Video variety

From simple broadcast tv to the delivery of advanced services. By **Mario Giani and Arnaud Duclap**.

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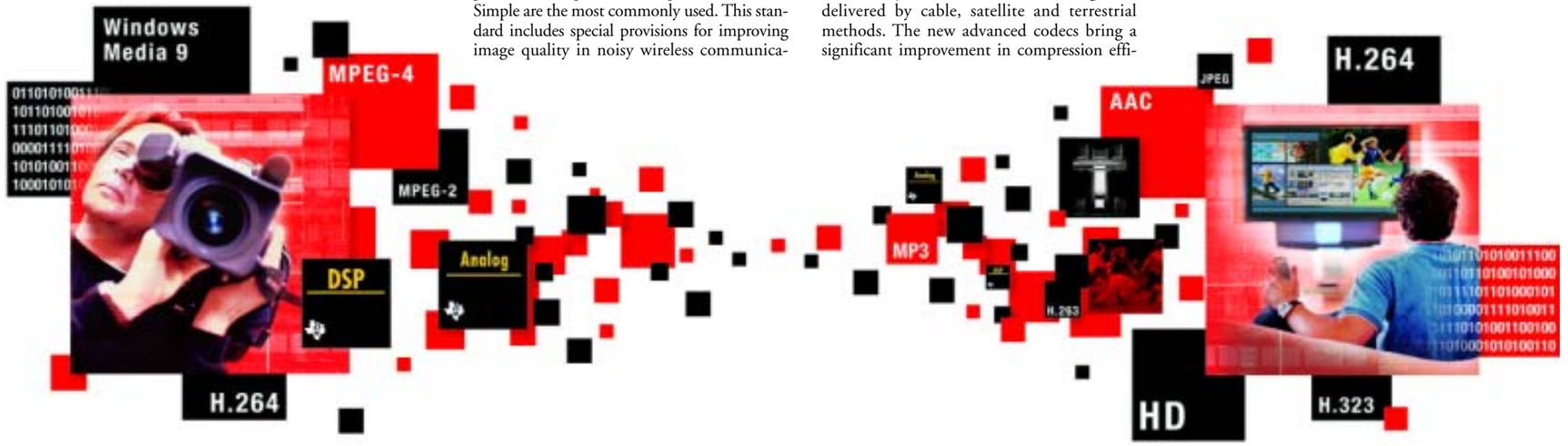
The increasing spread of broadband networks such as DSL has opened up new possibilities for services delivered by television. The availability of an in band fast return channel represents a big innovation with respect to the traditional satellite, cable or hertzian networks. And the use of a bidirectional IP infrastructure enables the deployment of a variety of services and applications.

These services are more varied and attractive than normal broadcast television. Particularly attractive is the fact that all these applications – usually associated with different devices – can be accessed through a single interface: the tv set connected to an IP based set top box. Some of these services include: interactive tv, where the user can select different angles of view or control instant replay of selected sequences; personal video recording, where the application records the transmitted program locally (for example, a hard disk or a DVD) to be played and/or edited later; video on demand; music or picture download; electronic program guide, web browsing and email; voice over IP; electronic commerce; video telephony; and games.

Obviously, the list is not exhaustive and a larger and richer variety of services can be imagined by the operators to match the customer demand.

Whilst we have seen technology starting to be deployed this year, next year will probably see mass deployment. Today, this is a niche market, with few units sold around the world, but if you look at the rate at which adsl has been adopted and the energy with which operators are pursuing the opportunities, this market is likely to grow rapidly for at least the next five years.

A factor which is limiting the deployment of IP set top box technology is the bandwidth provided by the broadband network. Traditional digital tv services are mostly based on Mpeg2.



To achieve good video quality in standard tv resolution – comparable to that of tv services on satellite or cable networks – the bit rate of an Mpeg2 encoded video should be in the range from 3 to 5Mbit/s. This is much higher than a dsl line can allow. Furthermore, high definition tv (HDTV) requires up to five times the bandwidth of the standard resolution and this will not be possible with current dsl systems.

