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Technical Whitepaper

Hardware-Level Protection Against USB-Based Threats

Lenovo ThinkPad USB-C Restricted Mode

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1. Introduction

Modern organizations face increasing exposure to physical device interfaces that were once considered trusted. A single compromised or unauthorized peripheral connection can create a direct path into the heart of the device, bypassing traditional software-based defenses. The result is not just a technical problem; it's also a business continuity risk.

A compromised endpoint can trigger data loss, credential theft, and ransomware propagation. This can in turn lead to costly remediation efforts, loss of customer trust, and potential regulatory penalties. Even short periods of endpoint downtime can disrupt productivity across the workforce, delay service delivery, and impact revenue. For industries that operate in public spaces or rely on shared charging or service stations, the exposure multiplies. Each unmonitored connection becomes a potential entry point. These incidents also place enormous strain on IT and security teams, diverting resources from innovation and growth to containment and recovery.

By ensuring built-in hardware-level protections, ThinkPad devices can mitigate unauthorized device interactions. This enables organizations to maintain stronger device integrity, safeguard sensitive data, and protect business operations from avoidable disruption. This level of embedded defense directly supports operational resilience, compliance assurance, and long-term business continuity.

2. USB-C Restricted Mode

USB-C Restricted Mode is a new security feature available on select 2024 ThinkPad models. It protects your data from theft via USB-C ports when using public charging stations (such as those in airports or cafés) or when connecting potentially malicious USB devices to your ThinkPad. These types of attacks are called “Juice Jacking” or “BadUSB attack”.

When you are connecting your ThinkPad to such public charging spots, simply press Fn + “U” then Fn + “S” keys to enable the USB-C Restricted Mode, so that you do not have to worry about the data breach risk through the USB port.

2.1 Background

USB-C is an industry standard interface that supports data transfer and charging on most of the recent digital devices (PCs, smartphones, and tablets). As it is industry standard, there are public charging spots (in airports, cafés, etc.) to charge the digital devices. The ubiquity of USB-C charging is very convenient. But at the same time, it has introduced a new attack vector where an attacker can add a malicious component to chargers and utilize the data connection of the USB-C standard to infect a system with malware or steal data.

If you use public USB charging spots to charge your ThinkPad, it is possible that they can steal data from your PC through the USB-C ports while charging.

2.2 USB-C Restricted Mode

To prevent data breaches or malware infections through public charging spots, ThinkPad devices are equipped with a feature known as USB-C Restricted Mode. Before you connect your ThinkPad device to a public charging spot or unknown AC adapter, simply press Fn + “U” then Fn + “S” keys to enable the **USB-C Restricted Mode**. This will ensure that your ThinkPad is protected.

3. How to use the “USB-C Restricted Mode”

When enabled, the USB-C Restricted Mode disables USB-C data lines (USB3/high speed signal and USB2) dynamically. Figure 1 shows the typical usage of this feature. Even if the system is in a public space and chargers are not trustworthy, users can enjoy system charging by disabling data communication channels using the USB-C Restricted Mode. Users can switch back to normal state dynamically, without rebooting the system.

