

Shinshu University Distance-Learning System using Broadband-Internet via Microwave

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Abstract

In Shinshu University, the campuses are connected by a microwave network called SUNS (Shinshu University Campus Collaboration Network System), in which 7.5 GHz digital microwave with the transmission capacity of 19 Mbps is used. SUNS is mainly composed of two networks: one is a video and audio data network with bilateral communication and other is a computer data network. Distance learning system applying SUNS is widely used for intercampus- and interuniversity- lectures, extension lectures, meetings and conferences.

In this paper, the network system configurations of SUNS and its application to the distance learning are introduced.

1. Introduction

Distance Learning is a technologically-assisted three way communication between students and a teacher who are separated with a long distance [1]. For the learning, it is required that information of teaching materials, students' response and the knowledge of results are transmitted without fail and delay. A bilateral communication of video and audio data satisfies the requirements, and besides, computer aided instruction is desirable. The bilateral system is constructed on media of wire and wireless communications, such as ISDN, CATV, microwave transmission, satellite communication, and so on.

In Japan, three network systems of the video and audio data communication are put in practice for distance learning. They are SCS(Space Collaboration System) of the National Institute of Multimedia Education in Japan, ANDES(Academic Network for Distance Education by Satellite) of Tokyo Institute of Technology and SUNS of Shinshu University. The formers are networks via communication satellite and the latter via microwave transmission.

In Shinshu University, the distance learning via the microwave network, SUNS, started in 1988. For the early 10 years from 1988 to 1997, the distance learning was operated only in the bilateral communication system of video and audio data of NTSC

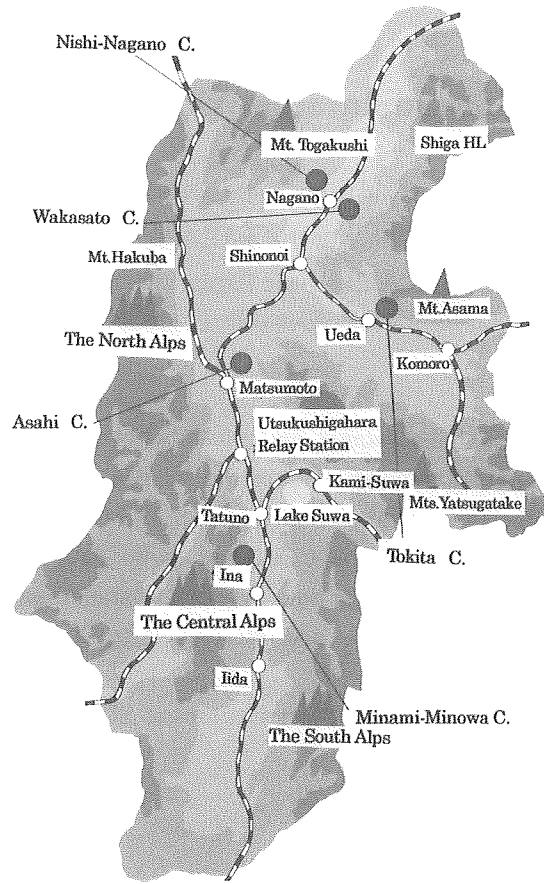


Fig.1 Location of the campuses of Shinshu University

-signals [2]. Since 1998, CAI system using the computer network is added. By the improvement it is expected that a distance learning makes great contributions to a systematic professional-education for undergraduates and graduate students.

2. Configurations of SUNS

In this chapter, the network system of SUNS and a distance learning system using multi-screen monitor are explained.

