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radisys.

Personalized VoLTE and Mobile Video Services

IMS MRF Solutions for Ubiquitous Multimedia Communications

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Overview

A battle over personal communication service revenue is underway, where "over the top" (OTT) players, like Skype, Viber and Google, are attacking the mainstay of more traditional communications service providers. The Internet, coupled with ubiquitous broadband access, changed the ground rules by enabling low-cost, IP-based services that deliver an enhanced customer experience through innovative features and video.

Perhaps communications service providers have been slow to respond, but now they can capitalize on the latest game changer—the transition to proven IP Multimedia Subsystem (IMS) service-delivery architecture. IMS opens the door to a wide range of rich personalized voice and video services, delivering the user experience of OTT services, with the added benefit of interoperability across any device or access network. This infrastructure provides full media processing support for Voice over LTE (VoLTE), Rich Communications Suite (RCS), voice mixing, video mail, video ring-back tones and video conferencing with live video share, among other services. Underlying all these real-time communication services is the Media Resource Function (MRF) in the IMS, which supports the types of personalized mobile applications and services that are forecasted to explode in the coming years.

Through the thoughtful deployment of IMS architecture—a relatively small incremental investment relative to LTE access and core IP network infrastructure investments—service providers will ultimately generate more revenue and ARPU. Bundling personalized mobile video services with broadband data plan services will improve the top line and possibly push some subscribers to larger data plans, further increasing revenues.

This paper is broken into two sections. Section 1 focusses on Personal Communication Services Architectures based on IMS, including an overview of the Media Resource Function (MRF) and the Media Resource Broker (MRB), and their role in multimedia communication service delivery. Section 2 provides many examples of personalized VoLTE and mobile services that can all be supported using an IMS, designed to help mobile operators generate more revenues from their LTE mobile network investments.

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Business Environment

There is growing disparity between ever-increasing network traffic and the relatively flat revenue growth that many communications service providers are experiencing. This mismatch, according to Heavy Reading, an independent research organization, is indicative of a transition from the "Voice Era" to the "Data Era".[1] The communications industry has entered the data era, which is characterized by traffic growth substantially outpacing revenue growth, as illustrated in Figure 1. Service providers are well aware of these trends, and they understand the path to greater profitability is lowering the cost per bit, while also developing exciting, new enhanced services to better monetize network bandwidth.

One of the promising opportunities for enhanced services is video, especially as more and more subscribers want this medium incorporated into ringtones, emails and conferencing. Video services are already established, as seen by the popularity of OTT services, like Internet TV, YouTube, live-event streaming and video calls. Prospects for mobile video are incredible, indicated by Cisco's forecast of a 24 times increase (90 percent CAGR) in traffic from 2011 to 2016.[2] Cisco also predicts mobile data as a whole will grow at a 78 percent CAGR, a much higher rate than the 29 percent CAGR of all Global IP traffic growth, as shown in Figure 2.[3] With a number of OTT players taking the lead in video over IP, there is a risk of communications service providers falling further behind. "Telecom operators are understandably worried that OTT providers will end up capturing all the value that video over IP promises, relegating the broadband network operator to the role of simply providing the proverbial dumb pipe,"[4] said James Crawshaw, Analyst at Large at Heavy Reading.

This scenario can be avoided by taking the extra step to deploy IMS architectures. These systems take full advantage of all-IP LTE networks, network intelligence and subscriber knowledge to enable new converged services that offer a differentiated and universal experience compared to OTT offerings.

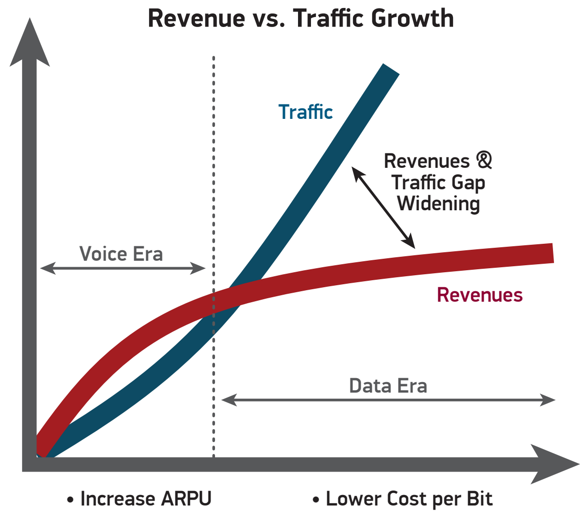

Figure 1. *Traffic Growth Overtaking Revenue Growth*[1]

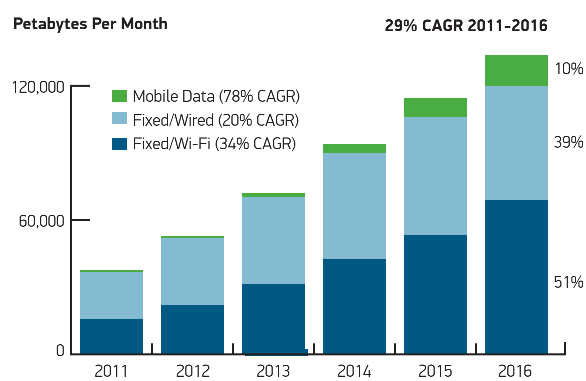

Figure 2. *Global IP Traffic, Wired and Wireless*

Market and Technology Drivers

The Transition from 3G to 4G/LTE

The convergence of telecom and IP networking, along with the persistent growth of bandwidth hungry services and applications, has driven the need for new standards, technologies and platforms. For example, 3G network bandwidth and latency constraints limit its applicability for 2-way delay-sensitive personalized mobile video services, a progression from today's more typical 1-way video streaming.

