From: David M. Ihnat Date: April 24, 1989

Subject: Clout: State of the Domain

ABSTRACT

The virtual distributed **clout** machine is now almost a year old. This paper is the written companion to a presentation given by the author at the April 26th meeting of the Chicago chapter of /usr/group, /usr/group/chicago. It summarizes the problem that resulted in the creation of **clout**; the genesis of the virtual distributed machine; and the experiences of the first year of operation. It also discusses current outstanding work, and directions for future development.

1. INTRODUCTION

The Chicago chapter of /usr/group, /usr/group/chicago, has supported a
fileserver for the **chi.il.us** namespace for almost a year. The site **clout**[1], which serves as the UUCP forwarder and Internet link for this namespace, however, is somewhat unique in that it is a distributed virtual machine--no such computer exists which is uniquely identified as **clout**. This paper summarizes the problems which provided the impetus for the design and implementation of **clout**; the steps taken to implement it, as well as the evolution of the model as it proceeded into its implementation phase; and problems and observations of the implementation group. It also covers the current state of the project, as well as pending work and future development directions.

At this point, it should be mentioned that there are a goodly number of people who have been ongoing, valuable contributors to the E-mail SIG. Their attendance and valuable input at the SIG meetings; their time and talent donated to design of the **clout** model; and their efforts behind the scenes in implementing and testing the

[1] The name **clout** was selected for its obviously appropriate association with the city of Chicago...

various ideas and schemes are what make this whole thing possible. There are too many people to individually thank in this presentation; but you should know that we all owe them thanks for their ongoing efforts on our behalf.

2. HISTORY

Ihnp4 is no more. For many years--indeed, almost the entire history of what eventually became USENET--this node served as the hub and feed for the entire Midwest. Its downfall was that it depended on the largesse of AT&T Bell Laboratories. While we all owe a debt of gratitude to the Labs for years of not-inconsiderable expense, both in terms of telephone bills and of maintenance and caretaker efforts, it was almost inevitable that someday it would be necessary to pay the piper, and the free ride would have to end. When it was finally announced that this was, indeed, happening, it was widely perceived as a catastrophic event destined to sever the network in the heartland of the United States. The fledgling branch of /usr/group in Chicago perceived in this crisis the type of situation to which it could offer some remedy.

2.1 /USR/GROUP SYMPOSIUM

A symposium on E-mail in the greater Chicagoland area was organized by /usr/group/chicago in the Spring of 1988. People instrumental in early USENET development as well as current activity, such as Gary Murakami and Gene Spafford, were invited as speakers to help provide a common basis for understanding of how the situation developed, a technical view of the current state of USENET, and what the problems actually were.

While a number of issues and topics were aired at the symposium, one issue--that of assuring continuing network connectivity for at least E-mail delivery--was obviously of concern to a number of attendees. Subsequent to the symposium itself, it was agreed that a special interest group, or **SIG**, dedicated to addressing the E-mail issue would be formed of interested /usr/group members and/or symposium attendees.

2.2 E-MAIL SIG

The E-mail SIG met several times at various host organizations in the Chicagoland area. In the course of the first couple of meetings, several goals surfaced as being obligatory in any solution offered by /usr/group/chicago:

- *Reliability*
  Any solution to be implemented had to offer not only reliable, timely mail delivery; it also had to be permanent. Never again should it be possible to face major disruption of mail service due to the actions of a single contributing organization or individual.

- *Redundancy and Utility*
  This is not simply related to reliability. It is certain that, at least at the start, and possibly indefinitely, /usr/group will not be able to totally provide hardware and telephone services. The solution must allow utilization of any resources offered by individuals or organizations, whether complete, dedicated machines or only portions; and in such a manner as to allow integration into--and removal from--the service in as transparent a manner as possible.
- *Economy*
  Again, since the generosity of individuals and organizations is a pleasant surprise, and not an obligation, the design of the replacement scheme should optimize resource usage while minimizing incurred costs.

With these goals as a working set of assumptions, the E-mail SIG members proceeded to examine the problem. First in the list of tasks was evaluating the current service being provided by /usr/group.

