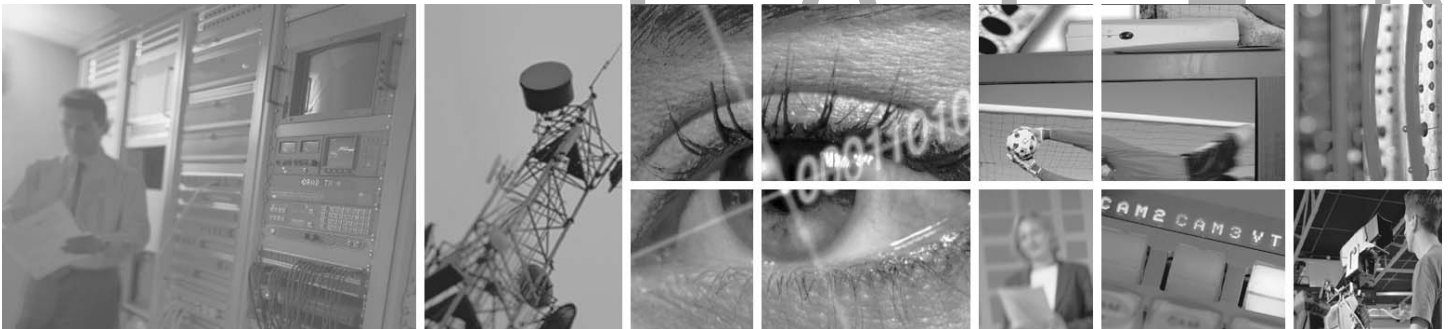


# MPEG-4 MULTI-RATE CODING AND ENVIVIO IMPLEMENTATION

# WHITE PAPER



**Addressing the Problem of Adaptive Video Streaming Over Heterogeneous Networks**

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# 1. Introduction

Scalable coding and multi-rate coding are the main solutions to address the problem of adaptive video streaming over heterogeneous networks.

The variety of capabilities and qualities of different networks and decoders obliges content distributors to produce assets targeted for particular bandwidths and decoding platforms. (GSM bandwidth and quality of service is far from the capabilities and bandwidth of a DSL line or new fiber deployments; CPU available on a mobile phone is poor compared to one of the latest set-top boxes or PCs.)

On IP networks, the problem is even more complex. Since there is hardly any guarantee on the bandwidth available, the quality of service may degrade unexpectedly and the bandwidth reduced in capacity.

Despite these varying conditions, MPEG-4 allows continuous transmission of content.

MPEG-4 has been designed with these network constraints in mind, and a set of features and algorithms have been incorporated into the standard to overcome these issues. Among them, multi-rate coding is the most promising solutions.

Envivio is implementing most of these features in its product line. This white paper describes multi-rate coding within Envivio products.

The multi-rate coding solution reduces travel costs while improving productivity with more efficient corporate communications. It meets enterprise needs for delivering a broad range of corporate communications, including morning calls, executive messages or HR announcements, corporate sales and partners' training, marketing messages, academic training and e-learning in corporate, financial, insurance, pharmaceutical, law, military, government, and academic environments.

