applications.

Copy: The **Copy** command copies the displayed Name, Type, Address, and Percent columns for the selected devices. The Clipboard will contain the data as tab-separated TEXT. Use **Shift-copy** to copy all names and types, not just the displayed names.

Select All: The **Select All** command selects all the devices in the device list. This causes all devices to be tested.

Invert Selection: The **Invert Selection** command reverses the selection state of all devices. You could use this to select all devices of a certain type, then choose **Invert Selection** to test everything *except* those devices.

Select Node Conflicts: The **Select Node Conflicts** command selects any devices which have the same network address. See page 14 for more information about node conflicts.

Find: The **Find** command allows you to search the entire device list for names and types that contain a desired string. *MacPing* always performs a case-insensitive string match. Names that match the string are selected and made visible in the device list. Figure 18 shows the dialog for specifying the search string.

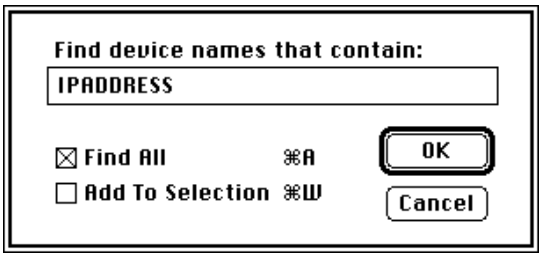


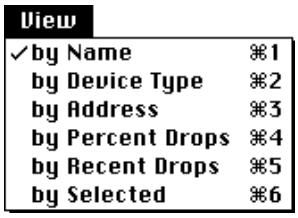
Figure 18. The Find dialog.

- The **Find All** checkbox will select all devices that match the search string. It is then convenient to use **View by Selected** (described below) to move these devices to the top of the device list.

- The **Add To Selection** checkbox causes newly found devices to be added to previously selected devices.

Find Again: The **Find Again** command selects the next device that contains a name or type that matches the **Find** string.

View Menu

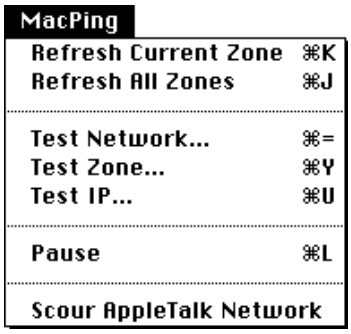


MacPing can display the names in several orders. Choose **View by**:

Name	To sort the device names alphabetically
Device Type	To sort the devices by their device type
Address	To sort the devices numerically by network address (AppleTalk or IP)
Percent Drops	To sort the devices by the percentage of dropped packets
Recent Drops	To sort the devices in the order of the most recent drops
Selected	To bring the currently selected devices to the top of the list

Note: Clicking on the column headings in the device list (Name, Type, Address, and %) sorts the entries in that order.

MacPing Menu



The **MacPing** menu allows you to modify the kind of test you are performing.

Refresh Current Zone: The **Refresh Current Zone** command clears the device list and rescans the network for all devices in the currently selected network and zone.

Refresh All Zones: The **Refresh All Zones** command rescans the network for AppleTalk zones. Use this command if the network status has changed (for example, when a new zone has been installed or a connection to a router has been lost or reestablished).

Test Network: You may select a network (or a range of networks) to be tested. Choose **Test Network** from the **MacPing** menu or **Test AppleTalk** from the **Network** pop-up menu. You will see the dialog box shown in Figure 19.

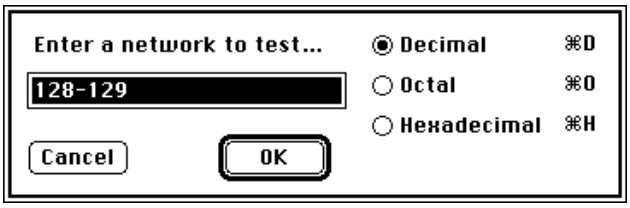


Figure 19. Network-selection dialog.

Type the desired network number and click **OK**.

To enter a network range, type the two numbers separated by a hyphen (-). *MacPing* will discover devices on the network number(s) and update the **Zone** pop-up menu properly. If you know the network address of a particular device that you want to test, you may enter that address in the form *network/node*. *MacPing* will test that address along with the other devices on that network.

> **Notes:** You can enter and display numbers in octal, decimal, or hexadecimal. These settings then apply throughout the program.
>
> You can use this feature as a number base converter. Type the number to be converted and select a new base.

