White Paper | September 2009

radisys

Interactive 3G Video Services

Solutions for Mass Market Deployment

Overview

Mobile telecommunications is the growth engine of the telecommunications industry. 3G 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. While the consumption of 1-way video streaming services continues to grow, interactive 2-way video telephony services based on 3G-324M standards present unique operational challenges for economical mass market deployment.

This white paper will outline deployment challenges and solutions for an IP service delivery core architecture designed for mass market deployment of personalized, interactive video telephony services. The paper will highlight how next generation VoIP technology, and its recent evolution to IMS multimedia service architectures, provides the foundation for delivering both scalability and economics for the deployment of a variety of services, including video conferencing, video ring back media, video mail, and interactive voice and video response services.

CONTENTS

Executive Summary

Video usage in both high-speed fixed line and wireless mobile networks has increased dramatically over the last few years. IP network usage projections recently published in a Cisco report (Cisco VNI Forecast: 2008- 2013) help to quantify the growth in video usage underway:

- A six fold Increase in IP network usage between 2007 and 2012 is due mainly to video and social networking.
- Internet video is now approximately one-third of all consumer Internet traffic (not including P2P video file sharing).
- The sum of all forms of video (TV, video on demand, Internet, and P2P) will account for over 91 percent of global consumer Internet traffic by 2013.
- Internet video communications traffic will increase tenfold from 2008 to 2013.

"3G mobile video services offer mobile operators many incremental revenue opportunities as their networks and subscriber bases expand and handsets and other devices continue to improve. The 3G-324M technology has proven to be resilient and adaptable for a wide range of video service offerings in combination with scalable, core mobile network components such as IP Media Servers. Since publishing Wainhouse Research's Personal Mobile Video Communications at the Launchpad in 2006, the market for certain mobile video technologies, particularly streaming, has indeed met and exceeded our expectations."

—Alan Greenberg, Senior Analyst and Partner at Wainhouse Research

WAINHOUSE Research

While Internet video usage is growing incredibly fast, it is the following growth in mobile video usage that is accelerating even faster right behind it. The Cisco report goes on to say that:

- Almost 64 percent of the world's mobile data traffic will be video by 2013.
- Mobile video will grow at a CAGR of 150 percent between 2008 and 2013.

The majority of recent mobile video service growth has been 1-way video streaming services, which often are consumed by mobile users as part of their unlimited data plans. That is why a heightened interest is underway amongst mobile operators to deliver 2-way conversational mobile video services in their 3G networks, in an effort to increase Average Revenue Per User (ARPU), compensating for pricing pressures from their unlimited data and voice plans.

Internet video usage is typically end-to-end IP connectivity from the video content source all the way through to the video capable IP device. But mobile operators do not have to wait for end-to-end IP connectivity in their networks to implement high ARPU 3G Video Services (3GVS). The standards organizations guiding the evolution of 3G networks have recognized this and created a protocol suite standard that enables high quality interactive video services in mobile networks called 3G-324M.

While many 3G packet-based wireless data networking technologies do a great job in delivering 1-way video streaming and Internet services, these technologies come with inherent overhead, higher bit error rates (BER), and routing delays, making it challenging to deliver reliable 2-way interactive services with acceptable quality. 3G-324M, on the other hand, was specifically designed for 2-way mobile video telephony applications on today's 3G cellular mobile networks. And by efficiently utilizing the circuit-switched wireless part of these networks—from handsets to connectivity to the core of the network—3G-324M is able to guarantee a synchronization of media delivery and user inputs for a wide variety of interactive 2-way video services.

This white paper will focus on how mobile operators can deliver high ARPU interactive, conversational video services in their current networks using a combination of 3G-324M technology in the wireless part of their mobile network and IP media servers in the core. This technology pairing ensures a scalable 3GVS architecture that will meet the high demands of these interactive video services as subscriber demand grows. And as 3G mobile operators evolve their networks to an end-to-end, all-IP network infrastructure, we will show how capital investments made in 3GVS delivery components today—3G-324M compatible network elements and IP media servers—will remain intact.

The Market Opportunity

Explosive Growth Forecasted for 3G Mobile Networks

As of the end of 2008, an incredible 4 billion people, or 60% of the world's 6.5 billion people, are mobile phone users! Sustained population growth markets, such as China, India, and Africa account for the fastest growth in the overall mobile subscriber base where fixed line communication alternatives don't always exist. These growth markets, along with a few key developed countries—Japan, Europe, and the United States—are still showing signs of continued mobile subscriber growth in part because their populations are increasing. In markets outside of the U.S. and Europe, people use mobile phones as their primary form of communication which also contributes to subscriber growth. Other regions/countries that are seeing significant mobile subscriber growth include Latin America, the Middle East, Pakistan, and Indonesia (Figure 1).

The ITU World Telecommunication ICT Indicators Database 2008 report also presents a clear shift from fixed to mobile networks and by the end of 2008; there were over three times more mobile cellular subscriptions than fixed telephone lines globally (Figure 2). The ITU reports that two thirds of those are now in the developing world compared with less than half in 2002.

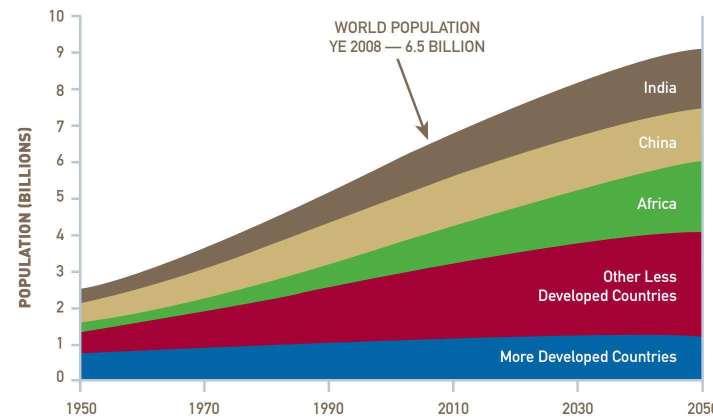

Figure 1. *Source: UN Population Division, World Population Prospects*

Fixed network usage is flat or decreasing. So service providers that have a broad portfolio of fixed and mobile network services are now focusing on the huge growth in mobile networks. Developing nations in particular are avoiding the capital-intensive rollout of fixed line networks and instead focusing on mobile network deployments.