2.3 INITIAL CLOUT SETUP: JHEREG AND HOMEBRU

At the time that these events were occuring, a member of /usr/group had already been running a volunteer fileserver from his home machine, *jhereg*, to support his efforts to get a local miscellaneous namespace in service in the

Chicago area. Mark Colburn had been involved in the setup of a namespace in Minneapolis, and was instrumental in this early implementation of the **chi.il.us** namespace. His machine, an AT&T 3B1, was running AT&T Basic Networking Utilities version 1.0, commonly called Honey-DanBer UUCP, or HDB UUCP (after its authors.) The importance of this was this package allows easy site name aliasing, or *spoofing*.

When Mark accepted a position back in Minneapolis, such machine connections and information as he'd already registered in the **chi.il.us** domain had to migrate to another, local machine. Dave Ihnat volunteered to allocate disk space and phone service on his home machine, *homebru*, which incidentally is also an AT&T 3B1. This was the situation at the time the E-mail SIG had to consider how to carry out the final implementation of its scheme for reliable E-mail service for the greater Chicago area.

2.4 VIRTUAL DISTRIBUTED CLOUT DESIGNED

In November of 1988, the E-mail SIG met at Argonne National Laboratories. At this time, Dave Ihnat presented them with a paper which summarized the ideas and concepts discussed in previous meetings, formalizing the concept of a *virtual distributed* machine. This would be a site that could reside on a physical installation that normally was known to the world by its 'own' name--such as *homebru* hosting **clout**--thus, the *virtual* machine. In addition, **clout** could well be--and certainly most often *would* be--hosted on multiple physical machines located in quite different geographic areas of Chicagoland, both to distribute the workload and to take advantage of donated resources. Thus, it would become a *distributed* machine. (Of course, nodes of the distributed machine may well actually be **clout** and only that machine, in the more traditional sense, and thus not be virtual; but they're still one part of the distributed **clout** site.)

In this early design, it was expected that the mechanism by which this would be accomplished would be via HDB UUCP-style spoofing, as had already been implemented for a single site. In addition to the goals stated above,

there were several additional concerns that were expressed and incorporated into the problem definition. Details of implementation using this model were also addressed, including such items as:

- Administration of multiple nodes of a distributed virtual **clout**
- Internet gateway tasks and MX record administration
- Required sets of existing and necessary new support software
- Failure fallback and re-routing procedures and software
- Pathalias map generation and maintenance for the **clout** nodes

3. CLOUT GOALS AND PURPOSE RESTATED

As finally determined, then, the purposes of the virtual distributed **clout** were several and varied; some of which are:

- Provide *free* domain membership to all requestors, as well as functional connectivity. (I.e., connection, but the burden of polling and assumption of phone charges lie with the members.)
- Assemble information and software packages for /usr/group domain members to aid in individual domain site setup and administration.
- Provide reliable, timely mail delivery between the namespace members and the rest of the UUCP network and Internet members. In addition, the actual implementations should allow for eventual inclusion of other networks, such as JNET and BITNET.
- Allow reliable and efficient use of resources that are provided. Especially, minimize costs arising from the newly-implemented Illinois Bell toll schemes, and allow utilization on any of the variant Unix architectures
- Allow for easy permanent addition and removal of resources as necessary.
- Provide for temporary loss of resources due to dead nodes, etc. This implies re-routing as necessary.

Especially as this is a totally unfunded volunteer effort, it was recognized that it would take some time to realize all these goals. In addition, it was necessary to actually implement this scheme and see if the model would stand up to the test of actual use on the various donated environments that were currently available.

4. CLOUT PHASE I: SPOOF!

At this point, Matt Crawford of the University of Chicago Astronomy Department had agreed to serve as the Internet gateway for the **chi.il.us** namespace, and was a very active contributing member of the SIG. He, and La Monte Yarroll, figured heavily in the attempts to graduate to a multiple-node **clout** site, using the University's machine 'gargoyle' as the host to the second node. Immediately, the differences between AT&T and BSD made themselves felt, as attempts to recreate the HDB UUCP spoofing scheme were made. At the same time, the number of **chi.il.us** members continued to grow, and it was necessary to continue to provide service to 'live' sites while working on the configuration and connectivity issues. Ongoing meetings between the SIG members allowed interchange of ideas and suggestions to the various problems which surfaced.

