Application Note
USB Hubs in Type-C Application

TEXAS INSTRUMENTS

Brian Zhou

ABSTRACT

USB Type-C® is now shaping up to be a replacement for older USB standards. A USB-C® hub is a device that expands the functionality of a USB-C port, which is a relatively new type of connector found on many modern devices. This application note covers what USB Type-C is and explains the role of USB hubs in Type-C applications. Some typical examples of Type-C hubs are presented in this application note.

Table of Contents

List of Figures

Trademarks
USB Type-C® and USB-C® are registered trademarks of USB Implementers Forum.
All trademarks are the property of their respective owners.

1 Introduction

The USB Type-C connector ecosystem addresses the evolving needs of modern platforms and devices, and the trend towards smaller, thinner, and lighter form-factor designs. Additionally, the modification of USB Power Delivery (USB PD) for the Type-C connector helps address the needs of power hungry applications.

To take advantage of Type-C benefits, USB-C hubs are a cost-effective and space-saving way to add ports to a laptop, PC, or gaming system, allowing users to connect extra monitors or peripherals to use.

2 What is Type-C?

USB Type-C consolidates data, power, and video into a single connector interface. USB-C also brings an opportunity to eliminate power barrel jack connector from new platforms. USB Type-C supports USB 2.0 and USB 3.1 while providing options for alternate (Alt) modes such as DisplayPort for video. USB Type-C supplies a native power capability of 15 W and an enhanced capability of up to 100 W with the addition of USB PD. The interface introduces smaller, thinner, and more robust connectors that can provide data rates up to 20Gbps. The cable is reversible and flippable and connects a host or a client device in either direction. System designers are actively pursuing ways to bring these desirable features and flexibility to their customers.

As seen in Figure 2-1, USB-C connector is an all in one design for USB data, video, and power delivery.
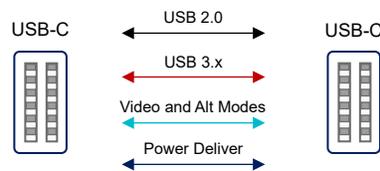
Figure 2-1. USB-C Connector

3 USB Hub in USB-C Application

3.1 Expanding USB-C Ports

USB hub can be used to expand the functionality of a USB-C port, adding ports to your laptop, PC, or gaming system so users can connect other devices or peripherals. Figure 3-1 shows three typical Type-C port expansions with TUSB8044A hub. In this application, the hub upstream port is connected to the USB host. Downstream ports can be used either as a Type-A port or configured as a Type-C DFP port.
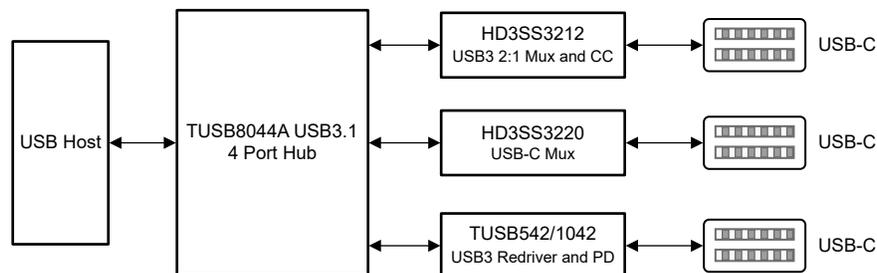
Figure 3-1. Expanding USB-C Ports With USB Hub

1: HD3SS3212 USB3 mux + CC controller:

HD3SS3212 is USB 3.1 SS MUX with 2:1 switching required to handle cable flips. The CC controller determines the orientation of the cable and controls the MUX selection.

2: HD3SS3220

HD3SS3220 has integrated USB 3.1 SS MUX HD3SS3212 and CC controller TUSB322. The device also provides this orientation signal as a GPIO signal DIR that can be used in the system for increased flexibility and features.

3: USB3 redriver mux + PD controller

USB Type-C ports can also be configured to support other data protocols using alternate modes. In theory, a cable maker can create a wire that transmits DisplayPort or HDMI data using the USB-C port. To support Alt mode or power deliver, PD controller is needed together with USB 3.1 redriver mux to achieve full Type-C features.

3.2 USB Hub in USB-C Monitor

A typical USB hub application in USB-C is USB-C hub monitor. This application usually contains a power jack, a DisplayPort input, one HDMI input, one USB Type-C port, two or more USB Type-A ports, one or more USB-C ports and an Ethernet jack.

USB-C hub monitors showcase the benefits and features of USB-C. USB-C can deliver the image to the monitor, have the monitor function as a USB hub, and if the monitor has a power source, a laptop can be powered through a single Thunderbolt 3 USB-C cable. Using compatible cables and devices, users can expect up to 4-K resolution at 60 frames per second (fps) to two monitors or 5-K resolution at 60 fps to a single monitor. Perhaps the most significant benefit is how the technology allows for easy daisy chaining of multiple monitors with display port.

A USB-C hub monitor can remove numerous cords from your desk. Instead of connecting peripherals to your PC, you can connect them to the monitor, which then connects to your PC over USB-C. Laptops that have USB-C benefit the most. The USB-C hub monitor can act as a video cable and power cable in one.

In USB-C hub monitor application, the hub upstream port is configured as UFP by PD controller, downstream ports can be used either as a Type-A port or Type-C DFP port.

3.3 USB Type-C Billboard for Alternate Mode with TUSB8044A

Figure 3-2 shows USB-C billboard for alternate mode with USB hub TUSB8044A.

USB Billboard is a device class to communicate the alternate modes supported to a host system. USB Billboard is a simple USB 2.0 device that is required for devices that support USB Type-C Alternate Modes.

Billboard descriptors are used to advertise the alternate mode capabilities and configurations supported by the device through a BOS descriptor capability.

Upon the successful entry into the alternate mode, there is no need to switch to read the Billboard descriptors. Only upon failure to enter the Alternate mode, the PD controller signals to TUSB8044A to expose the USB Billboard interface through GPIO. USB Billboard is exposed on through the USB 2.0 interface. Billboard is needed here to avoid silent failures for better user experience.
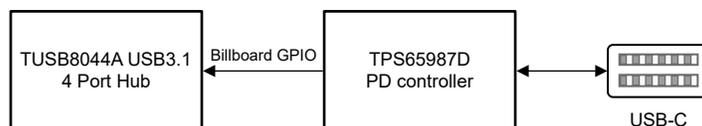
Figure 3-2. Type-C Billboard for Alternate Mode with TUSB8044A

4 Summary

USB Type-C is popular in the world of electronics because of the capability and flexibility the technology provides. Systems do not have to incur significant development and component costs to take advantage of the great benefits of USB Type-C. USB hub can expand USB-C ports and be designed within USB-C monitors as well as docking stations.

5 References

- Texas Instruments, TUSB8044A Four-Port USB 3.2 x1 Gen1 Hub with USB Billboard data sheet.
- USB 3.0 Promoter Group, Universal Serial Bus Type-C Cable and Connector specification.

IMPORTANT NOTICE AND DISCLAIMER