WHITE PAPER

Seshu Madhavapeddy
General manager of TI's Wireless OMAP™ mobile communication and computing business line

Deepu Talla
Director of business development Wireless

TEXAS INSTRUMENTS

Discrete Applications Processor

Discrete applications processor solution vs an integrated solution

Introduction

The technology that powers mobile devices is going through a revolutionary change and there are two competing mobile device chip architectures: the discrete applications processor solution and integrated solution.

This paper will examine the benefits of using a discrete applications processor – from both a hardware and software perspective – that ultimately lets device manufacturers quickly get to market with differentiated solutions.

Just a few years ago, all you could do with mobile devices was make phone calls. Now, with far greater functionality, they have become the easiest way for us to read e-mail, surf the Web, social network, take pictures, shoot and watch video, and even receive turn-by-turn directions.

This new functionality has led to dramatic changes in how these phones are built. In old, basic mobile phones, the radio baseband modem was the centerpiece of the phone. In the new smart phones, the heart of the phone is a discrete applications processor and the software that runs on it. The radio baseband modem is still needed to connect to the network, but is now adjunct to the applications processor.

The applications processor and modem work together to deliver features and applications. The modem receives signals and/or data from the antenna and converts the data to a useable format, which is then sent to the applications processor. The applications processor drives the ultimate user experience, leveraging modem data as needed to deliver experiences like high-definition (HD) 1080p video decode, graphics rendering for a UI or game, and PC-like Internet browsing.

The true differentiation in mobile devices is in the software running on the applications processor; these applications are often what define the device. Today, there is no "all-in-one" solution for the mobile market; each user wants a device that fits their personal needs.

A discrete applications processor solution, where the modem and applications processor are located on separate chips, provides device manufacturers with the ability to quickly and efficiently deliver multimedia-rich mobile computing solutions to meet various market or geographic needs. In comparison, an integrated solution, where the modem and applications processor are combined in a single chip, often requires compromise and sacrifice, slowing innovation and time to market.

Advantages of a discrete applications processor

Designing mobile devices requires a rich understanding of user expectations and experiences. Consumers are increasingly more demanding when it comes to the types of applications they expect their mobile devices to support. The ability to quickly and easily update products to meet these higher expectations and new market needs is critical to device manufacturers' success.

TI has identified six main benefits of the discrete applications processor architecture:

- Faster time to market
- Flexibility to address multiple markets and product tiers
- Ease of delivering a compelling user experience
- Software reuse
- Open-source software
- Applications processor-centric audio architecture

Let's take a detailed look at each benefit to explain how discrete applications processors help mobile device developers meet the full range of market and user requirements.

Faster time to market

The innovation rate for modems and the applications processors moves at different paces. Modem performance tends to grow at a discrete rate – governed by advances in wireless network infrastructure capabilities – while applications processor innovation rates are exponential. By decoupling the modem and applications processor, a mobile device product roadmap is no longer limited to the much slower innovation rate of the modem.

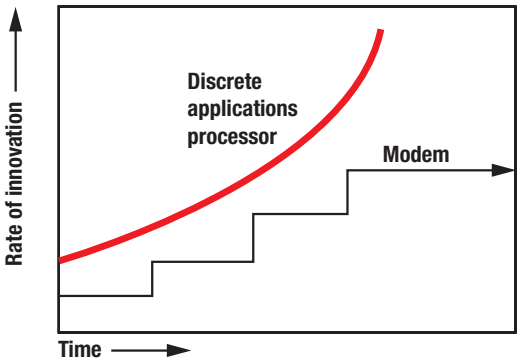

Figure 1: Rates of innovation for applications processor and modem technologies.

Current discrete applications processors, such as OMAP™ processors from Texas Instruments (TI), show about a six- to 12-month time-to-market feature advantage over integrated solution designs, all because of the easier design and reuse made possible with discrete parts.

