



# Mobile versus Internet Streaming: Key Challenges

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### Abstract

Today, more and more mobile network operators are deploying high-speed 3G and 3.5G networks to bring their subscribers more services and exciting feature-rich applications. Of these, multimedia applications are best suited to take advantage of the relatively high data speeds supported by these wireless networks.

Unlike the Internet, where downloading still prevails as the most popular method for delivering content, the mobile world is increasingly turning toward streaming to bring multimedia to users, in particular for live events and TV-type content. Streaming in the mobile space poses perhaps more significant challenges than traditional Internet streaming. These challenges include issues that relate to and affect quality and the overall user experience.

This article addresses five key problem areas inherent in mobile streaming and suggests approaches that can lead to more successful delivery of mobile multimedia services.

### Introduction

Wireless streaming is a relatively recent phenomenon, made possible by advances in mobile handset technology and the development of high-speed mobile networks. However, despite some encouraging success stories and growing popularity, there are still many challenges for the mobile operators, solution providers, and handset companies largely due to the inherent differences in technology in relation to the more established Internet-based services.

This article highlights some of the key issues in turn.

#### 1. Streaming Quality is Limited by the Wireless Data Rate

Mobile networks tend to provide a fairly limited data-rate compared with typical Internet connections. UMTS (“3G”) networks typically provide a mobile user with 128 Kbps downlink bandwidth and 384 Kbps in some scenarios, though sometimes even as low as 64 kbps. GPRS can deliver around 60 Kbps (approximately 16 times less than a basic 1 Mbps ADSL line) and EDGE a little higher. Hence, bandwidth is a critical factor in delivering high quality streaming, and compared to the Internet world this bandwidth is a severe restriction.

New advances such as HSDPA aim to deliver higher data rates up to several Mbps, comparable to many home broadband connections, which will alleviate the bandwidth restrictions to some extent. However the network operators must understand how to utilize these new technologies to support the products and services provided to their customers.

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Because huge demands are placed on the network bandwidth, advanced techniques are required to compress or ‘squeeze’ the bit-rate of the original content prior to streaming (e.g. to convert a full size TV-quality video into a small-screen version) using standards-based codecs<sup>1</sup>. Although Internet streaming also uses compressed formats such as Real, Windows Media and Flash, the mobile industry has adopted highly efficient new formats such as H.264 video and AAC+ audio, developed primarily with mobile devices in mind.

The operators and content providers face an important choice in the initial stages of content creation, as the video and audio quality depends mainly on the codec selected, and also the implementation of the software that encodes the content into the mobile format, ready to be streamed by a server to the handset.

It’s widely understood that competing vendors’ encoders produce different quality video and audio playback, because the standards concerned define the general codec technology but not the actual implementation. This means each vendor can optimize their own version, and the output quality will vary between competing encoders. Therefore, it is essential that an encoder gives the highest possible output quality and supports all the required media formats, in addition to offering advanced features relevant to mobile networks (such as error correction and data partitioning). A consideration at the content production stage is to use techniques sympathetic to viewing video on a small screen, such as to minimize the use of quick camera zooms and pans – there are many such techniques that can help produce the best quality content with minimal effort.

Mobile operators must deliver the highest quality streaming in the most efficient manner, *taking into account the characteristics of the wireless network*. Unlike the Internet cases, the operators have complete control of the data flowing across their networks to the end-user devices. As such, it’s possible to optimize the streams based upon knowledge of how the various network components function. For example, traffic flow and smoothing algorithms in the core network (such as the GGSN and SGSN) and streaming server can ensure a steady flow of data packets with minimal ‘spikes’ or bursts, and the data packets can be delivered over special real-time (RT) radio channels with a suitable quality of service, rather than the ‘best effort’ non real-time radio channels invariably used today.

Additionally the radio network bandwidth should be used more effectively, physical radio channels being used based on the actual properties of the stream itself, i.e. it is more efficient to deliver a 12.2 Kbps audio-only stream over a 16 Kbps RT radio channel than a 64 Kbps NRT channel. Operators are now beginning to deploy these methods as their existing streaming services mature and expand.

## 2. Fluctuations in the Wireless Network

When streaming over mobile networks, is it important to remember that the over the air bandwidth fluctuates depending on factors such as the prevailing network conditions and whether the user moves between cells. Most modern handsets have quite a limited buffer size and memory, so network issues are more readily observed in contrast with Internet streaming.

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<sup>1</sup> An encoder/decoder

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Therefore, it's advantageous to use a streaming server that can send the most appropriate bit-rate to the handset and can dynamically *adapt* the bit-rate to maximize quality (and eliminate annoying 'freezes' in playback), a term commonly referred to as Dynamic Bit-rate Adaptation (DBA). DBA techniques are fairly complex; each vendor implementation is different and some are much more effective than others.

DBA usually comes in two varieties with a distinction on where the bit-rate adaptation decisions are made: the first is implemented in the mobile player (which tells the server which bit-rate to send) and the other by the server. The latter case is possibly superior as it allows intelligent decisions to be made for *all* players, including those which do not have their own built-in DBA function. This is an important point because the majority of mobiles have no inherent rate-switching mechanism, so it is advantageous if the server can fulfill this task itself (or in conjunction with the player) based on universally-supported standards.

Equally important is the ability to customize the DBA behavior based on the handset type and the network technology. Certainly a single configuration may not achieve optimal results on all handsets and networks, and some optimizations derived from empirical tests are often required.

Unfortunately many operators don't have the experience necessary to identify these optimizations, and so should work closely with vendors that understand wireless streaming and the associated issues. In summary, DBA is a critical feature that can give significant improvements in the quality of the streaming services.