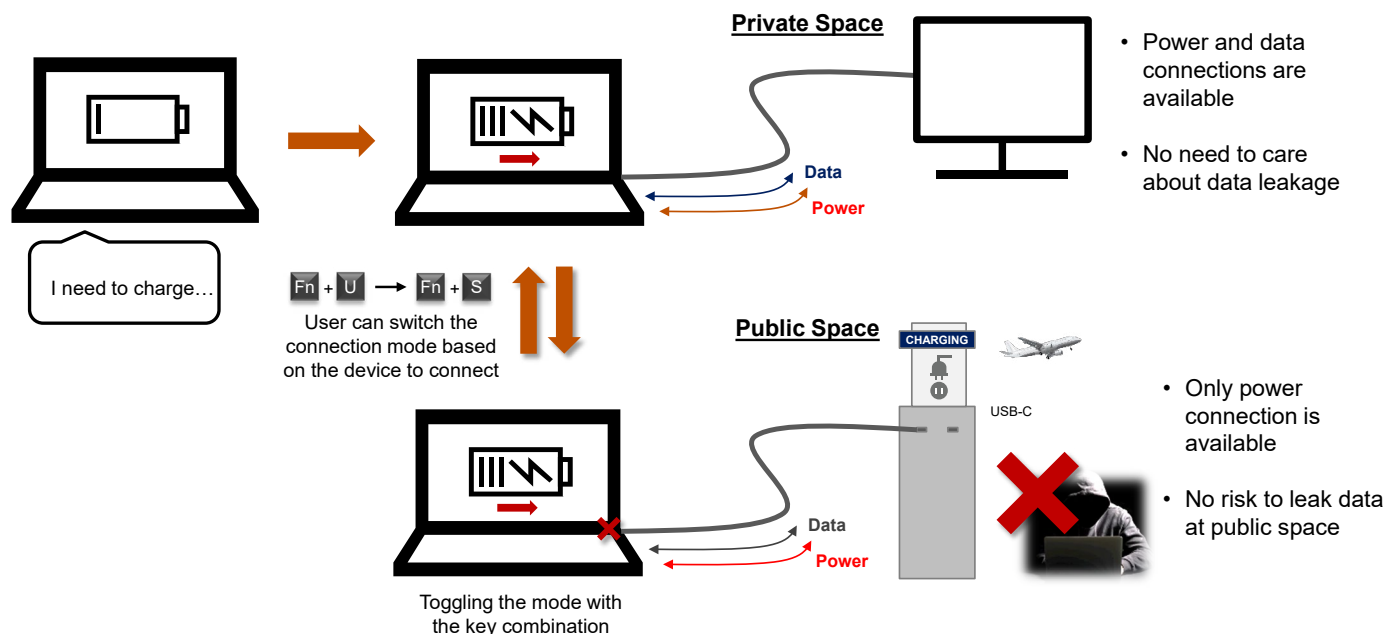
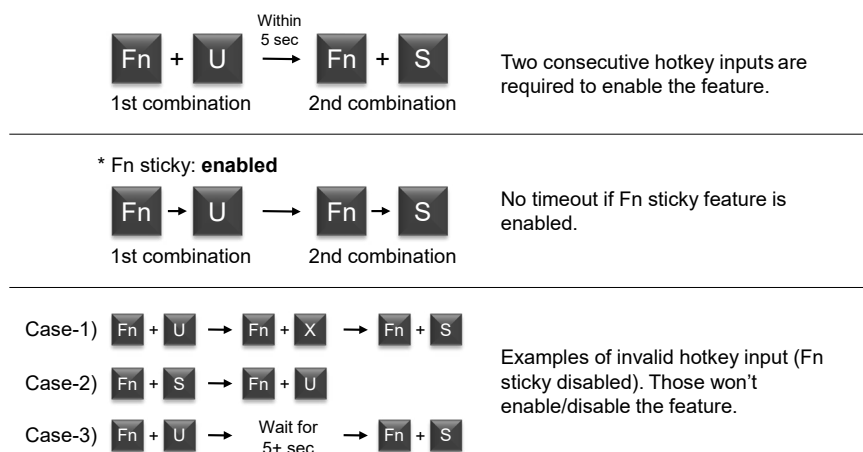


Figure 1 Typical user scenario of USB-C Restricted Mode

3.1 Toggling method

The USB-C Restricted Mode can be enabled and disabled via two key combination inputs. This aims to prevent users from enabling the feature accidentally. The key combination is defined as Fn + “U” for the first sequence and Fn + “S” for the second sequence. The key combination should be input consecutively to enable the feature. For example, the sequence of 1) Fn + “U”, 2) Fn + “X”, 3) Fn + “S” won’t enable the feature. Also, 1) Fn + “S” then 2) Fn + “U” won’t enable the USB-C Restricted Mode as well.

The time between the first and second key input should be within 5 seconds. For example, if you press 1) Fn + “U” then 2) Fn + “S” after 6 seconds, the feature won’t be enabled. Note that this timeout value will be extended to indefinitely in case Fn sticky mode has been enabled. Figure 2 describes the toggling method.



Please note that if the battery capacity is less than 5%, toggling the USB-C Restricted Mode is temporarily disabled to avoid unexpected device shutdown caused by the USB-C configuration change.