Test Zone: The **Test Zone** command allows you to select a zone to be tested. This is equivalent to selecting a zone from the **Zone** pop-up menu. You will see the dialog shown in Figure 20.

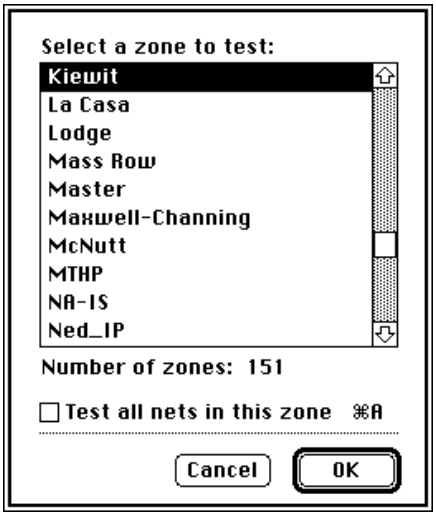


Figure 20. The Test Zone dialog.

Click the desired zone to be tested. You may also type the first characters of a zone name to select it. *MacPing* will test the network in the zone with the most respondents. Check the **Test all nets in this zone** checkbox if you want to test all devices that are part of the zone.

Test IP: The **Test IP** command allows you to select a host (or a range of hosts) to be tested. You will see the dialog in Figure 21.

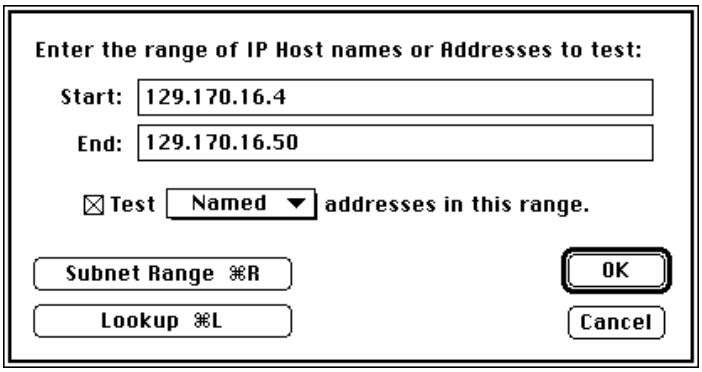


Figure 21. The IP Host selection dialog.

Typing a single DNS name (or IP address) will test that device. Entering two names (addresses) will test all the hosts between the two addresses.

If you click the **Lookup** button, *MacPing* will consult the DNS and change a name to its corresponding IP address, and vice versa.

You may click the **Subnet Range** button to set the range to the beginning and ending address of the device's subnet.

The pop-up menu **Test _____ addresses in this range** governs which hosts will be tested. You may choose between:

- **Named** Only test hosts with DNS names
- **Active** Only test hosts that answer an initial echo probe
- **All** Test all devices in the IP address range

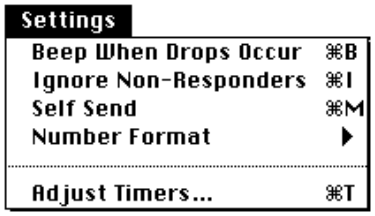
> **Notes:** You may enter IP addresses in hexadecimal. Type a "$" and then the hexadecimal digits. You may separate the bytes of the value with spaces or any other non-hexadecimal character. For example, 129.170.16.4 could be entered as "$81 AA 10 04".
>
> You may also convert between dotted decimal and hex notation by typing **⌘-H** (for hexadecimal) and **⌘-D** (decimal).

Pause: The **Pause** command suspends probing. Choosing **Pause** again resumes the probing. The lock icon in the device-list window reflects the current state of probing: an open lock indicates that *MacPing* is probing; a locked icon indicates that probing is paused. When paused, the lock icon will flash periodically.

Scour AppleTalk Network: If a single AppleTalk network is selected in the **Network** pop-up menu, the **Scour AppleTalk Network** command will cause *MacPing* to "scour" (perform a thorough scan of) that network. *MacPing* sends an NBP LkUp packet to each possible AppleTalk address that is not already in the device list. This often finds additional nodes that were missed in the first scan.

> **Warning**: This test puts a heavy load on certain routers, which may cause them to crash. Most network equipment will work well with this test.

Settings Menu



The **Settings** menu allows you to change the way *MacPing* operates. All settings except **Pause** will be preserved when you quit *MacPing*.

Beep When Drops Occur: To make it easier to notice that a packet has been dropped, choose **Beep When Drops Occur**. *MacPing* will beep the first time a device fails to reply to a probe packet. Clicking on the speaker icon in the window will also toggle the beep setting.

