Smartness-on-the-chip – The platformization route to Connected Entertainment

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Missing your best buddies as you catch a nail biting game on TV? Don’t worry, ping them over email/social media or chat with them, even place bets! Introducing a TV that lets you do more!

This advertisement is a testimony of the future of consumer electronic devices. Consumer electronic devices are getting smarter by the day, becoming capable of exchanging data/information via traditional communication or social media channels. Unfortunately, however, most smart consumer electronic devices today are designed to work in silos. What if these smart devices begin to recognize and communicate with each other? One would witness a truly empowered connected entertainment experience!

Connected Entertainment devices: Under the hood

But before we ponder further over the ultimate connected entertainment experience, let us analyze where do we stand today? Today, we live in a smart entertainment device era marked by the arrival of smart TVs, smartphones, tablets, etc. Each of these smart entertainment devices are driven by a complex system-on-chip (SOC) based application-cum-multimedia processor having rich audio/video processing, networking and display capabilities. The capabilities of these application-cum-multimedia processor SOCs are different across applications but architecturally similar (Table 1).

In other words, the processors required to power different classes of smart entertainment devices have a lot in common. So, is it possible to build a smart entertainment device platform and adapt it for other smart entertainment device needs? Before

<table>
<thead>
<tr>
<th>Feature</th>
<th>Technology Enabler(S)</th>
<th>Smart Device Type</th>
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</thead>
<tbody>
<tr>
<td></td>
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<td>Smart TV</td>
</tr>
<tr>
<td>Processing Power</td>
<td>Microprocessors/DSPs</td>
<td>Choice To Be Based Upon Compute Power Needed, Performance Requirements, Software Requirements</td>
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<tr>
<td>Internal Storage</td>
<td>Ddr2/3, Qdr, Lpddr, Nor/ Nand Flash</td>
<td>Varying Based Upon Storage, Performance &amp; Power Needed</td>
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<tr>
<td>Storage</td>
<td>USB, SSD, SATA</td>
<td>Varying Based Upon Storage, Performance &amp; Power Needed</td>
</tr>
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<td>Network Connectivity</td>
<td>Wifi, Ethernet, Lte/ Hspa/ Lte-A/ Hsdpa/</td>
<td>Wifi, Ethernet</td>
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<tr>
<td>Security</td>
<td>AES/SHA/Etc</td>
<td>Varying Based Upon Drm Schemes Supported/Targeted</td>
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<tr>
<td>Display Size</td>
<td>Multimedia, (Image/ Video), Display Tech</td>
<td>HD</td>
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<tr>
<td>Graphics</td>
<td>2D/3D Engines</td>
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<tr>
<td>Media Transport</td>
<td>Hdim, Display Port, Digital Tuner</td>
<td>YES</td>
</tr>
<tr>
<td>User Interface</td>
<td>Touch Screens, Voice Based Ui, Keypad/ Keyboard, Ir, Etc</td>
<td>GUI, IR</td>
</tr>
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Table 1: Hardware capabilities across smart entertainment device types
exploring the possibility of such a scalable entertainment platform, it is essential to scrutinize the necessity for one.

Cost pressures necessitate a scalable entertainment platform

The current design process involves building custom designs for each application from scratch. This requires large scale hardware and software design/re-design investments by device manufacturers or semiconductor companies. The cost for developing an application/media processor solution from scratch is exorbitant and can increase/decrease depending on code reuse from existing products or third party IP providers. The R&D costs for grounds up design of an app-processor SoC would be between 50-60 million USD, with software development alone amounting to 30% of costs. The development time for app-processor SoC would be around 18-24 months for SoC with software development taking anywhere between 12-18 months of time. These rising cost and time to market pressures for media/application SOC, spell out a strong demand for such a scalable entertainment platform. Manufacturers/semiconductor companies making devices across multiple categories in the smart entertainment segment are expected to benefit the most from such a platform approach.

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Design Challenges

One might wonder, how does one build such a scalable entertainment platform? Today, there are platform based SOCs readily available in the market. Many of these platform-based SOCs have also seen success in the recent past. The success of platform based strategies like TI OMAP Tegra and NovaThor in the smartphone/tablet/wireless communication space are living examples. To proliferate across different entertainment devices that demand different performance needs and varying levels of architecture customization, what is needed, is some nifty architectural scalability and flexibility.