Of the mobile market, the large majority continues to be GSM-based mobile networks, while CDMA networks, make up a smaller 10-15% of the market, but still represent sizable opportunities in North America and Japan.

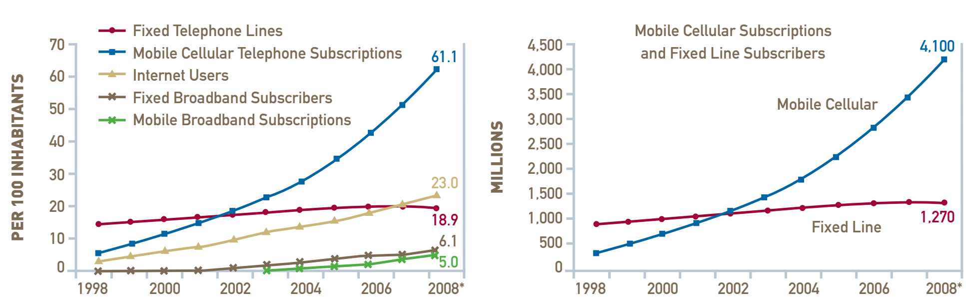

Figure 2. *Global ICT Developments*
*Note: *Estimates | Source: ITU World Telecommunication/ICT Indicators Database*

Taking a closer look at 3G mobile network market data (Figure 3) shows that there were just over 200 million 3G subscribers on WCDMA networks at YE 2008 of the total 4.1 mobile subscribers. This is the current addressable market for 3G-324M services assuming the mobile network and handsets were compatible. The forecasted addressable market grows to over 800 million subscribers by YE 2013, nearly a 4-fold increase in potential 3GVS subscribers.

The HSPA component of the forecast in the chart on the right refers to High-Speed Packet Access (HSPA) protocol that enhances current 3G network data speeds from over 1.8 Mbps in initial deployments to up to 28 Mbps. HSPA is WCDMA-based network technology that is the precursor to LTE cellular radio technology (that will be capable of supporting mobile network data speeds over 100 Mbps).

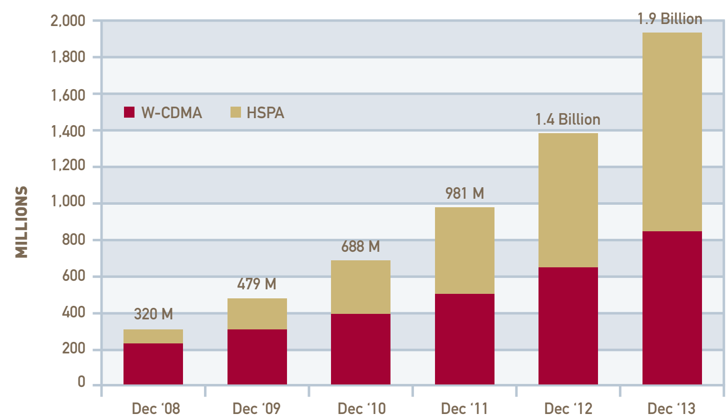

Figure 3. *Global Growth of 3G Subscribers*

Market Drivers

Next Generation Networks

From the technical perspective, the growing deployment of 3G-3.5G 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.

Advanced Handsets

A growing number of new devices support the expanding array of mobile video services. 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.

3G-324M is the current standard of choice for video telephony on 3G handsets. A large and growing number of vendors are launching 3G handsets, and as of March 2007, there are over 450 different WCDMA devices. For wide-scale deployment like this, interoperability is critical to the success of a commercial interactive video service.

ZTE-U981—A 3G mobile device with front-facing camera suitable for many interactive 3G video services

Another important consideration is 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 bitrates. Advanced codecs and standards also offer greater flexibility by being able to work in a wide range of network environments.

Video Service Architectures for Mobile Networks

3G mobile architectures are already doing a great job of streaming Video on Demand (VoD) or YouTube video content to thousands of mobile endpoints. But these types of video services are characterized as 1-way streaming content flows. Some content is Internet-based and accessible through a handset's browser. In the case of VoD services, content may be staged in a mobile operator's network, and is accessed through specially designed, handset accessible portals where content can be browsed and invoked. In both cases video content is served through the mobile network's data channel to the handset, typically requiring the subscriber to sign up for unlimited data plans in order to make accessing this content cost effective.

The scope of video services though also includes "interactive" or personalized communications, such as a 2-way video call, an N-way video conference, a video ring back clip that is personalized for a specific caller, or the ability to select or "interact" with a video content stream. Compared to 1-way video streaming services, interactive services are much more sensitive to delay, packet loss, jitter, bit errors, or audio/video stream synchronization (lip sync).

How does one efficiently deliver real-time interactive video services on a massive and growing scale? The following sections of this chapter will discuss the technology that makes this possible, how it can be deployed today, and how current investments can be maintained as 3G mobile networks evolve.

The 3G-324M Protocol and Standards

Widespread compliance with the 3G-324M standard is a key ingredient in the growth of the 3GVS market. Developed under the auspices of the Third Generation Partnership Project (3GPP), 3G-324M is not just one standardized communications protocol, but is a suite

- ISDN (NARROWBAND TERMINALS)
  H.320 (1990)
- ISDN H.320 LED TO:
  ATM (H.310)(1996)
  PSTN (H.324)(1996)
  LAN, Internet (H.323)(1996)
- PSTN H.324 LED TO MODIFICATION FOR MOBILE COMMUNICATIONS
  H.324 Annex C (1998)
- MOBILE COMMUNICATIONS NETWORK H.324 ANNEX C LED TO 3GPP SERVICES STANDARD
  3G-324M (1999) – 3GPP (WCDMA Standards)
  C.S0042 (2002) – 3G-324M Equivalent – 3GPP2 (CDMA2000 Standards)

Figure 4. *History of Audiovisual Terminal Standards*

of protocols that synchronizes the interaction of voice and video communications in a deterministic fashion between the circuit-switched 3G wireless radio access network and the core network.

