                     An Experiment in Remote Printing

Status of this Memo

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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/postcript

%!

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.

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   Washington, DC 20045
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   Phone: +1 202 628-2044
   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.