The telecom industry is currently in the middle of a significant mobile infrastructure upgrade from 3G to the latest 4G/LTE technology. LTE provides much higher throughput (i.e., four times more downlink and almost eight times more uplink) than its predecessor, High Speed Packet Access (HSPA), as shown in Figure 3. HSPA is the family of high-speed 3G digital data services delivered by cellular carriers worldwide using GSM. Furthermore, LTE has better cell edge performance, improved latency and lower cost per gigabyte, while servicing more users with a higher quality of service (QoS).

It is 4G/LTE that will finally deliver the mobile network requirements for personalized mobile video services. Not only does 4G/LTE deliver significant bandwidth improvements over 3G but also reduced network latency, which together provide the network requirements essential for delivering real-time, interactive, and personalized mobile video services.

Advanced Handsets

A growing number of new devices support the expanding array of mobile video services. Many of these handsets are built with ever larger high-resolution screens and enhanced color depth to enable a significantly better video viewing experience.

Another important consideration is camera configuration. A back facing video camera is adequate for video content creation and sharing, but it is a front-facing camera and screen that are essential for personalized 2-way video communications services. Handsets with two cameras (both front facing and back facing) were somewhat rare just a few years ago, but today dual cameras are an increasingly standard feature on modern smartphone devices, including the latest LTE smartphones and tablets.

Improved Video Codecs and Transcoding

Advanced video codecs facilitate improved video compression by providing high video quality at significantly lower bitrates. While H.263 codecs were prevalent in earlier generation video services, current rollouts are focused on the H.264 video codec, with 720p HD mobile video increasingly viable for high-quality,

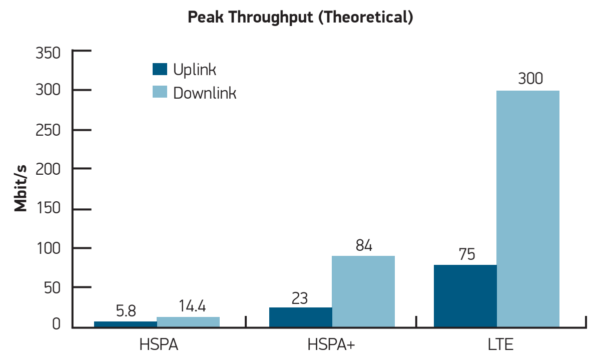

Figure 3. *Peak Throughput of 3G and 4G Mobile Networks*

Figure 4. *Samsung Galaxy S 4G/LTE Smartphone—one of a growing number of LTE devices supporting a front-facing camera with SIP video client software suitable for personalized mobile video services*

personalized mobile video services. In addition, VP8 is a new video codec associated with emerging WebRTC communiations. Advanced codecs and standards also offer greater flexibility by being able to work in a wide range of network environments.

Although some devices might have the power and LTE signal quality for HD 720p video, other device endpoints might have lower bandwidth connections or earlier generation mobile connections, necessitating lower-resolution screen size. So another important role of the MRF in many multi-point mobile video applications will be video transcoding between different codecs, and transrating between different screen sizes and bandwidth conditions.

Video Mobile Client Software

iPhone and iPad owners using Facetime have seen the power of personalized video calling and video conferencing, albeit with restrictions, like interactions limited to other Apple device owners. Likewise, Skype video calls can only be conducted between Skype users.

The vision of 3GPP standards around IMS is to deliver ubiquitous audio and video services to any mobile 3G and 4G/LTE device. IMS uses Session Initiation Protocol (SIP) for end-to-end signaling, so devices will require a SIP-based video client that is compatible with 3GPP standards and the IMS service delivery core.

SIP-based video clients will be realized in two phases. Today, SIP-based video client software is available from a growing list of industry vendors. Like other downloadable applications, they can be sourced from the provider's "application store," with the added benefit of being preconfigured to interwork with an operator's IMS core network.

Alternatively, it is expected over time that the industry will standardize around these client capabilities, like efforts around the Rich Communications Suite (RCS) of services, where RCS clients will be transparently embedded into the LTE phone itself, just as today's mobile devices have standard embedded software for dialing and receiving a voice call.

Personal Communication Service Architectures

Imagine a world where widespread broadband connectivity brings people and devices together, enabling unparalleled experiences and capabilities. Fast 4G/LTE networks and a variety of consumer devices (e.g., smartphones, laptops and tablets) will enable new services that combine voice, video and data in innovative ways. At the center of this convergence is media processing, which supports services such as Voice over LTE (VoLTE), voice mixing, multimedia streaming, video ring-back tones and conferencing with live video share.