The Origins of the 3G-324M Standard

The International Telecommunications Union (ITU) was the standards body that created a standard in the 1990s called ITU-T H.324. This protocol found it's way into devices that were then referred to as videophones. Videophones were designed to work point-to-point on regular analog phone lines (DS0s). They typically had a built-in V.34 modem (up to 33 Kbps) for transmission over the PSTN, the H.263 codec for video encoding and G.723.1 for audio. Many videophones were introduced to the market but they never reached mass market consumer appeal (Figure 4).

H.323 is another ITU-T protocol standard that supported many of the same audio and video codecs as H.324, but was specified to connect communicating endpoints via an IP connection. In the late 1990s, routers that implemented this protocol were used as the first VoIP gateways. Point-to-point router networks were set up between international countries to provide low-cost voice calling. Only the voice codecs where used in this application of H.323, but the originating caller—the subscriber—was able to arbitrage expensive international voice calls.

The 3GPP organization was able to leverage all of this legacy application experience when implementing the 3G-324M protocol suite for 3G mobile networks. The 3G-324M standard is essentially a derivative of ITU's H.324, which was developed for the PSTN. This provided the foundation as a proven technology platform for implementing 3GVS mobile networks.

The 3G-324M Protocol Suite

The 3G-324M protocol suite provides for multiplexing of audio, video, and H.245 signaling on a 64 Kbps circuit-switched connection. Along with the compression efficiencies inherent in codec technology today, this minimal bandwidth can deliver multiplexed audio, video, and control information over the same channel while delivering a quality, interactive video experience for the user.

Figure 5 shows the key 3G mobile network components in the 3G-324M protocol path. The circuit-switched path to the left of the Media Gateway is the 3G-324M protocol path connecting all the way out to a 3G-324M compatible handset. The media gateway interfaces to the IP media server and converts to/from the 3G-324M connections to RTP audio and video streams. All the interfaces to the right of the media gateway are IP connections. A 3G-324M protocol stack runs on both the media gateway and the handset.

The 3G-324M protocol also includes a specification for sending dual-tone multi-frequency (DTMF) style information from the handset. For mobile TV, these key presses can be used to change selections; control pause, fast forward, and rewind; as well as to provide interactive services, such as televoting. Latencies over the circuit-switched channel connection are kept to a minimum, so the reaction to a user's input typically will be seen in a few hundred milliseconds.

H.223

The key functions of the H.223 protocol include:

- Interleaving video, audio, data, and control streams into a combined bit stream.
- Dynamic allocation of bandwidth within a single 64 Kbps channel amongst the individual streams.
- Error detection and correction. H.223 was enhanced from its role as part of the H.324 protocol to correct against higher error rates in a wireless network that didn't occur on a V.34 modem.

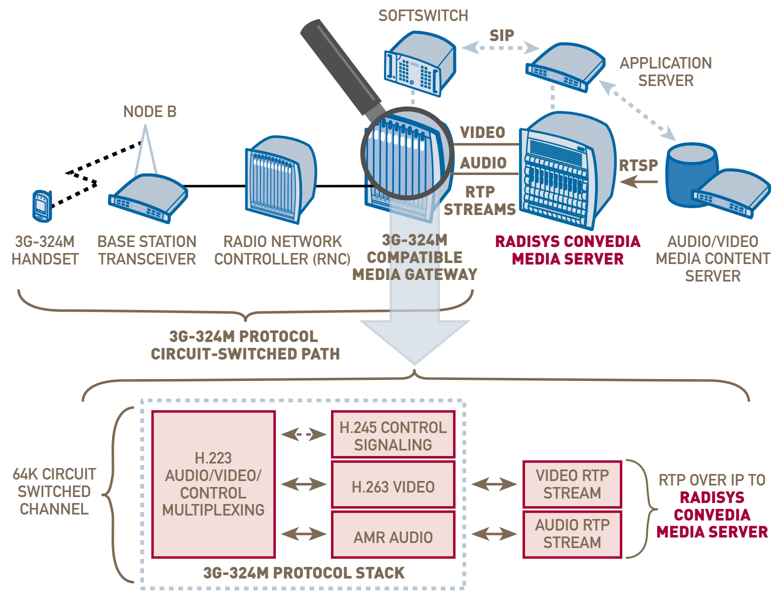

Figure 5. *The 3G-324M Protocol Stack*

H.245

3G-324M uses H.245 as a terminal control protocol and performs the following key functions:

- Master-slave determination is provided to determine which terminal is the master at the beginning of the session.
- Capability exchange is provided to exchange terminal capabilities, such as optional modes of multiplexing, type of audio/video codecs, data sharing mode and its related parameters, and/or other additional optional features.
- Logical channel signaling is provided to open/close the logical channels for media transmission.
- Round-trip delay measurement is provided to enable accurate quality characteristic measurement.

Voice Channel—The AMR Codec

The 3G-324M specifications define the Adaptive Multi-Rate (AMR) codec as mandatory, but also included the use of G.723.1. The AMR codec was originally developed and standardized by ETSI for GSM cellular systems. Optimized for mobile networks, it dynamically adjusts the amount of bits allocated to voice coding and error control, providing the best possible voice quality based on radio conditions.

The Video Channel

The 3G-324M standard specifies the H.263 codec as mandatory, with MPEG-4 as a recommended codec for video processing. H.263 is a legacy codec that is used by many existing H.323 wireline devices. However, MPEG-4 is the 3G-324M used by most vendors. Resiliency and high efficiency make MPEG-4 codec particularly well suited for 3G-324M. MPEG-4 is much more flexible and offers advanced error detection and correction services, which is beneficial when delivering video over a wireless network.

