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OSI環境下におけるPC間通信

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東北大学は仙台市内の5つのキャンパスを接続する総合情報ネットワークシステム(TAINS)を構築した。このシステムの基幹となる通信ネットワークはキャンパスを結合する光ファイバを持ちたバックボーンネットワークと各建物毎に構築されるインハウスネットワークから構成されている。バックボーンネットワークはFDDIに準拠しており、インハウスネットワークの標準プロトコルとしてはOSIが採用されている。ワークステーション(WS)はインハウスネットワークに直接接続できるため問題はないが、RS-232Cインターフェスしか持たないパソナルコンピュータ(PC)は通信アダプタCSを介して接続される。CSはインハウスネットワークの標準プロトコルを実装している。TAINSの利用者の多くはPCを利用しているのが現状であり、これらの利用者のための通信環境を整備することは重要である。本文は、OSI環境下におけるPC間通信を支援する目的で開発した*TM&T*について報告する。*TM&T*はPC利用者間での電子メール交換とキーボードによる会話(*talk*)を実現するものである。

PC Communication in an OSI Environment

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ABSTRACT

TAINS is an OSI-based large-scale campus network of Tohoku University. A very large number of the users of TAINS are using Personal Computers (PC's). Few of them, however, have any sort of network interface, therefore PC's are connected to TAINS via a communication adaptor called the *CS* (Communication Server) which enables PC's to communicate via the in-house coaxial cables and the optical fiber trunk line in accordance with the ISO 8802.3 protocol.

In this paper, we report the development of a communication application, *TM&T* (TAINS *M*ail & *T*alk system) which is designed to provide PC users with message exchanging functions viz. *TAINS Electronic mail* (*T-mail*) and simultaneous keyboard 'talk'ing (*T-talk*).

1. INTRODUCTION

Tohoku University has constructed a large-scale information network TAINS[3] (*T*ohoku *U*niversity *A*cademic *I*nformation *N*etwork *S*ystem). This network has adopted the OSI (Open System Interconnection) network architecture in its entirety and is the first of its kind. The primary function of the network is to facilitate an easy and efficient interconnection among the various computers, terminals and other scientific equipment in the university campus which is spread over geographically-separated locations in the metropolis of Sendai.

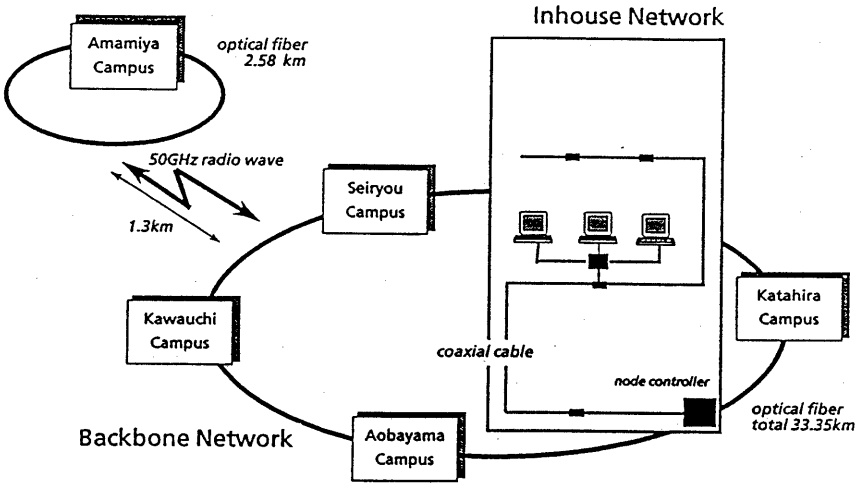

Fig. 1 Layout of TAINS

In keeping with the trend of the growing demands in research and education, networks of this type are becoming more and more popular among universities. However, there is a dearth of applications which realize the various potentials of such communication networks. This may be due to the fact that the protocol regulation for some of the upper layers is fairly recent while those of higher layers are still in the process of being finalised. In any case, the methodology of constructing these type of applications has not been fully explored.