4.1 PROBLEMS

Eventually, a number of problems surfaced which pointed to the fact that the spoofing algorithm was inadequate for a full-scale implementation:

- **Intermingling of host and clout passwd, L.sys/Systems, and USER/Permissions**
  As implemented, it was necessary to maintain the **clout** information—logins for member sites, UUCP information, and permissions--in the same files as the host machine used for its own UUCP communications. This became both confusing, and difficult to maintain.

- **Loss of bidirectional communications with existing host sites**
  If the host of a **clout** virtual node already had its

own communications with a site which became a member of the domain, it became impossible for the host to originate communications with the site. This is because, while it's possible to have multiple Permissions entries to allow inbound spoofing, there is no corresponding mechanism in the Systems file to do so for outbound calls.

- **Requirement for non-standard UUCP on systems without HDB UUCP.**

There were other problems which also require resolution; but they are more endemic to the virtual distributed machine, as it must interact with the Internet and UUCP worlds, rather than with the spoofing model itself.

Nevertheless, it became obvious that this model, while adequate for a single-site, small implementation, needed revamping for the full-blown multiple-node implementation. At this time, other potential **clout** partial machine donors do exist; but until these problems are ironed out, their implementation remains in abeyance.

5. CLOUT PHASE II: THE SAGA CONTINUES

The current model which is being re-implemented is somewhat cleaner in concept than the spoofing earlier employed. Rather than depend on a feature of the UUCP package itself, a capability which exists in all versions of the Unix kernel is to be exploited. A *sublogin* environment will be created using *chroot(2)*. In this model, an entire virtual machine is created in a subdirectory tree. Rather than actually executing \fIuucico\fP when logging in or sending jobs out for the virtual machine, a program is invoked which sets up the execution environment in this subdirectory and invokes the chroot call; from that point on, to all intents and purposes, it appears that subsequent program executions are on a virtual machine bounded by that subdirectory.

There are several advantages to be realized by this approach:

- Segregation of the **clout** configuration information
  Within this environment, all UUCP information is uniquely associated with the **clout** node.

- Security
  The host may more securely isolate its own devices, mass storage, and other resources from the virtual machine.

- Portability
  The amount of OS-specific code required to support this is much less than with the spoofing model; is not involved with licensed software; and may be properly conditionalized to support target environments.

- Simplicity
  Within the sublogin environment, everything appears to be a normal site. There are only two areas of 'magic' involved, in the uucico front end and with some minor redirection related to the distributed nature of **clout**.

There are, of course, some new problems uniquely associated with execution of sublogin environments. The uucico front end must guarantee setup of the sublogin environment and, when run in master mode, must arbitrate device locking between the sublogin and any 'real machine' UUCP processes.

Also, a separate utility must redirect UUCP jobs on the virtual node. Jobs destined for the host machine, or on the host machine destined for the resident virtual node, may simply be manipulated and moved. Jobs that are erroneously on this node for members served by another clout node must be redirected to that node. This, however, is an artifact of the distributed machine, and not unique to the sublogin model.

6. CURRENT STATUS

Despite the problems with the spoofing model, it is currently providing the lion's share of service on the 'homebru' node. The 'gargoyle' node is modeling the sublogin scheme, which will soon be cutover on 'homebru'

pending some resolution of UUCP map routing. As the statistics show, a decent amount of traffic flows through the 'homebru' node per week; and the same statistics also show a steady and perceptible rise in the overall volume. (Sometimes to the distress of the owner of 'homebru'...and its phone bills.)

6.1 HOSTS

Currently, only two **clout** hosts are 'live'--homebru and gargoyle. Two others are waiting 'in the wings' when the software to fully resolve multiple **clout** nodes on the UUCP side in the sublogin model is deemed suitably reliable.

6.2 MEMBERS

There are currently sixteen active domain members being served by **chi.il.us** via **clout**, with several pending requests. To date, the only problem noted has been an unfortunate side-effect of the original domain naming scheme, which is being resolved by manipulation of the UUCP maps.

6.3 SERVICE

Recently, it became necessary to modify the service offered by default. Originally, it was expected that it would be a purely demand-driven system, with the **clout** nodes calling all member sites that had any work pending, and vice versa. The author's first $225 telephone bill convinced him that altruism is one thing, stupidity another. (And if I feel this way, you may expect corporate comptrollers to certainly echo the sentiment!)

