

White Paper

Bringing Video to the Mobile Handheld Market

Background, Challenges,
and Potential

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White Paper

Executive Summary

This white paper presents useful background on the evolution of the mobile wireless network, discusses some of the challenges to be overcome to make video to the mobile handheld practical, and presents some example use scenarios highlighting the potential for video to the mobile handheld market.

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Introduction

A tremendous amount of hype surrounds video in the mobile communications market. From an entertainment perspective, mobile video services are gaining in popularity in the Asia-Pacific region, and new potential business applications are in the news on a regular basis. Figure 1 illustrates the growth in mobile video services. Companies like Apple have launched movie video services that allow users to download content to their iPod or iPhone. As the demand for content increases, the means of accessing it is increasingly challenged and could be problematic for the mobile community.

This white paper presents a brief background on the evolution of the mobile wireless network, discusses some of the challenges to be overcome to make video to the mobile handheld practical, not only as a source of entertainment but also as an enhanced collaborative business-communication tool, and presents some scenarios on the potential for video to the mobile handheld market.

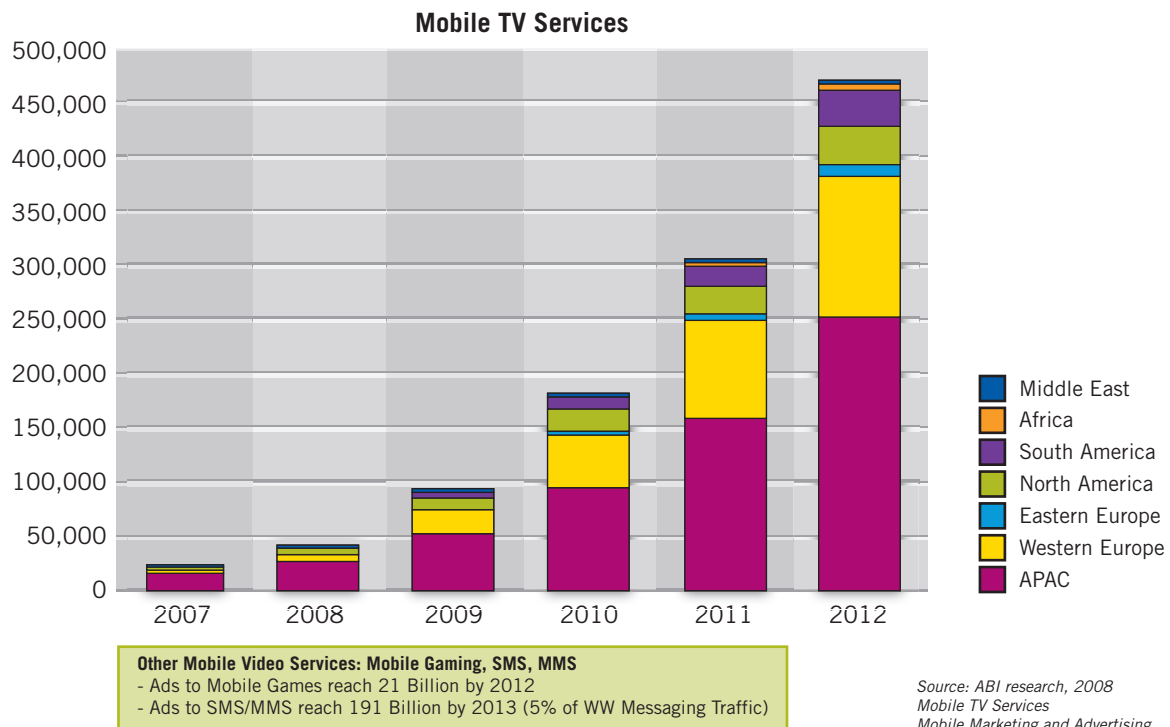


Figure 1. Video Content Explosion [Edwards]

Background on the Evolution of the Mobile Wireless Network

In order to fully appreciate the challenges and future feasibility of providing sufficient bandwidth to the mobile handheld to play (and record) video, this section reviews recent wireless evolutions, provides an example how one of the network standards is widely deployed in European networks today, and discusses how the current 3G standard is pressing forward with an all-IP network solution that could replace the current topologies.

2G, 3G, and 4G Networks

The 3G wireless network is defined by the Third Generation Partnership Project (3GPP). The main objective of the 3GPP was to build a network that used standard methodologies — as opposed to the many standards used in the 2G networks, such as TDMA, GSM, CDMA, and GPRS, with each being an improvement on the other — and thus solve a number of deficiencies within the existing wireless networks (2G/2.5G/2.75G). The deficiencies of the 2G series of networks, for the most part, involve the ability to enable new services. The 3G network was developed partly to address the carriers' need for new services such as worldwide roaming, multimedia services, and high-speed data connectivity.

One of the notable challenges to enabling new services is the amount of data throughput capacity the network could provide. Initial systems supported only about 14.4 kbps per user, but several advancements have allowed the provider to expand this capability to increase bandwidth to the user (for example, new services such as data access).

One such advancement, the Global System for Mobile communications (GSM), was introduced as a voice service with enhanced roaming capabilities. The GSM radio service is commonly known as 2G. Then, as an enhancement to the standard 2G capability, the General Packet Radio Service (GPRS) was added to increase data throughput, providing rates from 56 kbps up to 114 kbps per user. The next enhancement to the GSM infrastructure came with the Enhanced Data rates for GSM Evolution (EDGE) service, which became known in some circles as the 2.75G network. The nominal performance for EDGE is in the neighborhood of 384 kbps per user.

