

An Experiment in Remote Printing

Status of this Memo

This memo defines an Experimental Protocol for the Internet community. It does not specify an Internet standard. Discussion and suggestions for improvement are requested. Please refer to the current edition of the "IAB Official Protocol Standards" for the standardization state and status of this protocol. Distribution of this memo is unlimited.

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1. Introduction

Although electronic mail is preferable as a means of third-party communication, in some cases it may be necessary to print information, in hard-copy form, at a remote location. The remote output device may consist of a standard line printer, a printer with

multiple fonts and faces, a printer that can reproduce graphics, or a facsimile device. Remote output may be accompanied by information that identifies the intended recipient. This memo describes a technique for "remote printing" using the Internet mail infrastructure. In particular, this memo focuses on the case in which remote printers are connected to the international telephone network. Furthermore, it describes an experiment in remote printing.

1.1. The Advantage of a General-Purpose Infrastructure

The experiment in remote printing is about "outreach"; specifically, integrating the e-mail and facsimile communities. By providing easy access to remote printing recipients, enterprise-wide access is enhanced, regardless of kind of institution (e.g., commercial, educational, or government), or the size of institution (e.g., global, regional, or local). This approach at outreach allows an organization to make it easier for the "outside world" to communicate with the personnel in the organization who are users of facsimile but not e-mail; e.g., the sales person, the university registrar, or the (elected) official. The ease in which the Internet mail infrastructure can be used to provide this facility is (yet) another example of the power of a general-purpose infrastructure.

2. Procedure

When information is to be remotely printed, the user application constructs an RFC 822 [1] message, containing a "Message-ID" field along with a "multipart/mixed" content [2] having two parts, the first being a "application/remote-printing" content-type, and the second being an arbitrary content-type corresponding to the information to be printed. The message is then sent to the remote printer server's electronic mail address.

It should be noted that not all content-types have a natural printing representation, e.g., an "audio" or "video" content. For this reason, the second part of the "multipart/mixed" content should be one of the following:

text/plain, message/rfc822, application/postscript image/tiff
(defined in Appendix A), any multipart

Note that:

- (1) With the "text/plain" content-type, not all character sets may be available for printing.
- (2) With the "message" content-type, the subordinate content will be processed recursively.

- (3) With the "application/postscript" content-type, the remote printer server should evaluate the contents in a safe execution environment.
- (4) With the "multipart" content-type the subordinate contents will be processed recursively: for a "multipart/mixed" or "multipart/digest" content, each subordinate content will start on a new page, whilst for a "multipart/parallel" content, all subordinate contents will, if possible, start on the same page. Naturally, when processing a "multipart/alternative" content, only one subordinate content will be printed.

When the remote printer server finishes its processing, a message is returned to the originator, indicating either success or failure.

2.1. Naming, Addressing, and Routing

A printer is identified by a telephone number which corresponds to a G3-facsimile device connected to the international telephone network, e.g.,

+1 415 968 2510

where "+1" indicates the IDDD country code, and the remaining string is a telephone number within that country. This number is used to construct the address of a remote printer server, which forms the recipient address for the message, e.g.,

remote-printer@0.1.5.2.8.6.9.5.1.4.1.tpc.int

That is, the local-part of the remote printer server's address is ALWAYS "remote-printer", and the domain-part is constructed by reversing the telephone number, converting each digit to a domain-label, and being placed under "tpc.int."

The message is routed in exactly the same fashion as all other electronic mail, i.e., using the MX algorithm [3]. Since a remote printer server might be able to access many printers, the wildcarding facilities of the DNS [4,5] are used accordingly. For example, if a remote printer server residing at "dbc.mtview.ca.us" was willing to access any printer with a telephone number prefix of

+1 415 968

then this resource record might be present

*.8.6.9.5.1.4.1.tpc.int. IN MX 10 dbc.mtview.ca.us.

Naturally, if several remote printer servers were willing to access any printer in that prefix, multiple MX resource records would be present.

It should be noted that the presence of a wildcard RR which matches a remote printer server's address does not imply that the corresponding telephone number is valid, or, if valid, that a G3-facsimile device is connected at the phone number.

