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Using the Internet DNS to Distribute MIXER Conformant Global Address Mapping (MCGAM)

Status of this Memo

This document specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "Internet Official Protocol Standards" (STD 1) for the standardization state and status of this protocol. Distribution of this memo is unlimited.

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Abstract

This memo is the complete technical specification to store in the Internet Domain Name System (DNS) the mapping information (MCGAM) needed by MIXER conformant e-mail gateways and other tools to map RFC822 domain names into X.400 O/R names and vice versa. Mapping information can be managed in a distributed rather than a centralised way. Organizations can publish their MIXER mapping or preferred gateway routing information using just local resources (their local DNS server), avoiding the need for a strong coordination with any centralised organization. MIXER conformant gateways and tools located on Internet hosts can retrieve the mapping information querying the DNS instead of having fixed tables which need to be centrally updated and distributed.

This memo obsoletes RFC1664. It includes the changes introduced by MIXER specification with respect to RFC1327: the new 'gate1' (O/R addresses to domain) table is fully supported. Full backward compatibility with RFC1664 specification is mantained, too.

RFC1664 was a joint effort of IETF X400 operation working group (x400ops) and TERENA (formely named "RARE") Mail and Messaging working group (WG-MSG). This update was performed by the IETF MIXER working group.

1. Introduction

The connectivity between the Internet SMTP mail and other mail services, including the Internet X.400 mail and the commercial X.400 service providers, is assured by the Mail eXchanger (MX) record information distributed via the Internet Domain Name System (DNS). A number of documents then specify in details how to convert or encode addresses from/to RFC822 style to the other mail system syntax. However, only conversion methods provide, via some algorithm or a set of mapping rules, a smooth translation, resulting in addresses indistinguishable from the native ones in both RFC822 and foreign world.

MIXER describes a set of mappings (MIXER Conformant Global Address Mapping - MCGAM) which will enable interworking between systems operating the CCITT X.400 (1984/88/92) Recommendations and systems using using the RFC822 mail protocol, or protocols derived from RFC822. That document addresses conversion of services, addresses, message envelopes, and message bodies between the two mail systems. This document is concerned with one aspect of MIXER: the mechanism for mapping between X.400 O/R addresses and RFC822 domain names. As described in Appendix F of MIXER, implementation of the mappings requires a database which maps between X.400 O/R addresses and domain names; in RFC1327 this database was statically defined.

The original approach in RFC1327 required many efforts to maintain the correct mapping: all the gateways needed to get coherent tables to apply the same mappings, the conversion tables had to be distributed among all the operational gateways, and also every update needed to be distributed.

The concept of mapping rules distribution and use has been revised in the new MIXER specification, introducing the concept of MIXER Conformant Global Address Mapping (MCGAM). A MCGAM does not need to be globally installed by any MIXER conformant gateway in the world any more. However MIXER requires now efficient methods to publish its MCGAM.

Static tables are one of the possible methods to publish MCGAM. However this static mechanism requires quite a long time to be spent modifying and distributing the information, putting heavy constraints on the time schedule of every update. In fact it does not appear efficient compared to the Internet Domain Name Service (DNS). More over it does not look feasible to distribute the database to a large number of other useful applications, like local address converters, e-mail User Agents or any other tool requiring the mapping rules to produce correct results.

Two much more efficient methods are proposed by MIXER for publication of MCGAM: the Internet DNS and X.500. This memo is the complete technical specification for publishing MCGAM via Internet DNS.

A first proposal to use the Internet DNS to store, retrieve and maintain those mappings was introduced by two of the authors of RFC1664 (B. Cole and R. Hagens) adopting two new DNS resource record (RR) types: TO-X400 and TO-822. This proposal now adopts a more complete strategy, and requires one new RR only. The distribution of MCGAMs via DNS is in fact an important service for the whole Internet community: it completes the information given by MX resource record and it allows to produce clean addresses when messages are exchanged among the Internet RFC822 world and the X.400 one (both Internet and Public X.400 service providers).

A first experiment in using the DNS without expanding the current set of RR and using available ones was deployed by some of the authors of RFC1664 at the time of its development. The existing PTR resource records were used to store the mapping rules, and a new DNS tree was created under the ".it" top level domain. The result of the experiment was positive, and a few test applications ran under this provisional set up. This test was also very useful in order to define a possible migration strategy during the deployment of the new DNS containing the new RR. The Internet DNS nameservers wishing to provide this mapping information need in fact to be modified to support the new RR type, and in the real Internet, due to the large number of different implementations, this takes some time.

The basic idea is to adopt a new DNS RR to store the mapping information. The RFC822 to X.400 mapping rules (including the so called ’gate2’ rules) will be stored in the ordinary DNS tree, while the definition of a new branch of the name space defined under each national top level domain is envisaged in order to contain the X.400 to RFC822 mappings (’table1’ and ’gate1’). A "two-way" mapping resolution schema is thus fully implemented.

The creation of the new domain name space representing the X.400 O/R names structure also provides the chance to use the DNS to distribute dynamically other X.400 related information, thus solving other efficiency problems currently affecting the X.400 MHS service.

In this paper we will adopt the MCGAM syntax, showing how it can be stored into the Internet DNS.

1.1 Definitions syntax

The definitions in this document is given in BNF-like syntax, using the following conventions:

| | means choice
| \ | is used for continuation of a definition over several lines
| [] | means optional
| {} | means repeated one or more times

The definitions, however, are detailed only until a certain level, and below it self-explaining character text strings will be used.