Ignore Non-Responders: Devices that have been turned off or that don't respond make testing slower. Choose **Ignore Non-Responders** to cease probing devices after they fail to respond five times in a row. Choose **Ignore Non-Responders** again to select all devices again. Devices that are currently being ignored have a "◊" appended to the name and have no trace on the screen.

Self Send: A Macintosh computer will send packets to itself if the **Self Send** command is set. This is useful to see which AppleTalk NBP names are registered on the Macintosh running *MacPing*.

Number Format: *MacPing* can display numbers in three number bases: **Octal** (**⌘-O**), **Decimal** (**⌘-D**), or **Hexadecimal** (**⌘-H**). Choose one of the three to display these numbers in your preferred number base. The default choice is **Decimal**.

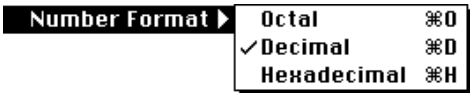


Figure 22. Number Format pop-up menu.

> **Note:** Time values, the Percent Dropped figures, and IP addresses are always displayed in decimal.

Adjust Timers: Choose **Adjust Timers** to change the timers of *MacPing*, as shown in Figure 23.

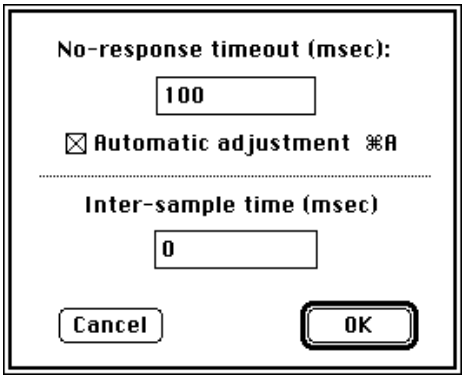


Figure 23. Adjust Timers dialog.

The **No-response timeout** tells *MacPing* how long to wait for a response to come back from a device. This is also the "Time-out" value shown at the bottom of the *MacPing* window. Set this to a value longer than the expected response time, but short enough that you can get a reasonable probing rate. *MacPing* adjusts the no-response timeout whenever you select a new network or zone. If the **Automatic adjustment** box is checked, *MacPing* will recompute the no-response timeout as the network response changes. The timeout will be set to 1.5 times the longest successful response, up to 10 seconds. You can also set the timeout manually. The checkbox will be unchecked automatically when you type.

> **Note:** Setting the timeout too short can flood the network with packets, since *MacPing* won't wait long enough for the responses to return.

The **Inter-sample time** adjusts how long *MacPing* waits before retesting the device list. Normally, *MacPing* will probe devices as fast as possible. That is, when the inter-sample time is set to zero, *MacPing* begins probing the device list immediately after redrawing the traces. You may increase the inter-sample time to send less traffic into the network.

Appendix A: Technical Details

This section discusses the detailed operation of *MacPing*. It gives the various methods *MacPing* uses to discover devices on a network; the ways it uses SNMP and Macintosh System Status packets to obtain system information; the normal testing steps; and the packet formats used during testing.

Locating Devices on a Single AppleTalk Network

MacPing uses several techniques to locate devices in an AppleTalk network. To locate all devices on a single AppleTalk network:

1. *MacPing* first sends a ZIP Query to the local router to obtain the zone name. When dialed in with ARA, the Macintosh acts as a router, so *MacPing* broadcasts an RTMP request to network 65,535 to find a router for the ZIP Query.

2. *MacPing* then sends three NBP =:=@*zone* BrRq's to the router. It waits until no responses have arrived for 0.75 seconds before sending the next BrRq. *MacPing* then collects and sorts the network numbers from all the NBP Responses and places them in the **Network** pop-up menu. If the user hasn't selected a network to test, the network with the most NBP Responses will be tested. *MacPing* also collects the names of all the devices that respond and places them in the device list.

   > **Note:** When starting up, *MacPing* always tests the zone and network to which it is connected.

3. After the NBP BrRq's, *MacPing* sends a single Echo Request packet to the network under test. This Echo Request is addressed to the broadcast link address (to evoke responses from all the devices on that network). *MacPing* collects Echo Responses until no responses arrive for one second.

4. If new devices are discovered by this broadcast Echo Request, *MacPing* sends a single directed =:=@*zone* LkUp to each device. If it responds, the names will be added to the pop-up menu in the device list. If no responses return, the device will be listed with name of "Node *xxxx/xx*" and a type of "Unknown," where *xxxx/xx* is the AppleTalk address.