At the present time, **clout** will not poll member sites, even if there is pending work to go out. It is expected they will poll on a regular basis to pick up and drop off mail items. There is some discussion of providing a higher grade of service for a fee, which will only be used to cover telephone costs; but this must be further resolved.

6.4 PROBLEMS

There are too many to list, but the one at the top of the list is **TIME**. All work is volunteer, by individuals in both industry and academia; and time is, as always, too short. The greatest need at this instant is to automate generation of the map entries for the various **clout** nodes, and the virtual **clout** entry itself, to allow proper re-routing of messages within the virtual **clout** machine.

Costs are still in flux; as mentioned, at least one person is donating about $200/month to the effort. I, at least, think this is unfair in the long term...

6.5 CURRENT WORKLIST

There are a large number of pressing items that must be addressed--designed, reviewed, implemented, and tested--and in a somewhat more timely manner than currently is the norm. By no means complete, the top items that occur to me are:

- **Sublogin Management Tools**
  The sublogin manager is currently in the implementation phase; determination of useful adjunct tools will follow a trial period of multiple-node operation.

- **UUCP Map Generation and MX Maintenance Tool**
  This will take a master description file, and generate--for each of the currently-defined **clout** nodes--the appropriate UUCP map, suitable for posting and framing. In addition, it will generate the **clout** map for the entire virtual machine itself. In addition, it should also be able to produce the list of prioritized MX servers for each of the domain members. This is currently top-priority.

- **Traffic Analysis Tools**
  Currently, two public domain submissions from USENET--*traffic* and *uucp.stat* --are used to provide coarse and fine-tuned traffic statistics. Grateful as we are to have even these tools, they suffer from inefficiency, redundant processing, and incompatibility with

different Unix bases. The model provided by these should be converted into a single, integrated tool which will provide the necessary statistics to allow proper **clout** load balancing and resource allocation, and to identify usage patterns of domain member sites.

- **Standardized set of approved software**
  Pathalias, smail, sendmail, elm, mush, etc.--what is considered the acceptable and useful basis for a successful **chi.il.us** domain member's electronic communications package? We've not only got to define reasonable configurations, but assemble them in a distributable package. This should be available to **all** domain members, whether they're /usr/group members or not.

- **Cleanup of pathalias**
  Since we've started working with it in detail, it's been noticed that there are some--quirks--in the paths and costs generated by *pathalias*. It's been an invaluable aid in setting up and maintaining the UUCP network, even so; but it's time to do some cleanup and updating. Some considerable work has already been done on this by one of the E-mail SIG members, Randy Herber. The next step is to see in what manner this work can be folded into the 'official' version.

There are, of course, more--many more--but these will suffice to use all available time for the forseeable future.

7. FUTURE DIRECTIONS

As stated earlier, a "help packet" for /usr/group members, containing both actual software--from the public domain, and developed by /usr/group/chicago--and arcana collected concerning the setup and administration of electronic communications is ultimately vital. This should certainly be restricted to /usr/group members only; after all, we should provide some incentive for becoming dues-paying members.

Ultimately, the connection between the Internet and UUCP will be nailed down. At that point, it will be appropriate to tackle other network interfaces, ideally resulting in a unified set of formally-defined gateways that are supported not on a haphazard basis, but as part of a professional offering by an ongoing concern--/usr/group.

8. CONCLUSIONS

Despite the fitful start and sometimes imperceptable rate of progress, the final conclusion must be that **clout**, and **chi.il.us**, is successful. The demise of 'ihnp4' did not result in the Midwest, and Chicago in particular, losing contact with the rest of the world. 'Clout', for **chi.il.us**, is actively providing communications with the rest of USENET, and the Internet, for a fair number of members; and this number is growing. As the level of sophistication of the machine model improves, and the support software and procedures necessary to maintain the virtual machine are defined, service quality can only improve, and the eventual goal of reliable and total network interconnectivity will become a reality.