2.1 Campuses and SUNS

Shinshu University consists of 8 faculties and two graduate schools with 6 divisions. The numbers of the students and the faculty members are 13,000 and 2,100, respectively. The campus is dispersed into 5 around Nagano Prefecture: Asahi Campus in Matsumoto City, Wakasato Campus and Nishi-Nagano Campus in Nagano City, Tokita Campus in

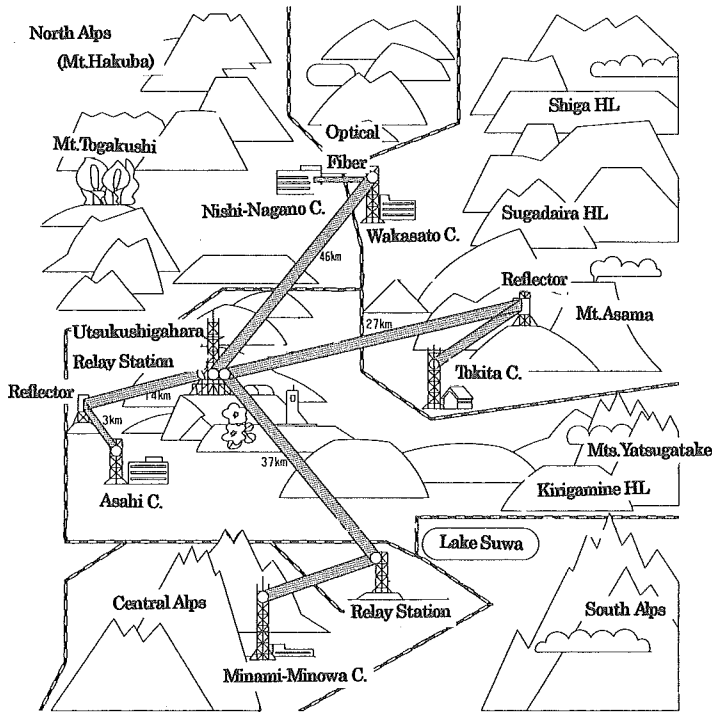


Fig.2 Route of SUNS

Table 1 Line specifications

(1) Digital Microwave Line
Frequency range : 7.5 GHz
Transmission Capacity : 19 Mbps
(1.5 Mbps x 12 ch)
Output Power : 1W
(2) Optical Fiber Line
Line Length : 4 km
Transmission Capacity : 2000 Mbps
(Single Mode)
Wave Length : 1.3 μm

Ueda City and Minami-Minowa Campus in Kami-Ina District as shown in Fig.1. The longest distance between campuses is over 200 km. The branch campuses are connected each other by a broadband microwave network with a star connection, and they can function effectively as an university in spite of the dispersion.

Fig.2 shows the route of SUNS. Nagano Prefecture is mountainous and the branch campuses are situated in four basins. A digital microwave connects the campuses via the central relay station on Utsukushigahara-Hilltop, two reflectors and a local relay