3G-324M Usage in Current 3G Networks

Today, IP packet networking technology in the core of a mobile network is quite common to handle network signaling and data specific services. However, true end-to-end IP connectivity that reaches out from the core across the wireless radio network to an IP-enabled mobile handset is still quite rare in today's networks, even in 3G UMTS and CDMA2000 networks.

The figure below—showing a simplified representation of a 3GPP Release 99 architecture—divides 3G mobile networks into three functional areas—the Radio Access Network (RAN), Core Network (CN), and a private IP network.

Starting on the left side in Figure 6, the RAN is essentially the "wireless" part of the mobile network. These components are dispersed geographically to provide radio network coverage for subscribers using mobile handsets. Although the CN has some packet data paths (for Internet access or SMS services), the CN is still primarily a circuit-switched domain with the Mobile Switch Controller (MSC) and Home Location Register (HLR) representing the heart of call processing in the network. These components handle voice calls, identify subscribers with the services they have signed up for, manage roaming, and provide connectivity to the PSTN off-network calls. For example, if an inbound call is requesting a video conferencing service, then the CN would hand-off the call to the private IP network where video-specific service processing is performed.

The private IP network is where the 3G-324M service elements are located and integrate with the CN. 3GVS primary elements include:

- Softswitch, which orchestrates video service requests.
- A 3G-324M compatible Media Gateway.

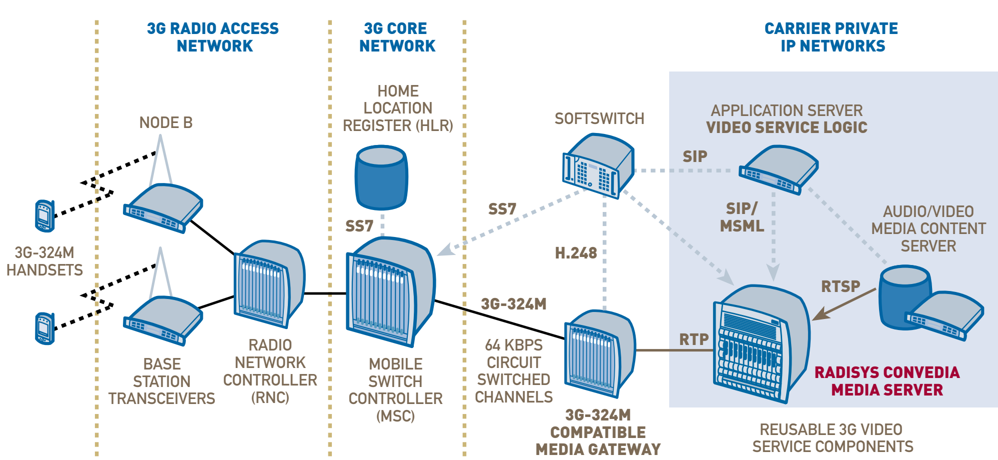

Figure 6. *3G-324M Environment integrated with IP-based 3G Video Service Components*[1]
[1]Simplified interpretation of 3GPP Release 99 architecture.

- The Application Server that runs the video service application (service logic). A Content Server for staging audio/video content inside the mobile operator's network.
- The IP Media Server that interfaces and coordinates with all of these elements bring the IP video (and audio) packet processing under the control of the Application Server onto the mobile network.

In the network topology shown above, the 3G-324M compatible Media Gateway is a dedicated network element used to convert between 3G-324M video circuits in the radio access network, and IP-based media and signaling streams for 3GVS IP components.

3G-324M Services and 3G Network Evolution Towards IMS

3GPP has defined a series of release architecture specifications since Release 99. The figure below depicts incorporating the first phase of the IP Multimedia Subsystem (IMS) components in 3G Release 5 mobile networks. This step essentially ratifies the role of the 3GVS elements as the approach to deploying value added service. This allows for re-use of the IP Media Server—now called the Media Resource Function (MRF) for other value added services as well (Figure 7).

Changes to note since Release 99 include:

- The MSC is now decomposed into the Circuit-Switched Media Gateway (CS-MGW) and Mobile Switching Center (MSC) Server. The HLR is now replaced by a Home Subscriber Server (HSS). The 3GPP introduction of these elements is another ratification of using NGN network elements to build out the mobile CN.
- The 3G-324M Media Gateway dedicated to 3GVS is not shown here since the CS-MGW can now support and convert 3G-324M video to RTP media streams. This eliminates additional TDM backhaul circuits that were needed before to connect the all-in-one MSC to the 3G-324M Media Gateway. The CS-MGW can now connect directly to the MRF saving incremental capital expenses to deploy 3GVS.

Going back to the Release 99 network Figure 7, you can see that the 3GVS components deployed in the Release 99 architecture are still relevant in the Release 5 environment, as shown by the shaded network components in both figures. So to maximize the value of any 3GVS infrastructure investments today, it is necessary that these components all speak the same interoperability language.

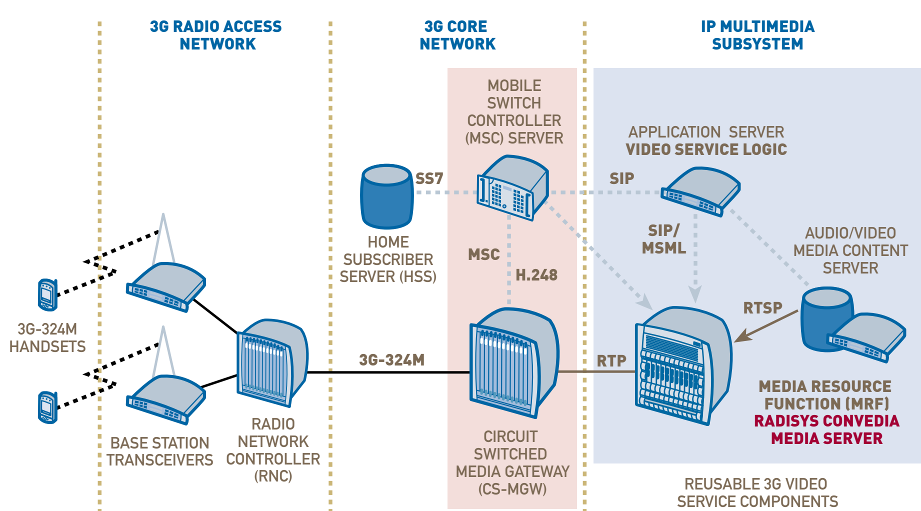

Figure 7. *3GPP Release 5 3G-324M Video Environment*

The key interoperability protocols include:

- For the Application Server interface with the…
  - MRF—SIP/MSML or VoiceXML
  - MSC Server and Content Server—SIP
- For the IP Media Server with the…
  - Softswitch and Application Server—SIP
  - 3G-324M compatible Media Gateway—RTP
  - Content Server—RTSP

This standard protocol compliance insures that 3GVS components can operate in both Pre-IMS and IMS 3G mobile networks as the 3GPP release architectures evolve.

Mobile Video Beyond 3G

The future of mobile video networks is based on an end-to-end IP services architecture often referred to as 4G. The CN (called the Evolved Packet Core Network by 3GPP) will rely more heavily on a decomposed architecture of function-specific IP components, while supporting IPv6-compliant 4G handsets. But it will also support backward compatibility with 3G RANs and handsets just as early 3G networks supported 2G handsets. This insures that the same 3GVS applications and service delivery elements will work in this future network topology as well (Figure 8).

The LTE Packet RAN will finally support IP data, voice, and signalling path all the way out to the 4G handset with QoS needed to handle both basic as well as realtime, interactive value-added services such as 3GVS. In this radio environment, the 3G-324M protocol would no longer be needed.

Even though the services will change in the 4G environment since the call logic and signalling will vary using the new CN components, the underlying requirements for MRF functionality and interoperability will not change substantially. These services will continue to share many common characteristics, 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 bridging audio/video streams together into a conference mix.

The future of mobile network technology is just before us but one thing is clear, the investment made in

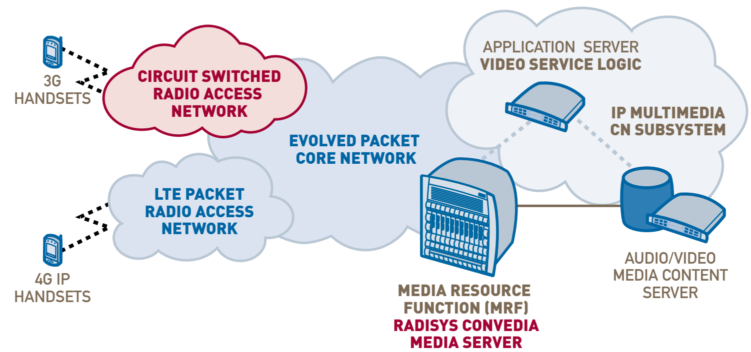

Figure 8. *3GPP Moving Towards End-to-End IP*

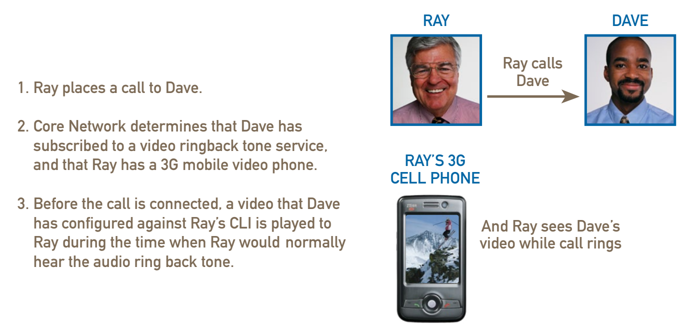

Figure 9. *Video Ring Back Media Service Use Case*

3GVS service delivery components today—the MRF, Application Server, and multimedia content—will be monetized long into the future as circuit-switched technologies gradually fade from mobile wireless access networks.

3G Mobile Video Service Examples

Video Ring Back Media Service

Ring back tones are the audio sounds heard by a caller while they wait for their connection to a called party to be completed. Traditionally, ring back tones were fixed by the service provider and consisted of uninteresting ringing or beeping sounds. Today, personalized ring back tone services, also known as Color Ring Back Tone (CRBT) services in some countries, allow subscribers to select the ring back sounds heard by their callers, giving them an innovative way to differentiate and express themselves to their friends and business contacts through favorite song clips or sounds (Figure 9).

A video ring back media service prescribes to the same usage model with mobile subscribers either purchasing video ring back content from their mobile operator or creating their own video ring back media. Through a service provider portal that is accessible via their handset or on the web using a computer, mobile subscribers can select from various video or audio content organized by categories. Personalizing service settings can enable the subscriber to specify different content based upon who is calling them as determined by the caller's number. For instance a short vacation video could be configured by the mobile subscriber to be used when any one number in a group of numbers identified as "family members" calls. Just like audio ring back tones, personalized ring back media services are a logical form of self-expression.

For mobile operators, this is a 3GVS that can be used to increase ARPU and deliver a quality network-based service that helps to minimize subscriber churn.

Figure 10 shows the 3G mobile network components needed to implement a video ring back service. The Application Server runs the video ring back service application. A mobile subscriber would either record a video using their handset or upload a favorite video using the service's self-service portal that would be staged in the mobile operator's network. When a caller using a 3G-324M handset calls the subscriber's handset, they are able to see the video until the call is either connected to the called party or is answered by voice mail.

The Application Server runs the service logic and instructs the Radisys Convedia Media Server how and when to manage the RTP audio and video streams that are streamed from the content server to the Media Server via the RTSP protocol.

Video Conferencing Service

Radisys Convedia Media Servers support two modes of mobile video conferencing. Continuous presence video conferencing is a mode where video streams from multiple video conference participants are rendered on a single screen. Unfortunately, with the limited screen size on most mobile devices, the individual video streams on a multi-pane display makes this mode somewhat impractical for mobile video conferencing applications.