Figure 2 Key input for function enabling

3.2 Persistency of the USB-C Restricted Mode

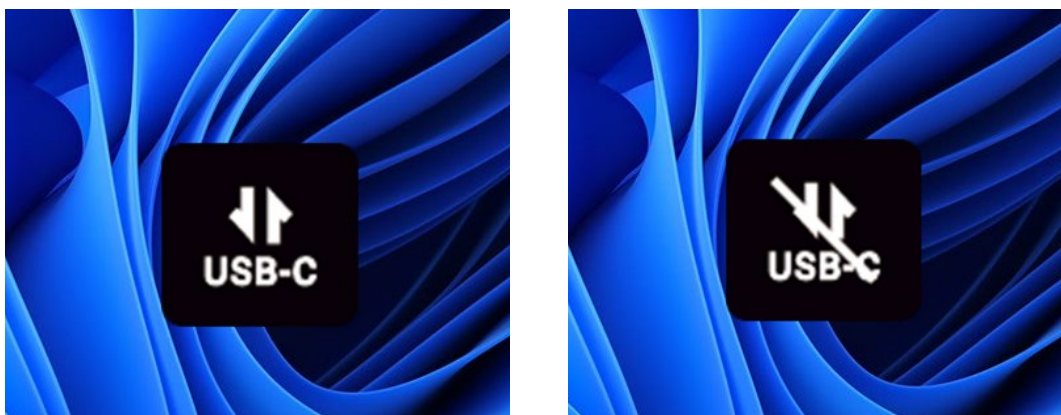
USB-C Restricted Mode setting is retained even in power off, hibernate or sleep state. This allows a user to charge systems safely in public spaces regardless of the device's power status.

During system off (including the sleep state), the key input is ignored. Any key input will not alter the state of the USB-C Restricted Mode.

3.3 Notification

3.3.1 On-Screen Display

To notify the user of the current mode, the icon will be shown as an On-Screen Display (OSD) notification. Figure 3 shows the icons.



A. Function enabled

B. Function disabled

Figure 3 USB-C Restricted Mode On-Screen Display icons

3.3.2 Toast message

When the USB-C Restricted Mode is turned on, the toast message is also shown in addition to OSD (Figure 4). The conditions to show the toast are below.

- Lenovo Vantage software is installed.
- The feature is turned on by the hotkey combination (Fn+"U" then Fn+"S").
The toast message will not appear when the feature is turned off (OSD still shows notification).

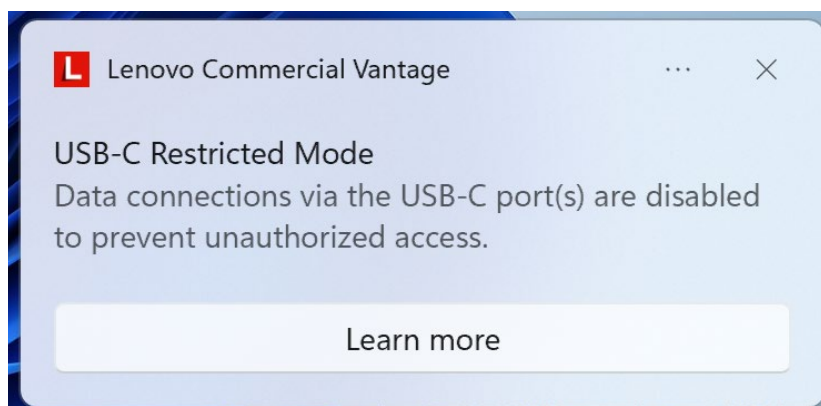


Figure 4 Toast message

3.3.3 DC-IN LED

If the device is attached as the feature is being enabled, DC-IN LED alternately blinks amber and white every 250ms, repeating 3 times (Figure 5).



Figure 5 DC-IN LED

This indicates:

- Either Lenovo Vantage or On-Screen Display service is not installed. Several ThinkPad models support Linux, but Lenovo Vantage is not supported on Linux. If it is the case, the user cannot tell if the feature is enabled or not.
- The device was connected in its power off state. During power off, no pop-up or OSD can be shown on the screen. (DC-IN LED will not blink during hibernation or shutdown if there is no AC connection.)

Below is the pattern of LED blinking. The LED only blinks when the device is attached as the feature is enabled.

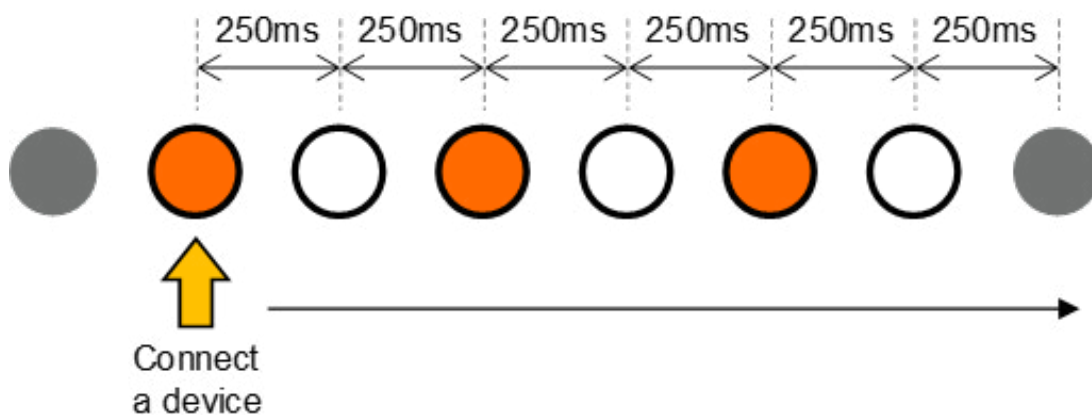


Figure 6 LED blinking pattern.

