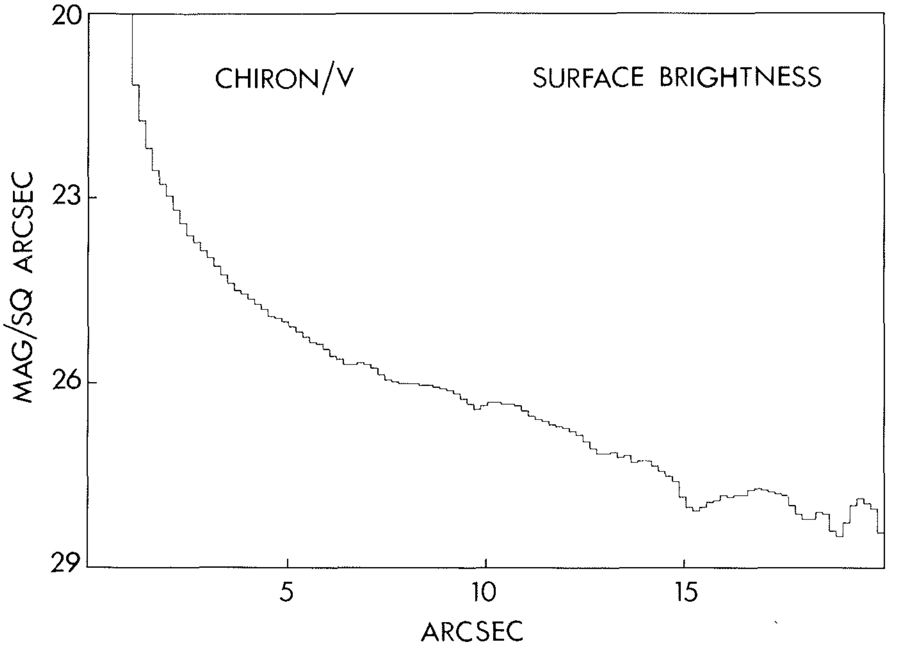


Figure 2: *Mean radial luminosity profile in V of Chiron's coma, after subtraction of the contribution from Chiron itself. The abscissa indicates the distance from the centre in arcseconds (1 arcsec = 7680 kilometres projected); the ordinate is the surface brightness in magnitudes per square arcsecond. The corresponding sky background emission is ~21 mag/arcsec^2.*

light; the remaining image, which is presumably that of the coma cloud immediately surrounding Chiron, is also blue, (B–V) = 0.4 ± 0.1.

The blue colour of the coma is most likely due to the scattering of the sunlight by small particles. The possible reddening outward can be explained by the destruction of the smallest particles as they drift away from Chiron, so that the relative content of larger particles increases outwards. This is therefore in general agreement with the idea that the coma is caused by the sublimation of ices on the surface, a process that apparently started when Chiron's inward-bound orbital motion brought it within ~12 A.U. of the Sun.

It will of course be necessary to study the coma in more wavebands before it is possible to be more specific about the nature of these particles, their size distribution, chemical composition and density.

Chiron's Rotation

By careful measurement of the brightness of the central condensation, it was possible to confirm the light variation noted earlier by Bus et al. (*Icarus,* **77,** p. 223, 1989), on the basis of CCD measurements in 1986 and 1988. Thanks to the longer time interval, the period of this variation, i.e. the rotation period, can now be estimated with higher accuracy: P = 5.91783 ± 0.00005 hours.

The absence of any significant, night-to-night changes in the coma structure, and the lack of evidence of "jets" or "spirals" in the coma, leaves the impression that the evaporation occurs over a larger surface area, rather than from isolated vents, like those detected on the nucleus of Halley. It can be seen (Fig. 1) that the innermost part of the coma is somewhat asymmetrically placed with respect to the nucleus. The direction of this elongation does not coincide with the direction to the Sun or the direction of orbital motion, both vectors being near West (p.a. = 269° and 289°, respectively).

It is in principle possible that this asymmetry is connected to the direction of the rotation axis, the projection of which might be perpendicular to the direction of inner coma elongation. Since the evaporation from the surface is likely to be strongest during the "Chiron afternoon", just after the most intensive solar heating at "noon", the direction of rotation would appear to be from NW to SE, as seen projected onto the sky. However, it should not be forgotten that even the inner coma features are still at several arcseconds' distance from the centre of light, i.e. more than 20,000 km from Chiron's surface. They may therefore not be directly connected to phenomena on or just above the surface.