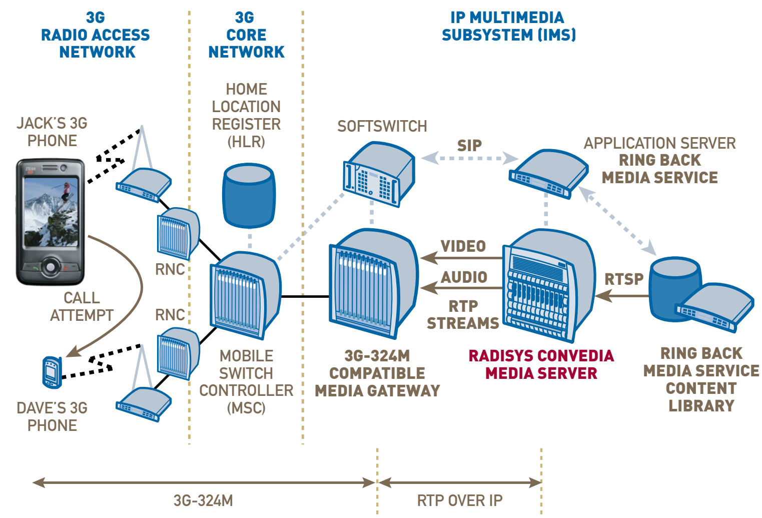

Figure 10. *Video Ring Back Media Service in 3G Network*

Figure 11. *3G Mobile Video Conference Subscriber Use Case*

A better approach is Voice-Activated Switching (VAS) that bridges multiple participants into a video conference, where everyone would see an identical real-time video stream of the active speaker (Figure 11). The addition of text-overlay allows the name of the participant to also be displayed at the bottom of the participants' video stream. Audio-only participants could also be added into the same conference mix. As the active speaker changes, the media server "switches" from one video-enabled participant to another.

In order to offer a 3G video conferencing service, the mobile operator will require a subscriber base where the mobile devices have a video camera and screen pointing the same direction (i.e. if you are looking at your screen, then the camera needs to be pointing at you).

The 3GVS network components used in this video conferencing service model can also be utilized in one-to-many video sharing applications, such as a subscriber sharing their live music concert experience with their friends. The service logic on the Application Server could then support both a mobile video conferencing and video sharing service (Figure 12).

Identification of the active speaker in an audio conference has always presented it's challenges to the mobile user, but the addition of video helps to create an environment where the participants on the call can easily determine who is the active speaker. This can enhance the conferencing experience and bring minutes of use to mobile operators that would have gone to off-network fixed-line conferencing service alternatives.

Video Mail

Video mail services add the personalization of video to traditional voicemail functionality. With the forecasted growth in 3G networks, video mail allows 3G users guaranteed completion of their video calls—even when the called party is busy, outside of 3G coverage, or unavailable. When a call is diverted to the video mail service, the caller can be greeted by a personal video clip, a "celebrity" video message, or a talking cartoon character. This level of personalization appeals to the growing teenage segment of the mobile subscriber base, as we've seen with the popularity of other personalization services such as ringtones 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 3G mobile subscribers (Figure 13).

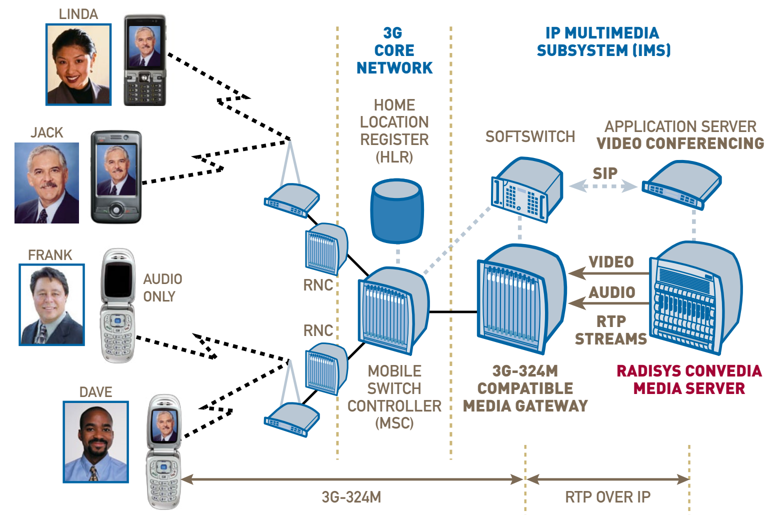

Figure 12. *Video Conferencing in 3G Mobile Network*

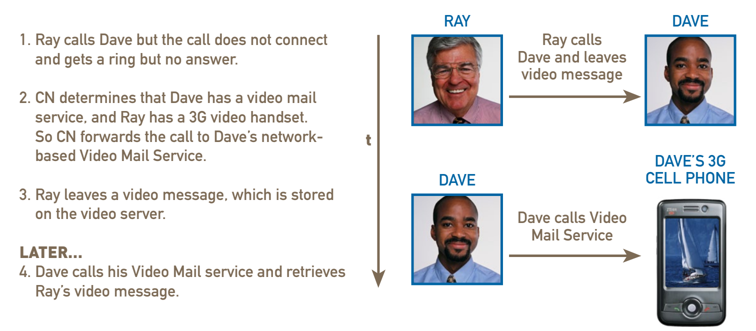

Figure 13. *Video Mail Service Use Case*

The ability to seize these market opportunities will again require reliability and scalability of the 3GVS components to support the high volume of video mail usage during peak 3G network usage. Many existing video mail service platforms are extensions of voice mail solutions that are based upon proprietary hardware and software integrations that have limited reliability, scalability, and density. The Radisys Convedia Media Server at the core of the 3GVS video mail solution is a standards-based approach, using purpose-built hardware designed for carrier-class video processing, and is essential to achieving the economics for a robust video voice mail solution (Figure 14).