The 3G evolution in terms of larger data bandwidths includes the North American 1x EvDO data access technology, and in Europe it includes the High Speed Packet Access (HSPA) data access technology. HSPA is further sub-divided into HSDPA and HSUPA for the “downlink” and “uplink” variations. This is important to note, because most data access technologies are asymmetrical, providing much greater downlink capability than uplink capability. These new data technologies will allow downlink speeds in excess of 3 Mbps, which is necessary for multimedia access, as discussed in the *Bandwidth and the Wireless Network Evolution* section.

The 4G network, often referred to as Long Term Evolution (LTE), boasts data rates upwards of 30 Mbps. While many countries are busy swapping in fiber links to route data within the Radio Access Network (RAN), the 2G and 3G networks are still largely dependant on existing circuit-switched DS1 level trunks to link the thousands of radio base stations that allow users to access the network. Methods have been devised that streamline the protocols used on these DS1 links (such as 3G-324M), but they remain a bottleneck in the overall bandwidth capacity of the RAN. One of the promises of the LTE is that the RAN would be pure IP, from the handheld through the base station and back to the core network. This would mean the existing circuit-switched data backhaul network of aggregated trunk lines in a SONET payload would have to be replaced with IP protocols, but doing this could streamline performance and expand the bandwidth of the data access network.

WLAN

In addition to the 3G/4G initiatives, the advent of Wireless Local Area Networks (WLAN) based on the IEEE 802.11 and 802.16 standards is seen as an alternative technology. These technologies have access rates from 10 Mbps to 40 Mbps, but are not well suited to high-speed mobility. The advantage of the 802-series technologies is that they do not have a legacy network to cope with. For 3G and 4G, a massive 2G network is already deployed with which the 3G and 4G networks must integrate.

WiMAX

Little difference exists between the 3G and Worldwide Interoperability for Microwave Access (WiMAX) solution requirements in terms of size, environment, and deployment scenario; however, several things make the WiMAX solution different:

1. WiMAX has no mandate to support toll quality voice traffic. This assumes that Voice over Internet Protocol (VoIP) will be used for voice traffic, which in turn leads to stringent latency requirements.
2. WiMAX can support more RF bandwidth at higher carrier frequencies. This complicates the RF sector and adds to cost; however, the return is much higher data throughputs than 3G.

3. WiMAX does not have “legacy” architecture in that it is an entirely new network, based purely on IP. This leads to a more complex Media Access Control (MAC) functionality because no Radio Network Controller (RNC) is used to manage these functions; but overall the network is simpler and the protocol overhead is easier to manage. The need for legacy DS1 links can also be eliminated.
4. Mobility in WiMAX is still not well understood and could end up causing complexity and cost when doing future roll-outs.

Example of 2.5G Architecture in UMTS Networks

Figure 2 is an example of a 2.5G architecture widely deployed in European Universal Mobile Telecommunications System (UMTS) networks (3G includes this standard), which is a common name in Europe for IMT-2000 and the official standard maintained by the International Telecommunications Union (ITU).

The major Network Elements are:

- **User equipment** — Cell phone, laptop, etc.
- **Node B** — Terminates the radio interface
- **RNC** — Implements the MAC layer of the 3G wireless network, collects the traffic from multiple Node Bs, and handles the mobility and access to the network
- **SGSN** — Collects the traffic from various RNCs and handles the mobility between them, as well as handling access to the Home Location Register (HLR) for data calls
- **GGSN** — Serves as an IP gateway for the data connectivity to the IP core network
- **MSC/G-MSC** — Establishes the Voice Network (PSTN) interface (also accesses the HLR for voice calls)

The uplink and downlink of information must traverse several hierarchies of equipment to reach the desired network. In the upper layers, circuit-switched data takes one path and packet-switched data takes another. Cellular handoff is managed by the RNC and SGSN functionalities, and roaming is handled by the SGSN and GGSN functions in cooperation with HLR (billing). Much of the network complexity is the result of previous infrastructure (all circuit-switched and ATM) upon which the newer 2.5G services were grafted.

User equipment broadcasts signals across the RAN. The RAN is often depicted as a set of adjacent hexagons (called “cells”) that form an overlapping matrix within which users can travel and never lose the connectivity of their voice or data session. Cells consist of a radio tower and its coverage area. Some cells can be quite large and others quite small. Thus, the terms macro, micro, pico, and now femto are used to describe the relative size of the cells.

The user equipment accesses the Node B via the Uu reference point. The Uu interface is the wireless connection between the user equipment and the radio tower, which is a set of antennas that transmits and receives the radio signal between the Node B equipment and the user equipment (see the *Radio Tower Cell Site* section).

The Node B equipment is responsible for translating the user flow between the digital and analog (radio) domains. The Node B must also interface to the RNC via the “Iub” interface. This interface is typically a mix of DS1s connecting into a SONET ring hierarchy between the RNC and the Node Bs, which functions as a Metropolitan Area Network (MAN). Flows are extracted from or added to the SONET ring via an Add-Drop MUX (ADM). This topology allows multiple RNCs to access multiple Node Bs, thus forming a highly resilient network.

RNCs communicate with each other via the same MAN used to access the Node Bs. This interface is known as the “Iur” interface, and is used for call hand-offs as the mobile user moves between adjacent Node Bs. The RNC must do a significant amount of processing of the incoming flows in order to properly manage the mobility of users across the RAN.

The “Iu” interface separates the UTRAN part from the Core Network part of the wireless infrastructure. This allows the two parts of the infrastructure to evolve independently. There are two interfaces within the Iu: “Iu-CS” (Circuit-Switched) and “Iu-PS” (Packet-Switched), which lie between the UTRAN and the Core Network (CN).

The RNC routes voice and data differently to and from the CN. This is partly an artifact of the migration from 2G networks. Most 2G networks originally only provided voice services. To add data services, the carriers use voice channels for both voice and data. GSM services eventually added the GPRS and EDGE, which provided a means to route data traffic to the CN IP backbone.