For example, the world's first smart phone that includes a 720p HD camcorder feature, the Samsung OmniHD, is based on TI's OMAP 3430 discrete applications processor introduced in early 3Q09. A comparable product based on an integrated solution has not yet debuted.

Indeed, even for modem technology, it's easier to bring the latest innovations to market faster as standalone "thin modems" rather than as part of an integrated solution.

Flexibility to address multiple markets

In addition to delivering innovation faster, developers can quickly and easily address different regional markets when using a discrete applications processor. Software need only be developed once for the applications processor, which can then be integrated with modem technologies such as UMTS, CDMA, TDSCDMA, HSPA+ and LTE to address various markets.

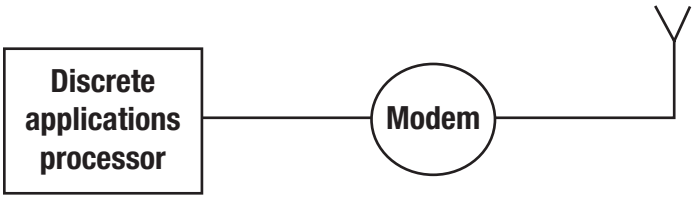

Figure 2: Discrete applications processor + "thin modem" split architecture.

For example, developers aiming for GSM/UMTS as the primary market may also want to create a solution for China's TD-SCDMA market. Instead of having to create an entirely new solution, they can simply replace the GSM/UMTS modem with a TD-SCDMA modem. This allows a quick solution delivery with minimal software redesign.

Another example is a product that supports both the cellular and Wi-Fi markets; developers can simply create a derivative product based on the same design that only requires Wi-Fi. Discrete applications processors easily allow for these types of quick redesigns that would be hindered by an integrated solution.

If device manufacturers use an integrated solution-based architecture, an extensive redesign using an entirely new chip is often required every time the manufacturer wishes to address a new market.

By decoupling the modem from the applications processor, designers can address a new market segment quickly, taking advantage of the discrete applications processor's flexibility without having to create entirely new software. This flexibility also allows designers more time to optimize user experiences on the hardware platform and deliver a uniform experience across multiple market segments.

Easily deliver a compelling user experience

Discrete applications processors inherently make it easier to deliver in-demand features and applications, from audio features to multimedia applications like HD video. A discrete solution has the ability to use the same applications technology across different products, no matter what modem is attached. A programmable discrete applications processor also makes it easier to integrate new standards and features as they become available, instead of being limited to the design cycle of the modem.

A good example of how quickly technology can change is video, for which new codecs are continuously developed and introduced. When the modem and applications processor reside on the same silicon, a whole new redesign has to take place to address a new codec. With a programmable applications processor, a minor software change allows the new codec to be easily added to the mobile phone's mix of technology.

Five years ago, no one could foresee the popularity of YouTube or Facebook. Supporting these applications requires specific codecs that are not always available in existing technologies. A device manufacturer using a discrete applications processor can easily update their platform, quickly delivering support for new codecs and applications to customers.

A discrete applications processor also allows more dedicated features to be integrated into the product. As features are integrated, the specific cores continue to provide inherently better performance. For example, in an integrated solution, multimedia computation is done by the same processor that handles voice functionality. This impacts overall multimedia performance, requiring the addition of coprocessors to enhance capabilities. Dedicated cores for imaging, video and other like features in a discrete applications processor – coupled with software programmability – optimize performance for these features.

Software reuse across multiple generations and product tiers

When the applications processor is separated from the modem, it allows the applications processor to be partitioned and gives designers vertical scalability with the same processor to deliver the right mix of applications and services. Using the same software, designers can scale a product up or down to address the full range of mobile market segments quickly and cost-effectively.