The environment of TAINS has the rich potential of supporting various features e.g. distributed processing, distributed databases, various kinds of data-communication facilities, etc. In this paper we will report on an attempt to develop a communication application which provides PC-users on TAINS with mail handling and simultaneous-keyboard-talking capabilities.

2. OVERVIEW OF TAINS

2.1.Purpose of the network and its functions: In a campus network the requirements are diverse, also, the skill of the network users vary from that of personal computer beginners to that of experts on computer networking.
Thus, the most important characteristic for campus networks is its flexibility in

catering to the various demands that arise in the heterogeneous environment of a University.

To efficiently serve the diverse requirements that arise in the university environment TAINS offers facilities for database retreival, on-line execution of scientific computations, document processing, processing of experimental data, image data processing, electronic mail exchange, communication among personal computers ... .

2.2.Network facility: TAINS is a packet-switching network with a two-layer structure(fig. 1). One layer is the 100Mbps multi-mode optical fiber cable which forms the backbone of the network. The other layer comprises of numerous 10Mbps coaxial cable each supporting an in-house network. The inhouse network is a bus type network and is set in the building of each faculty, research institute and so on. The branches formed by the coaxial cables are connected to the trunk line formed by the optical fiber cable, via node control units. The optical fiber trunk-loop forms a ring network and adapts the ANSI FDDI token passing

Data transfer (protocol)	Same Branch	Different Branch
PC → PC (non)	6.6 Kbps	6.6 Kbps
PC → WS (FTP)	14.8 Kbps	14.8 Kbps
WS → PC (FTP)	235.2 Kbps	235.2 Kbps
WS → WS (FTP)	520.0 Kbps	520.0 Kbps
WS → WS (XNS)		230.0 Kbps

Table-1. Rates of data transfer in TAINS.

protocol[2]. The ISO8802.3 protocol is followed as the MAC level protocol in the in-house networks. The node control equipment have a built-in learning function for addressing. Therefore, packets transmitted to destinations in the same inhouse network never appear in the trunk network. Thus, highly efficient transmission will be maintained. As TAINS has the appearance of one large ISO8802.3 network and addressing is carried out using MAC addresses, though it is based on the OSI protocol, other network architectures such as TCP/IP, XNS, DECNET, ... , also co-exist in the network. Table-1. shows some performance figures related to the rate of data transfer among various machines using different protocols.

2.3.CS: the communication server CS provides the interface between the RS-232C port of personal computers and the 10Mbps coaxial cable transmission line which serves as the in-house Ethernet. Table-2 shows some of the CS

Item	Specification
Data rate	10Mbps
Number of channels	Max 4 (Duplex), 8(Half Duplex)
Capacity	9600bps(Half Duplex) × 8
Power	AC100V, 50/60Hz
Environment	Temp 5-40° C Humidity 30-80%

Table-2. CS specifications

specifications. PCs can be connected to the Ethernet through this interface. Packet transmission and reception is carried out in the in-house network using the CSMA/CD (Carrier Sense Multiple Access with Collision Detection) protocol regulated by ISO8802.3.

The CS offers several features which enables a connected PC to realize communication facilities. This provides an excellent environment for developing communication applications without having to worry about lower layer protocols. Our system is an example of one such application. Fig. 2. shows schematically

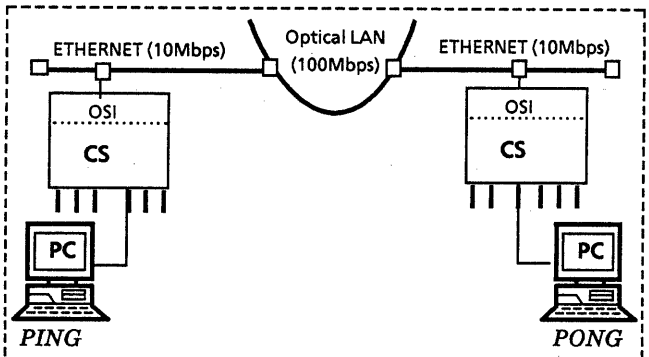

Fig. 2. PC-Communication in TAINS

the environment in which PC-communication is contemplated. The two PCs *PING* and *PONG* are connected to CS-ports. In the existing configuration, the ports are by default in *passive* mode listening for requests for connection from other parts of the network. In this case the port and the connected PC is said to be in the *server* state. If a PC (*PING)* wants to 'talk' to another PC (*PONG*), it first changes to the *client* state by going into the *active* mode and sends the communication request (**oc** / **otelnet**) through the port to the network. The

