quality) of data require such steps to produce the global and integrated picture of information and knowledge.

7. To Probe Further

For material throughout, see inter alia Albrecht and Egret (1991), and Heck and Murtagh (1992).

Section 1: See Pirenne and Ochsenbein (1990 – to be updated soon).

Section 2: For STARCAT, see Pirenne et al. (1992).

Section 3: For ESIS, *set host* to *esis* (29671) and login with username *esis* (no password); or telnet to *esis.esrin.esa.it* (192.106.252.127), again using username *esis* with no password. On the Correlation Environment, see Giommi et al. (1992).

Section 4: For SIMBAD, see Egret et al. (1991). For contact points of commercial database providers, see Watson (1991). On the CERN preprint server, see van Herwijnen (1992).

Section 5: For FAQs, see Higgins and Leech (1992). For archie see Feigelson and Murtagh (1992). For archie, Gopher, WAIS and WWW, see contributions in Heck and Murtagh (1993).

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References

1. M.A. Albrecht and D. Egret (Eds.) *Databases and On-Line Data in Astronomy*, Kluwer, Dordrecht, 1991.
2. D. Egret, M. Wenger and P. Dubois, "The SIMBAD astronomical database" in M.A. Albrecht and D. Egret, Eds., *Databases and On-Line Data in Astronomy*, Kluwer, Dordrecht, 1991, 79–88.
3. E.D. Feigelson and F. Murtagh, "Public software for the astronomer: an overwiew", *PASP*, **104**, 574–581, 1992.
4. P. Giommi et al., "The ESIS Correlation Environment prototype", in D.M. Worrall, C. Biemesderfer and J. Barnes, Eds., *Astronomical Data Analysis Software and Systems I*, Astronomical Society of the Pacific, San Francisco, 1992, 59–61.
5. A. Heck and F. Murtagh (Eds.), *Astronomy from Large Databases II*, ESO Conference and Workshop Proceedings, 1992.
6. A. Heck and F. Murtagh (Eds.), *Adding Intelligence to Information Retrieval: The Case of Astronomy and Related Space Sciences*, Kluwer, Dordrecht, 1993, forthcoming.
7. W. Higgins and J. Leech, "Compiling answers to frequently asked questions about space on computer networks", in *Proc. 43rd. Congress of the International Astronautical Federation*, Aug. 28–Sept. 5, 1992, in press.
8. B. Pirenne, M.A. Albrecht, D. Durand and S. Gaudet, "STARCAT: An Interface to Astronomical Databases", in A. Heck and F. Murtagh (Eds.), *Astronomy from Large Databases II*, ESO Conf. and Workshop Proc., 1992.
9. B. Pirenne and F. Ochsenbein, "New media for data distribution and exchange in astronomy", *ST-ECF Newsletter*, No. 12, Jan. 1990, 11–12.
10. E. van Herwijnen, "Are document servers replacing journals?", preprint AS/MI-92-05, CERN, 1992.
11. J.M. Watson, "Astronomical bibliography from commercial databases", in M.A. Albrecht and D. Egret, Eds., *Databases and On-Line Data in Astronomy*, Kluwer, Dordrecht, 1991, 199–210.

ESO Computer Networking

R. Hook, ST-ECF

1. Introduction

Astronomy has always been an international subject from the historical link to navigation up to the modern requirement to erect telescopes at the best sites in the world regardless of distance. ESO is itself a fine example of this trend – what could be more international than a collaborative organization of eight different countries running an observatory in the opposite hemisphere? Efficient operation requires efficient communications and in the era of predominantly digital data and text processing this means efficient computer networking.

Networking has now advanced enough that it reaches most astronomical sites world wide. Operations such as sending electronic mail from an Institute in Estonia to a student observing at La Silla are now taken for granted although they would have been unthinkable in more ways than one twenty years ago. Another important recent development, which is totally dependent on networks, is remote observing in Chile directly from an institute in an ESO Member State without either the astronomers having to travel to Garching to the remote control centre or all the way to Chile. This successful experiment was described in detail in the last edition of *The Messenger*.