2. Motivation

Implementations of MIXER gateways require that a database store address mapping information for X.400 and RFC822. This information must be made available (published) to all MIXER gateways. In the Internet community, the DNS has proven to be a practical mean for providing a distributed name service. Advantages of using a DNS based system over a table based approach for mapping between O/R addresses and domain names are:

- It avoids fetching and storing of entire mapping tables by every host that wishes to implement MIXER gateways and/or tools

- Modifications to the DNS based mapping information can be made available in a more timely manner than with a table driven approach.

- It allows full authority delegation, in agreement with the Internet regionalization process.

- Table management is not necessarily required for DNS-based MIXER gateways.

- One can determine the mappings in use by a remote gateway by querying the DNS (remote debugging).

Also many other tools, like address converters and User Agents can take advantage of the real-time availability of MIXER tables, allowing a much easier maintenance of the information.

3. The domain space for X.400 O/R name addresses

Usual domain names (the ones normally used as the global part of an RFC822 e-mail address) and their associated information, i.e., host IP addresses, mail exchanger names, etc., are stored in the DNS as a

distributed database under a number of top-level domains. Some top-level domains are used for traditional categories or international organisations (EDU, COM, NET, ORG, INT, MIL...). On the other hand any country has its own two letter ISO country code as top-level domain (FR, DE, GB, IT, RU, ...), including "US" for USA. The special top-level/second-level couple IN-ADDR.ARPA is used to store the IP address to domain name relationship. This memo defines in the above structure the appropriate way to locate the X.400 O/R name space, thus enabling to store in DNS the MIXER mappings (MCGAMs).

The MIXER mapping information is composed by four tables:

- 'table1' and 'gate1' gives the translation from X.400 to RFC822;
- 'table2' and 'gate2' tables map RFC822 into X.400.

Each mapping table is composed by mapping rules, and a single mapping rule is composed by a keyword (the argument of the mapping function derived from the address to be translated) and a translator (the mapping function parameter):

keyword#translator#

the '#' sign is a delimiter enclosing the translator. An example:

foo.bar.us#PRMD$foo\.bar.ADMD$intx.C$us#

Local mappings are not intended for use outside their restricted environment, thus they should not be included in DNS. If local mappings are used, they should be stored using static local tables, exactly as local static host tables can be used with DNS.

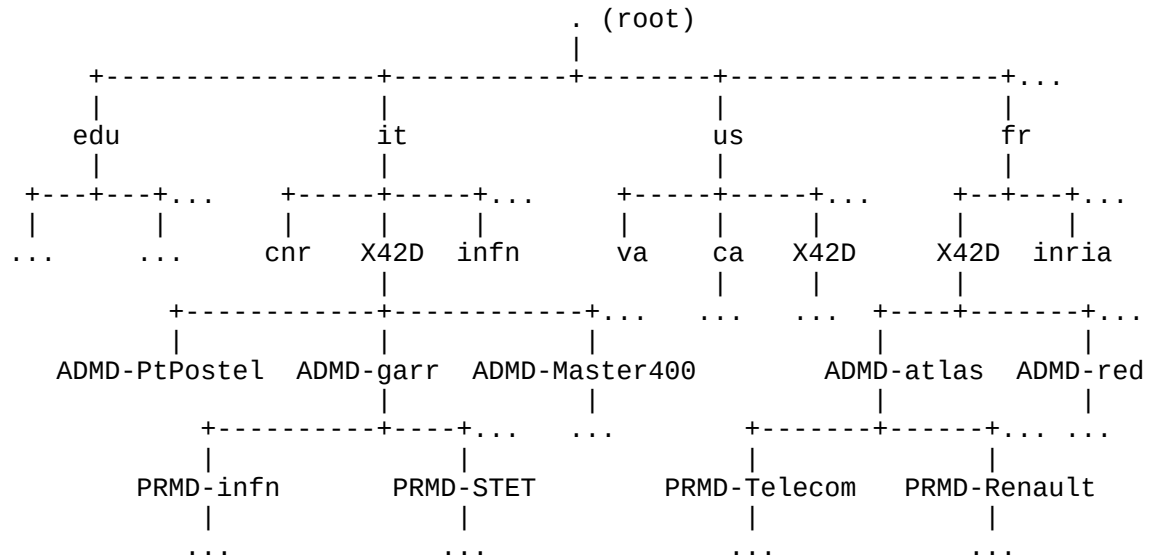
The keyword of a 'table2' and 'gate2' table entry is a valid RFC822 domain; thus the usual domain name space can be used without problems to store these entries.
On the other hand, the keyword of a 'table1' and 'gate1' entry belongs to the X.400 O/R name space. The X.400 O/R name space does not usually fit into the usual domain name space, although there are a number of similarities; a new name structure is thus needed to represent it. This new name structure contains the X.400 mail domains.

To ensure the correct functioning of the DNS system, the new X.400 name structure must be hooked to the existing domain name space in a way which respects the existing name hierarchy.

A possible solution was to create another special branch, starting from the root of the DNS tree, somehow similar to the in-addr.arpa tree. This idea would have required to establish a central authority

to coordinate at international level the management of each national X.400 name tree, including the X.400 public service providers. This coordination problem is a heavy burden if approached globally. More over the X.400 name structure is very 'country oriented': thus while it requires a coordination at national level, it does not have concepts like the international root. In fact the X.400 international service is based on a large number of bilateral agreements, and only within some communities an international coordination service exists.

The X.400 two letter ISO country codes, however, are the same used for the RFC822 country top-level domains and this gives us an appropriate hook to insert the new branches. The proposal is, in fact, to create under each national top level ISO country code a new branch in the name space. This branch represents exactly the X.400 O/R name structure as defined in each single country, following the ADMD, PRMD, O, OU hierarchy. A unique reserved label 'X42D' is placed under each country top-level domain, and hence the national X.400 name space derives its own structure:



The creation of the X.400 new name tree at national level solves the problem of the international coordination. Actually the coordination problem is just moved at national level, but it thus becomes easier to solve. The coordination at national level between the X.400 communities and the Internet world is already a requirement for the creation of the national static MIXER mapping tables; the use of the Internet DNS gives further motivations for this coordination.

