Electronic messaging systems and devolved system administration

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Abstract

It is common practice for systems administration to be the responsibility of only one person. In a large organisation that person may delegate parts of their responsibility to others but retain overall control. This paper describes the administration of a Unix system where no individual has clear overall responsibility. The system is not a small one, supporting some 560 users with hundreds of login events each day. This means that there are quite a number of daily tasks that need administrative attention. All of the administrators are located at positions remote from the machine, and a few are some considerable distance away. The administration, therefore, must all be performed over a wide area network. To ensure effective running of the system a wide variety of electronic messaging systems are used.

The electronic messaging systems and their use in coordinating the activities of the administrators of this Unix system, and in assisting and informing users is described. The relationships between the human organisation and messaging system mechanisms is also discussed.

1 Introduction

This paper describes how the administration of a large multiuser Unix system has been devolved to a group of people and how electronic messaging systems make such a method possible. The group of people involved in administering the machine is about 20 in number.

1.1 History

The machine in question was a left-over from earlier funded research projects. It had reached the end of its life on those projects and yet still had sufficient utility for other purposes. It was therefore donated for general non-research Unix use. The machine was renamed **Tardis**, after a timemachine in a BBC TV science fiction programme. The machine is used for electronic messaging systems, software development and even game playing. Over time the machine accumulated a large and diverse user community; the main reason for this is the wide variety of software available and the *laissez faire* policy adopted towards machine usage. The large number of users accessing the machine (many hundreds) and the wide variety of software on the machine created a machine administration problem. Computers that are provided by regular funding mechanisms usually are administered by full time paid staff. Our machine was, by its very nature, self maintained. The problem is performing all the necessary daily tasks to support such a large number of users.

2 The Administration Structure

2.1 Early Informality

The administration structure of the machine developed over time. Initially there were only a few users and all those users had super-user privileges. Later the system developed a two class user structure: those that knew the super-user password and those that did not. In the early stages the knowledge of the password was divulged in an uncontrolled fashion. As the number of users increased it obviously became necessary to create a more formal structure for administration.

Initially new super-users were admitted to the clique by acclamation. As the machine became more heavily used it was clear that an increasing number of administration tasks needed to be performed in a timely manner. We were faced with the problem of having larger and larger groups of people having super-user status, or the existing super-users spending more time on the machine administration. It was simply not possible for the existing set of administrators to devote more time to the routine management of the machine as most of them had other full-time jobs to perform. For most super-users, therefore, machine administration is purely a hobby or the pastime of a dilettante. In addition to becoming more formal the machine administration devolved into a distributed solution[1].

2.2 Formal Groupings

The problem of too many administration tasks was solved by creating new groupings of administrators and machine users. We also adopted a formal approach to admitting people to the various groups of administrators and users. The methods we adopted are similar to other areas where groups operate[2]. The various groups also derived general sets of standards for group operation and membership[3, 4] some of which were codified in a group charter[5]. The structure we arrived at, following some minor iterations, was a three or four tiered system with general users at the bottom of the tiers and the super-user level administrators at the top with helpful users and administrative assistants between.

The advantages of having a tiered administrative structure is that a larger pool of expertise can be called upon at short notice, whilst access to super-user privileges remained restricted. The path to super-user now involves an apprentice period as an assistant. The administrative work load was distributed more widely still by allowing (or rather requiring) ordinary users to perform some of the more mundane tasks.

The main tasks performed by users are the rebooting of the machine when it has failed, the general monitoring of machine state and the help and assistance of novice users. There is then a mechanism for recruiting administrative assistants: if they perform well at the administrative tasks of a regular user they can acquire the additional privileges of an administrative assistant.

3 Electronic Messaging Systems

3.1 History.

To many people electronic mail is a new and novel technology. Even the implementors of computer systems and the authors of electronic mail and communication systems are not aware of the potential or implications of this medium. The tools are created and others exploit them in areas that were beyond the ideas of the initiators. Such is the case with electronic inter-personal computer communications.