--dmi David M. Ihnat

Appendix I: .chi.il.us Domain Member List as of 4/24/89

Members	
chinet.chi.il.us	- <Randy Suess (randy)
ennui.chi.il.us	- <Garret Toomey(garret)
homebru.chi.il.us	- <Dave Ihnat (ignatz)
jhereg.chi.il.us	- <Mark Colburn (mark)
jolnet.chi.il.us	- <Rich Andrews (rich)
kashruth.chi.il.us	- <Sheldon Blech (blech)
liltyke.chi.il.us	- <Darryl Baker (dpb)
limerick.chi.il.us	- <Mike Beirne (beirne)
mcdchg.chi.il.us	- <Ron Heiby (heiby)
mdbs.chi.il.us	- <Ray Grahm ()
tellabs.chi.il.us	- <Darryl Baker (dpb)
vfrot.chi.il.us	- <Doug Price (price)
yclept.chi.il.us	- <Randy Herber (rjh)
tarkus.chi.il.us	- <John Sucilla (jcs)
jpusa1.chi.il.us	- <Stu Heiss (stu)
vijit.chi.il.us	- <Dave Madsen (madsen)
obdient.chi.il.us	- <Doug Blair (blair)

Appendix II: Sample Statistics

```
*** This report run on 04.24.89 for the week ending the previous Sunday
***
*** Disregard dates on individual sections, as the statistic programs
***
*** are actually run on archived statistics from the previous week
***

/usr/spool/uucp/.Old/xferstats:

*** Detailed Statistic Breakdowns ***
```

Remote SiteName	KΓÇÉBytes Recv	KΓÇÉBytes Xmit	KΓÇÉBytes Total	Hours Recv	Hours Xmit	AvCps Recv	AvCps Xmit	## Recv	## Xmit
aicchi	1.23	24.17	25.40	0:00:06	0:01:48	205.0	223.8	2	4
amdahl	68.72	1.96	70.67	0:12:00	0:00:13	95.4	150.5	40	2
att	58.42	1.47	59.88	0:04:48	0:00:12	202.8	122.3	14	2
chinet	174.17	17.02	191.19	0:27:01	0:02:16	107.4	125.1	24	8
ddsw1	156.45	13.25	169.71	0:18:15	0:01:05	142.9	203.9	194	10
gargoyle	308.39	2.86	311.25	0:50:00	0:00:22	102.8	130.0	52	4
jolnet	0.00	381.33	381.33	0:00:00	2:22:05	0.0	44.7	0	56
jpusa1	0.00	7.93	7.93	0:00:00	0:00:33	0.0	240.4	0	6
kashruth	0.00	209.76	209.76	0:00:00	0:31:46	0.0	110.1	0	7
laidbak	6.15	0.00	6.15	0:00:53	0:00:00	116.0	0.0	4	0
limerick	1.96	0.97	2.93	0:00:11	0:00:03	178.5	323.3	2	2
mcdchg	10.69	13.48	24.16	0:01:32	0:00:55	116.2	245.1	10	10
obdient	0.00	7.86	7.86	0:00:00	0:01:04	0.0	122.8	0	8
oddjob	7.52	131.24	138.77	0:01:18	0:16:24	96.4	133.4	6	164
riccb	17.45	137.58	155.03	0:05:59	0:26:54	48.6	85.2	18	53
rutgers	0.00	40.82	40.82	0:00:00	0:05:40	0.0	120.0	0	54
simon	1.20	65.53	66.73	0:00:13	0:09:27	92.3	115.6	2	28
tarkus	3.72	11.95	15.68	0:00:18	0:00:50	206.7	239.1	4	8
tellab5	185.67	11.46	197.13	0:29:23	0:01:37	105.3	118.1	48	8
vfrot	0.00	1.19	1.19	0:00:00	0:00:09	0.0	132.7	0	2
vpnet	1.33	0.47	1.79	0:00:07	0:00:00	189.7	0.0	2	2
yclept	0.90	4.50	5.39	0:00:05	0:00:19	180.0	236.6	2	2
Total	1003.96	1086.79	2090.75	2:32:09	4:03:42			424	440

```
        *** Detailed Statistic Breakdowns ***


                        UUCP NETWORK TRANSACTION STATISTICS
                        (NODE: homebru  Mon Apr 24 05:39:29 CDT 1989)

                        (Processing All Transactions)
NODE        USER        XACT    BYTES      TIME (Sec)    RATE (Bytes/Sec)
-------------------------------------------------------------------------

aicchi      joeloda     2       1230       8             153
aicchi      root        4       24166      111           217
aicchi      TOTAL:      6       25396      119           213

amdahl      unknown     6       5763       64            90
```

