

## Multimedia Streaming

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## Executive summary

Enabling mobile Internet means that most mass-market services available on fixed Internet terminals need to be accessible on state-of-the-art mobile terminals. Multimedia streaming is a service that is providing intense technological competition to the fixed Internet. This service is also technically applicable in the evolution of second- and third-generation wireless networks; thus streaming clients will soon be deployed in advanced wireless communication devices.

The use of streaming services on the Internet is increasing and when it becomes mobile, animation, music and news services will be available regardless of location and time. Therefore, the forthcoming multimedia services are

also setting new challenges for the mobile environment. Streaming technology is one way to meet these challenges. Streaming provides consumers with an end-to-end application that allows them to enjoy multimedia content at any time.

### Open standard key for new services

Nokia believes that core multimedia services must be based on open standards to enable interoperability between terminals and services, as well as enabling other companies to create content and services. The current proliferation of proprietary streaming systems on the Internet is something that we need to avoid in the wireless service space where there are already several application and equipment interoperability issues between numerous terminal and network providers.

With regard to multimedia streaming, Nokia has been actively participating in

the 3rd Generation Partnership Project (3GPP), which has standardised a network transparent Packet Switched Streaming (PSS) service for Release 4 and new enriching content types and service optimisation tools that will be introduced in Release 5 of the service. Nokia believes that this will become a successful open IP standards based multimedia service – prior to and in parallel with the Session Initiation Protocol (SIP) based All-IP service and the Internet Multimedia Subsystem architecture of 3GPP Release 5.

The evolution of radio access technology has enabled streaming – pseudo-real-time packet data services – to mobile handsets even before the transition to All-IP with conversational mobile services using IP transport has taken place. This multimedia streaming launch is related to overall market development.

# Introduction to multimedia streaming

In the past, users had to download an entire clip or file to their local hard disk drive before viewing multimedia content on the Internet. During the last number of years, streaming has matured and gained high user acceptance, especially among users of Internet-enabled PCs. This technology is also seen as one of the new value-adding Internet services and competition in this area has been and continues to be intense.

As an overall concept, streaming technology can be seen as the pseudo-real-time consumption of multimedia content. With streaming services, a media player client opens a connection to the content server and starts to stream the media content at a payload rate. Then, the client starts to play the content with a minimum delay or none at all. This is done without the need to fully download the content onto the terminal first.

## Creating multiple benefits and new experiences

Streaming not only frees valuable terminal memory, but also enables the distribution of larger media content files as well as live services. The increasingly important issue of the illegal copying of material is also addressed because the content is not saved onto the terminal after the streaming session has ended. Content access, digital copyright management and streaming can be handled together, allowing a flexible and reliable way to distribute digital content on the mobile Internet.

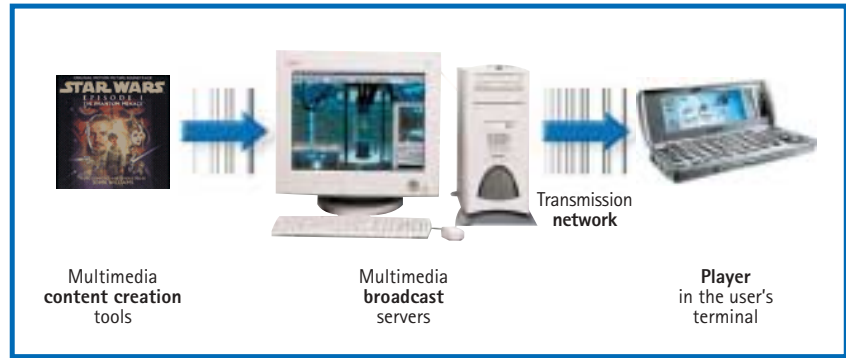


Figure 1. Streaming content distribution chain

The user needs a player, which is a special program that decompresses and sends video data to the display and audio data to the speakers. This client application must be able to control the streaming flows (control plane) and manage the media flows (user plane). In addition, the client also has to interface with the underlying transport network technology and its specific protocols and data bearers that are dedicated to the service.

As access to Internet services is possible on wireless devices, the available computing capacity of these devices increases and user rates for mobile subscribers are approaching those of wired terminals – or at least the limit of the majority of fixed line terminals that are connected to the Internet (28.8 kbit/s) – streaming services are also technically feasible on wireless handsets.

The first commercial streaming services may utilise existing circuit-switched bearer services but in 3G, the services will be offered over packet-switched bearers. Nokia believes that a standardised approach will provide operators with a better environment for creating productive businesses with extensive multimedia streaming services.

Multimedia streaming, by definition, generally includes one or several forms of media which are streamed or transported to the client over a network. Some examples of services are listed below.