The first wide-area electronic systems in common use involved the use of dial up modems and file transfer mechanisms. This became expanded to a more general wide area network in time, although it was still quite primitive, with manual message routing and the like. The world wide networks of the current genre have only existed for a few years. The proliferation and extent of these networks has not yet been fully appreciated even by those involved in them. A paper in the Communications of the ACM in October 1986 entitled "Notable Computer Networks"[6] was the first attempt to document the extent of networking, but even this paper was out of date and incorrect by the time it was published[7].

Expansions on the world networking front are happening on both the professional and amateur level. The amateur networking developments are now as large and sophisticated as the professional set-ups and both are interconnected in a variety of ways. One of the amateur developments in networking that may not be known to the readers is the Radio Amateur's global X.25 based network[8] which includes many large TCP/IP segments[9] and several amateur controlled, built and designed repeater satellites. There is also the IBM PC based network called FIDO whose reach includes many places around the world where small computers are found. There are networking developments that reach the Soviet Union, China, Antarctica[10] and many other unexpected places. A truly global phenomena that is only recently being matched by such developments as the Fax machine!

The significance and influence of electronic communication is taken seriously by several key people in some hi-tech companies in the US, where bulletin boards and mailing lists are monitored by key-people and any false stories or significant questions about the company or their products are rapidly responded to by the most senior people. This results in a up-to-the-minute resume of company policy, emanating from someone akin to the President, being sent to the appropriate list. This action has been taken on occasion by companies such as Wollangong, Atari, Apple, Sun and AT&T. Other companies monitor the net and ensure that any miss-statements are corrected by 'third-parties', in order to prevent false rumours from circulating and damaging the companies image. This has been done by companies such as IBM, DEC, HP and Next in the past.

Some companies have in-house communication and messaging systems that are almost as large as some of the international networks, and use them for the general information and education of the workforce[11]. Several chief executives are regular users or contributors to these in house discussions. Systems of this kind are in place in DEC, HP, Sun and Prime. For example, Ken Olson the founder of DEC is so committed to electronic mail that it is reputed that the size of his mailboxes cause difficulties for the local machine and system managers at DEC!

The wider usage of electronic messaging systems, particularly within the computer community itself, has created a further phenomena of associations and consortia that only exist within the realms of the electronic messaging system itself. These associations range from product user group, technical interest discussion groups, political pressure groups, and research collaborator meetings. It has now become possible for groups of people to get together for collaborative work and yet never ever leave their own office or even meet their fellow collaborators[12, 13].

3.2 Taxonomy of Electronic Messaging Systems

Several types of Electronic messaging systems have evolved since the genesis of the era of digital communications. There seems to be a mixing of terms between Computer Mediated Communication (CMC) and Electronic Messaging Systems (EMS). Whereas CMC always implies the use of a computer for communication, EMS does not. Conversely CMC may cover much more sophisticated communications such as video and multimedia using a computer, whereas EMS does not. The term Electronic Messaging Systems is used for the purposes of this paper.

Electronic Messaging Systems have evolved to satisfy different needs and operate in different ways. If one is to make effective use of the media one should be familiar with the capabilities of each. The main classifications in these messaging systems are:

- Electronic Mail.
  - To individuals
  - To Personal distribution lists
  - To closed distribution lists
  - To moderated distribution lists
  - To public distribution lists
  - To open distribution lists
- Broadcasts
  - Alert messages
  - Message of the day
  - Network Broadcasts
- Bulletin Boards
  - General Boards
  - Hierarchical category systems
  - Unmoderated groups
  - Moderated groups
  - Mailing lists gateways

- Talk Systems
  - Person to Person
    - half duplex
    - full duplex
  - Conference Call

Orthogonal with the type of messaging system is its reach. The reach can be classified in the following way:

- Single System
- Single network
- Global network
  - Unconstrained distribution
  - Constrained distribution

Note that we have divided the classifications up more upon the lines of the applications used. Other classifiers[10] have used the terms *Many-to-Many*, *One-to-One* and the like.

3.2.1 Electronic Mail

In many electronic mail systems a message is composed and sent to various specific readers via a store and forward method of distribution. There can be variable degrees of latency between different readers getting the message. The message arrives at the readers personal electronic mailbox along with all messages from other sources. The privacy of the messages can be controlled with electronic mail distribution. It has the disadvantage that each recipient gets a personal copy of the message thereby making many duplicates of the one message. This can be very wasteful of machine resources and communication costs.