Future Investigations

Details about these new observations of Chiron's coma will be reported in a forthcoming paper in *Astronomy & Astrophysics.* They pose a number of interesting questions which can only be answered by a more detailed investigation. For instance, it would be most desirable to perform photometry of the coma in other wavebands, also in the infrared region. Apparently, no gaseous emissions lines have been observed so far in the spectrum of Chiron, but it may well be that a gaseous component of the coma can be detected at a later time.

There is little doubt that Chiron will be a popular target for solar system astronomers during the coming years.

New Communication Link Between Garching and La Silla

A. WALLANDER, ESO

1. Introduction

In the beginning of February a new permanent communication link between ESO Headquarters and observatory came into operation. This new 64 kbps digital link will, among other things, become the backbone for remote control of the New Technology Telescope (NTT). Although the physical distance between Garching and La Silla will always be the same, the new communication link will make the logical distance between people working in Europe and South America smaller. It will contribute to a higher level of integration of the organization increasing the productivity both in technological and scientific areas.

La Silla and Garching have already been linked on a permanent basis for several years via an analogue leased line. Astronomers and engineers have become accustomed to call up colleagues on the other side of the Atlantic

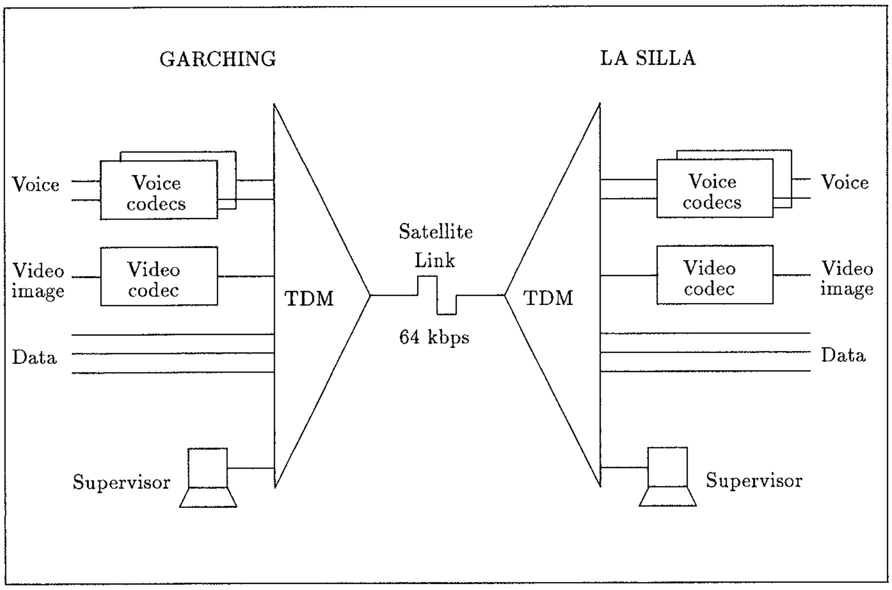


Figure 1: *System Architecture.*

simply by dialling a special prefix number. Many e-mail and fax messages pass over this line every day. The CAT or the 2.2-m telescope is controlled from Europe around 12 nights every month using this leased line. The new link will, at least for the time being, be a complement to these well-established communication facilities. In both cases the links are leased from the German and Chilean PTT's and are using Intelsat communication satellites.

When discussing long-distance communication links, the most important characteristic is bandwidth or the amount of information which can be transmitted within a time interval. The new digital link has five times higher capacity to transmit raw digital information compared to the analogue link and this to only a 20 % higher cost. This is in line with the present trend in international communication tariffing, whereby cost for higher bandwidth digital leased lines is decreasing.

2. Requirements

Experience with the existing remote observing facilities for the CAT and 2.2-m telescopes has shown the need to integrate voice, data and video image communications. Experience with the analogue line has also shown the importance of allowing more general communications during day time when no telescopes are remotely controlled. In fact, one could argue that this second point is more important since remote control always will be used less than 50 % of the time.

Integration of voice, data and video image communication has been a hot topic for some time and is addressed in developments like ISDN (Integrated Services Digital Network), fast packet switching and other upcoming technologies. To appreciate the difficulties, one has to consider the different characteristics of these types of communications. Voice and video are analogue in nature and need to be digitized before using digital transmission media. Voice and video transmissions are also sensitive to delays, but not so fuzzy about correctness. The opposite is true for digital data transmission, where correctness is a must, but reasonable delays are not so critical.

The combined requirements of remote control and general communications call for a system which integrates data, voice and video image communications. Depending on the type of operation, different users should be given access to the link. The system should be "future compatible" in the sense that new users should be easy to integrate, hardware should support a future higher bandwidth link and the system should be adaptable to new technologies. High reliability and availability should be guaranteed through the use of redundancy and powerful monitoring and diagnostic functions. These are very ambitious requirements, especially when considering the limited trunk bandwidth of 64 kbps.

