White Paper | November 2009

radisys®

Media Processing and Mobile Video Services

High Density Solutions for High Density Markets

Overview

Mobile telecommunications is the growth engine of the telecommunications industry. Mobile network infrastructures are being deployed at a rapid pace around the globe, with the capabilities and bandwidth to finally deliver captivating video services to handheld mobile devices including video conferencing, video ring back media, video mail, and interactive voice and video response services.

This white paper will show how Telecom Equipment Manufacturers (TEMs) can take advantage of the latest high density DSP technologies to incorporate media processing functions in their products that deliver the performance and scalability necessary to meet the needs of demanding mobile video services.

It will also illustrate the need for high density media processing in 3G and 4G mobile networks as network topologies evolve to an IMS interface and an end-to-end IP communications model requiring QoS and guaranteed low latency.

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Market Opportunity

We are just now seeing the early phase of the mobility revolution. The end user expectation for high speed Internet access has already been well established with fixed line broadband networks. Just as the cellular mobile phone started a communications paradigm shift more than 20 years ago, so called “mobile broadband” networks will have just as profound, if not greater impact on how we communicate and use the Internet. Mobile applications will begin to take advantage of advanced handsets, high-speed wireless Internet access, and integration with the functionality offered by next generation, end-to-end, IP mobile networks. And video content access will play an increasingly more prominent role in the user’s mobile experience, establishing the usage of very high quality video communications, entertainment and information access as table stakes.

Cisco is predicting in its Cisco Visual Networking Index (VNI) Forecast: 2008–2013 report that the advent of 4G services will lead to an explosion of new video applications that will transform telecom service providers into what the company is dubbing “experience providers.”

Cisco also predicts that high-speed wireless broadband technologies such as WiMAX and Long Term Evolution (LTE) will make high-definition video streaming widely available on both fixed and mobile devices. The upshot of this is that telecom providers will move into the cable companies’ traditional territory by offering more comprehensive video services. Cisco’s recent study on Internet traffic trends projects that by 2013:

- 64% of mobile data traffic will be for video,
- 19% for data services,
- 10% for peer-to-peer, and
- 7% for audio.

The study also says that the projected video traffic will increase four-fold between now and 2012. This coming increase in available video services and applications mirrors what has happened every time new Web services expand their bandwidth capabilities.

Take LTE for instance. LTE is the latest standard in the mobile network technology tree preceded by GSM/EDGE and UMTS/HSPA network technologies that now account for more than 85% of all mobile subscribers.

With target download speeds of 100 Mbps, upload speeds of 50 Mbps, mobility support up to 300 miles/hour, control plane latency < 10ms, and user plane latency < 5ms, LTE is expected to substantially improve end user throughputs, sector capacity and round-trip network latencies, bringing significantly improved user experience with mobile services. It will give a superior user experience and support even more demanding applications, such as interactive TV, user-generated videos, advanced games and professional services.

This white paper will focus on how ATCA building blocks, using cutting edge DSP technology, enable TEMs to deliver solutions to mobile operators for high ARPU, interactive video and other media-intensive services using high-density IP media servers in the next generation core mobile network. New DSP technologies continue to enable more services capacity in an already small footprint. Pairing resources using this technology along with much higher bandwidth, broadband mobile networks will help to ensure that mobile handsets users have the same rich media experience that is experienced with fixed line broadband networks.

Market Drivers

Next Generation Networks

From the technical perspective, the growing industry push behind the deployment of 3.5G/4G networks with higher bandwidths is spurring greater demand for mobile video services. From the marketing perspective, mobile operators that have deployed such networks are looking for revenue-generating services to offset their large infrastructure investments. Operators are making decisions today on how to advance their core networks with IP components, such as IP Media Servers, to meet the needs of much higher data throughput wireless networks. Even today a single high-end phone (such as an iPhone or Blackberry) generates more data traffic than 30 basic-feature cell phones, and a laptop air card generates more data traffic than 450 basic-feature cell phones. And mobile data usage will only increase as smart phones continue to grow in popularity for business professionals and consumers.