Media processing is provided by a MRF via IP media servers, designed from the outset to support IP packet-based voice and video communications services. The MRF fits within an overarching architecture—as defined by the IMS specification—that delivers converged services to a wide range of end-customer devices and evolving access networks. IMS is deployed and working in many mobile networks today.

Role of the MRF

Supporting higher levels of media convergence, next-generation networks will deliver services across multiple modes of communication: voice, fax, e-mail, instant messaging, web, images and video. Greatly facilitating all this innovation will be MRFs, which provide the underlying real-time audio and video packet stream processing essential in the delivery of dozens of personalized mobile audio and video services, while simultaneously lowering telecommunication costs. At the same time, the MRF will optimize the content by transcoding media streams, and adjusting content size and bit rate.

The MRF is a fundamental element in an IP-based services infrastructure, processing and integrating real-time audio and video media streams along with data and fax. This role is the foundation for many value-added services, including customer service, multimedia service demos, surveillance applications, tele-voting while watching mobile TV, and playback controls for video streams (e.g., pause, fast-forward and rewind).

MRF in the Mobile Network

The 3rd Generation Partnership Project (3GPP) standards body defined IMS architecture in 2002 to facilitate converged IP-based services, while providing a migration path from mobile GSM networks. Now, IMS and MRF deployments are common in wired and wireless networks.

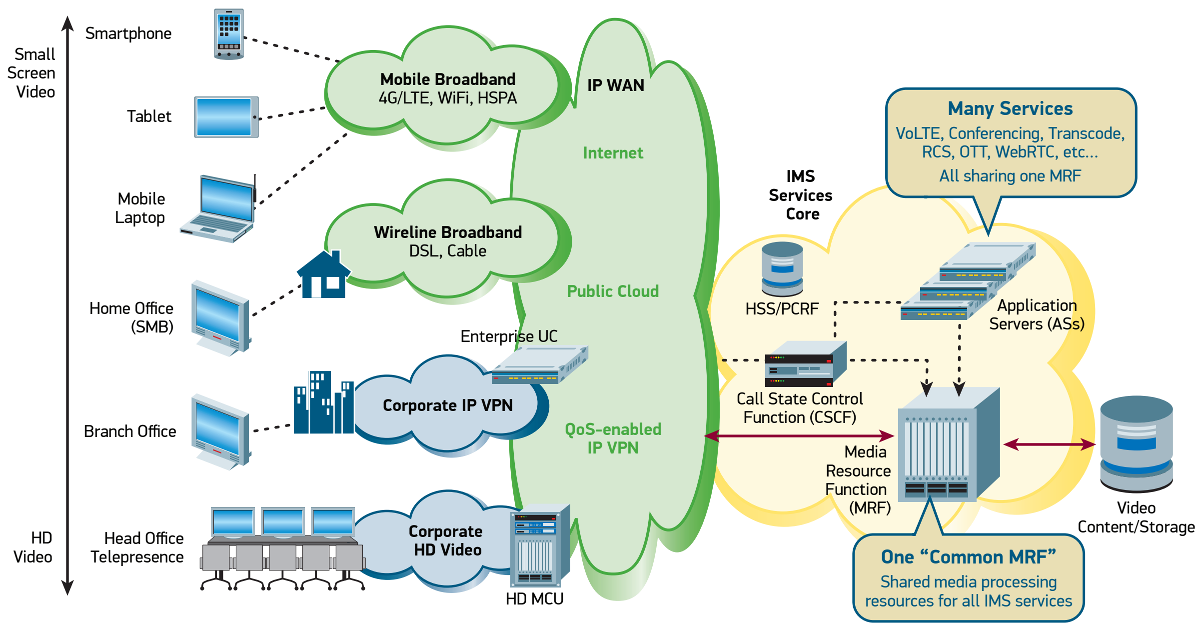

Figure 5. *IMS Architecture showing Common MRF supporting Many Services to Many Devices*

A detailed discussion of the IMS architecture, depicted simplistically in Figure 5, can be quite extensive and beyond the scope of this whitepaper. So the objective of this section is to focus on the role of real-time service delivery in the IMS architecture, which is centered on the following IMS elements:

- *Call State Control Function (CSCF)*—provides policy enforcement, and service control and orchestration.
- *Application Server (AS)*—executes the service logic and application software. An IMS deployment frequently has many application servers, often from different vendors, supporting many different applications.
- *Media Resource Function (MRF)*—delivers voice and video media processing functions, under the commands and control from the CSCF and/or application servers.
- *Content Server*—stores media content for services, such as ring-back tone (RBT), video mail, or video on demand (VoD).
- *Home Subscriber Server (HSS)*—contains subscriber information (e.g., services, preferences and device capabilities) and performs subscriber authentication and authorization.
- *Policy and Charging Rules and Enforcement Function (PCRF)*—determines policy and charging rules for controlling service data flows and IP bearer resources.

IMS is designed such that multiple AS elements can all use and share a single MRF (or share a smaller number of MRF nodes) in a network. It is this reuse of MRF resources across dozens of applications that drives the CapEx and operational savings in IMS architecture. For more detailed info on IMS service architectures for video services, please see the Radisys whitepaper, "MRF Media Processing in 4G/LTE Networks" at http://www.radisys.com/2011/mrf-media-processing-in-4g-networks/6/ [5]

The "Common MRF" Strategy

Many mobile operators have a history of rolling out value-add interactive services in isolation, each driving new media processing investments into the network. The result is a proliferation of media resources from a variety of vendors offering different capabilities, interfaces, and platforms, which results in inefficiencies in the overall use of media processing investments, along with a growing operational complexity, which increases ongoing operating expense (OPEX).

