

Navigat R- Dual Screen Application

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Abstract— Dual Screen applications provide a new user experience taking advantage of two displays. This all happens using Android for external devices (Android 4.2.2 and above) and MHL technology. MHL stands for Mobile High-Definition Link and is a technology found in many devices, displays and accessories today. MHL enabled smartphones and tablets connect to HD displays, delivering crystal-clear HD content and immersive surround sound, while simultaneously charging the phone. It's the Magic in the Middle. The MHL ecosystem has continued to grow with an installed base of hundreds of millions of products from many of the world's leading consumer and mobile device companies. One of the most important applications of this technology is in MHL supported presentations. When the presentation is started, it goes live on one of the display screens like projector which is connected via a MHL cable while on the other display screen the options like time limit for an individual slide, total time limit for the entire presentation. In addition to this the background color will change according to time. It will become orange for 20sec, red for 10sec and so on. Additional features like sound system like a single buzzer for 20 seconds, double buzzer for last 10 seconds and so on can be kept. Since this is all based on industry standards; the number of compatible devices is growing very rapidly.

Key words: Android for external devices, HDMI, MHL

I. INTRODUCTION

What is MHL? It acts as a technology that turns a common Micro USB cable into an HDMI cable, but with a few special features. [1]

MHL stands for Mobile High-definition Link, and it's the brainchild of a group of companies—including Nokia, Samsung, Silicon Image, Sony and Toshiba—that wanted a specification that could be used to connect smart phones, tablets, and other devices to an HDTV. As you'd expect, MHL supports 1080p video as well as 7.1-channel digital multi-channel audio, so it's an easy way to send HD videos from your portable device to your big-screen TV. Great, you might say, but can't we already do that wirelessly? Yes, but MHL adds a few cool new tricks. One is that it sends control data through the same cable, so you can control the portable device using your TV's remote. The other is that the cable provides power, so you won't drain your portable device's battery while the media is playing. [1]

If you have a smart phone that supports and an MHL-enabled TV, then the quickest route to trying this new technology is to get an MHL adapter cable, which has a Micro USB connector on one side and an HDMI slot on the other. Just connect the Micro USB connector to your phone, then run an HDMI cable from your TV's input to the HDMI slot on the adapter. No additional gear is needed. [1]

But even if a user doesn't have an MHL-enabled TV, contents can still be watched from the phone. Many MHL adapters have an additional port where the user can

plug in their portable device's MicroUSB charger so it won't power down. (Some may use a separate charging dongle attached to the adapter.) But you likely won't get the remote-control functionality. [1]

Fortunately, enjoying MHL doesn't cost that much. An MHL adapter is available in the range of 12\$ to 20\$, although there are more expensive ones. (Note that Samsung Galaxy S III phones, which use an 11-pin MicroUSB port instead of the standard 5-pin connector, require either a special MHL adapter or an 11- to 5-pin converter for use with standard adapters.) [1]

In addition to MHL-enabled smart phones, a growing number of other types of MHL-enabled devices, including TVs from Insignia (Best Buy), LG, Samsung, Sharp and Toshiba have been seen. The first MHL enabled Blu-Ray players have been successfully tested, from Sharp. [1]

MHL technology's profile may get a boost this fall when Roku starts selling its diminutive Roku Streaming Stick, a set-top-box-on-a-thumb-drive media streamer that plugs directly into a TV's MHL-enabled HDMI port. Several TV brands, including Apex, Element, Haier, Insignia, Mitsubishi, Onkyo, and Oppo, have announced "Roku-ready" gear that can use the Streaming Stick, and some will be bundling the Streaming Stick with the item. [1][2]

A. System Interface, Inputs and Outputs:

Dual Screen Application consists of five entities- Handheld device, HDTV, MHL adapter, USB cable, HDMI cable. The USB cable is used to connect the handheld device like a mobile phone to the MHL adapter on one end while the MHL-HDMI cable is used to connect the HDTV on the other end. The USB interface can be used for data connections to a PC. The input to the system is the operations to be performed on an application for e.g. changing slides in a presentation. The output will be the functionality of the application for e.g. slide will be changed, notification of time limit through a buzzer etc.