amdahl	uucp	36	64911	679	95
amdahl	TOTAL:	42	70674	743	95
att	auucp	8	7853	58	135
att	euucp	2	1722	10	172
att	guucp	4	48842	227	215
att	uucp	2	1467	12	122
att	TOTAL:	16	59884	307	195
chinet	ignatz	18	170762	1606	106
chinet	megabyte	2	1571	10	157
chinet	norm	2	884	6	147
chinet	utellab	2	952	7	136
chinet	uucp	8	17017	139	122
chinet	TOTAL:	32	191186	1768	108
ddsw1	arjay	52	35419	271	130
ddsw1	bbs	2	872		12
ddsw1	benfeen	4	3264	25	130
ddsw1	iguucp	4	3346	38	88
ddsw1	jeff	2	1298	9	144
ddsw1	karl	50	39252	340	115
ddsw1	kreiner	14	7348	45	163
ddsw1	maildae	2	2031	11	184
ddsw1	nvk	4	2756	18	153
ddsw1	peggy	34	32222	265	121
ddsw1	root	6	7979	48	166
ddsw1	uasiux1	2	741	6	123
ddsw1	uhcfeams	6	5712	39	146
ddsw1	ulll	2	765	6	127
ddsw1	umpx1	2	810	7	115
ddsw1	uucp	14	23369	123	189
ddsw1	vpuucp	4	2521	15	168
ddsw1	TOTAL:	204	169705	1278	132
gargoyle	UUCP	48	305588	2985	102
gargoyle	daemon	4	2803	34	82
gargoyle	uucp	4	2859	25	114
gargoyle	TOTAL:	56	311250	3044	102
jolnet	ignatz	2	952	8	119
jolnet	root	4	5435	99	54
jolnet	uucp	50	374944	8431	44
jolnet	TOTAL:	56	381331	8538	44
jpusa1	uucp	6	7934	33	240
jpusa1	TOTAL:	6	7934	33	240
kashruth	ignatz	3	185590	1691	109
kashruth	root	4	24170	220	109
kashruth	TOTAL:	7	209760	1911	109
laidbak	daemon	2	2572	23	111

laidbak	uucp	2	3574	33	108
laidbak	TOTAL:	4	6146	56	109
limerick	beirne	2	1963	11	178
limerick	uucp	2	970		5
limerick	TOTAL:	4	2933	16	183
mcdchg	Uyclept	4	3847	49	78
mcdchg	uucp	16	20317	108	188
mcdchg	TOTAL:	20	24164	157	153
obdient	uucp	8	7856	68	115
obdient	TOTAL:	8	7856	68	115
oddjob	UUCP	6	7523	82	91
oddjob	ignatz	2	653	5	130
oddjob	root	54	41432	347	119
oddjob	uucp	108	89158	751	118
oddjob	TOTAL:	170	138766	1185	117
riccb	ignatz	3	50850	463	109
riccb	mem	2	1296	16	81
riccb	nuucp	16	16156	355	45
riccb	root	4	16382	229	71
riccb	uucp	46	70351	956	73
riccb	TOTAL:	71	155035	2019	76
rutgers	ignatz	12	12996	120	108
rutgers	uucp	42	27821	256	108
rutgers	TOTAL:	54	40817	376	108
simon	steve	2	1200	15	80
simon	uucp	28	65526	585	112
simon	TOTAL:	30	66726	600	111
tarkus	jcs	4	3721	22	169
tarkus	uucp	8	11954	55	217
tarkus	TOTAL:	12	15675	77	203
tellab5	root	2	1260	11	114
tellab5	uucp	54	195868	1874	104
tellab5	TOTAL:	56	197128	1885	104
vfrot	uucp	2	1194	10	119
vfrot	TOTAL:	2	1194	10	119
vpnet	kylan	2	1328	8	
vpnet	lisbon	2	467	1	467
vpnet	TOTAL:	4	1795	9	199
yclept	Uwheaton	2	900	6	150
yclept	uucp	2	4495	21	214
yclept	TOTAL:	4	5395	27	199

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homebru    TOTAL:     864    2090750   24226        86
```