The "Common MRF" strategy is based on the objective to support the media processing requirements for as many services as possible, using a single (or few) MRF platforms. This is achieved by selecting an MRF supplier that offers open standards-based IMS interfaces, multi-service capabilities, and broad feature and codec support for all existing and future application requirements.

It is the reuse and sharing of a single MRF resource technology that can drive significant benefits into the mobile operators business. Capital expense (CAPEX) savings are achievable through scale economies. But the biggest savings would be in OPEX, achieved through minimized MRF platform variants, which lowers costs associated with integration testing, support, and ongoing maintenance of fewer media processing technologies and platforms.

Media Resource Broker (MRB)

Many leading network operators around the globe have growing deployments in IMS service architectures. However, even for savvy operators who have embraced a common MRF strategy, the physical number of MRF resources will often proliferate.

One reason for proliferation is obvious—large networks often need multiple MRF platforms. Another reason might be due to geographic redundancy strategies. In some use cases, media processing is often best achieved close to the users, so multiple MRF nodes might be deployed thousands of miles apart. Sometimes it is the nature of the services and applications themselves, as large capacity MRF platforms in the IMS core are best for centralized media processing (like multimedia conferencing mixing and switching), with edge-based media processing deployed for IP-to-IP transcoding at interconnect peering points. Suffice it to say that, even with a perfectly executed Common MRF strategy, the number of MRF nodes can grow.

As the number of MRF nodes grows, the location, capabilities, and dynamic changes in available MRF capacity will need to be stored and managed somewhere in the network. This knowledge and MRF selection logic was often included inside the

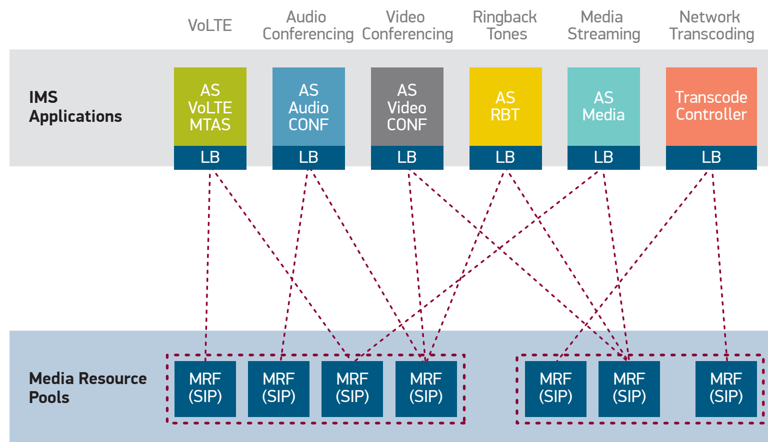

Figure 6. *MRF load balancing complexity increases with AS and MRF nodes*

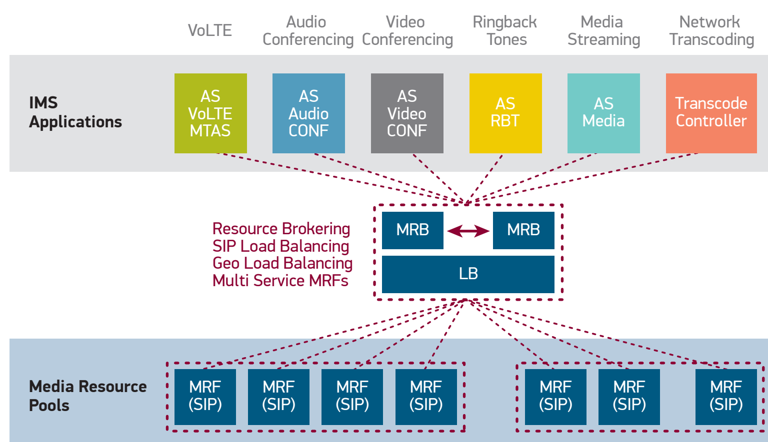

Figure 7. *Media Resource Broker (MRB) consolidates load balancing and MRF selection from individual AS nodes*

application servers (AS) themselves, but as the number of AS nodes, you can see that duplication in load balancing and MRF selection logic across the application services, as shown in Figure 6.

The Media Resource Broker (MRB), as depicted in Figure 7. The MRB is essentially an abstraction layer that sits between IMS applications and MRF resources. The MRB understands the capabilities of each underlying MRF, as well as dynamically updates the state and available capacity of each MRF node, allowing the MRB to support load balancing across the MRF resources.

When an application server requires media processing, it simply sends a single media processing request to one entity—the MRB. Based on MRF capabilities required, loading, geo location (or other MRF selection factors), the MRB then selects and forwards the AS media processing request to the selected MRF.

Benefits of an MRB in an IMS services architecture include:

1. *Reduced Over-engineering*—The MRB understands real-time utilization across all the MRF resources, allowing for improved MRF port utilization.