3.5G HSPA mobile data network technology is the next wave of high-speed mobile data access. As the mobile core network evolves from UMTS to Evolved Packet Core (EPC) networks supporting LTE radio access networks, we will begin to see the introduction of so called 4G speed networks. As early trials demonstrate, wireless access technologies are starting to interoperate with cellular radio access networks through the EPC including Femtocell and Picocell technology. WiMAX is also being deployed as an alternative to 3/3.5G networks, especially in Greenfield deployments where traditional cellular mobile networks are not as pervasive.

4G mobile video networks are based on an end-to-end IP services architecture. LTE is a step on the path to 4G radio technologies designed to increase the capacity and speed of cellular mobile networks. LTE is a set of enhancements to UMTS introduced in the 3rd Generation Partnership Project (3GPP) Release 8. Much of 3GPP Release 8 focuses on adopting 4G mobile communications technology, including an all-IP network architecture.

Advanced Handsets

A growing number of new devices support the expanding array of mobile video services (Figure 1). Many of these handsets are built with significantly larger screens (QVGA and even VGA) and enhanced color depth to enable a significantly better video viewing experience.

New screen technologies including OLED (Organic Light Emitting Diode) displays are being used in mobile handset applications to increase screen sizes with greater resolutions while reducing power consumption. Prototype OLED mobile phones have also been demonstrated with a flexible screen, allowing the phone to have a compact size without sacrificing larger screen sizes.

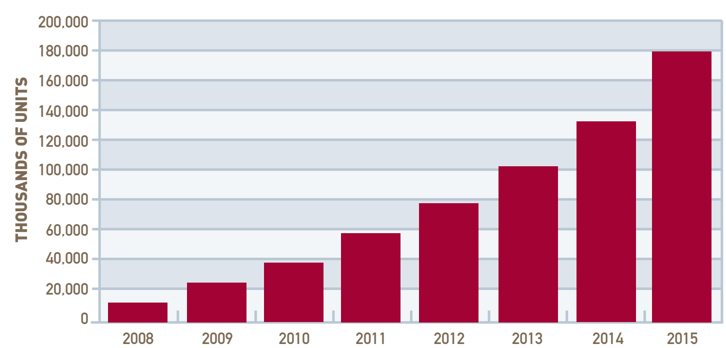

Figure 1. *iSupply Figures—Global Shipment Forecst of OLED Displays for use as Main Displays in Mobile Handsets (Thousands of Units)*

Another important handset attritubute to specifically support two-way video services is multiple camera configuration. A back-facing video camera allows video content creation and sharing, but does not allow mobile video conferencing which requires a front-facing camera and screen. Handsets with two cameras (both front-facing and back-facing) are increasingly available in Asia and Europe, and will soon follow into U.S. markets as well.

Improved Video Codecs

Advanced video codecs facilitate improved video compression by providing high video quality at significantly lower bit rates. Standardized codecs also offer greater flexibility as they are able to work in a wide range of network environments. The University of Essex estimated that there is a continuous 7% year-over-year gain in compression efficiency in a paper it published called the "Future Performance of Video Codecs."

To add to this is an upcoming technology that will play a significant role in delivering mobile video called Scalable Video Coding (SVC), the descriptive name given to an extension (Annex G) of the H.264/MPEG-4 AVC video compression standard. SVC is a video encoding algorithm that works in conjunction with MPEG-4 video compression, enabling high resolution video streams to be to be delivered to a video-capable device in a single bit stream at different:

- Frame rates (i.e. 15 or 30 fps)
- Aspect ratios (i.e. 4:3, 16:9), and
- Resolution levels (i.e. VGA @ 640x480 pixels, 720p HDTV @1280x720 pixels).

