

Solution Brief

Thunderbolt™ Technology



IT@Intel: Intel® Thunderbolt Analytics



Improving Thunderbolt intelligence: Data collection and event monitoring provide Intel IT with actionable insights for an improved experience for users.

Thunderbolt technology has established itself as the fastest, simplest, most reliable USB-C connection available—the premier connectivity solution IT can offer users throughout the organization.¹ Developed and maintained by Intel Corporation, Thunderbolt provides a universal cable connectivity solution delivering high-speed bandwidth ideal for fast data and video transfer. In addition, Thunderbolt simultaneously charges the user's laptop—all over a single cable.²

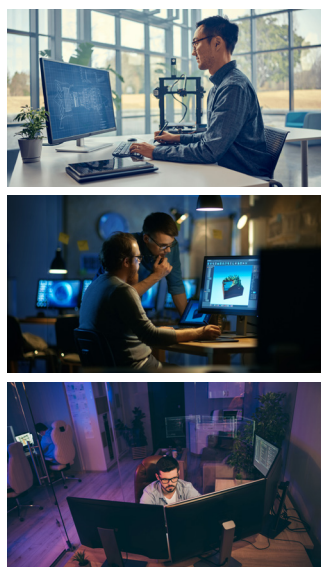
Thunderbolt standardization provides IT with the reliability and manageability needed to support users with greatly varying needs. Thunderbolt brand certification mandates a high level of minimum performance and capabilities for ports, cables, PCs, and accessories, increasing dependability across devices and operating systems. As the most comprehensive standard for USB-C connections available on the market, Thunderbolt technology provides IT with the freedom to choose from a broad range of compatible products. Plus, it delivers backward compatibility with earlier Thunderbolt devices, as well as USB-C and display devices.

And now, Intel has developed one more reason for Enterprise IT to take advantage of Thunderbolt technology: Intel® Thunderbolt Analytics (ITA), a new, sophisticated tool for monitoring and managing the Thunderbolt user experience.

The challenge that Intel IT has faced when providing their corporate users with the many advantages of Thunderbolt technology is a lack of visibility into what Thunderbolt users experience. There has been no telemetry to collect and transmit data on a range of events and parameters. How is performance on different applications? Are Intel workers having a seamless experience? Are they using the appropriate devices, and are those devices connecting properly, both individually and when chained together? Are monitors displaying content optimally? And so on. Prior to Intel Thunderbolt Analytics, Intel IT had few tools to help support users. When a user had a problem with a USB dock or Thunderbolt dock, tech support faced a virtual black box and, in some cases, required more lengthy support sessions to dig into the problem. The results were lengthy (and not always successful) support sessions and disgruntled users.

Intel Thunderbolt Analytics telemetry provides new insight and understanding of the user experience, helping Intel IT solve user problems more quickly and easily. Installing the tool on ~150,000 laptops throughout the company has enabled Intel IT to gather insights across the entire organization and improve the overall Thunderbolt experience—and do so in the background, transparently, with virtually no negative impact on system performance or usability.

Let's take a closer look....



Intel Authors:

Julian Braham
Enterprise Architect, Intel IT

Oren Duanias
Solution Architect, Intel IT

Manimaran Dhatchanamurthy
Systems Engineer, Intel IT

Isaac Hazan
Thunderbolt Software Architect,
Client Computing Group

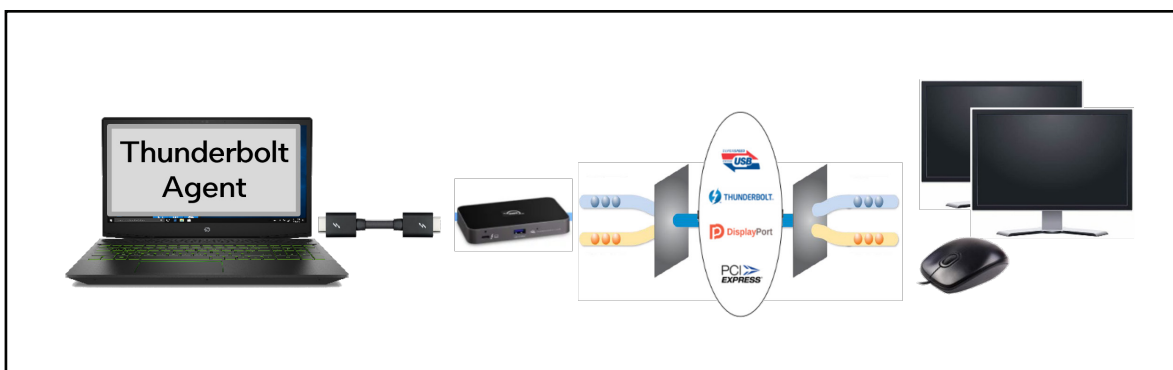


Figure 1. Thunderbolt event flow.