Unparalleled architectural scalability and flexibility can enable a manufacturer/semiconductor company to beat the time paucity challenge posed by varying customer needs. A scalable platform will also allow manufacturers to implement next generation user interfaces like speech or voice recognition, proximity sensing/fingerprint sensing, etc with significantly lower incremental unit cost.

Lastly, this will also ensure easy customization for different product applications at a greater pace and a fraction of the cost.

Scalable Multimedia Platform Architecture

However, embedding scalability into an existing platform based SOC is no easy task. A rough architecture for such a scalable entertainment platform is shown below (figure 1). It would comprise of a processor subsystem, media processing subsystem, media transport subsystem, display subsystem, storage subsystem, security and connectivity subsystems, user interface subsystem, processor tethering interface, software for OS (if required) and other subsystems.

The software layer is kept modular.
and plug & play, while hardware layer is architecturally plug & play but each device flavor will be optimized during the ASIC Implementation phase to squeeze out power or performance or die area. Hence the resultant NRE cost for creating various flavors of the device is much smaller compared to a typical ASIC derivative development.

The biggest challenge in architecting such a scalable entertainment platform catering to design and performance needs of multiple classes of products is enabling easy configurability and adaptability. This challenge is relevant both from the hardware and software features stand point.

Right architecture and design choices can help overcome this challenge. Take for example the task of ensuring that the platform is adaptable to specific performance needs. A cumulative approach of an external processor interface and media transport interface can help overcome this challenge. An external processor interface would allow the platform to co-exist with any external processing that the manufacturer might want to have specific to the device type. This will provide access for both the external processor and peripherals of the partner device. However, care needs to be taken that the interface chosen is a standard interface like MIPI or PCIe. Alongside, the media transport interface, if as per a standard interface followed for on-chip media transport, would enable product-specific or manufacturer-specific post-processing of media data.

Similarly, a daisy-chained on-chip-bus architecture would ensure easy customization when subsystems need to be added or removed. Configurable subsystems like processor subsystem, Media/Display Processing Subsystems, storage subsystem, etc. would help enable easy configurability. In a processor subsystem supporting multiple processor types will be able to provide variant computation power required by any end application. Similarly, media processing subsystem, catering to various devices must be able to configure processing engines for video/music/images and be able to set performance parameters like frame size, bit rate, encoding type, etc. Real-life transcoding for customizing frame size/bit rate at the point of display/rendering is a significant design challenge that will have to be addressed as part of such a platform.

Platform configurability must be embedded into the storage subsystem, security and connectivity and user interface subsystems as well. The storage subsystem must support storage types like SAS/SATA, USB, SSD, NandFlash, etc. On the other hand, security and connectivity subsystems must support wired and wireless LAN connectivity and implement numerous security engines to ensure adherence to widely accepted DRM norms (these vary across geographies). The user interface subsystem must also provide various kinds of interfaces to support different device types. These will include keypad, touchscreen, voice command and IR/Remote, and many other possible interfaces.

The expectations for adaptability and scalability of the platform also apply to the software aspects of such a platform. For instance, today, the software layer of DTV design vs. mobile phone design vs. a media player design are flavors of Android (Gingerbread, ICS, etc.). Thus, one can adopt a platform approach choosing application user interfaces relevant to the usage requirements of the product. The platform approach in hardware (where in the overall architecture remains the same except for some additional/removable blocks like 2D/3D graphics engine in TV, USB/HDMI in tablets, no L2 cache in a media player, etc.) would support the mixing and match of relevant applications as per device usage. The configurability at each level (hardware, OS, base driver, application) is crucial to enable smooth adaptation to different applications while ensuring compliance to norms set by DLNA, uPnP and WiFi certification bodies.

The way forward

The best way forward to build such a platform is not obvious. The platform, being an amalgam of media, transport, security and connectivity subsystems, can possibly use pre-existing discrete subsystems as a good starting point. Leveraging proven technology/architecture from these platforms will be imperative as it will help save time and money in the current economic climate.

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