30 MINUTES

Lab Exercise 11.01: Troubleshooting and Benchmarking USB

Universal serial bus (USB) has become the expected standard port for a wide variety of peripheral devices, from basic keyboards and mice to high-end external drives.

Most people take USB ports for granted—that is, until they don’t work right for some reason. “Not working right” could mean not working at all, or it could mean operating at a slower speed than anticipated. In this lab exercise, you will learn how to troubleshoot problems with a USB port, including benchmarking it to make sure it is transferring data at a rate commensurate with the USB standard it is supposed to conform to.

Learning Objectives

This lab teaches you some troubleshooting and benchmarking techniques for USB devices and ports.

At the end of this lab, you’ll be able to

- Troubleshoot problems with USB devices and ports
- Benchmark a USB storage device running on a specific port

Lab Materials and Setup

The materials you need for this lab are

- A Windows system
- A USB flash drive
- The USB Flash Benchmark utility, available from http://usbflashspeed.com

Getting Down to Business

In this lab exercise you will simulate troubleshooting for a variety of problems involving USB devices, including not being recognized, not being adequately powered, and not performing at expected data transfer rates.

Step 1  You connect a USB flash drive, and Windows ponders it for a minute or two. At long last, a message appears such as USB Device Not Recognized. Now what? In earlier days of USB devices, this was actually pretty common. Many USB devices therefore came with a disc containing the needed driver. Nowadays, you don’t see that so much, because most USB devices work smoothly with the generic USB devices and controllers on the average system.

When that dreaded error occurs, here are some steps to take to troubleshoot. Walk through these now, in preparation for needing them later. In the column on the right, jot down notes about why each of these steps might help, based on what you know about PCs, Windows, and USB. Refer to Chapter 11 of Mike Meyers’ CompTIA A+ Guide to Managing and Troubleshooting PCs as needed.
Step 2  Many USB devices are bus-powered; they draw the small amount of electricity they need from the USB port. USB keyboards and mice are like that, for example, as are USB flash drives. And that's fine, in most cases. On most motherboards, a USB host adapter supports only a couple of ports. Most external devices use somewhere between 100 and 200 mA (milliamps) apiece, and most host adapters deliver 500 mA, so a single host adapter has no trouble supporting them.

A problem can crop up, though, when you connect multiple bus-powered devices to USB ports that are themselves piggybacked on other bus-powered devices. You can nest USB hubs up to seven levels deep on a single port, so it is possible for a single port on the computer to end up supporting several dozen USB devices. Even if each device is just drawing a little bit of power, you can quickly run into a situation where there is insufficient power from the port to power all the devices if the externally connected USB devices and hubs don't have their own power supplies. You might see a Windows error message telling you that the device has insufficient power, or the device might simply not work right (or at all), especially when another device on the same host controller is also drawing power.

Follow these steps to check out the power usage of the devices plugged into your USB ports:

a. Open Device Manager:
   - In Windows 8.1 and later, right-click the Start button and choose Device Manager.
   - In Windows 7, open the Control Panel, navigate to System, and then click Device Manager.

b. Double-click the Universal Serial Bus Controllers category to expand it.

c. Double-click one of the Generic USB Hub or USB Root Hub entries to open its Properties box.

d. Click the Power tab. The Hub information section shows the total power available, and the Attached devices section shows what devices are connected already and how much power they require. Figure 11-1 shows an example from Windows 10.
e. For each of the entries in the Universal Serial Bus Controllers category in Device Manager that has a Power tab in its Properties box, record the following information:

<table>
<thead>
<tr>
<th>Device Name</th>
<th>Total Power Available</th>
<th>Devices Attached</th>
<th>Power Required for Each Attached Device</th>
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f. In the chart above, identify each of the devices in the Devices Attached column. You might be surprised to find out what devices are attached to the motherboard's USB bus. For example, my laptop has a built-in WiMAX controller and a built-in keyboard, and both of them show up as USB devices.

g. Close all open windows, including Device Manager, when you are finished.
Figure 11-2 Click this icon in the notification area to remove a USB drive safely.

Step 3 USB storage devices are fairly reliable in general, but they do have one Achilles' heel: if you unplug the device from the PC in the middle of a write operation, you get corrupted files. To prevent this, Windows offers the Safely Remove Hardware tool, which waits until the USB drive finishes its write operation and then shuts down the communication on that port and lets you know it is safe to disconnect the drive. Communication will not resume on that port until the device is disconnected and reconnected.

Follow these steps to try out the Safely Remove Hardware tool.

a. Connect an external USB drive to the PC.
b. Write a file to it.
c. In the notification area, click the Safely Remove Hardware icon (shown in Figure 11-2).
d. On the menu that appears, click the Eject command for the connected device.
e. Try accessing the connected device. What happens?

f. Disconnect and reconnect the device. Then try accessing it again. What happens?

Step 4 Not all USB ports are created equal. There are four different USB port standards that you may encounter on computing devices. The higher the standard number, the higher the maximum data throughput rate. Ports and connectors are color-coded: white is USB 1.1, black is USB 2.0, blue is USB 3.0, and teal is USB 3.1. There is basic backward compatibility, but if you connect a device that wants faster data throughput to a slower port, it won't perform to its top potential. Table 11-1 provides the maximum speeds for each type, although you won't see these top speeds in real-life usage.

