How Modems Work

Modems move mountains of data from computer to computer, but they don't have any moving parts. Yet, like an automated machine, they perform the same basic task over and over again: taking digital data from your computer, converting it into an analog format, and transmitting it over the phone line so that the modem at the other end can decode the analog data into a digital format for another computer.

The Connection Process

1 You direct the modem to dial a number. You may not realize you've done it, but when your computer starts to connect to your ISP (Internet service provider), the first thing it does is dial a phone number.

2 The computer interprets your actions (such as choosing to connect to your ISP) and sends the initialization string to the modem, followed by the command to dial your ISP's phone number. The initialization sets modem preferences, such as speaker volume and how long to wait for a dial tone.

3 The modem's controller receives the initialization string and dial command. Its preferences are reset to match those sent in the initialization string and it obeys the dial command by picking up the phone.

4 The modem's DSP (digital signal processor) generates the touch or pulse tones needed to dial the number and listens for a response from the modem at the other end.

5 Your ISP's modem answers the phone, announcing itself with a carrier tone.

6 The two modems begin to negotiate a connection. They both figure out what type of modem they're talking to and decide which speed to connect at and what protocols to use. If the modems are 28,800bps (bits per second) models or faster, your modem performs a line probe, analyze the results, and tell the ISP's modem how to set up the connection.

7 By agreeing on a speed and connection protocol, the modems also agree on what compression table to use. They use a table that corresponds with the protocol they're using.

8 Once connected, the modems can begin sending data back and forth. When one of the two modems is ready to disconnect, it simply drops its carrier signal. Because the other modem is constantly listening for signals, it detects that the other modem has gone silent and also hangs up.
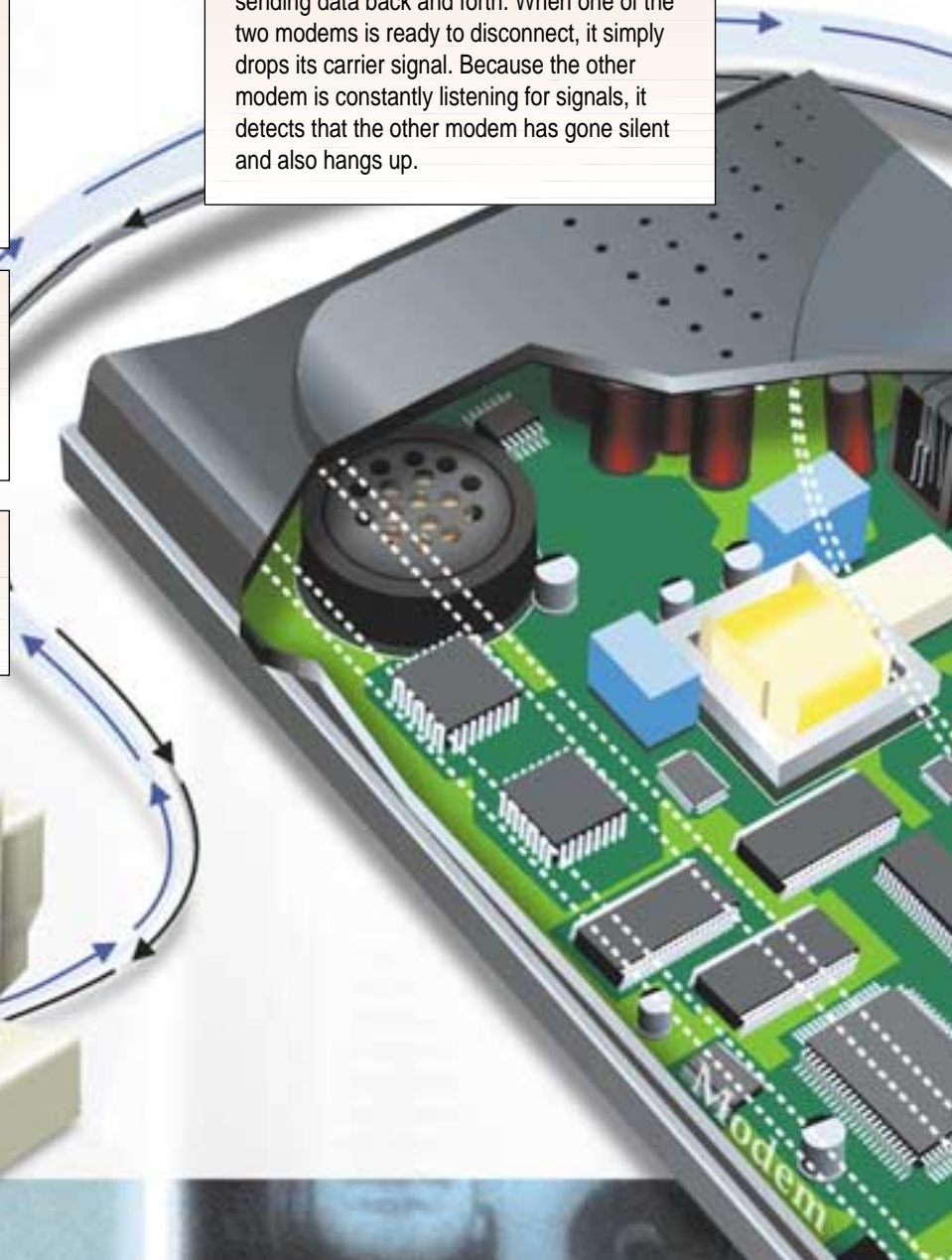
How Data Gets From Modem A To Modem B

When you're connected to an ISP, you're usually downloading data. At the same time, you constantly send data back to the ISP. For example, if you want to access a Web page, your Web browser will have to request it from the Web server by asking your computer to send a message through your modem, to your ISP, and on to the modem of the remote Web server. How does this data get from one modem to the other?

1 First, your computer checks whether the modem is ready to receive data. Flow control keeps the computer from sending data faster than the modem can handle it. If flow control shows the modem is ready to receive data, the computer sends the data in a stream, one bit at a time.

2 The data arrives in the modem's buffer. Your modem holds it here until it's ready to process it.

3 The modem takes data from the buffer and groups several bits of data together.

4 Before compressing the bits of data, the modem uses the error correction process to analyze the data and run an algorithm that represents the combination and sequence of the gathered bits as a number, or checksum. The checksum is attached to the block of data that the modem just retrieved from the buffer.

5 If the data is compressible (some data, such as ZIP files, is already compressed), the modem runs a compression algorithm on that chunk of data so that it can send several bits of data as one sound. Modems without compression capabilities represent each bit of data with a sound (usually a change in pitch or frequency). Modems with compression capabilities can use a more complicated sound to represent a string of several bits.

6 The compression algorithm consults its compression table to determine which sound symbolizes the string of bits it just gathered from the buffer.

7 The DSP then generates the sound specified by the compression table.

8 The receiving modem checks the sound it just heard against its copy of the compression table and decompresses the data into a string of several bits.

9 The receiving modem uses error correction to ensure the data wasn't corrupted in transit and generates its own checksum for the block of data. If this doesn't match the checksum that your modem sent, the data is thrown out and your modem is asked to resend it.

10 If this transmission of data passes inspection, the receiving modem passes it on to its computer.

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