Application of New Media in the University

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Abstract

The use of new media greatly affects the environment of education and research at universities. Here, multimedia, web technology, digital library, distance learning, and information network in the university are presented, mainly together with examples from Kyoto University.

Keywords

Multimedia, web technology, digital library, distance learning, information network

1. Introduction

The use of new media in the environment of education and research at universities has been rapidly changing along with the progress of information technology. This article discusses some uses of multimedia, web technology, digital library, distance learning, and the information network in the environment of the university. These topics are mainly presented together with examples from Kyoto University.

New media applications are available which are thought as an advanced model case in Kyoto University. Their purchase was accelerated greatly by a 17 trillion yen supplementary budget, which the government funded under the science and technology promotion exception law.

The environment of education and research in the university has achieved remarkable transitions. These days, network based web technology with which we can access geographically distributed information, and teleconference and distance learning systems are effectively utilized, resulting in big changes in the ways of performing various activities at the university.

2. Activities related to new media in Kyoto University

The sections below briefly discuss the following activities related to new media in Kyoto University:

- A digital library of multimedia applications of Web technology was developed in the University Library.
- Research and development of multimedia applications is carried out in the Center for Information and Multimedia Studies (CIMS) as well as in the University Museum.
- Teleconference and distance learning systems are operating in collaboration with other universities as well as with remote campus sites.
- Other activities include the super computing service, high performance networking, and research and education related to Informatics.

3. The digital library in the University Library

OPAC (the Online Public Access Catalog) service has been provided in the University Library since 1988.

The digital library, named Ariadne[1-3], in addition to the conventional collection of 5.5 million books was installed as a prototype in 1994, and the digital library service over the network was inaugurated in 1998. Invaluable classic books and cultural assets of national treasure class are digitized and compiled into hyper media, enhanced by the Web technology, in the digital library, and are open for public investigation. Figure 1 shows an example of the web pages of Ariadne. The on-line service of a CD-ROM library of journals is also available.