2.2. The application/remote-printing Content-Type

- (1) MIME type name: application
- (2) MIME subtype name: remote-printing
- (3) Required parameters: none
- (4) Optional parameters: none
- (5) Encoding considerations: 7bit preferred
- (6) Security considerations: none

The "application/remote-printing" content-type contains originator and recipient information used when generating a cover sheet. Using the ABNF notation of RFC 822, the syntax for this content is:

```

<content>          ::= <recipient-info> CRLF
                        <originator-info>
                        [CRLF <cover-info>]

<recipient-info>   ::=  "Recipient"      ":" <value> CRLF
                        <address-info>

<originator-info>  ::=  "Originator"     ":" <value> CRLF
                        <address-info>

<address-info>     ::=  ["Title"          ":" <value> CRLF]
                        ["Department"      ":" <value> CRLF]
                        ["Organization"    ":" <value> CRLF]
                        ["Mailstop"        ":" <value> CRLF]
                        ["Address"         ":" <value> CRLF]
                        ["Telephone"       ":" <value> CRLF]
                        ["Facsimile"       ":" <value> CRLF]
                        ["Email"           ":" <value> CRLF]

<value>            ::=  *text
                        [CRLF LWSP-char   <value>      ]

<cover-info>       ::=  *(*text CRLF)

```

Note that the value of the "Email" field is an RFC 822 mailbox address.

2.3. Usage Example

Suppose someone wished to send the author some comments on this memo using this facility. The message constructed might look like this:

```
To: remote-printer@0.1.5.2.8.6.9.5.1.4.1.tpc.int
From: "John Q. Public" <jpublic@tpd.org>
Date: Sun, 11 Apr 1993 20:34:13 -0800
Subject: Comments on "An Experiment in Remote Printing"
Message-ID: <19930411203413000.456@tpd.org>
MIME-Version: 1.0
Content-Type: multipart/mixed;
            boundary="-----=_aaaaaaaaaa0"
```

```
-----=_aaaaaaaaaa0
Content-Type: application/remote-printing
```

```
Recipient:    Marshall Rose
Title:        Principal
Organization:  Dover Beach Consulting, Inc.
Address:      420 Whisman Court
              Mountain View, CA 94043-2186
              US
Telephone:    +1 415 968 1052
Facsimile:    +1 415 968 2510
```

```
Originator:   John Q. Public
Organization:  The Public Domain
Telephone:    +1 801 555 1234
Facsimile:    +1 801 555 6789
EMail:        "John Q. Public" <jpublic@tpd.org>
```

Any text appearing here would go on the cover-sheet.

```
-----=_aaaaaaaaaa0
Content-Type: text/plain; charset="us-ascii"
```

Here are my comments on your draft.

...

```
-----=_aaaaaaaaaa0--
```

2.4. Remote Printing without MIME

If the originator's user agent doesn't support MIME, (e.g., the originator accesses the Internet mail infrastructure via a gateway in another mail dominion), then it is still possible for remote printing to occur, albeit in a more limited fashion. Specifically, because a "application/remote-printing" content is not present, cover sheet information must be derived from some other source; and, the message body will be treated as a "text/plain" content.

Typically, a cover sheet consists of three sections:

- o information identifying the originator;
- o information identifying the recipient; and,
- o additional information supplied by the remote printer server.

To identify the originator, the remote printer server will use the message headers, usually by stripping any trace headers (i.e., "Received" and "Return-Path") and then re-ordering the remaining headers starting with the "From" header.

To identify the recipient, an alternative syntax is used for recipient addressing, in which the local-part of the remote printer server's address consists of "remote-printer" followed by an RFC 822 atom, e.g.,

remote-printer.Arlington_Hewes/Room_403@0.1.5.2.8.6.9.5.1.4.1.tpc.int

This mailbox syntax is purposefully restricted in the interests of pragmatism.

The atom following "remote-printer" is considered an opaque string for use in recipient identification when generating a cover sheet.

To paraphrase RFC 822, an atom is defined as:

```
atom      = 1*atomchar
```

```
atomchar=  <any upper or lowercase alphabetic character (A-Z a-z)>
           / <any digit (0-9)>
           / "!" / "#" / "$" / "%" / "&" / "'" / "*" / "+"
           / "-" / "/" / "=" / "?" / "^" / "_" / "`" / "{"
           / "|" / "}" / "~"
```

When generating a cover sheet using this opaque string, the remote printer server will interpret an underscore character ("_") as a

space, and a solidus character ("/") as an end-of-line sequence. A remote printer server will interpret two consecutive underscore characters in the opaque string as a single underscore, and two consecutive solidus characters as a single solidus. So, the opaque string,

Arlington_Hewes/Room_403

used in the example above might appear on the cover sheet as

To: Arlington Hewes
Room 403

Note that some Internet mail software (especially gateways from outside the Internet) impose stringent limitations on the size of a mailbox-string. Thus, originating user agents should take care in limiting the local-part to no more than 70 or so characters.

