Mobile video quality: the new media-gateway revolution

By James Awad, Octasic -- 12/11/2009
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Telecommunications products and services—over many years—were based on the tenet "if you build it, they will come." Product designers and service providers led customers to new applications. More recently, however, customer-defined applications are driving product and service offerings. Video telephony is a case in point, and it's quite clear that mobile video is not far behind.

Consider that the Internet video revolution was started by video sharing sites like YouTube. The reasons for its success are quite simple: It was very easy to share videos and interact with the community, and, most important, it benefited from Internet economics. In other words, it was free to anyone with a Web browser!

In fact, a recent Infonetics report on IMS (IP Multimedia Subsystem) found that more than half of the service-provider respondents plan to deploy video telephony and converged mobile/fixed-line services over the next 12 to 18 months (**Reference 1**). The first wave of video services will expand within one or two years as we see a deluge of new products as competition from network operators increases.

How can the mobile video world emulate this success? Smartphones are making it possible to share or access video content on the go. For such services to take off, it must be easy for the consumer to get video from the mobile device onto the Internet. Conversely, when viewing video content on a mobile device, the video quality must be as good as on the desktop. The key success factors for these video gateways are the QOE (quality of experience), the ease of use, and the affordability for the end user.

Applications driving the market

As the mobile video market matures, the number of applications will increase. The first applications to market were video conferencing (over 3G-324M) and OTA (over-the-air) television, appearing as early as 2003 and 2005, respectively. OTA television actually operates without using any network bandwidth. Phones that support standards such as DVB-H, T-DMB, 1SEG, or Qualcomm's MediaFlo decode a broadcast RF signal in the UHF or VHF bands.

Video conferencing, when performed using 3G-324M, is carried over a 64 kbps bearer; this low-bandwidth connection provides less than ideal quality. This technology helped jump-start the deployment of mobile video services, but the limited bandwidth meant that image size and frame rates were kept low. Now that the age of an all-IP wireless network has arrived, this technology will be relegated to legacy status. Many systems will have to continue supporting this technology, but in small numbers of channels.

So what are the applications that will drive demand and deployment in the market? With the coverage of 3G networks increasing, new applications are taking over due to the large increase in downlink bandwidth. The most prevalent application is video streaming. Consumers want the YouTube experience on the go, and it's now possible over 3G networks.

Mobile video conferencing will get another chance, but it likely remains a business-only application where a structured "face to face" meeting has the most value. What is more likely to take off with consumers is video sharing, also known as "see what I see," which has much more potential. This is because it can be coupled with social networking and has the potential to grow in a viral fashion. The younger demographic is already snapping photos everywhere they go and uploading them to their favorite social networking sites, not to mention uploading videos. Imagine the potential if this could be done in real time. Teenagers will instantly show their friends and family what they're doing and what they're looking at, whether it's a rock concert or something funny that happened at the beach. Ultimately, everyone with a mobile video phone could have an always-on "TV station," broadcasting to other mobile phones or the internet. Web sites like www.Qik.com have already enabled this with today's technology.

The most exciting new service that is appearing is something called place shifting (**Figure 1**). Made popular by the Slingbox, this concept is being adopted by service providers as part of their "3-screen strategy." Your TV, Internet, and wireless service provider will allow you to access your TV

programming or stored media from any device. In other words, service providers can re-direct your broadcast TV programming to another screen, such as on your computer or mobile phone, when you're not at home.