Thunderbolt Structure

Intel Thunderbolt Analytics monitors system activity occurring through the Thunderbolt port as it provides connectivity between the system and other devices or peripherals. (See Figure 1.) After ITA collects event data, that data is available to various processes, including the Microsoft Windows Event Log. ITA also communicates with drivers, including Intel Thunderbolt Declarative Componentized Hardware (DCH) driver for IO control, the recently introduced Microsoft Inbox driver, known as the Thunderbolt Software Connection Manager (SW-CM) driver, the Kernel PnP (which handles mouse, keyboard, and USB drive events), and graphics drivers.

Intel developed Intel Thunderbolt Analytics to better support their corporate users and keep them up, running, and at optimal performance. Now that same technology, tested and proven with thousands of users, is available to IT departments, OEMs, and service providers. Contact your Intel representative for more information.

As shown in Figure 2, data collected and stored in event logs by Intel Thunderbolt Analytics can be transmitted to the cloud, and from there to an Intel IT-defined analytics

portal, where administrators can use a variety of tools to analyze the data, interpret it, and create action plans based on it.

It's important to note that, despite all this activity, Intel Thunderbolt Analytics has virtually no negative impact on overall system performance. Often, tools that monitor system functions impose significant penalties in the form of latency that are perceptible (and annoying) for the user. That is emphatically NOT the case with Intel Thunderbolt Analytics. Extensive tests³ have shown that ITA has a very light footprint. It runs in the background and is invisible to the user. Testing revealed no application or system crashes, no unexpected shutdowns, no perceptible memory or CPU issues, and no impact on battery use. Processor utilization was vanishingly small at 0.000051%, a level of insignificance that results in virtually no effect on the platform or the user.

Data Collection Events and Parameters

Intel Thunderbolt Analytics monitors a wide range of events and parameters related to connectivity, performance, and system configuration. In effect, ITA "listens" to the workings of Thunderbolt components throughout the system by tracking Thunderbolt driver activity.

A Thunderbolt event can be any interaction between devices that occurs through the system's Thunderbolt port.

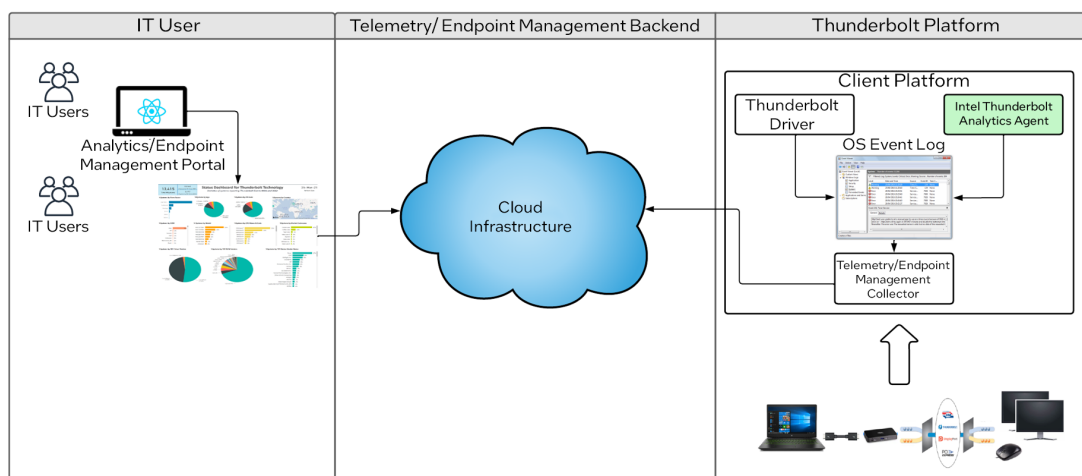


Figure 2. Data from collection to analysis.

