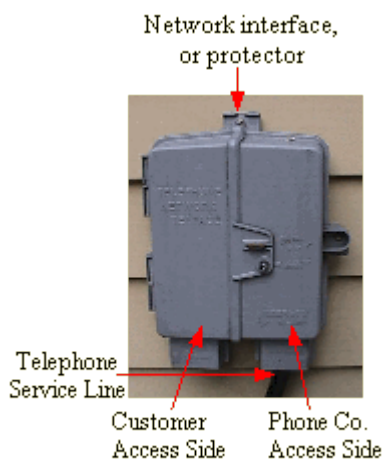


Lets go over the basics of telephone wiring.

Once you understand the basics, troubleshooting becomes a breeze. It may be time consuming, but a breeze. And at \$40 or more for a half hour's service from the telephone repair guy, the wind will be at your back!!

The really basic basics of telephone wiring...

Though you may have hundreds of feet of phone wire and countless connections, telephone wiring is really simple and logical. Take a walk around your house, and we'll figure it out together.

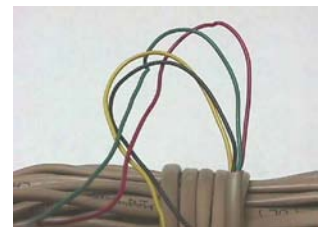


The telephone company, bless their souls, provides you with service through four wires or more wires leading to the outside of your house (there is actually more to it than that, but you don't need to know more to work on your own stuff). These wires connect to a box called a **network interface**, usually located outside your home for ease of access by the telephone company. It's also referred to as a **protector** (just the sound of it makes you tingle, eh?) The name "protector" is apt... it protects your house telephone wiring from unusual electrical surges from lightning strikes, power lines that may touch outside telephone cables, etc. Not a foolproof system, but very effective 99.9% of the time. The protector can often be found near your electrical service (meter), because the phone company and the electric company use the

same criteria for choosing an access point to your home.

The network interface acts as your main junction box- the place where all telephone cables leading into your house originate. Usually, part of it is off limits to you. It may be sealed with a lock, or screwed shut. This is where the phone company makes its connections. The wiring colors will not correspond with the color coding of your interior telephone wires.

The customer-accessible side uses the standard color coding that you will run into again and again in all telephone work. Most common telephone cables have four wires inside... red, green, black and yellow. In the trade they are referred to as "pairs". The red-green pair is used for basic one line service, and the black-yellow pair is used to provide a second line.





If you look at the blowup of the network interface to the left, you will see that there is a "block" with six colored screws. There are three pairs together... yellow-black, red-green and a second yellow-black. You will also notice that there are wires connected to the red and green terminals. In this connector, there is only one live telephone line... line 1.

Though the connector can carry up to three lines, for ease of customer use they usually only install one line per connector. If you had three lines, you would have one connector serving one line, and the second connector serving two lines. This network interface box has two such connectors, so this home could conceivably have up to six telephone lines installed.

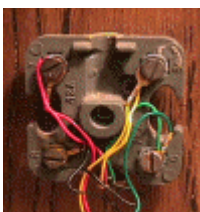
The actual connection to your wiring is made through the telephone jack in the connector by means of the removable plug attached to the black wire. Disconnecting this plug disables the telephone lines attached to the connector. This plug makes troubleshooting a little easier, since you can plug buttset into the jack to see if the telephone company's lines are okay (more later on troubleshooting).

Some older homes do not have easily accessible interfaces...

In older homes, the protector outside your home is a sealed box that does not allow customer access. It contains a special fuse to stop lightning from reaching your inside wiring. Essentially, it is a starting point for a standard 4-wire cable to enter the house, and you have no easy access to its innards!

Why was the phone company protective of its protector? Part of the reason for this is that, years ago, the phone company did it all... they owned all the phones, the wires, and the jacks, and it was illegal for you to mess with the wiring. So they had no incentive to make direct access to the inside of the protector available to you. Hooking your phone cables directly to the protector is advantageous because the telephone signal is the strongest there, and I recommend it when and if possible. In fact, if you have an older style protector, many phone companies will replace it with a modern connector, such as pictured above, at no charge. Especially if you are having phone problems or Internet connection problems!! Just cry and beg like I did!

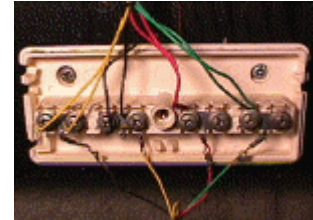
A second important reason why homeowners were denied access is because of the fear that they would connect wires to the unprotected side of the box, leaving their wiring systems vulnerable to lightning surges and the possibly disastrous consequences!



So if you have an old-style sealed protector, your access to the telephone company is via a run of cable (usually 4 wire, or two pair)

that enters your house and is connected to a **junction block** or **entrance bridge**. Junction blocks are rectangular plates that use screws to connect each of the four service wires (from the phone co.) together with your inside wires. A junction block has four terminals that hold the wires together with screws. The wires from the telephone company and your inside wires share a common screw based on the wire color... all reds to one terminal, blacks to another, etc. This system was great when people maybe had two phones (if they were filthy rich), but get a little crowded with three or four pair running off them to multiple telephone jacks.