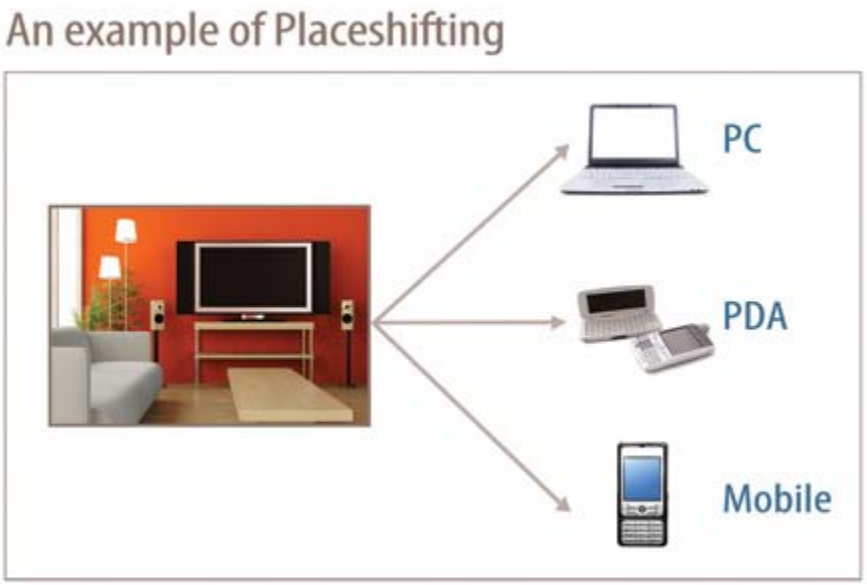

Figure 1: The place-shifting concept is part of service providers' "3-screen strategy."

Last but not least is messaging—adapting MMS (Multimedia Messaging Service) messages to the target device. This includes video mail and video ringback tones. Since MMS has always been a paid service, network operators have deployed systems to perform message adaptation. This has led to an increase in successful delivery rates and increased overall usage. The main difference between messaging and other applications is that it is non-real-time and needs to support a broad range of formats. For example, an H.263 video sequence can get converted to an animated GIF in order to make it compatible with a lower-end feature phone.

Barriers: cost and quality

The most important roadblock to mobile video services is still cost. Video gateways installed in carrier networks are still too costly. Today, as with many emerging markets, stand-alone systems were designed to address these new video requirements. These dedicated systems are often built using PC servers that allow visionaries to get to market very quickly. As this market matures, the video-processing function will be integrated into the core media gateways that are currently processing voice streams.

DSP-based solutions offer the highest area density and lowest power consumption per channel. But the real cost savings come from DSP solutions that can perform both voice and video processing on the same device. This will lower the price per port to a level where operators will be able to attract a large audience. DSP-based solutions also provide other benefits, such as low-latency processing.

The second barrier is related to video quality. Even if mobile video services were free, if the quality of the experience is not up to par, it will not be adopted by consumers. No one wants to watch a jerky video that is not properly formatted for the mobile screen, that is blurry, or that gets cut off before the end. If DSP-based solutions are the only way to reduce cost to an acceptable level, how does a developer select the right DSP solution? The two most important points to consider are power consumption and QOE.

Power consumption is probably the most important selection criterion. This will translate directly into the number of channels that a system blade can support, and therefore is key to lowering system cost. The most power-efficient solution on the market today can process five channels per watt in CIF (Common Intermediate Format) resolution at 30 frames per second. This is more power efficient than standard PC hardware by a factor of between 100 and 200 times. By 2010, this number will exceed 10 channels per watt. The reason for this huge increase in performance is due to the emergence of new DSP devices that take advantage of both multicore and innovative self-clocking architectures.

Having the most cost-effective solution is worthless without providing a high QOE. The difficulties in delivering high QOE in the mobile world are related to the broad spectrum of disparate mobile devices and varying network resource availability. In order to address the broad range of endpoints, the video gateway must be able to dynamically change things such as the video codec, frame rate, image resolution, and even bandwidth consumption.

While most solutions can effectively handle the codec and format conversions, adjusting the video quality to available bandwidth is a much more difficult task. In the case of mobile video, bandwidth is quite limited. Also, the available bandwidth can change dynamically during the session as the network becomes more or less congested. The video gateway has to be able to dynamically adjust to the varying bandwidth constraints.

Contrary to most voice codecs, which are CBR (constant-bit-rate) streams, video streams are VBR (variable bit rate). This means that if a sequence of images is encoded at a fixed quality level, the amount of bandwidth consumed would vary according to the complexity of each frame. Therefore, in order to transmit a video sequence over a channel with relatively fixed bandwidth, it is important that the video encoder adjust the quality level at each frame. Video-encoder algorithms include a component called the bit-rate controller, which is responsible for dynamically determining the quality level. A lot of research has gone into bit-rate controllers, and there are different approaches for different applications. Therefore, the algorithm used for encoding a Hollywood movie onto a DVD is quite different from that used in real-time communications for mobile video. The DVD encoding can be done using "multipass" encoding, where the encoder can make multiple attempts at encoding the whole movie before selecting the best approach. When operating in a real-time environment, decisions can only be made based on past information and heuristics.

