

Silicon Motion's Graphics Display SoCs

Enhance User Experience in USB Docking Stations

New InstantView™ technology enables plug-and-play display mirroring with no need to install a display driver

In professional and commercial settings such as large company offices, conference rooms or school and university teaching rooms, a USB docking station provides a convenient, simple means to connect any user's laptop computer or tablet to any standard peripheral, such as a display, keyboard, mouse or portable Flash drive.

Enterprise IT managers and administrators like the flexibility of a fixed infrastructure based on docking stations which provide single- or dual-display outputs plus a high-speed Ethernet connection to a corporate network. This infrastructure reflects the mobility of today's computer user, and supports companies' tendency to regularly reorganize or redeploy staff across large office buildings or campuses.

A USB docking station allows any worker or contractor to work at any desk or to present to a display in any meeting or conference room, just by plugging in a USB cable to their laptop computer or tablet. This set-up is also consistent with the BYOD (Bring Your Own Device) trend in enterprise IT, which empowers staff to use their own computing device for both personal and corporate functions – a trend which is popular with both users and IT managers.

USB: familiar and easy to use

This enterprise IT infrastructure based on docking stations is effective because of the simplicity, high

performance and universality of the USB interface:

- **Almost every computing device has a USB port**
- **All users understand that USB is a 'plug-and-play' type of connection**
- **The USB protocol has been carefully specified to ensure that every USB host – such as a laptop computer – is instantly interoperable with every USB device, such as a keyboard, mouse, printer or Flash drive. This interoperability removes the need for the user to do or download anything. USB just works.**

This USB docking station architecture, then, is ideal for users of USB peripherals such as keyboards and mice, which connect via a USB cable.

But there is one component of this architecture which does not normally offer a USB interface: the display. **And this creates the most troubling and time-consuming problem for IT managers in administering docking station deployments.** It also impairs the user experience: rather than a simple, plug-and-play operation, connecting to a display in many cases becomes a computing function requiring Administrator rights. This is because the use of a display via USB normally requires a display driver to be installed on the host device before the display can be connected to it.

Driver installation is inconvenient

Even if the user has sufficient Administrator rights to install a driver on their computer, they have to

correctly identify the correct driver software, and wait for it to download and install before they can use the display.

This makes for an unwelcome contrast with the use of a docking station's USB peripherals such as a keyboard or mouse, which are instantly and seamlessly available as soon as a USB connection is made to the docking station.

Driver installation is also risky and undesirable for the IT manager. The IT manager might give users Administrator rights, in order to allow them to download display drivers independently – but this risks undermining policies aimed at controlling the types and numbers of software packages installed on devices that the IT department has to support.

Alternatively, the IT manager might deny Administrator rights to ordinary users, but this means that the user will request help from the IT department every time they bump into this kind of issue. And since users typically want to use the docking station's display as soon as they connect to it, these calls for IT support will nearly always require urgent attention, disrupting the IT department's workflow.

The IT department will also need to spend time pre-loading every display driver on new computers or tablets before releasing them to staff.

So what both the user and the IT manager want from a docking station is a completely plug-and-play experience.

- **The user wants to plug a USB cable from their computer or tablet into the docking station, and then instantly enjoy use of all the peripherals associated with it – including the display.**
- **The IT manager wants to be free of any work created by use of a docking station. This means no requirement to pre-load display drivers on a new user's device; and no tickets to handle from existing users requiring an immediate display driver installation.**

Now this enhanced experience of using a docking station is promised by the latest graphics processor system-on-chip (SoC) from Silicon Motion. Thanks to unique technology developed by Silicon Motion and implemented in its SM768 SoC, users of a docking station can instantly mirror their computer screen to any external display, with no need to install a display driver.

When integrated in a docking station, the SM768 also imposes a low overhead on the host computer processor, operates with low display latency, and provides a 4K or Full HD output to one or two displays.

User-friendly InstantView technology

Silicon Motion's SM768 graphics processor SoC provides, in a single chip, a complete set of display functions plus a high-speed bridge between a source of content – such as a laptop computer – and display outputs via a choice of HDMI, DisplayPort, DVI and VGA interfaces.

The USB display bridging solution provided by Silicon Motion includes CAT™ Content Adaptive Technology software running on the host computer which applies separate compression algorithms to video, graphics and text content in order to limit the use of bandwidth on the USB interface between the host and the docking station. This compression is necessary because a single USB channel between the host laptop and the docking station has to carry not only the screen content, but also potentially Ethernet traffic, as well as other USB data such as information sent to and from a printer/scanner. Reducing the size of the screen content data leaves more headroom for these other data types to be transferred simultaneously.

At the SM768, the display content is recompiled, and converted into the appropriate digital, analog or HDMI format for the connected display.

Now Silicon Motion has additionally developed a new InstantView software application which

seamlessly configures the host content for viewing on any display, with no need for a display driver.



The InstantView software is an application which runs on the host computer. Like other types of USB driver software for peripherals such as mice and keyboards, it automatically starts up on the host computer when a USB connection is made to a docking station.

As soon as a computer with the InstantView app is connected to a docking station, a welcome message appears on the computer screen (see Figure1). This enables the user to instantly mirror the computer

screen to a single or dual display outputs linked to the docking station, by clicking the 'Connect' button. The effect for the user is of 'plug-and-play' display functionality: there is no delay, and no need for driver installation or other software operation.