SVC accomplishes this by encoding a base video stream with a base resolution and optionally enhancing the bit stream with additional layers of coding to increase frame rate, change aspect ratio or increase resolution. This layering technique provides a dramatically higher degree of error resiliency and video quality with no significant need for higher bandwidth–which is especially crucial for mobile video services. Additionally, a single multilayer SVC video stream can support a broad a range of devices and networks. We will see in the next section that this is very important as mobile networks evolve.

Video Services in Next Generation Mobile Networks

Video Media Servers, powered by the lastest technologies, will play a critical role in helping operators to deliver high ARPU video services. With mobile data bandwidth increasing at a faster pace than ever, it is critical for TEMs to make technology decisions that keep up with operator deployments of new mobile network capabilitites now and well into the future.

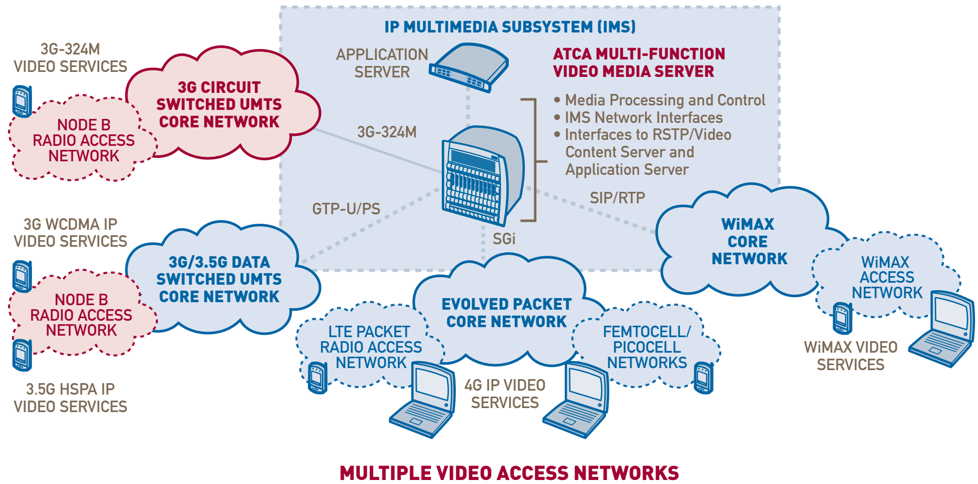

Figure 2.

The adaptibility of the Video Media Server to various broadband mobile networks is the key to it successfully delivering mobile video services as shown in the diagram above. Both the wireless core and access networks will change dramatically to support higher bandwidth data mobility and simplify network topologies to serve an ever increasing population of mobile subscribers. So the Video Media Server not only has to integrate multiple component functions that interface to the existing network, but needs to gracefully upgrade to include new functions and interfaces to avoid fork lift upgrades.

The Video Media Server's functions included in Figure 2 are:

- Media processing resources and control
- IMS Network Interfaces
- Interfaces to RSTP/Video Content Server & Application Server

These are the basic components that would be needed to maximize media processing density within the chassis, but other functions such as an Application Server could be configured inside the chassis as well, depending on how many media server video ports were needed. Again, the reason for this multi-purpose design is to configure and scale as needed within a compact footprint in order for video services to be deployed quickly, economically and with a high degree of serviceability.

Even though data throughput will increase dramatically in the 4G environment, the underlying requirements for Video Media Server functionality and interoperability will not change substantially. These services will continue to share many common functions, such as playing a media stream to an end point, collecting and storing a media stream from an end point, collecting digits from a telephony device keypad or video stream, bridging audio signals, or switching video streams for conferencing and collaboration applications.

The future of mobile network technology is before us and one thing is clear. The investment made in video service delivery components today, using a common ATCP Video Media Server architecture that includes multiple functions and interfaces combined with a high-density media processing footprint, will be monetized well into the future as circuit-switched technologies gradually fade from mobile core and access networks.

With carriers rolling out LTE now, 4G networks are becoming a reality for mobile operators. It is critical for TEMs to quickly position network components to their potential customers that can meet these demands in such a short product development cycle. And it is essential for device manufacturers and infrastructure vendors to be ready with differentiated and cost competitive LTE products so that they can gain market share and compete effectively in the wireless ecosystem of the future.