The coordination at national level also fits in the new concept of MCGAM pubblication. The DNS in fact allows a step by step authority distribution, up to a final complete delegation: thus organizations whishing to publish their MCGAM just need to receive delegation also for their branch of the new X.400 name space. A further advantage of the national based solution is to allow each country to set up its own X.400 name structure in DNS and to deploy its own authority delegation according to its local time scale and requirements, with no loss of global service in the mean time. And last, placing the new X.400 name tree and coordination process at national level fits into the Internet regionalization and internationalisation process, as it requires local bodies to take care of local coordination problems.

The DNS name space thus contains completely the information required by an e-mail gateway or tool to perform the X.400-RFC822 mapping: a simple query to the nearest nameserver provides it. Moreover there is no more any need to store, maintain and distribute manually any mapping table. The new X.400 name space can also contain further information about the X.400 community, as DNS allows for it a complete set of resource records, and thus it allows further developments. This set of RRs in the new X.400 name space must be considered ’reserved’ and thus not used until further specifications.

The construction of the new domain space trees will follow the same procedures used when organising at first the already existing DNS space: at first the information will be stored in a quite centralised way, and distribution of authority will be gradually achieved. A separate document will describe the implementation phase and the methods to assure a smooth introduction of the new service.

4. The new DNS resource record for MIXER mapping rules: PX

The specification of the Internet DNS (RFC1035) provides a number of specific resource records (RRs) to contain specific pieces of information. In particular they contain the Mail eXchanger (MX) RR and the host Address (A) records which are used by the Internet SMTP mailers. As we will store the RFC822 to X.400 mapping information in the already existing DNS name tree, we need to define a new DNS RR in order to avoid any possible clash or misuse of already existing data structures. The same new RR will also be used to store the mappings from X.400 to RFC822. More over the mapping information, i.e., the MCGAMs, has a specific format and syntax which require an appropriate data structure and processing. A further advantage of defining a new RR is the ability to include flexibility for some eventual future development.

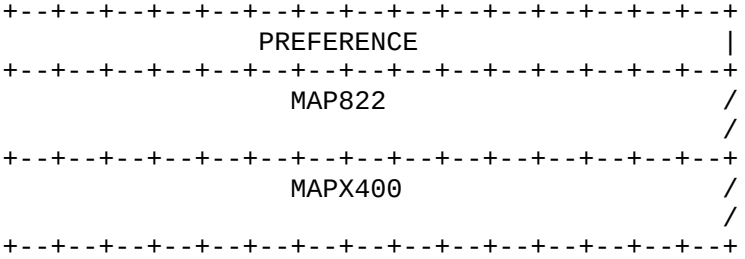
The definition of the new 'PX' DNS resource record is:

class: IN (Internet)

name: PX (pointer to X.400/RFC822 mapping information)

value: 26

The PX RDATA format is:



where:

PREFERENCE A 16 bit integer which specifies the preference given to this RR among others at the same owner. Lower values are preferred;

MAP822 A <domain-name> element containing <rfc822-domain>, the RFC822 part of the MCGAM;

MAPX400 A <domain-name> element containing the value of <x400-in-domain-syntax> derived from the X.400 part of the MCGAM (see sect. 4.2);

PX records cause no additional section processing. The PX RR format is the usual one:

<name> [<class>] [<TTL>] <type> <RDATA>

When we store in DNS a 'table1' or a 'gate1' entry, then <name> will be an X.400 mail domain name in DNS syntax (see sect. 4.2). When we store a 'table2' or a 'gate2' table entry, <name> will be an RFC822 mail domain name, including both fully qualified DNS domains and mail only domains (MX-only domains). All normal DNS conventions, like default values, wildcards, abbreviations and message compression, apply also for all the components of the PX RR. In particular <name>, MAP822 and MAPX400, as <domain-name> elements, must have the final "." (root) when they are fully qualified.

4.1 Additional features of the PX resource record

The definition of the RDATA for the PX resource record, and the fact that DNS allows a distinction between an exact value and a wildcard match for the <name> parameter, represent an extension of the MIXER specification for mapping rules. In fact, any MCGAM entry is an implicit wildcard entry, i.e., the rule

```
net2.it#PRMD$net2.ADMD$p400.C$it#
```

covers any RFC822 domain ending with 'net2.it', unless more detailed rules for some subdomain in 'net2.it' are present. Thus there is no possibility to specify explicitly a MCGAM as an exact match only rule. In DNS an entry like

```
*.net2.it.   IN  PX  10   net2.it.  PRMD-net2.ADMD-p400.C-it.
```

specify the usual wildcard match as for MIXER tables. However an entry like

```
ab.net2.it.  IN  PX  10   ab.net2.it.  O-ab.PRMD-net2.ADMDb.C-it.
```

is valid only for an exact match of 'ab.net2.it' RFC822 domain.

Note also that in DNS syntax there is no '#' delimiter around MAP822 and MAPX400 fields: the syntax defined in sect. 4.2 in fact does not allow the <blank> (ASCII decimal 32) character within these fields, making unneeded the use of an explicit delimiter as required in the MIXER original syntax.

Another extension to the MIXER specifications is the PREFERENCE value defined as part of the PX RDATA section. This numeric value has exactly the same meaning than the similar one used for the MX RR. It is thus possible to specify more than one single mapping for a domain (both from RFC822 to X.400 and vice versa), giving as the preference order. In MIXER static tables, however, you cannot specify more than one mapping per each RFC822 domain, and the same restriction apply for any X.400 domain mapping to an RFC822 one.

