Application Brief

Top Five Design Considerations for Smart Multi-display Systems

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While human-machine interface (HMI) systems are not a new technology, much of the potential to enhance the world and how humans interact with electronics is still unrealized. To expand the capabilities of HMI systems in automotive and industrial systems, developers need the freedom to design scalable, open-source, and reliable designs – with the potential to incorporate advanced functions like artificial intelligence (AI). Highly-integrated TI Arm®-based processors are designed to help developers implement high-performance processing capabilities in advanced HMI systems.

This article explores the benefits of high levels of integration in processors for HMI designs and selection criteria for designers when selecting the right processor.

Selecting a Processor for a Multi-display HMI System

With so many integration options, there are trade-offs to consider when selecting a processor. Often, a specific processor will not meet all of a design's feature, cost, and power budget needs. A family of processors that offer scalability across these requirements while maximizing design efficiency, particularly for software, is likely the best choice. The following points outline five design considerations when selecting a processor for an HMI design.

1. **Performance vs Power efficiency**

   The high amount of detail needed for larger, higher-resolution displays and multiple displays requires more processing capability, which often leads to a rise in system power consumption and thermal management. The use of specialized processing cores like graphical processing units (GPUs) helps mitigate this power efficiency design consideration. A scalable product offering provides designers with devices that can deliver the required power and thermal capabilities for a given system. These products are designed to provide a range of devices with the appropriate GPU performance for the given design, or options without a GPU when a GPU is not needed. TI's family of HMI application processors like the AM623 (without GPU), and AM625, AM62P, and AM67X (with GPUs), as shown in Table 1, helps designers add larger resolution and immersive graphics to designs while also delivering the best performance for a given power or thermal budget.

Table 1. Scalable HMI Portfolio

Core HMI		Smart HMI		
AM62	AM62Plus	AM67, AM67A	AM68, AM68A	AM69, AM69A
1–2 Displays	1–3 Displays	1–3 Displays	1–4 Displays	1–4 Displays
Small GPU (8 GFLOPS)	Large GPU (50 GFLOPS)	Large GPU (50 GFLOPS)	Large GPU (50 GFLOPS)	Large GPU (50 GFLOPS)
–	–	AI (4 TOPS)	AI (8 TOPS)	AI (32 TOPS)
–	–	–	Large Compute (25K DMIPS)	Huge Compute (100K DMIPS)

2. **AI for Smart HMI**

   The need to visualize and process more data for faster decision making is driving the use of larger and higher-resolution displays. Smart displays using intelligence and analytics to help present more data to users in better, more actionable formats to address this design challenge. To optimize a system for integrated analytics in smart HMI applications, designers can choose a development platform that includes devices with appropriate processing power and hardware accelerators, and a comprehensive software and tool offering.

   Adding analytics or machine learning to a display can enhance the user experience with the potential to also incorporate intuitive gesture control, predictive maintenance, and user or situational adaptive displays in more systems. The addition of these new features requires more processing capabilities. TI's portfolio of integrated analytics processors offers dedicated accelerators for optimized power efficiency, with additional processor cores to handle other functions. Like GPU selection, it is likely that designers need options with and without accelerators to efficiently meet design requirements across product offerings. TI's AM67X family of devices has options with and without AI accelerators, giving designers multiple processor options supported by a unified platform for increased scalability and reuse across designs.

3. **Interface capability and flexibility**

   With more display types, sizes and resolutions available, multiple physical interface options are required to meet performance expectations. Higher-resolution screens require Low-Voltage Differential Signaling (LVDS), Display Parallel Interface (DPI), and Mobile Industry Processor Interface (MIPI) Display Serial Interfaces (DSI) and processors with the performance to support them. Driving multiple displays to enhance user experience requires multiple interfaces on the same processor. Screen size, resolution, and design cost are some of the key selection criteria when choosing a processor. For example, a lower-cost system for a single-screen design may only require a DSI. While a more feature-rich system with higher-resolution displays and multiple displays can require screens that have an LVDS interface or DPI. With the increase in capability, systems require higher-speed interfaces like USB3, Peripheral Component Interconnect Express (PCIe), and Camera Serial Interface (CSI) to communicate with the rest of the environment. TI's AM6x family supports a variety of these interfaces in different configurations to meet these evolving design requirements.