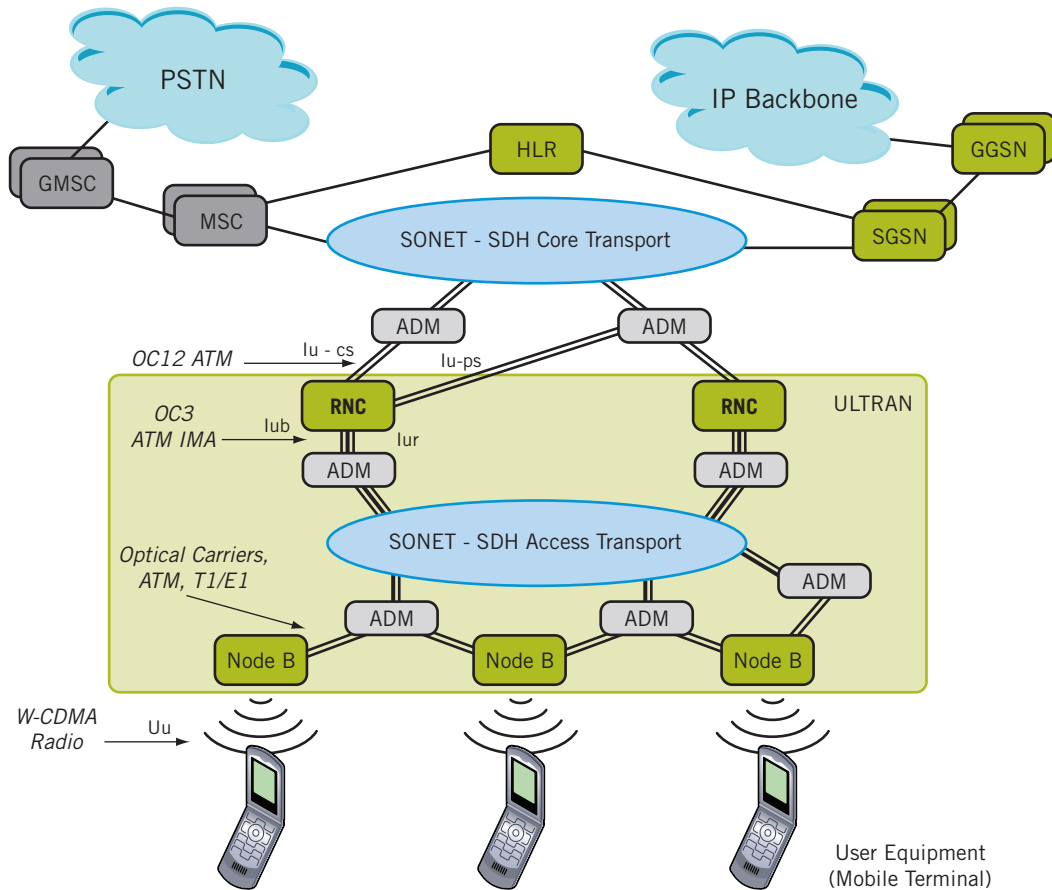


Figure 2. Modern W-CDMA Access Network [Holma]

If the user flow is a voice session, the information is routed out the lu-CS interface to the MSC. If the user flow is a data session, the information is routed out the lu-PS interface towards the SGSN (for UMTS) or PDSN (for CDMA2000).

The MSC and SGSN (or PDSN in the North American networks) access the Home Location Registry (HLR), which is used to determine to whose network the user is subscribed. The SGSN governs mobility between RNCs and so it can also enable hand-off between RNCs, a function similar to, but less complex than Node B handoff. The GGSN acts as a gateway/router to the core IP network.

Radio Tower Cell Site

It is important to understand the nature of a radio tower cell site, as it affects the performance calculations discussed in the *Bandwidth and the Wireless Network Evolution* section. Each cell tower is loaded with antennas, which are typically grouped at each tier on the cell tower in either a 3-sector or 4-sector configuration (see Figure 3). A radio frequency (called a “carrier”) is assigned to each set of antennas. Sometimes, the network provider will install more than one set of antennas on a single tower, but more often, towers are shared between multiple providers. Each antenna sector (shown as one of the four lobes in Figure 3) has the full capacity of the spectrum

bandwidth. So for an EDGE service, each lobe represents a separate 384 kbps of bandwidth for that cell. It is important to keep this in mind for performing a capacity analysis, as discussed in the *Bandwidth and the Wireless Network Evolution* section.