- Audio streaming (offering, for example,

music playback at the terminal)

- Streaming with an audio and a video component (news reviews, music videos)
- Audio streaming with a simultaneous visual presentation comprising still images and/or graphical animations; video clips presented in a pre-defined order.

To give an overview of streaming as a technology, the framework of a typical multimedia content creation and retrieval system is presented in Figure 1. The content creation system has one or more media sources, for example a camera and a microphone. In order to compose a multimedia clip consisting of different media types, the raw data captured from the sources is edited.

Typically, the storage space required for raw media data is huge. In order to facilitate an attractive multimedia retrieval service over widely available transport channels such as low bit rate modem connections, the media clips are compressed during the editing phase, after which the clips are stored on a server.

A number of clients can access the server over the network. The server is able to respond to the requests presented by the clients. The main task for the server is to transmit the desired multimedia content to the client. The client then decompresses and plays the clip. During the playback phase, the client uses one or more output devices, most often the client's own screen and speaker.

# Streaming services evolution

Early applications using HSCSD carriers will likely be concise content, pre-view or pre-listening applications, and audio content with still images. The challenge for streaming over GPRS, which is currently under evaluation, is the quality of service (QoS). Alternative technologies for technical architecture, such as progressive downloading, are also being evaluated.

The keys for providing an economic multimedia streaming service will be the QoS mechanisms in Releases 4 and 5 of the 3G networks, the creation of a PSS-compliant content server infrastructure and content creation tools on operator networks and the public Internet, the necessary application-aware firewall systems, and flexible charging mechanisms applied in the wireless operator's service infrastructure.

PSS can be deployed as a downlink transport mechanism for Multimedia Messaging Services (MMS), which will enable new MMS service possibilities. It will also remove the obstacles of limited memory storage on terminals, as the streamable content does not need to be downloaded and stored prior to playback by the user.

New features standardised for PSS (and MMS; from Rel 5 onwards, media will be aligned) will enable services that will include vector graphics animations, subtitles with formatted text and synthetic audio -(MIDI). There will be tools to optimise the service provisioning from servers to clients based on the terminals' media capabilities. With 3GPP Release 6, the multimedia services will have standardised digital rights

management tools (Mobile DRM) to provide highly copyrighted content for mobile streaming service subscribers.

## New services and business opportunities

The technical architecture links with the business architecture as new streaming applications are challenging not only from a technology perspective, but also from a pricing model and value chain perspective. In the packet-switched networks, the pricing models have to be flexible, for example content (URL) based pricing or flat fee access for certain amounts of content. Value chains are becoming more complex as different business models from the PC, content and mobile worlds are converging.

For operator services, streaming is one of the key areas that differentiates 3G from 2G as it enables new, attractive service concepts. Some of the most promising service concepts in multimedia streaming include:

- News and information services: streaming hotline, sports, news, etc. (audio, still images (SMIL), video)
- Entertainment: streaming before downloading games, pre-listen to music, preview movies before buying tickets, Internet radio
- Web cam, or preview digital content, pre-listen to digital music, image manipulation software
- Communication and messaging: View video content after a message is received, 'see-what-I-see', SIP voicemail control, talk and share video content by streaming (SIP)
- Multimedia streaming has also created an entirely new market channel for many content providers in the mobile world. As only a small amount of content is shown on the client at any time, streaming offers a relatively secure means of content distribution and complements downloading.

Moreover, because the content is never actually stored on the client terminal, the content copyright issues regarding illegal use are already supported.

## Standardisation

Nokia sees that core multimedia services must be based on open standards to enable interoperability between terminals and services, as well as enabling other companies to create content and services.

With regard to multimedia streaming, Nokia has been actively participating in 3GPP, which has standardised a network transparent Packet Switched Streaming service (PSS) for the first time in 3GPP Release 4 and later in Release 5, for which an enhanced PSS service was frozen in March 2002. 3GPP and Nokia will continue to enhance existing service features and include additional ones in later releases. Nokia believes that this will become a successful open IP standards based multimedia service. It will offer a gateway to packet switched multimedia services in Release 4 prior to the SIP based Internet Multimedia Subsystem (IMS) architecture of 3GPP Releases 5 and 6. Nokia has also been active in 3GPP2. The target is to coordinate the standards that define the streaming services.

### 3GPP

The 3GPP packet-switched multimedia streaming service is being standardised based on the control and transport sections of IETF protocols RTSP, RTP and SDP. A protocol stack for standardised streaming services is presented in Figure 2.

Codec standardisation has not evolved far from the codec set that was defined for multimedia services in 3GPP Release 99.