Despite these huge improvements, networking still has a long way to go before it becomes as consistent and easy to use as the telephone or FAX machine. There are several different networks in use and they all have their quirks, foibles and inconsistencies. They are also often too slow and sometimes don't work. This article describes briefly the most important current networks used by astronomers. It then describes in more detail how external users may contact ESO electronically and what facilities are available. People who are already familiar with the networks may find most of the important information they need in the box which summarizes ESO electronic contact points. The text inevitably uses rather a lot of acronyms for conciseness. These are explained in Table 1 which should be consulted when necessary.

2. The Main Networks

Computer networks have tended to expand from modest systems linking workers in a similar discipline or geographical area to huge "internets" spanning the globe and united by the use of a common protocol. The protocol may be thought of as the standardized set of rules for communication which is independent of the type or manufacturer of computer equipment. There are now two main "protocols" which are dominating international science networking. They are the TCP/IP protocols used by the Internet and the set of standard protocols defined by the International Standards Organization (ISO) and often referred to as OSI. In addition there are several other protocols in use which astronomers encounter, in particular DECnet (used by the SPAN network), Bitnet/EARN and UUCP. To some extent these may be used together. For example it is quite common for TCP/IP or DECnet to be implemented "on top of" the lower level OSI protocol X.25.

Table 1: *Networking Acronyms*

BITNET	"Because it's time" network
CISCO	Major manufacturer of network routers
CUNY	City University of New York
CWI	Company contracted to provide Dutch networking
DATEX-P	DBP's packet switching (X.25) system
DFN	Deutsches Forschungsnetz
DLR	Deutsche Luft- und Raumfahrt
DBP	Deutsche Bundespost Telekom
EARN	European Academic Research Network
Ebone	European backbone network
ECRC	European Computer Industry Research Centre GmbH
EUnet	European UUCP network
E-SPAN	European-SPAN
ESOC	European Space Operations Centre
ESTEC	European Space Technology Centre
STECF	Space Telescope European Coordinating Facility
STScI	Space Telescope Science Institute
GSFC	Goddard Space Flight Center
ISO	International Standards Organization
MPE	Max-Planck-Institut für Extraterrestrische Physik
OSI	Open Systems Interconnect
SPAN	Space Physics Analysis Network
TCP/IP	Transmission Control Protocol/Internet Protocol
UNIDO	University of Dortmund
UUCP	Unix to Unix Copy Protocol
WIN	Wissenschaftsnetz

2.1 The "Internet"

This network began in the US military (as ARPAnet) but has rapidly expanded in the US and joined up with other networks using the TCP/IP protocol to form what is now the largest global computer network used by astronomers. The total number of hosts worldwide is now close to one million. The word "internet" can be confusing – an "internet" is a group of "networks" which are linked together to form a single entity but the term "the Internet" (capital "I") is normally used to mean the global internet using the TCP/IP protocol. The Internet will be the dominant international science network of the next decade.

Every Internet host has a unique address which is normally written as four numbers separated by dots, e.g. 134.171.8.120. The addresses of all ESO machines begin "134.171.". Host names follow a hierarchical system using domains. Examples are "mc6.hq.eso.org" (a main UNIX computer at Garching), "lw0.ls.eso.org" (a UNIX machine at La Silla), "foca.stsci.edu" (a VAX at STScI) and "simbad.u-strasbg.fr" (the SIMBAD server at CDS Strasbourg). Typically the last part of the name (the domain) is either a country code (.de, .fr, .es, .jp, .se, .nz, etc.) or one of a few special cases such as ".edu" (used mainly for US academic hosts) or ".mil" (US military). The domain ".org" is used for international organizations not fitting into any other class, hence all ESO machines have names ending in ".eso.org" – ".hq.eso.org" for hosts at Garching and ".ls.eso.org" for La Silla hosts.