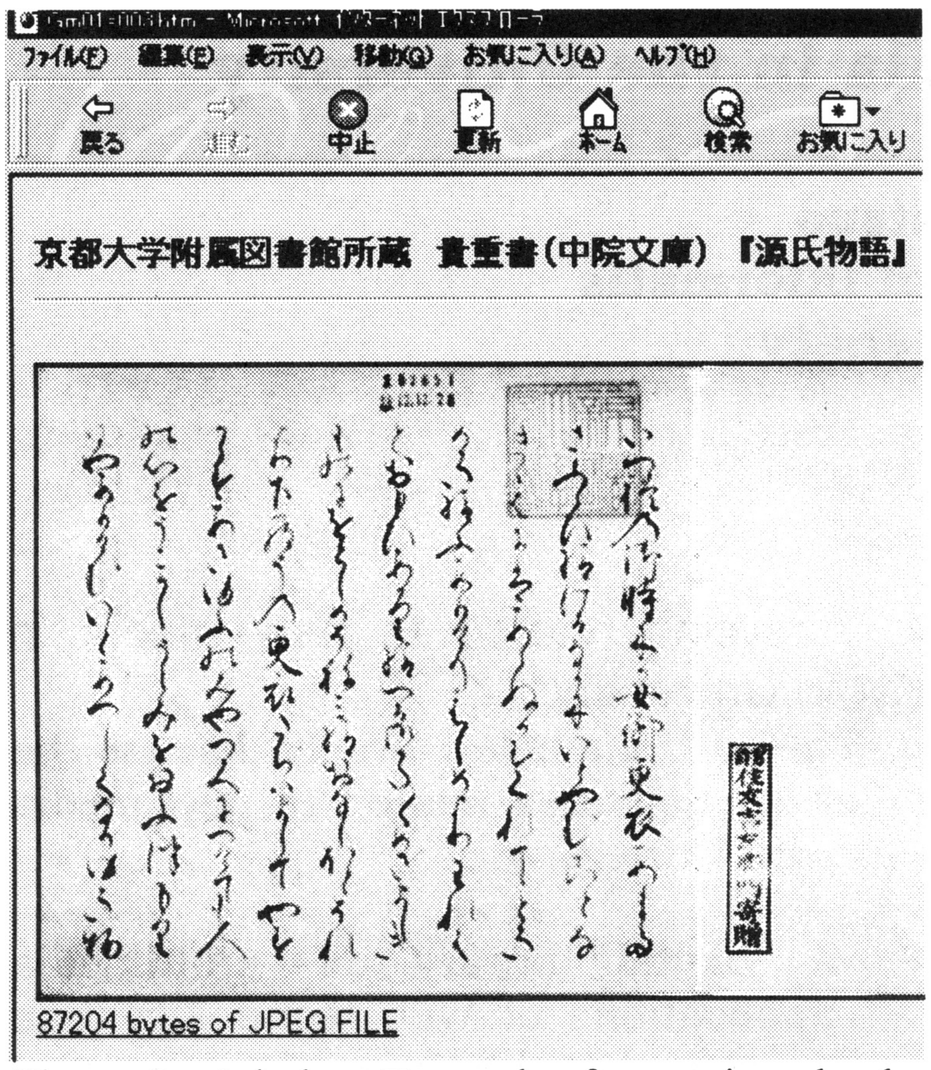

Figure 1 Ariadne: Example of a precious book, GENJI MONOGATARI

4. Development of multimedia facilities in CIMS[1]

4.1 Multimedia teaching material

The development of multimedia teaching material has been forwarded by an authoring system named CALAT, developed by NTT, which carries a co-operative research project with Kyoto University's Center for Information and Multimedia Studies[4]. It has functions for hyper-linked material handling as well as for authoring utilizing DB features.

As an example of developing teaching materials (for medical education) a short display concerning the growth of the fertilized egg is shown. Various DBs are necessary for the development of teaching material. Such items as relate to each other, must be arranged to refer mutually in DBs. Then material DBs are collected, and their use is investigated. Co-occurrence indexing is one of the features.

4.2 Multimedia archive of lectures

The use of the multimedia archive of lectures in which the video and voice/sound of the lectures are recorded is also considered effective for the development of teaching materials. However, if each separate task has to be operated manually, the recording of a lecture is a heavy, time-consuming labor. So the challenge which is currently carried is how to automatize video hypermedia recording. It is necessary, for example, to detect context changes in the lecture to compose hypermedia. The recording of a lecture on video targets the teacher, the blackboard, and the audience. Detection of context changes is attempted by processing the record by applying agent technology.