2. *Reduced Load Balancing Complexity in AS Layer*—MRB delivers optimized MRF selection and load balancing, eliminating the need for these requirements in each application.

3. *Geo- and Time-based Reuse*—The peak hour of usage in (for example) New York City is different than Los Angeles. An MRB, engineered in conjunction with a good QoS-enabled IP network, enables idle MRF resources in Los Angeles to help serve New York peak hour requirements.

4. *Minimized Strandard Resources*—An application with a dedicated MRF might have a spiked demand for DTMF collection, while another application has idle DTMF collectors. An MRB could receive a DTMF collection request, and route the request to an idle MRF.

5. *Improved Service Time to Market*—It's not all about cost savings. MRF resources, managed by an MRB, simplifies the application services layer. Hence, any new service innovation idea is an easier effort, which gets the service to market faster, shortening time to revenue.

Personalized Mobile Service Examples

Voice over LTE (VoLTE)[6]

With the aim of driving consistency, the Voice over LTE (VoLTE) specification was created by the One Voice Initiative, whose members included AT&T, Orange, Telefonica, TeliaSonera, Verizon, Vodafone, Alcatel-Lucent, Ericsson, Nokia Siemens Networks, Nokia, Samsung and Sony Ericsson. The VoLTE specification provides a common, standardized IMS voice solution by defining a recommended feature set; and most importantly, it specifies one approach when multiple options exist for a particular function. More specifically, the VoLTE profile defines a minimum set of features that wireless devices (the UE) and networks are required to implement to guarantee an interoperable, high-quality IMS-based telephony service over LTE radio access.

The MRF provides the media processing resources required for any VoLTE service, including playing a network announcement to a VoLTE device, or collecting dialled digits from the device. VoLTE also requires the MRF to support the AMR-WB high-definition audio codec, which delivers noticeable audio quality improvements relative to 3G voice quality that mobile subscribers tolerate today. But the network will also need backwards compatibility with AMR narrowband codecs (used in 3G GSM networks), EVRC codecs (used in CDMA networks), along with other legacy audio codecs. Hence, an important role of the MRF is scalable, cost-efficient transcoding, including support for dynamic codec modes and mode change requests.

Rich Communications Suite (RCS)

The GSM Association (GSMA) driven RCS industry initiative is gaining widespread momentum among operators, device manufacturers and application service providers. The scope of RCS includes a number of standardized services, including presence, voice calls, instant messaging, video share, image share, SMS and MMS. While some might argue that many operators, and even OTT providers, offer many of these service capabilities today, the intent of RCS is to deliver a ubiquitous service offering to any mobile device, all supported by the IMS architecture, including the notion of RCS service roaming between IMS systems in different operator networks. Hence, the main features of RCS include standardization efforts around an enhanced phonebook with presence information, enhanced messaging, including chat and messaging history, as well as enriched calling capabilities, like a commonly implemented "see what I see" capability.

Many of the services supported by RCS, like presence or SMS, do not involve RTP media processing; thus, the role of the MRF might be somewhat limited in the context of the overall scope of RCS. However, RCS scope does include voice and video calling, and it is the role of the MRF to deliver real-time RTP media processing essential to support these types of RCS services, particularly when transcoding and transrating may be required.

Video Ring-back Media Service

Ring-back tones are the audio sounds heard by callers while waiting for the called party or an answering machine to pick up. Traditionally, these sounds were fixed by the service provider and consisted of uninteresting ringing or beeping sounds. Today, personalized ring-back tone services, also known in some countries as color ring-back tone (CRBT), allow subscribers to select the sounds heard by their callers, giving them a fun way to differentiate and express themselves to their friends and business contacts through favorite songs, video clips or sounds, as depicted in Figure 8.

A video ring-back media service follows traditional usage models, where subscribers can either purchase video ring-back content from their mobile operator or create their own. Mobile subscribers can personalize their service using their handsets or a service provider portal to select from various video or audio content, so that, based on the caller's number, specific content plays. For instance, a mobile subscriber can configure a short vacation video to play whenever anyone in a group of "family members" calls. This value-added service can increase ARPU and deliver a quality network-based service that helps to minimize subscriber churn.

Figure 9 shows the mobile network components needed to implement a video ring-back service. The AS runs the video ring-back application, and the HSS tracks service subscriptions. During service setup, Dave could either record a video using his handset or upload a favorite video using the service's self-service portal that is staged in the mobile operator's network. Later, when Ray tries to call Dave and waits for a