More over, in the X.400 recommendations a note suggests than an ADMD=<blank> should be reserved for some special cases. Various national functional profile specifications for an X.400 MHS states that if an X.400 PRMD is reachable via any of its national ADMDs, independently of its actual single or multiple connectivity with them, it should use ADMD=<blank> to advertise this fact. Again, if a PRMD has no connections to any ADMD it should use ADMD=0 to notify its status, etc. However, in most of the current real situations, the ADMD service providers do not accept messages coming from their

subscribers if they have a blank ADMD, forcing them to have their own ADMD value. In such a situation there are problems in indicating properly the actually working mappings for domains with multiple connectivity. The PX RDATA 'PREFERENCE' extension was introduced to take in consideration these problems.

However, as these extensions are not available with MIXER static tables, it is strongly discouraged to use them when interworking with any table based gateway or application. The extensions were in fact introduced just to add more flexibility, like the PREFERENCE value, or they were already implicit in the DNS mechanism, like the wildcard specification. They should be used very carefully or just considered 'reserved for future use'. In particular, for current use, the PREFERENCE value in the PX record specification should be fixed to a value of 50, and only wildcard specifications should be used when specifying <name> values.

4.2 The DNS syntax for an X.400 'domain'

The syntax definition of the MCGAM rules is defined in appendix F of that document. However that syntax is not very human oriented and contains a number of characters which have a special meaning in other fields of the Internet DNS. Thus in order to avoid any possible problem, especially due to some old DNS implementations still being used in the Internet, we define a syntax for the X.400 part of any MCGAM rules (and hence for any X.400 O/R name) which makes it compatible with a <domain-name> element, i.e.,

```
<domain-name>    ::= <subdomain> | " "
<subdomain>      ::= <label> | <label> "." <subdomain>
<label>          ::= <alphanum>|
                     <alphanum> {<alphanumhyphen>} <alphanum>
<alphanum>       ::= "0".."9" | "A".."Z" | "a".."z"
<alphanumhyphen> ::= "0".."9" | "A".."Z" | "a".."z" | "-"
```

(see RFC1035, section 2.3.1, page 8). The legal character set for <label> does not correspond to the IA5 Printablestring one used in MIXER to define MCGAM rules. However a very simple "escape mechanism" can be applied in order to bypass the problem. We can in fact simply describe the X.400 part of a MCGAM rule format as:

```
  <map-rule>   ::= <map-elem> | <map-elem> { "." <map-elem> }
  <map-elem>   ::= <attr-label> "$" <attr-value>
  <attr-label> ::= "C" | "ADMD" | "PRMD" | "O" | "OU"
  <attr-value> ::= " " | "@" | IA5-Printablestring
```

As you can notice <domain-name> and <map-rule> look similar, and also <label> and <map-elem> look the same. If we define the correct method to transform a <map-elem> into a <label> and vice versa the problem to write a MCGAM rule in <domain-name> syntax is solved.

The RFC822 domain part of any MCGAM rule is of course already in <domain-name> syntax, and thus remains unchanged.

In particular, in a 'table1' or 'gate1' mapping rule the 'keyword' value must be converted into <x400-in-domain-syntax> (X.400 mail DNS mail domain), while the 'translator' value is already a valid RFC822 domain. Vice versa in a 'table2' or 'gate2' mapping rule, the 'translator' must be converted into <x400-in-domain-syntax>, while the 'keyword' is already a valid RFC822 domain.

4.2.1 IA5-Printablestring to <alphanumhyphen> mappings

The problem of unmatching IA5-Printablestring and <label> character set definition is solved by a simple character mapping rule: whenever an IA5 character does not belong to <alphanumhyphen>, then it is mapped using its 3 digit decimal ASCII code, enclosed in hyphens. A small set of special rules is also defined for the most frequent cases. Moreover some frequent characters combinations used in MIXER rules are also mapped as special cases.

Let's then define the following simple rules:

MCGAM rule	DNS store translation	conditions
<attr-label>$@	<attr-label>	missing attribute
<attr-label>$<blank>	<attr-label>"b"	blank attribute
<attr-label>$xxx	<attr-label>-xxx	elsewhere

Non <alphanumhyphen> characters in <attr-value>:

MCGAM rule	DNS store translation	conditions
-	-h-	hyphen
\.	-d-	quoted dot
<blank>	-b-	blank
<non A/N character>	-<3digit-decimal>-	elsewhere

If the DNS store translation of <attr-value> happens to end with an hyphen, then this last hyphen is omitted.

Let's now have some examples:

MCGAM rule	DNS store translation	conditions
PRMD$@	PRMD	missing attribute
ADMD$<blank>	ADMDb	blank attribute
ADMD$400-net	ADMD-400-h-net	hyphen mapping
PRMD$UK\.BD	PRMD-UK-d-BD	quoted dot mapping
O$ACME Inc\.	O-ACME-b-Inc-d	blank & final hyphen
PRMD$main-400-a	PRMD-main-h-400-h-a	hyphen mapping
O$-123-b	O--h-123-h-b	hyphen mapping
OU$123-x	OU-123-h-x	hyphen mapping
PRMD$Adis+co	PRMD-Adis-043-co	3digit mapping