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## 2. Multi-rate coding

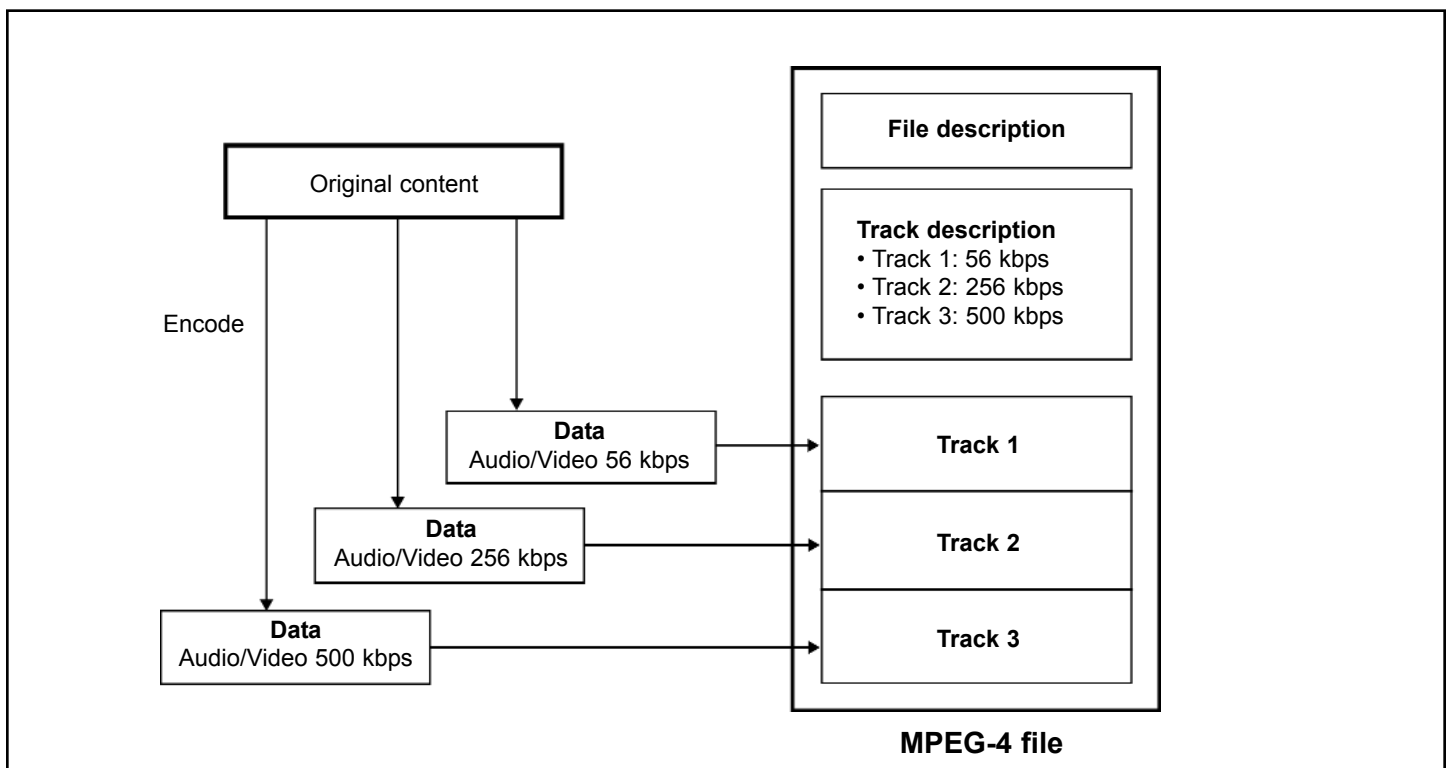
The simplest and most efficient solution to stream over heterogeneous networks is to encode content for different target bit rates. For example, today's video streams available on the Internet are encoded at 56 kbps, 256 kbps, 500 kbps; the user picks the correct bit rate according to the required bandwidth. This is the most basic version of 'multi-rate' encoding.

The content is optimally encoded for each of the above rates; but on the other hand, there is no way to switch automatically to a higher or lower bandwidth when network conditions change. It may also be necessary to produce multiple versions of the same content, thereby increasing the cost in storage and asset management system.

MPEG-4 part 1 (systems part) solves this issues by aggregating and signaling multiple versions of the same

content in one file: each target bit rate is stored in a track of the MPEG-4 file, and a track description is added inside the file header. By storing into different tracks and aggregating all the tracks in one file, MPEG-4 solves the following problems:

- Content management: One file represents one asset, all the metadata are common and included in the file header.
- Auto-configuration for streaming: The descriptions of the different tracks are sent during the streaming initialization; the decoder automatically picks the one that is the most suitable for its capacities and "tunes" to the corresponding track.
- Bandwidth adaptation: At any time, the decoder has the ability to "tune" to another track, according to the network conditions.



### 3. Scalable video

MPEG-4 part 2 (video part) also proposes a scalable approach with base track (also called layer) and enhancement layers. The base layer is encoded at the lowest bit rate, and the enhancement layers contain the necessary information to enrich the base layer and reach higher qualities and bit rates.

This approach is one step further in multi-rate coding and reduces the final size of the MPEG-4 file. Mathematical and subjective studies, however, have shown that the quality of a content with the (base layer + enhancement layer) at a certain bit rate is not as good as the same content encoded directly at an identical overall bit rate. For that reason, there has been no deployment of MPEG-4 scalable video in the market today.

