96Boards - TV Platform

Developing the Specification
Overview

- Motivation for a TV Platform Specification
- Comparison with CE Spec
- TV Platform requirements
  - Alignment with EE Specification
  - Hardware
- Variances from EE Spec
- TV Platform Board Layout
- Software Requirements
- Additional Considerations
Motivation for TV Platform Specification

- The goal is to define a readily available, low cost TV Platform that can accommodate a range of functionality and designs ranging from Home Gateways to OTT Streaming boxes to TV boards that meet the needs of developers.
- Target mid- to high-market segments
  - Low cost for community acceptance:
    - < $50 for mid-range board
    - < $99 for high-end board
- The requirements of a low cost development platform targeted at embedded Set-top box and TV markets were not satisfied by the current 96Boards Consumer Edition (CE) and Enterprise Edition (EE) specifications.
Comparison with 96Boards CE spec

- The 96Boards CE specification contained many of the desired media capabilities and peripherals, however:
  - Issues for some non-mobile SoCs with the MIPI DSI/CSI signals on the High Speed connector
  - Some set-top SoCs do not provide these mobile signals
  - Preferred to have a dedicated Ethernet port (RJ45) and UART on board
  - Ultra-small low-profile “card” form factor (85mm x 54mm) too small for a general set-top with a full complement of media connectors
  - The CE extended form factor option has some layout challenges due to the position of the low-speed expansion connector in the middle of the board
TV Platform Requirements

- Some popular boards used for comparison were the RPi2, Cubie4, nVidia ADT, as well as a reference board from STMicro B2120
  - Employed as references to initiate the requirements collection
  - Served as a basis for the initial specification
- No requirement to make the TV platform board a ‘product’; it is a development platform
- The TV Platform board can be based on either 32- or 64-bit SoC platforms
- More important to have a flexible platform to address different designs and market segments
- Worked with the LHG Steering Committee members to take initial requirements back to their hardware teams and provide feedback
  - Determined which features were mandatory and which were optional
TV Platform Requirements - EE Alignment

- After review of the requirements, it was decided the 96BoardsTV Platform specification will adopt the EE specification as a baseline
  - The EE board has the required flexibility to accommodate the range of solutions for the TV platform
  - Deliberately more flexible and can provide ample space for the SoC and supporting components
- The I/O is flexible and can fit any STB requirements
- Aligning with the EE specification prevented fragmentation of the 96Boards core specifications
- After a few revisions, the first draft of the TV Platform specification was created (Dec. 2015)
96Boards TV Platform - EE Alignment

- The EE specification is a common baseline for multiple segment groups
- For TV platform supports all the mandatory EE specification requirements, with a few modifications or exemptions
- The TV Platform specification is owned by the 96Boards team
## TV Platform Hardware Requirements

- Hardware (1 of 2)

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Board Form Factor</strong></td>
<td>160mm x 120mm</td>
<td><strong>EE Standard Form Factor</strong></td>
</tr>
<tr>
<td><strong>RAM</strong></td>
<td>Min. 1 GB; 2GB recommended</td>
<td></td>
</tr>
<tr>
<td><strong>Flash</strong></td>
<td>Min. 8 GB</td>
<td>eMMC memory</td>
</tr>
<tr>
<td><strong>WiFi</strong></td>
<td>min. 802.11 g/n; 802.11ac recommended</td>
<td>min. @ 2.4 GHz</td>
</tr>
<tr>
<td><strong>Bluetooth LE (optional)</strong></td>
<td>If provided, min. BLE 4.0</td>
<td>optional</td>
</tr>
</tbody>
</table>
## TV Platform Hardware Requirements

### Hardware (2 of 2)

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Display: min. one HDMI output</td>
<td>Min. HDMI 1.4; HDMI 2.0 rec. Min. HDCP 2.0; HDCP 2.2 rec.</td>
<td>Recommended settings are for 4k video with &gt; 30 fps; Layout location specified.</td>
</tr>
<tr>
<td>Input HDMI (Optional)</td>
<td>Same as above</td>
<td>For TV Boards</td>
</tr>
<tr>
<td>Optional Video</td>
<td>Composite, Component, S-Video</td>
<td>Not expecting older analog peripherals to be used</td>
</tr>
<tr>
<td>Ethernet</td>
<td>RJ45 System Ethernet Port</td>
<td>Recommended ≥ 100 Mbps</td>
</tr>
<tr>
<td>Audio</td>
<td>Mandatory: HDMI Audio Optional: Stereo I/O, S/PDIF</td>
<td></td>
</tr>
<tr>
<td>Low Speed Connector (40-pin low profile)</td>
<td>Mandatory: location specified in EE spec</td>
<td></td>
</tr>
</tbody>
</table>
TV Platform Options