Video Media Server Platform for Mobile Networks

The ATCA Advantage

3GPP network standards have evolved to make the network flatter—with fewer network elements so scalability per element is of essence. This means that modularity and density per module in some of the key network elements is an important requirement. Also, carriers will want to market trial video applications in limited deployents before going to wider service deployment. So there will be a need to configure a full range of video processing resources cost effectively that can then be readily expanded as video service usage grows. This can be addressed very well by a standards-based, flexible, carrier-grade platform built on the Advanced Telecommunications Computing Architecture (typically abbreviated as either ATCA or AdvancedTCA) standards with high-density DSPs, such as TI's TMS320C6472, that are capable of handling a wide range of codecs and media processing capabilities in a higly scalable, high-density form factor.

The market proven, ATCA open hardware specification was designed from the ground up to meet the demanding need of evolving networks and video services with service delivery packaging that provides unparralleled scalability, responsiveness, modularity and flexibility to meet ever increasing mobile video usage. The main objective of the ATCA standard is to enable building carrier-grade multi-function systems, i.e., systems that include multiple computing, high speed interconnect and media processing functions to support various network services.

With market trials of mobile video services becoming the norm, ATCA configured resources give mobile operators the ability to apply the right balance of network resources. By combining multiple video service functions implemented as different blades within a single ATCA chassis, small footprint Video Media Server configurations can help operators faciliate market trials with lower Capex spending versus discrete server farms, all while maintaining carrier-grade availability. Once demand for these services accelerates, as seen in Japan and China, new chassis and blades can easily be added in to meet the demand.

Media processing functions in the Video Media Server represent a key resource since they need to meet various video codec environments and need to scale directly with subscriber video usage. This requires advanced DSPs on media processing blades that have very high channel density.

ATCA Video Media Server Platform

Using existing Radisys ATCA components, a multi-function, highly scalable Video Media Server can be configured for deployment in any mobile network as needed. Typically this means interfacing with other IP Multimedia Subsystem (IMS) components to be accessible in the mobile core network. Figure 3 is an example configuration of how a 16-slot ATCA platform can be configured to perform the multi-function Video Media Server described earlier.

This configuration supports multiple IMS processing elements that include the MRFC (Media Resource Function Controller) and MRFP (Media Resource Function Processor) that make up the Media Resource Function (MRF). Also included are the Ethernet interconnects to the S-CSCF (Serving Call Session Control Function) and Application Server that is running the video service's application logic using IMS defined interface protocols.

With the ten ATCA-9100-TI Media Processing Modules identified in green, this 16-slot chassis configuration would support the following video channel density:

- For QCIF video resolution (144 x 176 pixels) at 30fps, the media processing module is capable of processing 1,000 video sessions. This format is typically seen on mobile handsets today in 3G networks.
- For D-1 video resolution (max at 720 x 576 pixels in PAL format) at 30fps, the media processing module is capable of processing 100 video sessions. This format represents DVD quality video.

So the total capacity for this Video Media Server configuration in an IMS environment with 1+1 computing redundancy would range from supporting 1,000 D-1 resolution video channels upwards to 10,000 QCIF resolution video channels.

IMS networks establish a standards-based environment for core network video capabilities such as an MRF to interoperate with other IMS core functions. And as the wireless radio access networks evolve from 3G to 3.5G to 4G technologies, the MRF-based Video Media Server will continue to serve the needs of mobile broadband video services (Figure 4).