To individuals This is where one person mails to named recipients

To Personal distribution lists This is where one person sets up a distribution list of recipients that is used to mail to. No other person can use the distribution list.

To closed distribution lists This is where the distribution lists can be used to direct mail to a group of recipients but there can be several known originators of messages. The originators may be the same set as the recipients.

To moderated distribution lists This is where the forwarding of messages to the distribution list is controlled by a human agent. The agent may decide not to forward some messages submitted to distribution, or edit incoming messages before distribution.

To public distribution lists This is where the existence of the list is made generally known and any person may originate a message for distribution to the list of recipients.

To open distribution lists This is a completely automated list to which anyone may add themselves as a recipient and also as an originator.

3.2.2 Broadcasts

These are messages that are generally distributed to all persons without regard to whether they wish to receive it or not. Broadcast has the advantage that there are limited copies of the message, and each person is not given a private copy, thereby saving space. There may be a copy for each network or each machine, depending on the systems used.

Alert messages All messages are sent to a message system and all people read all messages. There is no filtering.

Message of the day This is the login message given to people when they first access a system each time.

Network broadcasts This message is propagated across many users of many systems at many sites.

3.2.3 Bulletin Boards

Bulletin Boards provide a greater degree of choice for the message originator and the recipients. They also attempt to reduce the number of messages retained. There is often one copy of the message for many readers at many sites thereby saving on storage costs. The messages are often distributed by a store and forward system like mail.

General boards These are not confined to messages on any particular topic, but messages of a general nature are posted there. Like Notice boards.

Hierarchical category systems These have been divided up into many categories for the different message topics. The reader may select the categories and topics that interest them and read the messages therein. This operates much like a library, except that new contributions arrive continuously.

Unmoderated groups These are General or hierarchical systems whereby origination of messages is open to anyone.

Moderated groups These are message groups where the messages are filtered by a human editor before publication.

Authorised groups These are message groups where the messages may only be originated by specific originators.

Mailing lists gateways This is where the messages that flow across a mail distribution list to named recipients is also posted on a bulletin board for others not on the list to read.

3.2.4 Talk Systems

A talk system is interactive and not *store and forward*. It is much like the telephone. Those present at the time can both submit and read the messages flowing. There is no history retained.

Person to person This is where the messages being exchanged are private between one person and another.

> **half duplex** This is where only one person can use the talk system at any one time. There is a talker and there is a listener and they must use some method of switching places

full duplex This is where both parties can talk or listen as and when they choose

Conference call This is where several participants may be involved in the conversation.

3.2.5 Reach

Single System This just involves users on one computer system.

Single network This just involves users on a single network.

Global network This involves users on networks across the globe. The distribution may in some cases be restricted to some subset of those users, perhaps by region or organisation, but they exist on more than one network.

Unconstrained distribution This spans the globe and is available to users of many networks.

Constrained distribution This is a distribution that is available to users on several networks around the globe but is constrained to some subset of the potential users. A restriction to distribution in Europe would is an example of a constrained distribution.

3.3 EMS on Tardis

The Tardis machine has implementations of many Electronic Messaging System tools. The tools that are available can be classified according to the above taxonomy:

System	Classification	Tool and method used
Electronic Mail	GeneralTool	`mail mailx ream mush elm`
	To individuals	Apply tool to username
	Closed distribution lists	Apply tool to list alias: `timelords`, `assistants`
Broadcasts		
	Alert messages	`wall`
	Message of the day	`motd` file
Bulletin Boards		
	General Tools	`rn nn`
	Unmoderated hierarchical	Use tool on groups: `local.tardis` `local.general` `local.flame` `ed.unix-wizards`
	Authorized general board	`msgs`
	Authorized private board	`sumsgs`
Talk Systems		
	Person to Person	
	half duplex	`write`
	full duplex	`talk`
	Conference Call	`chat`

The details of how the tools are used are given later.