The problem of limited bandwidth has boosted the development of new encoding algorithms, known as advanced video codecs. These new compression techniques, together with the upgrade of DSL towards ADSL2 or ADSL2+, will enable the transmission of high quality multiple standard resolution tv signals and even the transmission of HDTV.

Other difficulties

In addition to the bandwidth problems, the IP network also creates new difficulties, such as the jitter in the reception of the packets and packet losses. These problems can not only be mitigated by using appropriate mechanisms like data buffering or by mechanism of forward error correction, but also by applying some techniques of error concealment and error resilient coding provided by the new codecs.

The main video codec algorithms are briefly outlined here.

- *Mpeg2:* This compression algorithm has been adopted by most of the traditional digital tv system. The typical bit rate for a standard tv resolution is 4 to 8Mbit/s with a 30:1 compression ratio. The key elements of this algorithm are block based discrete cosine transform (DCT) and motion compensation. It is also used for HDTV and DVD. A higher compression ratio is used for DSL, which results in lower quality of the decoded video.
- *Mpeg4:* This is the ISO audio visual coding standard for multimedia applications. It includes a variety of tools that support merging graphics objects with video. Like Mpeg2, it supports different profiles – Simple and Advanced Simple are the most commonly used. This standard includes special provisions for improving image quality in noisy wireless communications, so it is widely used in mobile systems. It has a slightly better compression than Mpeg2, especially at the lower bit rates.
- *WM9:* Windows Media 9 is a video compression algorithm developed and proposed by Microsoft. It produces the same quality as Mpeg2, but at half the bit rate. The key features of WM9 are the usage of multiple variable length coding tables, DCT with variable transform size, sub pixel motion compensation and adaptive in loop deblocking filtering. The availability of video content encoded with WM9 is rapidly increasing and this coding method is under consideration for use in high definition DVDs.
- *H.264, or Mpeg4 advanced video coding (AVC):* This standard has been developed jointly by ITU-T and ISO/IEC committees. The ITU-T name for the standard is H.264 (previously called H.26L), whilst the ISO/IEC name is Mpeg4 AVC, which will become Part 10 of the Mpeg4 standard. This video compression standard promises a significant improvement over both Mpeg2 and Mpeg4. Different profiles and levels are allowed and many different compression techniques can be present or not, depending on the profile and level.

In terms of coding efficiency, the highest profile and level provides at least a factor of two improvement in compression, combined with a substantial improvement in perceptual quality. The main additional features with respect to Mpeg2 are sub pixel motion compensation, reversible transform and non uniform quantisation, a loop deblocking filter and adaptive field or frame coding. The computational complexity of this codec, especially for a full feature implementation, is considerably higher than for other standards.

- *Others:* Other video codecs are used, especially in the internet world, and these include Real Video, Mjpeg, Mpeg1, DivX and VP6.

So far, the most successful of these standards has been Mpeg2, currently widely used in several systems such as DVD and digital tv delivered by cable, satellite and terrestrial methods. The new advanced codecs bring a significant improvement in compression efficiency and quality, so it is expected these codecs will become more popular in the future. However, due to the large amount of Mpeg 2 encoded video content, these systems are likely to continue to coexist with advanced codecs for many years.

A variety of algorithms is also in use for audio applications. These include: Mpeg1, Mpeg2, MP3, AC3, AAC, AAC High Efficiency and Real Audio.

IP set top box architecture

The proliferation of the audio/video codec standards makes the selection of a platform for an IP STB particularly difficult. Furthermore, the decision on the hardware platform to use is sometimes made in advance of product deployment. It is evident that a set top box must be built on a flexible programmable platform that can support many audio/video decoding standards and networking protocols. Such a solution should be flexible and should allow continued improvements in quality and adjustments to standards through software updates.

A dual processor platform, with a CPU and a DSP, is also advisable: the general purpose processor would be the best to handle the network protocols, operating systems and man machine interfaces, whilst the DSP would decode the highly computational intensive advanced video codecs.

For the near future as volumes ramp in the market, we believe the availability of dual core chips, including a general purpose processor and a dsp, will bring significant cost reduction and greater integration to the existing biprocessor architectures. NE

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