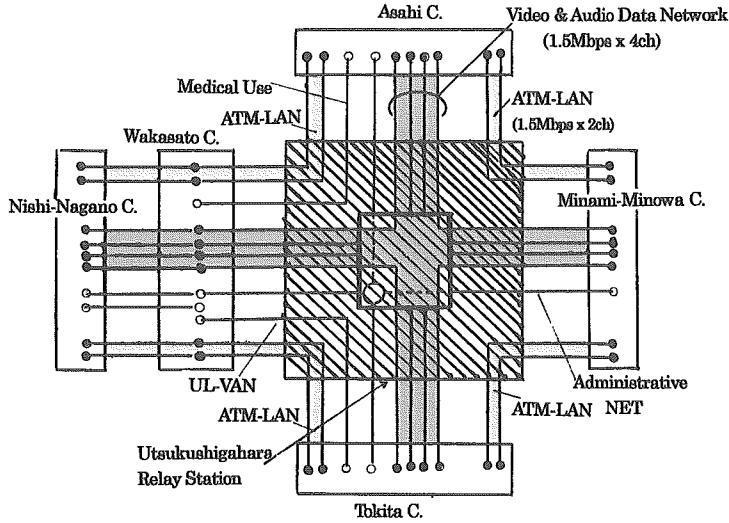


Fig.3 Sharing of the channels in microwave

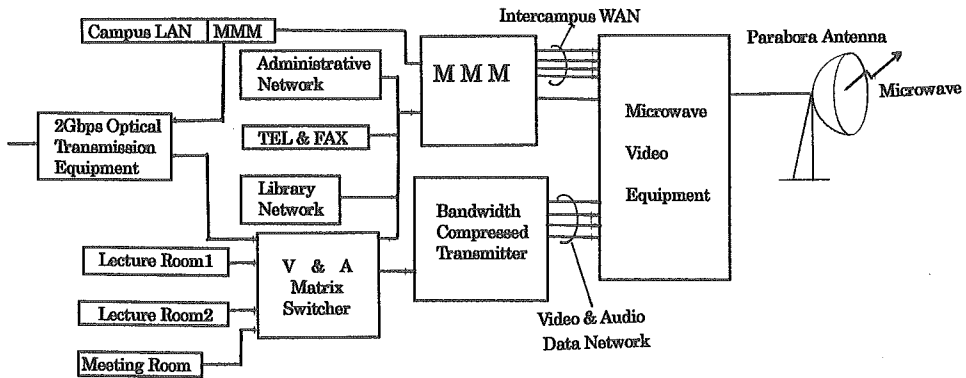


Fig.4 SUNS system in Wakasato Campus

station. However, Wakasato and Nishi-Nagano campuses are connected by an optical fiber cable because they are in a city area, where we cannot look down the street. SUNS is a self-managed network which Shinshu University owns.

The transmission line specifications of SUNS are shown in Table 1. The line is an ordinary system of a digital communication via microwave. The frequency of 7.5 GHz is used. The transmission capacity is 19 Mbps, and the bit-rate and the number of channel are 1.5 Mbps and 12, respectively. The modulation is done by the 4PSK-method, and the transmission power is 1 W.

The 12 channels of the microwave are portioned among the networks as shown in Fig.3. 4 channels are allotted for the video and audio data network. It can be considered that one channel deals with one campus. Through the channel, two motion-picture-images with sound and a still-picture-image of the other campus are watched. The image-data are transmitted after bandwidth-compression by a codec. And 4 channels are