## 4. Implementation of multi-rate encoding in Envivio product lines

3GPP has chosen in its latest specification to include the multi-rate feature of MPEG-4 since dynamic bandwidth management is crucial for the next generation of cell phones. Based on these specifications, Envivio is delivering the first 3GPP multi-rate live and offline encoder. These features will be generally available in the Envivio product line after the 3GPP release.

This section of the white paper provides a brief overview of Envivio products that will implement the multi-rate feature of MPEG-4 systems.

### 4Coder

Envivio 4Coder™ non real-time MPEG-4 encoder will allow the selection of multiple encoding profiles to produce one multi-rate MPEG-4 file based on the description given above.

### 4Caster

Envivio 4Caster™ real-time MPEG-4 encoder will encode simultaneously three or four live streams at different bit rates and resolutions. Along with these streams, it will transmit a description file (called "Session Description Protocol" file) giving full information about these different live streams. By using this description, a video server or a decoder will be able to pick the most appropriate stream.

### 4View / ETV

Envivio 4View™/EnvivioTV™ decoders will be able to select the most appropriate stream based on its initial bandwidth capabilities.

The player uses RTCP to report the quality of service back to the server. During the streaming, the decoder and server will use this quality of service report channel to exchange information and decisions for tuning to another higher or lower quality stream.

### 4Sight

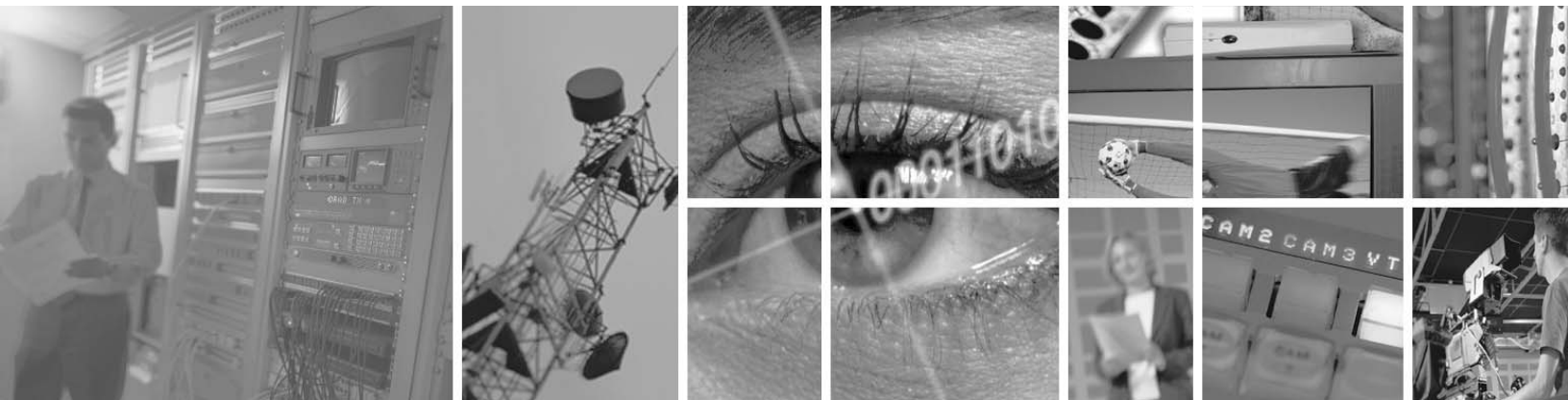
The Envivio 4Sight™ video streaming server will be able to handle multi-rate MPEG-4 file. Based on the information received from the players about the quality of the network and the player capacities, the server will pick the most appropriate stream to send to the player.

During streaming, the video server will be capable of switching seamlessly between one track and another, allowing dynamic bandwidth adaptation.

## 5. Conclusion

During the design phase of MPEG-4, a lot of thoughts have been put to answer the problems of streaming over heterogeneous networks. Multi-rate coding is today the best solution to this problem.

Envivio is committed to introduce this feature in its product line, following the development and adoption of the multi-rate extensions in the 3GPP specification. This will allow greater flexibility for content distributors as well as better content management for content creators.



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