Harmonisation with existing 3GPP codecs is listed as one of the main goals of this work. 3GPP finalised a basic version of the service for Release 4. The next 3GPP milestone, PSS Release 5 frozen in March 2002, adds some new media types, additional presentation & layout features, support for subtitling and karaoke, and a framework for enabling terminal capability based content adaptation in streaming servers.

Digital rights management (DRM) for streaming services will be dealt with in a later 3GPP release, which aims to create a general DRM framework for all 3G services.

Nokia supports this approach as we see the clear technical benefits of the low license costs of implementations, protocol convergence with regard to IMS services, and WAP and XHTML browser development on terminals.

As radio link layer optimisations for real time PS traffic can barely support dominant proprietary solutions (considering the multitude of terminal vendors, BSS providers, etc. that implement L2 protocols in their products), we see the open standards as the best way to develop and optimise streaming services from both the operator's and terminal vendor's points of view.

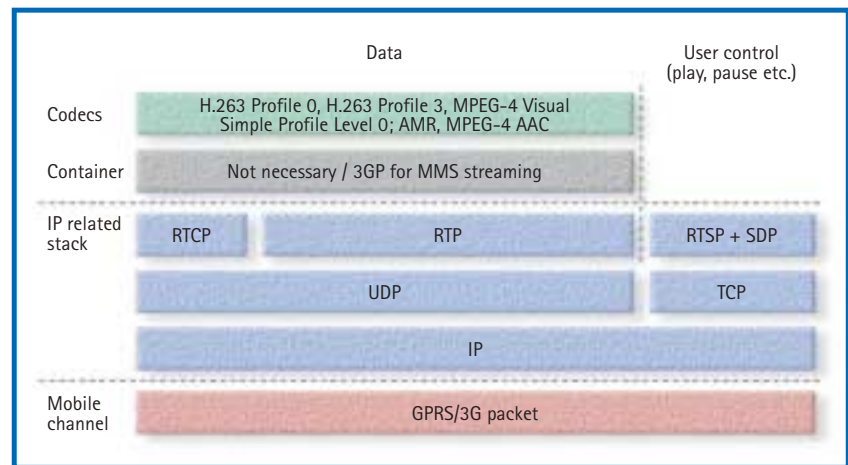
For example, the robust wireless RTP/UDP/IP header compression will only benefit IETF standards-based media types, as it provides optimised spectral efficiency for streaming and conversational class multimedia services. In networks and terminals, this meets the specifications of 3GPP Release 4 and onwards which specify the robust header compression functionality first in UTRAN and later in GERAN (the latter only in Release 5).

## 3GPP2

The competing 3G standardisation body on Code Division Multiple Access (CDMA2000), 3GPP2, is in the process of completing a baseline video streaming service. Currently, the definition of a new, enlarged multimedia streaming service (MSS), which is comparable to PSS Release 5, is in its early phase. The control and transport of this service rely heavily on existing IETF protocols and are

compatible with the existing IP protocol stack. Relevant IETF protocols mentioned in the latest contributions to 3GPP2 include specifications for control (RTSP), packetisation and transport (RTP), and are therefore similar to the ones suggested in 3GPP. There are subtle differences in mandated media types between the core services of 3GPP and 3GPP2, and also in the non-existence of static image media, presentation and layout protocols or definition of a file format.

Figure 2. 3GPP/3GPP2 streaming: protocol stack.



## Streaming and multimedia messaging service

The first release of the 3GPP Multimedia Messaging Service (MMS) will deliver messages that consist of "slide show presentations" containing still images, text and audio. MMS enables rich content to be created for messages while also functioning as a highly versatile platform for many mobile applications and services. Multimedia messages can also be sent, stored and forwarded to and from Internet applications. The messages will be pushed to the receiving terminal or e-mail account in a way that is similar to the Short Message Service (SMS).

Eventually, video clips will also be part of the multimedia message content. Therefore, when media content becomes more demanding in terms of message size, streaming might become necessary in order to deliver the messages from the server to the receiving terminal or Internet application. This functionality has been planned for inclusion in the second release of MMS.

## Streaming server aspects

Multimedia streaming solutions enhance existing mobile services by enabling the user to view and listen to online video and audio content. A mobile service enabler called a streaming server has a key role in the streaming solution. It creates new business areas for mobile operators, media-rich services for end-users and enables the development of more versatile applications. The streaming server has also an important role in optimising quality of service for the end-user. The streaming server consists of state-of-the-art functionality for video and audio streaming and it also has media caching servers.

### Server Location and QoS

Operators need to provide access to streaming content that is hosted on the Internet and also have the option to locally host content that is specific to their subscribers. Both scenarios require infrastructure software to be deployed within the mobile operator network to achieve a high-quality streaming media experience.

