Multimedia And Internetworking Architecture Infrastructure On Interactive E-Learning System

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Abstract. Interactive e-learning is a distance learning method that involves information technology, electronic system or computer as one means of learning system used for teaching and learning process that is implemented without having face to face directly between teacher and student. A strong dependence on emerging technologies greatly influences the way in which the architecture is designed to produce a powerful interactive e-learning network. In this paper analyzed an architecture model where learning can be done interactively, involving many participants (N-way synchronized distance learning) using video conferencing technology. Also used broadband internet network as well as multicast techniques as a troubleshooting method for bandwidth usage can be efficient.

1. Introduction
E-learning is a system or educational concept that utilizes information technology in teaching and learning process[2]. Here are some notions of E-learning from various sources:

1. The learning is organized with the purpose of using electronic or computer systems so as to support the learning process (Michael, 2013: 27).
2. The process of distance learning by combining principles in the learning process with technology (Chandrawati, 2010).
3. Learning system used as a means for teaching and learning process that is implemented without having face to face directly between teacher and student (Ardiansyah, 2013).

Distance learning is an educational process that involves technology that is free from distance constraints, places, and even time-free synchronization [1]. In its development, there are many methods used in distance learning. Asynchronized method means teachers and students are not involved in an interactive and not real time. So participation among them is not done on a regular basis Simultaneously or simultaneously. Currently the developing method is N-way synchronized distance learning by applying video conference technology or Interactive Distance Learning (IDL).

2. Research Method
The method used in this research is a Multimedia And Internetworking Architecture Infrastructure On Interactive E-Learning System which can be seen in figure 1. The components that build the E-learning system infrastructure are outlined in the next discussion.
2.1 Network System
The design of e-learning architecture is based on TCP/IP or Internet so it is expected to produce good quality and low bandwidth packet.
Multicast is a technique of spreading data from a sender to a set of recipients efficiently. Data addressed to a set of recipients belonging to a multicast group does not sent to each recipient directly, but only sent to one multicast address only [5]. Only one copy of the data is sent by the source, then multiplication/duplication of data according to the number of recipients performed by each router that is on the path between the recipient sources in a multicast group. Submission of multicast datagrams from one network to another (tree) will form a multicast network called multicast backbone. Each branch receives only one copy of the multicast datagram for a given group. In the use of multicast datagram must be connected to multicast backbone.

2.2 Video Conference By H.323

Video Conference With H.323 is the standard protocol recommended by ITU-T that defines real-time multimedia communications and conferences through packet-based networks that do not provide QoS guaranteed such as LAN and Internet. Packet-based networks include Internet Protocol (IP), Internet Packet Exchange (IPX), Local Area Network (LAN), Enterprise Network (EN), Metropolitan Area Network (MAN), and Wide Area Network (WAN). It is not a stand-alone standard but a collection of multiple components, protocols and procedures for building multimedia communications services that define the set of voice, video and data conference standards.
Table 1. The protocols are supported by H323

| Standar | Fungsi |
|---------|--------|
| H.225   | RAS (registration, admission, and status), Call Setup dan Tear Down (Q.931 call establishment) |
| H.245   | Call Control Messaging |
| H.261   | Video Format |
| H.263   | Video Format |
| G.711   | Audio Format |
| G.722   | Audio Format |
| G.723   | Audio Format |
| G.728   | Audio Format |

2.3 H.323 Videoconference Component

Five components in H.323 videoconference network include:

- Terminal
- Video Gatekeepers
- Gateway
- Multipoint Conference Unit (MCU)
- Proxies

- Video Terminal

Video terminals exist in various forms including in the system installed on the PC as a standalone desktop terminals and hardware group-focused shared conference room.

![Functional Components in the Video Terminal](image)

- Gatekeepers

Gatekeepers is one of the most important components in the network video conferencing h.323. Although the standard h.323 gatekeepers puts as optional device, but could not build a network video without the need for control of the gatekeepers. Each component of the infrastructure of the video recorded by the gatekeepers. Gatekeepers perform all the breaking of the address (the address resolution), bandwidth management, admission control, zone management, and intra-zone and inter-zone call routing.

- Gateway
Gateway provides interoperability between elements. For example, H.323 Gateway allows H.323 video terminals to communicate with video terminals H.320 and H.321. Video gateway performs translation between protocols, formats of audio encoding and video encoding formats that may be used by a variety of standard H.32x.

- **Multipoint Conference Unit (MCU)**
  In general video terminal is your point to point which only allows two participants of each conversation. A MCU allow video conference for extended to three or more participants. An MCU consists of a multipoint controller (MC) and multipoint processor (MP). MC govern all call setup control functions and conference resources while opening and closing the media stream. MP only process the audio and video media streams.

- **Proxy**
  A proxy agent is processing the call for stopping the H.323 calls from LAN and create a session with the H.323 endpoint location in the LAN and other zone. A proxy provides network administrators with the ability to set the Quality of Service (QoS) on the segment between zone. The proxy also provides a method of identifying the relationships that describing videoconferencing H.323 for tunneling through firewalls and Network Address Translation (NAT).