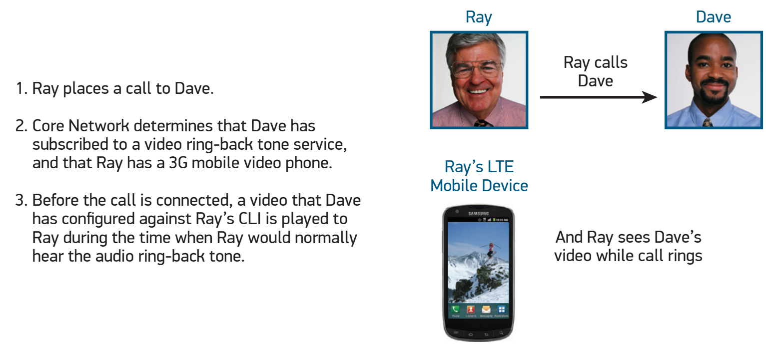

Figure 8. *Video Ring-back Media Service Use Case*

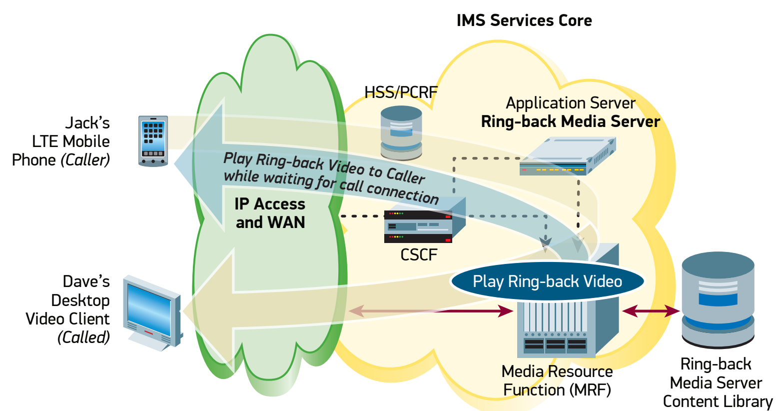

Figure 9. *IMS Delivery of Video Ring-back Media Service*

connection, the HSS verifies Dave's video ring-back service subscription and instructs the AS to play a ring-back clip to Ray. The AS runs the service logic and instructs the MRF to first get the clip from the content server using Real Time Streaming Protocol (RTSP), and then streams the audio and video content over the network via the Real Time Protocol (RTP).

Video Ring-back Advertising

The prior section described a use model where users define what they hear and/or see while waiting for a call to connect. For users who do not subscribe to this service, service providers could use the same infrastructure and, instead of playing the traditional ring-back tone, show an advertisement to generate advertising revenue. Alternatively, the advertising revenue could be used to subsidize LTE service for price-conscious market segments.

Video ring-back advertising can be deployed in a wide variety of ways. For example, a store may wish to play a video advertisement on customers' handset when they call the general information number. In a more advanced example, an LTE network detects when one of its female subscribers is standing at a downtown corner near a fashion store. The knowledge of the subscriber's buying patterns, coupled with geo-based location, would then trigger the IMS to send her an instantaneous video advertisement with a mobile coupon for a special deal at the store just across the street. IMS creates an opportunity for advertisers to target consumers near the point of purchase, thereby increasing sales, while also providing a value-added service.

While the MRF in and IMS provides a ubiquitous video advertising capability, service rollouts would still need to maintain the integrity of the call experience; thus, the advertisement should stop as soon as the caller answers, and calls should never be disrupted by advertising.

Video Conferencing

Video conferencing is a powerful communications tool in the modern business world. The ability to share important business discussions with body language and facial expressions delivers enormous benefits compared to any other conferencing medium. In many ways, video conferencing has truly become "the next-best thing to being there."

Radisys media servers simultaneously support two modes of mobile video conferencing: continuous presence (CP) and voice-activated switching (VAS). This flexibility is important due to the wide assortment of tablets, smartphones and legacy mobile phones, their corresponding screen capabilities, as well as the actual mobile bandwidth condition at each caller's location.

Well-suited to a tablet with a relatively large screen, CP video conferencing takes video streams from multiple video conference participants and renders them on a single screen. For mobile devices with a limited screen size, CP may be impractical since the panes displaying the participants may be too small to see clearly.

A better approach for small-screen devices is VAS because the user only sees the active speaker (one video stream) accompanied by his/her name displayed via a text-overlay feature. Depending on who is speaking, the MRF switches from one video-enabled participant to another. Audio-only participants can also be added into the same conference mix. Leading MRFs support VAS-video, CP-video and audio-only participants in the same conference mix.

The enhanced collaborative experience from mobile video conferencing services can help mobile operators capture minutes of use that otherwise go to off-network, fixed-line conferencing service alternatives. Another important feature of video conferencing is it's easy to identify the active speaker, which can be very difficult in an audio conference when the participants aren't familiar with each others' voices.

With the huge expansion in the number and variety of audio and video codecs used in modern telecommunication networks, the MRF also performs the codec conversion, called transcoding, allowing diverse devices to share information. Helping to save significant amounts of bandwidth, the MRF re-encodes video streams to a lower bit-rate, known as transrating, without changing its content. Transrating is used to convert high-resolution video streams to a lower resolution (i.e., lower bandwidth) video suitable for a handheld device with a small screen or limited available bandwidth. Therefore, video transrating, transcoding and other media conditioning are important functions for successfully deploying the industry's three-screen strategy for HD television, desktop and mobile devices.

In order to maximize conference participant options, service providers may want to ensure their offering interoperates with other video conferencing technologies, including H.323, Skype, GoogleTalk, Facetime or Microsoft Lync. An IMS-based MRF facilitates this objective because its capabilities and network location enables it to play a unique and valuable role in providing video interworking gateway functions. This can be seen in Figure 10, where the MRF mixes a wide range of media types and formats, and interfaces to the IP access network and WAN, which provide access to LTE clients, HD telepresence and other video conferencing technologies.