B. Information about the System:

MHL technology is a technology where a MHL cable is used to connect a mobile phone to a high-definition television or a monitor screen. MHL will act as the backbone of this project (it will be the interfacing between the Hand Held Devices and the HD Screen). One end of the MHL cable is a USB port which is used to connect the mobile phone and other connects the television/monitor screen through an HDMI port. [5]

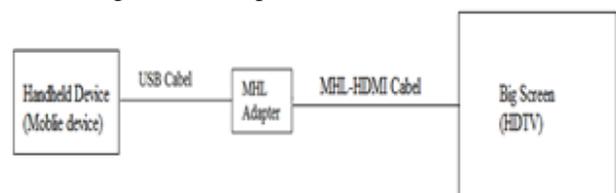


Fig. 1: Block Diagram.

C. Overview of the Target for the Final System:

The system is able to achieve targets that provide the following functionality-

- Bring games, photos, videos, and all your mobile application to the big screen
- Provide simultaneous charging of your phone while you're connected, so you'll never be interrupted by a dead battery
- Let you connect to a rapidly expanding universe of MHL-enabled products, from TVs and AVRs to streaming media sticks specialized docking stations, and more. [3][4]

D. Overview of the Technical Area:

The MHL technology is largely leveraged from HDMI technology but requires five signals/connector pins versus the 19 signals/connectors pins required by the HDMI protocol. It is essential for MHL to contain itself to 5 signals for it to map to a USB 2.0 connector. MHL supports a maximum bandwidth of 3.0 Gbps for up to a 1080p signal in a packed pixel mode of operation. MHL also supports HDCP technology, up to 7.1 surround audio formats, and power charging of up to 900mA at 5V. In addition, MHL supports Control BUS (CBUS) functionality that enables access to mobile content through a DTV remote control. [6]

II. THEORETICAL MODEL

In recent years, cell phone technology has evolved from voice phones, to feature phones, to smart phones, and now to super phones. These latest cell phones are powerful devices that handle a lot more than simple voice communication. They act as multimedia players, set-top boxes, game consoles, cameras, and even PCs. All of this functionality is packed into a small device that fits into the palm of your hand.

However, this small form factor brings with it two major problems: first, the screen size of a device that fits into the palm of your hand can never be satisfactory for high-end digital entertainment applications; and second, the battery technology that powers these mobile phones has not kept up with the functional demands.

Mobile high-definition link (MHL) is a new interface protocol that addresses both of these challenges. MHL provides wired high-definition audio/video connectivity between a mobile device (typically a cell phone or tablet) and a digital home display device (digital TV). In addition, MHL technology incorporates the capability to charge mobile devices while they are connected to a display device.

MHL is gaining popularity because it leverages the ubiquitous connection ports found in almost every household. MHL does not attempt to define a specific or unique connector, but it instead maps into already-popular connectors. For example, the most popular connector on cell phones is USB 2.0, and on DTVs it is HDMI. The MHL protocol works seamlessly with USB 2.0 and HDMI protocols and connectors. A typical MHL cable has a MicroUSB connector on one side and an HMDI connector on the other.

A. MHL Ecosystem:

The MHL Consortium was founded in 2009 with the goal of providing a seamless link between mobile devices and HDTVs. For the Consortium to be successful, it needed support from both cell phone/tablet and DTV manufacturers and its five founders (LG, Nokia, Samsung, Silicon Image, and Sony) represented leading consumer electronic giants of both cell phones and DTVs.

Backed by these strong founders, the MHL ecosystem is evolving quickly. As of 2012, there are over a dozen providers of mobile devices, and over a half-dozen providers of digital home devices, that have made major product announcements with MHL support. For example, there are products that integrate the entire functionality of a set-top box onto an "MHL dongle" that is about the size of a USB thumb drive. These dongles are typically Android-based systems with integrated WiFi access. Once plugged into a DTV, the dongle acts like a portable set-top box that does not require any external power supply as it derives its power through the MHL VBUS.

One of the key challenges for MHL is that most legacy DTVs do not support MHL. Indeed, the refresh rate of DTVs is very long, typically 10 years, unlike cell phones, which are replaced every 1-2 years. This problem has been circumvented with the use of MHL-to-HDMI dongles like the HTC dongle. The price of these dongles has dropped to ~\$10. The purpose of the second USB connector on the dongle is to provide battery charging since the HDMI protocol does not support any power charging as of version 1.4. Although the dongles provide a cluttered solution, it is a good compromise until MHL DTVs penetrate the market.

