            Principles of Operation for the TPC.INT Subdomain:
                  Radio Paging -- Technical Procedures

Status of this Memo

   This memo provides information for the Internet community. This memo
   does not specify an Internet standard of any kind. Distribution of
   this memo is unlimited.

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1. Introduction

   As an adjunct to the usual, two-way electronic mail service, it is at
   times useful to employ a one-way text notification service, called
   radio paging. This memo describes a technique for radio paging using
   the Internet mail infrastructure. In particular, this memo focuses
   on the case in which radio pagers are identified via the
   international telephone network.

   The technique described by this memo, mapping telephone numbers to
   domain names, is derived from the TPC.INT subdomain. Consult RFC
   1530, "Principles of Operation for the TPC.INT Subdomain: General
   Principles and Policy" for overview information.

2. Naming, Addressing, and Routing

   A radio pager is identified by a telephone number, e.g.,

      +1 415 940 8776

   where "+1" indicates the IDDD country code, and the remaining string
   is a telephone number within that country.

   In addition to a telephone number, a PIN may also be required to
   uniquely identify a radio pager.

2.1. Addressing

   This number is used to construct the address of a radio paging
   server, which forms the recipient address for the message, e.g., one
   of:

      pager.ATOM@6.7.7.8.0.4.9.5.1.4.1.tpc.int
      pager-alpha.ATOM@6.7.7.8.0.4.9.5.1.4.1.tpc.int
      pager-numeric@6.7.7.8.0.4.9.5.1.4.1.tpc.int

   where "ATOM" is an RFC 822 atom [1], an opaque string for use in
   recipient identification when communicating with the paging network,
   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 telephone number must not include any international
   access codes.)

   Note that the mailbox syntax is purposefully restricted in the
   interests of pragmatism. To paraphrase STD 11, 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)>
                / "!" / "#" / "$" / "%" / "&" / "'" / "*" / "+"
                / "-" / "/" / "=" / "?" / "^" / "_" / "`" / "{"
                / "|" / "}" / "~"

   Finally, 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.

2.2. Routing

   The message is routed in exactly the same fashion as all other
   electronic mail, i.e., using the MX algorithm [2]. Since a radio
   paging server might be able to access many radio pagers, the
   wildcarding facilities of the DNS [3,4] are used accordingly. For
   example, if a radio paging server residing at "dbc.mtview.ca.us" is
   willing to access any radio pager with a telephone number prefix of

      +1 415 940

   then this resource record might be present

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

   Naturally, if several radio paging servers were willing to access any
   radio pager in that prefix, multiple MX resource records would be
   present. (The DNS servers for the TPC.INT subdomain perform a
   rudimentary form of load balancing by rotating the order of the MX
   records returned on each query.)

   It should be noted that the presence of a wildcard RR which matches a
   radio paging server's address does not imply that the corresponding
   telephone number is valid, or, if valid, that a radio pager is
   identified by the phone number. Rather, the presence of a wildcard
   RR indicates that a radio paging server is willing to attempt access.

3. Procedure

   When information is to be sent to a radio pager, the user application
   constructs an RFC 822 message, containing a "Message-ID" field and a
   textual content (e.g., a "text/plain" content [5]).

   The message is then sent to the radio paging server's electronic mail
   address. The radio paging server begins by looking at the local part
   of the address.

3.1. Alpha-numeric Radio Pagers

   If the local-part is either "pager.ATOM" or "pager-alpha.ATOM" then
   this indicates that the recipient is using an alpha-numeric radio
   pager, and ATOM either identifies a paging network (CARRIER), or a
   radio pager identity number (PIN), or both, according to these rules:

   (1) if ATOM consists entirely of numeric characters, then ATOM is a
        PIN, and the domain-part refers to the IXO access telephone
        number for a radio paging carrier; otherwise,

(2) if ATOM does not contain a hyphen character ("-"), then ATOM is
     a CARRIER, a local database is consulted to determine the
     corresponding IXO access telephone number, and the telephone
     number corresponding to the domain-part is used to identify the
     radio pager; otherwise,

(3) if ATOM does contain a hyphen character ("-"), then everything
     to the left of the first hyphen is a CARRIER, and everything to
     the right of that hyphen is a PIN, a local database is consulted
     to determine the corresponding IXO access telephone number, and
     the PIN is used is used to identify the radio pager.

If the local-part starts with "pager.", then the message sent to the
radio pager consists of the body of the message; otherwise, if the
local-part starts with "pager-alpha.", then the radio paging server
determines which information in the headers and body of the message
are used when constructing the paging message. For example, some
radio paging servers might choose to examine the "To" and "Subject"
fields, in addition to the body, whilst other radio paging servers
might choose to simply send the body verbatim.

3.2. Numeric Radio Pagers

If the local-part is the literal string "pager-numeric" then this
indicates that the recipient is using a numeric pager, and the radio
pager dials the telephone number corresponding to the domain-part.

The message sent to the radio pager consists of the body of the
message, which must consist solely of digits.

3.3. MAILing versus SENDing

An SMTP client communicating with a radio paging server may use
attempt either the MAIL or SEND command. The radio paging server
MUST support the MAIL command, and MAY support any of the SEND, SOML,
or SAML commands.

If the MAIL command is used, then a positive completion reply to both
the RCPT and DATA commands indicates, at a minimum, that the message
has been queued for transmission into the radio paging network for
the recipient, but is at least queued for transmission into the radio
paging network.

If the SEND command is used, then a positive completion reply to both
the RCPT and DATA commands indicates that the message has been
accepted by the radio paging network for delivery to the recipient.

If the SOML or SAML command is used, then a positive completion reply
to both the RCPT and DATA commands indicates that the message may
have been accepted by the radio paging network for delivery to the
recipient.