Note that by using the alternative syntax for recipient addressing, it is completely legal to send non-textual messages in which the cover sheet information is automatically derived -- simply by including "MIME-Version:" and "Content-Type:" headers in the message, but omitting the initial "application/remote-printing" content, e.g.,

To: remote-printer.Arlington_Hewes/Room_403@0.1.5.2.8.6.9.5.1.4.1.tpc.int
cc: Marshall Rose <mrose@dbc.mtview.ca.us>
From: Carl Malamud <carl@malamud.com>
Date: Sun, 18 Jul 1993 09:14:13 -0500
Subject: proposal for enhancement
Message-ID: <19930718141413000.123@malamud.com>
MIME-Version: 1.0
Content-Type: application/postscript

%!

Note that by using the alternative syntax for recipient addressing, remote printing and e-mail recipients can be identified in the same message.

3. The Experiment

In order to gain experience with this style of remote printing, an experiment is underway.

3.1. Infrastructure

The domain "tpc.int." is being populated in order to provide the MX-based infrastructure for routing to a remote printer server. In order to facilitate distributed operations, this domain is divided into a zone for each IDDD country code. Sites participating in the experiment contact the appropriate zone administrator in order to be listed, by examining the SOA resource record associated with the zone. For example, a site in the Netherlands (IDDD country code 31) would contact the zone administrator for the domain "1.3.tpc.int." in order to be listed, e.g.,

```
% dig 1.3.tpc.int. soa
```

Each zone administrator has a simple set of procedures for listing a participant. For example, in the US (IDDD country code 1), participating sites send an "exchange file" to the administrator, which indicates the prefixes that the site wishes to list. The zone administrator for the domain "1.tpc.int." merges the exchange files from all participating sites to create a zone for each area code. These zones are then replicated using the normal DNS zone transfer procedures.

3.1.1. Zones

It should be noted that zones under "tpc.int" are created on the basis of IDDD country codes and area codes; they are not created for each subdomain. For example, in the US and Canada (IDDD country code 1), no more than one zone is allocated for each area code. In contrast, for countries with a smaller numbering plan, only a single zone, for the whole country would be allocated. For example, if Fiji (IDDD country code 679), were to join the experiment, then it is likely that a single zone would be added to the DNS, i.e., "9.7.6.tpc.int."

3.1.2. MX records

The MX records present in a zone can have an arbitrary level of precision. For example, the North American Numbering Plan (IDDD country code 1) is structured by a 3-digit area code, followed by a 3-digit exchange prefix, followed by a 4-digit station number. As such, one might expect that MX records in this zone would be similar to

```
*.5.1.4.1.tpc.int.          IN MX 10 dbc.mtview.ca.us.
```


which accessed any printer with a telephone number prefix of

+1 415

(i.e., allowing access to any printer in area code 415), or might be similar to

*.8.6.9.5.1.4.1.tpc.int. IN MX 10 dbc.mtview.ca.us.

(i.e., allowing access to any printer in area code 415, exchange prefix 968).

However, the level of precision is arbitrary. For example, if all of the printers in an organization had a telephone number prefix of

+1 415 96

then an MX record such as

*.6.9.5.1.4.1.tpc.int. IN MX 10 dbc.mtview.ca.us.

could be used.

3.2. Accounting and Privacy

There is no accounting nor settlement in the experiment; however, participating sites may implement access control to prevent abuse. Records may be kept for auditing purposes; however, the privacy of a participant's printing should be honored. As such, any auditing should contain at most this information:

- o the date the message was received;
- o the "From" and "Message-ID" fields;
- o the size of the body;
- o the identity (telephone number) of the printer;
- o any telephony-related information, such as call duration;
and,
- o any G3-related information, such recipient ID.

3.3. Mailing list

There is a mailing list for the experiment. Interested readers should send a note to:

tpc-rp-request@aarnet.edu.au

and ask to subscribe to the

tpc-rp@aarnet.edu.au

list.

3.4. Prototype Implementation

A prototype implementation is openly available. The MIME instructions for retrieval are:

```
MIME-Version: 1.0
Content-Type: multipart/alternative;
    boundary="-----=_aaaaaaaaaa0"
Content-Description:  pointers to ftp and e-mail access

-----=_aaaaaaaaaa0
Content-Type: message/external-body;
    access-type="mail-server";
    server="archive-server@ftp.ics.uci.edu"

Content-Type: application/octet-stream; type="tar";
    x-conversions="x-compress"
Content-ID: <4599.735726126.1@dbc.mtview.ca.us>

mimesend mrose/tpc/rp.tar.Z

-----=_aaaaaaaaaa0
Content-Type: message/external-body;
    access-type="anon-ftp"; name="rp.tar.Z";
    directory="mrose/tpc"; site="ftp.ics.uci.edu"

Content-Type: application/octet-stream; type="tar";
    x-conversions="x-compress"
Content-ID: <4599.735726126.2@dbc.mtview.ca.us>

-----=_aaaaaaaaaa0--
```

This package contains software for UNIX-based systems, and was developed and tested under SunOS, with an openly-available facsimile package (Sam Leffler's FlexFAX package), and contains information for sites acting as either client or server participants, and zone administrators.