Locating All Devices in an AppleTalk Zone

MacPing follows much the same procedure as above: it sends an =:=@*zone* BrRq to the local router but does not send the Echo packet. It then builds the device list from the devices that respond.

Refreshing Devices in a Single AppleTalk Network

MacPing broadcasts an =:=@*zone* NBP LkUp and a single Echo Request to the selected network. It then builds the device list from the devices that respond. This results in much less traffic than a BrRq sent to all networks of the zone, but side-steps the usual multicasting on an Ethernet.

Locating Devices in an AppleTalk Network Range

MacPing broadcasts an =:=@*zone* NBP LkUp to the first network of the range. After no more NBP responses have arrived for 0.75 seconds, it continues with each remaining network of the range. It does not broadcast an Echo Request to any network of the range.

Scouring an AppleTalk Network

When scouring a network, *MacPing* will probe each address of a network. It sends a =:=@* NBP LkUp directly to all addresses not already in the device list. Devices that respond will be added.

Getting Information about IP Devices

MacPing resolves a host name to an IP address using the DNS. It also requests the HINFO record for the device, and uses that information to build the Type field in the device list.

Determining the Range of an IP Subnet

MacPing resolves a host name using the DNS. It uses that IP address (“W.X.Y.Z”) to construct an SNMP Get-Next-Request containing the variable “ipAddrEntNetMask.(W.X.Y.Z)-1”. The SNMP response contains the subnet mask. *MacPing* then calculates the start and end addresses of the subnet.

Locating Devices in a Range of IP Addresses

MacPing uses several rules to decide whether to include a host in the device list:

- **Named Devices:** Send a POINTER query for the address to the DNS. Only include those hosts with names in the DNS server.
- **Active Devices:** Send one ICMP echo to the address and wait 0.5 seconds. Include the host if a response arrives.
- **All Devices:** Build the device list from each IP address in the range, whether it answers or not.

Normal Testing

After locating the devices to be tested, *MacPing* begins its normal testing. To test each device, *MacPing* sends the current probe packet and waits for the response. If the response arrives before the timeout interval, *MacPing* uses its arrival time to update the **Min**, **Max**, and **Avg** values. If the response packet does not arrive in time, *MacPing* notes that the device dropped a packet.

MacPing tests each device in the list, in the order shown on the screen. After probing each device, *MacPing* scrolls the traces to the right, updating the display to show the results of the latest test.

Late Arrivals

MacPing can detect and adapt to late arrivals of echo packets from AppleTalk devices. All echo packets contain a time stamp that indicates the time the Echo Request was sent. The time of arrival can then be used to compute the actual round-trip time. If *MacPing* is computing the timeout automatically, it will update the timeout to 1.5 times the longest round-trip time seen.

Node Conflicts

MacPing can detect node conflicts (duplicate AppleTalk addresses). Because the echo packets contain a time stamp, *MacPing* can detect that it has received two responses from the same Echo Request, and therefore that two devices may have answered. This is evidence that the devices have the same AppleTalk address. Click in the device's pop-up menu to discover NBP names for the machines with duplicate addresses.

Getting Additional Information about Devices

The following information is displayed in the pop-up menu shown when you **Option-click** on an item in the device list:

AppleTalk Devices

When testing AppleTalk devices, *MacPing* will query the Macintosh Responder with a System Status ATP request. It parses the reply to get the System and Finder versions, the AppleTalk version, and the AppleTalk ADEV used at startup.

LaserWriter

When testing a LaserWriter or other printer, *MacPing* sends a Printer Status ATP request. The response contains the printer's status information.

Macintosh with SNMP Agent

When testing a Macintosh with an SNMP Agent, *MacPing* sends several SNMP Get-Next-Requests to the SNMP socket (socket 8). The first request contains the variables: sysUpTime, sysContact, and sysLocation. The second request contains the variables gestaltEntry 'atkv' and 'sysv', snmpPhone, and snmpZone. To deduce the Ethernet address, *MacPing* traverses the atPortTable to find a matching address, then uses the ifIndex to get the ifPhysAddress of an Ethernet interface.

IP Host with SNMP Agent

When testing an IP host with an SNMP agent, *MacPing* sends two SNMP Get-Next-Requests using UDP to port 161. The first request gets these variables: sysUpTime, ipAdEntIfIndex.(w.x.y.z)-1, ipAdEntNetMask.(W.X.Y.Z)-1, ipRouteNextHop, sysContact, and sysLocation. The second request gets the ifPhysAddress with the correct ifIndex suffix from the first request.

