The Multimedia Interoperability Challenge

a report by
Emblaze Systems Ltd

'Interoperability' means different things to different people and organisations. Many technical and non-technical aspects of modern living are associated with the subject of interoperability.

Interoperability – as defined in the dictionary – is the ability of a system to use the parts or equipment of another system. Adopting a somewhat more common interpretation, interoperability is all about the ability of different components to talk to (or communicate sensibly between) one another.

Examples of the potential damage caused by the lack of interoperability are numerous:

- During NATO-led coalition activities in Bosnia, units from different nations experienced difficulties in communicating because of incompatible equipment.
- Many of us still remember the earlier famous Beta versus VHS wars that tried to set the standard for home video and created much chaos in the market.
- Nowadays, a European visiting Japan is typically forced to rent a local mobile phone.

The benefits of having interoperability can be demonstrated by the 'miraculous' way in which a Global System for Mobile communications™ (GSM) phone – when powered anywhere in Europe – immediately recognises the local carriers' equipment and establishes a connection with it. The advantages are further demonstrated by the ease of transferring digital multimedia data (e.g. pictures, audio and video clips) over the many different types of computers and operating systems.

How does one tackle such a far-reaching subject? To begin with, there must be some common guidelines for equipment manufacturers and content providers, to enable them to design and produce components and applications that fit each other and connect well. Such guidelines are typically the result of a standard, designed and specified by various standardisation bodies.

It should be noted that a de facto standard may not necessarily be based on some independent organisation's decisions:

- The common audio cassette was originally patented in the early 1960s by Philips, and quickly became the most interoperable media carrier in the market.
- Microsoft® Windows® is considered by many as 'standard'.
- The standard rail gauge for railways has evolved for centuries, reaching today's 'standard gauge' of about 1.5 metres, with some help from George Stephenson about 200 years ago.

Multimedia in particular, raises some exceptionally interesting topics concerning interoperability. This is partly due to the complexity involved in multimedia applications, and perhaps also because of the natural need for such applications, being a driving force for many different types of solutions and technologies that have emerged over time.

The most obvious issue concerning multimedia interoperability relates to formats. The DVD Forum has been improving the DVD format specifications since the mid 1990s. Moving Picture Experts Group (MPEG), a working group within the International Organization for Standardization/International Electrotechnical Commission (ISO/IEC) has been developing standards for digital video formats for many years now. These include MPEG-1, MPEG-2, MPEG-4 and others – each with its own internal layers, profiles and levels, not to mention many features that are optional or still under development.

Within the common digital formats of today's moving pictures (simply known as video) we also find H.263 and H.264 (commonly known as H.26L) from the International Telecommunication Union Telecommunication Standardization Sector (ITU-T) in co-operation with MPEG. In addition, the popularity of many proprietary video formats by Microsoft, RealNetworks, Apple and others, should be noted.

The situation does not get any better when trying to examine the current status of formats for audio, static images or other types of multimedia. Without going into the task of interpreting all acronyms, we often hear about formats such as PCM, AU, WAV, MP3, AMR, AAC, WMA and RA used for audio (mainly speech or music) and formats such as BMP, GIF, JPEG, PNG and TIFF that are used for static images. Other types of multimedia may include vector graphics (e.g. Flash or SVG), synthetic audio (e.g. MIDI), animations (e.g. Animated GIF or JPEG-2000), and composite presentations (e.g. SMIL).

Such a wealth of available formats inevitably produces interoperability problems, commonly solved by conversion or transcoding from one format to another. It should be noted that such conversions do not necessarily preserve all the characteristics and the quality of the original piece of multimedia. For example, an image may lose some of its fine details when converted from BMP to JPEG and the quality of an audio track may deteriorate when transcoded from AAC to AMR.

The ability to convert between many formats is not sufficient by itself. In a large system or network, where many types of device are available, a typical situation may arise when different 'client' devices possess different characteristics and capabilities. This can happen for two main reasons:

1. Different devices may possess different basic multimedia capabilities (e.g. screen size, colour depth, etc.).

2. Different devices may support different formats.

This has led to the development of additional features in the road to supporting interoperability: the capability exchange mechanism and the variant adaptation technology. Using the capability exchange mechanism, a multimedia server has the means of detecting the specific multimedia capabilities of the client. Using the variant adaptation technology, a multimedia server has the means to choose (or produce) the appropriate version of the same multimedia 'clip' that best fits these capabilities.

