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Introduction
to
Network Addressing

Introduction

Electronic networks are complex to use. The complexity arises for various reasons. Electronic networks are a combination of several disciplines. They combine information flow telecommunications, computing and social communication. Information flow comprises issues such as standards and the exchange information base. This paper introduces one of the standards needed to be established between electronic networks worldwide in order to communicate effectively: addressing formats used by electronic networks.

One of the primary functions of networks is electronic mail. All kinds of computer mediated communications are essentially extensions of electronic mail. Bulletin board systems are electronic mail between one host and many users, while electronic conferences are e-mail systems between many users. Mail is the "glue" for all forms of electronic networks. Even in certain resources sharing activities such as remote job entry, e-mail is sent with sets of commands to be executed by the host.

E-mail is thus not merely a collection of words and sentences for exchanging messages. It follows a standard format and also involves various social aspects. The standard format of electronic mail falls under addressing, while the social aspect of mailing falls under etiquette and ethics. The social aspect of electronic mail is a subject for further research and is not treated here.

The e-mail addressing format consists of a universal format similar to the one used in conventional letter writing: header, body and closing envelope. The header is the most important part of electronic mail. Several standards were suggested and developed over the years regarding the number and type of entries in the header and body of a message. One such standard is the RFC 822 (Request For Comment) 822. RFC 822 as developed by Internet specifies message formatting and is widely used by other research networks worldwide. It specifies both the header and the body of a message. The header lists information about the sender, the recipients, posting date and the subject of the message.

Each of the above terms form a field name. A field blank line is supplied by the system separating it from the field name by a colon as shown.

To:----------
From:----------
Date:----------
Subject:----------
CC:----------

In an electronic mail header most important fields are those addresses belonging to the recipient of the message- e.g. the To: CC: Bcc: Reply-To: and the subject lines. The date and sender name are usually inserted automatically by the computer.

Mail can also be sent in any other format than the usual text file. Binary files can readily be encoded in text that will pass through most mail services in the body of mail messages. It is also common to transfer source files, object files, binary graphics images and other kinds of data by electronic mail. The encoding used must be known to the sender and recipients, but this can often be done by using a commonly available format, noting its type in the subject header. In the Fido network the subject line contains 'FILE' if the sender attaches a file to the system. Files encoded by common application programs such as WordPerfect can also be sent over data lines.

The body of piea of mail is the part which contains the actual text of the message. Depending on the nature of the message the sender may or may not include salutations and append closing remarks and signatures. The size of the entire message is usually limited to 100,000 bytes. Some systems allow even larger message size. If one needs to send more than 20 Kbyte as e-mail it is advisable to cut the mail into different parts and attach them by consecutive numbering in order to attain a reliable mail link.

Electronic Addresses

One of the difficulties of electronic networks is that it is often confusing to connect to various systems. There should be one addressing syntax known to all networks and hosts worldwide. The current networking system is not ideal as such, and it is often unclear how to sort out the route which a mail follows in order to reach its destination. Users are often uncertain as to what networks are and how the mail gets from one machine to another across the country and around the world. In some cases the application of a fully transparent system to the user which connects easily to other machines and gateways handles the exchange of mail and messages across the network. However, as demand increases the transparent system ceases to fulfill most of the exchanges required. Users are usually forced to know such issues such as: routing, domains or attribute lists, and other subjects related to naming and addressing.

- **Routing**

Mail routing is one of the complex part of electronic networking. Routing is the process of making inter-connections different between international networks and/or, within the same network. The machines which are used for such interconnection are usually known as routers, repeaters, bridges or gateways. Repeaters correspond to the physical interconnection layer between networks, while bridges and routers correspond to interconnections to data link and network layers.

A gateway is a combination of bridge, repeater or router which connects machines with similar network protocols or different protocols. The usual interest is in gateways inter-connecting dissimilar networks. Gateways are usually unknown and the routing process is transparent. Due to political and economic reasons some other gateways are publicly known.