Thus, an X.400 part from a MCGAM like

```
OU$uuu.O$@.PRMD$ppp\.rrr.ADMD$aaa ddd-mmm.C$cc
```

translates to

```
OU-uuu.O.PRMD-ppp-d-rrr.ADMD-aaa-b-ddd-h-mmm.C-cc
```

Another example:

```
OU$sales dept\..O$@.PRMD$ACME.ADMD$ .C$GB
```

translates to

```
OU-sales-b-dept-d.O.PRMD-ACME.ADMDb.C-GB
```

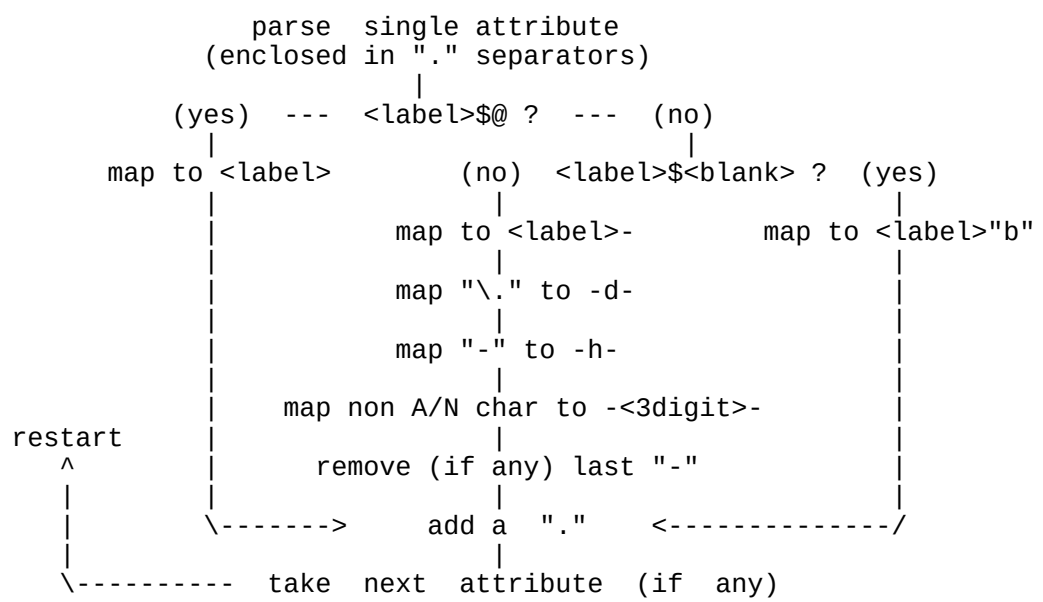
4.2.2 Flow chart

In order to achieve the proper DNS store translations of the X.400 part of a MCGAM or any other X.400 O/R name, some software tools will be used. It is in fact evident that the above rules for converting mapping table from MIXER to DNS format (and vice versa) are not user friendly enough to think of a human made conversion.

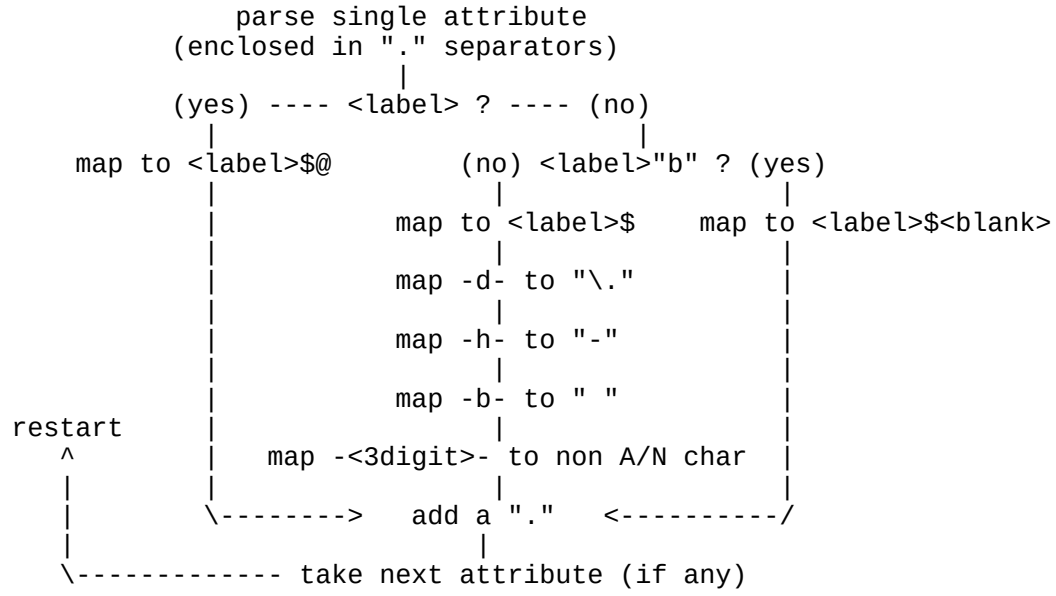
To help in designing such tools, we describe hereunder a small flow chart. The fundamental rule to be applied during translation is, however, the following:

> "A string must be parsed from left to right, moving appropriately the pointer in order not to consider again the already translated left section of the string in subsequent analysis."

Flow chart 1 - Translation from MIXER to DNS format:



Flow chart 2 - Translation from DNS to MIXER format:



Note that the above flow charts deal with the translation of the attributes syntax, only.

4.2.3 The Country Code convention in the <name> value.

The RFC822 domain space and the X.400 O/R address space, as said in section 3, have one specific common feature: the X.400 ISO country codes are the same as the RFC822 ISO top level domains for countries. In the previous sections we have also defined a method to write in <domain-name> syntax any X.400 domain, while in section 3 we described the new name space starting at each country top level domain under the X42D.cc (where 'cc' is then two letter ISO country code).

The <name> value for a 'table1' or 'gate1' entry in DNS should thus be derived from the X.400 domain value, translated to <domain-name> syntax, adding the 'X42D.cc.' post-fix to it, i.e.,

```
ADMD$acme.C$fr
```

produces in <domain-name> syntax the key:

```
ADMD-acme.C-fr
```

which is post-fixed by 'X42D.fr.' resulting in:

```
ADMD-acme.C-fr.X42D.fr.
```

However, due to the identical encoding for X.400 country codes and RFC822 country top level domains, the string 'C-fr.X42D.fr.' is clearly redundant.