"Thunderbolt technologies, over the years, have evolved into the mainstream, enabling simple and easy connection of laptops to external peripherals and monitors. This core technology allows workers to be productive when moving from their home office to work. However, we have seen some challenges with connectivity issues impacting user experience and productivity of employees. As we have deployed the initial release of Intel Thunderbolt Analytics (ITA), we immediately gained insights into the overall experience of Thunderbolt across our fleet, especially insights into the configurations and drivers deployed on our PC fleet. The ITA has already managed to help identify devices with older Thunderbolt driver issues and corrupted TBT drivers. We are now working to gather more insight from ITA, and through it, our workers have a seamless and productive work environment."

- Julian Braham, Principal Engineer, Enterprise Architect

This includes plugging and unplugging devices, as shown in Figure 3, as well as starting, loading, or updating drivers, checking versions or updating firmware, and more.

In addition, Intel Thunderbolt Analytics gathers connection data from a multitude of devices, including auxiliary displays, cameras, storage, media readers, and much more. It will report if network cards are installed and working properly, and if various peripheral drivers are working, missing, or in need of updates.

Plus, ITA collects information on both Thunderbolt and USB errors; examples of these are shown in Figure 4.

Finally, Intel Thunderbolt Analytics provides Intel IT with detailed information on a range of system parameters that are important for analyzing problems and planning for future configuration specifications. Among these are:

- Dock model name
- Dock OEM
- Model ID
- Vendor ID
- Thunderbolt Technology generation
- Firmware version
- Driver version

Note that ITA can monitor and collect data from various combinations of OEM systems and devices. A user can have a laptop connected to a dock from Company A, or a system from Company B with a display from Company C, and Intel IT can still support them with data from ITA.

Ultimately, the value of collected data depends on how IT uses it to solve problems today and head off problems tomorrow. Here are a few examples of typical situations that users face:

- A user connects a PC to a dock, and the mouse and keyboard do not function.
- A user connects a PC to a dock, and the monitors do not turn on.
- A device connected behind the dock does not load correctly.
- A user receives an error message about a Thunderbolt component.
- A user cannot access the network through a Thunderbolt dock.
- A user's camera is not working.
- A user's audio won't play.
- A user's system is slow to reboot or wake from sleep.

TBT Events Details

▪ Use case 1 events

- TBT Dock Plug/Unplug
- Keyboard Plug/Unplug
- Mouse Plug/Unplug
- TBT Monitor Plug/Unplug

▪ Use case 2 & 3 events

- Keyboard Plug/Unplug
- Mouse Plug/Unplug

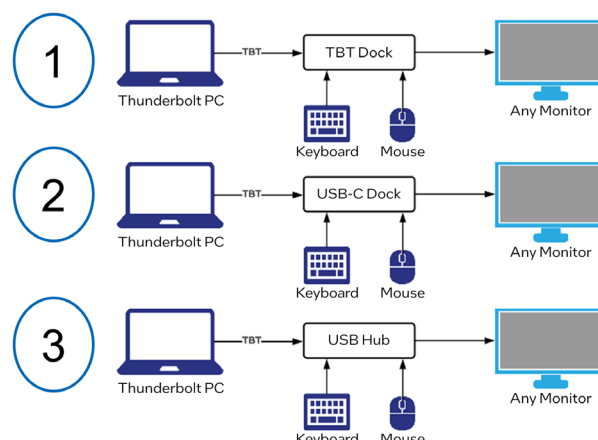


Figure 3. Event details.

In addition to providing invaluable assistance for solving user problems like these, ITA streamlines management and planning for IT. For instance, now Intel IT can quickly and easily:

- Calculate dock usage over time, detecting whether or not a dock is being used and identifying docks across multiple PCs.
- Plan refreshes and updates. IT can detect older-generation docks that need to be replaced and identify firmware versions.
- Monitor performance and the user experience. Admins can determine which dock models are the most stable and learn which dock or PC configurations are optimal.
- Keep track of host driver and firmware states. Are there PCs in need of updates?
- And much more, including instances in Figure 5, which compare different host and dock configurations.

Reporting

Virtually any OS generates data logs containing information about the system and system events. Typically, those logs are of little practical use for user support. Intel Thunderbolt Analytics, on the contrary, enables actionable data insights.

Once the raw data that ITA collects is available, the next step is to organize it so that Intel IT can review, understand, and act upon it. What's the best way to manage and view it? There's no one-size-fits-all answer, as circumstances and challenges require different solutions. That's why ITA data is structured for flexibility: Intel IT can select the data analysis tools and methods best suited to meet current needs.