Gateways usually consist of routing tables which are looked up by computer and transmitted through to another gateway or destination machine. A systems operator of a network is usually confronted with the assignment of correct routing procedures considering several factors:

· appropriate gateways to which reliable link could be attained

· communications cost

· political sensitivity, including issues such as the possibility of acquiring permission to transfer through a given gateway

· network technology

■ **Domains**

Networks communicating with each other tend to use common ways of sending mail across different networks and gateways. For instance, users of any one of networks such as CompuSereve, UUCP, Bitnet, Internet or FidoNet can exchange messages with users of any other and between these networks. The most common system of exchanging e-mail addresses is the domain naming system "DNS". This syntax is a standard address which can be usable and understandable across many different internal networks and systems which have different addressing structures.

A general DNS mail format is expressed as "user@host" as shown by the following example.

Lisahn@padis.gn.apc.org

Such syntax is known as the domain addressing system. The overall string is known as the mail address. The string at the left of "@" is usually known as a local address or mailbox name. Sometimes it describes the name of the sender of the electronic mail. It is not part of the address used by the system to route messages. The mailbox or the local part can belong to a user or a group of users. It can also be used by the postmaster or others to send distribution lists or alert other users.

Sometimes a local host can be used to route mail across a Local Area Network (LAN) or other servers which in turn distribute mail to local users. The mailbox then includes a local hosts or gateway such as:

John % HP3000@padis.gn.apc.org

User % host (local) indicates that the HP3000 mini-computer serves as the local host or gateway to the DNS system to distribute mail on a Local Area Network. Such an arrangement is usually done internally or between institutions which might also undergo several gateways before the mail reaches the main domain registered by

Internet. This also simplifies the the length of the routing table (nodediff) on Internet machines.

The part to the right of the @ is called a domain and denotes the place where the mail box is located. Most top level domains are usually registered by Internet. The furthest right part is called the top-level domain. The general syntax in network addressing is then in the form of:

Mailbox user % local gateway@sub-domain....subdomain1,top-level domain

In the above example, John % HP3000@padis.gn.apc.org indicates:

John	= Mail box user
HP3000	= Local host
PADIS	= sub-domain-3
gn	= sub-domain-2
apc	= sub-domain-1
org	= top-level-domain

The top-level domain and sub-domain1 are the most important elements. Most top-level domains can be the ISO code for countries, networks or organization designation.

In formats using countries,

Jeff@Physics.alberta.ca

denotes Alberta University in Canada. Ca is the ISO code for Canada. Similarly most countries use the ISO code as their top-level domain.

Jean@Carleton.BITNET denotes a bitnet address.

Networks such as BITNET and HEPnet (the former is an academic network of world universities, and the latter is a world-wide high energy physics network, prefer ".BITNET " and ".hep" as their top-level domain, respectively.

Jan@f1.n723.z5.fidonet.org is an organization which is non-commercial registered in the Internet domain. In United States the top-level Internet domain of organizations is classified into six groups.

Com	=commercial
edu	=educational
gov	=government
mil	=military
net	=network organization
org	=non-profit organizations

There are several ways of specifying the local part of an e-mail message and the domain of the mail. As indicated above, the internationally acknowledged format is the "User@host" format. The @ sign is used as a separator in most international networks such as BITNET, JANET, Internet, and many others. It is the most prevalent separator. The other separators include:

host::user	Used in Digital's EASYnet and other networks such as MFEnet.
host!user	The exclamation point (bang) is used in the UUCP network. Chains of UUCP hosts may be indicated by separating exclamation points. host!host2!host!user

When the syntax is a mixture of a number of domains and a local part as in (user% host!host2!@host) there is no way to tell what precedence to use merely from the syntax of a mail address. The gateway tables or the "nodediff" is very important in getting around these problems. A generally accepted addressing syntax is the only real solution. In order to generate an internationally accepted syntax there is a need for co-operation between networks.

FidoNet addressing and current inter-African addressing

Addressing within FidoNet is numeric with a bit of punctuation, and specifies a particular node in its administrative hierarchy. Addresses are in the form "zone:net/node.point" where zone is one of the six countries (North America, Europe, Oceania, Asia, or Africa), net is the city (or larger area if the node density is sparse), and node is the particular host within the local network. For example, 5:7511/1 is host number one (PADISnet host) within the East African zone which is in Africa. As shown the addressing scheme may be extended to accommodate points which are "power users" to reduce their connect time by using private (i.e.unlisted) nodes to exchange email and electronic news with public nodes. Thus the extended addressing scheme is zone:net/node. point, e.g., 5:7511/1.101 is the ILCA point of PADISnet.