For video mail originating to or from the 3G-324M mobile handsets, all of the 3GVS components from earlier service examples are reused again. In this application, the Radisys Convedia Media Server uses NFS, as this protocol supports both recording of incoming RTP video mail streams as a video message on the video mail server, as well as later retrieval of the messages for RTP streaming to the called party's 3G-324M device. The Video Mail Server would also support the industry-standard IMAP4 protocol, so that 3rd party mail application servers can also retrieve/deposit video messages, delivering the ability for subscribers to manage their video mail content using both a 3G mobile handset and/or conventional PC-based email applications.

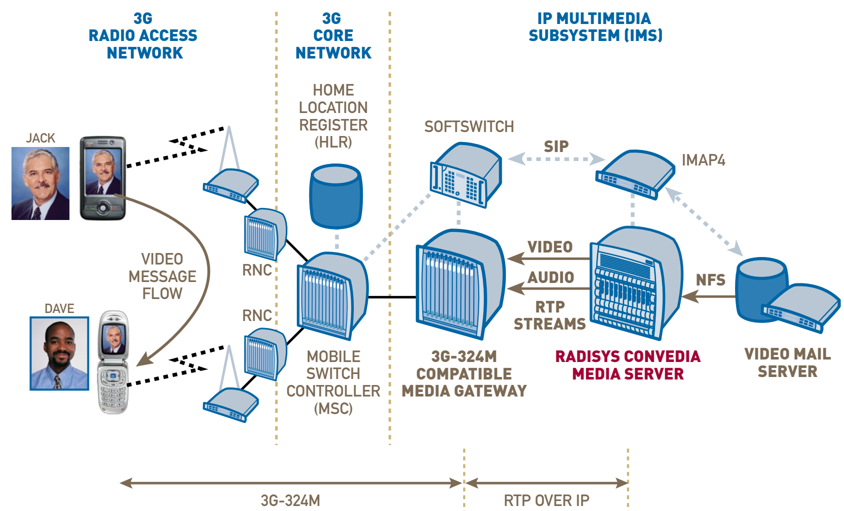

Figure 14. *Video Mail Service in 3G Mobile Network*

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 3G video services.

For example, consider a mobile surveillance application as outlined below. The mobile surveillance service subscriber will see a series of camera location options displayed in text over the video allowing control of the surveillance application. When a user makes a keypad entry to select a new camera location or "speaks" a selection, the live video is then sourced from the selected camera at the subscriber's home, and then streamed across the Internet through the Media Server to their handset.

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

IVVR is a horizontal application technology that can be applied to many different revenue generating services, for improving legacy service efficiencies or cost cutting applications including:

- Customer service applications
- Multi-media service demos with up-sell to live agentsSponsoring televoting spots for mobile accessed TV shows
- Control surveillance service cameras
- Used for Video-UI across all 3GVS where needed
- Content portal controls

IVVR technology is also attractive to application developers since they can more easily reach a broader mobile user base. Instead of developing handset-specific applets or custom mobile websites, developers can build IVVR applications that fit the 3G-324M 3GVS technology model, avoiding the product development costs they would incur to support all of the diverse handset environments that are available even from a single service provider. This allows them to focus on utilizing the 3GVS core elements to deliver IVVR services using many different handsets over a larger customer audience.

Also IVVR application developers can service many different vertical markets including:

- Mobile banking
- Mobile investment services
- Contact centers
- Airline & hotel reservation systems

Mobile operators can either have these application developers write applications for large enterprises in these vertical markets, or build out a these applications in house to serve this market directly and create new revenue streams.

Because Radisys Convedia Servers support the MRCP protocol that is used to access speech recognition servers, it can also be deployed to support IVVR applications that overlay speech over video applications. VoiceXML service logic running on the application server can utilize VoiceXML in the Media Server to support multi-modal IVVR applications.

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 that either select the video content, select a channel, or allow the user to skip forward and pause the video stream. 3GVS components in combination with a 3G-324M environment can help alleviate these usability issues in a mobile network.

As seen in Figure 15, the Radisys Convedia Media Server in conjunction with the Application Server will respond to commands issued by the VoD subscriber

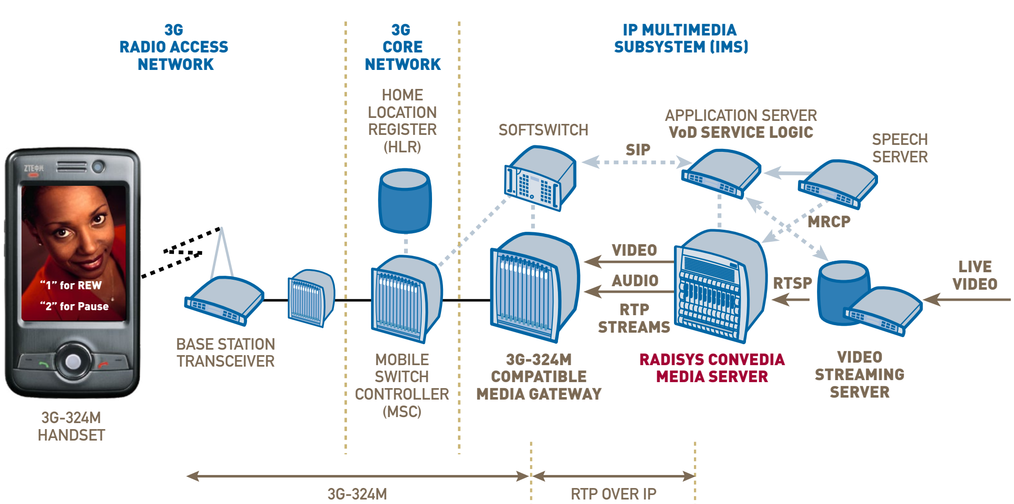

Figure 15. *Video on Demand (VoD) Service in 3G Mobile Network*

for requesting video content. These commands are captured by the mobile network and then passed back to the Application Server. The Application Server then signals the MRF that a new video is to be played. 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 that the subscriber is watching thus making it convenient for them to synchronize control while watching the video in real-time.