2.2 DECnet Networks

In the 1980s scientific computing was dominated by VAX computers and it was convenient to link them up using the protocol supplied by their manufacturer which is called DECnet. The most familiar DECnet network used by astronomers is called SPAN (the Space Physics Analysis Network) which has expanded from space physics to cover many astronomical sites worldwide. However, the general move away from VAX computers to higher performance UNIX machines as well as the desire to avoid dependence on single vendors has also led to the TCP/IP Internet largely superseding DECnet for astronomical communications, particularly in the USA. However, in Europe many sites still rely on SPAN and are not accessible via the Internet. DECnet nodes are identified by a name (with a maximum of six characters), this is equivalent to a number which may also be used if the name is not known on the local system. The new DECnet (Phase V) will move much closer to OSI standards but it is not clear that it will be widely used throughout the astronomical

ESO Electronic Contact Point Summary

Electronic Mail:

Usernames are normally first initial plus surname, truncated to 8 characters. Addresses take the form:

Internet:	user@eso.org	(preferred)
DECnet/SPAN:	eso::user -or- 28760::user	
Bitnet/EARN:	user@dgaeso51.bitnet	
UUCP:	user@eso.uucp -or- eso!user	
PSI mail:	Not supported	

Remote Login:

ESO supports several remote login facilities on the Garching "network host" (mc3.hq.eso.org = 134.171.8.4). This machine is also accessible over X.25 at the number 0262458900924 and via telephone modems (numbers on request, not recommended). There is no direct DECnet access.

Bulletin Boards:

Simple news facilities based on USENET News are available on the network host. Login as:
esobb – for general ESO news including La Silla schedules, MIDAS news, instrument news, etc.
stinfo – for news about the Hubble Space Telescope.

Anonymous FTP:

ftphost.hq.eso.org (134.171.8.4) – for general ESO files and ESOFORM.
ecf.hq.eso.org (134.171.11.4) – for Space Telescope related files.

In case of problems:

Send mail to "postmaster" at one of the addresses given above. If all else fails, telephone one of the Garching computer support staff:

Peter Dierckx	–	+49 89 32006-387
Renny de Roos	–	+49 89 32006-445
Richard Hook	–	+49 89 32006-389
Carlos Guirao	–	+49 89 32006-434