We thus define the 'Country Code convention' for the <name> key, i.e.,

> "The C-cc section of an X.400 domain in <domain-name> syntax must be omitted when creating a <name> key, as it is identical to the top level country code used to identify the DNS zone where the information is stored".

Thus we obtain the following <name> key examples:

X.400 domain	DNS <name> key
ADMD$acme.C$fr	ADMD-acme.X42D.fr.
PRMD$ux\.av.ADMD$ .C$gb	PRMD-ux-d-av.ADMDb.X42D.gb.
PRMD$ppb.ADMD$Dat 400.C$de	PRMD-ppb.ADMD-Dat-b-400.X42D.de.

4.3 Creating the appropriate DNS files

Using MIXER's assumption of an asymmetric mapping between X.400 and RFC822 addresses, two separate relations are required to store the mapping database: MIXER 'table1' and MIXER 'table2'; thus also in DNS we will maintain the two different sections, even if they will both use the PX resource record. More over MIXER also specify two additional tables: MIXER 'gate1' and 'gate2' tables. These additional tables, however, have the same syntax rules than MIXER 'table1' and 'table2' respectively, and thus the same translation procedure as 'table1' and 'table2' will be applied; some details about the MIXER 'gate1' and 'gate2' tables are discussed in section 4.4.

Let's now check how to create, from an MCGAM entry, the appropriate DNS entry in a DNS data file. We can again define an MCGAM entry as defined in appendix F of that document as:

<x400-domain>#<rfc822-domain># (case A: 'table1' and 'gate1' entry)

and

<rfc822-domain>#<x400-domain># (case B: 'table2' and 'gate2' entry)

The two cases must be considered separately. Let's consider case A.

- take <x400-domain> and translate it into <domain-name> syntax, obtaining <x400-in-domain-syntax>;
- create the <name> key from <x400-in-domain-syntax> i.e., apply the Country Code convention described in sect. 4.2.3;
- construct the DNS PX record as:

```
*.<name>  IN  PX  50  <rfc822-domain>  <x400-in-domain-syntax>
```

Please note that within PX RDATA the <rfc822-domain> precedes the <x400-in-domain-syntax> also for a 'table1' and 'gate1' entry.

an example: from the 'table1' rule

```
PRMD$ab.ADMD$ac.C$fr#ab.fr#
```

we obtain

```
*.PRMD-ab.ADMD-ac.X42D.fr. IN PX 50  ab.fr.  PRMD-ab.ADMD-ac.C-fr.
```

Note that <name>, <rfc822-domain> and <x400-in-domain-syntax> are fully qualified <domain-name> elements, thus ending with a ".".

Let’s now consider case B.

- take <rfc822-domain> as <name> key;
- translate <x400-domain> into <x400-in-domain-syntax>;
- construct the DNS PX record as:

```
*.<name>  IN  PX  50  <rfc822-domain>  <x400-in-domain-syntax>
```

an example: from the ’table2’ rule

```
ab.fr#PRMD$ab.ADMD$ac.C$fr#
```

we obtain

```
*.ab.fr.  IN  PX  50  ab.fr.  PRMD-ab.ADMD-ac.C-fr.
```

Again note the fully qualified <domain-name> elements.

A file containing the MIXER mapping rules and MIXER ’gate1’ and ’gate2’ table written in DNS format will look like the following fictious example:

```
!
! MIXER table 1: X.400 --> RFC822
!
*.ADMD-acme.X42D.it.                IN  PX  50  it. ADMD-acme.C-it.
*.PRMD-accred.ADMD-tx400.X42D.it.  IN  PX  50   \
                            accred.it. PRMD-accred.ADMD-tx400.C-it.
*.O-u-h-newcity.PRMD-x4net.ADMDb.X42D.it.  IN  PX  50   \
                   cs.ncty.it. O-u-h-newcity.PRMD-x4net.ADMDb.C-it.
!
! MIXER table 2: RFC822 --> X.400
!
*.nrc.it.    IN  PX  50   nrc.it. PRMD-nrc.ADMD-acme.C-it.
*.ninp.it.   IN  PX  50   ninp.it. O.PRMD-ninp.ADMD-acme.C-it.
*.bd.it.     IN  PX  50   bd.it. PRMD-uk-d-bd.ADMDb.C-it.
!
! MIXER Gate 1 Table
!
*.ADMD-XKW-h-Mail.X42D.it.          IN  PX  50   \
                         XKW-gateway.it. ADMD-XKW-h-Mail.C-it.G.
*.PRMD-Super-b-Inc.ADMDb.X42D.it.  IN  PX  50   \
                         GlobalGw.it. PRMD-Super-b-Inc.ADMDb.C-it.G.
!
! MIXER Gate 2 Table
!
my.it.  IN PX 50  my.it. OU-int-h-gw.O.PRMD-ninp.ADMD-acme.C-it.G.
co.it.  IN PX 50  co.it. O-mhs-h-relay.PRMD-x4net.ADMDb.C-it.G.
```

(here the "\" indicates continuation on the same line, as wrapping is done only due to typographical reasons).

