Multimedia Electronic Mail: Will the Dream Become a Reality?

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Text-only electronic mail (email) is a widely used and increasingly appreciated medium for interpersonal communications. As such, it is clearly a technological success story. For many years, researchers have sought to extend and enhance this successful technology by augmenting it to permit the exchange of multimedia messages. Multimedia e mail can permit correspondents to exchange formatted text, pictures, animations, audio, video, and more. Yet despite years of interest and a number of highly visible and usable prototypes, multimedia mail has failed to achieve widespread use. Why is this so, and what are the future prospects for multimedia mail?

A wealth of prototypes and products demonstrate the feasibility and allure of multimedia mail. Microsoft Mail [6] and other commercial products permit the exchange of pictures at the level of bit-images. NeXT's mail system [7] permits voice, formatted text, images, and audio to be sent via mail. The Diamond/Slate system [11] permits mail to include formatted text, pictures, sound, spreadsheets, and more. The Andrew Message System [2] enables compound multimedia messages that include formatted text, pictures, sound, spreadsheets, animations, hierarchical drawings, hypertext links, and even embedded programs to extend the available set of media types. Research prototypes have demonstrated mail that includes video. Many multimedia mail systems have achieved success with a moderate-sized user community, but all of them have failed to make multimedia capabilities a standard part of the email environment for a significant portion of the world. Existing mail standards (notably X.400 [9] and SMTP mail as defined by RFCs 822, 1049, and 1154 [4,8,10]) make the transmission and exchange of multimedia messages *possible*, but do not specify all that is necessary to make multimedia messaging *routine*. The biggest hurdle preventing the widespread adoption of multimedia mail is the lack of agreement on standard interchange formats.

The Interchange Format Problem

Although users of Andrew, Diamond, NeXT, and Microsoft Mail can all create and read bitmap pictures, they cannot exchange them with each other because the formats are often incompatible. (Actually, interchange between Andrew and Diamond has been demonstrated, using ODA [5] as an intermediate language, but the interchange was never made automatic and transparent to users.) Not only is there no general agreement on a suitable standard representation for interchange purposes, but there is no prospect of any early agreement. There are too many current or proposed standards (such as ODA and HyTime), too many people with commercial interests in particular representation formats (such as CDA and PostScript), and simply too much technical uncertainty about the requirements of such formats, for there to be much hope of seeing a standard settled on any time soon.

Unfortunately, a standard is much more critical for email than for most other multimedia technologies. Without a standard representation format, users can never be certain that any multimedia message they send will actually be readable by its recipients. This kind of uncertainty is likely to be fatal, in that few users will devote the necessary time to composing multimedia documents if they do not expect them to be readable. Experience with the Andrew project at Carnegie Mellon [3] tends to indicate that when multimedia mail *is* made ubiquitous within a community (as it was at Carnegie Mellon by administrative fiat), it is indeed heavily used and generally perceived as valuable. However, it is unlikely that most communities will be able to force enough users to switch to a particular multimedia mail interface to achieve the necessary "critical mass" for multimedia mail to prosper.

The lack of an exchange standard, and the low likelihood of agreement on such a standard, would appear to make the short- and medium-term prospects for multimedia mail rather dim. However, a new approach offers the possibility of obviating the need for a standard interchange format, at least temporarily. In this approach, which might be thought of as "bottom-up" multimedia mail, users are *not* required to change their habits and begin using a new mail-reading program. Instead, mail-reading programs (or "user agents," as they are known in the mail world) are themselves modified in a straightforward manner to notice when a piece of mail being read is a multimedia message of an unknown type.[1]

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When such a "foreign" multimedia message is encountered, the mail-reading user agent, instead of showing the message to the user as a normal piece of mail, will call a single external program to display the message. This program, which is to be called by *all* mail-reading user agents, consults a locally customizable file that tells how to display or translate various data representation formats, and will run appropriate locally installed software to actually display the message to the user.