III. FUNCTIONALITY OF THE SYSTEM

MHL is the new leading mobile device interface for transmitting video and audio. This interface can connect smartphones; tablet PCs and video cameras with display equipment such as TV sets, projectors and monitors. MHL uses the micro USB port which is already available on many mobile devices. The USB interface can be used for data connections to a PC as usual. When the built-in MHL transmitter chip recognizes an MHL-capable receiver at the other end, it switches into the MHL transmit mode. The MHL transmitter then sends the AV data over two of the five pins on the micro USB port. The control signals are transmitted via one of the other pins. The 5 V line is used to charge the mobile device while transmitting. [5]

A. System Link Overview:

The MHL link shown in the Figure below consists of a single differential Transition Minimized Differential Signaling (TMDS) pair. The MHL clock is the common mode of differential data signal and does not require separate pins/signals. Compare this to the three differential TMDS pairs, plus a differential clock pair, required in an HDMI link. In the given Figure, the red, green, and blue data signals are essentially time domain multiplexed in a single TMDS channel. Hence in case of MHL protocol, a single TMDS channel represents three logical data channels and the clock channel. In addition, the MHL link also consists of a CBUS and a VBUS. The CBUS protocol lets the user access the content on a mobile device via the

DTV's remote control. The VBUS is the power pin that allows for charging up to 900mA at 5V. [7]

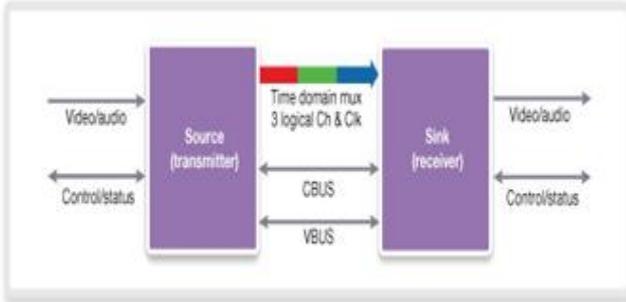


Fig. 2: MHL System Link Overview

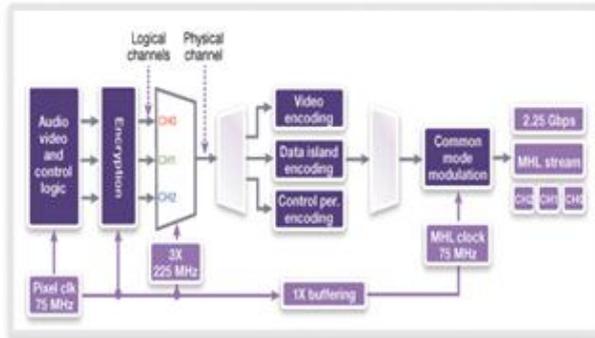


Fig. 3: MHL Bandwidth in Normal Mode

B. MHL Bandwidth:

MHL performance is defined up to 2.25 Gbps in normal mode of operation that can support a 1080i/720p, 60Hz, 24 bit color signal. As shown in Figure 3, in the normal mode of operation, the three logical red, green, and blue channels are multiplexed into a single physical channel. The pixel clock is running at 75MHz and the 10 bits per logical channel (30 bits total) are multiplexed to get a bandwidth of 2.25 Gbps. [7]

MHL also defines a packed pixel mode of operation up to 3 Gbps that can support up to a 1080p, 60Hz, 16 bit color signal. As shown in Figure 4, two logical channels are multiplexed into a single physical channel when operating in packed pixel mode. The MHL clock is running at 75MHz and it clocks out 40 bits per second to get a bandwidth of 3 Gbps. [7]

IV. INTERFACING AND PIN CONFIGURATION

Micro-USB is a standard connector for a wide range of portable devices, including cell phones and smartphones.

A. MHL Link Control Bus (CBUS):

The point-to-point single-wire CBUS provides the following functionality:

- A mechanism allowing source and sink devices to detect connectivity to an MHL-compliant sink and source device, respectively. A communications channel for DDC commands that is used by an MHL source device to determine the capabilities and characteristics of the sink device by reading the EDID data structure
- A communications channel for DDC commands that is used by an MHL source device to initiate all

register reads and writes required for content protection

- An MHL sideband channel (MSC) is provided for higher-level user functions such as automatic setup tasks or tasks typically associated with infrared remote control usage: remote control protocol (RCP), UTS-8 character protocol (UCP), request action protocol (RAP)

The CBUS has sufficient headroom to be used for other protocols in the future.