Historically, junction blocks originated when homes had just one telephone line and one telephone. A single wire entered the home and went to a single jack. As years went by and people began wanting more convenient telephones, additional wires were run off the junction block to service other phones. After about two connections, the blocks were jammed with wires and difficult to work with. Enter the **entrance bridge**... a vast improvement. Instead of having the telephone wires run to a junction block in the living area, the entrance bridge was installed in a basement or utility room. Entrance bridges perform the same function as junction blocks, but the incoming telephone company wires do not directly touch your home's cable wires. Instead, they use various methods of securing the wires onto an insulated metal frame which provides the connection. As you can see in the graphic, the telephone company's wires (entering the graphic from the bottom) each attach to a block with two screw terminals. Up to two telephone lines with two separate cables (upstairs and downstairs, for example) could be attached without the necessity of wire-sharing on a terminal.



As you can see, entrance bridges can hold more wire connections than junction blocks, and since each connection is separate are your preferred choice for new or replacement installations. You will have both a better electrical connection, less chance of wires inadvertently touching and less confusing wiring!

To summarize, two wires provide all your phone service if you have one line, four wires if you have two lines. And all of your wall phones, cordless phones, computer modems, answering machines, fax machines and even your remote home security system lead back to the phone company via these little wires.

What can go wrong?

Did you change or damage anything... If your phones are not working properly, think about any changes you may have made in your system. Did you install a new phone in the last week or two (sometimes electronics takes a little while to fail)? Did you move any furniture, accidentally yank a phone wire, or drop a phone? If you can

think of anything that may have damaged a phone, a jack, or a wire, it's a starting point in your detective work!

Are rodents eating your wires... Don't laugh! I have found more than one eaten phone cable over the years, as well as stereo speaker wires, coaxial (television) and antenna cable, and live electrical cable. "Dinner bell" cable runs are those where the cable runs into a concealed area, such as behind insulation along a basement wall. I think they know it aggravates us... that's why the mice do it! So if you have seen evidence of rodents, they have to be considered possible suspects. See [Mice everywhere!! I've had an exterminator but the problem recurs every year. Help!!](#) concerning how to find and hopefully eliminate mouseys from your houseys, without resorting to poison bait or traps.



Lightning striking again... You may have had a lightning strike affect your phone system and not even know it. A surge can selectively fry one of your phones, or a modular jack, or a single connection, leaving no glaring evidence other than the malfunction.

Poor wiring... Sometimes in their enthusiasm to get a project done, an amateur with the best of intentions neglects to double-check his work. The two possible outcomes are:

Short circuit: Two bare wires that shouldn't touch were a little too close, and time and bad luck caused them to reposition ever so slightly, and, voila... short circuit. If the wires touch, the phone company thinks you are on the phone, and you can't receive or make any phone calls. Fortunately, this is not a dangerous condition, because the high voltage surge that occurs when the phone rings can't occur. If it did, it could conceivably fry your wires. The corrective action, of course, is to separate the wires.

Open circuit: This is when a wire that is supposed to be connected isn't. In this case, the result is the opposite... the phone company thinks that your phones are OK, callers hear the ring, but your phone doesn't "get the message". The solution... find the loose wire or broken wire, connect it or repair it, and voila... the world awaits your return.

Reversed wires: As long as you follow the wire color conventions consistently, you should have no problem with adding new phones or cables. Because the voltage is DC and not AC, reversed wiring can cause malfunctions in your equipment. Sometimes, a single telephone can be mis-wired and still function. Add a second phone correctly wired and the system melts down!

First things first... is it your fault or the phone company's?

Always call the telephone repair service first... though they may not get to you immediately it will at least put you in the "queue" in case your problem is their problem!

Most newer homes have the ability to easily check if the problem is outside your home in the phone company's lines... as long as you have a network interface outside or inside your home. Open up the customer-accessible side of the interface and you will see a number of familiar items... phone jacks! Each jack corresponds to one or more of the telephone lines in your home. If you only have one phone line, there will be only one visible phone jack with colored wires attached. In this interface, you can see that the telephone company has written the last four digits of the telephone number on the interface to make locating the right plug easier.



Bring one of your phones outside, or obtain buttset at a hardware store, home store, electrical supply or electronics store. Unplug the short-wired phone plug from the jack in the interface corresponding to your phone line and plug in the phone (or buttset). A dial tone (or proper lighting sequence) will tell you that the phone company is not at fault. If you receive no dial tone, get on the cell phone and call the repair service!

If you have multiple lines, you will have more than one of these connectors active. You will need to test them all to figure out which is the defective one. You will also need a two-line telephone tester if one interface shares two lines, since the second line will not be detected by a standard single-line tester (or a one-line telephone).

If you have a junction block or entrance bridge, you can test the telco's wiring using a multimeter. For a typical four wire system, you don't need to disconnect any wires to perform this test. Touch the "+" probe of the multimeter to the green and "-" probe to the red wires. If you have a second line, "+" to black and "-" to yellow. If you get a low DC voltage reading across a pair of wires (red-green or black-yellow), around 48v, you know that you are connected to the telephone company. No voltage means you are not getting a signal from the telephone company.