Many different tiers of handsets exist within the mobile phone market, offering a wide range of features and services and requiring different levels of features and functionality. Low-end phones provide basic voice, texting and imaging capabilities, while the high-end market includes mobile computing devices that can support full-fledged Web browsing, HD imaging and video, and a host of other processing-intense applications. By using a discrete applications processor, designers can maximize scale by reusing common engineering investments to create products that span multiple product tiers. For example, developers can create a unique 3-D graphics user interface on the applications processor and easily span this software across all product tiers without major software rewrites.

The programmability of the applications processor also allows horizontal scalability. Given the ease and pace at which new technology advancements are made to applications processors, new market generations can be addressed quickly and with minimal additional software investment. This capability to reuse software makes it easier and faster to:

- Scale a product across multiple geographies, cellular standards and product tiers
- Move from one generation of a product to the next
- Bring the best radio technology to market faster

Software reuse is much more elusive in an integrated solution, requiring large amounts of software rewrites to address new technologies and markets and driving a significant increase in developer engineering investment.

Open-source software

In the new era of smarter mobile devices that perform a multitude of desktop applications, the software assets of mobile device manufacturers are their key competitive advantage. But unlike in the past, software is not always homegrown.

The ability to quickly collaborate and co-opt software developed by partners, suppliers and even competitors in now an essential tool for success. This new way of developing software is made possible by open source.

A discrete applications processor solution provides a more open platform, which fosters greater involvement by the open-source community. Discrete applications processors make it easier for the open-source community, which may not be savvy in radio and communication technology, to collaborate in developing software faster in those areas where community-led innovation is crucial: kernels, drivers, power management, Web technology, graphics, multimedia, etc.

With broader open-source support, a discrete applications processor solution spurs the innovation of new products, permits the reuse of software across an industry, and allows designers to add new and differentiated features and capabilities

On the other hand, integrated solutions are poor platforms for open-source projects because they encumber open-source developers with unnecessary complexity. Moreover, the essential patent and IP licensing issues relating to modem technology are well-known and significant. As a result, integrated solutions are often forced to be closed systems not open to open-source development.

Applications processor-centric audio architecture

So far we have made a compelling case for how a discrete applications processor-based split architecture accelerates the rate of innovation, offers more flexibility, allows software reuse, and facilitates open-source collaboration. But most strikingly, a discrete applications processor-based split architecture even helps in improving and reusing mobile device audio architectures.

In an integrated solution, the voice path is completely handled by the modem, which can severely limit the developer's ability to add innovative features. With a discrete applications processor, the voice path can be moved off the modem, allowing designers to improve voice quality as well as optimizing for exciting new voice features and concurrent use cases.

A great example of the ability to add new features is "whisper" technology on Enterprise IP-PBX phones. Whisper allows one-on-one communication to take place in the midst of an ongoing conference call. With this technology, two participants on a conference call can have a private conversation while other participants continue their meeting. The two participants can still hear the conference call taking place, but the others cannot hear their private conversation.

Whisper is done in software only and does not affect modem performance in any way. Yet device manufacturers can only incorporate these types of new technology if they are able to free the voice path from the modem. Features like whisper technology leverage the capabilities of the applications processor and help device manufacturers further differentiate their products.

TI's OMAP discrete applications processors

OMAP applications processors from TI – built with a solid ARM® foundation and enhanced multimedia cores such as a graphics hardware accelerator, IVA video accelerator and image signal processor – provide the optimal mix of performance and power sensitivity that rests at the heart of cutting-edge products. Power and performance are absolutely vital to mobile success.

As the mobile and consumer device markets converge, making even more features and capabilities available to the mobile device market, TI continues to provide the full scope of enabling technologies – from discrete applications processors and software to wireless connectivity, analog and power management.

TI's proven OMAP applications processors provide tiered offerings that allow full software reuse and minimal redesign to address different price and market tiers. For example, software written for OMAP3440, OMAP3430 and OMAP3420 processors can be reused for the higher-tier OMAP3630 family of applications processors, giving designers the flexibility to deliver improved new products efficiently with a shorter time to market.