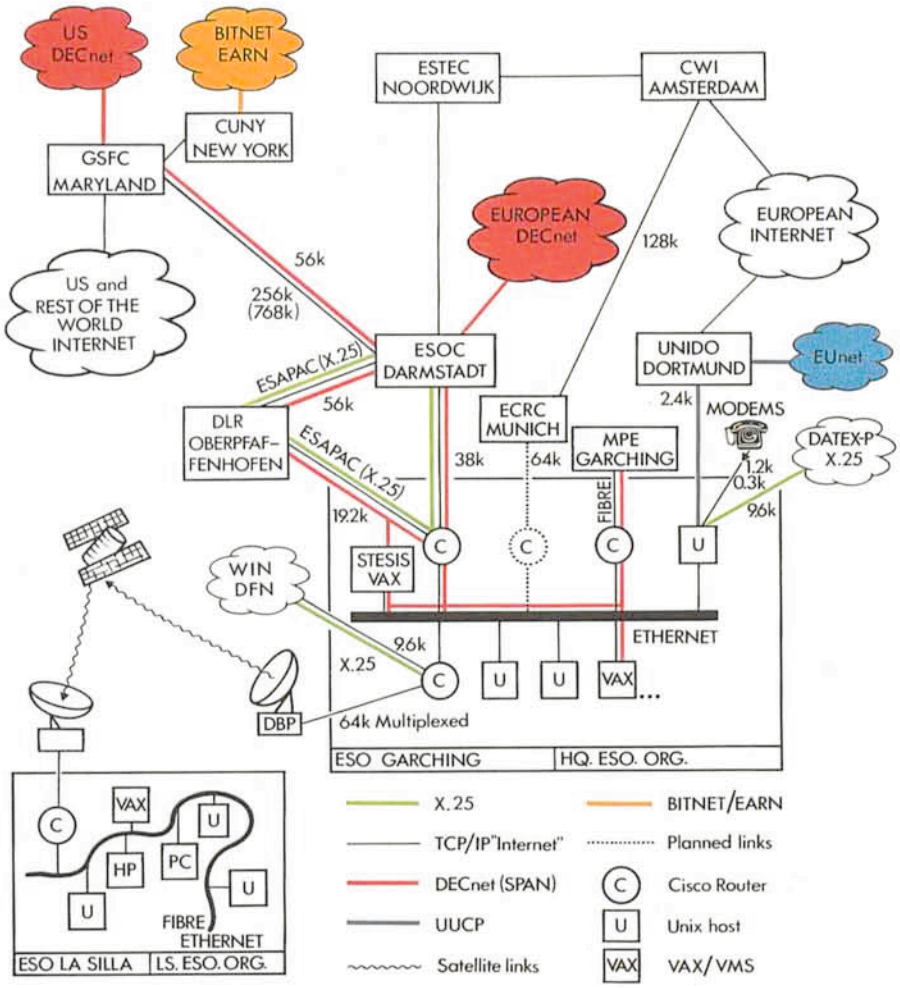

Figure 1.

world. The main ESO VAX for communication has the host name ESO (= 28760). La Silla is not directly accessible over DECnet.

2.3 Bitnet and EARN

These two networks use the same protocols and differ only in that the former is mainly confined to North America and the latter to Europe. They are based on the RSCS protocol developed by IBM, and many of the machines initially using this network were IBM mainframes. However other implementations (e.g. for VAXes) have been produced and are widespread. In the early days the networks were financially strongly supported by IBM which made them attractive. However the rise of the Internet has made their use start to decline. Bitnet/EARN is now primarily used for electronic mail but can support other facilities, such as file transfer, although these facilities are only likely to be used in conjunction with IBM computers. ESO retains the clumsy name DGAESO51 for electronic mail but is no longer directly connected to Bitnet/EARN.

2.4 UUCP

UUCP is a simple network system which originated as a way of connecting UNIX machines together over telephone modems. It is now little used in astronomy and is included here only because ESO has a UUCP link to the University of Dortmund and may be contacted at the address eso.uucp.

3. ESO Networking Configuration

Most ESO computers in Garching and La Silla run the UNIX operating system, but there are still a few VAX machines running VAX/VMS. As a matter of policy all the machines support the TCP/IP protocol and hence they can all communicate with each other and with the external Internet. Only the VAXes are also connected to SPAN although electronic mail may be sent between SPAN and the UNIX machines by using one of the VAXes as a gateway. Only TCP/IP is supported on the link between Garching and La Silla which is a multiplexed line also for other types of communications (e.g. remote observing).

ESO is directly connected to the Internet, DECnet (SPAN) and UUCP. Mail may be sent to and from Bitnet/EARN via gateways on the Internet. The configuration is shown in simplified, but still rather complex, form as Figure 1. In order to make it compact acronyms are used a great deal and these are explained in Table 1. Both SPAN and Internet traffic currently uses a line between Garching and ESOC which was originally established for communications between the Space Telescope Science Institute in Baltimore and the Space Telescope – European Coordinating Facility, which is based at ESO. Most European Internet traffic is routed from this ESA network onto the European high speed backbone (the Ebone) in Holland. Traffic for the rest of the world goes initially to Goddard Space Flight Center in the USA. This ESA link is an effective temporary solution but in the medium term ESO is planning to get its own high speed link into the Internet. One possibility which is being considered in detail at present is a new connection which will link ESO Garching with a "Point of Presence" in Munich and from there to the Ebone via Amsterdam. This link will allow comparable or better performance to the present system without having to use ESA lines originally installed for a different use. However, it must be stressed that this new link is far from being finalized yet and it may not prove to be possible in the form given here.

Other lines out of ESO include a slow telephone modem link to Dortmund which carries some electronic mail (e.g. UUCP mail), an X.25 connection to the German DATEX-P public packet switching network and an X.25 link into the German Wissenschaftsnetz (WIN) which also can carry Internet protocol traffic at low data rates.

4. Sending Mail to ESO Staff and Visitors

Most ESO Staff at both Garching and La Silla have a username on a UNIX computer. These usernames are normally the initial letter of the person's first name, followed by their surname and with the result truncated to eight characters, all in lowercase. E.g., the username of a hypothetical Helmut Mitterand would be "hmittera". The same rule is used at both Garching and La Silla. Once the username has been deduced, a message may be sent to one of the standard ESO addresses given in the summary box. It is not necessary to either specify a particular machine at Garching or La Silla. Typical addresses would be "hmittera@eso.org" or "hmittera@dgaeso51.bitnet" or "eso::hmittera". It should be noted that every UNIX username has a unique mail

delivery point and sending messages to specific machines in Chile or Garching will probably result in the message arriving at the same place anyway even if the user has a username on several different machines.