No problems with the telephone company? Check for a defective telephone!

One defective phone can mess up the whole works! **Unplug all phones and telephony devices...** computers, answering machines, etc. ... throughout your house. Then, taking your line tester (or one phone that you are sure works, go around and plug it into every outlet, checking for the proper lighting sequence (or, in the case of a telephone, dial tone). If all jacks appear to be dead (or you don't get dial tone anywhere), your problem is not with your telephones or telephony equipment..

However, if you do show a positive connection with your tester, you know a phone device is probably the culprit. Plug in each device one by one to see which one is the troublemaker. Once you find the culprit, and you can either trash it or have it repaired.

The next step is to test your wiring...

Right up front I must warn you that this can be difficult, confusing and try your patience! A variety of things can cause your telephone wiring to crash... improperly touching wires, mice eating the cables or an electrical surge frying a telephone jack are all possible culprits. I will try to give you as much information as I can, but in the end it is up to **you** to carefully learn and analyze your system!

1) Disconnect your inside wiring from the telephone company. As mentioned a few paragraphs back, if you have a network interface outside your home you should disconnect the plug serving the bad line. If you have a junction block or an entrance bridge, physically separate the telco's wiring from the block or bridge. Make sure none of the wires touch!

This action will "open" the circuit and allow you to use a multimeter to test the continuity of your wiring. A wire that has "continuity" allows electricity to freely flow through it. If two bare wires are touching, they also have continuity. If you don't want these wires touching, continuity indicates a defective condition. That is your goal... find where the defect is and correct it!

In a correctly wired home, each color of wire in your home is independent of all the others. Therefore, there should be no contact between any wires of different colors. Set your multimeter to test continuity (refer to the instructions with the meter). You should be able to touch your probes across any two wires of different colors and get no continuity. You can do this at a terminal block or entrance bridge without disconnecting any of your inside wires (except, of course, the telco's wires). **All phones and devices must be unplugged or this test will not work.**

If you get a continuity reading one of two things is happening... either two wires are touching somewhere in your home or you have a defective phone jack. Bare wires could be touching behind a telephone jack or at a junction block or entrance bridge. An electrical surge that made it into your system fried one of your jacks, causing an internal short circuit. Check all visible junction blocks first. Make a visible inspection to see if any wires attached to different terminals are touching, or if any wires appear to be disconnected or loose. If you see either of these conditions, separate the touching wires or tighten the connections. Go back to the prior step and test the lines again with a phone. If the phones are still not working, continue on to other blocks and telephone jacks. As you examine them, be sure that all bare wires are well clear of each other. Sometimes, just reinstalling a cover can cause close wires to touch!

Be aware that there may be **secondary junction blocks** or **parallel connections** in your home. These are used to run phone cable to a remote location by splicing into another phone's cable, rather than running a new cable from the main junction block or protector. Also, phone cables can "daisy chain" off each other (known in electrical parlance as parallel connection), one connecting to the next to the next and so on. If you look at your junction block and see two cables leading into the house, but you know you have six telephone outlets, one of these two scenarios is occurring. You should try to find any secondary junction blocks, and examine them for touching bare wires or loose wires. As far as parallel connections go, you will only discover them as you open up the phone outlets throughout the next phase of your troubleshooting, should you have to go that far.

Now, you have to determine whether it's the cable itself or the phone outlets, or jacks. Disconnect one wire of a pair (red or green, black or yellow) from each jack. This disables all the jacks without having to totally disconnect all the wires. Reconnect the circuit to the telco's wires. Then, one by one, reconnect the jacks one at a time testing with a phone or telephone line tester.

If none of the jacks work, then you have a short in the cable. If all work but one, your short is probably in the jack. You can get a new jack, and try out connecting the existing wires to it. I usually have one standard modular jack available for testing purposes whenever I troubleshoot phones.

I've got to admit that this is not the only way to troubleshoot phone lines... just one basic approach. After you get to know your own home's phone system, you may find shortcuts to testing that I have not even addressed here. Consider this a primer, but don't forget... you are a student of your own experience!!

[Is there a limit to the number of phones I can have hooked up to the same line?](#)

Yes and no. There really is no absolute limit on the number of phones or devices. Your phone or device has a label on it that states either a value called **REN** or **ringer equivalence**. There is a limited amount of power available from the phone company to make your phones ring. In other words, if you have too many phones, none of them will ring. Your callers will think your phone is ringing (they won't get a busy signal), but you won't hear any ringing!

Though the limit is around 5 total devices, you will know if you exceed the limit because the phones just will not ring anymore. If you call the phone company, they can give you your system's REN limit. Then, add up the REN of all your devices on the line. If they are less than the REN limit, you are OK, if you exceed the REN limit, your devices may not respond to the ring signal.

Most phones have a REN of around 1. Computer modems, fax machines, and answering machines also have a REN value, and you should take them into account when figuring your total REN. I have a US Robotics Sportster Voice Faxmodem, and it has a ringer equivalence of 0.4.

GOOD LUCK!