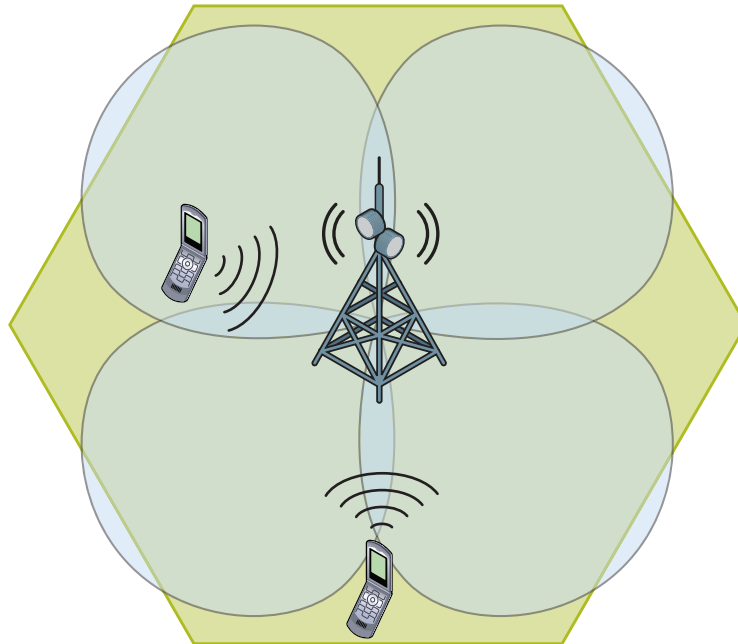


Figure 3. Antenna Sector Coverage Pattern in a Cell

3G Network Evolution

The 3G network evolution has promised many changes to the architecture in the previous example. A long-stated goal of the 3GPP is to simplify the network by eliminating the circuit-switched portions and providing a simple, packet-based IP protocol infrastructure from the handheld all the way to the core network. It is argued that by moving to an all-IP network, services can be more aptly applied in the IP network domain, and thereby much of the intervening complexity dissipates. This greatly simplified model is illustrated in Figure 4, and includes an IP Multimedia Subsystem (IMS) network, a modular standards-based service platform that uses the Internet Protocol (IP) and the Session Initiation Protocol (SIP).

Challenges Facing Video to the Handheld

Video to the desktop is so commonplace nowadays that one rarely stops to think about how the network and its content have evolved to enable that content to be viewed by the end user. Only ten years ago, video to the desktop content would have been rare to find, impossible to view in real time, and extremely slow to download.

Four major changes happened that now make video services available to the desktop environment. First, the network evolved, and download speeds resulting from the explosion of the broadband access network have made content access a relatively simple thing in most of the economically advanced parts of the world. Second, the evolution of video compression schemes has accelerated, making the size of the content much smaller. Third, the processing power needed to compress and decompress the video image has grown to the point where these operations do not exhaust the CPU cycles of the desktop. And fourth, the content providers have recognized the opportunities arising from these changes and made content readily and widely available to the masses.

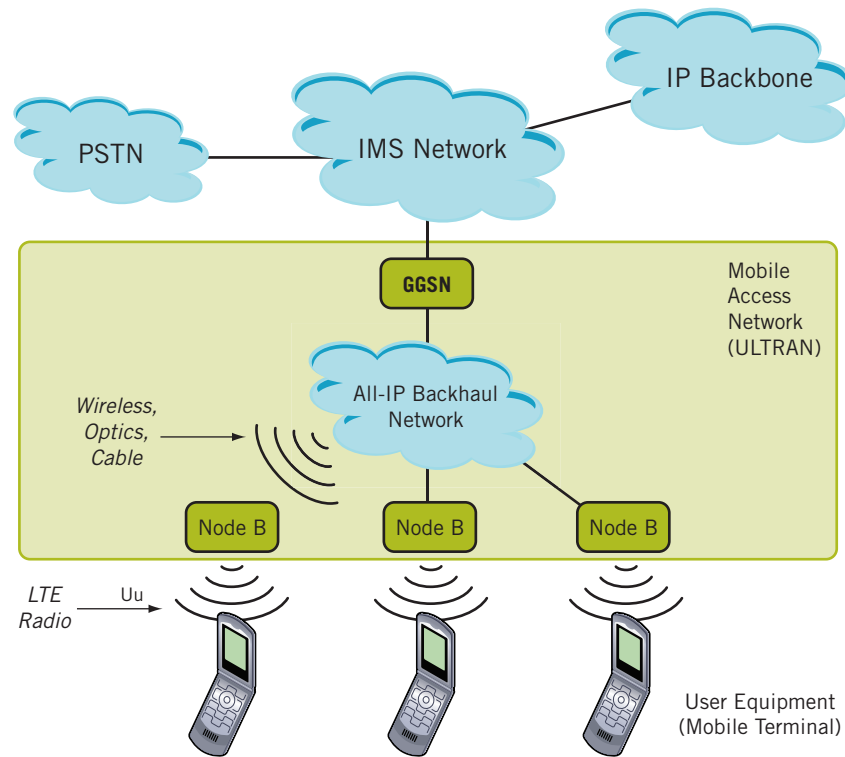


Figure 4. Forward-Looking All-IP Mobile Access Network

The desktop environment also continues to have several clear advantages that allow video compression/decompression operations to become common place. For one, the desktop environment has access to copious amounts of continuous electrical power, and it connects to a controlled communications network that allows high-speed data access.

So what are the main hurdles to making new video services accessible to the mobile handheld market in any place at any time? Quite simply, these are the limitations of bandwidth, screen size, resolution, and power.

Bandwidth and the Wireless Network Evolution

To the consumer, the 3G goals might mean little; however, these initiatives could allow for a more optimal user experience by removing many of the bandwidth bottlenecks inherent in the circuit-switched model. This evolution will take considerable time, but for the present, access technologies exist, such as the 3GPP/3GPP2 3G-324M data trunking standard, that allow the network provider to emulate a data trunk over a circuit-switched link. The 3G-324M standard, while very useful, makes use of T1 and E1 DS1 rate (1.544/2.0 Mbps) circuit-switched trunks that are still widely deployed to the Node B and RNC equipment in the field today. As these trunks are slowly removed from the wireless access network, a ubiquitous all-IP network will evolve that can reap the benefits of broadband communications all the way down to the Node B (cellular access point). Ultimately, anywhere these DS1 trunks are located, a restriction exists on the amount of data that can be accessed or back hauled. A single E1 can be used to provide data access in a 3-sectored EDGE cell, but immediately becomes a bottleneck in a 3G RAN.

In communications, the “last mile” is defined as the point between the very edge of the access network and the user’s equipment. In order for the mobile broadband access evolution to be complete, the last mile bandwidth issue still needs to be solved.