A list of all nodes in the public FidoNet net-work is automatically updated and distributed weekly. This list contains the data telephone number of each host, as well as the geographic location and name of the system operator (sysop). Every city maintains its local data and sends the region's aggregated data to a continental coordinator. The continental coordinators exchange their data, and create a list of the references between the current week's data and that of the previous week. This "nodediff" is then distributed back down the hierarchy to each individual node in the net-work.

As all modem phone numbers are published in the nodelist, point-to-point transfers are always possible. But, as store- and-forward capabilities are specified in

the basic standards, e-mail tends to be routed through a world-wide hierarchic topology and electronic news via a worldwide ad hoc, but generally geographically hierarchic, acyclic graph.

Fidonet's addressing hierarchy -zone,net, node, point - approximates the route which e-mail follows. Power users run points which may connect to only their respective host nodes to receive and deliver their e-mail and electronic news. As they are not in the public nodelist, points are not considered to be official nodes in the network, and thus are not subject to constraints of technology, national mail hours, etc.

Within a local network (i.e.city), nodes usually exchange e-mail directly with each other. For example, 5:7311/1 exchanges mail directly with all other nodes in 5:7511/1. In those cities where phone tariff zones divide the city, local nodes are used to concentrate intra-city traffic to reduce costs.

Each local network has one node with an alias of node zero (i.e.Zone:net/0) which is known as the "inbound host". By default, all mail from outside the local net is delivered to the inbound host to be distributed within the local network. Thus, a node in Kenya can deliver mail to all PADISnet node points with a single telephone call, as opposed to a call for every point which has mail. While each node is responsible for sending its own mail (as FidoNet is financed from the pockets of individuals or NGOs), some local networks also have an outbound host to concentrate all mail destined for outside the city.

Each of the six zones (continents) has a unique host which provides inter-zone e-mail routing. There are gateways between FidoNet and the uucp network, and thereby Internet. FidoNet is addressable from the Internet DNS universe via the zone fidonet.org addressing format. A FidoNet node 5:7511/1 has the DNS name f1.n7511.z5.fidonet.org. Gating is done almost exclusively via the uucp network.

The correct RFC822 address for a FidoNet power user on a point system user at point zz:no/ne.po is user@ppo.Eno.Nne.Zzo.FIDONET.ORG.

For example,

Lishan.Adam@f1.n7511.z5.fidonet.org

for Fido 5:7511/1

and, as points are optional in FIDONET. ORG

For example,

Makane.Faye@p114.f1.n7511.z15.fidonet.org

for Fido 5:7511/1.114

The UFGATE software, which allows an MS-DOS-based FidoNet node to simulate a uucp host, gates both e-mail and electronic news and made gating fairly popular by 1987. More recently, other DOS packages have provided implementation which runs on UNIX System V and Xenix, including gateware to transform between uucp/Internet. Currently there are on the order of one hundred gateway systems, most of them in North America. Aside from the expected inter-network e-mail, there is considerable gating of Usenet news to and from FidoNet echomail conferences.

The most extensively used gateway for African NGO nodes is the GnFido gateway which connects to GreenNet every two hours. GnFido is located in London and can be addressed as 2:254/70 from Fido networks. The FIDO-GreenNet machine run on a 386 personal computer under ISC 3.2 and also on a separate IBM compatible AT hard-wired to one of GreenNets's serial ports. It uses a slightly modified version of UFGATE software. The GreenNet machine provides hourly gateway connections to the APC (Association for Progressive Communications) X.25 hosts in Brazil, Australia, Sweden, Nicaragua, the United States and Canada, and many countries in Europe. Messages can be sent through these machines to outbound facsimile and telex servers as well as to commercial hosts such as Dialcom and GeoNet.

As a result of the GnFido gateway and an outstanding co-operation between node operators in Africa and GnFido gateway operators, an arrangement has been made for node in Africa to use Internet DNS format using the "apc.org" domain. Operating 24 hours a day are Johannesburg (WorkNet), Addis Ababa (PADIS), Dakar (ENDA), Harare (Mango), Nairobi (ELCI) and Accra (Ghastinet) which maintain close collaboration with GreenNet. The current arrangement is done in such a way that users transmit their messages not only through the Fidonet DNS format but also using the APC. Since APC is a registered domain in Internet users in Africa or elsewhere, one can use the following addressing formats to reach the listed nodes:

PADIS	PADIS@gn.apc.org
Ghastinet	Ghastinet@gn.apc.org
ELCI	elcidwr@gn.apc.org
ENDA	Endadakar@gn.apc.org

If a user wants to send electronic message through GnFido using the FidoNet format the follwing addressing format can be used.