Note the special suffix ".G." on the right side of the 'gate1' and 'gate2' Tables section whose aim is described in section 4.4. The corresponding MIXER tables are:

```
#
# MIXER table 1: X.400 --> RFC822
#
ADMD$acme.C$it#it#
PRMD$accred.ADMD$tx400.C$it#accred.it#
O$u-newcity.PRMD$x4net.ADMD$ .C$it#cs.ncty.it#
#
# MIXER table 2: RFC822 --> X.400
#
nrc.it#PRMD$nrc.ADMD$acme.C$it#
ninp.it#O.PRMD$ninp.ADMD$acme.C$it#
bd.it#PRMD$uk\.bd.ADMD$ .C$it#
#
# MIXER Gate 1 Table
#
ADMD$XKW-Mail.C$it#XKW-gateway.it#
PRMD$Super Inc.ADMD$ .C$it#GlobalGw.it#
#
# MIXER Gate 2 Table
#
my.it#OU$int-gw.O$@.PRMD$ninp.ADMD$acme.C$it#
co.it#O$mhs-relay.PRMD$x4net.ADMD$ .C$t#
```

4.4 Storing the MIXER 'gate1' and 'gate2' tables

Section 4.3.4 of MIXER also specify how an address should be converted between RFC822 and X.400 in case a complete mapping is impossible. To allow the use of DDAs for non mappable domains, the MIXER 'gate2' table is thus introduced.

In a totally similar way, when an X.400 address cannot be completely converted in RFC822, section 4.3.5 of MIXER specifies how to encode (LHS encoding) the address itself, pointing then to the appropriate MIXER conformant gateway, indicated in the MIXER 'gate1' table.

DNS must store and distribute also these 'gate1' and 'gate2' data.

One of the major features of the DNS is the ability to distribute the authority: a certain site runs the "primary" nameserver for one determined sub-tree and thus it is also the only place allowed to update information regarding that sub-tree. This fact allows, in our

case, a further additional feature to the table based approach. In fact we can avoid one possible ambiguity about the use of the 'gate1' and 'gate2' tables (and thus of LHS and DDAs encoding).

The authority maintaining a DNS entry in the usual RFC822 domain space is the only one allowed to decide if its domain should be mapped using Standard Attributes (SA) syntax or Domain Defined Attributes (DDA) one. If the authority decides that its RFC822 domain should be mapped using SA, then the PX RDATA will be a 'table2' entry, otherwise it will be a 'gate2' table entry. Thus for an RFC822 domain we cannot have any more two possible entries, one from 'table2 and another one from 'gate2' table, and the action for a gateway results clearly stated.

Similarly, the authority mantaining a DNS entry in the new X.400 name space is the only one allowed to decide if its X.400 domain should be mapped using SA syntax or Left Hand Side (LHS) encoding. If the authority decides that its X.400 domain should be mapped using SA, then the PX RDATA will be a 'table1' entry, otherwise it will be a 'gate1' table entry. Thus also for an X.400 domain we cannot have any more two possible entries, one from 'table1' and another one from 'gate1' table, and the action for a gateway results clearly stated.

The MIXER 'gate1' table syntax is actually identical to MIXER 'table1', and 'gate2' table syntax is identical to MIXER 'table2'. Thus the same syntax translation rules from MIXER to DNS format can be applied in both cases. However a gateway or any other application must know if the answer it got from DNS contains some 'table1', 'table2' or some 'gate1', 'gate2' table information. This is easily obtained flagging with an additional ".G." post-fix the PX RDATA value when it contains a 'gate1' or 'gate2' table entry. The example in section 4.3 shows clearly the result. As any X.400 O/R domain must end with a country code ("C-xx" in our DNS syntax) the additional ".G." creates no conflicts or ambiguities at all. This postfix must obviously be removed before using the MIXER 'gate1' or 'gate2' table data.

5. Finding MIXER mapping information from DNS

The MIXER mapping information is stored in DNS both in the normal RFC822 domain name space, and in the newly defined X.400 name space. The information, stored in PX resource records, does not represent a full RFC822 or X.400 O/R address: it is a template which specifies the fields of the domain that are used by the mapping algorithm.

When mapping information is stored in the DNS, queries to the DNS are issued whenever an iterative search through the mapping table would be performed (MIXER: section 4.3.4, State I; section 4.3.5, mapping

B). Due to the DNS search mechanism, DNS by itself returns the longest possible match in the stored mapping rule with a single query, thus no iteration and/or multiple queries are needed. As specified in MIXER, a search of the mapping table will result in either success (mapping found) or failure (query failed, mapping not found).

When a DNS query is issued, a third possible result is timeout. If the result is timeout, the gateway operation is delayed and then retried at a later time. A result of success or failure is processed according to the algorithms specified in MIXER. If a DNS error code is returned, an error message should be logged and the gateway operation is delayed as for timeout. These pathological situations, however, should be avoided with a careful duplication and chaching mechanism which DNS itself provides.

Searching the nameserver which can authoritatively solve the query is automatically performed by the DNS distributed name service.

5.1 A DNS query example

An MIXER mail-gateway located in the Internet, when translating addresses from RFC822 to X.400, can get information about the MCGAM rule asking the DNS. As an example, when translating the address SUN.CCE.NRC.IT, the gateway will just query DNS for the associated PX resource record. The DNS should contain a PX record like this:

```
*.cce.nrc.it.  IN PX 50   cce.nrc.it.  O-cce.PRMD-nrc.ADMD-acme.C-it.
```

The first query will return immediately the appropriate mapping rule in DNS store format.

There is no ".G." at the end of the obtained PX RDATA value, thus applying the syntax translation specified in paragraph 4.2 the MIXER Table 2 mapping rule will be obtained.

Let’s now take another example where a ’gate2’ table rule is returned. If we are looking for an RFC822 domain ending with top level domain "MW", and the DNS contains a PX record like this,

```
   *.mw.   IN  PX  50  mw.  O-cce.PRMD-nrc.ADMD-acme.C-it.G.
```

DNS will return ’mw.’ and ’O-cce.PRMD-nrc.ADMD-acme.C-it.G.’, i.e., a ’gate2’ table entry in DNS store format. Dropping the final ".G." and applying the syntax translation specified in paragraph 4.2 the original rule will be available. More over, the ".G." flag also tells the gateway to use DDA encoding for the inquired RFC822 domain.