Video Security Monitoring

Video conference mixing services can be extended beyond humans to inanimate objects. Mobile users on the road may want to keep an eye on their homes by viewing the various cameras installed around the house. In this case, the user calls into an IMS-based video security service, and the IMS returns live video feeds, possibly in a CP display, from cameras located in the front yard, back yard, front entrance, garage, etc. An IMS video security application server could then also command the MRF to overlay an image or text over the video feed, such as a simple label "garage camera," at the bottom of the video stream.

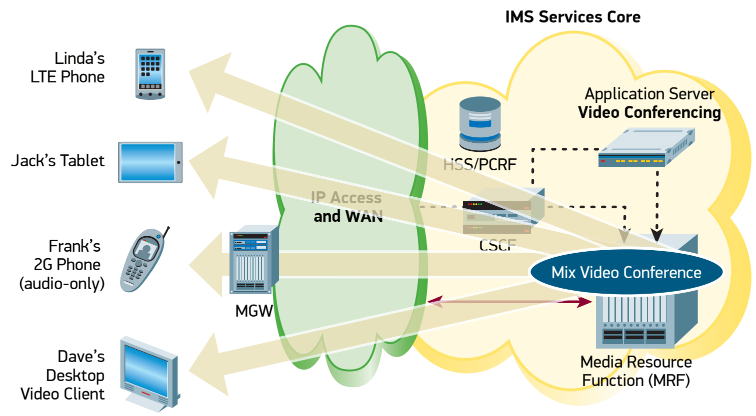

Figure 10. *IMS Delivery of Video Conferencing*

Video Mail

Video mail services add the personalization of video to traditional voicemail functionality. With the forecasted growth in mobile networks, video mail allows users guaranteed completion of their video calls—even when the called party is busy, outside of wireless coverage or unavailable. When a call is diverted to the video mail service, the caller could be greeted by a "celebrity" video message, a talking cartoon avatar, or a personal video clip (Figure 11).

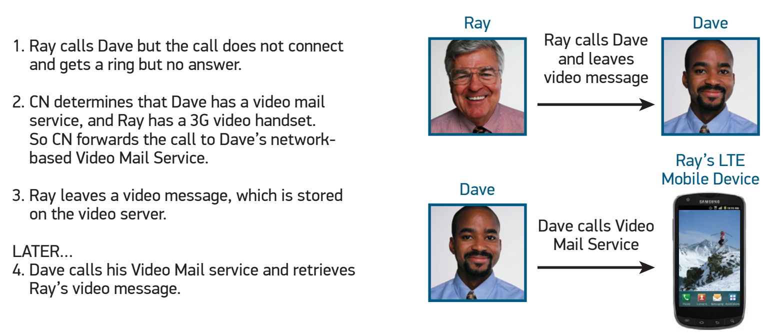

Figure 11. *Video Mail Service Use Case*

This level of personalization appeals to the growing teenage segment of the mobile subscriber base, as seen with the popularity of other personalization services, such as ring tones and ring-back tones. The branding and personalization possibilities around video mail services have industry experts predicting rapid growth and ongoing improvement in the ARPU generated from mobile subscribers.

The ability to seize these market opportunities will again require reliability and scalability of the value-added services components to support the high volume of video mail usage during peak network usage. Many existing video mail service platforms are extensions of voice mail solutions, based upon proprietary hardware and software integrations with limited reliability, scalability, and density. An IMS architecture, using the same MRF shared across many personalized mobile video services, provides the foundation for an economical video mail solution. If a video call can't be completed, the MRF will record and store the video message on the content server. Later, when the recipient checks their messages, the IMS will first check with the HSS on whether the message recipient has a video-enabled phone before delivering the video message; otherwise, the server plays an audio-only message. If transcoding or transrating are required, MRF will handle that as well.

IVVR—Interactive Voice and Video Response

Audio-only Interactive Voice Response (IVR) applications have long been used by service providers to reach vertical markets or enhance customer service interactions. IVVR is the same concept with the added benefit of using video content and prompts, rather then just audio. The result is a richer user experience with various video user interface (Video-UI) capabilities, including video text overlay and automatic speech recognition (ASR), that can be reused across numerous interactive mobile video services.

For example, consider the mobile surveillance application mentioned earlier and depicted in Figure 12. The user can select which home camera location to view—assisted by viewing the overlay text on the video stream—by making a keypad entry or "speaking" a selection. The live video from the selected camera is then streamed across the Internet through the MRF to their handset.

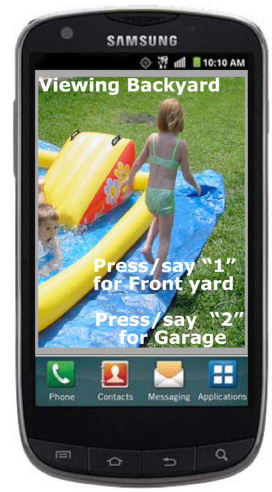

Figure 12. *Example Mobile Surveillance Application using IVVR, Text Overlay, and Automatic Speech Recognition (ASR)*

Mobile Coupons

According to recent data, less than two percent of consumers redeem paper coupons to get discounts on product or service purchases, whereas the mobile coupon redemption rate is closer to the 15 percent range. Product manufacturers are willing to pay distribution revenues to those who text coupons directly to consumers. However, mobile operators are typically left empty handed in the overall revenue stream, despite today's mobile coupon service providers using their networks.