- Additional functionality options
  - The TV platform specification is flexible and allows the board maker to add a variety of peripherals

<table>
<thead>
<tr>
<th>User Input</th>
<th>Optional: Infrared (IR) detector</th>
<th>Place at front of board for line of sight operation. More advanced implementations may use RF4CE remote controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Security Interfaces</td>
<td>Optional: SmartCard I/F</td>
<td>ISO/IEC 7816 compliant</td>
</tr>
<tr>
<td>Transport Stream I/F</td>
<td>Optional: Parallel Connector</td>
<td>Interface to tuner card (e.g., ATSC/DVB)</td>
</tr>
</tbody>
</table>
## Variances from the EE specification

The following variances are permitted for the TV Platform specification:

<table>
<thead>
<tr>
<th>Power Connection</th>
<th>The EE specification requires 2 power connectors: A TV platform version <em>may</em> omit the high power 4 pin DIN (up to 180 W) connector if the board design is such that a maximum of 90W will be drawn from the barrel jack connector. The barrel jack connector <em>shall</em> always be implemented.</th>
<th>Additional power may be required if PCIe is implemented.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boot ROM</td>
<td>The EE specification requires a minimum of 64MB of bootable flash memory. The TV Platform specification requires a minimum of 8GB of flash storage. If this storage is bootable then the EE specification is met. If the TV platform board designer wishes to implement a separate boot ROM then the size is at the discretion of the designer, and <em>may</em> be less than 64MB whether or not the flash storage is bootable.</td>
<td>In considering the boot ROM size requirements, designers should note that a separate boot ROM may be used for SoC-dependent binary code blobs as well as the boot software itself.</td>
</tr>
<tr>
<td>Ethernet</td>
<td>The location of the RJ45 Connector is recommended to be at the front of the board.</td>
<td>May place at back of board.</td>
</tr>
</tbody>
</table>
TV Platform Board Layout

M2.5, 2.5Ø hole, 5.0Ø keepout, x6
Corner hole centers 4.0mm from edges

Optional area for board designer to locate additional I/O connectors (e.g. HDMI, SPDIF, SATA, AV etc.) as required by board design/functionality.

Recommended location for Smart Card connector if implemented (board underside)
Software Requirements

- **Kernel**
  - Based on one of the following that can be built from source code and required binary blobs:
    - kernel.org latest “mainline” or “stable” kernel
    - Latest Google-supported Android kernel version
    - One of the latest two kernel.org LTS kernels (e.g., Linaro LSK)

- **Operating System**
  - Latest released (stable) version of one or more open source distributions for a 96Boards TV Platform design
    - Android, Debian, Ubuntu, Fedora, Red Hat
    - Linaro or vendor supported Linux using OE/Yocto
Software Requirements

- LHG uses Open Embedded / Yocto build system
- Boot architecture (at least one open source implementation available)
  - Support for vendor or open source bootloader (UBoot/FDT, UEFI/ACPI, UEFI/FDT)
  - Support for secure execution environment (strongly recommended)
    - Unlocked bootloader for OP-TEE
  - Support for ARM Trusted Firmware (for ARMv8), including PSCI APIs (optional)
- Accelerated graphics support
  - Graphics drivers need to be fully supported with either open source code or through royalty free binary drivers
  - Vendor will provide updated binary drivers/libraries to support new mainline kernel features
Additional Considerations

● ARM Trusted Firmware and OP-TEE
  ○ In order to implement support for ARM TF and/or an open source trusted execution environment, such as OPTEE, mechanisms are required to allow modifications to the bootloader.

● Automated Testing
  ○ The board can be automatically powered up; i.e., the board can be power cycled easily and return to the bootloader stage without manual intervention
  ○ Network boot capability from BL provided via NFS (e.g., UBoot implementation that supports network boot capability is desirable)

● ARM GPU
  ○ LHG uses Wayland-Weston with DRM/KMS and dma-buf extensions
  ○ ARM Mali GPU libraries support this in Midgard, ARM’s Mali-T600 and T-700 family GPUs
  ○ Older ARM Mali libraries 400/450 (Utgard family) require additional support from ARM for these features
Additional Considerations

● Grouping of Connectors
  ○ Most set-top boxes have all network, media connectors grouped on the back of the box
  ○ The front of the box usually has USB connector(s) for user access with USB sticks for photos and/or videos
  ○ Any user input devices requiring line of sight communications are also on the front

● User Access
  ○ Frequently accessed switches, buttons, connectors are easily accessible

● Power Management
  ○ In order to monitor power usage of the SoC, the ability to connect external probes to the board for power measurements is desirable
Thank you!

Please visit: https://wiki.linaro.org/LHG

and https://www.96boards.org/