A leading tool for data organization is Aternity Digital Experience Management (DEM). Intel has worked closely with Aternity to help ensure seamless compatibility with ITA. An off-the-shelf product data visualization package, Aternity DEM provides a single-pane-of-glass view that

TBT Errors		USB Errors	
TBT Error Type	Number of Errors	USB Error Type	Number of Errors
Ethernet Controller	666	SAMSUNG_Android	65
Intel(R) USB 3.1 eXtensible Host Controller - 1.10 (Microsoft)	74	Unknown USB Device (Device Descriptor Request Failed)	37
Intel(R) I210 Gigabit Network Connection	7	SanDisk Cruzer Blade USB Device	17
Intel(R) I210 Gigabit Network Connection #2	2	Unknown USB Device (Port Reset Failed)	14
Thunderbolt(TM) Controller - 9A1B	1	HID Ambient Light Sensor	11
Intel(R) Ethernet Controller (3) I225-LMvP	1	USB SanDisk 3.2Gen1 USB Device	8
Video Controller (VGA Compatible)	1	ThinkPad TBT 3 Dock	7
High Definition Audio Controller	1	Lauterbach POEUSB USB Controller	4
NVIDIA USB Type-C Port Policy Controller	1	Lenovo Powered Hub	4
Grand Total	754	FaceTime HD Camera (Display)	2
		Unknown USB Device (Link In SSlInactive)	2
		WD SES Device USB Device	1
		USB Camera	1
		Realtek USB GbE Family Controller #5	1
		MTP	1
		Grand Total	175

Figure 4. Thunderbolt technology and USB errors.

Real-World IT Use Cases:

Use Case	TBT Host + TBT dock	TBT Host + USB dock	Non-TBT Host
IT Fleet Inventory Audit and Correlation (Host + Dock + Peripherals)	✓	✗	✗
Stable Configuration Analysis: Host/Docks/Peripherals/Errors and User Actions	✓	✗	✗
Host and Dock Driver and FW Audits (Reactive/Proactive Updates)	✓	✗	✗
Missing Driver Detection (Driver Failed Install/Load Errors)	✓	✗	✗
Security/Hybrid Worker Peripheral Audits/Analysis	✓	✗	✗

Figure 5. Event-driven data examples available when using a TBT Host with a TBT dock.

gives IT a clear and detailed understanding of a broad range of system parameters. Using Aternity, Intel IT can more quickly and efficiently respond to system crashes and blue screens, view basic metrics and identifications, and more. (See Figure 6 for examples.) Intel and Aternity engineers worked together from concept through test and release, and Aternity's stability and capabilities make it a natural partner for ITA.

Aternity is only one way that insights can be extracted from ITA. IT is free to use any commercial database and can write custom code to work with other tools as desired.

Summary

Thanks to the visibility into user systems that Intel Thunderbolt Analytics provides, Intel IT is much better positioned to support users throughout the organization. In the past, problem-solving was all too often an exercise that went something like, "Please unplug the dock, then plug it back in...does it work? No? Let's try rebooting." The result was not a great experience for either the user or the support professional. Now, with ITA, admins can access the data they need to solve problems much more quickly and easily. And Intel IT has the visibility to plan acquisitions more accurately and cost-effectively thanks to guidance on what and when to upgrade. ITA empowers informed decision-making, helps lower total IT costs, boosts IT efficiency, and streamlines responses.

Future Ready: Thunderbolt is a mature and widely adopted technology. Standardized as the baseline for USB4 connectivity and interoperability, Thunderbolt is ideally positioned for growth well into the future, with new and improved features currently on the drawing board. With this growth, the ability of IT to monitor, manage, and support their Thunderbolt users will become even more critical than it is now.

Intel Thunderbolt Analytics delivers these capabilities to IT today, and will continue to do so into the future.

Related Content

Intel Thunderbolt Analytics

Your Intel representative.

Thunderbolt Technology

<https://www.intel.com/content/www/us/en/architecture-and-technology/thunderbolt/overview.html>

Aternity Digital Experience Management

<https://www.intel.com/content/dam/www/central-libraries/us/en/documents/aternity-digital-experience-platform-brief.pdf>

For more information on Intel IT best practices, visit intel.com/IT.

IT@Intel

We connect IT professionals with their IT peers inside Intel. Our IT department solves some of today's most demanding and complex technology issues, and we want to share these lessons directly with our fellow IT professionals in an open, peer-to-peer forum.

Our goal is simple: improve efficiency throughout the organization and enhance the value of IT investments.