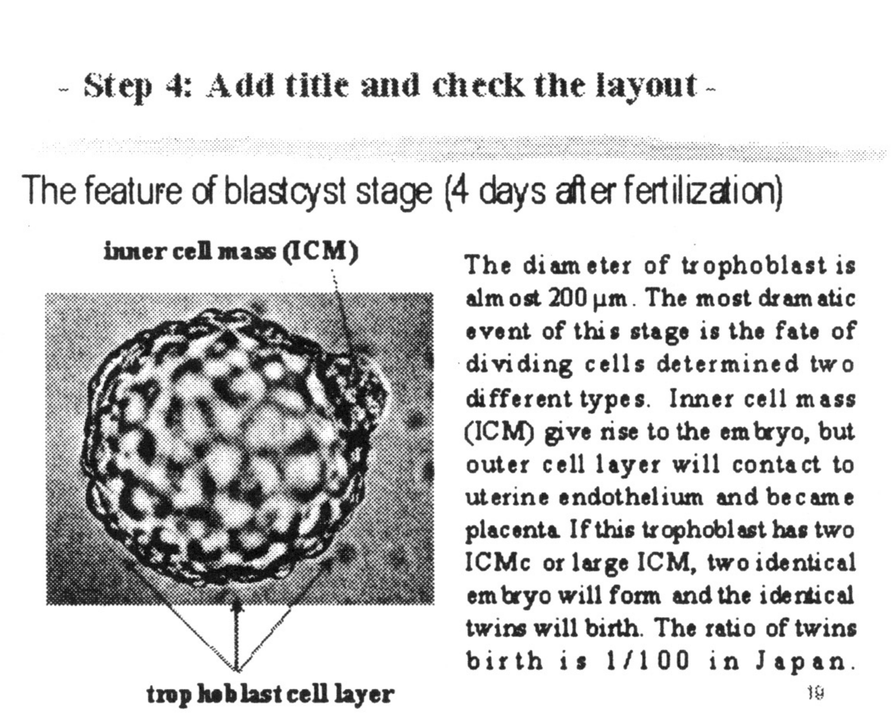

Figure 2 Example of a cut of course material
- Point out the focused region
- Add figure legends
- Add title and check layout

Courtesy of Prof. Minoh of CIMS

5. Distance learning system

Distance learning systems have the following remarkable features that other learning systems, such as audio visual assistance, LL facilities and CAI systems, do not have:

- No limits to space and time for study,
- Can select wide range topics for

[1]CIMS, the Center for Information and Multimedia Studies, was founded in 1997, amalgamating the Educational Center for Information Processing and the Integrated Media Environment Laboratory of the Faculty of Engineering. This center aims to conduct education in computer literacy and information processing, to conduct enhanced language study using computer assisted laboratories, to develop and to operate distance learning systems, and to support the development of multimedia teaching materials.

learner's intention and ability utilizing world-wide multimedia,
- Can take various study styles by multimedia,
- Can experiment effectively and economically in virtual space,
- Can communicate, cooperate and report over the network,

Distant learning systems give chances of learning to handicapped, sick-leave and workers who cannot go to school. However, learners need to have clear goal for study, ability of self-apprehension on his study performance, and strong will to pursue the goal.

The digital television technology will be a central technology for the new media applications. The advancement of compression-technology, the basis of the digital television, has been remarkable, and this is the key technology for collaboration, teleconference and distance learning systems. Already, teleconference systems and distance learning systems of the VHS/NTSC video quality with JPEG, H.261, and MPEG1 compression are supplied for practical use.

5.1 SCS: Space Collaboration System

The media education center, set up by the Japanese Ministry of Education in 1996, has distributed more than 100 vsat (very small aperture terminal) teleconference-stations mainly to National Universities throughout the country, and is offering the facility of distance learning[5].

This system, called the Space Collaboration System (SCS), employs NTSC video compressed by H.261 carried by a communications satellite channel of 1.5Mbps bandwidth for one video stream. A session held over this system uses up to 3 video streams, which are shared by stations that want to interact directly with each other in the session. That is, 2 or fewer streams for up-link transmission are used from a station, the total of which is 3 at most, and 3 or fewer streams for down-link reception at each station. All vsat stations are controlled by the central station lest the operation at each station needs a radio station license. Furthermore, one video stream can accommodate up to 2 pictures by dividing the frame rate. The number of stations attending a lecture is not limited; however the direct interaction is limited to 2 or 3 stations, according to the configuration of a session. At first, the total number of streams was 2; thus the number of streams now available is increased by one.

According to the operation of this system, the current university graduation requirement was revised so that distance