### 2.4 Select The Video Conference System

In choosing technology video conference should consider the advantage disadvantage of and the use of such technology, with caution. To get the best system then it should be noted the factors as follows:

- **The system expected**
  An election system is a very important thing discussed to get system level expected. As the frame rate and window size are realistic in the available bandwidth that may be much lower than expected. The expected system level must be adjusted to the available system.

- **The availability of a network load Bandwidth (bandwidth) required to consider.**
  Bandwidth is the resources of a network, the term given to describe the ability of the transfer of information (bits/second). Availability of bandwidth is a limiting factor (limiting factor) in the video conference system to avoid bottlenecks. Two methods used to avoid bottleneck is to increase the availability of bandwidth and by reducing the amount of data transmitted by using a system that supports H.264 compression for example.

- **Quality system**
  There are some steps that are used to reduce the amount of data that must be transmitted when doing a video conference. A real combination using the window size is very small in order to be accepted with a minimum frame rate. Video conference system using a lossy compression method. The use of lossy algorithms make a compromise between image quality expected and data volume. Other important considerations in the selection of compression technique is interoperability between systems that are used in a video conference.

- **Application of compression**
  H.261 was the original standard created by the ITU-T (International Telecommunication Union of Telecommunication) used in video conferencing. Development of rapidly into H.263 in 1995 which offers video compression methods higher efficiently and with higher quality at a low bitrate. After that it generates the h.264 offers quality two times better than h.263 on bandwidth equal or the same quality with only half the bandwidth of H.263.
2.5 The amount of the main Participants

In the relationship point to multipoint MCU (Multipoint Control Unit) to connect and organize the communication more than two participants.

![Multipoint Control Unit](image)

**Figure 4.** Multipoint Control Unit

H.323 MCU is always a part of separate hardware to connect all of the transmission medium used from each participant. Most of the H.323 system supports IP multicast. The basic functions of H.323 MCU is to set all audio, video, data, and control streams between all participants in the conference via IP.

2.6 Management System

Although management system standard H.323 gatekeepers describes as components optional, but in its application this is a very important tool for defining and controlling how the voice communication and video set melalui IP network.

Gatekeepers responsibilities are:
- provision of address translation between LAN alias and IP address
- controlling calls and routing services to H.323 end user
- set the system (management system)
- security policy (security policies)

2.7 The location of Participant

The location of the H.323 System Participants can operate simultaneously with the use of gateway. Gateway provides translation and transcoding between different circuit-switched and packet-based network that is different so the end user can communicate. The majority of gateway work are interconnected and incorporates the basic functions of the gatekeepers. The first question to this is how to begin the process of identification of video conference system; with whom and where people who want to conference. This is a network issue that determines how the form of participation to be formed and to consider the standards that afford applied (applicable).

2.8 The concept used

There are major differences in the use of concepts between desktop and video conference group systems. The group system is always in a special room. Furthermore the system group always has remote keyboard, PTZ camera (Pan, Tile and Zoom) with remote control. On the other hand, desktop video conferencing systems are PC based that use a familiar GUI.

3. Design Interactive E-Learning System

In the process of interactive e-learning with interactive distance learning (IDL) method, it needs a special room like a studio called virtual classroom interactive or video conference room, consisting of equipment Electronics such as video cameras, electronic whiteboards, audio, projection and teaching
materials synchronizing.

3.1. Equipment System

Audio, audiographic, video and internet for distance learning all require different tools. Anything selected for distance learning systems will depend on the end user's needs.

- Audio System

Audio (voice) teleconferencing equipment is terminal, telephone, microphone, and loudspeaker. In the selection of each of the above components will be found a variety of products to choose and set that will describe the outline of organizational needs tailored to the ability of the tool. Here is a brief description of the audio component requirements above, terminal. The terminal equipment is the heart of the audio system. This equipment provides the ability to support the microphone and loudspeaker.

- Audiographic System

The term relates to functions that include document conferencing, whiteboard conferencing and freeze video teleconferencing frames. Audiographic Teleconference can provide interactive exchange of printed documents, hand-drawn information, graphs, transparent materials (slides), viewgraphs and still-frame video images. Although the audio portion of the audiographic teleconference is identical with Audio teleconference, additional equipment needed to support graphics capabilities.

Here are some of the different types of audiographic interactions and the types of equipment needed to support one another:

- Interactive writing.

This equipment is often called an electronic whiteboard, allowing the instructor to illustrate the points made in his presentation. Diagram And images including multicolored images can be drawn on one location and received at another location, where they can be modified and deleted by participants on the remote site.

- Document conferencing.

Advances in PC and graphic computer capabilities have created a document conferencing system Which is very sophisticated. This tool enables participants at multiple locations to collaborate by sharing documents or graphics (shared document or graphic) which can then automatically be updated at all locations.

- Still video images.

Objects documents and other visual aid even draw the participants can be captured by the camera and Transmitted as a part of Audiographic teleconferencing. This image is recorded in electronic form Snapshot on PC and then Transmitted over a telecommunication channel to other locations where they can view it on a video monitor.