Packet Data Formats

MacPing sends several different packet formats for its probes. They are described below:

Short AppleTalk Echo Protocol Packet (AEP)

An AppleTalk Echo Protocol (AEP) packet, with 8 bytes of DDP data in the following format:

'*x*SEc'	*x* is 0x01 for the echo request; 0x02 for the response
time-stamp	32-bit time stamp (in Macintosh ticks)

Long AppleTalk Echo Packet

An AEP packet with 580 bytes of DDP data, making the longest legal AppleTalk packet. It has the following format:

'*x*LEc'	*x* is 0x01 for the echo request; 0x02 for the response
time-stamp	32-bit time stamp (in Macintosh ticks)
0x00	20 bytes of 0x00
0xFF	1 (one) byte of 0xFF
0x00010203	repeating sequence from 0x00 to 0xFF, repeated
0x04050607	to fill out the remainder of the packet
0x08090A0B	
... etc ...	

Name-Binding

MacPing sends a NBP LkUp directly to the specified AppleTalk address. The form of the LkUp packet is

name:type@*

where name and type are the strings shown in the device list.

Printer Status

An ATP TRequest, with the User Bytes set to 0x00000001.

Custom AEP

An AEP packet with the following format:

'*x*CEc'	*x* is 0x01 for the echo request; 0x02 for the response
time-stamp	32-bit time stamp (in Macintosh ticks)
0x????????	user-specified data begins

Random AEP

An AEP packet with the following format:

'*x*CEc'	*x* is 0x01 for the echo request; 0x02 for the response
time-stamp	32-bit time stamp (in Macintosh ticks)
0x????????	random data bytes, sufficient to fill the user-specified packet length

Short ICMP Echo

An ICMP Echo packet with 8 bytes of data in the following format:

'*x*IEc'	*x* is 0x00
0x00000000	4 bytes of 0x00

Medium ICMP Echo

An ICMP Echo packet with 544 bytes of data. This is the longest ICMP packet that can be encapsulated in DDP without fragmentation. The packet has the following format:

'*x*IEc'	*x* is 0x00
0x00000000	4 bytes of 0x00
0x00 ...	same packet format as Long AEP; 20 bytes of 0x00, 1 (one) byte of 0x01, and incrementing byte values

Long ICMP Echo

An ICMP Echo packet with 1,472 bytes of data. This is the longest ICMP echo that can be sent in an Ethernet frame without fragmentation. The packet has the following format:

'*x*IEc'	*x* is 0x00
0x00000000	4 bytes of 0x00
0x00 ...	same packet format as Long AEP; 20 bytes of 0x00, 1 (one) byte of 0x01, and incrementing byte values

Custom ICMP Echo

An ICMP Echo packet with the following format:

'*x*lEc'	*x* is 0x00
0x00000000	4 bytes of 0x00
0x????????	user-specified data begins

Random ICMP Echo

An ICMP Echo packet with the following format:

'*x*lEc'	*x* is 0x00
0x00000000	4 bytes of 0x00
0x????????	random data bytes, sufficient to fill the user-specified packet length

Appendix B: AppleScript Commands

MacPing accepts three AppleScript commands, allowing you to invoke *MacPing* from other programs running on your Macintosh.

The following explanations briefly describe the AppleScript command and the definition, as shown in the *MacPing* AppleScript dictionary.

TestZone

MacPing will test all networks contained in the specified zone. This command is equivalent to the **Test Zone** menu command.

TestZone: Test an AppleTalk zone

TestZone string -- *zone name*

Example:

tell MacPing **to** testzone “Research and Development”

TestIP

MacPing will test an IP host or range of hosts. This command is equivalent to the **Test IP** menu command.

TestIP: Test a single IP address or a range of addresses

TestIP string -- *an IP address or host name*
[**to** string] -- *end of range*
[**include** named/active/all] -- *search option*

Examples:

tell MacPing **to** testIP “foo1.bar.com”
tell MacPing **to** testIP “foo1.bar.com” to “foo2.bar.com”
tell MacPing **to** testIP “foo1.bar.com” to “foo2.bar.com” include named

TestNet

MacPing will test an AppleTalk network or range of networks. This command is equivalent to the **Test Network** menu command. The network numbers are passed as AppleScript integers; they must be typed as decimal numbers.

TestNet: Test AppleTalk network

TestNet integer -- *network number*
[**to** integer] -- *high end of range*

Examples:

tell MacPing **to** testnet 5
tell MacPing **to** testnet 100 to 107