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

1. The subscriber invokes video on demand service delivering default video content category based on user set profile.

2. Video is displayed and viewed.

3. Before end of video the subscriber is given more VoD choices overlaid as text on video screen.

4. Subscriber selects new video content using DTMF keys. The DTMF selections are captured by the Media Server, and relayed back to Application Server.

For Mobile TV, using 3GVS components can again significantly enhance the user experience by providing precise channel changing and other controls using a Video-UI. By using this technology, users will experience a faster response time to their inputs that can ultimately help to reduce subscriber churn and increase subscriber ARPU.

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 3GVS. This can generate an incremental revenue stream on payments made by advertisers. And just like web advertising, ads can be targeted and monitored as to who is choosing them to select more info about a product.

The following use case highlights how a mobile Video Advertising service could be implemented as part of a Video Conferencing service:

1. The subscriber calls into a video conference but is put on hold while other participants arrive for the conference.

2. Instead of listening to music on hold the conference participant can see an ad.

3. Using a Video-UI menu the use can select an option to get more information about the product using the DTMF number option displayed on the handset.

4. The Application Server can optionally send a short text message to the phone with special offers and a web URL to the service or product advertised.

Again, this capability is a horizontal 3GVS capability that could be added to any service call flow where it makes sense.

Revenues generated from video advertisements might be used to subsidize the overall service cost structure, which could allow the operator to lower service pricing to attract additional price-sensitive subscribers as another 3GVS growth strategy for mass market adoption.

Summary

While fixed network growth has remained relatively flat, Mobile network deployments continue to grow around the world. Of the 6.5Bn people on the planet, 4.1Bn already are mobile phone users, of which 400Mn (or about 10%) are connected using broadband 3G mobile technology.

Packet-based data services associated with 3G mobile networks provide the foundation for many of the 1-way video streaming services that 3G mobile users are already consuming at a voracious rate. However, performing 2-way interactive video services using today's packet-based 3G radio technology can be problematic due to delay, packet loss, jitter, bit errors, or audio/video stream synchronization (lip sync) in a mobile radio network.

The industry solution is the widespread compliance with 3G-324M, a proven circuit-based solution for video telephony services specifically designed for mobile network environments. 3G-324M comes from a long history of audio-visual industry standards, and is commonly supported in most 3G WCDMA networks.

While 3G-324M provides a standards-based technical solution for the radio access network, achieving scale economies requires consideration of the entire service delivery path into the core service delivery architecture. This white paper outlined additional considerations for the scalable mass market deployment of interactive 3G video services including:

A Video-enabled mobile control network, including the MSC and HLR/HSS being aware of which subscribers have 3G-324M enabled devices, what services each subscriber has signed up for, and where to "hand-off" an interactive 3G video service request for processing by specialized video application servers in the service delivery architecture.

- *IP-based service delivery architectures,* that immediately achieve cost efficiencies of processing video media in the IP domain, as opposed to traditional circuit-based video processing equipment.
- *Video-enabled handsets* which support front-facing cameras required for video conferencing, in addition to back-facing cameras commonly available today for video content creation of streaming applications.
- *Video service platforms* that are specifically designed to be shared and reused across many video services and call flow scenarios.
- *Standards-based service delivery architectures and interfaces* that can provide scalability and economics today in early generation 3GPP architectures, but provides a clear migration path to IP Multimedia Subsystems in the near future.

In the video service examples chapter, this white paper overviewed just a sample of the many interactive mobile video services that are enabled with the 3GVS architecture described in this white paper. However, a key take-away is that all these services (and many more) are enabled with the exact same IP-based video services infrastructure. It is the processing of interactive 3G video services in an IP environment, and then reusing and sharing the Radisys Convedia Media Server across this plethora of applications, that delivers the cost efficiencies and scale economics for the mass market deployment of interactive 3G video services.

Glossary

3GPP: Third Generation Partnership Project
3GPP2: 3rd Generation Partnership Project 2
3GVS: 3G Video Services
AMR: Adaptive Multi-Rate
ARPU: Average Revenue Per User
ARPU: Average Revenue Per User
ASR: Automatic Speech Recognition
ATM: Asynchronous Transfer Mode
BER: Bit Error Rate
CAGR: Compound Annual Growth Rate
CDMA: Code Division Multiple Access
CN: Core Network
DTMF: Dual-Tone Multi-Frequency
ETSI: European Telecommunications Standards Institute
GSM: Global System for Mobile communications
HLR: Home Location Register
HSDPA: High-Speed Downlink Packet Access
HSPA: High-Speed Packet Access
ICT: Information and Communications Technology
IMAP4: Internet Message Access Protocol
IMS: IP Multimedia Subsystems
ITU: International Telecommunications Union
IVR: Interactive Voice Response
IVVR: Interactive Voice and Video Response
Kbps: Kilobit per sec
LAN: Local Area Network
LTE: Long Term Evolution
Mbps: Megabit per second
MPEG: Moving Picture Experts Group
MRCP: Media Resource Control Protocol
MRF: Media Resource Function
MSC: Mobile Switch Controller or Mobile Switching Center
MSML: Media Server Markup Language
NGN: Next Generation Network
OLED: Organic Light Emitting Diode
P2P: Peer-to-peer
PSTN: Public Switched Telephone Network
QoS: Quality of Service
QVGA: Quarter Video Graphics Array
RAN: Radio Access Network
RTP: Real Time Protocol
RTSP: Real Time Streaming Protocol
SIP: Session Initiation Protocol
SMS: Short Message Service
TDM: Time Division Multiplexing
UMTS: Universal Mobile Telecommunications System
VaS: Voice Activated Switching
VGA: Video Graphics Array
Video-UI: Video User Interface
VNI: Visual Networking Index
VoD: Video on Demand
VoIP: Voice over IP
WCDMA: Wideband Code Division Multiple Access

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