On the other hand, translating from X.400 to RFC822 the address

C=de; ADMD=pkz; PRMD=nfc; O=top;

the mail gateway should convert the syntax according to paragraph 4.2, apply the 'Country code convention' described in 4.2.3 to derive the appropriate DNS translation of the X.400 O/R name and then query DNS for the corresponding PX resource record. The obtained record for which the PX record must be queried is thus:

O-top.PRMD-nfc.ADMD-pkz.X42D.de.

The DNS could contain:

*.ADMD-pkz.X42D.de. IN PX 50 pkz.de. ADMD-pkz.C-de.

Assuming that there are not more specific records in DNS, the wildcard mechanism will return the MIXER 'table1' rule in encoded format.

Finally, an example where a 'gate1' rule is involved. If we are looking for an X.400 domain ending with ADMD=PWT400; C=US; , and the DNS contains a PX record like this,

*.ADMD-PWT400.X42D.us. IN PX 50 intGw.com. ADMD-PWT400.C-us.G.

DNS will return 'intGw.com.' and 'ADMD-PWT400.C-us.G.', i.e., a 'gate1' table entry in DNS store format. Dropping the final ".G." and applying the syntax translation specified in paragraph 4.2 the original rule will be available. More over, the ".G." flag also tells the gateway to use LHS encoding for the inquired X.400 domain.

6. Administration of mapping information

The DNS, using the PX RR, is able to distribute the MCGAM rules to all MIXER gateways located on the Internet. However, not all MIXER gateways will be able to use the Internet DNS. It is expected that some gateways in a particular management domain will conform to one of the following models:

(a) Table-based, (b) DNS-based, (c) X.500-based

Table-based management domains will continue to publish their MCGAM rules and retrieve the mapping tables via the International Mapping Table coordinator, manually or via some automated procedures. Their MCGAM information can be made available also in DNS by the appropriate DNS authorities, using the same mechanism already in place for MX records: if a branch has not yet in place its own DNS

server, some higher authority in the DNS tree will provide the service for it. A transition procedure similar to the one used to migrate from the 'hosts.txt' tables to DNS can be applied also to the deployment phase of this specification. An informational document describing the implementation phase and the detailed coordination procedures is expected.

Another distributed directory service which can distribute the MCGAM information is X.500. Coordination with table-based domains can be obtained in an identical way as for the DNS case.

Coordination of MCGAM information between DNS and X.500 is more complex, as it requies some kind of uploading information between the two systems. The ideal solution is a dynamic alignment mechanism which transparently makes the DNS mapping information available in X.500 and vice versa. Some work in this specific field is already being done [see Costa] which can result in a global transparent directory service, where the information is stored in DNS or in X.500, but is visible completely by any of the two systems.

However we must remind that MIXER concept of MCGAM rules publication is different from the old RFC1327 concept of globally distributed, coordinated and unique mapping rules. In fact MIXER does not requires any more for any conformant gateway or tool to know the complete set of MCGAM: it only requires to use some set (eventually empty) of valid MCGAM rules, published either by Tables, DNS or X.500 mechanisms or any combination of these methods. More over MIXER specifies that also incomplete sets of MCGAM can be used, and supplementary local unpublished (but valid) MCGAM can also be used. As a consequence, the problem of coordination between the three systems proposed by MIXER for MCGAM publication is non essential, and important only for efficient operational matters. It does not in fact affect the correct behaviour of MIXER conformant gateways and tools.

7. Conclusion

The introduction of the new PX resource record and the definition of the X.400 O/R name space in the DNS structure provide a good repository for MCGAM information. The mapping information is stored in the DNS tree structure so that it can be easily obtained using the DNS distributed name service. At the same time the definition of the appropriate DNS space for X.400 O/R names provide a repository where to store and distribute some other X.400 MHS information. The use of the DNS has many known advantages in storing, managing and updating the information. A successful number of tests were been performed under the provisional top level domain "X400.IT" when RFC1664 was developed, and their results confirmed the advantages of the method. Operational exeprience for over 2 years with RFC1664 specification

confirmed the feasibility of the method, and helped identifying some operational procedures to deploy the insertion of MCGAM into DNS.

Software to query the DNS and then to convert between the textual representation of DNS resource records and the address format defined in MIXER was developed with RFC1664. This software also allows a smooth implementation and deployment period, eventually taking care of the transition phase. This software can be easily used (with little or null modification) also for this updated specification, supporting the new 'gate1' MIXER table. DNS software implementations supporting RFC1664 also supports with no modification this memo new specification.

A further informational document describing operational and implementation of the service is expected.

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10. Security Considerations

This document specifies a means by which DNS "PX" records can direct the translation between X.400 and Internet mail addresses.

This can indirectly affect the routing of mail across an gateway between X.400 and Internet Mail. A succesful attack on this service could cause incorrect translation of an originator address (thus "forging" the originator address), or incorrect translation of a recipient address (thus directing the mail to an unauthorized recipient, or making it appear to an authorized recipient, that the message was intended for recipients other than those chosen by the originator) or could force the mail path via some particular gateway or message transfer agent where mail security can be affected by compromised software.

There are several means by which an attacker might be able to deliver incorrect PX records to a client. These include: (a) compromise of a DNS server, (b) generating a counterfeit response to a client's DNS query, (c) returning incorrect "additional information" in response to an unrelated query.

Clients using PX records SHOULD ensure that routing and address translations are based only on authoritative answers. Once DNS Security mechanisms [RFC 2065] become more widely deployed, clients SHOULD employ those mechanisms to verify the authenticity and integrity of PX records.

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