4. Future Issues

The experiment in remote printing described herein does not address several issues, e.g.,

- o determining which content-types and character sets are supported by a remote printer server;
- o introduction of authentication, integrity, privacy, authorization, and accounting services;
- o preferential selection of a remote printer server; and,
- o aggregation of multiple print recipients in a single message.

Initially, the experiment will not address these issues. However, subsequent work might consider these issues in detail.

5. Security Considerations

Internet mail may be subject to monitoring by third parties, and in particular, message relays.

6. Acknowledgements

Carl Malamud of the Internet Multicasting Service provided substantive comments on the design of the experiment. Douglas Comer of Purdue, Daniel Karrenberg of RIPE, Sam Leffler of SGI, Paul Mockapetris of ARPA, also provided comments.

7. References

- [1] Crocker, D., "Standard for the Format of ARPA Internet Text Messages", STD 11, RFC 822, UDEL, August, 1982.
- [2] Borenstein, N., and N. Freed, "MIME: Mechanisms for Specifying and Describing the Format of Internet Message Bodies", RFC 1341, Bellcore, Innosoft, June 1992.
- [3] Partridge, C., "Mail Routing and the Domain System", RFC 974, CSNET CIC BBN, August 1982.
- [4] Mockapetris, P., "Domain Names -- Concepts and Facilities", STD 13, RFC 1034, USC/Information Sciences Institute, November 1987.

- [5] Mockapetris, P., "Domain Names -- Implementation and Specification", STD 13, RFC 1035, USC/Information Sciences Institute, November 1987.

8. Authors' Addresses

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Fax: +1 202 628 2042
EMail: carl@malamud.com

Appendix A. The image/tiff Content-Type

- (1) MIME type name: image
- (2) MIME subtype name: tiff
- (3) Required parameters: none
- (4) Optional parameters: none
- (5) Encoding considerations: base64
- (6) Security considerations: none
- (7) Published specification: TIFF class F, as defined in:

Tag Image File Format (TIFF) revision 6.0

Developer's Desk Aldus Corporation 411 First Ave. South Suite
200 Seattle, WA 98104 206-622-5500

Appendix B. Uniform Addressing

A user may choose to include several recipients in a message, one or more of which may be recipients reached via remote printing. However, the message format accepted by a remote printer server contains only a single recipient.

There are three solutions to this problem: first, during composition, a "smart" user agent can determine that one or more remote printing recipients are present, and submit the appropriate messages. This has the disadvantage that the submission for the e-mail recipients does not contain any information about the remote-printing recipients.

A second solution is to use the alternative syntax for recipient addressing described in Section 2.4 -- however, this minimizes useful information available when constructing the cover sheet.

A third solution is for a site participating as a client to offer a remote printing recipient exploder server to its users. Each remote printing recipient is assigned a mailbox relative to the exploder, and, as such, appears as an "ordinary" e-mail address. Using this strategy, the user agent has no knowledge of which recipients are accessible via e-mail or remote-printing -- the user simply specifies a collection of mailbox recipients. Those recipients which are accessible via remote-printing are automatically routed to the exploder. For each recipient in the envelope, a local database is

consulted to retrieve addressing information for the recipient, and a message is submitted to the appropriate remote printer server.

For example, if the original message submitted was:

```
To: mrose@rpexplode.tpd.org
cc: Arlington Hewes <tpcadmin@dbc.mtview.ca.us>
From: "John Q. Public" <jpublic@tpd.org>
Date: Sun, 11 Apr 1993 20:34:12 -0800
Subject: Comments on "An Experiment in Remote Printing"
Message-ID: <19930411203412000.123@tpd.org>
MIME-Version: 1.0
Content-Type: text/plain; charset=us-ascii
```

Here are my comments on your draft.

...

then the first recipient, "mrose@rpexplode.tpd.org", would be routed to an remote printing exploder, which would submit the message shown in the example in Section 2.3. The second recipient, "tpcadmin@dbc.mtview.ca.us", would receive the message shown here. Note that a reply by this recipient could include the remote printing recipient.