Tremendous strides have been made in terms of wireless communications. WiFi networks now provide significant speeds to the user terminal, allowing for broadband communications (1+ Mbps) even in a shared environment. Many handhelds like the Apple iPhone are becoming WiFi-enabled today, giving rise to the term Dual Mode Handset (DMH). However, the DMH presents problems not only to the network provider (as the user can bypass toll charges via the WiFi access), but also to the end user (restricted mobility, poor roaming, billing consolidation).

So in order to make video to the handheld truly mobile, the wireless technology evolution in the cellular infrastructure must be relied on as the necessary component in the overall mobile network evolution.

To better appreciate the impact of the wireless portion on video to the handheld service, the impact of video on today's mobile network must be evaluated by looking at the traffic load a streaming video represents on the user's network access. Table 1 shows the nominal rates for various encoded video streams.

Encoding Type	H.263 QCIF	H.264 CIF	HD 720p	HD 1080p
Resolution	175x144 @ 15 fps	352x288 @ 30 fps	1280x720 @ 60 fps	1920x1080 @ 60 fps
Bit Rate	64 kbps	768 kbps	20 Mbps	50 Mbps

Table 1. Approximate Data Rates for Popular Video Formats [ITU-T]

Table 1 indicates that the progression of content data bit rate required as a function of video quality is quite dramatic. When the compressed video stream rates are mapped against the cellular network airlink capacity, the real limitation to video to the mobile handheld comes from "the last mile" of wireless access throughput capacity.

Table 2 provides the airlink throughput capacity for popular wireless protocols and the theoretical maximum number of channels that could operate in that capacity for three more common video formats: QCIF, CIF, and HD. These numbers were computed based on the theoretical busy-hour capacity of each radio type and assumed an average video call hold-time of 20 minutes [Edwards] (taking into account not only short YouTube clips but full-length motion picture and IPTV show viewing). If tower sighting (multipath) or weather conditions are not ideal, then these numbers will go down.

Technology	Data Rate Throughput	Busy-Hour Capacity	Number of QCIF @ 15 fps Channels Supported per Carrier per Sector	Number of CIF @ 30 fps Channels Supported per Carrier per Sector	Number of HD 720p @ 60 fps Channels Supported per Carrier per Sector
EDGE	3.84E+05	1.3824E+09	18	2	0
EV-DO rel A	3.10E+06	1.1160E+10	145	12	0
HSDPA	3.60E+06	1.2960E+10	169	14	1
EV-DO rel B	9.30E+06	3.3480E+10	436	36	1
HSUPA	5.76E+06	2.0736E+10	270	23	1
HSDPA Evolution	1.44E+07	5.1840E+10	675	56	2
LTE	3.26E+08	1.1750E+12	15300	1275	49

Table 2. Approximate Number of Simultaneous Video Users per Sector per Carrier per Cell Site [Edwards, Holma, Kaaranen]

Since each cell tower typically has three sectors of radio per access provider, and oftentimes two or more spectral carriers (frequency bands) per sector, the total capacity per access provider per cell tower can be considered to be as much as six times the numbers shown in the three columns to the right. It should also be noted that the equivalent audio capacity for a two-minute voice call for the QCIF example alone is over 50 times the numbers shown for even the lowest quality video encoding scheme (QCIF). So for a typical UMTS sector-carrier running an EDGE service, one would expect nearly 1000 two-minute voice calls.

What this illustrates is that only low-resolution video content will be widely viewed in the near term. Ultimately, more robust data access technologies, such as the OFDMA technology targeted for the LTE schemes of 4G radio or WiMAX, will enable higher resolution video access on the order of what is experienced with voice today.

It should be noted that the LTE numbers provided assume a MIMO antenna array and a 20 MHz spectrum bandwidth per sector-carrier. Finding this kind of bandwidth, especially where more than one carrier per sector is desired, will be quite challenging and expensive. Current regulation has made 20 MHz spectrum chunks scarce, making competition for spectrum in a given area (between access providers) extremely fierce. To avoid this limitation, one can look outside of the current rules of spectrum allocation and evaluate the latest technology trend of Dynamic Spectrum Allocation (DSA).

DSA is a technology that enables a radio to look at the current spectrum map in a given area at a given time and look for open spectrum. Statistically speaking, a large amount of open spectrum exists in time and space. Some estimates indicate as much as 70% of all radio spectrum is available at any given time in any given area. What this means is that by searching for a quantity of spectrum based on the call type and negotiating that spectrum with a compatible radio base station, a handheld can accommodate any user demand. The Ultra Wideband (UWB) short-haul radio links designed for wireless TV in residences already employ this technology. In fact, some UWB equipment today can scan the local spectrum usage in the home and formulate a transmit radio pattern that works around the observed transmitters, using gaps between and on either side of two or more established transmitters. Using a similar technology in cellular communications, coupled with

advances in antenna and spread spectrum communications, it is conceivable that the LTE video channel capacity could be expanded by a factor of ten or more in a single sector-carrier, coming close to 1500 HD 702p @ 60 fps video channels per access provider in a single 3-sector-carrier cellular tower (assuming a 20 minute hold time).

Screen Size and Resolution

All this extra bandwidth means nothing, however, if the handheld cannot provide a suitable screen size for viewing. The fundamental problems with screen size are power and the size of a person's hand. Screen size is constantly growing. It is not uncommon to find screens larger than 2.5 inches these days that are capable of displaying a CIF-sized image with high clarity. At least one business handheld now boasts a four-inch screen size with 640x480 VGA resolution. This is nearly four times the resolution of a CIF image; however, it is more likely to be used with downloaded content (loaded into the handheld's memory via a USB interface to a PC).

Going beyond this, the products coming on the market now allow a user to plug an external eight-inch monitor and keyboard into the USB or Bluetooth connections on a Windows® Mobile handheld, greatly increasing the viewable image area and providing a suitable keyboard for real content creation (as opposed to that used for SMS text messages and short emails). Eventually, head-set mounted displays will most likely be available that create high-image resolution in front of the eye.

