

Environment to Environment (E2E) Communication Systems for Collaborative Work

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ABSTRACT

E2E is an initiative to harness the power of the World Wide Web (WWW) along with intelligent sensing of environments, to provide effective bi-directional communication which is free from the limitations imposed by devices. Through a sentient information system, automatic selection of the best media streams can be done. Thus, the user need not worry about the location of sensors and presentation devices. Moreover, various forms of interactions can be supported through the capabilities provided by the Web. Hence, apart from point-to-point communication, social networking, virtual meetings, shared collaborative work and asynchronous communication can also be done. The ability to index, archive, retrieve and search *event*-specific multimedia enhances the versatility of communication.

Author Keywords

E2E, connecting environments, sentient communication.

ACM Classification Keywords

H5.1. Multimedia information Systems

INTRODUCTION

Advancement in communication capabilities has not been commensurate with the development and popularity of the World Wide Web. Internet based communication approaches have begun to make use of multimedia. However, they are restrictive in two respects. Firstly, the limitations imposed by devices constrain the communication. For example, a user is forced to remain within the field of view of a camera, or within audible distance of a microphone. Secondly, managing such a multimodal communication is a challenge. Browsing and retrieval of multimedia becomes a difficult task unless these streams have been indexed in a way suitable for searching human understandable concepts. These limitations restrict natural interaction and constrain collaborative work.

Many CSCW applications, like teleconferencing systems (HP's Halo, Cisco's Telepresence and Microsoft's RoundTable) assume that participating environments are symmetric in terms of device sophistication. Other solutions like Mediaspaces [1] cater for asymmetry in environments. However, they fail to provide affordances that make

communication *natural* for the user [2]. Also, there is no emphasis on harnessing the power of the World Wide Web in these solutions.

Environment to Environment (E2E) communication is an initiative to bring communication and the Web together. The aim is to provide natural interaction between participants along with the capability to manage and share multimedia streams. The first goal is met by using a sentient information system along with appropriate number of devices so that the user is not constrained by a single device. The system makes intelligent decisions automatically regarding which media streams to send. The other goal of managing multi-modal streams is realized through EventWeb [3] that enables indexing, retrieval and sharing of multimedia streams with other environments. E2E can provide communication as simple as text exchange, and as complex as shared workspaces and meeting rooms. Any user can create an environment to capture events and put this environment on the Web to share with any interested user.

Here, we briefly describe the motivating principles and design of E2E system architecture.

MOTIVATION FOR E2E SYSTEMS

We have considered several guiding principles for the development of E2E systems. Chief among them are:

1. *Seamless connectivity*: The user must have the ability to move within or between environments.
2. *Connecting asymmetric environments*: Communicating environments need not be symmetric in terms of device sophistication. A teleconference room should be able to connect to a PDA with graceful degradation of services.
3. *Semantic interaction*: The system should be intelligent enough to make semantic level decisions in order to facilitate interaction. Thus, selection of the camera that covers the best pose of a user should be done automatically.
4. *Versatility*: The system should be flexible enough to handle communication as simple as text messaging, and as complex as virtual meeting rooms.
5. *Support for multimedia*: The system should support interactions based on text, audio, images, video and other data streams.

6. *Support archival of data streams*: People often want to refer back to the meeting notes and discussions after the meeting is over. Hence, the system should support indexing, archival and retrieval of the events in the meeting.

E2E ARCHITECTURE

Based upon the requirements mentioned in the previous section, E2E architecture is designed. This led to the following facts regarding the E2E architecture.

1. *Event-based*: Event based architecture helps in making decisions related to selection of media streams and rendering devices.
2. *Web-based*: Web based approach provides scalability and inclusion of features like social networking and messaging.
3. *Modular*: E2E architecture is highly modular. There are different modules that abstract functional and contextual information, that are independent of other modules. This provides flexibility to the system to adapt to different scenarios.

Figure 1 shows major components of the E2E architecture. Data is gathered and analyzed by the **Data Acquisition and Analysis** stage and stored in a **Multimedia Database (MMDB)**. Information obtained from data analysis is combined with the physical environment layout information provided by the **Environment Model**, along with the application specific contextual information provided by the **Situation Model**, to detect events. These events are archived in an **EventBase** and based on security settings, a subset of these events is shared via an **Event Server** with other environments over the Internet. Event Server also routes the incoming information to appropriate actuator devices with the help of Environment Model and the Situation Model. The EventBase and Multimedia Database offer the capability to review the stored data streams later on. Communication session between interacting environments is handled by the **Joint Situation Model (JSM)** (Figure 2). JSM can support various paradigms of interaction, like chat room, virtual meeting room, social networking, etc.

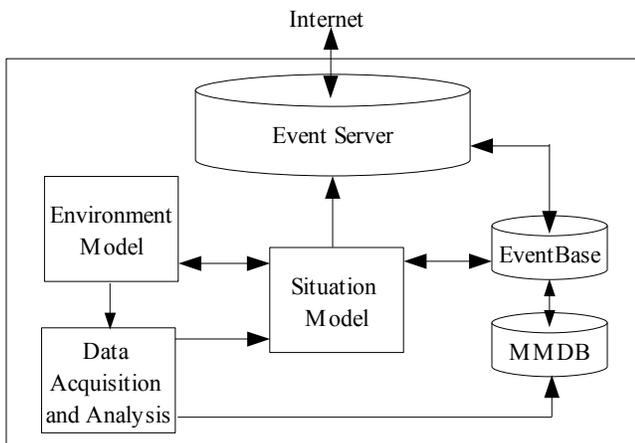


Figure 1. Major components of E2E environment

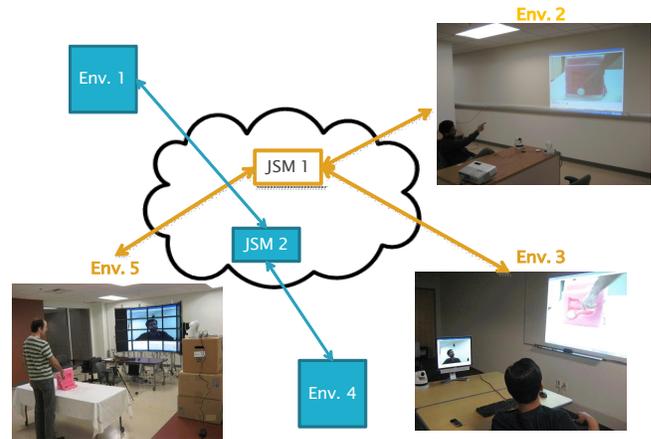


Figure 2. Overview of E2E communication

DIFFERENCES WITH OTHER SYSTEMS

E2E provides the following capabilities, a gestalt of which distinguishes it from other communication approaches.

1. *Natural interaction*: Sentient information system makes intelligent decisions to choose the best data streams to transmit, thus freeing the user of the device constraints.
2. *EventWeb*: EventWeb supports multiple forms of interactions along with capabilities to store, retrieve and share multimedia effectively, thus enhancing the versatility of communication. This differentiates E2E from approaches like MediaSpaces and Office of the Future [5].
3. *Internet-based*: Communicating over the pervasive Internet lets people interact across the globe. This also makes E2E architecture scalable. Telepresence systems fail on this front as most of them use a specialized connection (not Internet) and hence cannot scale up.

As initial implementation, we have developed E2E for two applications – Telemedicine and Office demonstration. Further information can be found in [4].

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