3.4 Bespoke Tools

Some of the tools we use in our system come as standard with Unix, but others were imported or implemented locally for our needs:

Electronic Mail			
	`mail`	Standard Unix	
	`mailx`	Standard bsd Unix	Imported
	`elm`	freeware tool	Imported from net
	`mush`	freeware too	Imported from net
	`ream`	New tool	Written locally
Bulletin Board			
	`rn`	freeware tool	Imported from net
	`nn`	freeware tool	Imported from net
	`msgs`	Standard bsd Unix tool	Imported and modified for local conditions
	`sumsgs`	Modified `msgs`	
Talk Systems			
	`write`	Built in software	
	`talk`	Standard Unix software	Imported
	`chat`	Local tool	locally written

Many of the tools that come into use on our machine and our uses of those tools comes from our administrators learning about other useful tools using EMS systems. We also improve the configurations of our tools based on each others experience of those tools[14].

4 CSCW and system administration

4.1 Use of Tardis EMS in system administration

When we first started to use EMS in machine management things were, like the whole machine, *ad-hoc*. We would email the person we thought needed to know about a problem in the location we thought they would read it. Often several people who should have been informed about what was happening were not. We later implemented an email distribution list of the administrators. This helped to keep people informed. The mailing list for the administrators distributed mail to their mailbox on the machine being administered. This had its advantages and disadvantages. As has already been mentioned the administration team of Tardis had other jobs, tasks and duties to perform. This meant that they did not always devote a large amount of time to the task. If information about the machine was available on the machine it meant that they accessed the machine more often, and were as much users of the facilities as administrators. Conversely, if the mailings about the machine were directed to the regular daily use machine of the administrator then they would receive the information in a timely manner. The situation could arise, and sometimes did arise, whereby the administrators could all effectively communicate with each other about problems and policies of machine management when unknown to them the machine was non-operational. However, if the machine itself had been used for the communications, they would have been aware of the fact yet be unable to communicate with the others about what to do about it.

We have now settled down on a system where users and administrators communicate with users using the machine Tardis itself, whereas administrators and their assistants communicate with each other using mailing lists based on other machines for resiliance and privacy. It would be better if any administrator could use the method of communication most convenient to their own needs and have all the various means gatewayed together. This would mean having local restricted bulletin boards which are gatewayed to mailing lists.

The following sections discuss how each of the tools are used in the different scenarious. Some of the information is taken from experiences of the situations, and some by examining recordings made of example conversation sessions. Space considerations mean that detaled examination of these recordings is omitted from this paper.

4.1.1 Messages from Administrators to Users

As do most other Unix administrators we put notices in the `motd` (Message of the Day) file. This file is printed out at the start of a session by commands in the start up file. Some users do try and avoid reading the `motd` as they log in via slow connections over the wide area network. We try to encourage everyone to read this message by keeping it as short as possible, using a standard format and highlighting any special parts. Some users only wish to see changes to the message and use a file difference comparator. We update the messages by editing the Unix file `/etc/motd` with any convenient text editor. We allow both the super-users and assistants to edit this file.

If we have a message for the users that is of a transitory and instant nature, such as restarting the machine we can use the `wall` program. This allows us to broadcast to all users on at any particular moment, but the message is not retained.

If we have a message or information for the users that should be read by all users but it is not critical for them to see it at any particular time we can use the `msgs` bulletin board program. This places a message on this general bulletin board. Users can then check for this message at a time convenient for them.

If we have a message for the users that might require more of a dialogue between the users and various administrators we can use the categorised bulletin board system that is both readable and writable by all users. The tools `rn` and `nn` give us access to these.

If an administrator needs to communicate with an individual user they can use one of the electronic mail utilities `mail,mailx,elm,mush` or `ream` to send them a message. If the user is logged in at the time the administrator is using the machine and the message is urgent then one of the talk systems could be used. If the message is brief and little conversation is required then the `write` utility can be used. This displays a brief message directly on the terminal of the user. If a bidirectional conversation is required then `talk` can be used. If a conversation involving more than one person is required then `chat` can be used. Note that it requires consent from the user to enter a `talk` or `chat` session whereas `write` output is displayed without the user's consent.

4.1.2 Messages from Users to Administrators

Users sometimes wish to contact administrators directly. They can do this by sending electronic mail, as in most other Unix systems to the user `root`. Our users can also send confidential mail off of the machine to our superusers by mailing to the mailing list `timelords`.

Some users want immediate help and they often catch one of the machine administrators logged in and poll them using one of the talk utilities `write, talk` or `chat` mentioned earlier. If the discussion is to take place in public, the user can post a message to the bulletin board system. The public discussions are on things like "why is this machine so slow?".