Power

It could be argued that screen size and resolution are already ahead of the network's capacity to deliver content to the user. The next critical issue to solve is the need for power. Three things drive the need for power in the handheld:

- The processor
- The radio
- The display

Processor

Some believe that processing power consumption will drop as a function of the normal progression of silicon manufacturing technology, but obviously anything that the network can do on behalf of the processor will help offload that work and

allow the processor to conserve battery power. In the realm of video, a classic example of this is video conferencing. This paper addresses applications in the *Usage Scenarios* section; however, some recent attempts to run a conference using peer-to-peer techniques with the application loaded in the handheld itself show a sizeable increase in power consumption, network bandwidth, and processor MIPS. It can be argued that such applications are best run in the network equipment, where they can be done more efficiently and with less cost to the handheld's battery.

Radio

Radio power is a function of spectrum power and distance. The greater the amount of spectrum and the greater the distance needed to communicate, the more power that is consumed. Higher efficiencies in antenna design can help to a degree, but

there is no getting around the simple fact that the power of a radio signal degrades as a function of distance.

In urban areas, more cell sites can be built and even wireless mesh networks and femto-cells can be introduced that could maintain a high-speed wireless connection within a hundred feet of any handheld unit. In urban areas, it is known that vehicular networks, not only the roads and highways but the vehicles themselves, can act as mobile base stations for getting close to the access point and as powerful relay transmitters. Some of these concepts are illustrated in Figure 5.

Display

Still, the battle is with the constant power drain of the display screen. The larger and higher resolution the screen, the more power it tends to consume. Advances in LCD technology

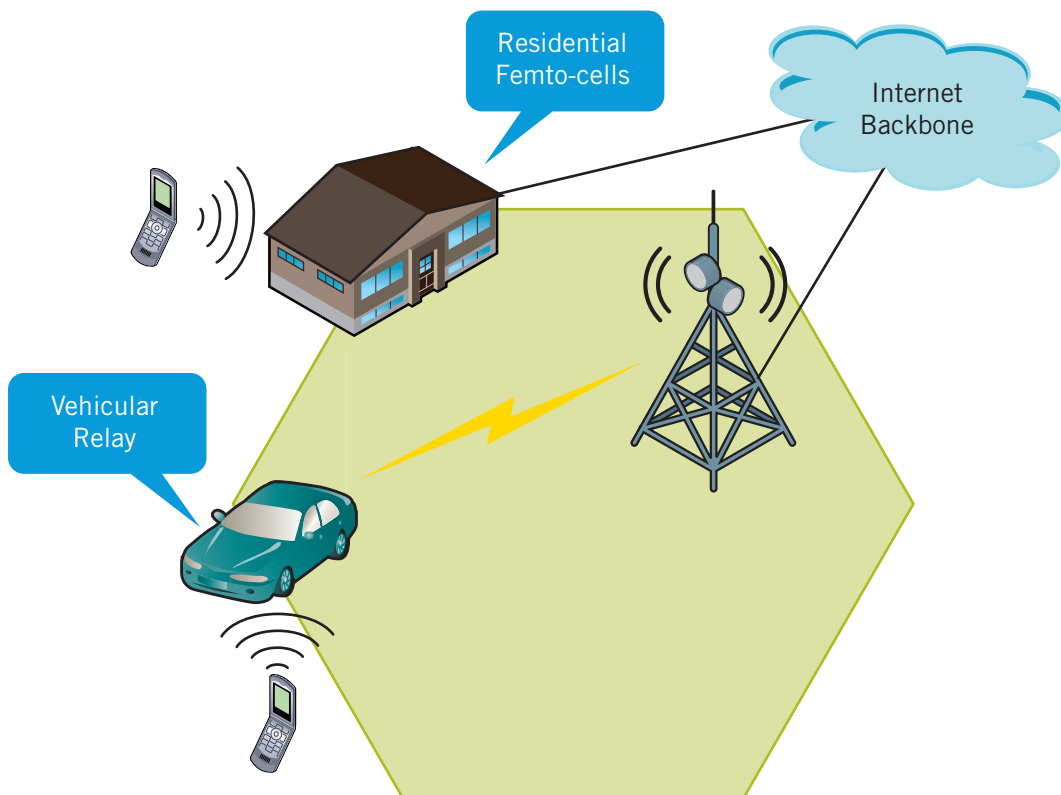


Figure 5. Advanced Forms of Mobile Access in the Network

have greatly improved screen power consumption, but the constantly changing and *always-on* nature of a video call will rapidly consume the battery. And although battery technology is continually being improved, its advances thus far have lagged behind those of other technologies.

Some of the improvements in battery technology are coming out of the vehicular market, where the push toward environmentally friendly electric cars is driving the need for better battery technology. Another related technology being explored is for the military — one that allows a generator to operate off a standard body motion. Such advances could help alleviate the power source issue.

Other Factors Affecting Video to the Handheld

Audio and Visual Logistics

One of the interesting issues having to do with the use of video to the handheld device is whether a mobile handheld device user can participate in a video conference. Central to this issue is a camera that can point in the same direction as the video screen so the user can view the other participants while appearing on the same video. Several features can address this requirement:

- A camera with 180 degree rotation
- Two cameras, mounted on the front and back
- A remote camera that uses Bluetooth technology or USB

These options add cost to the handheld; however, the third option can be marketed for those who opt to do mobile video conferencing. The challenge is can somebody still be “mobile” while conducting such a conference? As can be demonstrated with a camera on the phone, the user must hold the camera at the appropriate orientation all the time to ensure the other participants can see the user. This can mean holding the handheld out to arm’s length, and using a Bluetooth headset or wired headset to enable the audio portion of the conference. This is still not practical for movement however. More than likely, the mobile video conference would be conducted with the participant standing or sitting still while adjusting a remote camera so that the image is not constantly shifting and the participant’s arm would not get tired. Another option would be to have the phone equipped with a small tripod that positions the screen and camera in a stationary manner.