Visitors to La Silla may be contacted by sending mail to the special account "lasilla" at the same address. This is read regularly at La Silla and a message may be delivered to the required person. To make the recipient clear the "subject" line should specify whom it is intended for.

Electronic Network Access to ESO

for Image Processing Group, P. GROSBØL

November 13, 1992

The main emphasis for ESO's Wide Area Network connections will be placed on providing a fast and reliable access through Internet although connections to SPAN, EARN and UUCP will be maintained as long as it is reasonable considering both usage and cost. During the major part of this year, ESO has been allowed to route a significant part of its Internet traffic through an ESA/NASA link. This has significantly contributed to the stabilization and been greatly appreciated by both ESO and its user community. ESO is now in the process of establishing a faster and more direct link to the European Internet Backbone to accommodate the increasing network traffic.

5. Other ESO Networking Facilities

ESO provides a number of facilities which may be accessed via the networks. Firstly there are two anonymous FTP accounts which may be reached by anyone on the Internet. The first of these is ESO specific and provides MIDAS software updates and general information. The second is maintained by the ST-ECF and contains files relevant to HST's operation. In particular there is a large software library from many sources and documents and software useful for proposal preparation. The addresses of these FTP accounts are given in the summary box. They are accessed in the usual way–connect to the machine using FTP and give "anonymous" as the username and your electronic mail address as the identification string when prompted.

In addition, two Bulletin Board systems may also be accessed over the Internet. They provide access to up-to-date information using the USENET News system. The first, "esobb" gives information about the ESO computer systems, MIDAS news and other news for visitors to Garching or La Silla. The second is for HST news and has the username "stinfo". Again the details are given in the summary box. Just login and try them, no password is required.

It is also possible to access the ESO/ST-ECF STARCAT system over the network. STARCAT provides access to the Hubble Space Telescope catalogue and the ESO Archive catalogue as well as many other astronomical catalogues and data bases. There are two kinds of access. Firstly one may login to the account "starcat" on the Internet host dbhost.hq.eso.org or to the DECnet host STESIS (28771). These are captive accounts which have no password but give interactive access to the STARCAT system.

It is often inefficient to use STARCAT interactively over a slow network link. To provide an effective way of issuing STARCAT commands remotely in a batch style, a new facility called STARMAIL is now available. To use this, one prepares a set ot STARCAT commands remotely and sends them as an electronic mail message to "starmail" at the standard ESO addresses. The commands are automatically issued to STARCAT and the resultant output is returned to the remote user by electronic mail. For more details please contact Miguel Albrecht (username "malbrech"). STARMAIL will be described in detail in the forthcoming *ST-ECF Newsletter* (Number 19, January 1993).

A final and important new networking facility is the support of electronic observing time proposal submission and validation for the ESO La Silla telescopes. This system is called ESOFORM and it is a three-stage process:

1. Collect the LaTeX style files and proposal validation software from the ESO anonymous FTP. The directory is eso/proposal and the file which should be collected (using binary FTP) is the compressed "tar" file esoform-NN.tar.Z where NN is the ESO observing period number e.g. 52). Alternatively the files may be copied over DECnet from the directory ESO::ANONYMOUS:[ESOFORM].
2. Prepare the proposal in the correct form on the local machine using the LaTeX style files and template provided and validate it using the software which is also available from the same place.
3. Send the completed proposal to the username "proposal" at the standard ESO addresses. The text sent will automatically be validated on arrival and a message returned to the sender either notifying him/her that the proposal has been validated correctly and has been passed on to the ESO Observing Programmes Committee (OPC) or that it failed validation and will have to be re-submitted.

6. A Bright Future

The near future plans for ESO are based on getting improved TCP/IP communications between Garching, La Silla and the astronomical community. Other protocols will be maintained where they are required but are likely to fade away quite quickly as the demand for them from other institutes also fades.