- Teaching material synchronizing

The goal to display electronic materials to all virtual classroom interactive simultaneously.

3.2 Video Equipment

The video conferencing system includes the equipment required for the transmission and reception of motion video (motion video). It also includes equipment Audiovisual to improve presentation skills. The categories of video equipment include coder-decoder (CODEC) signal processor, control room (room controllers), camera, monitor, microphone and loudspeaker.

- CODEC.

A signal processor. Its function is to convert analog signals generated into digital form and compress the signal to be transmitted on a digital transmission line. On the receiving end, the CODEC function
is to convert the digital signal back into an analog signal to be received and displayed in the studio.

- **Room Controller.**
  A control room that allows the instructor or participant to operate the studio from one place. Most of these units are in keypad form with keypad sequences designed for special functions. This unit may also be in the form of a touch sensitive video monitor that contains symbols for various functions.

- **Video Components.**
  Video conference in-room video conferencing consists of cameras and special monitors. This system will display the visual information on the video screen. All participants (lecturers and students) will appear on the screen. The number and types of these units depend on how large the room, the number of participants and the type of activities most likely to be performed.

### 3.3 Auxiliary Equipment

Transmit and receive images and sounds from teleconferencing, many video conferencing rooms installed equipment for sharing of supporting materials. This equipment is very similar to the equipment found in the audiographic in the video conference room which includes the following:

- **Facsimile machine** for transmitting paper documents
- **PC (computer)** to present the many graphics and diagrams used in the presentation video. Most graphic images are created on the PC, so this makes it minimize Expenditure in the manufacture of intermediate media such as slides and transparencies when this can be transmitted electronically directly to the video teleconference system
- **Scan converter** to allow the user to display graphics from a computer on a television monitor. Scan converter will convert a digital signal from a Video Graphic Array (VGA) or Super Video Graphic Array (SVGA) of a PC into a standard analog signal National Television System Committee (NTSC) so that all remote participants can view the graphics on their television monitors
- **Video cassette recorders (VCRs)** to create a permanent record of the learning process. VCRs are also used to combine video segments from teleconferences in other locations.

### 4. Multimedia Architecture

The interactive multimedia-based learning module created is a CBT model which is a computer-based learning process by utilizing CD-ROM media. In terms of appearance, this learning module is an application program that contains content of digital resources. To design the learning module page, it is necessary to teach the subject based on the curriculum which is valid as the material material from the making of the learning module along with the art and beauty elements, that is by inserting the graphic elements in it, the graphic element which will be included in the application program of this learning module Logos, themes modules, buttons, and other images. For that, graphics processing applications needed such as Photoshop CS2 and CorelDrawX3 to create graphical elements. In achieving the creation of multimedia-based application program modules required for audio processing applications such as fruityloop studio and GoldWave and applications for video processing such as Windows Movie Maker and Macromedia Flash 8 Video Encoder which is the default application from Macromedia Flash 8 Professional. After the supporting elements in the making of this learning module application program is complete then the learning module is designed using Macromedia Flash Professional 8 as the main tool in making multimedia-based learning module where in it happened input process of subject matter, graphic element, animation, audio, video and arrangement Navigation between pages to make the user move to the desired page.

### 4.1 Multimedia Interface

Design a medium of learning, the most important aspect to note is the characteristics and modalities of individual learners' learning styles, as mentioned in the "Quantum Learning" and "Learning Style Inventory" approaches. Media designed should have its own charm to stimulate a fun learning process. Furthermore the presentation scenario of "teaching materials" should be with a modular system with reference to the taxonomic bloom approach. This is intended to occur in a structured, dynamic and
flexible learning process, without always being tied to classrooms, time and or teachers [8]. It should be noted that the ultimate goal of studying a subject is for students to have competencies as defined in the competency standards. For that step / scenario the presentation of learning in each subject topics should be written clearly in a module. Thus expected the students will be involved in the process of learning thorough (mastery learning) and meaningful (meaningful learning). The steps of designing the learning modules, namely concept, design, material collection, manufacture, testing, and distribution are described in Figure 6.1 below.

![Figure 5. Step-by-step steps for designing interactive multimedia-based learning modules](image)

5. Evaluation Result for Architecture System E-learning
In the process of interactive e-learning with interactive distance learning (IDL) method, it needs a special room like a studio called virtual classroom interactive or video conference room, consisting of equipment electronics such as video cameras, electronic whiteboards, audio, projection and teaching materials synchronizing. In this architecture combines a variety of systems including network systems, H323 framework as a VoIP, video conference system and multimedia architecture. So that the process of distance learning can run optimally

6. Conclusion and Future Work
In building an interactive e-learning system infrastructure with interactive distance learning (IDL) method, it is expected to consider the standard equipment design system so that it can be applied with economical bandwidth usage to improve performance and to achieve QoS. Interface of multimedia architecture is in addition to studying the substance of lecture materials, also ‘learn how to learn’ (learning how to learn). The strategy, approach, and method of learning refers to the constructivism concept that encourages and rewards students’ learning efforts with the inquiry and discovery learning process. Multimedia has great potential in facilitating the learning process and as an alternative to knowledge transformation.
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