Operators can get in the game by hosting mobile coupon applications, building on the intelligence captured by the IMS regarding subscriber location. By extending the IMS-based IVVR service architecture described above, mobile coupons services position the operator to become the financial broker in a growing ecosystem, rather than giving away the business to third parties supporting an OTT model, such as a downloadable app.

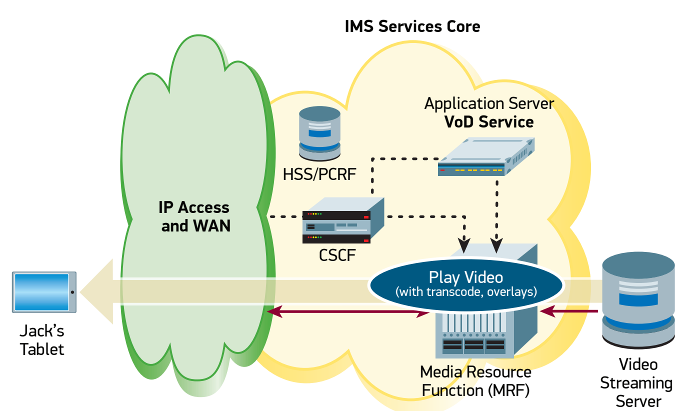

Figure 13. *IMS Delivery of Mobile Video on Demand (VoD)*

Enhanced Video on Demand and Mobile TV

Video on Demand and Mobile TV are widely deployed on today's mobile networks. The one weak spot of these services has been the response time to user inputs: select the video content, select a channel, or allow the user to pause, forward or skip the video stream. With the bandwidth and minimized delay in LTE mobile access networks, IMS components can help alleviate these usability issues in a mobile network.

As seen in Figure 13, an MRF, used in conjunction with the Video on Demand (VoD) application server, responds to commands issued by the VoD subscriber for requesting video content. These commands are captured by the mobile network and then passed back to the AS, which signals the MRF to play the video content.

The MRF sends a new menu selection interface to the subscriber along with the video and audio streams, allowing the subscriber to fast forward, pause or rewind the chosen video on request. These video playback control options are overlaid on the video the subscriber is watching, thus making it convenient to synchronize control while watching the video in real-time.

The following use case highlights how a mobile VoD service works:

- The subscriber invokes the video on demand service, which delivers a default video content category based on user set profile.
- Video is displayed and viewed.
- Before the video ends, the subscriber is given more VoD choices overlaid as text on video screen.
- The subscriber selects new video content using DTMF keys. The DTMF selections are captured by the MRF and relayed back to AS.

For Mobile TV, using IMS components can again noticeably enhance the user experience by providing precise channel changing and other controls using a Video-UI. This technology has a fast response time to user inputs and can significantly improve the customer experience.

Video Advertising

Think of mobile video advertising as the corollary to web based banner ads. Service providers can run brief video ads during various points in any value-added service, and as a result, collect incremental revenue from advertisers. And just like web advertising, ads can be targeted and monitored since demographics information about mobile phone subscribers is known in an IMS. The following use case highlights how a mobile video advertising service could be implemented as part of a video conferencing service:

- The subscriber calls into a video conference but is put on hold while other participants arrive for the conference.
- Instead of listening to music on hold, the conference participants see an advertisement.
- The Video-UI menu lets users select an option to get more information about the product using the DTMF number option displayed on the handset.
- The AS can optionally send a short text message to the phone with special mobile coupon offers and a web URL to the service or product advertised.

These are horizontal capabilities, meaning they can be added to any service call flow where it makes sense.

As part of an operator's growth strategy for mass market adoption, revenues generated from video advertisements could be used to reduce service pricing in order to attract more price-sensitive subscribers.

Creating Revenue Opportunities with Video

In addition to consuming more and more network bandwidth, users are demanding a richer communications experience. OTT players are working hard to address this need, most notably by supporting video calls, conferencing and Internet TV; but these services will always be limited in scope and reach to populations of subscribers using the same OTT service or technology.

Mobile operators deploying 4G/LTE networks have a significant opportunity. Building out the 4G/LTE infrastructure to support broadband data is only the first phase in realizing the broadband data plan revenue opportunity. In addition, operators should take the extra and final step to deploy IMS architectures in order to offer personalized VoLTE and mobile video services. By taking this extra step, operators will generate service revenues with data plan revenues and maximize their ROI on the large 4G/LTE network investments already underway.

Within these IMS deployments is the important need for real-time audio and video media packet processing delivered by the MRF. Radisys is a recognized leader in MRF products and technologies, specifically designed to support a wide range of personalized multimedia mobile services as described in this paper, among many more. These products process the video and voice content for diverse services, while performing transcoding and transrating functions in order to achieve interoperability across various devices and access networks. Radisys, the leading supplier of media processing technologies, offers hardware, software, and cloud media processing solutions for mobile operators seeking to generate revenues from personalized VoLTE and mobile video services.

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