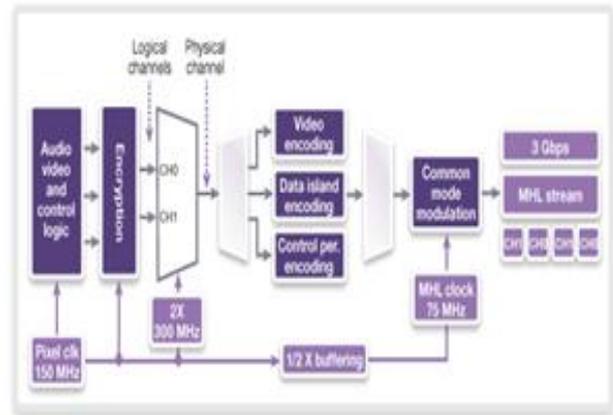


Fig. 4: MHL Bandwidth in Packed Pixel Mode

B. MHL Voltage Bus (VBUS):

The VBUS provides a minimum of 5 V/900 mA power between sink (e.g. TV) and source (e.g. mobile phone).

C. USB Pin out signals:

USB is a serial bus. It uses 4 shielded wires: two for power (+5v & GND) and two for differential data signals (labeled as D+ and D- in pin out). NRZI (Non Return to Zero Invert) encoding scheme used to send data with a sync field to synchronize the host and receiver clocks. In USB data cable Data+ and Data- signals are transmitted on a twisted pair. No termination needed. Half-duplex differential signaling helps to combat the effects of electromagnetic noise on longer lines. Contrary to popular belief, D+ and D- operate together; they are not separate simplex connections.

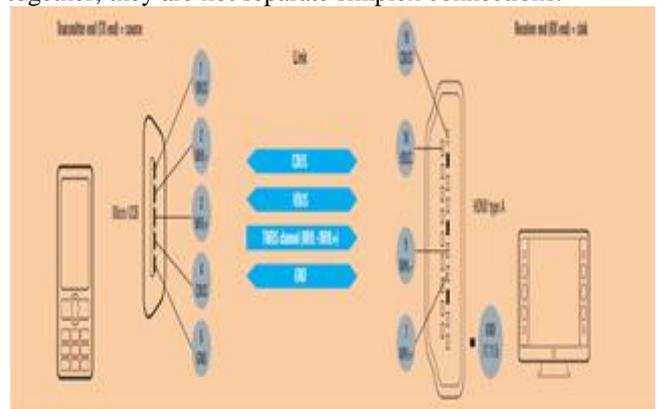


Fig. 5: Interfacing and pin assignment

| Pin | Name | Cable color | Description |
|-----|------|-------------|------------------------------|
| 1 | VCC | Red | +5 VDC |
| 2 | D- | White | Data - |
| 3 | D+ | Green | Data + |
| 4 | ID | | Mode Detect. May be N/C, GND |

| | | | |
|---|-----|-------|---|
| | | | or used as an attached device presence indicator (shorted to GND with resistor) |
| 5 | GND | Black | Ground |

Table 1: Micro USB Pin Functionality

V. FEASIBILITY TESTING

The feasibility study is an evaluation and analysis of the potential of a proposed project which is based on extensive investigation and research to support the process of decision making.

One of the most important applications of this technology is in MHL supported presentations. When the user taps start, the presentation goes live on one of the display screens like projector which is connected via an HDMI cable while on the other display screen we can keep various options like time limit for an individual slide, total time limit for the entire presentation. In addition to this the background color will change according to time. It will become orange for 20sec, red for 10sec and so on. Other functionalities like sound system like a single buzzer for 20 seconds, double buzzer for last 10 seconds and so on.

Other applications include:

- Gaming,
- Multimedia- music

VI. EXPECTED OUTCOME

The proposed model provides features like fast charging up to 10W (Power charging); brilliant resolution- ultra high definition display with up to 4k video; immersive audio that is 8-channel sound and no lag which is ideal for playing music, videos and gaming.

VII. CONCLUSION

Dual Screen application provides a new user experience taking advantage of two displays. This all happens using Android for external devices (Android 4.2.2 and above) and MHL technology. MHL enabled smartphones and tablets connect to HD displays, delivering crystal-clear HD content and immersive surround sound, while simultaneously charging the phone. One of the most important applications of this technology is in MHL supported presentations.

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