Future products developed for high-end markets using the OMAP 4 platform can also be easily migrated through software reuse to lower-tier markets. With TI's OMAP processors, developers only have to design applications once; with simple adjustments, the same capabilities can be easily migrated to new markets. OMAP processors allow faster designs with open-source compatibility, as well as software reuse and flexibility.

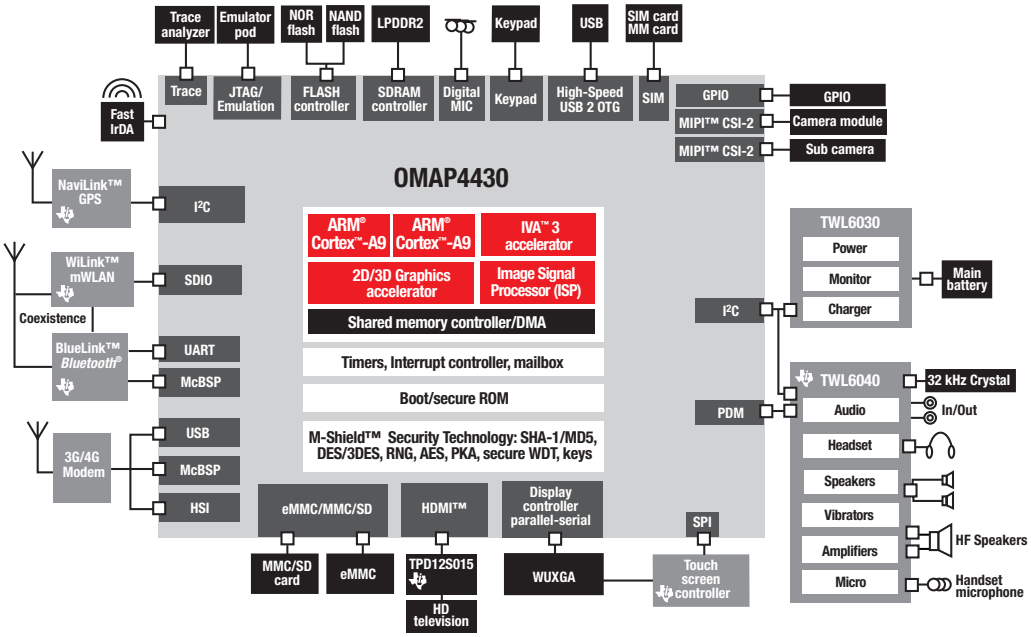

Figure 3: OMAP 4 discrete applications processor.

TI has provided OMAP processors to the mobile device industry for the past decade, helping to foster the emergence, innovation and growth of the smart phone market as well as other mobile devices. The OMAP platform offers solutions for Linux, Android Mobile Platform, Symbian and Microsoft Windows Mobile high-level operating systems, as well as the support of a vibrant and active ecosystem of more than 250 partners.

Discrete applications processors bring you to market faster

Device manufacturers are experiencing great success with discrete applications processor designs. Evidence rests in OMAP 3 processor-based devices hitting shelves today, like the Palm Pre, Motorola DROID, and Samsung OmniaHD. To generate demand and a loyal following, a compelling user experience is required; this is easier to deliver when the design is not tied down to the slower innovation rates of modem technology. The high level of innovation in the smart phone market drives the need for a discrete applications processor implementation.

A discrete applications processor solution allows greater reuse of software across generations and gives the flexibility to address multiple market segments. The discrete applications processor approach is also fostering a thriving open-source community, making it possible for device manufacturers to benefit greatly from collaborative software development. Discrete applications processors allow greater improvements in the voice path, allowing new features as well as higher voice quality.

All of these reasons lead to one conclusion: Discrete applications processors allow faster and more innovative designs for mobile devices today and scale manufacturers' investments well into the future.

For more information

For more information about TI's OMAP family of applications processors, see www.ti.com/omap-wireless-wp.

E010208

SWPY024