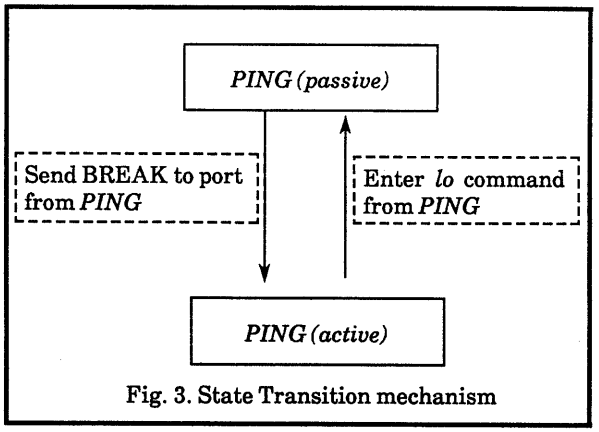

Fig. 3. State Transition mechanism

change of state from server to client (*passive* to *active*) and vice-versa is carried out at run-time depending on the users requirement. The mechanism of the change of state is shown in Fig. 3. Once the (TELNET) link is established the two PC's can communicate with each other through the RS-232C interface as if there is a direct cable connection between them. This is the basis on which the *TM&T (TAINS Mail & Talk)* application is built.

3.The *TM & T* SYSTEM

TM&T is a terminal application program which supports key board talking and mail handling functions on PC's in TAINS. The CS provides the necessary interface between the RS-232C port of personal computers and the 10Mbps in-house network. The schematic diagram of the *TM&T* system is shown in fig. 4.

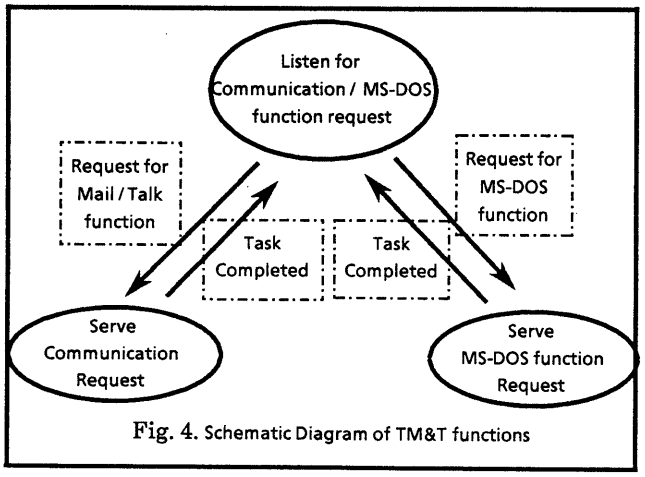

Fig. 4. Schematic Diagram of TM&T functions

The *communication request service* involves capturing character strings recieved at the CS-port, separating CS status information from the communication data and taking necessary action depending on the extracted information.

Addressing: To start communication *TM&T* first requests the CS to establish a connection. The addressing in *TM&T* is carried out in terms of the destination CS name and port number. There are two levels at which address resolution facilities are provided -

i. Network wide resolution using the services of an *address server.* For this purpose, *PC*s taking part in the *TM&T* network keep exchanging information with the address server.

ii. Local resolution: users can store the name and address of colleagues, so that they are free from remembering addresses.

The address server also provides a directory service using which details of network users may be referred.

At start-up *TM&T* sets the port in the *passive* mode and waits for a request. Requests may be of the following categories.

From the user

- For some MS-DOS operation
- A communication request : (send mail or talk to someone).

From the network

- Someone wants to talk to the user
- Some one is sending some mail.

The service of a communication request *from* the user basically consists of three phases- establish link & session, communicate, close link / session. To establish a link *TM&T (caller)* sends a request to the network indicating the destination with which a link is being sought. *TM&T(callee)* services the link request by completing the link and returning an acknowledgment. Following the establishment of the link negotiation for starting the communication session is carried out.

