                    DNS Encoding of Geographical Location

Status of this Memo

   This memo defines an Experimental Protocol for the Internet
   community. This memo does not specify an Internet standard of any
   kind. Discussion and suggestions for improvement are requested.
   Distribution of this memo is unlimited.

Abstract

   This document defines the format of a new Resource Record (RR) for
   the Domain Naming System (DNS), and reserves a corresponding DNS type
   mnemonic and numerical code. This definition deals with associating
   geographical host location mappings to host names within a domain.
   The data shown in this document is fictitious and does not
   necessarily reflect the real Internet.

1. Introduction

   It has been a long standing problem to relate IP numbers to
   geographical locations. The availability of Geographical location
   information has immediate applications in network management. Such
   information can be used to supplement the data already provided by
   utilities such as whois [Har85], traceroute [VJ89], and nslookup
   [UCB89]. The usefulness and functionality of these already widely
   used tools would be greatly enhanced by the provision of reliable
   geographical location information.

   The ideal way to manage and maintain a database of information, such
   as geographical location of internet hosts, is to delegate
   responsibility to local domain administrators. A large distributed
   database could be implemented with a simple mechanism for updating
   the local information. A query mechanism also has to be available
   for checking local entries, as well as inquiring about data from
   non-local domains.

2. Background

   The Internet continues to grow at an ever increasing rate with IP
   numbers allocated on a first-come-first-serve basis. Deciding when
   and how to setup a database of geographical information about
   internet hosts presented a number of options. The uumap project
   [UU85] was the first serious attempt to collect geographical location
   data from sites and store it centrally. This project met with
   limited success because of the difficulty in maintaining and updating
   a large central database. Another problem was the lack of tools for
   the checking the data supplied, this problem resulted in some
   erroneous data entering the database.

2.1 SNMP:

   Using an SNMP get request on the sysLocation MIB (Management
   Information Base) variable was also an option, however this would
   require the host to be running an appropriate agent with public read
   access. It was also felt that MIB data should reflect local
   management data (e.g., "this" host is on level 5 room 74) rather than
   a hosts geographical position. This view is supported in the
   examples given in literature in this area [ROSE91].

2.2 X500:

   The X.500 Directory service [X.500.88] defined as part of the ISO
   standards also appears as a potential provider of geographical
   location data. However due to the limited implementations of this
   service it was decided to defer this until this service gains wider
   use and acceptance within the Internet community.

2.3 BIND:

   The DNS [Mock87a][Mock87b] represents an existing system ideally
   suited to the provision of host specific information. The DNS is a
   widely used and well-understood mechanism for providing a distributed
   database of such information and its extensible nature allows it to
   be used to disseminate virtually any information. The most commonly
   used DNS implementation is the Berkeley Internet Name Domain server
   BIND [UCB89]. The information we wished to make available needed to
   be updated locally but available globally; a perfect match with the
   services provided by the DNS. Current DNS servers provide a variety
   of useful information about hosts in their domain but lack the
   ability to report a host's geographical location.

3. RDATA Format

```
      MSB                                               LSB
      +--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
      /                   LONGITUDE                   /
      +--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
      /                   LATITUDE                    /
      +--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
      /                   ALTITUDE                    /
      +--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

   where:

   LONGITUDE The real number describing the longitude encoded as a
             printable string. The precision is limited by 256 charcters
             within the range -90..90 degrees. Positive numbers
             indicate locations north of the equator.

   LATITUDE The real number describing the latitude encoded as a
             printable string. The precision is limited by 256 charcters
             within the range -180..180 degrees. Positive numbers
             indicate locations east of the prime meridian.

   ALTITUDE The real number describing the altitude (in meters) from
             mean sea-level encoded as a printable string. The precision
             is limited by 256 charcters. Positive numbers indicate
             locations above mean sea-level.

   Latitude/Longitude/Altitude values are encoded as strings as to avoid
   the precision limitations imposed by encoding as unsigned integers.
   Although this might not be considered optimal, it allows for a very
   high degree of precision with an acceptable average encoded record
   length.

4. The GPOS RR

   The geographical location is defined with the mnemonic GPOS and type
   code 27.

   GPOS has the following format:
           <owner> <ttl> <class> GPOS <longitude> <latitude> <altitude>

   A floating point format was chosen to specify geographical locations
   for reasons of simplicity. This also guarantees a concise
   unambiguous description of a location by enforcing three compulsory
   numerical values to be specified.

The owner, ttl, and class fields are optional and default to the last
defined value if omitted. The longitude is a floating point number
ranging from -90 to 90 with positive values indicating locations
north of the equator. For example Perth, Western Australia is
located at 32^ 7' 19" south of the equator which would be specified
as -32.68820. The latitude is a number ranging from -180.0 to 180.0.
For example Perth, Western Australia is located at 116^ 2' 25" east
of the prime meridian which would be specified as 116.86520. Curtin
University, Perth is also 10 meters above sea-level.

The valid GPOS record for a host at Curtin University in Perth
Western Australia would therefore be:

                GPOS -32.6882 116.8652 10.0

There is no limit imposed on the number of decimal places, although
the length of the encoded string is limited to 256 characters for
each field. It is also suggested that administrators limit their
entries to the minimum number of necessary characters in each field.

5. Master File Format

   Each host requires its own GPOS field in the corresponding DNS RR to
   explicitly specify its geographical location and altitude. If the
   GPOS field is omitted, a DNS enquiry will return no position
   information for that host.

   Consider the following example:

```
; Authoritative data for cs.curtin.edu.au.
;
@     IN     SOA       marsh.cs.curtin.edu.au. postmaster.cs.curtin.edu.au.
                 (
                         94070503           ; Serial (yymmddnn)
                         10800              ; Refresh (3 hours)
                         3600               ; Retry (1 hour)
                         3600000            ; Expire (1000 hours)
                         86400              ; Minimum (24 hours)
                 )

                 IN     NS      marsh.cs.curtin.edu.au.

marsh          IN     A       134.7.1.1
               IN     MX      0       marsh
               IN     HINFO   SGI-Indigo IRIX-4.0.5F
               IN     GPOS    -32.6882 116.8652 10.0
ftp            IN     CNAME   marsh
```

```
lillee          IN      A       134.7.1.2
                IN      MX      0       marsh
                IN      HINFO   SGI-Indigo IRIX-4.0.5F
                IN      GPOS    -32.6882 116.8652 10.0

hinault         IN      A       134.7.1.23
                IN      MX      0       marsh
                IN      HINFO   SUN-IPC SunOS-4.1.3
                IN      GPOS    -22.6882 116.8652 250.0

merckx          IN      A       134.7.1.24
                IN      MX      0       marsh
                IN      HINFO   SUN-IPC SunOS-4.1.1

ambrose         IN      A       134.7.1.99
                IN      MX      0       marsh
                IN      HINFO   SGI-CHALLENGE_L IRIX-5.2
                IN      GPOS    -32.6882 116.8652 10.0
```

The hosts marsh, lillee, and ambrose are all at the same geographical location, Perth Western Australia (-32.68820 116.86520). The host hinault is at a different geographical location, 10 degrees north of Perth in the mountains (-22.6882 116.8652 250.0). For security reasons we do not wish to give the location of the host merckx.

Although the GPOS clause is not a standard entry within BIND configuration files, most vendor implementations seem to ignore whatever is not understood upon startup of the DNS. Usually this will result in a number of warnings appearing in system log files, but in no way alters naming information or impedes the DNS from performing its normal duties.

7. References

   [ROSE91]   Rose M., "The Simple Book: An Introduction to
                       Management of TCP/IP-based Internets", Prentice-Hall,
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   [X.500.88]   CCITT: The Directory - Overview of Concepts, Models
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   [Mock87a]   Mockapetris P., "Domain Names - Concepts and
                       Facilities", STD 13, RFC 1034, USC/Information
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   [Mock87b]   Mockapetris P., "Domain Names - Implementation and
                       Specification", STD 13, RFC 1035, USC/Information
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   [FRB93]   Ford P., Rekhter Y., and H-W. Braun, "Improving the
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   [VJ89]   Jacobsen V., "The Traceroute(8) Manual Page",
                       Lawrence Berkeley Laboratory, Berkeley,
                       CA, February 1989.

   [UCB89]   University of California, "BIND: Berkeley Internet
                       Name Domain Server", 1989.
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                       anonymous FTP from ftp.uu.net., 1985.

8. Security Considerations

   Once information has been entered into the DNS, it is considered
   public.

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