IVVR: the next rung

As video gateways evolve, they will offer more advanced functionality. As a result, current equipment manufacturers may choose to retarget their mobile video gateways to the enterprise segment. Banks, governments, schools, retail stores, and many other organizations are developing IVVR (interactive voice and video response) systems to interact with their customers (**Figure 2**). IVVR systems are vastly extending the world of "press 1 to speak to a representative." Instead of interfacing with an audio-only system, IVVR allows customers to make a call via their mobile phone and see menu options, photos, or other information on their mobile screen. When calling the technical-support line for your computer, they will be able to stream a video to your phone, showing you how to open the case and install a new video card—a world of improvement compared with a voice-only conversation. When calling your bank's helpline, you will be able to view the balances for your various accounts while on hold, or see how your stock portfolio is doing.

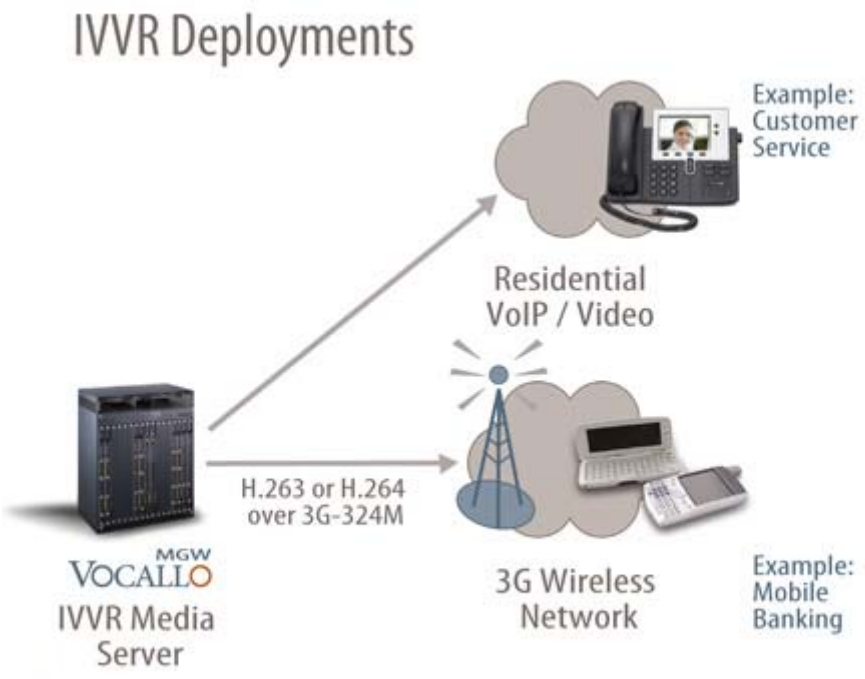

Figure 2: IVVR allows users to see menu options, photos, or other information on their mobile screens.

IVVR systems enable video-based services on lower-end feature phones that may not have a Web browser. While the proportion of smartphones in the world is growing, lower-end devices still make up 80% of the market. Enabling video for this broad user base is possible with server-side IVVR systems. In order to offer these services, the DSP solution must provide a powerful toolkit that allows text overlay, video streaming, picture in picture, and so on.

We are finally seeing the deployment of video services to consumers. Driven by the deployment of 3G networks, high-performance smartphones, and the market pull from social networks, video is definitely the next battleground for network operators. Unlike voice services, where poor quality leads to customer churn, video services are still a novelty, and therefore poor quality may simply hinder adoption. As carriers work to increase their average revenue per user, providing high-quality video services is considered the only way to get customers onboard.

After the first wave of video services is deployed, what will we see next? Once again, the next wave will be driven by the increased performance of endpoints and the latest Internet trends. High-definition video encoding and decoding will be available on endpoints, meaning that video gateways will have to support ever-increasing resolutions. Pico-projectors embedded in cell phones will increase video consumption further as it will become even easier to share media at any time on any surface. Last but not least, when 4G networks deliver on the promise of 50 to 100-MBps uplink rates, we may see HD video conferencing on the go within a decade.

In the next wave of the applications evolution, not only will service providers have to upgrade their networks, but media-gateway manufacturers will need to seek out best-in-class video DSP solutions that will deliver the QOE consumers demand while providing the cost savings and flexibility necessary for an ever-changing mobile landscape.

References

1. *IMS Plans: Global Service Provider Survey,* August 2009

Author Information

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