The benefits of the bottom-up approach are at least threefold. First, at the cost of a small modification to the code in each mail-reading interface, this approach avoids the need to convince users to change their mail-reading habits or the set of tools they use for creating and editing messages. For normal text mail, at least, nothing visible to the user needs to change at all. Second, by centralizing the handling of nontext mail in a single configurable program, this approach simplifies the administrative burden of administering multimedia mail in a heterogeneous environment. Third, by allowing the set of recognized data representation formats to grow and be individually configured at each site, it allows a multimedia mail community to grow and develop in advance of any single data exchange format standard. The bottom-up approach will thus permit users to enter the age of multimedia mail without traumatic software upheavals or arguments over interchange formats, and will permit administrators to gradually upgrade the multimedia capabilities of their site, with all mail-reading interfaces simultaneously benefiting from the upgrade.

This approach has been prototyped by the author at Bellcore and is currently being tested on a small but heterogeneous user community. Fifteen different mail-reading programs have been modified on four different hardware platforms, permitting all of their users to exchange formatted text, pictures, sound, computation objects, and even video, as permitted by the capabilities of the machines on which the mail-reading programs are run. (For example, when audio mail is read on a machine without audio capabilities, the user sees a simple message explaining that the message contains audio data that can only be read on an appropriate machine.) The results of the current deployment will be reported in a future publication.

This bottom-up approach was the focus of a recent workshop on multimedia mail sponsored by IFIP Working Group 6.5, at the MHS '90 conference [1]. Participants in that conference endorsed the bottom-up approach to multimedia mail, with individual participants volunteering to work on providing software to realize the approach and to improve X.400/SMTP gateways to permit the full exchange of multimedia messages. The workshop also proposed that a few "low-level" formats (such as FAX or some other standard for bitmap images, and some yet-unspecified standards for audio, computation, and compound messages) be promoted as *de facto* standards, so that new formats can quickly be made more widely readable via translators to more ubiquitous low-level formats. Further work from the IFIP working group, it is hoped, will produce concrete proposals for the realization of bottom-up multimedia mail.

Other Problems with Multimedia Mail

Beyond the problems posed

[1] In X.400, the international standard model for mail transport, this information is provided by the content type of the body part, while in SMTP (Internet) mail the information is encoded in a special header, as defined by RFC 1049 [8].

by the data format issue, an even thornier problem is posed by video and other media with extremely high storage requirements. Virtually all existing email systems are built on the notion of frequently copying and forwarding the entire text of a message. This is no problem at all for text, or for other media with relatively low storage requirements. However, the amount of data inherent in even a short video clip is likely to cause transmission delays and other problems in any existing message transport system. The basic paradigm of store-and-forward email may eventually need to be replaced by a new paradigm in which the delivery system usually passes around pointers to large objects, and copies those objects only when absolutely necessary, as in delivery to an external site. This will require significant extensions and modifications to existing delivery paradigms such as X.400 and SMTP—modifications which are not currently under way. Therefore multimedia mail that includes video and other data-intensive media would appear to be particularly far away at the present time.

It is often said that another impediment to multimedia mail is the lack of standard facilities for viewing and composing such mail. If the standards are defined properly, however, this is less of a problem than it seems. It is relatively easy, for example, to make a mailer say, for example, "there was a picture here but I can't show it to you on this hardware." Limited disk space on many systems is a somewhat more genuine problem, but one that is easily and incrementally solved by the addition of new storage devices at sites where multimedia mail actually catches on. It seems unlikely that lack of storage or lack of uniformly available multimedia hardware are crucial issues impeding the progress of multimedia mail.

Conclusion

In summary, multimedia mail is a very promising technology that has been crippled by a lack of standards. (Alternately, viewed against the profusion of competing standards for multimedia data representation, one could say that multimedia mail has been crippled by an *excess* of standards.) While the potential usefulness of the technology is enormous, that potential is unlikely to be realized until the power of multimedia mail is made available to a large enough community of potential users. In the absence of a generally-accepted standard, the "bottom-up" approach being pursued by IFIP and others is probably the best hope for turning the dream of multimedia mail into a reality. ◘

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