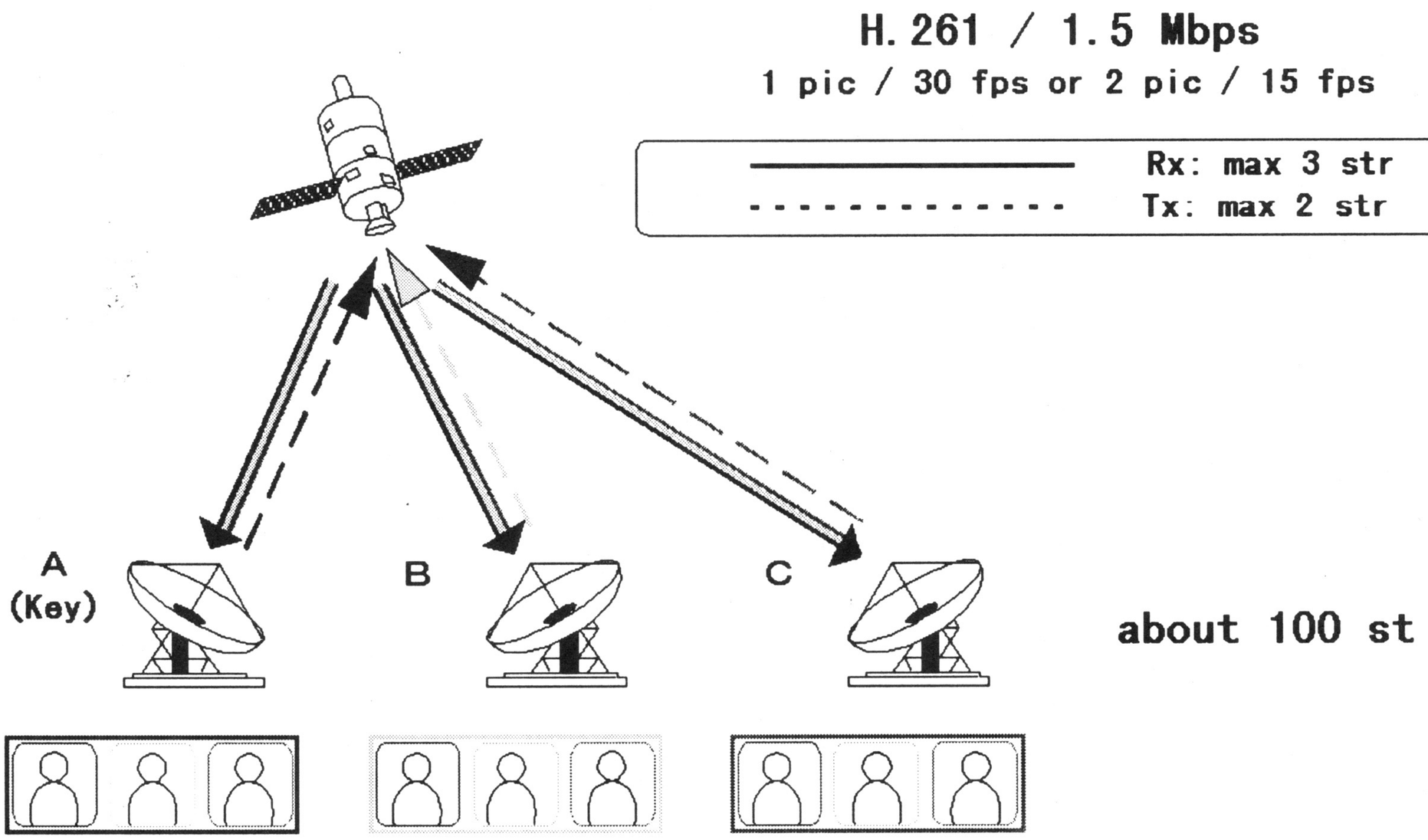

Figure 3 Space Collaboration System

learning may be counted as attendance at a lecture and contributes up to 30 units towards the graduation requirement.

5.2 Distance learning system by MPEG2 / KUINS-II ATM LAN

15 distance learning systems which employ MPEG2 coding utilizing KUINS-II ATM LAN, the network platform in Kyoto University as explained later, were installed in Kyoto University in 1998 and have been used in cooperation with SCS. The bandwidth of these systems can be extended to more than 8Mbps, thus the quality of images is excellent, though the delay of image and voice is about 1 second, which is too big for intense interaction between lecturer and remote students.