Lishan.Adam@f1.n7511.z5.gnfiod.fidoNet.org

This will route the mail to GnFido in London instead of sending it to Zone Gate (South Africa).

Networks are dynamic in their nature and, like personal addresses, e-mail addresses change frequently. Co-operation between systems is be useful to promote not only the exchange of information but also to standardize the network itself. As the above document indicates, standardization is complex and needs day-to-day follow up in order to operate a connectable network node.

Annex I

Commonly used addressing formats

Network	Syntax between same network	Example
BITNET	User@host	Def@CUNY.BITNET
CDNnet	User@ subdomain	HQ@CDNET. CD
CGNET	XX: CG/YYY	157:CG/.00
Compuserve	NNNNN,NNN	71234.567
CSNET	User@relay CS,net	CIC@sh.CS.net
EARN	User@site.BITNET	AURO@FRM.BITNET
FIDONET	Z: n/f.p	5:751/1.106
INTERNET	User@subdomain	nic@nc.ddn.mil
JANET	User@subdomain	JNT@RUTHER.ac.UK
GEONET	User@Geonet	CODESRIA@Geonet
APC	User@apc.org	NT@Gin.APC.org
WEB	User@Web	IDRC@Web

Annex II

Internet Addressing Syntax

Network	System
Internet	User@domain
BITNET	User% host.bitnet@cunyvm.cuny.edu
SPAN	User% host.span@vlsi.jpl.nasa.gov
SPAN	User% host span@ star.stanford.edu
HEPnet	User% host.HEPNET@ LBL.GOV
HEPnet	User% host.HEPNET@.BL.BITNET
ACSnet	User@ domain.(ACSNET-domain)
UUCP	User% host.uucp@gateway
UUCP	host;user@uunet.uu.net
Ean	user%domain.(Ean-domain%ubc.cs@relay.cs.net
XEROX Internet	user.(XEROX-domain)@xerox.com
XEROX CIN	Name.foreign Refistry@Xerox.COM
EASYnet	user%host.dec@decwrl.dec.com
VNET	user% host@ibm.com
JANET	User@domain.(JANET-domain)@nss.cs.ucl.ac.uk
JANET	User%domain.(JANET-domain)@cunyvm.cuny.edu
Starlink	User@starlink.jodrell-bank.manchester.ac.uk
Strilnk	Useer@star.jb.man.ac.UK

Annex III

Current FidoNet Node Assignement for Africa

= already allocated.

Region 70 #
7001 Botswana #
7021 Namibia
7031 Angola

Region 71 - South Africa #
Nets within RSA
7101 Transvaal #
7102 Western Cape #
7103 Natal #
7104 Eastern Cape #
7105 Orange Free State #

Region 72 #
721 Zimbabwe -#
7221 Mozambique
7231 Malawi
7241 Swaziland
7251 Lesotho
7261 Mauritius #
7271 Madagascar
7281 Comoros & Seychelles

Region 73 #
7311 Kenya
7321 Uganda
7331 Tanzania
7341 Burundi
7351 Ruanda

Region 74 - vacant

Region 75 #
7511 Ethiopia #
7521 Djibouti
7531 Somalia
7541 Sudan

Region 76 #
761 Zambia - To be changed to 7611 #
7621 Zaire

7631 Central African Republic
7641 Sao Tome & Principe, Ascension Island & St Helena

Region 77 #
7711 Senegal #
7721 Cote D'Ivoire
7731 Burkina Faso
7741 Mali
7751 Cameroon
7761 Gabon
7771 Congo
7781 Benin & Togo

Region 78
7811 Ghana
7821 Liberia
7831 Sierra Leone
7841 Guinea
7851 Guinea Bissau
7861 Nigeria
7871 Equatorial Guinea
7881 Gambia

Region 79
7911 Tunisia
7921 Egypt
7931 Libya
7941 Algeria
7951 Morocco
7961 Spanish Sahara
7971 Mauritania
7981 Cape Verde, Canary Islands & Mediera

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