### 3. Handset Compatibility Issues

Media players on mobile handsets are generally standards-compliant (and implement the various technologies recommended by 3GPP such as MPEG-4 video, RTP and RTSP protocols, AMR audio, etc); however this doesn't necessarily mean there is 100% compatibility between streaming servers and handsets. Currently, mobile operators invest substantial effort to ensure their servers are compatible with the handsets on their network.

Comprehensive interoperability tests are in fact conducted between the handset and server vendors but it's not viable to exhaustively test all possible combinations in the test programs. International interoperability testing efforts organized by bodies such as the IMTC do go a long way to alleviate this issue, and having multi-national customers is an advantage for a vendor to resolve any problems that do occur.

Considering the handset compatibility issues, a streaming solution ideally offers on-the-fly settings to adapt its behavior to a specific handset model (or version). For example some handsets do not properly implement a specific feature or the operator may find minor bugs when it's already live on the network. In this situation, a workaround is required and in this case a streaming server that can alter its behavior based on the handset type can solve many performance, quality and compatibility issues.

### 4. Handset Feature-Set

Customers are coming to expect a user experience on mobile comparable to that of other mediums (such an iPod-like music experience and the ability to change channels like a TV when watching videos). The majority of media players on a mobile offer quite a limited feature-set compared with most PC players, and it's not possible to download a new feature and upgrade the player to handle new formats and features. As a result the overall experience is heavily dependent on the player implementation.

Music-based services should have advanced features like play-lists, and TV services should allow users to quickly switch channels (known as 'Fast Channel Switching') to maintain a high-quality experience. These features should be supported as standard by the server, which allows operator to build a more attractive proposition to the customers.

Furthermore, handsets support many different media formats and display properties such as the frame rate, screen size and so on, requiring a mechanism to deliver suitable content (sometimes called media asset selection) based on the handset's capabilities, without user intervention. Operators may carry out this function within the back-end systems, sending a URI to the mobile's browser causing the media player to connect to the most appropriate stream once the user clicks on the link.

At a basic level even the video formats commonly supported by handsets differ to that used in the majority of Internet-based applications. The most well-known video formats in the former case are MPEG-4 and H.263 (with the superior H.264 expected to have widespread adoption in future) and in the latter Windows Media, Flash and Real continue to be popular. This means the majority of existing Internet content cannot easily be played on a mobile device, without first being converted into the correct format.

### 5. Integration with Back-End Systems

Mobile streaming services are generally not free as are common Internet services, and require integration with the operator's existing billing and authorization systems. There are many different scenarios involving billing logic, thus a streaming solution must provide a flexible API which can easily be connected to the back-end systems and supports billing logic such as pre-paid, post-paid, and subscription types.

Seldom considered is the integration with existing monitoring and reporting systems. A solution that has extensive logging capabilities and can link to the systems in the control centre will be a huge benefit to the operator. In future, some handsets will send streaming quality of service information (such as the time to start a stream, and how many times it 'freezes' when congested) to the servers, allowing a real-time (and post-) view of the streaming quality delivered to customers.

Network operators also need flexibility to deliver 3<sup>rd</sup> party content to their customers, whether this is hosted by themselves, the content provider or an externally-hosted solution. In all cases there will be a degree of integration to the operator's internal systems, and whoever hosts the servers must also appreciate the idiosyncrasies of delivering over wireless networks.

### Conclusions

Wireless streaming is now maturing as a media delivery technology, and requires some innovative solutions to reduce the limitations associated with such networks. The operators must take an end-to-end approach and cannot simply apply the same principles of traditional Internet-based solutions.

The highest quality best-of-breed encoding tools must be used to create the live and on-demand content, considering the performance requirements in terms of speed of encoding and the desired quality. Flexible solutions are required that can adapt the stream data-rate dynamically based on the network conditions and the available bandwidth, plus the ability to customize key parameters to achieve the best performance possible.

With the advent of even higher speed networks such as HSDPA, there are new possibilities to create higher quality services with an improved user experience, so it is also vital to have a clear and progressive roadmap to deploy new technologies to achieve this goal.

Content should ideally be tailored to the mobile device from the offset, rather than simply re-package made-for-TV and Internet content; anyone who has watched TV news on a mobile will be familiar with the frustration of reading small text originally designed to be viewed on a larger screen.

Innovative service features also have a considerable impact on the customer experience. One such feature coined “Stop-N-Go” such as offered by the Vidiator Xenon Streaming Server, enables a customer to re-join a stream at the point where they previously finished – very useful if the connection was dropped (not uncommon at peak times or in congested cells) or they simply wish to stop watching and continue later on, saving both time in finding the same place and additional data charges.

Finally, the issues mentioned here can have a considerable impact on the effectiveness and success of wireless streaming services. One thing is certain; there has never been a more exciting and promising time to be involved in wireless streaming for content providers, network operators and solution providers.

### Abbreviations

3GPP	3 <sup>rd</sup> Generation Partnership Program
ADSL	Asymmetric Digital Subscriber Line
AMR	Adaptive Multi-Rate
API	Application Programming Interface
DBA	Dynamic Bit-rate Adaptation
EDGE	Enhanced Data Rates for GSM Evolution
GGSN	Gateway GPRS Support Node
GPRS	General Packet Radio Service
HSDPA	High Speed Downlink Packet Access
Kbps	Kilobits per second
Mbps	Megabits per second
MPEG	Motion Picture Experts Group
NRT	Non Real-Time
RT	Real-Time
RTP	Real-time Transport Protocol
RTSP	Real-Time Streaming Protocol
SGSN	Serving GPRS Support Node
UMTS	Universal Mobile Telecommunications System
URL	Uniform Resource Locator