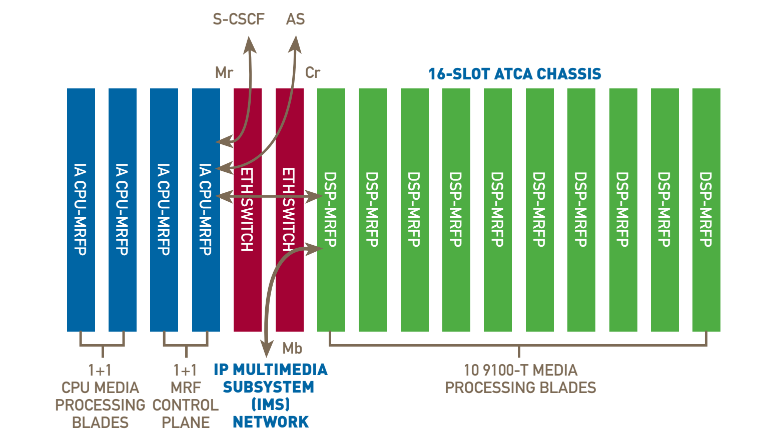

Figure 3.

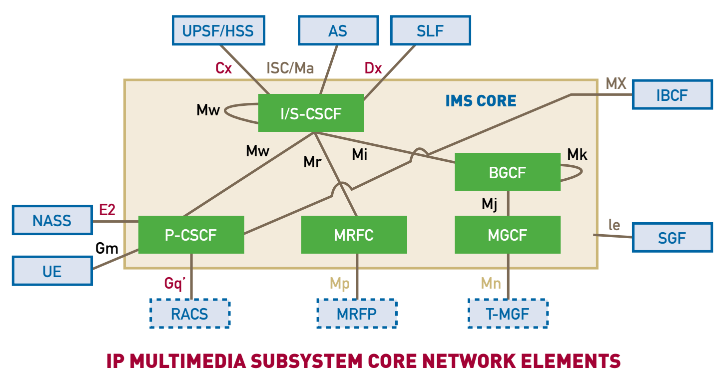

Figure 4.

ATCA-9100-TI Media Processing Module

The ATCA-9100-TI is a single slot AdvancedTCA Media Resource Module/Blade compliant with PICMG 3.1 Option 9 interface specification. It is based on a modular design for the DSP farms, and uses two purpose-built mezzanine cards to house up to ten 6-core TI TMS320C6472. Each multi-core DSP device is capable of processing hundreds of voice or video codec channels. The media resource module includes 10 GbE fabric capability (PICMG 3.1 Option 9), thus enabling high bandwidth connectivity to the DSPs for processing multi-media channels that require direct high bandwidth connections to DSP.

The base board of the ATCA-9100-TI is a carrier for hosting the DSP mezzanines. The base board includes a powerful Local Management Processor (LMP), Gigabit Ethernet switch, sRIO switch, and power and IPMI infrastructure. The LMP subsystem features a 1.3 GHz PowerQUICC III processor with up to 1GB of DDR2 SDRAM and dual 128MB Flash memory. Its primary responsibility is to host switch management software for both Gigabit Ethernet and sRIO switches, data path control software, diagnostics and application provisioning software.

The base board has two managed Broadcom BCM5650x switches to enable direct Gigabit Ethernet connectivity to the DSPs. The switches are capable of L2 and L3 functions in silicon and can be configured through CLI, API or SNMP interfaces running on the LMP. Each of the multi-core DSPs has a dedicated Gigabit Ethernet link to separate switches connecting to the ATCA backplane Base and Fabric interfaces as well as the LMP. Such high bandwidth connections to the DSP cores make this blade very powerful for video and VoIP applications, carrying MPEG Transport Streams, iTDM or RTP packets. The base (carrier) board also includes a Tundra sRIO switch array that facilitates access to each of the DSPs from the LMP, as well as the Zone 3 interfaces to the RTM.

The ATCA-9100-TI design incorporates two purpose-built DSP mezzanines which are optimized to carry the maximum number of multi-core DSPs, the LMP, as well as the Zone 3 interfaces to the RTM. The factory installed mezzanines are optimized for power and cooling to support the maximum number of multi-core DSPs. Each mezzanine incorporates ten TI TMS320C6472 six-core DSPs. The TMS320C6472 has six C64x™ DSP cores, each operating at 500 MHz. The mezzanine approach protects costly development investment and allows smooth upgrade to next generation DSPs.