A distance learning project is under way between UCLA and Kyoto University over the oversea ATM link, which is a tandem of links of ATM PVC (CBR) and IP over ATM (best effort). This project will start this October and a lecture will be given from each side every week for a half year.

5.3 Summary of the experience of the SCS operation

From the experience of two years' actual operation of the system the issues of distance learning with SCS may be summarized:

- Securing classrooms with the SCS facility that accommodate appropriately the number of students attending a lecture is difficult. But this problem is alleviated by the MPEG2 extensions of CIMS described above.
- It is a hard task to adjust schedules with the other party and to secure the SCS channel.
- The direct voice conversation function for 3 parties or more is urgently needed. The limitations in the past with this function have been alleviated a little currently, however.
- A sharing studio in Tokyo is desired for those who must go up there often.

Here is the summary of the evaluation from the questionnaire to the students.

Merits first of all

- You can attend the lectures of experts.
- There is a novelty different from usual lectures, the study desire is stimulated more, and the interest concerning the content is improved.
- Differing from usual lectures, the composition and the preparation for the broadcast lecture are often well performed.
- Some needed improvements to university education may be made by using the facilities of SCS.

Next, weak points

- It is not easy for those who attend a lecture to speak or to ask questions.
- A device is necessary for switching the camera according to the lecture situation and the size of characters presented, etc.
- A freely write- and erase-able electronic blackboard is wanted.
- Delays and temporal cuttings of the voice and the image are uncomfortable.

Some of these problems might come from lecture's lack of experience with the system. Thus, it is necessary to train the lecture method and the equipment operation. Compared with the commercial television program with professional director and cameraman the quality of SCS image and voice is poor. It is necessary to improve facilities when we set up the distance learning system in existing classrooms.

5.4 Future progress of distant learning and teleconference systems

In KUINS, about 60 remote conference systems were introduced this year. Systems of various methods have been employed in KUINS. For this, the interconnection of heterogeneous systems becomes a problem. This will be useful for making the technology universe. It will be assumed that several 100 systems will be set up in the near future. As a result, it is expected that daily use of such a system will become common.

6. Super computing service in the Data Processing Center

A super computing facility as well as a huge information network, KUINS, is

offered for research use in the Data Processing Center.

The super computer installed this March is a huge model of the 504GFlops, which is the top class in the world, and the 2nd or 3rd largest super computer in Japan. It is used for massive computation, for example, of fabrics in civil engineering or of chemical structure of molecules.

7. High performance network: KUINS LAN

Construction of LAN in Kyoto University started about 1985, and LAN organized academically has been operational since 1989. In 1996 an ATM LAN

(Asynchronous Transfer Mode Local Area Network) of the maximum scale in the world was constructed, and began to operate in 1996. This network is named the Kyoto University Integrated Network System (KUINS), and is operated by the data processing center.

There are 13,000 or more IP nodes that are allotted fixed IP addresses, many other nodes that have leased dynamic IP addresses with DHCP, and also nodes operated with private address in KUINS. The total of computers, WSs and PCs, is presumed to be 16,000 or more.

It is forecast that the traffic of KUINS ATM LAN will accommodate the multimedia applications including moving pictures such as videos well enough, since at present only a relatively small portion of the total capacity of the network is being used.

7.1 Construction of the high performance network

Multimedia applications mainly consist of real-time images and real-time sound. In the media applications in the future, real-time catering of digital videos and mass transmission of real-time streams over the high performance network will become the main usage. For this, the use of the broad-band network will be needed. The network traffic depends on the characteristic of media. And QoS control is required by the recipient ability.