The session is reliable, full-duplex, flow-controlled, stream between two *TM&T* programs. Once established the data-communication between the *caller* and the *callee* across the network, can be carried out without bothering about lower-level details of error-checks, corrections and retransmissions.

Once the communication is over *TM&T* orders lower level protocols to close the link and returns to the *passive* wait & listen state.

In general, if one is not sure about the address, help may be sought from the address server .

4.THE IMPLEMENTATION

4.1T-Mail: The Mail part of *TM&T* offers the standard mail features. The sender of a message indicates the destination which may be a address and user-name or a set of destination-user pairs.

In case the target machine is busy or is not up when the transmission of the mail is attempted, the message is retained in the local machine to be delivered when the target machine comes up or returns to the *not-busy state.* The arrival of a mail is announced to the receiver by *TM&T.* The recieved message is stored in a user-defined directory which is defaulted to *MAILBOX.* The user interface part of *TM&T* enables the user to *read, write, forward* and *delete* mails.

4.2T-Talk: T-Talk provides functions which allow users to chat with each other (silently!) through the keyboard. The system closely mimics the telephone system. When a 'talk' request arrives, the system announces it by sounding the buzzer and displaying the callers identity on the CRT. The called party is supposed to answer the call by keying in the appropriate reply, after this a regular dialog can be carried out. If there is no reply, after a certain time period, the system offers the T-Mail facility to the caller for leaving messages.

If the called party responds the talk session is started. During the talk session, the screen is split into horizontal windows one for speaking (writing) the other for listening (reading).

Fig. 5 shows a sample *talk* session.

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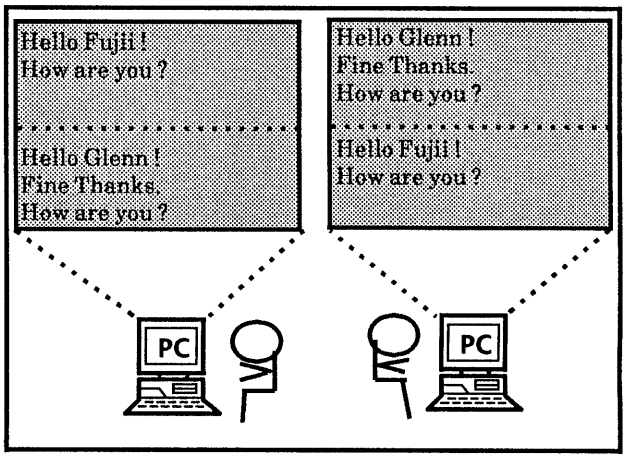

Fig. 5 Example of a Talk session

5.CONCLUSION

We have developed an application software *TM&T* on MS-DOS, to meet the demand of an easy communication link among personal computer users in TAINS. This system enables the users to actively participate in the networking with relatively cheap equipments. *TM&T* offers electronic-mail (T-Mail) and talk (T-Talk) features by utilizing CS's services. A prototype of the application is already operational on TAINS.

Further plans in this direction are-

1) To establish transparent connections with other mail systems. In future, T-Mail will interface with *MHS*, the OSI *M*ail *H*andling *S*ystem, which is currently under development and is scheduled for installation on TAINS in the near future. Interfaces with JUNET (*J*apan *U*nix *NET*work) and other computer networks also are planned.

2) To implement an automatic 'wake-up' function which will start up the system when there are incoming calls.

We hope that our system will pave the way for other network applications on TAINS and other similar networks.

REFERENCES:

(1) ISO 8802-3 Standard for Local Area Networks ; Carrier Sense Multiple Access with Collision Detection

(2) ISO 8802-4 Standard for Local Aera Networks ; Token-Passing Bus Access Method and Physical Layer Specifications

(3) Y.NEMOTO et al. "Tohoku University Academic / All-round / Advanced Information Network System : TAINS", The Record of Electrical and Communication Engineering Conversazione, Tohoku University.

(4) NEC N4685-11 OSI Communication Server ; Users Manual, 39010-1180-02, Nippon Electoric Co.

(5) A.KASAI "Micorsoft C Users Guide", Gijyutsu Hyouron Sya