3.4. Latency

Although the Internet electronic mail service tends to perform
delivery in a timely and reliable manner, some paging services will
wish to provide a higher degree of assurance to their clients, in
particular guaranteeing that a positive reply code means that the
page has been sent on the radio paging network. For such
requirements, the primary constraints are server implementation and
client/server network connectivity.

A client that uses the SEND or SAML commands is explicitly requesting
real-time transmission on the radio paging network and is requiring
that the server reply code will carry a statement of success or
failure about that transmission.

The IP level of the Internet performs datagram store-and-forward
service, but gives the end system hosts the appearance of direct
connectivity, by virtue of allowing interactive service. The
Internet electronic mail service adds another layer of store-and-
forward indirection, so that messages may go through any number of
relays (and/or gateways). This may introduce arbitrarily large
delays of minutes, hours, or days.

A client that configures their Internet attachment to permit "direct"
SMTP connectivity to a radio paging server will be able to submit
paging requests to the server directly, without additional SMTP-
relaying. That is, transmission from radio paging client to server
will be one "SMTP-hop"only. This will eliminate any possibility of
non-deterministic delay by the Internet itself.

The combination of configuring radio paging server and client to
allow direct IP/SMTP-level interaction and ensuring that they use
SEND or SAML commands only will mean that a client receiving a
positive reply from the server is assured that the page has been sent
on the radio paging network.

4. Usage Examples

These examples make use of the "iddd.tpc.int" subdomain. The DNS
servers for this subdomain, upon encountering a domain of the form:

        NUMBER.iddd.tpc.int

automatically create a CNAME RR of the form:

        R.E.B.M.U.N.iddd.tpc.int

    e.g.,

        14159408776.iddd.tpc.int

    will be treated as

        6.7.7.8.0.4.9.5.1.4.1.tpc.int

4.1. A MIME Example

        To: pager-alpha.98765@18005551234.iddd.tpc.int
        cc: Marshall Rose <mrose@dbc.mtview.ca.us>
        From: Carl Malamud <carl@malamud.com>
        Date: Thu, 22 Jul 1993 08:38:00 -0800
        Subject: First example, for an alphanumeric pager
        Message-ID: <19930908220700.1@malamud.com>
        MIME-Version: 1.0
        Content-Type: text/plain; charset=us-ascii

        A brief textual message sent to the radio paging network
        having an IXO access telephone number of "+1-8005551234"
        to the radio pager having a PIN of "98765".

4.2. A Non-MIME Example

        To: pager-numeric@14159408776.iddd.tpc.int
        From: Carl Malamud <carl@malamud.com>
        Date: Thu, 22 Jul 1993 08:38:00 -0800
        Subject: Second example, for a numeric pager
        Message-ID: <19930908220700.2@malamud.com>

        2026282044

5. Server Configuration Example

    A hypothetical radio paging carrier, e.g.,

        Pigeon Paging

    might choose to integrate its radio paging services with Internet e-
    mail in the following fashion:

(1)   The radio paging carrier establishes a top-level domain name,
      e.g.,

          pigeon.net

(2)   The radio paging carrier installs and operates one or more
      radio paging servers, each having a unique entry in the DNS,
       e.g.,

          ixo1.pigeon.net.   IN A a.b.c.d

      Each of these radio paging servers runs an SMTP server which
      implements the SEND command as described in Section 3.3 above.

(3)   The radio paging carrier coordinates with the administrators of
      the TPC.INT subdomain to have the appropriate MX records added
      to the DNS, assigning cost values in the MX records to reflect
      any difference in the quality of service between the radio
      paging servers, e.g.,

          4.3.2.1.5.5.5.0.0.8.1.tpc.int. IN MX 5 ixo1.pigeon.net.
          4.3.2.1.5.5.5.0.0.8.1.tpc.int. IN MX 5 ixo2.pigeon.net.

      which would provide both load-balancing and redundancy
      (particularly if the servers were located at different points in
      the Internet). At this point, messages can be sent using the
      addressing formats described in Section 2.2 above.

(4)   The radio paging carrier may choose to make available a client
      program which uses the SMTP SEND command, in order to achieve
      "real-time" delivery of messages into the radio paging network.

(5)   Finally, the radio paging carry may choose to assign each of its
      customers a mailbox, e.g.,

          mrose@pager.pigeon.net

      which maps to the TPC.INT address for the customer's radio pager.

      The system(s) listed in the DNS for this domain would maintain
      the appropriate mail aliases for this mapping, e.g.,

          R: 220 pager.pigeon.net SMTP ready
          S: HELO malamud.com
          R: 220 pager.pigeon.net
          S: EXPN mrose
          R: 250 <pager-alpha.98765@18005551234.iddd.tpc.int>

At the carrier's discretion, these systems may also be the
systems running the radio paging servers. However, this needn't
be the case. For example, consider a situation where a client
program which uses the SMTP SEND command, wants to ensure that it
is talking to radio paging server for an address: e.g.,

```
R: 220 pager.pigeon.net SMTP ready
S: EHLO malamud.com
R: 220-pager.pigeon.net
R: 220 SEND
S: VRFY mrose
R: 551 User not local;
        try <pager-alpha.98765@18005551234.iddd.tpc.int>
```

or

```
R: 220 pager.pigeon.net SMTP ready
S: EHLO malamud.com
R: 220-pager.pigeon.net
R: 220 SEND
S: VRFY mrose
R: 250 <pager-alpha.98765@18005551234.iddd.tpc.int>
```

6. Security Considerations

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

7. Acknowledgements

   This document was motivated by RFC 1568 [6] and RFC 1645 [7]. In
   addition, David Crocker, Carl Malamud, and Perry Metzger also
   provided substantive comments.

8. References

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