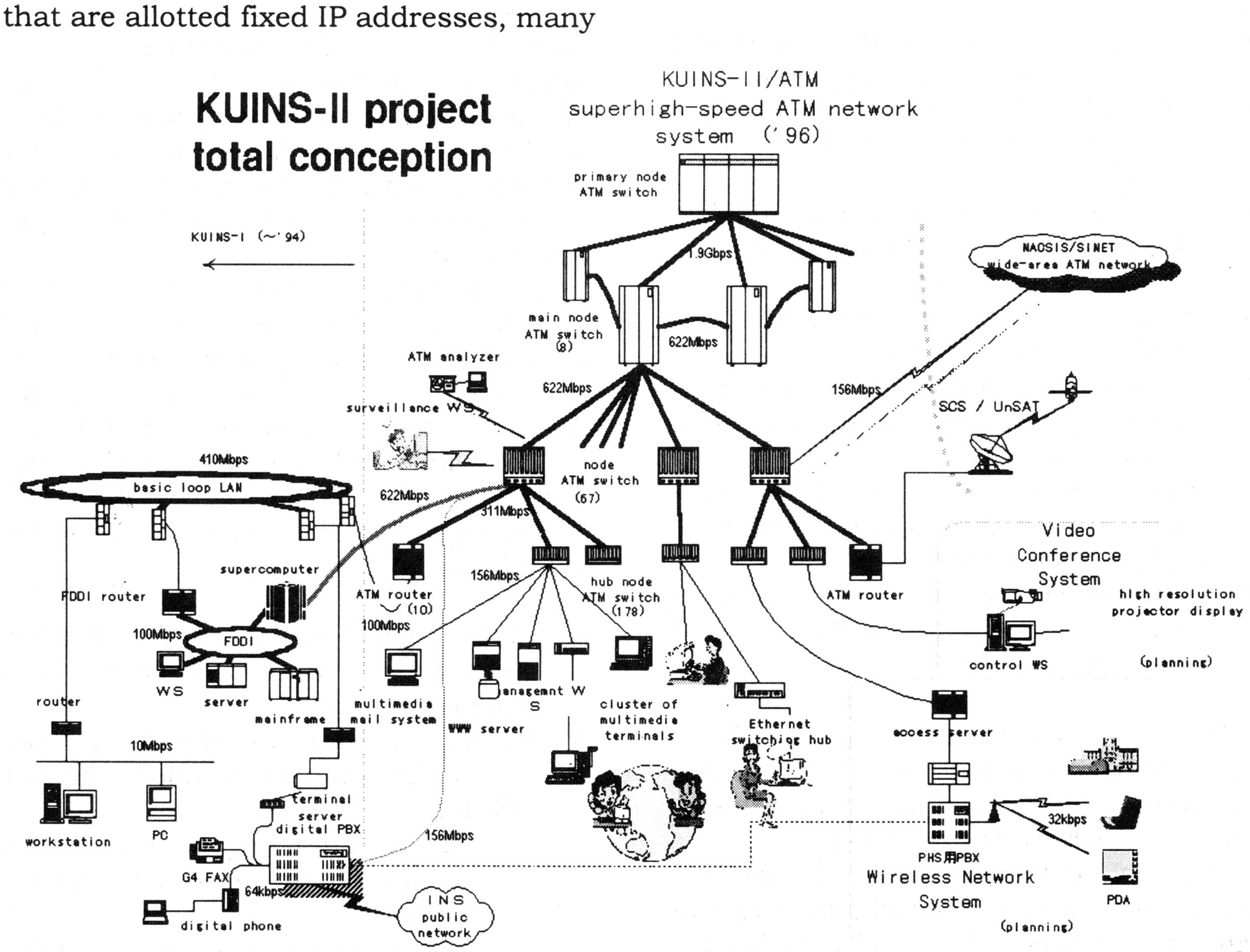

Figure 4 KUINS

7.2 Construction of ATM-LAN

In Kyoto University, ATM-LAN of the maximum scale in the world is operated and used as previously described.

Since 1989, KUINS-I: FDDI loop LAN
Since 1996, KUINS-II/ATM: ATM network

About 260 ATM switches are arranged in four-hierarchy composition as shown in Figure 4. The logical structure of the network divides the whole into eight areas (LIS), and the network is used as the IP backbone as well as SVC/ATM path. The transmission of video etc. can be accommodated, for instance, by using SVC/ATM.