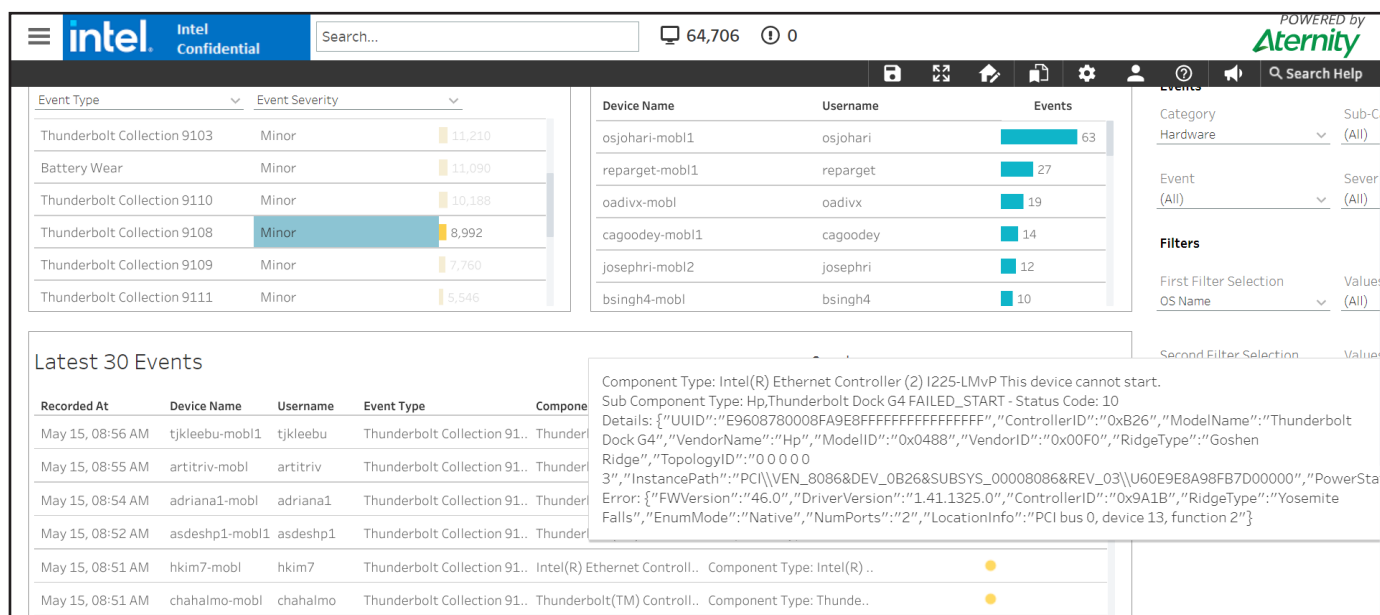


Figure 6. Aternity sample reports based on ITA data.



NOTICES AND DISCLAIMERS

Aternity is now part of Riverbed Technologies Inc.

1. Performance varies by use, configuration, and other factors. Learn more at www.Intel.com/PerformanceIndex.
2. Laptop Charging: For thin and light notebooks that require less than 100W to charge.
3. Internal Intel testing results.

You may not use or facilitate the use of this document in connection with any infringement or other legal analysis concerning Intel products described herein. You agree to grant Intel a non-exclusive, royalty-free license to any patent claim thereafter drafted which includes subject matter disclosed herein. No license (express or implied, by estoppel or otherwise) to any intellectual property rights is granted by this document. All information provided here is subject to change without notice. Contact your Intel representative to obtain the latest Intel product specifications and roadmaps. All product plans and roadmaps are subject to change without notice. The products described may contain design defects or errors known as errata, which may cause the product to deviate from published specifications. Current characterized errata are available on request.

Intel technologies' features and benefits depend on system configuration and may require enabled hardware, software, or service activation. No computer system can be absolutely secure. Check with your system manufacturer or retailer or learn more at intel.com. Intel disclaims all express and implied warranties, including without limitation, the implied warranties of merchantability, fitness for a particular purpose, and non-infringement, as well as any warranty arising from course of performance, course of dealing, or usage in trade. Intel technologies may require enabled hardware, software, or service activation. No product or component can be absolutely secure. Your costs and results may vary.

© Intel Corporation. Intel, the Intel logo, Thunderbolt, Intel Evo, Core, Intel vPro, and other Intel marks are trademarks of Intel Corporation or its subsidiaries.

*Other names and brands may be claimed as the property of others.

Copyright© Intel Corporation. All rights reserved.