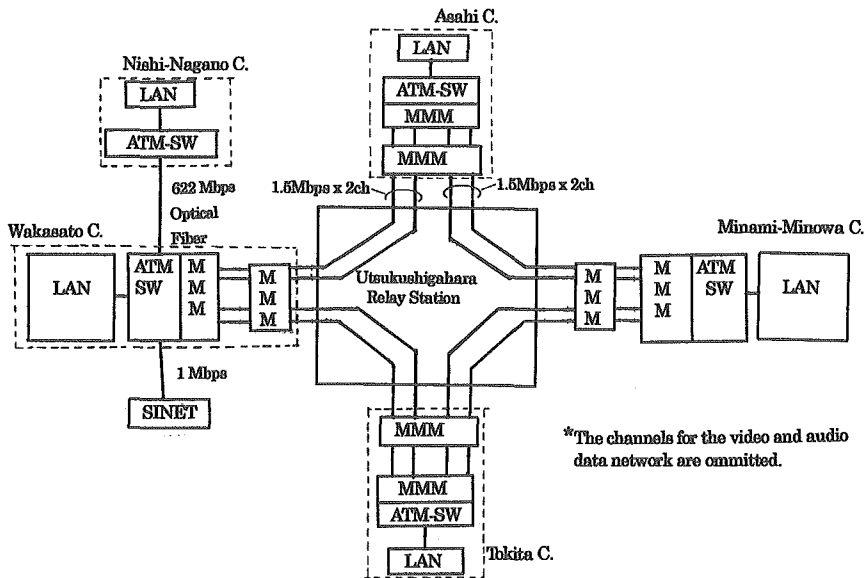


Fig.5 Intercampus-WAN and Campus LANs in SUNS

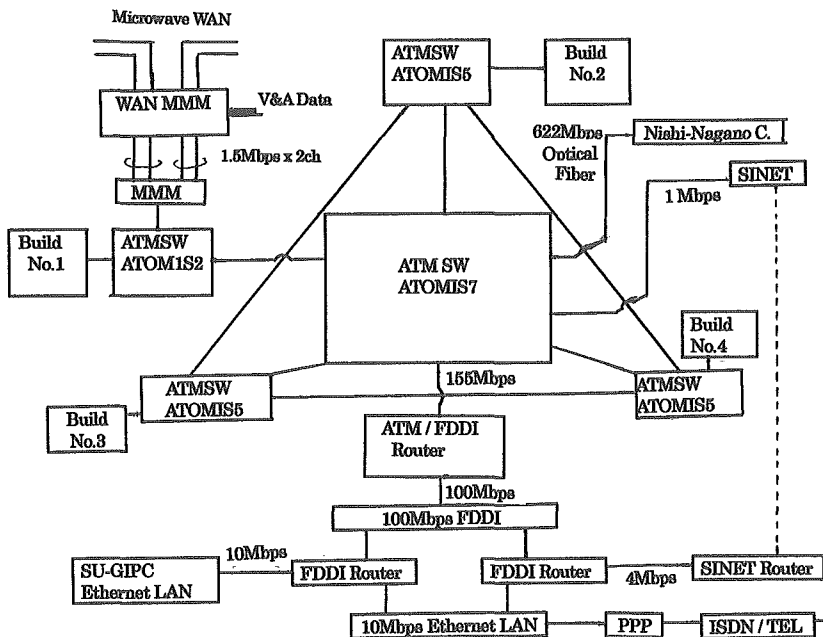


Fig.6 ATM-SW network in Wakasato Campus

allotted for the intercampus-WAN which forms an ATM-network with a quasi-loop connection. Furthermore, an exclusive computer network of the administration and an inter-campus telephone and facsimile lines operate in other channels. These data with various speeds of 9.6kbps-1.5Mbps are processed by a multimedia multiplexer and they

are sent to a microwave radio equipment as shown in Fig.4.

2.2 Intercampus WAN and campus LAN using SUNS

Fig.5 shows the systems of the intercampus-WAN and the campus-LAN in SUNS. As the WAN forms a quasi-loop connection, the data go back and forth between two neighboring campuses. And the ATM switches control the total data-flow not to exceed the maximum bit-rate of 1.5 Mbps a channel.

As an example of the system configurations of the campus LAN, the network of Wakasato campus is shown in Fig.6. In the LAN, two Ethernets operate: ATM-network with high speed of 100 Mbps and 10 Mbps Ethernet. The ATM switching network consists of a high-speed ATM-SW(ATOMIS7, 622Mbps) and four usual ATM-SW(ATOMIS5 and ATOMIS2, 155Mbps) which are set in each Department-buildings. The switches control the Fast-Ethernet of 100 Mbps. In the 10 Mbps Ethernet an access point using ppp(point to point protocol) connection has been provided. We can connect with SUNS at anytime from any place outside the university.

3. Distance learning system using SUNS

In this chapter, the features of the distance learning in Shinshu University are described and a new system using CAI is introduced.

3.1 The features of the distance learning and the needs of CAI

In Shinshu University, the distance learning of the early 10 years from 1988 was operated in the bilateral communication system of the video and audio data network. The early system in itself didn't force to participate to the lecture and to understand the details. The weak compulsion often acts as a shortcoming on the distance learning in a junior course education.

Generally, junior course students are inexperienced in scientific thinking and have less basic knowledge of a lecture. And the distance learning using only TV-data had less effect to them. When the students learn the backgrounds of a special course, the proverb which says "Practice makes perfect" is an important advice. The students are required to take an active part in the lecture:they can practice solving a problem and gathering reference-materials and information, as well as looking each other. Namely, CAI(Computer Aided Instructions) system is important for the learning.

A new system of the distance learning is required to have following functions:

1. Students and a teacher in a class can have a conversation with looking the face of each other.
2. The students can access promptly to the data of reference-materials and information.

3. The teacher can give an exercise to a student individually and can collect the answers quickly.
4. The teacher can preserve electronically the answers and correct them.
5. The students and the teacher can access to a HP of WWW and to the data of their University.