Recording Video

Another use of the camera’s phone is to record video. How wonderful would it be to record video with one’s handheld as the events unfold before one’s eyes? Emergency personnel or field technicians could use such devices (perhaps with remote cameras attached to their helmets) that would enable others to help monitor a situation from a distant location.

The challenge with recording video and uploading it to the network is not so much with the camera as with the uplink data bandwidth. Technically, this same issue applies to the uplink side of video conferencing. In nearly all broadband deployments, whether wired or wireless, the uplink bandwidth is never as good as the downlink bandwidth. HSUPA (see Table 2) is a wireless protocol designed to increase uplink bandwidth. Employing HSUPA helps alleviate this issue to some extent, but the uplink bandwidth is less because more data is downloaded than uploaded.

Usage Scenarios

The following are just a few examples of the wide variety of use case applications for mobile video, and most are the same as they would be for the desktop:

- Conferencing and viewing web-related content for YouTube, IPTV, etc., were discussed in the *Bandwidth and the Wireless Network Evolution* section. The web-related content is mostly stored (streaming) video; however, advancements in the technology could enable establishing a live video feed from news media for breaking events, conferences (webinars), and speeches, or, as in the previous example, from field personnel who are relaying video feeds from the handheld itself.
- For a business environment, mobile collaborative communication would be highly desirable. A conference is often more likely to include a Microsoft® PowerPoint® presentation with background audio. Whether a webinar or a brain-storming session, it still involves a video feed of the presentation to the remote handheld device coupled with a real-time audio connection.
- Outside of the business environment, collaborative communication could be used for services that could allow people to establish “how to” video sessions with a remote service (for example, to show drivers how to change an automobile tire or how to operate an automated kiosk in a foreign language).

- Another interactive service could be 3D maps, especially for pedestrians who are navigating through a city, that provide landmark displays for areas that are difficult to map, such as theme parks. Historical or museum-related tours could also be given via such a service. Maps could be shown as actual video footage or as 3D renditions of the surrounding environment.
- Video greetings, like personalized ring tones, could become an interesting market opportunity that could extend from web sites with video “welcome” advertisements to video on-hold or video port cards (essentially a video clip recorded by the handheld and forwarded to somebody with a voice-over or additional edits).
- Video messaging can provide more content and meaning than simple audio or text messaging. Like a video postcard or even video mail, these kinds of videos may require editing to provide a smoother message that could include text overlays, clip insertion and removal, audio tracks, or special effects. Such editing could require a handheld interface that in turn would allow the user to make changes to the video that resides on a remote server in the network.
- Those desiring to do an image- or video-based search on the web could take a picture or video with their handheld and upload it to their favorite web search engine.

Dialogic's Role

While it may not be in the handheld equipment market, Dialogic plays an important role in the network that enables it. Dialogic supports industry standards that those who are making forward-looking decisions have come to rely on when deploying effective and efficient next-generation networks. These standards also help to define the leading-edge Dialogic® products that work within these networks.

As seen in Figure 4, the all-IP network of the future is built around the standards-based IP Multimedia Subsystem (IMS) network, which provides enhanced IP-based services. A high-level depiction of IMS is shown in Figure 6 (the darker green boxes represent some of the many areas where Dialogic products are deployed). In the IMS network, which defines the future 3G wireless infrastructure, video processing would most likely be conducted in the Media Resource Function Processor (MRFP). The MRFP could be used to transcode and transrate content (for best quality and handheld compatibility). The same box could be used as a conferencing server for an all-mobile conference.

Figure 7 is a subset approximation of an IMS network in terms of the video streaming functionality. The control signaling via the wireless area network to the P-CSCF establishes the user handheld's session with the service. The MRF Controller (MRFC) establishes the call session with the video gateway resources within the MRFP “cluster.” This function is known as a cluster because it could entail multiple servers stacked in a redundant fashion to provide the necessary channel density for what could be a wide variety of services.

These services could consist of the video streaming “play” resources as depicted in the Figure 7 example, or resources that do both compression, decompression, conferencing image overlay, etc. These resources could be clustered in a different fashion depending on service requirements and billing dependencies, or they could be shared across applications.

Summary

This white paper presented a brief background on the evolution of the mobile wireless network, discussed several challenges that face the video to the mobile handheld market, as well as highlighted some of the many exciting applications that could be enabled by receiving and sending video with the handheld.