4. **Software efficiency**

   While flexible hardware design choices allow designers to optimize systems for several elements including cost, these choices can lead to a fragmented software architecture that is difficult to scale and maintain, leading to design inefficiency and, potentially, higher design costs. Designers and leadership teams often need to look at total cost of ownership across HMI products and select a scalable, flexible software architecture that can support the addition of features like graphics libraries to support GPUs and AI frameworks to seamlessly utilize accelerators to optimize the entire design effort. TI's Software Development Kits (SDKs) for popular open-source operating systems like Linux® and Android™ provide a solid foundation to build this efficiency. Foundational software elements that are scaled across a product portfolio can be written once and deployed across designs. For example, security features that are needed across multiple products. Writing and maintaining multiple secure over-the-air (OTA) update offerings or managing different secure boot flows due to differences in underlying software is exactly the kind of fragmentation that lowers design efficiency and adds cost and time (even more cost).

Figure 1 shows where TI's AM6x family provides foundational software to build an efficient software offering that scales to meet hardware differences without costly fragmentation.

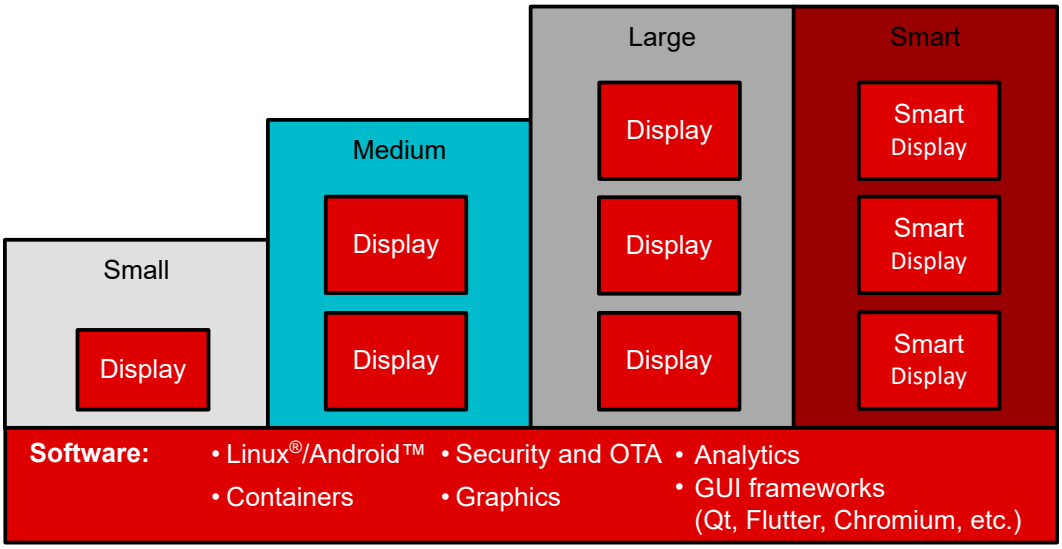

Figure 1. Software Efficiency in Scalable HMI Platforms

5. **Ease of use**

   For users to start enjoying the great new features of smart displays, designers must be able to integrate them into real product offerings. While ease-of-use changes for each team based on expertise and capability, there are certain common enablers to consider. Tools for common tasks that reduce the expertise needed can be a great ease-of-use enhancement. In addition to tools for specific tasks throughout the design process from board design and layout to production programming, TI offers an online, free tool, Edge AI Studio, to help simplify AI implementation in smart displays. When combined with TI's documentation and training resources, designers can more easily adjust to challenges during the design process.

While certainly not an exhaustive list, these five considerations help designers seamlessly add multi-display smart HMIs to expanding product portfolios. Innovation in the human machine interface is now enabled.

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