Delving deeper into the numerous aspects of multimedia interoperability, it can be concluded that simple format conversion may not always provide a solution. In many cases the customer's device does not support any format that is applicable for the current multimedia clip, for example, many mobile phones do not support video display, regardless of whether it is MPEG-4 or H.263 or any other video format. In other cases, the network infrastructure cannot support the appropriate bandwidth required to transfer bandwidth-demanding content such as video. The solution should involve scalability downgrade control. Putting it simply, we need to be able to adapt to totally different formats, typically less 'rich' and less 'consuming' of network or client resources. For example, conversion of a short video clip into a 'slide show', or perhaps even into a single image representing the clip.

While it is recognised that the existence of a wide-spread standard is necessary, this may not be sufficient. There may be issues that are mistakenly or intentionally left for interpretation, as well as room for proprietary enhancements. This phenomenon is encountered in today's mobile phone devices, where even though the same multimedia messaging service (MMS) standard has been implemented in several devices, they are still unable to transparently transfer multimedia messages between them. Another, somewhat older example, concerns the various ways in which WAP content is rendered by different mobile browsers.

For this reason, managing the implementation semantics is also an important part of interoperability. Whenever there is room for optional features or enhancements, some client implementation may be more restricted than others, and a server should be aware of these differences.

Similarly, a format – whether standard or not – may (and typically does) have several versions, representing its development over time. Generally, compatibility between versions (mainly backward compatibility) is dealt with, but this is not always the case. Therefore, proper version adaptation should complement capability exchange on the road to interoperability 'nirvana'.

In parallel with format conversion is the need to implement protocol conversion to complete the interoperability puzzle. Multimedia in particular presents situations where the method of transferring the content involves more than just copying it from one side to another. Consider multimedia streaming, where the content is displayed while being transferred. Another example is videoconferencing, where the realtime nature of the session is as important as the content itself.

In such cases, there are appropriate communication protocols in use, which assist in achieving the specific mode of media transfer: Protocols such as Real-time Transport Protocol (RTP) are used for transferring the media itself in a timely manner; Protocols such as Real-time Streaming Protocol (RTSP), Session Initiation Protocol (SIP), H.323 and H.324M are used for the appropriate signalling of session status. A media gateway may be in place to handle the required protocol conversion, such as between SIP and H.323 or H.324M.

There are other issues concerning testing and qualifying of products and their interoperability. The 3G Partnership Project™ (3GPP) specifies, among other things, the recommendations for multimedia support in the 3G cellular environments. Whereas, interoperability testing for this support between various manufacturers, is conducted by the International Multimedia Telecommunications Consortium (IMTC), who manage the task of testing the many client/server combinations.

Last, but not least, multimedia content should be protected against copyright violation. Digital rights management (DRM) technologies may be used for this purpose, to deal with two different aspects: appropriate encryption algorithms to actually provide the protection; and a proper way to signal the limitations, by using one of several rights languages (e.g. eXtensible rights Mark-up Language (XrML), Open Digital Rights Language (ODRL), eXtensible Media Commerce Language (XMCL)). In such cases, it is obvious that both server and client should also 'interoperate' at the DRM level. This is required in order to prevent two conflicting results: no one wants their subscribers to receive unauthorised content, but neither do they want to prevent them from receiving that which is authorised.

Emblaze Systems Ltd provides rich-media delivery solutions incorporating the components that handle interoperability at application, multimedia and network levels.

In addition to the actual development of components specifically for this purpose, Emblaze is an active and contributing member of the 3GPP Services & System Aspects Work Group 4 (SA WG4) that defines standards for mobile multimedia and codecs. Emblaze also serves as chair of the IMTC Packet Switched Streaming Activity Group (PSS-AG) for inter-operability testing according to 3GPP specifications. ■

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