3.2 The lecture rooms in SUNS

In each campuses of Shinshu University, three types of lecture room for the distance learning have been provided.: a large lecture room for 150 students, a middle lecture room for 80 students and a seminar room for 20 students. At the lecture rooms, 4 video cameras (2 for students and 2 for teacher), OHP and an electronic blackboard are prepared. The pictures of the other campuses are projected on monitors hung from the ceiling in the middle lecture room, and on a multiscreen-type monitor in the large lecture room. The system operation including camera-switching and -focusing are controlled by the teacher.

Furthermore, a reservation system of the SUNS-connection operates on the inter-campus WAN, and the booking in advance of three months is possible. The system controls automatically the power switch of SUNS; turning on at 5 minutes before the booking time and turning off at 5 minutes after.

3.3 The system configurations of the large lecture room with a multiscreen type monitor

The large lecture room is prepared for the distance learning with CAI. As an example of the room, the equipment of Room 200 in Wakasato Campus is shown in Fig.7. The room was converted from an usual lecture theater into the distance learning room, and it has 100 LAN boxes which consist of a cable connector and an electric outlet. A multiscreen type monitor has eight screens of which size is 40 inches.

On the multiscreen monitor, the images of the computers which the teacher and the students use can be enlarged as well as the pictures of the video data from other campuses. The LAN connectors are incorporated into a network by a server. The students in a class can access to the network by their own portable personal-computer.

In this system, the students in separate campuses can look all together the picture of the teacher and the computer images which are projected on the multi-screens. It is expected that the simultaneity gives the feeling of being at a class. A sense of unity develops between the students and the teacher, and even between the students themselves in the separate class.

Furthermore, a wide blackboard has been installed under the multiscreen monitor. By enlarging the picture on the board to the full size of the screen, the students in other campuses are able to hear the lecture with the feeling of being at a class.

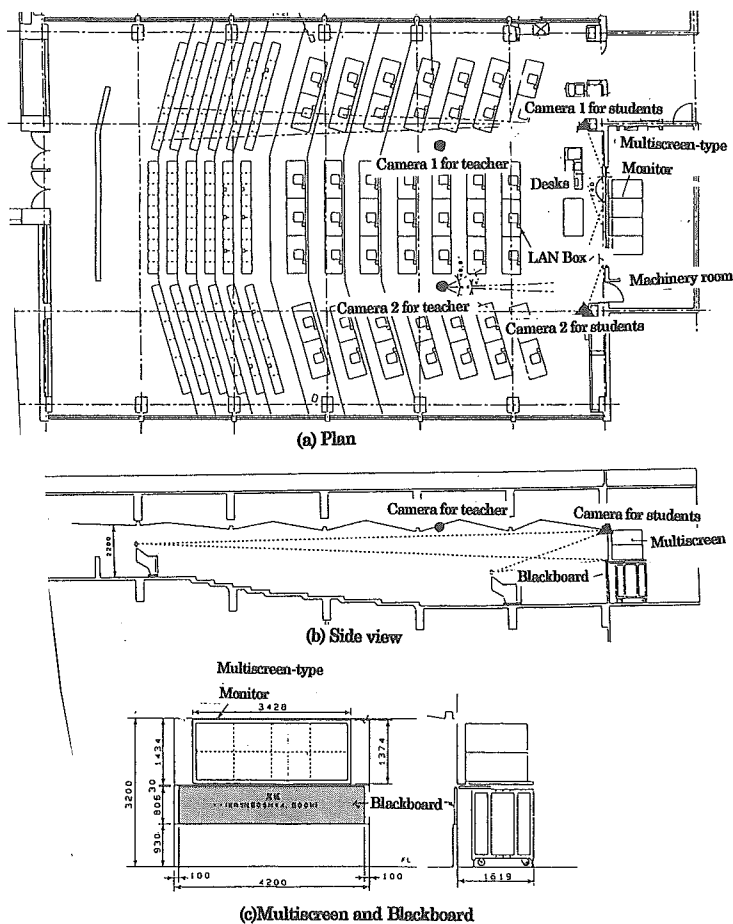


Fig.7 Overview of the distance learning room with CAI in Wakasato Campus (Room200)

Fig.8 shows the system configurations for the pictures and images in Room 200. The video data from other campuses via SUNS, the pictures of the video cameras in the room are distributed in the Matrix Switcher for NSTC-signals, and then they are transmitted to the multiscreen. The computer images of RGB-signals are distributed in the RGB-Matrix switcher and are transmitted to the multiscreen via a pre-splitter for the image-enlarging. Moreover, Room 200 is connected directly with Room 103 (an another lecture room for a distance learning), so that the two rooms work in cooperation as one class room.