The Radisys Promentum® ATCA-9100-TI is an ATCA media processing blade that provides the highest possible media processing channel density through the use of the TI TMS320C6472 DSP. It incorporates a powerful architecture to enable media processing for thousands of channels, yet offers flexibility in its design through modularity to provide smooth migration to future DSPs supporting even higher channel densities and new video processing codecs.

The ATCA-9100-TI's Texas Instruments DSP Capabilities

The Texas Instruments TMS320C6472 DSPs used on the 9100 are the leading industry solution for voice and video applications required for mobile network Video Media Servers.

The TMS320C6472 system-on-chip (SoC) is based on TI's industry-leading TMS320C64x+™ DSP subsystems. The TMS320C6472 has six C64x+™ DSP cores, each operating at 500 MHz. The device has more than 5.5 MB of integrated memory and an advanced set of communication peripherals like telecom serial interface ports (TSIP), Serial Rapid IO, UTOPIA and Gigabit Ethernet, making it the ideal platform for TDM and IP-based systems. The internal, non-blocking, switch-fabric architecture facilitates efficient on-chip data movements between DSPs, memory and peripherals. In addition, the chip includes a DDR2 external memory interface.

Based on early projections, TI TMS320C6472 DSPs can support approximately 100 to 200 MPEG4/H.264 coder instances, allowing as high as 2,000 to 4,000 channels per 9100 board for video processing, depending on the quality of the video required Performance of the DSP, combined with the two mezzanine architecture of the 9100 blade, provides great flexibility allowing TEMs to deploy lower density solutions to begin with and gradually increasing density by simply adding mezzanine or board level modules as service capacity demands. This allows smooth upgrades in smaller increments, reducing Capex and deployment risk significantly.

Wireless-specific Features and Enhancements

Operating in today's mobile networks requires much more than simply supporting wireless codecs. In addition to the standard wireless codecs, Telogy Software products support voice quality enhancements (VQE) such as automatic level control, tandem-free operation (TFO), acoustic echo control (AEC) and noise reduction (NR). Appropriate wireless protocol support is also available in the form of Iu/Nb over IP or ATM, along with many other wireless-specific features and enhancements.

Video Application Developer's Kit

Time-to-market is critical for today's video applications. TI provides a source code video developer's kit to address these complex solutions. This developer's kit integrates TI video codecs with applicable packetization, encapsulation modules and provides basic solutions for a multitude of video applications such as:

- Direct transcoding
- Text and graphics overlaying
- Video-conferencing mixing
- Integrated RTCP support
- Extension to QVGA, VGA and SD (D1)
- QoS–Bandwidth management, traffic policing
- Error resilience–FEC

As TEMs cater to mobile operator video market trials, these video enabling software development interfaces can help the TEMs to be responsive during market trials, ultimately bringing these services to market faster.

Conclusions

The realization of mobile video services is here today, using ATCA products and the latest in DSP technology. Radisys has the domain expertise to provide TEMs a network-ready platform that will help them achieve a signficant time-to-market advantage over their competition. And the race to provide this technology to mobile operators is on right now. The key question the operators will ask is–how can I start today and still know that as my network demands increase I will be positioned to take full advantage of the market need?

3GPP standards offer a new level of network simplicity with increased flexibility. Video Media Servers provide carrier-grade capability and modularity, combined with the cutting-edge performance offered by the ATCA-9100-TI. This media processing model based on TI DSP offers one of the best combinations in the market for a mobile network-ready platform solution.

Being carrier-grade shouldn't exclude cost effectiveness, flexibility and fast time-to-market. Radisys solutions can deliver on all of the above, helping Radisys' customers to expand and accelerate mobile operators' business models by implmenting the latest standards and technologies.

Corporate Headquarters

5435 NE Dawson Creek Drive
Hillsboro, OR 97124 USA
503-615-1100 | Fax 503-615-1121
Toll-Free: 800-950-0044
www.radisys.com | info@radisys.com

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