Bringing Video to the Mobile Handheld Market

Background, Challenges, and Potential

White Paper

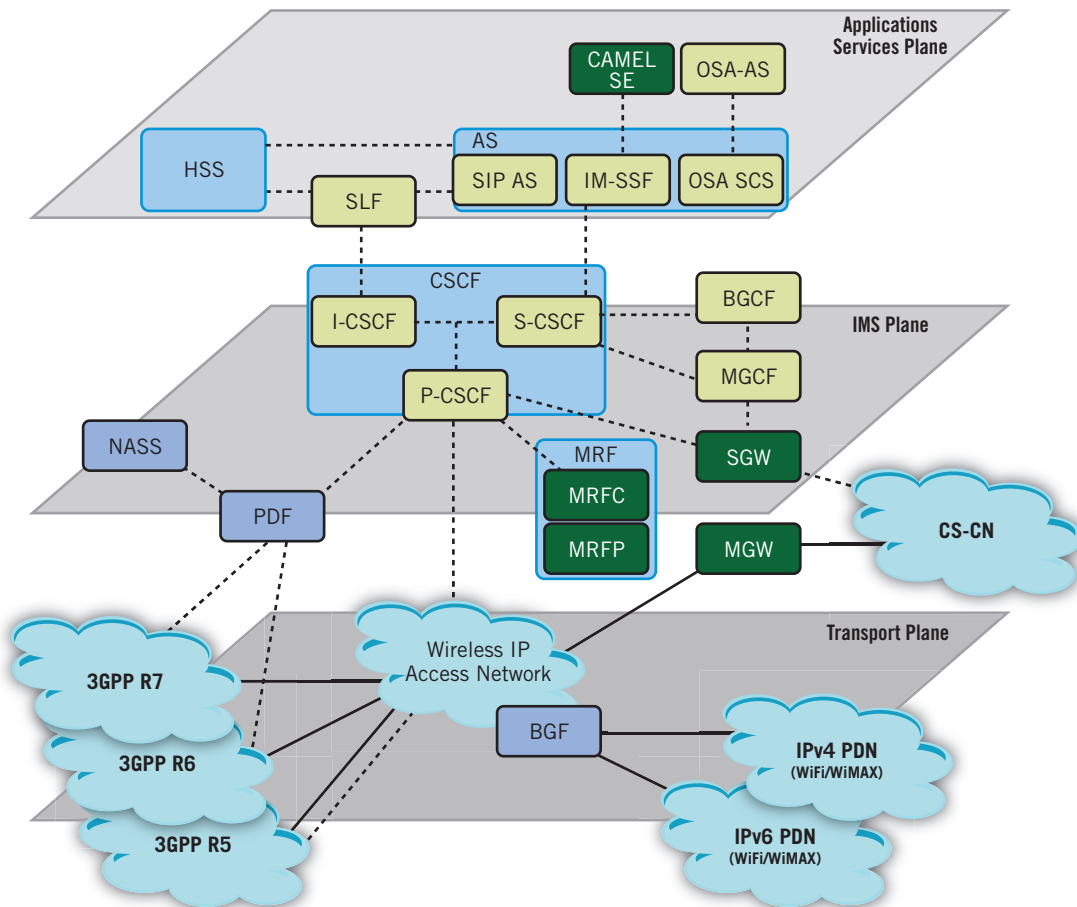


Figure 6. IMS Network

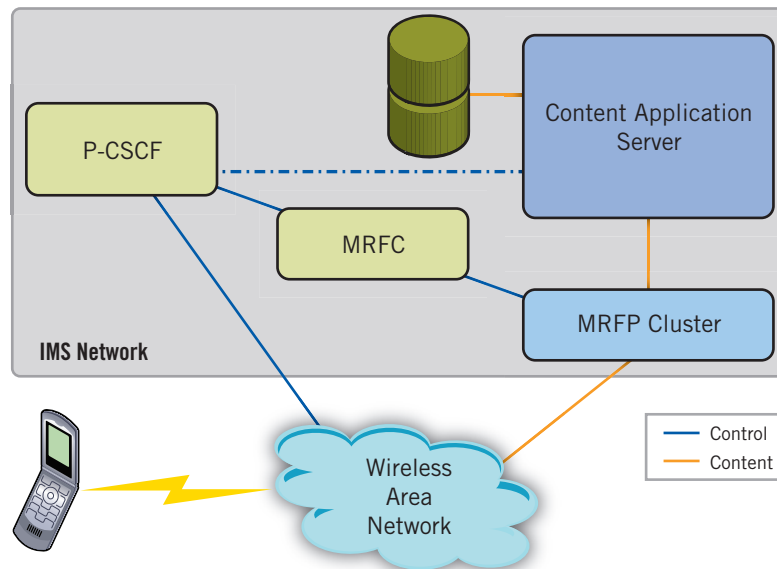


Figure 7. Video Streaming Application in an IMS Network

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Acronyms

3GPP	Third Generation Partnership Project
ADM	Add-Drop MUX
AS	Application Server
BGCF	Breakout Gateway Control Function
BGF	Border Gateway Function
CAMEL	Customized Applications for Mobile Network Enhanced Logic
CIF	Common Intermediate Format
CSCF	Call Session Control Function

CS-CN	Circuit Switched Core Network
DMH	Dual Mode Handset
DSA	Dynamic Spectrum Allocation
EDGE	Enhanced Data rates for GSM Evolution
GGSN	Gateway GPRS Support Node
GPRS	General Packet Radio Services
GSM	Global System for Mobile communications
HLR	Home Location Register
HSPA	High Speed Packet Access
HSS	Home Subscriber Server
IMS	IP Multimedia Subsystem
IM-SSF	IP Multimedia Service Switching Function
I-CSCF	Interrogating CSCF
IP-CN	Internet Protocol Core Network
ITU	International Telecommunications Union
LTE	Long Term Evolution
MAN	Metropolitan Area Network
MGW	Media Gate Way
MIMO	Multiple-Input and Multiple-Output
MIPS	Millions of Instructions Per Second
MRF	Media Resource Function
MRFC	Media Resource Function Controller
MRFP	Media Resource Function Processor
MSC/G-MSC	Mobile Switching Center/Gateway Mobile services Switching Center
NAS	Network Access Server

OSA	Open Services Architecture
PDF	Policy Decision Function
QCIF	Quarter Common Intermediate Format
RAN	Radio Access Network
RNC	Radio Network Controller
SBC	Session Border Controller
S-CSCF	Serving CSCF
SGSN	Serving GPRS Support Node
SGW	Signaling Gate Way
SLF	Subscription Locator Service
UMTS	Universal Mobile Telecommunications System
USB	Universal Serial Bus
UWB	Ultra Wideband
VGA	Video Graphics Array
VoIP	Voice over Internet Protocol
WiMAX	Worldwide Interoperability for Microwave Access
WLAN	Wireless Local Area Networks

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