4. An example of the distance learning

Finally, as an example the distance learning of the Department of Electrical and Electronic Engineering in Shinshu University is introduced.

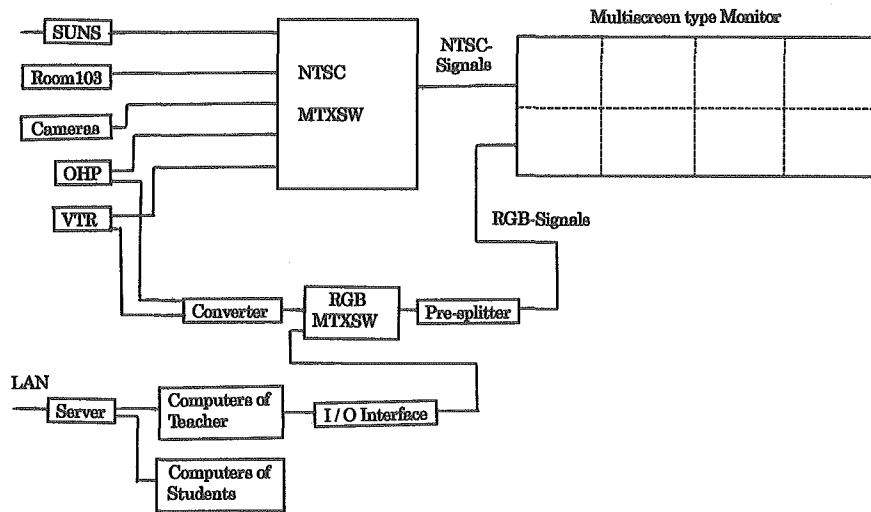


Fig.8 System configurations for the picture and image system in Room 200

4.1 The method to learn

The distance learning is performed between the students in Asahi Campus and the teacher in Wakasato Campus which are separated by the distance of 70 km. The titles of the subjects are “Electric Circuits I”, “Electric Circuits II” and “Electronic Circuits I”, which are given to the students in the first year. The three subjects are compulsory and they are very important for the backgrounds of the professional courses in the Department.

When the students of the department enter the university, they are told that a portable personal computer with a proper specification is needed for the lectures. After a simple training of operating the computer, the lectures start by accessing the teacher’s Home Pages in the ATM-network, in which the contents necessary for attending the class are appeared. The contents are the lecture-text, the problems for the exercises, notices to the students and so on. The access serves as a taking attendance. Furthermore, the students must answer the problems in the contents through the network during the lecture, and they must send homeworks to the teacher by e-mail.

4.2 Advantage and disadvantage in the learning

At the present time, the evaluation of the distance learning mentioned above have just started, and we have not sufficient data to discuss. We only describe the advantage and the disadvantage which are learned by the short experience.

The advantages in the learning are given as follows:

1. The students can study the subjects at any time because they can access and download the contents whenever they want.
2. Motion-images in the contents attract the interest of many students, and contrib-

ute greatly to the introductory remarks.

3. The teacher is not required to go out to the campus where the students learn.

The disadvantages are as follows:

1. Much times and many efforts are spent to make the contents.

2. Many efforts are necessary for teaching the operations of the computer because of the difference in understanding among the students.

3. As the lecture is carried out with referring the contents, few students take notes of the lecture.

5. Conclusions

In Shinshu University, the distance learning by using the bilateral communication via microwave network has been performed since 1988, and improvements have been made by adding CAI system. At the present, the distance learning system can attain to the practical stage. But it has many problems to solve. For a better result of the distance learning, a high speed operation of the network system is required as well as the development of effective contents for the lecture.

6. Acknowledgements

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7. References

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