The delivery of streaming media on the wireline Internet has evolved to a point where high-quality packet delivery (low latency, low loss) is usually accomplished by moving the content closer to the user – to the “edge of the network” – thereby minimising the network path between the content server and the consumer. This “edge delivery” architecture is used to reduce packet latency, allow audience scalability, minimise bandwidth consumption, and ultimately improve

end-user quality. Applying the same edge delivery approach to the mobile environment simply means that the mobile operator offers an additional node in a distributed delivery network.

The benefits of edge delivery on the wireline Internet can be realised in the mobile environment, even if not required. The deployment of replication technology within the mobile operator’s network must support the caching of static streaming content and the “splitting” of live content.

In addition, the deployment of a dedicated server and proxy within the Public Land Mobile Network (PLMN) also provides an opportunity to integrate QoS and billing mechanisms that are supported on the network to be tied directly to the delivery of streaming content. This provides greater flexibility in the plans for tiered-service access for mobile consumers.

### Streaming Server in action

Here is an example of a service taking advantage of Streaming Server. The end-user is checking cinema listings with his/her mobile phone and is offered preview clips of the films:

- Having selected a movie clip, a streaming request is authenticated and the service is authorised before transmission
- The streaming server begins transmission of the clip and generates accounting information
- The transmission quality is monitored and, in case of network congestion, an adjustment is made to optimise the quality of the playback if necessary
- At the end of the stream, the accounting information is updated and the session ends

## Digital rights management

When using streaming technology, the content is not saved onto the terminal after the streaming session is over, thus the increasingly important issues on the illegal copying of content are taken care of. Moreover, a flexible and reliable way to distribute digital content on the mobile Internet has been achieved as content access, digital copyrights management and streaming can be handled together. Mobile DRM (Digital Rights Management) provides the infrastructure for the usage and transaction control of content delivered over the air.

The ability to protect the intellectual property rights of the content owners is a key success factor in the mobile digital content market. Protecting commercial content from misuse – for example, from free copying or forwarding – has been mainly implemented by delivery control mechanisms combined with forward lock functionality. This means that the content is paid for before downloading is initiated, and the mobile terminal software prevents the downloaded content being forwarded. The development of copyright protection will continue by allowing the user to review content before paying for it.

In order to enable more new content discovery mechanisms, such as peer-to-peer distribution that can offer an increased audience for the content, new methods are needed for content protection. The superdistribution phase of DRM defines the ability to deliver the usage rights and the content separately from each other and at different times. For example, this enables a user to forward content to a friend who cannot

access it without purchasing the corresponding rights from an operator-run service. This feature enables peer-to-peer distribution of quality content from one user to another

Ultimately, Public Key Infrastructure or PKI-type security layers can be used to protect usage rights. However, this will require complex key management schemes and related investments; therefore, there is a need for jointly agreed open standards (3GPP Release 6).

With more mobile terminals supporting media capabilities, mobile DRM will become a major industry issue. The whole mobile industry will benefit from having good standards in place and the users will agree to pay for good quality content at the right price. Nokia is actively driving the process to standardise the mobile DRM structure and thus ensuring the interoperability of mobile terminals that support DRM.

## Conclusions

Streaming is an increasingly popular technology with which to view and listen to multimedia content. Streaming services are becoming available on wireless networks and offering new services and usage possibilities.

As a technology, streaming offers a "pseudo real-time service", which means that the user can play multimedia content without downloading the entire file. This has multiple benefits as it frees valuable terminal memory and enables the distribution of larger media files as well as live services.

Additionally, streaming also prevents illegal copying of the content because it is not saved onto the terminal after it has been played, making it a secure way to distribute digital content on the mobile Internet.

The streaming services provider requires a streaming server for content storage and delivery and the user must have a media player for content viewing. In short, the media player client opens the connection to the content server and starts to stream the multimedia content at a payload rate. The client then plays the content with a minimum delay or none at all.

Like most new technologies, streaming also enables new service concepts. The most promising early applications can be found in the fields of information, entertainment and person-to-person communication:

Streaming has multiple benefits. Consumers can enjoy multimedia content when choose to and even while on the move. Operators can provide different new service concepts. Content providers will have a new market for their Digital Rights Management protected content.

The ability to protect the intellectual property rights of the content owners is a key factor for success in the mobile digital content market. Nokia is actively driving the process to standardise the mobile Digital Rights Management structure, thus ensuring interoperability of mobile terminals that support DRM.

Nokia is also actively promoting 3GPP's Packet Switched Streaming (PSS) standard. Thus by using standardised solutions, we can create non-fragmented and interoperable mobile services across the markets.

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