<table>
<thead>
<tr>
<th>Name</th>
<th>Standard</th>
<th>Maximum Speed</th>
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</thead>
<tbody>
<tr>
<td>Low-Speed USB</td>
<td>USB 1.1</td>
<td>1.5 Mbps</td>
</tr>
<tr>
<td>Full-Speed USB</td>
<td>USB 1.1</td>
<td>12 Mbps</td>
</tr>
<tr>
<td>Hi-Speed USB</td>
<td>USB 2.0</td>
<td>480 Mbps</td>
</tr>
<tr>
<td>Super-Speed USB</td>
<td>USB 3.0</td>
<td>5 Gbps</td>
</tr>
<tr>
<td>Super-Speed USB 10 Gbps</td>
<td>USB 3.1 Gen 2</td>
<td>10 Gbps</td>
</tr>
</tbody>
</table>

Table 11-1 Data Transfer Rates per USB Standard
The real-life transfer rate is determined by whatever is the bottleneck point among these factors: the standard that the port supports, the standard that the drive supports, the limitations of the hardware, and the sizes of the files being transferred (larger files transfer faster than smaller ones). Generally speaking, USB 2.0 is adequate for most external storage devices, although some high-performance models may benefit from USB 3.0 or 3.1.

Follow these steps to benchmark the real-life performance of a flash drive:

a. Identify the USB ports available to you on the PC you’re working with. Choose the fastest port available if there are different port standards (for example, both USB 2.0 and 3.0 ports). Connect your flash drive to the port.


c. In the USB Flash Benchmark window, open the Drive drop-down list and choose the flash drive.

d. Click the Benchmark button to begin the test. Wait for the test to complete.

Figure 11-3 shows an example of the completed test. The top line represents the best case, and the bottom line the worst case. The numbers along the bottom of the chart represent different file sizes; notice that the larger file sizes (toward the left end) produce the fastest results.

What was the best transfer rate for a 16-GB file? 

What was the best transfer rate for a 2-GB file? 

**Figure 11-3 Flash Benchmark test results**
Lab Exercise 11.02: Disassembling and Cleaning a Keyboard

e. (Optional) If available, test other USB flash drives, and/or different USB ports on your PC, to see if the results vary.

How did the results vary, if at all?

⏰ 30 MINUTES

Lab Exercise 11.02: Disassembling and Cleaning a Keyboard

Keyboards are plentiful and common, and a new basic keyboard is very inexpensive. Even with cheap keyboards, users tend to get attached to these devices over time—and in the case of an expensive keyboard with lots of extra buttons and features, the user may have both a financial and an emotional attachment! For these reasons, it’s important that you learn to play “Dr. Keyboard,” fixing these devices when they break.

Learning Objectives

This lab teaches you how to clean and perform simple repairs on a standard keyboard.

At the end of this lab, you’ll be able to

- Repair stuck keyboard keys
- Dismantle and clean a keyboard

Lab Materials and Setup

The materials you need for this lab are

- A Windows system
- As many “throw-away” keyboards as possible (functional keyboards that you won’t mind throwing away at the end of this lab; connection type is unimportant as long as they’re usable by a Windows system)
- A medium-sized flathead screwdriver
- Compressed air
- A lint-free cloth
Lab Analysis Test

1. Mark loaned his computer to a co-worker, and when he got it back, the mouse pointer was moving slowly. He had to drag the mouse all the way across the mouse pad to get it to move just a few inches onscreen. Describe how you would troubleshoot and fix this problem.

2. Don has a wireless keyboard and wireless mouse. When he tries to enter CMOS Setup as his computer starts up, he can't do it, because the wireless keyboard isn't recognized until later in the boot process. What do you suggest he do?

3. Donna installed a new sound card in a system that already has built-in sound on the motherboard. She unplugs the speaker from the built-in sound port on the PC and plugs it into the speaker port on the new sound card. Then she boots into Windows. She turns up the volume, but hears no sound. What should she do?

4. Rita has been using two different computers at her desk at work. She has two cases, two monitors, two keyboards, and two mice. What device could she use to simplify this setup, and how would she set it up?

5. Jeff wants to buy a Blu-ray Disc drive to add to his old PC, as an additional drive (not removing his old optical drive). His motherboard supports both SATA and PATA. What should he consider in choosing an interface?

Key Term Quiz

Use the following terms to complete the following sentences. Not all terms will be used.

- drive bay
- recalibrated
- PCIe slot
- PS/2
- updated
- USB

1. If you connect an external USB hard drive to a USB _________ port, it might work but data transfers will be very slow.

2. Some very old keyboards use a purple _______ connector, but most newer ones use a(n) _______ connector.

3. When a trackball will only move the pointer up/down, it probably needs to be _________.

4. A sound card has a variety of ports, including both _______ and _______ inputs and outputs.

5. An optical drive would typically fit into a 5.25-inch _______ in a desktop case.