3.4 When device is connected as the function is being enabled

If the data communication capable device (such as USB memory key, USB-C/Thunderbolt docking station, USB-C monitor) is attached while USB data lines is disabled (i.e., the feature is enabled), the OSD will indicate that the system is in the data-lines-disabled mode. Note that the notification will not show if a USB-C AC adapter is connected because it is not a data communication capable device. Figure 7 is the flowchart of notification showing up mechanism.

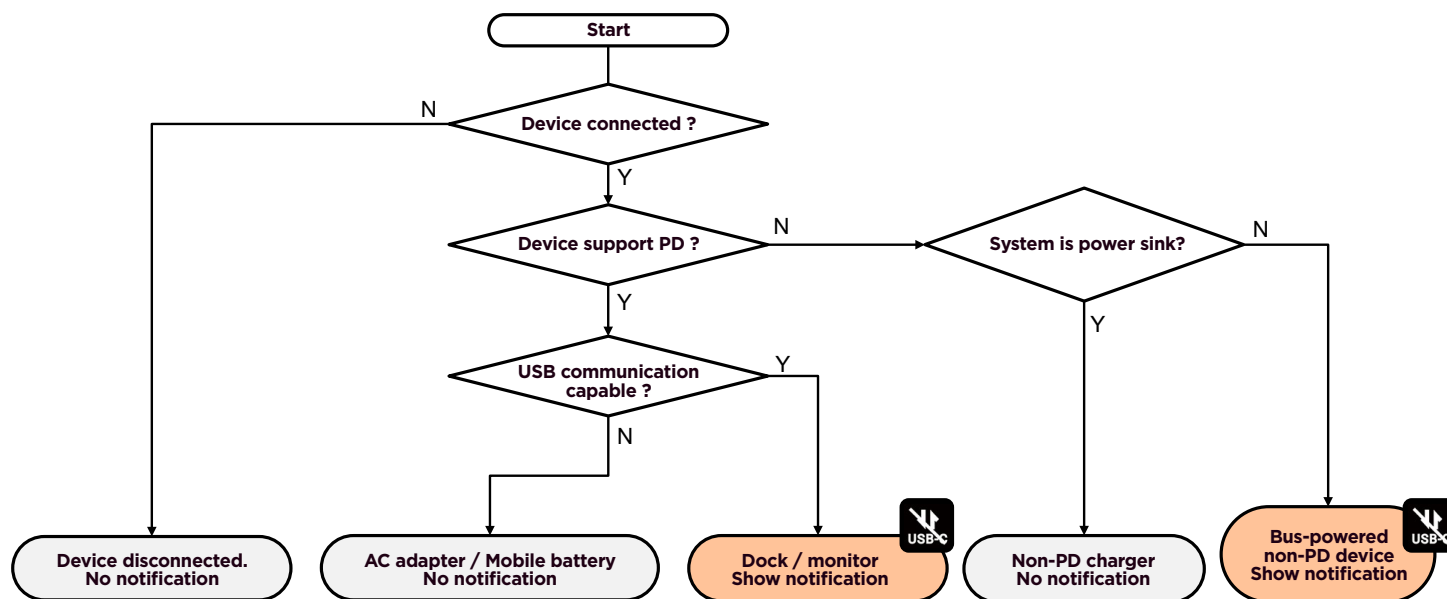


Figure 7 Conditions of notification.

3.5. Default setting

USB-C Restricted Mode is disabled by default.

3.6. Affected ports

Data lines disabling by the USB-C Restricted Mode will affect all USB-C ports of the system. When the USB-C Restricted Mode is enabled, all USB-C ports won't transmit data through high-speed data lines and USB2 data lines.

3.7. Reset

USB-C Restricted Mode settings will be reset by operating "factory default recovery" in BIOS setup menu.

4. Supported ThinkPad products

USB-C Restricted Mode is supported on select ThinkPad models released in 2024 and later. Contact your local Lenovo representative for more information.*

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