



Nathaniel Borenstein: Multipurpose Internet Mail Extensions (MIME)

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Nathaniel Borenstein describes how mail evolved from plaintext to multimedia.

Today, we think nothing of dragging a photo or spreadsheet into the email message we're composing and then pressing send. But as far back as 1990, email was primarily a text-only medium using the Latin character set. As messages moved across gateways connecting disparate networks such as Bitnet, Usenet, and NSFNet, messages were regularly corrupted.

I recently met with Nathaniel Borenstein, chief scientist of Mimecast and one of the coauthors (along with Ned Freed) of the Multipurpose Internet Mail Extensions (MIME), to talk about the tremendous leap from yesterday to today. Visit computer.org/computingconversations to watch our discussion.

GRADUATE SCHOOL

Borenstein's interest in email started when he was a graduate student at Carnegie Mellon University. In

1980, he was assigned to maintain a department email system, called Andrew, as part of a service commitment:

At that time, CMU had something called the "Lieberman queue," in which graduate students waited to be assigned a community service to their department. My assignment was maintaining this ancient email system on TOPS-10. It was such a cruddy system that I was motivated to rewrite a new one on Unix.

When Borenstein graduated and started looking for a job, Jim Morris, his thesis advisor and leader of the Andrew project, invited Borenstein to stay at CMU and "build the world's greatest email system." But building an application for the Andrew environment was a far cry from the typical email user interface:

Email was a text thing in English only.

Extensions had been made for other languages, but they only worked within national or linguistic communities. If a Japanese person went to France and used a computer there, she wouldn't be able to read Japanese email. We had a bunch of networks, including Bitnet, Usenet, and NSFNet, with people sending email to each other across them through gateways that weren't always perfect.

Using the Andrew platform, they were able to build a multimedia-enhanced application to exchange messages, but the Andrew community was a small subset of worldwide users:

What really got me thinking about standards was the day that Steve Jobs came to visit, and we showed him the Andrew Message System. He immediately tried to hire our whole team. Nobody went, so he went back to NeXT and put together his own group



to build a multimedia email system. NeXTMail—even today's Mac Mail.app, which is its descendant—is an imitation of the Andrew Message System. Of course, imitation is the sincerest form of flattery, so I had no problem with it. But once NeXTMail emerged, it was hard to ignore the fact that while my users could send pictures to each

the Internet Engineering Task Force (IETF) to develop a draft standard:

When you put together those three motivations—multipurpose, multi-language, and gateways—you get a lot of people in the mix. It doesn't matter how much good will you have, with that many people involved,

At that point, I was pretty sure I was on to something.

The MIME standard was clearly the right solution at the right time; it greatly benefitted from the earlier development of the OSI X-400 email protocol as well. X-400 was complete, well designed, and highly functional but completely impractical for incremental adoption. Critical to MIME's success was keeping it simple and backward-compatible enough to be an extension to existing practice rather than something completely new:

Borenstein realized that there were a number of important stakeholder groups interested in improving the ability to exchange enhanced email.

other and his users could send pictures to each other, my users couldn't send pictures to his users because we weren't doing it the same way.

As Borenstein started to think about who might be interested in a standard about message format interoperability, he realized that there were a number of important stakeholder groups interested in improving the ability to exchange enhanced email among different systems and networks:

Lots of people were worried about how to get non-English characters and other languages into email. Another problem was gateways: the people controlling them wanted standards for formatting that would make it possible to reliably exchange more high-level information between disparate systems and networks. MIME was a fortuitous coming together of those needs. The key moment was perhaps when Einar Steferud, one of the great unsung heroes of the early Internet, introduced me to Ned Freed and suggested we attack these problems together.

there are going to be differences of opinion. I would say we had about 70 people involved.

It took roughly a year and a half to produce a stable first draft and publish it as an IETF RFC (Request for Comments). The response was immediate:

It was a roaring success, almost overnight. One reason, I think, was that the whole time I was writing the draft RFC, I had a program called metamail that I updated to follow each version of the draft. Metamail let you make a very simple patch to existing text-only email systems, and it would call programs that would display the MIME parts. So all of a sudden, with very little work, these ancient systems started working with this cool stuff, like multiple languages or pictures. It showed that MIME was remarkably backward-compatible.

Borenstein simultaneously released the metamail software as open source and the MIME RFC-1341 publication, to make adoption as simple as possible:

I released the Unix version of metamail software and started getting patches for improvements the following day. Within the first week, I got patches for the DOS port and the Amiga port.

X-400 was the email standard from the OSI protocol stack that was supposed to replace the whole TCP/IP stack and never did. A lot of us looked at X-400 as tremendously complex and hard to integrate with existing mail systems. Our more simplified approach was a reaction to X-400's complexity, which is why you have things in MIME that you would never design if you were designing from scratch. For example, 80 column lines: the first video terminals had 80 columns so that they could easily handle punch cards, and it just went on from there. Basically, your raw email format today is still limited to short lines (though the number 80 has been somewhat relaxed) because of punch-card machines from 100 years ago.

THE WEB COMES CALLING

In addition to MIME's quick adoption for email, the emerging World Wide Web needed a way to handle file types other than plaintext and HTML:

As we were finishing it up, I got a message from someone in Switzerland saying, "I'm working on a project called the World Wide Web, and right now, it's text-only. We were thinking about how to get multimedia, and MIME might be the way to do it—do you have any opinions or ideas?"

The Web adopted the MIME approach to registering and identifying

OVERNIGHT SUCCESS

Borenstein had moved from Carnegie Mellon to Bellcore just before the MIME standardization effort got started. He and his collaborators decided to start a working group in

different types of content. The MIME content type registry continues to be an important mechanism for allowing applications to identify the different types of data being exchanged. The number of registered content types continues to grow:

When we released the MIME standard it had fewer than 20 content types, and the last time I looked, the IANA [Internet Assigned Numbers Authority] registry of MIME types was over 1,200. That kind of extensibility helped because a lot of people who had totally different motivations for what they wanted to do had an easy way to identify the data for the Web and for email.

Sometimes a less-than-elegant standard that's a perfect fit for real-world marketplace constraints is the best solution. By ensuring that the MIME standard was always implementable as a simple extension to existing email systems, MIME triggered a rapid switch from plaintext to enhanced mail around the world and across many systems. The content type registry helps keep an increasingly complex set of mail and web applications and data formats interoperable. Not too bad an outcome for a graduate student who was randomly assigned the task of maintaining a departmental email system way back in 1980. 

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revised 7 Feb. 2014