4.1.3 Messages from Users to Users

A lot of the work done on other systems by administrators on some machine is done by users on ours. One of the main loads taken by users is the handholding of other users who are less well informed. There is considerable traffic between one user and another discussing the machine itself and how to get the most out of it. These conversations take place in all of the message forums with the exception of Broadcasts. These are entirely the domain of the machine administrators and used to communicate to users in a one way conversation.

We have found, that on our machine some people have extremely lengthy discussions using the various talk programmes. Some can go on for hours and hours, particularly late at night and on weekends. Some of the conversations are technically marvellous and worthy of the finest University Lecture or text book. Some have been captured for posterity, but others have dissipated into the computerized ether fondly known as the *bit bucket*.

4.1.4 Messages from Administrator to Administrator

Administrators usually contact each other by mail. They sometime have interactive conversations using `write` or `talk` but for security reasons have to be careful. The `chat` tool can be used but in this case the administrators move to a private area and lock it to avoid being evesdropped. The tool **sumsgs** allows a message to be posted on a bulletin board that can only be read by other administrators but usage of this has fallen out of fashion as indicated earlier.

4.2 Supplementing EMS

Despite the wide variety of electronic messaging systems and media for communication between the many administrators and users of the system, we find that often we still resort to using old fashioned methods of communication. We still have occasional meetings of the administrators to deal with a particularly difficult issue. It is our experience that an hours personal contact can be equivalent of several days or weeks of electronic contact. This is not to say that we are unable to reach a consensus or even the same conclusion when we use EMS for discussion. The problems are usually that other items also have our attention when we remain in our normal location[15]. It is often the change of location and the focus on a few specific problems that enable us to form a conclusion. This is often the same with doing business over the telephone[16].

We also still use the telephone to supplement email and other messaging systems. The telephone is good when we want to short-circuit some misunderstanding or bring someones attention to a very pressing and urgent matter. One of the remaining problems with email is that you are never sure that the recipient has received it and has given it the priority you think it deserves.

Interactions between our users and between the users and the administrators is often supplemented by social functions. There are several *Birds-of-a-Feather* get-togethers of our users at various technical conferences and meetings. The computer is also given a birthday party each year where people can meet each other who have only previously conversed electronically.

5 Problem areas

The heavy use of electronic messaging systems by the administrators and users of our system to utilise and manage a computer over a wide area network from great distances has not removed the need for some of the more normal tedium from machine management. We still need a human to go and operate the power and reset switches! We also need people who are not too remote from the machine who can do minor maintenance at short notice. We also have people local to the machine who perform the disc backups. These could be performed remotely over the network, but that is not always the most efficient way of protecting large volumes of data.

6 The future

In the long term it would be advantageous to have a distributed computing resource managed by several people in the same distributed fashion. This would give the system a degree of resiliance not provided by the current arrangements. The various machines and the administrative EMS mechanisms could then be connected through Wide area networks[17, 18].

There is also some interest in using electronic imaging software to assist the group members who never meet or see each other. A small collection of face images is being collected in a database so that members of the various administrative groups can at least see each other. Further developments could allow more interactive video connections and co-authoring software[19]. At the time of writing this paper one of the co-authors had not met the other two and we certainly felt we would benefit from some of the more advanced co-authoring tools.

7 Conclusion

We are successfully managing a machine using Electronic Messaging Systems over a wide area network using groups of people who have not met in person. Our groups of like minded experts certainly form the *invisible team* as encountered in other areas of group operation using CSCW[20]. We have not experienced that our group methods of making decisions are causing any greater risk to the system or the user[21, 22], rather we seem to experience the opposite. We seem have a system that quickly identifies areas of risk and deals with them, but is very slow to undo the actions[23]; for example we can readily disable a user account suspected of being linked to security risks but can never agree to re-enable it when the risk has passed.

We have no problems with our main group members being unfamiliar with the technology being used as most of them are experienced in their use. We do experience a critical mass effect however in the choice of which particular tools or method of communication[24].

Finally the computer system considered in this paper is an experiment in self-managed groups, but it now seems that we are no longer sure who are the experimenters and who are the subjects.

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