At present the revolution in the way astronomers use computer networks is just beginning. There are three main changes which will inevitably happen over the next few years. Firstly there will be much greater line speeds, these are obtainable easily using current fibre-optics technology, the delays are practical and financial. End-to-end speeds of roughly a Megabit/s should be attainable throughout Europe within five years. In the US, where TCP/IP networking is far more advanced, such speeds are already available between some sites. Improvements of this magnitude would, for example, allow a future Hungarian ESO astronomer to display a CCD image which had just been taken by the VLT in a few seconds on their own workstation in Budapest. The second change will be the global adoption of more compatible protocols, almost certainly using TCP/IP as the *lingua franca*. This change is already well advanced and will allow the vast majority of computers worldwide to talk to one another. The final change may prove to be the most important for the actual user. Once networks become compatible and fast, the mechanisms of moving information around on them will become less obvious and the systems will become more distributed. Instead of users invoking basic network facilities (ftp, mail and telnet) more advanced tools (probably using a graphical user interface based on X11) will use the net as and when required, rather as a current ethernet is used within an organization. In such an environment finding and organizing information will become more

of an obstacle to effective research than the practical aspects of how to move information around. These issues are addressed by Fionn Murtagh's article in this edition of *The Messenger*.

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Report on ALD-II, Astronomy from Large Databases II

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The colloquium on "Astronomy from Large Databases II" was held from September 14–16, 1992. It was a follow-up to a meeting with the same title ("Astronomy from Large Databases: Scientific Objectives and Methodological Approaches") held in Garching in 1987. The proceedings of both meetings were published by ESO.

If one considers the two terms of the title, "astronomy" and "large databases", then the aim of the conference was the directed link between these. Hence the objective was not so much to cater for new astronomical results – there are many appropriate fora for this – nor to deal thoroughly with database technicalities. Rather the aim was to share experiences, and to focus interests, along the interface between these areas.

The meeting was structured so as to prioritize discussion. Twenty-odd invited talks were complemented by around 70 posters which were on display throughout. A number of talks covered database and archive usage on the part of extant projects (IUE, HST, ROSAT, HIPPARCOS, COBE, etc.). Reference was made to the myriad databases constituting a back-drop to such large projects. Panchromatic astronomy is certainly the order of the day. Subsequent talks included coverage of: classification-oriented front-ends for databases; current research and perspectives in the information retrieval community; data security issues; the astronomer's research environment; and other topics. Poster papers covered such themes as: statistical and pattern recognition studies; visualization; quality control of data; thesauri; sky survey databases; and many descriptions of functionality offered by particular projects.

A feature of note, regarding this conference, was the fact that the role of libraries (paradigmatic large databases, of course, even if not always in electronic form) in astronomy was addressed. A discussion panel involving librarians from ESO, AAO and others, as

well as the President of IAU Commission 5 (Data and Documentation), focused further on this topic. What is aimed at is nothing less than the increasingly better integration of data and information that the astronomer has to deal with, whether bibliographic, symbolic, numeric, image, or whatever. Following this conference, one no longer has any right to consider astronomical databases separately from the role played by astronomical libraries.

Conferences such as this are of great help in combating "photonic provincialism" (D. Wells). The lowering of boundaries, and the bridging of what were until recently distinct areas, can only be for the betterment of our science.

The New MIDAS Release: 92NOV

ESO Image Processing Group

The new 92NOV release of MIDAS is now available for general distribution. The one-year release cycle introduced last year has made it possible to extend the validation tests significantly. The current release is actually based on the development version of MIDAS frozen in August. This frozen version is first going through a one month α-test inside ESO, after which a β-test version is sent out to 5–10 test sites. The final release version is made in the course of November, taking into account the different test reports. We hope that this rigorous test procedure and full configuration control of the source code will provide a stable and reliable system for the users.

The introduction of source code control and other CASE tools for code production in MIDAS not only improves the development cycle but also provides interesting statistics as a side effect. The number of source code lines is shown in Table 1 for different types of files, where FORTRAN and C correspond to actual programme code, while prg refers to high-level MIDAS procedures. Documentation is mostly in the form of LaTeX or ASCII help files. In a few cases, the size has decreased due to revisions and rearrangements of old code. For the first time, the new release contains more C than FORTRAN code. The change is caused by a significant