3. System Architecture

The integration of many users has been implemented by means of time division multiplexing (TDM). This technique allows the 64 kbps trunk to be spit up into smaller bandwidth user channels. The method of time division implies that the sum of the user channels bandwidth is less than the trunk bandwidth. The allocation of bandwidth is done from a supervisor terminal connected to the TDM microprocessor. Reconfiguration can be made from one side on-line or via preprogrammed configurations activated at a defined time of day. The system is extendable in the sense that new users (input channels) can be added by plug in modules. The system also allows for

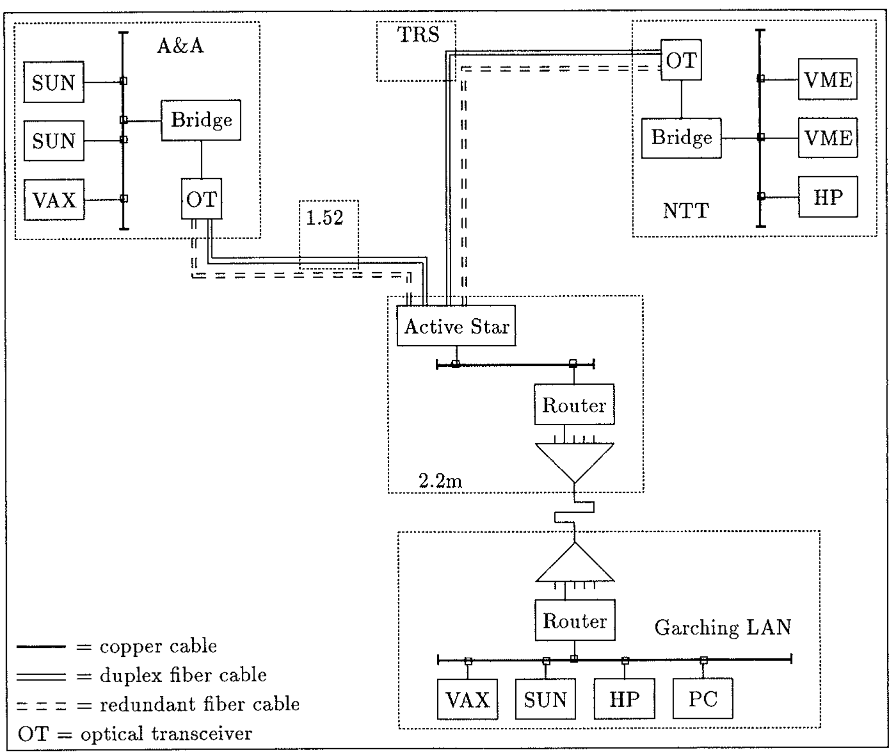


Figure 2: *ESO Wide Area Network.*

duplication of processor board and power supply with automatic switch over in case of failure.