The InstantView software supports instant screen mirroring to display. The software also supports an 'Extended Display' option. The operation of this Extended Display option involves the silent installation by the InstantView software of the relevant display driver, after which enhanced dual-display functions are available to the user.

Whether the user chooses the mirroring or extended display option, the entire display operation is controlled via the intuitive and user-friendly InstantView user interface. This eliminates the need for any intervention by IT support staff.

Complete docking-station-on-chip

With the SM768, Silicon Motion provides a complete, single-chip solution for a high-performance USB docking station. It features an integrated I2S interface



Fig. 1: the InstantView software user interface

for a dedicated audio channel, typically to a 3.5mm audio jack. The SM768 supports space-saving docking station designs: it is housed in a small BGA chip with a 19mm x 19mm footprint, and supports up to 1GB of external DRAM. It can alternatively be specified as a multi-chip module with 256MB of DDR3 DRAM for even greater space savings.

High performance, low latency

Docking stations based on the SM768 solution combine high graphics performance with low processor loading and low power consumption.

The CAT compression technology implemented by Silicon Motion offers a high compression ratio while imposing a low processing overhead on the host computer's CPU (see Figure 2). Excessive 'CPU loading', as it is known, can affect the performance of the host computer, slowing down the implementation of other functions not related to the display so much that the user sees a noticeable lag.

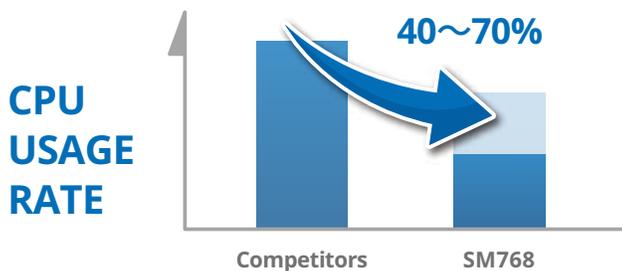


Fig. 2: SMI CAT uses 40%~70% less loading compared to competitors

Silicon Motion's CAT system, which runs on host computers based on Windows, MacOS, ChromeOS or Linux and smartphones based on Android, takes advantage of hardware acceleration capabilities in graphics chipsets from Intel and Nvidia. By contrast, competing USB graphics processors are not configured for execution by hardware acceleration engines, and their compression algorithms therefore have to run entirely in software.

By offloading much of the compression work to a hardware accelerator, the CAT technology from

Silicon Motion both runs faster and imposes less loading on the CPU. This helps the SM768 to achieve very low latency, making viewing of the external display as comfortable and enjoyable as viewing content on a laptop computer's or tablet's integrated display.

The efficiency of the SM768's CAT feature, its low-power ARM Cortex-R5 core and its lean graphics and display engines combine to produce high-speed operation with low power consumption. High-speed operation produces low latency of <20ms for a Full HD frame. This latency is undetectable to the human eye (see Figure 3).



Fig. 3: testing side-by-side with a native display connection shows that the latency of the SM768 is invisible

The value of low-power performance

This high-speed operation is produced at low power: the SM768 consumes <2.0W when bridging dual Full HD or a single 4K display to a host device over a USB 3.0 connection. This low power consumption is very important: first, it enables the bridging system to operate from USB power without needing an external power brick.

Second, the high efficiency of the SM768's operation means that it can operate without a heat sink, enabling OEMs to implement very compact designs.

Reference design for fast implementation

The Silicon Motion solution for USB docking stations based on the SM768 is available now as a production-ready reference design (see Figure 4). Use of this reference design as the basis for an end product design helps docking station manufacturers to reduce development time and shorten time-to-market for new product designs. It is compatible with all current versions of the Microsoft Windows, Apple macOS and Linux operating systems, and includes extensions for the Android and ChromeOS environments.

Even better, with the addition of the new InstantView software application, a docking station based on the SM768 reference design allows users to connect instantly to any display without installing a display driver, giving a true plug-and-play experience of every device connected to the docking station.

With the InstantView application, Silicon Motion has delivered a breakthrough in docking station performance, making the display as easy for the user to connect to as any true USB peripheral such as a mouse, keyboard or Flash drive.

For users and buyers, the value of a new docking station is now higher if it is based on an SM768 SoC than on any other type of USB docking or dongle device.

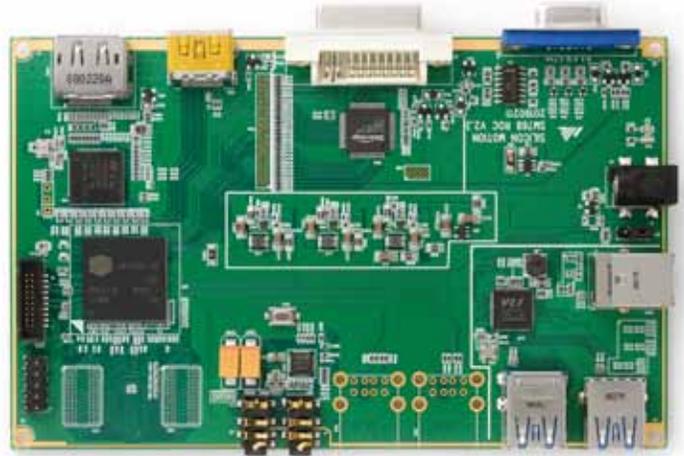


Fig. 4: Silicon Motion reference design for a USB docking station based on the SM768 SoC

For more information about SM768, please go to www.siliconmotion.com