A virtual LAN for CIMS, which connects 1200 computers in 17 satellite classrooms throughout the campus, is constructed over KUINS-II, offering a high performance network with a private IP address system.

Here is the summary of the experience of the installation and management of KUINS:

- ATM is as reasonable and convenient as off-the-shelf technology.
- The traffic of the ATM network does not seem to be saturated for the time being.
- The wavelength division multiplexing (WDM) technology will become a main current in the future.
- It costs much to set transmission line to around the campus.
- If virtual LAN (VLAN) technology only is required, the data link need not be necessarily ATM.
- The routing control by open-shortest-path-first method (OSPF) is difficult to manage.
- Because the scale of the network is large, setting is difficult and laborious.

It is a hard task to set up a network. In the network installation, as in the system, the budget, technology, and management, there are high walls everywhere.

Last 10 meters problem, i.e. wireless connection to the network, to give full mobility to users still remains in KUINS.

8. Web technology

Recently, the Internet has come to be used all over the world as a supporter of the multimedia. However, the present Internet and the Web, which occupies the central role in the Internet, are still in need of further development. For instance, the majority of applications of the present Web environment basically starts the processing of the application side after completing the reception of data packet of the file transfer type as is seen in browsers. This is because the networks where present Internet is composed are slow and the environment in which real-time type application is developed is not well organized.

However, real-time reproduction type systems like the video on demand (VOD) system, bi-directional teleconference or broadcasting type applications using the multicast backbone (Mbone) technology, etc. have begun to be used. Also, the experiments of Internet 2 and the NGI plan are being carried out to improve the performance of the Internet.

On the other hand, languages like Java by which the application of the hyperlink type and the hypermedia type can be developed without being restricted to the machine platform become more and more important for the development environment of these real-time type applications.

It is thought that the above-mentioned applications will become a main current along with the improvement of performance of the network and the development environment in the future.

The following keywords can be drawn from the topics of the international Web Technology workshop held in November 1998 at Kyoto University.

- Web Agent: to serve for flexible, functional, and efficient web operations,
- VR-based Web: to provide a real-world like interface to users utilizing VRML:

  Users can navigate into virtual world, feel and interact with the world.
  VRML serves as a simple, multi-platform language for publishing

3D pages.

- Data Mining and Search Engine: based on association rules and relevant feedback keywords to modify initially entered queries.
- Speech-based Browser,
- Multi-lingual Browser,
- Smart Pull, Real Push.

9. Conclusion

New media applications and related topics in the environment of university, including multimedia, web technology, the digital library, distance learning, and high performance networks, have been presented here from the technology point of view.

No topics relating to ethical matters are touched, however these are not trivial and should be treated in full on another occasion. Indeed, unauthorized installations of forbidden software and databases, implantation of new virus, and escapade modifications even to the BIOS are sometimes found in PCs and WSs for public use in the University Library.

In developing multimedia materials in digital library or in CIMS, the copyright issue is a serious and difficult-to-solve problem. At this moment, the investigation of the contents of copyrighted books in the digital library is limited to research use, and the permission of the publisher of such books is not obtained for a general opening to the public. Moreover, we can not use TV images freely, for example, for the academy to announce the result of research unless we get written permission from the author or publisher. It is very bothersome to get this permission, and hinders smooth promotion of research. Kyoto University's Professor emeritus Dr. Kitagawa is advocating installing a copyright market, the copy-mart, to solve such a problem.

Research and development projects in the future include:

- AR, augmented reality: to enhance the sense of immersion,
- MR, mixed reality: to merge the real world and the virtual world to realize flexible presentation,
- Tangible bits and InTouch: to produce the sense of tangibility.
- The "Live-base" of Real Video: new type of multimedia database.

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