3.1 Voice

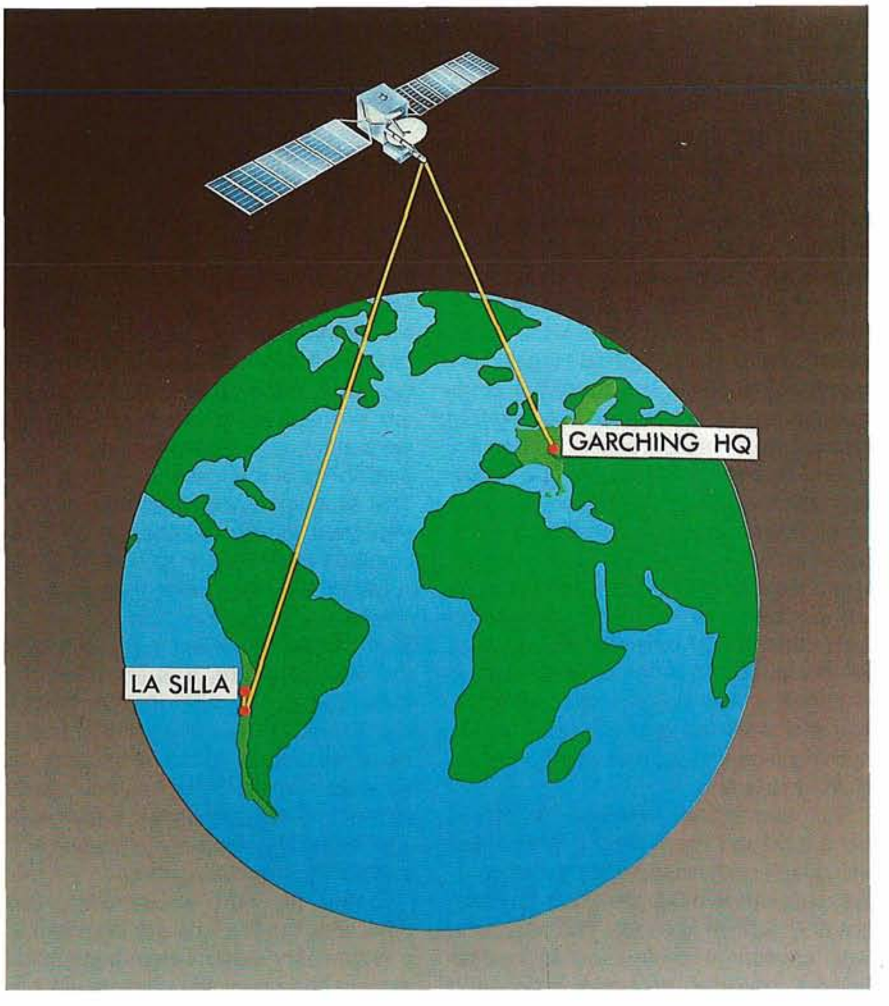
To implement meaningful voice connections the telephone exchanges (PBX) at the two sites need to be connected. This allows any extension at one site calling any extension at the other site using a prefix number to access the external tie line. That is exactly the way the present tie line connection over the analogue link works. However, in order to interface to the TDM, the analogue voice signal first has to be digitized.

The common method to digitize voice is to use pulse code modulation (PCM). The analogue voice signal is sampled at 8000 Hz and each sample is coded in 8 bits, thus a bandwidth of 64 kbps is required for one voice channel. Using this method obviously is bad economy over the new digital link (remember the initial statement that this line has five times the capacity of the analogue line). Different types of delta modulation, where the difference between two samples is coded instead of the absolute value, improves the situation and the same voice quality can be obtained using only 32 kbps. By using parametric coding instead of waveform coding, it is possible to further decrease the necessary bandwidth. This requires more complex signal processing and powerful hardware. With present technology it is not possible to maintain the same voice quality when going down in bandwidth. The main question is if the voice quality using this method is acceptable to the users.

Considering the need to share the 64 kbps trunk between many users, it was decided to install state-of-the-art voice codecs using only 2.4 kbps. Thus it would in principle be possible to have 26 such voice channels over the link. Two such voice codecs have been installed and were taken into operation after some initial interfacing problems to the PBX at La Silla were rapidly solved by Luis Aguila. The initial experience is that these voice channels are useable. Improvements are still possible as some problems have been identified and should be solved in the near future. This system may anyway be complemented with one higher quality, higher bandwidth voice channel. Use of such a voice channel will however penalize other users and cannot be available all the time.

3.2 Video Images

The remote observing astronomer needs to have access to TV pictures available locally at the telescopes. Therefore, a video image transmission system is required. One could also think of other applications, like some type of video conferencing, where such a system could be useful. However, when considering the enormous information contents in a video signal and the limited bandwidth available, compromises have to be sought. A full motion digitized video signal requires a bandwidth of hundreds of Mbps. By using advanced compression algorithms it is however possible to transmit lower resolution and/or lower refresh rate video images over a lower bandwidth channel.



A slow scan television system has been chosen that operates either in high resolution (576 * 720 pixels) or medium resolution (356 * 576 pixels) mode. In high resolution mode a video image is captured and digitized using 16 bits per pixel into 6 Mbits of data. These data are compressed 20 times before transmission. Because compression, transmission and decompression are carried out in parallel and communication overhead is minimized, the resulting frame refresh rate over a 48 kbps channel is about 10 seconds. In medium resolution mode this figure is reduced by a factor of two.

A preliminary version of this system was used during the NTT inauguration to transmit images from the auditorium in Garching to La Silla.

3.3 Data

Data communication for remote control of the CAT and the 2.2-m telescope is based on a point-to-point connection between the remote control computer and the instrument computer. A similar connection has been implemented to the NTT control computer over the new digital link. However, this type of connection does not solve the need for generality and connections to other computers. At La Silla there had been the wish for some time to build up a network connecting the various telescopes and the general off-line computers.

In close collaboration with people from La Silla, in particular Gaetano Andreoni, a design was worked out to start implementing such a network. The initial need was to connect the local area network (LAN) of the NTT and the general computer LAN in the administration building with the LAN in Garching. Due to the distances at La Silla (diameter over 3000 m) the transmission media had to be optical fiber. Use of fiber optics also have the advantage of removing problems of earthing and risk for damage to equipments during lightning. It was decided to start implementing a fiber optic Ethernet backbone network. A backbone network only carries traffic between the connected LAN's, while local traffic is contained locally by means of bridges. The hardware components were chosen in such a way that new points of interest easily can be integrated by pulling new fibers and installing new modules. For reliability reasons all fiber links are duplicated with automatic switch over in case of fiber breakage. Fibers have also been chosen to be compatible with the next generation LAN called FDDI (fiber distributed data interface) running at ten times the speed (100 Mbps). The delicate work of installing and terminating fibers, using fusion splicing technology, was carried out by Rolando Medina.

The connection between the backbone LAN and the TDM is implemented using high performance OSI level 3 routers, supporting multi protocols (at present only TCP/IP is used). This approach was chosen in preference to remote bridges because of performance and security reasons. A router gives better performance for short interactive messages and provides much more powerful security and diagnostic facilities.

This implementation gives full connectivity between all computers connected to a LAN in Garching or La Silla using TCP/IP protocol. The routers allow access control on a host basis as well as definition of type of access, e.g. a host may be allowed to send e-mail, but not allowed to do a remote login (TELNET, rlogin).

4. Experience After the First Months of Operation

In the long term, the availability of the link will become crucial. More and more users will realize the advantage using this communication facility and take for granted it should be available. At ESO we can build in redundancy and recovery procedures in our equipment, but we cannot do anything to guarantee the availability of the leased line from PTTs. This situation is very frustrating and it is important to collect statistics and analyse fault conditions in this initial phase.

During the first weeks of operation the downtime of the link was about 30%. This terrible figure has improved, but at the time of writing it is still 10%. It is clear that this is still unacceptable for the future, but hopefully the improving trend will continue. Good working relationship with the PTTs has been established and by identifying weak points and improving recovery procedures the availability should improve.

During the NTT inauguration, three days after the link was available to ESO, a preliminary video image transmission system and one voice channel were operational. The point-to-point connection to the NTT computer has been used extensively for software upgrades and troubleshooting during the last months. It will continue to prove to be an important tool during the integration of EMMI and later IRSPEC software. The fiber optic backbone network at La Silla was taken into operation and connected to Garching LAN without problems. At the time of writing it is normal to see at least one user from La Silla logged in on the main VAX in Garching. It is fair to say that this proves the usefulness of this connection and it is expected that the use of this facility will increase drastically in the near future.

It should be noted that all installations at La Silla have been carried out by local staff, in particular Gaetano Andreoni, Rolando Medina and Luis Aguila. During the commissioning phase the communication system itself was used extensively. Troubleshooting and integration of new components are facilitated by an intense communication via e-mail, file transfers and telephone conversations.

5. Future Developments

During the coming year work will concentrate on implementing remote control of the NTT. This application will have priority and other users will have to accept this.

However, it is expected that other applications will also gain in importance. For example, it is already planned to extend the backbone network at La Silla to other telescopes. New local applications over the backbone network are expected, e.g. data sharing between telescopes, archiving, centralized information accessible on-line from the telescopes (STARCAT, seeing measurements), etc.

Software development and maintenance, not only for telescope and instrument control, but also for MIDAS and other applications, will become much easier.

In the long run, the experience and know-how gained by using this communication link will be an asset for the VLT project.

Atmospheric Extinction at La Silla from September to December 1989

N. CRAMER, Observatoire de Genève, Sauverny, Switzerland

Since November 1975, the Geneva Observatory photometry group has been systematically carrying out measurements in the Geneva 7-colour system at La Silla. Special care has been taken to ensure the conservation of the passbands and of the reduction procedures over the period of almost 30 years that the system has been in use. This guarantees the long-term homogeneity of the data recorded.

The M+D technique developed by F. Rufener (see for example a description in *Astron. Astrophys.* **165,** 275–286, 1986; or in *IAU Symp.* **111,** 253–268, 1985) allows the measurement of the atmospheric extinction coefficients and their evolution with time over the duration of a night of observations. Our observers usually apply that technique when the meteorological conditions are judged to remain good during the whole night; otherwise, the observations are carried out at a constant air mass and the reduction is generally done by using the mean extinction values of the site. During the reductions of M + D observations, however, the instantaneous monochromatic extinction coefficients corresponding to the mean wavelength of each filter are computed throughout the duration of the night.

Over the years, we have frequently